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

OFFICE OF
PREVENTION, PESTICIDES AND
TOXIC SUBSTANCES

DP Barcodes: D313814, D316736, D316735
PC Code: 128008

Date: September 8, 2005

SUBJECT: Risk Assessment for Proposed Use of Boscalid on Leafy Vegetables, Spinach, and Celery and as a Seed Treatment for Brassicas, Bulb Vegetables, Cucurbits, Legume Vegetables, Peanut and Sunflower.

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I. Executive Summary

EFED has completed reviews for the requested uses of boscalid on leafy vegetables and as a seed treatment for multiple crops listed below.

The IR-4 request is for the use of boscalid (Pristine® (+pyraclostrobin) and Endura®) to control *Cercospora*, white rust and other diseases on leafy vegetables except brassica vegetables (DP Barcode D313814). Endura (70% boscalid) is to be applied via ground spray at a rate of up to 9 fl oz (0.396 lb a.i.) per acre and not more than 18 fl oz (0.792 lb a.i.) per acre per season. Pristine (25.2% boscalid and 12.8% pyraclostrobin) is to be applied via ground spray at a rate of up to 25 fl. oz (0.395 lb a.i.) per acre and not more than a total of 50 fl. oz (0.790 lb a.i.) per acre per season. Applications of Endura or Pristine should occur prior to disease development and continue on a 7- to 14-day interval; they should

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not be applied at intervals less than 7 days. This assessment is based on maximum application rates for boscalid only.

An application was also submitted for the use of boscalid (BAS 510 04F and BAS 516 04F) for use as a seed treatment to control multiple diseases in brassicas, bulb vegetables, cucurbits, legume vegetables, peanut, and sunflower (DP Barcodes D316736, D316735). The proposed application rates for seed for BAS 510 04F (Endura® is alternate trade name) range from 0.02 to 0.48 lb a.i. per 100 lb of seed. The proposed application rate for BAS 516 04F (Pristine® is alternate trade name) ranges from 0.015 to 0.10 lb a.i. per 100 lb of seed. This assessment is based on maximum application rates of boscalid only (BAS 516 04F also contains the fungicide, pyraclostrobin).

Boscalid is fairly persistent in the environment and characterized by moderately-slow biodegradation and medium mobility in some soils. The primary pathway for degradation in soil is via aerobic metabolism, which proceeds slowly (half-lives range from 96 to 578 days) and results in intermediates that are transformed to CO_2 or bound to soil. Boscalid is stable to hydrolysis and photolysis in soil and water. In aquatic systems, boscalid is not significantly transformed under aerobic or anaerobic conditions but can be transferred from the water phase to the sediment phase through sorption to sediment.

The proposed foliar use of boscalid on leafy vegetables is not expected to result in acute risks to birds, mammals, terrestrial invertebrates, fresh and saltwater fish and invertebrates, reptiles and amphibians or terrestrial and aquatic plants. Also, chronic risks are not expected for birds, reptiles, amphibians, and fresh and saltwater fish and invertebrates. At maximum use rates, RQs exceed the chronic risk level of concern (LOC) for mammals in or near the use site. Application rates for a single application would have to be reduced to less than 0.05 lb a.i./A to result in RQs to below the chronic risk LOC. However, a more thorough assessment suggests that even if exposures were to occur at the maximum label rates, the equivalent exposure level may be below the level where biologically significant effects occurred in laboratory studies. Therefore, the probability of adverse effects to mammals, including listed species, is expected to be low for proposed foliar uses of boscalid on leafy vegetables.

Analysis of the proposed uses of boscalid as a seed treatment on brassica vegetables, bulb vegetables, cucurbits, legume vegetables, peanut, and sunflower indicated that RQs exceed the avian chronic risk LOCs. A more thorough assessment indicates that adverse effects associated with the proposed seed treatments may be limited although potential risks to listed avian species cannot be completely precluded. A survey of listed avian species indicated that for several species, a more thorough assessment is required, as specified under the Endangered Species Act.

For mammals, RQs exceeded the chronic risk LOC for the proposed uses of boscalid as a seed treatment on brassica vegetables, bulb vegetables, cucurbits, legume vegetables, peanut, and sunflower. However, the laboratory study on which the NOAEC was based, showed that biologically significant effects were apparent only at the highest exposure concentration, which was 100 times higher than the NOAEC. These data, combined with a potentially short exposure window and potentially low seed availability, indicate that the probability of adverse effects to mammalian species is low for the proposed uses of boscalid as a seed treatment.

Also, studies have shown that chronic exposure to boscalid results in a 13% reduction in the number of eggs laid in birds, and resulted in alteration of thyroid hormone levels in mammals. Since egg production and hormonal levels are endocrine-mediated processes, it is uncertain as to the extent that boscalid exposure can impact endocrine-mediated processes. The data on mammals suggests that the effects on the thyroid-pituitary axis is secondary to liver toxicity. It is recommended that when the appropriate tests are developed, boscalid be evaluated to determine whether it is capable of affecting endocrine-mediated processes.

The maximum application rates for the proposed uses boscalid do not exceed the previous maximum application rate for any crop. Thus, the values reported in the previous drinking water assessment dated 2/28/2003 (D278387 and others; 5/5/2005 memo D313814), and presented again here, are recommended for use by the Health Effects Division. Estimated Drinking Water Concentrations (EDWCs) for boscalid in drinking water sources are 87.5 ppb (acute) and 25.8 ppb (chronic) for surface water and 0.63 ppb for groundwater based on the labeled use on turf.

There is only one major data gap for boscalid. The terrestrial plant toxicity studies do not adequately capture potential toxicological effects of boscalid because Tier I studies did not reflect the highest label rate. Although data are lacking, simulations with current EFED exposure models indicated that risks to terrestrial plants are unlikely.

II. Problem Formulation

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) requires that registered pesticide uses do not pose unreasonable adverse effects to the environment. Also, the Endangered Species Act requires that any federal regulatory actions must not adversely affect species Federally listed as endangered or threatened ("listed") or their habitats. This risk assessment is aimed at evaluating whether the proposed uses of boscalid on leafy vegetables except brassica, (hereafter referred to as 'leafy vegetables') and as a seed treatment for several crops presents risk to non-target organisms including endangered species, addressing the potential of boscalid to adversely affect survival, reproduction, or growth in potentially exposed organisms.

The registrant, BASF, has proposed a maximum application rate for boscalid of 0.396 lbs a.i. per acre with a maximum of 2 applications (0.792 lbs a.i./acre/season) for the leafy vegetables. This applies to all proposed uses of boscalid as the Endura® formulation. The maximum application rate is slightly lower at 0.790 lbs a.i./acre/season for boscalid as the Pristine® formulation. This assessment is based on the maximum proposed use of 0.396 lbs. a.i./A with a 7 day interval and maximum of 2 applications per season. These proposed use rates fall within previously assessed use rates (D27837-D278390, D278418) and are not expected to result in acute risks to animal species.

BASF is also seeking registration for the use of two different boscalid formulations, BAS 510 04F and BAS 516 04F, as seed treatments for brassicas, bulb vegetables, cucurbits, legume vegetables, peanut, and sunflower. The proposed application rates for seed for BAS 510 04F (Endura® is alternate trade name) range from 0.02 to 0.48 lb a.i. per 100 lb of seed. The proposed application rate for BAS 516 04F (Pristine® is alternate trade name) ranges from 0.015 to 0.10 lb a.i. per 100 lb of seed.

A. Assessment Endpoints

Assessment endpoints are defined as "explicit expressions of the actual environmental value that is to be protected." The assessment endpoints for this ecological risk assessment are survival and reproduction of terrestrial and aquatic animals and survival, growth, and reproduction of aquatic and terrestrial plants.

These endpoints, while not directly addressing population- and community-level effects, provide some insight into the potential of a chemical to alter these higher levels of biological organization.

Measures of effect and measures of exposure are explicit toxicity and exposure measurements or estimates used to identify risks. Measures of effect are obtained from laboratory toxicity studies while measures of exposure are obtained from standard models with laboratory or field data as inputs. Toxicity and exposure values are used to generate a risk quotient (RQ), which is the risk measurement endpoint for these screening-level estimates of risk. .

B. Conceptual Model

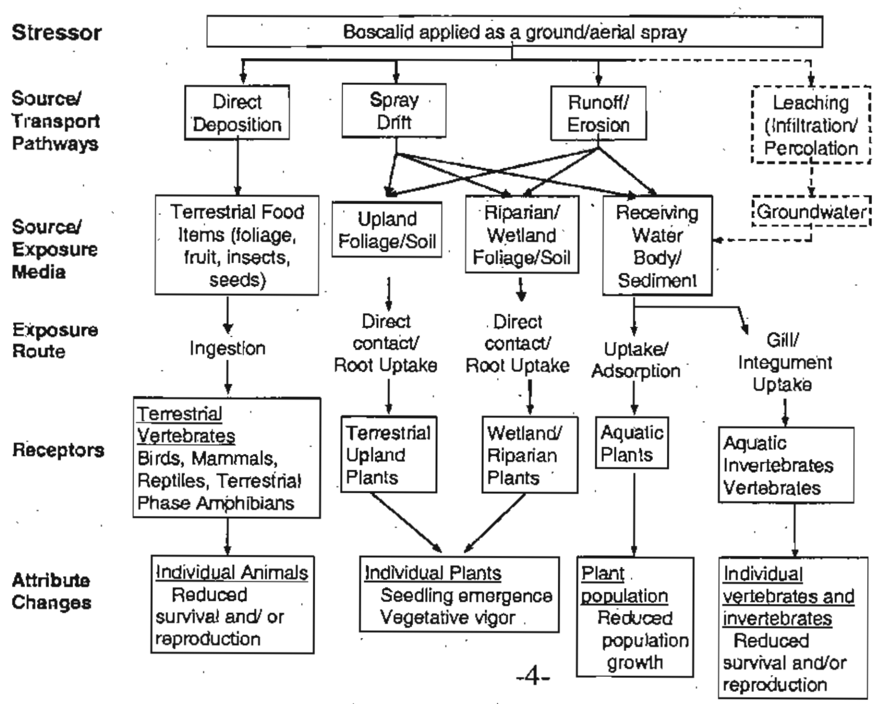
The Office of Pesticide Programs assumes a screening risk hypothesis for initial risk assessments.

The risk hypothesis is that the use of boscalid in accordance with the label results in adverse effects on survival and/or fecundity to terrestrial and/or aquatic animals and adverse effects on survival, reproduction, and/or growth to terrestrial, aquatic, and semi-aquatic plants.

The subsequent assessment is aimed at refuting or accepting this hypothesis.

The conceptual model used to depict the potential ecological risk associated with the proposed foliar uses of boscalid is fairly generic. The model assumes that boscalid is capable of affecting terrestrial and aquatic animals provided environmental concentrations are sufficiently elevated as a result of proposed uses on leafy vegetables (**Figure 1**). The results from the previous risk assessment (DP Barcode: D27837-D278390, D278418) did not indicate acute risk to any non-target organisms at application rates equal to the proposed rates for the use of boscalid on leafy vegetables although there was chronic risk to birds and mammals. The conceptual model for the proposed use of boscalid as a seed treatment is much simpler in that the model assumes that seed-eating birds and mammals may be exposed to boscalid directly from consuming treated seeds for chronic exposure scenarios.

Figure 1. Conceptual model of the fate and effects of boscalid in the environment.



Analysis Plan

Risk quotients (RQs) are the primary risk value used in this screening-level assessment and result from dividing measures of exposures by measures of effect. Commonly used measures of exposure include estimated exposure concentrations (EECs) and commonly used measures of effect include laboratory-based toxicity values (LC_{50}s, NOAECs). The resulting RQs are compared to specified levels of concern (LOCs), which represent points of departure for a conclusion of expected risk; if a given RQ exceeds the LOC, risks are triggered. Generally, the higher the RQ the more likely are the potential for risks.

To evaluate the potential risk to non-target animals and plants from tbe use of boscalid, maximum label rates/minimum application intervals are used to generate the EECs for both terrestrial and aquatic organisms. The EECs are then compared to measures of effect obtained from laboratory toxicity studies on a few test species. The measure of effects are based on the most sensitive species tested for a given exposure duration and taxonomic group.

Measures of Exposure

Measures of exposure are based on maximum proposed use rates for boscalid. Under the current request, the maximum use rate is for boscalid (as the Endura formulation) for use on leafy vegetables (except brassica vegetables). The aquatic exposure measurement endpoint for acute assessments is the annual peak concentration that is equaled or exceeded every ten years at a site that is more vulnerable to loading of the pesticide to surface water than 90% of the sites which are used to grow the crop. The chronic exposure measurement endpoint is the greatest running average concentration of a specified duration that is equaled or exceeded every ten years at the same site as that used to assess acute risk. The specific durations are 21 days for invertebrates and 60 days for fish and aquatic phase amphibians. The terrestrial measure of exposure is the 90 percentile of the distribution of concentrations on the foliage immediately after application, normalized for the application rate and food types that are expected to have similar pesticide interception capacities and consumption patterns (*e.g.* tall grass, seeds, insects)

Measures of exposure are generated using standard, screening-level models. Tier I aquatic exposure estimates were obtained using GENEEC2 with input parameters derived from registrant-submitted environmental fate laboratory studies. Terrestrial exposure was estimated using T-REX version 1.2.2, which is based on empirically determined pesticide residues on various terrestrial food items (Kenaga and Hoerger, 1972; Fletcher et al., 1994). This assessment represents the use of boscalid on a national-level and hence, estimates of exposure are not spatially-explicit.

Assessing the risks associated with the request for the use of boscalid as a seed treatment requires a somewhat different approach. In this case, boscalid is applied to seeds prior to treatment providing less opportunity for off-site transport. When appropriate, the LD_{50}/ft^2 method is used to address acute risks to mammals and birds and accounts for all routes of potential exposure resulting from the planting of treated seeds. Chronic exposure estimates are based directly on seed treatment; the EEC is equal to the application rate of boscalid to seeds (i.e., 0.48 lb a.i./100 lb seed).

For assessments of aquatic species, the dominant source of exposure comes from atmospheric transport resulting from spray drift. For terrestrial animal species, atmospheric transport is not explicitly assessed. Also for terrestrial animal species, this assessment does not account for ingestion of boscalid via drinking water, contaminated grit, preening activities, or uptake through inhalation or dermal absorption. Exposure to terrestrial animals is based solely on dietary consumption of foliar residues. The assessment for aquatic species accounts for direct exposures.

