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OFFICE OF CHEMICAL SAFETY AND POLLUTION PREVENTION

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MEMORANDUM

Subject: Cyflumetofen: *Revised* New Chemical Ecological Risk Assessment for Section 3 New Use on Citrus, Pome Fruits, Grapes, Strawberries, Tomatoes, Tree Nuts, and Ornamentals

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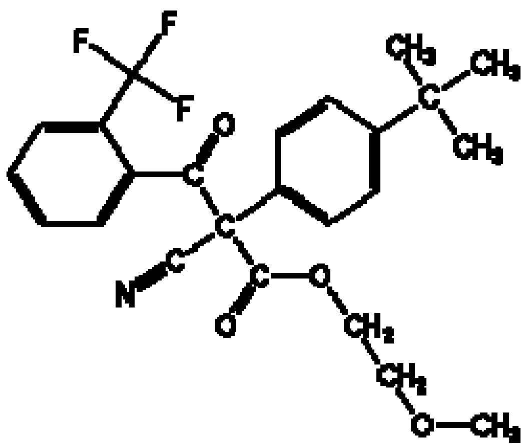
This assessment supercedes the previous assessment dated April 25, 2013 and corrects typos on pages 24 (replacement of "less than 21 days" with "less than 22 days" and deletion of "(Check this value)") and pages 61-62 (replacement of "greater than test concentrations" with "less than test concentrations").

Attached is the new chemical ecological risk assessment for the miticide, cyflumetofen.

Based on Agency Level of Concern (LOC) exceedances, results of this screening-level ecological risk assessment indicate that the proposed uses of cyflumetofen have the potential for direct adverse effects to listed and non-listed mammals from chronic exposure as well as listed dicots. Risk quotients (RQs) could not be calculated for monocots due to the lack of appropriate endpoints for seedling emergence. However, direct adverse effects to listed monocots are expected based on a comparison of terrestrial plant EECs and available seedling emergence data. In addition, given the inability to determine a seedling emergence EC_{25} for monocots, risk to non-listed monocots cannot be precluded. A Tier II seedling emergence continuation study is necessary to reduce uncertainty in the characterization of risk to listed and non-listed monocots.

NEW CHEMICAL REGISTRATION
ECOLOGICAL RISK ASSESSMENT

Cyflumetofen



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Contents

1 Executive Summary

The purpose of this screening-level ecological risk assessment is to evaluate potential risks to non-target species, both non-listed and federally-listed endangered and threatened species (hereafter referred to as non-listed and listed species, respectively), from proposed uses of the new insecticide, cyflumetofen.

Cyflumetofen (2-methoxyethyl (*RS*)-2-(4-*tert*-butylphenyl)-2-cyano-3-oxo-3-(α,α,α-trifluoro-*o*-tolyl)propionate) is a non-systemic, contact miticide that provides knockdown and residual control of tetranychid mites. Cyflumetofen acts as a mitochondria complex II electron transport inhibitor and is classified as a Group 25 acaricide by the Insecticide Resistance Action Committee (IRAC).

Proposed uses of cyflumetofen include citrus, pome fruits, grapes, strawberries, tomatoes, tree nuts, and ornamentals. The proposed maximum single application rate and maximum application rate per crop cycle or year are 0.2 lb a.i./A and 0.4 lb a.i./A, respectively, corresponding to a maximum of 2 applications per crop cycle or year. The proposed minimum application interval is 14 days. Cyflumetofen is formulated as a suspension concentrate and is proposed to be applied via ground equipment. Aerial application is proposed only for tomatoes.

The parent chemical, cyflumetofen, is expected to degrade rapidly in the environment, but undergoes a complex series of transformations that result in the production of many degradates of concern. Some of the degradates of concern are much more persistent than the parent.

A summary of direct and indirect effects to non-listed and listed taxa from the proposed uses of cyflumetofen is provided in **Table 1-1**. Direct or indirect effects to specific listed species have not been definitively determined; further investigation into temporal, geographical, and biological associations between the proposed uses and affected taxa is needed before definitive effects determinations can be made.

Based on Agency Level of Concern (LOC) exceedances, results of this screening-level ecological risk assessment indicate that the proposed uses of cyflumetofen have the potential for direct adverse effects to listed and non-listed mammals and listed dicots. Risk quotients (RQs) could not be calculated for monocots due to the lack of appropriate endpoints for seedling emergence. However, direct adverse effects to listed monocots are expected based on a comparison of terrestrial plant EECs and available seedling emergence data. In addition, given the inability to determine a seedling emergence EC_{25} for monocots, risk to non-listed monocots cannot be precluded. A Tier II seedling emergence continuation study is necessary to reduce uncertainty in the characterization of risk to listed and non-listed monocots.

Table 1-1. Summary of Direct and Indirect Effects Associated with Proposed Uses of Cyflumetofen

Taxon	Risk Concern for Direct Effects?*		Risk Concern for Indirect Effects to Listed Species?**
	Non-Listed	Listed**	
Birds	No	No	Yes[a,b]
Reptiles	No	No	Yes[a,b]

Taxon	Risk Concern for Direct Effects?*		Risk Concern for Indirect Effects to Listed Species?**
	Non-Listed	**Listed****	
Terrestrial-phase amphibians	No	No	Yes[a,b]
Mammals	**Yes (chronic exposure[c])**	**Yes (chronic exposure[c])**	Yes[b]
Terrestrial invertebrates	No[d]	No[d]	Yes[a,b]
Terrestrial (upland and semi-aquatic) plants : monocots	**Yes[e]**	**Yes[f]**	Yes[a]
Terrestrial (upland and semi-aquatic) plants: dicots	No	Yes	Yes[a]
Freshwater fish	No	No	Yes[b]
Aquatic-phase amphibians	No	No	Yes[b]
Freshwater invertebrates	No	No	Yes[b]
Estuarine/marine fish	No	No	Yes[b]
Estuarine/marine invertebrates	No	No	Yes[b]
Sediment-dwelling (benthic) invertebrates	No	No	Yes[b]
Aquatic vascular plants	No	No	Yes[b]
Aquatic non-vascular plants	No	NA	Yes[b]

NA = not applicable because there are no listed aquatic non-vascular plants
* Unless otherwise specified, the Agency Level of Concern (LOC) was exceeded.
** Direct or indirect effects to specific species have not been definitively determined; further investigation into temporal, geographical, and biological associations between the proposed uses and affected taxa is needed before definitive effects determinations can be made.
[a] due to direct effects to non-listed mammals
[b] due to direct effects to non-listed monocots which cannot be precluded given the inability to determine a seedling emergence EC_{25} for monocots
[c] small and medium mammals consuming short grass, tall grass, broadleaf plants, or arthropods and large mammals consuming short grass or tall grass
[d] Given the insecticidal mode of action of cyflumetofen, the potential for risk to sensitive, non-target terrestrial invertebrates exists.
[e] Given the inability to determine a seedling emergence EC_{25} for monocots, risk to non-listed monocots cannot be precluded.
[f] Although RQs could not be calculated for listed monocots due to the lack of a NOAEC for seedling emergence, adverse direct effects to listed monocots are expected based on a comparison of terrestrial plant EECs and the available seedling emergence data.

2 Problem Formulation

The purpose of this assessment is to evaluate the environmental fate and ecological risks for the registration of the new chemical, cyflumetofen. As a new insecticide being proposed for use in the United States, EPA is required under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) to ensure that cyflumetofen does not have the potential to cause unreasonable adverse effects to the environment. A "preliminary assessment" to determine the potential for direct and indirect effects to federally-listed endangered and threatened species (hereafter referred to listed species) is also conducted. Further investigation into temporal, geographical, and biological associations between the proposed uses of cyflumetofen and affected listed taxa is needed before definitive effects determinations can be made. To these ends, this assessment follows EPA guidance on conducting ecological risk assessments (USEPA, 1998) and the Office of Pesticide Program's policies for assessing risk to non-target and listed organisms (USEPA, 2004).

Among the end products of the EPA pesticide registration process is a determination of whether a product is eligible for registration and, if so, a description of how the product may be used. A label represents the legal document that stipulates how and where a given pesticide may be used. End-use labels describe the formulation type, acceptable methods of application, where the product may be applied, and any restrictions on how applications may be conducted. Thus, the use, or potential use, described by the pesticide's labels is considered "the action" being assessed. This assessment is in support of the new chemical registration of cyflumetofen.

2.1 Stressor: Source and Distribution

2.1.1 Source and Intensity

Cyflumetofen, a non-systemic, contact miticide, is a new chemical that is undergoing registration by BASF. In addition to the technical, two end-use products are being proposed for registration in the United States (**Table 2-1**). According to the proposed labels, the products would provide knockdown and residual control of tetranychid mites (**Table 2-2**) in citrus, grapes, pome fruits, strawberries, tomatoes, tree nuts, and ornamentals (**Table 2-3**).

Table 2-1. Proposed End-Use Products of Cyflumetofen

End-Use Product	Use	% Active Ingredient	Type of Formulation	Registration Number
Nealta™ miticide	Citrus, grapes, pome fruits, strawberries, tree nuts, tomatoes	18.7	Suspension concentrate	7969-GGA
Sultan™ miticide	Ornamentals	18.7	Suspension concentrate	7969-GGT

Table 2-2. Tetranychid Mites Controlled by Proposed End-Use Products of Cyflumetofen

Common Name	Scientific name
Carmine	*Tetranychus cinnabarinus*
Citrus red	*Panonychus citri*
Banks grass	*Oligonychus pratensis*
Brown almond	*Bryobia rubrioculus*
Brown wheat	*Petrobia lateens*
European red	*Panonychus ulmi*
Texas citrus	*Eutetranychus banks*
Spider mites	
McDaniel	*Tetranychus mcdaniel*
Pacific spider	*Tetranychus pacificus*
Spruce spider	*Oligonychus ununguis*
Strawberry spider	*Tetranychus turkestan*
Two spotted	*Tetranychus urticae*
Willamette	*Eotetranychus willamettei*
Yuma	*Eotetranychus yumensis*

Table 2-3. Proposed Uses of Cyflumetofen

Citrus Fruit Group			
Calamondin	Citrus citron	Citrus hybrids	Chironja
Grapefruit	Kumquat	Lemon	Lime
Mandarin orange (sweet and sour)	Pummelo	Satsuma	Tangelo
	Tangerine	Tangor	
Grapes			
Pome Fruit Group			
Apple	Crabapple	Loquat	Mayhaw
Oriental Pear	Pear	Quince	

Strawberry			
Tomato			
Tree Nuts Group			
Almonds	Beech nut	Brazil nut	Butternut
Cashew	Chestnut	Chinquapin	Filbert
Hickory nut	Macadamia nut	Pecan	Walnuts (black and English)
Ornamentals			
annual and perennial herbaceous plants		woody trees and shrubs	

2.1.2 Pesticide Type, Class, and Mode of Action

Cyflumetofen is a non-systemic, contact miticide that belongs to the benzoylacetonitrile class of compounds. It is classified as a Group 25 acaricide by the Insecticide Resistance Action Committee (IRAC); the only other active ingredient in this group – cyenopyrafen – is not registered in the United States. Cyflumetofen acts as a mitochondria complex II electron transport inhibitor resulting in knockdown and residual control of the egg, nymph, and adult stages of tetranychid mites.

2.1.3 Physical/Chemical/Fate and Transport Properties

Cyflumetofen is non-volatile, has limited solubility in water, and is quite lipophilic and therefore would be expected to absorb to foliage surfaces and soil (Koc of 1.3 x 10^5 ml/g) at the site of application. Selected physical and chemical properties are summarized in **Table 2-4**. Once deposited, either at the site of application or farther afield through runoff and/or spray drift, the parent molecule is expected to degrade quickly through multiple fate processes (half-lives of hours to several days) under environmental conditions.

Table 2-4. Selected Physical and Chemical Properties for Cyflumetofen

Property	Value
Common Name	Cyflumetofen
Chemical Name	2-methoxyethyl (*RS*)-2-(4-*tert*-butylphenyl)-2-cyano-3-oxo-3-(α,α,α-trifluoro-*o*-tolyl)propionate
CAS Number	400882-07-7
Pesticide Class	Mitochondria complex II electron transport inhibitor (IRAC Group 25) – Acaricide
Molecular Formula	$C_{24}H_{24}F_3NO_4$
Molecular Weight	447.45g/mol
Physical State	Milky white, odorless suspension concentrated liquid, with density of 1.0682 g/cm3 @ 20ºC
Vapor Pressure	$< 4.43 \times 10^{-8}$ torr at 25ºC
Water Solubility	28 µg/L
Henry's Law Constant	$< 9.3 \times 10^{-7}$ Pa*m^3/mol at 20ºC
Log Kow	4.3 at 25°C

IRAC = Insecticide Resistance Action Committee

Cyflumetofen forms many degradates with a wide range of fate properties (*e.g.*, from highly soluble to less soluble than the parent). Many of these degradates were considered degradates of concern by EFED due to the presence of a cyano group (C≡N). However, the reason for developing a very broad and inclusive set of degradates of concern is more out of a concern for efficiency in the Ecological Risk Assessment, rather than the toxicological properties of the individual degradates. Attempts to quantify exposure and effects for each of the many individual degradates of cyflumetofen would produce considerable uncertainty in the risk assessment. Instead, a strategy was devised to estimate a maximum exposure to total cyflumetofen degradates and show that even in the most conservative case with all of the potential degradates of concern assumed to be the most toxic degradate that the degradates would not pose a risk individually or as a group. Note that this strategy is applied to the aquatic portions of the risk assessment. Other arguments are provided for the terrestrial portions of this assessment. This definition of the degradates of concern for the Ecological Risk Assessment differs from the degradates of concern in the drinking water assessment conducted for human health concerns by the Agency's Health Effects Division, which included only the parent and "AB" degradates (described in **Section 3**; Negrón-Encarnación, 2013).

2.1.4 Overview of Pesticide Usage

Proposed uses of cyflumetofen include citrus, pome fruits, grapes, strawberries, tomatoes, tree nuts, and ornamentals. Cyflumetofen is formulated as a suspension concentrate and is proposed to be applied via ground equipment. Aerial application is proposed only for tomatoes. Application information is provided in **Table 2-5**. Since this a new chemical, the Agency does not have any usage information for cyflumetofen. The assessment assumes one crop cycle per year.

Table 2-5. Application Information for Proposed Uses of Cyflumetofen

Use	Form.	App. Method	Max. Single App. Rate (lb a.i./A)	Max. Number of App.	Max. App. Rate Per Crop Cycle or Year (lb a.i./A)	Min. App. Interval (Days)	PHI (Days)
Citrus	Nealta™ miticide	Ground	0.2	2/crop cycle	0.4	14	7
Grapes			0.2	2/crop cycle	0.4	14	14
Pome fruits			0.2	2/crop cycle	0.4	14	7
Strawberries			0.2	2/crop cycle	0.4	14	1
Tree nuts			0.2	2/crop cycle	0.4	14	7
Tomatoes		Aerial, ground	0.2	2/crop cycle	0.4	14	3
Ornamentals[a]	Sultan™ miticide	Ground	0.2	2/yr	0.4	14	NA

App. = application; Form. = formulation; Max. = maximum; Min. = minimum; NA = not applicable; PHI = Preharvest interval

[a] annual and perennial herbaceous plants and woody trees and shrubs

2.2 Receptors: The Biological Entities Exposed to the Stressor

2.2.1 Effects to Aquatic and Terrestrial Organisms

Table 2-6 provides examples of taxonomic groups and species that are tested to help understand potential ecological effects of pesticides to non-target organisms. Within each of these very broad taxonomic groups, a measure of effect from acute and/or chronic exposure is selected from the available data.

Table 2-6. Taxonomic Groups and Test Species Evaluated for Ecological Effects in Screening-Level Risk Assessments

Taxonomic Group	Example(s) of Representative Species
Birds[1]	Mallard duck (*Anas platyrhynchos*) Bobwhite quail (*Colinus virginianus*)
Mammals	Laboratory rat (*Rattus norvegicus*)
Terrestrial invertebrates	Honeybee (*Apis mellifera*)
Freshwater fish[2]	Bluegill sunfish (*Lepomis macrochirus*) Rainbow trout (*Oncorhynchus mykiss*)
Freshwater invertebrates	Water flea (*Daphnia magna*)
Estuarine/marine fish	Sheepshead minnow (*Cyprinodon variegatus*)
Estuarine/marine invertebrates	Mysid (*Americamysis bahia)* Eastern oyster (*Crassostrea virginica*)
Terrestrial plants[3]	Monocots – corn (*Zea mays*) Dicots – soybean (*Glycine max*)
Aquatic vascular plants	Duckweed (*Lemna gibba*)
Aquatic non-vascular plants	Green algae (*Pseudokirchneriella subcapitata*) Freshwater diatom (*Navicula pelliculosa*) Marine diatom (*Skeletonema costatum*) Cyanobacterium (*Anabaena flos-aquae*)

[1] Birds serve as surrogates for terrestrial-phase amphibians and reptiles.
[2] Freshwater fish serve as 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.

2.2.2 Ecosystems Potentially at Risk

The ecosystems potentially at risk include aquatic and terrestrial areas adjacent to or downstream from the application site. In addition, organisms that use the application site as part of their habitat (*e.g.,* birds foraging for insects within application areas) are also considered to be part of the ecosystems potentially at risk.

2.3 Assessment Endpoints

FIFRA Part 158 guideline toxicity tests (CFR 40 §158.630, 2009) are intended to determine pesticide effects on a variety of organisms, including birds, mammals, fish, terrestrial and aquatic invertebrates, and plants. These tests include both short-term and long-term exposure periods and evaluate the survival, reproduction, and/or growth of laboratory species. The studies, when available, are used to evaluate the potential of a pesticide to cause adverse effects, to determine whether further testing is required, and to determine the need for precautionary label statements to minimize the potential adverse effects to non-target animals and plants (CFR 40 §158.630, 2009).

Assessment endpoints are intended to represent valued attributes of the environment that, if detrimentally altered, could pose a risk to the environment. The assessment endpoints of this ecological risk assessment include terrestrial and aquatic animal and plant mortality following acute exposure to cyflumetofen and terrestrial and aquatic animal reproduction, growth and survival effects from chronic exposure to cyflumetofen. Surrogate species are used to represent all freshwater fish (2000+) and bird (680+) species in the United States. For mammals, acute studies are usually limited to the Norway rat (*Rattus norvegicus*) or the house mouse (*Mus musculus*). Usually data from estuarine/marine testing are limited to a crustacean, a mollusk, and a fish. The assessment of risk or hazard makes the assumption that avian toxicity is similar to terrestrial-phase amphibians and reptiles, unless more appropriate data are available. The same assumption is made for fish and aquatic-phase amphibians. The most sensitive toxicity endpoints are used from surrogate test species to estimate treatment-related direct effects on mortality and reproductive and growth assessment endpoints.

For terrestrial and semi-aquatic plants, the screening assessment endpoints for non-target species (crops and non-crop plant species) are based on the emergence and growth of seedlings and vegetative vigor of annuals. Measures of effect for this assessment focus on alterations to plant emergence and/or to active growth.

For aquatic plants, the assessment endpoint is the maintenance and growth of standing crop or biomass. Measures of effect for this assessment focus on non-vascular, *e.g.*, algae, and vascular plant, *e.g.*, duckweed (*Lemna gibba*), growth rates and biomass measurements.

The Agency acknowledges that pesticides have the potential to exert indirect effects upon listed organisms by, for example, perturbing forage or prey availability, altering the extent of nesting habitat, and creating gaps in the food chain. In conducting a screen for indirect effects, the endpoints for each taxonomic group are used to make inferences concerning the potential for indirect effects upon listed species that rely upon non-listed organisms as resources critical to their life cycle.

The endpoints are typically derived from registrant-submitted studies which have undergone review and were classified as "acceptable" (conducted under guideline conditions and considered to be scientifically valid) or "supplemental" (conditions deviated from guidelines but the results are considered to be scientifically valid). Additional details on EFED's study classification system and study guidelines can be found in the Agency's Overview Document (USEPA, 2004).

Assessment endpoints can also be derived from the open literature. Toxicity data from the open literature are identified via the ECOTOX[1] search engine which is maintained by the U.S. EPA Office of Research and Development (ORD). To be included in the ECOTOX database, papers must meet several criteria. Data that pass the ECOTOX screen are evaluated relative to the data provided by the registrant and may be incorporated qualitatively or quantitatively into the risk assessment after a formal review conducted in accordance with current guidelines for evaluating ecological toxicity data in the open literature.[2] Specific studies may warrant inclusion in the ecological risk assessment when:

- tested endpoints are more sensitive than those in registrant data;
- the test data are based on under-represented taxa; and/or
- the data include ecologically relevant endpoints not normally evaluated in registrant studies

Although all endpoints are measured at the individual level, they can provide some insight about the potential for adverse effects at higher levels of biological organization (*e.g.* populations and

[1] USEPA 2011. Ecotoxicity database http://cfpub.epa.gov/ecotox/

[2] http://www.epa.gov/pesticides/science/efed/policy_guidance/team_authors/endangered_species_reregistration_workgroup/esa_evaluation_open_literature.htm

communities). For example, pesticide effects on individual survivorship have important implications for both population rates and habitat carrying capacity.

No cyflumetofen studies from the open literature were identified using the public version of ECOTOX[3].

2.4 Conceptual Model

2.4.1 Risk Hypothesis

The Agency presumes the following risk hypothesis for this screening-level ecological risk assessment:

Based on mode of action, the proposed use patterns, and the sensitivity of non-target aquatic and terrestrial species, the proposed uses of cyflumetofen have the potential to reduce survival, reproduction, and/or growth in non-target terrestrial and aquatic animals and plants through direct application, spray drift and/or runoff. These non-target organisms include Federally-listed threatened and endangered species as well as non-listed species.

To pose an ecological risk, a chemical must reach non-target organisms at concentrations found to cause adverse effects. The analysis of ecological exposure pathways in this assessment includes an examination of the source and potential migration pathways of cyflumetofen exposure and the determination of potential adverse effects to non-target species.

2.4.2 Exposure Pathways of Concern

This screening-level ecological risk assessment considers potential exposure to cyflumetofen as a result of direct application, spray drift, and runoff.

For terrestrial vertebrates, the major route of exposure to cyflumetofen is considered to be via dietary ingestion of food items such as seeds, plants, and/or animals that have cyflumetofen residues as a result of direct application, spray drift, and runoff. Exposure to parent cyflumetofen through the consumption of drinking water alone is not considered a potential concern for birds or mammals based on the results of EFED's Screening Imbibition Program (SIP v. 1.0)[4] using parent cyflumetofen's solubility (0.0281 mg/L) and non-definitive endpoints for mammalian and avian acute oral toxicity (rat and bobwhite quail LD_{50} > 2000 mg/kg-bw, MRIDs 48542669 and 48542772, respectively) and endpoints for mammalian and avian chronic toxicity (rat NOAEC = 9.21 mg/kg-bw/day, MRID 48542702; mallard NOAEC = 930 mg/kg-diet, MRID 48542778; bobwhite quail NOAEC = 154 mg/kg-diet, MRID 48542777; **Appendix A**). Exposure to terrestrial vertebrates through inhalation is considered unlikely given cyflumetofen's low vapor pressure and the results of EFED's Screening Tool for Inhalation Risk (STIR v. 1.0)[5] using conservative non-definitive endpoints for mammalian and avian acute oral toxicity (LD_{50} > 2000 mg/kg-bw) and a conservative non-definitive endpoint for mammalian acute inhalation toxicity (LC_{50} > 2.65 mg/L, MRID 48542672) (**Appendix B**).

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[3] Quick Database Query conducted on CAS number 400882-07-7 at http://cfpub.epa.gov/ecotox/
[4] http://www.epa.gov/oppefed1/models/terrestrial/index.htm#sip
[5] http://www.epa.gov/oppefed1/models/terrestrial/index.htm#stir

For terrestrial invertebrates, the major routes of exposure to cyflumetofen are considered to be direct contact as a result of direct application and spray drift and dietary ingestion of plants/pollen/nectar, animals, and/or soil that have cyflumetofen residues as a result of direct application, spray drift, and runoff.

For terrestrial (upland and semi-aquatic) non-target plants, the major routes of exposure to cyflumetofen are considered to be direct contact as a result of direct application and spray drift and root uptake via soil contaminated via spray drift and runoff.

For aquatic animals, the major route of exposure to cyflumetofen is considered to be uptake via the respiratory surface (gills) or the integument from surface water/sediment that has cyflumetofen residues as a result of spray drift, runoff, and leaching to groundwater from soil.

For aquatic plants, the major routes of exposure to cyflumetofen are considered to be uptake from surface water/sediment containing cyflumetofen residues as a result of spray drift, runoff, and leaching to groundwater from soil.

2.5 Analysis Plan

As with any pesticide, there is concern regarding the potential effects cyflumetofen use may pose to non-target animals and plants. This document characterizes the environmental fate of cyflumetofen to assess whether its use as proposed on the label provides a means of exposure to non-target species. Additionally, the toxicity of cyflumetofen is characterized. Then both potential exposure and effects are integrated to estimate the likelihood of adverse effects (risk) to non-target listed and non-listed animals and plants that could potentially affect the registration decision of cyflumetofen under FIFRA, the Food Quality Protection Act (FQPA), and the Endangered Species Act (ESA).

2.5.1 Stressors of Concern

Cyflumetofen forms many degradates. Eleven of these degradates are considered degradates of concern by EFED due to the presence of a cyano group (C≡N) and for some degradates, similarity in structure to the parent molecule. Ten of the 11 degradates of concern are considered to be major degradates (occurring as >10% of the applied radioactivity) in the registrant-submitted fate studies. Only AB-12 was a minor degradate (<10% of the applied radioactivity). Again as stated in Section 2.1.3, the purpose of identifying a large and inclusive list of degradates of concern is to make the risk assessment more efficient by addressing the maximum possible exposure to degradates of potential concern, comparing this exposure to the most toxic degradate endpoints, and showing that the degradates individually and as a group do not pose risks to the environment.

2.5.1.1 Aquatic Assessment

For the aquatic exposure assessment, both cyflumetofen and its degradates of concern were included in the risk assessment. Calculating exposure to the parent was accomplished using standard EFED methods. However, estimating exposure to the degradates is more challenging and was accomplished by making conservative assumptions of the estimated environmental concentrations (EECs) using a modified total toxic residue (TTR) approach. Typically in the TTR approach, all of the degradates of concern are assumed as toxic as the **parent**. This assumption is considered conservative (protective of the environment) for most chemicals because structural changes in molecules as pesticides degrade tend to result in chemicals that are less toxic. Additionally, degradates are typically smaller and often more water soluble than the parent molecule, which typically results in a molecule that is easier to excrete from target and non-target organisms resulting in more limited exposure durations.

In the case of cyflumetofen and its degradates, the available toxicity data indicates that cyflumetofen is more toxic than its degradates. However, toxicity data is only available for selected degradates (**Section 5**). In the modified TTR approach used in this assessment, all of the degradates of concern are assumed to be as toxic as the most toxic degradate for which data is available rather than as toxic as the parent. The modified TTR approach essentially treats the parent and degradates of concern as a single chemical that 1) persists as long as any of the parent and degradates of concern persist in fate studies; and 2) occurs at concentrations over time commensurate with the sum of the concentrations of the parent and all degradates of concern at each sampling date in the fate studies. The chemicals included in the TTR approach include: cyflumetofen, A-1, A-2, A-18, AB-1, AB-7, AB-11, AB-12, AB-15, AB-1 dimer (which is dimer of two AB-1 molecules joined together), AU16 (which is dimer of two A-1 molecules joined together), and AU17 (which is dimer of an A-1 and AB-1 molecules joined together). The TTR half-lives are discussed in **Section 3**. Structures of cyflumetofen and its degradates are presented in **Appendix Table C-1**.

This modified TTR approach is considered conservative (protective of environmental concerns) because the EECs of the most toxic degradate is likely to be less than the TTR EECs (*i.e.*, not all of the TTR exposure is to that most toxic degradate). Further, the potential of the degradates of concern for which toxicity data is unavailable is discussed in terms of how much more toxic would that degradate have to be than the most toxic degradate for there to be an effect to aquatic ecological listed and non-listed species.

2.5.1.2 Terrestrial Assessment

For the terrestrial exposure assessment, exposure is based on the parent cyflumetofen alone since there is no defined process for including specific degradates in terrestrial exposure estimates using the current model (*i.e.*, T-REX). Additionally, while consideration of degradates in the terrestrial assessment would lengthen the window of exposure, it would not affect the resulting RQs.

2.5.2 Measures of Exposure

To estimate risks to aquatic and terrestrial organisms from exposure to cyflumetofen, all exposure modeling and resulting risk conclusions are made based on maximum application rates, application methods, and any mitigation measures specifically indicated on the label. Models used to predict estimated environmental concentrations (EECs) of cyflumetofen are discussed on

OPP's model website[6] and include: PRZM (Pesticide Root Zone Model) and EXAMS (EXposure Analysis Modeling System), T-REX, and TerrPlant.

2.5.2.1 PRZM and EXAMS

PRZM and EXAMS are simulation models coupled with the linkage program shell, PE5, which incorporates the standard scenarios developed by EFED. The models generate daily exposures and calculate 1-in-10 year EECs that may occur in surface water bodies adjacent to application sites. PRZM simulates pesticide fate and transport as a result of leaching, direct spray drift, runoff and erosion from an agricultural field, and EXAMS estimates environmental fate and transport of pesticides in a surface water body for a 30-year period. The standard scenarios used for ecological pesticide assessments assume application to a 10-hectare agricultural field that drains into an adjacent 1-hectare water body that is 2 meters deep (20,000 m^3 volume) with no outlet. The combined models (*i.e.*, PRZM/EXAMS) are designed to estimate pesticide concentrations found in the water body (standard pond) at the edge of the treated field. As such, they provide high-end values of the pesticide concentrations that might be found in ecologically sensitive environments following pesticide application. The location of the field is specific to the crop being simulated using site-specific information on the soils, weather, cropping, and management factors associated with the scenario. The crop/location scenario is intended to represent a high-end exposure site on which the crop is normally grown. Based on historical rainfall patterns, the receiving water body receives multiple runoff events during the years simulated. Weather and agricultural practices are simulated for 30 years so that the 10-year exceedance probability at the site can be estimated. The simulation is generated using 30 years of meteorological data, typically, encompassing the years from 1961 to 1990. Additional information on these models can be found at OPP's model website[7].

2.5.2.2 T-REX

The T-REX model (v1.5.1; August 20, 2012), a Tier 1 model for screening-level assessments of pesticides, is used to estimate terrestrial animal exposure values resulting from possible dietary ingestion of cyflumetofen residues on vegetative matter and insects present on non-food and food items from exposure to cyflumetofen. This model incorporates the Kenaga nomograph, as modified by Fletcher *et al.* (1994), which is based on a large set of actual field residue data. The upper limit values from the nomograph represent the 95th percentile of residue values from actual field measurements (Hoerger and Kenaga, 1972). In all screening-level assessments, the organisms are assumed to consume 100% of their diet as one food type. The T-REX model determines (1) EECs for different food items of birds and mammals, (2) risk to birds and mammals via calculation of risk quotients (RQs), and (3) EECs (*i.e.*, for tall grass) to evaluate risk to terrestrial invertebrates from dietary exposure.

2.5.2.3 TerrPlant

TerrPlant (v1.2.2; October 29, 2009), a Tier 1 model for screening-level assessments of pesticides, is used to estimate exposure to terrestrial plants from single pesticide applications; the model does not consider exposures to plants from multiple pesticide applications. TerrPlant

[6] http://www.epa.gov/oppefed1/models/terrestrial/index.htm
[7] http://www.epa.gov/oppefed1/models/water/index.htm

determines (1) EECs in runoff and in spray drift and (2) risk to non-listed and listed species of monocots and dicots inhabiting dry (upland) and semi-aquatic areas via calculation of RQs.

2.5.2.4 AgDRIFT

The AgDRIFT (v 2.1.1) model[8] is used to estimate spray drift from aerial and ground spray applications. In addition, AgDRIFT is used to estimate buffer distances, *i.e.*, the distance offsite where effects to non-target organisms are no longer expected, in cases where a proposed use of cyflumetofen results in a LOC exceedance. The AgDRIFT spray drift model has undergone thorough peer review and can be used to provide estimates of off-target spray drift deposition from aerial and ground boom application methods (USEPA 1997, 1999). Tier 1 AgDRIFT conditions are used to estimate spray drift deposition from pesticide applications as allowed by product labels.

2.5.2.5 KABAM

KABAM (KOW (based) Aquatic BioAccumulation Model; v. 1.0; April 9, 2009) is used to estimate potential bioaccumulation of hydrophobic organic pesticides in freshwater aquatic food webs and subsequent risks to mammals and birds via consumption of contaminated aquatic prey. KABAM is composed of two parts: 1) a bioaccumulation model estimating pesticide concentrations in aquatic organisms and 2) a risk component translating exposure and toxicological effects of a pesticide into risk estimates for mammals and birds consuming contaminated aquatic prey. The bioaccumulation portion of KABAM is based on an aquatic food web bioaccumulation model published by Arnot and Gobas (2004). The bioaccumulation portion of KABAM relies on a pesticide's octanol-water partition coefficient (KOW) to estimate uptake and elimination constants through respiration and diet of aquatic organisms in different trophic levels. Pesticide tissue concentrations in aquatic organisms are calculated for different trophic levels of a food web through diet and respiration. In the risk component of KABAM, pesticide concentrations in aquatic organisms are used to estimate dose- and dietary-based exposures and associated risk quotients for mammals and birds consuming aquatic organisms.

2.5.3 Measures of Effect

Measures of effect are obtained from a suite of registrant-submitted guideline studies conducted with a limited number of surrogate species or studies found in the open literature. The test species are not intended to be representative of the most sensitive species but rather are selected based on their ability to thrive under laboratory conditions. The acute measures of effect routinely used for listed and non-listed animals in screening level assessments are the LD_{50}, LC_{50} or EC_{50}, depending on taxon (**Table 2-6**). LD stands for "Lethal Dose", and LD_{50} is the amount of a material (*e.g.*, mg/kg-bw), given all at once, that is estimated to cause the death of 50% of a group of test organisms. LC stands for "Lethal Concentration", and LC_{50} is the concentration of a chemical (*e.g.*, mg/kg-diet; mg/L) that is estimated to kill 50% of a sample population. EC stands for "Effective Concentration", and the EC_{50} is the concentration of a chemical that is estimated to produce some measured effect (*e.g.*, mortality; reduced growth and/or reproduction) in 50% of the test population. Endpoints for chronic measures of exposure for listed and non-

[8] http://www.agdrift.com

listed organisms are the NOAEL or NOAEC. NOAEL stands for "No Observed-Adverse-Effect-Level" and refers to the highest tested dose (*e.g.*, mg/kg-bw) of a substance that has been reported to have no harmful (adverse) effects on a test population. The NOAEC (*i.e.*, "No-Observed-Adverse-Effect-Concentration") is the highest test concentration (*e.g.*, mg/kg-diet; mg/L) at which none of the observed results were statistically different from the control. For non-listed plants, the Agency uses EC_{25}(IC_{25}) for terrestrial plants and EC_{50} (IC_{50}) for aquatic plants; for listed plants, the Agency uses the EC_{05} (IC_{05}) or NOAEC (**Table 2-7**).

Table 2-7. Acute and Chronic Measures of Effect

Taxon	Assessment	Measure of Effect
Birds	Acute/sub-acute	Lowest LD_{50} (single oral dose)/LC_{50} (sub-acute dietary)
	Chronic	Lowest NOAEC (21-week reproduction)
Mammals	Acute	Lowest LD_{50} (single oral dose)
	Chronic	Lowest NOAEC (two-generation reproduction)
Terrestrial invertebrates	Acute	Lowest LD_{50} (acute contact)
Terrestrial plants: monocots and dicots	Acute/chronic	<u>Non-listed</u>: Lowest EC_{25} (IC_{25}) (seedling emergence and vegetative vigor) <u>Listed</u>: EC_{05} (IC_{05}) or NOAEC associated with the lowest EC_{25} (IC_{25}) (seedling emergence and vegetative vigor)
Fish and aquatic invertebrates	Acute	Lowest EC_{50} or LC_{50} (acute toxicity tests)
	Chronic	Lowest NOAEC (early life-stage or full life-cycle tests)
Aquatic plants: vascular and non-vascular	Acute/chronic	<u>Non-listed</u>: Lowest EC_{50} (IC_{50}) <u>Listed</u>: EC_{05} (IC_{05}) or NOAEC associated with the lowest EC_{50}

Where available, sublethal effects observed in both registrant-submitted and open literature studies will be evaluated qualitatively. Such effects may include behavioral changes (*e.g.*, lethargy and changes in coloration). However, quantitative assessments of risks are limited to those endpoints that can be directly linked to the Agency's assessment endpoints of impaired survival, growth, and reproduction.

Information on the potential effects of cyflumetofen to non-target organisms is also collected from reviews of incidents associated with the use of cyflumetofen.

The assessment of risk for direct effects to non-target organisms makes the assumption that the toxicity of cyflumetofen to birds is similar to terrestrial-phase amphibians and reptiles. The same assumption is made for the relationship between fish and aquatic-phase amphibians.

2.5.4 Integration of Exposure and Effects

Risk characterization is the integration of exposure and ecological effect characterizations to determine the potential ecological risk from the use of cyflumetofen and the likelihood of direct and indirect effects to non-target organisms in aquatic and terrestrial habitats. The exposure and effects data are integrated to evaluate potential adverse ecological effects on non-target species. The risk quotient (RQ) method will be used to compare estimated exposure and measured toxicity values. Acute and chronic EECs will be divided by acute and chronic toxicity values. The resulting, unitless RQs will then be compared to the Agency's Levels of Concern (LOC) (USEPA, 2004). As outlined in the Overview Document (USEPA, 2004), the likelihood of effects to individual organisms from particular uses of a chemical may also be estimated using the probit dose-response slope and either the LOC or the actual calculated risk quotient value.

Collectively, these methods are used to indicate when cyflumetofen's use, as directed on the labels, has the potential to cause adverse direct or indirect effects to non-target organisms.

2.5.5 Endangered Species Assessments

Consistent with the Agency's responsibility under the Endangered Species Act (ESA), the Agency evaluates risks to Federally-listed threatened and/or endangered (listed) species from registered uses of cyflumetofen. This assessment is conducted in accordance with the Overview Document (USEPA, 2004), provisions of the Endangered Species Act (ESA), and the Services' *Endangered Species Consultation Handbook* (USFWS/NMFS, 1998).

The assessment of effects associated with the registration of cyflumetofen is based on an action area. The action area is considered to be the area directly or indirectly affected by the federal action, as indicated by the exceedance of Agency LOCs used to evaluate direct or indirect effects. The Agency's approach to defining the action area under the provisions of the Overview Document (USEPA, 2004) considers the results of the risk assessment process to establish boundaries for that action area with the understanding that exposures below the Agency's defined LOCs constitute a no-effect threshold. For the purposes of this assessment, attention is focused on the footprint of the action (*i.e.*, the area where cyflumetofen application occurs) and all areas where offsite transport (*i.e.*, spray drift, runoff, *etc.*) may result in potential exposure that exceeds the Agency's LOCs. Specific measures of ecological effect that define the action area for listed species include any direct and indirect effects and/or potential modification of its critical habitat, including reduction in survival, growth, and reproduction as well as the full suite of sublethal effects available in the effects literature. Therefore, the action area extends to a point where environmental exposures are below any measured lethal or sublethal effect threshold for any biological entity at the whole organism, organ, tissue, and cellular level of organization. In situations where it is not possible to determine the threshold for an observed effect, the action area is assumed to encompass the entire United States.

2.5.6 Endocrine Disruptor Screening Program

As required by FIFRA and the Federal Food, Drug, and Cosmetic Act (FFDCA), EPA reviews numerous studies to assess potential adverse outcomes from exposure to chemicals. Collectively, these studies include acute, subchronic and chronic toxicity, including assessments of carcinogenicity, neurotoxicity, developmental, reproductive, and general or systemic toxicity. These studies include endpoints which may be susceptible to endocrine influence, including effects on endocrine target organ histopathology, organ weights, estrus cyclicity, sexual maturation, fertility, pregnancy rates, reproductive loss, and sex ratios in offspring. For ecological hazard assessments, EPA evaluates acute tests and chronic studies that assess growth, developmental and reproductive effects in different taxonomic groups and reviews these data and selects the most sensitive endpoints for relevant risk assessment scenarios from the existing hazard database. However, as required by FFDCA section 408(p), cyflumetofen is subject to the endocrine screening part of the Endocrine Disruptor Screening Program (EDSP).

EPA has developed the EDSP to determine whether certain substances (including pesticide active and other ingredients) may have an effect in humans or wildlife similar to an effect produced by a "naturally occurring estrogen, or other such endocrine effects as the Administrator may designate." The EDSP employs a two-tiered approach to making the statutorily required determinations. Tier 1 consists of a battery of 11 screening assays to identify the potential of a chemical substance to interact with the estrogen, androgen, or thyroid (E, A, or T) hormonal systems. Chemicals that go through Tier 1 screening and are found to have the potential to interact with E, A, or T hormonal systems will proceed to the next stage of the EDSP where EPA will determine which, if any, of the Tier 2 tests are necessary based on the available data. Tier 2 testing is designed to identify any adverse endocrine-related effects caused by the substance, and establish a dose-response relationship between the dose and the E, A, or T effect.

Under FFDCA section 408(p), the Agency must screen all pesticide chemicals for endocrine effects. Between October 2009 and February 2010, EPA issued test orders/data call-ins for the first group of 67 chemicals, which contains 58 pesticide active ingredients and 9 inert ingredients. For additional information on the EDSP program, visit http://www.epa.gov/endo/.

2.6 Data Gaps

Submission of data to eliminate data gaps would reduce uncertainties in the ecological risk assessment. Data gaps have been assigned either a low or high potential to add value to the ecological risk assessment. While still considered data gaps according to 40 CFR Part 158, data from low potential studies are unlikely to change risk conclusions, and alternate methods and weight of evidence can be used in the absence of data. In contrast, data from high potential studies are likely to impact risk conclusions and allow the Agency to be better able to characterize potential risks by eliminating uncertainties for both non-listed and listed species that cannot be accounted for using alternate methods or weight of evidence.

2.6.1 Environmental fate

Table 2-8 provides environmental fate studies by MRID that offer data for each guideline requirement as well as study classifications and whether or not further data are needed to support the ecological risk assessment (*i.e.*, whether there is a data gap).

Table 2-8. Environmental Fate Data for Cyflumetofen and Remaining Data Gaps

Guideline	Description	MRID (parent unless otherwise specified)	Classification	Data Gap?	Comments
835.2120 161-1	Hydrolysis	48542624 48542625	Supplemental Acceptable	No	MRID 48542624 did not identify/quantify degradates.
835.2240 161-2	Photodegradation in Water	48542627	Acceptable	No	
835.2410 161-3	Photodegradation in Soil	48542750 (A-label) 48542751 (B-label)	Acceptable Acceptable	No	
835.4100 162-1	Aerobic Soil Metabolism - parent	48542745 48542748 48542752	Acceptable Acceptable Acceptable	No	Of the 8 soils studied, only 2 used an A-label.
	Aerobic Soil Metabolism - degradate	48542754 (B-1) 48542755 (AB-1) 48542756 (B-3)	Supplemental Supplemental Supplemental	No	Did not identify/ quantify degradates. Not radio-labeled.

Guideline	Description	MRID (parent unless otherwise specified)	Classification	Data Gap?	Comments
835.4200 162-2	Anaerobic Soil Metabolism	48542749	Acceptable	No	
835.4300 162-4	Aerobic Aquatic Metabolism	48542768 48542770 48542771	Acceptable Acceptable Acceptable	No	
835.4400 162-3	Anaerobic Aquatic Metabolism	48542769	Acceptable	No	
835.1230 163-1	Sediment and soil Adsorption/ Desorption	48542759 (parent) 48542760 (B-1) 48542761 (AB-1) 48542762 (B-3) 48542763 (B-1, B-3, and A-2) 48542786 (AB-1 dimer)	Supplemental Supplemental Supplemental Supplemental Supplemental Supplemental	No	Did not use Agency approved methods.
835.1240 163-1	Soil column leaching	48542764 (B-1) 48542765 (B-1)	Supplemental Supplemental	No	Not required
835.6100 164-1	Terrestrial Field Dissipation	48542757	Not classified yet	**In review**	Storage stability study is not finished. Preliminary results show parent not stable for as long as samples stored before analysis.
850.6100	Analytical Method - Soil	48542828 (parent, A-2, B-3, B-1, and AB-1 dimer) 48542647 (parent, A-2, B-3, B-1, and AB-1 dimer)	Acceptable Acceptable	No	
850.6100	Analytical Method - Water	48542650 (parent) 48542651 (B-1) 48542652 (B-3)	Acceptable Acceptable Acceptable	No	
850.6100	Analytical Method-Sediment	48542657 (AB-1)	Acceptable	No	
850.1730 165-4	Accumulation in fish	48542785	Acceptable	No	Did not identify/ quantify degradates.

Because there were no aquatic risks identified in this assessment, there are no fate related studies that would have a **high potential** to affect the ecological risk assessment for cyflumetofen.

Data from the following fate guideline studies are considered to have **low potential** to add value to the ecological risk assessment for cyflumetofen:

Guideline 835.1240 – Soil Column Leaching of Parent: Cyflumetofen has hydrophobic characteristics and is unlikely to persist long in wet aerobic/anaerobic environments. Therefore, it is unlikely that the parent will leach in substantial quantities.

Guideline 835.6100 – Terrestrial Field Dissipation: The 2-year storage stability is incomplete but interim reports appear to show that cyflumetofen cannot be stored for long in frozen soil samples without degradation. Therefore, it is likely that the study will need to be repeated, but a non-radiolabeled field study cannot address the unextracted residue issue using the current analytical methods. If an analytical method using harsher extraction methods was shown to greatly reduce unextracted residues, it would be more useful to repeat the terrestrial field dissipation study with the harsher extraction methods.

2.6.2 Ecological Effects

Table 2-9 provides ecological effects studies by MRID that offer data for each guideline requirement as well as study classifications and whether or not further data are needed to support the ecological risk assessment (*i.e.*, whether there is a data gap).

Table 2-9. Ecological Effects Data for Cyflumetofen and Remaining Data Gaps

Guideline	Description	MRID (parent unless otherwise specified)	Classification	Data Gap?	Potential for Additional Data to Add Value
850.1010	Acute toxicity freshwater invertebrates	48542789 48542790 (A-2) 48542787 (B-1) 48542788 (B-2) 48542921 (form.)	Acceptable Acceptable Acceptable Supplemental Supplemental	No	NA
850.1025 850.1055	Acute toxicity estuarine/marine mollusk	48542810	Acceptable	No	NA
850.1035 850.1045	Acute toxicity estuarine/marine invertebrate	48542711	Acceptable	No	NA
850.1075	Acute toxicity freshwater fish (cold water species)	48542779 48542780 (form.)	Acceptable Supplemental	No	NA
	Acute toxicity freshwater fish (warm water species)	48542780 48542782 (A-2) 48542781 (B-1)	Acceptable Acceptable Acceptable	No	NA
	Acute toxicity estuarine/marine fish	48542812	Acceptable	No	NA
850.1300	Aquatic invertebrate life cycle (freshwater)	48542791	Acceptable	No	NA
850.1350	Aquatic invertebrate life cycle (saltwater)	--	--	Yes	Low
850.1400	Fish early life stage (freshwater)	48542783	Supplemental	Yes	Low
	Fish early life stage (saltwater)	--	--	Yes	Low
850.1740	Whole sediment: acute marine invertebrates	48542798	Acceptable	No	NA
	Whole sediment: chronic freshwater invertebrates	48542802 48542801 (AB-1) 48542803 (AB-1 dimer)	Acceptable Acceptable Acceptable	No	NA
850.2100	Avian oral toxicity (upland game or waterfowl species)	48542772 48542773	Acceptable	No	NA

Guideline	Description	MRID (parent unless otherwise specified)	Classification	Data Gap?	Potential for Additional Data to Add Value
	Avian oral toxicity (passerine species)	48542774	Acceptable	No	NA
850.2200	Avian dietary toxicity (upland game species)	48542775	Acceptable	No	NA
	Avian dietary toxicity (waterfowl species)	48542776	Acceptable	No	NA
850.2300	Avian reproduction (upland game species)	48542777	Acceptable	No	NA
	Avian reproduction (waterfowl species)	48542778	Acceptable	No	NA
850.3020	Honeybee acute contact toxicity	48542805	Acceptable	No	NA
850.4100	Seedling emergence (terrestrial plants)	48542933	Supplemental	Yes	**High**
850.4150	Vegetative vigor (terrestrial plants)	48542932	Acceptable	No	NA
850.4400	Aquatic plant growth (aquatic vascular plant toxicity)	48542804	Acceptable	No	NA
850.4500	Aquatic plant growth (aquatic non-vascular plant: algal toxicity)	48542792 48542793 48542795 48542796 (AB-11) 48542797 (B-1) 48542922 (form.)	Acceptable Acceptable Acceptable Acceptable Supplemental Supplemental	No	NA
850.4550	Aquatic plant growth (aquatic non-vascular plant: cyanobacteria toxicity)	48542794	Acceptable	No	NA

form. = formulation; NA = not applicable; FW = freshwater; SW = saltwater

Data from the following guideline studies are considered to have **high potential** to add value to the ecological risk assessment for cyflumetofen:

Guideline 850.4100 – Seedling Emergence and Seedling Growth: Acceptable seedling emergence data are not available. The submitted seedling emergence study (MRID 48542933) was classified as Supplemental because for the most sensitive monocot – oat, dry weight and shoot length of the lowest treatment group (*i.e.*, 0.000706 lb a.i./A) were significantly reduced (*i.e.*, 33.2 and 27.3 %, respectively) when compared to the control group resulting in the lack of a NOAEC for monocots. In addition, an EC_{25} for monocots could not be determined because the oat endpoints of dry weight and shoot length displayed an atypical concentration-response relationship leading to issues with model convergence (see **Figure 5-1**). A continuation, Tier II test with oat is necessary to reduce uncertainty in characterizing risk to listed and non-listed monocots and is considered to have a high potential to add value to the ecological risk assessment.

Data from the following guideline studies are considered to have **low potential** to add value to the ecological risk assessment for cyflumetofen:

Guideline 850.1350 – Mysid Chronic Toxicity Test: Aquatic invertebrate life cycle toxicity data for an estuarine/marine invertebrate are required under 40 CFR Part 158 if the product is expected to enter the environment in significant concentrations because of its expected use or mobility patterns. No studies have been submitted for this data requirement. Given that there is no evidence to indicate that estuarine/marine animals are substantially more sensitive to cyflumetofen than freshwater animals, fulfilling this data requirement has a low potential to add value to the ecological risk assessment. In the absence of these data, toxicity to estuarine/marine invertebrates from chronic exposure to cyflumetofen will be characterized using toxicity data for freshwater invertebrates (*e.g.*, *Daphnia*).

Guideline 850.1400 – Fish Early Life Stage Toxicity Test, freshwater: Acceptable early life stage toxicity data are not available for a freshwater fish. The submitted freshwater fish early life stage study was classified as supplemental because the high:low ratio and percent coefficient of variation for measured test concentrations were 2.1 and 27%, respectively, exceeding the 1.5 and 20% maxima for acceptable variability in aquatic studies (MRID 48542783). Since repeating this study is likely to yield the same variability with respect to exposure concentrations due to the rapid hydrolysis of cyflumetofen in aqueous environments, fulfilling this data requirement has a low potential to add value to the ecological risk assessment. In the absence of these data, toxicity to freshwater fish from chronic exposure to cyflumetofen will be characterized using the NOAEC (= 31.6 µg/L) from the submitted study (MRID 48542783) and acknowledging the associated uncertainty.

Guideline 850.1400 – Fish Early Life Stage Toxicity Test, estuarine/marine: Early life stage toxicity data for an estuarine/marine fish are required under 40 CFR Part 158 if the product is expected to enter the environment in significant concentrations because of its expected use or mobility patterns. No studies have been submitted for this data requirement. Given that there is no evidence to indicate that estuarine/marine animals are substantially more sensitive to cyflumetofen than freshwater animals, fulfilling this data requirement has a low potential to add value to the ecological risk assessment. In the absence of these data, toxicity to estuarine/marine fish from chronic exposure to cyflumetofen will be characterized using toxicity data for freshwater fish.

3 Fate and Transport Characterization

Cyflumetofen is not persistent in the environment and rapidly converts to degradates via abiotic hydrolysis reactions (DT_{50} = 9.75 hours at pH 7) and biotic reactions with (DT_{50} of less than 22 days). Many of the degradates (*e.g.*, A-2, A-18, AB-1, and B-1) are much more persistent than the parent. Maximum formation fractions and limited chemical property and mobility data for the degradates identified in cyflumetofen fate studies appear in **Appendix Table C-1**, and transformation pathways are depicted in **Appendix Figures C-1** through **C-5** for abiotic hydrolysis, aquatic photolysis, aerobic soil metabolism, aerobic aquatic metabolism, and anaerobic aquatic metabolism, respectively.

Cyflumetofen has two rings, both of which were radio-labeled in fate studies. The phenyl ring label (see cyflumetofen structure in **Figure 3-1** for location) is referred to as the A label, and the tolyl ring label is referred to as the B label. These label designations were used in naming the cyflumetofen degradates. Degradates that retain only the A label (phenyl ring) typically are named with the prefix "A", whereas degradates that retain only the B label (tolyl ring) typically are named with the prefix "B". Degradates that retain both rings are named with the prefix "AB".

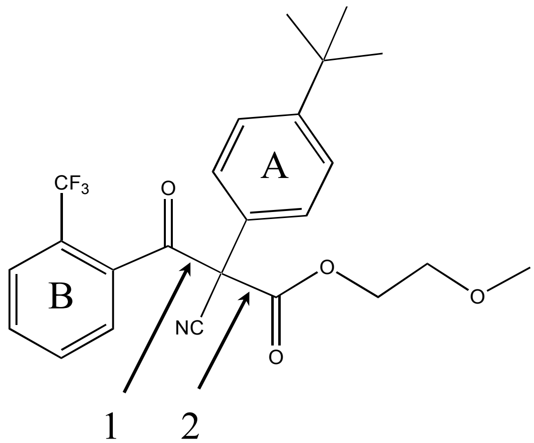


Figure 3-1. Cyflumetofen chemical structure with A and B rings denoted and bonds identified that are important in the initial degradation of the molecule through most fate pathways.

There are two bonds that readily break (denoted in **Figure 3-1**) in all of the fate studies involving water other than photolysis (*i.e.*, hydrolysis, aerobic and anaerobic soil and aquatic metabolism, and terrestrial field dissipation studies). If the bond denoted 1 in **Figure 3-1** breaks, the A and B degradates are formed. If the bond denoted 2 in **Figure 3-1** breaks (or less typically, some other bond on the same unlabeled side chain), the AB degradates are formed.

"B" degradates (*i.e.*, tolyl ring degradates; B-1 and B-3) are water soluble (range: 363.3 – 13,000 mg/L), have low estimated Koc's (range: 79 – 121.5 L/kg-organic carbon), and lack the cyano group (C≡N) of the parent. "A" degradates (*i.e.*, phenyl ring degradates; A-1, A-2, A-12, and A-18) are also water soluble (range: 28.94 – 201.8 mg/L) and have low estimated Koc's (range: 113.7 – 1200 L/kg-organic carbon), but most (A-1, A-2, and A-18) retain the cyano group of the parent. The "AB" degradates (AB-1, AB-7, AB-11, AB-15, and AB-12) have low water solubility (range: 0.01 – 0.142 mg/L), high estimated Koc's (range: 10,400 – 85,630 L/kg-organic carbon), and retain the cyano group of the parent.

Some of the degradates that have a cyano group (A-1 and AB-1) formed dimers in the fate studies (AB-1 Dimer, AU16, and AU17). The dimers are formed by two molecules with cyano groups bonding together (2 only) at the carbon to which the cyano group is attached in each molecule (the carbon atom located between the 1 and 2 bonds in **Figure 3-1**). It is not clear whether these dimers would actually form in the environment or simply form during the sample extraction process. These dimers are predicted (EpiSuite v4.10) to have extremely low water solubility (range: 4×10^{-10} – 7×10^{-3} mg/L) and high Koc's (range: 50,600 – 1.6×10^{8} L/kg-organic carbon).

For comparison, cyflumetofen has a comparatively low water solubility of 0.0277 mg/L at 20ºC (MRID 48542621) and Koc of 131,826 L/kg-organic carbon. Only degradates AB-11, AB-12, AB-1 dimer, AU16 (dimer), and AU17 (dimer) are predicted to have lower water solubilities than the parent. Similarly, only degradates AB-12, AB-1 dimer, and AU17 (dimer) are predicted to have higher Kocs than the parent. Therefore, the vast majority of the degradates are expected to be more mobile than the parent. (All degradate data on solubility and Koc data were estimated using EpiSuite v4.10 and are included in **Appendix Table C-1**. For purposes of consistency with the estimated degradate data provided, the water solubility and Koc values reported in this paragraph and **Appendix Table C-1** are also EpiSuite estimates. The text following this point in the document is based on registrant-submitted cyflumetofen fate studies.)

3.1 Degradation

3.1.1 Hydrolysis

Cyflumetofen's hydrolytic degradation appears to be pH dependent, with degradation rate increasing (half-life time [DT_{50}] decreasing) and with increasing pH. The DT_{50} values decrease from 7.42 days at pH 4, to 6.16 days at pH 5, to 0.406 days (~9.7 hours) at pH 7, to 0.00518 days (~7.5 minutes) at pH 9 (T = 25ºC; average of both labels, MRID 48542625). Hydrolytic degradation in the A-labeled studies yielded: A-1, A-18, A-2, and AB-1 (**Appendix Figure C-1**). All of the A-labeled hydrolysis degradates retain a cyano-group and therefore, are of concern. Therefore in terms of TTR half-life calculation, cyflumetofen is stable to hydrolysis since it only produces degradates of concern (**Appendix Table D-1**). Hydrolytic degradation in the B-labeled studies yielded: AB-1 and B-1. (Notice, the production of B-1 which does not have a cyano-group in the B-label study does not indicate that the TTR half-life should not be considered stable since it results in the production of A-1. A-1 just does not show up in the B-label studies.)

A second study (MRID 48542624), measured hydrolysis rates at 3 temperatures (20, 25, and 40ºC) and three pHs (4, 7, and 9). (No degradates were identified or quantified in this study.) At 25ºC, the results were similar (9.25 days at pH 4, 5 hours at pH 7, and 12 minutes at pH 9).

3.1.2 Aquatic Photolysis

The aqueous photolysis study shows a photo transformation half-life in distilled water of about 1.2 hours or 0.0511 days (T = 25ºC; average of both labels, MRID 48542627). This same study provides a similar estimate of 0.04 days natural water at 25ºC (average of both labels). Degradates produced included degradates of concern (A-1, A-18, A-2, AB-1, AB-6, AB-7, and AB-15) and degradates not of concern (A-14, A-12, and B-1) (**Appendix Figure C-2**). The TTR half-life in distilled water is 17.6 days (**Appendix Table D-1**).

3.1.3 Soil photolysis

Soil photolysis studies were conducted for the parent, cyflumetofen, with a DT_{50} value of 4.9 days (A-label, MRID 48542750) and 5.9 days (B-label, MRID 48542751). Degradates produced included degradates of concern (AB-8, AB-11, and AB-12) and degradates not of concern (AB-13 and B-1). Maximum occurrence of unextracted residues ranged from 25.5 to 47.7% of applied radioactivity. The highest unextracted residue value came from the A-labeled soil, possibly indicating some contribution from an A-labeled chemical that would not show up in the B-labeled studies (~22% more in A- than B-labels from the same soil). The TTR half-life from the A-label study is 68.5 days (**Appendix Table D-1**).

3.1.4 Aerobic Soil Metabolism

Aerobic soil metabolism DT_{50} values from eight soils were available from registrant-submitted studies for the parent, cyflumetofen, with half-lives ranging from 2.24 to 13.3 days (MRIDs 48542745, 48542748, and 48542752). However, only two of these soils were studied with an A-label radio-tracer. Degradates produced included degradates of concern (A-1, A-2, AB-1, AU17, and AB-1 dimer) and degradates not of concern (B-1, B-3, and A-12) (**Appendix Figure C-3**). Maximum occurrence of unextracted residues ranged from 21.6 to 43.4% of applied radioactivity. The highest unextracted residue value came from the A-labeled soil, possibly indicating some contribution from an A-labeled chemical that would not show up in the B-labeled studies (~8-10% more in A- than B-labels from the same soil). The TTR half-lives from the A-label studies are 64.1 and 846 days (**Appendix Table D-1**).

