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

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MEMORANDUM

Subject: Registration Review –Ecological Risk Assessment and Effects Determination of Quizalofop-P-Ethyl

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Attached is the ecological risk assessment and effects determination for the registration review of the herbicide, quizalofop-p-ethyl.

In general, registered uses of quizalofop-p-ethyl may cause direct adverse effects for:

- Chronic risk to mammals (all uses) (listed and non-listed species)
- Chronic risk to freshwater fish (surrogate for aquatic-phase amphibians) (pineapple only) (listed and non-listed species)
- Acute risk to freshwater invertebrates (pineapple only) (listed species)

- Acute risk to estuarine/marine invertebrates (pineapple only) (listed species)
- Terrestrial monocots (all uses) (listed and non-listed species)

More specifically, mammals with diets of short grass, tall grass, broadleaf plants, and arthropods and may be at chronic risk from all quizalofop-p-ethyl uses. EECs from scenarios with risk quotients above the level of concern were 1 to 4 times the value of the LOAEC. Likewise, all quizalofop-p-ethyl application scenarios present risks to terrestrial monocots via spray drift and many through runoff as well. The pineapple use in Hawaii and Puerto Rico presents chronic risks to freshwater fish (EECs were half the value of the LOAEC and twice the value of the NOAEC) and acute risks to freshwater and estuarine/marine invertebrates.

The spray drift analysis indicated that buffers may reduce the risk to terrestrial monocots for ground applications of quizalofop-p-ethyl. Implementing buffers (52 to 394 ft) lowers the risk quotients so that they are below the LOCs. It should be noted that this mitigation option is only applicable to risks from spray drift; the runoff exposure pathway still results in risk quotients above the LOC for ground applications.

Risks from registered quizalofop-p-ethyl uses are not expected for the following:

- Terrestrial dicots
- Acute risk to mammals
- Acute and chronic risk to birds, reptiles, and terrestrial-phase amphibians
- Acute risk to freshwater fish and aquatic-phase amphibians
- Acute and chronic risk to estuarine/marine fish
- Chronic risk to freshwater invertebrates
- Chronic risk to estuarine/marine invertebrates
- Acute risk to terrestrial insects

Given that there are possible direct effects to mammals, freshwater fish, aquatic invertebrates, and terrestrial monocots, indirect effects to other organisms could occur. Indirect effects may include, but are not necessarily limited to, food, shelter, seed dispersal/pollination, or other habitat alterations.

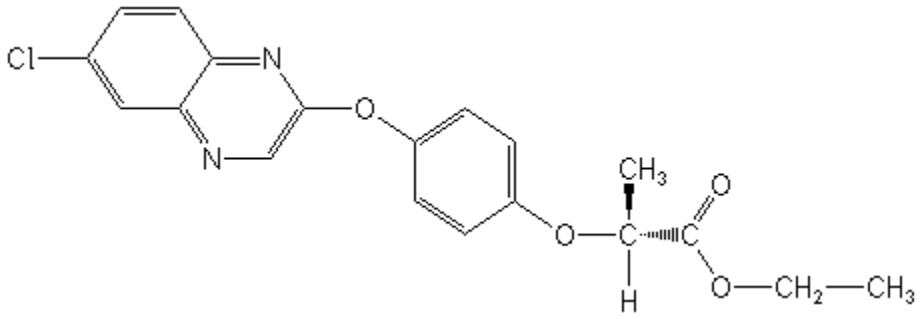
REGISTRATION REVIEW

ECOLOGICAL RISK ASSESSMENT AND EFFECTS DETERMINATION

Quizalofop-P-Ethyl

CAS Number 100646-51-3

USEPA PC CODE 128709



ethyl (2*R*)-2-[4-[(6-chloro-2-quinoxalinyl)oxy]phenoxy]propanoate

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Executive Summary

Quizalofop-p-ethyl is the active ingredient in quizalofop-ethyl herbicides. "Quizalofop-ethyl" is commonly used to refer to a pesticide composed of a 50/50 racemic mixture of R- and S-enantiomers (PC 128711). "Quizalofop-p-ethyl" is used to refer to a pesticide composed almost exclusively of the R-enantiomer (PC 128709). The R- enantiomer is the isomer with pesticidal properties. Both isomers were first registered in 1988, but only quizalofop-p-ethyl (PC 128709) has current active registrations.

E.1 Nature of Stressor

Quizalofop-p-ethyl is a systemic herbicide for the control of annual and perennial grasses that is registered for use on numerous crops such as cotton, soybeans, dry beans, lentils, sunflower, flax, wheat, and barley. Affected plant tissues become necrotic/chlorotic and die leaving treated plants stunted and non-competitive. Products are applied as liquid sprays (aerial and ground application equipment) and the timing corresponds with weed control at all stages of agricultural production (e.g., pre-emergence, during planting, post-emergence, pre-harvest, and burn down). Products are sold as emulsifiable concentrates and ready-to-use solutions that are 1.4% or 10.3% active ingredient.

Quizalofop-p-ethyl degrades into quizalofop acid (the actual active ingredient; sometimes referred to as "quizalofop"), a major degradate, which further degrades into 3-OH-quizalofop acid (another major degradate) and several minor degradates. The quizalofop-p-ethyl molecule is better able to penetrate the waxy cuticle of a leaf because of its relatively lipophilic nature, while quizalofop acid is better able to penetrate the cell wall and cell membrane because of its semi-lipophilic nature (less lipophilic, but not hydrophilic either). Quizalofop-p-ethyl, quizalofop acid, and 3-OH-quizalofop acid (because of its structural similarities to quizalofop acid) are considered the stressors for this risk assessment.

E.2 Assessment of Risk

Fate and effects data are largely available only for the parent chemical, quizalofop-p-ethyl. A total residues approach was used to adjust exposure half-lives to account for the duration of exposure to all three chemicals of concern. This issue affects the certainty of the risk conclusions.

E.2.1 Physico-Chemical and Environmental Fate Properties

Quizalofop-p-ethyl is relatively stable to hydrolysis at pHs of 5 and 7, but degrades much faster at pH 9 with a half life of 2 days. Quizalofop-p-ethyl is relatively stable to photolysis in water and soil ($t_{1/2}$ > 40 days). Laboratory aerobic soil metabolism studies show that quizalofop-p-ethyl degrades with a half-life of ~30 days to quizalofop acid, 3-OH-quizalofop

acid, and phenolic compounds. This compares with the terrestrial field dissipation (TFD) study producing quizalofop-p-ethyl half-lives of 1 to 12 days with quizalofop acid and 3-OH-quizalofop acid as degradates. (Note that field dissipation encompasses more transport and degradation pathways than laboratory degradation studies.) Laboratory anaerobic aquatic metabolism studies indicate half-lives of 95 and 107 days. (No studies have been submitted for anaerobic soil and aerobic aquatic metabolism.) Based on available fate studies conducted on the parent, quizalofop acid appears to be less persistent than the parent under aerobic conditions, but similar in mobility to the parent compound. As for mobility, the mean adsorption K_{oc} of quizalofop acid is 256 ml/g, whereas the mean adsorption K_{oc} value of quizalofop-p-ethyl is 298 (both classified as moderately mobile). No data are available for 3-OH-quizalofop acid, but it is assumed to have properties similar to quizalofop acid, based on structural similarities.

E.2.2 Ecological Risk Conclusions

The specific taxa that may be at risk from quizalofop-p-ethyl are dependent on the specific registered quizalofop-p-ethyl use. In general, registered uses of quizalofop-p-ethyl may cause direct adverse effects to mammals (chronic) and terrestrial monocots. EECs from scenarios that indicated potential chronic risks to mammals were 1 to 4 times the value of the LOAEC. The pineapple use may cause direct adverse effects to freshwater fish (chronic – EECs were half of the LOAEC and twice the NOAEC), freshwater invertebrates (acute), and estuarine/marine invertebrates (acute). It should be noted that the "paved area" scenario also indicated potential risk to aquatic organisms, but the scenario was very conservative because it assumed a spot treatment for weeds in paved areas would be applied over an entire acre. By assuming a more realistic percentage (treating 25% of an acre), risks were eliminated. Direct effects are not expected for other taxonomic groups.

Given that there are possible direct effects to mammals, freshwater fish, aquatic invertebrates, and plants, indirect effects to other organisms could occur. Indirect effects could include changes to food, shelter, seed dispersal/pollination, or other alterations of habitat.

A spray drift analysis indicated that risks to terrestrial monocots from ground applications of quizalofop-p-ethyl could be eliminated through the implementation of buffers (52 to 394 ft). These buffers only apply to risks from spray drift as a result of ground applications; risks to terrestrial monocots from runoff and/or aerial applications may be lessened through the use of these buffers, but not necessarily eliminated.

Tables E.1 – E.3 list the potential direct and indirect effects to listed and non-listed species, based on risk quotients exceeding the level of concern, as well as the organism group and

size classes potentially at risk from the highest application rate for each use of quizalofop-p-ethyl.

Table E.1. Potential direct effects to listed and non-listed terrestrial organisms from exposure to quizalofop-p-ethyl[1]

Quizalofop-p-ethyl	Listed Terrestrial Species					Non-listed Terrestrial Species				
	Birds[2]		Mammals		Plants	Birds[2]		Mammals		Plants
	Acute	Chronic	Acute	Chronic		Acute	Chronic	Acute	Chronic	
ID, MT, WA, OR, WY, only Non-food/non-feed seed production: alfalfa, carrot, Chinese cabbage, garlic, onion, radish, red beets, spinach, Swiss chard	N	N	N	Y (S,M,L)	Y	N	N	N	Y (S,M,L)	Y
Except NY: barley, wheat	N	N	N	Y (S,M)	Y	N	N	N	Y (S,M)	Y
Canola/rape, crambe, soybeans, sunflowers	N	N	N	Y (S,M,L)	Y	N	N	N	Y (S,M,L)	Y
Field corn seed production (herbicide-tolerant)	N	N	N	Y (S,M)	Y	N	N	N	Y (S,M)	Y
Sorghum (herbicide-tolerant)	N	N	N	Y (S,M,L)	Y	N	N	N	Y (S,M,L)	Y
Cotton	N	N	N	Y (S,M)	Y	N	N	N	Y (S,M)	Y
Dry beans	N	N	N	Y (S,M,L)	Y	N	N	N	Y (S,M,L)	Y
Dry and succulent peas, lentils, snap beans	N	N	N	Y (S,M)	Y	N	N	N	Y (S,M)	Y
TX, OK, KS, CO, only: fallow	N	N	N	Y (S,M,L)	Y	N	N	N	Y (S,M,L)	Y
Flax, garbanzos (including chick peas)	N	N	N	Y (S,M,L)	Y	N	N	N	Y (S,M,L)	Y
ME, MN, only: hybrid cottonwood/ poplar plantations	N	N	N	Y (S,M,L)	Y	N	N	N	Y (S,M,L)	Y
Mint (spearmint and peppermint)	N	N	N	Y (S,M,L)	Y	N	N	N	Y (S,M,L)	Y
Non-crop areas	N	N	N	Y (S,M,L)	Y	N	N	N	Y (S,M,L)	Y
Puerto Rico only: pineapple HI only: pineapple and ornamental and/or shade trees	N	N	N	Y (S,M,L)	Y	N	N	N	Y (S,M,L)	Y

Quizalofop-p-ethyl	Listed Terrestrial Species					Non-listed Terrestrial Species				
	Birds[2]		Mammals		Plants	Birds[2]		Mammals		Plants
	Acute	Chronic	Acute	Chronic		Acute	Chronic	Acute	Chronic	
Paved areas	N	N	N	Y (S,M,L)	Y	N	N	N	Y (S,M,L)	Y
MN only: perennial ryegrass grown for seed	N	N	N	Y (S,M,L)	Y	N	N	N	Y (S,M,L)	Y

[1] Y= Potential direct effects (RQ ≥ LOC); N = Potential direct effects not expected (RQ < LOC); S, M or L indicate which size class is potentially affected; S = small bird (20 g) or mammal (15 g); M = medium bird (100 g) or mammal (35 g); L = large bird (1000 g) or mammal (1000 g). For mammals, chronic size classes are for dose-based exposure only. Dietary-based acute and chronic exposure for birds and mammals is not evaluated using body weights. RQ values were determined for these specific weights only, therefore, it is expected that potential direct effects may exist between two size classes in which the lower size class exceeded the LOC but the next size class did not. Therefore, for example, if small birds (20 g) exceeded the LOC but medium birds (100 g) did not, then potential direct effects may exist for all birds less than 100 g at any life stage until can be shown otherwise.

[2] Birds are surrogates for terrestrial reptiles and terrestrial-phase amphibians.

Table E.2. Potential direct effects to listed aquatic organisms from exposure to quizalofop-p-ethyl[1]

Quizalofop-p-ethyl									
	Freshwater Fish		Estuarine/Marine Fish		Vascular Aquatic Plants	Freshwater Invertebrates		Estuarine/Marine Invertebrates	
	Acute	Chronic	Acute	Chronic		Acute	Chronic	Acute	Chronic
ID, MT, WA, OR, WY, only Non-food/non-feed seed production: alfalfa, carrot, Chinese cabbage, garlic, onion, radish, red beets, spinach, Swiss chard	N	N	N	N	N	N	N	N	N
Except NY: barley, wheat	N	N	N	N	N	N	N	N	N
Canola/rape, crambe, soybeans, sunflowers	N	N	N	N	N	N	N	N	N
Field corn seed production (herbicide-tolerant)	N	N	N	N	N	N	N	N	N
Sorghum (herbicide-tolerant)	N	N	N	N	N	N	N	N	N

Quizalofop-p-ethyl									
	Freshwater Fish		Estuarine/Marine Fish		Vascular Aquatic Plants	Freshwater Invertebrates		Estuarine/Marine Invertebrates	
	Acute	Chronic	Acute	Chronic		Acute	Chronic	Acute	Chronic
Cotton	N	N	N	N	N	N	N	N	N
Dry beans	N	N	N	N	N	N	N	N	N
Dry and succulent peas, lentils, snap beans	N	N	N	N	N	N	N	N	N
TX, OK, KS, CO, only: fallow	N	N	N	N	N	N	N	N	N
Flax, garbanzos (including chick peas)	N	N	N	N	N	N	N	N	N
ME, MN, only: hybrid cottonwood/ poplar plantations	N	N	N	N	N	N	N	N	N
Mint (spearmint and peppermint)	N	N	N	N	N	N	N	N	N
Non-crop areas	N	N	N	N	N	N	N	N	N
Puerto Rico only: pineapple HI only: pineapple and ornamental and/or shade trees	N	Y	N	N	N	Y	N	Y	N
Paved areas	N	N	N	N	N	N	N	N	N
MN only: perennial ryegrass grown for seed	N	N	N	N	N	N	N	N	N

[1] Y= Potential direct effects; N = Potential direct effects not expected

Table E.3. Potential direct effects to non-listed aquatic organisms from exposure to quizalofop-p-ethyl[1]

Quizalofop-p-ethyl									
	Freshwater Fish		Estuarine/Marine Fish		Vascular Aquatic Plants	Freshwater Invertebrates		Estuarine/Marine Invertebrates	
	Acute	Chronic	Acute	Chronic		Acute	Chronic	Acute	Chronic

Quizalofop-p-ethyl									
	Freshwater Fish		Estuarine/Marine Fish		Vascular Aquatic Plants	Freshwater Invertebrates		Estuarine/Marine Invertebrates	
	Acute	Chronic	Acute	Chronic		Acute	Chronic	Acute	Chronic
ID, MT, WA, OR, WY, only Non-food/non-feed seed production: alfalfa, carrot, Chinese cabbage, garlic, onion, radish, red beets, spinach, Swiss chard	N	N	N	N	N	N	N	N	N
Except NY: barley, wheat	N	N	N	N	N	N	N	N	N
Canola/rape, crambe, soybeans, sunflowers	N	N	N	N	N	N	N	N	N
Field corn seed production (herbicide-tolerant)	N	N	N	N	N	N	N	N	N
Sorghum (herbicide-tolerant)	N	N	N	N	N	N	N	N	N
Cotton	N	N	N	N	N	N	N	N	N
Dry beans	N	N	N	N	N	N	N	N	N
Dry and succulent peas, lentils, snap beans	N	N	N	N	N	N	N	N	N
TX, OK, KS, CO, only: fallow	N	N	N	N	N	N	N	N	N
Flax, garbanzos (including chick peas)	N	N	N	N	N	N	N	N	N
ME, MN, only: hybrid cottonwood/ poplar plantations	N	N	N	N	N	N	N	N	N
Mint (spearmint and peppermint)	N	N	N	N	N	N	N	N	N
Non-crop areas	N	N	N	N	N	N	N	N	N
Puerto Rico only: pineapple HI only: pineapple and ornamental and/or shade trees	N	Y	N	N	N	N	N	N	N
Paved areas	N	N	N	N	N	N	N	N	N
MN only: perennial ryegrass grown for seed	N	N	N	N	N	N	N	N	N

[1] Y= Potential direct effects; N = Potential direct effects not expected

E.3 Uncertainties

Certain data and other supporting information were not available to the Agency as it conducted the preliminary risk assessment for quizalofop-p-ethyl. As such, certain assumptions were made and conclusions were based on the information that was available. For some taxa, this may have resulted in the use of overly conservative approaches for evaluating risk. EFED has identified the information it believes may help best resolve these uncertainties. Additional information may allow EFED to refine its risk conclusions for certain species. Below is a summary of the uncertainties associated with the risk assessment of quizalofop-p-ethyl.

E.3.1 Ecotoxicity Data Gaps and Uncertainties

There were several ecotoxicity endpoints for which data were not available or available data were non-definitive.

- Estuarine/Marine Fish (Acute) OPPTS 850.1075. In the Problem Formulation, data were not requested because a registrant study had recently been submitted for this endpoint. A detailed review of the study at a later date indicated that it was "invalid" and thus not useable for risk assessments. To compensate for this data gap, freshwater and estuarine/marine acute fish toxicity studies for two structurally similar chemicals (fenoxaprop-p-ethyl and fenoxaprop-ethyl) were reviewed. The fenoxaprop-ethyl data indicated that freshwater fish are more sensitive than estuarine/marine fish. A comparison of quizalofop-p-ethyl acute freshwater fish data to fenoxaprop-ethyl indicated that quizalofop-p-ethyl is more toxic than fenoxaprop-ethyl. Thus it was determined that acute freshwater fish data from quizalofop-p-ethyl would be a protective surrogate for the missing estuarine/marine data.
- Estuarine/Marine Invertebrate (Chronic) OPPTS 850.1350. In the Problem Formulation, data were not requested because it was possible to calculate an acute-to-chronic ratio using freshwater invertebrates (waterflea) as a surrogate. An acute-to-chronic ratio will be used in the registration review risk assessment as well.
- Freshwater Fish (Chronic) OPPTS 850.1400. Chronic data are available for the fathead minnow; however, the most sensitive acute freshwater fish endpoint is for the rainbow trout. Acute toxicity information is not available for the fathead minnow. To ensure that the most sensitive chronic endpoint for freshwater fish was employed in the risk assessment, the acute to chronic ratio methodology was applied. An acute-chronic pair of data was available for the fathead minnow for fenoxaprop-p-ethyl, a structurally similar chemical to quizalofop-p-ethyl. The ratio between the fenoxaprop-p-ethyl fathead minnow endpoints was applied to the quizalofop-p-ethyl acute freshwater fish endpoint to derive a protective freshwater fish chronic endpoint.
- Avian (Acute) (LD_{50}) OPPTS 850.2100. Definitive data were not available for the LD_{50}, and the NOAEL was reported as a "less than" value because effects were observed. EECs, based on the highest application rate, were less than one tenth of the

highest dose tested (2000 mg ai/kg-bw), indicating that more refined, definitive data were not necessary for this assessment.

- Passerine Birds (Acute) (LD_{50}) OPPTS 850.2100. Data were not available. At the time the Problem Formulation was written, passerine bird data were not required. In lieu of this endpoint, the acute oral toxicity of quizalofop-p-ethyl to the mallard duck and common quail was used to evaluate risk.
- Avian (Chronic) (NOAEC) OPPTS 850.2300. The mallard duck study presented a non-definitive (less than) NOAEC. Given that the NOAEC was a "less than" value it presents uncertainty as to the true NOAEC and cannot be used in the risk assessment to calculate risk quotients. Mallard duck data from two structurally similar chemicals (fenoxaprop-p-ethyl and fenoxaprop-ethyl) were considered as potential surrogates for the toxicity data. Fenoxaprop-ethyl yielded a NOAEC (180 mg ai/kg-diet) that was below the quizalofop-p-ethyl value (< 296 mg ai/kg-diet). Given the similarity between fenoxaprop and quizalofop, it was decided that the fenoxaprop-ethyl mallard duck NOAEC could be used in place of the non-definitive quizalofop-p-ethyl value.
- Aquatic Non-Vascular Plants (EC_{50}) OPPTS 850.5400. Three of the four Tier 2 studies for non-vascular plants were non-definitive (greater than); these were also the most sensitive toxicity values. To justify the use of a less sensitive endpoint, non-vascular studies from two structurally similar chemicals (fenoxaprop-p-ethyl and fenoxaprop-ethyl) were considered. These chemicals also presented non-definitive toxicity values at the lowest concentrations tested and definitive toxicity numbers at higher concentrations. In addition, the fenoxaprop toxicity values were within the same order of magnitude as the quizalofop values. Thus, it was determined that using the definitive quizalofop-p-ethyl toxicity value was a reasonable approach, given that the lower toxicity values were all "greater than" values.

E.3.2 Application Rates

Several labels did not include the seasonal and/or annual maximum application rate of quizalofop-p-ethyl. In these cases, seasonal maximum application rates were assumed based on other information from the label or similar application patterns for uses that did contain the complete information. The Biological and Economic Division (BEAD) of OPP was consulted for their expertise. The following scenarios were affected:

- Non-crop areas (uncultivated areas, fence rows, roadsides, equipment storage areas, and other similar areas) – seasonal maximum application rate assumed to be equivalent to twice the maximum single application rate
- Paved areas (private roads/sidewalks) – seasonal maximum application rate assumed to be equivalent to single maximum application rate
- Hybrid cottonwood/poplar plantations – seasonal maximum application rate assumed to be equivalent to two applications at the single maximum application rate

E.3.3 Fate Data Gaps

A quizalofop-p-ethyl hydrolysis study was submitted to address deficiencies in the previously submitted study. However, the second hydrolysis study was not performed under Agency guidelines (elevated temperature without quantification of degradates). Studies have not been provided for anaerobic soil and aerobic aquatic metabolism. Additionally, the parent fish bioconcentration study was not performed under conditions that allowed the fish to be continuously exposed to the parent compound. The highest BCF was seen in viscera in the first few days of the study, presumably when the parent had not yet degraded. As the test progressed, the BCFs declined.

Few data are available for the degradates of concern. For quizalofop acid and 3-OH-quizalofop acid, information is unavailable on aqueous and soil photolysis, aerobic and anaerobic soil metabolism, and aerobic and anaerobic aquatic metabolism (terrestrial field dissipation studies are typically not performed on degradates because these studies are based on formulated products). Additionally, hydrolysis and adsorption/desorption studies are not available for 3-OH-quizalofop acid.

E.3.4 Incomplete Life Histories of Listed Species

Currently, a database of life histories for each of the listed animals and plants is not available for use by EFED. These life histories would include information such as body size at each life stage, food sources, relationships with other taxa, habitat, and reproductive habits. As such, conservative (protective) assumptions were made concerning the potential relationships between species in that each species was assumed to have a relationship with the other taxa. This is assumed to be an overestimation of the actual species that have a species dependant relationship.

E.3.5 Locations of Listed Species

In addition, the specific occurrences of listed species are not known in some cases beyond the county-level. If the location of a species was not known in greater detail than the county level, the species was assumed to occur anywhere within that county at any time. Likewise, crop location data are also uncertain. Crops may rotate every year and some spatial datasets combine several crop types, making it impossible to distinguish one crop from another. Further, timing may play a role in the location of species and whether it overlaps with the time that a particular crop is in a field. These assumptions may lead to an overestimation of co-occurrence with quizalofop-p-ethyl exposure and overestimation of the number of species potentially at risk.

Table of Contents

List of Abbreviated Terms and Symbols

@	symbol for "at"
%	symbol for "percent"
>	symbol for "greater than"
<	symbol for "less than"
µg/L	symbol for "micrograms per liter"
ºC	symbol for "degrees Celsius"
ai	active ingredient
Acc#	accession number
BEAD	Biological and Economical Analysis Division
bw	body weight
CI	confidence interval
CL	confidence limit
DP#	data package
EC	emulsifiable concentrate
EC_{25}	25% effect concentration
EC_{50}	50% (or median) effect concentration
ECOTOX	EPA managed database
EEC	estimated environmental concentration
EFED	Environmental Fate and Effects Division
e.g.	Latin *exempli gratia* ("for example")
et al.	Latin *et alii* ("and others")
etc.	Latin *et cetera* ("and the rest" or "and so forth")
FESTF	FIFRA Endangered Species Task Force
FIFRA	Federal Insecticide Fungicide and Rodenticide Act
FQPA	Food Quality Protection Act
ft	feet
g	gram
GENEEC	Generic Estimated Exposure Concentration model
IC_{50}	50% (or median) inhibition concentration
i.e.	Latin for *id est* ("that is")
IMS	information management system
Kg	kilogram(s)
Km	kilometer(s)
K_{oc}	symbol for the organic carbon partitioning coefficient
LAA	likely to adversely affect
Lbs	pounds
lb ai/A	pound(s) of active ingredient per acre
LC_{50}	50% (or median) lethal concentration
LD_{50}	50% (or median) lethal dose

LOAEC	lowest observable adverse effect concentration
LOAEL	lowest observable adverse effect level
LOC	level of concern
LOD	level of detection
LOEC	lowest observable effect concentration
K_{ow}	symbol for the octanol water partitioning coefficient
LOQ	level of quantitation
LUIS	label use information system
m	meter(s)
MA	may affect
mg	milligram(s)
mg/kg	milligrams per kilogram (equivalent to ppm, except in the case of discussing dose such as mg/kg-bw)
mg/L	milligrams per liter (equivalent to ppm)
mi	mile(s)
MM	may modify primary constituent element
MM/NSF	may modify primary constituent element/no shapefile
mmHg	millimeter of mercury
MRID	master record identification number
MW	molecular weight
NASS	National Agricultural Statistics Service
NAWQA	National Water Quality Assessment
NE	no effect
NLAA	not likely to adversely affect
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOAEC	no observable adverse effect concentration
NOAEL	no observable adverse effect level
NOEC	no observable effect concentration
OCSPP	Office of Chemical Safety and Pollution Prevention
OPP	Office of Pesticide Programs
OPPTS	Office of Prevention, Pesticides and Toxic Substances
pH	symbol for the negative logarithm of the hydrogen ion activity in an aqueous solution, dimensionless
pKa	symbol for the negative logarithm of the acid dissociation constant, dimensionless
ppb	parts per billion (equivalent to µg/L or µg/kg)
ppm	parts per million (equivalent to mg/L or mg/kg)
SLUA	screening level usage analysis
USDA	United States Department of Agriculture

USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
Wt	weight

Introduction

Purpose of Assessment

The purpose of this assessment is to evaluate the potential risks of quizalofop-p-ethyl's registered uses on federally listed endangered and threatened ("listed") species and all other non-target plant and animal ("non-listed") species. This risk assessment incorporates the available effects data, modeling, and risk methodologies, some of which may not have been available at the time when previous quizalofop-p-ethyl registration actions occurred. Risks from direct and indirect effects are derived and evaluated in accordance with the risk assessment methodology described in the Agency's Overview Document (USEPA, 2004). These risk findings are then used as part of an "effects determination" for listed species. The Agency will reach one of the following three conclusions regarding the potential for the registered quizalofop-p-ethyl use on food and non-food crops to affect federally listed species:

- "No effect";
- "May affect, but not likely to adversely affect"; or
- "May affect, and likely to adversely affect".

If the results of the risk assessment show no indirect effects and the levels of concern (LOC) are not exceeded for direct effects for a given listed species taxonomic grouping (*e.g.*, freshwater fish, small herbivorous mammal), a "no effect" (NE) determination is made, based on quizalofop-p-ethyl's use within the action area for "species" with the given taxonomic group. If, however, there is a potential for indirect effects and/or exposure exceeds the listed species LOC values for direct effects for a given group, the Agency concludes a preliminary "may affect" (MA) "species" within the taxonomic group. The Agency then considers additional lines of evidence such as the geographical nature of the exposure, as well as more in-depth evaluations of the toxicological and ecological requirements to determine a rationale for a "not likely to adversely affect" (NLAA) or "likely to adversely affect" (LAA) determination.

Similarly the Agency will reach one of the following conclusions regarding the potential for quizalofop-p-ethyl uses to result in destruction or adverse modification of critical habitat:

- "No effect";
- "May Modify Primary Constituent Elements"

The Agency uses the risk assessment analysis for direct effects to categories of biological resource requirements to draw conclusions about effects to principle constituent elements of

critical habitat. The Agency is limited in a practical sense to those principle constituent elements of critical habitat that are of a biological nature. If the results of the risk assessment show that no LOC is exceeded for all taxonomic groups a "no effect" (NE) determination for habitat modification is made. If a LOC is exceeded for one or more taxonomic groupings the Agency then considers additional lines of evidence such as direct effects to the species, the type and degree of effect on the taxonomic groupings, expected resultant effects on biologically mediated environmental processes (*e.g.*, increased sedimentation from loss of vegetation) as compared to baseline environmental conditions, co-occurrence of the action area with critical habitat, the type of principle constituent elements associated with critical habitat for listed species in a taxonomic grouping to determine a rationale for a "may modify primary constituent elements".

Problem Formulation

The problem formulation for this assessment and effects determination was provided in the USEPA Registration Review – EFED Problem Formulation for Quizalofop-p-ethyl Registration Review November 7, 2007 document. Data were requested for four studies; classifications after EFED evaluation are listed in parentheses:

- 850.4225 – Seedling emergence tier II ("supplemental" classification)
- 850.2300 – Vegetative vigor tier II ("supplemental" classification)
- 850.4100 – Algal toxicity tiers I and II ("acceptable" classification)
- Special Study – Aquatic emergent study conducted on rice ("acceptable" classification)

All submitted studies for quizalofop-ethyl and quizalofop-p-ethyl are listed in the MRID bibliography in Appendix A.

There were two modifications to the risk assessment process originally proposed in the problem formulation.

- Registrations for rapeseed subgroup 20A, herbicide-tolerant field corn seed production, and herbicide-tolerant sorghum were added to the quizalofop-p-ethyl label. These were added to the uses assessed in this risk assessment.
- 3-OH-quizalofop acid was added as a degradate of concern and therefore, included in the total residue EECs. This degradate was only identified in one relatively recently submitted fate study (MRID 43235603).

Under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), all pesticides distributed or sold in the United States generally must be registered by the United States

Environmental Protection Agency (USEPA). To determine whether a pesticide can be registered, the USEPA evaluates its safety to non-target species based on a wide range of environmental and health effects studies. In 1996, FIFRA was amended by the Food Quality Protection Act (FQPA), and EPA was mandated to implement a new program for the periodic review of pesticides, *i.e.*, registration review[1]. The registration review program is intended to ensure that as the ability to assess risk evolves and as policies and practices change, all registered pesticides continue to meet the statutory standard of no unreasonable adverse effects to human health and the environment. Changes in science, public policy, and pesticide use practices will occur over time. Through the registration review program, the Agency periodically reevaluates pesticides to make sure that as change occurs, products in the marketplace can be used safely.

Previous Risk Assessments

The most recent completed screening level risk assessments for use on rapeseed subgroup 20a, sorghum containing the DuPont™ Inzen™ AII Herbicide Tolerance Trait, and corn containing DAS-4027809 (USEPA 2011a, DP Barcode D384583/386679) identified direct risks to mammals and terrestrial plants. In the absence of data, direct risks were assumed for aquatic vascular plants and estuarine/marine fish. Indirect risks were assumed for all listed taxa because of their potential dependence on monocots for survival.

Stressor Source and Distribution

Mechanism of Action and Side Effects

Quizalofop-p-ethyl is an organic phenoxy herbicide that belongs to a subclass of phenoxy compounds known as aryloxyphenoxys (fops; Appendix B). Herbicides categorized as aryloxyphenoxys have several modes of action in terrestrial and aquatic vascular and non vascular plants: (1) inhibition of acetyl CoA carboxylase (ACCase), a key enzyme in lipid biosynthesis; (2) inhibition of cell mitosis or immediate termination of mitosis once exposure has been known to occur; and (3) inhibition of Acetyl-CoA carboxylase and the fatty acid synthesis pathway causes an inhibition of thylakoid membrane formation, chloroplast formation and multiplication, and finally a halt of cell membrane formation and cell division.

Quizalofop-p-ethyl is absorbed from the leaf surface and moved throughout the plant. It accumulates in the active growing regions of stems and roots. Through ingestion, quizalofop-p-ethyl can affect the muscle membranes of terrestrial mammals causing increased irritability and rigidity followed by paralysis. Also, quizalofop-p-ethyl, like many of the other phenoxy herbicides, may induce severe gastrointestinal effects in mammals after moderate toxic exposure. Gastrointestinal effects often include: (1) vomiting; (2) unquenchable thirst; (3) severe diarrhea (with the appearance of specks of blood); and (4) frequent urination (Adams, 1999). Quizalofop-p-ethyl is known to initiate muscular control

[1] http://www.epa.gov/oppsrrd1/registration_review/

problems in aquatic organisms (fish, invertebrates, and amphibians) once these organisms have been exposed to certain dose levels (Adams, 1999).

OVERVIEW OF PESTICIDE USE AND USAGE

Quizalofop-p-ethyl, also known by the trade names Assure II, Matador, Quizalofop, and Targa, is an herbicide that is currently registered for application to a number of food and non-food crops to control monocot weeds, including some varieties of volunteer monocot crops (*e.g.*, sorghum, corn). It was recently registered on herbicide-tolerant corn for seed production and herbicide-tolerant sorghum. Registered application methods for quizalofop-p-ethyl are aerial, ground, low-pressure ground, band, tractor-mounted, and hooded sprayer. It is registered for use on a number of food and non-food crops including grains, non-cultivated areas, beans, cotton, mint, ornamental trees, soybean, and grasses. Five different companies currently have registered products with quizalofop-p-ethyl concentrations ranging from 1.4 to 10.3 percent (Tables 1 and 2).

An average of 53,500 pounds of quizalofop-p-ethyl (averaged from 2003-2010) is applied on agricultural crops in the United States each year with the majority being applied to dry beans/peas and soybeans (20,000 lb each). Quizalofop-p-ethyl is also used on sunflowers (4000 lb), sugar beets (3000 lb), canola/rapeseed (2000 lb), alfalfa and cotton (1000 lb each), and barley, green beans, garlic, onions, and green peas (<500 lb each) (USEPA 2011b)[2].

[2] Based on USDA-NASS (United States Department of Agriculture's National Agricultural Statistics Service) and Private Pesticide Market Research

Table 1. Current registrations for quizalofop-p-ethyl

Product Name	Registrant	EPA Registration # (latest label date)	Active Ingredient (% w/w)	Form	Use(s)
Targa Herbicide	Nissan Chemical Industries, Ltd.	33906-9 4/6/10	10.3	Emulsifiable concentrate	Alfalfa (non-food/non-feed for seed production), barley, canola/rape, carrot (non-food/non-feed for seed production), Chinese cabbage (non-food/non-feed for seed production), cotton, crambe, dry beans, dry and succulent peas, fallow, flax, garlic (non-food/non-feed for seed production), lentils, mint (spearmint and peppermint), non-crop areas (uncultivated areas, fence rows, roadsides, equipment storage areas, and other similar areas), onion (non-food/non-feed for seed production), ornamental and/or shade trees, paved areas (private roads/sidewalks), perennial ryegrass grown for seed, pineapple, radish (non-food/non-feed for seed production), red beets (non-food/non-feed for seed production), snap beans, soybeans, spinach (non-food/non-feed for seed production), sugar beets, sunflowers, Swiss chard (non-food/non-feed for seed production), wheat

Product Name	Registrant	EPA Registration # (latest label date)	Active Ingredient (% w/w)	Form	Use(s)
DuPont Assure II Herbicide	E. I. Du Pont de Nemours and Company	352-541 4/12/12	10.3	Emulsifiable concentrate	Alfalfa (non-food/non-feed for seed production), canola/rape, carrot (non-food/non-feed for seed production), Chinese cabbage (non-food/non-feed for seed production), cotton, crambe, dry beans, dry and succulent peas, flax, garbanzos (including chick peas), garlic (non-food/non-feed for seed production), Hybrid cottonwood/poplar plantations, lentils, mint (spearmint and peppermint), non-crop areas (uncultivated areas, fence rows, roadsides, equipment storage areas, and other similar areas), onion (non-food/non-feed for seed production), ornamental and/or shade trees, Perennial ryegrass grown for seed, pineapple, radish (non-food/non-feed for seed production), red beets (non-food/non-feed for seed production), snap beans, sorghum (herbicide tolerant), soybeans, spinach (non-food/non-feed for seed production), sugar beets, sunflowers, Swiss chard (non-food/non-feed for seed production)

Product Name	Registrant	EPA Registration # (latest label date)	Active Ingredient (% w/w)	Form	Use(s)
Quizalofop EC	Sharda USA, LLC	83529-15 3/11/09	10.3	Emulsifiable concentrate	Alfalfa (non-food/non-feed for seed production), canola/rape, carrot (non-food/non-feed for seed production), Chinese cabbage (non-food/non-feed for seed production), cotton, crambe, dry beans, dry and succulent peas, flax, garbanzos (including chick peas), garlic (non-food/non-feed for seed production), hybrid cottonwood/poplar plantations, lentils, mint (spearmint and peppermint), non-crop areas (uncultivated areas, fence rows, roadsides, equipment storage areas, and other similar areas), onion (non-food/non-feed for seed production), ornamental and/or shade trees, paved areas (private roads/sidewalks), perennial ryegrass grown for seed, pineapple, radish (non-food/non-feed for seed production), red beets (non-food/non-feed for seed production), snap beans, soybeans, spinach (non-food/non-feed for seed production), sugar beets, sunflowers, Swiss chard (non-food/non-feed for seed production)
Mon 78746 Herbicide	Monsanto Company	524-523 8/28/00	1.4	Ready-to-use	Cotton, soybeans
Matador Herbicide	FMC Corp. Agricultural Products Group	279-3183 2/13/97	10.3	Emulsifiable concentrate	Cotton, soybeans
DuPont Assure II Herbicide	E. I. Du Pont de Nemours and Company	HI110001 11/16/11 IL110001 6/9/11 IN110003 5/3/11 Section 24c	10.3	Emulsifiable concentrate	Field corn seed production (herbicide-tolerant)
DuPont Assure II Herbicide	Agro Servicios, Inc.	PR110002 11/3/11	10.3	Emulsifiable concentrate	Field corn seed production (herbicide-tolerant)

Product Name	Registrant	EPA Registration # (latest label date)	Active Ingredient (% w/w)	Form	Use(s)
DuPont Assure II Herbicide	E. I. Du Pont de Nemours and Company	ME050002 8/19/05 MN000006 11/29/00	10.3	Emulsifiable concentrate	Hybrid cottonwood/poplar plantations

Table 2. Use and application rate information for quizalofop-p-ethyl

Crop	Maximum Application Rate	Application Method	Shortest Application Interval (days)	Reg. #[1]
Idaho, Montana, Washington, Oregon, and Wyoming only Non-food/non-feed for seed production: Alfalfa, carrot, Chinese cabbage, garlic, onion, radish, red beets, spinach, Swiss chard All states, food item: Sugar beets	Single max = 0.0834 lb ai/A Seasonal max = 0.174 lb ai/A	Spray (aerial and ground)	7	33906-9 352-541 83529-15
Except New York Barley, wheat	Single max = 0.0695 lb ai/A Seasonal max = 0.0695 lb ai/A	Spray (aerial and ground)	N/A	33906-9
Canola/rape, crambe, soybeans, sunflowers	Single max = 0.0834 lb ai/A Seasonal max = 0.125 lb ai/A	Spray (aerial and ground)	7	33906-9 352-541 83529-15 524-523 (soybean) 279-3183 (soybean)
Field corn seed production (herbicide-tolerant)	Single max = 0.0834 lb ai/A Seasonal max = 0.0834 lb ai/A (corn)	Spray (aerial and ground)	N/A	HI110001 IL110001 IN110003 PR110002 352-541
Cotton	Single max = 0.034 lb ai/A Seasonal max = 0.125 lb ai/A	Spray (aerial and ground)	7	33906-9 352-541 83529-15 524-523 279-3183
Dry beans	Single max = 0.0834 lb ai/A Seasonal max = 0.195 lb ai/A	Spray (aerial and ground)	7	33906-9 352-541 83529-15
Dry and succulent peas, lentils, snap beans	Single max = 0.0834 lb ai/A Seasonal max = 0.0973 lb ai/A	Spray (aerial and ground)	7	33906-9 352-541 83529-15

Crop	Maximum Application Rate	Application Method	Shortest Application Interval (days)	Reg. #[1]
Texas, Oklahoma, Kansas, and Colorado only Fallow	Single max = 0.0834 lb ai/A Seasonal max = 0.21 lb ai/A	Spray (aerial and ground)	7	33906-9
Flax, garbanzos (including chick peas)	Single max = 0.0834 lb ai/A Seasonal max = 0.167 lb ai/A	Spray (aerial and ground)	7	33906-9 (garbanzos excluded) 352-541 83529-15
Maine and Minnesota only Hybrid cottonwood/poplar plantations	Single max = 0.0695 lb ai/A Seasonal max = NS[3]	Spray (aerial and ground)	7	352-541 83529-15 ME050002 MN000006
Mint (spearmint and peppermint)	Single max = 0.0834 lb ai/A Seasonal max = 0.209 lb ai/A	Spray (aerial and ground)	7	33906-9 352-541 83529-15
Non-crop areas (uncultivated areas, fence rows, roadsides, equipment storage areas, and other similar areas)	Single max = 0.111 lb ai/A Seasonal max = 0.222 lb ai/A[3]	Spray (aerial and ground)	7	33906-9 352-541 83529-15
Puerto Rico (pineapple only) and Hawaii only Ornamental and/or shade trees, pineapple	Single max = 0.208 lb ai/A Seasonal max = 0.417 lb ai/A	Spray (aerial and ground)	7	33906-9 352-541 83529-15
Paved areas (private roads/sidewalks)	Single max = 0.108 lb ai/A Seasonal max = NS[2]	Spray (aerial and ground)	N/A	33906-9 352-541 83529-15
Minnesota only Perennial ryegrass grown for seed	Single max = 0.0695 lb ai/A Seasonal max = 0.139 lb ai/A	Spray (aerial and ground)	7	33906-9 352-541 83529-15

Crop	Maximum Application Rate	Application Method	Shortest Application Interval (days)	Reg. #[1]
Sorghum (herbicide-tolerant)	Single max = 0.0834 lb ai/A Seasonal max = 0.14 lb ai/A	Spray (aerial) and ground	7	352-541

N/A- not applicable
NS - not specified on label
[1]Application rates represent maximum application rate for a least one of the EPA Reg. # listed. Other labels may have slightly different application rates.
[2]Assuming the seasonal maximum is equivalent to the single application rate
[3]Assuming two applications at the highest rate for the seasonal maximum

Environmental Fate and Transport

SUMMARY OF ENVIRONMENTAL FATE

Quizalofop-p-ethyl is relatively stable to hydrolysis at pHs of 5 and 7, but degrades much faster at pH 9 with a half life of 2 days. At pHs 5, 7, and 9, the only degradate formed was quizalofop acid (the active ingredient). Therefore, quizalofop acid is stable to abiotic hydrolysis.

Quizalofop-p-ethyl is relatively stable to photolysis in water and soil ($t_{1/2}$ > 40 days). Laboratory aerobic soil metabolism studies show that quizalofop-p-ethyl degrades with a half-life of ~30 days to quizalofop acid, 3-OH-quizalofop acid, and phenolic compounds. This compares with the terrestrial field dissipation (TFD) study that produced quizalofop-p-ethyl half-lives of 1 to 12 days with degradates of quizalofop acid and 3-OH-quizalofop acid. Based on available fate studies, quizalofop acid appears to be less persistent than both the parent and 3-OH-quizalofop acid under aerobic conditions, but similar in mobility to the parent compound. As for mobility, the mean adsorption K_{oc} of quizalofop acid is 256 ml/g, whereas the mean adsorption K_{oc} value of quizalofop-p-ethyl is 298 (both classified as moderately mobile).

The submitted fish bioaccumulation study was conducted under static conditions (not flow-through). Given that quizalofop-p-ethyl degraded to quizalofop acid during the study (99% quizalofop acid in water at 28 days) and the highest accumulation of radioactive residues occurred in the first few days of the 28-day exposure period, it is EFED's interpretation that the initial peak exposures (3900x and 4600x for the 0.004 and 0.04 mg ai/L exposures, respectively) are likely more reflective of quizalofop-p-ethyl's ability to bioaccumulate, the 28-day values (1X and 4X for exposure concentrations of 0.004 and 0.04 mg ai/L exposures, respectively) are more reflective of quizalofop acid's ability to bioaccumulate (Table 3).

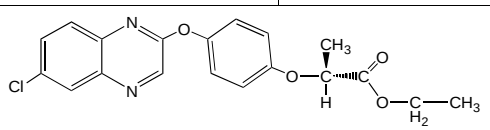
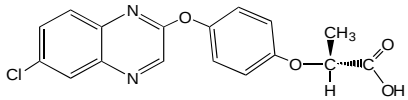
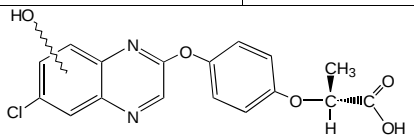
Quizalofop acid and 3-OH-quizalofop acid are degradates of concern for aquatic exposures. Quizalofop acid is the active ingredient. For chemicals in the Aryloxyphenoxypropionate Chemical Family ("FOPs"), the relatively non-polar parent molecule undergoes hydrolysis to form a more polar ("semi-polar") acid. Having a non-polar parent molecule (quizalofop-p-ethyl) aids in penetrating the waxy cuticle of a plant leaf, while the semi-polar quizalofop acid is better able to cross the cell wall and cell membrane. Quizalofop acid has also been detected in livestock tissues and is included in the tolerance expression and the HED risk assessment. The mammalian toxicity level was determined by HED to be equivalent to or less than that of the parent.

Appendix B compares the structures of the parent and acid degradates for all of the FOPs. The right half of the acid degradates is the structurally similar, which helps explain the similar mode of action across the FOP family. The oxygen of the rightmost hydroxy group of the degradates is attached to various non-polar substituent groups in the parent molecules.

3-OH-quizalofop acid is included as a residue of concern because of its similar structure to quizalofop acid. The only registrant-submitted laboratory study that identified this degradate (maximum of 21% of applied radioactivity at 60 days) was an aerobic soil metabolism study (MRID 43235603). The only registrant-submitted field study that identified this degradate (maximum of 5.4 ng/g at 58 days) was a terrestrial field dissipation study (MRID 47408416). Chemical structures and information on the maximum amount of degradate formation in each of the environmental fate studies can be found in Appendix C.

For ecological risk assessment purposes, the toxicity of quizalofop-p-ethyl, quizalofop acid, and 3-OH-quizalofop acid will be considered to be roughly equivalent. This assumption is conservative; a review of the European Footprint Database (http://sitem.herts.ac.uk/aeru/footprint/en/index.htm) indicates that major degradates are of similar toxicity, or in many cases, less toxic than the parent. Given that the Agency has not reviewed the studies from which these database entries were made, a total toxic residues (TTR) approach will be used in this risk assessment. The TTR approach models the three chemicals (parent and two degradates) and un-extracted residues as one chemical by adjusting the parent exposure half-lives to account for the duration of exposure to all three chemicals of concern (and their un-extracted residues).

Table 3. Physical, chemical, and environmental fate properties of quizalofop-p-ethyl, quizalofop acid and 3-OH-quizalofop acid

	Quizalofop-P-Ethyl		Quizalofop Acid		3-OH-quizalofop Acid	
Parameter	**Value**	**Source/MRID #**	**Value**	**Source/MRID #**	**Value**	**Source/MRID #**
Chemical name	Ethyl (R)-2-[4-(6-chloroquinoxalin-2-yl oxy)-phenoxy]propionate	Assure II Label	2-[4-[(6-chloro-2-quinoxalinyl)oxy]phenoxy]propanoic acid	PPDB (CAS name)	(*R*)-2-[4-(6-chloro-3-hydroxyquinoxalin-2-yloxy)phenoxy]pro-pionic acid	PPDB (CAS name)
Chemical family	Aryloxyphenoxys	PPDB	Aryloxyphenoxypropionic acid	PPDB	Aryloxyphenoxypropionic acid	PPDB
Empirical formula	$C_{19}H_{17}ClN_2O_4$	PPDB	$C_{17}H_{13}ClN_2O_4$	PPDB	$C_{17}H_{13}ClN_2O_5$	EPI Suite 4.1
Structure						
Molecular mass	372.8 g/mol	PPDB	344.76 g/mol	EPI Suite 4.1	360.76 g/mol	EPI Suite 4.1
Water solubility (20°C)	0.4 mg/L	Product Chemistry	0.3 mg/L	Tomlin, C. 1994	115.7 mg/L	EPI Suite 4.1 (WSKOW v1.41)
Vapor pressure	3×10^{-7} mm Hg @ 20°C	Product Chemistry	5.72×10^{-8} mm Hg @ 25°C	EPI Suite 4.1 (Modified Grain Method)	4.03×10^{-12} mm Hg @ 25°C	EPI Suite 4.1 (Modified Grain Method)
Octanol/water partition coefficient (Log K_{ow})	4.61	PPDB	3.57	EPI Suite 4.1 (KowWIN v1.67)	3.09	EPI Suite 4.1 (KowWIN v1.67)
Hydrolysis ($t_{1/2}$)	>600 days @ pH5 30 days @ pH7 2 days @ pH9	MRID 00131583	Stable[1]	MRID 00131583	Unknown	
Direct Aqueous Photolysis ($t_{1/2}$)	69 days	MRID 00146693	Unknown		Unknown	
Soil Photolysis	41 days	MRID 40336002	Unknown		Unknown	
Aerobic Soil Metabolism ($t_{1/2}$)	30 days 37 days	MRID 00146695 MRID 43235603	Unknown[2]		Unknown	

	Quizalofop-P-Ethyl		Quizalofop Acid		3-OH-quizalofop Acid	
Parameter	**Value**	**Source/MRID #**	**Value**	**Source/MRID #**	**Value**	**Source/MRID #**
Anaerobic Soil Metabolism ($t_{1/2}$)	Unknown	MRID 00146696 is unacceptable.	Unknown		Unknown	
Aerobic Aquatic Metabolism ($t_{1/2}$)	Unknown	No study submitted	Unknown		Unknown	
Anaerobic Aquatic Metabolism ($t_{1/2}$)	107 and 95 days	MRID 00146697	Unknown		Unknown	
Soil Partition Coefficient (K_{oc})	298 ml/g	Mean quizalofop-acid K_{oc} (436, 267, 302, and 187) (MRID 00146698)	256 ml/g	Mean quizalofop-acid K_{oc} (136, 90, 372, 425) (MRID 00146947)	Unknown	
Terrestrial Field Dissipation ($t_{1/2}$)	United Kingdom – 2.2 days Germany – 1.6 days Southern France – 1 day Spain – 12 days	MRID 474084146	Unknown[2]		Unknown	
Fish Bioconcentration Factor (Static exposure conditions – 99% of applied quizalofop-ethyl had converted to quizalofop acid by day 28 in the water.)	0.004 µg/L Exposure Muscle BCF = 16 Viscera BCF =3900 Carcass BCF =31 Whole Fish BCF = 290 0.04 µg/L Exposure Muscle BCF = 10 Viscera BCF = 4600 Carcass BCF = 37 Whole Fish BCF = 380	MRID 00131583 (Peak BCF occurred in the first few days of the experiment and decreased presumably as quizalofop acid formed.)	Unknown, but presumably much lower than quizalofop-ethyl	MRID 00131583	Unknown	

PPDB = Pesticide Properties Database (http://sitem.herts.ac.uk/aeru/projects/ppdb/index.htm)

[1] No degradates formed in the quizalofop-p-ethyl hydrolysis study (MRID 00131583) other than quizalofop acid, which indicates the quizalofop acid formed did not degrade.

[2] Data appears in the footprint database (a pesticide data base used by the European Union - http://sitem.herts.ac.uk/aeru/footprint/en/index.htm) that may or may not be suitable for risk assessment that has not been submitted to the Agency for review.