Measures of Effect

Measures of effects are obtained from guideline laboratory toxicity studies conducted with a limited number of surrogate species. While these species are intended to represent other species within the taxa, it is unlikely that the surrogate species are the most sensitive species in the taxa. However, the lowest toxicity endpoints for a given exposure duration and taxa are used to accommodate some of this uncertainty. Functionally, the measures of effect used in risk assessments are laboratory derived toxicity values that could include data obtained from the primary literature. Acute measures of effect are typically the concentrations that produce 50% mortality or growth reduction in the test organisms (LC_{50}s and EC_{50}s, respectively). The measure of effect for terrestrial plants is the EC_{25}. Chronic effects endpoints are the lowest test concentration where there is no observed adverse effect (NOAECs) on survival, growth or reproduction.

While most taxa are represented by surrogate laboratory species of the same taxa, this is not the case for reptiles and amphibians. Currently, toxicity studies on reptiles and amphibians are not required for pesticide registration. Risks to herpetofouna, however, are based on measures of effect from birds for reptiles and terrestrial phase amphibians and fish for aquatic phase amphibians (US EPA, 2004).

III. Introduction

A. Mode of Action

Boscalid [2-chloro-N-(4'-chlorobiphenyl-2-yl)nicotinamide] is in the carboxamide family of fungicides and acts as an enzyme inhibitor interfering with energy metabolism of disease organisms. The exact target is succinate dehydrogenase, which is the only membrane-bound enzyme in the tricarboxylic acid cycle (TCA).

B. Use Characterization

As noted above, boscalid is proposed for use as a fungicide on leafy vegetables except brassica vegetables. These include amaranthus, arugula, cardoon, celery, chinese celery, celtuce, chervil, chrysanthemum (edible-leaved and garland), corn salad, cress (garden and upland), dandelion, dock, endive, fennel (florence), Lettuce (head and leaf), orach, parsley, purslane (garden and winter), radicchio, rhubarb, spinach, spinach (New Zealand and vine), and swiss chard. The maximum application rates of both formulations of boscalid are specified in **Table 1.a**. Since the use rates are so similar (differing by only 0.001 lb a.i./A) for both the Endura and Pristine formulations, the slightly higher rate of 0.396 lb a.i./A was used for this assessment.

Table 1.a. Boscalid proposed use rates for leafy vegetables (except brassicas).

Boscalid Formulation	Crop	Maximum application rate lb a.i./A	Maximum Seasonal Application	Number of Applications	Minimum Application Interval
Endura	Leafy vegetables (except Brassica)	0.396	0.792 lb a.i./A/year	2	7 days
Pristine	Leafy vegetables (except Brassica)	0.395	0.790 lb a.i./A/year	2	7 days

Boscalid is also proposed for use as a seed treatment to control multiple diseases in brassicas, bulb vegetables, cucurbits, legume vegetables, peanut, and sunflower. The proposed application rates for 100 lbs of seed are listed in **Table 1.b.**

Table 1.b. Boscalid proposed application rates for seed treatments of brassicas, bulb vegetables, cucurbits, legume vegetables, peanut, and sunflower.

Boscalid Formulation	Crop	Maximum application rate lb a.i./100 lb seed
BAS 510 04F	Brassica vegetables	0.48
BAS 510 04F	Bulb vegetables	0.07
BAS 510 04F	Cucurbits	0.025
BAS 510 04F	Legume vegetables	0.04
BAS 510 04F	Peanut	0.04
BAS 510 04F	Sunflower	0.02
BAS 516 04F	Brassica vegetables	0.1
BAS 516 04F	Bulb vegetables	0.1
BAS 516 04F	Cucurbits	0.03
BAS 516 04F	Legume vegetables	0.06
BAS 516 04F	Peanut	0.06
BAS 516 04F	Sunflower	0.03

IV. Exposure Characterization

A. Environmental Fate and Transport Characterization

Boscalid is a slowly biodegradable compound with moderate to low mobility in most soils. **Table 2** summarizes the physicochemical properties of boscalid. The primary degradation pathway is aerobic soil metabolism, which proceeds slowly with half-lives ranging from 96 to 578 days (MRIDs 454052-08, 456438-02; **Table 2**). This degradation pathway results in the formation of intermediates which are relatively rapidly transformed into CO_2 or bound soil residues. The majority of the apparent degradation of the compound is actually due to its transformation to bound residues. Degradates of the compound include 2-chloronicotinic acid (M510F47), 2-hydroxy-N-(4'-chlorobiphenyl-2-yl)-nicotinamide (M510F49), and an unknown (M510F50). Boscalid is hydrolytically stable and is photolytically stable on soil and in water. The compound is not transformed to any significant extent in either aerobic or anaerobic aquatic systems, but can be transferred from the water phase to the sediment phase by sorbing to the sediment.

Boscalid is likely to sorb to aquatic sediments given its medium soil mobility (K_{oc} ranges from 507 to 1110 mL/g). The coefficients of determination (r^2) for the relationships K_{ads} vs. organic carbon, K_{ads} vs. pH, and K_{ads} v. clay content were 0.88, 0.09, and 0.09, respectively, and indicate that adsorption was affected by organic carbon content. Terrestrial field dissipation studies showed that the maximum leaching depth for boscalid ranged from 0-7.5 cm (MRIDs 454052-19 thru -22; EPA, 2003). These data support results from batch equilibrium studies that indicate a low potential for leaching. A slightly higher potential for leaching exists for the compound in soils which are low in organic matter content, as is often the case with coarse-textured soils. Boscalid is likely to reach surface water through spraydrift when applied using ground spray. Given persistence of boscalid, transport to surface water via runoff water is probable. The slow biodegradation of boscalid in most soils will increase the potential for both groundwater and surface water contamination. However, the potential for groundwater contamination should be mitigated by the tendency of the compound to adsorb to surface soils, particularly those with relatively high levels of organic matter. The potential for boscalid to leach in significant quantities or to reach surface water will be mitigated by the low application rate ($\leq$2 lb a.i./A/season). Because boscalid does not biodegrade in aquatic systems, but can bind to sediments, the compound may accumulate in the sediment phase of these environments. The boscalid degradate 2-chloronicotinic acid is very mobile in soil and is not expected to bind to aquatic sediments. However, the degradate is metabolized rapidly in aerobic soil, and is mineralized to CO_2 or transformed to bound residues.

Table 2 summarizes the physico-chemical properties of boscalid and input parameters for Tier I modeling. A more thorough discussion of the the environmental fate of boscalid, can be found in the ecological risk assessment for the original registration of boscalid (formerly nicobifen) dated 5/28/03 (DP Barcode: D278387-D278390 & D278418).

Table 2. Fate and physical-chemical properties parameters of boscalid.

PARAMETER	VALUE	SOURCE
Chemical Name		–
IUPAC	2-chloro-N-(4'-chlorobiphenyl-2-yl)nicotinamide	–
CAS RN	188425-85-6	–
Molecular Weight	343.2	–
Solubility (pH 5 - 7, 20°C)	6 mg/L; 20°C	–
Vapor Pressure (20°C)	< 1 ×10^{-6} Pa; 25°C	–
Hydrolysis Half-life (pH 5, 7, 9, 25°C)	Stable	MRID 45405205
Aquatic Photolysis Half-life @ pH 7 (days)	Stable	MRID 45405206
Aerobic Aquatic Metabolism Half-life	Stable	MRID 45405214
Anaerobic Aquatic Metabolism Half-life	87 days	MRID 44346731
Organic Carbon Partitioning Coefficient (K_{oc}; mL/g)	507-1110 mL/g	Swann et al. 1983
Aerobic Soil Metabolism Half-life	182-578 days	MRID 45405208 MRID 45405209 MRID 45643802

B. Measures of Aquatic Exposure

The first-tier GENEEC2 (Version 2.0; May 1, 2001) simulation for application of boscalid (Endura formulation) to leafy vegetables was used to determine EECs for aquatic exposure. The input parameter values used in GENEEC2 are presented in **Table 3.a.** and the output is presented in **Appendix A.** The peak EECs and corresponding 21- and 60-day concentrations for ground spray application are presented in **Table 3.a.** A value of '0' was used for hydrolysis, photolysis, and aerobic aquatic metabolism input parameters as they were found to be stable to these routes of degradation in the laboratory.

Table 3.a. Input parameter values and EECs for boscalid (as Endura) **applied to leafy vegetables.**

Parameter	Value	Source
Application Rate (lb a.i./A)	0.396[1]	Label
Number of Applications	2[1]	Label
Interval between Applications (days)	7[1]	Label
Organic Carbon Partitioning Coefficient (K_{oc}; mL/g)	655[2]	Swann et al. 1983
Aerobic Soil Metabolism Half-life (days)	365[3]	MRID 45405208 MRID 45405209 MRID 45643802
Wetted in:	No	Standard Practice
Method of Application	ground spray[1]	Label
Solubility in Water (mg/L)	6 (pH 5 - 7, 20°C)	–
Aerobic Aquatic Metabolism Half-life (days)	0 (Stable)	MRID 45405214
Hydrolysis Half-life (days)	0 (Stable)	MRID 45405205
Aquatic Photolysis Half-life @ pH 7 (days)	0 (Stable)	MRID 45405206
GENEEC2 Results (ground spray EECs for aquatic exposure)	**Peak EEC (ppb): 3.41** **Max 21-day avg. EEC (ppb): 1.41** **Max 60-day avg. EEC (ppb): 0.56**	

[1]Application parameter value was obtained from the proposed use information for leafy vegetables. [2]Represents the lowest K_{oc} for a non-sand soil. [3]The aerobic soil metabolism half-life represents the 90[th] percentile of the upper confidence bound on the mean half-life of four soils.

A first-tier GENEEC2 simulation was also conducted for the proposed use of boscalid on seeds for both formulations **(Table 3.b.; Appendix A)**. The application rate was generated from label-specified seed application rates and commonly used seeding rates for proposed crops. Other input parameters were the same as those used in generating EECs for the proposed use of boscalid on leafy vegetables **(Table 3.a.)** except the chemical was wetted in and method of application was granular. Peak, maximum 21-day and maximum 60-day EECs for seed uses of boscalid are presented in **Table 3.b.**

Table 3.b. Input parameter values and EECs for boscalid applied as a seed treatment.

Boscalid Formulation	Crop	Maximum application rate lb a.i./100 lb seed	Seeding Rate lbs seed/A (crop)	MaxApp. lb a.i./A	Peak, Max 21-d and Max 60-d EECs µg/L (ppb)
BAS 510 04F	Brassica vegetables	0.48	8 (cabbage)	0.038	1.04, 1.02, 0.98
BAS 510 04F	Bulb vegetables	0.07	15 (onion)	0.01	< 1.0
BAS 510 04F	Cucurbits	0.025	5 (cucumber)	0.001	< 1.0
BAS 510 04F	Legume vegetables	0.04	160 (beans)	0.064	1.74, 1.70, 1.64
BAS 510 04F	Peanut	0.04	135	0.054	1.47, 1.44, 1.38
BAS 510 04F	Sunflower	0.02	4	0.0008	< 1.0
BAS 516 04F	Brassica vegetables	0.1	8 (cabbage)	0.008	< 1.0
BAS 516 04F	Bulb vegetables	0.1	15 (onion)	0.015	< 1.0
BAS 516 04F	Cucurbits	0.03	5 (cucumber)	**0.0015**	< 1.0
BAS 516 04F	Legume vegetables	0.06	160 (beans)	0.096	2.61, 2.55, 2.45
BAS 516 04F	Peanut	0.06	135	0.081	2.20, 2.15, 2.07
BAS 516 04F	Sunflower	0.03	4	0.0012	< 1.0

C. Drinking Water Exposure

Estimated Drinking Water Concentrations (EDWC) for the drinking water assessment for boscalid in surface water and groundwater were calculated using the screening model FIRST (FQPA Index Reservoir Screening Tool; May 1, 2001) and regression model SCI-GROW (Version 2.3; June 29, 2003), respectively. The maximum application rate for the proposed use on leafy vegetables does not exceed the previous maximum application rate for any crop. Thus, the values reported in the previous drinking water assessment dated 5/13/2003 **(DP Barcode: D285210)**, and presented again here, are still current and are recommended for use in HED's risk assessment. The input parameter values and results for the surface water modeling, using FIRST, and the groundwater modeling, using SCI-GROW, are presented in **Tables 4** and **5**, respectively.

Table 4. FIRST input parameter values and results for boscalid applied to leafy vegetables by ground spray.

Parameter	Value	Source
Application Rate (lb a.i./A)	0.35[1]	Label
Number of Applications	6[1]	Label
Interval between Applications (days)	14[1]	Label
Organic Carbon Partitioning Coefficient (K_{oc}; mL/g)	655[2]	Swann et al. 1983
Aerobic Soil Metabolism Half-life (days)	401[3]	MRID 45405208 MRID 45405209 MRID 45643802
Wetted in?	No	Standard Practice
Method of Application	ground spray[1]	Label
Percent Cropped Area	0.87	DP Barcode: D279885
Solubility in Water (mg/L)	6	--
Aerobic Aquatic Metabolism Half-life (days)	0 (Stable)	MRID 45405214
Aquatic Photolysis Half-life @ pH 7 (days)	0 (Stable)	MRID 45405206
FIRST Results (EEC for surface water drinking water sources)	**Acute Concentration: 87.5 ppb** **Chronic Concentration: 25.8 ppb**	

[1]Application parameter values were obtained from the current label and proposed use information submitted by the registrant for use on turf. [2]Represents the lowest K_{oc} for a non-sand soil. [3]The aerobic soil metabolism half-life used in the models represents the 90[th] percentile of the upper confidence bound on the mean half-life of four soils.

Table 5. SCI-GROW2 input parameter values and results for boscalid[1].

Parameter	Value	Source
Application Rate (lb a.i./A)	**0.35[1]**	Label
Number of Applications	**6**	Label
Aerobic Soil Metabolism Half-life (days)	407.5	MRID 45405208 MRID 45405209 MRID 45643802
Organic Carbon Partitioning Coefficient (K_{oc})	821[2]	Swann et al. 1983
Results (EEC for groundwater drinking water sources)	**0.634 ppb**	

[1]Application parameter values were obtained from the current label for the use on turf. [2]Represents the median value.