Aerobic soil metabolism studies using non-radiolabeled material were conducted for three of the degradates of cyflumetofen. Because non-radiolabeled material was used, no estimate of unextractable residues can be made. Additionally, no degradates were identified in these studies. The degradate B-1 was studied in three European soils yielding degradation curves that roughly approximated first-order degradation kinetics with half-lives of 4.98, 16.8, and 36.3 days (**Appendix Table D-2** – separate from the parent degradation graphs in **Appendix Table D-1**). Similarly, B-3 yielded degradation curves that roughly approximated first-order degradation kinetics with half-lives of 6.32, 9.56, and 8.46 days. Both of these chemicals (B-1 and B-3) have relatively similar structures, are expected to be hydrophilic (see EpiSuite estimated water solubilities and Kocs in **Appendix Table C-1**), and seem to behave very similarly in terms of aerobic soil degradation (similar half-lives and shape of the degradation curve).

Degradate AB-1 (non-radiolabeled) was also studied in three European soils, yielded radically different degradation curves from those of B-1 and B-3. The AB-1 degradation curves initially dropped steeply to 14%, 13%, and 11% of applied radioactivity at their 24 hour sampling. These degradation curves then flattened-out to yield an almost linear decline for the remaining 119 days of the studies for final measurements at 120 days of 8%, 6%, and 3% of applied radioactivity. AB-1 is expected to be hydrophobic.

The Agency's interpretation of these AB-1 studies is the initial decline is likely due to the formation of unextractable residues and potentially, formation of dimers, rather than rapid degradation to simpler molecules. In the radio-labeled aerobic soil metabolism studies, AB-1 was a major degradate that persisted to the end of the studies. Potentially, AB-1 may persist in soil and sediment in some form of equilibrium with soil water or overlying and pore water in aquatic systems. Additional data from longer-term (at least 1 year duration) radio-labeled studies using more rigorous extraction methods (optimized to extract AB-1 and its degradates) would be beneficial in understanding the fate of this degradate.

3.1.5 Anaerobic Soil Metabolism

Anaerobic soil metabolism DT_{50} values from four soils were available from registrant-submitted studies for the parent, cyflumetofen, with half-lives ranging from 1.78 to 10.4 days (MRID 48542749). However, only one of these soils was studied with an A-label radio-tracer. Degradates produced included degradates of concern (A-1, A-2, AB-1, and AB-1 dimer) and degradates not of concern (B-1, B-3, and A-12). Maximum occurrence of unextracted residues ranged from 16.3 to 32.4% of applied radioactivity. The highest unextracted residue value came from the A-labeled soil, possibly indicating some contribution from an A-labeled chemical that would not show up in the B-labeled studies (~10% more in A- than B-labels from the same soil). The TTR half-life from the A-label study is 264 days (**Appendix Table D-1**).

3.1.6 Aerobic Aquatic Metabolism

Aerobic aquatic metabolism DT_{50} values from four systems were available from registrant-submitted studies for the parent, cyflumetofen, with half-lives ranging from 0.3 to 21.4 days (MRIDs 48542768, 48542770, and 48542771). All of these systems were studied with both A- and B-label radio-tracers. Degradates produced included degradates of concern (A-1, A-2, AB-1, and AB-1 dimer) and degradates not of concern (B-1, B-3, and A-12) (**Appendix Figure C-4**). Maximum occurrence of unextracted residues ranged from 14 to 44.2% of applied radioactivity. The highest unextracted residue values came from A-labeled soils, probably indicating some contribution from an A-labeled chemical that would not show up in the B-labeled studies (~2.7 - 20% more in A- than B-labels from the same soil). The TTR half-lives from the A-label studies range from 16.4 to 149 days (**Appendix Table D-1**).

3.1.7 Anaerobic Aquatic Metabolism

Anaerobic aquatic metabolism DT_{50} values from two systems were available from registrant-submitted studies for the parent, cyflumetofen, with half-lives ranging from 4.76 to 21.5 days (MRID 48542769). All of these systems were studied with both A- and B-label radio-tracers. Degradates produced included degradates of concern (A-2 and AB-1) and degradates not of concern (B-1 and A-12) (**Appendix Figure C-5**). Maximum occurrence in each system of unextracted residues ranged from 4.1 to 12.1% of applied radioactivity. However, unlike the other metabolism studies, there was no difference in unextracted residues in terms of percent applied radioactivity in one system (Pennsylvania), whereas the other system (Florida) had the highest unextracted residue values in the B-labeled samples (~8% more in B- than A-labeled samples from the Florida soil). The TTR half-lives from the A-label studies range from 3780 (Pennsylvania) to 31,300 (Florida) days (**Appendix Table D-1**).

3.2 Mobility

3.2.1 Volatility

Cyflumetofen appears to be non-volatile. This is supported by its water solubility (0.0277 mg/L at 20ºC; MRID 48542621) and low vapor pressure ($< 4.43 \times 10^{-8}$ torr at 25ºC; MRID 48542611) and Henry's Law constant ($< 9.3 \times 10^{-7}$ $Pa*m^3/mol$ at 20ºC; MRID 48542612).

3.2.2 Adsorption/desorption – Parent

The organic carbon normalized soil adsorption coefficient (Koc) of OK-5101 pure was determined by an HPLC method. Phenol, 4-methylbenzamide, methylbenzoate, naphthalene, 1,2,3-trichlorobenzene, fenthion, phenanthrene and p,p-DDT were used for the calibration standards. The organic carbon normalized soil adsorption coefficient (Koc) of OK-5101 pure was calculated to be 131,826 L/kg_{oc} (MRID 48542759).

3.2.3 Adsorption/desorption – Degradates

The adsorption behavior of B-1 to soil was studied in three soils using the batch equilibrium method: Speyer 2.2 soil (2.29% organic carbon (OC), loamy sand), Speyer 2.3 soil (1.02% OC, sandy loam) and Speyer 6S soil (1.9% OC, sandy clay). Adsorption isotherms were determined over a concentration range of 0.1-5 mg/L. Based on the kinetics experiment, B-1 hardly adsorbs to the soil. Therefore, the equilibrium time could not be determined accurately. B-1 adsorbs only very weakly to soil and can be considered highly mobile (MRID 48542760).

AB-1 in soils was studied in the same three soils. At a soil:solution ratio of only 1:200 the percentage adsorption was ≥87% in Speyer 2.2 and Speyer 2 3 soils and ≥30% in Speyer 6S soil. Given the strong adsorption of AB-1 to soil even at a very low soil:solution ratio and the low water solubility (0.0277 mg/L) in combination with the limit of quantification of 0.005 mg/L, isotherms could not be determined. Instead, the adsorption coefficient was determined in duplicate for each soil at soil solution ratios of 1:100 and 1:200. Based on the resulting Kom values ($\geq 2.6 \times 10^3$ ml/g) AB-1 should be considered immobile (MRID 48542761).

B-3 in soils was studied in the same three soils. Adsorption of B-3 on soil could be described by Freundlich adsorption isotherms. K_{foc} values were 11.726 (Speyer 2.2), 12.202 (Speyer 6S), and 16.863 L/kg (Speyer 2.3) for a mean of 13.597 and 1/n values were 0.874, 0.959 and 1.039, respectively (mean 0.957) (MRID 48542762).

The adsorption/desorption behavior of the radiolabeled metabolites of cyflumetofen B-1, B-3 and A-2 was investigated on different US and European soils. The six soils covered a range of pH from 5.8 to 8.1, a range of organic carbon content from 0.28% to 3.84% and four different USDA textural classes: Silty Clay Loam, Loam, Loamy sand and Sandy Loam. The average adsorption Koc was 4.4, 22.8, and 865 for B-1, B-3 and A-2, respectively (MRID 48542763).

The adsorption/desorption potential of the AB-1 dimer was investigated in four US soils, which included sandy loam, clay loam, sand, and loam and one German sandy loam soil. The soils covered a range of pH from 6.1 to 8.1 and a range of organic carbon content from 0.08 to 2.26. The adsorption coefficients Kd and Koc were estimated using 1 concentration level (0.28 ng/mL). The estimated Kd values for all the test soils ranged from 237.47 to 4341.91 L/kg. The adsorption coefficient, Koc, derived from the Kd values for the test soils was > 103,000 L/kg, indicating that the test substance AB-1 dimer is immobile in the test soils. The Koc value was also estimated by the HPLC method to be 8,315,788 L/kg.

3.3 Field Studies

The interpretation of the terrestrial field dissipation studies (MRID 48542757) awaits the completion of the storage stability study (interim report is MRID 48542829). Some of the terrestrial field dissipation samples were held under frozen conditions for 2 years. The interim report indicates that the parent cyflumetofen does not appear to be stable under the frozen storage conditions used in the study. This lack of stability of the parent would likely reduce the concentrations of the parent chemical measured at each time point and potentially enhance the concentration of degradates at each time point. It appears likely that the terrestrial field dissipation study may need to be repeated.

3.4 Bioconcentration

The measured BCF is approximately 200× in whole fish (other tissues were not measured separately) based on TRR (total radioactive residues). The BCF study is somewhat problematic in that the TRR was still increasing at the end of the accumulation phase. The identity of radioactivity measured in the BCF study was not determined in the fish BCF study. Therefore, it is unknown whether it is parent, degradate(s), or some combination of parent and degradate(s) that is accumulating in the fish. However, the rate of accumulation appears to slow over the 21 day accumulation phase with concentrations only doubling from day 1 (approximately 100×) to day 21 (approximately 200×) (MRID 48542785).

4 Exposure Assessment

4.1 Terrestrial Exposure

4.1.1 Birds, Mammals, and Terrestrial Invertebrates

Input parameters for T-REX[9] (**Table 4-1**) include a maximum application rate, number of applications, application interval, a default EFED foliar dissipation half-life of 35 days, and definitive toxicity endpoints for birds and mammals.

Table 4-1. Input Parameters for T-REX Modeling Scenarios

Use	Maximum Single Application Rate (lb a.i./A)	Maximum Number of Applications (Minimum Application Interval, Days)	Other Parameters[1]
Citrus Grapes Pome fruits Strawberries Tree nuts Tomatoes Ornamentals	0.2	2 (14)	Foliar dissipation half-life = 35 days (default) Avian NOAEC = 154 mg a.i./kg-diet (bobwhite quail; MRID 48542777) Mammalian NOAEC = 150 mg/kg-diet (9.21 mg/kg-bw) (rat; MRID 48542702)

[1] Avian acute oral, avian sub-acute dietary, and mammalian acute oral endpoints are non-definitive (*i.e.*, >) and are thus not included in this table because they cannot be used to calculate RQs.

[9] http://www.epa.gov/oppefed1/models/terrestrial/index.htm#trex

Results of T-REX modeling of cyflumetofen residue levels on dietary food items of mammals and birds are provided in **Tables 4-2**, **4-3**, and **4-4**. Results include dietary-based values (*i.e.*, mg/kg-food item) and dose-based values (*i.e.*, mg/kg-bw).

Table 4-2. Avian Dose-Based (mg/kg-bw) Estimated Exposure Concentrations (EECs)[a]

Use	Feeding Category	Dose-Based EECs (mg/kg-bw)[b]		
		Small (20 g)	**Medium (100 g)**	**Large (1000 g)**
Citrus Grapes Pome fruits Strawberries Tree nuts Tomatoes Ornamentals	Short grass	**96.10**	54.80	24.53
	Tall grass	44.04	25.12	11.24
	Broadleaf plants	54.05	30.82	13.80
	Fruits/pods	6.01	3.42	1.53
	Arthropods	37.64	21.46	9.61
	Seeds	1.33	0.76	**0.34**

[a] upper bound Kenaga values
[b] Minimum and maximum EECs are in **BOLD**.

Table 4-3. Mammalian Dose-Based (mg/kg-bw) Estimated Exposure Concentrations (EECs)[a]

Use	Feeding Category	Dose-Based EECs (mg/kg-bw)[b]		
		Small (15 g)	**Medium (35 g)**	**Large (1000 g)**
Citrus Grapes Pome fruits Strawberries Tree nuts Tomatoes Ornamentals	Short grass	**80.45**	55.60	12.89
	Tall grass	36.87	25.48	5.91
	Broadleaf plants	45.25	31.27	7.25
	Fruits/pods	5.03	3.47	0.81
	Arthropods	31.51	21.78	5.05
	Seeds	1.12	0.77	**0.18**

[a] upper bound Kenaga values
[b] Minimum and maximum EECs are in **BOLD**.

Table 4-4. Avian and Mammalian Dietary-Based (mg/kg-diet) Estimated Exposure Concentrations (EECs)[a]

Use	Feeding Category	Dietary-Based EECs[b] (mg/kg-diet)
Citrus Grapes Pome fruits Strawberries Tree nuts Tomatoes Ornamentals	Short grass	**84.38**
	Tall grass	38.67
	Broadleaf plants	47.46
	Fruits/pods/seeds	**5.27**
	Arthropods	33.05

[a] upper bound Kenaga values
[b] Minimum and maximum EECs are in **BOLD**.

4.1.2 Terrestrial (Upland and Semi-Aquatic) Plants

Input parameters for TerrPlant[10] (**Table 4-5**) include a maximum application rate, incorporation depth (1 inch; default), water solubility (0.0281 mg/L) to inform the run-off fraction (1%), spray drift fraction (1% for ground application; 5% for aerial application), and definitive toxicity endpoints from seedling emergence (SE) and vegetative vigor (VV) studies.

EECs used to evaluate potential risk to terrestrial plants are provided in **Table 4-6.**

Table 4-5. Input Parameters for TerrPlant Modeling Scenarios

Use (Application Method)	Maximum Single Application Rate (lb a.i./A)	Spray Drift Fraction[a] (%)	Other Parameters
Citrus Grapes Pome fruits Strawberries Tree nuts Tomatoes Ornamentals (Ground)	0.2	1	Incorporation depth = ≤ 1 inch Runoff fraction = 1% SE endpoints (MRID 48542933)[b] Dicot (Tomato) EC_{25} = 0.0393 lb a.i./A NOAEC = 0.000706 lb a.i./A VV endpoints (MRID 48542932)[c] Monocot & Dicot NOAEC = 0.273 lb a.i./A
Tomatoes (aerial)	0.2	5	

SE = seedling emergence; VV = vegetative vigor
[a] 1% for ground application; 5% for aerial application
[b] monocot SE endpoints are not available (*i.e.*, definitive) or could not be determined
[c] monocot and dicot VV EC_{25} endpoints are non-definitive (*i.e.*, >)

Table 4-6. Terrestrial (Upland and Semi-aquatic) Plant Estimated Exposure Concentrations (EECs)

Use (Application Method)	Runoff EEC (lb a.i./A)		Spray Drift EEC (lb a.i./A)	Total Loading EEC (Runoff + Spray Drift) (lb a.i./A)	
	Dry (Upland) Areas	Semi-Aquatic Areas	All Areas	Dry (Upland) Areas	Semi-Aquatic Areas
Citrus Grapes Pome fruits Strawberries Tree nuts Tomatoes Ornamentals (ground)	0.002	0.02	0.002	0.004	0.022
Tomatoes (aerial)	0.002	0.02	0.01	0.012	0.03

4.2 Aquatic Exposure

[10] http://www.epa.gov/oppefed1/models/terrestrial/index.htm#terrplant

The environmental fate properties used for modeling parent only and the total toxic residues (TTR) for cyflumetofen are summarized in **Table 4-7** and **Table 4-8**.

Table 4-7. PRZM/EXAMS Input Parameter Values for Parent Only Modeling

Parameter (Units)	Input Value and Unit	Source/Comments
Maximum Application Rate	See Table 4-10	Labels
Minimum Reapplication Interval	See Table 4-10	Labels
Modeling Scenarios	See Table 4-10	Professional Judgment
Initial Application Dates (dd-mm)	See Table 4-10	Professional Judgment
Application Method	Cam = 2	Foliar spray
Application Efficiency Fraction	Aerial – 0.95 or ground – 0.99	Default
Spray Drift Loading Fraction	Aerial – 0.305 Ground – 0.027	AgDRIFT – 15mph, boom height = 15ft (aerial) / 2 ft (ground), droplet size = fine
Incorporation depth (cm)	0	Default
Molecular Weight (g/mole)	447.45	MRID 48542621
Water Solubility (mg/L)	0.028	MRID 48542621
Vapor Pressure (torr)	4.43×10^{-8}	MRID 48542611
K_{OC} (L/kg_{oc})	72,000	Professional Judgment – a Koc value was chosen to represent a low-end value for the parent and be consistent with the degradates of concern that are considered likely to be more persistent.
Hydrolysis $t_{½}$ (days)	0.406	TTR – MRID 48542625
Aqueous Photolysis $t_{½}$ (days)	0.0511	TTR – MRID 48542627
Aerobic Soil Metabolism $t_{½}$ (days)	27.51[2]	TTR – MRIDs 48542745, 48542748, and 48542752
Aerobic Aquatic Metabolism $t_{½}$ (days)	38.89[3]	TTR – MRIDs 48542769, 48542770, and 48542771
Anaerobic Aquatic Metabolism $t_{½}$ (days)	6.59[4]	TTR – MRID 48542769

[1] Input Parameter Guidance Manual, Pesticides (Version 2.1; Oct. 22, 2009)
[2] Aerobic soil metabolism TTR half-lives of 2.24, 4.98, 2.27, 2.36, 3.4, 4.37, 13.3, and 2.53 days.
[3] Aerobic aquatic metabolism TTR half-lives of 21.4, 18.3, 11.3, and 0.297 days.
[4] Anaerobic aquatic metabolism TTR half-lives of 21.5 and 4.76 days.

Table 4-8. PRZM/EXAMS Input Parameter Values for Total Toxic Residues Modeling

Parameter (Units)	Input Value and Unit	Source/Comments
Maximum Application Rate	See Table 4-10	Labels
Minimum Reapplication Interval	See Table 4-10	Labels
Modeling Scenarios	See Table 4-10	Professional Judgment
Initial Application Dates (dd-mm)	See Table 4-10	Professional Judgment
Application Method	Cam = 2	Foliar spray
Application Efficiency Fraction	Aerial – 0.95 or ground – 0.99	Default
Spray Drift Loading Fraction	Aerial – 0.305 Ground – 0.027	AgDRIFT – 15mph, boom height = 15ft (aerial) / 2 ft (ground), droplet size = fine
Incorporation depth (cm)	0	Default
Molecular Weight (g/mole)	447.45	MRID 48542621
Water Solubility (mg/L)	0.028	MRID 48542621
Vapor Pressure (torr)	4.43×10^{-8}	MRID 48542611
K_{OC} (L/kg_{oc})	72,000	Professional Judgment – a Koc value was chosen to represent a low-end value for

Parameter (Units)	Input Value and Unit	Source/Comments
		the degradates of concern that are considered likely to be more persistent.
Hydrolysis $t_{½}$ (days)	Stable	TTR – MRID 48542625
Aqueous Photolysis $t_{½}$ (days)	17.6	TTR – MRID 48542627
Aerobic Soil Metabolism $t_{½}$ (days)	1096[2]	TTR – MRIDs 48542745 and 48542748
Aerobic Aquatic Metabolism $t_{½}$ (days)	173[3]	TTR – MRIDs 48542769, 48542770, and 48542771
Anaerobic Aquatic Metabolism $t_{½}$ (days)	60,000[4]	TTR – MRID 48542769

[1] Input Parameter Guidance Manual, Pesticides (Version 2.1; Oct. 22, 2009)
[2] Aerobic soil metabolism TTR half-lives of 61.4 and 846 days.
[3] Aerobic aquatic metabolism TTR half-lives of 149, 99.2, 16.4, and 40.3 days.
[4] Anaerobic aquatic metabolism TTR half-lives of 31,300 and 3780 days.

The label-required spray application conditions (release height greater than 15 feet above crop canopy and droplet size category of fine) are likely to transport cyflumetofen through spray drift in excess of EFED's default spray drift assumptions. Additionally, the label specifies 15 mph as the maximum wind speed during application. Non-default AgDRIFT modeling inputs are summarized in **Table 4-9**. AgDRIFT output is provided in **Appendix E**.

Table 4-9. Summary of Non-Default AgDRIFT Modeling Inputs

Parameter	Aerial Application	Ground Application
Droplet Size	Fine (DV_{05} = 179.6 µm)	ASAE Very fine to fine (DV_{05} = 175 µm)
Boom Height	15 ft. above ground	24" on label (20" modeled)
Data Percentile	NA	90th percentile
Wind Speed	15 mph	NA
Spray Volume		NA

NA = Not Applicable

The aquatic parent only and TTR EECs for the various scenarios and application practices are listed in **Table 4-10**. (See **Appendix E** for representative output from PRZM/EXAMS.) Surface water Parent only EECs for the proposed uses of cyflumetofen ranged from 0.26 to 3.2 µg/L for peak EECs, 0.016 to 0.20 µg/L for 1-in-10 year 21-day average EECs, and 0.006 to 0.078 µg/L for 1-in-10 year 60-day average EECs. Surface water TTR EECs for the proposed uses of cyflumetofen ranged from 0.48 to 7.8 µg/L for peak EECs, 0.25 to 5.1 µg/L for 1-in-10 year 21-day average EECs, and 0.23 to 4.9 µg/L for 1-in-10 year 60-day average EECs.

Pore water TTR EECs change slowly over time, displaying little inter-annual variation and ranging from 0.14 to 3.0 µg/L for peak EECs, 1-in-10 year 21-day average EECs, and 1-in-10 year 60-day average EECs across all scenarios (**Table 4-10**). Over multi-year time scales though, both surface water (**Figure 4-1c**) and pore water (**Figure 4-1d**) TTR EECs increase with time. (Notice that because inter-annual variation is small for pore water TTR EECs in **Figure 4-1d**, the peak, 21-day, and 60-day plot on top of each other for the same year.)

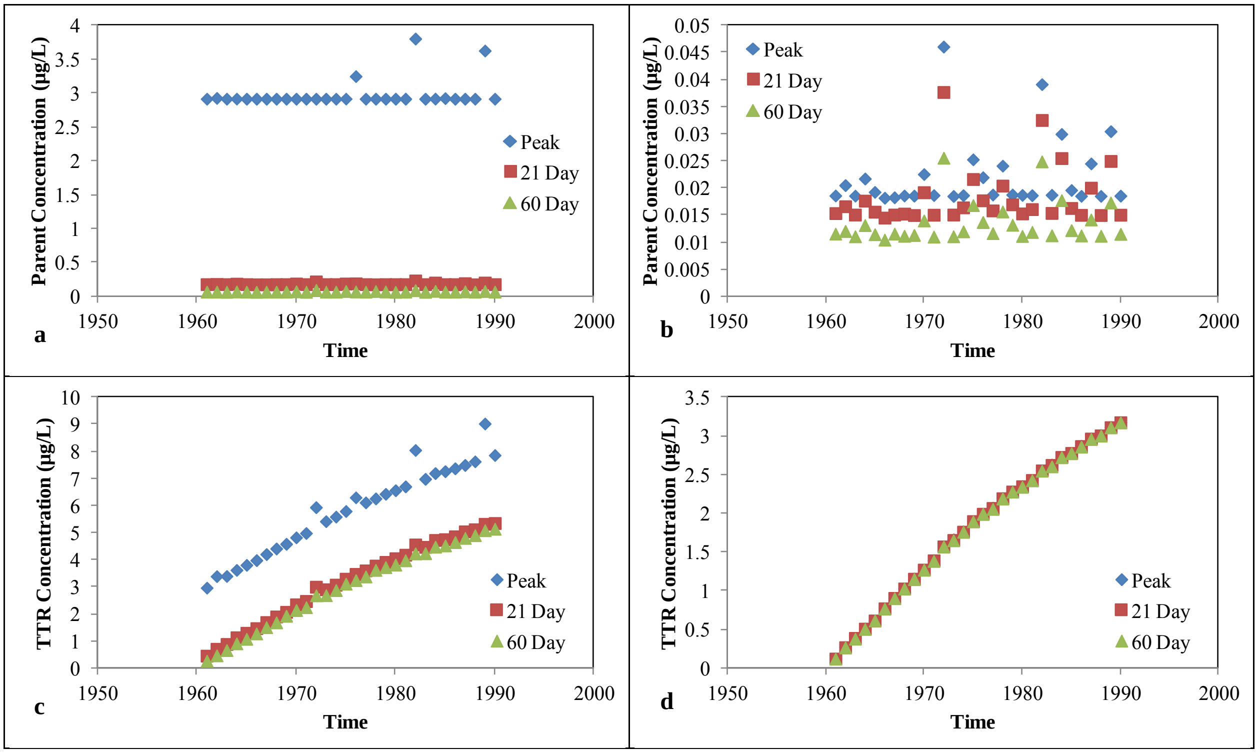


Figure 4-1. Temporal variation in cyflumetofen parent only surface (a) and benthic pore (b) water and total toxic residue (TTR) surface (c) and benthic pore (d) water estimated environmental concentrations (EECs).

Table 4-9. Parent Only and Total Toxic Residue (TTR) Estimated Environmental Concentrations (EECs) in Surface and Benthic Pore Water Cyflumetofen

Use/ Scenario	Aerial (A) or Ground (G) / Initial App. Dates (d-m)	Max. Single App. Rate (lb a.i./A)	Max. Number of App.	Max. App. Rate Per Crop Cycle/Season (lb a.i./A)	Min. App. Interval (Days)	Parent Only EECs (µg/L)				Total Toxic Residue EECs (µg/L)			
						Surface Water			Benthic Pore Water	Surface Water			Benthic Pore Water
						Peak	21-day	60-day	21-day	Peak	21-day	60-day	21-day
Citrus													
CA	G / 1-1	0.2	2/CC	0.4	14	0.258	0.016	0.006	0.002	0.478	0.253	0.233	0.140
FL	G / 1-1	0.2	2/CC	0.4	14	0.272	0.019	0.007	0.003	2.583	1.859	1.836	1.150
Grapes													
CA Grapes	G / 1-1	0.2	2/CC	0.4	14	0.258	0.017	0.007	0.002	0.553	0.328	0.308	0.186
CA Wine Grapes	G / 1-1	0.2	2/CC	0.4	14	0.445	0.037	0.016	0.010	2.458	1.503	1.470	0.914
NY Grapes	G / 1-6	0.2	2/CC	0.4	14	0.869	0.053	0.023	0.015	5.271	3.404	3.358	2.093
Pome Fruit													
NC	G / 1-6	0.2	2/CC	0.4	14	0.447	0.035	0.015	0.008	2.801	1.595	1.513	0.933
OR	G / 1-6	0.2	2/CC	0.4	14	0.258	0.016	0.006	0.002	1.322	1.064	1.036	0.645
PA	G / 1-6	0.2	2/CC	0.4	14	0.508	0.025	0.011	0.006	2.920	1.927	1.869	1.163
Strawberry													
CA	G / 1-1	0.2	2/CC	0.4	14	0.262	0.018	0.007	0.002	0.897	0.629	0.609	0.373
FL	G / 1-1	0.2	2/CC	0.4	14	0.259	0.016	0.006	0.002	2.495	1.897	1.859	1.142
Tree Nuts													
CA Almond	G / 1-1	0.2	2/CC	0.4	14	0.260	0.018	0.007	0.002	0.772	0.523	0.501	0.308
OR Filberts	G / 1-6	0.2	2/CC	0.4	14	0.258	0.016	0.006	0.002	1.289	1.035	1.006	0.626
GA Pecans	G / 1-6	0.2	2/CC	0.4	14	0.886	0.041	0.017	0.011	3.488	2.126	2.065	1.286
Tomatoes													
CA	A / 1-6	0.2	2/CC	0.4	14	2.914	0.176	0.065	0.015	5.012	2.501	2.271	1.357
	G / 1-6	0.2	2/CC	0.4	14	0.258	0.016	0.006	0.001	0.575	0.352	0.331	0.202
FL	A / 1-6	0.2	2/CC	0.4	14	2.980	0.185	0.069	0.016	6.058	3.566	3.349	2.029
	G / 1-6	0.2	2/CC	0.4	14	0.329	0.025	0.010	0.004	2.439	1.699	1.680	1.056
PA	A / 1-6	0.2	2/CC	0.4	14	**3.216**	**0.202**	**0.078**	**0.025**	**7.833**	**5.108**	**4.891**	**3.000**
	G / 1-6	0.2	2/CC	0.4	14	0.961	0.042	0.019	0.012	3.947	2.974	2.914	1.822
Nursery/Ornamental													
CA	G / 1-1	0.2	2/yr	0.4	14	0.413	0.032	0.014	0.008	3.115	1.510	1.481	0.913
FL	G / 1-1	0.2	2/yr	0.4	14	0.259	0.016	0.006	0.002	2.262	1.594	1.575	0.985
MI	G / 1-4	0.2	2/yr	0.4	14	0.264	0.018	0.007	0.002	2.572	1.903	1.858	1.160
NJ	G / 1-4	0.2	2/yr	0.4	14	0.279	0.022	0.009	0.004	2.624	1.732	1.704	1.062
OR	G / 1-4	0.2	2/yr	0.4	14	0.258	0.016	0.006	0.002	0.807	0.589	0.568	0.350
TN	G / 1-4	0.2	2/yr	0.4	14	0.259	0.019	0.008	0.003	2.311	1.739	1.726	1.076

Although the TTR EECs are increasing over time, it is important to note that in reality the accumulating mass of TTRs is changing in chemical composition over time (see the complex degradation pathways in **Appendix Figures C-1 to C-5**). The TTR EECs include all of the degradates that retain the cyano group expressed as the equivalent concentration of parent if all of those degradates were transformed back into the parent.

Typically, the degradation process proceeds from more complex (higher molecular weight) and less water soluble chemicals to simpler and more water soluble chemicals. ^{14}Carbon dioxide was produced in quantities greater than 5% of applied radioactivity in the A-labeled studies of the aerobic soil and aerobic aquatic metabolism studies (**Appendix Table C-1**). (The simpler chemicals that retain the cyano-group occur in the A-label studies.) Additionally, A-12 (which does not have a cyano-group but degrades from intermediate degradates that do possess a cyano-group) was detected in anaerobic soil and anaerobic aquatic metabolism studies. Therefore over time, it might be expected that the accumulated TTR mass represents mostly degradates slowly undergoing complete mineralization in aerobic environments or converting to degradates that are not of concern (*e.g.*, A-12) in anaerobic environments. This is probably a good assumption for the fraction of cyflumetofen that degrades through the pathway involving an initial break of the bond denoted #1 in **Figure 3-1**, since this break results in the production of mostly simple molecules. However, the pathway involving an initial break of the bond #2 in **Figure 3-1** results in the "AB" chemicals, which appear to be much more persistent.

Finally, the fate data also show the formation of dimers, which are complex (higher molecular weight) chemicals with very low water solubilities in the hydrolysis, aerobic and anaerobic soil metabolism, aerobic aquatic metabolism, and terrestrial field dissipation studies (**Appendix Table C-1**). If these dimers are actually forming in the environment (not a laboratory artifact), it is difficult to predict their environmental fate from the registrant-submitted fate data. Often these dimers were at their highest concentrations at, or near, the end of the fate studies (**Appendix Table C-1**). Additionally, the aerobic and anaerobic soil metabolism and aerobic and anaerobic aquatic metabolism studies had high proportions of the total applied radioactivity as unextractable, and therefore unidentified, residues.

4.2.1 Aquatic Bioaccumulation

The KABAM model (v. 1.0) was used to model a single high-end scenario based on the highest TTR EECs that result from any of the assessed uses of cyflumetofen (aerial application to Pennsylvania tomatoes). This scenario was chosen to represent the highest potential for bioaccumulation from the currently proposed cyflumetofen uses (**Table 4-11**).

Table 4-11. Bioaccumulation Model Input Values for Cyflumetofen

Parameter	Input Value	Source
Pesticide Name	Cyflumetofen	
Log K_{OW}	4.3	MRID 48542623
K_{OC}	72,000	Professional Judgment – a Koc value was chosen to represent a low-end value for the degradates of concern that are considered likely to be more persistent.
Concentration in sediment pore water (ppb)	2.9998	highest TTR EECs: aerial application to Pennsylvania tomatoes
Concentration in water column(ppb)	5.1084	

5 Effects Characterization

Data from registrant-submitted studies used to characterize the effects of parent cyflumetofen and degradates to non-target organisms are described in this section.

No cyflumetofen studies from the open literature were identified using the public version of ECOTOX[11].

5.1 Effects to Terrestrial Organisms

Summaries of data used to characterize the effects of parent cyflumetofen and degradates to terrestrial organisms are provided in **Tables 5-1** (parent) and **5-2** (degradates). The most sensitive definitive toxicity endpoints used in RQ calculations are bolded.

5.1.1 Birds

Based on studies with mallard duck, bobwhite quail, and zebra finch, cyflumetofen is practically non-toxic to birds on an acute oral basis. No mortality or sublethal effects were noted in the acute oral studies with zebra finch and mallard duck (MRIDs 48542774 and 48542773, respectively). There was no mortality in the study with bobwhite quail (MRID 48542772). However, hunched posture was observed in males from the 222 mg a.i./kg-bw treatment group and in males and females from the 667 and 2000 mg a.i./kg-bw treatment groups resulting in a NOAEL of 74 mg a.i./kg-bw based on clinical signs of toxicity. With the exception of one female from the 2000 mg/kg-bw treatment group showing abnormal posture of the head from Day 4 onwards, all animals recovered between days 1 and 3.

Based on studies with mallard duck and bobwhite quail, cyflumetofen is practically non-toxic to birds on a sub-acute dietary basis. No mortality or sublethal effects were noted in the acute oral study with mallard duck (MRIDs 48542776). In the study with bobwhite quail (MRID 485427775), there was 10% mortality (1 out of 10) in the second highest treatment group (*i.e.*, 2333 mg a.i./kg-diet). This death was considered incidental since no mortality occurred in the highest treatment group (*i.e.*, 5033 mg a.i./kg-diet). In addition, reduced weight gain was observed in the 2333 and 5033 mg a.i./kg-diet treatment groups resulting in a NOAEC of 1133 mg a.i./kg-diet based on sublethal effects.

In the reproduction study with mallard duck (MRID 48542778), one mortality was reported with the cause of death unknown. A statistically-significant decrease in eggshell thickness was detected in the lowest treatment group (*i.e.*, 160 mg a.i./kg-diet) but not the intermediate and highest treatment groups. Since the reduction in eggshell thickness was not concentration-dependent, and there were no treatment-related effects detected for any adult, offspring, or other reproductive parameter at any treatment level, the NOAEC for this study was set at the highest treatment level (*i.e.*, 930 mg a.i./kg-diet).

[11] Quick Database Query conducted on CAS number 400882-07-7 at http://cfpub.epa.gov/ecotox/

Table 5-1. Endpoints Used to Characterize the Effects of Cyflumetofen to Terrestrial Organisms

Assessment Endpoint	Measurement Endpoint	TGAI / Form. (%)	Species	Toxicity Values[1,2] (Effects) & Acute Toxicity Classification (if applicable)	Source & Classification
Survival, growth, and reproduction of birds (surrogate for reptiles and terrestrial-phase amphibians)	Most sensitive avian acute oral LD_{50}	TGAI (98.4)	Bobwhite quail (*Colinus virginianus*)	14-day LD_{50} > 2000 mg a.i./kg-bw (nom) 14-day NOAEL = 74 mg a.i./kg-bw (nom) (no mortality; NOAEL based on clinical signs of toxicity including hunched posture) Practically non-toxic	MRID 48542772 Acceptable
		TGAI (98.4)	Zebra finch (*Taeniopygia guttata*)	14-day LD_{50} > 2000 mg a.i./kg-bw (nom) 14-day NOAEL = 2000 mg a.i./kg-bw (nom) (no mortality or sublethal effects) Practically non-toxic	MRID 48542774 Acceptable
		TGAI (98.0)	Mallard duck (*Anas platyrhynchos*)	14-day LD_{50} > 2250 mg a.i./kg-bw (nom) 14-day NOAEL = 2250 mg a.i./kg-bw (nom) (no mortality or sublethal effects) Practically non-toxic	MRID 48542773 Acceptable
	Most sensitive avian sub-acute dietary LC_{50}	TGAI (98.0)	Bobwhite quail (*Colinus virginianus*)	8-day LC_{50} > 5033 mg a.i./kg-bw (m) 8-day NOAEC = 1133 mg a.i./kg-bw (m) (10% [1 out of 10] mortality at 2333 mg a.i./kg-diet; NOAEC based on reduced body weight gain) Practically non-toxic	MRID 48542775 Acceptable
		TGAI (98.4)	Mallard duck (*Anas platyrhynchos*)	8-day LC_{50} > 5760 mg a.i./kg-bw (m) 8-day NOAEC = 5760 mg a.i./kg-bw (m) (no mortality or sublethal effects) Practically non-toxic	MRID 48542776 Acceptable
	Most sensitive avian chronic NOAEC	TGAI (98.4)	Bobwhite quail (*Colinus virginianus*)	22-week NOAEC = **154** mg a.i./kg-diet (m) 22-week LOAEC = 389 mg a.i./kg-diet (m) (NOAEC based on eggs cracked per pen and eggs not cracked/eggs laid)	MRID 48542777 Acceptable
		TGAI (98.4)	Mallard duck (*Anas platyrhynchos*)	22-week NOAEC = 930 mg a.i./kg-diet (m) 22-week LOAEC > 930 mg a.i./kg-diet (m) (no effects)	MRID 48542778 Acceptable
Survival, growth, and reproduction of mammals	Most sensitive mammalian acute LD_{50}	TGAI (98.0)	Han Wistar rat (*Rattus norvegicus*)	14-day (females) $LD_{50} \geq$ 2000 mg/kg-bw (no mortality; 1 out of 5 females with loose feces on study day 1 only) Practically non-toxic	MRID 48542669 Acceptable
	Most sensitive mammalian chronic NOAEC	TGAI (97.67)	Wistar Hannover (*Rattus norvegicus*)	Two-generation reproduction Parental NOAEL = **150** mg/kg-diet (**9.21**/13.8 mg/kg-bw/day in males/females)	MRID 48542702 Acceptable

Assessment Endpoint	Measurement Endpoint	TGAI / Form. (%)	Species	Toxicity Values[1,2] (Effects) & Acute Toxicity Classification (if applicable)	Source & Classification
				LOAEL = 500 mg/kg-diet (30.6/46.6 mg/kg-bw/day in males/females) (based on effects to adrenals: increased organ weights and histopathology) Reproductive Male NOAEL ≥ 1500 mg/kg-diet (89.4 mg/kg-bw/day) Female NOAEL = 500 mg/kg-diet (46.6 mg/kg-bw/day) Female LOAEL = 1500 mg/kg-diet (141.1 mg/kg-bw-day) (based on hormone changes and increased estrous cycle length) Offspring NOAEL = **150** mg/kg-diet (**9.21**/13.8 mg/kg-bw/day in males/females) LOAEL = 500 mg/kg-diet (30.6/46.6 mg/kg-bw/day in males/females) (based on effects to adrenals: increased organ weights and histopathology)	
Survival, growth, and reproduction of terrestrial invertebrates	Most sensitive terrestrial invertebrate (honeybee) acute LD_{50}	TGAI (98.0)	Honey bee (*Apis mellifera*)	Acute contact 96-hr LD_{50} > 100 µg a.i./bee (nom) 96-hr NOAEL = 20.7 µg a.i./bee (nom) (NOAEL based on statistically-significant mortality; 10, 0, 7, 20, and 13% in the 4.3, 9.4, 20.7, 45.5, and 100 µg a.i./bee treatment groups) Practically non-toxic	MRID 48542805 Acceptable
		Form. (20.4)	Honey bee (*Apis mellifera*)	Acute contact 48-hr LD_{50} > 100 µg a.i./bee (nom) 48-hr NOAEL = 4.6 µg a.i./bee (nom) (no statistically-significant mortality; NOAEL based on lethargy) Practically non-toxic	MRID 48542914 Acceptable
		Form. (20.3)	Honey bee (*Apis mellifera*)	Acute oral 96-hr LD_{50} > 116 µg a.i./bee (nom) 96-hr NOAEL = 116 µg a.i./bee (nom) (no statistically-significant mortality) Practically non-toxic	MRID 48542923 Acceptable
		Form. (20.3)	Parasitic wasp (*Aphidius rhopalosiphi*)	Limit test 48-hr LR_{50} > 1.2 lb a.i./A (nom) 48-hr NOAEC = 1.2 lb a.i./A (nom)	MRID 48542924 Acceptable (non-guideline)

Assessment Endpoint	Measurement Endpoint	TGAI / Form. (%)	Species	Toxicity Values[1,2] (Effects) & Acute Toxicity Classification (if applicable)	Source & Classification
				(no mortality or sublethal effects)	
		Form. (20.3)	Predatory mite (*Typhlodromus pyri*)	Limit test 7-day LR_{50} > 1.2 lb a.i./A (nom) 7-day NOAEC = 1.2 lb a.i./A (nom) (5 and 11% mortality in the control and 1.2 lb a.i./A treatment group, respectively; no sublethal effects)	MRID 48542925 Acceptable (non-guideline)
		TGAI (98.0)	Earthworm (*Eisenia fetida fetida*)	14-day LC_{50} > 1000 mg a.i./kg-dw (soil; nom) 14-day NOAEC = 100 mg a.i./kg-dw (soil; nom) (no mortality; NOAEC based on reduced weight gain)	MRID 48542824 Acceptable (non-guideline)
		Form. (20.4)	Earthworm (*Eisenia fetida fetida*)	14-day LC_{50} > 1050 mg a.i./kg-dw (soil; nom) 14-day NOAEC = 106 mg a.i./kg-dw (soil; nom) (10% mortality at 1.1 mg a.i./kg-dw; NOAEC based on reduced weight gain)	MRID 48542916 Acceptable (non-guideline)
		TGAI (98.4)	Earthworm (*Eisenia fetida fetida*)	28- & 56-day NOAEC = 1000 mg a.i./kg-dw (soil; nom) 28- & 56-day LOAEC > 1000 mg a.i./kg-dw (soil; nom) (based on mortality, growth, and reproduction)	MRID 48542808 Acceptable (non-guideline)
Survival, growth and reproduction of terrestrial plants	Seedling emergence: Most sensitive monocot EC_{25} and NOAEC	Form. (19.64)	Oat (*Avena sativa*)	21/22-day EC_{25}: Could not be determined 21/22-day EC_{05}: Could not be determined 21/22-day NOAEC < 0.000706 lb a.i./A (m) (based on dry weight & shoot length)	MRID 48542933 Supplemental (due to lack of a definitive NOAEC for monocots)
	Seedling emergence: Most sensitive dicot EC_{25} and NOAEC		Tomato (*Lycopersicon esculentum*)	21-day EC_{25} (95% C.I.) = **0.0393** (0.0174-0.0889) lb a.i./A (m) 21-day NOAEC = **0.000706** lb a.i./A (m) (based on dry weight)	
	Vegetative vigor: Most sensitive monocot EC_{25} and NOAEC	Form. (19.64)	Could not be determined	21-day EC_{25} > 0.250/0.268/0.273 lb a.i./A (m) 21-day NOAEC = **0.250/0.268/0.273** lb a.i./A (m) (endpoint depends on species tested)	MRID 48542932 Acceptable
	Vegetative vigor: Most sensitive dicot EC_{25} and NOAEC		Could not be determined	21-day EC_{25} > 0.250/0.268/0.273 lb a.i./A (m) 21-day NOAEC = **0.250/0.268/0.273** lb a.i./A (m) (endpoint depends on species tested)	

Form = formulation; NS = not specified; TGAI = technical grade active ingredient
[1] **BOLD** values used in RQ calculations
[2] m = measured; mm = mean-measured; nom = nominal

Table 5-2. Endpoints Used to Characterize the Effects of Degradates of Cyflumetofen to Terrestrial Organisms

Assessment Endpoint	Degradate (%)	Species	Toxicity Values[1] (Effects)	Source & Classification
Survival, growth, and reproduction of terrestrial invertebrates (earthworms)	AB-1 (99.8)	Earthworm (*Eisenia fetida fetida*)	14-day LC_{50} > 1000 mg/kg-dw (soil; nom) 14-day NOAEC = 100 mg/kg-dw (soil; nom) (2.5, 0, 0, 2.5, 12.5, and 20% mortality in the control, 100, 180, 320, 560, and 1000 mg a.i./kg-dw treatment groups; NOAEC based on reduced weight gain)	MRID 48542806 Acceptable (non-guideline)
	B-1 (99.1)	Earthworm (*Eisenia fetida fetida*)	14-day LC_{50} > 1000 mg/kg-dw (soil; nom) 14-day NOAEC = 1000 mg/kg-dw (soil; nom) (no mortality; NOAEC based on mortality and weight gain)	MRID 48542807 Acceptable (non-guideline)

[1] nom = nominal

In the reproduction study with bobwhite quail (MRID 48542777), eight incidental mortalities were reported; the mortalities were mostly attributed to head and/or neck lesions. In addition, there was a statistically-significant increase in eggs cracked per pen and a statistically-significant decrease in eggs not cracked per eggs laid resulting in a NOAEC of 154 mg a.i./kg-diet.

5.1.2 Mammals

Based on a study with female rats, cyflumetofen is practically non-toxic to mammals on an acute oral basis. In this limit study (MRID 48542669), no mortality, treatment-related necropsy findings, or changes in weight were reported; however, one out of the 5 tested females exhibited loose feces on study day 1 only.

In the 2-generation study with rats (MRID 48542702), adrenal weights were increased in P and F_1 parental females at ≥ 500 mg/kg-diet. In parental males at 1500 mg/kg-diet, adrenal weights were increased in the P and F_1 generations. In addition, ovary weights were increased in P generation females at 1500 mg/kg-diet only. Histopathological examination of the adrenals revealed an increased incidence of hypertrophy of the zona glomerulosa at ≥ 500 mg/kg-diet in P generation females and F_1 generation males and females and in P males at 1500 mg/kg-diet. Additionally in the adrenals, an increased incidence of vacuolation of the zona fasciculata cells was observed at 1500 mg/kg-diet in P generation females and in both sexes of the F_1 generation. An increased incidence of vacuolation of the interstitial cells of the ovary was also noted at 1500 mg/kg-diet in F_1 females. These findings resulted in a parental NOAEL of 150 mg/kg-diet (9.21/13.8 mg/kg-bw/day in males/females) based on effects on the adrenals (increased organ weights and histopathology).

An increase in estrous cycle length was noted at 1500 mg/kg-diet. In addition, decreased FSH levels were noted at 500 mg/kg-diet and above and decreased progesterone was noted at 150 mg/kg-diet and above in F_1 females. As for the decreases in progesterone at 150 and 500 ppm, and in FSH at 500 mg/kg-diet in females, there were no corresponding changes in estrous cycle length or reproductive performance after sexual maturation at these dose levels. In females at 1500 mg/kg-diet, increased estrous cycle length was accompanied by decreases in FSH, progesterone and 17β-estradiol. These findings resulted in a reproductive NOAEL in females of 500 mg/kg-diet (46.6 mg/kg-bw/day) based on hormone changes and increased estrous cycle length; the reproductive NOAEL in males is ≥1500 mg/kg-diet (89.4 mg/kg-bw/day).

Adrenal weights were increased at 500 mg/kg-diet and above in both sexes of both generations of offspring. Microscopic examination of the adrenals revealed an increased incidence of hypertrophy of the zona glomerulosa cells in both generations of males at ≥ 500 mg/kg-diet and in both generations of females at 1500 mg/kg-diet. Additionally in the adrenals, an increased incidence of hypertrophy of the zona fasciculata cells was noted at ≥ 500 mg/kg-diet in F_1 males and females and F_2 males and at 1500 mg/kg-diet in F_2 females. Delayed sexual maturation was observed in females (increased time to vaginal opening) at ≥ 500 mg/kg-diet, and in males (increased time to preputial separation) at 1500 mg/kg-diet. These findings resulted in an offspring NOAEL is 150 mg/kg-diet (9.21/13.8 mg/kg-bw/day in males/females) based on effects on the adrenals (increased organ weights and histopathology) in both sexes and a delay in sexual maturation of females.

5.1.3 Terrestrial Invertebrates

Based on two honey bee contact toxicity studies, one with technical grade active ingredient (TGAI; MRID 48542805) and one with a 20.4% formulation (MRID 48542914), and a honey bee acute oral toxicity study with a 20.4% formulation, cyflumetofen is practically non-toxic to terrestrial invertebrates. In the acute contact toxicity study with technical grade cyflumetofen, mortality after 96 hours in the 4.3, 9.4, 20.7, 45.5, and 100 µg a.i./bee treatment groups was 10, 0, 7, 20, and 13%, respectively, resulting in a NOAEC of 20.7 µg a.i./bee based on statistically-significant mortality in the 45.5 µg a.i./bee treatment group. In the acute contact and oral toxicity studies with a 20.4% formulation of cyflumetofen, there was no statistically-significant mortality after 48 and 96 hours, respectively. However, observed lethargy in the acute contact study with a formulation resulted in a NOAEL of 4.6 µg a.i./bee based on sublethal effects.

Toxicity data from non-guideline studies are also available for arthropods and earthworms (**Tables 5-1** and **5-2**). Acute limit tests with two beneficial terrestrial arthropods – the parasitic wasp (*Aphidius rhopalosiphi*) and the predatory mite (*Typhlodromus pyri*) – using a 20.3% formulation of cyflumetofen both yielded a LR_{50} of >1.2 lb a.i./A and a NOAEC and 1.2 lb a.i./A. No mortality or sublethal effects were noted in the test with *A. rhopalosiphi*, and no sublethal effects or statistically-significant mortality were noted in the test with *T. pyri* (MRIDs 48542924 and 48542725, respectively).

A series of sub-chronic and/or chronic toxicity tests were conducted with earthworms (*Eisenia fetida fetida*) using technical grade cyflumetofen, a 20.4% formulation of cyflumetofen, and degradates AB-1 and B-1 at concentrations up to 1000 mg/kg-dw soil. For the sub-chronic, 14-day toxicity studies, NOAECs of 100-106 mg/kg-dw soil for technical grade and formulated cyflumetofen and degradate AB-1 were based on reduced weight gain (MRIDs 48542824, 48542916, 48542806) whereas the NOAEC for degradate B-1 was set at the highest treatment level (1000 mg/kg-dw soil; MRID 48542807). For the chronic, 56-day toxicity study, the NOAEC was set at the highest treatment level (1000 mg/kg-dw soil; MRID 48542808).

5.1.4 Terrestrial (Upland and Semi-Aquatic) Plants

In the vegetative vigor study (MRID 48542932), the most sensitive monocot and dicot species could not be determined because the NOAEC was the highest treatment level (*i.e.*, 0.250/0.268/0.273 lb a.i./A) for all tested species.

Species-specific endpoints for the seedling emergence study (MRID 48542933) are provided in **Table 5-3**. The most sensitive dicot was tomato, and the most sensitive monocot was oat. For oat, an EC_{25} could not be determined because the concentration-response relationship for dry wieght and shoot length was atypical leading to issues with model convergence (See **Figure 5-1**). In addition, oat dry weight and shoot length of the lowest treatment group (*i.e.*, 0.000706 lb a.i./A) were significantly reduced (*i.e.*, 33.2 and 27.3%, respectively) when compared to the control group resulting in the lack of a NOAEC for monocots and a Supplemental classification for the study.

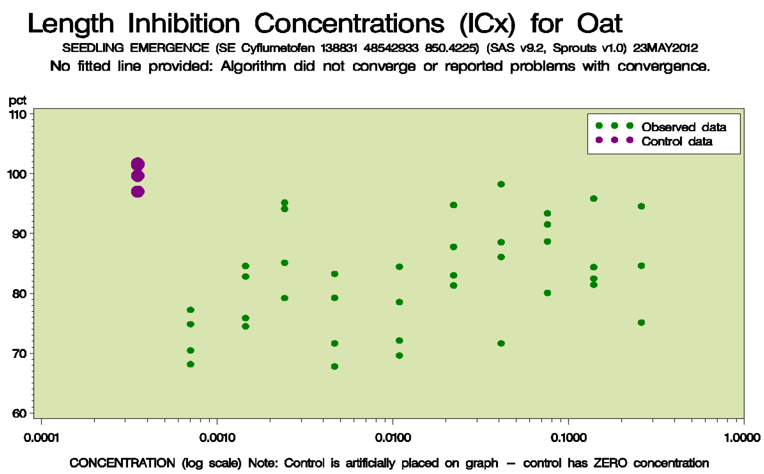
Table 5-3. Species-Specific Endpoints for Seedling Emergence

Species	Most Sensitive Endpoint	NOAEC/LOAEC (lb a.i./A)	% reduction[a] at NOAEC/LOAEC	EC_{25} (lb a.i./A)
Monocots				
Oat (*Avena sativa*)	Dry weight Shoot length	<0.000706/0.000706 <0.000706/0.000706	--/33.2 --/27.3	CBD[a]
Onion (*Allium sepa*)	Survival	0.0235/0.045	13.9/15.6	>0.267
Corn (*Zea mays*)	None	0.260/>0.260	NA	>0.260
Ryegrass (*Lolium perenne*)	None	0.260/>0.260	NA	>0.260
Dicots				
Tomato (*Lycopersicon esculentum*)	Dry weight	0.000706/0.00145	2.1/29.3	0.0393
Cucumber (*Cucumis sativa*)	Dry weight	0.0222/0.0413	14.3/15.5	>0.260
Sugarbeet (*Beta vulgaris*)	Emergence	0.139/0.260	7.7/10.3	>0.260
Radish (*Raphanus sativus*)	None	0.260/>0.260	NA	>0.260
Lettuce (*Lactuca sativa*)	None	0.260/>0.260	NA	>0.260
Soybean (*Glycine max*)	None	0.260/>0.260	NA	>0.260

CBD = could not be determined; NA = not applicable

[a] if NOAEC < highest treatment concentration

[b] While statistically-significant reductions were detected, there were issues with model convergence. Therefore, an EC_{25} could not be determined.



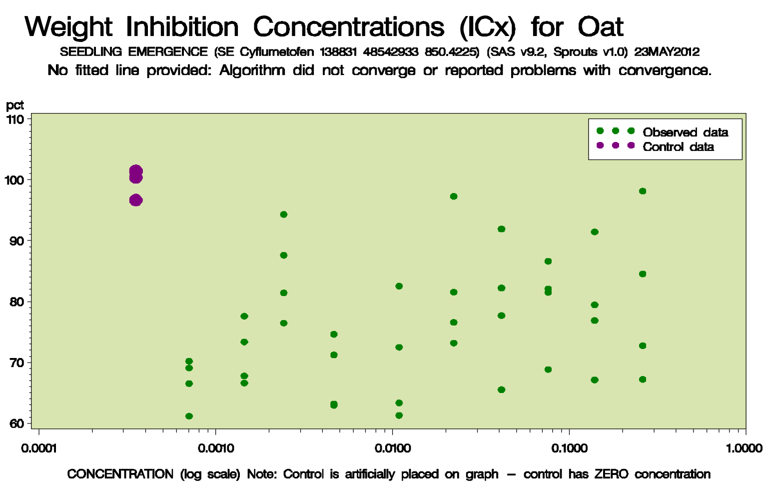


Figure 5-1. Seedling emergence length and weight data for oat graphed in terms of exposure concentration (lb a.i./A) using SAS (v. 8.2), Sprouts (v. 1.0)

5.2 Effects to Aquatic Organisms

Summaries of data used to characterize the effects of cyflumetofen and degradates to aquatic organisms are provided in **Tables 5-3** (parent) and **5-4** (degradates). The most sensitive definitive toxicity endpoints used in RQ calculations are bolded.

5.2.1 Parent Cyflumetofen

5.2.1.1 Fish

Fish acute and early life stage toxicity studies with technical grade cyflumetofen were conducted as limit tests because of the low solubility of cyflumetofen (*i.e.*, 28.1 µg/L at 20°C). Mean-measured concentrations of 17.5 µg a.i./L for rainbow trout (MRID 48542779), 29.2 and 31.6 µg a.i./L for fathead minnow (MRIDs 48542780 and 48542783; acute and early life stage tests, respectively), and 7.59 µg a.i./L for sheepshead minnow (MRID 48542783) were achieved using a saturator column and flow-through exposure. An acute toxicity study with rainbow trout was also conducted with a 20.4% formulation of cyflumetofen which resulted in a mean-measured concentration of 837 µg a.i./L (MRID 48542920). A non-guideline juvenile growth study with carp that achieved mean-measured concentrations of 7.2, 16, 34, 72 and 179 µg a.i./L was conducted using a flow through exposure and a solvent consisting of 1:1 mixture of dimethylformamide (DMF) and cremophor.

Based on studies with rainbow trout, fathead minnow, and sheepshead minnow, technical grade cyflumetofen is practically non-toxic to fish up to the tested solubility limit on an acute basis. No mortality or sublethal effects were noted in any of the acute studies (MRIDs 48542779, 48542780, and 48542783), including the study with a 20.4% formulation of cyflumetofen (MRID 48542920).

In the early life stage study with fathead minnow (MRID 48542783), there were no effects on hatching success, survival, or growth (length and dry weight). The study was classified as Supplemental because the high:low ratio and percent coefficient of variation for measured test concentrations were 2.1 and 27%, respectively, exceeding the 1.5 and 20% maxima for acceptable variability in aquatic studies.

5.2.1.1 Aquatic Invertebrates

Similar to fish, aquatic invertebrate acute and chronic toxicity studies with technical grade cyflumetofen were conducted as limit tests because of the low solubility of cyflumetofen (*i.e.*, 28.1 µg/L at 20°C). Mean-measured concentrations of 17.2 and 16.2 µg a.i./L for *Daphnia magna* (MRIDs 48542789 and 48542791; acute and chronic tests, respectively), 6.30 µg a.i./L for Eastern oyster (MRID 48542810) and 22.7 µg a.i./L for mysid shrimp (MRID 48542811) were achieved using a saturator column and flow-through exposure. An acute toxicity study with *Daphnia magna* was also conducted with a 20.4% formulation of cyflumetofen which resulted a mean-measured concentration of 744 µg a.i./L (MRID 48542921).

Based on studies with daphnids, Eastern oyster, and mysid shrimp, technical grade cyflumetofen is practically non-toxic to aquatic invertebrates up to the tested solubility limit on an acute basis.

Table 5-3. Endpoints Used to Characterize the Effects of Cyflumetofen to Aquatic Organisms

Assessment Endpoint	Measurement Endpoint	TGAI (%)	Species	Toxicity Values[1,2] (Effects) & Acute Toxicity Classification (if applicable)	Source & Classification
Survival, growth, and reproduction of freshwater fish (surrogate for aquatic-phase amphibians)	Most sensitive freshwater fish acute LC_{50}	TGAI (97.08)	Rainbow trout (*Oncorhynchus mykiss*)	Limit test 96-hr LC_{50} > 17.5 µg a.i./L (mm) 96-hr NOAEC = 17.5 µg a.i./L (mm) (no mortality or sublethal effects) Practically non-toxic up to solubility limit	MRID 48542779 Acceptable
		TGAI (97.08)	Fathead minnow (*Pimephales promelas*)	Limit test 96-hr LC_{50} > 29.2 µg a.i./L (mm) 96-hr NOAEC = 29.2 µg a.i./L (mm) (no mortality or sublethal effects) Practically non-toxic up to solubility limit	MRID 48542780 Acceptable
		Form. (20.4)	Rainbow trout (*Oncorhynchus mykiss*)	Limit test 96-hr LC_{50} > 837 µg a.i./L (mm) 96-hr NOAEC = 837 µg a.i./L (mm) (no mortality or sublethal effects)	MRID 48542920 Supplemental (due to use of a form.)
	Most sensitive freshwater fish chronic NOAEC	TGAI (97.08)	Fathead minnow (*Pimephales promelas*)	Limit test Early life-stage 34-day NOAEC = **31.6** µg a.i./L (TWA) 34-day LOAEC > 31.6 µg a.i./L (TWA) (no effects)	MRID 48542783 Supplemental (due to variable exposure concentrations)
		TGAI (98.4)	Carp (*Cyprinus carpio*)	Juvenile growth 28-day EC_{50} = 180.65 µg a.i./L (mm) 28-day NOAEC = 72 µg a.i./L (mm) (based on growth rate)	MRID 48542784 Supplemental (due to use of a non-standard species)
Survival, growth, and reproduction of estuarine/marine fish	Most sensitive estuarine/marine fish acute LC_{50}	TGAI (97.08)	Sheepshead minnow (*Cyprinodon variegatus*)	Limit test 96-hr LC_{50} > 7.59 µg a.i./L (mm) 96-hr NOAEC = 7.59 µg a.i./L (mm) (no mortality or sublethal effects) Practically non-toxic up to solubility limit	MRID 48542812 Acceptable
Survival, growth, and reproduction of freshwater invertebrates	Most sensitive freshwater invertebrate acute EC_{50}	TGAI (97.08)	Water flea (*Daphnia magna*)	Limit test 48-hr EC_{50} > 17.2 µg a.i./L (mm) 48-hr NOAEC = 17.2 µg a.i./L (mm) (no effects) Practically non-toxic up to solubility limit	MRID 48542789 Acceptable
		Form. (20.4)	Water flea (*Daphnia magna*)	Limit test 48-hr EC_{50} > 744 µg a.i./L (mm) 48-hr NOAEC = 744 µg a.i./L (mm) (no effects)	MRID 48542921 Supplemental (due to use of a form.)