Receptors

EFFECTS TO ORGANISMS

Studies are available for both quizalofop-p-ethyl (the concentrated active isomer) and quizalofop-ethyl (50/50 racemic mixture of active and inactive isomers). The most sensitive toxicity value was selected for the risk analysis, regardless of the chemical form.

Registrant Submitted Studies for Quizalofop-P-Ethyl

The registrant(s) have submitted a number of studies in support of quizalofop-p-ethyl new use registrations and registration review that are considered scientifically sound for use in risk assessments. Seven acute freshwater fish studies indicate quizalofop-p-ethyl (3 studies) and quizalofop-ethyl (4 studies) is slightly to highly toxic. Chronic freshwater and estuarine/marine fish studies also are available. Four acute freshwater invertebrate studies (2 each for quizalofop-p-ethyl and quizalofop-ethyl) show the chemical to be slightly toxic to highly toxic to the waterflea. Acute estuarine/marine invertebrate toxicity testing indicates quizalofop-p-ethyl (1 study) and quizalofop-ethyl (2 studies) to be highly toxic. Five non-vascular plant studies and two vascular aquatic plant studies are available for quizalofop-p-ethyl.

For terrestrial organisms, acute toxicity studies are available for birds, with quizalofop-ethyl (5 studies), that indicate it is practically non-toxic to birds. Two chronic studies with quizalofop-p-ethyl are also available. Rat studies with quizalofop-ethyl indicate it is slightly toxic on an acute oral basis; a two generation rat study is also available. Quizalofop-p-ethyl is classified as practically non-toxic to honeybees. A number of studies were performed on terrestrial plants with both quizalofop-p-ethyl (3 studies) and quizalofop-ethyl (2 studies) typical end-use products that documented the toxicity to dicots and monocots.

Open Literature Studies

Open literature studies from the ECOTOX database were reviewed for inclusion in the risk assessment. Studies were screened to determine if they provided information about species for which EFED does not usually receive information, or lower toxicity endpoints than registrant-submitted studies. No additional studies from ECOTOX were identified. All ECOTOX papers and rationales of why they were not included in the risk assessment are listed in Appendix D.

INCIDENT DATABASE REVIEW

A review of the Ecological Incident Information System on September 26, 2012 (EIIS, version 2.1.1), which is maintained by the Agency's Office of Pesticide Programs, the Aggregate Summary Module of OPP's Incident Database, and the Avian Monitoring Information System (AIMS), which is maintained by the American Bird Conservancy, was conducted for both quizalofop-p-ethyl and quizalofop-ethyl.

According to Office of Pesticides Program Ecological Incident Information System (EIIS), one incident for quizalofop-p-ethyl has been reported. The incident (I016677-001) occurred when spray drift from an application of Assure II (quizalofop-p-ethyl) and Flexstar (sodium fomesafen) to soybeans came into contact with a garden in the vicinity of the soybean field. Hundreds of herbaceous plants in a home herb garden (20 ft away) and various vegetables in another garden (150 ft away) were reported to have been damaged (leaf burn and spotting). The incident occurred on 8/2/05 in Missouri and is classified as "possible" to have been caused by quizalofop-p-ethyl; however there is some uncertainty given that sodium fomesafen was also applied.

There was one minor incident listed in the Aggregate Summary Module of OPP's Incident Database for quizalofop-p-ethyl. The formulation, Assure II, was associated with minor plant damage between 7/1/01 and 9/30/01. No further information was available. There were no quizalofop incidents reported in the AIMS database and EFED is unaware of other incidents outside of these three databases.

DATA GAPS IDENTIFIED

The following toxicity data gaps have been identified:

- OPPTS 850.1075- Acute Estuarine/Marine Fish Toxicity Test
- OPPTS 850.1350- Chronic Estuarine/Marine Invertebrate Toxicity Test
- OPPTS 850.2100- Acute Oral Toxicity Test with a Passerine Species

These data were not identified as gaps in the quizalofop-p-ethyl problem formulation. At the time, an acute estuarine/marine fish study had been submitted by the registrant. The study was assumed to be acceptable, but was found to be invalid when it was formally reviewed several years later. Data were not requested for chronic effects to estuarine/marine invertebrates because it was possible to calculate an acute-to-chronic ratio to estimate that toxicity value. Finally, the acute oral toxicity test with a passerine species did not become a data requirement until after the data call-in was issued.

ECOSYSTEMS POTENTIALLY AT RISK

The ecosystems at risk are often extensive in scope, and as a result it may not be possible to be specific at the screening level. Quizalofop-p-ethyl is registered on a variety of food (*e.g.*, grains, beans, mint, pineapple) and non-food (cotton, non-agricultural areas, ornamentals, seed production) uses. In general terms, terrestrial ecosystems potentially at risk could include the areas next to treated fields, plantations, roadsides, fencerows, equipment storage areas, and paved areas. These areas could include cultivated fields, fencerows and hedgerows, meadows, fallow fields or grasslands, woodlands, riparian habitats and other uncultivated areas.

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

All of the uses apply quizalofop-p-ethyl as a foliar spray (ground or aerial) to vegetation. Given the diversity of uses (corn to pineapple), it is expected that quizalofop-p-ethyl applications could occur in most areas of the United States.

Conceptual Model

For a chemical to pose an ecological risk, it must reach ecological receptors in biologically significant concentrations. An exposure pathway is the means by which a pesticide moves in the environment from a source to an ecological receptor. For an ecological exposure pathway to be complete, it must have a source, a release mechanism, an environmental transport medium, a point of exposure for ecological receptors, and a feasible route of exposure.

The conceptual model (Figures 1 and 2) depicts the potential pathways for ecological risk associated with quizalofop-p-ethyl (including its degradates) use. The conceptual model provides an overview of the expected exposure routes for organisms within the quizalofop-p-ethyl action area. For terrestrial organisms, the major route of exposure considered is the dietary route; consumption of food items such as plant leaves or insects that have quizalofop-p-ethyl residues as a result of spraying and drift. Exposure through inhalation is unlikely given quizalofop-p-ethyl's low vapor pressure and the results of EFED's Screening Tool for Inhalation Risk (STIR v. 1.0). EFED's Screening Imbibition Program (SIP v. 1.0) indicated that drinking water exposure alone was not a potential concern for birds or mammals (acute and chronic exposures) (Appendix E).

For aquatic animal species, the major routes of exposure are considered to be via the respiratory surface (gills) or the integument.

Direct contact and/or root uptake is the major route of exposure for terrestrial and wetland (riparian) plants, while aquatic plants may be exposed via direct uptake and adsorption. Estimated exposure concentrations for all organisms are obtained through the use of several Agency exposure models.

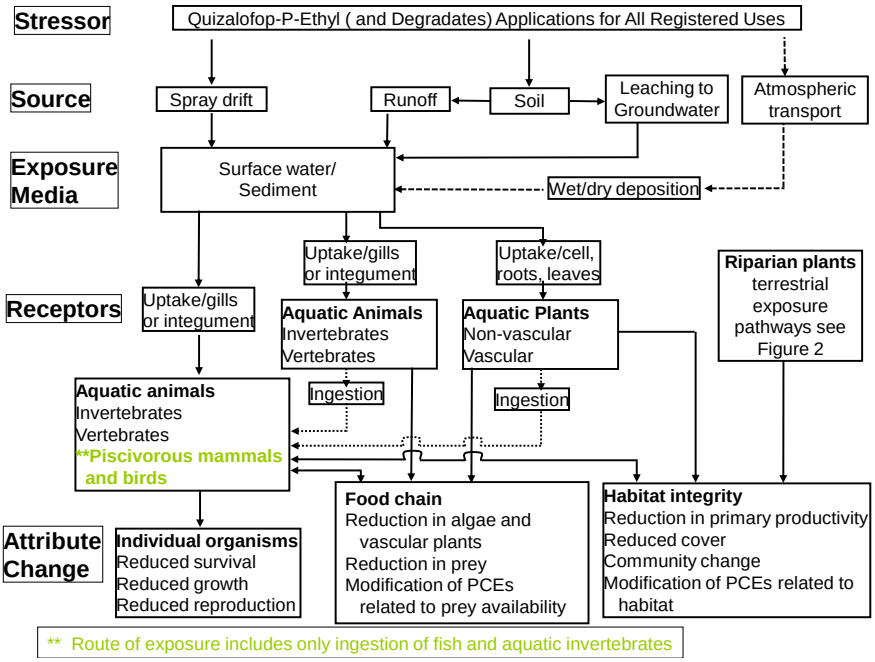


Figure 1. Conceptual model for the aquatic effects of quizalofop-p-ethyl applications. Dotted lines indicate the pathway is not expected to be significant.

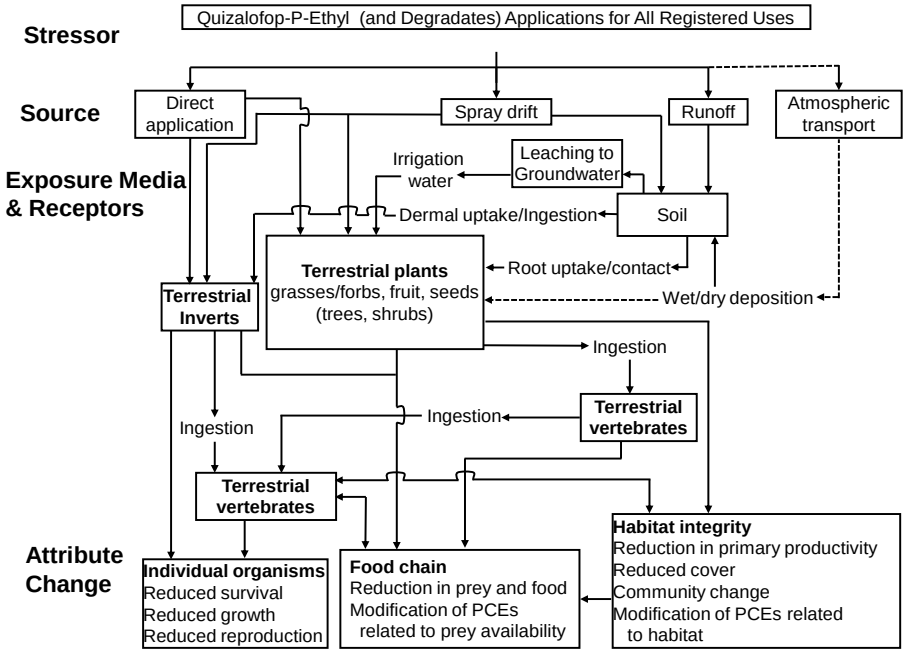


Figure 2. Conceptual model for the terrestrial effects of quizalofop-p-ethyl applications.

Risk Hypothesis

For quizalofop-p-ethyl and its degradates, the following ecological risk hypotheses are being tested in this baseline risk assessment:

Terrestrial Environment

- Exposure to quizalofop-p-ethyl and degradate residues on insects, seeds, foliage, and other plant parts from direct deposition or spray drift from the labeled use of the pesticide has the potential to cause reduced survival, growth and reproduction to terrestrial vertebrates (birds, mammals, reptiles, terrestrial-phase amphibians) and terrestrial invertebrates.

- Exposure to quizalofop-p-ethyl and degradate residues on foliage, roots, or other plant parts from spray drift alone or from runoff from labeled use of the pesticide has the potential to result in reduced survival and biomass to upland plants and riparian/wetland plants in areas adjacent to a treated area.

Aquatic Environment

- Exposure to quizalofop-p-ethyl and degradate residues in water from spray drift or runoff from the labeled uses of the herbicide has the potential to cause reduced survival, growth and reproduction to aquatic invertebrates, fish, and plants (vascular and non-vascular) in surface waters adjacent to a treated area.

Analysis Plan

In registration review, pesticide ecological risk assessments will follow the Agency's Guidelines for Ecological Risk Assessment and will be in compliance with the paper entitled "Overview of the Ecological Risk Assessment Process in the Office of Pesticide Programs, U.S. Environmental Protection Agency" (US EPA, 2004).

The focus of an ecological risk assessment is on both the toxic effects of a pesticide to non-target organisms and the potential routes of the pesticide's exposure to non-target organisms. In addition to addressing a pesticide's toxic effects and potential routes of exposure, an ecological risk assessment addresses the uncertainties associated with a pesticide's risk to non-target organisms.

MEASURES TO EVALUATE THE RISK HYPOTHESIS AND CONCEPTUAL MODEL

Measures of exposure are based on aquatic and terrestrial models that predict estimated environmental concentrations (EECs) of quizalofop-p-ethyl using maximum labeled application rates and methods of application. The model used to predict aquatic EECs is the PRZM [**P**esticide **R**oot **Z**one **M**odel (PRZM v3.12.2)] and EXAMS [**EX**posure **A**nalysis

Modeling **S**ystem (v2.98.4.6)] models. The model used to predict terrestrial EECs on food items is T-REX [Terrestrial Residue Exposure Model version 1.5 (Mar. 22, 2012)]. The model used to derive EECs relevant to terrestrial and wetland plants is TerrPlant [Version 1.2.2 (10/29/09)].

MEASURES OF EFFECT

Data identified in the Effects Characterization Section are used as measures of effect for direct and indirect effects to non-target organisms. Data were obtained from registrant submitted studies or from open literature studies identified by ECOTOX. The ECOTOXicology database (ECOTOX) was searched to provide more ecological effects data and to bridge existing data gaps. ECOTOX is a source for locating single chemical toxicity data for aquatic life, terrestrial plants, and wildlife. ECOTOX was created and is maintained by the USEPA, Office of Research and Development, and the National Health and Environmental Effects Research Laboratory's Mid-Continent Ecology Division.

The acute measures of effect used for animals in this screening level assessment are the LD_{50}, LC_{50} and EC_{50}. LD stands for "Lethal Dose", and LD_{50} is the amount of a material, given all at once, that is estimated to cause the death of 50% of the test organisms. LC stands for "Lethal Concentration" and LC_{50} is the concentration of a chemical that is estimated to kill 50% of the test organisms. EC stands for "Effective Concentration" and the EC_{50} is the concentration of a chemical that is estimated to produce a specific effect in 50% of the test organisms. Endpoints for chronic measures of exposure for listed and non-listed animals are the NOAEL/NOAEC and NOEC. NOAEL stands for "No Observed-Adverse-Effect-Level" and refers to the highest tested dose of a substance that has been reported to have no harmful (adverse) effects on test organisms. The NOAEC (*i.e.*, "No-Observed-Adverse-Effect-Concentration") is the highest test concentration at which none of the observed effects were statistically different from the control. The NOEC is the No-Observed-Effects-Concentration. For non-listed plants, only acute exposures are assessed (*i.e.*, EC_{25} for terrestrial plants and EC_{50} for aquatic plants).

INTEGRATION OF EXPOSURE AND EFFECTS

Risk characterization is the integration of exposure and ecological effects characterization to determine the potential ecological risk from agricultural and non-agricultural uses of quizalofop-p-ethyl, and the likelihood of direct and indirect effects to non-target organisms in aquatic and terrestrial habitats. The exposure and toxicity effects data are integrated to evaluate the risks of adverse ecological effects on non-target species. For the assessment of quizalofop-p-ethyl risks, the risk quotient (RQ) method is used to compare exposure and measured toxicity values. EECs are divided by acute and chronic toxicity values. The resulting RQs are then compared to the Agency's levels of concern (LOCs) (US EPA, 2004).

There is no established acute listed or non-listed LOC for terrestrial invertebrates. The LOCs currently in use for birds, mammals and aquatic species are based on 1975 regulations for the enforcement of FIFRA (40 CFR Part 154: 49005; 49007; 49016). Refer to Appendix F for addition information on the LOCs.

ANALYSIS OF CO-OCCURANCE OF FEDERALLY LISTED SPECIES WITH QUIZALOFOP-P-ETHYL

Consistent with the Agency's responsibility under the Endangered Species Act (ESA), the Agency will evaluate risks to federally-listed threatened and/or endangered (listed) species from registered uses of quizalofop-p-ethyl. This assessment will be conducted in accordance with the Overview Document (US EPA, 2004), provisions of the ESA, and the Services' *Endangered Species Consultation Handbook* (U.S. FWS/NMFS, 1998).

In the case of a nation-wide risk assessment conducted under Registration Review, the action area will encompass the entire U.S. and its territories. The purpose of defining the action area as the entire U.S. and its territories is to ensure that the initial area of consideration encompasses all areas where the pesticide may be used now and in the future, including the potential for off-site transport via spray drift and downstream dilution. Additionally, the concept of a nationwide action area takes into account the potential for direct and indirect effects and any potential modification to critical habitat based on ecological effect measures associated with reduction in survival, growth, and reproduction, as well as the full suite of sub-lethal effects available in the effects literature.

It is important to note that the nation-wide action area does not imply that direct and/or indirect effects and critical habitat modification are expected to or are likely to occur over the full extent of the action area, but rather to identify all listed species and critical habitat that may potentially be affected by the action. The Agency will use more rigorous analysis including consideration of available land cover data, toxicity data, and exposure information to determine areas where individual listed species and designated critical habitat may be affected or modified via endpoints associated with reduced survival, growth, or reproduction.

The Information Management System (IMS), a work product of the industry-based FIFRA Endangered Species Task Force (FESTF) will be used to evaluate the co-occurrence of listed species and critical habitat within the quizalofop-p-ethyl action area. FESTF was formed to fulfill data requirements relative to species/pesticide use proximity.

Exposure Assessment

Aquatic Exposure Assessment

Monitoring Data

Quizalofop-p-ethyl, quizalofop acid, and 3-OH-quizalofop acid do not appear to be included in the list of the analytes monitored in the U.S. surface and groundwater under the USGS's National Water Quality Assessment (NAWQA) program. There were no available monitoring data at the time of this assessment (October 2012).

Aquatic Exposure Modeling

Tier II screening-level surface water exposures for aquatic risk assessment were conducted for all registered uses. Modeled application rates represent the maximum use pattern of the proposed label for all uses. The aquatic exposure estimates presented in this assessment were based on the use of models because no surface or groundwater monitoring data are available for quizalofop-p-ethyl within the continental U.S. Two major environmental degradates, quizalofop acid and 3-OH-quizalofop acid, were identified in the environmental fate and terrestrial field dissipation studies. There are no Agency-reviewed toxicity data related to aquatic species for these major degradates that can be used to exclude any of the degradates listed above (Europe's Footprint database[3] does have data that support the premise that the degradates may be less toxic than the parent, but EPA does not have access to these studies for evaluation). Therefore, a total residue (parent plus degradates of concern) approach is used and expected to provide protective exposure estimation for aquatic organisms exposed to the major degradates of quizalofop-p-ethyl. Essentially, this method simply extends the duration of the predicted EECs to account for the time it would take for both the parent and degradates of concern to dissipate in the environment. It assumes that the degradates have equivalent fate and ecotoxicity properties as the parent – a conservative assumption (Table 4).

TIER II PRZM/EXAMS Model

The Tier II model Pesticide Root Zone Model (PRZM v3.12.2) linked with EXposure Analysis Modeling System (EXAMS v2.98.4.6) via the model shell PRZM/EXAMS (PE v5.0, Nov. 15, 2006) was used to estimate baseline-level exposures for representative crop scenarios. The PRZM model simulates pesticide movement and transformation on and across the agricultural field resulting from crop applications. The EXAMS model simulates pesticide loading via runoff, erosion, and spray drift assuming a "standard" 1-ha pond, 2-m

[3] http://sitem.herts.ac.uk/aeru/footprint/en/index.htm

deep (20,000 m^3) with no outlet that borders a 10-ha treated field. Simulations are run for multiple (usually 30) years, and the Agency estimates peak and running mean values that are expected once every ten years based on the daily values generated during the simulation. The coupled PE models and users manuals are available from the U.S. Environmental Protection Agency Water Models Web-page (U.S. EPA, 2011).

Exposure estimates generated using this "standard" pond are intended to represent a wide variety of vulnerable water bodies that occur in the upper reaches of watersheds including prairie pot holes, playa lakes, wetlands, vernal pools, man-made and natural ponds, and intermittent and first-order streams. As a group, there are factors that make these water bodies more or less vulnerable than the standard surrogate pond. Static water bodies that have larger ratios of pesticide-treated drainage area to water body volume would be expected to have higher peak EECs than the standard pond. These water bodies will be either smaller in size or have large drainage areas. Smaller water bodies have limited storage capacity and thus may overflow and carry pesticide in the discharge, whereas the standard pond has no discharge. As watershed size increases, it becomes increasingly unlikely that the entire watershed is planted with a non-major single crop that is all treated simultaneously with the pesticide. Headwater streams can also have peak concentrations higher than the standard pond, but they likely persist for only short periods of time and are then carried and dissipated downstream.

Table 4. PRZM-EXAMS input parameter values for quizalofop-p-ethyl

Input Parameter	Value	Comment	Source
Single Application Rate (kg ai/ha)	See Table 2		
Applications per Year			
Application Interval (days)			
CAM Input	2	Foliar	Labels[1]
IPSCND Input	1	Default	Input parameter guidance (USEPA, 2009)
Spray Drift Fraction	1% - ground; 5% - aerial	Default	
Application Efficiency	99% - ground; 95% - aerial	Default	
Molecular Mass (g/mol)	344.8	Quizalofop acid	EPI Suite 4.1
Vapor Pressure at 25°C (torr)	3×10^{-7}	Parent quizalofop-p-ethyl	Product Chemistry
Solubility in Water at 25°C (mg/L)	0.4	Parent quizalofop-p-ethyl	Product Chemistry
Organic Carbon Partition	256	Mean quizalofop-acid	MRID

Input Parameter	Value	Comment	Source
Coefficient (K_{OC}) (L/kg_{OC})		K_{oc} (136, 90, 372, 425)	00146947
Aerobic Soil Metabolism Half-life (days)	407	Combined parent, quizalofop-acid, 3-OH-quizalofop acid, and bound residues[2]	MRID 00146697 MRID 43235603
Aerobic Aquatic Metabolism Half-life (days)	814 days	2 × aerobic soil metabolism $t_{½}$	Input parameter guidance (USEPA, 2009)
Anaerobic Aquatic Metabolism Half-life (days)	420	Combined parent, quizalofop-acid, and bound residues[2]	MRID 00146697
Hydrolysis Half-lives (days)	Stable (pH 7)	Combined parent and quizalofop-acid residues[2]	MRID 00131583
Aqueous Photolysis Half-life (days)	85.4 days	Combined parent and quizalofop-acid[2]	MRID 00146693

[1]LUIS Report. 1/6/2012. Quizalofop-p-ethyl (128709).

[2]The TTR approach sums residues of concern at each time point in each of the fate studies and fits degradation curves through this residue sum. These comments indicate the residues summed for each study.

Aquatic Exposure Modeling Results

The aquatic EECs for the various scenarios and application methods are listed in Table 5. For some uses, the maximum seasonal application rate was not an integer multiple of the maximum individual application rate. Table 6 provides additional detail indicating how the maximum seasonal application rate was distributed between the individual applications.

The Agency has developed only a limited number of model scenarios. Some of the scenarios used to model a particular use are from regions outside of the geographic restrictions for that use. In these cases, EECs will necessarily be more uncertain than in those cases in which the scenario locations and geographic use restrictions better align.

Two scenarios require further clarification. First, EFED does not currently have a suitable scenario (or surrogate scenario) for applications to pineapple. To provide a high-end estimate of potential exposure from applications to pineapple, the Mississippi cotton scenario was selected because it has a meteorological file associated with it that is representative of areas with high amounts of rainfall. Hawaii and Puerto Rico receive large amounts of rain; rainfall is a driving force in the generation of EECs.

The second scenario in need of further clarification is the paved area scenario. EFED's understanding of this scenario is that paved areas would be sprayed to control weeds that would be growing in the cracks in the pavement. The EECs calculated are for a completely paved watershed draining into the standard pond. The EEC can be linearly scaled to the proportion of the watershed that is paved. For example, if 10% of the watershed is paved, then the appropriate exposure values are 10% of the values provided under the paved areas entry in Table 5 (see sample model output in Appendix G).

Table 5. Aquatic quizalofop-p-ethyl EEC values

Use (Scenario)	Ariel (A) or Ground (G)	1-in-10-year Aquatic EECs (µg/L)		
		Peak	21-day average	60-day average
Idaho, Montana, Washington, Oregon, and Wyoming, only *Non-food/non-feed seed production* *2 apps @ 0.0834 lb ai/A (7-day interval)*				
Alfalfa	A	3.2439	3.1591	3.0262
(MN alfalfa OP)	G	2.3641	2.2989	2.2357
Carrot	A	2.9219	2.8308	2.7275
(CA Row Crop RLF)	G	2.3906	2.3066	2.1727
Chinese cabbage	A	6.5102	6.3749	6.1363
(CA Cole Crop RLF)	G	5.9816	5.8582	5.6347
Garlic	A	3.1903	3.1109	2.9776
(CA Garlic RLF)	G	2.5178	2.4413	2.3342
Onion and Radish	A	1.7975	1.7556	1.7089
(CA onion W/irrig STD)	G	1.1664	1.1215	1.057
Red beets	A	2.9219	2.8308	2.7275
(CA Row Crop RLF)	G	2.3906	2.3066	2.1727
Spinach	A	4.7683	4.6423	4.5518
(CA lettuce STD)	G	4.1377	4.0219	3.9295
Swiss chard	A	4.7683	4.6423	4.5518
(CA lettuce STD)	G	4.1377	4.0219	3.9295
All states, food item *2 apps @ 0.0834 lb ai/A (7-day interval)*				
Sugar beets	A	1.7585	1.7034	1.6504
(CA sugar beet W/irrig OP)	G	1.00725	0.97215	0.92407
Sugar beets	A	4.9319	4.7972	4.5858
(MN sugar beet STD)	G	4.1284	4.0171	3.8903

Use (Scenario)	Ariel (A) or Ground (G)	1-in-10-year Aquatic EECs (µg/L)		
		Peak	21-day average	60-day average
Except New York *1 app at 0.0695 lb ai/A*				
Barley and Wheat	A	2.0586	1.9951	1.8964
(CA Wheat RLF)	G	1.7928	1.7317	1.6435
Barley and Wheat	A	2.1658	2.0984	2.0012
(ND wheat STD)	G	1.8393	1.7886	1.7234
Barley and Wheat	A	1.4209	1.3929	1.3693
(OR wheat OP)	G	1.1225	1.1009	1.0792
Barley and Wheat	A	2.0762	2.0123	1.8002
(TX wheat OP)	G	1.8911	1.8305	1.5982
1 app at 0.0834 and 1 app at 0.042 lb ai/A (7-days)				
Canola/rape	A	2.5532	2.4777	2.3773
(ND canola STD)	G	1.9196	1.8743	1.7927
Crambe	A	2.3499	2.2986	2.2133
(CA Row Crop RLF)	G	1.8572	1.8183	1.758
Crambe	A	3.962	3.8821	3.7321
(MI beans STD)	G	3.422	3.3373	3.2005
Soybeans	A	6.8374	6.5753	6.2246
(MS soybean STD)	G	6.498	6.2511	5.9149
Sunflowers	A	2.0317	1.9878	1.9277
(CA corn OP)	G	1.6713	1.651	1.6096
Sunflowers	A	3.9877	3.8931	3.8193
(IL Corn STD)	G	3.5359	3.4455	3.3792
Sunflowers	A	3.2332	3.1178	3.0022
(IN Corn Std)	G	2.8219	2.7235	2.6291
Sunflowers	A	5.8264	5.7292	5.554
(KS Corn Std)	G	5.4552	5.3695	5.204
Sunflowers	A	5.5477	5.3746	5.2468
(MS corn STD)	G	5.2201	5.0559	4.9238
Sunflowers	A	2.4737	2.409	2.2865
(NC corn E STD)	G	1.9695	1.9062	1.8052
Sunflowers	A	4.6154	4.4916	4.3731
(NC corn W OP)	G	4.1596	4.0464	3.9362
Sunflowers	A	3.7274	3.6242	3.5196
(ND corn OP)	G	3.1419	3.0556	2.988

Use (Scenario)	Ariel (A) or Ground (G)	1-in-10-year Aquatic EECs (µg/L)		
		Peak	21-day average	60-day average
Sunflowers	A	4.1211	3.9882	3.7995
(OH Corn STD)	G	3.6426	3.5189	3.3558
Sunflowers	A	3.4193	3.3448	3.2278
(PA corn STD)	G	2.8912	2.8137	2.7128
Sunflowers	A	4.7586	4.6189	4.4175
(TX corn OP)	G	4.4377	4.3101	4.1261
1 app at 0.0834 lb ai/A				
Field Corn	A	1.3485	1.3184	1.2708
(CA corn OP)	G	1.0866	1.074	1.04658
Field Corn	A	2.5371	2.4861	2.4345
(IL Corn STD)	G	2.2367	2.1826	2.1387
Field Corn	A	2.002	1.9378	1.8533
(IN Corn Std)	G	1.6963	1.6881	1.6329
Field Corn	A	3.9031	3.8406	3.6753
(KS Corn Std)	G	3.6589	3.6041	3.4161
Field Corn	A	3.6028	3.5287	3.4206
(MS corn STD)	G	3.3847	3.2985	3.2057
Field Corn	A	1.7521	1.6936	1.6334
(NC corn E STD)	G	1.3971	1.346	1.3045
Field Corn	A	2.9839	2.8907	2.8026
(NC corn W OP)	G	2.6822	2.5947	2.5098
Field Corn	A	2.4124	2.3455	2.2785
(ND corn OP)	G	2.0243	1.9684	1.9213
Field Corn	A	2.5186	2.4386	2.3673
(OH Corn STD)	G	2.1711	2.1024	2.0508
Field Corn	A	2.1426	2.0767	2.01
(PA corn STD)	G	1.8389	1.7764	1.6904
Field Corn	A	2.9889	2.8942	2.7204
(TX corn OP)	G	2.7755	2.677	2.5142
1 app at 0.0834 and 1 app at 0.057 lb ai/A (7-days)				
Sorghum	A	6.102	5.9538	5.6358
(TXsorghumOP)	G	5.7445	5.6002	5.3044
3 apps at 0.034 and 1 app at 0.023 lb ai/A (7-days)				
Cotton	A	1.1651	1.1303	1.0876
(CA cotton W/irrig STD)	G	0.57519	0.56616	0.54549

Use (Scenario)	Ariel (A) or Ground (G)	1-in-10-year Aquatic EECs (µg/L)		
		Peak	21-day average	60-day average
Cotton	A	5.0259	4.8656	4.6414
(MS cotton STD)	G	4.646	4.4933	4.2777
Cotton	A	5.1579	5.0175	4.8381
(NC cotton STD)	G	4.7392	4.6114	4.4581
Cotton	A	4.184	4.083	3.8877
(TX cotton OP)	G	3.8324	3.7307	3.5516
2 apps at 0.0834 and 1 app at 0.03 lb ai/A (7-days)				
Dry beans	A	3.4743	3.3538	3.1636
(CA Row Crop RLF)	G	2.8456	2.7449	2.5842
Dry beans	A	6.0823	5.9518	5.8049
(MI beans STD)	G	5.2971	5.1838	5.0563
1 app at 0.0834 and 1 app at 0.01 lb ai/A (7-days)				
Dry and succulent peas and	A	1.9447	1.9058	1.8241
lentils (CA Row Crop RLF)	G	1.5878	1.5563	1.4925
Snap beans	A	3.0984	2.9924	2.863
(CA Row Crop RLF)	G	2.5369	2.4472	2.3062
Snap beans	A	5.4748	5.3693	5.1845
(MI beans STD)	G	4.7557	4.6575	4.5155
Texas, Oklahoma, Kansas, and Colorado, only *2 apps at 0.0834 and 1 app at 0.04 lb ai/A (7-days)*				
Fallow	A	2.7513	2.6784	2.6034
(CA Turf RLF)	G	1.9472	1.9236	1.8834
2 apps at 0.0834 lb ai/A (7-days)				
Flax	A	2.9219	2.8308	2.7275
(CA Row Crop RLF)	G	2.3906	2.3066	2.1727
Garbanzos (including chick	A	2.9219	2.8308	2.7275
peas) (CA Row Crop RLF)	G	2.3906	2.3066	2.1727
Garbanzos (including chick	A	5.168	5.083	4.9093
peas) (MI beans STD)	G	4.4906	4.4037	4.265
Maine and Minnesota, only *2 apps at 0.0695 lb ai/A (7-days)*				
Hybrid cottonwood/poplar	A			
plantations	G	2.9575	2.8853	2.8009
(PA apple STD V2)		2.2796	2.2243	2.1669
2 apps at 0.0834 and 1 app at 0.04 lb ai/A (7-days)				

Use (Scenario)	Ariel (A) or Ground (G)	1-in-10-year Aquatic EECs (µg/L)		
		Peak	21-day average	60-day average
Mint (spearmint and peppermint) (CA lettuce STD)	A G	5.8014 5.176	5.6622 4.9992	5.4516 4.7857
2 apps at 0.111 lb ai/A (7-days)				
Non-crop areas (uncultivated areas, fence rows, roadsides, equipment storage areas, and other similar areas) (CA right-of-way RLF)	A G	6.9661 6.3427	6.8076 6.1987	6.2444 5.7362
Non-crop areas (CA Turf RLF)	A G	3.0643 2.1487	2.988 2.0988	2.9062 2.0586
Non-crop areas (FL turf STD)	A G	1.5729 0.68379	1.5197 0.65138	1.4449 0.6071
Non-crop areas (PA turf STD)	A G	2.4248 1.2399	2.3779 1.2116	2.2869 1.1741
Puerto Rico (pineapple only) and Hawaii, only *2 apps at 0.208 lb ai/A (7-days)*				
Ornamental and/or shade trees (CA nursery STD)	A G	4.3858 2.5917	4.2487 2.5068	4.1297 2.4053
Pineapple (MS cotton STD)	A G	19.073 17.804	18.664 17.371	18.185 16.934
1 app at 0.108 lb ai/A				
Paved areas (private roads/sidewalks) (CA Impervious RLF)	A G	19.649 19.959	19.207 19.516	18.327 18.624
Minnesota, only *2 apps at 0.0695 lb ai/A (7-days)*				
Perennial ryegrass grown for seed (ND wheat STD)	A G	4.4857 3.8345	4.335 3.7289	4.1339 3.5787
RLF = red legged frog OP = organophosphate STD = standard				

Terrestrial Exposure

Dietary-Based Quizalofop-P-Ethyl Residue Levels

The Agency uses the T-REX model (v1.5, USEPA, Mar. 22, 2012) to estimate the terrestrial animal exposure values resulting from possible dietary ingestion of quizalofop-p-ethyl residues on vegetative matter and insects present on non-food and food crops from exposure to quizalofop-p-ethyl. It is assumed that the degradates from quizalofop-p-ethyl are equivalent in their toxicity and this automatically incorporated into the model. In all screening-level assessments, the organisms are assumed to consume 100% of their diet as one food type. 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 represented the 95th percentile of residue values from actual field measurements (Hoerger and Kenaga, 1972). The Terrestrial Residue Exposure Model version 1.5 (T-REX) was employed to estimate (1) EECs for different food items for birds and mammals, (2) dose/diet based risk to birds as well as dose based risk to mammals, and (3) EECs for small and large insects to estimate risk to terrestrial invertebrates from direct contact. The short grass EECs were used to evaluate risk from acute oral exposure for terrestrial invertebrates (Table 6).

Results of the T-REX v1.5 modeling of quizalofop-p-ethyl residue levels on those dietary food items which potentially occur on some treated fields, for mammals and birds[4] are provided in Tables 7 and 8. Residue levels for dietary items were calculated for all foliage spray applications.

Results include dietary-based values (*i.e.*, milligrams of quizalofop-p-ethyl per kilogram of diet (mg/kg-diet)), and both an upper-bound and mean estimate of these exposure levels. The upper-bound values are derived using the upper-bound Kenaga nomogram which used the highest of the highest normalized residue values from a number of studies, as a tolerance limit approach.

As birds are also used as a surrogate for reptiles and terrestrial-phase amphibians within this assessment, it is assumed that dose-based exposure levels for these animals are the same as birds (*i.e.*, food ingestion rate per body weight for a bird is the same as for an amphibian and reptile). However, reptiles and amphibians have a lower ingestion rate for a given body weight than birds (US EPA, 1993). Therefore, the dose-based EECs presented here represent an overestimate of exposure for reptiles and amphibians of a given body size (see sample output in Appendix I).

[4] Birds are also used as a surrogate for reptiles and terrestrial-phase amphibians.

Table 6. T-REX modeling scenarios

Use	Maximum Application Rate (lb ai/A)	Number of Applications (Interval between Applications, days)
Idaho, Montana, Washington, Oregon, and Wyoming, only Non-food/non-feed seed production: alfalfa, carrot, Chinese cabbage, garlic, onion, radish, red beets, spinach, Swiss chard All states, food item: sugar beets	0.0834	2 (7-days)
Except New York Barley, wheat	0.0695	1
Canola/rape, crambe, soybeans, sunflowers	0.0834	1 at 0.0834 and 1 at 0.042 (7-days)
Field corn seed production (herbicide-tolerant)	0.0834	1
Sorghum (herbicide-tolerant)	0.0834	1 at 0.0834 and 1 at 0.057 (7-days)
Cotton	0.034	3 at 0.034 and 1 at 0.023 (7-days)
Dry beans	0.0834	2 at 0.0834 and 1 at 0.03 (7-days)
Dry and succulent peas, lentils, snap beans	0.0834	1 at 0.0834 and 1 at 0.01 (7-days)
Texas, Oklahoma, Kansas, and Colorado, only Fallow	0.0834	2 at 0.0834 and 1 at 0.04 (7-days)
Flax, garbanzos (including chick peas)	0.0834	2 (7-days)

Maine and Minnesota, only Hybrid cottonwood/poplar plantations	0.0695	2[2] (7-days)
Mint (spearmint and peppermint)	0.0834	2 at 0.0834 and 1 at 0.04
Non-crop areas (uncultivated areas, fence rows, roadsides, equipment storage areas, and other similar areas)	0.111	2[2]
Puerto Rico (pineapple only) and Hawaii, only Ornamental and/or shade trees, pineapple	0.208	2 (7-days)
Paved areas (private roads/sidewalks)	0.108	1[3]
Minnesota, only Perennial ryegrass grown for seed	0.0695	2 (7-days)
Parameters used in T-REX Model: Foliar half life = 35 days; Avian NOAEC – 180 mg ai/kg-diet (mallard duck)[1]; Mammal LD_{50} = 870 mg ai/kg-bw (rat); Mammal NOEL = 5 mg ai/kg-bw (rat) [1]Surrogate data from fenoxaprop-ethyl because quizalofop-p-ethyl NOAEC was non-definitive (< 269 mg ai/kg-diet. [2]Assuming two applications at the highest rate for the seasonal maximum. [3]Assuming the seasonal maximum is equivalent to the single application rate		

Table 7. Avian quizalofop-p-ethyl upper bound EEC values

Feeding Category	Dietary-based EECs (mg/kg-food item)	Dose-based EECs (mg/kg-bw)		
		Small (20 g)	Medium (100 g)	Large (1000 g)
Idaho, Montana, Washington, Oregon, and Wyoming, only *Non-food/non-feed seed production: alfalfa, carrot, Chinese cabbage, garlic, onion, radish, red beets, spinach, Swiss chard* *All states, food item: sugar beets* *2 apps at 0.0834 lb ai/A (7-day interval)*				
Short grass	37.44	42.64	24.32	10.89
Tall grass	17.16	19.54	11.14	4.99
Broadleaf plants	21.06	23.99	13.68	6.12
Fruits/pods	2.34	2.67	1.52	0.68
Arthropods	14.66	16.70	9.52	4.26
Seeds	-	0.59	0.34	0.15
Except New York *Barley, wheat* *1 app at 0.0695 lb ai/A*				
Short grass	16.68	19.00	10.83	4.85
Tall grass	7.65	8.71	4.97	2.22

Feeding Category	Dietary-based EECs (mg/kg-food item)	Dose-based EECs (mg/kg-bw)		
		Small (20 g)	Medium (100 g)	Large (1000 g)
Broadleaf plants	9.38	10.69	6.09	2.73
Fruits/pods	1.04	1.19	0.68	0.30
Arthropods	6.53	7.44	4.24	1.90
Seeds	-	0.26	0.15	0.07
Canola/rape, crambe, soybeans, sunflowers *1 app at 0.0834 and 1 app at 0.042 lb ai/A (7-days)*				
Short grass	27.50	31.33	17.86	8.00
Tall grass	12.61	14.36	8.19	3.67
Broadleaf plants	15.47	17.62	10.05	4.50
Fruits/pods	1.72	1.96	1.12	0.50
Arthropods	10.77	12.27	7.00	3.13
Seeds	-	0.44	0.25	0.11
Field corn seed production (herbicide-tolerant) *1 app at 0.0834 lb ai/A*				
Short grass	20.02	22.80	13.00	5.82
Tall grass	9.17	10.45	5.96	2.67
Broadleaf plants	11.26	12.82	7.31	3.27
Fruits/pods	1.25	1.42	0.81	0.36
Arthropods	7.84	8.93	5.09	2.28
Seeds	-	0.32	0.18	0.08
Sorghum (herbicide-tolerant) *1 app at 0.0834 and 1 app at 0.057 lb ai/A (7-days)*				
Short grass	31.10	35.43	20.20	9.04
Tall grass	14.26	16.24	9.26	4.15
Broadleaf plants	17.50	19.93	11.36	5.09
Fruits/pods	1.94	2.21	1.26	0.57
Arthropods	12.18	13.87	7.91	3.54
Seeds	-	0.49	0.28	0.13
Cotton *3 apps at 0.034 and 1 app at 0.023 lb ai/A (7-days)*				
Short grass	24.19	27.55	15.71	7.03
Tall grass	11.09	12.63	7.20	3.22
Broadleaf plants	13.61	15.50	8.84	3.96
Fruits/pods	1.51	1.72	0.98	0.44

Feeding Category	Dietary-based EECs (mg/kg-food item)	Dose-based EECs (mg/kg-bw)		
		Small (20 g)	Medium (100 g)	Large (1000 g)
Arthropods	9.47	10.79	6.15	2.76
Seeds	-	0.38	0.22	0.10
Dry beans *2 apps at 0.0834 and 1 app at 0.03 lb ai/A (7-days)*				
Short grass	39.79	45.32	25.84	11.57
Tall grass	18.24	20.77	11.85	5.30
Broadleaf plants	22.38	25.49	14.54	6.51
Fruits/pods	2.49	2.83	1.62	0.72
Arthropods	15.59	17.75	10.12	4.53
Seeds	-	0.63	0.36	0.16
Dry and succulent peas, lentils, snap beans *1 app at 0.0834 and 1 app at 0.01 lb ai/A (7-days)*				
Short grass	20.02	22.80	13.00	5.82
Tall grass	9.17	10.45	5.96	2.67
Broadleaf plants	11.26	12.82	7.31	3.27
Fruits/pods	1.25	1.42	0.81	0.36
Arthropods	7.84	8.93	5.09	2.28
Seeds	-	0.32	0.18	0.08
Texas, Oklahoma, Kansas, and Colorado, only *Fallow* *2 apps at 0.0834 and 1 app at 0.04 lb ai/A (7-days)*				
Short grass	42.19	48.06	27.40	12.27
Tall grass	19.34	22.03	12.56	5.62
Broadleaf plants	23.73	27.03	15.41	6.90
Fruits/pods	2.64	3.00	1.71	0.77
Arthropods	16.53	18.82	10.73	4.81
Seeds	-	0.67	0.38	0.17
Flax, garbanzos (including chick peas) *2 apps at 0.0834 lb ai/A (7-days)*				
Short grass	37.44	42.64	24.32	10.89
Tall grass	17.16	19.54	11.14	4.99
Broadleaf plants	21.06	23.99	13.68	6.12
Fruits/pods	2.34	2.67	1.52	0.68
Arthropods	14.66	16.70	9.52	4.26

Feeding Category	Dietary-based EECs (mg/kg-food item)	Dose-based EECs (mg/kg-bw)		
		Small (20 g)	Medium (100 g)	Large (1000 g)
Seeds	-	0.59	0.34	0.15
Maine and Minnesota, only *Hybrid cottonwood/poplar plantations* *2 apps at 0.0695 lb ai/A (7-days)*				
Short grass	31.20	35.53	20.26	9.07
Tall grass	14.30	16.29	9.29	4.16
Broadleaf plants	17.55	19.99	11.40	5.10
Fruits/pods	1.95	2.22	1.27	0.57
Arthropods	12.22	13.92	7.94	3.55
Seeds	-	0.49	0.28	0.13
Mint (spearmint and peppermint) *2 apps at 0.0834 and 1 app at 0.04 lb ai/A (7-days)*				
Short grass	42.19	48.06	27.40	12.27
Tall grass	19.34	22.03	12.56	5.62
Broadleaf plants	23.73	27.03	15.41	6.90
Fruits/pods	2.64	3.00	1.71	0.77
Arthropods	16.53	18.82	10.73	4.81
Seeds	-	0.67	0.38	0.17
Non-crop areas (uncultivated areas, fence rows, roadsides, equipment storage areas, and other similar areas) *2 apps at 0.111 lb ai/A (7-days)*				
Short grass	49.83	56.75	32.36	14.49
Tall grass	22.84	26.01	14.83	6.64
Broadleaf plants	28.03	31.92	18.20	8.15
Fruits/pods	3.11	3.55	2.02	0.91
Arthropods	19.52	22.23	12.68	5.67
Seeds	-	0.79	0.45	0.20
Puerto Rico (pineapple only) and Hawaii, only *Ornamental and/or shade trees, pineapple* *2 apps at 0.208 lb ai/A (7-days)*				
Short grass	93.38	106.35	60.64	27.15
Tall grass	42.80	48.74	27.80	12.44
Broadleaf plants	52.53	59.82	34.11	15.27
Fruits/pods	5.84	6.65	3.79	1.70

Feeding Category	Dietary-based EECs (mg/kg-food item)	Dose-based EECs (mg/kg-bw)		
		Small (20 g)	Medium (100 g)	Large (1000 g)
Arthropods	36.57	41.65	23.75	10.63
Seeds	-	1.48	0.84	0.38
Paved areas (private roads/sidewalks) *1 app at 0.108 lb ai/A*				
Short grass	25.92	29.52	16.83	7.54
Tall grass	11.88	13.53	7.72	3.45
Broadleaf plants	14.58	16.61	9.47	4.24
Fruits/pods	1.62	1.85	1.05	0.47
Arthropods	10.15	11.56	6.59	2.95
Seeds	-	0.41	0.23	0.10
Minnesota, only *Perennial ryegrass grown for seed* *2 apps at 0.0695 lb ai/A (7-days)*				
Short grass	31.20	35.53	20.26	9.07
Tall grass	14.30	16.29	9.29	4.16
Broadleaf plants	17.55	19.99	11.40	5.10
Fruits/pods	1.95	2.22	1.27	0.57
Arthropods	12.22	13.92	7.94	3.55
Seeds	-	0.49	0.28	0.13

Table 8. Mammalian quizalofop-p-ethyl upper bound EEC values

Feeding Category	Dietary-based EECs (mg/kg-food item)	Dose-based EECs (mg/kg-bw)		
		Small (15 g)	Medium (135 g)	Large (1000 g)
Idaho, Montana, Washington, Oregon, and Wyoming, only *Non-food/non-feed seed production: alfalfa, carrot, Chinese cabbage, garlic, onion, radish, red beets, spinach, Swiss chard* *All states, food item: sugar beets* *2 apps @ 0.0834 lb ai/A (7-day interval)*				
Short grass	37.44	35.70	24.67	5.72
Tall grass	17.16	16.36	11.31	2.62
Broadleaf plants	21.06	20.08	13.88	3.22
Fruits/pods	2.34	2.23	1.54	0.36

Feeding Category	Dietary-based EECs (mg/kg-food item)	Dose-based EECs (mg/kg-bw)		
		Small (15 g)	Medium (135 g)	Large (1000 g)
Arthropods	14.66	13.98	9.66	2.24
Seeds	-	0.50	0.34	0.08
Except New York *Barley, wheat* *1 app at 0.0695 lb ai/A*				
Short grass	16.68	15.90	10.99	2.55
Tall grass	7.65	7.29	5.04	1.17
Broadleaf plants	9.38	8.95	6.18	1.43
Fruits/pods	1.04	0.99	0.69	0.16
Arthropods	6.53	6.23	4.30	1.00
Seeds	-	0.22	0.15	0.04
Canola/rape, crambe, soybeans, sunflowers *1 app at 0.0834 and 1 app at 0.042 lb ai/A (7-days)*				
Short grass	27.50	26.22	18.12	4.20
Tall grass	12.61	12.02	8.31	1.93
Broadleaf plants	15.47	14.75	10.19	2.36
Fruits/pods	1.72	1.64	1.13	0.26
Arthropods	10.77	10.27	7.10	1.65
Seeds	-	0.36	0.25	0.06
Field corn seed production (herbicide-tolerant) *1 app at 0.0834 lb ai/A*				
Short grass	20.02	19.08	13.19	3.06
Tall grass	9.17	8.75	6.05	1.40
Broadleaf plants	11.26	10.73	7.42	1.72
Fruits/pods	1.25	1.19	0.82	0.19
Arthropods	7.84	7.47	5.17	1.20
Seeds	-	0.27	0.18	0.04
Sorghum (herbicide-tolerant) *1 app at 0.0834 and 1 app at 0.057 lb ai/A (7-days)*				
Short grass	31.10	29.66	20.50	4.75
Tall grass	14.26	13.59	9.39	2.18
Broadleaf plants	17.50	16.68	11.53	2.67
Fruits/pods	1.94	1.85	1.28	0.30
Arthropods	12.18	11.62	8.03	1.86

Feeding Category	Dietary-based EECs (mg/kg-food item)	Dose-based EECs (mg/kg-bw)		
		Small (15 g)	Medium (135 g)	Large (1000 g)
Seeds	-	0.41	0.28	0.07
Cotton *3 apps at 0.034 and 1 app at 0.023 lb ai/A (7-days)*				
Short grass	24.19	23.06	15.94	3.70
Tall grass	11.09	10.57	7.31	1.69
Broadleaf plants	13.61	12.97	8.97	2.08
Fruits/pods	1.51	1.44	1.00	0.23
Arthropods	9.47	9.03	6.24	1.45
Seeds	-	0.32	0.22	0.05
Dry beans *2 apps at 0.0834 and 1 app at 0.03 lb ai/A (7-days)*				
Short grass	39.79	37.94	26.22	6.08
Tall grass	18.24	17.39	12.02	2.79
Broadleaf plants	22.38	21.34	14.75	3.42
Fruits/pods	2.49	2.37	1.64	0.38
Arthropods	15.59	14.86	10.27	2.38
Seeds	-	0.53	0.36	0.08
Dry and succulent peas, lentils, snap beans *1 app at 0.0834 and 1 app at 0.01 lb ai/A (7-days)*				
Short grass	20.02	19.08	13.19	3.06
Tall grass	9.17	8.75	6.05	1.40
Broadleaf plants	11.26	10.73	7.42	1.72
Fruits/pods	1.25	1.19	0.82	0.19
Arthropods	7.84	7.47	5.17	1.20
Seeds	-	0.27	0.18	0.04
Texas, Oklahoma, Kansas, and Colorado, only *Fallow* *2 apps at 0.0834 and 1 app at 0.04 lb ai/A (7-days)*				
Short grass	42.19	40.23	27.80	6.45
Tall grass	19.34	18.44	12.74	2.95
Broadleaf plants	23.73	22.63	15.64	3.63
Fruits/pods	2.64	2.51	1.74	0.40
Arthropods	16.53	15.76	10.89	2.52
Seeds	-	0.56	0.39	0.09

Feeding Category	Dietary-based EECs (mg/kg-food item)	Dose-based EECs (mg/kg-bw)		
		Small (15 g)	Medium (135 g)	Large (1000 g)
Flax, garbanzos (including chick peas) *2 apps at 0.0834 lb ai/A (7-days)*				
Short grass	37.44	35.70	24.67	5.72
Tall grass	17.16	16.36	11.31	2.62
Broadleaf plants	21.06	20.08	13.88	3.22
Fruits/pods	2.34	2.23	1.54	0.36
Arthropods	14.66	13.98	9.66	2.24
Seeds	-	0.50	0.34	0.08
Maine and Minnesota, only *Hybrid cottonwood/poplar plantations* *2 apps at 0.0695 lb ai/A (7-days)*				
Short grass	31.20	29.75	20.56	4.77
Tall grass	14.30	13.63	9.42	2.18
Broadleaf plants	17.55	16.73	11.56	2.68
Fruits/pods	1.95	1.86	1.28	0.30
Arthropods	12.22	11.65	8.05	1.87
Seeds	-	0.41	0.29	0.07
Mint (spearmint and peppermint) *2 apps at 0.0834 and 1 app at 0.04 lb ai/A (7-days)*				
Short grass	42.19	40.23	27.80	6.45
Tall grass	19.34	18.44	12.74	2.95
Broadleaf plants	23.73	22.63	15.64	3.63
Fruits/pods	2.64	2.51	1.74	0.40
Arthropods	16.53	15.76	10.89	2.52
Seeds	-	0.56	0.39	0.09
Non-crop areas (uncultivated areas, fence rows, roadsides, equipment storage areas, and other similar areas) *2 apps at 0.111 lb ai/A (7-days)*				
Short grass	49.83	47.51	32.84	7.61
Tall grass	22.84	21.78	15.05	3.49
Broadleaf plants	28.03	26.72	18.47	4.28
Fruits/pods	3.11	2.97	2.05	0.48
Arthropods	19.52	18.61	12.86	2.98
Seeds	-	0.66	0.46	0.11

Feeding Category	Dietary-based EECs (mg/kg-food item)	Dose-based EECs (mg/kg-bw)		
		Small (15 g)	Medium (135 g)	Large (1000 g)
Puerto Rico (pineapple only) and Hawaii, only *Ornamental and/or shade trees, pineapple* *2 apps at 0.208 lb ai/A (7-days)*				
Short grass	93.38	89.03	61.53	14.27
Tall grass	42.80	40.80	28.20	6.54
Broadleaf plants	52.53	50.08	34.61	8.02
Fruits/pods	5.84	5.56	3.85	0.89
Arthropods	36.57	34.87	24.10	5.59
Seeds	-	1.24	0.85	0.20
Paved areas (private roads/sidewalks) *1 app at 0.108 lb ai/A*				
Short grass	25.92	24.71	17.08	3.96
Tall grass	11.88	11.33	7.83	1.82
Broadleaf plants	14.58	13.90	9.61	2.23
Fruits/pods	1.62	1.54	1.07	0.25
Arthropods	10.15	9.68	6.69	1.55
Seeds	-	0.34	0.24	0.06
Minnesota, only *Perennial ryegrass grown for seed* *2 apps at 0.0695 lb ai/A (7-days)*				
Short grass	31.20	29.75	20.56	4.77
Tall grass	14.30	13.63	9.42	2.18
Broadleaf plants	17.55	16.73	11.56	2.68
Fruits/pods	1.95	1.86	1.28	0.30
Arthropods	12.22	11.65	8.05	1.87
Seeds	-	0.41	0.29	0.07

Off-Field Terrestrial and Wetland/Riparian Plant Quizalofop-P-Ethyl Exposure

TerrPlant 1.2.2 (10/29/09) was used as a Tier 1 model for screening level assessments of pesticides. The model provides estimates of exposure to terrestrial plants from single pesticide applications; the model does not consider exposures to plants from multiple pesticide applications. TerrPlant derives pesticide EECs in runoff and in spray drift, and develops risk quotients for non-listed and listed species of monocots and dicots inhabiting dry and semi-aquatic areas.