D. Measures of Terrestrial Exposure

Estimated exposure concentrations for terrestrial receptors were determined using the standard screening-level exposure model, TREX (v.1.2.2) (US EPA, 2004). Maximum exposure levels for the use of boscalid on leafy vegetables were calculated based on the maximum proposed use rate, maximum application number, and minimum application interval. These terrestrial exposure estimates are based on a database of pesticide residues on wildlife food sources and follow a linear relationship for a single application (Hoerger and Kenaga, 1972 as modified by Fletcher et al., 1994). However, for multiple applications, TREX incorporates a first-order decay function to calculate residue concentrations. TREX calculates pesticide residues on each type of food item on a daily interval for one year and the maximum peak value is used as the EEC. Importantly, decay rate is determined by the foliar dissipation half-life. For boscalid, no data are available to determine a chemical-specific foliar dissipation half-life so the EFED default of 35 days is used in this assessment (Willis and McDowell, 1987).

To assess risks for pesticides applied as a nongranular products, the EECs on food items following pesticide application are compared to toxicity values (LC_{50}, NOAEC, etc.). The predicted maximum and mean boscalid residues on select avian and/or mammalian food items following application for leafy vegetables are presented in **Table 6.a.** The EECs are predicted based on maximum use rate of boscalid on leafy vegetables.

Table 6.a. Terrestrial EECs for avian and mammalian food items (ppm) following label specified applications of boscalid (as Endura) to leafy vegetables.

Crop	Application Rate lb a.i./A (# app / interval, days)	Food Items	Predicted Maximum Residue EEC (ppm)[1]	Predicted Mean Residue EEC (ppm)[1]
Leafy Vegetables	0.396 (2 / 7)	Short grass	177.78	62.96
		Tall grass	81.48	26.67
		Broadleaf plants/small insects	100	33.33
		Fruits, pods, seeds, and large insects	11.11	5.19

[1] Predicted maximum and mean residues are based on Hoerger and Kenaga (1972) as modified by Fletcher *et al.* (1994) using T-REX Version 1.2.2.

For the proposed use of boscalid as a seed treatment, a dietary approach for seed-eating mammals and birds was used to assess chronic risks. Note that toxicity studies showed that boscalid is practically non-toxic to birds and mammals on an acute exposure basis so acute exposures/risks associated with seed treatments were not evaluated. Chronic exposures for seed eating birds and mammals are based on boscalid concentration on seeds (mg a.i./kg seed) as determined by the label application rate (**Table 6.b.**). The RQ is calculated by dividing concentration on seeds by the dietary-based chronic toxicity value, both in units of mg/kg or ppm. This method does not rely on seeding rates to generate estimates of exposure and instead assumes that receptors are actively foraging on seeds.

Table 6.b. Terrestrial EECs (ppm) following label specified applications of boscalid to seeds for seed-eating mammals and birds.

Boscalid Formulation	Crop	Maximum application rate lb a.i./100 lb seed	Max. concentration on seed (mg a.i./kg seed)[1]
BAS 510 04F	Brassica vegetables	0.48	4800
BAS 510 04F	Bulb vegetables	0.07	700
BAS 510 04F	Cucurbits	0.025	250
BAS 510 04F	Legume vegetables	0.04	400
BAS 510 04F	Peanut	0.04	400
BAS 510 04F	Sunflower	0.02	200
BAS 516 04F	Brassica vegetables	0.07	700
BAS 516 04F	Bulb vegetables	0.07	700
BAS 516 04F	Cucurbits	0.02	200
BAS 516 04F	Legume vegetables	0.04	400
BAS 516 04F	Peanut	0.04	400
BAS 516 04F	Sunflower	0.02	200

[1] **Assumes 100% availability to foraging birds and mammals.**

V. Ecological Effects Characterization

Results from pesticide toxicity testing are not intended to represent all species of birds, mammals, or aquatic organisms. For example, only a few surrogate species for both fish and birds are used to represent all fish (2000+) and bird (680+) species in the United States. For mammals, studies are usually limited to Norway rat or the house mouse. Testing of estuarine/marine species is usually limited to a crustacean, a mollusk, and a fish. Also, reptiles and amphibians are not currently tested. Instead, avian toxicity studies are used to represent reptiles and terrestrial-phase amphibians while freshwater fish studies are used to represent aquatic-phase amphibians.

Toxicity studies indicate that boscalid is moderately toxic to fresh- and saltwater fish and invertebrates on an acute exposure basis. No chronic toxicity studies were available for estuarine/marine fish and invertebrates, however, there were effects of boscalid on freshwater fish and invertebrates as a result of longer-term exposures. For terrestrial species, study results show that boscalid is practically non-toxic to honeybees, birds, and mammals on an acute exposure basis. Chronic toxicity studies showed that boscalid causes some toxicological effects in birds and mammals at higher exposure levels. The most sensitive ecological toxicity endpoints used in this risk assessment are presented in **Table 7** for aquatic organisms and **Table 8-10** for terrestrial organisms.

A. Aquatic Effects Characterization

Freshwater Acute and Chronic

Boscalid is moderately toxic to two freshwater fish species tested. The rainbow trout (***Oncorhynchus mykiss***) LC_{50} was 2.7 ppm (MRID 454049-27) and the bluegill sunfish (***Lepomis macrochirus)*** LC_{50} was > 3.7 ppm (MRID 454049-28; **Table 7**). Both acute studies were classified as supplemental due to water quality and test material issues. A rainbow trout early life-stage test produced a NOAEC and LOAEC of 116 and 241 **ppb**, respectively (MRID 454050-06); the most sensitive endpoints were survival, lethargy, extended yolk sac, and vertebral deformations. Similar to the acute studies, the chronic study was also classified as supplemental due to water quality and test material issues.

Boscalid is characterized as slightly toxic to daphnids (EC_{50} = 5.33 ppm; MRID 454050-01; **Table 7**). This study was classified as supplemental because of uncertainties associated with the mean-measured exposure concentrations. **In a 21-day chronic toxicity test with daphnids, the NOAEC was 0.79 ppm (MRID 463514-06) with reproduction as the most sensitive endpoint.**

Studies were also conducted to assess the acute and chronic toxicity of boscalid to sediment-dwelling organisms. The acute study on the amphipod, *Hyalella azteca*, showed that there were no significant effects of boscalid on survival or dry mass. The NOAEC and LC_{50} values for the acute study were 97 and >97 mg/kg dry sediment, respectively. However, since the LC_{50} falls withing the range of 10-100 ppm, boscalid is characterized as slightly toxic to *Hyalella azteca* on an acute sediment exposure basis. In a chronic study of the toxicity of boscalid to chironimid larvae (*Chironomus riparius*), boscalid caused a reduction in emergence rate of chironomids at the 4 ppm level; the corresponding NOAEC was 2 ppm. Both studies were conducted in a scientifically sound manner but since non-guideline species were used, they were classified as supplemental.

Toxicity estimates (EC_{50}) for the effects of boscalid on vascular and non-vascular plants ranged from 1.34 to > 4.2 ppm. The EC_{50} for the aquatic vascular plants, *Lemna gibba*, was > 3.9 ppm. The freshwater green alga, *Pseudokirchneriella subcapitata*, was the mos sensitive nonvascular plant tested with an EC_{50} of 1.34 ppm.

Estuarine/Marine Acute

Boscalid is moderately toxic to estuarine/marine fish and invertebrates on an acute exposure basis. In an acute study on the sheepshead minnow, *Cyprinodon variegatus*, the LC_{50} for boscalid exceeded 3.86 ppm, the highest concentration tested. Since 3.86 ppm falls in the range 1 to 10 ppm, boscalid is categorized as moderately toxic to sheepshead minnow. Although there was insufficient mortality to generate a robust LC_{50}, sublethal signs of toxicity were noted at the 3.86 ppm treatment level including lethargy and loss of equilibrium. For invertebrates, acute toxicity studies were submitted on mysid shrimp and eastern oysters. In the mysid shrimp study, there were no effects of boscalid and the NOAEC and LC_{50} were $\geq$3.81 and > 3.81 ppm, respectively (MRID 454050-02). Boscalid caused significant reductions in oyster shell deposition at all treatment levels (MRID 454050-03). The NOAEC was < 0.421 ppm and the 96-hour EC_{50} was 1.02 ppm.

Table 7. Summary of most sensitive acute and chronic toxicity data for aquatic organisms exposed to boscalid.

Species	Study type	LC_{50} or EC_{50} (ppm)	NOAEC & LOAEC (ppm)	Source (MRID)
Rainbow Trout	freshwater fish acute	LC_{50} = 2.7	--	454049-27
Rainbow Trout	freshwater fish early-life stage	--	0.116 & 0.241	454050-06
Daphnia magna	freshwater invert. acute	EC_{50} = 5.33	--	454050-01
Daphnia magna	freshwater invert. life-cycle	--	0.79 & 1.54	463514-06
Hyalella azteca	invertebrate sediment acute toxicity test	EC_{50} > 97 mg/kg sed.	–	454050-09
Chironomus riparius	invertebrate sediment chronic toxicity test	–	2.0 & 4.0	454050-08
Sheepshead Minnow	estuarine/marine fish acute	$LC_{50} \geq$ 3.86	--	454050-04
Mysid shrimp	estuarine/marine invert. acute	$LC_{50} \geq$ 3.81	--	454050-02
Eastern oyster	oyster shell deposition	EC_{50} = 1.02	–	454050-03
Lemna gibba	vascular aquatic plant acute	EC_{50} >3.9	--	454050-13
Pseudokirchneriella subcapitata	non-vascular aquatic plant acute	EC_{50} = 1.34	--	454050-17

B. Terrestrial Effects Characterization

Avian Acute Oral, Dietary, and Chronic

Boscalid is classified as practically non-toxic to birds on acute and subacute exposure basis. In an acute oral toxicity test on bobwhite quail, *Colinus virginianus*, the LD50 exceeded the highest dose tested (> 2,000 mg/kg body weight) and no sublethal signs of toxicity were observed at any treatment level (MRID 454049-22). Similarly, in two subacute dietary studies, the LD50 for bobwhite quail (MRID 454049-23) and mallard ducks (*Anas platyrhynchos*; MRID 45404924) was greater than the highest dose test, which was 5247 mg/kg feed in both studies. Although the two dietary studies were unacceptable due to lower than recommended bird numbers and smaller than recommended cages, given the apparent lack of toxicity the studies were classified as supplemental.

Two avian reproduction studies were submitted for review. In the study on bobwhite quail (MRID 454049-25), 1,000 mg boscalid/kg feed caused significant effects on numbers of eggs laid, fertility rate, embryo mortality, and number of 14-day survivors. The NOAEC for this study was 300 mg/kg feed, which corresponded to a dose-based exposure of 25 mg/kg/d (NOAEL) as calculated from feed consumption and body weight data. There was about a 13% reduction in the number of eggs laid per female and a 37% reduction in number of 14-day survivors in the 1,000 ppm group compared to the control over the whole study period. Exposure was continuous for 10 weeks prior to egg-laying and then continued for an additional 12 weeks once the egg-laying period started. Conversely, for mallard ducks, there were no observed effects of boscalid on reproductive parameters or adult health under similar exposure conditions (levels and duration). The NOAEC for this study was $\geq$ 1,000 mg/kg feed. Both studies were classified as acceptable (formerly core).

Table 8. Summary of avian acute and chronic toxicity data for terrestrial organisms exposed to boscalid.

Species	Study type	LC_{50} or EC_{50} (ppm)	NOAEC (ppm) NOAEL (mg.kg/d)	Source (MRID)
Northern Bobwhite	14-day acute oral	$LC_{50} > 2000$	--	454049-22
Northern Bobwhite	5-day acute dietary	$LC_{50} > 5247$	--	454049-23
Mallard Duck	5-day acute dietary	$LC_{50} > 5247$	--	454049-24
Northern Bobwhite	Avian reproduction	--	NOAEC = 300 NOAEL = 25	454049-25
Mallard Duck	Avian reproduction	--	NOAEC > 1000	454049-25

Mammals, Acute and Chronic

Based on acute oral toxicity studies on rats, boscalid is categorized as practically non-toxic to mammals (LD_{50} > 5,000 mg/kg; MRID 454048-14; **Table 9**). In a chronic study, boscalid caused decreased body weight and decreased body weight gain in F2 male pups (NOAEC = 100 ppm; MRID 454049-06) at the 1000 ppm treatment level, which was equivalent to a dose-based exposure of 114 mg/kg/d. At the 1000 ppm exposure level, F2 pups (both sexes) showed a 7% lower body weight on postpartum day 21 and also impaired body weight gains (7%) from postpartum day 4 up to weaning . It is unlikely that a 7% reduction in F2 pup weight would result in reduced survival and/or reproduction. At 10,000 ppm, which was equivalent to a dose-based exposure of 1173 mg/kg/d, there were slightly greater effects with F2 pups showing a 10-12% lower body weight at weaning compared to control and reduced viability index (as indicator of perinatal pup mortality) from postpartum day 0 - 4. Pup viability in the F2 generation was 93% for control and 86% for the 10,000 ppm treatment. The study authors stated that while the viability of the high treatment group was within the range of historical control data (83-99%), the effects may have been treatment related given that there were other signs of toxicity at this treatment level. The 9% reduction in pup viability combined with the 12% reduction in growth rate may cause effects that have an impact at the population-level. Taken as a whole, these data indicate that while there were statistically significant effects at the 1000 ppm treatment level, biologically significant effects may only have occurred in the 10,000 ppm treatment level although those may be within the range of normal variation.

Table 9. Summary of acute and chronic mammalian toxicity data[1] for rats exposed to boscalid.

Species	Study type	LD_{50} or ED_{50} (ppm)	NOAEC (ppm) NOAEL(ppm)	Source (MRID)
Norway rat (*Rattus norvegicus*)	Acute oral	LD_{50} > 5000	--	454048-14
Norway rat (*Rattus norvegicus*)	2-Generation reproduction	--	100 ppm (diet) 11.2 mg/kg/d	454049-06

[1]Mammalian toxicity data provided and reviewed by EPA Health Effects Division.

In addition to the results seen in the above studies, some effects were noted on the thyroid-pituitary axis. In a special study to investigate hormone and enzyme induction, a decrease in circulating T_3 and T_4 and increasing TSH was observed and was likely the result of hepatic microsomal glucuronyltransferase. Reversal of thyroid and liver effects was observed with the cessation of test article administration. It was concluded that the induction of liver microsomal enzyme system resulted in increased glucuronidation of thyroxine, resulting in an increase in TSH secretion as a compensatory response of the physiological negative feedback system; increased TSH resulted in increased thyroid weight (HED D29002, 2003).