Assessment Endpoint	Measurement Endpoint	TGAI (%)	Species	Toxicity Values[1,2] (Effects) & Acute Toxicity Classification (if applicable)	Source & Classification
	Most sensitive freshwater invertebrate chronic NOAEC	TGAI (97.08)	Water flea (*Daphnia magna*)	Limit test 21-day NOAEC = **16.2** µg a.i./L (mm) 21-day LOAEC > 16.2 µg a.i./L (mm) (no effects)	MRID 48542791 Acceptable
Survival, growth, and reproduction of estuarine/marine invertebrates	Most sensitive estuarine/marine invertebrate acute EC_{50} or LC_{50}	TGAI (97.08)	Eastern oyster (*Crassostrea virginica*)	Limit test 96-hr EC_{50} > 6.30 µg a.i./L (mm) 96-hr NOAEC = 6.30 µg a.i./L (mm) (no effects) Practically non-toxic up to solubility limit	MRID 48542810 Acceptable
		TGAI (97.08)	Mysid shrimp (*Mysidopsis bahia*)	Limit test 96-hr LC_{50} > 22.7 µg a.i./L (TWA) 96-hr NOAEC = 22.7 µg a.i./L (TWA) (no mortality or sublethal effects) Practically non-toxic up to solubility limit	MRID 48542811 Acceptable
Survival, growth, and reproduction of sediment-dwelling invertebrates	Most sensitive sediment invertebrate acute LC_{50}	TGAI (97.08 non-radio; 96.0 radio)	Amphipod (*Leptocheirus plumulosus*)	Spiked sediment exposure Sediment concentrations 10-day LC_{50} >787 mg TRR/kg-dw (mm) 10-day NOAEC = 787 mg TRR/kg-dw (mm) Pore water concentrations 10-day LC_{50} > 19.7 mg TRR/L 10-day NOAEC = **19.7** mg TRR/L Overlying water concentrations 10-day LC_{50} > 5.2 mg TRR/L 10-day NOAEC = 5.2 mg TRR/L (no statistically-significant mortality)	MRID 48542798 Acceptable
	Most sensitive sediment invertebrate chronic NOAEC	TGAI (98.4 non-radio; ≥ 96.4 radio)	Non-biting midge (*Chironomus riparius*)	Spiked water exposure Overlying water concentrations 28-day EC_{50} > 65.9 µg a.i./L (TWA) 28-day NOAEC = **65.9** µg a.i./L (TWA) (no statistically-significant effects on rates of emergence and development)	MRID 48542799 Acceptable
		TGAI (97.08)	Non-biting midge (*Chironomus riparius*)	Spiked sediment exposure Sediment concentrations 28-day EC_{50} > 419 mg a.i./kg-dw (mm) 28-day NOAEC = 26.5 mg a.i./kg-dw (mm) Pore water concentrations 28-day EC_{50} > 10.4 µg a.i./L (mm)	MRID 48542802 Acceptable

Assessment Endpoint	Measurement Endpoint	TGAI (%)	Species	Toxicity Values[1,2] (Effects) & Acute Toxicity Classification (if applicable)	Source & Classification
				28-day NOAEC = **0.12** µg a.i./L (mm) Overlying water concentrations 28-day EC_{50} > 0.11 µg a.i./L (mm) 28-day NOAEC = 0.03 µg a.i./L (mm) (based on emergence rate)	
Survival, growth and reproduction of aquatic plants	Aquatic non-vascular species: Most sensitive EC_{50}	TGAI (97.08)	Green alga (*Pseudokirchneriella subcapitata*)	Tier II 96-hr EC_{50} > 23.8 µg a.i./L (im) 96-hr NOAEC = **23.8** µg a.i./L (im) (no effects)	MRID 48542792 Acceptable
		TGAI (97.08)	Cyanobacterium (*Anabaena flos-aqua*)	Tier II 96-hr EC_{50} > 31.5 µg a.i./L (im) 96-hr NOAEC = 31.5 µg a.i./L (im) (no effects)	MRID 48542793 Acceptable
		TGAI (97.08)	Marine diatom (*Skeletonema costatum*)	Tier II 96-hr EC_{50} > 33.6 µg a.i./L (im) 96-hr NOAEC = 33.6 µg a.i./L (im) (no effects)	MRID 48542794 Acceptable
		TGAI (97.08)	Freshwater diatom (*Navicula pelliculosa*)	Tier II 96-hr EC_{50} > 34.3 µg a.i./L (im) 96-hr NOAEC = 34.3 µg a.i./L (im) (no effects)	MRID 48542795 Acceptable
		Form. (20.4)	Green alga (*Pseudokirchneriella subcapitata*)	Tier I 72-hr EC_{50} > 340 µg a.i./L (TWA) 72-hr NOAEC = 340 µg a.i./L (TWA) (no effects)	MRID 48542922 Supplemental (due to guideline deviations & use of a form.)
	Aquatic vascular species: Most sensitive EC_{50}	TGAI (97.08)	Duckweed (*Lemna gibba*)	Tier II 7-dayEC_{50} > 38.3 µg a.i./L (im) 7-day NOAEC = **38.3** µg a.i./L (im) (no effects)	MRID 48542804 Acceptable

Form = formulation; C.I. = confidence interval; TGAI = technical grade active ingredient; TRR = total radioactive residues
[1] **BOLD** values used in RQ calculations
[2] im = initial-measured; mm = mean-measured; nom = nominal; TWA = time-weighted average, measured

Table 5-4. Endpoints Used to Characterize the Effects of Degradates of Cyflumetofen to Aquatic Organisms

Assessment Endpoint	Measurement Endpoint	Degradate (%)	Species	Toxicity Values[1,2] (Effects) & Acute Toxicity Classification (if applicable)	Source & Classification
Survival, growth, and reproduction of freshwater fish (surrogate for aquatic-phase amphibians)	Most sensitive freshwater fish acute LC_{50}	A-2 (98.3)	Rainbow trout (*Oncorhynchus mykiss*)	96-hr LC_{50} (95% C.I.) = **7.09** (5.04-9.96) mg a.i./L (mm) 96-hr NOAEC < 5.04 mg a.i./L (mm) (NOAEC based on sublethal effects including loss of equilibrium, unbalanced swimming, faulty respiratory function, and non-typical pigmentation) Moderately toxic	MRID 48542782 Acceptable
		B-1 (99.9)	Rainbow trout (*Oncorhynchus mykiss*)	96-hr LC_{50} > 97.9 mg a.i./L (mm) 96-hr NOAEC = 97.9 mg a.i./L (mm) (no mortality or sublethal effects) At most slightly toxic	MRID 48542781 Acceptable
Survival, growth, and reproduction of freshwater invertebrates	Most sensitive freshwater invertebrate acute EC_{50}	A-2 (98.3)	Water flea (*Daphnia magna*)	48-hr EC_{50} (95% C.I.) = **10.52** (8.50-13.10) mg a.i./L (mm) Probit Slope (95% C.I.) = 4.20 (2.77-5.62) 48-hr NOAEC = 3.83 mg a.i./L (mm) (NOAEC based on immobility) Slightly toxic	MRID 48542790 Acceptable
		B-1 (99.99)	Water flea (*Daphnia magna*)	Limit test 48-hr EC_{50} > 177.5 mg a.i./L (mm) 48-hr NOAEC = 177.5 mg a.i./L (mm) (no statistically-significant effects; 5% [1 out of 20] immobility at 177.5 mg a.i./L) Practically non-toxic	MRID 48542787 Acceptable
		B-2 (99.9)	Water flea (*Daphnia magna*)	Limit test 48-hr EC_{50} > 0.020 mg a.i./L (mm) 48-hr NOAEC = 0.020 mg a.i./L (mm) (no statistically-significant effects; 5% [1 out of 20] immobility at 0.020 mg a.i./L) Practically non-toxic up to the limit concentration	MRID 48542788 Supplemental (due to lack of a negative control)
Survival, growth, and reproduction of sediment-dwelling invertebrates	Most sensitive sediment invertebrate chronic NOAEC	AB-1 (99.8)	Non-biting midge (*Chironomus riparius*)	Spiked sediment exposure <u>Sediment concentrations</u> 28-day EC_{50} (95% C.I.) = 120 (100-130) mg a.i./kg-dw (mm) 28-day NOAEC = 36.1 mg a.i./kg-dw (mm) Probit Slope = 16.8 ± 4.14 <u>Pore water concentrations</u> 28-day EC_{50} (95% C.I.) = 68 (48-95) mg a.i./L (mm) 28-day NOAEC = **34.2** mg a.i./L (mm) Probit Slope = 4.53 ± 2.88 <u>Overlying water concentrations</u> 28-day EC_{50} (95% C.I.) = 23 (21-25) mg a.i./L (mm)	MRID 48542801 Acceptable

Assessment Endpoint	Measurement Endpoint	Degradate (%)	Species	Toxicity Values[1,2] (Effects) & Acute Toxicity Classification (if applicable)	Source & Classification
				28-day NOAEC = 9.06 mg a.i./L (mm) Probit Slope = 11.3 ± 1.96 (based on emergence rate)	
		AB-1 dimer (92.9)	Non-biting midge (*Chironomus riparius*)	Spiked sediment exposure <u>Sediment concentrations</u> 28-day EC_{50} > 75.3 mg a.i./kg-dw (mm) 28-day NOAEC = 75.3 mg a.i./kg-dw (mm) <u>Pore water concentrations</u> 28-day EC_{50} > 5.61 µg a.i./L (mm) 28-day NOAEC = **5.61** µg a.i./L (mm) <u>Overlying water concentrations</u> 28-day EC_{50} > 27.4 µg a.i./L (mm) 28-day NOAEC = 27.4 µg a.i./L (mm) (no statistically-significant effects on rates of emergence and development)	MRID 48542803 Acceptable
Survival, growth and reproduction of aquatic plants	Aquatic non-vascular species: Most sensitive EC_{50}	AB-11 (99.6)	Green alga (*Pseudo-kirchneriella subcapitata*)	Tier I 96-hr EC_{50} > 0.483 mg a.i./L (im) 96-hr NOAEC = **0.483** mg a.i./L (im) (no effects)	MRID 48542796 Acceptable
		B-1 (99.99)	Green alga (*Pseudo-kirchneriella subcapitata*)	Tier II 96-hr EC_{50} > 102.7 mg a.i./L (mm) 96-hr NOAEC < 0.10 mg a.i./L (nom) (NOAEC based on cell density, growth rate, and yield)	MRID 48542797 Supplemental (due to lack of a definitive NOAEC)

Form = formulation; C.I. = confidence interval
[1] **BOLD** values used in RQ calculations
[2] im = initial-measured; mm = mean-measured; nom = nominal; TWA = time-weighted average, measured

No mortality or sublethal effects were noted in any of the acute studies (MRIDs 48542789, 48542810, and 48542811), including the study with a 20.4% formulation of cyflumetofen (MRID 48542921).

In the chronic study with daphnids (MRID 48542791), there were no effects on parental survival, number of offspring per surviving parent, or growth (length and dry weight) (MRID 48542791).

5.2.1.2 Sediment-Dwelling (Benthic) Invertebrates

In an acute spiked sediment test conducted with the marine amphipod *Leptocheirus plumulosus* (MRID 48542798) and cyflumetofen, there was no statistically-significant mortality resulting in a non-definitive LC_{50} endpoint (*i.e.*, >) and the NOAEC being set at the highest treatment concentration: 787 mg TRR/kg-dw, 19.7 mg TRR/L, and 5.2 mg TRR/L for sediment, pore water, and overlying water. It should be noted that these endpoints are expressed in terms of total radioactive residue and thus may represent parent cyflumetofen as well as degradates.

Chronic spiked water and spiked sediment tests with the freshwater midge *Chironomus riparius* were conducted with cyflumetofen. In the test with spiked water, there were no statistically-significant effects on rates of emergence or development with the NOAEC being 65.9 µg a.i./L for overlying water (MRID 48542799). In the test with spiked sediment, the NOAECs of 26.5 mg a.i./kg-dw, 0.12 µg a.i./L, and 0.03 µg a.i./L for sediment, pore water, and overlying water were based on reduced rates of emergence (MRID 48542802).

5.2.1.3 Aquatic Plants

Aquatic plant Tier II studies were conducted with technical grade cyflumetofen (MRIDs 48542792-5, 48542804). In addition, a Tier I green algal study was conducted with a 20.4% formulation of cyflumetofen (MRID 48542922). Toxicity endpoints for studies testing technical grade cyflumetofen are based on initial-measured concentrations because the rapid hydrolysis of cyflumetofen typically resulted in concentrations that were below the level of detection or quantification at study termination. No effects were noted in any of the aquatic plant studies.

5.2.2 Degradates of Cyflumetofen

5.2.2.1 Freshwater Fish

Rainbow trout toxicity tests were conducted with cyflumetofen degradates A-2 and B-1. A-2 is moderately toxic to freshwater fish with a 96-hour LC_{50} of 7.09 mg a.i./L (MRID 48542782) whereas B-1 is at most slightly toxic to freshwater fish with a 96-hour LC_{50} of >97.9 mg a.i./L (MRID 48542781). No mortality or sublethal effects were reported in the study with B-1.
In the study with A-1, 100% mortality was observed in the four highest treatment groups (*i.e.*, 9.96, 19.24, 38.91, and 81.37 mg a.i./L). In the lowest treatment group of 5.04 mg a.i./L which had 0% mortality, reported sublethal effects included unbalanced swimming, faulty respiratory function, loss of equilibrium, and non-typical pigmentation. The former two sublethal effects were observed at 3-6 hours post-exposure, and loss of equilibrium was observed at 3-6 and 24 hours post-exposure; only non-typical pigmentation persisted until study termination at 96 hours. Therefore, a non-definitive NOAEC of <5.04 mg a.i./L was set for A-2 based on sublethal effects.

5.2.2.2 Freshwater Invertebrates

Daphnia toxicity tests were conducted with cyflumetofen degradates A-2, B-1, and B-2; tests with the latter two degradates were limit tests. A-2 is slightly toxic to freshwater invertebrates with an EC_{50} of 10.52 mg a.i./L (MRID 48542790); B-1 is practically non-toxic to freshwater invertebrates with an EC_{50} of >177 mg a.i./L (MRID 48542787); and B-2 is practically non-toxic up to the limit concentration (*i.e.*, 0.020 mg a.i./L; MRID 48542788). The NOAEC for the study with A-2 was set at 3.83 mg a.i./L based on immobility observed at higher concentrations. In the studies with B-1 and B-2, since there was no statistically-significant immobility, the NOAEC was set at the highest treatment concentration (*i.e.*, 177.5 mg a.i./L and 0.020 mg a.i./L, respectively).

5.2.2.3 Sediment-Dwelling (Benthic) Invertebrates

Chronic spiked sediment tests with *Chironomus riparius* were conducted with degradates AB-1 and AB-1 dimer. Endpoints in the test with AB-1 were based on reduced emergence rates with NOAECs of 36.1 mg a.i./kg-dw, 34.2 mg a.i./L, and 9.06 mg a.i./L for sediment, pore water, and overlying water (MRID 48542801). There were no statistically-significant effects on rates of emergence or development in the test with AB-1 resulting in the NOAEC being set at the highest treatment concentration: 75.3 mg a.i./kg-dw, 5.61 µg a.i./L, and 27.4 µg a.i./L for sediment, pore water, and overlying water (MRID 48542803).

5.2.2.4 Aquatic Plants

Toxicity tests with the green alga *Pseudokirchneriella subcapitata* were conducted with the cyflumetofen degradates AB-11 and B-1. There were no effects in the limit test with AB-11 (MRID 48542796). In the test with B-1, the EC_{50} was non-definitive (*i.e.*, >102.7 mg a.i./L), and there was no NOAEC (*i.e.,* <0.10 mg a.i./L) due to statistically-significant effects at the lowest treatment concentration (MRID 48542797). However, there is uncertainty associated with the latter study because of the lack of a clear concentration-response relationship.

5.3 Review of Incident Data

Reviews of the Ecological Incident Information System (EIIS, version 2.1) and the Avian Incident Monitoring System (AIMS) were conducted on March 21, 2013. There are no reported incidents for cyflumetofen in the EIIS or AIMS databases. In addition to the incidents recorded in EIIS and AIMS, additional pesticide incidents are reported to the Agency in aggregated incident reports. Ecological incidents reported in aggregate reports include those categorized as 'minor fish and wildlife' (W-B), 'minor plant' (P-B), and 'other non-target' (ONT) incidents. 'Other non-target' incidents include reports of adverse effects to insects and other terrestrial invertebrates. As of April 3, 2013, there have been no aggregate cyflumetofen ecological incidents reported to the Agency. Given that this is a new chemical that has not been registered for use in the United States, the existence of ecological incident reports would be unlikely.

6 Risk Characterization

6.1 Risk Estimation

Estimates of exposure to and toxicity of cyflumetofen are integrated using standard risk quotient (RQ) methods to evaluate the potential for adverse ecological effects to mammalian, avian, aquatic, and other non-target species. RQ results for non-target terrestrial and aquatic animals and plants are described in this section and represent expected direct effects to organisms (*i.e.* effects from direct toxicity to cyflumetofen exposure) in contrast to indirect effects to organisms resulting from a modification of a resource such as loss of their prey or habitat.

6.1.1 Direct Effects to Terrestrial Organisms

6.1.1.1 Birds, Reptiles, and Terrestrial-Phase Amphibians

Avian chronic, dietary-based RQs were calculated for the maximum application rate for each proposed use of cyflumetofen using the NOAEC from the bobwhite quail reproduction study (154 mg a.i./kg-diet; MRID 48542777). Avian chronic, dietary-based RQs range from 0.03 to 0.55 across all uses and feeding categories (**Table 6-1**). Therefore, the avian chronic LOC of 1 is not exceeded for birds of any feeding categories regardless of the proposed use.

No avian acute RQs were calculated because avian acute oral and sub-acute dietary toxicity studies for cyflumetofen have non-definitive endpoints (*i.e.*, >). Risk to birds from acute exposure to cyflumetofen as a result of the proposed uses is discussed in the Risk Description section of this document.

Table 6-1. Avian Chronic Dietary-Based Risk Quotients (RQs)

Use	Feeding Category	Dietary-Based RQs
Citrus Grapes Pome fruits Strawberries Tree nuts Tomatoes Ornamentals	Short grass	0.55
	Tall grass	0.25
	Broadleaf plants	0.31
	Fruits/pods	0.03
	Arthropods	0.21

6.1.1.2 Mammals

Mammalian chronic dose- and dietary-based RQs were calculated for the maximum application rate for each proposed use of cyflumetofen using the NOAEC from a rat 2-generation reproduction study (150 mg/kg-diet, 9.21 mg/kg-bw/day; MRID 48542702). Mammalian chronic dose- and dietary-based RQs range from 0.03 to 3.97 and 0.22 to 0.56, respectively, across all uses and feeding categories (**Tables 6-2** and **6-3**). The mammalian chronic LOC of 1 is exceeded small and medium mammals consuming short grass, tall grass, broadleaf plants, or arthropods and large mammals consuming short grass or tall grass.

No mammalian acute dose-based RQs were calculated because the mammalian acute oral toxicity study for cyflumetofen has a non-definitive endpoint (*i.e.*, >). No mammalian acute dietary-based RQs were calculated because a mammalian acute dietary-based endpoint (*i.e.*, LC_{50}, mg/kg-diet) is not available. Risk to mammals from acute exposure to cyflumetofen as a result of the proposed uses is discussed in the Risk Description section of this document.

Table 6-2. Mammalian Chronic Dose-Based Risk Quotients (RQs)

Use	Feeding Category	Chronic Dose-Based RQs		
		Small (15 g)	Medium (35 g)	Large (1000 g)
Citrus Grapes Pome fruits Strawberries Tree nuts Tomatoes Ornamentals	Short grass	**3.97***	**3.39***	**1.82***
	Tall grass	**1.82***	**1.56***	0.83
	Broadleaf plants	**2.24***	**1.91***	**1.02***
	Fruits/pods	0.25	0.21	0.11
	Arthropods	**1.56***	**1.33***	0.71
	Seeds	0.06	0.05	0.03

* exceeds mammalian chronic LOC (=1)

Table 6-3. Mammalian Chronic Dietary-Based Risk Quotients (RQs)

Use	Feeding Category	Chronic Dietary-Based RQs
Citrus Grapes Pome fruits Strawberries Tree nuts Tomatoes Ornamentals	Short grass	0.56
	Tall grass	0.26
	Broadleaf plants	0.32
	Fruits/pods/seeds	0.04
	Arthropods	0.22

6.1.1.3 Terrestrial Invertebrates

RQs for terrestrial invertebrates were not calculated because only non-definitive toxicity endpoints (*i.e.*, >) are available for honeybees. Risk to terrestrial invertebrates from exposure to cyflumetofen as a result of the proposed uses is discussed in the Risk Description section of this document.

6.1.1.4 Terrestrial (Upland and Semi-Aquatic) Plants

RQs for dicots were calculated for the maximum application rate and application method (ground, aerial) for each proposed use using the EC_{25} and NOAEC for the most sensitive dicot from the seedling emergence study (tomato, EC_{25}/NOAEC = 0.0393/0.000706 lb a.i./A, MRID 48542933) and dicot NOAEC from the vegetative vigor study (NOAEC = 0.273 lb a.i./A, MRID 48542932). RQs for monocots were not calculated due to the lack of definitive endpoints for monocots (*i.e.*, seedling emergence EC_{25}: could not be determined because the concentration-response relationship for dry weight and shoot length was atypical leading to issues with model convergence; seedling emergence NOAEC < 0.000706 lb a.i./A; vegetative vigor EC_{25} > 0.250 lb a.i./A). Risk to listed monocots from exposure to cyflumetofen as a result of the proposed uses will be discussed in the Risk Description section of this document.

RQs for terrestrial (upland and semi-aquatic) plants are provided in **Table 6-4**. For dicots inhabiting dry (upland) areas, RQs from exposure via total loading range from 0.10 to 17. For dicots inhabiting semi-aquatic areas, RQs from exposure via total loading range from 0.56 to 42. RQs from exposure via spray drift alone range from <0.1 to 14 for dicots. The terrestrial plant LOC of 1 is exceeded for listed dicots from exposure via total loading (runoff and spray drift) and spray drift alone for all proposed uses.

Table 6-4. Terrestrial (Upland and Semi-Aquatic) Plant Risk Quotients (RQs)

Use (Application Method)	Plant Type	RQs for Exposure via Total Loading (Runoff + Spray Drift)		RQs for Exposure via Spray Drift Alone
		Dry (Upland) Areas	Semi-Aquatic Areas	All Areas
Citrus Grapes Pome fruits Strawberries Tree nuts Tomatoes Ornamentals (ground)	Non-listed monocot	Not calculated[a]		Not calculated[b]
	Listed monocot	Not calculated[c]		Not calculated[c]
	Non-listed dicot	0.10	0.56	<0.1
	Listed dicot	**5.67***	**31.16***	**2.83***
Tomatoes (aerial)	Non-listed monocot	Not calculated[a]		Not calculated[b]
	Listed monocot	Not calculated[c]		Not calculated[c]
	Non-listed dicot	0.31	0.76	0.25
	Listed dicot	**17.00***	**42.49***	**14.16***

App. = application; SE = seedling emergence; VV = vegetative vigor
*exceeds terrestrial plant LOC (=1)
[a] due to lack of a SE EC_{25} for monocots
[b] due to due to the non-definitive VV EC_{25} for monocots and lack of a SE EC_{25} for monocots
[c] due to the lack of a SE NOAEC for monocots

6.1.2 Direct Effects to Aquatic Organisms

6.1.2.1 Fish, Aquatic-Phase Amphibians, and Aquatic Invertebrates

Fish acute toxicity endpoints are available for parent cyflumetofen (freshwater, estuarine/marine) and degradates A-2 (freshwater) and B-1 (freshwater). Aquatic invertebrate acute toxicity endpoints are available for parent cyflumetofen (freshwater, *Daphnia*; estuarine/marine, oyster and mysid shrimp) and degradates A-2 (freshwater, *Daphnia*), B-1 (freshwater, *Daphnia*), and B-2 (freshwater, *Daphnia*). All of the acute toxicity studies with parent cyflumetofen were conducted as limit tests due to its low solubility and have non-definitive endpoints (*i.e.*, >). Of the acute studies with degradates, only those with A-2 have definitive endpoints. Collectively, the data from these acute studies indicate that degradate A-2 is more toxic than parent cyflumetofen, B-1, and B-2.

Freshwater fish and invertebrate acute RQs were calculated for the maximum application rate for each proposed use using definitive toxicity endpoints for degradate A-2 (rainbow trout LC_{50} = 7.09 mg/L, MRID 48542782; daphnid EC_{50} = 10.52 mg/L, MRID 48542790) and surface water TTR residue EECs. These RQs represent risk based on the conservative assumption that the collective toxicity of the parent and all of its degradates is equivalent to the toxicity of the most toxic chemical among the parent and degradates for which data is available.

Freshwater fish and invertebrate chronic RQs were calculated for the maximum application rate for each proposed use using NOAECs from the early life-stage study with fathead minnow (31.6 µg a.i./L; MRID 48542783) and the life cycle study with *Daphnia* (16.2 µg a.i./L; MRID 48542791), respectively, and surface water parent only EECs because the chronic toxicity studies were conducted with technical grade cyflumetofen, and the level of exposure to degradates in these studies is unknown.

Freshwater fish and invertebrate acute RQs are all <0.01; freshwater fish and invertebrate chronic RQs for parent cyflumetofen are all <0.01. Therefore the aquatic animal acute and chronic LOCs of >0.05 and 1, respectively, are not exceeded for freshwater fish and invertebrates regardless of the proposed use.

No acute RQs were calculated for estuarine/marine fish and invertebrates due to the lack of definitive acute toxicity endpoints. No chronic RQs were calculated for estuarine/marine fish and invertebrates because there are no chronic toxicity endpoints, and application of an acute to chronic ratio (ACR) from data for the freshwater counterparts to existing acute toxicity endpoints for estuarine/marine taxa is not possible (*i.e.*, the freshwater fish and invertebrate and estuarine/marine fish and invertebrate acute toxicity endpoints are non-definitive). Risk to estuarine/marine fish as a result of the proposed uses of cyflumetofen is discussed in the Risk Description section of this document.

6.1.2.2 Sediment-Dwelling (Benthic) Invertebrates

Sub-chronic RQs for estuarine/marine sediment-dwelling invertebrates were calculated for the maximum application rate for each proposed use using the NOAEC of 19.7 mg TRR/L from a spiked sediment toxicity study with *L. plumulosus* (MRID 48542798) and both 21-day parent only benthic pore water EECs and 21-day TTR benthic pore water EECs. RQs were calculated for both types of EECs (*i.e.*, parent only, and TTR) because the degree to which "Total Radioactive Residue" represents parent only versus total toxic residues (*i.e.*, parent and degradates) is unknown.

For parent cyflumetofen, chronic RQs for freshwater sediment-dwelling invertebrates were calculated for the maximum application rate for each proposed use using NOAECs from spiked water and sediment toxicity studies with *C. riparius* (spiked water NOAEC = 65.9 µg a.i./L, MRID 48542799; spiked sediment NOAEC = 0.12 µg a.i./L, MRID 48542802) and 21-day parent only surface water EECs and 21-day parent only benthic pore water EECs, respectively. For degradates AB-1 and AB-1 dimer, chronic RQs for freshwater sediment-dwelling invertebrates were calculated for the maximum application rate for each proposed use using NOAECs from spiked sediment toxicity studies with *C. riparius* (AB-1 NOAEC = 34.2 mg a.i./L, MRID 48542801; AB-1 dimer NOAEC = 5.61 µg a.i./L, MRID 48542803) and 21-day TTR benthic pore water EECs. The RQs calculated with degradate toxicity endpoints represent risk based on the conservative, underlying assumption that the collective toxicity of the parent and all of its degradates is equivalent to the toxicity of the tested degradate.

Sub-chronic RQs for *L. plumulosus* exposed to sediment spiked with parent cyflumetofen are all <0.01; chronic RQs for *C. riparius* exposed to sediment spiked with parent cyflumetofen range from 0.02 to 0.21; chronic RQs for *C. riparius* exposed to sediment spiked with degradate AB-1 are all <0.01; RQs for *C. riparius* exposed to sediment spiked with degradate AB-1 dimer range from 0.02 to 0.53; and RQs for *C. riparius* exposed to water spiked with parent cyflumetofen range are all <0.01 (**Table 6-5**). Therefore, the aquatic animal acute and chronic LOCs of >0.05 and 1 are not exceeded for sediment-dwelling invertebrates regardless of the proposed use.

Table 6-5. Sediment-Dwelling (Benthic) Invertebrates Risk Quotients (RQs)

PRZM/EXAMS Use/Scenario	Method of App.	Spiked Sediment					Spiked Water
		Estuarine/marine		Freshwater			Freshwater
		L. plumulosus Cyflumetofen Endpoint		*C. riparius* Cyflumetofen Endpoint	*C. riparius* Degradate AB-1 Endpoint	*C. riparius* Degradate AB-1 Dimer Endpoint	*C. riparius* Cyflumetofen Endpoint
		21-Day Parent Only Benthic Pore Water EEC	21-Day TTR Benthic Pore Water EEC	21-Day Parent Only Benthic Pore Water EEC	21-Day TTR Benthic Pore Water EEC	21-Day TTR Benthic Pore Water EEC	21-Day Parent Only Surface Water EEC
Citrus							
CA	Ground	<0.01	<0.01	0.02	<0.01	0.02	<0.01
FL	Ground	<0.01	<0.01	0.03	<0.01	0.20	<0.01
Grapes							
CA Grapes	Ground	<0.01	<0.01	0.02	<0.01	0.03	<0.01
CA Wine Grapes	Ground	<0.01	<0.01	0.08	<0.01	0.16	<0.01
NY Grapes	Ground	<0.01	<0.01	0.13	<0.01	0.37	<0.01
Pome fruits							
NC	Ground	<0.01	<0.01	0.07	<0.01	0.17	<0.01
OR	Ground	<0.01	<0.01	0.02	<0.01	0.11	<0.01
PA	Ground	<0.01	<0.01	0.05	<0.01	0.21	<0.01
Strawberries							
CA	Ground	<0.01	<0.01	0.02	<0.01	0.07	<0.01
FL	Ground	<0.01	<0.01	0.02	<0.01	0.20	<0.01
Tree nuts							
CA Almond	Ground	<0.01	<0.01	0.02	<0.01	0.05	<0.01
OR Filberts	Ground	<0.01	<0.01	0.02	<0.01	0.11	<0.01
GA Pecans	Ground	<0.01	<0.01	0.09	<0.01	0.23	<0.01
Tomatoes							
CA	Aerial	<0.01	<0.01	0.13	<0.01	0.24	<0.01
	Ground	<0.01	<0.01	0.01	<0.01	0.04	<0.01
FL	Aerial	<0.01	<0.01	0.13	<0.01	0.36	<0.01
	Ground	<0.01	<0.01	0.03	<0.01	0.19	<0.01
PA	Aerial	<0.01	<0.01	0.21	<0.01	0.53	<0.01
	Ground	<0.01	<0.01	0.10	<0.01	0.32	<0.01
Ornamentals							
CA	Ground	<0.01	<0.01	0.07	<0.01	0.16	<0.01
FL	Ground	<0.01	<0.01	0.02	<0.01	0.18	<0.01
MI	Ground	<0.01	<0.01	0.02	<0.01	0.21	<0.01
NJ	Ground	<0.01	<0.01	0.03	<0.01	0.19	<0.01
OR	Ground	<0.01	<0.01	0.02	<0.01	0.06	<0.01
TN	Ground	<0.01	<0.01	0.03	<0.01	0.19	<0.01

6.1.2.3 Aquatic Plants

RQs for listed aquatic plants were calculated for the maximum application rate for each proposed use using the NOAECs from toxicity studies with parent cyflumetofen (duckweed NOAEC = 38.3 µg a.i./L, MRID 48542804; most sensitive algal NOAEC = 23.8 µg a.i./L, MRID 48542792) and degradate AB-11 (green algal NOAEC = 0.483 mg a.i./L, MRID 48542797) and parent only surface water EECs and TTR surface water EECs, respectively. RQs calculated with the degradate toxicity endpoint for AB-11 represent risk based on the conservative, underlying assumption that the collective toxicity of the parent and all of its degradates is equivalent to the toxicity of AB-11.

For parent cyflumetofen, RQs for listed non-vascular and vascular aquatic plants range from 0.01 to 0.08 and 0.01 to 0.14, respectively; for degradate AB-11, RQs for listed non-vascular plants range from <0.01 to 0.01 (**Table 6-6**). Therefore, the aquatic plant LOC of 1 is not exceeded for listed aquatic vascular and non-vascular plants regardless of the proposed use.

For degradate B-1, RQs for listed aquatic non-vascular plants were not calculated because of the lack of a NOAEC (*i.e.*, <). RQs for non-listed aquatic plants were not calculated because EC_{50} endpoints for parent cyflumetofen and degradates AB-11 and B-1 are non-definitive (*i.e.*, >). Risk to listed aquatic plants from exposure to B-1 and risk to non-listed aquatic plants from exposure to cyflumetofen and degradates AB-11 and B-1 as a result of the proposed uses will be discussed in the Risk Description section of this document.

Table 6-6. Listed Aquatic Plant Risk Quotients (RQs)

PRZM/EXAMS Use/Scenario	Method of App.	Aquatic Vascular Plant Cyflumetofen Endpoint	Aquatic Non-Vascular Plant Cyflumetofen Endpoint	Aquatic Non-Vascular Plant DegradateAB-11 Endpoint
		Peak Parent Only Surface Water EEC	Peak TTR Surface Water EEC	Peak TTR Surface Water EEC
Citrus				
CA	Ground	0.01	0.01	<0.01
FL	Ground	0.01	0.01	0.01
Grapes				
CA Grapes	Ground	0.01	0.01	<0.01
CA Wine Grapes	Ground	0.01	0.02	0.01
NY Grapes	Ground	0.02	0.04	0.01
Pome fruits				
NC	Ground	0.01	0.02	0.01
OR	Ground	0.01	0.01	<0.01
PA	Ground	0.01	0.02	0.01
Strawberries				
CA	Ground	0.01	0.01	<0.01
FL	Ground	0.01	0.01	0.01
Tree nuts				
CA Almond	Ground	0.01	0.01	<0.01
OR Filberts	Ground	0.01	0.01	<0.01
GA Pecans	Ground	0.02	0.04	0.01
Tomatoes				
CA	Aerial	0.08	0.12	0.01

PRZM/EXAMS Use/Scenario	Method of App.	Aquatic Vascular Plant Cyflumetofen Endpoint	Aquatic Non-Vascular Plant Cyflumetofen Endpoint	Aquatic Non-Vascular Plant DegradateAB-11 Endpoint
		Peak Parent Only Surface Water EEC	Peak TTR Surface Water EEC	Peak TTR Surface Water EEC
	Ground	0.01	0.01	<0.01
FL	Aerial	0.08	0.13	0.01
	Ground	0.01	0.01	0.01
PA	Aerial	0.08	0.14	0.02
	Ground	0.03	0.04	0.01
Ornamentals				
CA	Ground	0.01	0.02	0.01
FL	Ground	0.01	0.01	<0.01
MI	Ground	0.01	0.01	0.01
NJ	Ground	0.01	0.01	0.01
OR	Ground	0.01	0.01	<0.01
TN	Ground	0.01	0.01	<0.01

6.1.2.4 Aquatic Bioaccumulation

KABAM was used to calculate risk quotients from a bioaccumulation pathway for food items that may be consumed by listed and non-listed species. The RQs for bioaccumulation risk did not exceed levels of concern for mammals or birds (**Table 6-7**).

Table 6-7. Bioaccumulation Risk Quotients (RQs) for Mammals and Birds

Wildlife Species	Acute		Chronic	
	Dose Based	Dietary Based	Dose Based	Dietary Based
Mammals				
Fog/water shrew	0.001	N/A	0.116	0.021
Rice rat/star-nosed mole	0.001	N/A	0.140	0.021
Small mink	0.001	N/A	0.176	0.028
Large mink	0.001	N/A	0.195	0.028
Small river otter	0.001	N/A	0.210	0.028
Large river otter	0.001	N/A	0.247	0.031
Birds				
Sandpipers	0.003	0.001	N/A	0.025
Cranes	0.000	0.001	N/A	0.025
Rails	0.001	0.001	N/A	0.029
Herons	0.000	0.001	N/A	0.029
Small osprey	0.000	0.001	N/A	0.034
White pelican	0.000	0.001	N/A	0.037

6.2 Risk Description

The following risk description explains the overall direct effect conclusions regarding potential ecological risk from the proposed uses of cyflumetofen. The risk description takes into consideration all lines of evidence including: risk estimates (*i.e.*, RQ results); information on the chance of individual effect (*i.e.*, mortality or immobilization) for the acute RQ values; comparisons of non-definitive toxicity endpoints (*i.e.*, >) to EECs; data from monitoring, field studies, and reported incidents that may provide additional insights into the likelihood of exposure; and other factors that modify the likelihood of exposure such as timing of application, overlap of area affected and the degree of effect with the presence/absence of taxa, species sensitivity distribution, and presence/absence of dietary items.

6.2.1 Direct Effects to Birds, Reptiles, and Terrestrial-Phase Amphibians

Avian acute RQs were not calculated because avian acute oral and subacute-dietary toxicity studies for cyflumetofen have non-definitive endpoints (*i.e.*, >). Instead, the most sensitive, non-definitive acute dose- and dietary-based toxicity values for birds were compared directly to the highest avian acute dose- and dietary-based EECs for the proposed uses of cyflumetofen.

An acute oral study with bobwhite quail yielded the most sensitive, non-definitive avian dose-based toxicity endpoints, LD_{50} > 2000 mg a.i./kg-bw and NOAEL = 74 mg a.i./kg-bw based on the sublethal effect of hunched posture (MRID 48542772). A sub-acute dietary study with bobwhite quail yielded the most sensitive, non-definitive avian dietary-based endpoints, LC_{50} > 5033 mg a.i./kg-diet and NOAEC = 1133 mg a.i./kg-diet based on the sublethal effect of reduced weight gain (MRID 48542775).

The highest avian dose-based EECs correspond to those for small birds (20 g) and range from 1.33 (seeds) to 96.10 (short grass) mg/kg-bw. Dietary-based EECs range from 5.27 (fruits/pods/seeds) to 84.38 (short grass) mg/kg-diet. These EECs are unlikely to cause avian mortality since they are roughly 2-3 orders of magnitude less than test concentrations that caused no mortality in toxicity study. Similarly, these EECs are unlikely to cause reduced weight gain since they are at least an order of magnitude less than test concentrations that caused this sublethal effect in the bobwhite quail sub-acute dietary study. However, the range of dose-based EECs does include test concentrations that were associated with sublethal effects (*i.e.*, hunched posture) in the acute oral study with bobwhite quail. Given that hunched posture was not observed in the sub-acute dietary or chronic, reproductive studies with bobwhite quail, the potential for cyflumetofen to cause this effect as a result of the proposed uses is low. Therefore, this comparative analysis suggests that the likelihood of adverse effects to birds, reptiles, and terrestrial-phase amphibians from acute exposure to cyflumetofen for all proposed uses is low.

The avian chronic LOC (=1) is not exceeded for birds of any feeding category regardless of use. suggesting that the likelihood of adverse effects to birds, reptiles, and terrestrial-phase amphibians from chronic exposure to cyflumetofen for all proposed uses is low.

6.2.2 Direct Effects to Mammals

Mammalian acute RQs were not calculated because the mammalian acute oral toxicity study has a non-definitive endpoint (*i.e.*, >), and a mammalian acute dietary-based endpoint (*i.e.*, LC_{50}, mg/kg-diet) is not available. Instead, the non-definitive acute dose-based toxicity endpoint for mammals was compared directly to the highest mammalian acute dose-based EECs for the proposed uses of cyflumetofen.

An acute oral study with female Wistar rats yielded the non-definitive dose-based toxicity endpoint of LD_{50} > 2000 mg a.i./kg-bw (MRID 48542669). The highest mammalian dose-based EECs correspond to those for small mammals (15 g) and range from 1.12 (seeds) to 80.45 (short grass) mg/kg-bw. These EECs are unlikely to result in mammalian mortality or sublethal effects since they are roughly 2-3 orders of magnitude less than test concentrations that caused no mortality or transitory sublethal effects in the acute oral toxicity study. Therefore, this comparative analysis suggests that the likelihood of adverse effects to mammals from acute exposure to cyflumetofen for all proposed uses is low.

The mammalian chronic LOC of 1 is exceeded for small and medium mammals consuming short grass, tall grass, broadleaf plants, or arthropods and large mammals consuming short grass or tall grass for all of the proposed uses of cyflumetofen. The exceedances across multiple sizes and feeding categories of mammals suggest that they may be at risk from chronic exposure as a result of the proposed uses of cyflumetofen. Reducing the foliar dissipation half-life in T-REX from the default of 35 days to 1 day and number of applications from 2 to 1 still results in chronic LOC exceedances for small and medium consuming short grass or broadleaf plants, small mammals consuming tall grass, and large mammals consuming short grass.

6.2.3 Direct Effects to Terrestrial Invertebrates

Presently, the Agency does not have a formal methodology for evaluating risk to non-target terrestrial invertebrates. Instead, acute contact- and dietary-based EECs for the proposed uses of cyflumetofen were calculated (**Table 6-7**) and directly compared to acute contact- and oral-based toxicity values for honey bees, respectively.

Table 6-7. Calculation of Contact and Dietary EECs for Honey Bees

Contact EEC for forager bees receiving direct spray (µg a.i./bee) = maximum single application rate (lb a.i./A) x 2.7 (µg a.i./bee per 1 lb a.i./A) = 0.2 lb a.i./A x 2.7 µg a.i./bee per 1 lb a.i./A = 0.54 µg a.i./bee
Dietary (oral) EEC for adult bees (µg a.i./bee) = T-REX-generated upper-bound EECs for tall grass (mg a.i./kg-diet = µg a.i./g-diet) x 0.292 (g/day)[b] = 38.67 µg a.i./g-diet[a] x 0.292 (g/day) = 11.29 µg a.i./bee

[a] from **Table 4-4**
[b] most conservative food consumption rate for worker bees

For both technical grade cyflumetofen and a 20.4% formulation of cyflumetofen, the honey bee acute contact LD_{50} is >100 µg a.i./bee (MRIDs 48542805 and 48542914). This non-definitive contact toxicity endpoint is almost 3 orders of magnitude greater than the honey bee contact EEC of 0.54 µg a.i./bee. The NOAEL of 20.7 µg a.i./bee for the acute contact study with technical grade cyflumetofen, which is based on statistically-significant mortality at 45.5 lb a.i./bee, is almost 2 orders of magnitude greater than the honey bee contact EEC. The NOAEL of 4.6 µg a.i./bee for the acute contact study with a 20.4% formulation of cyflumetofen, which is based on the sublethal effect of lethargy, is almost an order of magnitude greater that the honey bee contact EEC. For a 20.3% formulation of cyflumetofen, the acute oral LD_{50} is >116 µg a.i./bee, and the NOAEL is 116 µg a.i./bee (MRID 48542923). These oral toxicity endpoints are an order of magnitude greater than the honey bee dietary (oral) EEC of 11.29 µg a.i./bee.

Additional toxicity data from studies with beneficial terrestrial arthropods bolsters the conclusion of the low likelihood of adverse effects to non-target terrestrial invertebrates from the proposed uses of cyflumetofen. Acute limit tests with two beneficial terrestrial arthropods – the parasitic wasp (*A. rhopalosiphi*) and the predatory mite (*T. pyri*) – using a 20.3% formulation of cyflumetofen both yielded a LR_{50} of >1.2 lb a.i./A and a NOAEC of 1.2 lb a.i./A which are greater than the single maximum application rate of 0.2 lb a.i./A for cyflumetofen (MRIDs 48542924 and 48542725).

Collectively, this comparative analysis suggests that the likelihood of adverse effects to honey bees and some beneficial terrestrial arthropods from acute contact and/or dietary/oral exposure to cyflumetofen for all proposed uses appears to be low. However, given the insecticidal mode of action of cyflumetofen, the potential for risk to sensitive, non-target terrestrial invertebrates exists.

6.2.4 Direct Effects to Terrestrial (Upland and Semi-Aquatic) Plants

The terrestrial plant LOC of 1 is not exceeded for non-listed dicots from exposure via total loading (runoff and spray drift) or spray drift only regardless of use suggesting that the likelihood of adverse effects to non-listed dicots from exposure to cyflumetofen for all proposed uses is low. In contrast, the terrestrial plant LOC of 1 is exceeded for listed dicots from exposure via total loading and spray drift only for all proposed uses suggesting that listed dicots may be at risk from exposure as a result of the proposed uses of cyflumetofen.

It should be noted that the most sensitive dicot in the seedling emergence study – tomato – is one of the proposed uses for cyflumetofen; the seedling emergence EC_{25} and NOAEC for tomato are 0.0393 lb a.i./A and 0.000706 lb a.i./A, respectively. However, effects noted in the seedling emergence study should not be applicable to the proposed uses of cyflumetofen since application presumably will not occur until plants reach the vegetative growth stage when no effects are expected based on results of the vegetative vigor study (*i.e.*, in the vegetative vigor study, there were no statistically-significant effects on tomato up to the highest concentration tested – 0.273 lb a.i./A – which is greater than the proposed maximum single application rate of 0.2 lb a.i./A).

RQs were not calculated for monocots due to the lack of appropriate endpoints for monocots. Specifically, for the most sensitive monocot of oat, a seedling emergence EC_{25} could not be determined because the endpoints of dry weight and shoot length displayed atypical concentration-responses leading to issues with model convergence. In addition, dry weight and shoot length of the lowest treatment group (*i.e.*, 0.000706 lb a.i./A) were significantly reduced when compared to the control group resulting in the lack of a NOAEC for monocots. In the absence of RQs for monocots, the lowest seedling emergence treatment concentration that yielded significant effects – 0.000706 lb a.i./A – was compared to the range of terrestrial plant EECs as presented in **Table 4-6** (*i.e.*, 0.002-0.02 lb a.i./A). The comparison indicates that terrestrial plant EECs are greater than an exposure concentration that caused a significant a decrease in oat dry weight and shoot length implying that listed monocots may be at risk from exposure via total loading (runoff and spray drift) and spray drift only for all proposed uses. Furthermore, given the inability to determine a seedling emergence EC_{25} for monocots, risk to non-listed monocots cannot be precluded.

Overall, adverse effects to terrestrial plants (listed dicots and all monocots) from exposure to cyflumetofen as a result of the proposed uses are possible. A Tier II seedling emergence continuation study with oat is necessary to reduce uncertainty associated with the risk conclusion for non-listed monocots as well as buffer distances for listed monocots.

6.2.4.1 Buffer Distances for Reducing Risk to Non-Target Terrestrial Plants from Spray Drift

Buffer distances for listed dicots and listed and non-listed monocots were determined via AgDRIFT using the NOAEC and EC_{25} endpoints for seedling emergence in **Table 5-3**. These buffer distances are provided in **Table 6-8**. In the absence of a NOAEC for oat, buffer distances for oat were calculated using the LOAEC. Therefore, the distance offsite where effects to oat are no longer expected are actually greater than those presented in the table. It should be noted that buffer distances for the aerial application scenarios exceed the AgDRIFT Tier 1 aerial modeling limit of ~1000 feet for oat and tomato.

Table 6-8. Buffer Distances for Listed Dicots and Listed and Non-Listed Monocots

Species	Distance (feet) From the Edge of Field Where the RQ Falls Below the Terrestrial Plant LOC for Seedling Emergence Endpoints							
	Ground Application[a]				Aerial Application			
	VF-F Drop Size		F-M/C Drop Size		VF-F Drop Size		F-M Drop Size	
	Listed	Non-listed	Listed	Non-listed	Listed	Non-listed	Listed	Non-listed
Monocots								
Oat (*Avena sativa*)[b]	299	CBD[c]	138	CBD[c]	>1000	CBD[c]	>1000	CBD[c]
Onion (*Allium sepa*)	10	CBD[d]	3	CBD[d]	256	CBD[d]	82	CBD[d]
Corn (*Zea mays*)	0	CBD[d]	0	CBD[d]	0	CBD[d]	0	CBD[d]
Ryegrass (*Lolium perenne*)	0	CBD[d]	0	CBD[d]	0	CBD[d]	0	CBD[d]
Dicots								
Tomato (*Lycopersicon esculentum*)	299	NA	138	NA	>1000	NA	>1000	NA
Cucumber (*Cucumis sativa*)	10		3		269		89	
Sugarbeet (*Beta vulgaris*)	3		3		0		0	
Radish (*Raphanus sativus*)	0		0		0		0	
Lettuce (*Lactuca sativa*)	0		0		0		0	
Soybean (*Glycine max*)	0		0		0		0	

CBD = could not be determined; NA = not applicable
VF-F = ASAE Very Fine to Fine; F-M/C = ASAE Fine to Medium/Course; F-M = ASAE Fine to Medium
[a] Low boom (20 inches)
[b] buffer distances calculated using the LOAEC due to the lack of a NOAEC
[c] While statistically-significant reductions were detected, there were issues with model convergence. Therefore, an EC_{25} could not be determined.
[d] The EC_{25} is greater than the highest tested concentration.

6.2.5 Direct Effects to Fish, Aquatic-Phase Amphibians, and Aquatic Invertebrates

The acute RQs calculated for freshwater fish and invertebrate represent risk based on the conservative assumption that the collective toxicity of parent cyflumetofen and all of its degradates is equivalent to the toxicity of the most toxic chemical among the parent and degradates for which data is available (*i.e.*, degradate A-2). Even under this conservative assumption, acute aquatic animal LOCs (>0.05) were not exceeded for freshwater fish or invertebrates regardless of use suggesting that the likelihood of adverse effects to freshwater fish and invertebrates and aquatic-phase amphibians from acute exposure as a result of the proposed uses of cyflumetofen is low.

It should be noted that the freshwater fish acute toxicity study with A-2 yielded a NOAEC of <5.04 mg a.i./L (MRID 48542782). This NOAEC is based on sublethal effects including unbalanced swimming, faulty respiratory function, loss of equilibrium, and non-typical pigmentation observed at the lowest concentration tested. Overall, the likelihood of adverse effects to freshwater fish and aquatic-phase amphibians from acute exposure to A-2 is considered low because: 1) acute RQs calculated using the LC_{50} endpoint did not exceed LOCs; 2) no sublethal effects were observed in fish acute toxicity studies with parent cyflumetofen where the organisms were presumably exposed to A-2 as a result of rapid hydrolysis, and 3) TTR surface water EECs, which represent parent cyflumetofen and multiple degradates including A-2, are at least 3 orders of magnitude less than the observed NOAEC for A-2.

The aquatic animal chronic LOC (=1) is not exceeded for freshwater fish or invertebrates regardless of use suggesting that the likelihood of adverse effects to freshwater fish and invertebrates and aquatic-phase amphibians from chronic exposure as a result the proposed uses of cyflumetofen is low.

Estuarine/marine fish and invertebrate RQs were not calculated because of the lack of appropriate toxicity endpoints. Based on a comparison of acute toxicity endpoints between freshwater and estuarine/marine organisms, there is no indication that estuarine/marine fish/invertebrates are more sensitive to parent cyflumetofen than freshwater fish/invertebrates. In addition, estuarine/marine fish/invertebrates would have to be several orders of magnitude more sensitive than freshwater fish/invertebrates to the most toxic degradate tested, A-2, to exceed Agency LOCs suggesting that the likelihood of adverse effects to estuarine/marine fish and invertebrates as a result of the proposed uses of cyflumetofen is low.

6.2.6 Direct Effects to Sediment-Dwelling (Benthic) Invertebrates

The aquatic animal acute and chronic LOCs (>0.05 and 1, respectively) are not exceeded for sediment-dwelling (benthic) invertebrates regardless of use suggesting that the likelihood of adverse effects to benthic invertebrates from acute or chronic exposure to cyflumetofen for all proposed uses is low.

6.2.7 Direct Effects to Aquatic Plants

The aquatic plant LOC (=1) is not exceeded for listed aquatic plants exposed to parent cyflumetofen or degradate AB-11 regardless of use suggesting that the likelihood of adverse effects to listed aquatic plants as a result of the proposed uses of cyflumetofen is low.

It should be noted that a *P. subcapitata* toxicity study with B-1 yielded a NOAEC of <0.10 mg a.i./L based on cell density, growth rate, and yield (MRID 48542797). However, there is uncertainty associated with this NOAEC due to the lack of a clear concentration-response relationship. Given that B-1 was not considered in the TTR approach for modeling surface water EECs because of its low expected toxicity (*i.e.*, due to lack of a cyano group) and the actual NOAEC for B-1would have to be 2 orders of magnitude lower than the lowest concentration tested to exceed the Agency LOC for listed aquatic plants, the likelihood of adverse effects to aquatic non-vascular plants from exposure to B-1 for all proposed uses is considered low.

RQs for non-listed aquatic plants were not calculated for parent cyflumetofen or degradates AB-11 and B-1 because of the lack of definitive EC_{50} endpoints (i.e., >). Given that risk to listed aquatic plants is based on the NOAEC, which is a more sensitive endpoint than the EC_{50}, and there were no exceedances for listed aquatic plants, the likelihood of adverse effects to non-listed aquatic non-vascular and vascular plants as a result of the proposed uses of cyflumetofen is low.

6.3 Summary of Direct Effects

A summary of the direct effects of cyflumetofen to terrestrial and aquatic taxa is provided in **Table 6-9**.

Table 6-9. Summary of Direct Effects

Taxon	**Risk Concern for Direct Effects?**	
	Non-Listed	**Listed***
Birds (surrogate for terrestrial-phase amphibians and reptiles)	No	No
Mammals	**Yes (chronic exposure[a])**	**Yes (chronic exposure[a])**
Terrestrial invertebrates	No	No
Terrestrial (upland and semi-aquatic) plants : monocots	**Yes[b]**	**Yes**
Terrestrial (upland and semi-aquatic) plants: dicots	No	**Yes**
Freshwater fish (surrogate for aquatic-phase amphibians)	No	No
Freshwater invertebrates	No	No
Estuarine/marine fish	No	No
Estuarine/marine invertebrates	No	No
Sediment-dwelling (benthic) invertebrates	No	No
Aquatic vascular plants (vascular and non-vascular)	No	No
Aquatic non-vascular plants	No	NA

NA = not applicable because there are no listed aquatic non-vascular plants

* Direct or indirect effects to specific listed species have not been definitively determined; further investigation into temporal, geographical, and biological associations between the proposed uses and affected taxa is needed before definitive effects determinations can be made.

[a] small and medium mammals consuming short grass, tall grass, broadleaf plants, or arthropods and large mammals consuming short grass or tall grass

[b] Given the inability to determine a seedling emergence EC_{25} for monocots, risk to non-listed monocots cannot be precluded.

6.4 Indirect Effects

Direct effects to mammals (non-listed and listed) from chronic exposure could result in indirect effects to terrestrial organisms including birds, terrestrial invertebrates, and terrestrial plants due to general habitat modification and/or food/prey supply disruption.

Direct effects to monocots (listed and non-listed) and listed dicots could result in indirect effects to terrestrial organisms including birds, mammals, and terrestrial invertebrates due to general habitat modification (most likely due to effects on non-listed plants), host plant loss, and/or food supply disruption as well as indirect effects to aquatic organisms due to changes in water quality and/or habitat.

6.5 Federally Threatened and Endangered (Listed) Species Concerns

6.5.1 Action Area

For listed species assessment purposes, the action area is considered to be the area affected directly or indirectly by the federal action and not merely the immediate area involved in the action. At the initial screening-level, the risk assessment considers broadly described taxonomic groups and conservatively assumes that listed species within those broad groups are 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 that has the relatively highest potential exposure to the pesticide, and that exposures are likely to decrease with distance from the treatment area.

If the assumptions associated with the screening-level action area result in risk quotients 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, risk quotients below the listed species LOCs for a given taxonomic group indicate no concern for indirect effects upon listed species that depend upon the taxonomic group covered by the risk quotient as a resource. However, in situations where the screening assumptions lead to risk quotients 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 could be considered to determine the extent to which screening assumptions regarding an action area apply to a particular listed organism. These subsequent refinement steps could consider how this information would affect the action area for a particular listed organism and may potentially include areas of exposure that are downwind and downstream of the pesticide use site.

6.5.2 Taxonomic Groups Potentially at Risk

The Level I screening assessment process for listed species uses the generic taxonomic group-based process to make inferences on direct effect concerns for listed species. The first iteration of reporting the results of the Level I screening is a listing of pesticide use sites and taxonomic groups for which RQ calculations reveal values that meet or exceed the listed species LOCs or other evidence suggests that adverse effects are likely or cannot be precluded (for more information see, USEPA, 2004).

Results of this screening-level ecological risk assessment indicate that the proposed uses of cyflumetofen have the potential for direct adverse effects to listed mammals, dicots, and monocots (**Table 6-10**).

The Agency acknowledges that pesticides have the potential to exert indirect effects upon listed organisms by, for example, perturbing forage or prey availability, altering the extent of nesting habitat, and creating gaps in the food chain. In conducting a screen for indirect effects, direct effect LOCs for each taxonomic group are used to make inferences concerning the potential for indirect effects upon listed species that rely upon non-listed organisms in these taxonomic groups as resources critical to their life cycle.

Results of this screening-level ecological risk assessment indicate that the proposed uses of cyflumetofen have the potential for direct adverse effects to non-listed mammals and monocots. Therefore, there is potential for indirect effects to all listed species that depend on non-listed mammals and monocots for food, habitat, or other environmental resources (**Table 6-10**). Species-specific concerns for indirect effects to listed organisms will require a determination of the coincidence of cyflumetofen use with locations of listed species and the biologically-based resources upon which they depend.

Table 6-10. Risk to Listed Taxa Associated with Potential Direct or Indirect Effects from the Proposed Uses of Cyflumetofen*

Listed Taxon	Direct Effects	Indirect Effects
Birds	No	Yes[a,b]
Reptiles	No	Yes[a,b]
Terrestrial-phase amphibians	No	Yes[a,b]
Mammals	Yes (chronic exposure)	Yes[b]
Terrestrial invertebrates	No	Yes[a,b]
Terrestrial (upland and semi-aquatic) plants : monocots	Yes	Yes[a]
Terrestrial (upland and semi-aquatic) plants: dicots	Yes	Yes[a]
Freshwater fish	No	Yes[b]
Aquatic-phase amphibians	No	Yes[b]
Freshwater invertebrates	No	Yes[b]
Estuarine/marine fish	No	Yes[b]
Estuarine/marine invertebrates	No	Yes[b]
Sediment-dwelling (benthic) invertebrates	No	Yes[b]
Aquatic vascular plants	No	Yes[b]
Aquatic non-vascular plants	NA	Yes[b]

NA = not applicable because there are no listed aquatic non-vascular plants

* Direct or indirect effects to specific listed species have not been definitively determined; further investigation into temporal, geographical, and biological associations between the proposed uses and affected taxa is needed before definitive effects determinations can be made.

[a] due to direct effects to non-listed mammals

[b] due to direct effects to non-listed monocots which cannot be precluded given the inability to determine a seedling emergence EC_{25} for monocots

6.5.2.1 Probit Slope Dose-Response Analysis of LOC and Acute RQ Values

As part of risk estimation, the Agency provides additional information on the potential for acute direct effects to exposed individuals in terms of the chance of an individual event (*i.e.*, mortality or immobilization) should exposure at the EEC actually occur for a species with sensitivity to cyflumetofen on par with the acute toxicity endpoint selected for RQ calculation. This is accomplished using the slope of the dose-response relationship available from the toxicity study used to establish the acute toxicity measures of effect for each taxonomic group. The individual effects probability associated with the acute RQ is based on the mean estimate of the slope and an assumption of a probit dose-response relationship. In addition to a single effects probability estimate based on the mean, upper and lower estimates of the effects probability are also provided to account for variance in the slope, if available. Individual effect probabilities are calculated based on an Excel spreadsheet tool IECv1.1 (Individual Effect Chance Model Version 1.1) developed by U.S. EPA, OPP, Environmental Fate and Effects Division (June 22, 2004). The model provides the option of inserting taxa-specific probit slopes and confidence intervals. If specific information is not available, the model uses a default value of 4.5 for the probit slope and 2 and 9 for the upper and lower 95% confidence interval bounds.