The estimated exposure concentrations of quizalofop-p-ethyl for terrestrial plants are presented below (Table 9). The most protective ground and aerial application scenarios for each use were selected, based on information from the label (see Appendix H for sample output).

Table 9. Terrestrial plant exposure concentration estimates for quizalofop-p-ethyl

Description	Equation	EEC (lb ai/A)	
		Ground	Aerial
Idaho, Montana, Washington, Oregon, and Wyoming, only *Non-food/non-feed seed production: alfalfa, carrot, Chinese cabbage, garlic, onion, radish, red beets, spinach, Swiss chard* *1 app at 0.0834 lb ai/A*			
Runoff to dry areas	(A/I)*R	0.000834	0.000834
Runoff to semi-aquatic areas	(A/I)*R*10	0.00834	0.00834
Spray drift	A*D	0.000834	0.00417
Total for dry areas	((A/I)*R)+(A*D)	0.001668	0.005004
Total for semi-aquatic areas	((A/I)*R*10)+(A*D)	0.009174	0.01251
Except New York *Barley, wheat* *1 app at 0.0695 lb ai/A*			
Runoff to dry areas	(A/I)*R	0.000695	0.000695
Runoff to semi-aquatic areas	(A/I)*R*10	0.00695	0.00695
Spray drift	A*D	0.000695	0.003475
Total for dry areas	((A/I)*R)+(A*D)	0.00139	0.00417
Total for semi-aquatic areas	((A/I)*R*10)+(A*D)	0.007645	0.010425
Canola/rape, crambe, soybeans, sunflowers, field corn seed production (herbicide-tolerant), sorghum (herbicide-tolerant), dry beans, dry and succulent peas, lentils, snap beans, flax, garbanzos (including chick peas), mint (peppermint and spearmint), sugar beet *1 app at 0.0834*			
Runoff to dry areas	(A/I)*R	0.000834	0.000834
Runoff to semi-aquatic areas	(A/I)*R*10	0.00834	0.00834
Spray drift	A*D	0.000834	0.00417
Total for dry areas	((A/I)*R)+(A*D)	0.001668	0.005004
Total for semi-aquatic areas	((A/I)*R*10)+(A*D)	0.009174	0.01251
Cotton *1 app at 0.034*			
Runoff to dry areas	(A/I)*R	0.00034	0.00034
Runoff to semi-aquatic areas	(A/I)*R*10	0.0034	0.0034

Description	Equation	EEC (lb ai/A)	
		Ground	Aerial
Spray drift	A*D	0.00034	0.0017
Total for dry areas	((A/I)*R)+(A*D)	0.00068	0.00204
Total for semi-aquatic areas	((A/I)*R*10)+(A*D)	0.00374	0.0051
Texas, Oklahoma, Kansas, and Colorado, only *Fallow* *1 app at 0.0834*			
Runoff to dry areas	(A/I)*R	0.000834	0.000834
Runoff to semi-aquatic areas	(A/I)*R*10	0.00834	0.00834
Spray drift	A*D	0.000834	0.00417
Total for dry areas	((A/I)*R)+(A*D)	0.001668	0.005004
Total for semi-aquatic areas	((A/I)*R*10)+(A*D)	0.009174	0.01251
Maine and Minnesota, only *Hybrid cottonwood/poplar plantations* *1 app at 0.0695 lb ai/A*			
Runoff to dry areas	(A/I)*R	0.000695	0.000695
Runoff to semi-aquatic areas	(A/I)*R*10	0.00695	0.00695
Spray drift	A*D	0.000695	0.003475
Total for dry areas	((A/I)*R)+(A*D)	0.00139	0.00417
Total for semi-aquatic areas	((A/I)*R*10)+(A*D)	0.007645	0.010425
Non-crop areas (uncultivated areas, fence rows, roadsides, equipment storage areas, and other similar areas) *1 app at 0.111 lb ai/A*			
Runoff to dry areas	(A/I)*R	0.00111	0.00111
Runoff to semi-aquatic areas	(A/I)*R*10	0.0111	0.0111
Spray drift	A*D	0.00111	0.00555
Total for dry areas	((A/I)*R)+(A*D)	0.00222	0.00666
Total for semi-aquatic areas	((A/I)*R*10)+(A*D)	0.01221	0.01665
Puerto Rico (pineapple only) and Hawaii, only *Ornamental and/or shade trees, pineapple* *1 app at 0.208 lb ai/A*			
Runoff to dry areas	(A/I)*R	0.00208	0.00208
Runoff to semi-aquatic areas	(A/I)*R*10	0.0208	0.0208
Spray drift	A*D	0.00208	0.0104
Total for dry areas	((A/I)*R)+(A*D)	0.00416	0.01248
Total for semi-aquatic areas	((A/I)*R*10)+(A*D)	0.02288	0.0312
Paved areas (private roads/sidewalks)			

Description	Equation	EEC (lb ai/A)	
		Ground	Aerial
1 app at 0.108 lb ai/A			
Runoff to dry areas	(A/I)*R	0.00108	0.00108
Runoff to semi-aquatic areas	(A/I)*R*10	0.0108	0.0108
Spray drift	A*D	0.00108	0.0054
Total for dry areas	((A/I)*R)+(A*D)	0.00216	0.00648
Total for semi-aquatic areas	((A/I)*R*10)+(A*D)	0.01188	0.0162
Minnesota, only *Perennial ryegrass grown for seed* *1 app at 0.0695 lb ai/A*			
Runoff to dry areas	(A/I)*R	0.000695	0.000695
Runoff to semi-aquatic areas	(A/I)*R*10	0.00695	0.00695
Spray drift	A*D	0.000695	0.003475
Total for dry areas	((A/I)*R)+(A*D)	0.00139	0.00417
Total for semi-aquatic areas	((A/I)*R*10)+(A*D)	0.007645	0.010425
A = application rate I = incorporation R = runoff fraction D = drift fraction			

Effects Characterization

There are two enantiomers for quizalofop. Quizalofop-p-ethyl is the R-enantiomer and the isomer with pesticidal properties. Quizalofop-ethyl is a 50/50 racemic mixture of R- and S-enantiomers. Toxicity information has been submitted for both enantiomers. Given that the toxicity of quizalofop-ethyl is driven by the R-enantiomer in the mixture, the lowest toxicity endpoint for an organism was used in the assessment, regardless of the chemical tested (quizalofop-p-ethyl or quizalofop-ethyl).

Many quizalofop-p-ethyl toxicity studies were submitted by the registrant since the Registration Review Quizalofop Final Work Plan (US EPA, 2008) and have been incorporated into the chemical's toxicity profile. Of particular note are the studies that were requested in the DCI: vegetative vigor, seedling emergence, non-vascular aquatic plant, and a special aquatic monocot study with rice. The aquatic monocot and non-vascular plant studies were classified as "acceptable" and filled data gaps in the ecotoxicological risk picture. Several seedling emergence and vegetative vigor studies were submitted and classified as "supplemental" or "acceptable." Combined, they complete the risk picture for terrestrial plants.

No additional information was available from the open literature. The toxicity endpoints of the registrant-submitted studies were lower than those found in the open literature and there were not any open literature studies that addressed taxa not currently considered with the Agency-required data. A list of the quizalofop-p-ethyl open literature studies that were screened as part of this assessment is provided in Appendix D.

One data gap remains for quizalofop-p-ethyl – acute toxicity to estuarine/marine fish. In addition, there are several instances where the lowest toxicity endpoint is non-definitive (acute and chronic avian toxicity, and algal toxicity). In these instances, surrogate data from the structurally-similar chemicals fenoxaprop-p-ethyl and fenoxaprop-ethyl were considered. Finally, an acute-to-chronic ratio was employed to derive a chronic NOAEC for the most sensitive (on an acute-basis) species of freshwater fish. A summary of the quizalofop studies and surrogate data used in this risk assessment are described below.

Terrestrial Vertebrate Toxicology

Effects on Birds

There was one acute avian oral toxicity study with quizalofop-ethyl (MRID 00128210). The study was classified as "supplemental" because it tested the common quail in lieu of the bobwhite quail and there was uncertainty about the weight-measured doses received by the birds. The acute oral LD_{50} of quizalofop-ethyl was reported as >2000 mg/kg-bw in the mallard duck and common quail. The toxicity value is non-definitive and was compared to

toxicity values for fenoxaprop-p-ethyl and fenoxaprop-ethyl, two herbicides with similar chemical structures to quizalofop. The reported LD_{50}s for these chemicals were similar to quizalofop-ethyl (LD_{50} > 2000 and 2510 mg ai/kg-bw, fenoxaprop-p-ethyl and fenoxaprop-ethyl, respectively). Sublethal effects included a decrease in food consumption and body weight. A passerine bird study was not available; thus the most sensitive mallard duck and common quail toxicity data will be used instead (Table 10).

Two dietary studies were available for quizalofop-ethyl. MRID 00128211 determined the LC_{50} to be > 5000 mg ai/kg-diet for both the bobwhite quail and mallard duck. Decreases in food consumption and weight loss were observed. Similarly, MRID 00147574 studied the bobwhite quail and yielded an LC_{50} of > 5620 mg ai/kg-diet. Weight loss was observed. Together, the acute oral dose and dietary studies indicate that quizalofop is practically non-toxic on an acute basis to birds (Table 10).

There were two avian chronic studies available. Quizalofop-p-ethyl was found to be more toxic to the mallard duck (NOAEC < 269 mg ai/kg-diet) compared to the bobwhite quail (NOAEC = 1030 mg ai/kg-diet). The mallard duck's NOAEC is based on the proportion of eggs set. No adult parameters were affected; however a reduction in hatchability (31%), percent of eggs laid and set, and 14-day old survivors was noted in the 1030 mg ai/kg-diet treatment group. Hatchling weight also decreased by 5% at this treatment level. No sublethal effects were observed in the bobwhite quail study. Both studies were classified as "supplemental" because they did not verify the frozen storage stability of quizalofop-p-ethyl feed mixtures that had been prepared in advance, frozen, and then thawed for use. In addition, the non-definitive (less than) value of the mallard's toxicity endpoint lends uncertainty to estimating the true toxicity of quizalofop-p-ethyl. To decrease this uncertainty, the mallard NOAECs for fenoxaprop-p-ethyl and fenoxaprop-ethyl, two structurally-similar herbicides to quizalofop-p-ethyl, were examined. Fenoxaprop-p-ethyl yielded a NOAEC of 512 mg ai/kg-diet whereas the NOAEC for fenoxaprop-ethyl was 180 mg ai/kg-diet. Both of these values are similar to the quizalofop-p-ethyl NOAEC; it was determined that using the fenoxaprop-ethyl NOAEC of 180 mg ai/kg-diet would be a conservative definitive number to use in the risk assessment (Table 10).

Effects on Mammals

An acute oral mammal toxicity study yielded LD_{50}s of 870 and 1088 mg ai/kg-bw for female and male rats, respectively (MRID 41206105). Quizalofop-ethyl was assigned a toxicity class of "slightly toxic", based on these data. No sublethal effects were reported (Table 10).

A two-generation rat reproduction study yielded a NOAEC of 5 mg ai/kg-bw and a LOAEC of 20 mg ai/kg-bw. At 20 mg ai/kg-bw, there was a reduction in live pup births for both the F_1 and F_2 generations. Clinical observations of the offspring revealed an increase in the

incidence of hematomas, but it was not a dose-responsive effect. Decreases in pup body weight were also observed at the LOAEC. Specifically, there were decreases in the weight of the liver, kidney, heart, and spleen (Table 10).

Table 10. Summary of specific measurement endpoint values selected to evaluate risk for birds and mammal assessment endpoints

Assessment Endpoint	Measurement Endpoint	Selected Measurement Endpoint Value and Source		
		Species	**Endpoint, Toxicity and Effect(s)**	**Chemical / Source / Study Classification**
Survival and Reproduction of Birds, Reptiles and Amphibians	Mortality: acute oral avian LD_{50}	Mallard duck (*Anas platyrhynchos*) Common quail (*Coturnix coturnix*)	LD_{50} > 2000 mg ai/kg-bw NOAEL < 500 mg ai/kg-bw Decrease in food consumption and weight gain.	Quizalofop-ethyl technical grade, % purity not reported MRID 00128210 Supplemental
	Mortality: subacute avian LC_{50}	Mallard duck (*Anas platyrhynchos*) Bobwhite quail (*Colinus virginianus*)	8-day LC_{50} > 5,000 mg ai/kg-diet Decrease in food consumption and weight gain.	Quizalofop-ethyl technical grade, % purity not reported MRID 00128211 Acceptable
	Mortality: subacute avian LC_{50}	Bobwhite quail (*Colinus virginianus*)	8-day LC_{50} > 5620 mg ai/kg-diet NOAEC = 3160 mg ai/kg-diet Decrease in weight gain.	Quizalofop-ethyl technical grade, 99% ai MRID 00147574 Acceptable
	Reproduction: chronic reproduction NOAEC	Mallard duck (*Anas platyrhynchos*)	NOAEC = <269 mg ai/kg-diet LOAEC = 269 mg ai/kg-diet The most sensitive parameter was a reduction in the proportion of eggs set. Other effects included a reduction in hatchability, percent of eggs laid and set, 14-day old survivors, and weight in the 1030 mg ai/kg-diet groups.	Quizalofop-p-ethyl technical grade, 98.4% MRID 46607102 Supplemental
	Reproduction: chronic reproduction NOAEC	Bobwhite quail (*Colinus virginianus*)	NOAEC = 1030 mg ai/kg-diet LOAEC = >1030 mg ai/kg-diet No effects.	Quizalofop-p-ethyl technical grade 98.4% ai MRID 4660701 Supplemental

Assessment Endpoint	Measurement Endpoint	Selected Measurement Endpoint Value and Source		
		Species	Endpoint, Toxicity and Effect(s)	Chemical / Source / Study Classification
Survival and Reproduction of Mammals	Mortality: acute oral LD_{50}	Rat (*Rattus norvegicus)*	Female LD_{50} = 870 mg ai/kg-bw Male LD_{50} = 1088 mg ai/kg-bw Unsteady gait, loss of righting reflex, piloerection, coma, hypothermia, respiratory stress, and urinary incontinence appeared after 1-hour of dosing.	Quizalofop-ethyl technical grade, 97 % MRID 41206105 Acceptable
	Reproduction: chronic reproduction NOAEC	Rat (*Rattus norvegicus)*	NOAEC = 100 mg/kg-diet (5 mg/kg-bw) (2 generation reproduction study) LOAEC = 400 mg/kg-diet (20 mg/kg-bw) Decreases in male and female pup body weight and reduced number of live pup births in F_1 and F_2 generations.	Quizalofop-ethyl technical grade, 99.1% MRID 00153351 Acceptable

Terrestrial Invertebrate Toxicology

There was one acute contact toxicity study available for the honeybee (Table 11). The LD_{50} was > 50 µg ai/bee, which classifies quizalofop-ethyl as "practically non-toxic" to bees. No sublethal effects were observed and there were two mortalities (one in the lowest dose group and one in the highest dose group), that were considered incidental. The study was classified as "supplemental" because raw data were not included with the submission to verify the study's results.

Table 11. Summary of specific measurement endpoint values selected to evaluate risk for honey bees

Assessment Endpoint	Measurement Endpoint	Selected Measurement Endpoint Value and Source		
		Species	Endpoint, Toxicity, and Effect(s) (µg ai/bee)	Chemical / Source /
Acute Contact Toxicity	Mortality: acute contact LD_{50}	Honey Bee (*Apis mellifera*)	LD_{50} > 50 No effects.	Quizalofop-ethyl technical grade, 99.1% MRID 00150942 Supplemental

Aquatic Vertebrate (Fish) Toxicology

Effects to Freshwater Fish and Aquatic-Phase Amphibians

Data from seven studies are available for acute effects of quizalofop-p-ethyl and quizalofop-ethyl to warm and cold water species of freshwater fish. The most sensitive endpoint (LC_{50} = 0.21 mg ai/L (MRID 47408413) was derived from a rainbow trout study that used a quizalofop-p-ethyl typical end-use product. Endpoints from aquatic studies that use a typical end-use product are not used for risk quotient calculations; therefore, MRID 47408402 was used instead with its LC_{50} of 0.72 mg ai/L for the rainbow trout. Sub-lethal effects (*e.g.*, quiescence, sounding, weak, ceased swimming, loss of balance, dark discoloration and irregular respiration) were documented. Based on this toxicity value, quizalofop-p-ethyl is classified as "highly toxic" on an acute basis to freshwater fish. In addition to the two rainbow trout studies already described, there were three other studies performed with rainbow trout, which yielded toxicity endpoints that were higher (quizalofop-p-ethyl – MRID 47408405; quizalofop-ethyl – MRIDs 00128207, 00146680). Two bluegill sunfish studies were available (MRIDs 00128207, 00128208), both conducted with quizalofop-ethyl. Toxicity values ranged from < 0.46 to < 0.28 mg ai/L (Table 12).

Chronic data were available from an early-life stage study with the fathead minnow (MRID 00150109). The most sensitive endpoints were length and wet weight. Length was reduced by 10% at the LOAEC (0.030 mg ai/L) and weight by 18%. Larval survival was affected at the highest dose level (0.157 mg ai/L). Chronic data were not available for the rainbow trout, the most sensitive acute toxicity species. In these circumstances, an acute-to-chronic ratio (ACR) is calculated using the relationship between the acute and chronic toxicity endpoints for a pair of species. In the case of quizalofop, chronic data were only available for the fathead minnow and there was not an acute study available for this species. Instead, freshwater fish data for fenoxaprop-p-ethyl, a structurally similar chemical, were considered to derive a NOAEC for the rainbow trout with quizalofop-p-ethyl. In general, the fenoxaprop-p-ethyl acute toxicity data for rainbow trout was slightly more sensitive than that for quizalofop (quizalofop-p-ethyl LC_{50} = 0.72 mg ai/L compared with fenoxaprop-p-ethyl LC_{50} = 0.46 mg ai/L). Thus the use of fenoxaprop-p-ethyl data to derive the ACR was considered reasonable and protective. The chronic quizalofop-p-ethyl NOAEC was derived as follows:

$$\frac{LC_{50(\text{fenox. fathead})}}{NOAEC_{(\text{fenox. fathead})}} = \frac{LC_{50\ (\text{quiz. trout})}}{NOAEC_{(\text{quiz. trout})}} = \frac{0.466}{0.044} = \frac{0.72}{X} = 0.068 = NOAEC_{(\text{quiz. trout})}$$

However, when the ACR-derived NOAEC for rainbow trout was compared with the NOAEC from the quizalofop fathead minnow study, it was found to be more sensitive (0.010 mg ai/L). Consequently, the fathead minnow NOAEC was used in the risk assessment for risk quotient calculations.

Effects to Estuarine-Marine Fish

There were no estuarine/marine fish acute toxicity data available for quizalofop. To fill the data gap, toxicity information from fenoxaprop-p-ethyl and fenoxaprop-ethyl (two structurally similar chemicals) were examined. Neither chemical had an appropriate set of acute and chronic toxicity information for estuarine/marine fish that could be used to derive an ACR. Fenoxaprop-ethyl was the only chemical with an acute estuarine/marine value. Its LC_{50} was less toxic than the most sensitive value for freshwater fish. It was assumed that this same toxicity relationship would hold true for quizalofop-p-ethyl; thus it was considered protective and appropriate to use the quizalofop-p-ethyl acute toxicity value for rainbow trout as a surrogate for an estuarine/marine fish LC_{50} (Table 12).

One study is available for the chronic effects of quizalofop-p-ethyl to estuarine/marine fish (MRID 47910503). The endpoints are based on effects to larval survival and hatchability. No treatment-related effects were detected for time to hatch, but larval survival was affected in the 0.167 mg ai/L treatment group. The study was classified as "supplemental" because the solvent appeared to promote growth in fish. The hatchability and survival endpoints were not affected by the solvent, thus only these endpoints are considered valid for consideration in the risk assessment. The effect of quizalofop-p-ethyl on the growth of estuarine/marine fish remains uncertain, although based on the results of the chronic freshwater fish study, a decrease in growth could be expected (Table 12).

Table 12. Summary of specific measurement endpoint values selected to evaluate risk for fish and amphibian assessment endpoints

Assessment Endpoint	Measurement Endpoint	Selected Measurement Endpoint Value and Source		
		Species	**Endpoint, Toxicity, and Effect(s) (mg ai/L)**	**Chemical/ Source / Study Classification**
Survival and reproduction of freshwater fish	Acute mortality: most sensitive acute freshwater fish 96-hour LC_{50}	Rainbow trout (*Oncorhynchus mykiss*)	96-hour LC_{50} = 0.72 Quiescence, sounding, weakness, swimming cessation, loss of balance, dark discoloration, and irregular respiration.	Quizalofop-p-ethyl MRID 47408402 Acceptable
	Chronic Early Life Stage: most sensitive NOAEC	Fathead minnow (*Pimphales promelas*)	NOAEC = 0.010 LOAEC = 0.030 Decreased length and weight, and larval mortality.	Quizalofop-p-ethyl MRID 00150109 Acceptable
		Rainbow trout (*Oncorhynchus mykiss*)	Acute-to-Chronic Ratio NOAEC = 0.068	Fenoxaprop-p-ethyl MRIDs 48417901, 48492501
Survival and reproduction of estuarine/marine fish	Acute mortality: most sensitive acute estuarine/marine fish 96-hour LC_{50}	N/A Rainbow trout (*Oncorhynchus mykiss*) data used instead	48-hour LC_{50} = 0.72	Quizalofop-p-ethyl MRID 47408402 Acceptable
	Chronic Early Life Stage: most sensitive NOAEC	Sheepshead minnow (*Cyprinodon variegatus*)	NOAEC = 0.083 Survival, decreased larval size, and larval lethargy	Quizalofop-p-ethyl MRID 47910503 Supplemental

Aquatic Invertebrate Toxicology

Effects to Freshwater Invertebrates

Information is available for four acute toxicity studies conducted using *D. magna* – two with quizalofop-p-ethyl and two with quizalofop-ethyl. The lowest toxicity endpoint was generated by MRID 47408410. The EC_{50} was 0.35 mg ai/L, and sublethal effects (slow swimming and lying on the bottom of the test vessel) were observed at the 0.28 and 0.51 mg ai/L treatment levels. The study was classified as "supplemental" because it did not provide measured concentrations for all of the treatment solutions; however, the toxicity values are considered reliable because the quizalofop-p-ethyl recovery concentrations in the chambers that were tested were within acceptable limits (86% to 113%). The two studies with

quizalofop-ethyl (MRIDs 00128109, 00146951) were classified as "supplemental" because precipitate was observed in the test solutions. Measured samples were not centrifuged before quantitation, thus there is uncertainty surrounding the EC_{50} values (2.12 and 6.4 mg ai/L). Finally, MRID 47408407 was classified as "acceptable," but yielded a much less toxic value (EC_{50} = 51.9 mg ai/L). Sublethal effects were confined to one daphnid floating in the 11.8 and 22.9 mg ai/L treatment groups. Together, these studies classify quizalofop as "slightly toxic to highly toxic" (Table 13).

Two chronic freshwater invertebrate studies were available for quizalofop-p-ethyl. Both studies were scientifically sound, but classified as "supplemental" because they did not measure certain chronic endpoints (MRID 47408409 – growth; MRID 47910501 – growth, time to first brood, and offspring immobility). Consequently, it is possible that one of these endpoints (growth, in particular, since neither study measured it) could be the most sensitive endpoint. Both studies found that parental survival was the most sensitive endpoint. Effects were also noted in the number of offspring per adult; there was a 34% reduction in offspring at 72-74 mg ai/L (Table 13).

Effects to Estuarine-Marine Invertebrates

Three studies examined the acute effects of quizalofop-p-ethyl (MRID 40242204) and quizalofop-ethyl (MRIDs 40242205, 40242207) on estuarine/marine invertebrates. All of the studies were classified as "supplemental" – the two shrimp studies because of uncertainty regarding the rate of hydrolysis of the test compound and the oyster study because of observations of precipitate in the diluter chamber. The LC_{50}s from the studies produced a tight range of 0.15 to 0.25 mg ai/L. The most sensitive endpoint for these studies was mortality; sublethal effects were not observed for either the shrimp or the oyster. All three studies classify quizalofop as "highly toxic" to estuarine/marine invertebrates on an acute basis (Table 13).

Estuarine/marine invertebrate chronic toxicity data were not available. A toxicity value can be estimated based on the assumption that the acute-to-chronic ratio (ACR) for freshwater invertebrates applies to estuarine/marine invertebrates also. Thus, the following equation was used to estimate a NOAEC for mysid shrimp, the most sensitive estuarine/marine species on an acute basis (Table 13).

$$\frac{LC_{50(mysid)}}{NOAEC_{(mysid)}} = \frac{EC_{50\ (waterflea)}}{NOAEC_{(waterflea)}} = \frac{0.15}{X} = \frac{0.35}{0.787} = 0.34 = NOAEC_{(mysid)}$$

Table 13. Summary of specific measurement endpoint values selected to evaluate risk for aquatic invertebrate assessment endpoints

Assessment Endpoint	Measurement Endpoint	Selected Measurement Endpoint Value and Source		
		Species	**Endpoint, Toxicity, and Effect(s) (mg ai/L)**	**Chemical/ Source / Study Classification**
Survival and reproduction of freshwater invertebrates	Acute mortality: most sensitive acute freshwater invertebrate 48-hour EC_{50}	Water flea (*D. magna*)	48-hour EC_{50} = 0.35 Slow swimming, lying on the bottom of the test chamber	Quizalofop-p-ethyl, technical grade, 5.07% MRID 47408410 Supplemental
	Chronic effects: most sensitive NOAEC	Water flea (*D. magna*)	NOAEC = 26.6 Parental mortality	Quizalofop-p-ethyl, technical grade, 96.9% MRID 4740809 Supplemental
Survival and reproduction of estuarine/marine invertebrates	Acute mortality: most sensitive estuarine/marine invertebrate 96-hour EC_{50}	Mysid shrimp (*Americamysis bahia*)	EC_{50} = 0.15 Mortality	Quizalofop-p-ethyl, technical grade, 99.1% MRID 40242204 Supplemental
	Acute growth: most sensitive estuarine/marine invertebrate 96-hour EC_{50}	Eastern oyster (*Crassostrea virginianus*)	EC_{50} = 0.19* Shell growth	Quizalofop-ethyl, technical grade, 99.1% MRID 40242207 Supplemental
	Chronic effects: most sensitive NOAEC	Mysid shrimp (*Americamysis bahia*)	Acute-to-Chronic Ratio NOAEC = 0.34	Quizalofop-p-ethyl, technical grade, 5.07-99.1%. MRIDs 47408410, 40242204, 4740809 Supplemental
*Used in the Risk Description section of the assessment.				

Terrestrial Plant Toxicology

Several plant studies were available for quizalofop typical end-use products (quizalofop-p-ethyl – MRIDs 48038101, 47910505, 48038102; quizalofop-ethyl – MRIDs 47408411, 47408412); only the most sensitive endpoints are presented in Table 14. MRID 47910505

yielded the most sensitive vegetative vigor endpoints. Wheat was the most sensitive monocot, based on dry weight. Similarly, dry weight was the most sensitive parameter in dicots (cucumber). Plant height was also affected in both the cucumber and wheat. Signs of phytotoxicity included: necrosis, chlorosis, and leaf curl.

For seedling emergence, MRID 4708411 presented the lowest monocot endpoints. Fresh weight in corn (23-78% reduction) and oat (3-35%) was the most sensitive parameter. Seedling inhibition and survival ranged from -3 to 12% in treated plants compared to the controls. Some phytotoxic effects were also observed (chlorosis, necrosis, and growth reduction). The study was classified as "supplemental" because it only tested three monocot species whereas the guidelines require data on four species.

MRID 4708411 also presented the most sensitive toxicity data for dicot seedling emergence; however, the values were non-definitive. Given that no effects were observed in the species tested, the other seedling emergence study (MRID 48038101) was considered. This study tested higher concentrations of quizalofop; however, it also reached a non-definitive EC_{25} and based its NOAEC on the highest concentration tested. The study was classified supplemental in part because only four species of dicots were tested instead of six (including soybean, which is a required species). Given that no effects were seen and that quizalofop is an herbicide that targets monocots, the less sensitive toxicity values will be used in the risk assessment as it is believed that they more accurately reflect the true toxicity of quizalofop on dicots.

Table 14. Summary of specific measurement endpoint values selected to evaluate risk for terrestrial plant assessment endpoints

Assessment Endpoint	Measurement Endpoint	Selected Measurement Endpoint Value and Source		
		Species	**Endpoint, Toxicity, and Effect(s) (lb ai/A)**	**Chemical/ Source / Study Classification**
Effects to terrestrial plants	Vegetative vigor: dicot EC_{25} and NOAEC	Cucumber (*Cucumis sativa*)	EC_{25} = 0.0931 NOAEC = 0.0477 Dry weight.	Quizalofop-p-ethyl typical end-use product, 10.13% MRID 47910505 Acceptable
	Vegetative vigor: monocot EC_{25} and NOAEC	Wheat (*Triticum aestivum*)	EC_{25} = 0.00146 NOAEC = 0.000791 Dry weight.	Quizalofop-p-ethyl typical end-use product, 10.13% MRID 47910505 Acceptable
Effects to terrestrial plants	Seedling emergence: dicot EC_{25} and NOAEC	Cabbage (*Brassica oleracea*), carrot (*Daucus carota*), cucumber (*Cucumis sativa*), soybean (*Glycine max*), sunflower (*Helianthus annuus*), cotton (*Gossypium hirsutum*), and flax (*Linum usitatissimum*)	EC_{25} > 0.086 NOAEC = 0.086 None.	Quizalofop-ethyl typical end-use product, 5.07% MRID 47408411 Supplemental
	Seedling emergence: dicot EC_{25} and NOAEC	Cabbage (*Brassica oleracea*), sunflower (*Helianthus annuus*), carrot (*Daucus carota*), cucumber (*Cucumis sativa*)	EC_{25} > 0.127 NOAEC = 0.127	Quizalofop-p-ethyl typical end-use product, 5% MRID 48038101 Supplemental
	Seedling emergence: monocot EC_{25} and NOAEC	Corn (*Zea mays*)	EC_{25} = 0.019 NOAEC = 0.0096 Fresh weight	Quizalofop-ethyl typical end-use product, 5.07% MRID 47408411 Supplemental

Aquatic Plant Toxicology

Aquatic plant toxicity data (Table 15) are available for quizalofop-p-ethyl from five studies (green algae – 2; freshwater diatom – 1; blue-green algae – 1; and estuarine/marine diatom – 1). A limit test (Tier 1) with a freshwater diatom showed 3.66% inhibition at 0.098 mg ai/L (MRID 43270901). Four Tier 2 studies were available for quizalofop-p-ethyl, given that it is an herbicide. Three of these studies yielded non-definitive (greater than) toxicity values; the EC_{50}s ranged from > 0.082 to > 1.09 mg ai/L (MRIDs 48041401, 43235602, 43270902). No effects were documented in these studies and it was believed that the non-definitive values were much more conservative than a definitive value would be. To justify the use of a less sensitive endpoint, non-vascular plant studies from two structurally similar chemicals (fenoxaprop-p-ethyl and fenoxaprop-ethyl) were considered. These chemicals showed a similar trend – non-definitive toxicity values at low test concentrations and definitive numbers at higher test concentrations. In addition, the fenoxaprop toxicity values were within the same order of magnitude as the quizalofop values. The European Footprint database[5] reported a toxicity value (EC_{50} = 23 µg ai/L) that was lower than the most sensitive definitive toxicity value for algae (4100 µg ai/L). This value could not be used in this risk assessment because the Agency did not have access to the original study for an independent evaluation. Although substantially lower, the 23 µg ai/L does not result in a risk quotient above the LOC for non-vascular plants. Thus, it was determined that using the definitive quizalofop-p-ethyl toxicity value was a reasonable approach.

The most sensitive definitive quizalofop-p-ethyl value was from a green algae study. The EC_{50} of 41 mg ai/L was based on a reduction in cell density. Biomass and growth rate were also affected. The study was classified as "supplemental" because the duration of the study was 72 hours (per OECD guidelines). A 96-hour value would likely be only slightly more sensitive than a 72 hour EC_{50} (MRID 48037501).

Two studies with quizalofop-p-ethyl were available for non-vascular plants. A special study (MRID 48356801) on a monocot aquatic plant (rice) was requested because quizalofop-p-ethyl is an herbicide that primarily targets monocots. This study yielded the most sensitive EC_{50} of 34.5 µg ai/L for dry weight. Number of leaves per plant, number of tillers per plant, and plant height also were affected (EC_{50}s = 41, 58, and 66 µg ai/L, respectively). Other effects included chlorosis, necrosis, leaf curl, and mortality. A duckweed study (MRID 48037504) was also available, but was considered incomplete because of a solvent effect in frond development and frond growth rate; these endpoints were not useable. In this study, frond biomass was the most sensitive parameter (consistent with the rice study); however, the EC_{50} was much higher (>658 µg ai/L). The greater sensitivity of aquatic monocots to quizalofop compared to dicots parallels the pattern seen in terrestrial plants (Table 15).

[5] http://sitem.herts.ac.uk/aeru/footprint/en/index.htm

Table 15. Summary of specific measurement endpoint values selected to calculate risk quotient values to evaluate risk for aquatic plant assessment endpoints

Assessment Endpoint	Measurement Endpoint	Selected Measurement Endpoint Value and Source		
		Species	**Endpoint, Toxicity, and Effect(s) (µg ai/L)**	**Chemical/ Source / Study Classification**
Survival and biomass of aquatic vascular and non-vascular plants	Non-vascular species: the most sensitive productivity EC_{50}	Green algae (*Selenastrum capricornutum*)	72-hour EC_{50} = 41000 Cell density	Quizalofop-p-ethyl, technical grade, 95.9% MRID 48037501 Supplemental
	Vascular species: endpoints based on mortality EC_{50}	Rice (*Oryza sativa*)	EC_{50} = 34.5 Dry weight	Quizalofop-p-ethyl, typical end-use product, 10.4% MRID 48356801 Acceptable

Results: Risk Characterization

Risk Estimation

As described in the Quizalofop-P-Ethyl Work Plan, estimates of exposure and ecotoxicity of quizalofop-p-ethyl are integrated using standard risk quotient (RQ) methods to evaluate the potential for adverse ecological effects to mammalian, avian, and other non-target species. Risk quotient results for non-target terrestrial and aquatic animals and plants are described in this section. Risk quotient results in this case represent expected direct effects to organisms (*i.e.* effects from direct toxicity to quizalofop-p-ethyl exposure) in contrast to indirect effects to an organism resulting from a modification of a resource such as loss of their prey or habitat.

Direct Effects to Non-Target Terrestrial Vertebrates

DIRECT EFFECTS TO BIRDS, REPTILES, AND (LAND-PHASE) AMPHIBIANS

Risk quotients were not calculated for acute dose-based or acute dietary-based risks because all of the toxicity data were non-definitive. Risks from these potential exposure pathways are evaluated and discussed in the Risk Description Section.

Chronic dietary risk quotients were calculated with T-REX for the maximum usage rates of quizalofop-p-ethyl for all uses (Table 16). Risk quotients ranged from 0.01 to 0.52; no uses yielded risk quotients that exceeded the chronic LOC of 1.

Table 16. Upper bound chronic dietary-based risk quotients for birds derived from T-REX

Risk Quotients Based on Kenaga Upper Bound EEC	**Chronic Dietary-Based Risk Quotients**
Idaho, Montana, Washington, Oregon, and Wyoming, only *Non-food/non-feed seed production: alfalfa, carrot, Chinese cabbage, garlic, onion, radish, red beets, spinach, Swiss chard* *All states, food item: sugar beets* *2 apps at 0.0834 lb ai/A (7-day interval)*	
Short grass	0.21
Tall grass	0.10
Broadleaf plants	0.12
Fruits/pods/seeds	0.01
Arthropods	0.08
Except New York *Barley, wheat*	

Risk Quotients Based on Kenaga Upper Bound EEC	Chronic Dietary-Based Risk Quotients
1 app at 0.0695 lb ai/A	
Short grass	0.09
Tall grass	0.04
Broadleaf plants	0.05
Fruits/pods/seeds	0.01
Arthropods	0.04
Canola/rape, crambe, soybeans, sunflowers *1 app at 0.0834 and 1 app at 0.042 lb ai/A (7-days)*	
Short grass	0.15
Tall grass	0.07
Broadleaf plants	0.09
Fruits/pods/seeds	0.01
Arthropods	0.06
Field corn seed production (herbicide-tolerant) *1 app at 0.0834 lb ai/A*	
Short grass	0.11
Tall grass	0.05
Broadleaf plants	0.06
Fruits/pods/seeds	0.01
Arthropods	0.04
Sorghum (herbicide-tolerant) *1 app at 0.0834 and 1 app at 0.057 lb ai/A (7-days)*	
Short grass	0.17
Tall grass	0.08
Broadleaf plants	0.10
Fruits/pods/seeds	0.01
Arthropods	0.07
Cotton *3 apps at 0.034 and 1 app at 0.023 lb ai/A (7-days)*	
Short grass	0.13
Tall grass	0.06
Broadleaf plants	0.08
Fruits/pods/seeds	0.01
Arthropods	0.05
Dry beans *2 apps at 0.0834 and 1 app at 0.03 lb ai/A (7-days)*	

Risk Quotients Based on Kenaga Upper Bound EEC	Chronic Dietary-Based Risk Quotients
Short grass	0.22
Tall grass	0.10
Broadleaf plants	0.12
Fruits/pods/seeds	0.01
Arthropods	0.09
Dry and succulent peas, lentils, snap beans *1 app at 0.0834 and 1 app at 0.01 lb ai/A (7-days)*	
Short grass	0.11
Tall grass	0.05
Broadleaf plants	0.06
Fruits/pods/seeds	0.01
Arthropods	0.04
Texas, Oklahoma, Kansas, and Colorado, only *Fallow* *2 apps at 0.0834 and 1 app at 0.04 lb ai/A (7-days)*	
Short grass	0.23
Tall grass	0.11
Broadleaf plants	0.13
Fruits/pods/seeds	0.01
Arthropods	0.09
Flax, garbanzos (including chick peas) *2 apps at 0.0834 lb ai/A (7-days)*	
Short grass	0.21
Tall grass	0.10
Broadleaf plants	0.12
Fruits/pods/seeds	0.01
Arthropods	0.08
Maine and Minnesota, only *Hybrid cottonwood/poplar plantations* *2 apps at 0.0695 lb ai/A (7-days)*	
Short grass	0.17
Tall grass	0.08
Broadleaf plants	0.10
Fruits/pods/seeds	0.01
Arthropods	0.07
Mint (spearmint and peppermint)	

Risk Quotients Based on Kenaga Upper Bound EEC	**Chronic Dietary-Based Risk Quotients**
2 apps at 0.0834 and 1 app at 0.04 lb ai/A (7-days)	
Short grass	0.23
Tall grass	0.11
Broadleaf plants	0.13
Fruits/pods/seeds	0.01
Arthropods	0.09
Non-crop areas (uncultivated areas, fence rows, roadsides, equipment storage areas, and other similar areas) *2 apps at 0.111 lb ai/A (7-days)*	
Short grass	0.28
Tall grass	0.13
Broadleaf plants	0.16
Fruits/pods/seeds	0.02
Arthropods	0.11
Puerto Rico (pineapple only) and Hawaii, only *Ornamental and/or shade trees, pineapple* *2 apps at 0.208 lb ai/A (7-days)*	
Short grass	0.52
Tall grass	0.24
Broadleaf plants	0.29
Fruits/pods/seeds	0.03
Arthropods	0.20
Paved areas (private roads/sidewalks) *1 app at 0.108 lb ai/A*	
Short grass	0.14
Tall grass	0.07
Broadleaf plants	0.08
Fruits/pods/seeds	0.01
Arthropods	0.06
Minnesota, only *Perennial ryegrass grown for seed* *2 apps at 0.0695 lb ai/A (7-days)*	
Short grass	0.17
Tall grass	0.08
Broadleaf plants	0.10
Fruits/pods/seeds	0.01

Risk Quotients Based on Kenaga Upper Bound EEC	Chronic Dietary-Based Risk Quotients
Arthropods	0.07
No scenarios exceeded the chronic LOC of 1.	

DIRECT EFFECTS TO MAMMALS

Acute Effects

Acute dose-based risk quotients were calculated for the maximum application rates for all quizalofop-p-ethyl uses (Table 17). Risk quotients ranged from < 0.01 to 0.05; none of the uses produced risk quotients that exceeded the acute listed species LOC of 0.1.

Chronic Effects

Chronic dose-based risk quotients ranged from 0.01 to 8.10 (Table 17). All uses exceeded the LOC (1) for small and medium-sized mammals consuming diets of short grass. Most uses exceeded the LOC for large mammals and/or additional food items in the small and medium-sized mammal classes as well. Risk quotients for mammals consuming fruits, pods, or seeds never exceeded the LOC of 1. Chronic dietary-based risk quotients were also calculated. These ranged from 0.01 to 0.93; none of the uses produced risk quotients that exceeded the LOC of 1.

Table 17. Dietary upper bound risk quotients for mammals

Risk Quotients Based on Kenaga Upper Bound EEC	Dose-Based RQs						Chronic Dietary-Based RQs
	15 g		35 g		1000 g		
	Acute	Chronic	Acute	Chronic	Acute	Chronic	
Idaho, Montana, Washington, Oregon, and Wyoming, only *Non-food/non-feed seed production: alfalfa, carrot, Chinese cabbage, garlic, onion, radish, red beets, spinach, Swiss chard* *All states, food item: sugar beets* *2 apps at 0.0834 lb ai/A (7-day interval)*							
Short grass	0.02	**3.25*** **	0.02	**2.77*** **	0.01	**1.49*** **	0.37
Tall grass	0.01	**1.49*** **	0.01	**1.27*** **	<0.01	0.68	0.17
Broadleaf plants	0.01	**1.83*** **	0.01	**1.56*** **	<0.01	0.84	0.21
Fruits/pods	<0.01	0.20	<0.01	0.17	<0.01	0.09	0.02
Arthropods	0.01	**1.27*** **	0.01	**1.09*** **	<0.01	0.58	0.15
Seeds	<0.01	0.05	<0.01	0.04	<0.01	0.02	0.02
Except New York *Barley, wheat* *1 app at 0.0695 lb ai/A*							

Risk Quotients Based on Kenaga Upper Bound EEC	Dose-Based RQs						Chronic Dietary-Based RQs
	15 g		35 g		1000 g		
	Acute	Chronic	Acute	Chronic	Acute	Chronic	
Short grass	0.01	**1.45*** **	0.01	**1.24*** **	<0.01	0.66	0.17
Tall grass	<0.01	0.66	<0.01	0.57	<0.01	0.30	0.08
Broadleaf plants	<0.01	0.81	<0.01	0.70	<0.01	0.37	0.09
Fruits/pods	<0.01	0.09	<0.01	0.08	<0.01	0.04	0.01
Arthropods	<0.01	0.57	<0.01	0.48	<0.01	0.26	0.07
Seeds	<0.01	0.02	<0.01	0.02	<0.01	0.01	0.01
Canola/rape, crambe, soybeans, sunflowers *1 app at 0.0834 and 1 app at 0.042 lb ai/A (7-days)*							
Short grass	0.01	**2.39*** **	0.01	**2.04*** **	0.01	**1.09*** **	0.28
Tall grass	0.01	**1.09*** **	0.01	0.93	<0.01	0.50	0.13
Broadleaf plants	0.01	**1.34*** **	0.01	**1.15*** **	<0.01	0.61	0.15
Fruits/pods	<0.01	0.15	<0.01	0.13	<0.01	0.07	0.02
Arthropods	0.01	0.93	<0.01	0.80	<0.01	0.43	0.11
Seeds	<0.01	0.03	<0.01	0.03	<0.01	0.02	0.02
Field corn seed production (herbicide-tolerant) *1 app at 0.0834 lb ai/A*							
Short grass	0.01	**1.74*** **	0.01	**1.48*** **	<0.01	0.80	0.20
Tall grass	<0.01	0.80	<0.01	0.68	<0.01	0.36	0.09
Broadleaf plants	0.01	0.98	<0.01	0.83	<0.01	0.45	0.11
Fruits/pods	<0.01	0.11	<0.01	0.09	<0.01	0.05	0.01
Arthropods	<0.01	0.68	<0.01	0.58	<0.01	0.31	0.08
Seeds	<0.01	0.02	<0.01	0.02	<0.01	0.01	0.01
Sorghum (herbicide-tolerant) *1 app at 0.0834 and 1 app at 0.057 lb ai/A (7-days)*							
Short grass	0.02	**2.70*** **	0.01	**2.31*** **	0.01	**1.24*** **	0.31
Tall grass	0.01	**1.24*** **	0.01	**1.06*** **	<0.01	0.57	0.14
Broadleaf plants	0.01	**1.52*** **	0.01	**1.30*** **	<0.01	0.70	0.17
Fruits/pods	<0.01	0.17	<0.01	0.14	<0.01	0.08	0.02
Arthropods	<0.01	**1.06*** **	0.01	0.90	<0.01	0.48	0.12
Seeds	<0.01	0.04	<0.01	0.03	<0.01	0.02	0.02
Cotton *3 apps at 0.034 and 1 app at 0.023 lb ai/A (7-days)*							
Short grass	0.01	**2.10*** **	0.01	**1.79*** **	0.01	0.96	0.24
Tall grass	0.01	0.96	<0.01	0.82	<0.01	0.44	0.11

Risk Quotients Based on Kenaga Upper Bound EEC	Dose-Based RQs						Chronic Dietary-Based RQs
	15 g		35 g		1000 g		
	Acute	Chronic	Acute	Chronic	Acute	Chronic	
Broadleaf plants	0.01	**1.18*** **	0.01	**1.01*** **	<0.01	0.54	0.14
Fruits/pods	<0.01	0.13	<0.01	0.11	<0.01	0.06	0.02
Arthropods	<0.01	0.82	<0.01	0.70	<0.01	0.38	0.09
Seeds	<0.01	0.03	<0.01	0.02	<0.01	0.01	0.02
Dry beans *2 apps at 0.0834 and 1 app at 0.03 lb ai/A (7-days)*							
Short grass	0.02	**3.45*** **	0.02	**2.95*** **	0.01	**1.58*** **	0.40
Tall grass	0.01	**1.58*** **	0.01	**1.35*** **	<0.01	0.72	0.18
Broadleaf plants	0.01	**1.94*** **	0.01	**1.66*** **	0.01	0.89	0.22
Fruits/pods	<0.01	0.22	<0.01	0.18	<0.01	0.10	0.02
Arthropods	0.01	**1.35*** **	0.01	**1.16*** **	<0.01	0.62	0.16
Seeds	<0.01	0.05	<0.01	0.04	<0.01	0.02	0.02
Dry and succulent peas, lentils, snap beans *1 app at 0.0834 and 1 app at 0.01 lb ai/A (7-days)*							
Short grass	0.01	**1.74*** **	0.01	**1.48*** **	<0.01	0.80	0.20
Tall grass	<0.01	0.80	<0.01	0.68	<0.01	0.36	0.09
Broadleaf plants	0.01	0.98	<0.01	0.83	<0.01	0.45	0.11
Fruits/pods	<0.01	0.11	<0.01	0.09	<0.01	0.05	0.01
Arthropods	<0.01	0.68	<0.01	0.58	<0.01	0.31	0.08
Seeds	<0.01	0.02	<0.01	0.02	<0.01	0.01	0.01
Texas, Oklahoma, Kansas, and Colorado, only *Fallow* *2 apps at 0.0834 and 1 app at 0.04 lb ai/A (7-days)*							
Short grass	0.02	**3.66*** **	0.02	**3.13*** **	0.01	**1.68*** **	0.42
Tall grass	0.01	**1.68*** **	0.01	**1.43*** **	<0.01	0.77	0.19
Broadleaf plants	0.01	**2.06*** **	0.01	**1.76*** **	0.01	0.94	0.24
Fruits/pods	<0.01	0.23	<0.01	0.20	<0.01	0.10	0.03
Arthropods	0.01	**1.43*** **	0.01	**1.22*** **	<0.01	0.66	0.17
Seeds	<0.01	0.05	<0.01	0.04	<0.01	0.02	0.03
Flax, garbanzos (including chick peas) *2 apps at 0.0834 lb ai/A (7-days)*							
Short grass	0.02	**3.25*** **	0.02	**2.77*** **	0.01	**1.49*** **	0.37
Tall grass	0.01	**1.49*** **	0.01	**1.27*** **	<0.01	0.68	0.17
Broadleaf plants	0.01	**1.83*** **	0.01	**1.56*** **	<0.01	0.84	0.21

Risk Quotients Based on Kenaga Upper Bound EEC	Dose-Based RQs						Chronic Dietary-Based RQs
	15 g		35 g		1000 g		
	Acute	Chronic	Acute	Chronic	Acute	Chronic	
Fruits/pods	<0.01	0.20	<0.01	0.17	<0.01	0.09	0.02
Arthropods	0.01	**1.27*** **	0.01	**1.09*** **	<0.01	0.58	0.15
Seeds	<0.01	0.05	<0.01	0.04	<0.01	0.02	0.02
Maine and Minnesota, only *Hybrid cottonwood/poplar plantations* *2 apps at 0.0695 lb ai/A (7-days)*							
Short grass	0.02	**2.71*** **	0.01	**2.31*** **	0.01	**1.24*** **	0.31
Tall grass	0.01	**1.24*** **	0.01	**1.06*** **	<0.01	0.57	0.14
Broadleaf plants	0.01	**1.52*** **	0.01	**1.30*** **	<0.01	0.70	0.18
Fruits/pods	<0.01	0.17	<0.01	0.14	<0.01	0.08	0.02
Arthropods	0.01	**1.06*** **	0.01	0.91	<0.01	0.49	0.12
Seeds	<0.01	0.04	<0.01	0.03	<0.01	0.02	0.02
Mint (spearmint and peppermint) *2 apps at 0.0834 and 1 app at 0.04 lb ai/A (7-days)*							
Short grass	0.02	**3.66*** **	0.02	**3.13*** **	0.01	**1.68*** **	0.42
Tall grass	0.01	**1.68*** **	0.01	**1.43*** **	<0.01	0.77	0.19
Broadleaf plants	0.01	**2.06*** **	0.01	**1.76*** **	0.01	0.94	0.24
Fruits/pods	<0.01	0.23	<0.01	0.20	<0.01	0.10	0.03
Arthropods	0.01	**1.43*** **	0.01	**1.22*** **	<0.01	0.66	0.17
Seeds	<0.01	0.05	<0.01	0.04	<0.01	0.02	0.03
Non-crop areas (uncultivated areas, fence rows, roadsides, equipment storage areas, and other similar areas) *2 apps at 0.111 lb ai/A (7-days)*							
Short grass	0.02	**4.32*** **	0.02	**3.69*** **	0.01	**1.98*** **	0.50
Tall grass	0.01	**1.98*** **	0.01	**1.69*** **	0.01	0.91	0.23
Broadleaf plants	0.01	**2.43*** **	0.01	**2.08*** **	0.01	**1.11*** **	0.28
Fruits/pods	0.00	0.27	0.00	0.23	0.00	0.12	0.03
Arthropods	0.01	**1.69*** **	0.01	**1.45*** **	0.00	0.78	0.20
Seeds	0.00	0.06	0.00	0.05	0.00	0.03	0.03
Puerto Rico (pineapple only) and Hawaii, only *Ornamental and/or shade trees, pineapple* *2 apps at 0.208 lb ai/A (7-days)*							
Short grass	0.05	**8.10*** **	0.04	**6.92*** **	0.02	**3.71*** **	0.93
Tall grass	0.02	**3.71*** **	0.02	**3.17*** **	0.01	**1.70*** **	0.43

Risk Quotients Based on Kenaga Upper Bound EEC	Dose-Based RQs						Chronic Dietary-Based RQs
	15 g		35 g		1000 g		
	Acute	Chronic	Acute	Chronic	Acute	Chronic	
Broadleaf plants	0.03	**4.56*** **	0.02	**3.89*** **	0.01	**2.09*** **	0.53
Fruits/pods	<0.01	0.51	<0.01	0.43	<0.01	0.23	0.06
Arthropods	0.02	**3.17*** **	0.02	**2.71*** **	0.01	**1.45*** **	0.37
Seeds	<0.01	0.11	<0.01	0.10	<0.01	0.05	0.06
Paved areas (private roads/sidewalks) 1 app at 0.108 lb ai/A							
Short grass	0.01	**2.25*** **	0.01	**1.92*** **	0.01	**1.03*** **	0.26
Tall grass	0.01	**1.03*** **	0.01	0.88	<0.01	0.47	0.12
Broadleaf plants	0.01	**1.26*** **	0.01	**1.08*** **	<0.01	0.58	0.15
Fruits/pods	<0.01	0.14	<0.01	0.12	<0.01	0.06	0.02
Arthropods	0.01	0.88	<0.01	0.75	<0.01	0.40	0.10
Seeds	<0.01	0.03	<0.01	0.03	<0.01	0.01	0.02
Minnesota, only Perennial ryegrass grown for seed 2 apps at 0.0695 lb ai/A (7-days)							
Short grass	0.02	**2.71*** **	0.01	**2.31*** **	0.01	**1.24*** **	0.31
Tall grass	0.01	**1.24*** **	0.01	**1.06*** **	<0.01	0.57	0.14
Broadleaf plants	0.01	**1.52*** **	0.01	**1.30*** **	<0.01	0.70	0.18
Fruits/pods	<0.01	0.17	<0.01	0.14	<0.01	0.08	0.02
Arthropods	0.01	**1.06*** **	0.01	0.91	<0.01	0.49	0.12
Seeds	<0.01	0.04	<0.01	0.03	<0.01	0.02	0.02

Bold text indicates an LOC was exceeded.
* Exceeds the acute listed species LOC of 0.1
**Exceeds the acute non-listed species LOC of 0.5
***Exceeds the chronic LOC of 1

Direct Effects to Non-Target Terrestrial Invertebrates

Only non-definitive honeybee toxicity data were available for quizalofop-p-ethyl. Risk quotients cannot be calculated from non-definitive values. A qualitative description of the risk is available in the Risk Description Section of this document.