Terrestrial Invertebrates

Boscalid is practically nontoxic to honey bees via both contact and oral exposure routes (**Table 10**). The LD_{50}s for the oral and contact exposure were > 165.96 µg/bee and > 200 µg/bee, respectively. This study was scientifically sound and classified by EFED as acceptable. Also, a study on the toxicity of boscalid to earthworms, *Eisenia foetida*, was submitted for review (MRID 454050-20; **Table 10**). There were no significant effects of boscalid on survival or body weight of earthworms. Hence, the LC_{50} exceeded the highest concentration tested, 1000 mg/kg soil. Although several guideline requirements were not met, the study was classified as supplemental due to the apparent lack of toxicity.

Table 10. Summary of acute and chronic mammalian toxicity data[1] for rats exposed to boscalid.

Species	Study type	LD_{50} or ED_{50} (ppm)	NOAEL (ppm)	Source (MRID)
Apis mellifera	Acute oral Acute contact	> 165.96 (oral) > 200 (contact)	--	454050-19
Eisenia foetida	28-day earthworm study	--	100 (soil)	454050-20

Terrestrial Plants

Terrestrial plant toxicity studies (seedling emergence and vegetative vigor) are required for pesticides that have terrestrial use patterns and/or may move off of the application site via drift or volatilization. For boscalid, only Tier I vegetative vigor and seedling emergence studies are available. Results for the vegetative vigor and seedling emergence studies indicated that none of the tested plant species exhibited effects greater than a 25% difference compared to controls. However, tomato plants showed a 24.1% reduction and a 22.7% reduction in shoot weight in the seedling emergence and vegetative vigor studies, respectively. The resulting EC_{25} for both seedling emergence and vegetative vigor was higher than the highest (and only) tested concentration of 0.55 lb a.i./A. The Tier I plant studies were classified SUPPLEMENTAL since the only tested concentration (0.55 lb a.i./A) is lower than the highest maximum seasonal rate for boscalid It seems likely that at a higher exposure level, an EC_{25} may be reached, particularly for tomato plants.

VI. Risk Characterization

A. Risk Estimation

To evaluate the potential risk to non-target organisms from the proposed uses of boscalid, the risk quotient (RQ) method was used. An RQ is the ratio of estimated environmental concentrations (EECs) to ecotoxicity values and represent a deterministic, screening-level approach for estimating risks. The resulting RQ values for a given taxa are compared to specified levels of concern (LOCs), which are used by OPP to represent a point of departure for unacceptable risks; if the RQ exceeds the LOC, risks are triggered.

1. Aquatic

Acute Aquatic Animals and Plants

At the maximum proposed application rate for the use of boscalid on leafy vegetables, no acute risk LOCs are exceeded for freshwater or estuarine/marine fish or invertebrates (RQ <0.01: **Table 11**). Since freshwater fish are used as surrogates for aquatic-phase amphibians, no risks are assumed for this animal class. Also, no acute risk LOCs are exceeded for vascular (RQ <0.01) or non-vascular plants (RQ <0.01; **Table 11**). Listed species acute risk LOCs are not exceeded for the freshwater and marine fish and invertebrates and aquatic vascular and non-vascular plants. For seed treatments, the peak EEC was highest for the proposed use on legume vegetables with a value of 2.61 ppb; this estimate is less than

3.41 ppb peak EEC for the proposed use on leafy vegetables. Therefore, no acute risk LOCs are exceeded for the proposed uses of boscalid as a seed treatment.

Table 11. Risk quotients for acute exposures of aquatic organisms to boscalid associated with maximum use rates on leafy vegetables.

Species	LC_{50}/EC_{50} (ppm)	Application Rate (lb/acre)/ # Applications	Peak EEC (ppb)[1]	Risk Quotient	LOC Exceeded
		Freshwater			
Rainbow trout (*Oncorhynchus mykiss*)	2.7 (96-h)	0.396/2	3.41	<0.01	No
Daphnid (*Daphnia magna*)	5.33 (48-h)	0.396/2	3.41	<0.01	No
Lemna gibba	≥3.9 (14-day)	0.396/2	3.41	<0.01	No
Pseudokirchneriella subcapitata	1.34 (5-day)	0.396/2	3.41	<0.01	No
		Estuarine/Marine			
Sheepshead minnow (*Cyprinodon variegatus*)	≥3.9 (96-h)	0.396/2	3.41	<0.01	No
Mysid shrimp (*Americamysis bahia*)	≥3.8 (96-h)	0.396/2	3.41	<0.01	No

[1] Calculated using GENEEC2.
Acute risk LOC = RQ ≥ 0.5
Listed species acute risk LOC = RQ ≥ 0.05

Chronic Aquatic Animals

No chronic risk LOCs are exceeded for freshwater fish (RQ = 0.005-0.02) or invertebrates (RQ = 0.001-0.002; **Table 12**), including the listed species chronic risk LOCs for uses of boscalid on leafy vegetables or as a seed treatment. No data were required for chronic toxicity to estuarine/marine fish or invertebrates; thus, no RQs were calculated. Freshwater fish are used as surrogates for aquatic-phase amphibians; no risks are assumed for this animal class.

Table 12. Chronic RQ values for freshwater fish and invertebrates exposed to boscalid.

Crop Application Rate lb a.i./A (# apps / interval, days)	EECs Peak 21-day Average 60-day Average (µg/L)	Chronic Risk Quotients Freshwater Fish[a] NOEC = 116 ppb	Chronic Risk Quotients Freshwater Invertebrate[b] NOAEC = 1310 ppb
Leafy vegetables 0.396 (2 / 7)	3.41 1.41 0.56	-- -- 0.005	-- 0.001 --

Crop Application Rate lb a.i./A (# apps / interval, days)	EECs Peak 21-day Average 60-day Average (µg/L)	Chronic Risk Quotients	
		Freshwater Fish[a] NOEC = 116 ppb	Freshwater Invertebrate[b] NOAEC = 1310 ppb
Seed Treatment Legume vegetables 0.096 (1/–)	2.61 2.55 2.45	– – 0.02	– 0.002 --

[a] Rainbow trout (*Oncorhynchus mykiss*; MRID 44346745)
[b] Water flea (*Daphnia magna*; MRID 44346744))
Chronic risk LOC = RQ ≥ 1

2. Terrestrial

Avian Acute and Chronic Risk

As discussed in the *Terrestrial Effects Characterization* section, no mortality occurred in an avian acute oral toxicity test on bobwhite quail or avian dietary studies conducted on bobwhite quail and mallard ducks. However, an avian reproduction study using bobwhite quail did show chronic reproductive effects at the highest concentration tested. For the proposed use of boscalid on leafy vegetables, no RQs were calculated for acute exposures since there was no apparent toxicity for this exposure duration, however, chronic RQs were calculated and are presented in **Table 13**. No chronic risk LOCs (RQ ≥ 1.0) were exceeded.

Table 13. Dietary-based avian chronic RQs for the proposed use of boscalid on leafy vegetables based on an avian NOAEL of 300 ppm.

Use	Application Rate lb a.i./A (# app / interval)	Food Items	EECs (ppm)		Chronic Dietary-based RQ (EEC/ NOEC)	
			Upper-bound	Mean	Upper-bound Kenaga	Mean Kenaga
Leafy Vegetables	0.396 (2 / 7)	Short grass	124	63	0.59	0.21
		Tall grass	57	27	0.27	0.09
		Broadleaf plants/small insects	70	33	0.33	0.11
		Fruits, pods, seeds, and large insects	8	5	0.04	0.02

Chronic risk LOC (RQ ≥ 1.0).

Similarly, for the proposed use of boscalid as a seed treatment for brassica vegetables, bulb vegetables, cucurbits, legume vegetables, peanuts, and sunflower, acute RQs were not calculated given the low acute toxicity of this compound to birds. Chronic RQs were calculated for seed-eating birds and were based on the concentration of boscalid on seeds as determined by label application rates. **Table 14** lists the RQs for boscalid formulations and seed treatments by crop at the maximum application rate. For all seed treatments except for cucurbits and sunflower for the BAS 510 04F formulation, the non-listed and listed species chronic risk LOC was exceeded (RQ range: 1 - 16). Importantly, this analysis assumes that boscalid-treated seeds are the only diet item and that seeds are readily available.

Table 14. Chronic RQs for seed-eating birds following label specified applications of boscalid to seeds; based on an avian NOAEC of 300 ppm and assuming 100% seed diet.

Boscalid Formulation	Crop	Max. concentration on seed (mg a.i./kg seed)	Chronic RQ[1]
BAS 510 04F	Brassica vegetables	4800	**16**
BAS 510 04F	Bulb vegetables	700	**2.3**
BAS 510 04F	Cucurbits	250	0.8
BAS 510 04F	Legume vegetables	400	**1.3**
BAS 510 04F	Peanut	400	**1.3**
BAS 510 04F	Sunflower	200	0.7
BAS 516 04F	Brassica vegetables	1000	**3.3**
BAS 516 04F	Bulb vegetables	1000	**3.3**
BAS 516 04F	Cucurbits	300	**1**
BAS 516 04F	Legume vegetables	600	**2**
BAS 516 04F	Peanut	600	**2**
BAS 516 04F	Sunflower	300	**1**

[1] Bolded values represent an exceedance of the chronic risk LOC (RQ > 1.0) for non-listed and listed species.

Mammalian Acute and Chronic Risk

As discussed in the *Terrestrial Effects Characterization* section, based on acute oral toxicity studies on rats (LD50 > 5000), boscalid is categorized as practically non-toxic to small mammals. Therefore, no acute RQ values were calculated for mammals.

However, a study did show that under chronic, dietary exposure conditions, boscalid produced some toxic effects in rats. The mammalian dietary-based NOAEC is 100 mg/kg and the dose-based NOAEL is 5.0 mg/kg-bw, which was calculated using a standard FDA laboratory rat conversion. The dose-based RQs are calculated using a body weight-adjusted and consumption-weighted equivalent dose. The adjustments account for differences in food consumption based on body weight (smaller mammals eat relatively more) and differences in food-item content. By expressing the Kenaga nomogram estimated residues in terms of daily equivalent dose, estimated environmental concentrations can then be compared to the dose-based NOAEL.

Chronic Dose-Based RQs

Chronic risk LOCs are exceeded for mammals ranging in size from 15 to 1000g that forage on short grass, tall grass, and broadleaf plants/small insects (RQ range: 1.45 - 6.89; **Table 15**) for maximum proposed use rates of boscalid. The chronic risk quotients are based on the upper-bound residues reported in Hoerger and Kenaga (1972) as modified by Fletcher et al. (1994) and typically account for 87-97% of possible exposures. In comparison, the mean Kenaga values (**Table 16**) account for approximately only 65% of potential exposures. Risk quotients based on the mean Kenaga values provide a similar risk profile compared to RQs based on the upper-bound Kenaga values; the chronic risk LOC is exceeded for small, intermediate, and large-sized mammals that consume short grass, tall grass, broadleaf plants, and/or small insects (RQ range: 1.3 - 5.4; **Table 16**).

Table 15. Chronic dose-based RQ values for mammals feeding on short grass, tall grass, broadleaf plants/small insects, fruits/pods/large insects or seeds exposed to *upper-bound* boscalid residues following multiple applications (based on a rat NOAEL of 11.2 mg/kg/d).

Use	Application Rate lb a.i./A (# app / interval)	Body Weight, g	Upper-bound Dose-Based Chronic Risk Quotients				
			Short Grass	Tall Grass	Broadleaf Plants/Small Insects	Fruits/pods/ large insects	Seeds
Leafy Vegetables	0.396 (2 / 7)	15	**6.89**	**3.16**	**3.87**	0.43	0.10
		35	**5.88**	**2.70**	**3.31**	0.37	0.08
		1000	**3.15**	**1.45**	**1.77**	0.20	0.04

Bold RQ values exceed chronic risk levels of concern (RQ ≥ 1.0).

Table 16. Chronic dose-based RQ values for mammals feeding on short grass, tall grass, broadleaf plants/small insects, fruits/pods/large insects or seeds exposed to *mean* boscalid residues following multiple applications (based on a rat NOAEL of 11.2 mg/kg/d).

Use	Application Rate lb a.i./A (# app / interval)	Body Weight, g	Mean Dose-Based Chronic Risk Quotients				
			Short Grass	Tall Grass	Broadleaf Plants/Small Insects	Fruits/pods/ large insects	Seeds
Leafy Vegetables	0.396 (2 / 7)	15	**2.43**	**1.03**	**1.29**	0.20	0.04
		35	**2.09**	**0.88**	**1.10**	0.17	0.04
		1000	**1.10**	0.46	**0.58**	0.09	0.02

Bolded RQ values exceed chronic risk LOC (RQ ≥ 1.0).

Chronic Dietary-Based RQs

A dietary-based assessment of chronic risk to mammals associated with the use of boscalid on leafy vegetables was also conducted. The NOAEL was 11.2 mg/kg body weight/day and was determined experimentall (MRID 454049-06) No chronic risk LOCs are exceeded for mammals foraging on short grass and broadleaf plants/small insects (RQ < 1; **Table 17**). For mammals feeding on tall grass and fruits/pods/seeds/large insects, chronic risk quotients do not exceed the LOCs. For dietary RQ values based on mean Kenaga residue values, no chronic risk LOCs are exceeded.

Table 17. Dietary-based mammalian chronic RQs for the proposed use of boscalid on leafy vegetables based on a rat NOAEL of 11.2 mg/kg body weight.

Use	Application Rate lb a.i./A (# app / interval)	Food Items	EECs (ppm)		Chronic Dietary-based RQ (EEC/ NOEC)	
			Upper-bound	Mean	Upper-bound Kenaga	Mean Kenaga
Leafy Vegetables	0.396 (2 / 7)	Short grass	177	63	0.79	0.28
		Tall grass	81	27	0.36	0.12
		Broadleaf plants/small insects	100	33	0.45	0.15
		Fruits, pods, seeds, and large insects	11	5	0.05	0.02

Bold RQ valued exceed chronic risk levels of concern (RQ ≥ 1.0).