For cyflumetofen, avian, mammalian, fish, and aquatic invertebrate acute toxicity studies with parent cyflumetofen yielded non-definitive endpoint values (*i.e.*, >), so this probit slope analysis is not applicable.

6.5.2.2 Critical Habitat

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

The screening-level risk assessment has identified potential concerns for indirect effects to listed species dependent upon some non-listed species (mammals and monocots). In light of the potential for indirect effects, the next step for EPA and the Services is to identify which listed species and their designated critical habitat(s), if applicable, are potentially implicated. Analytically, the identification of such species and their critical habitat can occur by determining whether the action area overlaps designated critical habitat or the occupied range of any listed species. If so, EPA would examine whether the pesticide's potential effects to non-listed species would affect the listed species indirectly, or directly affect a constituent element of the critical habitats. At present, the information reviewed by EPA does not permit use of this analytical approach to make a definitive identification of species that are potentially affected indirectly or designated critical habitats that are potentially affected directly by the proposed uses of cyflumetofen.

This screening-level risk assessment for critical habitats provides a listing of potential biological features that, if they are constituent elements of one or more critical habitats, would be of potential concern. These correspond to the taxa identified above as being of potential concern for adverse effects. This should serve as an initial step in problem formulation for further assessment of designated critical habitat impacts outlined above, should additional work be necessary.

6.5.2.3 Co-occurrence Analysis

The goal of the analysis for co-location is to determine whether sites of cyflumetofen proposed use are geographically associated with known locations of listed species. At the screening level, this analysis is accomplished using the LOCATES (version 2.2.5) database. The database uses location information for listed species at the county level and compares it to agricultural census data (from 2007) for crop production at the same county level of resolution. The product is a listing of federally-listed species that are located within counties known to produce the crops upon which cyflumetofen is proposed to be used. The current analysis is based on the following proposed uses of cyflumetofen: almonds, apples, chestnut, cironjas, citron, citrus fruit-all, grapefruit, grapes, hazel nuts (filberts), kumquats, lemons, lemons and limes, limes, macadamia nuts, pears-all, pears-Bartlett, pears-other, pecans-all, pecans-improved, pecans-native and seedling, tangelo, tangerine, walnuts-English. For potential direct effects, only listed mammals, monocots, and dicots will be considered, since they were the only taxa for which direct risks were identified. For indirect effects, all other taxa will be considered since there is a potential for indirect effects to taxa that might rely on non-listed mammals and monocots for some stage of their life-cycle.

LOCATES identified a total of 1368 listed species that overlap at the county level with areas where cyflumetofen is proposed to be used (see **Appendix F** for a complete species list). This preliminary analysis indicates that there is a potential for cyflumetofen 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 cyflumetofen 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.

7 Uncertainties

A description of basic assumptions, uncertainties, strengths, and limitations of a typical risk assessment is described in Chapter 6 of the Agency's Overview Document (USEPA, 2004) and includes those related to exposure for all taxa, those related to exposure for aquatic species, those related to exposure for terrestrial animals, those related to the effects assessment, and those associated with the acute LOC values. Additional uncertainties for this assessment are discussed below.

7.1 Data Gaps

7.1.1 Environmental Fate

Uncertainties in the fate data with the dimers and unextracted residues were described in detail in **Sections 2.6** and **4.2.** Dimers that formed in the hydrolysis, aerobic and anaerobic soil metabolism, aerobic aquatic metabolism, and terrestrial field dissipation studies. Unextracted residues formed in the aerobic and anaerobic soil metabolism and aerobic and anaerobic aquatic metabolism studies. The issues of dimers and unextracted residues are somewhat intertwined in that: the dimers are expected to be hydrophobic and would likely accumulate in soil and sediment; the dimers and unextracted residues tend to occur at their highest quantities at the end of the fate studies; and high quantities of dimers and unextracted residues tend to occur in the same studies (aerobic and anaerobic soil metabolism and aerobic aquatic metabolism).

The concern would be that dimers will form, persist and accumulate in the environment. However, this risk assessment did not identify risks to aquatic organisms. Therefore, it seems further clarification on these issues would be unlikely to change this aquatic risk finding. If future risk assessments were to identify aquatic risks, more information of the formation of dimers and composition of the unextracted residues might be useful.

7.1.2 Ecological Effects

Oat data from a Tier II seedling emergence continuation study (**Guideline 850.4100 – Seedling Emergence and Seedling Growth)** would allow the Agency to better characterize potential risks by eliminating uncertainties for both non-listed and listed monocots that cannot be accounted for using alternate methods or weight of evidence. The submitted seedling emergence study (MRID 48542933) was classified as Supplemental because for the most sensitive monocot – oat, dry weight and shoot length of the lowest treatment group (*i.e.*, 0.000706 lb a.i./A) were significantly reduced (*i.e.*, 33.2 and 27.3 %, respectively) when compared to the control group resulting in a non-definitive NOAEC for monocots. In addition, an EC_{25} for monocots could not be determined because the oat endpoints of dry weight and shoot length an displayed atypical concentration-response relationship leading to issues with model convergence

8 References

Arnot, J.A. and F.A.P.C. Gobas. 2004. A food web bioaccumulation model for organic chemicals in aquatic ecosystems. Environmental Toxicology & Chemistry, 23 (10): 2343-2355.

Fletcher, J.S., J.E. Nellessen, and T.G. Pfleeger. 1994. Literature review and evaluation of the EPA food-chain (Kenaga) nomogram, an instrument for estimating pesticide residues on plants. Environmental Toxicology & Chemistry 13:1383-1391.

Hoerger, F. and E. E. Kenaga. 1972. Pesticide Residues on Plants: Correlation of Representative Data as a Basis for Estimation of their Magnitude in the Environment. In F. Coulston and F. Korte, eds., *Environmental Quality and Safety: Chemistry, Toxicology, and Technology,* Georg Thieme Publ., Stuttgart, West Germany, pp. 9-28.

USEPA. 1999. Downwind Deposition Tolerance Bounds for Orchards. Scientific Advisory Panel background document. Office of Pesticide Programs. Washington, D.C. July 23, 1999. http://www.epa.gov/scipoly/sap/1999/july/airblast.pdf

USEPA. 1997. Estimating Drinking Water Exposure as a Component of the Dietary Risk Assessment; Spray Drift Program, Washington, D.C. http://www.epa.gov/scipoly/sap/meetings/1997/121097

USEPA. 1998. Guidelines for Ecological Risk Assessment. Risk Assessment Forum, Office of Research and Development, Washington, D.C. EPA/630/R-95/002F. April 1998. http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=30759

USEPA. 2004. Overview of the Ecological Risk Assessment Process in the Office of Pesticide Programs. United States Environmental Protection Agency (USEPA). Environmental Fate and Effects Division. Office of Pesticide Programs. Available at: http://www.epa.gov/espp/consultation/ecorisk-overview.pdf

U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS). 1998. Endangered Species Consultation Handbook: Procedures for Conducting Consultation and Conference Activities Under Section 7 of the Endangered Species Act. Final Draft. March 1998.

9 Bibliography of Cited MRIDs

Fate studies

48542624 Knight, L. (2004) OK-5101 - Hydrolysis Under Laboratory Conditions. Project Number: OTSA/0076/US/OCR, OSK/035/032048, EU/OSK/035. Unpublished study prepared by Huntingdon Life Sciences, Ltd. 75p.

48542625 Nakamura, H. (2004) (Carbon 14)OK-5101 (Phenyl-ring-U-and tolyl-ring-U-label): A Hydrolysis Study. Project Number: OTSA/0156/EN//FR/US/OCR, EU/IET/02/8006. Unpublished study prepared by Institute of Environmental Toxicology. 167p.

48542626 Knight, L. (2004) OK-5101 - Photodegradation in Water and Quantum Yield of Direct Photodegradation in Water. Project Number: OTSA/0078/US/OCR, OSK/036/032551, EU/OSK/036. Unpublished study prepared by Huntingdon Life Sciences, Ltd. 104p.

48542627 Ohyama, K. (2004) (Carbon 14)OK-5101 (Phenyl-ring-U-and Tolyl-ring-U-label): A Photolysis Study in Water. Project Number: OTSA/0157/EN//FR/US/OCR, EU/IET/02/8007. Unpublished study prepared by Institute of Environmental Toxicology. 193p.

48542750 Noorloos, B.; Brands, C.; Stienstra, N. (2007) Photodegradation of A-(Ring-U-(Carbon 14)) OK-5101 on Soil Surfaces. Project Number: 2007/1067406/US/OCR EU/477282. Unpublished study prepared by Notox B.V. 54p.

48542751 Noorloos, B.; Brands, C.; Stienstra, N. (2007) Photodegradation of B-(Ring-U-(Carbon 14)) OK-5101 on Soil Surfaces. Project Number: 2007/1067407/US/OCR EU/475932. Unpublished study prepared by Notox B.V. 56p.

48542759 Iijima, K. (2004) OK-5101 Pure: Adsorption Study in Soil. Project Number: A/0044/EN//FR/US/OCR EU/IET/01/6018/11. Unpublished study prepared by Institute of Environmental Toxicology. 30p.

48542760 Noorloos, B.; Stienstra, N. (2011) Adsorption of B-1 on Three Soils (Including Amendment No. 1). Project Number: 2011/7005177/OCR EU/475897. Unpublished study prepared by Notox B.V. 47p.

48542761 Noorloos, B.; Stienstra, N. (2011) Adsorption of AB-1 on Three Soils (Including Amendment No. 1). Project Number: 2011/7005180/OCR EU/475919. Unpublished study prepared by Notox B.V. 50p.

48542762 Brands, C.; Willems, H. (2008) Adsorption of B-3 on Three Soils. Project Number: 2008/1098894/US/OCR EU/487923. Unpublished study prepared by Notox B.V. 47p.

48542763 Vasques, A. (2011) Adsorption/Desorption Behavior of Cyflumetofen Metabolites (Carbon 14)-B1, (Carbon 14)-B3 and (Carbon 14)-A2 on Different US and European Soils. Project Number: 2011/1257446/US/OCR U/2119/11 EU/379627. Unpublished study prepared by BASF S.A.: Global Environmental and Consumer Safety Laboratory - GENCS. 198p.

48542786 Singh, M.; Traversa, E. (2011) Adsorption/Desorption of AB-1 Dimer Metabolite (Reg. No. 5756389) of BAS 9210 I: Final Report. Project Number: 2011/7005168/OCR 111/06/01 415935. Unpublished study prepared by BASF Crop Protection. 62p.

48542764 Tan, N. (2009) Leaching of B-1 in Three Soils. Project Number: 2009/1126720/US/OCR EU/488795. Unpublished study prepared by Notox B.V. 36p.

48542765 Tan, N. (2009) Leaching of B-1 in One Soil. Project Number: 2009/1126721/US/OCR EU/490991. Unpublished study prepared by Notox B.V. 29p.

48542766 Brands, C. (2008) Photochemical Degradation of A-(Ring-U-(Carbon 14))OK-5101 in Water. Project Number: OTSA/0341/FR/US/OCR EU/477293. Unpublished study prepared by Notox B.V. 43p.

48542767 Brands, C. (2008) Photochemical Degradation of B-(Ring-U-(Carbon 14))OK-5101 in Water. Project Number: OTSA/0342/FR/US/OCR EU/475943. Unpublished study prepared by Notox B.V. 56p.

48542629 Willems, H. (2008) OK-5101 - Atkinson Calculation. Project Number: OTSA/0330/FR/US/OCR, EU/480228. Unpublished study prepared by Notox B.V. 7p.

48542746 Knight, L. (2007) OK-5101 - Investigations into the Identity of Aerobic Soil Metabolites of OK-5101. Project Number: 2007/1067405/US/OCR NOT0003/072339 EU/NOT0003. Unpublished study prepared by Huntingdon Life Sciences, Ltd. 37p.

48542747 Willems, H. (2008) OK-5101 - Estimation of Soil DT50 and DT90 Values Using Degradation Data Taken from a Soil Degradation Study by Knight L. (2004) - Annex IIA 7.1.1. Project Number: OTSA/0431/FR/US/OCR US/488454. Unpublished study prepared by Notox B.V. 19p.

48542748 Ta, C.; Strobush, A. (2011) Aerobic Soil Metabolism of (Carbon 14)-BAS 9210 I: Final Report. Project Number: 2011/7000200/OCR 111/13/01 US/350780. Unpublished study prepared by Agvise Inc., BASF Corporation and BASF SE. 318p.

48542752 Brands, C. (2011) Determination of the Aerobic Degradation Rate of B-(Ring-U-(Carbon 14))OK-5101 in Three Soils (Including Amendment No. 1). Project

Number: 2011/7005186/OCR EU/478338. Unpublished study prepared by Notox B.V. 80p.

48542753 Willems, H. (2008) OK-5101 - Estimation of Soil DT50 and DT90 Values Using Degradation Data Taken from a Soil Degradation Study by Brands (2008)- Annex llA 7.2.1. Project Number: 2008/1098893/US/OCR EU/488456. Unpublished study prepared by Notox B.V. 23p.

48542754 Brands, C.; Corral, E. (2011) Determination of the Aerobic Degradation Rate of B-1 in Three Soils (Including Amendment 1 and Amendment 2). Project Number: 2011/7005183/OCR EU/485925. Unpublished study prepared by Notox B.V. 44p.

48542755 Brands, C.; Corral, E. (2010) Determination of the Aerobic Degradation Rate of AB-1 in Three Soils (Including Amendment No. 1). Project Number: 2010/1224815/US/OCR EU/485926. Unpublished study prepared by Notox B.V. 50p.

48542756 Brands, C.; Corral, E. (2010) Determination of the Aerobic Degradation Rate of B-3 in Three Soils (Including Amendment No. 1). Project Number: 2010/1224816/US/OCR EU/487925. Unpublished study prepared by Notox B.V. 46p.

48542749 Ta, C.; Traversa, E. (2011) Anaerobic Soil Metabolism of (Carbon 14)-BAS 9210 I: Final Report. Project Number: 2011/7005339/OCR US/350781. Unpublished study prepared by BASF Corporation and Agvise Laboratories, Inc. 203p.

48542768 Ta, C.; Traversa, E. (2011) Aerobic Aquatic Metabolism of (Carbon 14)-BAS 9210 I: Final Report. Project Number: 2011/7000768/OCR 111/14/01 US/395301. Unpublished study prepared by BASF Corporation and Agvise, Inc. 203p.

48542769 Singh, M. (2011) BAS 9210 I (Cyflumetofen): Anaerobic Aquatic Metabolism: Final Report. Project Number: 2011/7001153/OCR 111/07/01 US/350777. Unpublished study prepared by Agvise Laboratories, Inc., and BASF Agro Research. 196p.

48542647 Perez, S.; Miska, J.; Saha, M. (2011) Independent Laboratory Validation of BASF Analytical Method D1002: Determination of Cyflumetofen (BAS 9210 I) and its Metabolites in Soil Using LC-MS/MS: Final Report. Project Number: 2011/7005075/OCR, 379626, ADPEN/2K11/903/379626. Unpublished study prepared by ADPEN Laboratories, Inc. 156p.

48542757 Jordon, J.; Warren, R. (2011) Terrestrial Field Dissipation of Cyflumetofen (BAS 9210 I) following Applications of BAS 9210 0I in Orchard/Vineyard and Row Crop Use Patterns. Project Number: 2011/7004042/OCR 111/27/02 US/350785. Unpublished study prepared by BASF Agricultural Research Center. 926p.

48542828 Carter, M. (2011) Validation of BASF Analytical Method D1002: Determination of Cyflumetofen (BAS 9210 I) and Its Metabolites in Soil using LC-MS/MS. Project Number: 2011/7005073/OCR, US/ADPEN/2K11/416947. Unpublished study prepared by ADPEN Laboratories, Inc. 209p.

48542829 Gordon, B. (2011) Freezer Storage Stability of Cyflumetofen (BAS 9210 I) and Its

Relevant Metabolites in Soil Samples. Project Number: 2011/7002604/OCR, 350786. Unpublished study prepared by BASF Crop Protection. 135p.

48542785 Bouwman, L. (2007) Bioconcentration Test in Carp with OK-5101 (Flow-through). Project Number: 2007/1067412/US/OCR EU/472872. Unpublished study prepared by Notox B.V. 61p.

Ecological effects studies

48542772 Teunissen, M. (2011) Acute Oral Toxicity Study in Northern Bobwhite with OK-5101 (Including Amendment No. 1). Project Number: 2011/7005171/OCR EU/381926. Unpublished study prepared by Notox B.V. 74p.

48542773 Gallagher, S.; Beavers, J. (2006) OK-5101: An Acute Oral Toxicity Study with the Mallard. Project Number: 2006/1048773/US/OCR EU/181/116. Unpublished study prepared by Wildlife International, Ltd. 58p.

48542774 Zok, S. (2010) BAS 9210 I (Cyflumetofen) - Acute Toxicity in the Zebra Finch (*Taeniopygia guttata*) after Single Oral Administration (LD50). Project Number: 2010/1009633/US/OCR 15W0510/095034 375046. Unpublished study prepared by BASF SE. 69p.

48542775 Teunissen, M. (2011) 5-Day Dietary Toxicity Study in Northern Bobwhite with OK-5101 (Including Amendment No. 1). Project Number: 2011/7005174/OCR EU/381937. Unpublished study prepared by Notox B.V. 107p.

48542776 Gallagher, S.; Martin, K.; Beavers, J. (2006) OK-5101: A Dietary LC50 Study with the Mallard. Project Number: 2011/7005174/OCR EU/381937. Unpublished study prepared by Wildlife International, Ltd. 65p.

48542777 Temple, D.; Beavers, J.; Martin, K. et al. (2008) OK-5101: A Reproduction Study with the Northern Bobwhite Quail. Project Number: 2008/1098900/US/OCR EU/181/118. Unpublished study prepared by Wildlife International, Ltd. 161p.

48542778 Zok, S. (2010) BAS 9210 I (Cyflumetofen) - 1-Generation Reproduction Study on the Mallard Duck (*Anas platyrhynchus*) by Administration in the Diet. Project Number: 2010/1065743/US/OCR 72W0510/095026 350826. Unpublished study prepared by BASF SE. 351p.

48542779 Salinas, E. (2011) BAS 9210 I (Cyflumetofen) - Acute Toxicity Study with the Rainbow Trout (*Oncorhynchus mykiss*). Project Number: 2011/1109258/US/OCR 12F0510/09E023 365853. Unpublished study prepared by BASF SE. 45p.

48542780 Salinas, E. (2011) BAS 9210 I (Cyflumetofen) - Acute Toxicity Study with the Fathead Minnow (*Pimephales promelas*). Project Number: 2011/1102368/US/OCR 19F0510/09E024 375047. Unpublished study prepared by BASF SE. 47p.

48542781 Nierzedska, E. (2011) Reg.No. 104415 (Metabolite B-1 of BAS 9210 I, Cyflumetofen) - Acute Toxicity for Rainbow Trout. Project Number:

2011/1123577/US/OCR 1869190 W/31/11. Unpublished study prepared by Institute of Industrial Organic Chemistry. 37p.

48542782 Nierzedska, E. (2011) Reg.No. 133276 - (Metabolite A-2 of BAS 9210 I, Cyflumetofen) - Acute Toxicity for Rainbow Trout. Project Number: 2011/1123576/US/OCR 382915 1/86/91/99. Unpublished study prepared by Institute of Industrial Organic Chemistry. 39p.

48542783 Salinas, E. (2011) BAS 9210 I (Cyflumetofen) - Early Life-stage Toxicity Test on the Fathead Minnow (*Pimephales promelas*) in a Flow-through System. Project Number: 2011/1109259/US/OCR 375050 50F0510/09E021. Unpublished study prepared by BASF SE. 84p.

48542784 Migchielsen, M. (2011) Carp, Juvenile Growth test - 28 Days with OK-5101 (Flow-through) (Including Amendment No. 1). Project Number: 2011/7005297/OCR EU/475763. Unpublished study prepared by Notox B.V. 46p.

48542787 Migchielsen, M. (2008) Acute Toxicity Study in *Daphnia magna* with B-1 (Static). Project Number: 2008/1098912/US/OCR EU/488671. Unpublished study prepared by Notox B.V. 27p.

48542788 Bouwman, L. (2009) Acute Toxicity Study in *Daphnia magna* with B-2 (Static). Project Number: 2009/1126740/US/OCR EU/488674. Unpublished study prepared by Notox B.V. 26p.

48542789 Salinas, E. (2011) BAS 9210 I (Cyflumetofen) - Acute Toxicity (Immobilisation) Study in the Water Flea *Daphnia magna* STRAUS (Including Amendment No. 1). Project Number: 2011/7006303/OCR 50E0510/09E025 375048. Unpublished study prepared by BASF SE. 54p.

48542790 Swierkot, A. (2011) Reg.No. 133276 (Metabolite A-2 of BAS 9210 I, Cyflumetofen) - *Daphnia magna* Acute Immobilization Test. Project Number: 2011/1124105/US/OCR W/33/11 1/86/91/87. Unpublished study prepared by Institute of Industrial Organic Chemistry. 36 p.

48542791 Salinas, E. (2011) BAS 9210 I (Cyflumetofen) - *Daphnia magna* Reproduction Test. Project Number: 2011/1109261/US/OCR 51E0510/09E022 375049. Unpublished study prepared by BASF SE. 58p.

48542792 Bergfield, A. (2011) BAS 9210 I: Static Toxicity Test with the Green Alga, *Pseudokirchneriella subcapitata*. Project Number: 2011/7001354/OCR US/65258 350816. Unpublished study prepared by ABC Laboratories, Inc. 65p.

48542793 Rebstock, M. (2011) BAS 9210 I: Static Toxicity Test with the Blue-green Alga, *Anabaena flos-aquae*. Project Number: 2011/7001234/OCR 350817 65259. Unpublished study prepared by ABC Laboratories, Inc. 60p.

48542794 Rebstock, M. (2011) BAS 9210 I: Static Growth Inhibition Test with the Marine Diatom, *Skeletonema costatum*. Project Number: 2011/7000375/OCR SUBNO/201104/05/01 65261. Unpublished study prepared by ABC Laboratories, Inc. 62p.

48542795 Rebstock, M. (2011) BAS 9210 I: Growth Inhibition Test with the Freshwater Diatom, *Navicula pelliculosa*. Project Number: 2011/7000374/OCR SUBNO/201104/03/01 65260. Unpublished study prepared by ABC Laboratories, Inc. 62p.

48542796 Migchielsen, M. (2011) Fresh Water Algal Growth Inhibition Test with AB-11 (Including Amendment No. 1). Project Number: 2011/7005237/OCR EU/488678. Unpublished study prepared by Notox B.V. 36p.

48542797 Migchielsen, M. (2008) Fresh Water Algal Growth Inhibition Test with B-1. Project Number: 2008/1098913/US/OCR EU/488672. Unpublished study prepared by Notox B.V. 34p.

48542798 Gerke, A. (2011) BAS 9210 I: Whole Sediment Acute Toxicity to the Marine Amphipod, *Leptocheirus plumulosus*. Project Number: 2011/7000699/OCR 105/02/01 375053. Unpublished study prepared by ABC Laboratories, Inc. 68p.

48542799 Koopmans, D. (2009) Sediment-water Chironomid Toxicity Test Using Water Spiked with OK-5101. Project Number: 2009/1126743/US/OCR EU/487988. Unpublished study prepared by Notox B.V. 59p.

48542801 Desmares-Koopmans, M. (2009) Sediment-Water Chironomid Toxicity Test Using Sediment Spiked with AB-1. Project Number: 2009/1126744/OCR, 489663. Unpublished study prepared by Notox B.V. 52p.

48542802 Backfisch, K.; Weltje, L. (2011) Chronic Toxicity of Reg. No. 5465430 (BAS 9210 I; Cyflumetofen) to the Non-Biting Midge *Chironomus riparius* - A Spiked Sediment Study. Project Number: 2010/1145507/OCR, 375052. Unpublished study prepared by BASF Aktiengesellschaft. 39p.

48542803 Weltje, L.; Backfisch, K. (2011) Chronic Toxicity of Reg. No. 5756389 (AB-1 Dimer; Metabolite of Cyflumetofen) to the Non-Biting Midge *Chironomus riparius* - A Spiked Sediment Study. Project Number: 2011/1266754/OCR, 382909. Unpublished study prepared by BASF SE. 44p.

48542804 Bergfield, A. (2011) BAS 9210 I: Growth Inhibition Test with the Freshwater Aquatic Plant, Duckweed, *Lemna gibba*. Project Number: 2011/7005069/OCR, 375041, 65262. Unpublished study prepared by ABC Laboratories, Inc. 71p.

48542805 Geuijen, W. (2002) Acute Contact Toxicity Study in the Honeybee with OK-5101 (Laboratory Test). Project Number: OTSA/0080/FR/OCR, 358594. Unpublished study prepared by Notox B.V. 23p.

48542806 Migchielsen, M. (2008) Acute Toxicity Study in the *Earthworm Eisenia fetida* with AB-1. Project Number: 2008/1098914/OCR, 488673. Unpublished study prepared by Notox B.V. 25p.

48542807 Migchielsen, M. (2008) Acute Toxicity Study in the *Earthworm Eisenia fetida* with B-1 (Combined Limit/Range-Finding Test). Project Number: 2008/1098915/OCR, 488670. Unpublished study prepared by Notox B.V. 19p.

48542808 McCormac, A. (2009) Determination of Chronic (Sub-Lethal) Toxicity of Technical-Grade OK-5101 to the Earthworm *Eisenia fetida* in an Artificial Soil Substrate. Project Number: 2009/1126745/OCR, NOT/09/1. Unpublished study prepared by Mambo-Tox, Ltd. 40p.

48542810 Gerke, A. (2011) BAS 9210 I: Effect on New Shell Growth of the Eastern Oyster (*Crassostrea virginica*). Project Number: 2011/7005234/OCR, 350824, 65256. Unpublished study prepared by ABC Laboratories, Inc. 61p.

48542811 Bergfield, A. (2011) BAS 9210 I: Acute Toxicity to the Mysid Shrimp, *Americamysis bahia*, Determined under Flow-Through Conditions. Project Number: 2011/7005280/OCR, 65255, 350823. Unpublished study prepared by ABC Laboratories, Inc. 55p.

48542812 Gerke, A. (2011) BAS 9210 I: Acute Toxicity to the Sheepshead Minnow, *Cyprinodon variegatus*, Determined under Flow-Through Conditions. Project Number: 2011/7005233/OCR, 65254, 350822. Unpublished study prepared by ABC Laboratories, Inc. 56p.

48542824 Van-Sikkelerus, B. (2003) Acute Toxicity Study in the Earthworm *Eisenia fetida* with OK-5101 (Combined Range-Finding and Limit Test). Project Number: OTSA/0108/OCR, 358605. Unpublished study prepared by Notox B.V. 16p.

48542914 Geuijen, W. (2006) Acute Contact Toxicity Study in the Honeybee with OK-5101 20% SC (Laboratory Test). Project Number: EU/472927 OTSA/0309/FR/US/OCR. Unpublished study prepared by Notox B.V. 21p.

48542916 Geuijen, W. (2006) Acute Toxicity Study in the Earthworm *Eisenia fetida fetida* (Sic) with OK-5101 20% SC. Project Number: OTSA/0323/FR/US/OCR EU/472938. Unpublished study prepared by Notox B.V. 21p.

48542920 Migchielsen, M. (2006) 96-Hour Acute Toxicity Study in Rainbow Trout with OK-5101 20% SC (Static). Project Number: OTSA/0304/FR/US/OCR EU/472894. Unpublished study prepared by Notox B.V. 27p.

48542921 Migchielsen, M. (2006) Acute Toxicity Study in *Daphnia magna* with OK-5101 20% SC (Static). Project Number: OTSA/0303/FR/US/OCR EU/472905. Unpublished study prepared by Notox B.V. 28p.

48542922 Migchielsen, M. (2006) Fresh Water Algal Growth Inhibition Test with OK-5101 20% SC. Project Number: OTSA/0302/FR/US/OCR EU/472916. Unpublished study prepared by Notox B.V. 32p.

48542923 Geuijen, W. (2003) Acute Oral Toxicity Study in the Honeybee with OK-5101 20 SC (Laboratory Test). Project Number: OTSA/0137/FR/US/OCR EU/366751. Unpublished study prepared by Notox B.V. 22p.

48542924 Geuijen, W. (2004) Toxicity Study in the Parasitic Wasp *Aphidius rhopalosiphi* with OK-5101 20 SC (Laboratory Test). Project Number: OTSA/0142/US/OCR EU/386156. Unpublished study prepared by Notox B.V. 18p.

48542925 Geuijen, W. (2004) Dose Response Toxicity Study in the Predatory Mite *Typhlodromus pyri* with OK-5101 20 SC (Laboratory Test). Project Number: OTSA/0143/US/OCR EU/386167. Unpublished study prepared by Notox B.V. 20p.

48542932 Lee, B. (2011) Cyflumetofen 20SC: Effects on the Vegetative Vigor of Non-target Terrestrial Plants (Tier II). Project Number: 2011/7000530/OCR 350814 65248. Unpublished study prepared by ABC Laboratories, Inc. 114p.

48542933 Lee, B. (2011) Cyflumetofen 20SC: Effects on the Seedling Emergence and Growth of Non-target Terrestrial Plants (Tier II). Project Number: 2011/7000529/OCR 65247 350813. Unpublished study prepared by ABC Laboratories, Inc. 125p.

Appendix A: Input and Results of Screening Imbibition Program (SIP v. 1.0)

<u>Assumptions:</u>

SIP employs the following conservative assumptions to derive upper bound exposure estimates:

1) The chemical concentration in drinking water is at the solubility limit in water (at 25^{o}C).
2) The assessed animals obtain 100% of their daily water needs through drinking water.
3) The daily water need is equivalent to the daily water flux rate as calculated by Nagy and Peterson (1988).
4) The body weight of the assessed bird is equivalent to the smallest generic bird modeled in T-REX (i.e., 20 g). This assumption results in the highest ratio of exposure to toxicity for the 3 assessed avian body weights of T-REX (i.e., 20, 100, 1000 g).

Table 1. Inputs

Parameter	Value	
Chemical name	cyflumetofen	
Solubility (in water at 25^{o}C; mg/L)	0.0281	
Mammalian LD_{50} (mg/kg-bw)	2000	Non-definitive endpoint
Mammalian test species	laboratory rat	
Body weight (g) of "other" mammalian species		
Mammalian NOAEL (mg/kg-bw)	9.21	
Mammalian test species	laboratory rat	
Body weight (g) of "other" mammalian species		
Avian LD_{50} (mg/kg-bw)	2000	NOTE: Non-definitive
Avian test species	northern bobwhite quail	
Body weight (g) of "other" avian species		
Mineau scaling factor	1.15	
Mallard NOAEC (mg/kg-diet)	930	
Bobwhite quail NOAEC (mg/kg-diet)	154	
NOAEC (mg/kg-diet) for other bird species		
Body weight (g) of other avian species		
NOAEC (mg/kg-diet) for 2nd other bird species		
Body weight (g) of 2nd other avian species		

Table 2. Mammalian Results

Parameter	Acute	Chronic
Upper bound exposure (mg/kg-bw)	0.0048	0.0048
Adjusted toxicity value (mg/kg-bw)	1538.3211	7.0840
Ratio of exposure to toxicity	0.0000	0.0007
Conclusion*	**Drinking water exposure alone is NOT a potential concern for mammals**	**Drinking water exposure alone is NOT a potential concern for mammals**

Table 3. Avian Results

Parameter	Acute	Chronic
Upper bound exposure (mg/kg-bw)	0.0228	0.0228
Adjusted toxicity value (mg/kg-bw)	1440.8590	16.3699
Ratio of exposure to acute toxicity	0.0000	0.0014
Conclusion*	**Drinking water exposure alone is NOT a potential concern for birds**	**Drinking water exposure alone is NOT a potential concern for birds**

*Conclusion is for drinking water exposure alone. This does not combine all routes of exposure. Therefore, when aggregated with other routes (*i.e*., diet, inhalation, dermal), pesticide exposure through drinking water may contribute to a total exposure that has potential for effects to non-target animals.

Appendix B: Input and Output of Screening Tool for Inhalation Risk (STIR v. 1.0)

A. Ground application

Welcome to the EFED Screening Tool for Inhalation Risk

This tool is designed to provide the risk assessor with a rapid method for determining the potential significance of the inhalation exposure route to birds and mammals in a risk assessment.

Input

Application and Chemical Information		
Enter Chemical Name	cyflumetofen	
Enter Chemical Use	all proposed uses	
Is the Application a Spray? (enter y or n)	y	
If Spray What Type (enter ground or air)	ground	
Enter Chemical Molecular Weight (g/mole)	447.45	
Enter Chemical Vapor Pressure (mmHg)	4.40E-08	
Enter Application Rate (lb a.i./acre)	0.2	
Toxicity Properties		
Bird		
Enter Lowest Bird Oral LD_{50} (mg/kg bw)	2000	Non-definitive endpoint
Enter Mineau Scaling Factor	1.15	
Enter Tested Bird Weight (kg)	0.178	
Mammal		
Enter Lowest Rat Oral LD_{50} (mg/kg bw)	2000	Non-definitive endpoint
Enter Lowest Rat Inhalation LC_{50} (mg/L)	2.65	Non-definitive endpoint
Duration of Rat Inhalation Study (hrs)	4	
Enter Rat Weight (kg)	0.35	

Output

Results Avian (0.020 kg)		
Maximum Vapor Concentration in Air at Saturation (mg/m^3)	1.06E-03	
Maximum 1-hour Vapor Inhalation Dose (mg/kg)	1.33E-04	
Adjusted Inhalation LD_{50}	1.48E+01	
Ratio of Vapor Dose to Adjusted Inhalation LD_{50}	9.01E-06	**Exposure not Likely Significant**
Maximum Post-treatment Spray Inhalation Dose (mg/kg)	2.11E-02	
Ratio of Droplet Inhalation Dose to Adjusted Inhalation LD_{50}	1.43E-03	**Exposure not Likely Significant**

Results Mammalian (0.015 kg)		
Maximum Vapor Concentration in Air at Saturation (mg/m^3)	1.06E-03	
Maximum 1-hour Vapor Inhalation Dose (mg/kg)	1.67E-04	
Adjusted Inhalation LD_{50}	1.58E+02	
Ratio of Vapor Dose to Adjusted Inhalation LD_{50}	1.06E-06	**Exposure not Likely Significant**
Maximum Post-treatment Spray Inhalation Dose (mg/kg)	2.66E-02	
Ratio of Droplet Inhalation Dose to Adjusted Inhalation LD_{50}	1.68E-04	**Exposure not Likely Significant**

B. Aerial application

Welcome to the EFED Screening Tool for Inhalation Risk

This tool is designed to provide the risk assessor with a rapid method for determining the potential significance of the inhalation exposure route to birds and mammals in a risk assessment.

Input

Application and Chemical Information		
Enter Chemical Name	cyflumetofen	
Enter Chemical Use	tomato	
Is the Application a Spray? (enter y or n)	y	
If Spray What Type (enter ground or air)	air	
Enter Chemical Molecular Weight (g/mole)	447.45	
Enter Chemical Vapor Pressure (mmHg)	4.40E-08	
Enter Application Rate (lb a.i./acre)	0.2	
Toxicity Properties		
Bird		
Enter Lowest Bird Oral LD_{50} (mg/kg bw)	2000	Non-definitive endpoint
Enter Mineau Scaling Factor	1.15	
Enter Tested Bird Weight (kg)	0.178	
Mammal		
Enter Lowest Rat Oral LD_{50} (mg/kg bw)	2000	Non-definitive endpoint
Enter Lowest Rat Inhalation LC_{50} (mg/L)	2.65	Non-definitive endpoint
Duration of Rat Inhalation Study (hrs)	4	
Enter Rat Weight (kg)	0.35	

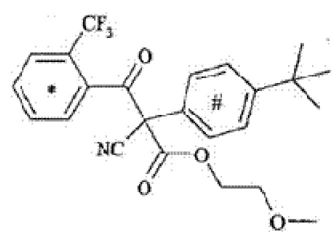
Output

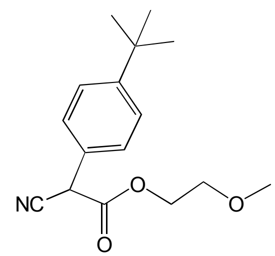
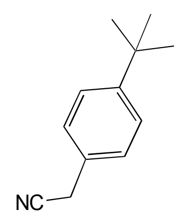
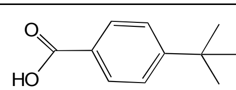
Results Avian (0.020 kg)		
Maximum Vapor Concentration in Air at Saturation (mg/m^3)	1.06E-03	
Maximum 1-hour Vapor Inhalation Dose (mg/kg)	1.33E-04	
Adjusted Inhalation LD_{50}	1.48E+01	
Ratio of Vapor Dose to Adjusted Inhalation LD_{50}	9.01E-06	**Exposure not Likely Significant**
Maximum Post-treatment Spray Inhalation Dose (mg/kg)	1.92E-02	
Ratio of Droplet Inhalation Dose to Adjusted Inhalation LD_{50}	1.30E-03	**Exposure not Likely Significant**

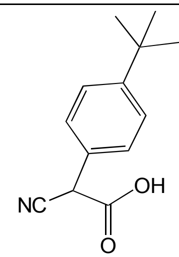
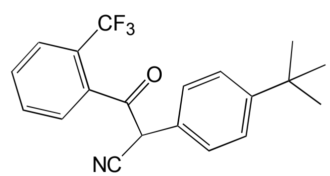
Results Mammalian (0.015 kg)		
Maximum Vapor Concentration in Air at Saturation (mg/m^3)	1.06E-03	
Maximum 1-hour Vapor Inhalation Dose (mg/kg)	1.67E-04	
Adjusted Inhalation LD_{50}	1.58E+02	
Ratio of Vapor Dose to Adjusted Inhalation LD_{50}	1.06E-06	**Exposure not Likely Significant**
Maximum Post-treatment Spray Inhalation Dose (mg/kg)	2.42E-02	
Ratio of Droplet Inhalation Dose to Adjusted Inhalation LD_{50}	1.53E-04	**Exposure not Likely Significant**

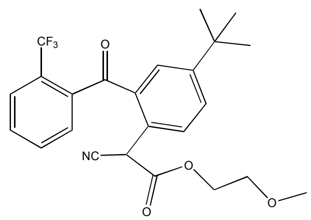
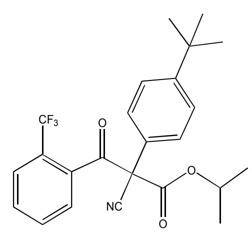
Appendix C: Cyflumetofen and Its Environmental Transformation Products and Degradation Pathways

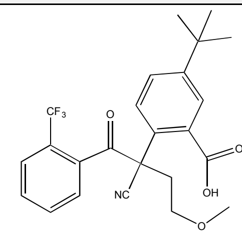
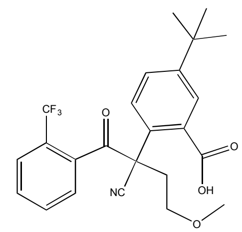
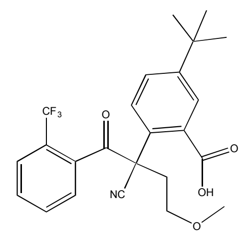
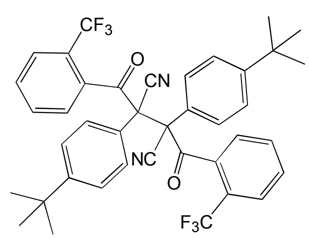
Table 2. Cyflumetofen and Its Environmental Transformation Products. [A]

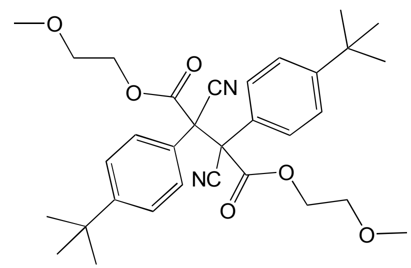
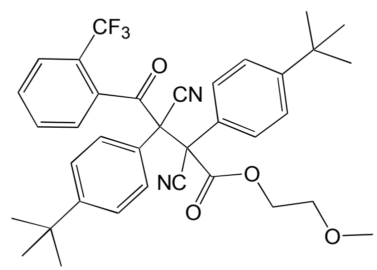
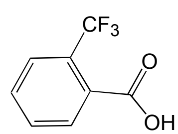
Code Name/ Synonym	Chemical Name, Solubility, and K_{OC}	Chemical Structure	Study Type	MRID	Label, Maximum %AR (day)	Final %AR (study length)
PARENT						
Cyflumetofen **BAS 92102I** **OK-5101**	**IUPAC:** 2-methoxyethyl (*RS*)-2-(4-tert-butylphenyl)-2-cyano-3-oxo-3-(α,α,α-trifluoro-o-tolyl)propionate **CAS:** 2-methoxyethyl α-cyano-α-[4-(1,1-dimethylethyl)phenyl]-β-oxo-2-(trifluoromethyl) benzenepropanoate **CAS No.:** 400882-07-7 **Formula:** $C_{24}H_{24}F_3NO_4$ **MW:** 447.45g/mol **SMILES:** FC(F)(F)c2ccccc2C(=O)C(C#N)(c1ccc(cc1)C(C)(C)C)C(=O)OCCOC Mobility **Water solubility:** 0.0281 mg/L **Koc:** 173,900 L/kg	 # Denotes position of A-[ring-U-^{14}C]OK-5101 radiolabelled in the phenyl ring * Denotes position of B-[ring-U-^{14}C]OK-5101 radiolabelled in the tolyl ring	Hydrolysis pH4	48542625		6.38 (30)
			Hydrolysis pH5			4.00 (30)
			Hydrolysis pH7			<LOQ (30)
			Hydrolysis pH9			<LOQ (1)
			Aqueous photolysis	48542627		<LOQ (2)
			Aerobic soil NJ	48542748		2.75 (120)
			Aerobic soil CA			5.04 (120)
			Aerobic soil IN			1.93 (120)
			Aerobic soil WI			3.19 (120)
			Aerobic soil 1	48542752		10.2 (120)
			Aerobic soil 2			10.6 (120)
			Aerobic soil 3			5.4 (120)
			Aerobic soil	48542745		1.8 (181)
			Anaerobic soil NJ	48542748		A <LOQ (120) B 0.7 (120)
			Anaerobic soil CA			B 2.1 (120)
			Anaerobic soil IN			B 0.5 (120)
			Anaerobic soil WI			B 1.2 (120)
			Aerobic aquatic FL	48542768		A **19.0** (133) B 1.7 (133)
			Aerobic aquatic PA			A **12.7** (133) B 2.5 (133)
			Aerobic aquatic 1	48542770 48542771		A 2.4 (98) B 1.5 (103)
			Aerobic aquatic 2			A 3.2 (57) B <LOQ (103)
			Anaerobic aquatic FL	48542769		A 3.84 (120) B 0.54 (120)

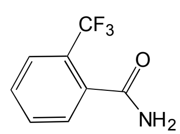
Code Name/ Synonym	Chemical Name, Solubility, and K_{OC}	Chemical Structure	Study Type	MRID	Label, Maximum %AR (day)	Final %AR (study length)
			Anaerobic aquatic PA			A <LOQ (120) B <LOQ (120)
			TFD WA	48542757		<LOQ (195)
			TFD NY			<LOQ (372)
			TFD FL			<LOQ (134)
			TFD CA			<LOQ (104)
MAJOR (>10%) TRANSFORMATION PRODUCTS						
A-1 (A label only)	**Formula:** $C_{16}H_{21}NO_3$ **MW:** 275.35 g/mol **SMILES:** C(C#N)(c1ccc(cc1)C(C)(C)C)C(=O)OCCOC Mobility **Water solubility:** 38 mg/L **Koc:** 459.1 L/kg (EpiSuite estimates)		Hydrolysis pH4	48542625	**26.94** (21)	**21.03** (30)
			Hydrolysis pH5		**10.02** (7)	0.51 (30)
			Hydrolysis pH7		**14.44%** (8 hours)	<0.22 (30)
			Hydrolysis pH9		**28.27%** (15 min)	<LOQ (1)
			Anaerobic soil NJ	48542748	A **20.8** (120)	**20.8** (120)
			Anaerobic soil CA		B label measured only, Metabolism studies did not follow this degradate	
			Anaerobic soil IN			
			Anaerobic soil WI			
A-2 (A label only)	**Formula:** $C_{12}H_{15}N$ **MW:** 173.26 g/mol **SMILES:** C(C#N)(c1ccc(cc1)C(C)(C)C) Mobility **Water solubility:** 34.95mg/L **Koc:** 1200 L/kg (EpiSuite estimates)		Hydrolysis pH4	48542625	**14.55** (30)	**14.55** (30)
			Hydrolysis pH5		**14.12** (21)	**12.41** (30)
			Hydrolysis pH7		**44.12** (30)	**44.12** (30)
			Hydrolysis pH9		**15.05** (1.5 h)	6.17 (1)
			Aerobic soil NJ	48542748	2.58 (7)	0.44 (120)
			Aerobic soil CA		B label measured only, Study did not follow this degradate	
			Aerobic soil IN			
			Aerobic soil WI			
			Anaerobic aquatic FL	48542769	**46.15** (90)	**25.79** (120)
			Anaerobic aquatic PA		**26.02** (62)	**13.65** (120)
			TFD WA	48542757	<LOQ	<LOQ (195)
			TFD NY		<LOQ	<LOQ (372)
			TFD FL		<LOQ	<LOQ (134)
			TFD CA		<LOQ	<LOQ (104)
A-12 (A label only)	**Formula:** $C_{11}H_{14}O_2$ **MW:** 178.23 g/mol **SMILES:**		Anaerobic soil NJ	48542749	9.9 (120)	9.9 (120)
			Anaerobic soil CA		B label measured only, Study did not follow this degradate	
			Anaerobic soil IN			

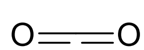
Code Name/ Synonym	Chemical Name, Solubility, and K_{OC}	Chemical Structure	Study Type	MRID	Label, Maximum %AR (day)	Final %AR (study length)
	C(=O)(c1ccc(cc1)C(C)(C)C)O Mobility **Water solubility:** 28.94 mg/L **Koc:** 113.7 L/kg (EpiSuite estimates)		Anaerobic soil WI			
			Aerobic aquatic FL	48542768	**17.6** (15)	0.8 (133)
			Aerobic aquatic PA		4.5 (8)	<LOQ (133)
			Anaerobic aquatic FL	48542769	Not detected	
			Anaerobic aquatic PA		**30.53** (15)	**20.28** (120)
A-18 (A label only)	**Formula:** $C_{13}H_{15}NO_2$ **MW:** 217.27 g/mol **SMILES:** C(C#N)(c1ccc(cc1)C(C)(C)C)C(=O)O Mobility **Water solubility:** 201.8 mg/L **Koc:** 139 L/kg (EpiSuite estimates)	 	Hydrolysis pH4	48542625	**12.63** (30)	**12.63** (30)
			Hydrolysis pH5		8.63 (21)	7.37 (30)
			Hydrolysis pH7		**36.22** (5)	**10.85** (10)
			Hydrolysis pH9		**48.8** (1)	**48.8** (1)
			Aerobic aquatic 1	48542770	4.9 (30)	1.9 (98)
			Aerobic aquatic 2		**22.7** (5)	**11.3** (57)
AB-1 (both labels)	**Formula:** $C_{20}H_{18}F_3NO$ **MW:** 345.37 g/mol **SMILES:** FC(F)(F)c2ccccc2C(=O)C(C#N)(c1ccc(cc1)C(C)(C)C) Mobility **Water solubility:** 0.142 mg/L **Koc:** 66,920 L/kg (EpiSuite estimates)	 	Hydrolysis pH4	48542625	**34.8** (30)	**34.8** (30)
			Hydrolysis pH5		**23.67** (14)	**23.35** (30)
			Hydrolysis pH7		**44.51** (5)	**36.96** (10)
			Hydrolysis pH9		**45.68** (1)	**45.68** (1)
			Aerobic soil NJ	48542748	9.72 (58)	3.83 (120)
			Aerobic soil CA		6.8 (29)	2.17 (120)
			Aerobic soil IN		6.25 (58)	3.29 (120)
			Aerobic soil WI		**11.06** (16)	6.86 (120)
			Aerobic soil	48542745	A 8.3 (59) B 7.8 (30)	3.8 (181) 5.1 (181)
			Anaerobic soil NJ	48542749	A **20.8** (120) B **23.5** (7)	**20.8** (120) **19.4** (120)
			Anaerobic soil CA		B **19.9** (7)	9.6 (120)
			Anaerobic soil IN		B **19.6** (30)	**17.2** (120)
			Anaerobic soil WI		B **31.2** (30)	**26.8** (120)
			Aerobic aquatic FL	48542768	A 8.5 (133) B **11.8** (8)	8.5 (133) **10.5** (133)
			Aerobic aquatic PA		A 3.8 (30) B 7.2 (100)	3.8 (133) 5.1 (133)
			Aerobic aquatic 1	48542770 48542771	A 6.6 (15) B <LOQ	<LOQ (98) <LOQ (103)
			Aerobic aquatic 2		A **15.1** (29)	2.4 (57)

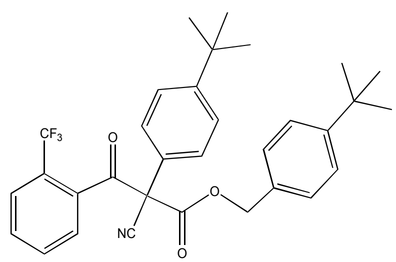
Code Name/ Synonym	**Chemical Name, Solubility, and K_{OC}**	**Chemical Structure**	**Study Type**	**MRID**	**Label, Maximum %AR (day)**	**Final %AR (study length)**
					B **16.2** (0.7)	2.4 (103)
			Anaerobic aquatic FL	48542769	A **34.61** (120) B **26.11** (120)	**34.61** (120) **26.11** (120)
			Anaerobic aquatic PA		A **38.77** (15) B **38.3** (30)	**22.81** (120) **22.56** (120)
			Fate Studies Using AB-1 as Parent			
			Aerobic soil 1	48542755	**95** (0)	8 (120)
			Aerobic soil 2		**88** (0)	6 (120)
			Aerobic soil 3		**90** (0)	3 (120)
AB-7	**Formula:** $C_{24}H_{24}F_3NO_4$ **MW:** 447.46 **SMILES:** C(C#N)(c1c(C(=O)c2ccccc2C(F)(F)(F))cc(cc1)C(C)(C)C)C(=O)OCCOC <u>Mobility</u> **Water solubility:** 0.05367 mg/L **Koc:** 25,600 L/kg (EpiSuite estimates)		Aquatic Photolysis	48542627	**10.82** (4 hrs.)	5.73 (2)
AB-11	**CAS No.:** 400882-00-0 **Formula:** $C_{24}H_{24}F_3NO_3$ **MW:** 431.5 **SMILES:** FC(F)(F)c2ccccc2C(=O)C(C#N)(c1ccc(cc1)C(C)(C)C)C(=O)OC(C)C <u>Mobility</u> **Water solubility:** 0.0102 mg/L **Koc:** 85,630 L/kg (EpiSuite estimates)		Aerobic aquatic 1	48542770	Not detected	
			Aerobic aquatic 2		A **13.7** (0.7)	5.9 (57)

Code Name/ Synonym	Chemical Name, Solubility, and K_{OC}	Chemical Structure	Study Type	MRID	Label, Maximum %AR (day)	Final %AR (study length)
AB-15	**Formula:** $C_{24}H_{24}F_3NO_4$ **MW:** 447.46 **SMILES:** FC(F)(F)c2ccccc2C(=O)C(C#N)(c1c(C(=O)O)cc(cc1)C(C)(C)C)CCOC Mobility **Water solubility:** 0.04085 mg/L **Koc:** 10,400 L/kg (EpiSuite estimates)	  	Aquatic Photolysis	48542627	**54.67** (2)	**54.67** (2)
AB-1 Dimer	**Formula:** $C_{40}H_{36}F_6N_2O_2$ **MW:** 690.73 **SMILES:** C(C#N)(c1ccc(cc1)C(C)(C)C)(FC(F)(F)c2ccccc2C(=O))C(C#N)(c1ccc(cc1)C(C)(C)C)(FC(F)(F)c2ccccc2C(=O)) Mobility **Water solubility:** 4.082×10^{-10} mg/L **Koc:** 1.617×10^{8} L/kg (EpiSuite estimates)		Aerobic soil NJ	48542748	**25.37** (120)	**25.37** (120)
			Aerobic soil CA		**18.7** (120)	**18.7** (120)
			Aerobic soil IN		**10.7** (120)	**10.7** (120)
			Aerobic soil WI		**23.0** (120)	**23.0** (120)
			Anaerobic soil NJ	48542748	A **14.1** (3) B **16.1** (3)	**12.6** (120) 8.4 (120)
			Anaerobic soil CA		B **16.0** (3)	**14.6** (120)
			Anaerobic soil IN		B **12.8** (3)	7.7 (120)
			Anaerobic soil WI		B **12.4** (3)	**10.2** (120)
			Aerobic aquatic FL	48542768	A 5.5 (30) B 3.8 (30)	4.9 (133) 2.5 (133)
			Aerobic aquatic PA		A 5.0 (133) B 6.8 (133)	5.0 (133) 6.8 (133)

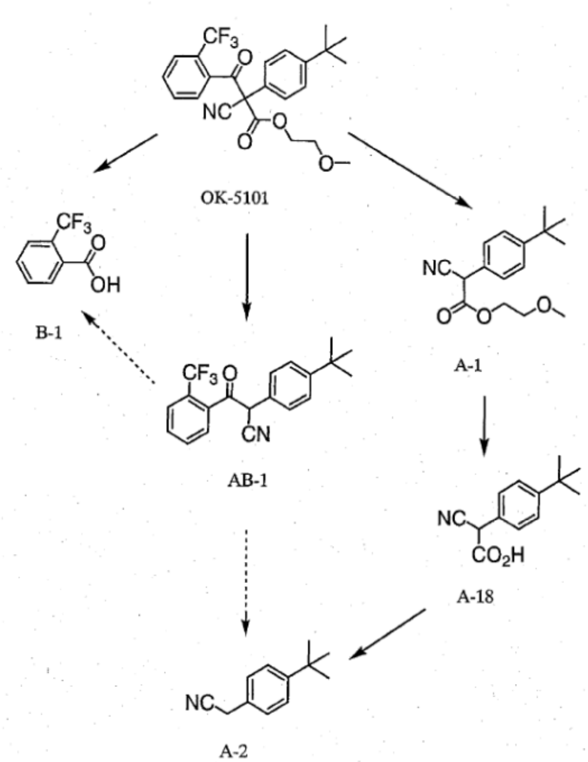
Code Name/ Synonym	Chemical Name, Solubility, and K_{OC}	Chemical Structure	Study Type	MRID	Label, Maximum %AR (day)	Final %AR (study length)
			TFD WA	48542757	0.004 ppm (14)	<LOQ (195)
			TFD NY		0.012 ppm (132)	<LOQ (372)
			TFD FL		0.003 ppm (14)	<LOQ (134)
			TFD CA		0.003 ppm (5)	<LOQ (104)
AU16 (A-1/A-1 Dimer) (A label only)	**Formula:** $C_{32}H_{40}N_2O_6$ **MW:** 548.69g/mol **SMILES:** C(C#N)(c1ccc(cc1)C(C)(C)C)(C(=O)OCCOC)C(C#N)(c1ccc(cc1)C(C)(C)C)(C(=O)OCCOC) Mobility **Water solubility:** 0.00722 mg/L **Koc:** 50,600 L/kg (EpiSuite estimates)		Hydrolysis pH4	48542625	6.56 (14)	5.53 (30)
			Hydrolysis pH5		**15.78** (30)	**15.78** (30)
			Hydrolysis pH7		5.03 (10)	5.03 (10)
			Hydrolysis pH9		4.16 (1)	4.16 (1)
			Aerobic soil NJ	48542748	A 2.33 (59)	0.46 (120)
			Aerobic soil CA		B label measured only, Degradate not followed in this study	
			Aerobic soil IN			
			Aerobic soil WI			
AU17 (A-1/AB-1 Dimer) (both labels)	**Formula:** $C_{36}H_{38}F_3N_2O_4$ **MW:** 619.71g/mol **SMILES:** C(C#N)(c1ccc(cc1)C(C)(C)C)(FC(F)(F)c2ccccc2C(=O))C(C#N)(c1ccc(cc1)C(C)(C)C)(C(=O)OCCOC) Mobility **Water solubility:** 1.728×10^{-6} mg/L **Koc:** 2.86×10^{6} L/kg (EpiSuite estimates)		Hydrolysis pH4	48542625	7.76 (21)	6.39 (30)
			Hydrolysis pH5		**21.09** (30)	**21.09** (30)
			Hydrolysis pH7		Not detected	
			Hydrolysis pH9		Not detected	
			Aerobic soil NJ	48542748	6.93 (29)	5.92 (120)
			Aerobic soil CA		8.2 (120)	8.2 (120)
			Aerobic soil IN		4.79 (16)	3.09 (120)
			Aerobic soil WI		3.88 (120)	3.88 (120)
B-1 **2-(trifluoro methyl) benzoic acid** **2-TFMBA** (B label only)	**IUPAC:** o-trifluoromethylbenzoic acid **CAS:** 2-(trifluoromethyl)benzoic acid **CAS No.:** 433-97-6 **Formula:** $CF_3C_6H_4COOH$ **MW:** 190.12 g/mol **SMILES:** OC(=O)c1ccccc1C(F)(F)F		Hydrolysis pH4	48542625	**48.4** (30)	**48.4** (30)
			Hydrolysis pH5		**52.62** (30)	**52.62** (30)
			Hydrolysis pH7		**53.17** (2)	**52.85** (10)
			Hydrolysis pH9		**50.31** (1)	**50.31** (1)
			Aerobic soil NJ	48542748	**30.85** (16)	<LOQ (120)
			Aerobic soil CA		**43.79** (58)	**42.08** (120)
			Aerobic soil IN		**23.97** (7)	0.21 (120)
			Aerobic soil WI		**21.0** (7)	0.56 (120)
			Aerobic soil 1	48542752	**55.2** (21)	**33.8** (120)
			Aerobic soil 2		**43.2** (35)	2.6 (120)
			Aerobic soil 3		**52.8** (58)	**43.0** (120)

Code Name/ Synonym	Chemical Name, Solubility, and K_{OC}	Chemical Structure	Study Type	MRID	Label, Maximum %AR (day)	Final %AR (study length)
	Mobility **Water solubility:** 363.3 mg/L (EpiSuite estimate) **Koc:** 79 L/kg		Aerobic soil	48542745	**22.9** (6)	2.7 (181)
			Anaerobic soil NJ	48542749	**49** (120)	**49** (120)
			Anaerobic soil CA		**50.3** (120)	**50.3** (120)
			Anaerobic soil IN		**50.1** (120)	**50.1** (120)
			Anaerobic soil WI		**44.2** (120)	**44.2** (120)
			Aerobic aquatic FL	48542768	**58.1** (15)	**26.5** (133)
			Aerobic aquatic PA		**60.2** (59)	**33.8** (133)
			Aerobic aquatic 1	48542771	**56.8** (62)	**52.5** (103)
			Aerobic aquatic 2		**84.4** (12)	**67.6** (103)
			Anaerobic aquatic FL	48542769	**68.78** (90)	**63.38** (120)
			Anaerobic aquatic PA		**72.39** (90)	**63.88** (120)
			TFD WA	48542757	0.030 ppm (1)	<LOQ (195)
			TFD NY		0.056 ppm (3)	<LOQ (372)
			TFD FL		0.026 ppm (24)	<LOQ (134)
			TFD CA		0.079 ppm (19)	<LOQ (104)
			Fate Studies Using B-1 as Parent			
			Aerobic soil 1	48542754	**102** (0)	<LOQ (120)
			Aerobic soil 2		**105** (0)	1.3 (120)
			Aerobic soil 3		**100** (0)	**20** (120)
B-3 **2-(trifluoro methyl) benzamide** (B label only)	**CAS:** 2-(trifluoromethyl) benzamide **CAS No.:** 360-64-5 **Formula:** $C_8H_6F_3NO$ **MW:** 189.137 g/mol **SMILES:** C(C1=C(C(=O)N)C=CC=C1)(F)(F) F Mobility **Water solubility:** 13,000 mg/L **Koc:** 121.5 (EpiSuite estimate)		Aerobic soil NJ	48542748	4.98 (7)	<LOQ (120)
			Aerobic soil CA		**17.96** (16)	<LOQ (120)
			Aerobic soil IN		4.62 (7)	<LOQ (120)
			Aerobic soil WI		3.21 (16)	0.99 (120)
			Aerobic soil 1	48542752	**23.0** (21)	5.2 (120)
			Aerobic soil 2		**12.7** (6)	<LOQ (120)
			Aerobic soil 3		4.8 (21)	<LOQ (120)
			Anaerobic soil NJ	48542749	A B 0.9 (58)	<LOQ (120)
			Anaerobic soil CA		B 2.9 (30)	2.0 (120)
			Anaerobic soil IN		B 3.0 (15)	<LOQ (120)
			Anaerobic soil WI		B 1.3 (30)	<LOQ (120)
			TFD WA	48542757	<LOQ	<LOQ (195)
			TFD NY		<LOQ	<LOQ (372)
			TFD FL		<LOQ	<LOQ (134)