Direct Effects to Terrestrial and Wetland/Riparian Plants

TerrPlant was used to model potential runoff and spray drift effects from the different quizalofop-p-ethyl uses (Table 18). The maximum application rate for each crop was used to calculate risk quotients for semi-aquatic and upland terrestrial plants. Insufficient data were

available to calculate risk quotients for non-listed monocots; thus this group is discussed in the Risk Description Section.

Monocots were more sensitive than dicots. Ground application risk quotients ranged from < 0.01 to 1.42 while aerial application risk quotients ranged from 0.11 to 13.15. All ground and aerial spray drift scenarios exceeded the LOC (1) for listed and non-listed monocots. Application rates of 0.0695 lb ai/A and higher yielded risk quotients that exceeded the LOCs in additional scenarios. Dicots did not exceed the LOC of 1 for any scenario. For ground applications, risk quotients ranged from < 0.01 to 0.18. For aerial applications, risk quotients ranged from 0.01 to 0.25.

Table 18. Summary of risk quotient values for plants in dry and semi-aquatic areas exposed to quizalofop-p-ethyl through runoff and spray drift

Plant Type	Listed Status	Dry		Semi-Aquatic		Spray Drift	
		Ground	Aerial	Ground	Aerial	Ground	Aerial
Idaho, Montana, Washington, Oregon, and Wyoming, only *Non-food/non-feed seed production: alfalfa, carrot, Chinese cabbage, garlic, onion, radish, red beets, spinach, Swiss chard* *1 app at 0.0834 lb ai/A*							
Monocot	non-listed	<0.1	0.26	0.48	0.66	0.57	**2.86***
Monocot	listed	0.17	0.52	0.96	**1.30***	**1.05***	**5.27***
Dicot	non-listed	N/A	N/A	N/A	N/A	<0.1	<0.1
Dicot	listed	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Except New York *Barley, wheat* *1 app at 0.0695 lb ai/A*							
Monocot	non-listed	<0.1	0.22	0.40	0.55	0.48	**2.38***
Monocot	listed	0.14	0.43	0.80	**1.09***	0.88	**4.39***
Dicot	non-listed	N/A	N/A	N/A	N/A	<0.1	<0.1
Dicot	listed	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Canola/rape, crambe, soybeans, sunflowers, field corn seed production (herbicide-tolerant), sorghum (herbicide-tolerant), dry beans, dry and succulent peas, lentils, snap beans, flax, garbanzos (including chick peas), mint (spearmint and peppermint), sugar beet *1 app at 0.0834*							
Monocot	non-listed	<0.1	0.26	0.48	0.66	0.57	**2.86***
Monocot	listed	0.17	0.52	0.96	**1.30***	**1.05***	**5.27***
Dicot	non-listed	N/A	N/A	N/A	N/A	<0.1	<0.1
Dicot	listed	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

Plant Type	Listed Status	Dry		Semi-Aquatic		Spray Drift	
		Ground	Aerial	Ground	Aerial	Ground	Aerial
Cotton *1 app at 0.034*							
Monocot	non-listed	<0.1	0.11	0.20	0.27	0.23	**1.16***
Monocot	listed	<0.1	0.21	0.39	0.53	0.43	**2.15***
Dicot	non-listed	N/A	N/A	N/A	N/A	<0.1	<0.1
Dicot	listed	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Texas, Oklahoma, Kansas, and Colorado, only *Fallow* *1 app at 0.0834*							
Monocot	non-listed	<0.1	0.26	0.48	0.66	0.57	**2.86***
Monocot	listed	0.17	0.52	0.96	**1.30***	**1.05***	**5.27***
Dicot	non-listed	N/A	N/A	N/A	N/A	<0.1	<0.1
Dicot	listed	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Maine and Minnesota, only *Hybrid cottonwood/poplar plantations* *1 app at 0.0695 lb ai/A*							
Monocot	non-listed	<0.1	0.22	0.40	0.55	0.48	**2.38***
Monocot	listed	0.14	0.43	0.80	**1.09***	0.88	**4.39***
Dicot	non-listed	N/A	N/A	N/A	N/A	<0.1	<0.1
Dicot	listed	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Non-crop areas (uncultivated areas, fence rows, roadsides, equipment storage areas, and other similar areas) *1 app at 0.111 lb ai/A*							
Monocot	non-listed	0.12	0.35	0.64	0.88	0.76	**3.80***
Monocot	listed	0.23	0.69	**1.27***	**1.73***	**1.40***	**7.02***
Dicot	non-listed	N/A	N/A	N/A	N/A	<0.1	<0.1
Dicot	listed	<0.1	<0.1	<0.1	0.13	<0.1	<0.1
Puerto Rico (pineapple only) and Hawaii, only *Ornamental and/or shade trees, pineapple* *1 app at 0.208 lb ai/A*							
Monocot	non-listed	0.22	0.66	**1.20***	**1.64***	**1.42***	**7.12***
Monocot	listed	0.43	**1.30***	**2.38***	**3.25***	**2.63***	**13.15***
Dicot	non-listed	N/A	N/A	N/A	N/A	<0.1	0.11
Dicot	listed	<0.1	<0.1	0.18	0.25	<0.1	<0.1
Paved areas (private roads/sidewalks) *1 app at 0.108 lb ai/A*							

Plant Type	Listed Status	Dry		Semi-Aquatic		Spray Drift	
		Ground	Aerial	Ground	Aerial	Ground	Aerial
Monocot	non-listed	0.11	0.34	0.63	0.85	0.74	**3.70***
Monocot	listed	0.23	0.68	**1.24***	**1.69***	**1.37***	**6.83***
Dicot	non-listed	N/A	N/A	N/A	N/A	<0.1	<0.1
Dicot	listed	<0.1	<0.1	<0.1	0.13	<0.1	<0.1
Minnesota, only *Perennial ryegrass grown for seed* *1 app at 0.0695 lb ai/A*							
Monocot	non-listed	<0.1	0.22	0.40	0.55	0.48	**2.38***
Monocot	listed	0.14	0.43	0.80	**1.09***	0.88	**4.39***
Dicot	non-listed	N/A	N/A	N/A	N/A	<0.1	<0.1
Dicot	listed	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

N/A – RQ could not be calculated because of a non-definitive EC_{25}
Bold text indicates an LOC was exceeded.
*Exceeds LOC of 1.

Direct Effects to Freshwater Fish (Amphibians), Invertebrates and Estuarine-Marine Fish (Amphibians) and Invertebrates, and Aquatic Plants

Risk quotients for aquatic organisms are calculated using aquatic EECs derived as described in the exposure analysis using PRZM/EXAMS in conjunction with selected acute and chronic fish, aquatic invertebrate, and aquatic plant toxicity values. The calculated risk quotients are based on total toxic residue exposure from the parent quizalofop-p-ethyl and its major degradates (quizalofop acid and 3-OH-quizalofop acid) for the aquatic environment.

Freshwater Fish and Aquatic-Phase Amphibians – Acute Risk

For freshwater fish (surrogate for aquatic-phase amphibians), acute risk quotients ranged from 0.001 to 0.028 and did not exceed the listed species acute LOC of 0.05 for any registered quizalofop-p-ethyl uses (Table 19).

Freshwater Fish and Aquatic-Phase Amphibians – Chronic Risk

For freshwater fish (surrogate for aquatic-phase amphibians), chronic risk quotients ranged from 0.069 to 1.86. Two uses exceeded the chronic LOC (1): pineapple (ground and aerial), and paved areas (ground and aerial). All other quizalofop-p-ethyl uses were below the LOC of 1 (Table 19).

Estuarine/Marine Fish – Acute Risk

For estuarine/marine fish, acute risk quotients ranged from 0.001 to 0.028 and did not exceed the listed species acute LOC of 0.05 for any registered quizalofop-p-ethyl uses (Table 19).

Estuarine/Marine Fish – Chronic Risk

For estuarine/marine fish, chronic risk quotients ranged from 0.007 to 0.224 and did not exceed the chronic LOC of 1 (Table 19).

Table 19. Acute and chronic risks from quizalofop-p-ethyl to freshwater fish, estuarine/marine fish, and amphibians

Use (Scenario)	Ariel (A) or Ground (G)		1-in-10-year Aquatic EECs (µg/L)		
		Freshwater Fish Acute RQ (Peak EEC/LC_{50}) LC_{50} = 720 µg ai/L[1]	Freshwater Fish Chronic RQ (60-Day EEC/ NOAEC) NOAEC = 10 µg ai/L[2]	Estuarine / Marine Fish Acute RQ (Peak EEC/LC_{50}) LC_{50} = 720 µg ai/L	Estuarine / Marine Fish Chronic RQ (60-Day EEC/ NOAEC) NOAEC = 83 µg ai/L
Idaho, Montana, Washington, Oregon, and Wyoming, only *Non-food/non-feed seed production* *2 apps @ 0.0834 lb ai/A (7-day interval)*					
Alfalfa	A	0.005	0.303	0.005	0.037
(MN alfalfa OP)	G	0.003	0.223	0.003	0.027
Carrot	A	0.004	0.273	0.004	0.033
(CA Row Crop RLF)	G	0.003	0.217	0.003	0.026
Chinese cabbage	A	0.009	0.614	0.009	0.074
(CA Cole Crop RLF)	G	0.008	0.563	0.008	0.068
Garlic	A	0.004	0.298	0.004	0.036
(CA Garlic RLF)	G	0.004	0.233	0.004	0.028
Onion and Radish					
(CA onion W/irrig	A	0.003	0.171	0.003	0.021
STD)	G	0.002	0.106	0.002	0.013
Red beets	A	0.004	0.273	0.004	0.033
(CA Row Crop RLF)	G	0.003	0.217	0.003	0.026
Spinach	A	0.007	0.455	0.007	0.055
(CA lettuce STD)	G	0.006	0.393	0.006	0.047
Swiss chard	A	0.007	0.455	0.007	0.055
(CA lettuce STD)	G	0.006	0.393	0.006	0.047
All states, food item *2 apps @ 0.0834 lb ai/A (7-day interval)*					

Use (Scenario)	Ariel (A) or Ground (G)	1-in-10-year Aquatic EECs (µg/L)			
		Freshwater Fish Acute RQ (Peak EEC/LC_{50}) LC_{50} = 720 µg ai/L[1]	Freshwater Fish Chronic RQ (60-Day EEC/ NOAEC) NOAEC = 10 µg ai/L[2]	Estuarine / Marine Fish Acute RQ (Peak EEC/LC_{50}) LC_{50} = 720 µg ai/L	Estuarine / Marine Fish Chronic RQ (60-Day EEC/ NOAEC) NOAEC = 83 µg ai/L
Sugar beets					
(CA sugar beet W/irrig	A	0.002	0.165	0.002	0.020
OP)	G	0.001	0.092	0.001	0.011
Sugar beets	A	0.007	0.459	0.007	0.055
(MN sugar beet STD)	G	0.006	0.389	0.006	0.047
Except New York *1 app at 0.0695 lb ai/A*					
Barley and Wheat	A	0.003	0.190	0.003	0.023
(CA Wheat RLF)	G	0.002	0.164	0.002	0.020
Barley and Wheat	A	0.003	0.200	0.003	0.024
(ND wheat STD)	G	0.003	0.172	0.003	0.021
Barley and Wheat	A	0.002	0.137	0.002	0.017
(OR wheat OP)	G	0.002	0.108	0.002	0.013
Barley and Wheat	A	0.003	0.180	0.003	0.022
(TX wheat OP)	G	0.003	0.160	0.003	0.019
1 app at 0.0834 and 1 app at 0.042 lb ai/A (7-days)					
Canola/rape	A	0.004	0.238	0.004	0.029
(ND canola STD)	G	0.003	0.179	0.003	0.022
Crambe	A	0.003	0.221	0.003	0.027
(CA Row Crop RLF)	G	0.003	0.176	0.003	0.021
Crambe	A	0.006	0.373	0.006	0.045
(MI beans STD)	G	0.005	0.320	0.005	0.039
Soybeans	A	0.010	0.622	0.010	0.075
(MS soybean STD)	G	0.009	0.591	0.009	0.071
Sunflowers	A	0.003	0.193	0.003	0.023
(CA corn OP)	G	0.002	0.161	0.002	0.019
Sunflowers	A	0.006	0.382	0.006	0.046
(IL Corn STD)	G	0.005	0.338	0.005	0.041
Sunflowers	A	0.004	0.300	0.004	0.036
(IN Corn Std)	G	0.004	0.263	0.004	0.032
Sunflowers	A	0.008	0.555	0.008	0.067
(KS Corn Std)	G	0.008	0.520	0.008	0.063

Use (Scenario)	Ariel (A) or Ground (G)		1-in-10-year Aquatic EECs (µg/L)		
		Freshwater Fish Acute RQ (Peak EEC/LC_{50}) LC_{50} = 720 µg ai/L[1]	Freshwater Fish Chronic RQ (60-Day EEC/ NOAEC) NOAEC = 10 µg ai/L[2]	Estuarine / Marine Fish Acute RQ (Peak EEC/LC_{50}) LC_{50} = 720 µg ai/L	Estuarine / Marine Fish Chronic RQ (60-Day EEC/ NOAEC) NOAEC = 83 µg ai/L
Sunflowers	A	0.008	0.525	0.008	0.063
(MS corn STD)	G	0.007	0.492	0.007	0.059
Sunflowers	A	0.003	0.229	0.003	0.028
(NC corn E STD)	G	0.003	0.181	0.003	0.022
Sunflowers	A	0.006	0.437	0.006	0.053
(NC corn W OP)	G	0.006	0.394	0.006	0.047
Sunflowers	A	0.005	0.352	0.005	0.042
(ND corn OP)	G	0.004	0.299	0.004	0.036
Sunflowers	A	0.006	0.380	0.006	0.046
(OH Corn STD)	G	0.005	0.336	0.005	0.040
Sunflowers	A	0.005	0.323	0.005	0.039
(PA corn STD)	G	0.004	0.271	0.004	0.033
Sunflowers	A	0.007	0.442	0.007	0.053
(TX corn OP)	G	0.006	0.413	0.006	0.050
1 app at 0.0834 lb ai/A					
Field Corn	A	0.002	0.127	0.002	0.015
(CA corn OP)	G	0.002	0.105	0.002	0.013
Field Corn	A	0.004	0.243	0.004	0.030
(IL Corn STD)	G	0.003	0.214	0.003	0.026
Field Corn	A	0.003	0.185	0.003	0.022
(IN Corn Std)	G	0.002	0.163	0.002	0.020
Field Corn	A	0.005	0.368	0.005	0.044
(KS Corn Std)	G	0.005	0.342	0.005	0.041
Field Corn	A	0.005	0.342	0.005	0.041
(MS corn STD)	G	0.005	0.321	0.005	0.039
Field Corn	A	0.002	0.163	0.002	0.020
(NC corn E STD)	G	0.002	0.130	0.002	0.016
Field Corn	A	0.004	0.280	0.004	0.034
(NC corn W OP)	G	0.004	0.251	0.004	0.030
Field Corn	A	0.003	0.228	0.003	0.027
(ND corn OP)	G	0.003	0.192	0.003	0.023

Use (Scenario)	Ariel (A) or Ground (G)		1-in-10-year Aquatic EECs (µg/L)		
		Freshwater Fish Acute RQ (Peak EEC/LC_{50}) LC_{50} = 720 µg ai/L[1]	Freshwater Fish Chronic RQ (60-Day EEC/ NOAEC) NOAEC = 10 µg ai/L[2]	Estuarine / Marine Fish Acute RQ (Peak EEC/LC_{50}) LC_{50} = 720 µg ai/L	Estuarine / Marine Fish Chronic RQ (60-Day EEC/ NOAEC) NOAEC = 83 µg ai/L
Field Corn	A	0.004	0.237	0.004	0.029
(OH Corn STD)	G	0.003	0.205	0.003	0.025
Field Corn	A	0.003	0.201	0.003	0.024
(PA corn STD)	G	0.003	0.169	0.003	0.020
Field Corn	A	0.004	0.272	0.004	0.033
(TX corn OP)	G	0.004	0.251	0.004	0.030
1 app at 0.0834 and 1 app at 0.057 lb ai/A (7-days)					
Sorghum	A	0.008	0.564	0.008	0.068
(TXsorghumOP)	G	0.008	0.530	0.008	0.064
3 apps at 0.034 and 1 app at 0.023 lb ai/A (7-days)					
Cotton					
(CA cotton W/irrig	A	0.002	0.109	0.002	0.013
STD)	G	0.001	0.055	0.001	0.007
Cotton	A	0.007	0.464	0.007	0.056
(MS cotton STD)	G	0.006	0.428	0.006	0.052
Cotton	A	0.007	0.484	0.007	0.058
(NC cotton STD)	G	0.007	0.446	0.007	0.054
Cotton	A	0.006	0.389	0.006	0.047
(TX cotton OP)	G	0.005	0.355	0.005	0.043
2 apps at 0.0834 and 1 app at 0.03 lb ai/A (7-days)					
Dry beans	A	0.005	0.316	0.005	0.038
(CA Row Crop RLF)	G	0.004	0.258	0.004	0.031
Dry beans	A	0.008	0.580	0.008	0.070
(MI beans STD)	G	0.007	0.506	0.007	0.061
1 app at 0.0834 and 1 app at 0.01 lb ai/A (7-days)					
Dry and succulent peas					
and lentils (CA Row	A	0.003	0.182	0.003	0.022
Crop RLF)	G	0.002	0.149	0.002	0.018
Snap beans	A	0.004	0.286	0.004	0.034
(CA Row Crop RLF)	G	0.004	0.231	0.004	0.028
Snap beans	A	0.008	0.518	0.008	0.062
(MI beans STD)	G	0.007	0.452	0.007	0.054

Use (Scenario)	Ariel (A) or Ground (G)		1-in-10-year Aquatic EECs (µg/L)		
		Freshwater Fish Acute RQ (Peak EEC/LC_{50}) LC_{50} = 720 µg ai/L[1]	**Freshwater Fish Chronic RQ (60-Day EEC/ NOAEC) NOAEC = 10 µg ai/L[2]**	**Estuarine / Marine Fish Acute RQ (Peak EEC/LC_{50}) LC_{50} = 720 µg ai/L**	**Estuarine / Marine Fish Chronic RQ (60-Day EEC/ NOAEC) NOAEC = 83 µg ai/L**
Texas, Oklahoma, Kansas, and Colorado, only *2 apps at 0.0834 and 1 app at 0.04 lb ai/A (7-days)*					
Fallow (CA Turf RLF)	A G	0.004 0.003	0.260 0.188	0.004 0.003	0.031 0.023
2 apps at 0.0834 lb ai/A (7-days)					
Flax (CA Row Crop RLF)	A G	0.004 0.003	0.273 0.217	0.004 0.003	0.033 0.026
Garbanzos (including chick peas) (CA Row Crop RLF)	A G	0.004 0.003	0.273 0.217	0.004 0.003	0.033 0.026
Garbanzos (including chick peas) (MI beans STD)	A G	0.007 0.006	0.508 0.440	0.007 0.006	0.059 0.051
Maine and Minnesota, only *2 apps at 0.0695 lb ai/A (7-days)*					
Hybrid cottonwood/poplar plantations (PA apple STD V2)	A G	0.004 0.003	0.289 0.222	0.004 0.003	0.034 0.026
2 apps at 0.0834 and 1 app at 0.04 lb ai/A (7-days)					
Mint (spearmint and peppermint) (CA lettuce STD)	A G	0.008 0.007	0.566 0.500	0.008 0.007	0.066 0.058
2 apps at 0.111 lb ai/A (7-days)					

Use (Scenario)	Ariel (A) or Ground (G)		1-in-10-year Aquatic EECs (µg/L)		
		Freshwater Fish Acute RQ (Peak EEC/LC_{50}) LC_{50} = 720 µg ai/L[1]	Freshwater Fish Chronic RQ (60-Day EEC/ NOAEC) NOAEC = 10 µg ai/L[2]	Estuarine / Marine Fish Acute RQ (Peak EEC/LC_{50}) LC_{50} = 720 µg ai/L	Estuarine / Marine Fish Chronic RQ (60-Day EEC/ NOAEC) NOAEC = 83 µg ai/L
Non-crop areas (uncultivated areas, fence rows, roadsides, equipment storage areas, and other similar areas) (CA right-of-way RLF)	A G	0.010 0.009	0.624 0.574	0.010 0.009	0.075 0.069
Non-crop areas (CA Turf RLF)	A G	0.004 0.003	0.291 0.206	0.004 0.003	0.035 0.025
Non-crop areas (FL turf STD)	A G	0.002 0.001	0.144 0.061	0.002 0.001	0.017 0.007
Non-crop areas (PA turf STD)	A G	0.003 0.002	0.229 0.117	0.003 0.002	0.028 0.014
Puerto Rico (pineapple only) and Hawaii, only 2 apps at 0.208 lb ai/A (7-days)					
Ornamental and/or shade trees (CA nursery STD)	A G	0.006 0.004	0.425 0.251	0.006 0.004	0.050 0.029
Pineapple (MS cotton STD)	A G	0.03 0.02	**1.82***** **1.70*****	0.03 0.02	0.220 0.204
1 app at 0.108 lb ai/A					
Paved areas (private roads/sidewalks) (CA Impervious RLF)	A G	0.027 0.028	**1.83***** **1.86*****	0.027 0.028	0.220 0.224
Minnesota, only 2 apps at 0.0695 lb ai/A (7-days)					
Perennial ryegrass grown for seed (ND wheat STD)	A G	0.006 0.005	0.413 0.358	0.006 0.005	0.500 0.431

Use (Scenario)	Ariel (A) or Ground (G)		1-in-10-year Aquatic EECs (µg/L)		
		Freshwater Fish Acute RQ (Peak EEC/LC_{50}) LC_{50} = 720 µg ai/L[1]	**Freshwater Fish Chronic RQ (60-Day EEC/ NOAEC) NOAEC = 10 µg ai/L[2]**	**Estuarine / Marine Fish Acute RQ (Peak EEC/LC_{50}) LC_{50} = 720 µg ai/L**	**Estuarine / Marine Fish Chronic RQ (60-Day EEC/ NOAEC) NOAEC = 83 µg ai/L**

Bold text indicates an LOC was exceeded.
*Exceeds acute listed species LOC (0.05)
**Exceeds acute non-listed species LOC (0.5)
***Exceeds chronic LOC (1)
RLF = red legged frog
OP = organophosphate
STD = standard

Freshwater Invertebrates – Acute Risk

For freshwater invertebrates, the acute risk quotients ranged from 0.002 to 0.057. Two uses exceeded the acute listed species LOC (0.05): pineapple (ground and aerial), and paved areas (ground and aerial). All other quizalofop-p-ethyl uses were below the LOC of 0.05 (Table 20).

Freshwater Invertebrates – Chronic Risk

For freshwater invertebrates, the chronic risk quotients were all < 0.001. None of them exceeded the chronic LOC (1) for any registered use of quizalofop-p-ethyl (Table 20).

Estuarine/Marine Invertebrates – Acute Risk

For estuarine/marine invertebrates, the acute risk quotients ranged from 0.004 to 0.133. Two uses exceeded the acute listed species LOC (0.05): pineapple (ground and aerial), and paved areas (ground and aerial). All other quizalofop-p-ethyl uses were below the LOC of 0.05 (Table 20).

Estuarine/Marine Invertebrates – Chronic Risk

For estuarine/marine invertebrates, the chronic risk quotients ranged from 0.002 to 0.057. None of them exceeded the chronic LOC (1) for any registered use of quizalofop-p-ethyl (Table 20).

Table 20. Acute and chronic risks from quizalofop-p-ethyl to freshwater and estuarine/marine invertebrates

Use (Scenario)	Ariel (A) or Ground (G)		1-in-10-year Aquatic EECs (µg/L)		
		Freshwater Invertebrates Acute RQ (Peak EEC/LC_{50}) LC_{50} = 350 µg ai/L	Freshwater Invertebrates Chronic RQ (21-Day EEC/ NOAEC) NOAEC = 26600 µg ai/L	Estuarine / Marine Invertebrates Acute RQ (Peak EEC/LC_{50}) LC_{50} = 150 µg ai/L	Estuarine / Marine Invertebrates Chronic RQ (21-Day EEC/ NOAEC) NOAEC = 340 µg ai/L
Idaho, Montana, Washington, Oregon, and Wyoming, only *Non-food/non-feed seed production* *2 apps @ 0.0834 lb ai/A (7-day interval)*					
Alfalfa	A	0.009	<0.001	0.022	0.009
(MN alfalfa OP)	G	0.007	<0.001	0.016	0.007
Carrot	A	0.008	<0.001	0.019	0.008
(CA Row Crop RLF)	G	0.007	<0.001	0.016	0.007

Use (Scenario)	Ariel (A) or Ground (G)		1-in-10-year Aquatic EECs (µg/L)		
		Freshwater Invertebrates Acute RQ (Peak EEC/LC_{50}) LC_{50} = 350 µg ai/L	Freshwater Invertebrates Chronic RQ (21-Day EEC/ NOAEC) NOAEC = 26600 µg ai/L	Estuarine / Marine Invertebrates Acute RQ (Peak EEC/LC_{50}) LC_{50} = 150 µg ai/L	Estuarine / Marine Invertebrates Chronic RQ (21-Day EEC/ NOAEC) NOAEC = 340 µg ai/L
Chinese cabbage	A	0.019	<0.001	0.043	0.019
(CA Cole Crop RLF)	G	0.017	<0.001	0.040	0.017
Garlic	A	0.009	<0.001	0.021	0.009
(CA Garlic RLF)	G	0.007	<0.001	0.017	0.007
Onion and Radish					
(CA onion W/irrig	A	0.005	<0.001	0.012	0.005
STD)	G	0.003	<0.001	0.008	0.003
Red beets	A	0.008	<0.001	0.019	0.008
(CA Row Crop RLF)	G	0.007	<0.001	0.016	0.007
Spinach	A	0.014	<0.001	0.032	0.014
(CA lettuce STD)	G	0.012	<0.001	0.028	0.012
Swiss chard	A	0.014	<0.001	0.032	0.014
(CA lettuce STD)	G	0.012	<0.001	0.030	0.012
All states, food item *2 apps @ 0.0834 lb ai/A (7-day interval)*					
Sugar beets					
(CA sugar beet W/irrig	A	0.005	<0.001	0.012	0.005
OP)	G	0.003	<0.001	0.007	0.003
Sugar beets	A	0.014	<0.001	0.033	0.014
(MN sugar beet STD)	G	0.012	<0.001	0.028	0.012
Except New York *1 app at 0.0695 lb ai/A*					
Barley and Wheat	A	0.006	<0.001	0.014	0.006
(CA Wheat RLF)	G	0.005	<0.001	0.012	0.005
Barley and Wheat	A	0.006	<0.001	0.014	0.006
(ND wheat STD)	G	0.005	<0.001	0.012	0.005
Barley and Wheat	A	0.004	<0.001	0.009	0.004
(OR wheat OP)	G	0.004	<0.001	0.007	0.003
Barley and Wheat	A	0.006	<0.001	0.014	0.006
(TX wheat OP)	G	0.005	<0.001	0.013	0.005
1 app at 0.0834 and 1 app at 0.042 lb ai/A (7-days)					

Use (Scenario)	Ariel (A) or Ground (G)		1-in-10-year Aquatic EECs (µg/L)		
		Freshwater Invertebrates Acute RQ (Peak EEC/LC_{50}) LC_{50} = 350 µg ai/L	Freshwater Invertebrates Chronic RQ (21-Day EEC/ NOAEC) NOAEC = 26600 µg ai/L	Estuarine / Marine Invertebrates Acute RQ (Peak EEC/LC_{50}) LC_{50} = 150 µg ai/L	Estuarine / Marine Invertebrates Chronic RQ (21-Day EEC/ NOAEC) NOAEC = 340 µg ai/L
Canola/rape	A	0.007	<0.001	0.017	0.007
(ND canola STD)	G	0.005	<0.001	0.013	0.006
Crambe	A	0.007	<0.001	0.016	0.007
(CA Row Crop RLF)	G	0.005	<0.001	0.012	0.005
Crambe	A	0.011	<0.001	0.026	0.011
(MI beans STD)	G	0.010	<0.001	0.022	0.010
Soybeans	A	0.020	<0.001	0.046	0.019
(MS soybean STD)	G	0.019	<0.001	0.043	0.018
Sunflowers	A	0.006	<0.001	0.014	0.006
(CA corn OP)	G	0.005	<0.001	0.011	0.005
Sunflowers	A	0.011	<0.001	0.027	0.011
(IL Corn STD)	G	0.010	<0.001	0.024	0.010
Sunflowers	A	0.009	<0.001	0.022	0.009
(IN Corn Std)	G	0.008	<0.001	0.019	0.008
Sunflowers	A	0.017	<0.001	0.039	0.017
(KS Corn Std)	G	0.016	<0.001	0.036	0.016
Sunflowers	A	0.016	<0.001	0.037	0.016
(MS corn STD)	G	0.015	<0.001	0.035	0.015
Sunflowers	A	0.007	<0.001	0.016	0.007
(NC corn E STD)	G	0.006	<0.001	0.013	0.006
Sunflowers	A	0.013	<0.001	0.031	0.013
(NC corn W OP)	G	0.012	<0.001	0.028	0.012
Sunflowers	A	0.011	<0.001	0.025	0.011
(ND corn OP)	G	0.009	<0.001	0.021	0.009
Sunflowers	A	0.012	<0.001	0.027	0.012
(OH Corn STD)	G	0.010	<0.001	0.024	0.010
Sunflowers	A	0.010	<0.001	0.022	0.010
(PA corn STD)	G	0.008	<0.001	0.019	0.008
Sunflowers	A	0.014	<0.001	0.032	0.014
(TX corn OP)	G	0.013	<0.001	0.030	0.013
1 app at 0.0834 lb ai/A					

Use (Scenario)	Ariel (A) or Ground (G)	1-in-10-year Aquatic EECs (µg/L)			
		Freshwater Invertebrates Acute RQ (Peak EEC/LC_{50}) LC_{50} = 350 µg ai/L	Freshwater Invertebrates Chronic RQ (21-Day EEC/ NOAEC) NOAEC = 26600 µg ai/L	Estuarine / Marine Invertebrates Acute RQ (Peak EEC/LC_{50}) LC_{50} = 150 µg ai/L	Estuarine / Marine Invertebrates Chronic RQ (21-Day EEC/ NOAEC) NOAEC = 340 µg ai/L
Field Corn (CA corn OP)	A	0.004	<0.001	0.009	0.004
	G	0.003	<0.001	0.007	0.003
Field Corn (IL Corn STD)	A	0.007	<0.001	0.017	0.007
	G	0.006	<0.001	0.015	0.006
Field Corn (IN Corn Std)	A	0.006	<0.001	0.013	0.006
	G	0.005	<0.001	0.011	0.005
Field Corn (KS Corn Std)	A	0.011	<0.001	0.026	0.011
	G	0.010	<0.001	0.024	0.010
Field Corn (MS corn STD)	A	0.010	<0.001	0.024	0.010
	G	0.010	<0.001	0.023	0.010
Field Corn (NC corn E STD)	A	0.005	<0.001	0.012	0.005
	G	0.004	<0.001	0.009	0.004
Field Corn (NC corn W OP)	A	0.009	<0.001	0.020	0.008
	G	0.008	<0.001	0.018	0.007
Field Corn (ND corn OP)	A	0.007	<0.001	0.016	0.007
	G	0.006	<0.001	0.013	0.006
Field Corn (OH Corn STD)	A	0.007	<0.001	0.017	0.007
	G	0.006	<0.001	0.014	0.006
Field Corn (PA corn STD)	A	0.006	<0.001	0.014	0.006
	G	0.005	<0.001	0.012	0.005
Field Corn (TX corn OP)	A	0.028	<0.001	0.020	0.009
	G	0.008	<0.001	0.019	0.008
1 app at 0.0834 and 1 app at 0.057 lb ai/A (7-days)					
Sorghum (TXsorghumOP)	A	0.017	<0.001	0.041	0.018
	G	0.016	<0.001	0.038	0.016
3 apps at 0.034 and 1 app at 0.023 lb ai/A (7-days)					
Cotton (CA cotton W/irrig STD)	A	0.003	<0.001	0.008	0.003
	G	0.002	<0.001	0.004	0.002
Cotton (MS cotton STD)	A	0.014	<0.001	0.034	0.014
	G	0.013	<0.001	0.031	0.013

Use (Scenario)	Ariel (A) or Ground (G)		1-in-10-year Aquatic EECs (µg/L)		
		Freshwater Invertebrates Acute RQ (Peak EEC/LC_{50}) LC_{50} = 350 µg ai/L	**Freshwater Invertebrates Chronic RQ (21-Day EEC/ NOAEC) NOAEC = 26600 µg ai/L**	**Estuarine / Marine Invertebrates Acute RQ (Peak EEC/LC_{50}) LC_{50} = 150 µg ai/L**	**Estuarine / Marine Invertebrates Chronic RQ (21-Day EEC/ NOAEC) NOAEC = 340 µg ai/L**
Cotton	A	0.015	<0.001	0.034	0.015
(NC cotton STD)	G	0.014	<0.001	0.032	0.014
Cotton	A	0.012	<0.001	0.028	0.012
(TX cotton OP)	G	0.011	<0.001	0.026	0.011
2 apps at 0.0834 and 1 app at 0.03 lb ai/A (7-days)					
Dry beans	A	0.010	<0.001	0.023	0.010
(CA Row Crop RLF)	G	0.008	<0.001	0.019	0.008
Dry beans	A	0.017	<0.001	0.041	0.018
(MI beans STD)	G	0.015	<0.001	0.035	0.015
1 app at 0.0834 and 1 app at 0.01 lb ai/A (7-days)					
Dry and succulent peas and lentils (CA Row Crop RLF)	A	0.006	<0.001	0.013	0.006
	G	0.005	<0.001	0.011	0.005
Snap beans	A	0.009	<0.001	0.021	0.009
(CA Row Crop RLF)	G	0.007	<0.001	0.017	0.007
Snap beans	A	0.016	<0.001	0.036	0.016
(MI beans STD)	G	0.014	<0.001	0.032	0.014
Texas, Oklahoma, Kansas, and Colorado, only 2 apps at 0.0834 and 1 app at 0.04 lb ai/A (7-days)					
Fallow	A	0.008	<0.001	0.018	0.008
(CA Turf RLF)	G	0.006	<0.001	0.013	0.006
2 apps at 0.0834 lb ai/A (7-days)					
Flax	A	0.008	<0.001	0.019	0.008
(CA Row Crop RLF)	G	0.007	<0.001	0.016	0.007
Garbanzos (including chick peas) (CA Row Crop RLF)	A	0.008	<0.001	0.019	0.008
	G	0.007	<0.001	0.016	0.007
Garbanzos (including chick peas) (MI beans STD)	A	0.015	<0.001	0.037	0.015
	G	0.013	<0.001	0.030	0.013

Use (Scenario)	Ariel (A) or Ground (G)		1-in-10-year Aquatic EECs (µg/L)		
		Freshwater Invertebrates Acute RQ (Peak EEC/LC_{50}) LC_{50} = 350 µg ai/L	**Freshwater Invertebrates Chronic RQ (21-Day EEC/ NOAEC) NOAEC = 26600 µg ai/L**	**Estuarine / Marine Invertebrates Acute RQ (Peak EEC/LC_{50}) LC_{50} = 150 µg ai/L**	**Estuarine / Marine Invertebrates Chronic RQ (21-Day EEC/ NOAEC) NOAEC = 340 µg ai/L**
Maine and Minnesota, only *2 apps at 0.0695 lb ai/A (7-days)*					
Hybrid cottonwood/poplar plantations (PA apple STD V2)	A G	0.008 0.007	<0.001 <0.001	0.020 0.015	0.009 0.007
2 apps at 0.0834 and 1 app at 0.04 lb ai/A (7-days)					
Mint (spearmint and peppermint) (CA lettuce STD)	A G	0.017 0.014	<0.001 <0.001	0.039 0.035	0.017 0.015
2 apps at 0.111 lb ai/A (7-days)					
Non-crop areas (uncultivated areas, fence rows, roadsides, equipment storage areas, and other similar areas) (CA right-of-way RLF)	A G	0.020 0.018	<0.001 <0.001	0.046 0.042	0.020 0.018
Non-crop areas (CA Turf RLF)	A G	0.009 0.006	<0.001 <0.001	0.020 0.014	0.009 0.006
Non-crop areas (FL turf STD)	A G	0.004 0.002	<0.001 <0.001	0.010 0.005	0.004 0.002
Non-crop areas (PA turf STD)	A G	0.007 0.004	<0.001 <0.001	0.016 0.008	0.007 0.004
Puerto Rico (pineapple only) and Hawaii, only *2 apps at 0.208 lb ai/A (7-days)*					
Ornamental and/or shade trees (CA nursery STD)	A G	0.013 0.007	<0.001 <0.001	0.029 0.017	0.012 0.007

Use (Scenario)	Ariel (A) or Ground (G)	1-in-10-year Aquatic EECs (µg/L)			
		Freshwater Invertebrates Acute RQ (Peak EEC/LC_{50}) LC_{50} = 350 µg ai/L	**Freshwater Invertebrates Chronic RQ (21-Day EEC/ NOAEC) NOAEC = 26600 µg ai/L**	**Estuarine / Marine Invertebrates Acute RQ (Peak EEC/LC_{50}) LC_{50} = 150 µg ai/L**	**Estuarine / Marine Invertebrates Chronic RQ (21-Day EEC/ NOAEC) NOAEC = 340 µg ai/L**
Pineapple (MS cotton STD)	A G	**0.055*** **0.051***	<0.001 <0.001	**0.130*** **0.119***	0.055 0.051
1 app at 0.108 lb ai/A					
Paved areas (private roads/sidewalks) (CA Impervious RLF)	A G	**0.056*** **0.057***	<0.001 <0.001	**0.131*** **0.133***	0.056 0.057
Minnesota, only *2 apps at 0.0695 lb ai/A (7-days)*					
Perennial ryegrass grown for seed (ND wheat STD)	A G	0.013 0.011	<0.001 <0.001	0.030 0.026	0.013 0.011

Bold text indicates an LOC was exceeded.
*Exceeds acute listed species LOC (0.05)
**Exceeds acute non-listed species LOC (0.5)
***Exceeds chronic LOC (1)
RLF = red legged frog
OP = organophosphate
STD = standard

Aquatic Vascular and Non-vascular Plants

Aquatic vascular plant risk quotients ranged from 0.015 to 0.580. Aquatic non-vascular plant risk quotients were all < 0.001. None of the aquatic plant risk quotients exceeded the LOC of 1 for any registered use of quizalofop-p-ethyl (Table 21).

Table 21. Risks from quizalofop-p-ethyl to aquatic vascular and non-vascular plants

Use (Scenario)	Ariel (A) or Ground (G)	1-in-10-year Aquatic EECs (µg/L)

		Aquatic Vascular Plants RQ (Peak EEC/EC_{50}) EC_{50} = 34.5 µg ai/L	**Aquatic Non-Vascular Plants RQ (Peak EEC/EC_{50}) EC_{50} = 41000 µg ai/L**
Idaho, Montana, Washington, Oregon, and Wyoming, only *Non-food/non-feed seed production* *2 apps @ 0.0834 lb ai/A (7-day interval)*			
Alfalfa	A	0.090	<0.001
(MN alfalfa OP)	G	0.068	<0.001
Carrot	A	0.085	<0.001
(CA Row Crop RLF)	G	0.069	<0.001
Chinese cabbage	A	0.189	<0.001
(CA Cole Crop RLF)	G	0.173	<0.001
Garlic	A	0.092	<0.001
(CA Garlic RLF)	G	0.073	<0.001
Onion and Radish			
(CA onion W/irrig	A	0.052	<0.001
STD)	G	0.034	<0.001
Red beets	A	0.085	<0.001
(CA Row Crop RLF)	G	0.069	<0.001
Spinach	A	0.138	<0.001
(CA lettuce STD)	G	0.120	<0.001
Swiss chard	A	0.138	<0.001
(CA lettuce STD)	G	0.120	<0.001
All states, food item *2 apps @ 0.0834 lb ai/A (7-day interval)*			
Sugar beets			
(CA sugar beet W/irrig	A	0.051	<0.001
OP)	G	0.029	<0.001
Sugar beets	A	0.143	<0.001
(MN sugar beet STD)	G	0.120	<0.001
Except New York *1 app at 0.0695 lb ai/A*			
Barley and Wheat	A	0.060	<0.001
(CA Wheat RLF)	G	0.052	<0.001
Barley and Wheat	A	0.063	<0.001
(ND wheat STD)	G	0.053	<0.001

Use (Scenario)	Ariel (A) or Ground (G)	1-in-10-year Aquatic EECs (µg/L)	
		Aquatic Vascular Plants RQ (Peak EEC/EC_{50}) EC_{50} = 34.5 µg ai/L	Aquatic Non-Vascular Plants RQ (Peak EEC/EC_{50}) EC_{50} = 41000 µg ai/L
Barley and Wheat (OR wheat OP)	A	0.041	<0.001
	G	0.032	<0.001
Barley and Wheat (TX wheat OP)	A	0.060	<0.001
	G	0.055	<0.001
1 app at 0.0834 and 1 app at 0.042 lb ai/A (7-days)			
Canola/rape (ND canola STD)	A	0.074	<0.001
	G	0.056	<0.001
Crambe (CA Row Crop RLF)	A	0.068	<0.001
	G	0.054	<0.001
Crambe (MI beans STD)	A	0.115	<0.001
	G	0.099	<0.001
Soybeans (MS soybean STD)	A	0.198	<0.001
	G	0.188	<0.001
Sunflowers (CA corn OP)	A	0.059	<0.001
	G	0.048	<0.001
Sunflowers (IL Corn STD)	A	0.116	<0.001
	G	0.103	<0.001
Sunflowers (IN Corn Std)	A	0.094	<0.001
	G	0.082	<0.001
Sunflowers (KS Corn Std)	A	0.169	<0.001
	G	0.158	<0.001
Sunflowers (MS corn STD)	A	0.161	<0.001
	G	0.151	<0.001
Sunflowers (NC corn E STD)	A	0.072	<0.001
	G	0.057	<0.001
Sunflowers (NC corn W OP)	A	0.134	<0.001
	G	0.121	<0.001
Sunflowers (ND corn OP)	A	0.108	<0.001
	G	0.091	<0.001
Sunflowers (OH Corn STD)	A	0.119	<0.001
	G	0.106	<0.001

Use (Scenario)	Ariel (A) or Ground (G)	1-in-10-year Aquatic EECs (µg/L)	
		Aquatic Vascular Plants RQ (Peak EEC/EC_{50}) EC_{50} = 34.5 µg ai/L	Aquatic Non-Vascular Plants RQ (Peak EEC/EC_{50}) EC_{50} = 41000 µg ai/L
Sunflowers	A	0.099	<0.001
(PA corn STD)	G	0.084	<0.001
Sunflowers	A	0.138	<0.001
(TX corn OP)	G	0.129	<0.001
1 app at 0.0834 lb ai/A			
Field Corn	A	0.039	<0.001
(CA corn OP)	G	0.032	<0.001
Field Corn	A	0.074	<0.001
(IL Corn STD)	G	0.065	<0.001
Field Corn	A	0.058	<0.001
(IN Corn Std)	G	0.049	<0.001
Field Corn	A	0.113	<0.001
(KS Corn Std)	G	0.106	<0.001
Field Corn	A	0.104	<0.001
(MS corn STD)	G	0.098	<0.001
Field Corn	A	0.051	<0.001
(NC corn E STD)	G	0.041	<0.001
Field Corn	A	0.086	<0.001
(NC corn W OP)	G	0.078	<0.001
Field Corn	A	0.070	<0.001
(ND corn OP)	G	0.059	<0.001
Field Corn	A	0.073	<0.001
(OH Corn STD)	G	0.063	<0.001
Field Corn	A	0.062	<0.001
(PA corn STD)	G	0.053	<0.001
Field Corn	A	0.087	<0.001
(TX corn OP)	G	0.081	<0.001
1 app at 0.0834 and 1 app at 0.057 lb ai/A (7-days)			
Sorghum	A	0.177	<0.001
(TXsorghumOP)	G	0.166	<0.001
3 apps at 0.034 and 1 app at 0.023 lb ai/A (7-days)			

Use (Scenario)	Ariel (A) or Ground (G)	1-in-10-year Aquatic EECs (µg/L)	
		Aquatic Vascular Plants RQ (Peak EEC/EC_{50}) EC_{50} = 34.5 µg ai/L	Aquatic Non-Vascular Plants RQ (Peak EEC/EC_{50}) EC_{50} = 41000 µg ai/L
Cotton (CA cotton W/irrig STD)	A	0.034	<0.001
	G	0.017	<0.001
Cotton (MS cotton STD)	A	0.146	<0.001
	G	0.135	<0.001
Cotton (NC cotton STD)	A	0.150	<0.001
	G	0.137	<0.001
Cotton (TX cotton OP)	A	0.121	<0.001
	G	0.111	<0.001
2 apps at 0.0834 and 1 app at 0.03 lb ai/A (7-days)			
Dry beans (CA Row Crop RLF)	A	0.101	<0.001
	G	0.083	<0.001
Dry beans (MI beans STD)	A	0.176	<0.001
	G	0.154	<0.001
1 app at 0.0834 and 1 app at 0.01 lb ai/A (7-days)			
Dry and succulent peas and lentils (CA Row Crop RLF)	A	0.056	<0.001
	G	0.046	<0.001
Snap beans (CA Row Crop RLF)	A	0.090	<0.001
	G	0.074	<0.001
Snap beans (MI beans STD)	A	0.159	<0.001
	G	0.138	<0.001
Texas, Oklahoma, Kansas, and Colorado, only 2 apps at 0.0834 and 1 app at 0.04 lb ai/A (7-days)			
Fallow (CA Turf RLF)	A	0.080	<0.001
	G	0.057	<0.001
2 apps at 0.0834 lb ai/A (7-days)			
Flax (CA Row Crop RLF)	A	0.085	<0.001
	G	0.069	<0.001

Use (Scenario)	Ariel (A) or Ground (G)	1-in-10-year Aquatic EECs (µg/L)	
		Aquatic Vascular Plants RQ (Peak EEC/EC_{50}) EC_{50} = 34.5 µg ai/L	**Aquatic Non-Vascular Plants RQ (Peak EEC/EC_{50}) EC_{50} = 41000 µg ai/L**
Garbanzos (including chick peas) (CA Row Crop RLF)	A G	0.085 0.069	<0.001 <0.001
Garbanzos (including chick peas) (MI beans STD)	A G	0.015 0.130	<0.001 <0.001
Maine and Minnesota, only *2 apps at 0.0695 lb ai/A (7-days)*			
Hybrid cottonwood/poplar plantations (PA apple STD V2)	A G	0.086 0.066	<0.001 <0.001
2 apps at 0.0834 and 1 app at 0.04 lb ai/A (7-days)			
Mint (spearmint and peppermint) (CA lettuce STD)	A G	0.168 0.150	<0.001 <0.001
2 apps at 0.111 lb ai/A (7-days)			
Non-crop areas (uncultivated areas, fence rows, roadsides, equipment storage areas, and other similar areas) (CA right-of-way RLF)	A G	0.202 0.184	<0.001 <0.001
Non-crop areas (CA Turf RLF)	A G	0.089 0.062	<0.001 <0.001
Non-crop areas (FL turf STD)	A G	0.046 0.020	<0.001 <0.001

Use (Scenario)	Ariel (A) or Ground (G)	1-in-10-year Aquatic EECs (µg/L)	
		Aquatic Vascular Plants RQ (Peak EEC/EC_{50}) EC_{50} = 34.5 µg ai/L	**Aquatic Non-Vascular Plants RQ (Peak EEC/EC_{50}) EC_{50} = 41000 µg ai/L**
Non-crop areas (PA turf STD)	A	0.070	<0.001
	G	0.036	<0.001
Puerto Rico (pineapple only) and Hawaii, only 2 apps at 0.208 lb ai/A (7-days)			
Ornamental and/or shade trees (CA nursery STD)	A	0.127	<0.001
	G	0.075	<0.001
Pineapple (MS cotton STD)	A	0.554	<0.001
	G	0.516	<0.001
1 app at 0.108 lb ai/A			
Paved areas (private roads/sidewalks) (CA Impervious RLF)	A	0.568	<0.001
	G	0.580	<0.001
Minnesota, only 2 apps at 0.0695 lb ai/A (7-days)			
Perennial ryegrass grown for seed (ND wheat STD)	A	0.130	<0.001
	G	0.111	<0.001
***Exceeds the LOC (1) RLF = red legged frog OP = organophosphate STD = standard			

Probit Slope Response Analysis of LOC Values and Acute RQ Values

As part of the risk estimation, the probability of mortality associated with the listed acute LOC values is estimated along with the probability of acute mortality occurring if exposure at the EEC actually occurs. The probability of mortality calculations are based on the probit slope dose-response relationship. The probability of mortality for an exposed individual is calculated using an Excel spreadsheet tool IECV1.1 (Individual Effect Chance Model

Version 1.1) developed by EFED of the 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 quizalofop-p-ethyl, taxa-specific data were only available for freshwater invertebrates; default values were used for other taxonomic groups.