A dietary-based assessment for mammals was also conducted for the use of boscalid as a seed treatment for brassica vegetables, bulb vegetables, cucurbits, legume vegetables, peanut, and sunflower (**Table 18**). The RQs were based on a comparison of the concentration of boscalid on seeds to the chronic mammalian NOAEC; both are in units of mg/kg seed (or feed). For all proposed uses of bosalid as a seed treatment, the non-listed and listed species chronic risk LOC was exceeded (RQ range: 2.5 - 48). Results from this analysis assume that 100% of the diet is obtained from seeds and that seeds are readily available.

Table 18. Chronic RQs for seed-eating mammals following label specified applications of boscalid to seeds; based on mammalian NOAEC of 100 ppm and assuming 100% seed diet.

Boscalid Formulation	Crop	Max. concentration on seed (mg a.i./kg seed)	Chronic RQ[1]
BAS 510 04F	Brassica vegetables	4800	**48**
BAS 510 04F	Bulb vegetables	700	**7**
BAS 510 04F	Cucurbits	250	**2.5**
BAS 510 04F	Legume vegetables	400	**4**
BAS 510 04F	Peanut	400	**4**
BAS 510 04F	Sunflower	200	**2**
BAS 516 04F	Brassica vegetables	1000	**7**
BAS 516 04F	Bulb vegetables	1000	**7**

Boscalid Formulation	Crop	Max. concentration on seed (mg a.i./kg seed)	Chronic RQ[1]
BAS 516 04F	Cucurbits	300	**2**
BAS 516 04F	Legume vegetables	600	**4**
BAS 516 04F	Peanut	600	**4**
BAS 516 04F	Sunflower	300	**2**

[1] Bolded values represent an exceedance of the chronic risk LOC (RQ > 1.0) for non-listed and listed species.

Terrestrial Invertebrates

Results from toxicity tests on honey bees (*Apis mellifera*) indicated that boscalid is practically non-toxic to honey bees via acute dermal exposure. Given the low toxicity of boscalid to honey bees, acute RQs were not calculated. Similarly, the LC_{50} for earthworms exposed to boscalid exceeded the highest concentrations tested (1000 mg/kg) and RQs were not calculated for sediment-dwelling invertebrates.

Terrestrial Plants

As discussed above, the dataset on the toxicity of boscalid to plants is incomplete since the highest use rates of boscalid were not used in Tier I studies. Moreover, since only one concentration was used, a reliable NOAEC and EC_{05} were not obtained; these values are used in assessing risks to listed plant species. However, TerrPlant (v.1(1).0) was used to obtain a general sense of the potential risks to plant species for the proposed use of boscalid on leafy vegetables. If the EC_{25} was 0.55 lb a.i./A (the highest tested concentration), no risks are expected for non-listed plant species since RQs ranged from 0.07 to 0.16 (LOC is RQ $\geq$ 1). For listed plant species, the NOAEC or the EC_{05} would have to be < 0.09 lb a.i./A for the RQ to equal or exceed the listed species LOC of 1.0. These simulations were based on a maximum seasonal application rate of 0.792 lb a.i./A and suggest that risks to terrestrial plant species associated with the proposed use of boscalid on leafy vegetables are unlikely.

B. Risk Description

1. Risks to Aquatic Organisms

Based on a deterministic screening-level assessment of fate (environmental exposure) and toxicity data (ecological effects) for the use of boscalid on leafy vegetables and as a seed treatment for multiple crops, acute and chronic risk to aquatic organisms (fish, invertebrates, and plants) is not expected. No acute risk LOCs were exceeded for freshwater and estuarine/marine fish and invertebrates and no chronic risk LOCs were exceeded for freshwater fish and invertebrates. Chronic toxicity tests for boscalid are not available for estuarine/marine fish and invertebrates. However, risks to these species associated with boscalid use is not expected given the low toxicity of boscalid to other aquatic organisms and the low potential for exposure. Once boscalid is in a surface water body, it has a strong tendency to sorb to sediments thereby reducing the potential for exposure to many aquatic organisms. In this case, there may be risks to benthic invertebrates residing in contaminated sediments. However, results from toxicity studies on benthic invertebrates indicate that boscalid is not that toxic to selected laboratory species suggesting that risks to benthic invertebrates would not be expected.

The risk profile could change if boscalid levels in sediment accumulate over time associated with continued, yearly use of the compound. In the 2003 risk assessment for boscalid, the potential risks associated with accumulation of sediment residues was evaluated for the use of boscalid on turf, which is expected to generate higher exposures than the use patterns in this risk assessment.. Tier 2 modeling using the PRZM for the turf field and the EXAMS for the receiving water body was simulated for 36 years for a pond with no flushing due to external flows therefore allowing accumulation beyond which would be expected for more normal pond scenarios where some external flow occurs. The resulting concentration was 316 ug/L, which is lower than the acute EC_{50} for *H. azteca* of 97000 ppb and the chronic NOAEC for *C. riparius* of 2000 ppb. Hence, risks to benthic organisms, even under conditions of sediment accumulation, are not expected for the currently proposed uses of boscalid.

2. Risks to Terrestrial Organisms

Avian Risk

Foliar Use of Boscalid on Leafy Vegetables

Boscalid is practically non-toxic to birds and acute risk LOCs were not exceeded. No mortality was observed at the maximum concentrations tested in two avian dietary studies conducted on bobwhite quail and mallard ducks (LC_{50}s of >5247 for both). In addition, an avian acute oral toxicity test on bobwhite quail resulted in no mortality at any concentration tested, including the maximum dose (2000 mg/kg body weight). In an avian reproduction study using bobwhite quail there were some chronic reproductive effects observed and the NOAEC was 300 ppm. However, estimated EECs on avian food items did not reach levels high enough to result in any exceedances of the chronic risk LOC ($RQ \geq 1.0$) for the proposed foliar uses of boscalid on leafy vegetables.

Seed Treatment Uses of Boscalid

In contrast to the results of the chronic risk analysis for foliar uses of boscalid, the use of boscalid as a seed treatment for brassica vegetables, bulb vegetables, cucurbits, legume vegetables, peanut, and sunflower indicated potential risks to avian species under chronic exposure conditions. Risk quotients ranged from 1 to 3.3 for BAS 516 04F and from 1.3 to 16 for BAS 510 04F. The highest RQ (16) is associated with use on brassicas although typical seeding rates tend to be low for these plants at around 1-2 lbs per acre, which would lessen the potential for exposure. To eliminate chronic risk to avian species, the application rate of boscalid to seed would have to be lower than 0.03 lb a.i./ 100 lb seed. Notably, this value (and lower) falls within the range for the proposed use on cucurbits, legume vegetables, peanut, and sunflower for the BAS 516 04F formulation and on cucurbits and sunflower for the BAS 510 04F formulation. Also, RQs were higher for uses based on the BAS 510 04F formulation. This is presumably due to the fact that the BAS 510 04F formulation has boscalid as the only active ingredient while the BAS 516 04F also contains pyraclostrobin.

Importantly, there are several assumptions built into this analysis that warrant discussion. The assessment is based on the assumption that foraging birds will consume only seeds. The assessment indicates, that for some crops, only around 30% of the diet must be comprised of seed for RQs to equal or exceed the LOC. Also, while it may be true that some birds will consume a substantial number of seeds, it is likely that exposure will drop as seeds germinate and then grow. Birds can consume seedlings or young plants but the dose may be lessened due to the greater mass and bulk of the plant form compared to seeds. The assessment also assumes that seeds are readily available. This may or may not be the case and is likely dependent on the seeding depth with availability decreasing with increasing depth of planting and seeding efficiency. Also, it is likely that once seeds are planted, boscalid will leach from the seed coat to the surrounding soil, further lessening potential exposures. Lastly, this assessment is based on chronic exposures but the exposure due to seed treatment is likely to be 2 weeks or less (germination time). Whether chronic effects can manifest during this duration is unknown. It is not beyond reason to expect birds foraging in a freshly planted field to actively seek seeds even if seeds are partially buried by soil. However, it may be unlikely for a given bird to consume seeds for long enough time period and for boscalid levels on seeds to remain elevated enough to cause a toxicological response. The reproductive study on bobwhite quail (MRID 454049-25) showed that at 1000 mg/kg feed there were significant effects on reproductive parameters such as numbers of eggs laid, fertility rate, embryo mortality and number of 14-day survivors. Effects such as these could result in population-level effects but it necessitates exposure consistently above the NOAEC (300 mg/kg) for significant duration (probably greater than 2 weeks) for effects to manifest.

An analysis was conducted to further evaluate the potential for elevated exposures to avian species that feed on boscalid-treated seeds (**Table 19; Appendix B**). It was assumed that 2% of seeds planted were available for consumption. The NOAEL of 25 mg/kg/d was based on data collected in the original study and represents an average for all birds over the entire duration of the experiment (MRID 454049-25). The analysis showed that for birds feeding on seeds from onion (bulb vegetable), cabbage (brassica vegetable), beans (legume), and peanuts the number of seeds eaten that would result in an exposure equal to the NOAEL is less than the number of seeds that could be eaten in a day. Moreover, looking at the required foraging area (planted field) shows that for these representative crops, 5% or less of an acre would need to be effectively foraged, which is approximately a 48 x 48 foot plot. For all other crop scenarios, either the area required to forage is unrealistically large and/or the seed consumption required for a high enough exposure (RQ = 1) is beyond what would typically be consumed in a day (**Table 19**). Importantly for the cabbage scenario, the high-end seeding rate of 8 lbs/A was used although for most brassica vegetables, including cabbage, seeding rates are less than 4 lbs/A and typically in the range of 1-2 lbs/A. At 2 lbs seed/A, a bird would have to consume all seeds available on 0.05 acres which is likely still possible. This analysis indicates that for bulb vegetables, brassica vegetables, legumes, and peanuts, some birds may become exposed to boscalid at levels that are near of above the NOAEL of 25 mg/kg/d. However, the avian chronic NOAEL is based on exposures that occurred for a total of 22 weeks and a pre-egg laying exposure of 10 weeks. In most cases, seeds would not be available for that long of a duration and are more likely to germinate within 2 weeks or less for most of these crops. Although this analysis indicates that for some uses as a seed treatment, boscalid may cause deleterious effects in avian species it seems unlikely unless exposure occurred during a critical window of sensitivity for avian species.

Table 19. Seeds eaten and forage area for a 200 g bird assuming 2% availability of seeds and based on an avian dose-based NOAEL of 25 mg/kg/d.

Crop[1]	mg a.i./ 100 lb seed	Seeds/ lb	Seed weight (mg)	Seeding rate lb seed/A	# Seeds required for RQ = 1.0	# Seeds eaten daily[2]	Proportion acre foraged
Onion	31752	15200	29.8	15	**2394**	**5392**	**0.05**
Cabbage	217728	120000	3.8	8	**276**	**4257**	**0.01**
Cucumber	13608	16000	28.4	5	588	568	0.37
Beans	27216	1600	283.5	160	**29**	**57**	**0.006**

Crop[1]	mg a.i./ 100 lb seed	Seeds/ lb	Seed weight (mg)	Seeding rate lb seed/A	# Seeds required for RQ = 1.0	# Seeds eaten daily[2]	Proportion acre foraged
Sunflower	13608	5000	90.7	4	184	177	0.46
Peanuts	27216	550	824.7	135	**10**	**39**	**0.007**

[1]One representative crop for each proposed seed use.
[2]Seed consumption = 16 g/d based on food ingestion rate (Nagy, 1987; FIR(g) = 0.301 X $200g^{0.751}$)
Bolded numbers indicate potential exposures in excess of the NOAEL

Mammalian Risk

Foliar Use of Boscalid on Leafy Vegetables

Studies on the acute toxicity of boscalid to mammals indicated that boscalid is practically non-toxic to laboratory mammals and is unlikely to result in risks to wild mammals under acute exposure conditions. However, for uses of boscalid on leafy vegetables, chronic risk quotients for mammals exceed LOCs by factors ranging from 2 to 10 for mammals ranging in size from 15 to 1000g that forage on short grass, tall grass, and broadleaf plants/small insects when RQs are calculated on an equivalent oral dose basis. If RQ values are calculated using mean residues rather than upper-bound residues, the RQ values are roughly 65% lower, but still exceed LOCs. It is important to note, however, that RQ values based on mean residues will likely underestimate potential risk since these residue levels will only capture about 65% of likely exposures. The risk profile for dietary-based RQs indicates that only mammals consuming short grass are at risk (RQ = 1.2).

Although both methods (dietary-based and dose-based) are used to assess chronic risk to mammals, they result in considerably different RQ estimates and both have associated uncertainties. The dose-based calculation takes into account that different sized animals consume different amounts of food based on the higher relative metabolic needs of smaller mammals. An important uncertainty for the dose-based approach is in the estimation of dose. Under ideal circumstances, animal body weight, feed consumption, and concentration of chemical in feed can be used to generate a reliable estimate of dose. However, when these data are not readily available, a standard FDA conversion is used as in this assessment. The dietary-based approach incorporates treatment level (mg chemical in kg feed) into the RQ with no consideration for feed consumption (or avoidance). Also, this approach does not require adjusting exposure estimates to body weight, which can be a significant factor in estimating exposure. As it stands, both estimates yield somewhat similar results and taken together provide a likely chronic risk scenario for mammals.

Exposure simulations using T-REX v.1.2.2 with different application scenarios (rates and intervals) were conducted to provide some insight on the magnitude of risks and potential mitigation options. To obtain dietary-based RQs that do not exceed the chronic risk LOCs, the maximum application rate must be reduced to 0.31b a.i./A, for 2 applications, 7 days apart. However, to obtain dose-based RQs that do not exceed any chronic risk LOCs for mammals, the use of boscalid must be reduced to an application rate below 0.04 lb a.i./A, even if the application interval is extended to 14 days. For only one application of boscalid, the application rate would have to below 0.08 lb a.i./A and 0.60 lb a.i./A to not exceed LOCs for dose-based and dietary-based exposures, respectively.

Seed Treatment Uses of Boscalid

To assess the risks for the proposed boscalid seed treatments, only chronic risk estimates for mammals were generated since laboratory studies showed that boscalid is practically non-toxic to this taxa under acute exposure conditions. Results showed that chronic risk LOCs are exceeded for mammals for most of the requested uses for both formulations of boscalid (BAS 510 04F and BAS 516 04F) with RQs ranging from 2 to 48. To reduce RQs to below the LOCs for mammalian species, the application rate of boscalid to seed would have to be lower than 0.01 lb a.i./ 100 lb seed. Notably, this value is lower than the range for all proposed uses for both formulations. Similar to the assessment on avian species, RQs were higher for uses based on the BAS 510 04F formulation. This is presumably due to the fact that the BAS 510 04F formulation has boscalid as the only active ingredient while the BAS 516 04F also contains pyraclostrobin.