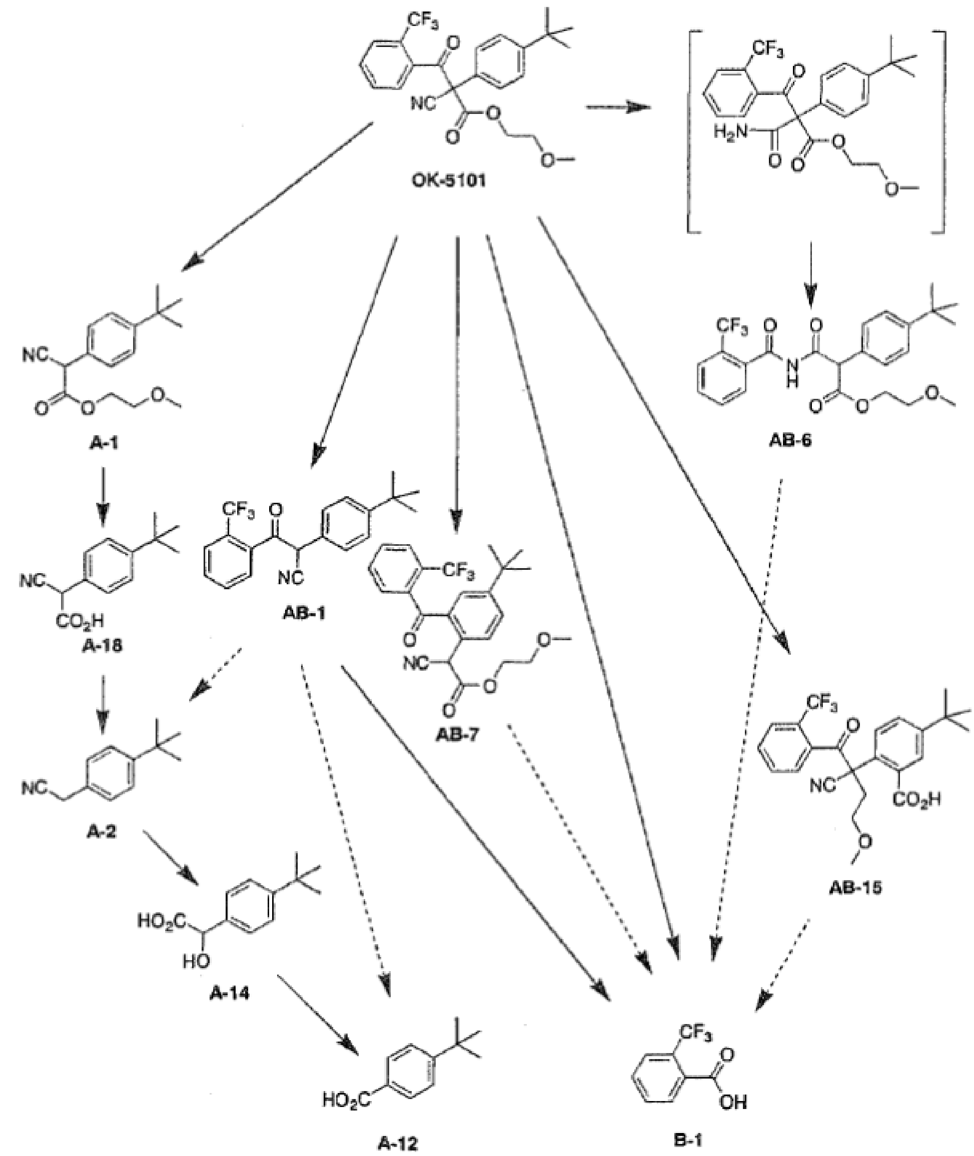
Code Name/ Synonym	Chemical Name, Solubility, and K_{OC}	Chemical Structure	Study Type	MRID	Label, Maximum %AR (day)	Final %AR (study length)
			TFD CA		0.005 ppm (14)	<LOQ (104)
			Fate Studies Using B-3 as Parent			
			Aerobic soil 1	48542756	**86** (0)	5.6 (48)
			Aerobic soil 2		**87** (0)	1.5 (48)
			Aerobic soil 3		**87** (0)	0.2 (48)
Unextracted residues (both labels)	(not applicable)	(not applicable)	Aerobic soil NJ	48542748	B **35.04** (58) A **43.07** (120)	**32.59** (120) **43.07** (120)
			Aerobic soil CA		B **21.58** (120)	**21.58** (120)
			Aerobic soil IN		B **38.29** (58)	**37.98** (120)
			Aerobic soil WI		B **35.66** (58)	**31.59** (120)
			Aerobic soil 1	48542752	B **32.1** (58)	**30.1** (120)
			Aerobic soil 2		B **40.1** (120)	**40.1** (120)
			Aerobic soil 3		B **38.4** (35)	**33** (120)
			Aerobic soil	48542745	A **43.4** (14) B **34.9** (59)	**37.9** (181) **30.7** (181)
			Anaerobic soil NJ	48542749	A **32.4** (120) B **22.6** (3)	**32.4** (120) **14.6** (120)
			Anaerobic soil CA		B **20** (1)	**18.3** (120)
			Anaerobic soil IN		B **21.2** (3)	**15.4** (120)
			Anaerobic soil WI		B **16.3** (7)	**14.6** (120)
			Aerobic aquatic FL	48542768	A **34.3** (133) B **29.8** (100)	**34.3** (133) **22.6** (133)
			Aerobic aquatic PA		A **44.2** (59) B **23.7** (100)	**21.5** (133) **14.7** (133)
			Anaerobic aquatic FL	48542769	A 4.12 (120) B **12.07** (90)	4.12 (120) **11.15** (120)
			Anaerobic aquatic PA		A 8.73 (90) B 8.39 (30)	7.46 (120) 8.33 (120)
Carbon dioxide	Carbon dioxide **Formula:** CO_2 **MW:** 44.1 g/mol **SMILES:** O=C=O		Aerobic soil NJ	48542748	B **24.1** (120) A **17.3** (120)	**24.1** (120) **17.3** (120)
			Aerobic soil CA		B 9.9 (120)	9.9 (120)
			Aerobic soil IN		B **17.6** (120)	**17.6** (120)
			Aerobic soil WI		B **17.3** (120)	**17.3** (120)
			Aerobic soil 1	48542752	B 9.5 (120)	9.5 (120)
			Aerobic soil 2		B **20.7** (120)	**20.7** (120)

Code Name/ Synonym	Chemical Name, Solubility, and K_{OC}	Chemical Structure	Study Type	MRID	Label, Maximum %AR (day)	Final %AR (study length)
			Aerobic soil 3		B 1.8 (90)	1.7 (120)
			Aerobic soil	48542745	A **27.9** (181) B **39.3** (181)	**27.9** (181) **39.3** (181)
			Anaerobic soil NJ	48542749	A 2.6 (120) B 1.0 (120)	2.6 (120) 1.0 (120)
			Anaerobic soil CA		B 0.8 (120)	0.8 (120)
			Anaerobic soil IN		B 1.0 (120)	1.0 (120)
			Anaerobic soil WI		B 1.0 (120)	1.0 (120)
			Aerobic aquatic FL	48542768	A 8.3 (133) B 3.0 (133)	8.3 (133) 3.0 (133)
			Aerobic aquatic PA		A 8.3 (133) B 3.3 (133)	8.3 (133) 3.3 (133)
			Aerobic aquatic 1	48542770 48542771	A **19.9** (98) B 2.8 (103)	**19.9** (98) 2.8 (103)
			Aerobic aquatic 2		A 1.8 (57) B 3.2 (103)	1.8 (57) 3.2 (103)
			Anaerobic aquatic FL	48542769	A 0.53 (120) B 0.06 (120)	0.53 (120) 0.06 (120)
			Anaerobic aquatic PA		A 1.53 (120) B 0.16 (120)	1.53 (120) 0.16 (120)
MINOR (<10%) TRANSFORMATION PRODUCTS						
AB-12	**Formula:** $C_{32}H_{32}F_3NO_3$ **MW:** 535.6 **SMILES:** FC(F)(F)c2ccccc2C(=O)C(C#N)(c1ccc(cc1)C(C)(C)C)C(=O)OC(c1ccc(cc1)C(C)(C)C) Mobility **Water solubility:** 1.074×10^{-5} mg/L **Koc:** 7.876×10^{6} (EpiSuite estimates)		Aerobic aquatic 1	48542770	Not detected	
			Aerobic aquatic 2		A 7.6 (2)	1.9 (57)

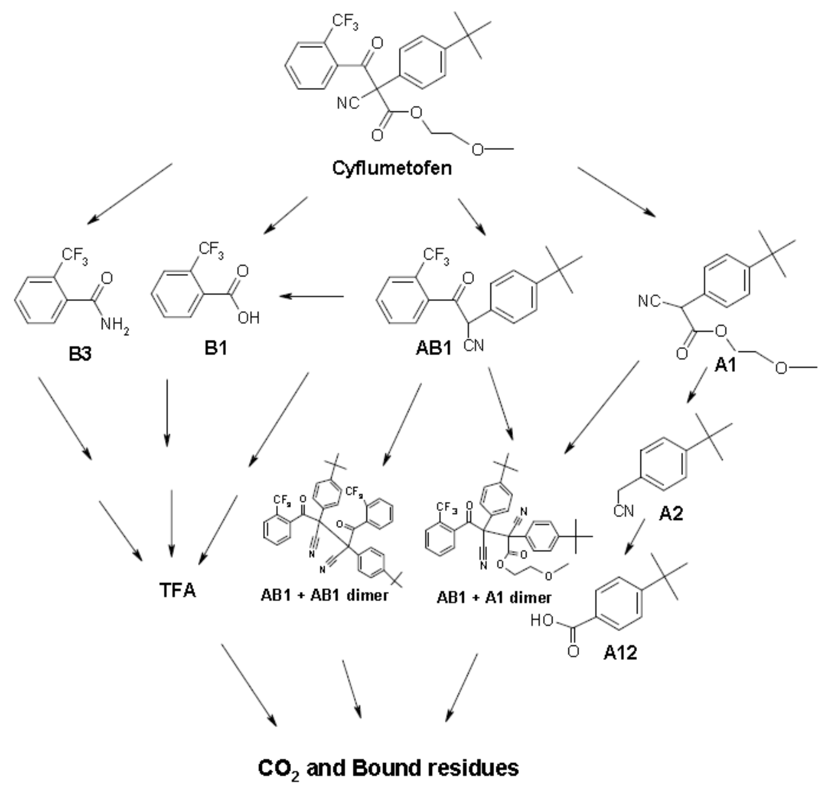
[A] nd means "not detected". AR means "applied radioactivity". MW means "molecular weight". LOQ means "limit of quantitation". Bolded values are laboratory study values >10%AR. TFD means Terrestrial Field Dissipation Study.



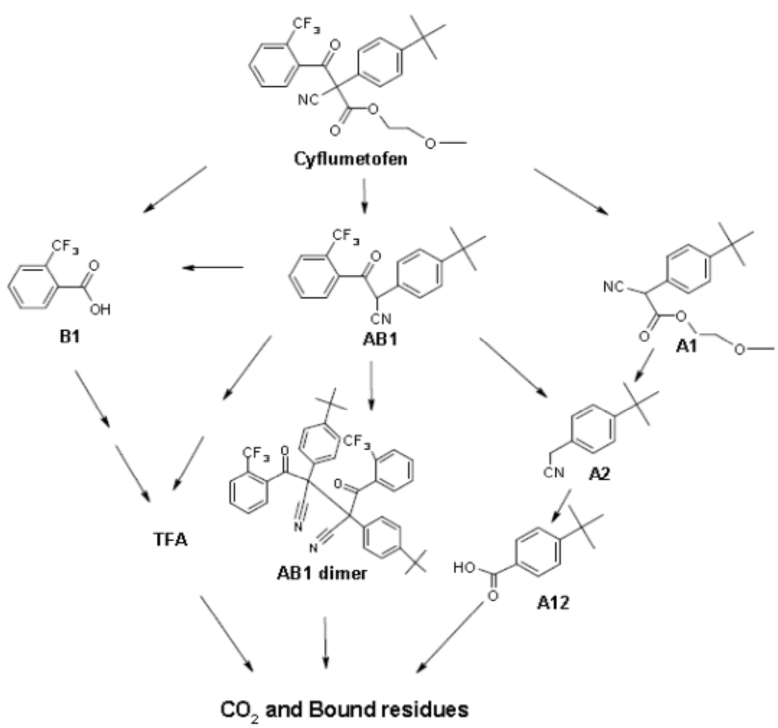
1. **Appendix Figure C-1 Abiotic hydrolysis.**



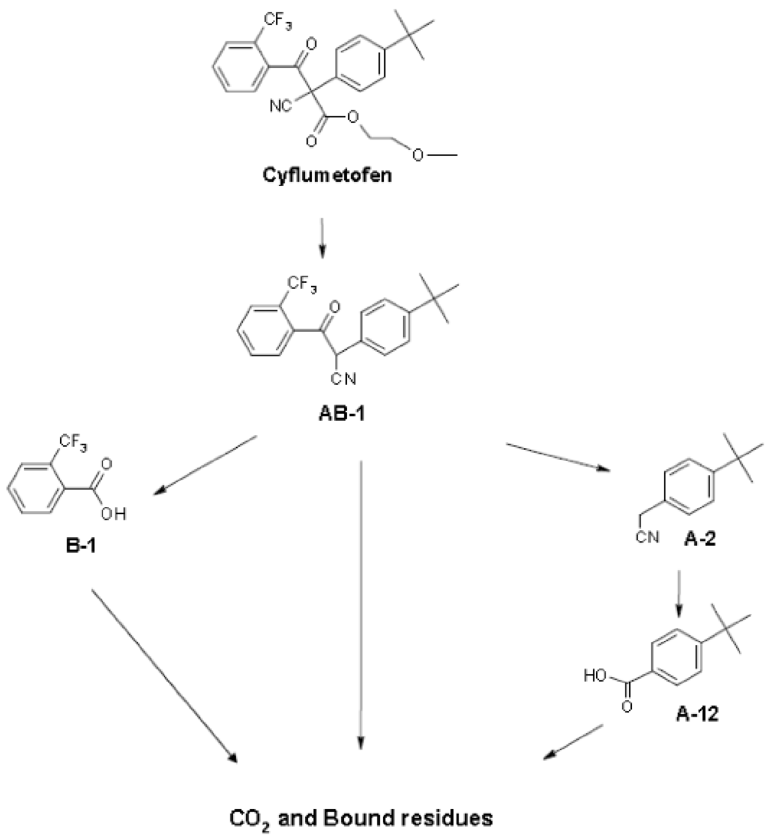
Appendix Figure C-2. Aquatic photolysis.



Appendix Figure C-3. Aerobic soil metabolism.



Appendix Figure C-4. Aerobic aquatic metabolism.



Appendix Figure C-5. Anaerobic aquatic metabolism.

Appendix D: Parent and Total Toxic Residue (TTR) PestDF Degradation Half-life Estimation Output and Available Degradate Study Half-life Estimation Output

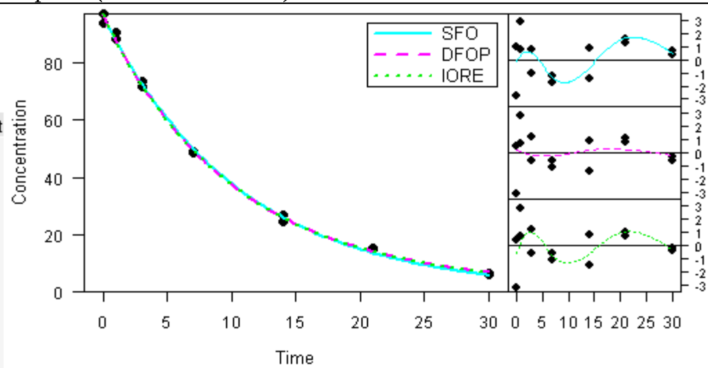
Appendix Table D-1. Parent and Total Toxic Residue (TTR) PestDF Degradation Half-life Estimation Output

Parent Only	Total Toxic Residue (TTR)

Hydrolysis – pH 4 (MRID 48542625)

Parent Only

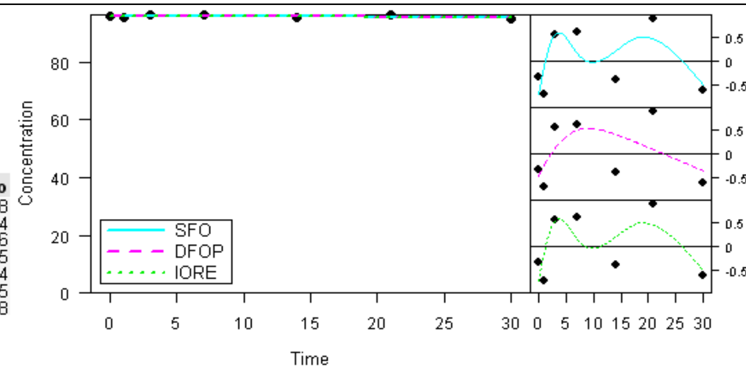
Days	Parent
0	93.8
0	97.4
1	90.7
1	88.6
3	71.9
3	73.7
7	48.5
7	49.
14	26.9
14	24.6
21	14.9
21	15.2
30	6.26
30	6.50



	DT_{50}	DT_{90}	χ^2	C_0	Parameters		
SFO	7.42	24.6	1.7	96.5	k= 0.0934	S_C	32.9
DFOP	7.23	25.6	1.8	97	f = 0.862, k_0 = 0.106, k_1 = 0.0464	S_{SFO}	30.7
IORE	7.23	25.5	1.7	97	N = 1.07, k= 0.0709	Slow $t_{1/2}$	14.9
						$t_{R\ IORE}$	7.67

Total Toxic Residue (TTR)

Days	Eco
0	95.8
1	95.4
3	96.6
7	96.5
14	95.4
21	96.5
30	94.8

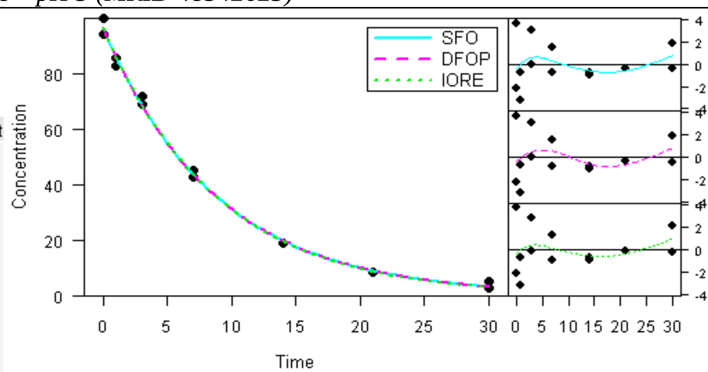


	DT_{50}	DT_{90}	χ^2	C_0	Parameters		
SFO	2930	9734	0.51	96.1	k= 0.000237	S_C	4.49
DFOP	2930	9733	0.61	96.1	f = 0.0558, k_0 = 0.000237, k_1 = 0.000237	S_{SFO}	2.63
IORE	2671	7180	0.55	96.1	N = 0.717, k = 0.000857	Slow $t_{1/2}$	2.93e+03
						$t_{R\ IORE}$	2.16e+03

Hydrolysis – pH 5 (MRID 48542625)

Parent Only

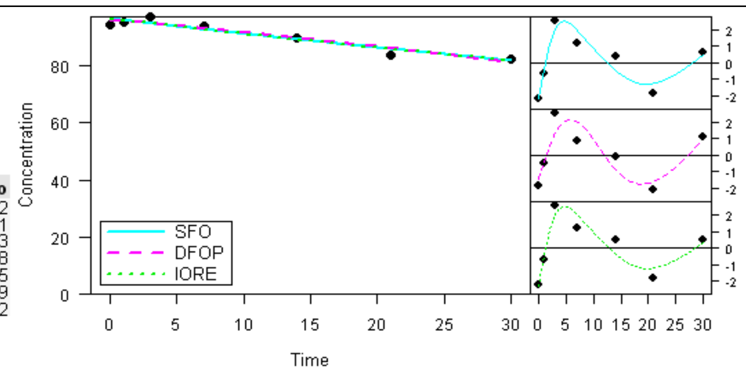
Days	Parent
0	94.2
0	100.
1	85.4
1	82.9
3	71.8
3	68.8
7	45.3
7	43.0
14	18.9
14	19.1
21	8.71
21	8.70
30	5.15
30	2.85



	DT_{50}	DT_{90}	χ^2	C_0	Parameters		
SFO	6.16	20.5	1.8	96.4	k = 0.113	S_C	56.9
DFOP	6.16	20.5	2.2	96.4	f = 1, k_0 = 0.113, k_1 = 0.00719	S_{SFO}	46.6
IORE	6.21	20.3	2	96.2	N = 0.979, k = 0.122	Slow $t_{1/2}$	96.4
						$t_{R\ IORE}$	6.1

Total Toxic Residue (TTR)

Days	Eco
0	94.2
1	95.1
3	97.3
7	93.8
14	89.5
21	83.9
30	82.2

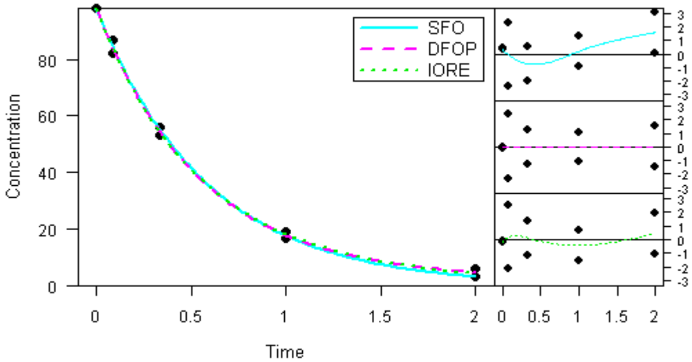


	DT_{50}	DT_{90}	χ^2	C_0	Parameters		
SFO	126	418	1.4	96.3	k = 0.00551	S_C	29.7
DFOP	93.6	250	1.6	96	f = -0.681, k_0 = 0.0215, k_1 = 0.0112	S_{SFO}	17.1
IORE	155	1032	1.5	96.4	N = 1.73, k = 0.000204	Slow $t_{1/2}$	62.1
						$t_{R\ IORE}$	311

Hydrolysis – pH 7 (MRID 48542625)

Parent Only	Total Toxic Residue (TTR)

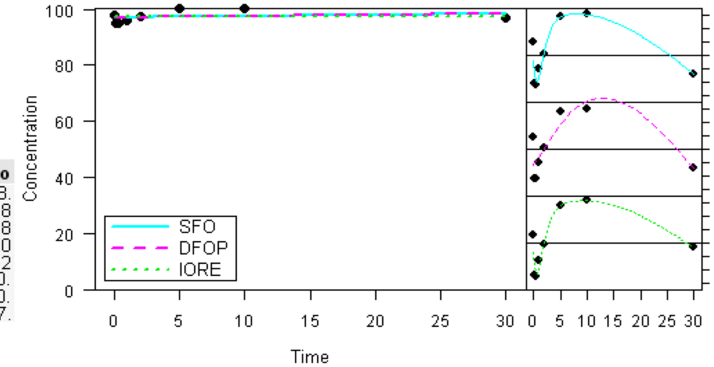
Days	Parent
0	98.
0.0833	82.3
0.333	53.3
1	19.0
2	6.32
0	98.1
0.0833	87.
0.333	55.8
1	16.8
2	3.29



	DT_{50}	DT_{90}	χ^2	C_0	Parameters
SFO	0.406	1.35	1.2	97.6	k= 1.71
DFOP	0.395	1.4	0.051	98	f= 0.973, k_0= 1.82, k_1= 0.0687
IORE	0.394	1.42	0.54	98.2	N= 1.1, k= 1.17

S_C	30.3
S_{SFO}	27.5
Slow $t_{1/2}$	10.1
$t_{R\ IORE}$	0.426

Days	Eco
0	98.
0.0833	94.8
0.333	94.8
1	96.0
2	97.2
5	100.
10	100.
30	97.

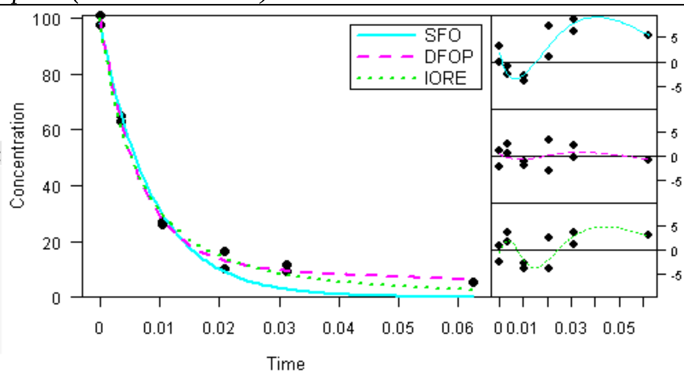


	DT_{50}	DT_{90}	χ^2	C_0	Parameters
SFO	-1517	-5041	1.6	97	k= -0.000457
DFOP	NA	NA	1.8	97	f= -0.117, k_0 = 0.000975, k_1 = -0.00031
IORE	-9496260855	-10647724298	1.8	97.3	N= -2.2, k= -6.79e-05

S_C	[illegible]
S_{SFO}	[illegible]
Slow $t_{1/2}$	-2.2
$t_{R\ IORE}$	-3.2

Hydrolysis – pH 9 (MRID 48542625)

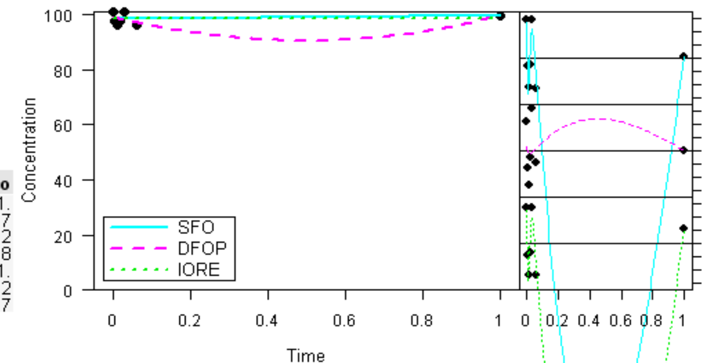
days	Parent
0	101.
0	97.9
0.00347	64.9
0.00347	63.1
0.0104	26.9
0.0104	25.9
0.0208	16.5
0.0208	10.1
0.0312	9.02
0.0312	11.5
0.0625	5.58



	DT_{50}	DT_{90}	χ^2	C_0	Parameters
SFO	0.00606	0.0201	9.1	97.9	k= 114
DFOP	0.00523	0.0285	2.6	100	f= 0.879, k_0= 157, k_1= 10.3
IORE	0.00518	0.0266	5.2	100	N= 1.48, k= 17.1

S_C	116
S_{SFO}	245
Slow $t_{1/2}$	0.0675
$t_{R\ IORE}$	0.00801

days	Eco
0	101.
0.00347	97.7
0.0104	96.2
0.0208	97.8
0.0312	101.
0.0625	96.2
1	99.7



	DT_{50}	DT_{90}	χ^2	C_0	Parameters
SFO	-55.5	-184	1.6	98.4	k= -0.0125
DFOP	NA	NA	1.8	99.1	f= 0.256, k_0 = -0.966, k_1 = 0.801
IORE	16274310	17214393	1.8	98.6	N= -3.19, k= 3.18

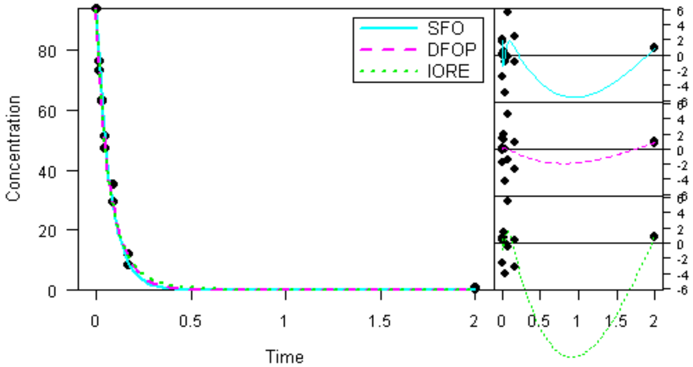
S_C	48.6
S_{SFO}	27.2
Slow $t_{1/2}$	-0.718
$t_{R\ IORE}$	5.18e+06

Parent Only	Total Toxic Residue (TTR)

Aquatic Photolysis – Distilled Water (MRID 48542627)

Parent Only

Days	Parent
0	94.
0	94.3
0.0139	73.5
0.0139	76.6
0.0278	63.0
0.0278	63.8
0.0417	51.5
0.0417	47.4
0.0833	29.5
0.0833	35.4
0.167	8.61
0.167	12.1
2	0.980
2	0.740

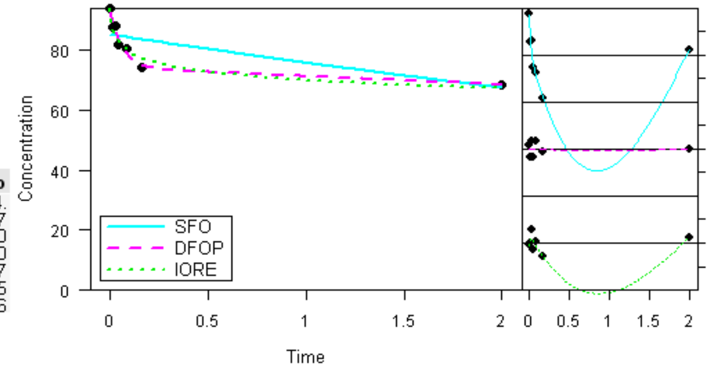


	DT_{50}	DT_{90}	χ^2	C_0	Parameters
SFO	0.0511	0.17	3.1	92.3	k= 13.6
DFOP	0.049	0.182	2.6	94.1	f= 0.105, k_0= 64.6, k_1= 12.1
IORE	0.0487	0.189	2.7	93.5	N= 1.18, k= 6.63

S_C	83.7
S_{SFO}	83.1
Slow $t_{1/2}$	0.0574
$t_{R\ IORE}$	0.0568

Total Toxic Residue (TTR)

Days	Eco
0	94.
0.0139	87.7
0.0278	88.0
0.0417	82.0
0.0833	80.7
0.167	74.5
2	68.6



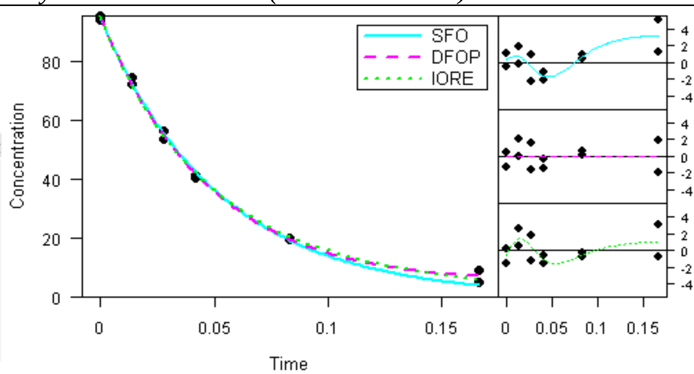
	DT_{50}	DT_{90}	χ^2	C_0	Parameters
SFO	5.94	19.7	5.1	85.2	k= 0.117
DFOP	11.8	52.7	1.6	93.1	f= 0.203, k_0= 15.7, k_1= 0.0394
IORE	1072	2059407910075957	1.8	94.2	N= 18.6, k= 2.1e-34

S_C	36.2
S_{SFO}	198
Slow $t_{1/2}$	17.6
$t_{R\ IORE}$	6.2e+14

Aquatic Photolysis – Natural Water (MRID 48542627)

Parent Only

Days	Parent
0	93.9
0	95.6
0.0139	74.3
0.0139	72.2
0.0278	53.4
0.0278	56.5
0.0417	41.6
0.0417	40.6
0.0833	20.2
0.0833	19.8
0.167	5.20
0.167	9.04

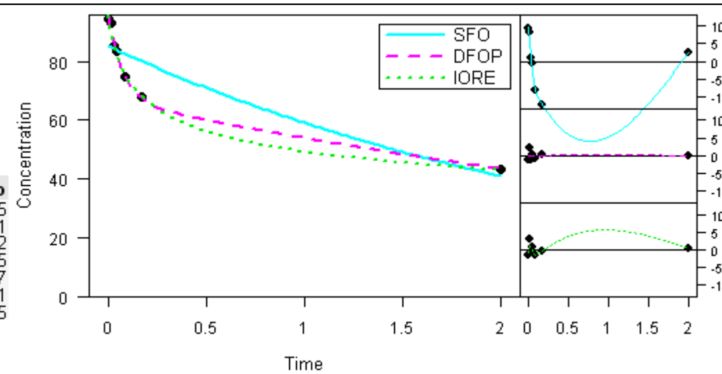


	DT_{50}	DT_{90}	χ^2	C_0	Parameters
SFO	0.0364	0.121	2.5	94.5	k= 19.1
DFOP	0.0352	0.133	1.3	95.2	f= 0.984, k_0= 20.4, k_1= -5.68
IORE	0.035	0.134	1.7	95.5	N= 1.17, k= 9.82

S_C	34.7
S_{SFO}	44.9
Slow $t_{1/2}$	-0.122
$t_{R\ IORE}$	0.0402

Total Toxic Residue (TTR)

Days	Eco
0	94.5
0.0139	93.1
0.0278	85.2
0.0417	83.5
0.0833	74.7
0.167	68.1
2	43.5



	DT_{50}	DT_{90}	χ^2	C_0	Parameters
SFO	1.89	6.29	7.5	85.2	k= 0.366
DFOP	1.56	9.06	1.4	95.6	f= 0.302, k_0= 13, k_1= 0.215
IORE	1.15	3469	1.6	96	N= 5.96, k= 7.88e-10

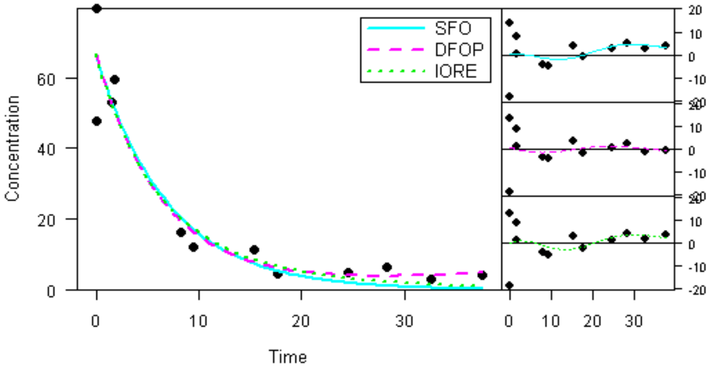
S_C	23.7
S_{SFO}	371
Slow $t_{1/2}$	3.23
$t_{R\ IORE}$	1.04e+03

Parent Only	Total Toxic Residue (TTR)

Soil Photolysis – A-label (MRID 48542750)

Parent Only

Days	Parent
0	47.9
0	79.7
1.6	53.0
1.8	59.4
8.2	16.3
9.5	12.1
15.4	11.5
17.7	4.50
24.5	4.80
28.3	6.50
32.6	3.20
37.6	4.40

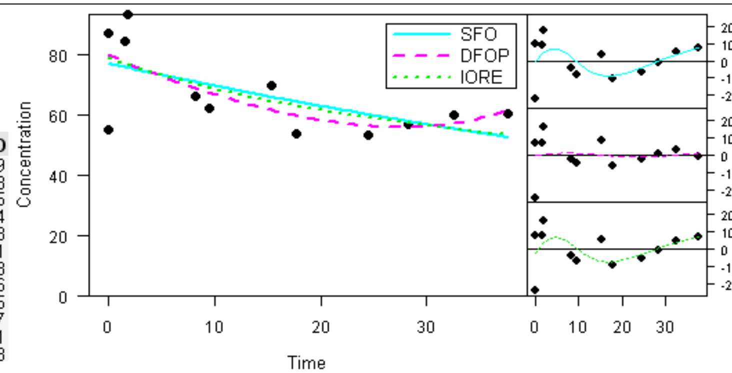


	DT_{50}	DT_{90}	χ^2	C_0	Parameters
SFO	4.9	16.3	13	66.1	k = 0.142
DFOP	4.59	17	12	66.6	f = 0.985, k_0 = 0.156, k_1 = -0.0421
IORE	4.66	17.8	14	66.5	N = 1.16, k = 0.079

S_C	893
S_{SFO}	704
Slow $t_{1/2}$	-16.5
$t_{R\ IORE}$	5.35

Total Toxic Residue (TTR)

Days	ECO
0	54.9
0	86.8
1.6	84.5
1.8	93.4
8.2	66.3
9.5	62.1
15.4	69.8
17.7	53.6
24.5	53.5
28.3	56.7
32.6	60.1
37.6	60.3



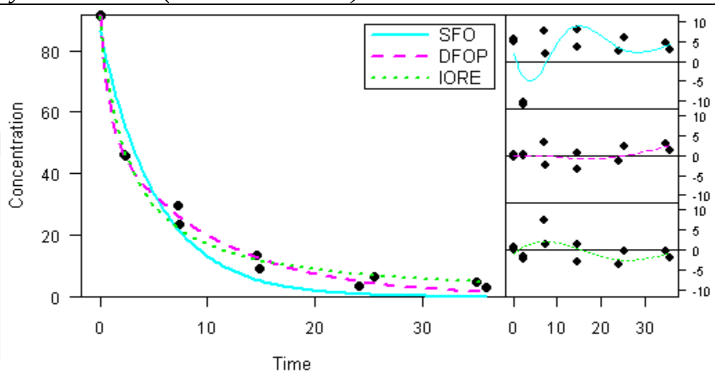
	DT_{50}	DT_{90}	χ^2	C_0	Parameters
SFO	68.5	228	10	76.9	k = 0.0101
DFOP	NA	NA	9.4	79.7	f = 0.986, k_0 = 0.0203, k_1 = -0.0821
IORE	97	3772	9.9	78.9	N = 3.12, k = 1.57e-06

S_C	1.62e+03
S_{SFO}	1.32e+03
Slow $t_{1/2}$	-8.44
$t_{R\ IORE}$	1.14e+03

Soil Photolysis – B-label (MRID 48542751)

Parent Only

Days	Parent
0	91.2
0	91.8
2.2	46.3
2.3	45.8
7.2	29.9
7.4	23.5
14.8	9.10
14.6	13.4
25.5	6.60
24.1	3.60
35	4.80
35.9	3.00



	DT_{50}	DT_{90}	χ^2	C_0	Parameters
SFO	3.69	12.3	17	86.3	k = 0.188
DFOP	2.29	18	6	91.5	f = 0.409, k_0 = 1.16, k_1 = 0.0989
IORE	2.51	19.6	8	91.1	N = 1.88, k = 0.00725

S_C	120
S_{SFO}	484
Slow $t_{1/2}$	7.01
$t_{R\ IORE}$	5.9

Total Toxic Residue (TTR)

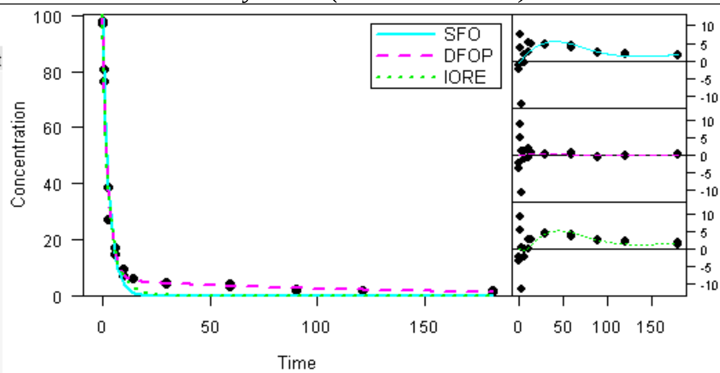
Not Applicable

Parent Only	Total Toxic Residue (TTR)

Aerobic Soil Metabolism – Sandy Loam (MRID 48542745)

Parent Only

DAT	Parent
0	96.8
0	98.0
1	76.6
1	80.6
3	27.1
3	38.8
6	15.1
6	17.5
10	9.80
10	7.10
14	6.20
14	6.30
30	4.60
30	5.00
59	3.60
59	4.40
90	2.20
90	2.60
121	1.90
121	2.20
181	1.30
181	1.80

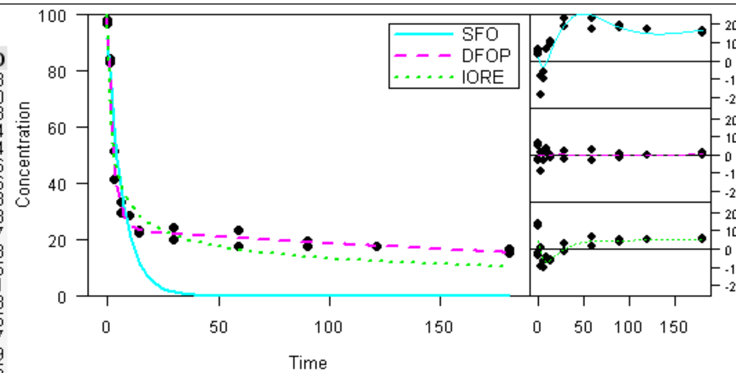


	DT_{50}	DT_{90}	χ^2	C_0	Parameters
SFO	2.24	7.45	14	99.4	k = 0.309
DFOP	2.09	8.35	10	101	f = 0.943, k_0 = 0.36, k_1 = 0.00773
IORE	2.11	8.43	13	100	N = 1.22, k = 0.13

S_C	436
S_{SFO}	420
Slow $t_{1/2}$	89.7
$t_{R\ IORE}$	2.54

Total Toxic Residue (TTR)

DAT	ECO
0	96.8
0	98.0
1	82.8
1	84.4
3	41.4
3	51.6
6	29.6
6	33.3
10	28.8
10	28.7
14	22.3
14	23.5
30	20.1
30	24.3
59	23.5
59	17.7
90	17.9
90	19.5
121	17.5
121	17.5
181	16.6
181	15.5



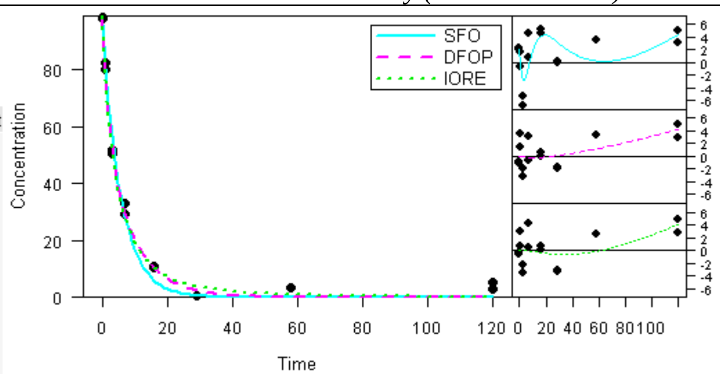
	DT_{50}	DT_{90}	χ^2	C_0	Parameters
SFO	4.96	16.5	31	91.6	k = 0.14
DFOP	3.03	364	6.1	100	f = 0.762, k_0 = 0.35, k_1 = 0.00238
IORE	3.18	204	15	100	N = 3.46, k = 6.76e-06

S_C	1.11e+03
S_{SFO}	4.51e+03
Slow $t_{1/2}$	291
$t_{R\ IORE}$	61.4

Aerobic Soil Metabolism – CA Soil B-label Only (MRID 48542748)

Parent Only

DAT	Parent
0	98.1
0	98.2
1	82.2
1	80.1
3	51.6
3	50.2
7	33.
7	29.2
16	11.0
16	10.4
29	0.698
29	0.551
58	3.53
120	2.99
120	5.04



	DT_{50}	DT_{90}	χ^2	C_0	Parameters
SFO	3.98	13.2	7.6	96.1	k = 0.174
DFOP	3.45	16.4	5.9	99.1	f = 0.372, k_0 = 0.469, k_1 = 0.112
IORE	3.5	16.5	5.7	98.7	N = 1.4, k = 0.0368

S_C	128
S_{SFO}	200
Slow $t_{1/2}$	6.19
$t_{R\ IORE}$	4.98

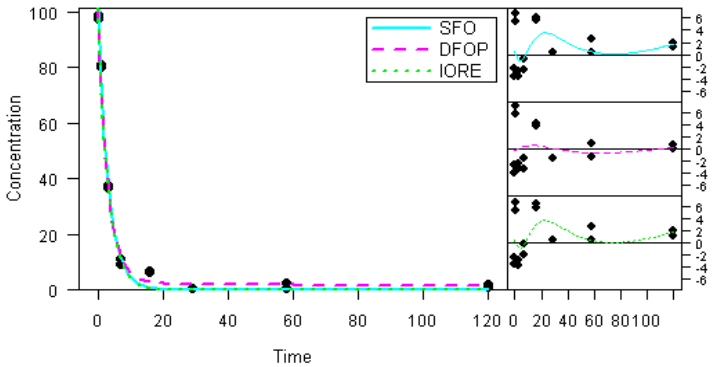
Total Toxic Residue (TTR)

Not Applicable

Parent Only	Total Toxic Residue (TTR)

Aerobic Soil Metabolism – IN Soil B-label Only (MRID 48542748)

DAT	Parent
0	97.6
0	98.9
1	80.0
1	81.3
3	36.9
3	37.8
7	11.2
7	9.48
16	6.88
16	6.37
29	0.374
29	0.447
58	2.66
58	0.362
120	1.21
120	1.93



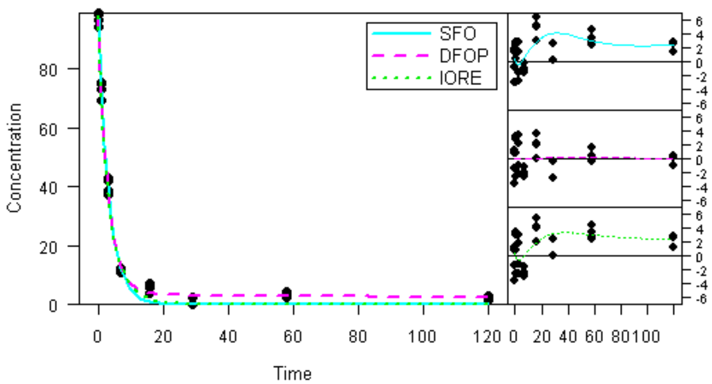
	DT_{50}	DT_{90}	χ^2	C_0	Parameters		
						S_C	238
SFO	2.27	7.54	9.4	101	k = 0.305	S_{SFO}	202
DFOP	2.23	7.88	10	102	f = 0.977, k_0 = 0.321, k_1 = 0.00456	Slow $t_{1/2}$	152
IORE	2.28	7.41	10	101	N = 0.972, k = 0.342	$t_{R\ IORE}$	2.23

Total Toxic Residue (TTR): Not Applicable

Aerobic Soil Metabolism – NJ Soil A- and B-label (MRID 48542748)

Parent Only

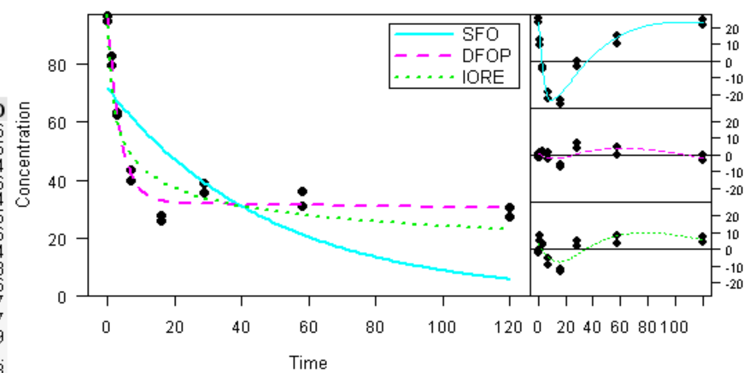
DAT	Parent
0	99.3
0	98.8
0	96.6
0	94.5
1	75.5
1	75.0
1	69.6
1	73.
3	41.8
3	37.6
3	43.0
3	38.8
7	10.8
7	12.2
7	11.4
7	11.1
16	3.72
16	5.97
16	5.80
16	7.27
29	2.59
29	0.220
58	2.72
58	4.45
58	3.33
58	2.38
120	2.75
120	1.30



	DT_{50}	DT_{90}	χ^2	C_0	Parameters		
						S_C	247
SFO	2.36	7.83	5.9	97.6	k = 0.294	S_{SFO}	235
DFOP	2.29	8.4	3.8	98.1	f = 0.966, k_0 = 0.319, k_1 = 0.00269	Slow $t_{1/2}$	258
IORE	2.3	8.36	6.1	98	N = 1.11, k = 0.19	$t_{R\ IORE}$	2.52

Total Toxic Residue (TTR)

DAT	ECO
0	96.6
0	94.5
1	79.4
1	82.6
3	63.4
3	62.5
7	39.6
7	43.4
16	25.8
16	27.6
29	38.7
29	35.7
58	35.9
58	31.
120	30.3
120	27.4



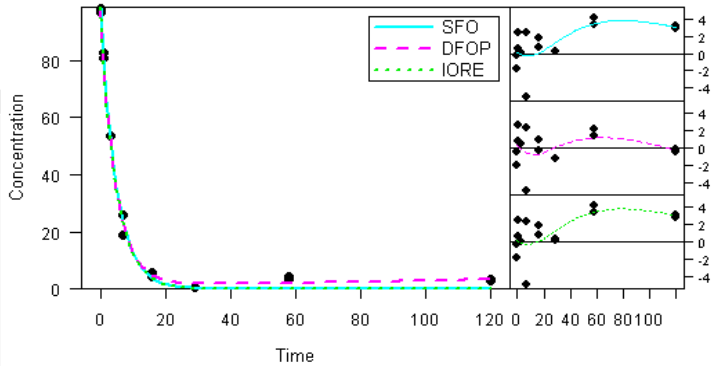
	DT_{50}	DT_{90}	χ^2	C_0	Parameters		
						S_C	872
SFO	33.1	110	27	71.6	k = 0.0209	S_{SFO}	4.86e+03
DFOP	5.29	2362	5.7	96	f = 0.664, k_0 = 0.263, k_1 = 0.000514	Slow $t_{1/2}$	1.35e+03
IORE	7.2	2811	11	97.2	N = 4.66, k = 2.38e-08	$t_{R\ IORE}$	846

Parent Only	Total Toxic Residue (TTR)

Aerobic Soil Metabolism – WI Soil B-label Only (MRID 48542748)

Parent Only

DAT	Parent
0	96.8
0	98.4
1	82.9
1	81.0
3	53.6
3	53.5
7	18.7
7	26.
16	4.49
16	5.62
29	0.552
29	0.486
58	3.41
58	4.19
120	3.19
120	2.83



	DT_{50}	DT_{90}	χ^2	C_0	Parameters
SFO	3.4	11.3	4.6	98.6	k = 0.204
DFOP	3.35	11.6	3.3	98.9	f= 0.987, k_0= 0.211, k_1= -0.00816
IORE	3.4	11.3	5	98.6	N= 0.997, k= 0.207

S_C	109
S_{SFO}	91.6
Slow $t_{1/2}$	-84.9
$t_{R\ IORE}$	3.39

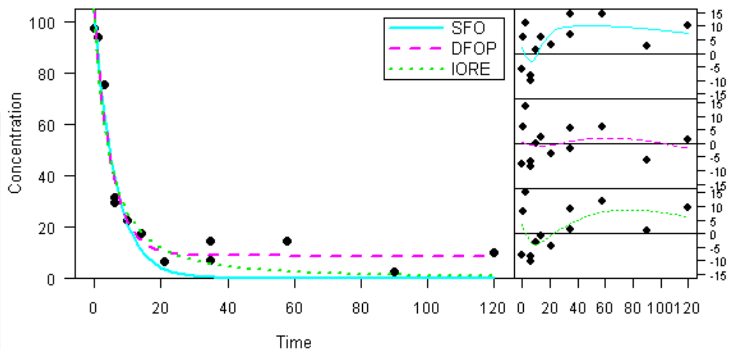
Total Toxic Residue (TTR)

Not Applicable

Aerobic Soil Metabolism – Speyer 2.2 Soil B-label Only (MRID 48542752)

Parent Only

DAT	Parent
0	97.5
1	94.1
3	75.7
6	31.6
6	29.6
10	22.4
14	17.4
21	6.70
35	14.7
35	7.10
58	14.7
90	2.60
120	10.2



	DT_{50}	DT_{90}	χ^2	C_0	Parameters
SFO	4.37	14.5	21	103	k= 0.159
DFOP	4	20.6	17	105	f= 0.915, k_0= 0.197, k_1= 0.000124
IORE	3.92	22.3	21	105	N = 1.58, k = 0.0144

S_C	1.1e+03
S_{SFO}	1e+03
Slow $t_{1/2}$	5.58e+03
$t_{R\ IORE}$	6.71

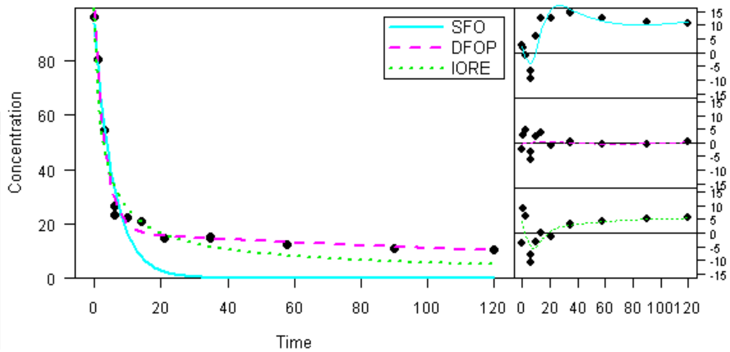
Total Toxic Residue (TTR)

Not Applicable

Parent Only	Total Toxic Residue (TTR)

Aerobic Soil Metabolism – Speyer 2.3 Soil B-label Only (MRID 48542752)

DAT	Parent
0	96.2
1	80.3
3	54.4
6	23.4
6	26.4
10	22.3
14	20.9
21	14.7
35	15.2
35	14.6
58	12.5
90	11.2
120	10.6



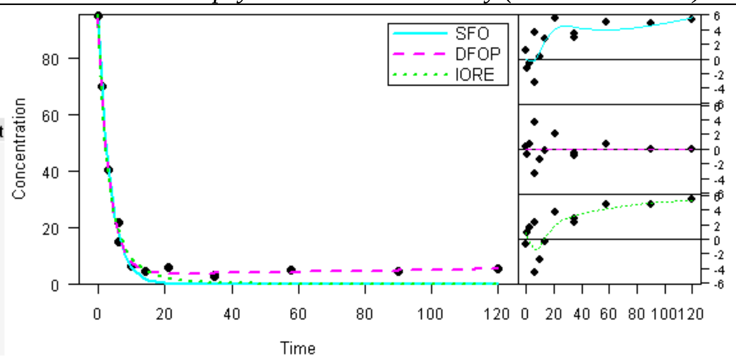
	DT_{50}	DT_{90}	χ^2	C_0	Parameters
SFO	3.98	13.2	25	93.7	k= 0.174
DFOP	3.03	128	7.8	98.8	f= 0.829, k_0= 0.303, k_1= 0.0042
IORE	2.79	44.3	14	99.7	N = 2.46, k = 0.000522

S_C	518
S_{SFO}	1.32e+03
Slow $t_{1/2}$	165
$t_{R\ IORE}$	13.3

Total Toxic Residue (TTR): Not Applicable

Aerobic Soil Metabolism – Speyer 6S Soil B-label Only (MRID 48542752)

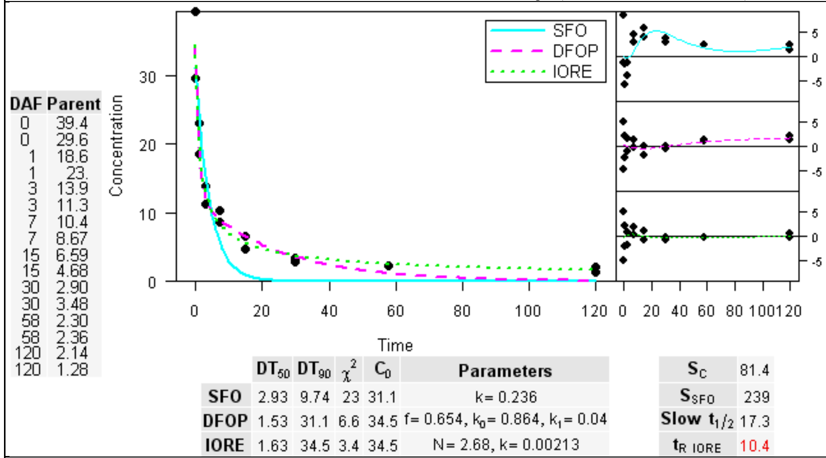
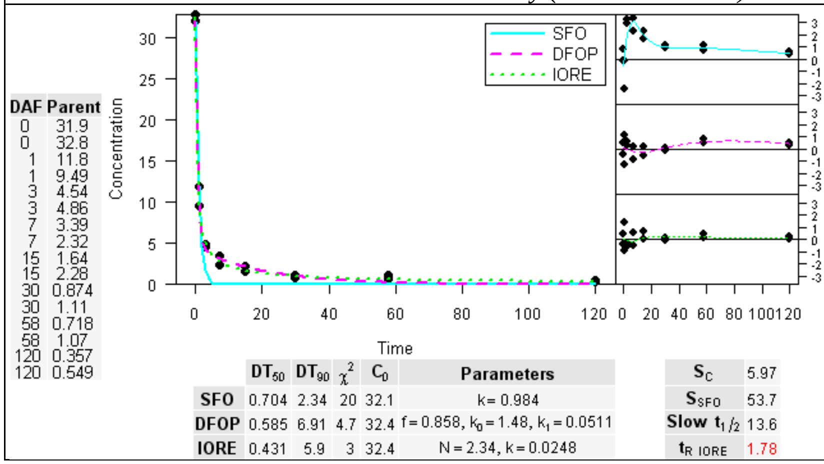
DAT	Parent
0	95.1
1	70.1
3	40.8
6	14.9
6	21.8
10	6.40
14	4.80
21	5.90
35	3.40
35	3.00
58	5.00
90	4.80
120	5.40



	DT_{50}	DT_{90}	χ^2	C_0	Parameters
SFO	2.53	8.42	13	94	k = 0.274
DFOP	2.4	8.98	3.6	94.8	f= 0.963, k_0= 0.305, k_1= -0.00379
IORE	2.25	9.78	12	95.9	N= 1.31, k= 0.0831

S_C	176
S_{SFO}	164
Slow $t_{1/2}$	-183
$t_{R\ IORE}$	2.95

Total Toxic Residue (TTR): Not Applicable

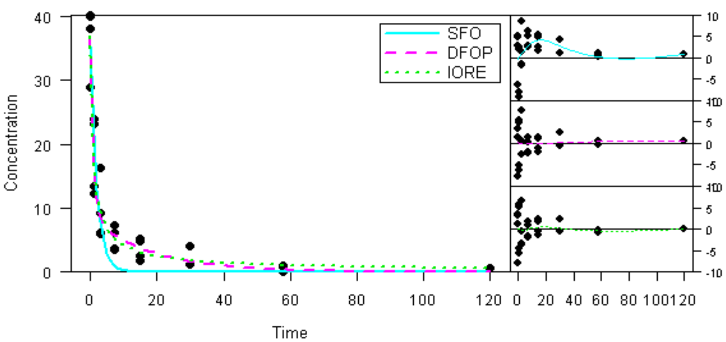
Parent Only	Total Toxic Residue (TTR)
Anaerobic Soil Metabolism – CA Soil B-label Only (MRID 48542749)	
	Not Applicable
Anaerobic Soil Metabolism – IN Soil B-label Only (MRID 48542749)	
	Not Applicable