Probabilities of mortality were only calculated for scenarios where the risk quotient exceeded the acute listed species LOC. For quizalofop-p-ethyl there were only two groups that met this criterion – freshwater invertebrates and estuarine/marine invertebrates. All scenarios with risk quotients that exceeded the acute LOC were modeled (Table 22).

Table 22. Odds of mortality for an individual freshwater or estuarine/marine invertebrate for quizalofop-p-ethyl

	RQ	Slope	95% Confidence Interval	Odds (1 in…)
Freshwater invertebrates (pineapple - aerial)	0.055	7.82	4.56-11.1	2.93×10^{22}
Freshwater invertebrates (pineapple - ground)	0.051	7.82	4.56-11.1	3.88×10^{23}
Freshwater invertebrates (paved areas - aerial)	0.056	7.82	4.56-11.1	1.60×10^{22}
Freshwater invertebrates (paved areas - ground)	0.057	7.82	4.56-11.1	8.82×10^{21}
Estuarine/marine invertebrates (pineapple - aerial)	0.130	4.5	2-9	29,900
Estuarine/marine invertebrates (pineapple - ground)	0.119	4.5	2-9	62,900
Estuarine/marine invertebrates (paved areas)	0.131	4.5	2-9	28,100
Estuarine/marine invertebrates (paved areas)	0.133	4.5	2-9	24,800

Risk Description

The following risk description explains the overall direct effect conclusions regarding the potential ecological risk from the various uses of quizalofop-p-ethyl. The risk conclusions take into consideration all lines of evidence, such as the risk estimates (risk quotient results); information on the odds of mortality for the acute risk quotient values; comparisons of non-

definitive endpoints (*i.e.*, limit tests) to EECs; information such as monitoring data, field studies, and incident data 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.

DIRECT EFFECTS TO TERRESTRIAL BIRDS, REPTILES, AND AMPHIBIANS

Acute Risk

Acute dose-based and dietary-based risk quotients could not be calculated to evaluate the risks to birds because only non-definitive acute toxicity data were available. Instead, the non-definitive toxicity values were directly compared to the EECs (Table 23). In all cases, none of the dietary EECs were larger than the non-definitive toxicity values for mallard duck, the most sensitive. Thus, the potential for risk is considered to be low for acute dose-based and dietary-based exposure of birds, reptiles, and land-phase amphibians from quizalofop-p-ethyl for all registered uses.

Table 23. Comparison of the highest calculated EEC for each use of quizalofop-p-ethyl to the most sensitive avian acute toxicity values

Application Scenario	Dietary Item	EEC (mg ai/kg-bw)	LD_{50} (mallard) mg ai/kg-bw	EEC (mg ai/kg-diet)	LC_{50} (mallard) mg ai/kg-diet
Idaho, Montana, Washington, Oregon, and Wyoming, only Non-food/non-feed seed production: alfalfa, carrot, Chinese cabbage, garlic, onion, radish, red beets, spinach, Swiss chard All states, food item: sugar beets 2 apps at 0.0834 lb ai/A (7-day interval)	Short grass	42.64	>2000	37.44	>5000
Except New York Barley, wheat 1 app at 0.0695 lb ai/A	Short grass	19.00	>2000	16.68	>5000
Canola/rape, crambe, soybeans, sunflowers 1 app at 0.0834 and 1 app at 0.042 lb ai/A (7-days)	Short grass	31.33	>2000	27.50	>5000
Field corn seed production (herbicide-tolerant) 1 app at 0.0834 lb ai/A	Short grass	22.80	>2000	20.02	>5000
Sorghum (herbicide-tolerant) 1 app at 0.0834 and 1 app at 0.057 lb ai/A (7-days)	Short grass	35.43	>2000	31.10	>5000
Cotton 3 apps at 0.034 and 1 app at 0.023 lb ai/A (7-days)	Short grass	27.55	>2000	24.19	>5000

Application Scenario	Dietary Item	EEC (mg ai/kg-bw)	LD_{50} (mallard) mg ai/kg-bw	EEC (mg ai/kg-diet)	LC_{50} (mallard) mg ai/kg-diet
Dry beans 2 apps at 0.0834 and 1 app at 0.03 lb ai/A (7-days)	Short grass	45.32	>2000	39.79	>5000
Dry and succulent peas, lentils, snap beans 1 app at 0.0834 and 1 app at 0.01 lb ai/A (7-days)	Short grass	22.80	>2000	20.02	>5000
Texas, Oklahoma, Kansas, and Colorado, only Fallow 2 apps at 0.0834 and 1 app at 0.04 lb ai/A (7-days)	Short grass	48.06	>2000	42.19	>5000
Flax, garbanzos (including chick peas) 2 apps at 0.0834 lb ai/A (7-days)	Short grass	42.64	>2000	37.44	>5000
Maine and Minnesota, only Hybrid cottonwood/poplar plantations 1 app at 0.0695 lb ai/A	Short grass	35.53	>2000	31.20	>5000
Mint (spearmint and peppermint) 2 apps at 0.0834 and 1 app at 0.04 lb ai/A (7-days)	Short grass	48.06	>2000	42.19	>5000
Non-crop areas (uncultivated areas, fence rows, roadsides, equipment storage areas, and other similar areas) 1 app at 0.111 lb ai/A	Short grass	30.34	>2000	26.64	>5000
Puerto Rico (pineapple only) and Hawaii, only Ornamental and/or shade trees, pineapple 2 apps at 0.208 lb ai/A (7-days)	Short grass	106.35	>2000	93.38	>5000
Paved areas (private roads/sidewalks) 1 app at 0.108 lb ai/A	Short grass	29.52	>2000	25.92	>5000
Minnesota, only Perennial ryegrass grown for seed 2 apps at 0.0695 lb ai/A (7-days)	Short grass	35.53	>2000	31.20	>5000

Chronic Risk

Risk quotients were calculated for dietary-based chronic risks. None of the uses exceeded the LOC of 1; consequently, effects to listed and non-listed avian, reptile, and terrestrial-phase amphibian species are considered unlikely.

Summary of Risks from Direct Effects

A summary of the potential for acute and chronic risks to birds (surrogates for reptiles and land-phase amphibians) is listed below:

- The potential for acute risk to non-listed birds (surrogates for reptiles and land-phase amphibians) is low, based on comparisons between dose-based and dietary-based

EECs and toxicity data. For all uses, the EECs are much lower than the toxicity value.

- The potential for chronic risk to birds (reptiles and land-phase amphibians) is low for all quizalofop-p-ethyl uses, based on risk quotients not exceeding the LOC (1).

DIRECT EFFECTS TO TERRESTRIAL MAMMALS

Acute Risk

Risk quotients were calculated for dietary and dose-based acute exposures. None of the quizalofop-p-ethyl uses exceeded the LOC of 0.1, for listed species. Therefore, effects to listed and non-listed mammals are not expected.

Chronic Risk

Risk quotients were calculated for dietary and dose-based chronic exposures. None of the quizalofop-p-ethyl uses yielded chronic dietary RQs that exceeded the LOC (1); however, all uses had multiple scenarios that exceeded the chronic dose-based LOC of 1. Specifically, all uses had risk quotients that exceeded the LOC for small (15 g) and medium-sized (35 g) mammals consuming diets of short grass. Most uses yielded risk quotients that exceeded the LOC for other food items and the large (1000 g) mammal size class (Table 24). The NOAEL for mammals is 5 mg ai/kg-bw and the LOAEL is 20 mg ai/kg-bw. For scenarios with risk quotients that exceeded the LOC, EECs ranged from 17.08 to 89.03 mg ai/kg-bw. Essentially, the EECs are approximately 1 to 4 times the lowest dose tested in which effects were observed (3 to 18 times higher than the dose at which no effects were observed). Effects included decreases in male and female pup body weight and reduced number of live pup births in F_1 and F_2 generations. Chronic risk quotients for mammals consuming fruits, pods, or seeds never exceeded the LOC of 1.

Table 24 Quizalofop-p-ethyl uses that exceeded the chronic dose-based LOC (1) for mammals

Use	Dose-based RQs											
	Short grass			Tall grass			Broadleaf plants			Arthropods		
	15 g	35 g	1000 g	15 g	35 g	1000 g	15 g	35 g	1000 g	15 g	35 g	1000 g
ID, MT, WA, OR, WY, only: Non-food/non-feed seed production: alfalfa, carrot, Chinese cabbage, garlic, onion, radish, red beets, spinach, Swiss chard TX, OK, KS, CO, only: fallow All states, food item: sugar beets, dry beans, flax, garbanzos (including chick peas), mint (spearmint and peppermint)	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	No	**Yes**	**Yes**	No	**Yes**	**Yes**	No
Except New York: barley, wheat All states: field corn seed production (herbicide-tolerant), dry and succulent peas, lentils, snap beans	**Yes**	**Yes**	No	No	No	No	No	No	No	No	No	No
Canola/rape, crambe, soybeans, sunflowers, paved areas (private roads/sidewalks)	**Yes**	**Yes**	**Yes**	**Yes**	No	No	**Yes**	**Yes**	No	No	No	No
Non-crop areas (uncultivated areas, fence rows, roadsides, equipment storage areas, and other similar areas)	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	No	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	No
ME, MN, only: hybrid cottonwood/poplar plantations MN, only: perennial ryegrass grown for seed All states: sorghum (herbicide-tolerant)	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	No	**Yes**	**Yes**	No	**Yes**	No	No
Cotton	**Yes**	**Yes**	No	No	No	No	**Yes**	**Yes**	No	No	No	No
Puerto Rico, only: pineapple HI, only: pineapple, ornamental and/or shade trees	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

Summary of Risks from Direct Effects

A summary of the potential for acute and chronic risks to mammals is listed below:

- The potential for acute risk to mammals is low for all quizalofop-p-ethyl uses, based on risk quotients not exceeding the listed species LOC (0.1).
- There is the potential for chronic risk to listed and non-listed mammals for all quizalofop-p-ethyl uses based on the dose-based risk quotients exceeding the LOC (1).

DIRECT EFFECTS TO TERRESTRIAL INVERTEBRATES

There is no defined LOC for non-listed terrestrial insects; the interim listed terrestrial invertebrate LOC is 0.05. Currently, there is no established threshold for risk to terrestrial invertebrates. As such, the level of direct effects to terrestrial invertebrates necessary to indirectly affect other taxa that rely on terrestrial invertebrates as a food source or for pollination has not been established on a national level, and the use of the interim LOC of 0.05 will apply to all terrestrial invertebrates without the demarcation of non-listed and listed.

The acute contact toxicity value for the honeybee study with quizalofop-p-ethyl was non-definitive (LD_{50} > 50 µg ai/bee); therefore, risk quotients were not calculated. The toxicity value was converted to mg/kg-bee, based on the weight of one bee (0.128 g). The extrapolated acute contact LD_{50} values for terrestrial invertebrates was calculated as > 391 mg ai/kg-diet[6] and compared to the arthropod predicted EEC. The highest EEC (36.57 mg ai/kg-diet) was derived from the pineapple and ornamental and/or shade trees application scenario (two applications at 0.208 lb ai/A, 7-days apart). This value was much lower than the extrapolated acute contact LD_{50} (391 mg ai/kg-diet) that was calculated for the honeybee. Given that the other quizalofop-p-ethyl application rates are lower, it is unlikely that the registered uses will adversely affect terrestrial insects

Summary of Risks from Direct Effects

A summary of the potential for acute risks terrestrial invertebrates is listed below:

- The potential for acute risk to terrestrial invertebrates is not expected, based on honeybee acute contact LD_{50} data.

[6] $Extrapolated\ LD50_{terrestrial\ insect} = \frac{LD50_{honey\ bee}}{BW_{honey\ bee}} = \frac{50}{0.128}\frac{\mu g}{g} = 391\ \text{ppm}$

DIRECT EFFECTS TO TERRESTRIAL PLANTS

Risk quotients were calculated for listed dicots and listed and non-listed monocots. For dicots, risk quotients did not exceed the LOC (1) for listed species. The most sensitive EC_{25} for dicots was non-definitive; consequently, risk quotients could not be calculated for non-listed dicot species. However; given that a NOAEC was available for the dicot listed species calculations and that the risk quotients from these scenarios did not exceed the LOC, non-listed dicots are also not expected to be at risk from any of the registered quizalofop-p-ethyl uses.

All ground and aerial spray drift scenarios exceeded the LOC (1) for listed and non-listed monocots. Application rates of 0.0695 lb ai/A and higher yielded risk quotients that exceeded the LOCs in additional scenarios (Table 25). Further, there was one major incident reported in the EIIS database for quizalofop-p-ethyl. The incident (# I016677-001) occurred when spray drift from an application of Assure II (quizalofop-p-ethyl) and Flexstar (sodium fomesafen) to soybeans came into contact with a garden in the vicinity of the soybean field. Hundreds of herbaceous plants in a home herb garden (20 ft away) and various vegetables in another garden (150 ft away) were reported to have been damaged (leaf burn and spotting). The incident occurred on 8/2/05 in Missouri and is classified as "possible" to have been caused by quizalofop-p-ethyl; however there is some uncertainty given that sodium fomesafen was also applied. There was one minor incident listed in the Aggregate Summary Module of OPP's Incident Database for quizalofop-p-ethyl. The formulation, Assure II, was associated with minor plant damage between 7/1/01 and 9/30/01. No further information was available.

Table 25. Quizalofop-p-ethyl application scenarios that exceeded the LOC for listed and non-listed monocots

Use	Non-listed monocot						Listed monocot					
	Dry		Semi-aquatic		Spray drift		Dry		Semi-aquatic		Spray drift	
	Ground	Aerial	Ground	Aerial	Ground	Aerial	Ground	Aerial	Ground	Aerial	Ground	Aerial
ID, MT, WA, OR, WY, only: Non-food/non-feed seed production: alfalfa, carrot, Chinese cabbage, garlic, onion, radish, red beets, spinach, Swiss chard TX, OK, KS, CO, only: fallow All states: canola/rape, crambe, soybeans, sunflowers, field corn seed production (herbicide-tolerant), sorghum (herbicide-tolerant), dry beans, dry and succulent peas, lentils, snap beans, flax, garbanzos (including chick peas), mint (spearmint and peppermint), sugar beet)	No	No	No	No	No	**Yes**	No	No	No	**Yes**	**Yes**	**Yes**
ME, MN, only: hybrid cottonwood/poplar plantations MN only: perennial ryegrass grown for seed Except NY: barley, wheat	No	No	No	No	No	**Yes**	No	No	No	**Yes**	No	**Yes**
Cotton	No	No	No	No	No	**Yes**	No	No	No	No	No	**Yes**
Non-crop areas, paved areas	No	No	No	No	No	**Yes**	No	No	**Yes**	**Yes**	**Yes**	**Yes**
Puerto Rico only: pineapple HI only: pineapple and ornamental and/or shade trees	No	No	**Yes**	**Yes**	**Yes**	**Yes**	No	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

Buffers may offer a potential mitigation strategy to reduce the concentration of quizalofop-p-ethyl that reaches non-target monocots. Spray drift from ground and aerial applications was modeled to estimate the distance that spray applications can drift from the treated area and still be present at concentrations that exceed levels of concern. A quantitative analysis of spray drift distances was completed using AgDRIFT (v. 2.11) using default inputs for ground applications (i.e., high boom, ASAE droplet size distribution = Very Fine to Fine, 90th data percentile) and aerial applications (i.e., ASAE Very Fine to Fine). The results indicate that buffers could be set to mitigate adverse effects to non-target species from ground applications (spray drift only – runoff is not considered); however, buffers for aerial application would need to be greater than 1000 ft (Table 26). These results should be considered with the caveat that the most conservative application assumptions were used as inputs to the model.

Table 26. Buffer distances for terrestrial monocot scenarios with risk quotients that exceeded the spray drift LOC

Use	Single application Rate (lb ai/A)	Fraction of Applied	Buffer Distance (ft)	
			Ground	Aerial
Listed Monocots				
ID, MT, WA, OR, WY, only Non-food/non-feed seed production: alfalfa, carrot, Chinese cabbage, garlic, onion, radish, red beets, spinach, Swiss chard TX, OK, KS, CO, only: fallow All states: canola/rape, crambe, soybeans, sunflowers, field corn seed production (herbicide-tolerant), sorghum (herbicide-tolerant), dry beans, dry and succulent peas, lentils, snap beans, flax, garbanzos (including chick peas) mint (spearmint and peppermint), sugar beet	0.0834	0.009	213	>1000
ME, MN, only: hybrid cottonwood/poplar plantations MN only: perennial ryegrass grown for seed Except New York: barley, wheat	0.0695	0.011	180	>1000
Cotton	0.034	0.023	95	>1000
Non-crop areas	0.111	0.007	262	>1000
Puerto Rico: pineapple HI, only: pineapple and ornamental and/or shade	0.208	0.004	394	>1000

trees				
Paved areas	0.108	0.007	262	>1000
Non-Listed Monocots				
ID, MT, WA, OR, WY, only Non-food/non-feed seed production: alfalfa, carrot, Chinese cabbage, garlic, onion, radish, red beets, spinach, Swiss chard TX, OK, KS, CO, only: fallow All states: canola/rape, crambe, soybeans, sunflowers, field corn seed production (herbicide-tolerant), sorghum (herbicide-tolerant), dry beans, dry and succulent peas, lentils, snap beans, flax, garbanzos (including chick peas) mint (spearmint and peppermint), sugar beet	0.0834	0.018	118	>1000
ME, MN, only: hybrid cottonwood/poplar plantations MN only: perennial ryegrass grown for seed Except New York: barley, wheat	0.0695	0.021	102	>1000
Cotton	0.034	0.043	52	>1000
Non-crop areas	0.111	0.013	157	>1000
Puerto Rico: pineapple HI, only: pineapple and ornamental and/or shade trees	0.208	0.007	262	>1000
Paved areas	0.108	0.014	148	>1000

Summary of Risks from Direct Effects

A summary of the potential for risks terrestrial plants is listed below:

- The potential for direct effects to listed and non-listed terrestrial dicot plants from all registered uses of quizalofop-p-ethyl is not expected, based on the risk quotients not exceeding the LOC (1).
- The potential for direct effects to listed and non-listed terrestrial monocots plants is expected to occur for all registered uses of quizalofop-p-ethyl, based on the risk quotients exceeding the LOC (1) and plant incident data.

DIRECT EFFECTS TO AQUATIC FISH, INVERTEBRATES, AND PLANTS

Freshwater Fish and Amphibians (Aquatic-Phase), and Estuarine-Marine Fish

Acute Risk

Acute risk quotients for freshwater fish did not exceed the LOCs for listed (0.05) or non-listed (0.5) species. No incidents with freshwater fish or aquatic-phase amphibians were reported, thus adverse effects to freshwater fish on an acute exposure basis are not expected for registered quizalofop-p-ethyl uses.

Acute data were not available for estuarine/marine fish; however the freshwater fish acute data were determined to be sufficiently protective to use as a surrogate (see Effects Characterization Section). As with the freshwater fish, risk quotients for estuarine/marine fish did not exceed the LOCs for listed (0.05) or non-listed (0.5) species. No incidents with estuarine/marine fish were reported, thus adverse effects to estuarine/marine fish on an acute exposure basis are not expected from the registered uses of quizalofop-p-ethyl.

Chronic Risk

Chronic freshwater fish data were available and used to represent aquatic-phase amphibians in addition to fish. Specifically, data from the fathead minnow were used, although the rainbow trout presented a more sensitive acute toxicity value. When the acute-to-chronic ratio method was used to estimate a NOAEC for the rainbow trout, it was less conservative than the NOAEC in the existing fathead minnow study. Two uses exceeded the chronic LOC (1): pineapple (ground and aerial), and paved areas (ground and aerial).

The pineapple use is geographically restricted to Hawaii and Puerto Rico. The NOAEC and LOAEC for freshwater fish was 10 and 30 µg ai/L, respectively. Risk quotients that exceeded the LOC had EECs ranging from 17.8 to 19.1 µg ai/L – about half the value of the LOAEC and double the value of the NOAEC. Effects for freshwater fish included decreased length and weight, and larval mortality.

The paved area use is nation-wide; however, the model was run with the conservative assumption that 100% of the quizalofop-p-ethyl applied to an acre was available for off-site transport. In reality, this number is probably much lower. Quizalofop is being used as a spot treatment for weeds that are present in cracks within a paved area. It is unlikely that it would be applied over an entire acre of paved area. EECs for risk quotients that exceeded the LOC (100% paved area treated) ranged from 19.6 to 20.0 µg ai/L – about half the value of the LOAEC and double the value of the NOAEC (see above paragraph on pineapple use). Table 27 compares the risk quotients for ground and aerial paved area scenarios with less conservative assumptions. Using an assumption that 50% of an acre is treated with quizalofop (still a very conservative assumption), the EECs fall below the LOC, indicating risk to listed and non-listed species is unlikely from the paved area use.

All other quizalofop-p-ethyl uses were below the LOC of 1 and do not present a chronic concern for freshwater fish.

Chronic estuarine/marine fish data were available for risk analysis. Risk quotients did not exceed the LOC of 1 and no incidents have been reported. Therefore, adverse effects to estuarine/marine fish on a chronic basis are not expected from the registered uses of quizalofop-p-ethyl.

Table 27. Risk quotients for alternative quizalofop-p-ethyl offsite transport availability for the paved area scenario [bolded values exceed the LOC (acute = 0.05; chronic = 1)]

Scenario	100%		75%		50%		25%	
	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
Aerial (freshwater fish – chronic)	18.33	**1.83**	13.74	**1.37**	9.17	0.917	4.58	0.458
Ground (freshwater fish- chronic)	18.62	**1.86**	13.97	**1.40**	9.31	0.931	4.66	0.458
Aerial (freshwater invert – acute)	19.65	**0.056**	14.73	0.042	9.83	0.028	4.91	0.014
Ground (freshwater invert – acute)	19.96	**0.057**	14.97	0.043	9.98	0.029	4.99	0.014
Aerial (estuarine/ marine invert – acute)	19.65	**0.131**	14.73	**0.098**	9.83	**0.066**	4.91	0.033
Ground (estuarine/ marine invert – acute)	19.96	**0.133**	14.97	**0.100**	9.98	**0.067**	4.99	0.033

Freshwater and Estuarine-Marine Invertebrates

Acute Risk

Acute quizalofop-p-ethyl toxicity data for freshwater invertebrates were available. Two uses exceeded the acute listed species LOC (0.05), but none exceeded the acute non-listed species LOC (0.5). The first use, pineapple, is geographically restricted to Hawaii and Puerto Rico. The other use, paved areas, is nation-wide. The paved area scenario was modeled using the conservative assumption that 100 percent of the applied material is available for off-site transport. In reality, it is probably a much lower percentage. Quizalofop is being used as a spot treatment for weeds that are present in cracks within a paved area. It is unlikely that it would be applied over an entire acre of paved area. Table 27 presents the EECs and risk quotients that would be derived from less conservative scenarios. Given that a 75% offsite transport assumption (still very conservative) results in risk quotients below the LOC, it is unlikely that quizalofop-p-ethyl applications to paved areas would result in adverse acute risks to freshwater invertebrates. There was a 1 in 2.93×10^{22} chance of an individual being affected by the pineapple use and a 1 in 8.82×10^{21} chance of an individual being affected by the paved area use. All other quizalofop-p-ethyl uses presented risk quotients below the LOC of 0.05, indicating these uses are not expected to affect freshwater invertebrates on an acute basis.

Acute quizalofop-p-ethyl toxicity data for estuarine/marine invertebrates were available. Two uses exceeded the acute listed species LOC (0.05), but none exceeded the acute non-

listed species LOC (0.5). The first use, pineapple, is geographically restricted to Hawaii and Puerto Rico. The other use, paved areas, is nation-wide. The paved area scenario was modeled using the conservative assumption that 100 percent of the applied material is available for off-site transport. In reality, it is probably a much lower percentage. Quizalofop is being used as a spot treatment for weeds that are present in cracks within a paved area. It is unlikely that it would be applied over an entire acre of paved area. Table 27 presents the EECs and risk quotients that would be derived from less conservative scenarios. Given that a 25% offsite transport assumption (reasonably conservative assumption) results in risk quotients below the LOC, it is unlikely that quizalofop-p-ethyl applications to paved areas would result in adverse acute risks to estuarine/marine invertebrates. There is a 1 in 29,900 chance of an individual being affected by the pineapple use and a 1 in 24,800 chance of an individual being affected by the paved area use. All other quizalofop-p-ethyl uses presented risk quotients below the LOC of 0.05, indicating these uses are not expected to affect estuarine/marine invertebrates on an acute basis.

Acute toxicity data were available for estuarine/marine mollusks (Eastern oyster). The data were based on shell growth and were not the most sensitive endpoint (EC_{50} = 0.19 mg ai/L), thus risk quotients were not calculated. However, to refine the risk assessment, the oyster endpoint was considered to determine if mollusks could be removed from the pool of species potential at-risk from registered quizalofop uses. In particular, pineapple is the only use where risk quotients exceeded the LOC for acute exposures to freshwater and estuarine/marine invertebrates. The difference between the most sensitive EC_{50} (mysid shrimp = 0.15 mg ai/L) and the oyster EC_{50} is small and still results in risk quotients above the LOC for the pineapple use. The value is used as a surrogate for freshwater mollusks because data are not otherwise available. Consequently, freshwater and estuarine/marine mollusks may be adversely affected by the pineapple use on an acute basis.

As with plants, AgDrift (ver. 2.11) was used to determine a buffer distance at which quizalofop-p-ethyl residues from spray drift would be below the acute listed species LOC (0.05). The default inputs for ground applications (*i.e.*, high boom, ASAE droplet size distribution = Very Fine to Fine, 90th data percentile) and aerial applications (*i.e.*, ASAE Very Fine to Fine) were used. The results (0 ft buffers) indicated that spray drift is not the driving force for the scenarios that produced risk quotients that exceeded the LOC (Table 28).

Table 28. Buffer distances for freshwater and estuarine/marine invertebrate scenarios with risk quotients that exceeded the LOC

Use	Single application Rate (lb ai/A)	Initial Average Concentration (ng ai/L) at acute listed LOC (0.05). FW = 17500; E/M = 7500

		Freshwater Invert. Buffer (ft)	Estuarine/ Marine Invert. Buffer (ft)
Paved areas (ground)	0.108	0	0
Paved areas (aerial)	0.108	0	0
Pineapple (ground)	0.208	0	0
Pineapple (aerial)	0.208	0	0

Chronic Risk

Quizalofop-p-ethyl chronic toxicity data for freshwater invertebrates were available. Risk quotients were all quite low (< 0.001) and did not exceed the LOC of 1 for any registered quizalofop-p-ethyl uses.

Quizalofop-p-ethyl chronic toxicity data for estuarine/marine invertebrates were not available; thus, the acute-to-chronic ratio method was used to estimate a NOAEC. The risk quotients did not exceed the LOC (1) for any of the registered quizalofop-p-ethyl uses.

Aquatic Plants – Vascular and Non-vascular

Data were available for aquatic vascular and non-vascular plants. Risk quotients for both groups were below the LOC of 1. Thus adverse effects to listed species from registered quizalofop-p-ethyl uses are not expected to occur.

Summary of Risk from Direct Effects

A summary of the potential for risks to aquatic organisms is listed below:

- Risk is unlikely for acute exposures to freshwater fish, aquatic-phase amphibians, and estuarine/marine fish.
- Risk is unlikely for chronic exposures to freshwater invertebrates, estuarine/marine invertebrates, and estuarine/marine fish.
- There is the potential for acute risks for freshwater invertebrates for the pineapple (Hawaii and Puerto Rico) and the paved areas (nation-wide) uses.
- There is the potential for acute risks for estuarine/marine invertebrates for the pineapple (Hawaii and Puerto Rico) and paved areas (nation-wide) uses.
- There is the potential for chronic risks for freshwater fish for the pineapple (Hawaii and Puerto Rico) and paved areas (nation-wide) uses.

Listed Species Effects Analysis

The direct and indirect effects analysis for general taxa of listed species is summarized in Table 29, for quizalofop-p-ethyl uses. The analysis is based on the direct and indirect effects concluded from the analysis of risk estimates.

Table 29. Summary of indirect and direct effects to listed species and preliminary effects determination for quizalofop-p-ethyl uses

Listed species group	Direct Effect Assessment Endpoints	Direct Effects	Indirect Effects	Effects Determination
Non-vascular Aquatic Plant Species	Primary productivity	No Effect – risk quotients below LOC.	Direct effects to non-listed and listed terrestrial monocots may occur from quizalofop-p-ethyl spray drift or runoff. This could result in reduced growth of non-target plants and modify the structural habitat near aquatic environments. It could affect non-vascular plant habitat by changing the water temperature, dissolved oxygen levels, sedimentation, etc. Therefore, indirect effects to aquatic non-vascular plants from effects to terrestrial plants may occur. However, currently, there are no listed non-vascular aquatic plant species, therefore adverse effects to listed non-vascular plants are not expected.	No Effect
Vascular Aquatic Plant Species	Primary productivity assessed from effects on main stem length, total stem length (main + laterals), and fresh weight	No Effect – risk quotients below LOC.	Direct effects to non-listed and listed monocots terrestrial may occur from quizalofop-p-ethyl spray drift or runoff. This could result in reduced growth of non-target plants and modify the structural habitat near aquatic environments. It could affect vascular plant habitat by changing the water temperature, dissolved oxygen levels, sedimentation, etc. Therefore, indirect effects to aquatic vascular plants from effects to terrestrial plants may occur. May affect and likely affected based on indirect effects from direct effects on terrestrial monocots.	May Affect, Likely to Adversely Affect
Freshwater Fish and Amphibians	Acute mortality	No Effect – risk quotients below LOC.	Adverse direct effects may be expected to aquatic organisms [fish (chronic), invertebrates (acute), terrestrial monocots] as potential food sources. Direct effects to non-listed and listed terrestrial monocots may occur from quizalofop-p-ethyl spray drift or runoff. This could result in reduced growth of non-target plants and modify the structural habitat near aquatic environments. It could affect freshwater fish and amphibian habitat by	May Affect, Likely to Adversely Affect

Listed species group	Direct Effect Assessment Endpoints	Direct Effects	Indirect Effects	Effects Determination
	Chronic survival, growth and reproduction	May Affect, Likely to Adversely Effect- risk quotients above LOC.	changing the water temperature, dissolved oxygen levels, sedimentation, etc. Therefore, indirect effects to freshwater fish and amphibians from effects to terrestrial monocots may occur. Indirect effects to aquatic habitats from terrestrial monocots could indirectly affect aquatic organism availability as a food source for other organisms. This could adversely affect freshwater fish and amphibians by altering prey populations. The may affect, likely to adversely affect determination is based on direct chronic effects to freshwater fish and amphibians as well as indirect effects from direct effects on aquatic organisms (fish, invertebrates, terrestrial monocots), if the species is dependent on them as a food source, and from adverse effects on terrestrial monocots which may affect habitat and/or aquatic prey populations	
Freshwater Invertebrates	Acute mortality	May Affect, Likely to Adversely Affect – risk quotients above LOC.	Direct effects to non-listed and listed terrestrial monocots may occur from quizalofop-p-ethyl spray drift or runoff. It could result in reduced growth of non-target plants and modify the structural habitat near aquatic environments. This could affect freshwater invertebrate habitat by changing the water temperature, dissolved oxygen levels, sedimentation, etc. Therefore, indirect effects to freshwater invertebrates from effects to terrestrial monocots may occur. Indirect effects to aquatic habitats from terrestrial monocots could indirectly affect aquatic organism availability as a food source for other organisms. This could adversely affect freshwater invertebrates affected by changing prey populations. The may affect and likely to adversely affect determination is based on direct acute effects to freshwater invertebrates and indirect effects from direct effects on terrestrial monocots, which may affect habitat and and/or aquatic prey populations.	May Affect, Likely to Adversely Affect
	Chronic survival and reproduction	No Effect – risk quotients below LOC.		

Listed species group	Direct Effect Assessment Endpoints	Direct Effects	Indirect Effects	Effects Determination
Estuarine/ Marine Fish	Acute mortality	No Effect – risk quotients below LOC (based on surrogate data).	Direct effects to non-listed and listed terrestrial monocots may occur from quizalofop-p-ethyl spray drift or runoff. This could result in reduced growth of non-target plants and modify the structural habitat near aquatic environments. It could affect estuarine/marine fish habitat by changing the water temperature, dissolved oxygen levels, sedimentation, etc. Therefore, indirect effects to estuarine/marine fish from effects to terrestrial monocots may occur. Indirect effects to aquatic habitats from terrestrial monocots could indirectly affect aquatic organism availability as a food source for other organisms. This could adversely affect estuarine/marine fish by altering prey populations. Direct effects to estuarine/marine invertebrates on an acute basis could decrease the food supply for estuarine/marine fish. The may affect and likely to adversely affect determination is based on indirect effects from direct effects to terrestrial monocots and aquatic organisms, which may affect habitat and and/or aquatic prey populations.	May Affect, Likely to Adversely Affect
	Assessment of chronic growth and survival	No Effect – risk quotients below LOC.		
Estuarine/ Marine Invertebrates	Acute mortality	May Affect, Likely to Adversely Affect-risk quotients above LOC	Direct effects to non-listed and listed terrestrial monocots may occur from quizalofop-p-ethyl spray drift or runoff. This could result in reduced growth of non-target plants and modify the structural habitat near aquatic environments. It could affect estuarine/marine invertebrate habitat by	May Affect, Likely to Adversely Affect

Listed species group	Direct Effect Assessment Endpoints	Direct Effects	Indirect Effects	Effects Determination
	Assessment of chronic growth and reproductive effects	May Affect, Likely to Adversely Affect – risk quotients above LOC (based on acute-to-chronic ratio).	changing the water temperature, dissolved oxygen levels, sedimentation, etc. Therefore, indirect effects to estuarine/marine invertebrates from effects to terrestrial monocots may occur. Indirect effects to aquatic habitats from terrestrial plants could indirectly affect aquatic organism availability as a food source for other organisms. Thus, estuarine/marine invertebrates may be adversely affected by changes in prey populations. The may affect and likely to adversely affect determination is based on direct acute and chronic risks to estuarine/marine invertebrates and indirect effects from direct effects on terrestrial monocots, which may affect habitats and/or aquatic prey populations	
Non-target plants in terrestrial and semi-aquatic areas	Primary productivity assessed from effects on biomass as measured using survival and dry weight; incident data.	May Affect and Likely to Adversely Affect – Risk quotients above LOC for monocots	Direct chronic effects to mammals may adversely affect plants because some mammals act as seed dispersers and pollinators. A reduction in these services could affect plant reproduction and establishment. The may affect and likely to adversely affect determination is based on direct risks to terrestrial monocots and indirect effects from direct effects to mammals (chronic), which may act as pollinators and seed dispersers.	May Affect, Likely to Adversely Affect
Birds, Reptiles, and Land-Phase	Acute mortality	No Effect – EECs below LOC.	Direct effects to non-listed and listed terrestrial monocots may occur from quizalofop-p-ethyl spray drift or runoff. This could result in reduced growth of non-target plants and modify the structural habitat. Resources for nests,	May Affect, Likely to Adversely Affect

Listed species group	Direct Effect Assessment Endpoints	Direct Effects	Indirect Effects	Effects Determination
Amphibians	Chronic reproduction	No Effect – risk quotients below LOC.	food, or camouflage may be diminished. Therefore, indirect effects to birds, reptiles, and land-phase amphibians from effects to terrestrial monocots may occur. Direct chronic effects to mammals may reduce prey availability for birds, reptiles, and land-phase amphibians. These mammals may also provide habitat by modifying the environment (e.g., building a burrow that is later used by a reptile). Aquatic food sources may also be affected because of direct effects to aquatic invertebrates (acute), and freshwater fish (chronic). This may decrease food availability for those birds, reptiles, and land-phase amphibians that rely on aquatic organisms. The may affect and likely adversely affect determination is based on indirect effects from direct effects to terrestrial monocots, mammals (chronic), aquatic invertebrates (acute), and freshwater fish (chronic).	
Mammals	Acute mortality	No Effect – risk quotients below LOC.	Direct effects to non-listed and listed terrestrial monocots may occur from quizalofop-p-ethyl spray drift or runoff. This could result in reduced growth of non-target plants and modify the structural habitat. Resources for nests, food, or camouflage may be diminished. Therefore, indirect effects to mammals from effects to terrestrial monocots may occur. Aquatic food sources may also be affected because of direct effects to aquatic invertebrates (acute), and freshwater fish (chronic). This may decrease food availability for those mammals that rely on aquatic organisms. The may affect and likely to adversely affect determination is based on indirect effects from direct effects to terrestrial monocots, aquatic invertebrates (acute), and freshwater fish (chronic).	May Affect, Likely to Adversely Affect
	Chronic Reproduction	May Affect, Likely to Adversely Affect – risk quotients above LOC.		

Listed species group	Direct Effect Assessment Endpoints	Direct Effects	Indirect Effects	Effects Determination
Terrestrial Insects	Acute mortality based on contact	No Effect – EECs below LOC.	Direct effects to non-listed and listed terrestrial monocots may occur from quizalofop-p-ethyl spray drift and runoff exposure; therefore, indirect effects could occur from an alteration in habitat in which a species relies on for forage, shelter, and/or reproduction needs. The may affect and likely to adversely affect determination is based on indirect effects from direct effects to terrestrial monocots.	May Affect, Likely to Adversely Affect

ACTION AREA

In the case of a nation-wide risk assessment conducted under registration review, the action area will encompass the entire U.S. and its territories. The purpose of defining the action area as the entire U.S. and its territories is to ensure that the initial area of consideration encompasses all areas where the pesticide may be used now and in the future, including the potential for off-site transport via spray drift and downstream dilution. Additionally, the concept of a nation-wide action area takes into account the potential for direct and indirect effects and any potential modification to critical habitat based on ecological effect measures associated with reduction in survival, growth, and reproduction, as well as the full suite of sub-lethal effects available in the effects literature.

It is important to note that the nationwide action area does not imply that direct and/or indirect effects and critical habitat modification are expected to or are likely to occur over the full extent of the action area, but rather to identify all listed species and critical habitat that may potentially be affected by the action. The Agency will use more rigorous analysis including consideration of available land cover data, toxicity data, and exposure information to determine areas where individual listed species and designated critical habitat may be affected or modified via endpoints associated with reduced survival, growth, or reproduction.

EFFECTS AREA DETERMINATION

The potential for direct and/or indirect effects is possible to listed species from exposure to quizalofop-p-ethyl.

Direct Effects

There are potential direct effects to listed species for the following taxa:

- Mammals (based on chronic risk quotients exceeding the LOC)
- Terrestrial Monocots (based on risk quotients exceeding the LOC)
- Freshwater Fish (based on chronic risk quotients exceeding the LOC)
- Freshwater Invertebrates (based on acute risk quotients exceeding the LOC)
- Estuarine/Marine Invertebrates (based on acute risk quotients exceeding the LOC)

Indirect Effects

As there are potential direct effects to mammals, terrestrial monocots, freshwater fish, freshwater invertebrates, and estuarine/marine invertebrates, indirect effects could occur to other taxa.

- Indirect effects to listed fish, aquatic invertebrates, amphibians, reptiles, and other terrestrial organisms (*e.g.* birds, mammals and other invertebrates) that are dependent on aquatic invertebrates and plants for food.
- Indirect effects to terrestrial plants for which terrestrial animals (*e.g.* birds and mammals) are needed for reproduction (*e.g.* pollination, seed dispersal) as there may be a potential change in terrestrial animal communities/populations.
- Indirect effects to a listed species that is dependent on a mammal, freshwater fish, or aquatic invertebrate.
- Indirect effects to listed species that are dependent on a monocot in terrestrial or semi-aquatic areas during some phase of their life-cycle for things such as food, shelter, and reproductive habitats.

The following table shows the potential taxa indirectly affected by direct effects (Table 30)

Table 30. Organism groups that are potentially indirectly affected by direct effects to other organisms (specific to quizalofop-p-ethyl uses)

Taxon Directly Affected	Taxon Indirectly Affected	Reason for Indirect Effect
Mammals	Reptiles, Birds, Plants, Amphibians	Change in prey population (food source); Reduction in potential pollinators/seed dispersers
Aquatic Invertebrates	Fish, Reptiles, Amphibians, Plants, Mammals	Change in prey population (food source)
Fish	Reptiles, Fish, Amphibians, Mammals, Birds	Change in prey population (food source)
Terrestrial Monocots	All taxa (birds, mammals, reptiles, amphibians, fish, aquatic and terrestrial invertebrates)	Change in food sources; change in habitats

Based on this screening-level assessment, there are potential risks of direct effects to listed mammals, monocots, freshwater invertebrates, estuarine/marine invertebrates, and freshwater fish and non-listed monocots, mammals, and freshwater fish from the use of quizalofop-p-ethyl on some of its registered use sites. Listed species of all taxa may also be affected through indirect effects because of the potential direct effects on listed and non-listed species. Potential direct effects on listed mammals, monocots, freshwater invertebrates, estuarine/marine invertebrates, and freshwater fish and non-listed monocots, mammals, and freshwater fish from the use of quizalofop-p-ethyl may be associated with modification of primary constituent elements of designated critical habitats, where such designations have been made. However, at this current stage of the Registration Review process, it is

premature to make effects determinations for listed species until further refinements are conducted. To make effects determinations for individual species, useful refinements may include analyses of 1) more detailed, species-specific ecological and biological data; 2) more detailed and accurate information on quizalofop-p-ethyl use patterns; and 3) sub-county level spatial proximity data for the co-occurrence of potential effects areas and listed species and any designated critical habitat. Examples of such refinements are described below.

EFED is currently developing tools that are expected to further refine the assessment and are designed to support effects determinations for individual federally listed species and their designated critical habitats (where applicable). Scientific information obtained from the U.S. Fish & Wildlife Service (USFWS), the National Marine Fisheries Service (NMFS), and other reliable sources is being collated by EFED to address all currently listed species. The information will be stored in an Office of Pesticide Programs Pesticide Registration Information SysteM (PRISM) knowledgebase. The listed species knowledgebase will consist of an information repository that houses biological and behavioral information relevant to individual species (*e.g.*, habitat, diet, and life history, including specific temporal and spatial associations) and a document repository that contains supporting documents (*e.g.*, USFWS recovery plans) and electronic information (*e.g.*, GIS data files). For terrestrial taxa, the biological information relevant to risk quotient (RQ) calculations (*e.g.*, diet and body weight) will be used to parameterize exposure estimates to derive species-specific RQs using a method consistent with currently used methods in the T-REX and T-HERPS models.

Refinements may also include more detailed analyses of the registered uses and their use patterns that result in LOC exceedances for federally listed species in the screening-level assessment. The analyses may include more information on where, when, and how quizalofop-p-ethyl is used on all use sites. Actual usage data (when available) and national land-cover datasets that indicate potential use sites [*e.g.*, national land cover dataset (NLCD), crop data layer (CDL)] may be used to support a more refined analysis of where quizalofop-p-ethyl is reasonably expected to be used. Similarly, refinements for the timing of applications and how quizalofop-p-ethyl is used may be based on the analysis of additional usage data, beyond what were available at the time of the screening-level assessment, and a more in-depth exploration of agronomic practices.

In addition, a committee of the National Research Council (NRC) has been tasked with providing advice on ecological risk assessment tools and scientific approaches under ESA and FIFRA (Project Identification Number DELS-BEST-11-01). The committee has been asked to review the use of "best available data;" methods for evaluating sublethal, indirect, and cumulative effects; the state of the science regarding assessment of mixtures and pesticide inert ingredients; the development, application, and interpretation of results from predictive models; uncertainty factors; and what constitutes authoritative geospatial and temporal information for the assessment of individual species and habitat effects. The Agency anticipates that this NRC report, tentatively expected in Spring 2013, will provide recommendations to ensure the scientific soundness and maximize the utility of risk assessment refinements for listed species.

The refinements based on individual species data; additional, detailed usage information, when available; and further recommendations from the NRC report are expected to help to more accurately identify potential areas of effect and to better inform effects and habitat determinations for listed species and any designated critical habitats. For example, if quizalofop-p-ethyl is used when a particular species of concern is not present (*e.g.*, it is migratory) or is not co-located in space, then risk of potential direct effects to the species may often be precluded. If LOCs are still exceeded for monocots, mammals, freshwater invertebrates, estuarine/marine invertebrates, and freshwater fish after conducting the refined analyses, further analyses of the potential spatial and temporal co-occurrence of listed species of concern (and any designated critical habitat) may be conducted. The extent of possible refinement in the analyses of spatial/temporal co-occurrence will largely depend on the scale and quality of the available sub-county level use site (*e.g.*, NLCD, CDL) and species location data.

The Agency has made several refinements to the list of endangered and threatened species that may be affected by quizalofop-p-ethyl uses. To date, there are 1442 listed species identified in the LOCATES database (v. 2.2.4, derived from USFWS and NMFS). For 1295 of these, a "no effect" determination for direct and indirect effects can be made based on a lack of geographical overlap, based on a county level of resolution, between the species and quizalofop-p-ethyl uses (Appendix J, Table J-1). A further 26 species can be eliminated from consideration of direct effects (i.e., "no effects") based on species specific ecological and biological information from listed species trustee agencies (Appendix J, Table J-2). The remaining 121 species will need to be considered in more depth before effects calls are made (Appendix J, Table J-3). The biological, geographical, and use pattern information outlined above will be necessary to refine the assessment.

Uncertainties

A description of assumptions, uncertainties, strengths, and limitations of the basic risk assessment performed is described in Chapter 6 of the Agency's Overview Document (EPA, 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. This Chapter discusses additional uncertainties associated with refinements made to the basic risk assessment.

Effects and Risk Assessment Uncertainties

Ecotoxicity Data Gaps

There were several ecotoxicity endpoints for which data were not available or available data were non-definitive.

- Estuarine/Marine Fish (Acute) OPPTS 850.1075. In the Problem Formulation, data were not requested because a registrant study had recently been submitted for this endpoint. A detailed review of the study at a later date indicated that it was "invalid" and thus not useable for risk assessments. To fill this data gap, freshwater and estuarine/marine acute fish toxicity studies for two structurally similar chemicals (fenoxaprop-p-ethyl and fenoxaprop-ethyl) were reviewed. The fenoxaprop-ethyl data indicated that freshwater fish are more sensitive than estuarine/marine fish. A comparison of quizalofop-p-ethyl acute freshwater fish data to fenoxaprop-ethyl indicated that quizalofop-p-ethyl is more toxic than fenoxaprop-ethyl. Thus it was determined that acute freshwater fish data from quizalofop-p-ethyl would be a protective surrogate for the missing estuarine/marine data.
- Estuarine/Marine Invertebrate (Chronic) OPPTS 850.1350. In the Problem Formulation, data were not requested because it was possible to calculate an acute-to-chronic ratio using freshwater invertebrates (waterflea) as a surrogate.
- Freshwater Fish (Chronic) OPPTS 850.1400. Chronic data are available for the fathead minnow; however, the most sensitive acute freshwater fish endpoint is for the rainbow trout. Acute toxicity information is not available for the fathead minnow. To ensure that the most sensitive chronic endpoint for freshwater fish was employed in the risk assessment, the acute to chronic ratio methodology was applied. An acute-chronic pair of data was available for the fathead minnow for fenoxaprop-p-ethyl, a structurally similar chemical to quizalofop-p-ethyl. The ratio between the fenoxaprop-p-ethyl fathead minnow endpoints was applied to the quizalofop-p-ethyl acute freshwater fish endpoint to derive a protective freshwater fish chronic endpoint.
- Avian (Acute) (L_{D50}) OPPTS 850.2100. Definitive data were not available for either the LD_{50} or NOEL. EECs, based on the highest application rate, were less than one

tenth of the LD_{50} (>2000 mg ai/kg-bw), indicating that more refined, definitive data were not necessary for this assessment.

- Passerine Birds (Acute) (LD_{50}) OPPTS 850.2100. Data were not available. At the time the Problem Formulation was written, passerine bird data were not required. In lieu of this endpoint, the acute oral toxicity of quizalofop-p-ethyl to the mallard duck and common quail was used to evaluate risk.
- Avian (Chronic) (NOAEC) OPPTS 850.2300. The mallard duck study presented a non-definitive (less than) NOAEC. Given that the NOAEC was a "less than" value it presents uncertainty as to the true NOAEC and cannot be used in the risk assessment to calculate risk quotients. Mallard duck data from two structurally similar chemicals (fenoxaprop-p-ethyl and fenoxaprop-ethyl) were considered as potential surrogates for the toxicity data. Fenoxaprop-ethyl yielded a NOAEC (180 mg ai/kg-diet) that was below the quizalofop-p-ethyl value (< 296 mg ai/kg-diet). Given the similarity between fenoxaprop and quizalofop, it was decided that the fenoxaprop-ethyl mallard duck NOAEC could be used in place of the non-definitive quizalofop-p-ethyl value.
- Aquatic Non-Vascular Plants (E_{C50}) OPPTS 850.5400. Three of the four Tier 2 studies for non-vascular plants were non-definitive (greater than); these were also the most sensitive toxicity values. To justify the use of a less sensitive endpoint, non-vascular studies from two structurally similar chemicals (fenoxaprop-p-ethyl and fenoxaprop-ethyl) were considered. These chemicals showed a similar trend – non-definitive toxicity values for the more toxic endpoints and definitive numbers at higher values. In addition, the fenoxaprop toxicity values were within the same order of magnitude as the quizalofop values. Thus, it was determined that using the definitive quizalofop-p-ethyl toxicity value was a reasonable approach, given that the lower toxicity values were all "greater than" values.

Application Rates

Several labels did not include the seasonal maximum application rate for quizalofop-p-ethyl. In these cases, seasonal maximum application rates were assumed based on other information from the label or similar application patterns for uses that did contain the complete information. The Biological and Economic Division (BEAD) of OPP was consulted and they concurred with the assumptions. The following scenarios were affected:

- Non-crop areas (uncultivated areas, fence rows, roadsides, equipment storage areas, and other similar areas) – seasonal maximum application rate assumed to be equivalent to twice the single maximum application rate
- Paved areas (private roads/sidewalks) – seasonal maximum application rate assumed to be equivalent to single maximum application rate
- Hybrid cottonwood/poplar plantations – seasonal maximum application rate assumed to be equivalent to two applications at the single maximum application rate

Fate Data Gaps

Little data are available for the degradates of concern. Potentially, degradate fate data could be estimated from parent studies. However, the resulting estimates might be highly uncertain. The 3-OH-quizalofop acid degradate was only found in more recent studies. Potentially, this degradate of concern is unaccounted for in the TTR calculated from older fate studies and therefore represents an additional source of uncertainty.

Additionally, the parent fish bioconcentration study was not performed under conditions that did not allow the fish to be continuously exposed to the parent compound. The highest BCF was seen in viscera in the first few days of the study, presumably when the parent had not yet degraded. As the test progressed, the BCFs declined.

Incomplete Life Histories of Listed Species

Currently, a database of life histories for each of the listed animals and plants is not available for use by EFED. These life histories would include information such as body size at each life stage, food sources, relationships with other taxa, habitat, and reproductive habits. As such, conservative (protective) assumptions were made concerning the potential relationships between species in that each species was assumed to have a relationship with the other taxa. This is assumed to be an overestimation of the actual species that have a species dependant relationship.

Locations of Listed Species

In addition, the specific occurrences of listed species are not known in some cases beyond the county-level. If the location of a species was not known in greater detail than the county level, the species was assumed to occur anywhere within that county at any time. Likewise, crop location data are also uncertain. Crops may rotate every year and some spatial datasets combine several crop types, making it impossible to distinguish one crop from another. Further, timing may play a role in the location of species and whether it overlaps with the time that a particular crop is in a field. These assumptions may lead to an overestimation of co-occurrence with quizalofop-p-ethyl exposure and overestimation of the number of species potentially at risk.