The assessment method assumes that a mammalian receptor would acquire all energy needs from consuming seeds that have been treated with boscalid. While seemingly a conservative assumption, it is possible given observed gorging behavior in some animals and the opportunistic nature of most wildlife species. The assessment also assumes that all boscalid applied to the seed remains on the seed until the seed is ingested although it is likely that some boscalid will leach from the seed coat to the surrounding soil. Moreover, it is possible that availability of seeds may be limited or may decrease with time as a result of soil coverage. Despite the possibility of boscalid exposure for seed-eating mammals, the chronic effects seen in laboratory studies were mainly limited to diminished growth in F2 male pups. While growth is an important biological parameter that can have ecological impacts, it does not necessarily result in population-level effects as would a reduction in reproductive output or survival. Close examination of the rat reproductive study showed that biologically significant effects only manifested at the highest treatment level (10000ppm); the effects were decreased pup viability (still within historically normal ranges) and a slightly greater than 10% reduction in body weight of pups.

An analysis was conducted to further evaluate the potential for elevated exposures to mammalian species that feed on boscalid-treated seeds (**Table 20**). It was assumed that 2% of seeds planted were available for consumption. The analysis showed that for mammals feeding on treated seeds, exposures in excess of the NOAEL. However, as noted above, biologically significant effects on mammals occurred at exposure concentrations that were 100 times higher than the NOAEL and slight effects on pup body weight occurred at a level 10 times higher than the NOAEL. Hence, effects in wild mamals may not be exptected to manifest unless exposure concentrations are between 1000 and 10,000 ppm and perhaps closer to 10,000 ppm. The only scenario in Table 20 for which there's a greater than 10 fold difference between the number of seeds required to reach an effect level and the number of seeds that can possibly be consumed is the cabbage (brassica vegetable) scenario. However, even for this scenario, a 100 fold difference, which would be equivalent to the biologically-significant effect level, would not be possible under this simulation; a mammal couldn't eat enough seeds. Notably, the cabbage scenario is a high-end estimate for brassica vegetables in general since the 8 lb seed/A is much higher than more typical 1-2 lb seed/A for most brassica crops. Taken as a whole, these lines of evidence suggest that deleterious effects are not expected for mammals that consume seeds treated with boscalid at the proposed use rates.

Table 20. Seeds eaten and forage area for a 25 g mammal assuming 2% availability of seeds and based on an experimentally-determined dose-based NOAEL[1] of 11.2 mg/kg/d.

Crop[2]	mg a.i./ 100 lb seed	Seeds/ lb	Seed weight (mg)	Seeding rate seed/A	# Seeds required for RQ = 1.0	# Seeds eaten daily[3]	Proportion acre foraged
onion	31752	15200	29.8	15	**134**	**1278**	**0.12**
cabbage	217728	120000	3.8	8	**15**	**1009**	**0.03**
Cucumber	13608	16000	28.4	5	**33**	**135**	**0.82**
Beans	27216	1600	283.5	2	**66**	**13**	**0.01**
Sunflower	13608	5000	90.7	10	**412**	**42**	**1.02**
Peanuts	27216	550	824.7	1	**23**	**5**	**0.02**

[1]NOAEL obtained from 2 generation rat reproductive study (MRID 454049-06)
[3]One representative crop for each proposed seed use.
[2]Seed consumption = 3.8g and is based on mammalian food ingestion rate equation (Nagy, 1987; FIR(g) = 0.621 X $25g^{0.564}$).
Bolded numbers indicate potential exposures in excess of the NOAEL

3. Review of Incident Data

No incidents of wildlife or aquatic species poisonings associated with uses of boscalid were found in the Ecological Incident Information System (EIIS) database.

4. Federally Threatened and Endangered (Listed) Species Concerns

To facilitate compliance with the requirements of the Endangered Species Act subsection (a)(2) the Environmental Protection Agency, Office of Pesticide Programs has established procedures to evaluate whether a proposed registration action may directly or indirectly reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of any listed species (U.S. EPA 2004). After the Agency's screening level risk assessment is performed, if any of the Agency's Endangered Species LOC Criteria are exceeded for either direct or indirect effects, a determination is made to identify if any listed or candidate species may co-occur in the area of the proposed pesticide use. If determined that listed or candidate species may be present in the proposed use areas, further biological assessment is undertaken. The extent to which listed species may be at risk then determines the need for the development of a more comprehensive consultation package as required by the Endangered Species Act.

Federal Action

The federal action addressed herein is the proposed registration of pesticide products that contain the **active ingredient boscalid (3-pyridinecarboxamide, 2-chloro-N-(4'-chloro(1,1'-biphenyl)-2-yl). Crops for which boscalid uses are proposed for registration are identified in Section III.B..** Growing areas for these crops encompasses most of the United States.

Action Area

For listed species assessment purposes, the action area is considered to be the area affected directly or indirectly by the Federal action and not merely the immediate area involved in the action. At the initial screening-level, the risk assessment considers broadly described taxonomic groups and so conservatively assumes that listed species within those broad groups are collocated with the pesticide treatment area. This means that terrestrial plants and wildlife are assumed to be located on or adjacent to the treated site and aquatic organisms are assumed to be located in a surface water body adjacent to the treated site. The assessment also assumes that the listed species are located within an assumed area which has the relatively highest potential exposure to the pesticide, and that exposures are likely to decrease with distance from the treatment area.

Based on the proposed maximum rate for the foliar use of boscalid on leafy vegetables, listed species chronic risk LOCs are exceeded for mammals that forage on short grass, tall grass, and broadleaf plants/small insects. For the proposed use of boscalid as a seed treatment, the listed species chronic risk LOC was exceeded for both birds and mammals for all uses for at least one of the formulations. As a result of the exceedances, LOCATES (version 2.9.7) was used to identify the federally listed endangered/threatened mammals and birds that co-occur in counties with the proposed uses of boscalid for which the LOCs were exceeded. In addition, since birds are used as surrogates for terrestrial-phase amphibian and reptiles, these taxa were also included in the LOCATES search.

Taxonomic Groups Potentially at Risk

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

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

Birds

For avian species, listed species chronic risk LOC (RQ $\geq$ 1.0) was exceeded for all uses of boscalid as a seed treatment. These results also apply to reptiles and terrestrial-phase amphibians since avian species are used as surrogates for these taxonomic groups. It should be noted, however, that there are very few reptile and amphibian species that consume seeds as a major component of their diet. These taxa were included as part of the screening-level approach and are not expected to be impacted by seed treatments especially considering the uncertainties associated with exposures as a result of seed application explained above. For birds, although exposure is more likely compared to reptiles and amphibians, it seems unlikely that listed avian species will be heavily impacted by the use of boscalid on seeds. In particular, exposure to boscalid would likely be limited by soil coverage, leaching of boscalid from seeds to soil, and germination and growth which limits the window of possible exposure. As demonstrated in the risk description section (Table 15 and associated text), the uses of boscalid on seeds of bulb vegetables, brassica vegetables, legume vegetables, and peanuts, exposures were likely to approach or exceed the NOAEL. Importantly, this component of the assessment is based on chronic exposures, which require continuous exposure at or above the NOAEL for a duration long enough to cause effects. For example, in the reproductive study that forms the basis of the NOAEL, birds were exposed to boscalid in feed for a total of 22 weeks and effects were seen only at the highest concentration tested. While the exact duration required to elicit a toxic response is uncertain, since seeds have a relatively short existence and since exposures did not exceed the NOAEL by large margin, this suggests that deleterious effects to birds associated with the use of boscalid on seeds are unlikely. For listed avian species, deleterious effects associated with the use of boscalid as a seed treatment are not expected although given the uncertainties, risks cannot be completely precluded, particularly for granivore species that occupy habitats near agricultural areas.

The listed species acute and chronic risk LOCs were not exceeded for the proposed foliar uses of boscalid on leafy vegetables (except brassica vegetables).

Mammals

For mammalian species, the listed species chronic risk LOC (RQ > 1.0) was exceeded the proposed uses of boscalid on leafy vegetables. For the proposed use of boscalid as a seed treatment, the chronic risk LOCs (RQ > 1) were exceeded for mammals that consume seeds as a major component of their diet. A more detailed analysis was conducted to evaluate the feasability of these results. Table 16 and associated text indicates that small mammals may be exposed to boscalid at levels near or above the NOAEL for all proposed uses on seeds.

While evidence from this screening-level analysis indicates a potential for effects on mammals, careful scrutiny of the toxicity data suggests otherwise. Although the NOAEL was 11.2 mg/kg/d (100 ppm diet), the effects at the LOAEL of 114 mg/kg/d (1000 ppm diet) were unlikely to be biologically significant; F2 pups weighed 7% less than control pups. Additionally, even at the highest concentration tested (10,000 ppm diet), effects were marginally biologically significant with pup viability at 86%, which is within the historically normal range of 83-99%. Importantly, these effects manifested in the F2 generation indicating that exposure durations may have to continue over several generations for effects to manifest.

For the proposed foliar uses, the highest RQ was near 7. If exposure were to occur at a level equivalent to the RQ, the exposure concentration would be 700 ppm, which is lower than the 1000 ppm LOAEL where effects were not biologically significant. Hence, risks to listed species associated with the foliar uses of boscalid are not expected.

For the proposed uses of boscalid as a seed treatment, RQs ranged from 2 to 48 with all but one with an RQ below 7. The RQ of 48 was associated with the high application rate for brassica vegetables. For the other uses with RQs below 7, even if exposure were to occur at this level it would equal 700 ppm, which is lower than the LOAEL of 1000 ppm where effects were not biologically significant. For the use of BAS 510 04F on brassica seeds, if exposure were to occur at the RQ of 48, this would be equivalent to approximately 4800 ppm, which is below where biologically significant effects were seen in the laboratory (10,000). Moreover, it may also be unlikely that deleterious effects on mammals may result from this use given the likely exposure duration. In the study on which the NOAEL of 100 ppm is based, exposure were continuous through 2 generations and the greatest effects manifested in second generation pups. Given that most brassica seeds probably germinate in a few weeks and that boscalid may leach from the seed to the soil, exposure durations in the field may not be long enough to result in a toxicological response.

Taken together, the factors outlined above suggest that deleterious effects to mammals from proposed uses of boscalid as a seed treatment and as a foliar treatment are unlikely.

Probit Dose-Response Analysis

A probit dose-response analysis was not conducted for the current assessment since no acute risk LOCs were exceeded for any taxa.

Indirect Effects

Pesticides have the potential to cause indirect effects to endangered or threatened species by, for example, perturbing forage or prey availability, altering the extent of nesting habitat, etc. The potential for indirect effects is determined by comparing RQs to the listed species LOCs. If the RQ exceeds the listed species LOC then there is the potential for indirect effects to listed species dependent on those taxa for which the RQ exceeded the listed species LOC.

For terrestrial species, the screening-level analysis indicated that, for uses as a seed treatement, boscalid may present deleterious risks to birds (chronic risk LOCs are exceeded). This suggests potential concern for indirect effects on listed organisms dependant upon avian species as prey items. A potential drop in vertebrate biomass associated with boscalid use may reduce a significant portion of the prey base. While it is likely that fields can be repopulated by immigrants and living breeders after the use of pesticides, if the prey base is removed at a critical life-cycle juncture, over a large area or of if it is removed for a long enough duration, some species may have difficulty meeting energy needs. Also, some species may be particularly sensitive during reproductive or developmental periods. A starting point for evaluating the potential risk of such a scenario would be to first identify listed species likely to occur in boscalid use areas, compare life histories of listed species in known boscalid use areas and determine if use is likely to overlap with a sensitive life-cycle component.

Critical Habitat for Listed Species

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

The screening-level risk assessment has identified potential concerns for indirect effects on listed species for those organisms dependant upon **birds, reptiles, terrestrial phase amphibians, freshwater invertebrates, aquatic plants, and molluscs.** In light of the potential for indirect effects, the next step for EPA and the Service(s) is to identify which listed species and critical habitat are potentially implicated

Analytically, the identification of such species and critical habitat can occur in either of two ways. First, the agencies could determine whether the action area overlaps critical habitat or the occupied range of any listed species. If so, EPA would examine whether the pesticide's potential impacts on non-endangered species would affect the listed species indirectly or directly affect a constituent element of the critical habitat. Alternatively, the agencies could determine which listed species depend on biological resources, or have constituent elements that fall into the taxa that may be directly or indirectly impacted by the pesticide. Then EPA would determine whether use of the pesticide overlaps the critical habitat or the occupied range of those listed species. **EPA and the Service(s) are presently working together to conduct the necessary analysis.**

This screening-level risk assessment for critical habitat provides a listing of potential biological features that, if they are constituent elements of one or more critical habitats, would be of potential concern. These correspond to the taxa identified above as being of potential concern for indirect effects and include the following **mammals, birds, reptiles, and terrestrial phase amphibians.** This list should serve as an initial step in problem formulation for further assessment of critical habitat impacts outlined above, should additional work be necessary.

Listed Species Occurrence Associated with Boscalid Uses

A preliminary analysis of the co-occurrence of listed species and proposed new uses of boscalid was conducted using EFED's LOCATES database version 2.9.7. The objective was to provide insight into the potential for exposure of listed species and to identify those areas, crop uses, and listed species that warrant further attention. A tabulation of the number of unique listed species that occur in the vicinity of proposed boscalid uses by state is provided in **Table 21.**

Listed Avian Species Co-occurrence with Proposed Boscalid Uses

The LOCATES analysis for seed treatments of brassica vegetables, bulb vegetables, legume vegetables, and peanuts indicated that a total of 69 listed avian species may occur in counties where these crops are grown and where boscalid could be used. A complete list of the listed avian species in each state associated with the specified uses of boscalid as a seed treatment are provided in Appendix C. A preliminary screen was conducted to evaluate, on a species-by-species, basis whether there were reasons to exclude some avian species from the list based on either habitat or diet. Natureserve (www.natureserve.org) was used to collect life history and ecology information on each bird species. Of the 69 species that are found in counties where brassica vegetables, bulb vegetables, legume vegetables, and peanuts are grown, only four consume seeds as a major dietary component and occupy habitats that could be near agricultural areas. The four species include the masked bobwhite *(Colinus virginianus ridgway)*, the San Clemente sage sparrow *(Amphispiza belli clementeae)*, the Florida grasshopper sparrow *(Ammodramus savannarum floridanus)*, and the Attwater's greater prairie chicken *(Tympanuchus cupido attwater)*. Although these species consume seeds as a major component of their diet, it is very likely that they occupy habitats that would reduce the possibility for exposure. Moreover,

the limited duration of exposure associated with germination and growth of the seed further reduces the possibility that chronic exposures would be sufficient to cause deleterious effects. However, a more thorough analysis to include clear delineation of action area and specific species locations/habits would be warranted; this was not conducted for the present assessment. The majority of the 69 bird species listed in Appendix C occupy distinctly non-agricultural habitats and/or do not consume seeds as a major component of their diet.