Parent Only	Total Toxic Residue (TTR)

Anaerobic Soil Metabolism – NJ Soil A- and B-label (MRID 48542749)

Parent Only

DAF	Parent
0	40.3
0	40.1
0	38.1
0	29.
1	23.2
1	23.9
1	13.4
1	12.3
3	16.3
3	9.15
3	6.15
3	5.98
7	6.18
7	7.27
7	3.57
7	3.69
15	5.26
15	4.79
15	2.52
15	1.71
30	4.10
30	1.12
30	1.13
58	0.127
58	0.895
58	0.771
120	0.664

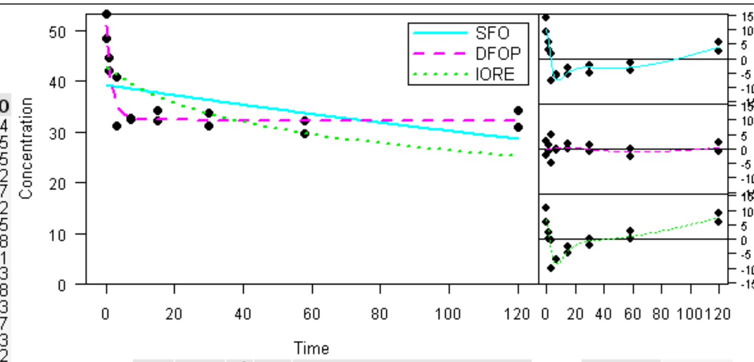


	DT_{50}	DT_{90}	χ^2	C_0	Parameters
SFO	1.38	4.57	18	35.4	k= 0.504
DFOP	1.01	15.3	4.1	36.8	f= 0.769, k_0= 0.996, k_1= 0.0547
IORE	0.952	11.8	2.4	36.9	N = 2.26, k = 0.0123

S_C	329
S_{SFO}	491
Slow $t_{1/2}$	12.7
$t_{R\ IORE}$	3.54

Total Toxic Residue (TTR)

DAF	ECO
0	53.4
0	48.5
1	44.5
1	42.2
3	40.7
3	31.2
7	32.5
7	32.8
15	32.1
15	34.3
30	33.8
30	31.3
58	29.7
58	32.3
120	34.2
120	31.0



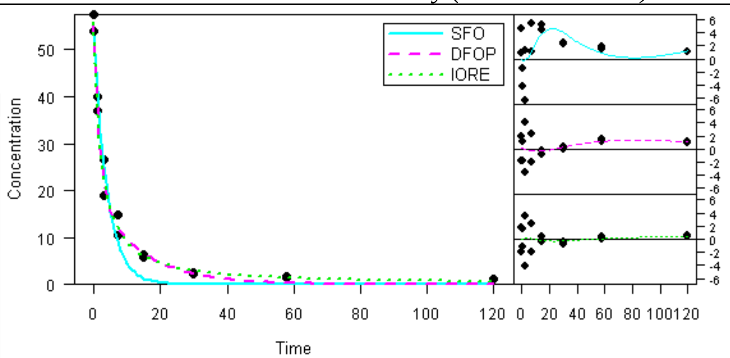
	DT_{50}	DT_{90}	χ^2	C_0	Parameters
SFO	264	877	12	39.2	k= 0.00263
DFOP	2984	22997	1.5	51	f = 0.364, k_0 = 0.544, k_1 = 8.04e-05
IORE	226	56580	12	42.8	N= 4.37, k= 3.91e-08

S_C	611
S_{SFO}	587
Slow $t_{1/2}$	8.62e+03
$t_{R\ IORE}$	1.7e+04

Anaerobic Soil Metabolism – WI Soil B-label Only (MRID 48542749)

Parent Only

DAF	Parent
0	53.9
0	57.7
1	39.9
1	37.1
3	18.9
3	26.5
7	14.7
7	10.4
15	5.73
15	6.43
30	2.25
30	2.58
58	1.48
58	1.79
120	1.03
120	1.18



	DT_{50}	DT_{90}	χ^2	C_0	Parameters
SFO	2.79	9.27	13	53.1	k= 0.248
DFOP	2.11	17.4	3.4	55.7	f= 0.655, k_0= 0.554, k_1= 0.0711
IORE	2.14	16.2	1.5	55.8	N = 1.85, k = 0.0143

S_C	60.8
S_{SFO}	179
Slow $t_{1/2}$	9.75
$t_{R\ IORE}$	4.89

Total Toxic Residue (TTR)

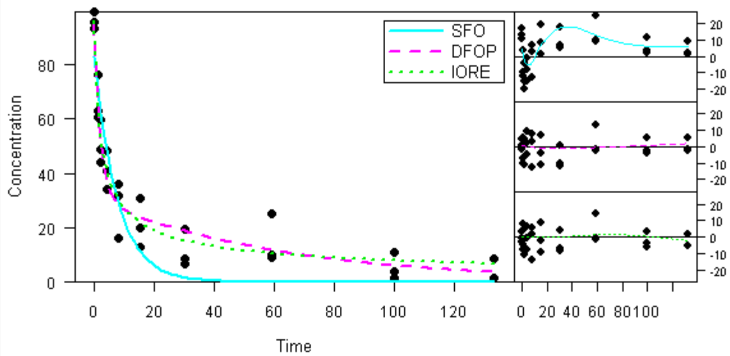
Not Applicable

Parent Only	Total Toxic Residue (TTR)

Aerobic Aquatic Metabolism – FL System A- and B-label (MRID 48542768)

Parent Only

0	95.6
1	60.4
1	63.2
1	76.1
1	76.1
2	48.9
2	43.9
2	59.6
2	59.6
4	40.7
4	34.3
4	48.3
4	48.3
8	31.8
8	16.2
8	35.9
8	35.9
15	19.7
15	12.9
15	30.9
15	30.9
30	8.69
30	6.88
30	19.3
30	19.3
59	25.0
59	9.20
59	10.2
59	10.2
100	1.72

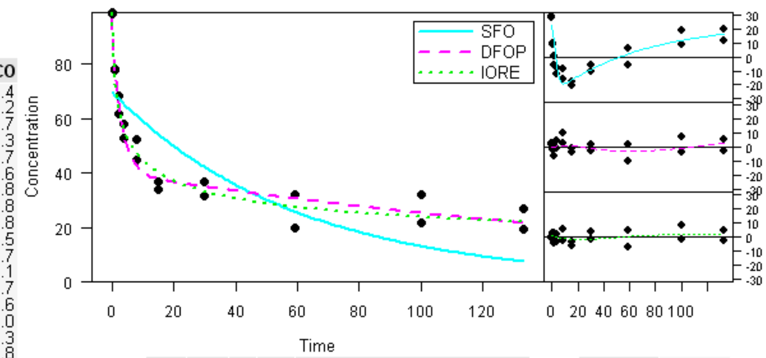


	DT_{50}	DT_{90}	χ^2	C_0	Parameters
SFO	5.3	17.6	21	82.9	k= 0.131
DFOP	2.75	72.5	6.3	94.8	f= 0.678, k_0= 0.459, k_1= 0.0161
IORE	2.86	71	3.7	96.2	N= 2.79, k= 0.000133

S_C	1.68e+03
S_{SFO}	5.04e+03
Slow $t_{1/2}$	43
$t_{R\ IORE}$	21.4

Total Toxic Residue (TTR)

DAT	ECO
0	98.4
0	99.2
1	77.7
1	78.3
2	61.7
2	68.6
4	52.8
4	57.8
8	44.8
8	52.5
15	36.7
15	34.1
30	31.7
30	36.6
59	20.0
59	32.3
100	21.8
100	32.4
133	19.2
133	27.1



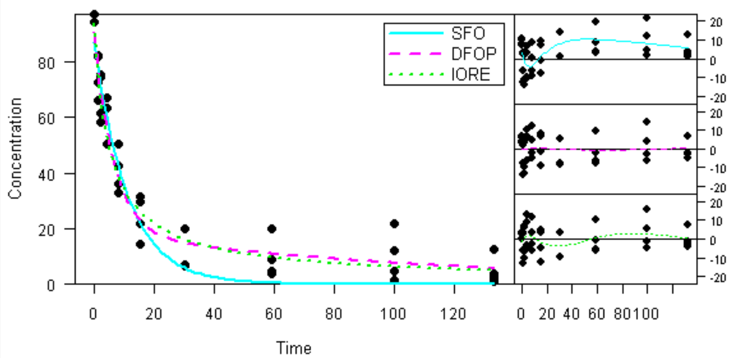
	DT_{50}	DT_{90}	χ^2	C_0	Parameters
SFO	41.4	137	23	69.9	k= 0.0168
DFOP	5.33	307	5.5	96.6	f= 0.583, k_0= 0.345, k_1= 0.00466
IORE	6.61	2407	3.7	99.3	N= 4.61, k= 2.89e-08

S_C	386
S_{SFO}	4.34e+03
Slow $t_{1/2}$	149
$t_{R\ IORE}$	725

Aerobic Aquatic Metabolism – PA System A- and B-label (MRID 48542768)

Parent Only

0	94.5
1	66.5
1	72.8
1	82.1
1	82.3
2	61.6
2	58.4
2	74.6
2	75.4
4	50.6
4	50.3
4	63.6
4	67.1
8	33.2
8	36.0
8	42.8
8	50.7
15	14.5
15	21.7
15	29.7
15	31.6
30	6.61
30	6.90
30	20.1
30	20.0
59	4.50
59	3.67
59	9.01
59	20.1
100	1.56

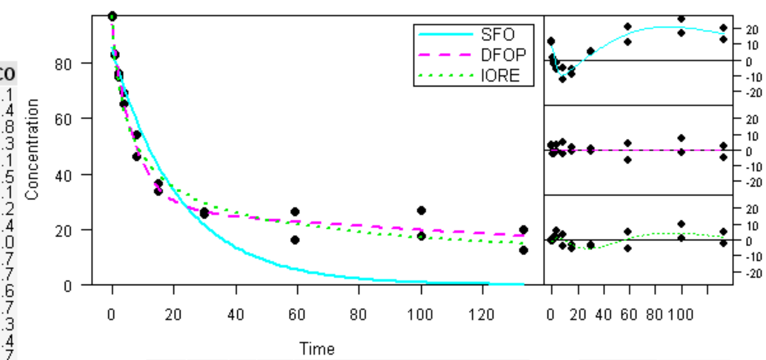


	DT_{50}	DT_{90}	χ^2	C_0	Parameters
SFO	7.7	25.6	13	86.9	k= 0.09
DFOP	6.17	80.7	6.2	90.8	f= 0.797, k_0= 0.154, k_1= 0.0088
IORE	5.53	60.7	5	94.2	N= 2.17, k= 0.000964

S_C	2.04e+03
S_{SFO}	3.26e+03
Slow $t_{1/2}$	78.8
$t_{R\ IORE}$	18.3

Total Toxic Residue (TTR)

DAT	ECO
0	97.1
0	96.4
1	82.8
1	83.3
2	75.1
2	76.5
4	65.1
4	69.2
8	46.4
8	54.0
15	33.7
15	36.7
30	26.6
30	25.7
59	16.3
59	26.4
100	17.7
100	26.8
133	12.6
133	20.



	DT_{50}	DT_{90}	χ^2	C_0	Parameters
SFO	15.1	50.2	18	85.4	k= 0.0459
DFOP	8.79	313	3.2	94	f= 0.702, k_0= 0.137, k_1= 0.00348
IORE	8.87	330	4.8	97.3	N= 3.08, k= 1.26e-05

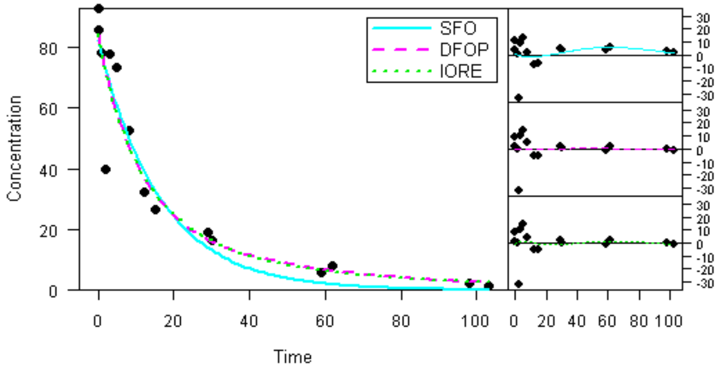
S_C	365
S_{SFO}	2.71e+03
Slow $t_{1/2}$	199
$t_{R\ IORE}$	99.2

Parent Only	Total Toxic Residue (TTR)

Aerobic Aquatic Metabolism – Goorven System A- and B-label (MRIDs 48542770/48542771)

Parent Only

DAT	Parent
0	86.0
0	93.1
1	78.5
2	39.9
3	77.7
5	73.3
8	52.5
12	32.4
15	26.8
29	19.0
30	16.6
59	5.80
62	7.90
98	2.40
103	1.50

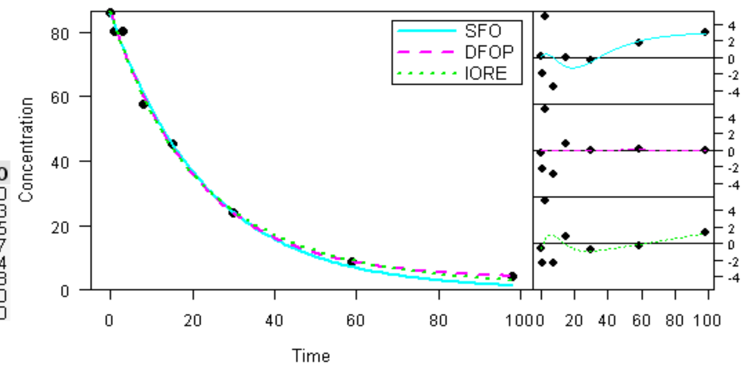


	DT_{50}	DT_{90}	χ^2	C_0	Parameters
SFO	11.3	37.7	21	82.4	k= 0.0612
DFOP	10	51.2	22	84.3	f= 0.68, k_0= 0.101, k_1= 0.0235
IORE	10	49.4	21	84.6	N= 1.44, k= 0.0113

S_C	1.87e+03
S_{SFO}	1.65e+03
Slow $t_{1/2}$	29.5
$t_{R\ IORE}$	14.9

Total Toxic Residue (TTR)

DAT	ECO
0	86.0
1	80.3
3	80.5
8	57.7
15	45.4
30	23.8
59	8.80
98	4.30



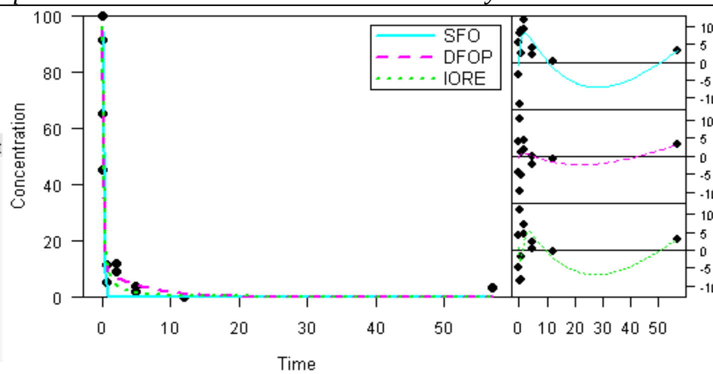
	DT_{50}	DT_{90}	χ^2	C_0	Parameters
SFO	16.4	54.4	4.2	85.9	k= 0.0423
DFOP	15.8	59.3	4.2	86.4	f= 0.962, k_0= 0.0466, k_1= -0.000458
IORE	15.6	60.6	4	86.7	N= 1.18, k= 0.0209

S_C	64.4
S_{SFO}	51.8
Slow $t_{1/2}$	-1.51e+03
$t_{R\ IORE}$	18.2

Aerobic Aquatic Metabolism – Schoonrewoerdsewiel System A- and B-label (MRIDs 48542770/48542771)

Parent Only

DAT	Parent
0	100.
0	91.5
0.1	45.3
0.1	65.3
0.7	5.10
0.7	11.5
2	9.30
2	11.9
5	2.00
5	4.10
12	0.300
57	3.20

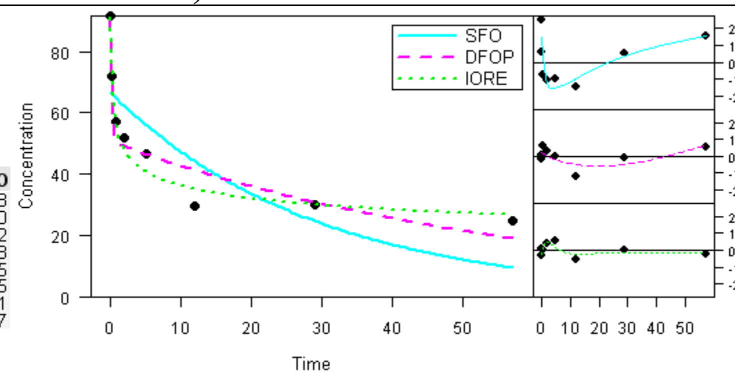


	DT_{50}	DT_{90}	χ^2	C_0	Parameters
SFO	0.137	0.455	13	94.9	k= 5.06
DFOP	0.126	0.829	6.4	96	f= 0.888, k_0= 6.5, k_1= 0.182
IORE	0.127	0.986	9.6	96.2	N= 1.87, k= 0.139

S_C	519
S_{SFO}	588
Slow $t_{1/2}$	3.81
$t_{R\ IORE}$	0.297

Total Toxic Residue (TTR)

DAT	ECO
0	91.8
0.1	72.0
0.7	57.2
2	51.8
5	46.5
12	29.5
29	30.1
57	24.7



	DT_{50}	DT_{90}	χ^2	C_0	Parameters
SFO	20.3	67.5	21	66.5	k= 0.0341
DFOP	6.34	100	9.6	91.1	f= 0.442, k_0= 5.76, k_1= 0.0172
IORE	2.69	29231	5.8	91	N= 6.76, k= 1.77e-11

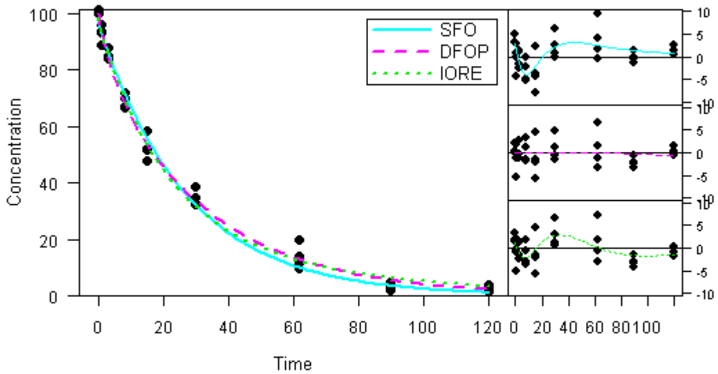
S_C	147
S_{SFO}	1.41e+03
Slow $t_{1/2}$	40.3
$t_{R\ IORE}$	8.8e+03

Parent Only	Total Toxic Residue (TTR)

Anaerobic Aquatic Metabolism – FL System A- and B-label (MRID 48542769)

Parent Only

DAT	Parent
0	102.
0	99.8
0	99.7
0	99.9
1	96.1
1	93.8
1	88.9
1	93.1
3	87.8
3	84.9
3	88.0
3	84.0
8	72.1
8	69.8
8	67.3
8	66.8
15	58.2
15	52.3
15	48.0
15	51.6
30	35.
30	33.
30	38.5
30	32.3
62	19.6
62	11.8
62	14.3
62	9.56
90	4.96
90	3.17

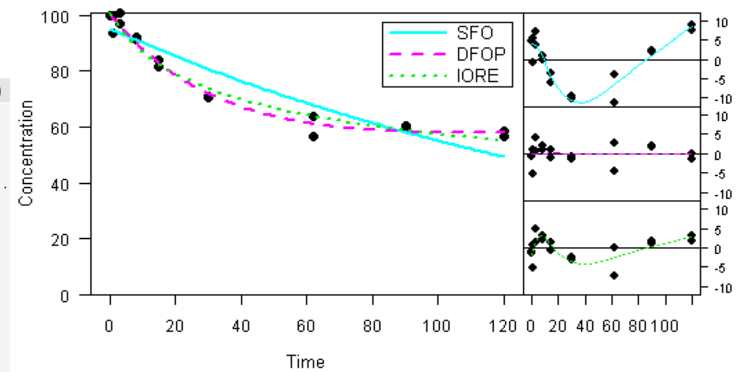


	DT_{50}	DT_{90}	χ^2	C_0	Parameters
SFO	19	63.1	3.9	96.6	k = 0.0365
DFOP	17.3	70.7	1.9	99.7	f = 0.174, k_0 = 0.185, k_1 = 0.0298
IORE	17.4	71.6	2.9	98.2	N = 1.25, k = 0.0139

S_C	335
S_{SFO}	423
Slow $t_{1/2}$	23.2
$t_{R\ IORE}$	21.5

Total Toxic Residue (TTR)

DAT	ECO
0	99.7
0	99.9
1	93.9
1	100.
3	101.
3	97.2
8	92.1
8	91.0
15	81.7
15	83.9
30	71.3
30	70.5
62	63.9
62	56.7
90	60.0
90	60.5
120	58.4
120	56.9



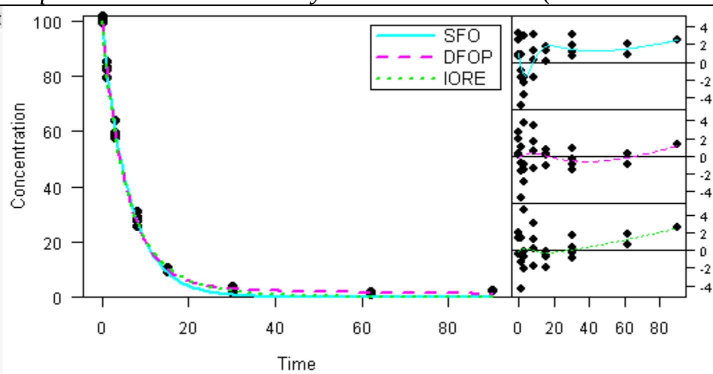
	DT_{50}	DT_{90}	χ^2	C_0	Parameters
SFO	127	422	5.8	95.1	k = 0.00546
DFOP	NA	NA	1.7	101	f = 0.505, k_0 = 0.0303, k_1 = -0.00113
IORE	175	103998	2.6	101	N = 4.93, k = 2.77e-10

S_C	188
S_{SFO}	663
Slow $t_{1/2}$	-615
$t_{R\ IORE}$	3.13e+04

Anaerobic Aquatic Metabolism – PA System A- and B-label (MRID 48542769)

Parent Only

DAT	Parent
0	99.7
0	102.
0	102.
0	99.8
1	85.3
1	82.6
1	79.6
1	83.5
3	64.3
3	59.7
3	57.7
3	59.1
8	29.
8	30.9
8	25.9
8	28.
15	10.9
15	10.4
15	9.15
15	10.3
30	2.04
30	1.46
30	2.67
30	3.91
62	0.840
62	1.99

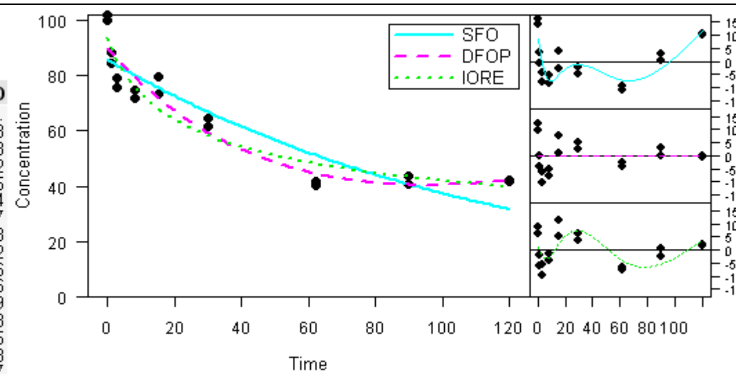


	DT_{50}	DT_{90}	χ^2	C_0	Parameters
SFO	4.35	14.5	3	99	k = 0.159
DFOP	4.22	15.2	2.1	99.5	f = 0.964, k_0 = 0.172, k_1 = 0.0117
IORE	4.1	15.8	2.3	100	N = 1.18, k = 0.0789

S_C	95
S_{SFO}	124
Slow $t_{1/2}$	59.5
$t_{R\ IORE}$	4.76

Total Toxic Residue (TTR)

DAT	ECO
0	102.
0	99.8
1	84.3
1	88.2
3	75.5
3	79.4
8	74.7
8	71.8
15	73.2
15	79.6
30	64.6
30	61.9
62	41.8
62	40.5
90	40.8
90	43.7
120	42.2
120	41.7



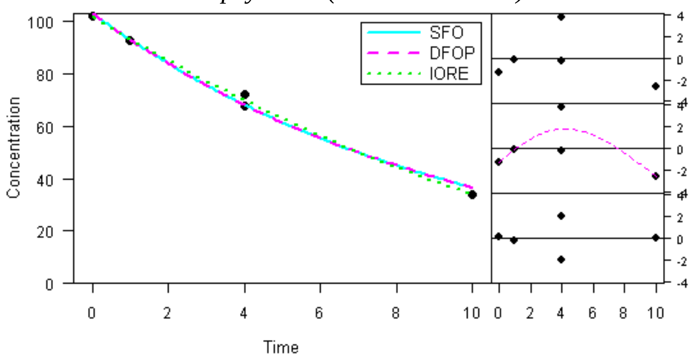
	DT_{50}	DT_{90}	χ^2	C_0	Parameters
SFO	83.6	278	9.3	85.8	k = 0.00829
DFOP	NA	NA	7.6	89.9	f = 0.849, k_0 = 0.0197, k_1 = -0.0079
IORE	69.4	12586	7.1	93.5	N = 4.16, k = 2.16e-08

S_C	733
S_{SFO}	1.14e+03
Slow $t_{1/2}$	-87.8
$t_{R\ IORE}$	3.79e+03

Appendix Table D-2. Available Degradate Study Half-life Estimation Output

B-1 Aerobic Soil Metabolism – Speyer 2.2 (MRID 48542754)

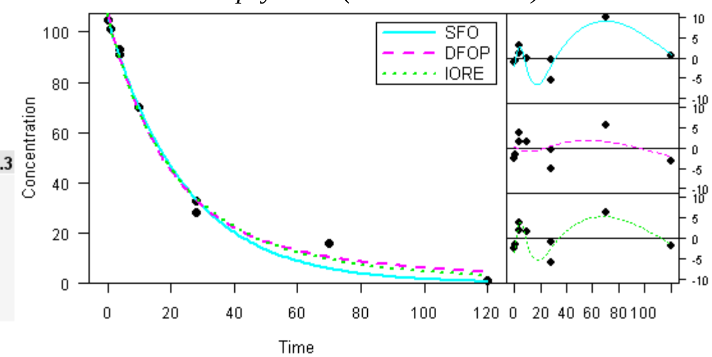
DAT	Speyer 2.2
0	102.
1	93.0
4	72.0
4	68.0
10	34.0



	DT_{50}	DT_{90}	χ^2	C_0	Parameters		
						S_C	21.9
SFO	6.68	22.2	1.9	103	k = 0.104	S_{SFO}	22.9
DFOP	6.68	22.2	Inf	103	f = 0.467, k_0 = 0.104, k_1 = 0.104	Slow $t_{1/2}$	6.68
IORE	6.89	16.5	0.21	102	N = 0.545, k = 0.709	$t_{R\ IORE}$	4.98

B-1 Aerobic Soil Metabolism – Speyer 2.3 (MRID 48542754)

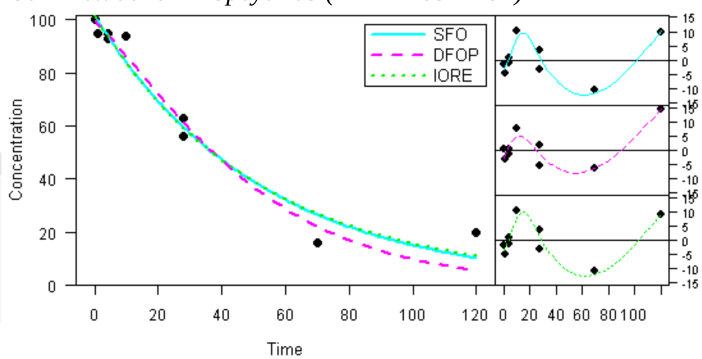
DAT	Speyer 2.3
0	105.
1	101.
4	91.0
4	93.0
10	70.0
28	28.0
28	33.0
70	16.0
120	1.30



	DT_{50}	DT_{90}	χ^2	C_0	Parameters		
						S_C	159
SFO	16.8	55.7	5.4	106	k = 0.0413	S_{SFO}	144
DFOP	15.6	68.7	4.9	108	f = 0.793, k_0 = 0.0558, k_1 = 0.0134	Slow $t_{1/2}$	51.9
IORE	15.8	65.6	4.7	108	N = 1.26, k = 0.0142	$t_{R\ IORE}$	19.7

B-1 Aerobic Soil Metabolism – Speyer 6S (MRID 48542754)

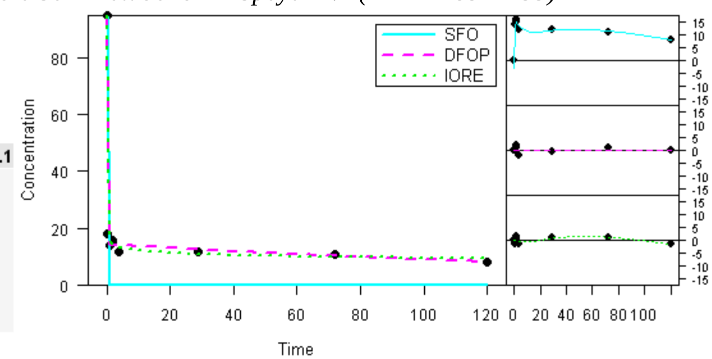
DAT	Speyer 6S
0	100.
1	95.0
4	95.0
4	93.0
10	94.0
28	56.0
28	63.0
70	16.0
120	20.0



	DT_{50}	DT_{90}	χ^2	C_0	Parameters		
						S_C	519
SFO	36.3	120	7.8	102	k = 0.0191	S_{SFO}	361
DFOP	37.4	NA	9.1	99.6	f = -2.94, k_0 = 0.0391, k_1 = 0.0322	Slow $t_{1/2}$	21.5
IORE	35.9	125	8.4	102	N = 1.05, k = 0.0154	$t_{R\ IORE}$	37.5

AB-1 Aerobic Soil Metabolism – Speyer 2.1 (MRID 48542755)

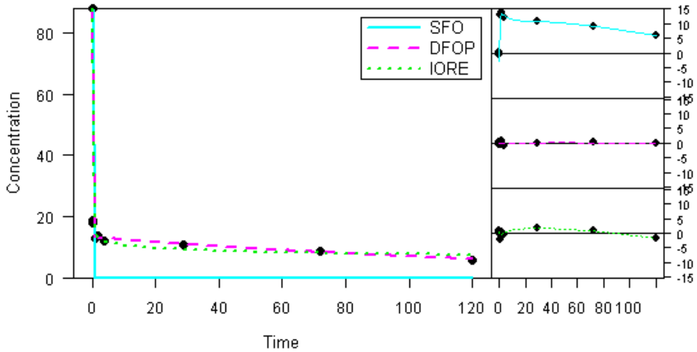
DAT	Speyer 2.1
0	95.0
0.25	18.0
0.25	18.0
1	14.0
2	15.0
2	16.0
4	12.0
29	12.0
72	11.0
120	8.00



	DT_{50}	DT_{90}	χ^2	C_0	Parameters		
						S_C	15.7
SFO	0.105	0.348	39	94.9	k = 6.61	S_{SFO}	1.15e+03
DFOP	0.0718	89.7	3.9	95	f = 0.849, k_0 = 12.4, k_1 = 0.00461	Slow $t_{1/2}$	150
IORE	0.0000177	119	4.3	95	N = 10.8, k = 2.42e-13	$t_{R\ IORE}$	35.9

AB-1 Aerobic Soil Metabolism – Speyer 2.2 (MRID 48542755)

DAT	Speyer 2.2
0	88.0
0.25	18.0
0.25	19.0
1	13.0
2	14.0
2	14.0
4	12.0
29	11.0
72	9.00
120	6.00

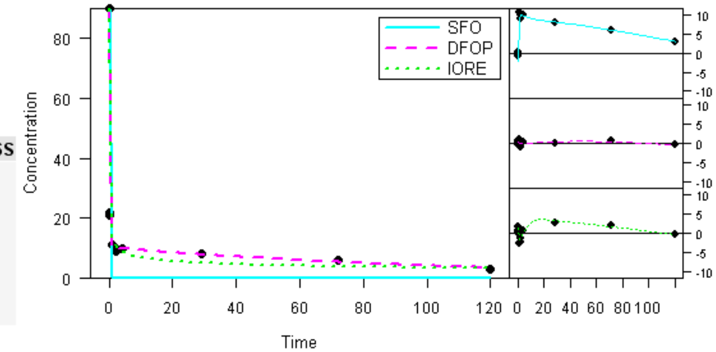


	DT_{50}	DT_{90}	χ^2	C_0	Parameters
SFO	0.112	0.373	38	87.9	k = 6.18
DFOP	0.0829	66.8	2.4	88	f = 0.847, k_0 = 10.8, k_1 = 0.00635
IORE	0.000424	45.3	4.7	88	N = 8.19, k = 4.97e-10

S_C	15.3
S_{SFO}	939
Slow $t_{1/2}$	109
$t_{R\ IORE}$	13.6

AB-1 Aerobic Soil Metabolism – Speyer 6S (MRID 48542755)

DAT	Speyer 6S
0	90.0
0.25	22.0
0.25	21.0
1	11.0
2	9.00
2	10.0
4	10.0
29	8.00
72	6.00
120	3.00

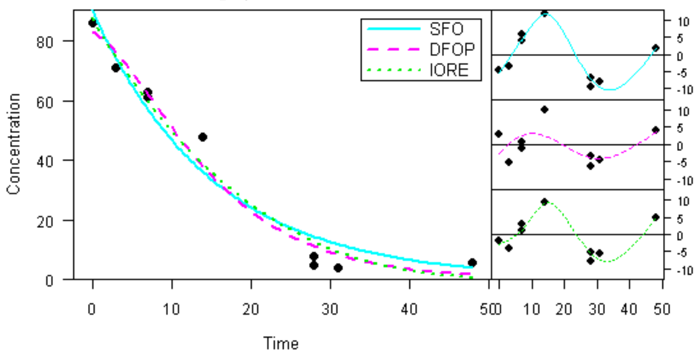


	DT_{50}	DT_{90}	χ^2	C_0	Parameters
SFO	0.122	0.406	30	89.9	k = 5.66
DFOP	0.106	14.6	2.2	90	f = 0.886, k_0 = 7.82, k_1 = 0.00883
IORE	0.0148	4.24	7.8	90	N = 4.46, k = 3.43e-05

S_C	40.3
S_{SFO}	505
Slow $t_{1/2}$	78.5
$t_{R\ IORE}$	1.28

B-3 Aerobic Soil Metabolism – Speyer 2.2 (MRID 48542755)

DAT	Speyer 2.2
0	86.0
3	71.0
7	61.0
7	63.0
14	48.0
28	4.80
28	7.60
31	3.90
48	5.60

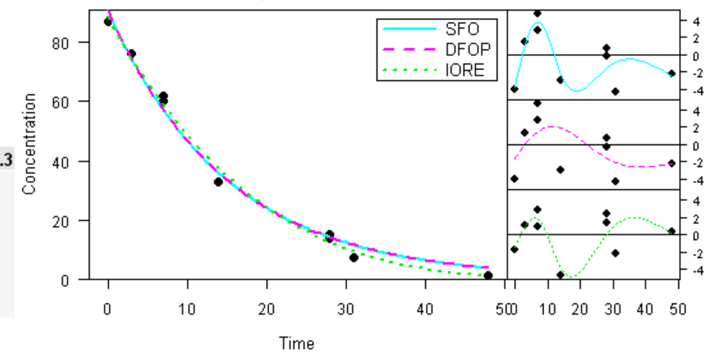


	DT_{50}	DT_{90}	χ^2	C_0	Parameters
SFO	10.5	35	14	90.6	k = 0.0657
DFOP	12.9	NA	13	82.9	f = -3.37, k_0 = 0.139, k_1 = 0.11
IORE	12.1	31.7	12	87.7	N = 0.679, k = 0.216

S_C	376
S_{SFO}	426
Slow $t_{1/2}$	6.32
$t_{R\ IORE}$	9.55

B-3 Aerobic Soil Metabolism – Speyer 2.3 (MRID 48542755)

DAT	Speyer 2.3
0	87.0
3	76.0
7	60.0
7	62.0
14	33.0
28	14.0
28	15.0
31	7.40
48	1.50

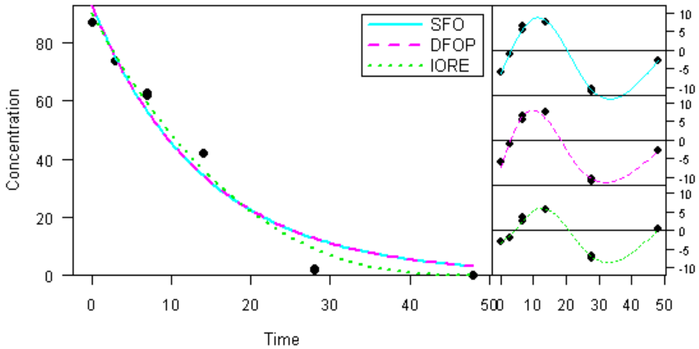


	DT_{50}	DT_{90}	χ^2	C_0	Parameters
SFO	10.5	34.8	6.1	91	k = 0.0662
DFOP	10.5	34.8	7.3	91	f = 0.86, k_0 = 0.0662, k_1 = 0.0662
IORE	11.6	31.8	5	88.7	N = 0.749, k = 0.169

S_C	67.7
S_{SFO}	81.4
Slow $t_{1/2}$	10.5
$t_{R\ IORE}$	9.56

B-3 Aerobic Soil Metabolism – Speyer 6S (MRID 48542755)

DAT	Speyer 6S
0	87.0
3	74.0
7	63.0
7	62.0
14	42.0
28	1.70
28	2.20
48	0.200



	DT_{50}	DT_{90}	χ^2	C_0	Parameters
SFO	9.75	32.4	12	93	k= 0.0711
DFOP	9.75	32.4	16	93	f= 0.909, k_0 = 0.0711, k_1 = 0.071
IORE	11.2	28.1	8.7	90	N= 0.618, k= 0.304

S_C	252
S_{SFO}	407
Slow $t_{1/2}$	9.77
$t_{R\ IORE}$	8.46

Appendix E: Example PRZM/EXAMS Modeling Output and AgDRIFT® Input Data Summary

Surface Water – Aerial PA Tomatoes

stored as Cyflu.out
Chemical: Cyflumetofen
PRZM environment: PAtomatoSTD.txt modified Tueday, 29 May 2007 at 14:01:58
EXAMS environment: pond298.exv modified Tueday, 26 August 2008 at 06:14:08
Metfile: w14751.dvf modified Tueday, 26 August 2008 at 06:15:00
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	2.964	1.058	0.454	0.2667	0.2435	0.1253
1962	3.39	1.356	0.7062	0.4681	0.4407	0.3393
1963	3.395	1.488	0.8839	0.6628	0.6261	0.5379
1964	3.619	1.711	1.134	0.9079	0.8638	0.7529
1965	3.806	1.899	1.301	1.074	1.045	0.9381
1966	3.98	2.073	1.468	1.274	1.263	1.141
1967	4.203	2.297	1.692	1.509	1.487	1.37
1968	4.41	2.503	1.9	1.681	1.666	1.562
1969	4.582	2.675	2.072	1.927	1.893	1.764
1970	4.821	3.015	2.347	2.14	2.099	1.97
1971	4.98	3.073	2.471	2.242	2.251	2.145
1972	5.935	4.202	3	2.682	2.617	2.407
1973	5.417	3.512	2.907	2.685	2.657	2.573
1974	5.587	3.682	3.077	2.877	2.847	2.754
1975	5.793	3.872	3.294	3.114	3.062	2.944
1976	6.297	4.128	3.469	3.241	3.197	3.112
1977	6.111	4.204	3.6	3.379	3.333	3.25
1978	6.256	4.349	3.779	3.622	3.571	3.431
1979	6.426	4.519	3.915	3.722	3.675	3.589
1980	6.559	4.652	4.048	3.816	3.769	3.691
1981	6.702	4.783	4.18	3.976	3.938	3.834
1982	8.044	5.335	4.556	4.229	4.167	4.003
1983	6.979	5.075	4.471	4.236	4.191	4.116
1984	7.19	5.538	4.722	4.477	4.422	4.288
1985	7.26	5.354	4.755	4.522	4.475	4.393
1986	7.368	5.461	4.858	4.648	4.628	4.528
1987	7.491	5.584	5.04	4.798	4.749	4.668
1988	7.625	5.718	5.116	4.901	4.855	4.767
1989	9.021	6.288	5.322	5.084	5.04	4.9
1990	7.856	5.949	5.348	5.136	5.109	5.017

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258064516129	9.021	6.288	5.348	5.136	5.109	5.017
0.0645161290322581	8.044	5.949	5.322	5.084	5.04	4.9
0.0967741935483871	7.856	5.718	5.116	4.901	4.855	4.767
0.129032258064516	7.625	5.584	5.04	4.798	4.749	4.668

0.161290322580645	7.491	5.538	4.858	4.648	4.628	4.528
0.193548387096774	7.368	5.461	4.755	4.522	4.475	4.393
0.225806451612903	7.26	5.354	4.722	4.477	4.422	4.288
0.258064516129032	7.19	5.335	4.556	4.236	4.191	4.116
0.290322580645161	6.979	5.075	4.471	4.229	4.167	4.003
0.32258064516129	6.702	4.783	4.18	3.976	3.938	3.834
0.354838709677419	6.559	4.652	4.048	3.816	3.769	3.691
0.387096774193548	6.426	4.519	3.915	3.722	3.675	3.589
0.419354838709677	6.297	4.349	3.779	3.622	3.571	3.431
0.451612903225806	6.256	4.204	3.6	3.379	3.333	3.25
0.483870967741936	6.111	4.202	3.469	3.241	3.197	3.112
0.516129032258065	5.935	4.128	3.294	3.114	3.062	2.944
0.548387096774194	5.793	3.872	3.077	2.877	2.847	2.754
0.580645161290323	5.587	3.682	3	2.685	2.657	2.573
0.612903225806452	5.417	3.512	2.907	2.682	2.617	2.407
0.645161290322581	4.98	3.073	2.471	2.242	2.251	2.145
0.67741935483871	4.821	3.015	2.347	2.14	2.099	1.97
0.709677419354839	4.582	2.675	2.072	1.927	1.893	1.764
0.741935483870968	4.41	2.503	1.9	1.681	1.666	1.562
0.774193548387097	4.203	2.297	1.692	1.509	1.487	1.37
0.806451612903226	3.98	2.073	1.468	1.274	1.263	1.141
0.838709677419355	3.806	1.899	1.301	1.074	1.045	0.9381
0.870967741935484	3.619	1.711	1.134	0.9079	0.8638	0.7529
0.903225806451613	3.395	1.488	0.8839	0.6628	0.6261	0.5379
0.935483870967742	3.39	1.356	0.7062	0.4681	0.4407	0.3393
0.967741935483871	2.964	1.058	0.454	0.2667	0.2435	0.1253

0.1	7.8329	5.7046	5.1084	4.8907	4.8444	4.7571

Average of yearly averages: 2.83035

Inputs generated by pe5.pl - Novemeber 2006

Data used for this run:
Output File: Cyflu
Metfile: w14751.dvf
PRZM scenario: PAtomatoSTD.txt
EXAMS environment file: pond298.exv
Chemical Name: Cyflumetofen
Description Variable Name Value Units Comments
Molecular weight mwt 447.45 g/mol
Henry's Law Const. henry atm-m^3/mol
Vapor Pressure vapr 4.43e-8 torr
Solubility sol 0.028 mg/L
Kd Kd mg/L
Koc Koc 72000 mg/L
Photolysis half-life kdp 17.6 days Half-life
Aerobic Aquatic Metabolism kbacw 173 days Halfife
Anaerobic Aquatic Metabolism kbacs 6e4 days Halfife
Aerobic Soil Metabolism asm 1096 days Halfife
Hydrolysis: pH 7 0 days Half-life
Method: CAM 2 integer See PRZM manual
Incorporation Depth: DEPI cm
Application Rate: TAPP .224 kg/ha
Application Efficiency: APPEFF .95 fraction
Spray Drift DRFT .305 fraction of application rate applied to pond

Application Date	Date	1-6	dd/mm or dd/mmm or dd-mm or dd-mmm	
Interval 1	interval	14	days	Set to 0 or delete line for single app.
app. rate 1	apprate		kg/ha	
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)

Benthic Pore Water – Aerial PA Tomatoes

stored as Cyfluben.out
Chemical: Cyflumetofen
PRZM environment: PAtomatoSTD.txt modified Tueday, 29 May 2007 at 14:01:58
EXAMS environment: pond298.exv modified Tueday, 26 August 2008 at 06:14:08
Metfile: w14751.dvf modified Tueday, 26 August 2008 at 06:15:00
Benthic segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	0.1238	0.1238	0.1225	0.1202	0.1187	0.05893
1962	0.2696	0.2696	0.2695	0.2642	0.2583	0.1907
1963	0.3895	0.3895	0.3894	0.3791	0.3688	0.3178
1964	0.5097	0.5095	0.5079	0.5036	0.5015	0.4526
1965	0.614	0.6139	0.6138	0.6132	0.6126	0.5705
1966	0.771	0.771	0.7709	0.767	0.7649	0.6918
1967	0.905	0.905	0.9046	0.9013	0.8974	0.8381
1968	1.027	1.027	1.027	1.025	1.024	0.9593
1969	1.154	1.154	1.153	1.148	1.147	1.086
1970	1.27	1.27	1.27	1.269	1.266	1.216
1971	1.391	1.391	1.391	1.383	1.379	1.325
1972	1.572	1.572	1.571	1.568	1.566	1.483
1973	1.661	1.66	1.654	1.649	1.647	1.595
1974	1.763	1.763	1.761	1.759	1.759	1.709
1975	1.897	1.897	1.896	1.894	1.893	1.824
1976	1.992	1.992	1.992	1.991	1.989	1.933
1977	2.07	2.07	2.066	2.055	2.05	2.022
1978	2.194	2.194	2.192	2.188	2.186	2.133
1979	2.281	2.281	2.28	2.278	2.277	2.232
1980	2.348	2.348	2.347	2.34	2.33	2.299
1981	2.428	2.428	2.427	2.424	2.421	2.389
1982	2.554	2.553	2.552	2.548	2.545	2.49
1983	2.627	2.627	2.623	2.604	2.595	2.563
1984	2.726	2.726	2.725	2.721	2.718	2.672
1985	2.778	2.778	2.778	2.773	2.769	2.739
1986	2.87	2.87	2.865	2.858	2.855	2.821
1987	2.963	2.963	2.962	2.958	2.956	2.91
1988	3.007	3.006	3.004	3	2.999	2.977
1989	3.111	3.111	3.109	3.107	3.104	3.053
1990	3.174	3.174	3.173	3.172	3.168	3.131

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258064516129	3.174	3.174	3.173	3.172	3.168	3.131
0.0645161290322581	3.111	3.111	3.109	3.107	3.104	3.053
0.0967741935483871	3.007	3.006	3.004	3	2.999	2.977

0.129032258064516	2.963	2.963	2.962	2.958	2.956	2.91
0.161290322580645	2.87	2.87	2.865	2.858	2.855	2.821
0.193548387096774	2.778	2.778	2.778	2.773	2.769	2.739
0.225806451612903	2.726	2.726	2.725	2.721	2.718	2.672
0.258064516129032	2.627	2.627	2.623	2.604	2.595	2.563
0.290322580645161	2.554	2.553	2.552	2.548	2.545	2.49
0.32258064516129	2.428	2.428	2.427	2.424	2.421	2.389
0.354838709677419	2.348	2.348	2.347	2.34	2.33	2.299
0.387096774193548	2.281	2.281	2.28	2.278	2.277	2.232
0.419354838709677	2.194	2.194	2.192	2.188	2.186	2.133
0.451612903225806	2.07	2.07	2.066	2.055	2.05	2.022
0.483870967741936	1.992	1.992	1.992	1.991	1.989	1.933
0.516129032258065	1.897	1.897	1.896	1.894	1.893	1.824
0.548387096774194	1.763	1.763	1.761	1.759	1.759	1.709
0.580645161290323	1.661	1.66	1.654	1.649	1.647	1.595
0.612903225806452	1.572	1.572	1.571	1.568	1.566	1.483
0.645161290322581	1.391	1.391	1.391	1.383	1.379	1.325
0.67741935483871	1.27	1.27	1.27	1.269	1.266	1.216
0.709677419354839	1.154	1.154	1.153	1.148	1.147	1.086
0.741935483870968	1.027	1.027	1.027	1.025	1.024	0.9593
0.774193548387097	0.905	0.905	0.9046	0.9013	0.8974	0.8381
0.806451612903226	0.771	0.771	0.7709	0.767	0.7649	0.6918
0.838709677419355	0.614	0.6139	0.6138	0.6132	0.6126	0.5705
0.870967741935484	0.5097	0.5095	0.5079	0.5036	0.5015	0.4526
0.903225806451613	0.3895	0.3895	0.3894	0.3791	0.3688	0.3178
0.935483870967742	0.2696	0.2696	0.2695	0.2642	0.2583	0.1907
0.967741935483871	0.1238	0.1238	0.1225	0.1202	0.1187	0.05893

0.1 3.0026 3.0017 2.9998 2.9958 2.9947 2.9703

Average of yearly averages: 1.75605766666667

Inputs generated by pe5.pl - Novemeber 2006

Data used for this run:
Output File: Cyflu
Metfile: w14751.dvf
PRZM scenario: PAtomatoSTD.txt
EXAMS environment file: pond298.exv
Chemical Name: Cyflumetofen
Description Variable Name Value Units Comments
Molecular weight mwt 447.45 g/mol
Henry's Law Const. henry atm-m^3/mol
Vapor Pressure vapr 4.43e-8 torr
Solubility sol 0.028 mg/L
Kd Kd mg/L
Koc Koc 72000 mg/L
Photolysis half-life kdp 17.6 days Half-life
Aerobic Aquatic Metabolism kbacw 173 days Halfife
Anaerobic Aquatic Metabolism kbacs 6e4 days Halfife
Aerobic Soil Metabolism asm 1096 days Halfife
Hydrolysis: pH 7 0 days Half-life
Method: CAM 2 integer See PRZM manual
Incorporation Depth: DEPI cm
Application Rate: TAPP .224 kg/ha
Application Efficiency: APPEFF .95 fraction
Spray Drift DRFT .305 fraction of application rate applied to pond
Application Date Date 1-6 dd/mm or dd/mmm or dd-mm or dd-mmm
Interval 1 interval 14 days Set to 0 or delete line for single app.
app. rate 1 apprate kg/ha
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)
```

AgDRIFT® Input Data Summary – Aerial

```
AgDRIFT® Input Data Summary

--General--
Tier: II
Title: Untitled
Notes:

Calculations Done: Yes
Run ID: AgDRIFT®  2.1.1 03-14-2013 11:27:08

Default values appear when they differ from the Current values.

--Aircraft--               ----------Current----------- ----------Default-----------
Name                                  Air Tractor AT-401
Type                                     Slow Fixed-wing
Boom Length (%)                                     76.3
Boom Height (ft)                                      15                           10
Flight Lines                                          20