Other Routes of Exposure

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

Incidental soil ingestion exposure - This risk assessment does not consider incidental soil ingestion. Available data suggest that up to 15% of the diet can consist of incidentally ingested soil depending on the species and feeding strategy (Beyer *et al.*, 1994). This route

of exposure may be important for applications of quizalofop-p-ethyl for spray applications, especially before crops are planted.

Dermal Exposure - The screening assessment does not consider dermal exposure, except as it is indirectly included in calculations of risk quotient's based on lethal doses per unit of pesticide treated area. Dermal exposure may occur through three potential sources: (1) direct application of spray to terrestrial wildlife in the treated area or within the drift footprint, (2) incidental contact with contaminated vegetation, or (3) contact with contaminated water or soil. As foliar applications are primary application routes on the registered labels for quizalofop-p-ethyl, dermal contact with quizalofop-p-ethyl to non-target animals may occur.

Foliar Dissipation Half-life

An additional source of uncertainty is the foliar dissipation half-life, which is useful for spray applications to foliage. No half-life data were provided, thus a default of 35 days was used. It is not known if this half-life over or under-estimates the true half-life for quizalofop-p-ethyl.

Species Sensitivity

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

The Agency is not limited to a base set of surrogate toxicity information in establishing risk assessment conclusions. The Agency also considers toxicity data on non-standard test species when available.

Endocrine Disruptor Screening Program (EDSP)

As required by FIFRA and 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 cycling, 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. As part of its recent registration on

herbicide-tolerant corn and sorghum, EPA reviewed these data and selected the most sensitive endpoints for relevant risk assessment scenarios from the existing hazard database. However, as required by FFDCA section 408(p), quizalofop-p-ethyl 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. 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. Quizalofop-p-ethyl is not among the group of 58 pesticide active ingredients on the initial list to be screened under the EDSP. Accordingly, as part of registration review, EPA will issue future EDSP orders/data call-ins, requiring the submission of EDSP screening assays for quizalofop-p-ethyl. For further information on the status of the EDSP, the policies and procedures, the list of 67 chemicals, future lists, the test guidelines and the Tier 1 screening battery, please visit our website: http://www.epa.gov/endo/.

Spatial Analysis

Data are not available for the percent of cropped areas and changes in crops (e.g., crop rotation or permanent shifts) over time. This remains an uncertainty, particularly for the proximity analysis for listed species. Additionally, future expansions in the use of quizalofop-p-ethyl are not considered. For example, many labels have geographical restrictions (e.g., ryegrass grown for seed in Minnesota). Likewise, expansions to other crops (e.g., expansion to use on herbicide-tolerant field corn; current label only allows herbicide-tolerant field corn grown for seed). As labels change and uses are expanded, the result may be a larger geographical area in which quizalofop-p-ethyl can be used.

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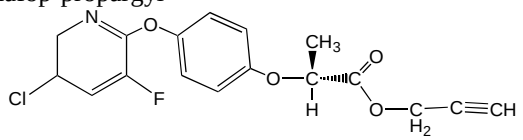
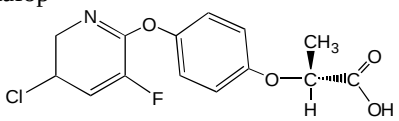
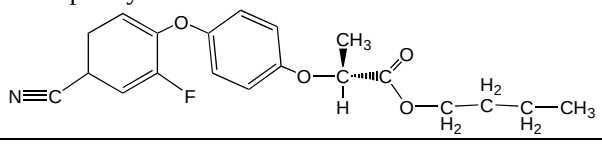
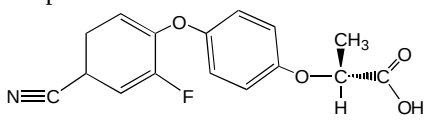
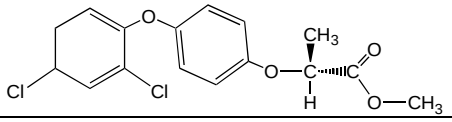
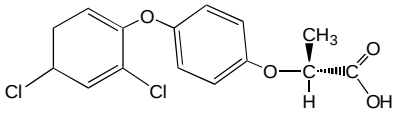
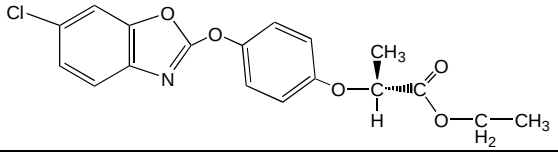
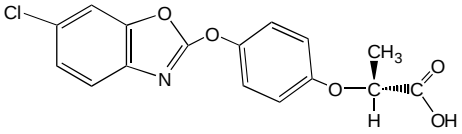
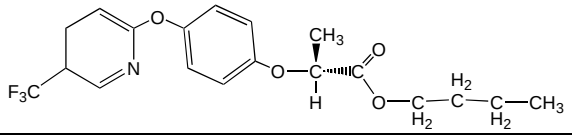
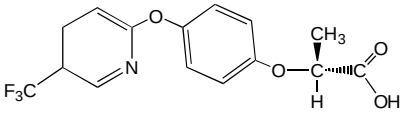
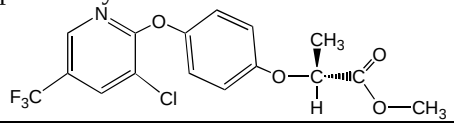
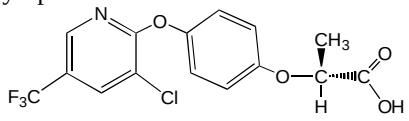
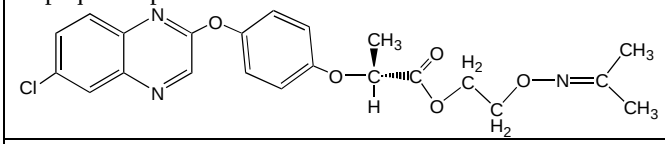
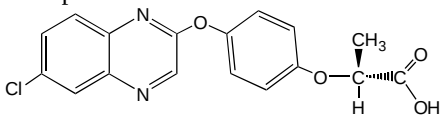
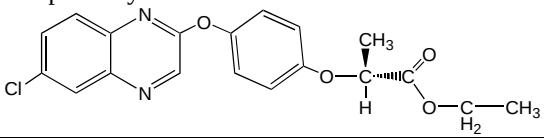
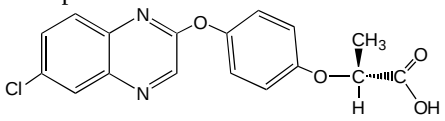
Appendix B – Aryloxyphenoxypropionate Chemical Family ("FOPs")

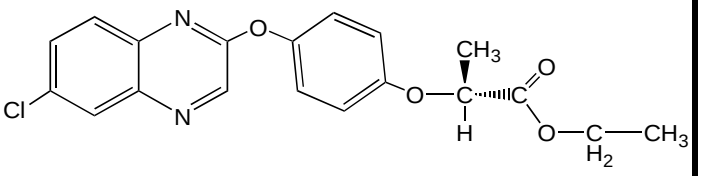
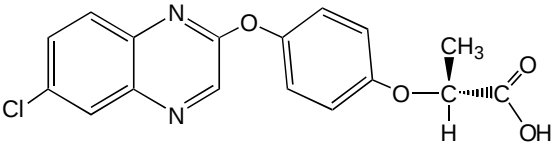
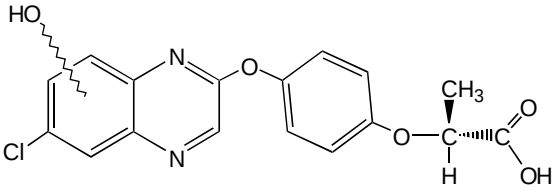
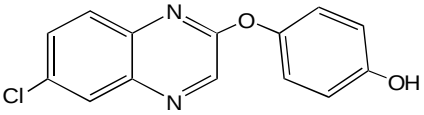
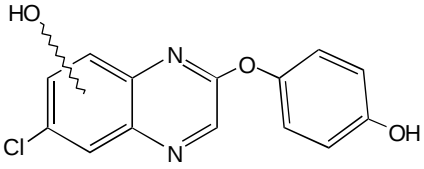
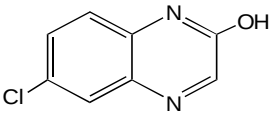
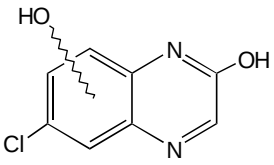
Table B-1. Structures of the Aryloxyphenoxypropionate Chemical Family parents and corresponding primary degradate, which is the active ingredient.

Parent	Primary Degradate (Active Ingredient)
Clodinafop-propargyl 	Clodinafop 
Cyhalofop-butyl 	Cyhalofop 
Diclofop-methyl 	Diclofop 
Fenoxaprop-P-ethyl 	Fenoxaprop-P 
Fluazifop-P-butyl 	Fluazifop-P 
Haloxyfop-R-methyl 	Haloxyfop-R 
Propaquizafop 	Quizalofop 
Quizalofop-P-ethyl 	Quizalofop 

Based on pesticides included as aryloxyphenoxypropionate herbicides (http://pested.okstate.edu/pdf/herbicide%20moa.pdf).

Appendix C – Chemical Structures and Maximum Degradate Formation

Table C-1. Chemical Names and Structures of Quizalofop-P-Ethyl and its Degradates

Chemical Name	Structure
Quizalofop-p-ethyl IUPAC name: ethyl (*R*)-2-[4-(6-chloroquinoxalin-2-yloxy)phenoxy]propionate CAS name: ethyl (2R)-2-[4-[(6-chloro-2-quinoxalinyl)oxy]phenoxy]propanoate	
Quizalofop acid IUPAC name: (*RS*)-2-[4-(6-chloroquinoxalin-2-yloxy)phenoxy]propionic acid CAS name: 2-[4-[(6-chloro-2-quinoxalinyl)oxy]phenoxy]propanoic acid	
3-OH-quizalofop acid CAS name: (*R*)-2-[4-(6-chloro-3-hydroxyquinoxalin-2-yloxy)phenoxy]propionic acid	
Phenol 1	
Hydroxylated Phenol 1	
Phenol 2	
Hydroxy phenol 2 CAS name: 6-chloroquinoxaline-2,3-diol	

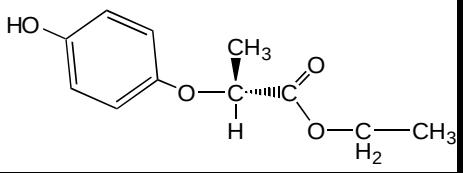
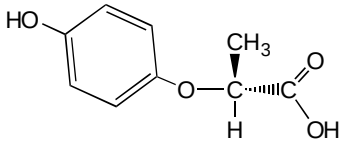
Chemical Name	Structure
Phenol 3	
Phenol 4	

Table C-2. Maximum Reported Amounts of Quizalofop-p-ethyl Degradation Products.

Degradate	Maximum % of Applied (µg/L or µg/kg in Field Studies)	Study Type	MRID
Quizalofop acid	*Laboratory studies*		
	~100%	Hydrolysis	00131583
	4.1% (28 d)	Aqueous photolysis	00146693
	7.2% (15 d)	Soil photolysis	40336002
	78.3% (2 d)	Aerobic soil metabolism	00146695
	62.6% (15 d)	Aerobic soil metabolism	43235603
	80.2% (2 d)	Anaerobic soil metabolism	00146697
	51% of residues in viscera	Fish bioaccumulation	00131583
	Terrestrial field dissipation studies		
	79.7 ng/g	Southern France Soil	474084146
3-OH-quizalofop acid	*Laboratory studies*		
	20.8% (60 d)	Aerobic soil metabolism	43235603
	Terrestrial field dissipation studies		
	5.4 ng/g	United Kingdom Soil	474084146
Phenol 1	*Laboratory studies*		
	5.1% (28 d)	Aqueous photolysis	00146693
	6.1% (24 d)	Aerobic soil metabolism	00146695
	2.3% (30 d)	Aerobic soil metabolism	43235603
	9.5% (52 d)	Anaerobic soil metabolism	00146697
Phenol 2	*Laboratory studies*		
	2.7% (22 d)	Aqueous photolysis	00146693
	5.0% (60 d)	Aerobic soil metabolism	43235603
	13.2% (6 d)	Anaerobic soil metabolism	00146697
Hydroxy phenol 2	*Laboratory studies*		
	11.2% (91 d)	Aerobic soil metabolism	43235603
	25.4% (52 d)	Anaerobic soil metabolism	00146697
Phenol 3	*Laboratory studies*		
	2.0% (53 d)	Aerobic soil metabolism	00146695
Phenol 4	*Laboratory studies*		
	31.1% (5 d)	Aerobic soil metabolism	00146695
Unextracted Residue	*Laboratory studies*		
	29.9% (53 d)	Aerobic soil metabolism	00146695
	26.6% (91 d)	Aerobic soil metabolism	43235603
	34.0% (30 d)	Anaerobic soil metabolism	00146697
Carbon Dioxide	*Laboratory studies*		
	22.3% (32 d)	Soil photolysis	40336002
	41.1% (53 d)	Aerobic soil metabolism	00146695
	8.3% (91 d)	Aerobic soil metabolism	43235603

d = days; m = months

Appendix D – ECOTOX Literature Search

Papers That Were Accepted

Ahemad, M. and Khan, M. S. Toxicity Assessment of Herbicides Quizalafop-p-Ethyl and Clodinafop Towards Rhizobium Pea Symbiosis. BCM,GRO,REPSOIL,ENV; 2009; 82, (6): 761-766.
Notes: EcoReference No.: 150237
Chemical of Concern: QZFPE

Rejected because units were not convertable to lb ai/A.

De, R. K.; Mandal, R. K.; Sarkar, S., and Ghorai, A. K. Non-Target Effect of Herbicides on Macrophomina phaseolina Causing Stem Rot of Jute. POPENV; 2007; 25S, (2): 475-478.
Notes: EcoReference No.: 100606
Chemical of Concern: QZFE,TFN

Rejected because the units are not convertable to lb ai/A

Dear, B. S.; Sandral, G. A., and Wilson, B. C. D. Tolerance of Perennial Pasture Grass Seedlings to Pre- and Post-Emergent Grass Herbicides. GRO,PHYSOIL,ENV; 2006; 46, (5): 637-644.
Notes: EcoReference No.: 86670
Chemical of Concern: ATZ,CLT,CSF,CZE,DFPM,FNPPE,FZFB,MBZ,PDM,PZM,QZFE,SXD,SZ,TFN,TKY,TRL,TSF

Rejected because the units are not convertible to lb ai/A

Eleftherohorinos, I. G. and Dhima, K. V. Red Rice (Oryza sativa) Control in Rice (O. sativa) with Preemergence and Postemergence Herbicides. POPAQUA; 2002; 16, (3): 537-540.
Notes: EcoReference No.: 95840
Chemical of Concern: ACO,ACR,DMM,GFS,GYP,MTL,PQT,QZFE

Rejected because the test duration was too long.

Hall, L. M.; Moss, S. R., and Powles, S. B. Mechanisms of Resistance to Aryloxyphenoxypropionate Herbicides in Two Resistant Biotypes of Alopecurus myosuroides (Blackgrass): Herbicide Metabolism as a Cross-Resistance Mechanism. GROSOIL,ENV; 1997; 57, (2): 87-98.
Notes: EcoReference No.: 108307
Chemical of Concern: DFPM,FNPE,QZFE,SXD,TKY

Rejected because an EC_{25} endpoint was needed

Heap, I. M. and Morrison, I. N. Resistance to Aryloxyphenoxypropionate and Cyclohexanedione Herbicides in Green Foxtail (Setaria viridis). GRO,POPSOIL,ENV,MIXTURE; 1996; 44, (1): 25-30.
Notes: EcoReference No.: 120407
Chemical of Concern: CLFP,CLT,CTL,DFPM,EFL,FNPPE,QZFE,SXD,TKY

Rejected because an EC_{25} endpoint was needed

Kuk, Y. I.; Wu, J.; Derr, J. F., and Hatzios, K. K. Mechanism of Fenoxaprop Resistance in an Accession of Smooth Crabgrass (Digitaria ischaemum). ACC,BCM,GROSOIL,ENV; 1999; 64, (2): 112-123.
Notes: EcoReference No.: 109535
Chemical of Concern: FNPE,FNPPE,QZFPE,SXD

Rejected because the endpoint was not an EC_{25}

Matthews, N.; Powles, S. B., and Preston, C. Mechanisms of Resistance to Acetyl-Coenzyme A Carboxylase-Inhibiting Herbicides in a Hordeum leporinum Population. ACC,BCM,MORSOIL,ENV; 2000; 56, 441-447.
Notes: EcoReference No.: 63953
Chemical of Concern: CLT,DFP,FZFB,QZFPE,SXD,TKY

Rejected because the endpoint was not an EC_{25}

Pannacci, E.; Graziani, F., and Covarelli, G. Use of Herbicide Mixtures for Pre and Post-Emergence Weed Control in Sunflower (Helianthus annuus). PHY,POPSOIL,ENV,MIXTURE; 2007; 26, (8): 1150-1157.
Notes: EcoReference No.: 101888
Chemical of Concern: FFC,LNR,MTC,OXF,PDM,QZFPE

Rejected because it was not the lowest endpoint

Rea, B. L.; Mayes, A. J., and Marshall, J. FBC 32197 for Annual and Perennial Grass Weed Control in Oilseed Rape. POPSOIL,ENV,MIXTURE; 1984; 6, 191-198.
Notes: EcoReference No.: 31475
Chemical of Concern: CPR,FZFB,QZFE

Rejected because the test duration was too long

Sakata, G.; Makino, K.; Kusano, K.; Satow, J.; Ikai, T., and Suzuki, K. Preparation of Optically Pure Ethyl (R)-(+) and (S)-(-)-2-(4-(6-Chloro-2-Quinoxalinyloxy)Phenoxy]Propanoate by Resolution Method and Their Herbicidal Activities. GROSOIL,ENV; 1985; 10, 75-79.
Notes: EcoReference No.: 100574
Chemical of Concern: QZFE,QZFPE

Rejected because the units were not convertible to lb ai/A

Sakata, G.; Makino, K.; Morimoto, K.; Ikai, T., and Hasebe, S. Synthesis and Herbicidal Activity of Optically Active Ethyl 2-[4-(6-Chloro-2-Quinoxalinyloxy)Phenoxy]Propanoate. GROSOIL,ENV; 1985; 10, (1): 69-73.
Notes: EcoReference No.: 100572
Chemical of Concern: QZFE,QZFPE

Rejected because the units were not convertible to lb ai/A

Soltani, N.; Robinson, D. E.; Shropshire, C., and Sikkema, P. H. Adzuki Bean (Vigna angularis) Responses to Post-Emergence Herbicides. BCM,GRO,PHY,POPSOIL,ENV,MIXTURE; 2006; 25, (6): 613-617.
Notes: EcoReference No.: 100593
Chemical of Concern: BT,FSF,IZX,QZFPE,SXD

Rejected because there was already a lower endpoint

Zhang, X.; Wang, S.; Wang, Y.; Xia, T.; Chen, J., and Cai, X. Differential Enantioselectivity of Quizalofop Ethyl and Its Acidic Metabolite: Direct Enantiomeric Separation and Assessment of Multiple Toxicological Endpoints. PHY,POPAQUA; 2011; 186, (1): 876-882.
Notes: EcoReference No.: 154896
Chemical of Concern: QZFE,QZFPE

Rejected because it was not the lowest endpoint

Papers That Were Not Accepted

Accepted for EcoTox but not OPP

De Prado, R. ; Gonzalez-Gutierrez, J.; Menendez, J.; Gasquez, J.; Gronwald, J. W., and Gimenez-Espinosa, R. Resistance to Acetyl CoA Carboxylase-Inhibiting Herbicides in Lolium multiflorum, ACC,MOR: SOIL,ENV,TOP; 2000UR
ECOTOX,EFED,P.
Notes: EcoReference No.: 59397
Chemical of Concern: CLT,DFPM,HFPM,QZFE,SXD

Hanin, O.; Rubin, B.; Applebaum, S. W., and Rafaeli, A. Structure-Activity Relationships of Pheromonostasis Induced by ACCase-Inhibitor Herbicides in the Moth Helicoverpa armigera, MOR: ORAL; 2008UR
ECOTOX,EFED,INSECT.
Notes: EcoReference No.: 154892
Chemical of Concern: DFP,DFPM,QZFE,TKY

Hautier, L.; Jansen, J. P.; Mabon, N., and Schiffers, B. Selectivity Lists of Pesticides to Beneficial Arthropods for IPM Programs in Carrot - First Results, MOR,POP: ENV,MIXTURE; 2005TV [Okapi]
ECOTOX,EFED,BEES,INSECT.
Notes: EcoReference No.: 104765
Chemical of Concern: AZX,CMZ,CPP,DFC,DM,DMT,FZFB,IPD,LCYT,LNR,MYC,PIM,PQT,PRIG,QZFPE,SFR,TEZ

Hidayat, I. and Preston, C. Enhanced Metabolism of Fluazifop Acid in a Biotype of Digitaria sanguinalis Resistant to the Herbicide Fluazifop-P-Butyl, ACC,BCM,MOR.
cpreston@walte.adelaide.edu.au//C. Preston, CRC for Weed Management Systems, Department of Crop Protection, University of Adelaide, Glen Osmond, SA 5064, Australia//: SOIL,ENV,MIXTURE,TOP; 1997UR
ECOTOX,EFED,P.
Notes: EcoReference No.: 64594
Chemical of Concern: CLT,FZFB,HFPM,MLN,PPB,QZFPE,SXD,TKY

Kawahigashi, H.; Hirose, S.; Inui, H.; Ohkawa, H., and Ohkawa, Y. Enhanced Herbicide Cross-Tolerance in Transgenic Rice Plants Co-Expressing Human CYP1A1, CYP2B6, and CYP2C19, CEL,GRO,REP: SOIL,ENV,MIXTURE; 2005UR
ECOTOX,EFED,P.
Notes: EcoReference No.: 115263
Chemical of Concern: ACO,MTL,NFZ,QZFE

Kawahigashi, H.; Hirose, S.; Ohkawa, H., and Ohkawa, Y. Transgenic Rice Plants Expressing Human CYP1A1 Exude Herbicide Metabolites from Their Roots, REP: SOIL,ENV; 2003UR
ECOTOX,EFED,P.
Notes: EcoReference No.: 101467
Chemical of Concern: ATZ,NFZ,QZFE

Kawahigashi, H.; Hirose, S.; Ohkawa, H., and Ohkawa, Y. Evaluation of Herbicide Metabolism in Transgenic Rice Plants Expressing CYP1A1 and CYP2B6, ACC: SOIL,ENV; 2005UR
ECOTOX,EFED,P.
Notes: EcoReference No.: 101418
Chemical of Concern: ACO,ACR,CPP,Kusanagi, T. Herbicides: Upland Crops, NOC:

SOIL,ENV,MIXTURE; 1985UR
ECOTOX,EFED,P.
Notes: EcoReference No.: 117867
Chemical of Concern: ACR,BT,DU,FSF,LNR,MTL,ODZ,PMT,QZFE,TRB
DU,MTL,NFZ,PDM,QZFE,TFN

Kawahigashi, H.; Hirose, S.; Ohkawa, H., and Ohkawa, Y. Transgenic Rice Plants Expressing Human P450 Genes Involved in Xenobiotic Metabolism for Phytoremediation, GRO: SOIL,ENV; 2008UR
ECOTOX,EFED,P.
Notes: EcoReference No.: 118859
Chemical of Concern: ACO,ACR,ATZ,DU,MTL,NFZ,QZFE,SZ,TFN

Luo, X. Y.; Sunohara, Y., and Matsumoto, H. Fluazifop-Butyl Causes Membrane Peroxidation in the Herbicide-Susceptible Broad Leaf Weed Bristly Starbur (Acanthospermum hispidum), BCM,GRO,PHY. hmatsu@biol.tsukuba.ac.jp//H. Matsumoto, Institute of Applied Biochemistry, University of Tsukuba, Tsukuba, Ibaraki, 305-8572, Japan//: SOIL,ENV; 2004UR
ECOTOX,EFED,P.
Notes: EcoReference No.: 109549
Chemical of Concern: AVIG,FNPE,FZFB,QZFE,SXD

Makino, K.; Sakata, G.; Kawamura, Y., and Ikai, T. Quantitative Structure-Activity Relationships of 2-[4-(2-Quinoxalinyloxy)Phenoxy]Propanoic Acid Derivatives, Using a Convenient Parameter, Retention Volume, in High-Performance Liquid Chromatography, GRO: SOIL,ENV; 1986UR
ECOTOX,EFED,P.
Notes: EcoReference No.: 100573
Chemical of Concern: QZFE

Qasem, J. R. Chemical Weed Control in Seedbed Sown Onion (Allium cepa L.), POP: SOIL,ENV; 2006UR
ECOTOX,EFED,P.
Notes: EcoReference No.: 87396
Chemical of Concern: DCPA,MBZ,ODZ,OXF,PAQT,PDM,PMT,PQT,PYZ,PZM,QZFE,TFN

Samsoe-Petersen, L. Effects of 67 Herbicides and Plant Growth Regulators on the Rove Beetle Aleochara bilineata (Col.: Staphylinidae) in the Laboratory, MOR,REP: ENV,MIXTURE; 1995TV [BMN, DPP2, EFS, FZFB, MCPA, NAA, NAD, TSF, Gallant super, quinmerac, Starane 180, rh 0265, Goltix, Tribunil, Ustinex PA, pyridate-terbuthylazine mixt., pyridate-terbuthylazine-metolachlor mixt., fluoroglycofen, cga 1136872, Ioxynil, Faneron]
ECOTOX,EFED,INSECT.
Notes: EcoReference No.: 63490
Chemical of Concern:
ATZ,BMC,BMN,BT,CBL,CQTC,DFPM,DMDP,DPP1,DPP2,EFS,FXP,FZFB,GFSNH,GYPI,
MCPA,MCPP1,MCPP2,MLNR,MTL,MTSM,NAA,NAD,PDM,PYD,PZM,QZFE,SZ,TKY,TSF

Schumacher, C. E. and Hatterman-Valenti, H. M. Effect of Dose and Spray Volume on Early-Season Broadleaved Weed Control in Allium Using Herbicides, GRO,POP: SOIL,ENV,MIXTURE; 2007UR
ECOTOX,EFED,P.
Notes: EcoReference No.: 154894
Chemical of Concern: BMN,CLT,MZB,OXF,PDM,QZFPE

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Notes: Chemical of Concern: QZFPE

Appendix E – SIP and STIR Model Output

STIR

Input		
Application and Chemical Information		
Enter Chemical Name	Quizalofop-p-ethyl	
Enter Chemical Use		
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)	372.8	
Enter Chemical Vapor Pressure (mmHg)	3.00E-07	
Enter Application Rate (lb a.i./acre)	0.667	
Toxicity Properties		
Bird		
Enter Lowest Bird Oral LD_{50} (mg/kg bw)	2000	
Enter Mineau Scaling Factor	1.15	
Enter Tested Bird Weight (kg)	1.58	
Mammal		
Enter Lowest Rat Oral LD_{50} (mg/kg bw)	870	
Enter Lowest Rat Inhalation LC_{50} (mg/L)	5119	
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)	6.02E-03	
Maximum 1-hour Vapor Inhalation Dose (mg/kg)	7.57E-04	
Adjusted Inhalation LD_{50}	4.73E+04	
Ratio of Vapor Dose to Adjusted Inhalation LD_{50}	1.60E-08	**Exposure not Likely Significant**
Maximum Post-treatment Spray Inhalation Dose (mg/kg)	7.05E-02	
Ratio of Droplet Inhalation Dose to Adjusted Inhalation LD_{50}	1.49E-06	**Exposure not Likely Significant**
Results Mammalian (0.015 kg)		
Maximum Vapor Concentration in Air at Saturation (mg/m^3)	6.02E-03	
Maximum 1-hour Vapor Inhalation Dose (mg/kg)	9.51E-04	
Adjusted Inhalation LD_{50}	3.05E+05	
Ratio of Vapor Dose to Adjusted Inhalation LD_{50}	3.12E-09	**Exposure not Likely Significant**
Maximum Post-treatment Spray Inhalation Dose (mg/kg)	8.86E-02	
Ratio of Droplet Inhalation Dose to Adjusted Inhalation	2.91E-07	**Exposure not Likely Significant**

LD_{50}		

SIP

Table 1. Inputs

Parameter	Value
Chemical name	Quizalofop-p-ethyl
Solubility (in water at 25°C; mg/L)	0.4
Mammalian LD_{50} (mg/kg-bw)	870
Mammalian test species	laboratory rat
Body weight (g) of "other" mammalian species	
Mammalian NOAEL (mg/kg-bw)	5
Mammalian test species	laboratory rat
Body weight (g) of "other" mammalian species	
Avian LD_{50} (mg/kg-bw)	2000
Avian test species	mallard duck
Body weight (g) of "other" avian species	
Mineau scaling factor	1.15
Mallard NOAEC (mg/kg-diet)	180
Bobwhite quail NOAEC (mg/kg-diet)	1030
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)	0.0688	0.0688
Adjusted toxicity value (mg/kg-bw)	669.1697	3.8458
Ratio of exposure to toxicity	0.0001	0.0179
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)	0.3240	0.3240
Adjusted toxicity value (mg/kg-bw)	1038.4508	8.9303

Ratio of exposure to acute toxicity	0.0003	0.0363
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 F – Risk Quotient Method and Levels of Concern

The Risk Quotient Method is the means by which the Environmental Fate and Effects Division (EFED) integrates the results of exposure and ecotoxicity data. In this method, both acute and chronic risk quotients are calculated by dividing exposure estimates by the most sensitive ecotoxicity values derived from the studies. Calculated risk quotients are then compared to OPP's levels of concern. The levels of concern are the criteria used by OPP to indicate potential risk to non-target organisms and the need to consider regulatory action. EFED has defined levels of concern for acute risk, potential restricted use, and for listed species. Risk presumptions, along with the corresponding risk quotients and levels of concern are summarized in the table below.

Levels of Concern for Assessed Taxa

Risk Presumption	Risk Quotient	Level of Concern
Birds		
Acute Risk	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day	0.5
Acute Restricted Use	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day (or LD_{50} < 50 mg/kg)	0.2
Acute Listed Species	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day	0.1
Chronic Risk	EEC/NOAEC	1
Mammals		
Acute Risk	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day	0.5
Acute Restricted Use	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day (or LD_{50} < 50 mg/kg)	0.2
Acute Listed Species	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day	0.1
Chronic Risk	EEC/NOAEC	1
Aquatic Animals		
Acute Risk	EEC/LC_{50} or EC_{50}	0.5
Acute Restricted Use	EEC/LC_{50} or EC_{50}	0.1
Acute Listed Species	EEC/LC_{50} or EC_{50}	0.05
Chronic Risk	EEC/NOAEC	1
Terrestrial and Semi-Aquatic Plants		
Acute Risk	EEC/EC_{25}	1
Acute Listed Species	EEC/EC_{05} or NOAEC	1

Risk Presumption	Risk Quotient	Level of Concern
Aquatic Plants		
Acute Risk	EEC/EC_{50}	1
Acute Listed Species	EEC/EC_{05} or NOAEC	1

Appendix G – Surface Water Model Results and Sample Input and Outputs

This expample output (inputs included at end of output) is for the first scenario presented in Table 5, the aerial alfalfa scenario (MN alfalfa OP; 2 applications at 0.0834 lb ai/A with a 7-day re-application interval).

stored as Quiz.out
Chemical: Quizalofop
PRZM environment: MNalfalfaOP.txt modified Thuday, 14 June 2007 at 11:21:44
EXAMS environment: pond298.exv modified Tueday, 26 August 2008 at 06:14:08
Metfile: w14914.dvf modified Tueday, 26 August 2008 at 06:15:16
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	0.6225	0.6176	0.6011	0.5749	0.5616	0.297
1962	1.816	1.798	1.744	1.72	1.692	1.145
1963	1.978	1.965	1.927	1.833	1.818	1.578
1964	2.714	2.694	2.616	2.471	2.419	1.953
1965	2.43	2.421	2.385	2.303	2.267	2.079
1966	2.217	2.206	2.165	2.079	2.048	1.916
1967	2.08	2.07	2.037	1.967	1.919	1.737
1968	1.853	1.843	1.808	1.743	1.7	1.528
1969	2.361	2.346	2.283	2.185	2.119	1.733
1970	2.316	2.303	2.264	2.214	2.16	1.994
1971	2.657	2.642	2.587	2.479	2.407	2.17
1972	2.417	2.406	2.358	2.267	2.231	2.077
1973	2.137	2.128	2.086	2.001	1.96	1.857
1974	2.65	2.633	2.565	2.446	2.399	2.032
1975	3.615	3.597	3.496	3.303	3.197	2.588
1976	2.884	2.871	2.816	2.712	2.649	2.46
1977	3.295	3.272	3.185	3.029	2.946	2.539
1978	3.201	3.183	3.112	3.001	2.948	2.665
1979	2.835	2.822	2.772	2.716	2.715	2.553
1980	2.694	2.681	2.629	2.544	2.481	2.407
1981	3.243	3.223	3.142	3.001	2.924	2.448
1982	2.569	2.558	2.513	2.445	2.407	2.314
1983	2.614	2.6	2.557	2.502	2.498	2.336
1984	3.198	3.177	3.096	2.943	2.845	2.473
1985	3.244	3.226	3.161	3.06	3.019	2.681

1986	2.969	2.954	2.899	2.825	2.789	2.587
1987	2.908	2.892	2.838	2.722	2.691	2.451
1988	2.452	2.438	2.383	2.287	2.221	2.163
1989	2.483	2.47	2.422	2.325	2.265	2.144
1990	2.625	2.611	2.553	2.496	2.436	2.156

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258064516129	3.615	3.597	3.496	3.303	3.197	2.681
0.0645161290322581	3.295	3.272	3.185	3.06	3.019	2.665
0.0967741935483871	3.244	3.226	3.161	3.029	2.948	2.588
0.129032258064516	3.243	3.223	3.142	3.001	2.946	2.587
0.161290322580645	3.201	3.183	3.112	3.001	2.924	2.553
0.193548387096774	3.198	3.177	3.096	2.943	2.845	2.539
0.225806451612903	2.969	2.954	2.899	2.825	2.789	2.473
0.258064516129032	2.908	2.892	2.838	2.722	2.715	2.46
0.290322580645161	2.884	2.871	2.816	2.716	2.691	2.451
0.32258064516129	2.835	2.822	2.772	2.712	2.649	2.448
0.354838709677419	2.714	2.694	2.629	2.544	2.498	2.407
0.387096774193548	2.694	2.681	2.616	2.502	2.481	2.336
0.419354838709677	2.657	2.642	2.587	2.496	2.436	2.314
0.451612903225806	2.65	2.633	2.565	2.479	2.419	2.17
0.483870967741936	2.625	2.611	2.557	2.471	2.407	2.163
0.516129032258065	2.614	2.6	2.553	2.446	2.407	2.156
0.548387096774194	2.569	2.558	2.513	2.445	2.399	2.144
0.580645161290323	2.483	2.47	2.422	2.325	2.267	2.079
0.612903225806452	2.452	2.438	2.385	2.303	2.265	2.077
0.645161290322581	2.43	2.421	2.383	2.287	2.231	2.032
0.67741935483871	2.417	2.406	2.358	2.267	2.221	1.994
0.709677419354839	2.361	2.346	2.283	2.214	2.16	1.953
0.741935483870968	2.316	2.303	2.264	2.185	2.119	1.916
0.774193548387097	2.217	2.206	2.165	2.079	2.048	1.857
0.806451612903226	2.137	2.128	2.086	2.001	1.96	1.737
0.838709677419355	2.08	2.07	2.037	1.967	1.919	1.733
0.870967741935484	1.978	1.965	1.927	1.833	1.818	1.578
0.903225806451613	1.853	1.843	1.808	1.743	1.7	1.528
0.935483870967742	1.816	1.798	1.744	1.72	1.692	1.145
0.967741935483871	0.6225	0.6176	0.6011	0.5749	0.5616	0.297

0.1	3.2439	3.2257	3.1591	3.0262	2.9478	2.5879

Average of yearly averages: 2.10203333333333

Inputs generated by pe5.pl - Novemeber 2006

Data used for this run:
Output File: Quiz
Metfile: w14914.dvf
PRZM scenario: MNalfalfaOP.txt
EXAMS environment file: pond298.exv
Chemical Name: Quizalofop

Description	Variable Name		Value	Units	Comments
Molecular weight	mwt	344.8	g/mol		
Henry's Law Const.	henry		atm-m^3/mol		
Vapor Pressure	vapr	3e-7	torr		
Solubility	sol	0.4	mg/L		
Kd	Kd		mg/L		
Koc	Koc	256	mg/L		
Photolysis half-life	kdp	85.4	days	Half-life	
Aerobic Aquatic Metabolism	kbacw	814	days	Halfife	
Anaerobic Aquatic Metabolism	kbacs	420	days	Halfife	
Aerobic Soil Metabolism	asm	390	days	Halfife	
Hydrolysis:	pH 7	0	days	Half-life	
Method:	CAM	2	integer	See PRZM manual	
Incorporation Depth:	DEPI		cm		
Application Rate:	TAPP	.093	kg/ha		
Application Efficiency:		APPEFF	.95	fraction	
Spray Drift	DRFT	.05	fraction of application rate applied to pond		
Application Date	Date	15-05	dd/mm or dd/mmm or dd-mm or dd-mmm		
Interval 1	interval	7	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)		

Appendix H – TerrPlant Output

Example output for a single application of quizalofop-p-ethyl at 0.108 lb ai/A (paved areas, private roadways)

Table 1. Chemical Identity.	
Parameter	**User Inputs**
Chemical Name	**quizalofop-p-ethyl**
PC code	**128709**
Use	**Herbicide for grasses**
Application Method	**Spray**
Application Form	**Liquid**
Solubility in Water (ppm)	**0.4**

Table 2. Input parameters used to derive EECs.			
Input Parameter	**Symbol**	**Value (user inputs)**	**Units**
Application Rate	A	**0.108**	
Incorporation	I	**1**	none
Runoff Fraction	R	**0.01**	none
Drift Fraction	D	**0.05**	none

Table 3. EECs for quizalofop-p-ethyl. Units in .		
Description	**Equation**	**EEC**
Runoff to dry areas	(A/I)*R	0.00108
Runoff to semi-aquatic areas	(A/I)*R*10	0.0108
Spray drift	**A*D**	**0.0054**
Total for dry areas	**((A/I)*R)+(A*D)**	**0.00648**
Total for semi-aquatic areas	**((A/I)*R*10)+(A*D)**	**0.0162**

Table 4. Plant survival and growth data used for RQ derivation. Units are in . All values are user inputs				
	Seedling Emergence		**Vegetative Vigor**	
Plant type	**EC_{25}**	**NOAEC**	**EC_{25}**	**NOAEC**
Monocot	**0.019**	**0.0096**	**0.00146**	**0.000791**
Dicot		**0.127**	**0.0931**	**0.0477**

Table 5. RQ values for plants in dry and semi-aquatic areas exposed to quizalofop-p-ethyl through runoff and/or spray drift.*				
Plant Type	**Listed Status**	**Dry**	**Semi-Aquatic**	**Spray Drift**
Monocot	non-listed	0.34	0.85	3.70
Monocot	listed	0.68	1.69	6.83
Dicot	non-listed	#DIV/0!	#DIV/0!	<0.1

Dicot	listed	<0.1	0.13	<0.1
*If RQ > 1.0, the LOC is exceeded, resulting in potential for risk to that plant group.				

Appendix I – T-REX Output

Example output from application of quizalofop-p-ethyl at 0.0695 lb ai/A, 2 applications, 7 days apart

Summary of Risk Quotient Calculations Based on Upper Bound Kenaga EECs

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

Size Class (grams)	Adjusted LD50	EECs and RQs											
		Short Grass		Tall Grass		Broadleaf Plants		Fruits/Pods/ Seeds		Arthropods		Granivore	
		EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
20	0.00	35.53	#DIV/0!	16.29	#DIV/0!	19.99	#####	2.22	#DIV/0!	13.92	#####	0.49	#####
100	0.00	20.26	#DIV/0!	9.29	#DIV/0!	11.40	#####	1.27	#DIV/0!	7.94	#####	0.28	#####
1000	0.00	9.07	#DIV/0!	4.16	#DIV/0!	5.10	#####	0.57	#DIV/0!	3.55	#####	0.13	#####

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

	EECs and RQs									
	Short Grass		Tall Grass		Broadleaf Plants		Fruits/Pods/Seeds		Arthropods	
LC50	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
0	31.20	#DIV/0!	14.30	#DIV/0!	17.55	#DIV/0!	1.95	#####	12.22	#DIV/0!

Size class not used for dietary risk quotients

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

	EECs and RQs									
	Short Grass		Tall Grass		Broadleaf Plants		Fruits/Pods/Seeds		Arthropods	
NOAEC (ppm)	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ

180	31.20	0.17	14.30	0.08	17.55	0.10	1.95	0.01	12.22	0.07

Table X. Upper Bound Kenaga, Acute Mammalian Dose-Based Risk Quotients													
Size Class (grams)	**Adjusted LD50**	**EECs and RQs**											
		Short Grass		**Tall Grass**		**Broadleaf Plants**		**Fruits/Pods /Seeds**		**Arthropods**		**Granivore**	
		EEC	**RQ**	**EEC**	**RQ**	**EEC**	**RQ**	**EEC**	**RQ**	**EEC**	**RQ**	**EEC**	**RQ**
15	1912.11	29.75	0.02	13.63	0.01	16.73	0.01	1.86	0.00	11.6511	0.0061	0.4132	0.0002
35	1547.10	20.56	0.01	9.42	0.01	11.56	0.01	1.28	0.00	8.05249	0.0052	0.2855	0.0002
1000	669.17	4.77	0.01	2.18	0.00	2.68	0.00	0.30	0.00	1.867	0.0028	0.0662	1E-04

Table X. Upper Bound Kenaga, Acute Mammalian Dietary Based Risk Quotients										
LC50 (ppm)	**EECs and RQs**									
	Short Grass		**Tall Grass**		**Broadleaf Plants**		**Fruits/Pods/Seeds**		**Arthropods**	
	EEC	**RQ**	**EEC**	**RQ**	**EEC**	**RQ**	**EEC**	**RQ**	**EEC**	**RQ**
0	31.20	#DIV/0!	14.30	#DIV/0!	17.55	#DIV/0!	1.95	#####	12.22	#DIV/0!

Size class not used for dietary risk quotients

Table X. Upper Bound Kenaga, Chronic Mammalian Dietary Based Risk Quotients										
NOAEC (ppm)	**EECs and RQs**									
	Short Grass		**Tall Grass**		**Broadleaf Plants**		**Fruits/Pods/Seeds/Large Insects**		**Arthropods**	
	EEC	**RQ**	**EEC**	**RQ**	**EEC**	**RQ**	**EEC**	**RQ**	**EEC**	**RQ**
100	31.20	0.31	14.30	0.14	17.55	0.18	1.95	0.02	12.22	0.12

Size class not used for dietary risk quotients

Table X. Upper Bound Kenaga, Chronic Mammalian Dose-Based Risk Quotients													
Size Class (grams)	**Adjusted NOAEL**	**EECs and RQs**											
		Short Grass		**Tall Grass**		**Broadleaf Plants**		**Fruits/Pods /Seeds**		**Arthropods**		**Granivore**	
		EEC	**RQ**	**EEC**	**RQ**	**EEC**	**RQ**	**EEC**	**RQ**	**EEC**	**RQ**	**EEC**	**RQ**
15	10.99	29.75	2.71	13.63	1.24	16.73	1.52	1.86	0.17	11.65	1.06	0.41	0.04
35	8.89	20.56	2.31	9.42	1.06	11.56	1.30	1.28	0.14	8.05	0.91	0.29	0.03

1000	3.85	4.77	1.24	2.18	0.57	2.68	0.70	0.30	0.08	1.87	0.49	0.07	0.02

APPENDIX J – Listed Species Analysis

Table J-1. "No Effects" (Direct and Indirect Effects) Determination for Listed Species Outside the Geographical Range of Quizalofop-P-Ethyl Uses

Common and Scientific Name	
(ncn)	*Tetraplasandra bisattenuata*
(ncn)	*Tetraplasandra lydgatei*
(ncn)	*Platydesma cornuta var. cornuta*
(ncn)	*Platydesma cornuta var. decurrens*
(ncn)	*Lysimachia vinosa*
(ncn)	*Phyllostegia hispida*
(ncn)	*Schiedea attenuata*
(ncn)	*Stenogyne kealiae*
(ncn)	*Keysseria (=Lagenifera) erici*
(ncn)	*Keysseria (=Lagenifera) helenae*
(ncn)	*Cyanea kolekoleensis*
(ncn)	*Lysimachia iniki*
(ncn)	*Lysimachia pendens*
(ncn)	*Lysimachia scopulensis*
(ncn)	*Phyllostegia renovans*
(ncn)	*Tetraplasandra flynnii*
(ncn)	*Diellia mannii*
(ncn)	*Doryopteris takeuchii*
(ncn)	*Doryopteris angelica*
Abalone, Black	*Haliotis cracherodii*
Abalone, White	*Haliotis sorenseni*
Abutilon eremitopetalum (ncn)	*Abutilon eremitopetalum*
Abutilon sandwicense (ncn)	*Abutilon sandwicense*
Achyranthes mutica (ncn)	*Achyranthes mutica*
Achyranthes splendens var. rotundata (ncn)	*Achyranthes splendens var. rotundata*
Adobe Sunburst, San Joaquin	*Pseudobahia peirsonii*
a'e	*Zanthoxylum oahuense*
A'e (Zanthoxylum dipetalum var. tomentosum)	*Zanthoxylum dipetalum var. tomentosum*
A'e (Zanthoxylum hawaiiense)	*Zanthoxylum hawaiiense*
'Aiea (Nothocestrum breviflorum)	*Nothocestrum breviflorum*
'Aiea (Nothocestrum peltatum)	*Nothocestrum peltatum*
Akekee	*Loxops caeruleirostris*
'Akepa, Hawaii	*Loxops coccineus coccineus*
'Akepa, Maui	*Loxops coccineus ochraceus*
'Akia Loa, Kauai (Hemignathus procerus)	*Hemignathus procerus*
'Akia Pola'au (Hemignathus munroi)	*Hemignathus munroi*
Akoko	*Chamaesyce remyi var. kauaiensis*
'akoko	*Chamaesyce eleanoriae*
'Akoko (Chamaesyce celastroides var. kaenana)	*Chamaesyce celastroides var. kaenana*
'Akoko (Chamaesyce deppeana)	*Chamaesyce deppeana*
'Akoko (Chamaesyce herbstii)	*Chamaesyce herbstii*
'Akoko (Chamaesyce kuwaleana)	*Chamaesyce kuwaleana*
'Akoko (Chamaesyce rockii)	*Chamaesyce rockii*
'Akoko (Chamaesyce skottsbergii var. skottsbe	*Chamaesyce skottsbergii var. kalaeloana*
'Akoko (Euphorbia haeleeleana)	*Euphorbia haeleeleana*
Alabama pearlshell	*Margaritifera marrianae*

Common and Scientific Name	
alani	*Melicope christophersenii*
alani	*Melicope degeneri*
alani	*Melicope makahae*
alani	*Melicope paniculata*
alani	*Melicope hiiakae*
alani	*Melicope puberula*
Alani (Melicope adscendens)	*Melicope adscendens*
Alani (Melicope balloui)	*Melicope balloui*
Alani (Melicope haupuensis)	*Melicope haupuensis*
Alani (Melicope knudsenii)	*Melicope knudsenii*
Alani (Melicope lydgatei)	*Melicope lydgatei*
Alani (Melicope mucronulata)	*Melicope mucronulata*
Alani (Melicope munroi)	*Melicope munroi*
Alani (Melicope ovalis)	*Melicope ovalis*
Alani (Melicope pallida)	*Melicope pallida*
Alani (Melicope quadrangularis)	*Melicope quadrangularis*
Alani (Melicope reflexa)	*Melicope reflexa*
Alani (Melicope saint-johnii)	*Melicope saint-johnii*
Alani (Melicope zahlbruckneri)	*Melicope zahlbruckneri*
Albatross, Short-tailed	*Phoebastria (=Diomedea) albatrus*
Alligator, American	*Alligator mississippiensis*
Allocarya, Calistoga	*Plagiobothrys strictus*
Alsinidendron obovatum (ncn)	*Alsinidendron obovatum*
Alsinidendron trinerve (ncn)	*Alsinidendron trinerve*
Alsinidendron viscosum (ncn)	*Alsinidendron viscosum*
Amaranth, Seabeach	*Amaranthus pumilus*
Amaranthus brownii (ncn)	*Amaranthus brownii*
Ambersnail, Kanab	*Oxyloma haydeni kanabensis*
Ambrosia, San Diego	*Ambrosia pumila*
Ambrosia, South Texas	*Ambrosia cheiranthifolia*
Amphianthus, Little	*Amphianthus pusillus*
Amphipod, Hay's Spring	*Stygobromus hayi*
Amphipod, Illinois Cave	*Gammarus acherondytes*
Amphipod, Noel's	*Gammarus desperatus*
Amphipod, Peck's Cave	*Stygobromus (=Stygonectes) pecki*
'Anaunau (Lepidium arbuscula)	*Lepidium arbuscula*
Anole, Culebra Island Giant	*Anolis roosevelti*
'Anunu (Sicyos alba)	*Sicyos alba*
Asplenium fragile var. insulare (ncn)	*Asplenium fragile var. insulare*
Aster, Decurrent False	*Boltonia decurrens*
Aster, Florida Golden	*Chrysopsis floridana*
Aster, Ruth's Golden	*Pityopsis ruthii*
Auerodendron pauciflorum (ncn)	*Auerodendron pauciflorum*
aumakua, Palapalai	*Dryopteris crinalis podosorus*
Aupaka (Isodendrion hosakae)	*Isodendrion hosakae*
Aupaka (Isodendrion laurifolium)	*Isodendrion laurifolium*
Aupaka (Isodendrion longifolium)	*Isodendrion longifolium*
Avens, Spreading	*Geum radiatum*
awikiwiki	*Canavalia napaliensis*
'Awikiwiki (Canavalia molokaiensis)	*Canavalia molokaiensis*
'Awiwi (Centaurium sebaeoides)	*Centaurium sebaeoides*
'Awiwi (Hedyotis cookiana)	*Hedyotis cookiana*

Common and Scientific Name	
Ayenia, Texas	*Ayenia limitaris*
Baccharis, Encinitas	*Baccharis vanessae*
Bankclimber, Purple	*Elliptoideus sloatianus*
Barbara Buttons, Mohr's	*Marshallia mohrii*
Barberry, Island	*Berberis pinnata ssp. insularis*
Barberry, Nevin's	*Berberis nevinii*
Bariaco	*Trichilia triacantha*
Bat, Little Mariana Fruit	*Pteropus tokudae*
Bat, Mariana Fruit (=Mariana Flying Fox)	*Pteropus mariannus mariannus*
Bear, American Black	*Ursus americanus*
Bear, polar	*Ursus maritimus*
Bearclaw poppy, Dwarf	*Arctomecon humilis*
Beardtongue, Penland	*Penstemon penlandii*
Bedstraw, El Dorado	*Galium californicum ssp. sierrae*
Bedstraw, Island	*Galium buxifolium*
Beetle, American Burying	*Nicrophorus americanus*
Beetle, Casey's June	*Dinacoma caseyi*
Beetle, Coffin Cave Mold	*Batrisodes texanus*
Beetle, Comal Springs Dryopid	*Stygoparnus comalensis*
Beetle, Comal Springs Riffle	*Heterelmis comalensis*
Beetle, Delta Green Ground	*Elaphrus viridis*
Beetle, Helotes Mold	*Batrisodes venyivi*
Beetle, Hungerford's Crawling Water	*Brychius hungerfordi*
Beetle, Kretschmarr Cave Mold	*Texamaurops reddelli*
Beetle, Mount Hermon June	*Polyphylla barbata*
Beetle, Northeastern Beach Tiger	*Cicindela dorsalis dorsalis*
Beetle, Ohlone Tiger	*Cicindela ohlone*
Beetle, Puritan Tiger	*Cicindela puritana*
Beetle, Salt Creek Tiger	*Cicindela nevadica lincolniana*
Beetle, Tooth Cave Ground	*Rhadine persephone*
Beetle, Valley Elderberry Longhorn	*Desmocerus californicus dimorphus*
Bellflower, Brooksville	*Campanula robinsiae*
Birch, Virginia Round-leaf	*Betula uber*
Bird's-beak, Palmate-bracted	*Cordylanthus palmatus*
Bird's-beak, Pennell's	*Cordylanthus tenuis ssp. capillaris*
Bird's-beak, salt marsh	*Cordylanthus maritimus ssp. maritimus*
Bird's-beak, Soft	*Cordylanthus mollis ssp. mollis*
Birds-in-a-nest, White	*Macbridea alba*
Bittercress, Small-anthered	*Cardamine micranthera*
Blackbird, Yellow-shouldered	*Agelaius xanthomus*
blackline Hawaiian damselfly	*Megalagrion nigrohamatum nigrolineatum*
Bladderpod, Dudley Bluffs	*Lesquerella congesta*
Bladderpod, Kodachrome	*Lesquerella tumulosa*
Bladderpod, Lyrate	*Lesquerella lyrata*
Bladderpod, Missouri	*Lesquerella filiformis*
Bladderpod, San Bernardino Mountains	*Lesquerella kingii ssp. bernardina*
Bladderpod, Spring Creek	*Lesquerella perforata*
Bladderpod, White	*Lesquerella pallida*
Bladderpod, Zapata	*Lesquerella thamnophila*
Blazing Star, Ash Meadows	*Mentzelia leucophylla*
Blazing Star, Heller's	*Liatris helleri*
Blazing Star, Scrub	*Liatris ohlingerae*