5. Uncertainties

Use of the Default Foliar Dissipation Half-life

Data on the foliar dissipation half-life of boscalid are not available and therefore terrestrial exposure assessments relied on the default value of 35 days. While an experimentally determined foliar dissipation half-life may decrease the some uncertainty in this assessment it would not, in all likelihood, alter the risk conclusions. For example, reducing the foliar dissipation half-life to 1.0 day would not alter the chronic risk profile for mammals; LOCs would be exceeded for small, intermediate, and large mammals that consume short grass, tall grass, and broadleaf plants/small insects.

Non-dietary Routes of Exposure

This screening-level risk assessment spray applications and seed treatments of boscalid only considers dietary exposures. Other routes of exposure, not considered in this assessment, include inhalation, dermal, and incidental soil ingestion. Although, these exposure routes can play an important role in some scenarios, given the chemical characteristics of boscalid, they are unlikely to drastically alter the risk profile identified by considering dietary exposures only.

Receptor Location

For screening terrestrial risk assessments for listed species, a generic bird or mammal is assumed to occupy either the treated field or adjacent areas receiving pesticide at a rate similar to the treatment rate on the field. This assumption leads to an overestimation of exposure to species that do not occupy the treated field. For screening risk assessment purposes, the actual habitat requirements of any particular terrestrial species are not considered, and it assumed that species occupy, exclusively and permanently, the treated area being modeled. This assumption leads to an overestimate of exposure in the risk estimates for a proportion of individuals of the exposed population. Although this estimate represents higher levels of exposure, it is within the range of possibility as some species may occupy habitats near the use site and use the use site to forage. Gorging can be a common opportunistic behavior in some animals whereby food items are consumed in excess of the daily requirement due to availability. This example is more likely to support an acute exposure scenario. Chronic exposure is more difficult to ascertain since it occurs over a longer duration providing more opportunity for animals to move and seek forage elsewhere. Nonetheless, many animals do forage over a range that would be included in agricultural fields; all prey items for these species may come from agricultural use areas.

Terrestrial Residue Levels

As discussed earlier in the exposure section of this document, the Agency relies on the work of Kenaga and Fletcher *et al.* (1994) for setting the assumed pesticide residues in wildlife dietary items. The Agency believes that these residue assumptions reflect a realistic upper-bound residue estimate, although the degree to which this assumption reflects a specific percentile estimate is difficult to accurately quantify although estimates based on observed data indicate that the upper-bound residue estimates account for about 87->97% of observed residue levels. However, it is important to note that the field measurement efforts used to develop the Fletcher estimates of exposure involve highly varied sampling techniques. It is entirely possible that much of these data reflect residues averaged over entire above ground plants in the case of grass and forage sampling. Depending upon a specific wildlife species' foraging habits, whole aboveground plant samples may either underestimate or overestimate actual exposure.

Dietary Intake - The Differences Between Laboratory and Field Conditions

The acute and chronic characterization of risk rely on comparisons of wildlife dietary residues with LC_{50} or NOAEC values expressed in concentrations of pesticides in laboratory feed. These comparisons assume that ingestion of food items in the field occurs at rates similar to those in the laboratory. Although the screening assessment process adjusts dry-weight estimates of food intake to reflect the increased mass in fresh-weight wildlife food intake estimates, it does not allow for gross energy and assimilative efficiency differences between wildlife food items and laboratory feed. Differences in assimilative efficiency between laboratory and wild diets suggest that current screening assessment methods do not account for a potentially important aspect of food requirements. Depending upon species and dietary matrix, bird assimilation of wild diet energy ranges from 23 - 80%, and mammal assimilation of diet ranges from 41 - 85% **(EPA, 1993)**. If it is assumed that laboratory chow is formulated to maximize assimilative efficiency (*e.g.*, a value of 85%), a potential for underestimation of exposure may exist by assuming that consumption of food in the wild is comparable with consumption during laboratory testing. In the screening process, exposure may be underestimated because metabolic rates are not related to food consumption.

Finally, the screening procedure does not account for situations where the feeding rate may be above or below requirements to meet free living metabolic requirements. Gorging behavior is a possibility under some specific wildlife scenarios (*e.g.*, bird migration) where the food intake rate may be greatly increased. **Kirkwood (1983)** has suggested that an upper-bound limit to this behavior might be the typical intake rate multiplied by a factor of 5. In contrast, there is the potential for avoidance, operationally defined as animals responding to the presence of noxious chemicals in their food by reducing consumption of treated dietary elements. This response is seen in nature where herbivores avoid plant secondary compounds. However, reduced food intake, particularly over an extended period, could result in reduced survival or reproductive output.

Lack of Data for Herpetofauna

Currently, toxicity studies on amphibians and reptiles are not required for pesticide registration. Since these data are lacking, the Agency uses fish as surrogates for aquatic phase amphibians and birds as surrogates for terrestrial phase amphibians and reptiles. These surrogates are thought to be reflective of or protective (more sensitive) of herpetofauna. Amphibians are characterized by a permeable skin. The most important route of exposure for aquatic amphibians would likely be the dermal route. Using freshwater fish may be suitable surrogates since exposure would likely be surface area dependent and the gill surface of many fish is a fairly large surface area. Also, both fish and amphibians are ectothermic so metabolic rates and demands would likely be similar. For terrestrial species, however, the difference between amphibians and birds and reptiles and birds is quite large. Terrestrial amphibians and reptiles are both ectothermic while birds are endothermic; birds have a higher basal metabolic rate to required to maintain constant body temperature. The higher metabolic demands of birds may be predispose birds to

higher relative exposures. However, this does not address any potential differences in toxicity. To date, there are few controlled studies on reptile species that could be used to compare to similar studies on birds. *A priori*, there is no strong reason to think that one taxa is more or less sensitive than another. Further research is required to determine whether, in general, reptiles and terrestrial-phase amphibians are suitably represented by birds species in assessing risks.

Use of the Most Sensitive Species Tested

Although the screening risk assessment relies on a selected toxicity endpoint from the most sensitive species tested, it does not necessarily mean that the selected toxicity endpoints reflect sensitivity of the most sensitive species existing in a given environment. The relative position of the most sensitive species tested in the distribution of all possible species is a function of the overall variability among species to a particular chemical. The relationship between the sensitivity of the most tested species versus wild species (including listed species) is unknown and a source of significant uncertainty. The use of laboratory species has historically been driven by availability and ease of maintenance. A widespread comparison of species is lacking, however, even variation within a species can be quite high. For example, in this assessment, acute studies on waterfleas yielded three different values. Granted these were within an order of magnitude but examples exist where differences have been more extreme.

Data Gaps

For boscalid, the only major data gap is the lack of robust terrestrial plant studies. Tier I studies, although scientifically sound were not conducted using the appropriate exposure concentration. The concentration used was 0.55 lb a.i./A, which is lower than the highest proposed rates (for turf) and lower than the highest seasonal application rate under the current request of 0.792 lb a.i./A. Given that the study showed an almost 25% effect in some species, it is likely that an EC_{25} could have been estimated using more appropriate exposure concentrations. Moreover, the lack of a Tier II study with multiple exposure levels greatly increases the uncertainty associated with potential toxicological effects that may occur at the EC_{05}. The lack of a NOAEC and an EC_{05} prevents the estimation of risks to listed terrestrial plant species. Despite the lack of an EC_{05} or a NOAEC, simulations with TerrPlant (Version 1.0) indicate that the EC_{05} or NOAEC would have to be lower than 0.09 lb/A for the RQ to exceed the listed species LOC.

Another potentially important data gap is the lack of toxicity data for common degredates of boscalid. While not required, the data would be useful in more accurately quantifying and characterizing risks.

V. Literature Cited

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APPENDIX A

GENEEC

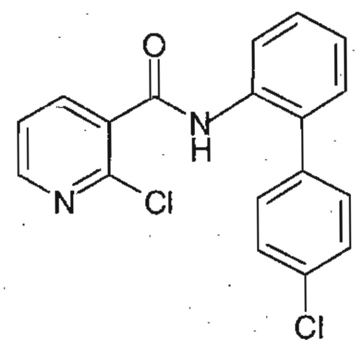
```
RUN No.  1 FOR Boscalid       ON  Leafy vege   * INPUT VALUES *
--------------------------------------------------------------------
RATE (#/AC)  No.APPS &  SOIL  SOLUBIL  APPL TYPE  NO-SPRAY INCORP
 ONE(MULT)   INTERVAL   Kd   (PPM )  (%DRIFT)  ZONE(FT)  (IN)
--------------------------------------------------------------------
.396(  .787)  2  7    655.0   6.0  GRHIFI( 6.6)   .0   .0

FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)
--------------------------------------------------------------------
METABOLIC  DAYS UNTIL  HYDROLYSIS  PHOTOLYSIS  METABOLIC  COMBINED
 (FIELD)  RAIN/RUNOFF   (POND)    (POND-EFF)    (POND)     (POND)
--------------------------------------------------------------------
 365.00      2       N/A      .00-    .00     .00     .00

GENERIC EECs (IN MICROGRAMS/LITER (PPB))   Version 2.0 Aug 1, 2001
--------------------------------------------------------------------
  PEAK     MAX 4 DAY    MAX 21 DAY   MAX 60 DAY   MAX 90 DAY
  GEEC     AVG GEEC     AVG GEEC     AVG GEEC     AVG GEEC
--------------------------------------------------------------------
   3.41      2.95         1.41         .56          .38
```

Gennec for cabbage: 8 lbs/A

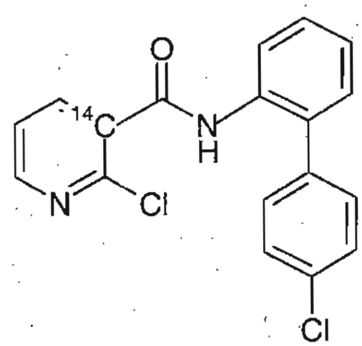
```
RUN No.  4 FOR bosc         ON  cabbage     * INPUT VALUES *
--------------------------------------------------------------------
 RATE (#/AC)  No.APPS &  SOIL  SOLUBIL  APPL TYPE NO-SPRAY INCORP
  ONE(MULT)   INTERVAL   Koc  (PPM )  (%DRIFT)  (FT)   (IN)
--------------------------------------------------------------------
3.840( 3.840)  1  1    655.0   6.0  GRANUL(  .0)   .0  1.0

FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)
--------------------------------------------------------------------
METABOLIC  DAYS UNTIL  HYDROLYSIS  PHOTOLYSIS  METABOLIC  COMBINED
 (FIELD)  RAIN/RUNOFF   (POND)    (POND-EFF)    (POND)     (POND)
--------------------------------------------------------------------
 365.00      0       N/A      .00-    .00     .00     .00

GENERIC EECs (IN MICROGRAMS/LITER (PPB))   Version 2.0 Aug 1, 2001
--------------------------------------------------------------------
  PEAK     MAX 4 DAY    MAX 21 DAY   MAX 60 DAY   MAX 90 DAY
  GEEC     AVG GEEC     AVG GEEC     AVG GEEC     AVG GEEC
--------------------------------------------------------------------
  104.26    103.93       102.09        98.12        95.28
```

APPENDIX A. STRUCTURES FOR NICOBIFEN (BAS 510 F) PARENT AND DEGRADATES FROM THE ENVIRONMENTAL FATE STUDIES

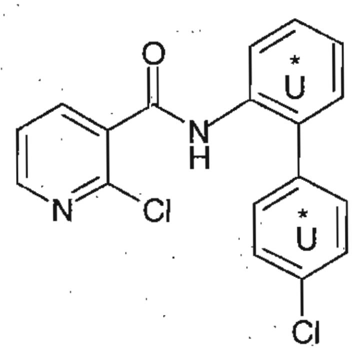
IUPAC name: 2-Chloro-*N*-(4-chlorobiphenyl-2-yl)-nicotinamide.
CAS name: 2-Chloro-*N*-(4-chloro[1,1-biphenyl]-2-yl)-3-pyridinecarboxamide.
CAS No: 188425-85-6.
Synonyms: 2-Chloro-*N*-(4'-chlorobiphenyl-2-yl)-nicotinamide, BAS 510 F.



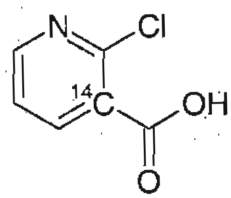
[Pyridine-3-^{14}C]-labeled BAS 510 F



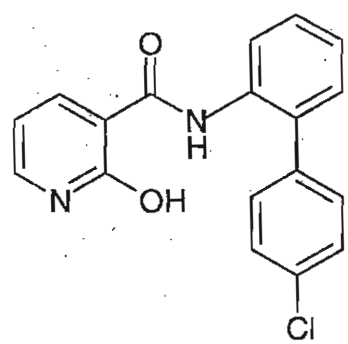
[Diphenyl-U-^{14}C]-labeled BAS 510 F



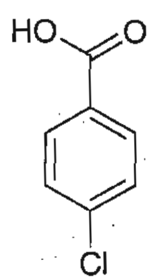
M510F47 2-chloronicotinic acid-[pyridine-3-^{14}C]



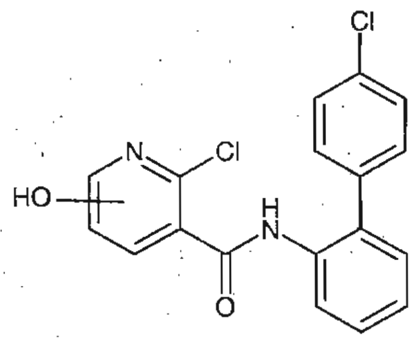
M510F49 (2-Hydroxy-N-(4'-chlorobiphenyl-2-yl)nicotinamide)



M510F64 (*p*-Chloro-benzoic acid)



M510F50
Unknown 2



APPENDIX B
Sample Calculations for Seed Analysis

Avian Receptor:

200 g body weight
Food ingestion rate = 0.301 * (200g ^ 0.751) = 16 g/day (per bird)
NOAEL = 25 mg a.i./kg body weight/day = 5 mg/day for 200 g bird

Crop: onion (bulb vegetable), 152000 seeds/lb, 15 lbs seed/A at planting
Boscalid application rate: 0.07 lbs a.i./100 lbs seed

mg a.i./seed = (0.07 lb a.i./100 lb seed) x (453600 mg/lb) x (1 lb/152000 seeds) = 0.00208 mg a.i./seed

seeds consumed to equal NOAEL = (5 mg/d) / (0.00208 mg a.i./seed) = 2394 seeds

seeds possibly consumed = (16 g food/day) / ((453.6 g / lb) / (152000 seeds/lb)) = 5362 seeds

Forage area required:

assume 2% seeds available after planting

#available seeds/acre = (15 lbs seed/A) x (152000 seeds/lb) x (0.02 available) = 45600

proportion of A foraged with 100% efficiency to equal exposure at NOAEC = 2394/45600 = 0.05

The interpretation of this analysis is that all available seeds on 5% of a planted acre would need to be eaten for exposure to equal the NOAEL assuming 2% availability of seeds.