--Drop Size Distribution-- ----------Current----------- ----------Default-----------
Name                                 ASAE Fine to Medium
Type                                               Basic
Drop Categories          #       Diam (um)          Frac       Diam (um)         Frac
                         1           10.77        0.0010
                         2           16.73        0.0003
                         3           19.39        0.0007
                         4           22.49        0.0003
                         5           26.05        0.0007
                         6           30.21        0.0010
                         7           35.01        0.0010
                         8           40.57        0.0020
                         9           47.03        0.0033
                        10           54.50        0.0053
                        11           63.16        0.0067
                        12           73.23        0.0090
                        13           84.85        0.0133
                        14           98.12        0.0223
                        15          113.71        0.0330
                        16          131.73        0.0393
                        17          152.79        0.0480
                        18          177.84        0.0647
                        19          205.84        0.0830
                        20          238.45        0.1147
                        21          276.48        0.1283
                        22          320.60        0.1380
                        23          372.18        0.1127
                        24          430.74        0.0640
                        25          498.91        0.0440
                        26          578.54        0.0317
                        27          670.72        0.0203
                        28          777.39        0.0093
                        29          900.61        0.0010
                        30         1044.42        0.0007
                        31         1210.66        0.0003
```

--Swath--	----------Current-----------	----------Default-----------
Swath Width	60 ft	
Swath Displacement	0.3722 x Swath Width	

--Spray Material--	----------Current-----------	----------Default-----------
Nonvolatile Rate (lb/ac)	1	0.501
Active Rate (lb/ac)	1	0.2505
Spray Volume Rate (gal/ac)	10	2
Carrier Type	Water	

--Meteorology--	----------Current-----------	----------Default-----------
Wind Speed (mph)	15	10
Temperature (deg F)	86	
Relative Humidity (%)	50	

--Transport--	----------Current-----------	----------Default-----------
Flux Plane (ft)	0	

Appendix F: Listed Species That Overlap at the County Level with Areas Where Cyflumetofen Is Proposed To Be Used as Identified by LOCATES (v. 2.2.5)

Based on the following crops: almonds, apples, chestnut, cironjas, citron, citrus fruit-all, grapefruit, grapes, hazel nuts (filberts), kumquats, lemons, lemons and limes, limes, macadamia nuts, pears-all, pears-Bartlett, pears-other, pecans-all, pecans-improved, pecans-native and seedling, tangelo, tangerine, walnuts-English

Common Name	Scientific Name	Status	Taxon	Potential for Direct Effects to Taxon?
Coqui, Golden	*Eleutherodactylus jasperi*	T	Amphibian	No
Frog, California Red-legged	*Rana aurora draytonii*	T	Amphibian	No
Frog, Chiricahua Leopard	*Rana chiricahuensis*	T	Amphibian	No
Frog, Dusky Gopher (Mississippi DPS)	*Rana capito sevosa*	E	Amphibian	No
Frog, Mountain Yellow-legged	*Rana muscosa*	E	Amphibian	No
Guajon	*Eleutherodactylus cooki*	T	Amphibian	No
Ozark Hellbender	*Cryptobranchus alleganiensis bishopi*	E	Amphibian	No
Salamander, Barton Springs	*Eurycea sosorum*	E	Amphibian	No
Salamander, California Tiger	*Ambystoma californiense*	E	Amphibian	No
Salamander, Cheat Mountain	*Plethodon nettingi*	T	Amphibian	No
Salamander, Desert Slender	*Batrachoseps aridus*	E	Amphibian	No
Salamander, Frosted Flatwoods	*Ambystoma cingulatum*	T	Amphibian	No
Salamander, Red Hills	*Phaeognathus hubrichti*	T	Amphibian	No
Salamander, Reticulated flatwoods	*Ambystoma bishopi*	E	Amphibian	No
Salamander, San Marcos	*Eurycea nana*	T	Amphibian	No
Salamander, Santa Cruz Long-toed	*Ambystoma macrodactylum croceum*	E	Amphibian	No
Salamander, Shenandoah	*Plethodon shenandoah*	E	Amphibian	No
Salamander, Sonora Tiger	*Ambystoma tigrinum stebbinsi*	E	Amphibian	No
Salamander, Texas Blind	*Typhlomolge rathbuni*	E	Amphibian	No
Toad, Arroyo Southwestern	*Bufo californicus (=microscaphus)*	E	Amphibian	No
Toad, Houston	*Bufo houstonensis*	E	Amphibian	No
Toad, Puerto Rican Crested	*Peltophryne lemur*	T	Amphibian	No
Harvestman, Bee Creek Cave	*Texella reddelli*	E	Arachnid	No
Harvestman, Bone Cave	*Texella reyesi*	E	Arachnid	No

Common Name	Scientific Name	Status	Taxon	Potential for Direct Effects to Taxon?
Harvestman, Cokendolpher Cave	*Texella cokendolpheri*	E	Arachnid	No
Meshweaver, Braken Bat Cave	*Cicurina venii*	E	Arachnid	No
Meshweaver, Government Canyon Bat Cave	*Cicurina vespera*	E	Arachnid	No
Meshweaver, Madla's Cave	*Cicurina madla*	E	Arachnid	No
Meshweaver, Robber Baron Cave	*Cicurina baronia*	E	Arachnid	No
Pseudoscorpion, Tooth Cave	*Tartarocreagris texana*	E	Arachnid	No
Spider, Government Canyon Bat Cave	*Neoleptoneta microps*	E	Arachnid	No
Spider, Kauai Cave Wolf	*Adelocosa anops*	E	Arachnid	No
Spider, Spruce-fir Moss	*Microhexura montivaga*	E	Arachnid	No
Spider, Tooth Cave	*Leptoneta myopica*	E	Arachnid	No
Akekee	*Loxops caeruleirostris*	E	Bird	No
'Akepa, Hawaii	*Loxops coccineus coccineus*	E	Bird	No
'Akepa, Maui	*Loxops coccineus ochraceus*	E	Bird	No
'Akia Loa, Kauai (Hemignathus procerus)	*Hemignathus procerus*	E	Bird	No
'Akia Pola'au (Hemignathus munroi)	*Hemignathus munroi*	E	Bird	No
Albatross, Short-tailed	*Phoebastria (=Diomedea) albatrus*	E	Bird	No
Blackbird, Yellow-shouldered	*Agelaius xanthomus*	E	Bird	No
Bobwhite, Masked	*Colinus virginianus ridgwayi*	E	Bird	No
Caracara, Audubon's Crested	*Polyborus plancus audubonii*	T	Bird	No
Condor, California	*Gymnogyps californianus*	E	Bird	No
Coot, Hawaiian (=Alae keo keo)	*Fulica americana alai*	E	Bird	No
Crane, Mississippi Sandhill	*Grus canadensis pulla*	E	Bird	No
Crane, Whooping	*Grus americana*	E	Bird	No
Creeper, Hawaii	*Oreomystis mana*	E	Bird	No
Creeper, Oahu (Alauwahio)	*Paroreomyza maculata*	E	Bird	No
Crow, Hawaiian ('Alala)	*Corvus hawaiiensis*	E	Bird	No
Crow, Mariana	*Corvus kubaryi*	E	Bird	No
Curlew, Eskimo	*Numenius borealis*	E	Bird	No
Duck, Hawaiian (Koloa)	*Anas wyvilliana*	E	Bird	No
Eider, Steller's	*Polysticta stelleri*	T	Bird	No
Elepaio, Oahu	*Chasiempis sandwichensis ibidis*	E	Bird	No
Falcon, Northern Aplomado	*Falco femoralis septentrionalis*	E	Bird	No
Flycatcher, Southwestern Willow	*Empidonax traillii extimus*	E	Bird	No

Common Name	Scientific Name	Status	Taxon	Potential for Direct Effects to Taxon?
Gnatcatcher, Coastal California	*Polioptila californica californica*	T	Bird	No
Goose, Hawaiian (Nene)	*Branta (=Nesochen) sandvicensis*	E	Bird	No
Hawk, Hawaiian (Io)	*Buteo solitarius*	E	Bird	No
Hawk, Puerto Rican Broad-winged	*Buteo platypterus brunnescens*	E	Bird	No
Hawk, Puerto Rican Sharp-shinned	*Accipiter striatus venator*	E	Bird	No
Honeycreeper, Crested ('Akohekohe)	*Palmeria dolei*	E	Bird	No
Kauai creeper	*Oreomystis bairdi*	E	Bird	No
Kingfisher, Guam Micronesian	*Halcyon cinnamomina cinnamomina*	E	Bird	No
Kite, Everglades Snail	*Rostrhamus sociabilis plumbeus*	E	Bird	No
Megapode, Micronesian (La Perouse's)	*Megapodius laperouse*	E	Bird	No
Moorhen, Hawaiian Common	*Gallinula chloropus sandvicensis*	E	Bird	No
Moorhen, Mariana Common	*Gallinula chloropus guami*	E	Bird	No
Murrelet, Marbled	*Brachyramphus marmoratus*	T	Bird	No
Nightjar, Puerto Rico	*Caprimulgus noctitherus*	E	Bird	No
Nuku Pu'u, Kauai	*Hemignathus lucidus hanapepe*	E	Bird	No
Nuku Pu'u, Maui	*Hemignathus lucidus affinus*	E	Bird	No
'O'o, Kauai (='A'a)	*Moho braccatus*	E	Bird	No
'O'u (Honeycreeper)	*Psittirostra psittacea*	E	Bird	No
Owl, Mexican Spotted	*Strix occidentalis lucida*	T	Bird	No
Owl, Northern Spotted	*Strix occidentalis caurina*	T	Bird	No
Palila	*Loxioides bailleui*	E	Bird	No
Parrot, Puerto Rican	*Amazona vittata*	E	Bird	No
Parrotbill, Maui	*Pseudonestor xanthophrys*	E	Bird	No
Petrel, Hawaiian Dark-rumped	*Pterodroma phaeopygia sandwichensis*	E	Bird	No
Pigeon, Puerto Rican Plain	*Columba inornata wetmorei*	E	Bird	No
Plover, Piping	*Charadrius melodus*	E/T	Bird	No
Plover, Western Snowy	*Charadrius alexandrinus nivosus*	T	Bird	No
Po'ouli	*Melamprosops phaeosoma*	E	Bird	No
Prairie-chicken, Attwater's Greater	*Tympanuchus cupido attwateri*	E	Bird	No
Rail, California Clapper	*Rallus longirostris obsoletus*	E	Bird	No
Rail, Guam	*Rallus owstoni*	E	Bird	No
Rail, Light-footed Clapper	*Rallus longirostris levipes*	E	Bird	No
Rail, Yuma Clapper	*Rallus longirostris yumanensis*	E	Bird	No

Common Name	Scientific Name	Status	Taxon	Potential for Direct Effects to Taxon?
Scrub-Jay, Florida	*Aphelocoma coerulescens*	T	Bird	No
Shearwater, Newell's Townsend's	*Puffinus auricularis newelli*	T	Bird	No
Shrike, San Clemente Loggerhead	*Lanius ludovicianus mearnsi*	E	Bird	No
Sparrow, Cape Sable Seaside	*Ammodramus maritimus mirabilis*	E	Bird	No
Sparrow, Florida Grasshopper	*Ammodramus savannarum floridanus*	E	Bird	No
Sparrow, San Clemente Sage	*Amphispiza belli clementeae*	T	Bird	No
Stilt, Hawaiian (=Ae'o)	*Himantopus mexicanus knudseni*	E	Bird	No
Stork, Wood	*Mycteria americana*	E	Bird	No
Swiftlet, Mariana Gray (=Vanikoro)	*Aerodramus vanikorensis bartschi*	E	Bird	No
Tern, California Least	*Sterna antillarum browni*	E	Bird	No
Tern, Interior (population) Least	*Sterna antillarum*	E	Bird	No
Tern, Roseate	*Sterna dougallii dougallii*	E/T	Bird	No
Thrush, Large Kauai	*Myadestes myadestinus*	E	Bird	No
Thrush, Small Kauai (Puaiohi)	*Myadestes palmeri*	E	Bird	No
Towhee, Inyo Brown	*Pipilo crissalis eremophilus*	T	Bird	No
Vireo, Black-capped	*Vireo atricapilla*	E	Bird	No
Vireo, Least Bell's	*Vireo bellii pusillus*	E	Bird	No
Warbler (=Wood), Golden-cheeked	*Dendroica chrysoparia*	E	Bird	No
Warbler (=Wood), Kirtland's	*Dendroica kirtlandii*	E	Bird	No
Warbler, Bachman's	*Vermivora bachmanii*	E	Bird	No
Warbler, nightingale reed (old world warbler)	*Acrocephalus luscinia*	E	Bird	No
White-eye, Bridled (Nossa)	*Zosterops conspicillatus conspicillatus*	E	Bird	No
White-eye, Rota Bridled	*Zosterops rotensis*	E	Bird	No
Woodpecker, Ivory-billed	*Campephilus principalis*	E	Bird	No
Woodpecker, Red-cockaded	*Picoides borealis*	E	Bird	No
Alabama pearlshell	*Margaritifera marrianae*	E	Bivalve	No
Bankclimber, Purple	*Elliptoideus sloatianus*	T	Bivalve	No
Choctaw Bean	*Villosa choctawensis*	E	Bivalve	No
Combshell, Southern (=Penitent mussel)	*Epioblasma penita*	E	Bivalve	No
Combshell, Upland	*Epioblasma metastriata*	E	Bivalve	No
Elktoe, Appalachian	*Alasmidonta raveneliana*	E	Bivalve	No
Fanshell	*Cyprogenia stegaria*	E	Bivalve	No
Fatmucket, Arkansas	*Lampsilis powelli*	T	Bivalve	No

Common Name	Scientific Name	Status	Taxon	Potential for Direct Effects to Taxon?
fuzzy pigtoe	*Pleurobema strodeanum*	T	Bivalve	No
Kidneyshell, Triangular	*Ptychobranchus greenii*	E	Bivalve	No
Mucket, Orange-nacre	*Lampsilis perovalis*	T	Bivalve	No
Mucket, Pink (Pearlymussel)	*Lampsilis abrupta*	E	Bivalve	No
Mussel, Acornshell Southern	*Epioblasma othcaloogensis*	E	Bivalve	No
Mussel, Alabama Moccasinshell	*Medionidus acutissimus*	T	Bivalve	No
Mussel, Black (=Curtus' Mussel) Clubshell	*Pleurobema curtum*	E	Bivalve	No
Mussel, Clubshell	*Pleurobema clava*	E	Bivalve	No
Mussel, Coosa Moccasinshell	*Medionidus parvulus*	E	Bivalve	No
Mussel, Cumberland Combshell	*Epioblasma brevidens*	E	Bivalve	No
Mussel, Cumberland Elktoe	*Alasmidonta atropurpurea*	E	Bivalve	No
Mussel, Cumberland Pigtoe	*Pleurobema gibberum*	E	Bivalve	No
Mussel, Dark Pigtoe	*Pleurobema furvum*	E	Bivalve	No
Mussel, Dwarf Wedge	*Alasmidonta heterodon*	E	Bivalve	No
Mussel, Fat Threeridge	*Amblema neislerii*	E	Bivalve	No
Mussel, Fine-lined Pocketbook	*Lampsilis altilis*	T	Bivalve	No
Mussel, Fine-rayed Pigtoe	*Fusconaia cuneolus*	E	Bivalve	No
Mussel, Flat Pigtoe (=Marshall's Mussel)	*Pleurobema marshalli*	E	Bivalve	No
Mussel, Georgia pigtoe	*Pleurobema hanleyianum*	E	Bivalve	No
Mussel, Gulf Moccasinshell	*Medionidus penicillatus*	E	Bivalve	No
Mussel, Heavy Pigtoe (=Judge Tait's Mussel)	*Pleurobema taitianum*	E	Bivalve	No
Mussel, Heelsplitter Carolina	*Lasmigona decorata*	E	Bivalve	No
Mussel, Heelsplitter Inflated	*Potamilus inflatus*	T	Bivalve	No
Mussel, Ochlockonee Moccasinshell	*Medionidus simpsonianus*	E	Bivalve	No
Mussel, Oval Pigtoe	*Pleurobema pyriforme*	E	Bivalve	No
Mussel, Ovate Clubshell	*Pleurobema perovatum*	E	Bivalve	No
Mussel, Oyster	*Epioblasma capsaeformis*	E	Bivalve	No
Mussel, Ring Pink (=Golf Stick Pearly)	*Obovaria retusa*	E	Bivalve	No
Mussel, Rough Pigtoe	*Pleurobema plenum*	E	Bivalve	No
Mussel, Scaleshell	*Leptodea leptodon*	E	Bivalve	No
Mussel, Shiny Pigtoe	*Fusconaia cor*	E	Bivalve	No
Mussel, Shiny-rayed Pocketbook	*Lampsilis subangulata*	E	Bivalve	No
Mussel, snuffbox	*Epioblasma triquetra*	E	Bivalve	No

Common Name	**Scientific Name**	**Status**	**Taxon**	**Potential for Direct Effects to Taxon?**
Mussel, Southern Clubshell	*Pleurobema decisum*	E	Bivalve	No
Mussel, Southern Pigtoe	*Pleurobema georgianum*	E	Bivalve	No
Mussel, Speckled Pocketbook	*Lampsilis streckeri*	E	Bivalve	No
Mussel, Winged Mapleleaf	*Quadrula fragosa*	E	Bivalve	No
Narrow Pigtoe	*Fusconaia escambia*	T	Bivalve	No
Pearlshell, Louisiana	*Margaritifera hembeli*	T	Bivalve	No
Pearlymussel, Alabama Lamp	*Lampsilis virescens*	E	Bivalve	No
Pearlymussel, Appalachian Monkeyface	*Quadrula sparsa*	E	Bivalve	No
Pearlymussel, Birdwing	*Lemiox rimosus*	E	Bivalve	No
Pearlymussel, Cracking	*Hemistena lata*	E	Bivalve	No
Pearlymussel, Cumberland Bean	*Villosa trabalis*	E	Bivalve	No
Pearlymussel, Cumberland Monkeyface	*Quadrula intermedia*	E	Bivalve	No
Pearlymussel, Curtis'	*Epioblasma florentina curtisii*	E	Bivalve	No
Pearlymussel, Dromedary	*Dromus dromas*	E	Bivalve	No
Pearlymussel, Fat Pocketbook	*Potamilus capax*	E	Bivalve	No
Pearlymussel, Green-blossom	*Epioblasma torulosa gubernaculum*	E	Bivalve	No
Pearlymussel, Higgins' Eye	*Lampsilis higginsii*	E	Bivalve	No
Pearlymussel, Little-wing	*Pegias fabula*	E	Bivalve	No
Pearlymussel, Orange-footed	*Plethobasus cooperianus*	E	Bivalve	No
Pearlymussel, Pale Lilliput	*Toxolasma cylindrellus*	E	Bivalve	No
Pearlymussel, Purple Cat's Paw	*Epioblasma obliquata obliquata*	E	Bivalve	No
Pearlymussel, Tubercled-blossom	*Epioblasma torulosa torulosa*	E	Bivalve	No
Pearlymussel, Turgid-blossom	*Epioblasma turgidula*	E	Bivalve	No
Pearlymussel, White Cat's Paw	*Epioblasma obliquata perobliqua*	E	Bivalve	No
Pearlymussel, White Wartyback	*Plethobasus cicatricosus*	E	Bivalve	No
Pearlymussel, Yellow-blossom	*Epioblasma florentina florentina*	E	Bivalve	No
Purple Bean	*Villosa perpurpurea*	E	Bivalve	No
Rabbitsfoot, Rough	*Quadrula cylindrica strigillata*	E	Bivalve	No
Rayed Bean	*Villosa fabalis*	E	Bivalve	No
Riffleshell, Northern	*Epioblasma torulosa rangiana*	E	Bivalve	No
Riffleshell, Tan	*Epioblasma florentina walkeri (=E. walkeri)*	E	Bivalve	No
Rock-pocketbook, Ouachita (=Wheeler's pm)	*Arkansia wheeleri*	E	Bivalve	No
Round Ebonyshell	*Fusconaia rotulata*	E	Bivalve	No

Common Name	Scientific Name	Status	Taxon	Potential for Direct Effects to Taxon?
Sheepnose mussel	*Plethobasus cyphyus*	E	Bivalve	No
Slabshell, Chipola	*Elliptio chipolaensis*	T	Bivalve	No
Southern Kidneyshell	*Ptychobranchus jonesi*	E	Bivalve	No
Southern Sandshell	*Hamiota australis*	T	Bivalve	No
Spectaclecase mussel	*Cumberlandia monodonta*	E	Bivalve	No
Spinymussel, Altamaha	*Elliptio spinosa*	E	Bivalve	No
Spinymussel, James River	*Pleurobema collina*	E	Bivalve	No
Spinymussel, Tar River	*Elliptio steinstansana*	E	Bivalve	No
Stirrupshell	*Quadrula stapes*	E	Bivalve	No
Tapered Pigtoe	*Fusconaia burkei*	T	Bivalve	No
Cypress, Gowen	*Cupressus goveniana ssp. goveniana*	T	Conf/cycds	No
Cypress, Santa Cruz	*Cupressus abramsiana*	E	Conf/cycds	No
Torreya, Florida	*Torreya taxifolia*	E	Conf/cycds	No
Coral, Elkhorn	*Acropora palmata*	T	Coral	No
Coral, Staghorn	*Acropora cervicornis*	T	Coral	No
Amphipod, Illinois Cave	*Gammarus acherondytes*	E	Crustacean	No
Amphipod, Kauai Cave	*Spelaeorchestia koloana*	E	Crustacean	No
Amphipod, Noel's	*Gammarus desperatus*	E	Crustacean	No
Amphipod, Peck's Cave	*Stygobromus (=Stygonectes) pecki*	E	Crustacean	No
Crayfish, Cave (Cambarus aculabrum)	*Cambarus aculabrum*	E	Crustacean	No
Crayfish, Cave (Cambarus zophonastes)	*Cambarus zophonastes*	E	Crustacean	No
Crayfish, Nashville	*Orconectes shoupi*	E	Crustacean	No
Crayfish, Shasta	*Pacifastacus fortis*	E	Crustacean	No
Fairy Shrimp, Conservancy Fairy	*Branchinecta conservatio*	E	Crustacean	No
Fairy Shrimp, Longhorn	*Branchinecta longiantenna*	E	Crustacean	No
Fairy Shrimp, Riverside	*Streptocephalus woottoni*	E	Crustacean	No
Fairy Shrimp, San Diego	*Branchinecta sandiegonensis*	E	Crustacean	No
Fairy Shrimp, Vernal Pool	*Branchinecta lynchi*	T	Crustacean	No
Isopod, Lee County Cave	*Lirceus usdagalun*	E	Crustacean	No
Isopod, Madison Cave	*Antrolana lira*	T	Crustacean	No
Isopod, Socorro	*Thermosphaeroma thermophilus*	E	Crustacean	No
Shrimp, Alabama Cave	*Palaemonias alabamae*	E	Crustacean	No
Shrimp, California Freshwater	*Syncaris pacifica*	E	Crustacean	No

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Shrimp, Kentucky Cave	*Palaemonias ganteri*	E	Crustacean	No
Shrimp, Squirrel Chimney Cave	*Palaemonetes cummingi*	T	Crustacean	No
Tadpole Shrimp, Vernal Pool	*Lepidurus packardi*	E	Crustacean	No
(ncn)	*Cyanea kolekoleensis*	E	Dicot	Yes
(ncn)	*Keysseria (=Lagenifera) erici*	E	Dicot	Yes
(ncn)	*Keysseria (=Lagenifera) helenae*	E	Dicot	Yes
(ncn)	*Lysimachia iniki*	E	Dicot	Yes
(ncn)	*Lysimachia pendens*	E	Dicot	Yes
(ncn)	*Lysimachia scopulensis*	E	Dicot	Yes
(ncn)	*Lysimachia venosa*	E	Dicot	Yes
(ncn)	*Phyllostegia hispida*	E	Dicot	Yes
(ncn)	*Phyllostegia renovans*	E	Dicot	Yes
(ncn)	*Platydesma cornuta var. cornuta*	E	Dicot	Yes
(ncn)	*Platydesma cornuta var. decurrens*	E	Dicot	Yes
(ncn)	*Schiedea attenuata*	E	Dicot	Yes
(ncn)	*Stenogyne kealiae*	E	Dicot	Yes
(ncn)	*Tetraplasandra bisattenuata*	E	Dicot	Yes
(ncn)	*Tetraplasandra flynnii*	E	Dicot	Yes
(ncn)	*Tetraplasandra lydgatei*	E	Dicot	Yes
Abutilon sandwicense (ncn)	*Abutilon sandwicense*	E	Dicot	Yes
Achyranthes mutica (ncn)	*Achyranthes mutica*	E	Dicot	Yes
Achyranthes splendens var. rotundata (ncn)	*Achyranthes splendens var. rotundata*	E	Dicot	Yes
Adobe Sunburst, San Joaquin	*Pseudobahia peirsonii*	T	Dicot	Yes
a'e	*Zanthoxylum oahuense*	E	Dicot	Yes
A'e (Zanthoxylum dipetalum var. tomentosum)	*Zanthoxylum dipetalum var. tomentosum*	E	Dicot	Yes
A'e (Zanthoxylum hawaiiense)	*Zanthoxylum hawaiiense*	E	Dicot	Yes
'Aiea (Nothocestrum breviflorum)	*Nothocestrum breviflorum*	E	Dicot	Yes
'Aiea (Nothocestrum peltatum)	*Nothocestrum peltatum*	E	Dicot	Yes
Akoko	*Chamaesyce remyi var. kauaiensis*	E	Dicot	Yes
'akoko	*Chamaesyce eleanoriae*	E	Dicot	Yes
'Akoko (Chamaesyce celastroides var. kaenana)	*Chamaesyce celastroides var. kaenana*	E	Dicot	Yes
'Akoko (Chamaesyce deppeana)	*Chamaesyce deppeana*	E	Dicot	Yes
'Akoko (Chamaesyce herbstii)	*Chamaesyce herbstii*	E	Dicot	Yes

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'Akoko (Chamaesyce kuwaleana)	*Chamaesyce kuwaleana*	E	Dicot	Yes
'Akoko (Chamaesyce rockii)	*Chamaesyce rockii*	E	Dicot	Yes
'Akoko (Chamaesyce skottsbergii var. skottsbe	*Chamaesyce skottsbergii var. kalaeloana*	E	Dicot	Yes
'Akoko (Euphorbia haeleeleana)	*Euphorbia haeleeleana*	E	Dicot	Yes
alani	*Melicope christophersenii*	E	Dicot	Yes
alani	*Melicope degeneri*	E	Dicot	Yes
alani	*Melicope hiiakae*	E	Dicot	Yes
alani	*Melicope makahae*	E	Dicot	Yes
alani	*Melicope paniculata*	E	Dicot	Yes
alani	*Melicope puberula*	E	Dicot	Yes
Alani (Melicope adscendens)	*Melicope adscendens*	E	Dicot	Yes
Alani (Melicope balloui)	*Melicope balloui*	E	Dicot	Yes
Alani (Melicope haupuensis)	*Melicope haupuensis*	E	Dicot	Yes
Alani (Melicope knudsenii)	*Melicope knudsenii*	E	Dicot	Yes
Alani (Melicope lydgatei)	*Melicope lydgatei*	E	Dicot	Yes
Alani (Melicope mucronulata)	*Melicope mucronulata*	E	Dicot	Yes
Alani (Melicope ovalis)	*Melicope ovalis*	E	Dicot	Yes
Alani (Melicope pallida)	*Melicope pallida*	E	Dicot	Yes
Alani (Melicope quadrangularis)	*Melicope quadrangularis*	E	Dicot	Yes
Alani (Melicope saint-johnii)	*Melicope saint-johnii*	E	Dicot	Yes
Alani (Melicope zahlbruckneri)	*Melicope zahlbruckneri*	E	Dicot	Yes
Allocarya, Calistoga	*Plagiobothrys strictus*	E	Dicot	Yes
Alsinidendron obovatum (ncn)	*Alsinidendron obovatum*	E	Dicot	Yes
Alsinidendron trinerve (ncn)	*Alsinidendron trinerve*	E	Dicot	Yes
Alsinidendron viscosum (ncn)	*Alsinidendron viscosum*	E	Dicot	Yes
Amaranth, Seabeach	*Amaranthus pumilus*	T	Dicot	Yes
Ambrosia, San Diego	*Ambrosia pumila*	E	Dicot	Yes
Ambrosia, South Texas	*Ambrosia cheiranthifolia*	E	Dicot	Yes
Amphianthus, Little	*Amphianthus pusillus*	T	Dicot	Yes
'Anaunau (Lepidium arbuscula)	*Lepidium arbuscula*	E	Dicot	Yes
'Anunu (Sicyos alba)	*Sicyos alba*	E	Dicot	Yes
Aster, Decurrent False	*Boltonia decurrens*	T	Dicot	Yes
Aster, Florida Golden	*Chrysopsis floridana*	E	Dicot	Yes

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Aster, Ruth's Golden	*Pityopsis ruthii*	E	Dicot	Yes
Auerodendron pauciflorum (ncn)	*Auerodendron pauciflorum*	E	Dicot	Yes
Aupaka (Isodendrion hosakae)	*Isodendrion hosakae*	E	Dicot	Yes
Aupaka (Isodendrion laurifolium)	*Isodendrion laurifolium*	E	Dicot	Yes
Aupaka (Isodendrion longifolium)	*Isodendrion longifolium*	T	Dicot	Yes
Avens, Spreading	*Geum radiatum*	E	Dicot	Yes
awikiwiki	*Canavalia napaliensis*	E	Dicot	Yes
'Awiwi (Centaurium sebaeoides)	*Centaurium sebaeoides*	E	Dicot	Yes
'Awiwi (Hedyotis cookiana)	*Hedyotis cookiana*	E	Dicot	Yes
Ayenia, Texas	*Ayenia limitaris*	E	Dicot	Yes
Baccharis, Encinitas	*Baccharis vanessae*	T	Dicot	Yes
Barbara Buttons, Mohr's	*Marshallia mohrii*	T	Dicot	Yes
Barberry, Island	*Berberis pinnata ssp. insularis*	E	Dicot	Yes
Barberry, Nevin's	*Berberis nevinii*	E	Dicot	Yes
Bariaco	*Trichilia triacantha*	E	Dicot	Yes
Bearclaw poppy, Dwarf	*Arctomecon humilis*	E	Dicot	Yes
Bedstraw, El Dorado	*Galium californicum ssp. sierrae*	E	Dicot	Yes
Bedstraw, Island	*Galium buxifolium*	E	Dicot	Yes
Bellflower, Brooksville	*Campanula robinsiae*	E	Dicot	Yes
Birch, Virginia Round-leaf	*Betula uber*	T	Dicot	Yes
Bird's-beak, Palmate-bracted	*Cordylanthus palmatus*	E	Dicot	Yes
Bird's-beak, Pennell's	*Cordylanthus tenuis ssp. capillaris*	E	Dicot	Yes
Bird's-beak, salt marsh	*Cordylanthus maritimus ssp. maritimus*	E	Dicot	Yes
Bird's-beak, Soft	*Cordylanthus mollis ssp. mollis*	E	Dicot	Yes
Birds-in-a-nest, White	*Macbridea alba*	T	Dicot	Yes
Bittercress, Small-anthered	*Cardamine micranthera*	E	Dicot	Yes
Bladderpod, Dudley Bluffs	*Lesquerella congesta*	T	Dicot	Yes
Bladderpod, Kodachrome	*Lesquerella tumulosa*	E	Dicot	Yes
Bladderpod, Lyrate	*Lesquerella lyrata*	T	Dicot	Yes
Bladderpod, Missouri	*Lesquerella filiformis*	T	Dicot	Yes
Bladderpod, San Bernardino Mountains	*Lesquerella kingii ssp. bernardina*	E	Dicot	Yes
Bladderpod, Spring Creek	*Lesquerella perforata*	E	Dicot	Yes
Bladderpod, White	*Lesquerella pallida*	E	Dicot	Yes

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Bladderpod, Zapata	*Lesquerella thamnophila*	E	Dicot	Yes
Blazing Star, Ash Meadows	*Mentzelia leucophylla*	T	Dicot	Yes
Blazing Star, Heller's	*Liatris helleri*	T	Dicot	Yes
Blazing Star, Scrub	*Liatris ohlingerae*	E	Dicot	Yes
Bluecurls, Hidden Lake	*Trichostema austromontanum ssp. compactum*	T	Dicot	Yes
Blue-star, Kearney's	*Amsonia kearneyana*	E	Dicot	Yes
Bluet, Roan Mountain	*Hedyotis purpurea var. montana*	E	Dicot	Yes
Bonamia menziesii (ncn)	*Bonamia menziesii*	E	Dicot	Yes
Bonamia, Florida	*Bonamia grandiflora*	T	Dicot	Yes
Boxwood, Vahl's	*Buxus vahlii*	E	Dicot	Yes
Broom, San Clemente Island	*Lotus dendroideus ssp. traskiae*	E	Dicot	Yes
Buckwheat, Cushenbury	*Eriogonum ovalifolium var. vineum*	E	Dicot	Yes
Buckwheat, Ione (incl. Irish Hill)	*Eriogonum apricum (incl. var. prostratum)*	E	Dicot	Yes
Buckwheat, Scrub	*Eriogonum longifolium var. gnaphalifolium*	T	Dicot	Yes
Buckwheat, Southern Mountain Wild	*Eriogonum kennedyi var. austromontanum*	T	Dicot	Yes
Buckwheat, Steamboat	*Eriogonum ovalifolium var. williamsiae*	E	Dicot	Yes
Bush-mallow, San Clemente Island	*Malacothamnus clementinus*	E	Dicot	Yes
Bush-mallow, Santa Cruz Island	*Malacothamnus fasciculatus var. nesioticus*	E	Dicot	Yes
Buttercup, Autumn	*Ranunculus aestivalis (=acriformis)*	E	Dicot	Yes
Butterfly Plant, Colorado	*Gaura neomexicana var. coloradensis*	T	Dicot	Yes
Butterweed, Layne's	*Senecio layneae*	T	Dicot	Yes
Butterwort, Godfrey's	*Pinguicula ionantha*	T	Dicot	Yes
Button-celery, San Diego	*Eryngium aristulatum var. parishii*	E	Dicot	Yes
Cactus, Arizona Hedgehog	*Echinocereus triglochidiatus var. arizonicus*	E	Dicot	Yes
Cactus, Bakersfield	*Opuntia treleasei*	E	Dicot	Yes
Cactus, Black Lace	*Echinocereus reichenbachii var. albertii*	E	Dicot	Yes
Cactus, Brady Pincushion	*Pediocactus bradyi*	E	Dicot	Yes
Cactus, Bunched Cory	*Coryphantha ramillosa*	T	Dicot	Yes
Cactus, Chisos Mountain Hedgehog	*Echinocereus chisoensis var. chisoensis*	T	Dicot	Yes
Cactus, Cochise Pincushion	*Coryphantha robbinsorum*	T	Dicot	Yes
Cactus, Colorado hookless	*Sclerocactus glaucus*	T	Dicot	Yes
Cactus, Knowlton	*Pediocactus knowltonii*	E	Dicot	Yes
Cactus, Kuenzler Hedgehog	*Echinocereus fendleri var. kuenzleri*	E	Dicot	Yes
Cactus, Lee Pincushion	*Coryphantha sneedii var. leei*	T	Dicot	Yes

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Cactus, Lloyd's Mariposa	*Echinomastus mariposensis*	T	Dicot	Yes
Cactus, Mesa Verde	*Sclerocactus mesae-verdae*	T	Dicot	Yes
Cactus, Nellie Cory	*Coryphantha minima*	E	Dicot	Yes
Cactus, Nichol's Turk's Head	*Echinocactus horizonthalonius var. nicholii*	E	Dicot	Yes
Cactus, Pariette	*Sclerocactus brevispinus*	T	Dicot	Yes
Cactus, Peebles Navajo	*Pediocactus peeblesianus peeblesianus*	E	Dicot	Yes
Cactus, Pima Pineapple	*Coryphantha scheeri var. robustispina*	E	Dicot	Yes
Cactus, San Rafael	*Pediocactus despainii*	E	Dicot	Yes
Cactus, Siler Pincushion	*Pediocactus (=Echinocactus,=Utahia) sileri*	T	Dicot	Yes
Cactus, Sneed Pincushion	*Coryphantha sneedii var. sneedii*	E	Dicot	Yes
Cactus, Star	*Astrophytum asterias*	E	Dicot	Yes
Cactus, Tobusch Fishhook	*Ancistrocactus tobuschii*	E	Dicot	Yes
Cactus, Uinta Basin hookless	*Sclerocactus wetlandicus*	T	Dicot	Yes
Cactus, Winkler	*Pediocactus winkleri*	T	Dicot	Yes
Cactus, Wright Fishhook	*Sclerocactus wrightiae*	E	Dicot	Yes
Calyptranthes Thomasiana (ncn)	*Calyptranthes thomasiana*	E	Dicot	Yes
Campion, Fringed	*Silene polypetala*	E	Dicot	Yes
Capa Rosa	*Callicarpa ampla*	E	Dicot	Yes
Catchfly, Spalding's	*Silene spaldingii*	T	Dicot	Yes
Catesbaea Melanocarpa (ncn)	*Catesbaea melanocarpa*	E	Dicot	Yes
Cat's-eye, Terlingua Creek	*Cryptantha crassipes*	E	Dicot	Yes
Ceanothus, Coyote	*Ceanothus ferrisae*	E	Dicot	Yes
Ceanothus, Pine Hill	*Ceanothus roderickii*	E	Dicot	Yes
Ceanothus, Vail Lake	*Ceanothus ophiochilus*	T	Dicot	Yes
Centaury, Spring-loving	*Centaurium namophilum*	T	Dicot	Yes
Chaffseed, American	*Schwalbea americana*	E	Dicot	Yes
Chamaecrista glandulosa (ncn)	*Chamaecrista glandulosa var. mirabilis*	E	Dicot	Yes
Chamaesyce Halemanui (ncn)	*Chamaesyce halemanui*	E	Dicot	Yes
Checker-mallow, Keck's	*Sidalcea keckii*	E	Dicot	Yes
Checker-mallow, Kenwood Marsh	*Sidalcea oregana ssp. valida*	E	Dicot	Yes
Checker-mallow, Nelson's	*Sidalcea nelsoniana*	T	Dicot	Yes
Checker-mallow, Pedate	*Sidalcea pedata*	E	Dicot	Yes
Checker-mallow, Wenatchee Mountains	*Sidalcea oregana var. calva*	E	Dicot	Yes

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Chumbo, Higo	*Harrisia portoricensis*	T	Dicot	Yes
Chupacallos	*Pleodendron macranthum*	E	Dicot	Yes
Clarkia, Pismo	*Clarkia speciosa ssp. immaculata*	E	Dicot	Yes
Clarkia, Presidio	*Clarkia franciscana*	E	Dicot	Yes
Clarkia, Springville	*Clarkia springvillensis*	T	Dicot	Yes
Clarkia, Vine Hill	*Clarkia imbricata*	E	Dicot	Yes
Cliffrose, Arizona	*Purshia (=cowania) subintegra*	E	Dicot	Yes
Clover, Fleshy Owl's	*Castilleja campestris ssp. succulenta*	T	Dicot	Yes
Clover, Leafy Prairie	*Dalea foliosa*	E	Dicot	Yes
Clover, Monterey	*Trifolium trichocalyx*	E	Dicot	Yes
Clover, Prairie Bush	*Lespedeza leptostachya*	T	Dicot	Yes
Clover, Running Buffalo	*Trifolium stoloniferum*	E	Dicot	Yes
Clover, Showy Indian	*Trifolium amoenum*	E	Dicot	Yes
Cobana Negra	*Stahlia monosperma*	T	Dicot	Yes
Coneflower, Smooth	*Echinacea laevigata*	E	Dicot	Yes
Cordia bellonis (ncn)	*Cordia bellonis*	E	Dicot	Yes
Coyote-thistle, Loch Lomond	*Eryngium constancei*	E	Dicot	Yes
Crownbeard, Big-leaved	*Verbesina dissita*	T	Dicot	Yes
Crownscale, San Jacinto Valley	*Atriplex coronata var. notatior*	E	Dicot	Yes
Cyanea undulata (ncn)	*Cyanea undulata*	E	Dicot	Yes
Cycladenia, Jones	*Cycladenia jonesii (=humilis)*	T	Dicot	Yes
Daisy, Lakeside	*Hymenoxys herbacea*	T	Dicot	Yes
Daisy, Parish's	*Erigeron parishii*	T	Dicot	Yes
Daisy, Willamette	*Erigeron decumbens var. decumbens*	E	Dicot	Yes
Daphnopsis hellerana (ncn)	*Daphnopsis hellerana*	E	Dicot	Yes
Dawn-flower, Texas Prairie (=Texas Bitterweed)	*Hymenoxys texana*	E	Dicot	Yes
DeBeque phacelia	*Phacelia submutica*	T	Dicot	Yes
Delissea rhytodisperma (ncn)	*Delissea rhytidosperma*	E	Dicot	Yes
Dogweed, Ashy	*Thymophylla tephroleuca*	E	Dicot	Yes
Dropwort, Canby's	*Oxypolis canbyi*	E	Dicot	Yes
Dubautia latifolia (ncn)	*Dubautia latifolia*	E	Dicot	Yes
Dubautia pauciflorula (ncn)	*Dubautia pauciflorula*	E	Dicot	Yes
Dudleya, Conejo	*Dudleya abramsii ssp. parva*	T	Dicot	Yes

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Dudleya, Marcescent	*Dudleya cymosa ssp. marcescens*	T	Dicot	Yes
Dudleya, Santa Clara Valley	*Dudleya setchellii*	E	Dicot	Yes
Dudleya, Santa Cruz Island	*Dudleya nesiotica*	T	Dicot	Yes
Dudleya, Santa Monica Mountains	*Dudleya cymosa ssp. ovatifolia*	T	Dicot	Yes
Dudleya, Verity's	*Dudleya verityi*	T	Dicot	Yes
Dwarf-flax, Marin	*Hesperolinon congestum*	T	Dicot	Yes
Erubia	*Solanum drymophilum*	E	Dicot	Yes
Eugenia Woodburyana	*Eugenia woodburyana*	E	Dicot	Yes
Evening-primrose, Antioch Dunes	*Oenothera deltoides ssp. howellii*	E	Dicot	Yes
Evening-primrose, Eureka Valley	*Oenothera avita ssp. eurekensis*	E	Dicot	Yes
Evening-primrose, San Benito	*Camissonia benitensis*	T	Dicot	Yes
Fiddleneck, Large-flowered	*Amsinckia grandiflora*	E	Dicot	Yes
Flannelbush, Mexican	*Fremontodendron mexicanum*	E	Dicot	Yes
Flannelbush, Pine Hill	*Fremontodendron californicum ssp. decumbens*	E	Dicot	Yes
Fleabane, Zuni	*Erigeron rhizomatus*	T	Dicot	Yes
Four-o'clock, Macfarlane's	*Mirabilis macfarlanei*	T	Dicot	Yes
Frankenia, Johnston's	*Frankenia johnstonii*	E	Dicot	Yes
Fringe Tree, Pygmy	*Chionanthus pygmaeus*	E	Dicot	Yes
Fringepod, Santa Cruz Island	*Thysanocarpus conchuliferus*	E	Dicot	Yes
Fruit, Earth (=geocarpon)	*Geocarpon minimum*	T	Dicot	Yes
Geranium, Hawaiian Red-flowered	*Geranium arboreum*	E	Dicot	Yes
Gerardia, Sandplain	*Agalinis acuta*	E	Dicot	Yes
Gesneria pauciflora (ncn)	*Gesneria pauciflora*	T	Dicot	Yes
Gilia, Hoffmann's Slender-flowered	*Gilia tenuiflora ssp. hoffmannii*	E	Dicot	Yes
Gilia, Monterey	*Gilia tenuiflora ssp. arenaria*	E	Dicot	Yes
Goetzea, Beautiful (Matabuey)	*Goetzea elegans*	E	Dicot	Yes
Golden Sunburst, Hartweg's	*Pseudobahia bahiifolia*	E	Dicot	Yes
Goldenrod, Blue Ridge	*Solidago spithamaea*	T	Dicot	Yes
Goldenrod, Houghton's	*Solidago houghtonii*	T	Dicot	Yes
Goldenrod, Short's	*Solidago shortii*	E	Dicot	Yes
Goldenrod, White-haired	*Solidago albopilosa*	T	Dicot	Yes
Goldfields, Burke's	*Lasthenia burkei*	E	Dicot	Yes
Goldfields, Contra Costa	*Lasthenia conjugens*	E	Dicot	Yes

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Gooseberry, Miccosukee	*Ribes echinellum*	T	Dicot	Yes
Gouania hillebrandii (ncn)	*Gouania hillebrandii*	E	Dicot	Yes
Gouania meyenii (ncn)	*Gouania meyenii*	E	Dicot	Yes
Gouania vitifolia (ncn)	*Gouania vitifolia*	E	Dicot	Yes
Gourd, Okeechobee	*Cucurbita okeechobeensis ssp. okeechobeensis*	E	Dicot	Yes
Grass, Hairy Orcutt	*Orcuttia pilosa*	E	Dicot	Yes
Grass, Sacramento Orcutt	*Orcuttia viscida*	E	Dicot	Yes
Grass, Slender Orcutt	*Orcuttia tenuis*	T	Dicot	Yes
Ground-plum, Guthrie's	*Astragalus bibullatus*	E	Dicot	Yes
Groundsel, San Francisco Peaks	*Senecio franciscanus*	T	Dicot	Yes
Gumplant, Ash Meadows	*Grindelia fraxino-pratensis*	T	Dicot	Yes
ha`iwale	*Cyrtandra kaulantha*	E	Dicot	Yes
ha`iwale	*Cyrtandra sessilis*	E	Dicot	Yes
Haha	*Cyanea calycina*	E	Dicot	Yes
Haha	*Cyanea dolichopoda*	E	Dicot	Yes
haha	*Cyanea eleeleensis*	E	Dicot	Yes
Haha	*Cyanea kuhihewa*	E	Dicot	Yes
Haha	*Cyanea lanceolata*	E	Dicot	Yes
haha	*Cyanea purpurellifolia*	E	Dicot	Yes
Haha (Cyanea acuminata)	*Cyanea acuminata*	E	Dicot	Yes
Haha (Cyanea asarifolia)	*Cyanea asarifolia*	E	Dicot	Yes
Haha (Cyanea copelandii ssp. copelandii)	*Cyanea copelandii ssp. copelandii*	E	Dicot	Yes
Haha (Cyanea copelandii ssp. haleakalaensis)	*Cyanea copelandii ssp. haleakalaensis*	E	Dicot	Yes
Haha (Cyanea Crispa) (=Rollandia crispa)	*Cyanea (=Rollandia) crispa*	E	Dicot	Yes
Haha (Cyanea glabra)	*Cyanea glabra*	E	Dicot	Yes
Haha (Cyanea grimesiana ssp. grimesiana)	*Cyanea grimesiana ssp. grimesiana*	E	Dicot	Yes
Haha (Cyanea grimesiana ssp. obatae)	*Cyanea grimesiana ssp. obatae*	E	Dicot	Yes
Haha (Cyanea hamatiflora ssp. carlsonii)	*Cyanea hamatiflora ssp. Carlsonii*	E	Dicot	Yes
Haha (Cyanea hamatiflora ssp. hamatiflora)	*Cyanea hamatiflora ssp. hamatiflora*	E	Dicot	Yes
Haha (Cyanea humboldtiana)	*Cyanea humboldtiana*	E	Dicot	Yes
Haha (Cyanea koolauensis)	*Cyanea koolauensis*	E	Dicot	Yes
Haha (Cyanea lobata)	*Cyanea lobata*	E	Dicot	Yes
Haha (Cyanea longiflora)	*Cyanea longiflora*	E	Dicot	Yes

Common Name	**Scientific Name**	**Status**	**Taxon**	**Potential for Direct Effects to Taxon?**
Haha (Cyanea mceldowneyi)	*Cyanea mceldowneyi*	E	Dicot	Yes
Haha (Cyanea pinnatifida)	*Cyanea pinnatifida*	E	Dicot	Yes
Haha (Cyanea platyphylla)	*Cyanea platyphylla*	E	Dicot	Yes
Haha (Cyanea recta)	*Cyanea recta*	T	Dicot	Yes
Haha (Cyanea remyi)	*Cyanea remyi*	E	Dicot	Yes
Haha (Cyanea shipmanii)	*Cyanea shipmannii*	E	Dicot	Yes
Haha (Cyanea stictophylla)	*Cyanea stictophylla*	E	Dicot	Yes
Haha (Cyanea St-Johnii) (=Rollandia St-Johnii)	*Cyanea st-johnii*	E	Dicot	Yes
Haha (Cyanea superba)	*Cyanea superba*	E	Dicot	Yes
Haha (Cyanea truncata)	*Cyanea truncata*	E	Dicot	Yes
haiwale	*Cyrtandra gracilis*	E	Dicot	Yes
haiwale	*Cyrtandra paliku*	E	Dicot	Yes
haiwale	*Cyrtandra waiolani*	E	Dicot	Yes
Ha'Iwale (Cyrtandra crenata)	*Cyrtandra crenata*	E	Dicot	Yes
Ha'Iwale (Cyrtandra dentata)	*Cyrtandra dentata*	E	Dicot	Yes
Ha'Iwale (Cyrtandra giffardii)	*Cyrtandra giffardii*	E	Dicot	Yes
Ha'Iwale (Cyrtandra limahuliensis)	*Cyrtandra limahuliensis*	T	Dicot	Yes
Ha'Iwale (Cyrtandra munroi)	*Cyrtandra munroi*	E	Dicot	Yes
Ha'iwale (Cyrtandra oenobarba)	*Cyrtandra oenobarba*	E	Dicot	Yes
Ha'Iwale (Cyrtandra polyantha)	*Cyrtandra polyantha*	E	Dicot	Yes
Ha'Iwale (Cyrtandra subumbellata)	*Cyrtandra subumbellata*	E	Dicot	Yes
Ha'Iwale (Cyrtandra tintinnabula)	*Cyrtandra tintinnabula*	E	Dicot	Yes
Ha'Iwale (Cyrtandra viridiflora)	*Cyrtandra viridiflora*	E	Dicot	Yes
Haplostachys Haplostachya (ncn)	*Haplostachys haplostachya*	E	Dicot	Yes
Harebells, Avon Park	*Crotalaria avonensis*	E	Dicot	Yes
Harperella	*Ptilimnium nodosum*	E	Dicot	Yes
Hau Kauhiwi (Hibiscadelphus woodi)	*Hibiscadelphus woodii*	E	Dicot	Yes
Hau Kuahiwi (Hibiscadelphus distans)	*Hibiscadelphus distans*	E	Dicot	Yes
Hau Kuahiwi (Hibiscadelphus giffardianus)	*Hibiscadelphus giffardianus*	E	Dicot	Yes
Hau Kuahiwi (Hibiscadelphus hualalaiensis)	*Hibiscadelphus hualalaiensis*	E	Dicot	Yes
Hayun Lagu (Tronkon Guafi)	*Serianthes nelsonii*	E	Dicot	Yes
Heartleaf, Dwarf-flowered	*Hexastylis naniflora*	T	Dicot	Yes
Heather, Mountain Golden	*Hudsonia montana*	T	Dicot	Yes

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Heau (Exocarpos luteolus)	*Exocarpos luteolus*	E	Dicot	Yes
Hedyotis degeneri (ncn)	*Hedyotis degeneri*	E	Dicot	Yes
Hedyotis parvula (ncn)	*Hedyotis parvula*	E	Dicot	Yes
Hedyotis St.-Johnii (ncn)	*Hedyotis st.-johnii*	E	Dicot	Yes
Hesperomannia arborescens (ncn)	*Hesperomannia arborescens*	E	Dicot	Yes
Hesperomannia arbuscula (ncn)	*Hesperomannia arbuscula*	E	Dicot	Yes
Hesperomannia lydgatei (ncn)	*Hesperomannia lydgatei*	E	Dicot	Yes
Hibiscus, Clay's	*Hibiscus clayi*	E	Dicot	Yes
Higuero De Sierra	*Crescentia portoricensis*	E	Dicot	Yes
ho'awa	*Pittosporum napaliense*	E	Dicot	Yes
Holei (Ochrosia kilaueaensis)	*Ochrosia kilaueaensis*	E	Dicot	Yes
Holly, Cook's	*Ilex cookii*	E	Dicot	Yes
Howellia, Water	*Howellia aquatilis*	T	Dicot	Yes
Hypericum, Highlands Scrub	*Hypericum cumulicola*	E	Dicot	Yes
Ilex sintenisii (ncn)	*Ilex sintenisii*	E	Dicot	Yes
Iliau (Wilkesia hobdyi)	*Wilkesia hobdyi*	E	Dicot	Yes
Ipomopsis, Holy Ghost	*Ipomopsis sancti-spiritus*	E	Dicot	Yes
Ivesia, Ash Meadows	*Ivesia kingii var. eremica*	T	Dicot	Yes
Jacquemontia, Beach	*Jacquemontia reclinata*	E	Dicot	Yes
Jewelflower, California	*Caulanthus californicus*	E	Dicot	Yes
Jewelflower, Metcalf Canyon	*Streptanthus albidus ssp. albidus*	E	Dicot	Yes
Jewelflower, Tiburon	*Streptanthus niger*	E	Dicot	Yes
Joint-vetch, Sensitive	*Aeschynomene virginica*	T	Dicot	Yes
kamakahala	*Labordia helleri*	E	Dicot	Yes
kamakahala	*Labordia pumila*	E	Dicot	Yes
Kamakahala (Labordia cyrtandrae)	*Labordia cyrtandrae*	E	Dicot	Yes
Kamakahala (Labordia lydgatei)	*Labordia lydgatei*	E	Dicot	Yes
Kamakahala (Labordia tinifolia var. wahiawaen)	*Labordia tinifolia var. wahiawaensis*	E	Dicot	Yes
Kauila (Colubrina oppositifolia)	*Colubrina oppositifolia*	E	Dicot	Yes
kaulu	*Pteralyxia macrocarpa*	E	Dicot	Yes
Kaulu (Pteralyxia kauaiensis)	*Pteralyxia kauaiensis*	E	Dicot	Yes
Kio'Ele (Hedyotis coriacea)	*Hedyotis coriacea*	E	Dicot	Yes
Kiponapona (Phyllostegia racemosa)	*Phyllostegia racemosa*	E	Dicot	Yes

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ko`oko`olau	*Bidens amplectens*	E	Dicot	Yes
Koki'o (Kokia drynarioides)	*Kokia drynarioides*	E	Dicot	Yes
Koki'o (Kokia kauaiensis)	*Kokia kauaiensis*	E	Dicot	Yes
Koki'o Ke'oke'o (Hibiscus waimeae ssp. hannerae)	*Hibiscus waimeae ssp. hannerae*	E	Dicot	Yes
Kolea	*Myrsine knudsenii*	E	Dicot	Yes
kolea	*Myrsine mezii*	E	Dicot	Yes
Kolea (Myrsine juddii)	*Myrsine juddii*	E	Dicot	Yes
Kolea (Myrsine linearifolia)	*Myrsine linearifolia*	T	Dicot	Yes
Ko'oko'olau (Bidens micrantha ssp. kalealaha)	*Bidens micrantha ssp. kalealaha*	E	Dicot	Yes
Ko'oloa'ula (Abutilon menziesii)	*Abutilon menziesii*	E	Dicot	Yes
kopiko	*Psychotria grandiflora*	E	Dicot	Yes
kopiko	*Psychotria hobdyi*	E	Dicot	Yes
Kuawawaenohu (Alsinidendron lychnoides)	*Alsinidendron lychnoides*	E	Dicot	Yes
Kulu'I (Nototrichium humile)	*Nototrichium humile*	E	Dicot	Yes
Larkspur, Baker's	*Delphinium bakeri*	E	Dicot	Yes
Larkspur, San Clemente Island	*Delphinium variegatum ssp. kinkiense*	E	Dicot	Yes
Larkspur, Yellow	*Delphinium luteum*	E	Dicot	Yes
Laukahi Kuahiwi (Plantago hawaiensis)	*Plantago hawaiensis*	E	Dicot	Yes
Laukahi Kuahiwi (Plantago princeps)	*Plantago princeps*	E	Dicot	Yes
Laulihilihi (Schiedea stellarioides)	*Schiedea stellarioides*	E	Dicot	Yes
Layia, Beach	*Layia carnosa*	E	Dicot	Yes
Lead-plant, Crenulate	*Amorpha crenulata*	E	Dicot	Yes
Leather-flower, Alabama	*Clematis socialis*	E	Dicot	Yes
Leather-flower, Morefield's	*Clematis morefieldii*	E	Dicot	Yes
lehua makanoe	*Lysimachia daphnoides*	E	Dicot	Yes
Lessingia, San Francisco	*Lessingia germanorum (=L.g. var. germanorum)*	E	Dicot	Yes
Liliwai (Acaena exigua)	*Acaena exigua*	E	Dicot	Yes
Lipochaeta venosa (ncn)	*Lipochaeta venosa*	E	Dicot	Yes
Liveforever, Laguna Beach	*Dudleya stolonifera*	T	Dicot	Yes
Liveforever, Santa Barbara Island	*Dudleya traskiae*	E	Dicot	Yes
Lobelia monostachya (ncn)	*Lobelia monostachya*	E	Dicot	Yes
Lobelia niihauensis (ncn)	*Lobelia niihauensis*	E	Dicot	Yes
Lobelia oahuensis (ncn)	*Lobelia oahuensis*	E	Dicot	Yes

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Locoweed, Fassett's	*Oxytropis campestris var. chartacea*	T	Dicot	Yes
Lomatium, Bradshaw's	*Lomatium bradshawii*	E	Dicot	Yes
Lomatium, Cook's	*Lomatium cookii*	E	Dicot	Yes
Loosestrife, Rough-leaved	*Lysimachia asperulaefolia*	E	Dicot	Yes
Lousewort, Furbish	*Pedicularis furbishiae*	E	Dicot	Yes
Lupine, Clover	*Lupinus tidestromii*	E	Dicot	Yes
Lupine, Kincaid's	*Lupinus sulphureus (=oreganus) ssp. kincaidii (=var. kincaidii)*	T	Dicot	Yes
Lupine, Nipomo Mesa	*Lupinus nipomensis*	E	Dicot	Yes
Lupine, Scrub	*Lupinus aridorum*	E	Dicot	Yes
Lyonia truncata var. proctorii (ncn)	*Lyonia truncata var. proctorii*	E	Dicot	Yes
Lysimachia filifolia (ncn)	*Lysimachia filifolia*	E	Dicot	Yes
Lysimachia lydgatei (ncn)	*Lysimachia lydgatei*	E	Dicot	Yes
Mahoe (Alectryon macrococcus)	*Alectryon macrococcus*	E	Dicot	Yes
Makou (Peucedanum sandwicense)	*Peucedanum sandwicense*	T	Dicot	Yes
Malacothrix, Island	*Malacothrix squalida*	E	Dicot	Yes
Malacothrix, Santa Cruz Island	*Malacothrix indecora*	E	Dicot	Yes
Mallow, Kern	*Eremalche kernensis*	E	Dicot	Yes
Mallow, Peter's Mountain	*Iliamna corei*	E	Dicot	Yes
Manioc, Walker's	*Manihot walkerae*	E	Dicot	Yes
Manzanita, Del Mar	*Arctostaphylos glandulosa ssp. crassifolia*	E	Dicot	Yes
Manzanita, Ione	*Arctostaphylos myrtifolia*	T	Dicot	Yes
Manzanita, Morro	*Arctostaphylos morroensis*	T	Dicot	Yes
Manzanita, Pallid	*Arctostaphylos pallida*	T	Dicot	Yes
Manzanita, Santa Rosa Island	*Arctostaphylos confertiflora*	E	Dicot	Yes
Ma'o Hau Hele (Hibiscus brackenridgei)	*Hibiscus brackenridgei*	E	Dicot	Yes
Ma'oli'oli (Schiedea apokremnos)	*Schiedea apokremnos*	E	Dicot	Yes
Ma'oli'oli (Schiedea kealiae)	*Schiedea kealiae*	E	Dicot	Yes
Mapele (Cyrtandra cyaneoides)	*Cyrtandra cyaneoides*	E	Dicot	Yes
Meadowfoam, Butte County	*Limnanthes floccosa ssp. californica*	E	Dicot	Yes
Meadowfoam, Large-flowered Woolly	*Limnanthes floccosa ssp. Grandiflora*	E	Dicot	Yes
Meadowfoam, Sebastopol	*Limnanthes vinculans*	E	Dicot	Yes
Meadowrue, Cooley's	*Thalictrum cooleyi*	E	Dicot	Yes

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Mehamehame (Flueggea neowawraea)	*Flueggea neowawraea*	E	Dicot	Yes
Milkpea, Small's	*Galactia smallii*	E	Dicot	Yes
Milk-vetch, Applegate's	*Astragalus applegatei*	E	Dicot	Yes
Milk-vetch, Ash Meadows	*Astragalus phoenix*	T	Dicot	Yes
Milk-vetch, Braunton's	*Astragalus brauntonii*	E	Dicot	Yes
Milk-vetch, Clara Hunt's	*Astragalus clarianus*	E	Dicot	Yes
Milk-vetch, Coachella Valley	*Astragalus lentiginosus var. coachellae*	E	Dicot	Yes
Milk-vetch, Coastal Dunes	*Astragalus tener var. titi*	E	Dicot	Yes
Milk-vetch, Cushenbury	*Astragalus albens*	E	Dicot	Yes
Milk-vetch, Deseret	*Astragalus desereticus*	T	Dicot	Yes
Milk-vetch, Fish Slough	*Astragalus lentiginosus var. piscinensis*	T	Dicot	Yes
Milk-vetch, Heliotrope	*Astragalus montii*	T	Dicot	Yes
Milk-vetch, Holmgren	*Astragalus holmgreniorum*	E	Dicot	Yes
Milk-vetch, Jesup's	*Astragalus robbinsii var. jesupi*	E	Dicot	Yes
Milk-vetch, Lane Mountain	*Astragalus jaegerianus*	E	Dicot	Yes
Milk-vetch, Mancos	*Astragalus humillimus*	E	Dicot	Yes
Milk-vetch, Pierson's	*Astragalus magdalenae var. peirsonii*	T	Dicot	Yes
Milk-vetch, Sentry	*Astragalus cremnophylax var. cremnophylax*	E	Dicot	Yes
Milk-vetch, Shivwits	*Astragalus ampullarioides*	E	Dicot	Yes
Milk-vetch, Triple-ribbed	*Astragalus tricarinatus*	E	Dicot	Yes
Milk-vetch, Ventura Marsh	*Astragalus pycnostachyus var. lanosissimus*	E	Dicot	Yes
Milkweed, Mead's	*Asclepias meadii*	T	Dicot	Yes
Milkweed, Welsh's	*Asclepias welshii*	T	Dicot	Yes
Mint, Garrett's	*Dicerandra christmanii*	E	Dicot	Yes
Mint, Lakela's	*Dicerandra immaculata*	E	Dicot	Yes
Mint, Longspurred	*Dicerandra cornutissima*	E	Dicot	Yes
Mint, Otay Mesa	*Pogogyne nudiuscula*	E	Dicot	Yes
Mint, San Diego Mesa	*Pogogyne abramsii*	E	Dicot	Yes
Mint, Scrub	*Dicerandra frutescens*	E	Dicot	Yes
Mitracarpus Maxwelliae	*Mitracarpus maxwelliae*	E	Dicot	Yes
Mitracarpus Polycladus	*Mitracarpus polycladus*	E	Dicot	Yes
Monardella, Willowy	*Monardella linoides ssp. viminea*	E	Dicot	Yes
Monkey-flower, Michigan	*Mimulus glabratus var. michiganensis*	E	Dicot	Yes

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Monkshood, Northern Wild	*Aconitum noveboracense*	T	Dicot	Yes
Morning-glory, Stebbins	*Calystegia stebbinsii*	E	Dicot	Yes
Mountainbalm, Indian Knob	*Eriodictyon altissimum*	E	Dicot	Yes
Mountain-mahogany, Catalina Island	*Cercocarpus traskiae*	E	Dicot	Yes
Munroidendron racemosum (ncn)	*Munroidendron racemosum*	E	Dicot	Yes
Mustard, Carter's	*Warea carteri*	E	Dicot	Yes
Mustard, Slender-petaled	*Thelypodium stenopetalum*	E	Dicot	Yes
Myrcia Paganii	*Myrcia paganii*	E	Dicot	Yes
na`ena`e	*Dubautia imbricata imbricata*	E	Dicot	Yes
na`ena`e	*Dubautia plantaginea magnifolia*	E	Dicot	Yes