Common and Scientific Name	
Bluecurls, Hidden Lake	*Trichostema austromontanum ssp. compactum*
Blue-star, Kearney's	*Amsonia kearneyana*
Bluet, Roan Mountain	*Hedyotis purpurea var. montana*
Boa, Mona	*Epicrates monensis monensis*
Boa, Puerto Rican	*Epicrates inornatus*
Boa, Virgin Islands Tree	*Epicrates monensis granti*
Bobwhite, Masked	*Colinus virginianus ridgwayi*
Bonamia menziesii (ncn)	*Bonamia menziesii*
Bonamia, Florida	*Bonamia grandiflora*
Boxwood, Vahl's	*Buxus vahlii*
Broom, San Clemente Island	*Lotus dendroideus ssp. traskiae*
Buckwheat, Cushenbury	*Eriogonum ovalifolium var. vineum*
Buckwheat, Ione (incl. Irish Hill)	*Eriogonum apricum (incl. var. prostratum)*
Buckwheat, Scrub	*Eriogonum longifolium var. gnaphalifolium*
Buckwheat, Southern Mountain Wild	*Eriogonum kennedyi var. austromontanum*
Buckwheat, Steamboat	*Eriogonum ovalifolium var. williamsiae*
Bush-mallow, San Clemente Island	*Malacothamnus clementinus*
Bush-mallow, Santa Cruz Island	*Malacothamnus fasciculatus var. nesioticus*
Buttercup, Autumn	*Ranunculus aestivalis (=acriformis)*
Butterfly [Cassius Blue, Ceraunus Blue, Nickerbean Blue]	*Leptotes and Hemiargus and Cyclargus genus*
Butterfly Plant, Colorado	*Gaura neomexicana var. coloradensis*
Butterfly, Bay Checkerspot (Wright's euphydryas)	*Euphydryas editha bayensis*
Butterfly, Behren's Silverspot	*Speyeria zerene behrensii*
Butterfly, Callippe Silverspot	*Speyeria callippe callippe*
Butterfly, Ceranus Blue	*Hemiargus ceraunus antibubastus*
Butterfly, El Segundo Blue	*Euphilotes battoides allyni*
Butterfly, Fender's Blue	*Icaricia icarioides fenderi*
Butterfly, Karner Blue	*Lycaeides melissa samuelis*
Butterfly, Lange's Metalmark	*Apodemia mormo langei*
Butterfly, Lotis Blue	*Lycaeides argyrognomon lotis*
Butterfly, Miami Blue	*Cyclargus thomasi bethunebakeri*
Butterfly, Mission Blue	*Icaricia icarioides missionensis*
Butterfly, Mitchell's Satyr	*Neonympha mitchellii mitchellii*
Butterfly, Myrtle's Silverspot	*Speyeria zerene myrtleae*
Butterfly, Nickerbean Blue	*Cyclargus ammon*
Butterfly, Oregon Silverspot	*Speyeria zerene hippolyta*
Butterfly, Palos Verdes Blue	*Glaucopsyche lygdamus palosverdesensis*
Butterfly, Quino Checkerspot	*Euphydryas editha quino (=E. e. wrighti)*
Butterfly, Saint Francis' Satyr	*Neonympha mitchellii francisci*
Butterfly, San Bruno Elfin	*Callophrys mossii bayensis*
Butterfly, Schaus Swallowtail	*Heraclides aristodemus ponceanus*
Butterfly, Smith's Blue	*Euphilotes enoptes smithi*
Butterfly, Uncompahgre Fritillary	*Boloria acrocnema*
Butterweed, Layne's	*Senecio layneae*
Butterwort, Godfrey's	*Pinguicula ionantha*
Button-celery, San Diego	*Eryngium aristulatum var. parishii*
Cactus, Arizona Hedgehog	*Echinocereus triglochidiatus var. arizonicus*
Cactus, Bakersfield	*Opuntia treleasei*
Cactus, Black Lace	*Echinocereus reichenbachii var. albertii*
Cactus, Brady Pincushion	*Pediocactus bradyi*
Cactus, Bunched Cory	*Coryphantha ramillosa*

Common and Scientific Name	
Cactus, Chisos Mountain Hedgehog	*Echinocereus chisoensis var. chisoensis*
Cactus, Cochise Pincushion	*Coryphantha robbinsorum*
Cactus, Colorado hookless	*Sclerocactus glaucus*
Cactus, Key Tree	*Pilosocereus robinii*
Cactus, Knowlton	*Pediocactus knowltonii*
Cactus, Kuenzler Hedgehog	*Echinocereus fendleri var. kuenzleri*
Cactus, Lee Pincushion	*Coryphantha sneedii var. leei*
Cactus, Lloyd's Mariposa	*Echinomastus mariposensis*
Cactus, Mesa Verde	*Sclerocactus mesae-verdae*
Cactus, Nellie Cory	*Coryphantha minima*
Cactus, Nichol's Turk's Head	*Echinocactus horizonthalonius var. nicholii*
Cactus, Pariette	*Sclerocactus brevispinus*
Cactus, Peebles Navajo	*Pediocactus peeblesianus peeblesianus*
Cactus, Pima Pineapple	*Coryphantha scheeri var. robustispina*
Cactus, San Rafael	*Pediocactus despainii*
Cactus, Siler Pincushion	*Pediocactus (=Echinocactus,=Utahia) sileri*
Cactus, Sneed Pincushion	*Coryphantha sneedii var. sneedii*
Cactus, Star	*Astrophytum asterias*
Cactus, Tobusch Fishhook	*Ancistrocactus tobuschii*
Cactus, Uinta Basin hookless	*Sclerocactus wetlandicus*
Cactus, Winkler	*Pediocactus winkleri*
Cactus, Wright Fishhook	*Sclerocactus wrightiae*
Calyptranthes Thomasiana (ncn)	*Calyptranthes thomasiana*
Campeloma, Slender	*Campeloma decampi*
Campion, Fringed	*Silene polypetala*
Capa Rosa	*Callicarpa ampla*
Caracara, Audubon's Crested	*Polyborus plancus audubonii*
Catchfly, Spalding's	*Silene spaldingii*
Catesbaea Melanocarpa (ncn)	*Catesbaea melanocarpa*
Catfish, Yaqui	*Ictalurus pricei*
Cat's-eye, Terlingua Creek	*Cryptantha crassipes*
Cavefish, Alabama	*Speoplatyrhinus poulsoni*
Cavefish, Ozark	*Amblyopsis rosae*
Cavesnail, Tumbling Creek	*Antrobia culveri*
Ceanothus, Coyote	*Ceanothus ferrisae*
Ceanothus, Pine Hill	*Ceanothus roderickii*
Ceanothus, Vail Lake	*Ceanothus ophiochilus*
Centaury, Spring-loving	*Centaurium namophilum*
Chaffseed, American	*Schwalbea americana*
Chamaecrista glandulosa (ncn)	*Chamaecrista glandulosa var. mirabilis*
Chamaesyce Halemanui (ncn)	*Chamaesyce halemanui*
Checker-mallow, Keck's	*Sidalcea keckii*
Checker-mallow, Kenwood Marsh	*Sidalcea oregana ssp. valida*
Checker-mallow, Nelson's	*Sidalcea nelsoniana*
Checker-mallow, Pedate	*Sidalcea pedata*
Checker-mallow, Wenatchee Mountains	*Sidalcea oregana var. calva*
Choctaw Bean	*Villosa choctawensis*
Chub, Bonytail	*Gila elegans*
Chub, Borax Lake	*Gila boraxobius*
Chub, Chihuahua	*Gila nigrescens*
Chub, Gila	*Gila intermedia*
Chub, Humpback	*Gila cypha*

Common and Scientific Name	
Chub, Hutton Tui	*Gila bicolor ssp.*
Chub, Mohave Tui	*Gila bicolor mohavensis*
Chub, Oregon	*Oregonichthys crameri*
Chub, Owens Tui	*Gila bicolor snyderi*
Chub, Pahranagat Roundtail	*Gila robusta jordani*
Chub, Slender	*Erimystax cahni*
Chub, Sonora	*Gila ditaenia*
Chub, Spotfin	*Erimonax monachus*
Chub, Virgin River	*Gila seminuda (=robusta)*
Chub, Yaqui	*Gila purpurea*
Chucky Madtom	*Noturus crypticus*
Chumbo, Higo	*Harrisia portoricensis*
Chupacallos	*Pleodendron macranthum*
Cladonia, Florida Perforate	*Cladonia perforata*
Clarkia, Pismo	*Clarkia speciosa ssp. immaculata*
Clarkia, Presidio	*Clarkia franciscana*
Clarkia, Springville	*Clarkia springvillensis*
Clarkia, Vine Hill	*Clarkia imbricata*
Cliffrose, Arizona	*Purshia (=cowania) subintegra*
Clover, Fleshy Owl's	*Castilleja campestris ssp. succulenta*
Clover, Leafy Prairie	*Dalea foliosa*
Clover, Monterey	*Trifolium trichocalyx*
Clover, Prairie Bush	*Lespedeza leptostachya*
Clover, Running Buffalo	*Trifolium stoloniferum*
Clover, Showy Indian	*Trifolium amoenum*
Cobana Negra	*Stahlia monosperma*
Combshell, Southern (=Penitent mussel)	*Epioblasma penita*
Combshell, Upland	*Epioblasma metastriata*
Condor, California	*Gymnogyps californianus*
Coneflower, Smooth	*Echinacea laevigata*
Coot, Hawaiian (=Alae keo keo)	*Fulica americana alai*
Coral, Elkhorn	*Acropora palmata*
Coral, Staghorn	*Acropora cervicornis*
Cordia bellonis (ncn)	*Cordia bellonis*
Coyote-thistle, Loch Lomond	*Eryngium constancei*
Crane, Mississippi Sandhill	*Grus canadensis pulla*
Crane, Whooping	*Grus americana*
Crayfish, Cave (Cambarus aculabrum)	*Cambarus aculabrum*
Crayfish, Cave (Cambarus zophonastes)	*Cambarus zophonastes*
Crayfish, Nashville	*Orconectes shoupi*
Crayfish, Shasta	*Pacifastacus fortis*
Creeper, Hawaii	*Oreomystis mana*
Creeper, Molokai (Kakawahie)	*Paroreomyza flammea*
Creeper, Oahu (Alauwahio)	*Paroreomyza maculata*
Crimson Hawaiian damselfly	*Megalagrion leptodemas*
Crocodile, American	*Crocodylus acutus*
Crow, Hawaiian ('Alala)	*Corvus hawaiiensis*
Crow, Mariana	*Corvus kubaryi*
Crownbeard, Big-leaved	*Verbesina dissita*
Crownscale, San Jacinto Valley	*Atriplex coronata var. notatior*
Cui-ui	*Chasmistes cujus*
Cumberland darter	*Etheostoma susanae*

Common and Scientific Name	
Curlew, Eskimo	*Numenius borealis*
Cyanea undulata (ncn)	*Cyanea undulata*
Cycladenia, Jones	*Cycladenia jonesii (=humilis)*
Cypress, Gowen	*Cupressus goveniana ssp. goveniana*
Cypress, Santa Cruz	*Cupressus abramsiana*
Dace, Ash Meadows Speckled	*Rhinichthys osculus nevadensis*
Dace, Blackside	*Phoxinus cumberlandensis*
Dace, Clover Valley Speckled	*Rhinichthys osculus oligoporus*
Dace, Desert	*Eremichthys acros*
Dace, Foskett Speckled	*Rhinichthys osculus ssp.*
Dace, Independence Valley Speckled	*Rhinichthys osculus lethoporus*
Dace, Kendall Warm Springs	*Rhinichthys osculus thermalis*
Dace, Moapa	*Moapa coriacea*
Daisy, Lakeside	*Hymenoxys herbacea*
Daisy, Parish's	*Erigeron parishii*
Daisy, Willamette	*Erigeron decumbens var. decumbens*
Damselfly, Flying Earwig Hawaiian	*Megalagrion nesiotes*
Damselfly, Pacific Hawaiian	*Megalagrion pacificum*
Daphnopsis hellerana (ncn)	*Daphnopsis hellerana*
Darter, Amber	*Percina antesella*
Darter, Bayou	*Etheostoma rubrum*
Darter, Bluemask (=jewel)	*Etheostoma sp.*
Darter, Boulder	*Etheostoma wapiti*
Darter, Cherokee	*Etheostoma scotti*
Darter, Duskytail	*Etheostoma percnurum*
Darter, Etowah	*Etheostoma etowahae*
Darter, Fountain	*Etheostoma fonticola*
Darter, Goldline	*Percina aurolineata*
Darter, Leopard	*Percina pantherina*
Darter, Maryland	*Etheostoma sellare*
Darter, Niangua	*Etheostoma nianguae*
Darter, Okaloosa	*Etheostoma okaloosae*
Darter, Relict	*Etheostoma chienense*
Darter, Slackwater	*Etheostoma boschungi*
Darter, Snail	*Percina tanasi*
Darter, Vermilion	*Etheostoma chermocki*
Darter, Watercress	*Etheostoma nuchale*
Dawn-flower, Texas Prairie (=Texas Bitterweed)	*Hymenoxys texana*
DeBeque phacelia	*Phacelia submutica*
Delissea rhytodisperma (ncn)	*Delissea rhytidosperma*
Diellia erecta (ncn)	*Diellia erecta*
Diellia falcata (ncn)	*Diellia falcata*
Diellia pallida (ncn)	*Diellia pallida*
Diellia unisora (ncn)	*Diellia unisora*
Diplazium molokaiense (ncn)	*Diplazium molokaiense*
Dogweed, Ashy	*Thymophylla tephroleuca*
Dragonfly, Hine's Emerald	*Somatochlora hineana*
Dropwort, Canby's	*Oxypolis canbyi*
Dubautia latifolia (ncn)	*Dubautia latifolia*
Dubautia pauciflorula (ncn)	*Dubautia pauciflorula*
Duck, Hawaiian (Koloa)	*Anas wyvilliana*
Duck, Laysan	*Anas laysanensis*

Common and Scientific Name	
Dudleya, Conejo	*Dudleya abramsii ssp. parva*
Dudleya, Marcescent	*Dudleya cymosa ssp. marcescens*
Dudleya, Santa Clara Valley	*Dudleya setchellii*
Dudleya, Santa Cruz Island	*Dudleya nesiotica*
Dudleya, Santa Monica Mountains	*Dudleya cymosa ssp. ovatifolia*
Dudleya, Verity's	*Dudleya verityi*
Dugong	*Dugong dugon*
Dwarf-flax, Marin	*Hesperolinon congestum*
Eider, Spectacled	*Somateria fischeri*
Eider, Steller's	*Polysticta stelleri*
Elepaio, Oahu	*Odocoileus virginianus clavium*
Elepaio, Oahu	*Chasiempis sandwichensis ibidis*
Elimia, Lacy	*Elimia crenatella*
Elktoe, Appalachian	*Alasmidonta raveneliana*
Erubia	*Solanum drymophilum*
Eugenia Woodburyana	*Eugenia woodburyana*
Evening-primrose, Antioch Dunes	*Oenothera deltoides ssp. howellii*
Evening-primrose, Eureka Valley	*Oenothera avita ssp. eurekensis*
Evening-primrose, San Benito	*Camissonia benitensis*
Fairy Shrimp, Conservancy Fairy	*Branchinecta conservatio*
Fairy Shrimp, Longhorn	*Branchinecta longiantenna*
Fairy Shrimp, Riverside	*Streptocephalus woottoni*
Fairy Shrimp, San Diego	*Branchinecta sandiegonensis*
Fairy Shrimp, Vernal Pool	*Branchinecta lynchi*
Falcon, Northern Aplomado	*Falco femoralis septentrionalis*
Fanshell	*Cyprogenia stegaria*
Fatmucket, Arkansas	*Lampsilis powelli*
Fern, Adiantum vivesii	*Adiantum vivesii*
Fern, Alabama Streak-sorus	*Thelypteris pilosa var. alabamensis*
Fern, Aleutian Shield	*Polystichum aleuticum*
Fern, American hart's-tongue	*Asplenium scolopendrium var. americanum*
Fern, Elaphoglossum serpens	*Elaphoglossum serpens*
Fern, Pendant Kihi (Adenophorus periens)	*Adenophorus periens*
Fern, Thelypteris inabonensis	*Thelypteris inabonensis*
Fern, Thelypteris verecunda	*Thelypteris verecunda*
Fern, Thelypteris yaucoensis	*Thelypteris yaucoensis*
Fiddleneck, Large-flowered	*Amsinckia grandiflora*
Finch, Laysan	*Telespyza cantans*
Finch, Nihoa	*Telespyza ultima*
Flannelbush, Mexican	*Fremontodendron mexicanum*
Flannelbush, Pine Hill	*Fremontodendron californicum ssp. decumbens*
Fleabane, Zuni	*Erigeron rhizomatus*
Fly, Delhi Sands Flower-loving	*Rhaphiomidas terminatus abdominalis*
Fly, Hawaiian picture-wing	*Drosophila aglaia*
Fly, Hawaiian picture-wing	*Drosophila heteroneura*
Fly, Hawaiian picture-wing	*Drosophila montgomeryi*
Fly, Hawaiian picture-wing	*Drosophila mulli*
Fly, Hawaiian picture-wing	*Drosophila musaphilia*
Fly, Hawaiian picture-wing	*Drosophila neoclavisetae*
Fly, Hawaiian picture-wing	*Drosophila obatai*
Fly, Hawaiian picture-wing	*Drosophila substenoptera*
Fly, Hawaiian picture-wing	*Drosophila tarphytrichia*

Common and Scientific Name	
Fly, Hawaiian picture-wing	*Drosophila hemipeza*
Fly, Hawaiian picture-wing	*Drosophila ochrobasis*
Fly, Hawaiian picture-wing	*Drosophila differens*
Flycatcher, Southwestern Willow	*Empidonax traillii extimus*
Four-o'clock, Macfarlane's	*Mirabilis macfarlanei*
Frankenia, Johnston's	*Frankenia johnstonii*
Fringe Tree, Pygmy	*Chionanthus pygmaeus*
Fringepod, Santa Cruz Island	*Thysanocarpus conchuliferus*
Frog, California Red-legged	*Rana aurora draytonii*
Frog, Chiricahua Leopard	*Rana chiricahuensis*
Frog, Dusky Gopher (Mississippi DPS)	*Rana capito sevosa*
Frog, Mountain Yellow-legged	*Rana muscosa*
Fruit, Earth (=geocarpon)	*Geocarpon minimum*
fuzzy pigtoe	*Pleurobema strodeanum*
Gahnia Lanaiensis (ncn)	*Gahnia lanaiensis*
Gambusia, Big Bend	*Gambusia gaigei*
Gambusia, Clear Creek	*Gambusia heterochir*
Gambusia, Pecos	*Gambusia nobilis*
Gambusia, San Marcos	*Gambusia georgei*
Gecko, Monito	*Sphaerodactylus micropithecus*
Geranium, Hawaiian Red-flowered	*Geranium arboreum*
Gerardia, Sandplain	*Agalinis acuta*
Gesneria pauciflora (ncn)	*Gesneria pauciflora*
Gilia, Hoffmann's Slender-flowered	*Gilia tenuiflora ssp. hoffmannii*
Gilia, Monterey	*Gilia tenuiflora ssp. arenaria*
Gnatcatcher, Coastal California	*Polioptila californica californica*
Goby, Tidewater	*Eucyclogobius newberryi*
Goetzea, Beautiful (Matabuey)	*Goetzea elegans*
Golden Sunburst, Hartweg's	*Pseudobahia bahiifolia*
Goldenrod, Blue Ridge	*Solidago spithamaea*
Goldenrod, Houghton's	*Solidago houghtonii*
Goldenrod, Short's	*Solidago shortii*
Goldenrod, White-haired	*Solidago albopilosa*
Goldfields, Burke's	*Lasthenia burkei*
Goldfields, Contra Costa	*Lasthenia conjugens*
Goose, Hawaiian (Nene)	*Branta (=Nesochen) sandvicensis*
Gooseberry, Miccosukee	*Ribes echinellum*
Gouania hillebrandii (ncn)	*Gouania hillebrandii*
Gouania meyenii (ncn)	*Gouania meyenii*
Gouania vitifolia (ncn)	*Gouania vitifolia*
Gourd, Okeechobee	*Cucurbita okeechobeensis ssp. okeechobeensis*
Grass, Hairy Orcutt	*Orcuttia pilosa*
Grass, Sacramento Orcutt	*Orcuttia viscida*
Grass, Slender Orcutt	*Orcuttia tenuis*
Grasshopper, Zayante Band-winged	*Trimerotropis infantilis*
Ground-plum, Guthrie's	*Astragalus bibullatus*
Groundsel, San Francisco Peaks	*Senecio franciscanus*
Gumplant, Ash Meadows	*Grindelia fraxino-pratensis*
ha`iwale	*Cyrtandra kaulantha*
ha`iwale	*Cyrtandra sessilis*
Haha	*Cyanea lanceolata*
Haha	*Cyanea calycina*

Common and Scientific Name	
haha	*Cyanea purpurellifolia*
Haha	*Cyanea kuhihewa*
haha	*Cyanea eleeleensis*
Haha	*Cyanea dolichopoda*
Haha (Cyanea acuminata)	*Cyanea acuminata*
Haha (Cyanea asarifolia)	*Cyanea asarifolia*
Haha (Cyanea copelandii ssp. copelandii)	*Cyanea copelandii ssp. copelandii*
Haha (Cyanea copelandii ssp. haleakalaensis)	*Cyanea copelandii ssp. haleakalaensis*
Haha (Cyanea Crispa) (=Rollandia crispa)	*Cyanea (=Rollandia) crispa*
Haha (Cyanea dunbarii)	*Cyanea dunbarii*
Haha (Cyanea glabra)	*Cyanea glabra*
Haha (Cyanea grimesiana ssp. grimesiana)	*Cyanea grimesiana ssp. grimesiana*
Haha (Cyanea grimesiana ssp. obatae)	*Cyanea grimesiana ssp. obatae*
Haha (Cyanea hamatiflora ssp. carlsonii)	*Cyanea hamatiflora ssp. Carlsonii*
Haha (Cyanea hamatiflora ssp. hamatiflora)	*Cyanea hamatiflora ssp. hamatiflora*
Haha (Cyanea humboldtiana)	*Cyanea humboldtiana*
Haha (Cyanea koolauensis)	*Cyanea koolauensis*
Haha (Cyanea lobata)	*Cyanea lobata*
Haha (Cyanea longiflora)	*Cyanea longiflora*
Haha (Cyanea Macrostegia var. gibsonii)	*Cyanea macrostegia ssp. gibsonii*
Haha (Cyanea mannii)	*Cyanea mannii*
Haha (Cyanea mceldowneyi)	*Cyanea mceldowneyi*
Haha (Cyanea pinnatifida)	*Cyanea pinnatifida*
Haha (Cyanea platyphylla)	*Cyanea platyphylla*
Haha (Cyanea procera)	*Cyanea procera*
Haha (Cyanea recta)	*Cyanea recta*
Haha (Cyanea remyi)	*Cyanea remyi*
Haha (Cyanea shipmanii)	*Cyanea shipmannii*
Haha (Cyanea stictophylla)	*Cyanea stictophylla*
Haha (Cyanea St-Johnii) (=Rollandia St-Johnii)	*Cyanea st-johnii*
Haha (Cyanea superba)	*Cyanea superba*
Haha (Cyanea truncata)	*Cyanea truncata*
haiwale	*Cyrtandra waiolani*
haiwale	*Cyrtandra gracilis*
haiwale	*Cyrtandra paliku*
Ha'Iwale (Cyrtandra crenata)	*Cyrtandra crenata*
Ha'Iwale (Cyrtandra dentata)	*Cyrtandra dentata*
Ha'Iwale (Cyrtandra giffardii)	*Cyrtandra giffardii*
Ha'Iwale (Cyrtandra limahuliensis)	*Cyrtandra limahuliensis*
Ha'Iwale (Cyrtandra munroi)	*Cyrtandra munroi*
Ha'iwale (Cyrtandra oenobarba)	*Cyrtandra oenobarba*
Ha'Iwale (Cyrtandra polyantha)	*Cyrtandra polyantha*
Ha'Iwale (Cyrtandra subumbellata)	*Cyrtandra subumbellata*
Ha'Iwale (Cyrtandra tintinnabula)	*Cyrtandra tintinnabula*
Ha'Iwale (Cyrtandra viridiflora)	*Cyrtandra viridiflora*
Haplostachys Haplostachya (ncn)	*Haplostachys haplostachya*
Harebells, Avon Park	*Crotalaria avonensis*
Harperella	*Ptilimnium nodosum*
Harvestman, Bee Creek Cave	*Texella reddelli*
Harvestman, Bone Cave	*Texella reyesi*
Harvestman, Cokendolpher Cave	*Texella cokendolpheri*
Hau Kauhiwi (Hibiscadelphus woodi)	*Hibiscadelphus woodii*

Common and Scientific Name	
Hau Kuahiwi (Hibiscadelphus distans)	*Hibiscadelphus distans*
Hau Kuahiwi (Hibiscadelphus giffardianus)	*Hibiscadelphus giffardianus*
Hau Kuahiwi (Hibiscadelphus hualalaiensis)	*Hibiscadelphus hualalaiensis*
Hawaiian picture-wing Fly	*Drosophila sharpi*
Hawk, Hawaiian (Io)	*Buteo solitarius*
Hawk, Puerto Rican Broad-winged	*Buteo platypterus brunnescens*
Hawk, Puerto Rican Sharp-shinned	*Accipiter striatus venator*
Hayun Lagu (Tronkon Guafi)	*Serianthes nelsonii*
Heartleaf, Dwarf-flowered	*Hexastylis naniflora*
Heather, Mountain Golden	*Hudsonia montana*
Heau (Exocarpos luteolus)	*Exocarpos luteolus*
Hedyotis degeneri (ncn)	*Hedyotis degeneri*
Hedyotis parvula (ncn)	*Hedyotis parvula*
Hedyotis St.-Johnii (ncn)	*Hedyotis st.-johnii*
Hesperomannia arborescens (ncn)	*Hesperomannia arborescens*
Hesperomannia arbuscula (ncn)	*Hesperomannia arbuscula*
Hesperomannia lydgatei (ncn)	*Hesperomannia lydgatei*
Hibiscus, Clay's	*Hibiscus clayi*
Higuero De Sierra	*Crescentia portoricensis*
ho'awa	*Pittosporum napaliense*
Holei (Ochrosia kilaueaensis)	*Ochrosia kilaueaensis*
Holly, Cook's	*Ilex cookie*
Honeycreeper, Crested ('Akohekohe)	*Palmeria dolei*
Hornsnail, rough	*Pleurocera foremani*
Howellia, Water	*Howellia aquatilis*
Hypericum, Highlands Scrub	*Hypericum cumulicola*
Iguana, Mona Ground	*Cyclura cornuta stejnegeri*
'Ihi'Ihi (Marsilea villosa)	*Marsilea villosa*
Ilex sintenisii (ncn)	*Ilex sintenisii*
Iliau (Wilkesia hobdyi)	*Wilkesia hobdyi*
Ipomopsis, Holy Ghost	*Ipomopsis sancti-spiritus*
Isopod, Lee County Cave	*Lirceus usdagalun*
Isopod, Madison Cave	*Antrolana lira*
Isopod, Socorro	*Thermosphaeroma thermophilus*
Ivesia, Ash Meadows	*Ivesia kingii var. eremica*
Jacquemontia, Beach	*Jacquemontia reclinata*
Jewelflower, California	*Caulanthus californicus*
Jewelflower, Metcalf Canyon	*Streptanthus albidus ssp. albidus*
Jewelflower, Tiburon	*Streptanthus niger*
Joint-vetch, Sensitive	*Aeschynomene virginica*
kamakahala	*Labordia helleri*
kamakahala	*Labordia pumila*
Kamakahala (Labordia cyrtandrae)	*Labordia cyrtandrae*
Kamakahala (Labordia lydgatei)	*Labordia lydgatei*
Kamakahala (Labordia tinifolia var. lanaiensis)	*Labordia tinifolia var. lanaiensis*
Kamakahala (Labordia tinifolia var. wahiawaen)	*Labordia tinifolia var. wahiawaensis*
Kamakahala (Labordia triflora)	*Labordia triflora*
Kanaloa kahoolawensis (ncn)	*Kanaloa kahoolawensis*
Kauai creeper	*Oreomystis bairdi*
Kauila (Colubrina oppositifolia)	*Colubrina oppositifolia*
kaulu	*Pteralyxia macrocarpa*
Kaulu (Pteralyxia kauaiensis)	*Pteralyxia kauaiensis*

Common and Scientific Name	
Kidneyshell, Triangular	*Ptychobranchus greenii*
Kingfisher, Guam Micronesian	*Halcyon cinnamomina cinnamomina*
Kio'Ele (Hedyotis coriacea)	*Hedyotis coriacea*
Kiponapona (Phyllostegia racemosa)	*Phyllostegia racemosa*
Kite, Everglades Snail	*Rostrhamus sociabilis plumbeus*
ko`oko`olau	*Bidens amplectens*
Koki'o (Kokia drynarioides)	*Kokia drynarioides*
Koki'o (Kokia kauaiensis)	*Kokia kauaiensis*
Koki'o Ke'oke'o (Hibiscus arnottianus ssp. immaculatus)	*Hibiscus arnottianus ssp. immaculatus*
Koki'o Ke'oke'o (Hibiscus waimeae ssp. hannerae)	*Hibiscus waimeae ssp. hannerae*
Koki'o, Cooke's (Kokia cookei)	*Kokia cookie*
kolea	*Myrsine mezii*
Kolea	*Myrsine knudsenii*
Kolea (Myrsine juddii)	*Myrsine juddii*
Kolea (Myrsine linearifolia)	*Myrsine linearifolia*
Ko'oko'olau (Bidens micrantha ssp. kalealaha)	*Bidens micrantha ssp. kalealaha*
Ko'oko'olau (Bidens wiebkei)	*Bidens wiebkei*
Ko'oloa'ula (Abutilon menziesii)	*Abutilon menziesii*
Kopa (Hedyotis schlechtendahliana var. remyi)	*Hedyotis schlechtendahliana var. remyi*
kopiko	*Psychotria grandiflora*
kopiko	*Psychotria hobdyi*
Kuawawaenohu (Alsinidendron lychnoides)	*Alsinidendron lychnoides*
Kulu'I (Nototrichium humile)	*Nototrichium humile*
Larkspur, Baker's	*Delphinium bakeri*
Larkspur, San Clemente Island	*Delphinium variegatum ssp. kinkiense*
Larkspur, Yellow	*Delphinium luteum*
Laukahi Kuahiwi (Plantago hawaiensis)	*Plantago hawaiensis*
Laukahi Kuahiwi (Plantago princeps)	*Plantago princeps*
Laulihilihi (Schiedea stellarioides)	*Schiedea stellarioides*
Laurel dace	*Chrosomus aylori*
Layia, Beach	*Layia carnosa*
Lead-plant, Crenulate	*Amorpha crenulata*
Leather-flower, Alabama	*Clematis socialis*
Leather-flower, Morefield's	*Clematis morefieldii*
lehua makanoe	*Lysimachia daphnoides*
Leptocereus grantianus (ncn)	*Leptocereus grantianus*
Lessingia, San Francisco	*Lessingia germanorum (=L.g. var. germanorum)*
Lichen, Rock Gnome	*Gymnoderma lineare*
Liliwai (Acaena exigua)	*Acaena exigua*
Limpet, Banbury Springs	*Lanx sp.*
Lipochaeta venosa (ncn)	*Lipochaeta venosa*
Liveforever, Laguna Beach	*Dudleya stolonifera*
Liveforever, Santa Barbara Island	*Dudleya traskiae*
Lizard, Blunt-nosed Leopard	*Gambelia silus*
Lizard, Coachella Valley Fringe-toed	*Uma inornata*
Lizard, Island Night	*Xantusia riversiana*
Lizard, St. Croix Ground	*Ameiva polops*
Lo`ulu (Pritchardia munroi)	*Pritchardia munroi*
Lo`ulu (Pritchardia remota)	*Pritchardia remota*
Lobelia monostachya (ncn)	*Lobelia monostachya*
Lobelia niihauensis (ncn)	*Lobelia niihauensis*

Common and Scientific Name	
Lobelia oahuensis (ncn)	*Lobelia oahuensis*
Locoweed, Fassett's	*Oxytropis campestris var. chartacea*
Logperch, Conasauga	*Percina jenkinsi*
Logperch, Roanoke	*Percina rex*
Lomatium, Bradshaw's	*Lomatium bradshawii*
Lomatium, Cook's	*Lomatium cookii*
Loosestrife, Rough-leaved	*Lysimachia asperulaefolia*
Lousewort, Furbish	*Pedicularis furbishiae*
Lupine, Clover	*Lupinus tidestromii*
Lupine, Kincaid's	*Lupinus sulphureus (=oreganus) ssp. kincaidii (=var. kincaidii)*
Lupine, Nipomo Mesa	*Lupinus nipomensis*
Lupine, Scrub	*Lupinus aridorum*
Lyonia truncata var. proctorii (ncn)	*Lyonia truncata var. proctorii*
Lysimachia filifolia (ncn)	*Lysimachia filifolia*
Lysimachia lydgatei (ncn)	*Lysimachia lydgatei*
Lysimachia maxima (ncn)	*Lysimachia maxima*
Madtom, Neosho	*Noturus placidus*
Madtom, Pygmy	*Noturus stanauli*
Madtom, Scioto	*Noturus trautmani*
Madtom, Smoky	*Noturus baileyi*
Madtom, Yellowfin	*Noturus flavipinnis*
Mahoe (Alectryon macrococcus)	*Alectryon macrococcus*
Makou (Peucedanum sandwicense)	*Peucedanum sandwicense*
Malacothrix, Island	*Malacothrix squalida*
Malacothrix, Santa Cruz Island	*Malacothrix indecora*
Mallow, Kern	*Eremalche kernensis*
Mallow, Peter's Mountain	*Iliamna corei*
Manioc, Walker's	*Manihot walkerae*
Manzanita, Del Mar	*Arctostaphylos glandulosa ssp. crassifolia*
Manzanita, Ione	*Arctostaphylos myrtifolia*
Manzanita, Morro	*Arctostaphylos morroensis*
Manzanita, Pallid	*Arctostaphylos pallida*
Manzanita, Presidio (=Raven's)	*Arctostaphylos hookeri var. ravenii*
Manzanita, Santa Rosa Island	*Arctostaphylos confertiflora*
Ma'o Hau Hele (Hibiscus brackenridgei)	*Hibiscus brackenridgei*
Ma'oli'oli (Schiedea apokremnos)	*Schiedea apokremnos*
Ma'oli'oli (Schiedea kealiae)	*Schiedea kealiae*
Mapele (Cyrtandra cyaneoides)	*Cyrtandra cyaneoides*
Marstonia, Royal (=Royal Snail)	*Pyrgulopsis ogmorhaphe*
Meadowfoam, Butte County	*Limnanthes floccosa ssp. californica*
Meadowfoam, Large-flowered Woolly	*Limnanthes floccosa ssp. Grandiflora*
Meadowfoam, Sebastopol	*Limnanthes vinculans*
Meadowrue, Cooley's	*Thalictrum cooleyi*
Megapode, Micronesian (La Perouse's)	*Megapodius laperouse*
Mehamehame (Flueggea neowawraea)	*Flueggea neowawraea*
Meshweaver, Braken Bat Cave	*Cicurina venii*
Meshweaver, Government Canyon Bat Cave	*Cicurina vespera*
Meshweaver, Madla's Cave	*Cicurina madla*
Meshweaver, Robber Baron Cave	*Cicurina baronia*
Milkpea, Small's	*Galactia smallii*
Milk-vetch, Applegate's	*Astragalus applegatei*

Common and Scientific Name	
Milk-vetch, Ash Meadows	*Astragalus phoenix*
Milk-vetch, Braunton's	*Astragalus brauntonii*
Milk-vetch, Clara Hunt's	*Astragalus clarianus*
Milk-vetch, Coachella Valley	*Astragalus lentiginosus var. coachellae*
Milk-vetch, Coastal Dunes	*Astragalus tener var. titi*
Milk-vetch, Cushenbury	*Astragalus albens*
Milk-vetch, Deseret	*Astragalus desereticus*
Milk-vetch, Fish Slough	*Astragalus lentiginosus var. piscinensis*
Milk-vetch, Heliotrope	*Astragalus montii*
Milk-vetch, Holmgren	*Astragalus holmgreniorum*
Milk-vetch, Jesup's	*Astragalus robbinsii var. jesupi*
Milk-vetch, Lane Mountain	*Astragalus jaegerianus*
Milk-vetch, Mancos	*Astragalus humillimus*
Milk-vetch, Osterhout	*Astragalus osterhoutii*
Milk-vetch, Pierson's	*Astragalus magdalenae var. peirsonii*
Milk-vetch, Sentry	*Astragalus cremnophylax var. cremnophylax*
Milk-vetch, Shivwits	*Astragalus ampullarioides*
Milk-vetch, Triple-ribbed	*Astragalus tricarinatus*
Milk-vetch, Ventura Marsh	*Astragalus pycnostachyus var. lanosissimus*
Milkweed, Mead's	*Asclepias meadii*
Milkweed, Welsh's	*Asclepias welshii*
Millerbird, Nihoa	*Acrocephalus familiaris kingi*
Minnow, Devils River	*Dionda diaboli*
Minnow, Loach	*Tiaroga cobitis*
Minnow, Rio Grande Silvery	*Hybognathus amarus*
Mint, Garrett's	*Dicerandra christmanii*
Mint, Lakela's	*Dicerandra immaculata*
Mint, Longspurred	*Dicerandra cornutissima*
Mint, Otay Mesa	*Pogogyne nudiuscula*
Mint, San Diego Mesa	*Pogogyne abramsii*
Mint, Scrub	*Dicerandra frutescens*
Mitracarpus Maxwelliae	*Mitracarpus maxwelliae*
Mitracarpus Polycladus	*Mitracarpus polycladus*
Monardella, Willowy	*Monardella linoides ssp. viminea*
Monkey-flower, Michigan	*Mimulus glabratus var. michiganensis*
Monkshood, Northern Wild	*Aconitum noveboracense*
Moorhen, Hawaiian Common	*Gallinula chloropus sandvicensis*
Moorhen, Mariana Common	*Gallinula chloropus guami*
Morning-glory, Stebbins	*Calystegia stebbinsii*
Moth, Blackburn's Sphinx	*Manduca blackburni*
Moth, Kern Primrose Sphinx	*Euproserpinus euterpe*
Mountainbalm, Indian Knob	*Eriodictyon altissimum*
Mountain-mahogany, Catalina Island	*Cercocarpus traskiae*
Mouse, Key Largo Cotton	*Peromyscus gossypinus allapaticola*
Mucket, Orange-nacre	*Lampsilis perovalis*
Mucket, Pink (Pearlymussel)	*Lampsilis abrupta*
Munroidendron racemosum (ncn)	*Munroidendron racemosum*
Murrelet, Marbled	*Brachyramphus marmoratus*
Mussel, Acornshell Southern	*Epioblasma othcaloogensis*
Mussel, Alabama Moccasinshell	*Medionidus acutissimus*
Mussel, Black (=Curtus' Mussel) Clubshell	*Pleurobema curtum*
Mussel, Clubshell	*Pleurobema clava*

Common and Scientific Name	
Mussel, Coosa Moccasinshell	*Medionidus parvulus*
Mussel, Cumberland Combshell	*Epioblasma brevidens*
Mussel, Cumberland Elktoe	*Alasmidonta atropurpurea*
Mussel, Cumberland Pigtoe	*Pleurobema gibberum*
Mussel, Dark Pigtoe	*Pleurobema furvum*
Mussel, Dwarf Wedge	*Alasmidonta heterodon*
Mussel, Fat Threeridge	*Amblema neislerii*
Mussel, Fine-lined Pocketbook	*Lampsilis altilis*
Mussel, Fine-rayed Pigtoe	*Fusconaia cuneolus*
Mussel, Flat Pigtoe (=Marshall's Mussel)	*Pleurobema marshalli*
Mussel, Georgia pigtoe	*Pleurobema hanleyianum*
Mussel, Gulf Moccasinshell	*Medionidus penicillatus*
Mussel, Heavy Pigtoe (=Judge Tait's Mussel)	*Pleurobema taitianum*
Mussel, Heelsplitter Carolina	*Lasmigona decorata*
Mussel, Heelsplitter Inflated	*Potamilus inflatus*
Mussel, Ochlockonee Moccasinshell	*Medionidus simpsonianus*
Mussel, Oval Pigtoe	*Pleurobema pyriforme*
Mussel, Ovate Clubshell	*Pleurobema perovatum*
Mussel, Oyster	*Epioblasma capsaeformis*
Mussel, Ring Pink (=Golf Stick Pearly)	*Obovaria retusa*
Mussel, Rough Pigtoe	*Pleurobema plenum*
Mussel, Scaleshell	*Leptodea leptodon*
Mussel, Shiny Pigtoe	*Fusconaia cor*
Mussel, Shiny-rayed Pocketbook	*Lampsilis subangulata*
Mussel, snuffbox	*Epioblasma triquetra*
Mussel, Southern Clubshell	*Pleurobema decisum*
Mussel, Southern Pigtoe	*Pleurobema georgianum*
Mussel, Speckled Pocketbook	*Lampsilis streckeri*
Mussel, Winged Mapleleaf	*Quadrula fragosa*
Mustard, Carter's	*Warea carteri*
Mustard, Penland Alpine Fen	*Eutrema penlandii*
Mustard, Slender-petaled	*Thelypodium stenopetalum*
Myrcia Paganii	*Myrcia paganii*
Na`ena`e	*Dubautia waialealae*
na`ena`e	*Dubautia imbricata imbricata*
na`ena`e	*Dubautia plantaginea magnifolia*
Naenae	*Dubautia kalalauensis*
Naenae	*Dubautia kenwoodii*
Na'ena'e (Dubautia herbstobatae)	*Dubautia herbstobatae*
Na'ena'e (Dubautia plantaginea ssp. humilis)	*Dubautia plantaginea ssp. humilis*
Nani Wai'ale'ale (Viola kauaensis var. wahiawaensis)	*Viola kauaiensis var. wahiawaensis*
Nanu (Gardenia mannii)	*Gardenia mannii*
Narrow Pigtoe	*Fusconaia escambia*
Na'u (Gardenia brighamii)	*Gardenia brighamii*
Naucorid, Ash Meadows	*Ambrysus amargosus*
Naupaka, Dwarf (Scaevola coriacea)	*Scaevola coriacea*
Navarretia, Few-flowered	*Navarretia leucocephala ssp. Pauciflora*
Navarretia, Many-flowered	*Navarretia leucocephala ssp. plieantha*
Navarretia, Spreading	*Navarretia fossalis*
Nehe (Lipochaeta fauriei)	*Lipochaeta fauriei*
Nehe (Lipochaeta kamolensis)	*Lipochaeta kamolensis*
Nehe (Lipochaeta lobata var. leptophylla)	*Lipochaeta lobata var. leptophylla*

Common and Scientific Name	
Nehe (Lipochaeta micrantha)	*Lipochaeta micrantha*
Nehe (Lipochaeta tenuifolia)	*Lipochaeta tenuifolia*
Nehe (Lipochaeta waimeaensis)	*Lipochaeta waimeaensis*
Neraudia angulata (ncn)	*Neraudia angulata*
Neraudia ovata (ncn)	*Neraudia ovata*
Neraudia sericea (ncn)	*Neraudia sericea*
Nesogenes rotensis (ncn)	*Nesogenes rotensis*
Nightjar, Puerto Rico	*Caprimulgus noctitherus*
Nioi (Eugenia koolauensis)	*Eugenia koolauensis*
Niterwort, Amargosa	*Nitrophila mohavensis*
nohoanu	*Geranium kauaiense*
Nohoanu (Geranium multiflorum)	*Geranium multiflorum*
Nuku Pu'u, Kauai	*Hemignathus lucidus hanapepe*
Nuku Pu'u, Maui	*Hemignathus lucidus affinus*
Oahu wild coffee	*Psychotria hexandra ssp. Oahuensis*
Oak, Hinckley	*Quercus hinckleyi*
Oceanic Hawaiian damselfly	*Megalagrion oceanicum*
'Oha (Delissea rivularis)	*Delissea rivularis*
'Oha (Delissea subcordata)	*Delissea subcordata*
'Oha (Delissea undulata)	*Delissea undulata*
'Oha (Lobelia gaudichaudii koolauensis)	*Lobelia gaudichaudii ssp. koolauensis*
'Oha Wai (Clermontia drepanomorpha)	*Clermontia drepanomorpha*
'Oha Wai (Clermontia lindseyana)	*Clermontia lindseyana*
'Oha Wai (Clermontia oblongifolia ssp. brevipes)	*Clermontia oblongifolia ssp. brevipes*
'Oha Wai (Clermontia oblongifolia ssp. mauiensis)	*Clermontia oblongifolia ssp. mauiensis*
'Oha Wai (Clermontia peleana)	*Clermontia peleana*
'Oha Wai (Clermontia pyrularia)	*Clermontia pyrularia*
'Oha Wai (Clermontia samuelii)	*Clermontia samuelii*
'Ohai (Sesbania tomentosa)	*Sesbania tomentosa*
'Ohe'ohe (Tetraplasandra gymnocarpa)	*Tetraplasandra gymnocarpa*
'Olulu (Brighamia insignis)	*Brighamia insignis*
'O'o, Kauai (='A'a)	*Moho braccatus*
Opuhe (Urera kaalae)	*Urera kaalae*
Osmoxylon mariannense (ncn)	*Osmoxylon mariannense*
Otter, Northern Sea	*Enhydra lutris kenyoni*
'O'u (Honeycreeper)	*Psittirostra psittacea*
Owl, Mexican Spotted	*Strix occidentalis lucida*
Owl, Northern Spotted	*Strix occidentalis caurina*
Oxytheca, Cushenbury	*Oxytheca parishii var. goodmaniana*
Ozark Hellbender	*Cryptobranchus alleganiensis bishopi*
Pagosa Skyrocket	*Ipomopsis polyantha*
Paintbrush, Ash-grey Indian	*Castilleja cinerea*
Paintbrush, Golden	*Castilleja levisecta*
Paintbrush, San Clemente Island Indian	*Castilleja grisea*
Paintbrush, Soft-leaved	*Castilleja mollis*
Paintbrush, Tiburon	*Castilleja affinis ssp. neglecta*
Palila	*Loxioides bailleui*
Palo Colorado (Ternstroemia luquillensis)	*Ternstroemia luquillensis*
Palo de Jazmin	*Styrax portoricensis*
Palo de Nigua	*Cornutia obovata*
Palo de Ramon	*Banara vanderbiltii*
Palo de Rosa	*Ottoschulzia rhodoxylon*

Common and Scientific Name	
Pamakani (Viola chamissoniana ssp. chamissoniana)	*Viola chamissoniana ssp. chamissoniana*
Papala	*Charpentiera densiflora*
Parachute Beardtongue	*Penstemon debilis*
Parrot, Puerto Rican	*Amazona vittata*
Parrotbill, Maui	*Pseudonestor xanthophrys*
Pauoa (Ctenitis squamigera)	*Ctenitis squamigera*
Pawpaw, Beautiful	*Deeringothamnus pulchellus*
Pawpaw, Four-petal	*Asimina tetramera*
Pawpaw, Rugel's	*Deeringothamnus rugelii*
Pearlshell, Louisiana	*Margaritifera hembeli*
Pearlymussel, Alabama Lamp	*Lampsilis virescens*
Pearlymussel, Appalachian Monkeyface	*Quadrula sparsa*
Pearlymussel, Birdwing	*Lemiox rimosus*
Pearlymussel, Cracking	*Hemistena lata*
Pearlymussel, Cumberland Bean	*Villosa trabalis*
Pearlymussel, Cumberland Monkeyface	*Quadrula intermedia*
Pearlymussel, Curtis'	*Epioblasma florentina curtisii*
Pearlymussel, Dromedary	*Dromus dromas*
Pearlymussel, Fat Pocketbook	*Potamilus capax*
Pearlymussel, Green-blossom	*Epioblasma torulosa gubernaculum*
Pearlymussel, Higgins' Eye	*Lampsilis higginsii*
Pearlymussel, Little-wing	*Pegias fibula*
Pearlymussel, Orange-footed	*Plethobasus cooperianus*
Pearlymussel, Pale Lilliput	*Toxolasma cylindrellus*
Pearlymussel, Purple Cat's Paw	*Epioblasma obliquata obliquata*
Pearlymussel, Tubercled-blossom	*Epioblasma torulosa torulosa*
Pearlymussel, Turgid-blossom	*Epioblasma turgidula*
Pearlymussel, White Cat's Paw	*Epioblasma obliquata perobliqua*
Pearlymussel, White Wartyback	*Plethobasus cicatricosus*
Pearlymussel, Yellow-blossom	*Epioblasma florentina florentina*
Pebblesnail, Flat	*Lepyrium showalteri*
Penny-cress, Kneeland Prairie	*Thlaspi californicum*
Pennyroyal, Todsen's	*Hedeoma todsenii*
Penstemon, Blowout	*Penstemon haydenii*
Pentachaeta, Lyon's	*Pentachaeta lyonii*
Pentachaeta, White-rayed	*Pentachaeta bellidiflora*
Peperomia, Wheeler's	*Peperomia wheeleri*
Peppergrass, Slick Spot	*Lepidium papilliferum*
Petrel, Hawaiian Dark-rumped	*Pterodroma phaeopygia sandwichensis*
Phacelia, Clay	*Phacelia argillacea*
Phacelia, Island	*Phacelia insularis ssp. insularis*
Phacelia, North Park	*Phacelia formosula*
Phlox, Texas Trailing	*Phlox nivalis ssp. texensis*
Phlox, Yreka	*Phlox hirsuta*
Phyllostegia hirsuta (ncn)	*Phyllostegia hirsuta*
Phyllostegia kaalaensis (ncn)	*Phyllostegia kaalaensis*
Phyllostegia knudsenii (ncn)	*Phyllostegia knudsenii*
Phyllostegia mannii (ncn)	*Phyllostegia mannii*
Phyllostegia mollis (ncn)	*Phyllostegia mollis*
Phyllostegia parviflora (ncn)	*Phyllostegia parviflora*
Phyllostegia velutina (ncn)	*Phyllostegia velutina*
Phyllostegia waimeae (ncn)	*Phyllostegia waimeae*