Na`ena`e	*Dubautia waialealae*	E	Dicot	Yes
Naenae	*Dubautia kalalauensis*	E	Dicot	Yes
Naenae	*Dubautia kenwoodii*	E	Dicot	Yes
Na'ena'e (Dubautia herbstobatae)	*Dubautia herbstobatae*	E	Dicot	Yes
Na'ena'e (Dubautia plantaginea ssp. humilis)	*Dubautia plantaginea ssp. humilis*	E	Dicot	Yes
Nani Wai'ale'ale (Viola kauaensis var. wahiawaensis)	*Viola kauaiensis var. wahiawaensis*	E	Dicot	Yes
Nanu (Gardenia mannii)	*Gardenia mannii*	E	Dicot	Yes
Na'u (Gardenia brighamii)	*Gardenia brighamii*	E	Dicot	Yes
Naupaka, Dwarf (Scaevola coriacea)	*Scaevola coriacea*	E	Dicot	Yes
Navarretia, Few-flowered	*Navarretia leucocephala ssp. Pauciflora*	E	Dicot	Yes
Navarretia, Many-flowered	*Navarretia leucocephala ssp. plieantha*	E	Dicot	Yes
Navarretia, Spreading	*Navarretia fossalis*	T	Dicot	Yes
Nehe (Lipochaeta fauriei)	*Lipochaeta fauriei*	E	Dicot	Yes
Nehe (Lipochaeta kamolensis)	*Lipochaeta kamolensis*	E	Dicot	Yes
Nehe (Lipochaeta lobata var. leptophylla)	*Lipochaeta lobata var. leptophylla*	E	Dicot	Yes
Nehe (Lipochaeta micrantha)	*Lipochaeta micrantha*	E	Dicot	Yes
Nehe (Lipochaeta tenuifolia)	*Lipochaeta tenuifolia*	E	Dicot	Yes
Nehe (Lipochaeta waimeaensis)	*Lipochaeta waimeaensis*	E	Dicot	Yes
Neraudia angulata (ncn)	*Neraudia angulata*	E	Dicot	Yes
Neraudia ovata (ncn)	*Neraudia ovata*	E	Dicot	Yes
Neraudia sericea (ncn)	*Neraudia sericea*	E	Dicot	Yes
Nioi (Eugenia koolauensis)	*Eugenia koolauensis*	E	Dicot	Yes
Niterwort, Amargosa	*Nitrophila mohavensis*	E	Dicot	Yes

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nohoanu	*Geranium kauaiense*	E	Dicot	Yes
Nohoanu (Geranium multiflorum)	*Geranium multiflorum*	E	Dicot	Yes
Oahu wild coffee	*Psychotria hexandra ssp. Oahuensis*	E	Dicot	Yes
Oak, Hinckley	*Quercus hinckleyi*	T	Dicot	Yes
'Oha (Delissea rivularis)	*Delissea rivularis*	E	Dicot	Yes
'Oha (Delissea subcordata)	*Delissea subcordata*	E	Dicot	Yes
'Oha (Delissea undulata)	*Delissea undulata*	E	Dicot	Yes
'Oha (Lobelia gaudichaudii koolauensis)	*Lobelia gaudichaudii ssp. koolauensis*	E	Dicot	Yes
'Oha Wai (Clermontia drepanomorpha)	*Clermontia drepanomorpha*	E	Dicot	Yes
'Oha Wai (Clermontia lindseyana)	*Clermontia lindseyana*	E	Dicot	Yes
'Oha Wai (Clermontia oblongifolia ssp. mauiensis)	*Clermontia oblongifolia ssp. mauiensis*	E	Dicot	Yes
'Oha Wai (Clermontia peleana)	*Clermontia peleana*	E	Dicot	Yes
'Oha Wai (Clermontia pyrularia)	*Clermontia pyrularia*	E	Dicot	Yes
'Oha Wai (Clermontia samuelii)	*Clermontia samuelii*	E	Dicot	Yes
'Ohai (Sesbania tomentosa)	*Sesbania tomentosa*	E	Dicot	Yes
'Ohe'ohe (Tetraplasandra gymnocarpa)	*Tetraplasandra gymnocarpa*	E	Dicot	Yes
'Olulu (Brighamia insignis)	*Brighamia insignis*	E	Dicot	Yes
Opuhe (Urera kaalae)	*Urera kaalae*	E	Dicot	Yes
Oxytheca, Cushenbury	*Oxytheca parishii var. goodmaniana*	E	Dicot	Yes
Pagosa Skyrocket	*Ipomopsis polyantha*	E	Dicot	Yes
Paintbrush, Ash-grey Indian	*Castilleja cinerea*	T	Dicot	Yes
Paintbrush, Golden	*Castilleja levisecta*	T	Dicot	Yes
Paintbrush, San Clemente Island Indian	*Castilleja grisea*	E	Dicot	Yes
Paintbrush, Soft-leaved	*Castilleja mollis*	E	Dicot	Yes
Paintbrush, Tiburon	*Castilleja affinis ssp. neglecta*	E	Dicot	Yes
Palo Colorado (Ternstroemia luquillensis)	*Ternstroemia luquillensis*	E	Dicot	Yes
Palo de Jazmin	*Styrax portoricensis*	E	Dicot	Yes
Palo de Nigua	*Cornutia obovata*	E	Dicot	Yes
Palo de Ramon	*Banara vanderbiltii*	E	Dicot	Yes
Palo de Rosa	*Ottoschulzia rhodoxylon*	E	Dicot	Yes
Pamakani (Viola chamissoniana ssp. chamissoniana)	*Viola chamissoniana ssp. chamissoniana*	E	Dicot	Yes
Papala	*Charpentiera densiflora*	E	Dicot	Yes
Parachute Beardtongue	*Penstemon debilis*	T	Dicot	Yes

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Pawpaw, Beautiful	*Deeringothamnus pulchellus*	E	Dicot	Yes
Pawpaw, Four-petal	*Asimina tetramera*	E	Dicot	Yes
Pawpaw, Rugel's	*Deeringothamnus rugelii*	E	Dicot	Yes
Penny-cress, Kneeland Prairie	*Thlaspi californicum*	E	Dicot	Yes
Pennyroyal, Todsen's	*Hedeoma todsenii*	E	Dicot	Yes
Penstemon, Blowout	*Penstemon haydenii*	E	Dicot	Yes
Pentachaeta, Lyon's	*Pentachaeta lyonii*	E	Dicot	Yes
Pentachaeta, White-rayed	*Pentachaeta bellidiflora*	E	Dicot	Yes
Peperomia, Wheeler's	*Peperomia wheeleri*	E	Dicot	Yes
Peppergrass, Slick Spot	*Lepidium papilliferum*	T	Dicot	Yes
Phacelia, Clay	*Phacelia argillacea*	E	Dicot	Yes
Phacelia, Island	*Phacelia insularis ssp. insularis*	E	Dicot	Yes
Phacelia, North Park	*Phacelia formosula*	E	Dicot	Yes
Phlox, Texas Trailing	*Phlox nivalis ssp. texensis*	E	Dicot	Yes
Phlox, Yreka	*Phlox hirsuta*	E	Dicot	Yes
Phyllostegia hirsuta (ncn)	*Phyllostegia hirsuta*	E	Dicot	Yes
Phyllostegia kaalaensis (ncn)	*Phyllostegia kaalaensis*	E	Dicot	Yes
Phyllostegia knudsenii (ncn)	*Phyllostegia knudsenii*	E	Dicot	Yes
Phyllostegia mannii (ncn)	*Phyllostegia mannii*	E	Dicot	Yes
Phyllostegia mollis (ncn)	*Phyllostegia mollis*	E	Dicot	Yes
Phyllostegia parviflora (ncn)	*Phyllostegia parviflora*	E	Dicot	Yes
Phyllostegia velutina (ncn)	*Phyllostegia velutina*	E	Dicot	Yes
Phyllostegia waimeae (ncn)	*Phyllostegia waimeae*	E	Dicot	Yes
Phyllostegia warshaueri (ncn)	*Phyllostegia warshaueri*	E	Dicot	Yes
Phyllostegia wawrana (ncn)	*Phyllostegia wawrana*	E	Dicot	Yes
Pilo (Hedyotis mannii)	*Hedyotis mannii*	E	Dicot	Yes
pilo kea lau li`i	*Platydesma rostrata*	E	Dicot	Yes
Pinkroot, Gentian	*Spigelia gentianoides*	E	Dicot	Yes
Pitaya, Davis' Green	*Echinocereus viridiflorus var. davisii*	E	Dicot	Yes
Pitcher-plant, Alabama Canebrake	*Sarracenia rubra alabamensis*	E	Dicot	Yes
Pitcher-plant, Green	*Sarracenia oreophila*	E	Dicot	Yes
Pitcher-plant, Mountain Sweet	*Sarracenia rubra ssp. jonesii*	E	Dicot	Yes
Plum, Scrub	*Prunus geniculata*	E	Dicot	Yes

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Po'e (Portulaca sclerocarpa)	*Portulaca sclerocarpa*	E	Dicot	Yes
Polygala, Lewton's	*Polygala lewtonii*	E	Dicot	Yes
Polygala, Tiny	*Polygala smallii*	E	Dicot	Yes
Polygonum, Scott's Valley	*Polygonum hickmanii*	E	Dicot	Yes
Pondberry	*Lindera melissifolia*	E	Dicot	Yes
Poolfish, Pahrump (= Pahrump Killifish)	*Empetrichthys latos*	E	Dicot	Yes
Popcornflower, Rough	*Plagiobothrys hirtus*	E	Dicot	Yes
Popolo 'Aiakeakua (Solanum sandwicense)	*Solanum sandwicense*	E	Dicot	Yes
Popolo Ku Mai (Solanum incompletum)	*Solanum incompletum*	E	Dicot	Yes
Poppy, Sacramento Prickly	*Argemone pleiacantha ssp. pinnatisecta*	E	Dicot	Yes
Poppy-mallow, Texas	*Callirhoe scabriuscula*	E	Dicot	Yes
Potato-bean, Price's	*Apios priceana*	T	Dicot	Yes
Potentilla, Hickman's	*Potentilla hickmanii*	E	Dicot	Yes
Prickly-apple, Fragrant	*Cereus eriophorus var. fragrans*	E	Dicot	Yes
Prickly-ash, St. Thomas	*Zanthoxylum thomasianum*	E	Dicot	Yes
Primrose, Maguire	*Primula maguirei*	T	Dicot	Yes
Pua'ala (Brighamia rockii)	*Brighamia rockii*	E	Dicot	Yes
Pussypaws, Mariposa	*Calyptridium pulchellum*	T	Dicot	Yes
Rattleweed, Hairy	*Baptisia arachnifera*	E	Dicot	Yes
Reed-mustard, Barneby	*Schoenocrambe barnebyi*	E	Dicot	Yes
Reed-mustard, Clay	*Schoenocrambe argillacea*	T	Dicot	Yes
Reed-mustard, Shrubby	*Schoenocrambe suffrutescens*	E	Dicot	Yes
Remya kauaiensis (ncn)	*Remya kauaiensis*	E	Dicot	Yes
Remya montgomeryi (ncn)	*Remya montgomeryi*	E	Dicot	Yes
Remya, Maui	*Remya mauiensis*	E	Dicot	Yes
Rhododendron, Chapman	*Rhododendron chapmanii*	E	Dicot	Yes
Ridge-cress (=Pepper-cress), Barneby	*Lepidium barnebyanum*	E	Dicot	Yes
Rock-cress, Braun's	*Arabis perstellata E. L. Braun var. ampla Rollins*	E	Dicot	Yes
Rock-cress, Hoffmann's	*Arabis hoffmannii*	E	Dicot	Yes
Rock-cress, McDonald's	*Arabis mcdonaldiana*	E	Dicot	Yes
Rock-cress, Santa Cruz Island	*Sibara filifolia*	E	Dicot	Yes
Rock-cress, Shale Barren	*Arabis serotina*	E	Dicot	Yes
Rock-cress, Small	*Arabis perstellata E. L. Braun var. perstellata Fernald*	E	Dicot	Yes

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Rosemary, Apalachicola	*Conradina glabra*	E	Dicot	Yes
Rosemary, Cumberland	*Conradina verticillata*	T	Dicot	Yes
Rosemary, Etonia	*Conradina etonia*	E	Dicot	Yes
Rosemary, Short-leaved	*Conradina brevifolia*	E	Dicot	Yes
Roseroot, Leedy's	*Sedum integrifolium ssp. leedyi*	T	Dicot	Yes
Rush-pea, Slender	*Hoffmannseggia tenella*	E	Dicot	Yes
Rush-rose, Island	*Helianthemum greenei*	T	Dicot	Yes
Sandalwood, Lanai (='Iliahi)	*Santalum freycinetianum var. lanaiense*	E	Dicot	Yes
Sandlace	*Polygonella myriophylla*	E	Dicot	Yes
Sand-verbena, Large-fruited	*Abronia macrocarpa*	E	Dicot	Yes
Sandwort, Bear Valley	*Arenaria ursina*	T	Dicot	Yes
Sandwort, Cumberland	*Arenaria cumberlandensis*	E	Dicot	Yes
Sandwort, Marsh	*Arenaria paludicola*	E	Dicot	Yes
Sanicula mariversa (ncn)	*Sanicula mariversa*	E	Dicot	Yes
Sanicula purpurea (ncn)	*Sanicula purpurea*	E	Dicot	Yes
Schiedea haleakalensis (ncn)	*Schiedea haleakalensis*	E	Dicot	Yes
Schiedea helleri (ncn)	*Schiedea helleri*	E	Dicot	Yes
Schiedea hookeri (ncn)	*Schiedea hookeri*	E	Dicot	Yes
Schiedea kaalae (ncn)	*Schiedea kaalae*	E	Dicot	Yes
Schiedea kauaiensis (ncn)	*Schiedea kauaiensis*	E	Dicot	Yes
Schiedea membranacea (ncn)	*Schiedea membranacea*	E	Dicot	Yes
Schiedea nuttallii (ncn)	*Schiedea nuttallii*	E	Dicot	Yes
Schiedea spergulina var. leiopoda (ncn)	*Schiedea spergulina var. leiopoda*	E	Dicot	Yes
Schiedea spergulina var. spergulina (ncn)	*Schiedea spergulina var. spergulina*	T	Dicot	Yes
Schiedea, Diamond Head (Schiedea adamantis)	*Schiedea adamantis*	E	Dicot	Yes
Schoepfia arenaria (ncn)	*Schoepfia arenaria*	T	Dicot	Yes
Sea-blite, California	*Suaeda californica*	E	Dicot	Yes
Silene hawaiiensis (ncn)	*Silene hawaiiensis*	T	Dicot	Yes
Silene lanceolata (ncn)	*Silene lanceolata*	E	Dicot	Yes
Silene perlmanii (ncn)	*Silene perlmanii*	E	Dicot	Yes
Silversword, Haleakala ('Ahinahina)	*Argyroxiphium sandwicense ssp. macrocephalum*	T	Dicot	Yes
Silversword, Ka'u (Argyroxiphium kauense)	*Argyroxiphium kauense*	E	Dicot	Yes
Silversword, Mauna Kea ('Ahinahina)	*Argyroxiphium sandwicense ssp. sandwicense*	E	Dicot	Yes

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Skullcap, Florida	*Scutellaria floridana*	T	Dicot	Yes
Skullcap, Large-flowered	*Scutellaria montana*	T	Dicot	Yes
Snakeroot	*Eryngium cuneifolium*	E	Dicot	Yes
Sneezeweed, Virginia	*Helenium virginicum*	T	Dicot	Yes
Snowbells, Texas	*Styrax texanus*	E	Dicot	Yes
Spermolepis hawaiiensis (ncn)	*Spermolepis hawaiiensis*	E	Dicot	Yes
Spineflower, Ben Lomond	*Chorizanthe pungens var. hartwegiana*	E	Dicot	Yes
Spineflower, Howell's	*Chorizanthe howellii*	E	Dicot	Yes
Spineflower, Monterey	*Chorizanthe pungens var. pungens*	T	Dicot	Yes
Spineflower, Orcutt's	*Chorizanthe orcuttiana*	E	Dicot	Yes
Spineflower, Robust	*Chorizanthe robusta va r. robusta*	E	Dicot	Yes
Spineflower, Scotts Valley	*Chorizanthe robusta var. hartwegii*	E	Dicot	Yes
Spineflower, Slender-horned	*Dodecahema leptoceras*	E	Dicot	Yes
Spineflower, Sonoma	*Chorizanthe valida*	E	Dicot	Yes
Spiraea, Virginia	*Spiraea virginiana*	T	Dicot	Yes
Spurge, Deltoid	*Chamaesyce deltoidea ssp. deltoidea*	E	Dicot	Yes
Spurge, Garber's	*Chamaesyce garberi*	T	Dicot	Yes
Spurge, Hoover's	*Chamaesyce hooveri*	T	Dicot	Yes
Spurge, Telephus	*Euphorbia telephioides*	T	Dicot	Yes
Stenogyne angustifolia (ncn)	*Stenogyne angustifolia var. angustifolia*	E	Dicot	Yes
Stenogyne campanulata (ncn)	*Stenogyne campanulata*	E	Dicot	Yes
Stenogyne kanehoana (ncn)	*Stenogyne kanehoana*	E	Dicot	Yes
Stickseed, Showy	*Hackelia venusta*	E	Dicot	Yes
Stickyseed, Baker's	*Blennosperma bakeri*	E	Dicot	Yes
Stonecrop, Lake County	*Parvisedum leiocarpum*	E	Dicot	Yes
Sumac, Michaux's	*Rhus michauxii*	E	Dicot	Yes
Sunflower, Pecos	*Helianthus paradoxus*	T	Dicot	Yes
Sunflower, San Mateo Woolly	*Eriophyllum latilobum*	E	Dicot	Yes
Sunflower, Schweinitz's	*Helianthus schweinitzii*	E	Dicot	Yes
Sunray, Ash Meadows	*Enceliopsis nudicaulis var. corrugata*	T	Dicot	Yes
Taraxacum, California	*Taraxacum californicum*	E	Dicot	Yes
Tarplant, Gaviota	*Deinandra increscens ssp. villosa*	E	Dicot	Yes
Tarplant, Otay	*Deinandra (=Hemizonia) conjugens*	T	Dicot	Yes

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Tarplant, Santa Cruz	*Holocarpha macradenia*	T	Dicot	Yes
Ternstroemia subsessilis (ncn)	*Ternstroemia subsessilis*	E	Dicot	Yes
Tetramolopium arenarium (ncn)	*Tetramolopium arenarium*	E	Dicot	Yes
Tetramolopium capillare (ncn)	*Tetramolopium capillare*	E	Dicot	Yes
Tetramolopium filiforme (ncn)	*Tetramolopium filiforme*	E	Dicot	Yes
Tetramolopium lepidotum ssp. lepidotum (ncn)	*Tetramolopium lepidotum ssp. lepidotum*	E	Dicot	Yes
Tetramolopium remyi (ncn)	*Tetramolopium remyi*	E	Dicot	Yes
Tetramolopium rockii (ncn)	*Tetramolopium rockii*	T	Dicot	Yes
Thelypody, Howell's Spectacular	*Thelypodium howellii spectabilis*	T	Dicot	Yes
Thistle, Chorro creek Bog	*Cirsium fontinale var. obispoense*	E	Dicot	Yes
Thistle, Fountain	*Cirsium fontinale var. fontinale*	E	Dicot	Yes
Thistle, La Graciosa	*Cirsium loncholepis*	E	Dicot	Yes
Thistle, Pitcher's	*Cirsium pitcheri*	T	Dicot	Yes
Thistle, Sacramento Mountains	*Cirsium vinaceum*	T	Dicot	Yes
Thistle, Suisun	*Cirsium hydrophilum var. hydrophilum*	E	Dicot	Yes
Thornmint, San Diego	*Acanthomintha ilicifolia*	T	Dicot	Yes
Thornmint, San Mateo	*Acanthomintha obovata ssp. duttonii*	E	Dicot	Yes
Townsendia, Last Chance	*Townsendia aprica*	T	Dicot	Yes
Trematolobelia singularis (ncn)	*Trematolobelia singularis*	E	Dicot	Yes
Tuctoria, Green's	*Tuctoria greenei*	E	Dicot	Yes
Twinpod, Dudley Bluffs	*Physaria obcordata*	T	Dicot	Yes
Uhiuhi (Caesalpinia kavaiensis)	*Caesalpinia kavaiense*	E	Dicot	Yes
Umbel, Huachuca Water	*Lilaeopsis schaffneriana var. recurva*	E	Dicot	Yes
Uvillo	*Eugenia haematocarpa*	E	Dicot	Yes
Vernonia Proctorii (ncn)	*Vernonia proctorii*	E	Dicot	Yes
Vervain, California	*Verbena californica*	T	Dicot	Yes
Vetch, Hawaiian (Vicia menziesii)	*Vicia menziesii*	E	Dicot	Yes
Vigna o-wahuensis (ncn)	*Vigna o-wahuensis*	E	Dicot	Yes
Viola helenae (ncn)	*Viola helenae*	E	Dicot	Yes
Viola oahuensis (ncn)	*Viola oahuensis*	E	Dicot	Yes
Wahine Noho Kula (Isodendrion pyrifolium)	*Isodendrion pyrifolium*	E	Dicot	Yes
Wallflower, Ben Lomond	*Erysimum teretifolium*	E	Dicot	Yes
Wallflower, Contra Costa	*Erysimum capitatum var. angustatum*	E	Dicot	Yes

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Wallflower, Menzie's	*Erysimum menziesii*	E	Dicot	Yes
Warea, Wide-leaf	*Warea amplexifolia*	E	Dicot	Yes
Watercress, Gambel's	*Rorippa gambellii*	E	Dicot	Yes
Water-willow, Cooley's	*Justicia cooleyi*	E	Dicot	Yes
Whitlow-wort, Papery	*Paronychia chartacea*	T	Dicot	Yes
Wild-buckwheat, Clay-loving	*Eriogonum pelinophilum*	E	Dicot	Yes
Wild-buckwheat, Gypsum	*Eriogonum gypsophilum*	T	Dicot	Yes
Wings, Pigeon	*Clitoria fragrans*	T	Dicot	Yes
Wireweed	*Polygonella basiramia*	E	Dicot	Yes
Woodland-star, San Clemente Island	*Lithophragma maximum*	E	Dicot	Yes
Woolly-star, Santa Ana River	*Eriastrum densifolium ssp. sanctorum*	E	Dicot	Yes
Woolly-threads, San Joaquin	*Monolopia (=Lembertia) congdonii*	E	Dicot	Yes
Xylosma crenatum (ncn)	*Xylosma crenatum*	E	Dicot	Yes
Yellowhead, Desert	*Yermo xanthocephalus*	T	Dicot	Yes
Yerba Santa, Lompoc	*Eriodictyon capitatum*	E	Dicot	Yes
Ziziphus, Florida	*Ziziphus celata*	E	Dicot	Yes
(ncn)	*Diellia mannii*	E	Ferns	No
(ncn)	*Doryopteris angelica*	E	Ferns	No
(ncn)	*Doryopteris takeuchii*	E	Ferns	No
Asplenium fragile var. insulare (ncn)	*Asplenium fragile var. insulare*	E	Ferns	No
aumakua, Palapalai	*Dryopteris crinalis podosorus*	E	Ferns	No
Diellia erecta (ncn)	*Diellia erecta*	E	Ferns	No
Diellia falcata (ncn)	*Diellia falcata*	E	Ferns	No
Diellia pallida (ncn)	*Diellia pallida*	E	Ferns	No
Diellia unisora (ncn)	*Diellia unisora*	E	Ferns	No
Diplazium molokaiense (ncn)	*Diplazium molokaiense*	E	Ferns	No
Fern, Adiantum vivesii	*Adiantum vivesii*	E	Ferns	No
Fern, Alabama Streak-sorus	*Thelypteris pilosa var. alabamensis*	T	Ferns	No
Fern, American hart's-tongue	*Asplenium scolopendrium var. americanum*	T	Ferns	No
Fern, Elaphoglossum serpens	*Elaphoglossum serpens*	E	Ferns	No
Fern, Pendant Kihi (Adenophorus periens)	*Adenophorus periens*	E	Ferns	No
Fern, Thelypteris inabonensis	*Thelypteris inabonensis*	E	Ferns	No
Fern, Thelypteris verecunda	*Thelypteris verecunda*	E	Ferns	No

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Fern, Thelypteris yaucoensis	*Thelypteris yaucoensis*	E	Ferns	No
'Ihi'Ihi (Marsilea villosa)	*Marsilea villosa*	E	Ferns	No
Pauoa (Ctenitis squamigera)	*Ctenitis squamigera*	E	Ferns	No
Polystichum calderonense (ncn)	*Polystichum calderonense*	E	Ferns	No
Pteris lidgatei (ncn)	*Pteris lidgatei*	E	Ferns	No
Quillwort, Black-spored	*Isoetes melanospora*	E	Ferns	No
Quillwort, Louisiana	*Isoetes louisianensis*	E	Ferns	No
Quillwort, Mat-forming	*Isoetes tegetiformans*	E	Ferns	No
Tectaria Estremerana	*Tectaria estremerana*	E	Ferns	No
Tree Fern, Elfin	*Cyathea dryopteroides*	E	Ferns	No
Wawae'Iole (Phlegmariurus (=Huperzia) mannii)	*Huperzia mannii*	E	Ferns	No
Wawae'Iole (Phlegmariurus (=Lycopodium) nutans)	*Lycopodium (=Phlegmariurus) nutans*	E	Ferns	No
Catfish, Yaqui	*Ictalurus pricei*	T	Fish	No
Cavefish, Alabama	*Speoplatyrhinus poulsoni*	E	Fish	No
Cavefish, Ozark	*Amblyopsis rosae*	T	Fish	No
Chub, Bonytail	*Gila elegans*	E	Fish	No
Chub, Chihuahua	*Gila nigrescens*	T	Fish	No
Chub, Gila	*Gila intermedia*	E	Fish	No
Chub, Humpback	*Gila cypha*	E	Fish	No
Chub, Hutton Tui	*Gila bicolor ssp.*	T	Fish	No
Chub, Mohave Tui	*Gila bicolor mohavensis*	E	Fish	No
Chub, Oregon	*Oregonichthys crameri*	E	Fish	No
Chub, Owens Tui	*Gila bicolor snyderi*	E	Fish	No
Chub, Pahranagat Roundtail	*Gila robusta jordani*	E	Fish	No
Chub, Slender	*Erimystax cahni*	T	Fish	No
Chub, Sonora	*Gila ditaenia*	T	Fish	No
Chub, Spotfin	*Erimonax monachus*	T	Fish	No
Chub, Virgin River	*Gila seminuda (=robusta)*	E	Fish	No
Chub, Yaqui	*Gila purpurea*	E	Fish	No
Chucky Madtom	*Noturus crypticus*	E	Fish	No
Cui-ui	*Chasmistes cujus*	E	Fish	No
Cumberland darter	*Etheostoma susanae*	E	Fish	No
Dace, Ash Meadows Speckled	*Rhinichthys osculus nevadensis*	E	Fish	No

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Dace, Blackside	*Phoxinus cumberlandensis*	T	Fish	No
Dace, Clover Valley Speckled	*Rhinichthys osculus oligoporus*	E	Fish	No
Dace, Desert	*Eremichthys acros*	T	Fish	No
Dace, Foskett Speckled	*Rhinichthys osculus ssp.*	T	Fish	No
Dace, Independence Valley Speckled	*Rhinichthys osculus lethoporus*	E	Fish	No
Dace, Moapa	*Moapa coriacea*	E	Fish	No
Darter, Amber	*Percina antesella*	E	Fish	No
Darter, Bayou	*Etheostoma rubrum*	T	Fish	No
Darter, Bluemask (=jewel)	*Etheostoma sp.*	E	Fish	No
Darter, Boulder	*Etheostoma wapiti*	E	Fish	No
Darter, Cherokee	*Etheostoma scotti*	T	Fish	No
Darter, Duskytail	*Etheostoma percnurum*	E	Fish	No
Darter, Etowah	*Etheostoma etowahae*	E	Fish	No
Darter, Fountain	*Etheostoma fonticola*	E	Fish	No
Darter, Goldline	*Percina aurolineata*	T	Fish	No
Darter, Leopard	*Percina pantherina*	T	Fish	No
Darter, Maryland	*Etheostoma sellare*	E	Fish	No
Darter, Niangua	*Etheostoma nianguae*	T	Fish	No
Darter, Okaloosa	*Etheostoma okaloosae*	E	Fish	No
Darter, Relict	*Etheostoma chienense*	E	Fish	No
Darter, Slackwater	*Etheostoma boschungi*	T	Fish	No
Darter, Snail	*Percina tanasi*	T	Fish	No
Darter, Vermilion	*Etheostoma chermocki*	E	Fish	No
Darter, Watercress	*Etheostoma nuchale*	E	Fish	No
Gambusia, Big Bend	*Gambusia gaigei*	E	Fish	No
Gambusia, Clear Creek	*Gambusia heterochir*	E	Fish	No
Gambusia, Pecos	*Gambusia nobilis*	E	Fish	No
Gambusia, San Marcos	*Gambusia georgei*	E	Fish	No
Goby, Tidewater	*Eucyclogobius newberryi*	E	Fish	No
Laurel dace	*Chrosomus aylori*	E	Fish	No
Logperch, Conasauga	*Percina jenkinsi*	E	Fish	No
Logperch, Roanoke	*Percina rex*	E	Fish	No
Madtom, Neosho	*Noturus placidus*	T	Fish	No

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Madtom, Pygmy	*Noturus stanauli*	E	Fish	No
Madtom, Scioto	*Noturus trautmani*	E	Fish	No
Madtom, Smoky	*Noturus baileyi*	E	Fish	No
Madtom, Yellowfin	*Noturus flavipinnis*	T	Fish	No
Minnow, Devils River	*Dionda diaboli*	T	Fish	No
Minnow, Loach	*Tiaroga cobitis*	E	Fish	No
Minnow, Rio Grande Silvery	*Hybognathus amarus*	E	Fish	No
Pupfish, Ash Meadows Amargosa	*Cyprinodon nevadensis mionectes*	E	Fish	No
Pupfish, Comanche Springs	*Cyprinodon elegans*	E	Fish	No
Pupfish, Desert	*Cyprinodon macularius*	E	Fish	No
Pupfish, Devils Hole	*Cyprinodon diabolis*	E	Fish	No
Pupfish, Leon Springs	*Cyprinodon bovinus*	E	Fish	No
Pupfish, Owens	*Cyprinodon radiosus*	E	Fish	No
Pupfish, Warm Springs	*Cyprinodon nevadensis pectoralis*	E	Fish	No
Rockfish, Bocaccio	*Sebastes paucispinis*	E	Fish	No
Rush darter	*Etheostoma phytophilum*	E	Fish	No
Salmon, Atlantic	*Salmo salar*	E	Fish	No
Salmon, Chinook	*Oncorhynchus (=Salmo) tshawytscha*	E/T	Fish	No
Salmon, Chum	*Oncorhynchus (=Salmo) keta*	T	Fish	No
Salmon, Coho	*Oncorhynchus (=Salmo) kisutch*	E/T	Fish	No
Salmon, Sockeye	*Oncorhynchus (=Salmo) nerka*	E	Fish	No
Sawfish, Smalltooth	*Pristis pectinata*	E	Fish	No
Sculpin, Pygmy	*Cottus paulus (=pygmaeus)*	T	Fish	No
Shiner, Arkansas River	*Notropis girardi*	T	Fish	No
Shiner, Beautiful	*Cyprinella formosa*	T	Fish	No
Shiner, Blue	*Cyprinella caerulea*	T	Fish	No
Shiner, Cahaba	*Notropis cahabae*	E	Fish	No
Shiner, Cape Fear	*Notropis mekistocholas*	E	Fish	No
Shiner, Palezone	*Notropis albizonatus*	E	Fish	No
Shiner, Pecos Bluntnose	*Notropis simus pecosensis*	T	Fish	No
Shiner, Topeka	*Notropis topeka (=tristis)*	E	Fish	No
Silverside, Waccamaw	*Menidia extensa*	T	Fish	No
Smelt, Delta	*Hypomesus transpacificus*	T	Fish	No

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Spikedace	*Meda fulgida*	E	Fish	No
Spinedace, Big Spring	*Lepidomeda mollispinis pratensis*	T	Fish	No
Spinedace, Little Colorado	*Lepidomeda vittata*	T	Fish	No
Spinedace, White River	*Lepidomeda albivallis*	E	Fish	No
Springfish, Hiko White River	*Crenichthys baileyi grandis*	E	Fish	No
Springfish, Railroad Valley	*Crenichthys nevadae*	T	Fish	No
Springfish, White River	*Crenichthys baileyi baileyi*	E	Fish	No
Squawfish, Colorado	*Ptychocheilus lucius*	E	Fish	No
Steelhead	*Oncorhynchus (=Salmo) mykiss*	E/T	Fish	No
Stickleback, Unarmored Threespine	*Gasterosteus aculeatus williamsoni*	E	Fish	No
Sturgeon, Alabama	*Scaphirhynchus suttkusi*	E	Fish	No
Sturgeon, Gulf	*Acipenser oxyrinchus desotoi*	T	Fish	No
Sturgeon, North American green	*Acipenser medirostris*	T	Fish	No
Sturgeon, Pallid	*Scaphirhynchus albus*	E	Fish	No
Sturgeon, Shortnose	*Acipenser brevirostrum*	E	Fish	No
Sturgeon, Shovelnose	*Scaphirhynchus platorynchus*	SAT	Fish	No
Sturgeon, White	*Acipenser transmontanus*	E	Fish	No
Sucker, June	*Chasmistes liorus*	E	Fish	No
Sucker, Lost River	*Deltistes luxatus*	E	Fish	No
Sucker, Modoc	*Catostomus microps*	E	Fish	No
Sucker, Razorback	*Xyrauchen texanus*	E	Fish	No
Sucker, Santa Ana	*Catostomus santaanae*	T	Fish	No
Sucker, Shortnose	*Chasmistes brevirostris*	E	Fish	No
Sucker, Warner	*Catostomus warnerensis*	T	Fish	No
Topminnow, Gila (Yaqui)	*Poeciliopsis occidentalis*	E	Fish	No
Trout, Apache	*Oncorhynchus apache*	T	Fish	No
Trout, Bull	*Salvelinus confluentus*	T	Fish	No
Trout, Gila	*Oncorhynchus gilae*	E	Fish	No
Trout, Greenback Cutthroat	*Oncorhynchus clarki stomias*	T	Fish	No
Trout, Lahontan Cutthroat	*Oncorhynchus clarki henshawi*	T	Fish	No
Trout, Little Kern Golden	*Oncorhynchus aguabonita whitei*	T	Fish	No
Trout, Paiute Cutthroat	*Oncorhynchus clarki seleniris*	T	Fish	No
Woundfin	*Plagopterus argentissimus*	E	Fish	No

Common Name	Scientific Name	Status	Taxon	Potential for Direct Effects to Taxon?
Yellowcheek darter	*Etheostoma moorei*	E	Fish	No
Abalone, Black	*Haliotis cracherodii*	E	Gastropod	No
Abalone, White	*Haliotis sorenseni*	E	Gastropod	No
Ambersnail, Kanab	*Oxyloma haydeni kanabensis*	E	Gastropod	No
Campeloma, Slender	*Campeloma decampi*	E	Gastropod	No
Cavesnail, Tumbling Creek	*Antrobia culveri*	E	Gastropod	No
Elimia, Lacy	*Elimia crenatella*	T	Gastropod	No
Hornsnail, rough	*Pleurocera foremani*	E	Gastropod	No
Limpet, Banbury Springs	*Lanx sp.*	E	Gastropod	No
Marstonia, Royal (=Royal Snail)	*Pyrgulopsis ogmorhaphe*	E	Gastropod	No
Pebblesnail, Flat	*Lepyrium showalteri*	E	Gastropod	No
Riversnail, Anthony's	*Athearnia anthonyi*	E	Gastropod	No
Rocksnail, interrupted	*Leptoxis foremani*	E	Gastropod	No
Rocksnail, Painted	*Leptoxis taeniata*	T	Gastropod	No
Rocksnail, Plicate	*Leptoxis plicata*	E	Gastropod	No
Rocksnail, Round	*Leptoxis ampla*	T	Gastropod	No
Shagreen, Magazine Mountain	*Mesodon magazinensis*	T	Gastropod	No
Snail, Armored	*Pyrgulopsis (=Marstonia) pachyta*	E	Gastropod	No
Snail, Bliss Rapids	*Taylorconcha serpenticola*	T	Gastropod	No
Snail, Chittenango Ovate Amber	*Succinea chittenangoensis*	T	Gastropod	No
Snail, Flat-spired Three-toothed	*Triodopsis platysayoides*	T	Gastropod	No
Snail, Iowa Pleistocene	*Discus macclintocki*	E	Gastropod	No
Snail, Lioplax Cylindrical	*Lioplax cyclostomaformis*	E	Gastropod	No
Snail, Morro Shoulderband	*Helminthoglypta walkeriana*	E	Gastropod	No
Snail, Newcomb's	*Erinna newcombi*	T	Gastropod	No
Snail, Noonday	*Mesodon clarki nantahala*	T	Gastropod	No
Snail, O'ahu Tree (Achatinella abbreviata)	*Achatinella abbreviata*	E	Gastropod	No
Snail, O'ahu Tree (Achatinella apexfulva)	*Achatinella apexfulva*	E	Gastropod	No
Snail, O'ahu Tree (Achatinella bellula)	*Achatinella bellula*	E	Gastropod	No
Snail, O'ahu Tree (Achatinella buddii)	*Achatinella buddii*	E	Gastropod	No
Snail, O'ahu Tree (Achatinella bulimoides)	*Achatinella bulimoides*	E	Gastropod	No
Snail, O'ahu Tree (Achatinella byronii)	*Achatinella byronii*	E	Gastropod	No
Snail, O'ahu Tree (Achatinella caesia)	*Achatinella caesia*	E	Gastropod	No

Common Name	**Scientific Name**	**Status**	**Taxon**	**Potential for Direct Effects to Taxon?**
Snail, O'ahu Tree (Achatinella casta)	*Achatinella casta*	E	Gastropod	No
Snail, O'ahu Tree (Achatinella cestus)	*Achatinella cestus*	E	Gastropod	No
Snail, O'ahu Tree (Achatinella concavospira)	*Achatinella concavospira*	E	Gastropod	No
Snail, O'ahu Tree (Achatinella curta)	*Achatinella curta*	E	Gastropod	No
Snail, O'ahu Tree (Achatinella decipiens)	*Achatinella decipiens*	E	Gastropod	No
Snail, O'ahu Tree (Achatinella decora)	*Achatinella decora*	E	Gastropod	No
Snail, O'ahu Tree (Achatinella dimorpha)	*Achatinella dimorpha*	E	Gastropod	No
Snail, O'ahu Tree (Achatinella elegans)	*Achatinella elegans*	E	Gastropod	No
Snail, O'ahu Tree (Achatinella fulgens)	*Achatinella fulgens*	E	Gastropod	No
Snail, O'ahu Tree (Achatinella fuscobasis)	*Achatinella fuscobasis*	E	Gastropod	No
Snail, O'ahu Tree (Achatinella juddii)	*Achatinella juddii*	E	Gastropod	No
Snail, O'ahu Tree (Achatinella juncea)	*Achatinella juncea*	E	Gastropod	No
Snail, O'ahu Tree (Achatinella lehuiensis)	*Achatinella lehuiensis*	E	Gastropod	No
Snail, O'ahu Tree (Achatinella leucorraphe)	*Achatinella leucorraphe*	E	Gastropod	No
Snail, O'ahu Tree (Achatinella lila)	*Achatinella lila*	E	Gastropod	No
Snail, O'ahu Tree (Achatinella livida)	*Achatinella livida*	E	Gastropod	No
Snail, O'ahu Tree (Achatinella lorata)	*Achatinella lorata*	E	Gastropod	No
Snail, O'ahu Tree (Achatinella mustelina)	*Achatinella mustelina*	E	Gastropod	No
Snail, O'ahu Tree (Achatinella papyracea)	*Achatinella papyracea*	E	Gastropod	No
Snail, O'ahu Tree (Achatinella phaeozona)	*Achatinella phaeozona*	E	Gastropod	No
Snail, O'ahu Tree (Achatinella pulcherrima)	*Achatinella pulcherrima*	E	Gastropod	No
Snail, O'ahu Tree (Achatinella pupukanioe)	*Achatinella pupukanioe*	E	Gastropod	No
Snail, O'ahu Tree (Achatinella rosea)	*Achatinella rosea*	E	Gastropod	No
Snail, O'ahu Tree (Achatinella sowerbyana)	*Achatinella sowerbyana*	E	Gastropod	No
Snail, O'ahu Tree (Achatinella spaldingi)	*Achatinella spaldingi*	E	Gastropod	No
Snail, O'ahu Tree (Achatinella stewartii)	*Achatinella stewartii*	E	Gastropod	No
Snail, O'ahu Tree (Achatinella swiftii)	*Achatinella swiftii*	E	Gastropod	No
Snail, O'ahu Tree (Achatinella taeniolata)	*Achatinella taeniolata*	E	Gastropod	No
Snail, O'ahu Tree (Achatinella thaanumi)	*Achatinella thaahumi*	E	Gastropod	No
Snail, O'ahu Tree (Achatinella turgida)	*Achatinella turgida*	E	Gastropod	No
Snail, O'ahu Tree (Achatinella valida)	*Achatinella valida*	E	Gastropod	No
Snail, O'ahu Tree (Achatinella viridans)	*Achatinella viridans*	E	Gastropod	No
Snail, O'ahu Tree (Achatinella vittata)	*Achatinella vittata*	E	Gastropod	No

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Snail, O'ahu Tree (Achatinella vulpina)	*Achatinella vulpina*	E	Gastropod	No
Snail, Pecos Assiminea	*Assiminea pecos*	E	Gastropod	No
Snail, Snake River Physa	*Physa natricina*	E	Gastropod	No
Snail, Tulotoma	*Tulotoma magnifica*	T	Gastropod	No
Snail, Virginia Fringed Mountain	*Polygyriscus virginianus*	E	Gastropod	No
Springsnail, Alamosa	*Tryonia alamosae*	E	Gastropod	No
Springsnail, Bruneau Hot	*Pyrgulopsis bruneauensis*	E	Gastropod	No
Springsnail, Chupadera	*Pyrgulopsis chupaderae*	E	Gastropod	No
Springsnail, Koster's	*Juturnia kosteri*	E	Gastropod	No
Springsnail, Roswell	*Pyrgulopsis roswellensis*	E	Gastropod	No
Springsnail, San Bernardino	*Pyrgulopsis bernardina*	E	Gastropod	No
Springsnail, Socorro	*Pyrgulopsis neomexicana*	E	Gastropod	No
Springsnail, Three Forks	*Pyrgulopsis trivialis*	E	Gastropod	No
Beetle, American Burying	*Nicrophorus americanus*	E	Insect	No
Beetle, Casey's June	*Dinacoma caseyi*	E	Insect	No
Beetle, Coffin Cave Mold	*Batrisodes texanus*	E	Insect	No
Beetle, Comal Springs Dryopid	*Stygoparnus comalensis*	E	Insect	No
Beetle, Comal Springs Riffle	*Heterelmis comalensis*	E	Insect	No
Beetle, Delta Green Ground	*Elaphrus viridis*	T	Insect	No
Beetle, Helotes Mold	*Batrisodes venyivi*	E	Insect	No
Beetle, Hungerford's Crawling Water	*Brychius hungerfordi*	E	Insect	No
Beetle, Kretschmarr Cave Mold	*Texamaurops reddelli*	E	Insect	No
Beetle, Mount Hermon June	*Polyphylla barbata*	E	Insect	No
Beetle, Northeastern Beach Tiger	*Cicindela dorsalis dorsalis*	T	Insect	No
Beetle, Ohlone Tiger	*Cicindela ohlone*	E	Insect	No
Beetle, Puritan Tiger	*Cicindela puritana*	T	Insect	No
Beetle, Salt Creek Tiger	*Cicindela nevadica lincolniana*	E	Insect	No
Beetle, Tooth Cave Ground	*Rhadine persephone*	E	Insect	No
Beetle, Valley Elderberry Longhorn	*Desmocerus californicus dimorphus*	T	Insect	No
blackline Hawaiian damselfly	*Megalagrion nigrohamatum nigrolineatum*	E	Insect	No
Butterfly [Cassius Blue, Ceraunus Blue, Nickerbean Blue]	*Leptotes and Hemiargus and Cyclargus genus*	SAT	Insect	No
Butterfly, Bay Checkerspot (Wright's euphydryas)	*Euphydryas editha bayensis*	T	Insect	No
Butterfly, Behren's Silverspot	*Speyeria zerene behrensii*	E	Insect	No

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Butterfly, Callippe Silverspot	*Speyeria callippe callippe*	E	Insect	No
Butterfly, Ceranus Blue	*Hemiargus ceraunus antibubastus*	SAT	Insect	No
Butterfly, El Segundo Blue	*Euphilotes battoides allyni*	E	Insect	No
Butterfly, Fender's Blue	*Icaricia icarioides fenderi*	E	Insect	No
Butterfly, Karner Blue	*Lycaeides melissa samuelis*	E	Insect	No
Butterfly, Lange's Metalmark	*Apodemia mormo langei*	E	Insect	No
Butterfly, Lotis Blue	*Lycaeides argyrognomon lotis*	E	Insect	No
Butterfly, Miami Blue	*Cyclargus thomasi bethunebakeri*	E	Insect	No
Butterfly, Mission Blue	*Icaricia icarioides missionensis*	E	Insect	No
Butterfly, Mitchell's Satyr	*Neonympha mitchellii mitchellii*	E	Insect	No
Butterfly, Myrtle's Silverspot	*Speyeria zerene myrtleae*	E	Insect	No
Butterfly, Nickerbean Blue	*Cyclargus ammon*	SAT	Insect	No
Butterfly, Oregon Silverspot	*Speyeria zerene hippolyta*	T	Insect	No
Butterfly, Palos Verdes Blue	*Glaucopsyche lygdamus palosverdesensis*	E	Insect	No
Butterfly, Quino Checkerspot	*Euphydryas editha quino (=E. e. wrighti)*	E	Insect	No
Butterfly, Saint Francis' Satyr	*Neonympha mitchellii francisci*	E	Insect	No
Butterfly, San Bruno Elfin	*Callophrys mossii bayensis*	E	Insect	No
Butterfly, Smith's Blue	*Euphilotes enoptes smithi*	E	Insect	No
Butterfly, Uncompahgre Fritillary	*Boloria acrocnema*	E	Insect	No
Crimson Hawaiian damselfly	*Megalagrion leptodemas*	E	Insect	No
Damselfly, Flying Earwig Hawaiian	*Megalagrion nesiotes*	E	Insect	No
Damselfly, Pacific Hawaiian	*Megalagrion pacificum*	E	Insect	No
Dragonfly, Hine's Emerald	*Somatochlora hineana*	E	Insect	No
Fly, Delhi Sands Flower-loving	*Rhaphiomidas terminatus abdominalis*	E	Insect	No
Fly, Hawaiian picture-wing	*Drosophila aglaia*	E	Insect	No
Fly, Hawaiian picture-wing	*Drosophila hemipeza*	E	Insect	No
Fly, Hawaiian picture-wing	*Drosophila heteroneura*	E	Insect	No
Fly, Hawaiian picture-wing	*Drosophila montgomeryi*	E	Insect	No
Fly, Hawaiian picture-wing	*Drosophila mulli*	T	Insect	No
Fly, Hawaiian picture-wing	*Drosophila musaphilia*	E	Insect	No
Fly, Hawaiian picture-wing	*Drosophila neoclavisetae*	E	Insect	No
Fly, Hawaiian picture-wing	*Drosophila obatai*	E	Insect	No
Fly, Hawaiian picture-wing	*Drosophila ochrobasis*	E	Insect	No

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Fly, Hawaiian picture-wing	*Drosophila substenoptera*	E	Insect	No
Fly, Hawaiian picture-wing	*Drosophila tarphytrichia*	E	Insect	No
Grasshopper, Zayante Band-winged	*Trimerotropis infantilis*	E	Insect	No
Hawaiian picture-wing Fly	*Drosophila sharpi*	E	Insect	No
Moth, Blackburn's Sphinx	*Manduca blackburni*	E	Insect	No
Moth, Kern Primrose Sphinx	*Euproserpinus euterpe*	T	Insect	No
Naucorid, Ash Meadows	*Ambrysus amargosus*	T	Insect	No
Oceanic Hawaiian damselfly	*Megalagrion oceanicum*	E	Insect	No
Rhadine exilis (ncn)	*Rhadine exilis*	E	Insect	No
Rhadine infernalis (ncn)	*Rhadine infernalis*	E	Insect	No
Skipper, Carson Wandering	*Pseudocopaeodes eunus obscurus*	E	Insect	No
Skipper, Laguna Mountain	*Pyrgus ruralis lagunae*	E	Insect	No
Skipper, Pawnee Montane	*Hesperia leonardus montana*	T	Insect	No
Cladonia, Florida Perforate	*Cladonia perforata*	E	Lichen	No
Lichen, Rock Gnome	*Gymnoderma lineare*	E	Lichen	No
Bat, Gray	*Myotis grisescens*	E	Mammal	Yes
Bat, Hawaiian Hoary	*Lasiurus cinereus semotus*	E	Mammal	Yes
Bat, Indiana	*Myotis sodalis*	E	Mammal	Yes
Bat, Lesser (=Sanborn's) Long-nosed	*Leptonycteris curasoae yerbabuenae*	E	Mammal	Yes
Bat, Little Mariana Fruit	*Pteropus tokudae*	E	Mammal	Yes
Bat, Mariana Fruit (=Mariana Flying Fox)	*Pteropus mariannus mariannus*	T	Mammal	Yes
Bat, Mexican Long-nosed	*Leptonycteris nivalis*	E	Mammal	Yes
Bat, Ozark Big-eared	*Corynorhinus (=Plecotus) townsendii ingens*	E	Mammal	Yes
Bat, Virginia Big-eared	*Corynorhinus (=Plecotus) townsendii virginianus*	E	Mammal	Yes
Bear, American Black	*Ursus americanus*	SAT	Mammal	Yes
Bear, Grizzly	*Ursus arctos horribilis*	T	Mammal	Yes
Bear, Louisiana Black	*Ursus americanus luteolus*	T	Mammal	Yes
Bison, Wood	*Bison bison athabascae*	E	Mammal	Yes
Caribou, Woodland	*Rangifer tarandus caribou*	E	Mammal	Yes
Deer, Columbian White-tailed	*Odocoileus virginianus leucurus*	E	Mammal	Yes
Ferret, Black-footed	*Mustela nigripes*	E	Mammal	Yes
Fox, San Joaquin Kit	*Vulpes macrotis mutica*	E	Mammal	Yes
Fox, San Miguel Island	*Urocyon littoralis littoralis*	E	Mammal	Yes

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Fox, Santa Catalina Island	*Urocyon littoralis catalinae*	E	Mammal	Yes
Fox, Santa Cruz Island	*Urocyon littoralis santacruzae*	E	Mammal	Yes
Fox, Santa Rosa Island	*Urocyon littoralis santarosae*	E	Mammal	Yes
Gray Wolf	*Canis lupus*	E	Mammal	Yes
Jaguar	*Panthera onca*	E	Mammal	Yes
Jaguarundi, Gulf Coast	*Herpailurus (=Felis) yagouaroundi cacomitli*	E	Mammal	Yes
Jaguarundi, Sinaloan	*Herpailurus (=Felis) yagouaroundi tolteca*	E	Mammal	Yes
Kangaroo Rat, Fresno	*Dipodomys nitratoides exilis*	E	Mammal	Yes
Kangaroo Rat, Giant	*Dipodomys ingens*	E	Mammal	Yes
Kangaroo Rat, Morro Bay	*Dipodomys heermanni morroensis*	E	Mammal	Yes
Kangaroo Rat, San Bernardino Merriam's	*Dipodomys merriami parvus*	E	Mammal	Yes
Kangaroo Rat, Stephens'	*Dipodomys stephensi (incl. D. cascus)*	E	Mammal	Yes
Kangaroo Rat, Tipton	*Dipodomys nitratoides nitratoides*	E	Mammal	Yes
Killer whale, Southern Resident DPS	*Orcinus orca*	E	Mammal	Yes
Lynx, Canada	*Lynx canadensis*	T	Mammal	Yes
Manatee, West Indian	*Trichechus manatus*	E	Mammal	Yes
Mountain Beaver, Point Arena	*Aplodontia rufa nigra*	E	Mammal	Yes
Mouse, Alabama Beach	*Peromyscus polionotus ammobates*	E	Mammal	Yes
Mouse, Anastasia Island Beach	*Peromyscus polionotus phasma*	E	Mammal	Yes
Mouse, Choctawhatchee Beach	*Peromyscus polionotus allophrys*	E	Mammal	Yes
Mouse, Pacific Pocket	*Perognathus longimembris pacificus*	E	Mammal	Yes
Mouse, Perdido Key Beach	*Peromyscus polionotus trissyllepsis*	E	Mammal	Yes
Mouse, Preble's Meadow Jumping	*Zapus hudsonius preblei*	T	Mammal	Yes
Mouse, Salt Marsh Harvest	*Reithrodontomys raviventris*	E	Mammal	Yes
Mouse, Southeastern Beach	*Peromyscus polionotus niveiventris*	T	Mammal	Yes
Mouse, St. Andrew Beach	*Peromyscus polionotus peninsularis*	E	Mammal	Yes
Ocelot	*Leopardus (=Felis) pardalis*	E	Mammal	Yes
Otter, Northern Sea	*Enhydra lutris kenyoni*	T	Mammal	Yes
Otter, Southern Sea	*Enhydra lutris nereis*	T	Mammal	Yes
Panther, Florida	*Puma (=Felis) concolor coryi*	E	Mammal	Yes
Prairie Dog, Utah	*Cynomys parvidens*	T	Mammal	Yes
Pronghorn, Sonoran	*Antilocapra americana sonoriensis*	E	Mammal	Yes
Puma (=Cougar), Eastern	*Puma (=Felis) concolor (all subsp. except coryi)*	E	Mammal	Yes

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Rabbit, Pygmy	*Brachylagus idahoensis*	E	Mammal	Yes
Rabbit, Riparian Brush	*Sylvilagus bachmani riparius*	E	Mammal	Yes
Seal, Guadalupe Fur	*Arctocephalus townsendi*	T	Mammal	Yes
Seal, Hawaiian Monk	*Monachus schauinslandi*	E	Mammal	Yes
Seal, spotted	*Phoca largha*	T	Mammal	Yes
Sea-lion, Steller	*Eumetopias jubatus*	E/T	Mammal	Yes
Sheep, Peninsular Bighorn	*Ovis canadensis nelsoni*	E	Mammal	Yes
Sheep, Sierra Nevada Bighorn	*Ovis canadensis sierrae*	E	Mammal	Yes
Shrew, Buena Vista Lake Ornate	*Sorex ornatus relictus*	E	Mammal	Yes
Squirrel, Carolina Northern Flying	*Glaucomys sabrinus coloratus*	E	Mammal	Yes
Squirrel, Delmarva Peninsula Fox	*Sciurus niger cinereus*	E	Mammal	Yes
Squirrel, Mount Graham Red	*Tamiasciurus hudsonicus grahamensis*	E	Mammal	Yes
Squirrel, Northern Idaho Ground	*Spermophilus brunneus brunneus*	T	Mammal	Yes
Vole, Amargosa	*Microtus californicus scirpensis*	E	Mammal	Yes
Vole, Florida Salt Marsh	*Microtus pennsylvanicus dukecampbelli*	E	Mammal	Yes
Vole, Hualapai Mexican	*Microtus mexicanus hualpaiensis*	E	Mammal	Yes
Whale, beluga	*Delphinapterus leucas*	E	Mammal	Yes
Whale, Finback	*Balaenoptera physalus*	E	Mammal	Yes
Whale, Gray	*Eschrichtius robustus*	E	Mammal	Yes
Whale, Humpback	*Megaptera novaeangliae*	E	Mammal	Yes
Whale, North Atlantic right	*Eubalaena glacialis (incl. australis)*	E	Mammal	Yes
Whale, Sei	*Balaenoptera borealis*	E	Mammal	Yes
Whale, Sperm	*Physeter catodon (=macrocephalus)*	E	Mammal	Yes
Wolf, Red	*Canis rufus*	E	Mammal	Yes
Woodrat, Riparian	*Neotoma fuscipes riparia*	E	Mammal	Yes
Alopecurus, Sonoma	*Alopecurus aequalis var. sonomensis*	E	Monocot	Yes
Amole, Cammatta Canyon	*Chlorogalum purpureum var. reductum*	T	Monocot	Yes
Amole, Purple	*Chlorogalum purpureum var. purpureum*	T	Monocot	Yes
Aristida chaseae (ncn)	*Aristida chaseae*	E	Monocot	Yes
Arrowhead, Bunched	*Sagittaria fasciculata*	E	Monocot	Yes
Beaked-rush, Knieskern's	*Rhynchospora knieskernii*	T	Monocot	Yes
Beargrass, Britton's	*Nolina brittoniana*	E	Monocot	Yes
Beauty, Harper's	*Harperocallis flava*	E	Monocot	Yes

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Bluegrass, Hawaiian	*Poa sandvicensis*	E	Monocot	Yes
Bluegrass, Mann's (Poa mannii)	*Poa mannii*	E	Monocot	Yes
Bluegrass, Napa	*Poa napensis*	E	Monocot	Yes
Bluegrass, San Bernardino	*Poa atropurpurea*	E	Monocot	Yes
Brodiaea, Chinese Camp	*Brodiaea pallida*	T	Monocot	Yes
Brodiaea, Thread-leaved	*Brodiaea filifolia*	T	Monocot	Yes
Bulrush, Northeastern (=Barbed Bristle)	*Scirpus ancistrochaetus*	E	Monocot	Yes
Cranichis Ricartii	*Cranichis ricartii*	E	Monocot	Yes
Fritillary, Gentner's	*Fritillaria gentneri*	E	Monocot	Yes
Grass, California Orcutt	*Orcuttia californica*	E	Monocot	Yes
Grass, Colusa	*Neostapfia colusana*	T	Monocot	Yes
Grass, Eureka Dune	*Swallenia alexandrae*	E	Monocot	Yes
Grass, Fosberg's Love	*Eragrostis fosbergii*	E	Monocot	Yes
Grass, San Joaquin Valley Orcutt	*Orcuttia inaequalis*	T	Monocot	Yes
Grass, Solano	*Tuctoria mucronata*	E	Monocot	Yes
Grass, Tennessee Yellow-eyed	*Xyris tennesseensis*	E	Monocot	Yes
Hala Pepe (Pleomele hawaiiensis)	*Pleomele hawaiiensis*	E	Monocot	Yes
Hilo Ischaemum (Ischaemum byrone)	*Ischaemum byrone*	E	Monocot	Yes
Iris, Dwarf Lake	*Iris lacustris*	T	Monocot	Yes
Irisette, White	*Sisyrinchium dichotomum*	E	Monocot	Yes
Kamanomano (Cenchrus agrimonioides)	*Cenchrus agrimonioides*	E	Monocot	Yes
Ladies'-tresses, Canelo Hills	*Spiranthes delitescens*	E	Monocot	Yes
Ladies'-tresses, Navasota	*Spiranthes parksii*	E	Monocot	Yes
Ladies'-tresses, Ute	*Spiranthes diluvialis*	T	Monocot	Yes
Lau'ehu (Panicum niihauense)	*Panicum niihauense*	E	Monocot	Yes
Lepanthes eltorensis (ncn)	*Lepanthes eltoroensis*	E	Monocot	Yes
Lily, Minnesota Trout	*Erythronium propullans*	E	Monocot	Yes
Lily, Pitkin Marsh	*Lilium pardalinum ssp. pitkinense*	E	Monocot	Yes
Lily, Tiburon Mariposa	*Calochortus tiburonensis*	T	Monocot	Yes
Lily, Western	*Lilium occidentale*	E	Monocot	Yes
lo`ulu	*Pritchardia hardyi*	E	Monocot	Yes
Lo`ulu (Pritchardia affinis)	*Pritchardia affinis*	E	Monocot	Yes
Lo`ulu (Pritchardia kaalae)	*Pritchardia kaalae*	E	Monocot	Yes

Common Name	Scientific Name	Status	Taxon	Potential for Direct Effects to Taxon?
Lo`ulu (Pritchardia napaliensis)	*Pritchardia napaliensis*	E	Monocot	Yes
Lo`ulu (Pritchardia schattaueri)	*Pritchardia schattaueri*	E	Monocot	Yes
Lo`ulu (Pritchardia viscosa)	*Pritchardia viscosa*	E	Monocot	Yes
Manaca, palma de	*Calyptronoma rivalis*	T	Monocot	Yes
Mariscus fauriei (ncn)	*Mariscus fauriei*	E	Monocot	Yes
Mariscus pennatiformis (ncn)	*Mariscus pennatiformis*	E	Monocot	Yes
Onion, Munz's	*Allium munzii*	E	Monocot	Yes
Orchid, Eastern Prairie Fringed	*Platanthera leucophaea*	T	Monocot	Yes
Orchid, Western Prairie Fringed	*Platanthera praeclara*	T	Monocot	Yes
Pa'iniu	*Astelia waialealae*	E	Monocot	Yes
Panicgrass, Carter's (Panicum fauriei var.carteri)	*Panicum fauriei var. carteri*	E	Monocot	Yes
Pelos del Diablo	*Aristida portoricensis*	E	Monocot	Yes
Pink, Swamp	*Helonias bullata*	T	Monocot	Yes
Piperia, Yadon's	*Piperia yadonii*	E	Monocot	Yes
Platanthera holochila (ncn)	*Platanthera holochila*	E	Monocot	Yes
Poa siphonoglossa (ncn)	*Poa siphonoglossa*	E	Monocot	Yes
Pogonia, Small Whorled	*Isotria medeoloides*	T	Monocot	Yes
Pondweed, Little Aguja Creek	*Potamogeton clystocarpus*	E	Monocot	Yes
Pu'uka'a (Cyperus trachysanthos)	*Cyperus trachysanthos*	E	Monocot	Yes
Seagrass, Johnson's	*Halophila johnsonii*	T	Monocot	Yes
Sedge, Golden	*Carex lutea*	E	Monocot	Yes
Sedge, Navajo	*Carex specuicola*	T	Monocot	Yes
Sedge, White	*Carex albida*	E	Monocot	Yes
Trillium, Persistent	*Trillium persistens*	E	Monocot	Yes
Trillium, Relict	*Trillium reliquum*	E	Monocot	Yes
Walnut, Nogal	*Juglans jamaicensis*	E	Monocot	Yes
Water-plantain, Kral's	*Sagittaria secundifolia*	T	Monocot	Yes
Wild-rice, Texas	*Zizania texana*	E	Monocot	Yes
Alligator, American	*Alligator mississippiensis*	T	Reptile	No
Boa, Puerto Rican	*Epicrates inornatus*	E	Reptile	No
Boa, Virgin Islands Tree	*Epicrates monensis granti*	E	Reptile	No
Crocodile, American	*Crocodylus acutus*	T	Reptile	No
Lizard, Blunt-nosed Leopard	*Gambelia silus*	E	Reptile	No

Common Name	Scientific Name	Status	Taxon	Potential for Direct Effects to Taxon?
Lizard, Coachella Valley Fringe-toed	*Uma inornata*	T	Reptile	No
Lizard, Island Night	*Xantusia riversiana*	T	Reptile	No
Lizard, St. Croix Ground	*Ameiva polops*	E	Reptile	No
Rattlesnake, New Mexican Ridge-nosed	*Crotalus willardi obscurus*	T	Reptile	No
Sea turtle, green	*Chelonia mydas*	E/T	Reptile	No
Sea turtle, hawksbill	*Eretmochelys imbricata*	E	Reptile	No
Sea turtle, leatherback	*Dermochelys coriacea*	E	Reptile	No
Sea turtle, loggerhead	*Caretta caretta*	E/T	Reptile	No
Skink, Blue-tailed Mole	*Eumeces egregius lividus*	T	Reptile	No
Skink, Sand	*Neoseps reynoldsi*	T	Reptile	No
Snake, Atlantic Salt Marsh	*Nerodia clarkii taeniata*	T	Reptile	No
Snake, Eastern Indigo	*Drymarchon corais couperi*	T	Reptile	No
Snake, Giant Garter	*Thamnophis gigas*	T	Reptile	No
Snake, Northern Copperbelly Water	*Nerodia erythrogaster neglecta*	T	Reptile	No
Snake, San Francisco Garter	*Thamnophis sirtalis tetrataenia*	E	Reptile	No
Tortoise, Desert	*Gopherus agassizii*	T	Reptile	No
Tortoise, Gopher	*Gopherus polyphemus*	T	Reptile	No
Turtle, Alabama Red-bellied	*Pseudemys alabamensis*	E	Reptile	No
Turtle, Bog	*Clemmys muhlenbergii*	T	Reptile	No
Turtle, Flattened Musk	*Sternotherus depressus*	T	Reptile	No
Turtle, Plymouth Red-bellied	*Pseudemys rubriventris bangsi*	E	Reptile	No
Turtle, Ringed Map	*Graptemys oculifera*	T	Reptile	No
Turtle, Yellow-blotched Map	*Graptemys flavimaculata*	T	Reptile	No
Whipsnake (=Striped Racer), Alameda	*Masticophis lateralis euryxanthus*	T	Reptile	No