Common and Scientific Name	
Phyllostegia warshaueri (ncn)	*Phyllostegia warshaueri*
Phyllostegia wawrana (ncn)	*Phyllostegia wawrana*
Pigeon, Puerto Rican Plain	*Columba inornata wetmorei*
Pilo (Hedyotis mannii)	*Hedyotis mannii*
pilo kea lau li`i	*Platydesma rostrata*
Pinkroot, Gentian	*Spigelia gentianoides*
Pitaya, Davis' Green	*Echinocereus viridiflorus var. davisii*
Pitcher-plant, Alabama Canebrake	*Sarracenia rubra alabamensis*
Pitcher-plant, Green	*Sarracenia oreophila*
Pitcher-plant, Mountain Sweet	*Sarracenia rubra ssp. jonesii*
Plover, Piping	*Charadrius melodus*
Plover, Western Snowy	*Charadrius alexandrinus nivosus*
Plum, Scrub	*Prunus geniculata*
Po'e (Portulaca sclerocarpa)	*Portulaca sclerocarpa*
Polygala, Lewton's	*Polygala lewtonii*
Polygala, Tiny	*Polygala smallii*
Polygonum, Scott's Valley	*Polygonum hickmanii*
Polystichum calderonense (ncn)	*Polystichum calderonense*
Pondberry	*Lindera melissifolia*
Pondweed, Little Aguja Creek	*Potamogeton clystocarpus*
Poolfish, Pahrump (= Pahrump Killifish)	*Empetrichthys latos*
Po'ouli	*Melamprosops phaeosoma*
Popcornflower, Rough	*Plagiobothrys hirtus*
Popolo 'Aiakeakua (Solanum sandwicense)	*Solanum sandwicense*
Popolo Ku Mai (Solanum incompletum)	*Solanum incompletum*
Poppy, Sacramento Prickly	*Argemone pleiacantha ssp. pinnatisecta*
Poppy-mallow, Texas	*Callirhoe scabriuscula*
Potato-bean, Price's	*Apios priceana*
Potentilla, Hickman's	*Potentilla hickmanii*
Prairie-chicken, Attwater's Greater	*Tympanuchus cupido attwateri*
Prickly-apple, Fragrant	*Cereus eriophorus var. fragrans*
Prickly-ash, St. Thomas	*Zanthoxylum thomasianum*
Primrose, Maguire	*Primula maguirei*
Pseudoscorpion, Tooth Cave	*Tartarocreagris texana*
Pteris lidgatei (ncn)	*Pteris lidgatei*
Pua'ala (Brighamia rockii)	*Brighamia rockii*
Pupfish, Ash Meadows Amargosa	*Cyprinodon nevadensis mionectes*
Pupfish, Comanche Springs	*Cyprinodon elegans*
Pupfish, Desert	*Cyprinodon macularius*
Pupfish, Devils Hole	*Cyprinodon diabolis*
Pupfish, Leon Springs	*Cyprinodon bovinus*
Pupfish, Owens	*Cyprinodon radiosus*
Pupfish, Warm Springs	*Cyprinodon nevadensis pectoralis*
Purple Bean	*Villosa perpurpurea*
Pussypaws, Mariposa	*Calyptridium pulchellum*
Quillwort, Black-spored	*Isoetes melanospora*
Quillwort, Louisiana	*Isoetes louisianensis*
Quillwort, Mat-forming	*Isoetes tegetiformans*
Rabbit, Lower Keys Marsh	*Sylvilagus palustris hefneri*
Rabbitsfoot, Rough	*Quadrula cylindrica strigillata*
Rail, California Clapper	*Rallus longirostris obsoletus*
Rail, Guam	*Rallus owstoni*

Common and Scientific Name	
Rail, Light-footed Clapper	*Rallus longirostris levipes*
Rail, Yuma Clapper	*Rallus longirostris yumanensis*
Rattlesnake, New Mexican Ridge-nosed	*Crotalus willardi obscurus*
Rattleweed, Hairy	*Baptisia arachnifera*
Rayed Bean	*Villosa fabalis*
Reed-mustard, Barneby	*Schoenocrambe barnebyi*
Reed-mustard, Clay	*Schoenocrambe argillacea*
Reed-mustard, Shrubby	*Schoenocrambe suffrutescens*
Remya kauaiensis (ncn)	*Remya kauaiensis*
Remya montgomeryi (ncn)	*Remya montgomeryi*
Remya, Maui	*Remya mauiensis*
Rhadine exilis (ncn)	*Rhadine exilis*
Rhadine infernalis (ncn)	*Rhadine infernalis*
Rhododendron, Chapman	*Rhododendron chapmanii*
Rice Rat (=Silver Rice Rat)	*Oryzomys palustris natator*
Ridge-cress (=Pepper-cress), Barneby	*Lepidium barnebyanum*
Riffleshell, Northern	*Epioblasma torulosa rangiana*
Riffleshell, Tan	*Epioblasma florentina walkeri (=E. walkeri)*
Riversnail, Anthony's	*Athearnia anthonyi*
Rock-cress, Braun's	*Arabis perstellata E. L. Braun var. ampla Rollins*
Rock-cress, Hoffmann's	*Arabis hoffmannii*
Rock-cress, McDonald's	*Arabis mcdonaldiana*
Rock-cress, Santa Cruz Island	*Sibara filifolia*
Rock-cress, Shale Barren	*Arabis serotina*
Rock-cress, Small	*Arabis perstellata E. L. Braun var. perstellata Fernald*
Rockfish, Bocaccio	*Sebastes paucispinis*
Rockfish, Canary	*Sebastes pinniger*
Rock-pocketbook, Ouachita (=Wheeler's pm)	*Arkansia wheeleri*
Rocksnail, interrupted	*Leptoxis foremani*
Rocksnail, Painted	*Leptoxis taeniata*
Rocksnail, Plicate	*Leptoxis plicata*
Rocksnail, Round	*Leptoxis ampla*
Rosemary, Apalachicola	*Conradina glabra*
Rosemary, Cumberland	*Conradina verticillata*
Rosemary, Etonia	*Conradina etonia*
Rosemary, Short-leaved	*Conradina brevifolia*
Roseroot, Leedy's	*Sedum integrifolium ssp. leedyi*
Round Ebonyshell	*Fusconaia rotulata*
Rush darter	*Etheostoma phytophilum*
Rush-pea, Slender	*Hoffmannseggia tenella*
Rush-rose, Island	*Helianthemum greenei*
Salamander, Barton Springs	*Eurycea sosorum*
Salamander, California Tiger	*Ambystoma californiense*
Salamander, Cheat Mountain	*Plethodon nettingi*
Salamander, Desert Slender	*Batrachoseps aridus*
Salamander, Frosted Flatwoods	*Ambystoma cingulatum*
Salamander, Red Hills	*Phaeognathus hubrichti*
Salamander, Reticulated flatwoods	*Ambystoma bishopi*
Salamander, San Marcos	*Eurycea nana*
Salamander, Santa Cruz Long-toed	*Ambystoma macrodactylum croceum*
Salamander, Shenandoah	*Plethodon shenandoah*

Common and Scientific Name	
Salamander, Sonora Tiger	*Ambystoma tigrinum stebbinsi*
Salamander, Texas Blind	*Typhlomolge rathbuni*
Salmon, Atlantic	*Salmo salar*
Salmon, Chinook	*Oncorhynchus (=Salmo) tshawytscha*
Salmon, Chum	*Oncorhynchus (=Salmo) keta*
Salmon, Coho	*Oncorhynchus (=Salmo) kisutch*
Salmon, Sockeye	*Oncorhynchus (=Salmo) nerka*
San Francisco manzanita	*Arctostaphylos franciscana*
Sandalwood, Lanai (='Iliahi)	*Santalum freycinetianum var. lanaiense*
Sandlace	*Polygonella myriophylla*
Sand-verbena, Large-fruited	*Abronia macrocarpa*
Sandwort, Bear Valley	*Arenaria ursina*
Sandwort, Cumberland	*Arenaria cumberlandensis*
Sandwort, Marsh	*Arenaria paludicola*
Sanicula mariversa (ncn)	*Sanicula mariversa*
Sanicula purpurea (ncn)	*Sanicula purpurea*
Sawfish, Smalltooth	*Pristis pectinata*
Schiedea haleakalensis (ncn)	*Schiedea haleakalensis*
Schiedea helleri (ncn)	*Schiedea helleri*
Schiedea hookeri (ncn)	*Schiedea hookeri*
Schiedea kaalae (ncn)	*Schiedea kaalae*
Schiedea kauaiensis (ncn)	*Schiedea kauaiensis*
Schiedea lydgatei (ncn)	*Schiedea lydgatei*
Schiedea membranacea (ncn)	*Schiedea membranacea*
Schiedea nuttallii (ncn)	*Schiedea nuttallii*
Schiedea sarmentosa (ncn)	*Schiedea sarmentosa*
Schiedea spergulina var. leiopoda (ncn)	*Schiedea spergulina var. leiopoda*
Schiedea spergulina var. spergulina (ncn)	*Schiedea spergulina var. spergulina*
Schiedea verticillata (ncn)	*Schiedea verticillata*
Schiedea, Diamond Head (Schiedea adamantis)	*Schiedea adamantis*
Schoepfia arenaria (ncn)	*Schoepfia arenaria*
Scrub-Jay, Florida	*Aphelocoma coerulescens*
Sculpin, Pygmy	*Cottus paulus (=pygmaeus)*
Sea turtle, green	*Chelonia mydas*
Sea turtle, hawksbill	*Eretmochelys imbricata*
Sea turtle, Kemp's ridley	*Lepidochelys kempii*
Sea turtle, leatherback	*Dermochelys coriacea*
Sea turtle, loggerhead	*Caretta caretta*
Sea turtle, olive ridley	*Lepidochelys olivacea*
Sea-blite, California	*Suaeda californica*
Sheepnose mussel	*Plethobasus cyphyus*
Shiner, Arkansas River	*Notropis girardi*
Shiner, Beautiful	*Cyprinella formosa*
Shiner, Blue	*Cyprinella caerulea*
Shiner, Cahaba	*Notropis cahabae*
Shiner, Cape Fear	*Notropis mekistocholas*
Shiner, Palezone	*Notropis albizonatus*
Shiner, Pecos Bluntnose	*Notropis simus pecosensis*
Shiner, Topeka	*Notropis topeka (=tristis)*
Shrike, San Clemente Loggerhead	*Lanius ludovicianus mearnsi*
Shrimp, Alabama Cave	*Palaemonias alabamae*
Shrimp, California Freshwater	*Syncaris pacifica*

Common and Scientific Name	
Shrimp, Kentucky Cave	*Palaemonias ganteri*
Shrimp, Squirrel Chimney Cave	*Palaemonetes cummingi*
Silene alexandri (ncn)	*Silene alexandri*
Silene hawaiiensis (ncn)	*Silene hawaiiensis*
Silene lanceolata (ncn)	*Silene lanceolata*
Silene perlmanii (ncn)	*Silene perlmanii*
Silverside, Waccamaw	*Menidia extensa*
Silversword, Haleakala ('Ahinahina)	*Argyroxiphium sandwicense ssp. macrocephalum*
Silversword, Ka'u (Argyroxiphium kauense)	*Argyroxiphium kauense*
Silversword, Mauna Kea ('Ahinahina)	*Argyroxiphium sandwicense ssp. sandwicense*
Skink, Blue-tailed Mole	*Eumeces egregius lividus*
Skink, Sand	*Neoseps reynoldsi*
Skipper, Carson Wandering	*Pseudocopaeodes eunus obscurus*
Skipper, Laguna Mountain	*Pyrgus ruralis lagunae*
Skipper, Pawnee Montane	*Hesperia leonardus montana*
Skullcap, Florida	*Scutellaria floridana*
Skullcap, Large-flowered	*Scutellaria montana*
Slabshell, Chipola	*Elliptio chipolaensis*
Smelt, Delta	*Hypomesus transpacificus*
Snail, Armored	*Pyrgulopsis (=Marstonia) pachyta*
Snail, Bliss Rapids	*Taylorconcha serpenticola*
Snail, Chittenango Ovate Amber	*Succinea chittenangoensis*
Snail, Flat-spired Three-toothed	*Triodopsis platysayoides*
Snail, Iowa Pleistocene	*Discus macclintocki*
Snail, Lioplax Cylindrical	*Lioplax cyclostomaformis*
Snail, Morro Shoulderband	*Helminthoglypta walkeriana*
Snail, Noonday	*Mesodon clarki nantahala*
Snail, O'ahu Tree (Achatinella abbreviata)	*Achatinella abbreviata*
Snail, O'ahu Tree (Achatinella apexfulva)	*Achatinella apexfulva*
Snail, O'ahu Tree (Achatinella bellula)	*Achatinella bellula*
Snail, O'ahu Tree (Achatinella buddii)	*Achatinella buddii*
Snail, O'ahu Tree (Achatinella bulimoides)	*Achatinella bulimoides*
Snail, O'ahu Tree (Achatinella byronii)	*Achatinella byronii*
Snail, O'ahu Tree (Achatinella caesia)	*Achatinella caesia*
Snail, O'ahu Tree (Achatinella casta)	*Achatinella casta*
Snail, O'ahu Tree (Achatinella cestus)	*Achatinella cestus*
Snail, O'ahu Tree (Achatinella concavospira)	*Achatinella concavospira*
Snail, O'ahu Tree (Achatinella curta)	*Achatinella curta*
Snail, O'ahu Tree (Achatinella decipiens)	*Achatinella decipiens*
Snail, O'ahu Tree (Achatinella decora)	*Achatinella decora*
Snail, O'ahu Tree (Achatinella dimorpha)	*Achatinella dimorpha*
Snail, O'ahu Tree (Achatinella elegans)	*Achatinella elegans*
Snail, O'ahu Tree (Achatinella fulgens)	*Achatinella fulgens*
Snail, O'ahu Tree (Achatinella fuscobasis)	*Achatinella fuscobasis*
Snail, O'ahu Tree (Achatinella juddii)	*Achatinella juddii*
Snail, O'ahu Tree (Achatinella juncea)	*Achatinella juncea*
Snail, O'ahu Tree (Achatinella lehuiensis)	*Achatinella lehuiensis*
Snail, O'ahu Tree (Achatinella leucorraphe)	*Achatinella leucorraphe*
Snail, O'ahu Tree (Achatinella lila)	*Achatinella lila*
Snail, O'ahu Tree (Achatinella livida)	*Achatinella livida*
Snail, O'ahu Tree (Achatinella lorata)	*Achatinella lorata*
Snail, O'ahu Tree (Achatinella mustelina)	*Achatinella mustelina*

Common and Scientific Name	
Snail, O'ahu Tree (Achatinella papyracea)	*Achatinella papyracea*
Snail, O'ahu Tree (Achatinella phaeozona)	*Achatinella phaeozona*
Snail, O'ahu Tree (Achatinella pulcherrima)	*Achatinella pulcherrima*
Snail, O'ahu Tree (Achatinella pupukanioe)	*Achatinella pupukanioe*
Snail, O'ahu Tree (Achatinella rosea)	*Achatinella rosea*
Snail, O'ahu Tree (Achatinella sowerbyana)	*Achatinella sowerbyana*
Snail, O'ahu Tree (Achatinella spaldingi)	*Achatinella spaldingi*
Snail, O'ahu Tree (Achatinella stewartii)	*Achatinella stewartii*
Snail, O'ahu Tree (Achatinella swiftii)	*Achatinella swiftii*
Snail, O'ahu Tree (Achatinella taeniolata)	*Achatinella taeniolata*
Snail, O'ahu Tree (Achatinella thaanumi)	*Achatinella thaahumi*
Snail, O'ahu Tree (Achatinella turgida)	*Achatinella turgida*
Snail, O'ahu Tree (Achatinella valida)	*Achatinella valida*
Snail, O'ahu Tree (Achatinella viridans)	*Achatinella viridans*
Snail, O'ahu Tree (Achatinella vittata)	*Achatinella vittata*
Snail, O'ahu Tree (Achatinella vulpina)	*Achatinella vulpina*
Snail, Painted Snake Coiled Forest	*Anguispira picta*
Snail, Pecos Assiminea	*Assiminea pecos*
Snail, Snake River Physa	*Physa natricina*
Snail, Stock Island Tree	*Orthalicus reses (not incl. nesodryas)*
Snail, Tulotoma	*Tulotoma magnifica*
Snail, Virginia Fringed Mountain	*Polygyriscus virginianus*
Snake, Atlantic Salt Marsh	*Nerodia clarkii taeniata*
Snake, Eastern Indigo	*Drymarchon corais couperi*
Snake, Giant Garter	*Thamnophis gigas*
Snake, Northern Copperbelly Water	*Nerodia erythrogaster neglecta*
Snake, San Francisco Garter	*Thamnophis sirtalis tetrataenia*
Snakeroot	*Eryngium cuneifolium*
Sneezeweed, Virginia	*Helenium virginicum*
Snowbells, Texas	*Styrax texanus*
Southern Kidneyshell	*Ptychobranchus jonesi*
Southern Sandshell	*Hamiota australis*
Sparrow, Cape Sable Seaside	*Ammodramus maritimus mirabilis*
Sparrow, Florida Grasshopper	*Ammodramus savannarum floridanus*
Sparrow, San Clemente Sage	*Amphispiza belli clementeae*
Spectaclecase mussel	*Cumberlandia monodonta*
Spermolepis hawaiiensis (ncn)	*Spermolepis hawaiiensis*
Spider, Government Canyon Bat Cave	*Neoleptoneta microps*
Spider, Kauai Cave Wolf	*Adelocosa anops*
Spider, Spruce-fir Moss	*Microhexura montivaga*
Spider, Tooth Cave	*Leptoneta myopica*
Spikedace	*Meda fulgida*
Spinedace, Big Spring	*Lepidomeda mollispinis pratensis*
Spinedace, Little Colorado	*Lepidomeda vittata*
Spinedace, White River	*Lepidomeda albivallis*
Spineflower, Ben Lomond	*Chorizanthe pungens var. hartwegiana*
Spineflower, Howell's	*Chorizanthe howellii*
Spineflower, Monterey	*Chorizanthe pungens var. pungens*
Spineflower, Orcutt's	*Chorizanthe orcuttiana*
Spineflower, Robust	*Chorizanthe robusta va r. robusta*
Spineflower, Scotts Valley	*Chorizanthe robusta var. hartwegii*
Spineflower, Slender-horned	*Dodecahema leptoceras*

Common and Scientific Name	
Spineflower, Sonoma	*Chorizanthe valida*
Spinymussel, Altamaha	*Elliptio spinosa*
Spinymussel, James River	*Pleurobema collina*
Spinymussel, Tar River	*Elliptio steinstansana*
Spiraea, Virginia	*Spiraea virginiana*
Springfish, Hiko White River	*Crenichthys baileyi grandis*
Springfish, Railroad Valley	*Crenichthys nevadae*
Springfish, White River	*Crenichthys baileyi baileyi*
Springsnail, Alamosa	*Tryonia alamosae*
Springsnail, Bruneau Hot	*Pyrgulopsis bruneauensis*
Springsnail, Chupadera	*Pyrgulopsis chupaderae*
Springsnail, Koster's	*Juturnia kosteri*
Springsnail, Roswell	*Pyrgulopsis roswellensis*
Springsnail, San Bernardino	*Pyrgulopsis bernardina*
Springsnail, Socorro	*Pyrgulopsis neomexicana*
Springsnail, Three Forks	*Pyrgulopsis trivialis*
Spurge, Deltoid	*Chamaesyce deltoidea ssp. deltoidea*
Spurge, Garber's	*Chamaesyce garberi*
Spurge, Hoover's	*Chamaesyce hooveri*
Spurge, Telephus	*Euphorbia telephioides*
Squawfish, Colorado	*Ptychocheilus lucius*
Starling, Ponape Mountain	*Aplonis pelzelni*
Steelhead	*Oncorhynchus (=Salmo) mykiss*
Stenogyne angustifolia (ncn)	*Stenogyne angustifolia var. angustifolia*
Stenogyne bifida (ncn)	*Stenogyne bifida*
Stenogyne campanulata (ncn)	*Stenogyne campanulata*
Stenogyne kanehoana (ncn)	*Stenogyne kanehoana*
Stickleback, Unarmored Threespine	*Gasterosteus aculeatus williamsoni*
Stickseed, Showy	*Hackelia venusta*
Stickyseed, Baker's	*Blennosperma bakeri*
Stilt, Hawaiian (=Ae'o)	*Himantopus mexicanus knudseni*
Stirrupshell	*Quadrula stapes*
Stonecrop, Lake County	*Parvisedum leiocarpum*
Stork, Wood	*Mycteria americana*
Sturgeon, Alabama	*Scaphirhynchus suttkusi*
Sturgeon, Gulf	*Acipenser oxyrinchus desotoi*
Sturgeon, North American green	*Acipenser medirostris*
Sturgeon, Pallid	*Scaphirhynchus albus*
Sturgeon, Shortnose	*Acipenser brevirostrum*
Sturgeon, Shovelnose	*Scaphirhynchus platorynchus*
Sturgeon, White	*Acipenser transmontanus*
Sucker, June	*Chasmistes liorus*
Sucker, Lost River	*Deltistes luxatus*
Sucker, Modoc	*Catostomus microps*
Sucker, Razorback	*Xyrauchen texanus*
Sucker, Santa Ana	*Catostomus santaanae*
Sucker, Shortnose	*Chasmistes brevirostris*
Sucker, Warner	*Catostomus warnerensis*
Sumac, Michaux's	*Rhus michauxii*
Sunflower, Pecos	*Helianthus paradoxus*
Sunflower, San Mateo Woolly	*Eriophyllum latilobum*
Sunflower, Schweinitz's	*Helianthus schweinitzii*

Common and Scientific Name	
Sunray, Ash Meadows	*Enceliopsis nudicaulis var. corrugata*
Swiftlet, Mariana Gray (=Vanikoro)	*Aerodramus vanikorensis bartschi*
Tadpole Shrimp, Vernal Pool	*Lepidurus packardi*
Tapered Pigtoe	*Fusconaia burkei*
Taraxacum, California	*Taraxacum californicum*
Tarplant, Gaviota	*Deinandra increscens ssp. villosa*
Tarplant, Otay	*Deinandra (=Hemizonia) conjugens*
Tarplant, Santa Cruz	*Holocarpha macradenia*
Tectaria Estremerana	*Tectaria estremerana*
Tern, California Least	*Sterna antillarum browni*
Tern, Interior (population) Least	*Sterna antillarum*
Tern, Roseate	*Sterna dougallii dougallii*
Ternstroemia subsessilis (ncn)	*Ternstroemia subsessilis*
Tetramolopium arenarium (ncn)	*Tetramolopium arenarium*
Tetramolopium capillare (ncn)	*Tetramolopium capillare*
Tetramolopium filiforme (ncn)	*Tetramolopium filiforme*
Tetramolopium lepidotum ssp. lepidotum (ncn)	*Tetramolopium lepidotum ssp. lepidotum*
Tetramolopium remyi (ncn)	*Tetramolopium remyi*
Tetramolopium rockii (ncn)	*Tetramolopium rockii*
Thelypody, Howell's Spectacular	*Thelypodium howellii spectabilis*
Thistle, Chorro creek Bog	*Cirsium fontinale var. obispoense*
Thistle, Fountain	*Cirsium fontinale var. fontinale*
Thistle, La Graciosa	*Cirsium loncholepis*
Thistle, Pitcher's	*Cirsium pitcher*
Thistle, Sacramento Mountains	*Cirsium vinaceum*
Thistle, Suisun	*Cirsium hydrophilum var. hydrophilum*
Thornmint, San Diego	*Acanthomintha ilicifolia*
Thornmint, San Mateo	*Acanthomintha obovata ssp. duttonii*
Thrush, Large Kauai	*Myadestes myadestinus*
Thrush, Molokai (Oloma'o)	*Myadestes lanaiensis rutha*
Thrush, Small Kauai (Puaiohi)	*Myadestes palmeri*
Toad, Arroyo Southwestern	*Bufo californicus (=microscaphus)*
Toad, Houston	*Bufo houstonensis*
Toad, Wyoming	*Bufo baxteri (=hemiophrys)*
Topminnow, Gila (Yaqui)	*Poeciliopsis occidentalis*
Torreya, Florida	*Torreya taxifolia*
Tortoise, Desert	*Gopherus agassizi*
Tortoise, Gopher	*Gopherus polyphemus*
Towhee, Inyo Brown	*Pipilo crissalis eremophilus*
Townsendia, Last Chance	*Townsendia aprica*
Tree Fern, Elfin	*Cyathea dryopteroides*
Trematolobelia singularis (ncn)	*Trematolobelia singularis*
Trout, Apache	*Oncorhynchus apache*
Trout, Bull	*Salvelinus confluentus*
Trout, Gila	*Oncorhynchus gilae*
Trout, Greenback Cutthroat	*Oncorhynchus clarki stomias*
Trout, Lahontan Cutthroat	*Oncorhynchus clarki henshawi*
Trout, Little Kern Golden	*Oncorhynchus aguabonita whitei*
Trout, Paiute Cutthroat	*Oncorhynchus clarki seleniris*
Tuctoria, Green's	*Tuctoria greenei*
Turtle, Alabama Red-bellied	*Pseudemys alabamensis*
Turtle, Bog	*Clemmys muhlenbergii*

Common and Scientific Name	
Turtle, Flattened Musk	*Sternotherus depressus*
Turtle, Plymouth Red-bellied	*Pseudemys rubriventris bangsi*
Turtle, Ringed Map	*Graptemys oculifera*
Turtle, Yellow-blotched Map	*Graptemys flavimaculata*
Twinpod, Dudley Bluffs	*Physaria obcordata*
Uhiuhi (Caesalpinia kavaiensis)	*Caesalpinia kavaiense*
Ulihi (Phyllostegia glabra var. lanaiensis)	*Phyllostegia glabra var. lanaiensis*
Umbel, Huachuca Water	*Lilaeopsis schaffneriana var. recurva*
Uvillo	*Eugenia haematocarpa*
Vernonia Proctorii (ncn)	*Vernonia proctorii*
Vervain, California	*Verbena californica*
Vetch, Hawaiian (Vicia menziesii)	*Vicia menziesii*
Vigna o-wahuensis (ncn)	*Vigna o-wahuensis*
Viola helenae (ncn)	*Viola helenae*
Viola lanaiensis (ncn)	*Viola lanaiensis*
Viola oahuensis (ncn)	*Viola oahuensis*
Vireo, Black-capped	*Vireo atricapilla*
Vireo, Least Bell's	*Vireo bellii pusillus*
Wahane (Pritchardia aylmer-robinsonii)	*Pritchardia aylmer-robinsonii*
Wahine Noho Kula (Isodendrion pyrifolium)	*Isodendrion pyrifolium*
Wallflower, Ben Lomond	*Erysimum teretifolium*
Wallflower, Contra Costa	*Erysimum capitatum var. angustatum*
Wallflower, Menzie's	*Erysimum menziesii*
Warbler (=Wood), Golden-cheeked	*Dendroica chrysoparia*
Warbler (=Wood), Kirtland's	*Dendroica kirtlandii*
Warbler, Bachman's	*Vermivora bachmanii*
Warbler, nightingale reed (old world warbler)	*Acrocephalus luscinia*
Warea, Wide-leaf	*Warea amplexifolia*
Watercress, Gambel's	*Rorippa gambellii*
Water-willow, Cooley's	*Justicia cooleyi*
Wawae'Iole (Phlegmariurus (=Huperzia) mannii)	*Huperzia mannii*
Wawae'Iole (Phlegmariurus (=Lycopodium) nutans)	*Lycopodium (=Phlegmariurus) nutans*
Whale, Blue	*Balaenoptera musculus*
Whale, Bowhead	*Balaena mysticetus*
Whale, North Pacific right	*Eubalaena japonica*
Whipsnake (=Striped Racer), Alameda	*Masticophis lateralis euryxanthus*
White-eye, Bridled (Nossa)	*Zosterops conspicillatus conspicillatus*
White-eye, Ponape greater	*Rukia longirostra*
White-eye, Rota Bridled	*Zosterops rotensis*
Whitlow-wort, Papery	*Paronychia chartacea*
Wild-buckwheat, Clay-loving	*Eriogonum pelinophilum*
Wild-buckwheat, Gypsum	*Eriogonum gypsophilum*
Wings, Pigeon	*Clitoria fragrans*
Wire-lettuce, Malheur	*Stephanomeria malheurensis*
Wireweed	*Polygonella basiramia*
Woodland-star, San Clemente Island	*Lithophragma maximum*
Woodpecker, Ivory-billed	*Campephilus principalis*
Woodpecker, Red-cockaded	*Picoides borealis*
Woodrat, Key Largo	*Neotoma floridana smalli*
Woolly-star, Santa Ana River	*Eriastrum densifolium ssp. sanctorum*
Woolly-threads, San Joaquin	*Monolopia (=Lembertia) congdonii*
Woundfin	*Plagopterus argentissimus*

Common and Scientific Name	
Xylosma crenatum (ncn)	*Xylosma crenatum*
Yellowcheek darter	*Etheostoma moorei*
Yellowhead, Desert	*Yermo xanthocephalus*
Yerba Santa, Lompoc	*Eriodictyon capitatum*
Ziziphus, Florida	*Ziziphus celata*

Table J-2. "No Effects" (Direct Effects Only) Determination for Listed Species Within Geographical Range of Quizalofop-P-Ethyl Uses, Based on Species Ecology and Biology

Common and Scientific Name		Location	Taxon	Basis for "No Effects"
Bat, Lesser (=Sanborn's) Long-nosed	*Leptonycteris curasoae yerbabuenae*	Arizona, New Mexico	Mammal	Diet is seeds.[1] This dietary item does not produce EECs that yield RQs above the LOC.
Gray Wolf	*Canis lupus*	Michigan, Nebraska, Nevada, New Mexico, North Dakota, Washington, Wisconsin	Mammal	Diet is mammals and fish.[2] Not likely to be exposed to residues through diet.
Jaguar	*Panthera onca*	Arizona, California, New Mexico	Mammal	Diet is fish, mammals, reptiles, birds.[3] Unlikely to be exposed to residues through diet route.
Jaguarundi, Gulf Coast	*Herpailurus (=Felis) yagouaroundi cacomitli*	Texas	Mammal	Diet is mammals, birds, and reptiles.[4] Unlikely to be exposed to residues through diet route.
Jaguarundi, Sinaloan	*Herpailurus (=Felis) yagouaroundi tolteca*	Arizona	Mammal	Diet is amphibian, fish, birds, seeds, mammals, and reptiles.[5] Unlikely to be exposed to residues through diet route.
Killer whale, Southern Resident DPS	*Orcinus orca*	Washington	Mammal	Diet is fish, mammals, and aquatic invertebrates.[6] Not likely to be exposed to residues through diet.
Lynx, Canada	*Lynx canadensis*	Colorado, Idaho, Maine, Michigan, Minnesota, Montana, New Hampshire, Oregon, Utah, Vermont, Washington, Wisconsin, Wyoming	Mammal	Diet is mammals, carrion, and fish.[7] Unlikely to be exposed to residues through diet route.

Common and Scientific Name		Location	Taxon	Basis for "No Effects"
Manatee, West Indian	*Trichechus manatus*	Alabama, Florida, Georgia, Louisiana, Mississippi, North Carolina, Puerto Rico, South Carolina, Texas	Mammal	Diet is aquatic plants.[8] Unlikely to be exposed to residues through diet route.
Ocelot	*Leopardus (=Felis) pardalis*	Arizona, Texas	Mammal	Diet is mammals, birds, and reptiles.[9] Unlikely to be exposed to residues through diet route.
Otter, Southern Sea	*Enhydra lutris nereis*	California	Mammal	Diet is aquatic invertebrates and fish.[10] Unlikely to be exposed to residues through diet route.
Panther, Florida	*Puma (=Felis) concolor coryi*	Arkansas, Florida	Mammal	Diet is mammals and reptiles.[11] Unlikely to be exposed to residues through these food sources.
Seal, Guadalupe Fur	*Arctocephalus townsendi*	California	Mammal	Diet is aquatic invertebrates and fish.[12] Unlikely to be exposed to residues through diet route.
Seal, Hawaiian Monk	*Monachus schauinslandi*	Hawaii	Mammal	Diet is aquatic invertebrates and fish.[13] Unlikely to be exposed to residues through diet route.
Seal, spotted	*Phoca largha*	Alaska	Mammal	Diet is aquatic invertebrates and fish.[14] Unlikely to be exposed to residues through diet route.
Sea-lion, Steller	*Eumetopias jubatus*	California	Mammal	Diet is aquatic invertebrates and fish, may also include some mammals and birds.[15] Unlikely to be exposed to residues through diet route.
Squirrel, Mount Graham Red	*Tamiasciurus hudsonicus grahamensis*	Arizona	Mammal	Diet is carrion and seeds.[16] Carrion is not likely to be a source of residue exposures. Seeds yielded EECs that produced RQs below the LOC.
Whale, beluga	*Delphinapterus leucas*	Alaska	Mammal	Diet is aquatic invertebrates and fish.[17] Unlikely to be exposed to residues through diet route.
Whale, Finback	*Balaenoptera physalus*	California	Mammal	Diet is aquatic invertebrates and fish.[18] Unlikely to be exposed to residues through diet route.

Common and Scientific Name		Location	Taxon	Basis for "No Effects"
Whale, Gray	*Eschrichtius robustus*	Alaska, California, Oregon, Washington	Mammal	Diet is aquatic invertebrates.[19] Unlikely to be exposed to residues through diet route.
Whale, Humpback	*Megaptera novaeangliae*	California, Georgia	Mammal	Diet is aquatic invertebrates and fish.[20] Unlikely to be exposed to residues through diet route.
Whale, North Atlantic right	*Eubalaena glacialis (incl. australis)*	California, Georgia	Mammal	Diet is aquatic invertebrates.[21] Unlikely to be exposed to residues through diet route.
Whale, Sei	*Balaenoptera borealis*	California	Mammal	Diet is aquatic invertebrates and fish.[22] Unlikely to be exposed to residues through diet route.
Whale, Sperm	*Physeter catodon (=macrocephalus)*	California	Mammal	Diet is aquatic invertebrates and fish.[23] Unlikely to be exposed to residues through diet route.
Wolf, Red	*Canis rufus*	Kentucky, North Carolina	Mammal	Diet is mammals.[24] Unlikely to be exposed to residues through diet.
Guajon	*Eleutherodactylus cooki*	Puerto Rico	Amphibian	Lives in caves.[25] Unlikely to be exposed to residues.
Amphipod, Kauai Cave	*Spelaeorchestia koloana*	Hawaii	Crustacean	Lives in caves.[26] Unlikely to be exposed to residues.

[1]USFWS. 1994. Recovery plan for the lesser long-nosed bat.
[2]USFWS. 1982. Mexican wolf recovery plan.
[2]USFWS. 1987. Northern rocky mountain wolf recovery plan.
[2]USFWS. 1992. Recovery plan for the eastern timber wolf.
[2]USFWS. 2012. Gray wolf (*Canis lupus*).
[3]USFWS. 2010. Species profile for the jaguar.
[4]USFWS. 2001. Jaguarundi general species information.
[5]Arizona Game and Fish Department. 2004. Herpailurus yaguarondi tolteca. Unpublished abstract compiled and edited by the Heritage Data Management System.
[6]USNMFS. 2006. Designation of critical habitat for southern resident killer whale. Federal register. 71. No. 229.
[7]USFWS. 2012. Canada lynx (*Lynx canadensis*)
[8]USFWS. 2007. West indian manatee (*Trichechus manatus*) 5-year review: summary and evaluation.
[8]USFWS. 2001. Florida manatee (*Trichechus manatus latirostris*) recovery plan, third revision.
[8]USFWS. Recovery plan for the Puerto Rico population of the west indian (Antillean) manatee (*Trichechus manatus manatus*).
[9]USFWS. 2010. Ocelot (*Leopardus pardalis*) recovery plan, draft first revision.
[10]USFWS. 2003. Final revised recovery plan for the southern sea otter (*Enhydra lutris nereis*).
[11]USFWS. 2008. Third revision of the florida panther recovery plan.
[12]USNMFS. Species profile: Guadalupe fur seal. NOAA Fisheris Office of Protected Resources.
[13]USNMFS. 2007. Recovery plan for the Hawaiian monk seal (revision).
[14]USNMFS. 2010. Threatened status for the southern distinct population segment of the spotted seal. Federal Register. 75. No. 204.
[15]USNMFS. 2008. Recovery plan for the steller sea lion eastern and western distinct population segments (*Eumetopias jubatus*)
[16]USFWS. 2011. Draft mount graham red squirrel recovery plan, first revision. USFS.
[17]USNMFS. 2013. Species profile for the beluga whale. Office of Protected Resources, NOAA Fisheries.
[18]USNMFS. 2010. Recovery plan for the fin whale (*Baalaenoptera physalus*).
[19]USNMFS. 1991. Endangered fish and wildlife, gray whale. Federal Register. 56. No. 226.
[20]USNMFS. 1991. Final recovery plan for the humpback whale (*Megaptera novaeangliae*). Prepared by the Humpback Whale Recovery Team for the National Marine Fisheries Service, Silver Spring, MD.
[21]USFWS. 2010. North Atlantic right whale recovery plan.
[22]USNMFS. 2012. Sei whale (*Balaenoptera borealis*). NOAA Fisheries.

Common and Scientific Name	Location	Taxon	Basis for "No Effects"

[23]USNMFS. 2012. Sperm whales (*Physeter macrocephalus*). NOAA Fisheries.
[24]USFWS. 1995. FR Notice of critical habitat. Federal Register. 60. No. 71.
[24]Paradiso, J. L. and R. M. Nowak. 1972. *Canus rufus.* The American Society of Mammologists, Mammalian Species.
[25]USFWS. 2004. Recovery plan for the guajon or Puerto Rican demon (*Eleutherodactylus cooki*).
[26]USFWS. 2006. Final recovery plan for the Kaua'I cave arthropods: the Kaua'I cave wolf spider (*Adelocosa anops*) and the Kaua'I cave amphipod (*Spelaeorchestia koloana*).

Table J-3. Listed Species Within Geographical Range of Quizalofop-P-Ethyl Uses that Require Additional Information for Effects Calls

Common and Scientific Name		Habit	Location	Taxon
Coqui, Golden	*Eleutherodactylus jasperi*	Terrestrial, Freshwater	Puerto Rico	Amphibian
Llanero coqui	*Eleutherodactylus juanariveroi*	Terrestrial	Puerto Rico	Amphibian
Toad, Puerto Rican Crested	*Peltophryne lemur*	Terrestrial, Freshwater	Puerto Rico	Amphibian
Snail, Newcomb's	*Erinna newcombi*	Freshwater	Hawaii	Gastropod
Bat, Gray	*Myotis grisescens*	Terrestrial, Subterraneous	Alabama, Arkansas, Florida, Georgia, Illinois, Indiana, Kansas, Kentucky, Mississippi, Missouri, North Carolina, Oklahoma, Tennessee, Virginia	Mammal
Bat, Hawaiian Hoary	*Lasiurus cinereus semotus*	Terrestrial, Subterraneous	Hawaii	Mammal
Bat, Indiana	*Myotis sodalis*	Terrestrial, Subterraneous	Alabama, Arkansas, Connecticut, Florida, Georgia, Illinois, Indiana, Iowa, Kentucky, Maryland, Massachusetts, Michigan, Mississippi, Missouri, New Jersey, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, Tennessee, Vermont, Virginia, West Virginia	Mammal
Bat, Mexican Long-nosed	*Leptonycteris nivalis*	Terrestrial, Subterraneous	New Mexico, Texas	Mammal
Bat, Ozark Big-eared	*Corynorhinus (=Plecotus) townsendii ingens*	Terrestrial, Subterraneous	Arkansas, Oklahoma, Virginia	Mammal

Common and Scientific Name		Habit	Location	Taxon
Bat, Virginia Big-eared	*Corynorhinus (=Plecotus) townsendii virginianus*	Terrestrial, Subterraneous	Kentucky, North Carolina, West Virginia	Mammal
Bear, Grizzly	*Ursus arctos horribilis*	Terrestrial	Idaho, Montana, Washington	Mammal
Bear, Louisiana Black	*Ursus americanus luteolus*	Terrestrial	Louisiana, Mississippi, Texas	Mammal
Bison, Wood	*Bison bison athabascae*	Terrestrial	Alaska	Mammal
Caribou, Woodland	*Rangifer tarandus caribou*	Terrestrial	Idaho, Washington	Mammal
Deer, Columbian White-tailed	*Odocoileus virginianus leucurus*	Terrestrial	Oregon, Washington	Mammal
Ferret, Black-footed	*Mustela nigripes*	Terrestrial	Arizona, Colorado, Kansas, Montana, Nebraska, New Mexico, North Dakota, South Dakota, Utah, Wyoming	Mammal
Fox, San Joaquin Kit	*Vulpes macrotis mutica*	Terrestrial	California	Mammal
Fox, San Miguel Island	*Urocyon littoralis littoralis*	Terrestrial	California	Mammal
Fox, Santa Catalina Island	*Urocyon littoralis catalinae*	Terrestrial	California	Mammal
Fox, Santa Cruz Island	*Urocyon littoralis santacruzae*	Terrestrial	California	Mammal
Fox, Santa Rosa Island	*Urocyon littoralis santarosae*	Terrestrial	California	Mammal
Kangaroo Rat, Fresno	*Dipodomys nitratoides exilis*	Terrestrial	California	Mammal
Kangaroo Rat, Giant	*Dipodomys ingens*	Terrestrial	California	Mammal
Kangaroo Rat, Morro Bay	*Dipodomys heermanni morroensis*	Terrestrial	California	Mammal
Kangaroo Rat, San Bernardino Merriam's	*Dipodomys merriami parvus*	Terrestrial	California	Mammal
Kangaroo Rat, Stephens'	*Dipodomys stephensi (incl. D. cascus)*	Terrestrial	California	Mammal
Kangaroo Rat, Tipton	*Dipodomys nitratoides nitratoides*	Terrestrial	California	Mammal
Mountain Beaver, Point Arena	*Aplodontia rufa nigra*	Terrestrial, Freshwater	California	Mammal

Common and Scientific Name		Habit	Location	Taxon
Mouse, Alabama Beach	*Peromyscus polionotus ammobates*	Terrestrial, Coastal	Alabama	Mammal
Mouse, Anastasia Island Beach	*Peromyscus polionotus phasma*	Terrestrial, Coastal	Florida	Mammal
Mouse, Choctawhatchee Beach	*Peromyscus polionotus allophrys*	Terrestrial, Coastal	Florida	Mammal
Mouse, Pacific Pocket	*Perognathus longimembris pacificus*	Terrestrial	California	Mammal
Mouse, Perdido Key Beach	*Peromyscus polionotus trissyllepsis*	Terrestrial, Coastal	Alabama, Florida	Mammal
Mouse, Preble's Meadow Jumping	*Zapus hudsonius preblei*	Terrestrial	Colorado, Wyoming	Mammal
Mouse, Salt Marsh Harvest	*Reithrodontomys raviventris*	Terrestrial	California	Mammal
Mouse, Southeastern Beach	*Peromyscus polionotus niveiventris*	Terrestrial, Coastal	Florida	Mammal
Mouse, St. Andrew Beach	*Peromyscus polionotus peninsularis*	Terrestrial, Coastal	Florida	Mammal
Prairie Dog, Utah	*Cynomys parvidens*	Terrestrial, Subterraneous	Utah	Mammal
Pronghorn, Sonoran	*Antilocapra americana sonoriensis*	Terrestrial	Arizona	Mammal
Puma (=Cougar), Eastern	*Puma (=Felis) concolor (all subsp. except coryi)*	Terrestrial	Florida, North Carolina, Rhode Island	Mammal
Rabbit, Pygmy	*Brachylagus idahoensis*	Terrestrial	Washington	Mammal
Rabbit, Riparian Brush	*Sylvilagus bachmani riparius*	Terrestrial	California	Mammal
Sheep, Peninsular Bighorn	*Ovis canadensis nelsoni*	Terrestrial	California	Mammal
Sheep, Sierra Nevada Bighorn	*Ovis canadensis sierrae*	Terrestrial	California	Mammal
Shrew, Buena Vista Lake Ornate	*Sorex ornatus relictus*	Terrestrial	California	Mammal
Squirrel, Carolina Northern Flying	*Glaucomys sabrinus coloratus*	Terrestrial	North Carolina, Tennesee, Virginia	Mammal
Squirrel, Delmarva Peninsula Fox	*Sciurus niger cinereus*	Terrestrial	Delaware, Maryland, Virginia	Mammal
Squirrel, Northern Idaho Ground	*Spermophilus brunneus brunneus*	Terrestrial	Idaho	Mammal

Common and Scientific Name		Habit	Location	Taxon
Squirrel, Virginia Northern Flying	*Glaucomys sabrinus fuscus*	Terrestrial	Virginia	Mammal
Vole, Amargosa	*Microtus californicus scirpensis*	Terrestrial	California	Mammal
Vole, Florida Salt Marsh	*Microtus pennsylvanicus dukecampbelli*	Terrestrial, Brackish	Florida	Mammal
Vole, Hualapai Mexican	*Microtus mexicanus hualpaiensis*	Terrestrial	Arizona	Mammal
Woodrat, Riparian	*Neotoma fuscipes riparia*	Terrestrial	California	Mammal
Alopecurus, Sonoma	*Alopecurus aequalis var. sonomensis*	Unattributed Wetland Status	California	Monocot
Amole, Cammatta Canyon	*Chlorogalum purpureum var. reductum*	Unattributed Wetland Status	California	Monocot
Amole, Purple	*Chlorogalum purpureum var. purpureum*	Unattributed Wetland Status	California	Monocot
Aristida chaseae (ncn)	*Aristida chaseae*	Unattributed Wetland Status	Puerto Rico	Monocot
Arrowhead, Bunched	*Sagittaria fasciculata*	Wetland	North Carolina, South Carolina	Monocot
Beaked-rush, Knieskern's	*Rhynchospora knieskernii*	Wetland	New Jersey	Monocot
Beargrass, Britton's	*Nolina brittoniana*	Unattributed Wetland Status	Florida	Monocot
Beauty, Harper's	*Harperocallis flava*	Wetland	Florida	Monocot
Bluegrass, Hawaiian	*Poa sandvicensis*	Wetland	Hawaii	Monocot
Bluegrass, Mann's (Poa mannii)	*Poa mannii*	Wetland	Hawaii	Monocot
Bluegrass, Napa	*Poa napensis*	Wetland	California	Monocot
Bluegrass, San Bernardino	*Poa atropurpurea*	Wetland	California	Monocot
Brodiaea, Chinese Camp	*Brodiaea pallida*	Wetland	California	Monocot
Brodiaea, Thread-leaved	*Brodiaea filifolia*	Wetland	California	Monocot
Bulrush, Northeastern (=Barbed Bristle)	*Scirpus ancistrochaetus*	Wetland	Alabama, Maryland, Massachusetts, New Hampshire, Pennsylvania, Vermont, Virginia, West Virginia	Monocot

Common and Scientific Name		Habit	Location	Taxon
Cranichis Ricartii	*Cranichis ricartii*	Unattributed Wetland Status	Puerto Rico	Monocot
Fritillary, Gentner's	*Fritillaria gentneri*	Unattributed Wetland Status	Oregon	Monocot
Grass, California Orcutt	*Orcuttia californica*	Wetland	California	Monocot
Grass, Colusa	*Neostapfia colusana*	Wetland	California	Monocot
Grass, Eureka Dune	*Swallenia alexandrae*	Unattributed Wetland Status	California	Monocot
Grass, Fosberg's Love	*Eragrostis fosbergii*	Unattributed Wetland Status	Hawaii	Monocot
Grass, San Joaquin Valley Orcutt	*Orcuttia inaequalis*	Wetland	California	Monocot
Grass, Solano	*Tuctoria mucronata*	Wetland	California	Monocot
Grass, Tennessee Yellow-eyed	*Xyris tennesseensis*	Wetland	Alabama, Georgia, Tennessee	Monocot
Hala Pepe (Pleomele hawaiiensis)	*Pleomele hawaiiensis*	Unattributed Wetland Status	Hawaii	Monocot
Hilo Ischaemum (Ischaemum byrone)	*Ischaemum byrone*	Wetland	Hawaii	Monocot
Iris, Dwarf Lake	*Iris lacustris*	Wetland	Michigan, Wisconsin	Monocot
Irisette, White	*Sisyrinchium dichotomum*	Unattributed Wetland Status	North Carolina, South Carolina	Monocot
Kamanomano (Cenchrus agrimonioides)	*Cenchrus agrimonioides*	Unattributed Wetland Status	Hawaii	Monocot
Ladies'-tresses, Canelo Hills	*Spiranthes delitescens*	Wetland	Arizona	Monocot
Ladies'-tresses, Navasota	*Spiranthes parksii*	Unattributed Wetland Status	Texas	Monocot
Ladies'-tresses, Ute	*Spiranthes diluvialis*	Wetland	Arkansas, Colorado, Idaho, Montana, Nebraska, Nevada, Utah, Washington, Wyoming	Monocot
Lau'ehu (Panicum niihauense)	*Panicum niihauense*	Unattributed Wetland Status	Hawaii	Monocot
Lepanthes eltorensis (ncn)	*Lepanthes eltoroensis*	Unattributed Wetland Status	Puerto Rico	Monocot
Lily, Minnesota Trout	*Erythronium propullans*	Unattributed Wetland Status	Minnesota	Monocot
Lily, Pitkin Marsh	*Lilium pardalinum ssp. pitkinense*	Unattributed Wetland Status	California	Monocot

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Lily, Tiburon Mariposa	*Calochortus tiburonensis*	Unattributed Wetland Status	California	Monocot
Lily, Western	*Lilium occidentale*	Wetland	California, Oregon	Monocot
lo`ulu	*Pritchardia hardyi*	Wetland	Hawaii	Monocot
Lo`ulu (Pritchardia affinis)	*Pritchardia affinis*	Wetland	Hawaii	Monocot
Lo`ulu (Pritchardia kaalae)	*Pritchardia kaalae*	Wetland	Hawaii	Monocot
Lo`ulu (Pritchardia napaliensis)	*Pritchardia napaliensis*	Unattributed Wetland Status	Hawaii	Monocot
Lo`ulu (Pritchardia schattaueri)	*Pritchardia schattaueri*	Unattributed Wetland Status	Hawaii	Monocot
Lo`ulu (Pritchardia viscosa)	*Pritchardia viscosa*	Wetland	Hawaii	Monocot
Manaca, palma de	*Calyptronoma rivalis*	Wetland	Puerto Rico	Monocot
Mariscus fauriei (ncn)	*Mariscus fauriei*	Unattributed Wetland Status	Hawaii	Monocot
Mariscus pennatiformis (ncn)	*Mariscus pennatiformis*	Unattributed Wetland Status	Hawaii	Monocot
Onion, Munz's	*Allium munzii*	Unattributed Wetland Status	California	Monocot
Orchid, Eastern Prairie Fringed	*Platanthera leucophaea*	Wetland	Illinois, Indiana, Iowa, Maine, Michigan, New York, Ohio, Oklahoma, Virginia, Wisconsin	Monocot
Orchid, Western Prairie Fringed	*Platanthera praeclara*	Unattributed Wetland Status	Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, Oklahoma, South Dakota, Wyoming	Monocot
Pa'iniu	*Astelia waialealae*	Wetland	Hawaii	Monocot
Panicgrass, Carter's (Panicum fauriei var.carteri)	*Panicum fauriei var. carteri*	Unattributed Wetland Status	Hawaii	Monocot
Pelos del Diablo	*Aristida portoricensis*	Unattributed Wetland Status	Puerto Rico	Monocot
Pink, Swamp	*Helonias bullata*	Wetland	Georgia, Maryland, New Jersey, North Carolina, South Carolina, Virginia	Monocot
Piperia, Yadon's	*Piperia yadonii*	Unattributed Wetland Status	California	Monocot

Common and Scientific Name		Habit	Location	Taxon
Platanthera holochila (ncn)	*Platanthera holochila*	Wetland	Hawaii	Monocot
Poa siphonoglossa (ncn)	*Poa siphonoglossa*	Wetland	Hawaii	Monocot
Pogonia, Small Whorled	*Isotria medeoloides*	Wetland	Connecticut, Delaware, Georgia, Illinois, Maine, Massachusetts, Michigan, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Rhode Island, South Carolina, Tennessee, Vermont, Virginia, West Virginia	Monocot
Pu'uka'a (Cyperus trachysanthos)	*Cyperus trachysanthos*	Wetland	Hawaii	Monocot
Seagrass, Johnson's	*Halophila johnsonii*	Wetland	Florida	Monocot
Sedge, Golden	*Carex lutea*	Unattributed Wetland Status	North Carolina	Monocot
Sedge, Navajo	*Carex specuicola*	Wetland	Arizona, Utah	Monocot
Sedge, White	*Carex albida*	Wetland	California	Monocot
Trillium, Persistent	*Trillium persistens*	Unattributed Wetland Status	Georgia, South Carolina	Monocot
Trillium, Relict	*Trillium reliquum*	Unattributed Wetland Status	Alabama, Georgia, South Carolina	Monocot
Walnut, Nogal	*Juglans jamaicensis*	Unattributed Wetland Status	Puerto Rico	Monocot
Water-plantain, Kral's	*Sagittaria secundifolia*	Wetland	Alabama, Georgia	Monocot
Wild-rice, Texas	*Zizania texana*	Wetland	Texas	Monocot