APPENDIX C

Species Listing by State

No species were excluded

Minimum of 1 Acre.

Bulb vegetables, brassica vegetables, peanuts, and legume vegetables

Alabama (3) species affected		**Taxa**	Critical Habitat
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
PLOVER, PIPING *(Charadrius melodus)*	Endangered	Bird	Yes
STORK, WOOD *(Mycteria americana)*	Endangered	Bird	No
WOODPECKER, RED-COCKADED *(Picoides borealis)*	Endangered	Bird	No

Arizona (9) species affected		**Taxa**	Critical Habitat
BOBWHITE, MASKED *(Colinus virginianus ridgwayi)*	Endangered	Bird	No
CONDOR, CALIFORNIA *(Gymnogyps californianus)*	Endangred	Bird	Yes
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
FALCON, NORTHERN APLOMADO *(Falco femoralis septentrionalis)*	Endangered	Bird	No
FLYCATCHER, SOUTHWESTERN WILLOW *(Empidonax traillii extimus)*	Endangered	Bird	Yes
OWL, MEXICAN SPOTTED *(Strix occidentalis lucida)*	Threatened	Bird	Yes
PELICAN, BROWN *(Pelecanus occidentalis)*	Endangered	Bird	No
PYGMY-OWL, CACTUS FERRUGINOUS *(Glaucidium brasilianum cactorum)*	Endangered	Bird	Yes
RAIL, YUMA CLAPPER *(Rallus longirostris yumanensis)*	Endangered	Bird	No

Arkansas (3) species affected		**Taxa**	Critical Habitat
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
TERN, INTERIOR (POPULATION) LEAST *(Sterna antillarum)*	Endangered	Bird	No

WOODPECKER, RED-COCKADED *(Picoides borealis)*	Endangered	Bird	No
California (16) species affected		**Taxa**	Critical Habitat
CONDOR, CALIFORNIA *(Gymnogyps californianus)*	Endangered	Bird	Yes
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
FLYCATCHER, SOUTHWESTERN WILLOW *(Empidonax traillii extimus)*	Endangered	Bird	Yes
GNATCATCHER, COASTAL CALIFORNIA *(Polioptila californica californica)*	Threatened	Bird	Yes
MURRELET, MARBLED *(Brachyramphus marmoratus marmoratus)*	Threatened	Bird	Yes
OWL, NORTHERN SPOTTED *(Strix occidentalis caurina)*	Threatened	Bird	Yes
PELICAN, BROWN *(Pelecanus occidentalis)*	Endangered	Bird	No
PLOVER, WESTERN SNOWY *(Charadrius alexandrinus nivosus)*	Threatened	Bird	No
RAIL, CALIFORNIA CLAPPER *(Rallus longirostris obsoletus)*	Endangered	Bird	No
RAIL, LIGHT-FOOTED CLAPPER *(Rallus longirostris levipes)*	Endangered	Bird	No
RAIL, YUMA CLAPPER *(Rallus longirostris yumanensis)*	Endangered	Bird	No
SHRIKE, SAN CLEMENTE LOGGERHEAD *(Lanius ludovicianus meamsi)*	Endangered	Bird	No
SPARROW, SAN CLEMENTE SAGE *(Amphispiza belli clementeae)*	Threatened	Bird	No
TERN, CALIFORNIA LEAST *(Sterna antillarum browni)*	Endangered	Bird	No
TOWHEE, INYO BROWN *(Pipilo crissalis eremophilus)*	Threatened	Bird	Yes
VIREO, LEAST BELL'S *(Vireo bellii pusillus)*	Endangered	Bird	Yes
Colorado (3) species affected		**Taxa**	Critical Habitat
CRANE, WHOOPING *(Grus americana)*	Endangered	Bird	Yes
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No

OWL, MEXICAN SPOTTED *(Strix occidentalis lucida)*	Threatened	Bird	Yes
Connecticut (3) species affected		**Taxa**	Critical Habitat
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
PLOVER, PIPING *(Charadrius melodus)*	Endangered	Bird	Yes
TERN, ROSEATE *(Sterna dougallii dougallii)*	Endangered	Bird	No
Delaware (2) species affected		**Taxa**	Critical Habitat
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
PLOVER, PIPING *(Charadrius melodus)*	Endangered	Bird	Yes
Florida (9) species affected		**Taxa**	Critical Habitat
CARACARA, AUDUBON'S CRESTED *(Polyborus plancus audubonii)*	Threatened	Bird	No
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
JAY, FLORIDA SCRUB *(Aphelocoma coerulescens)*	Threatened	Bird	No
KITE, EVERGLADE SNAIL *(Rostrhamus sociabilis plumbeus)*	Endangered	Bird	Yes
PLOVER, PIPING *(Charadrius melodus)*	Endangered	Bird	Yes
SPARROW, CAPE SABLE SEASIDE *(Ammodramus maritimus mirabilis)*	Endangered	Bird	Yes
SPARROW, FLORIDA GRASSHOPPER *(Ammodramus savannarum floridanus)*	Endangered	Bird	No
STORK, WOOD *(Mycteria americana)*	Endangered	Bird	No
WOODPECKER, RED-COCKADED *(Picoides borealis)*	Endangered	Bird	No
Georgia (5) species affected		**Taxa**	Critical Habitat
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
PLOVER, PIPING *(Charadrius melodus)*	Endangered	Bird	Yes
STORK, WOOD	Endangered	Bird	No

(Mycteria americana)			
WARBLER (WOOD), KIRTLAND'S *(Dendroica kirtlandii)*	Endangered	Bird	No
WOODPECKER, RED-COCKADED *(Picoides borealis)*	Endangered	Bird	No
Hawaii (32) species affected		**Taxa**	Critical Habitat
'AKEPA, HAWAII *(Loxops coccineus coccineus)*	Endangered	Bird	No
'AKEPA, MAUI *(Loxops coccineus ochraceus)*	Endangered	Bird	No
'AKIA LOA, KAUAI (HEMIGNATHUS PROCERUS) *(Hemignathus procerus)*	Endangered	Bird	No
'AKIA POLA'AU (HEMIGNATHUS MUNROI) *(Hemignathus munroi)*	Endangered	Bird	No
ALBATROSS, SHORT-TAILED *(Phoebastria (=Diomedea) albatrus)*	Endangered	Bird	No
COOT, HAWAIIAN (=ALAE KEO KEO) *(Fulica americana alai)*	Endangered	Bird	No
CREEPER, HAWAII *(Oreomystis mana)*	Endangered	Bird	No
CREEPER, MOLOKAI (KAKAWAHIE) *(Paroreomyza flammea)*	Endangered	Bird	No
CREEPER, OAHU (ALAUWAHIO) *(Paroreomyza maculata)*	Endangered	Bird	No
CROW, HAWAIIAN ('ALALA) *(Corvus hawaiiensis)*	Endangered	Bird	No
DUCK, HAWAIIAN (KOLOA) *(Anas wyvilliana)*	Endangered	Bird	No
DUCK, LAYSAN *(Anas laysanensis)*	Endangered	Bird	No
ELEPAIO, OAHU *(Chasiempis sandwichensis ibidis)*	Endangered	Bird	Yes
FINCH, LAYSAN *(Telespyza cantans)*	Endangered	Bird	No
FINCH, NIHOA *(Telespyza ultima)*	Endangered	Bird	No
GOOSE, HAWAIIAN (NENE) *(Branta (=Nesochen) sandvicensis)*	Endangered	Bird	No
HAWK, HAWAIIAN (IO) *(Buteo solitarius)*	Endangered	Bird	No
HONEYCREEPER, CRESTED ('AKOHEKOHE)	Endangered	Bird	No

(Palmeria dolei)			
MILLERBIRD, NIHOA *(Acrocephalus familiaris kingi)*	Endangered	Bird	No
MOORHEN, HAWAIIAN COMMON *(Gallinula chloropus sandvicensis)*	Endangered	Bird	No
NUKU PU'U *(Hemignathus lucidus)*	Endangered	Bird	No
'O'O, KAUAI (='A'A) *(Moho braccatus)*	Endangered	Bird	No
'O'U (HONEYCREEPER) *(Psittirostra psittacea)*	Endangered	Bird	No
PALILA *(Loxioides bailleui)*	Endangered	Bird	Yes
PARROTBILL, MAUI *(Pseudonestor xanthophrys)*	Endangered	Bird	No
PETREL, HAWAIIAN DARK-RUMPED *(Pterodroma phaeopygia sandwichensis)*	Endangered	Bird	No
PO'OULI *(Melamprosops phaeosoma)*	Endangered	Bird	No
SHEARWATER, NEWELL'S TOWNSEND'S *(Puffinus auricularis newelli)*	Threatened	Bird	No
STILT, HAWAIIAN (=AE'O) *(Himantopus mexicanus knudseni)*	Endangered	Bird	No
THRUSH, LARGE KAUAI *(Myadestes myadestinus)*	Endangered	Bird	No
THRUSH, MOLOKAI (OLOMA'O) *(Myadestes lanaiensis rutha)*	Endangered	Bird	No
THRUSH, SMALL KAUAI (PUAIOHI) *(Myadestes palmeri)*	Endangered	Bird	No

Idaho (2) species affected		**Taxa**	Critical Habitat
CRANE, WHOOPING *(Grus americana)*	Endangered	Bird	Yes
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No

Illinois (3) species affected		**Taxa**	Critical Habitat
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
PLOVER, PIPING *(Charadrius melodus)*	Endangered	Bird	Yes
TERN, INTERIOR (POPULATION) LEAST	Endangered	Bird	No

(Sterna antillarum)

Indiana (3) species affected		Taxa	Critical Habitat
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
PLOVER, PIPING *(Charadrius melodus)*	Endangered	Bird	Yes
TERN, INTERIOR (POPULATION) LEAST *(Sterna antillarum)*	Endangered	Bird	No

Iowa (2) species affected		Taxa	Critical Habitat
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
PLOVER, PIPING *(Charadrius melodus)*	Endangered	Bird	Yes

Kansas (4) species affected		Taxa	Critical Habitat
CRANE, WHOOPING *(Grus americana)*	Endangered	Bird	Yes
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
PLOVER, PIPING *(Charadrius melodus)*	Endangered	Bird	Yes
TERN, INTERIOR (POPULATION) LEAST *(Sterna antillarum)*	Endangered	Bird	No

Kentucky (3) species affected		Taxa	Critical Habitat
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
TERN, INTERIOR (POPULATION) LEAST *(Sterna antillarum)*	Endangered	Bird	No
WOODPECKER, RED-COCKADED *(Picoides borealis)*	Endangered	Bird	No

Louisiana (6) species affected		Taxa	Critical Habitat
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
PELICAN, BROWN *(Pelecanus occidentalis)*	Endangered	Bird	No
PLOVER, PIPING *(Charadrius melodus)*	Endangered	Bird	Yes
TERN, CALIFORNIA LEAST *(Sterna antillarum browni)*	Endangered	Bird	No
TERN, INTERIOR (POPULATION) LEAST *(Sterna antillarum)*	Endangered	Bird	No

WOODPECKER, RED-COCKADED *(Picoides borealis)*	Endangered	Bird	No
Maine (3) species affected		**Taxa**	Critical Habitat
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
PLOVER, PIPING *(Charadrius melodus)*	Endangered	Bird	Yes
TERN, ROSEATE *(Sterna dougallii dougallii)*	Endangered	Bird	No
Maryland (1) species affected		**Taxa**	Critical Habitat
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
Massachusetts (3) species affected		**Taxa**	Critical Habitat
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
PLOVER, PIPING *(Charadrius melodus)*	Endangered	Bird	Yes
TERN, ROSEATE *(Sterna dougallii dougallii)*	Endangered	Bird	No
Michigan (3) species affected		**Taxa**	Critical Habitat
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
PLOVER, PIPING *(Charadrius melodus)*	Endangered	Bird	Yes
WARBLER (WOOD), KIRTLAND'S	Endangered	Bird	No
Minnesota (3) species affected		**Taxa**	Critical Habitat
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
PLOVER, PIPING *(Charadrius melodus)*	Endangered	Bird	Yes
WOLF, GRAY *(Canis lupus)*	Threatened	Mammal	Yes
Mississippi (6) species affected		**Taxa**	Critical Habitat
CRANE, MISSISSIPPI SANDHILL *(Grus canadensis pulla)*	Endangered	Bird	Yes
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
PELICAN, BROWN *(Pelecanus occidentalis)*	Endangered	Bird	No

PLOVER, PIPING *(Charadrius melodus)*	Endangered	Bird	Yes
TERN, INTERIOR (POPULATION) LEAST *(Sterna antillarum)*	Endangered	Bird	No
WOODPECKER, RED-COCKADED *(Picoides borealis)*	Endangered	Bird	No
Missouri (3) species affected		**Taxa**	Critical Habitat
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
PLOVER, PIPING *(Charadrius melodus)*	Endangered	Bird	Yes
TERN, INTERIOR (POPULATION) LEAST *(Sterna antillarum)*	Endangered	Bird	No
Montana (4) species affected		**Taxa**	Critical Habitat
CRANE, WHOOPING *(Grus americana)*	Endangered	Bird	Yes
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
PLOVER, PIPING *(Charadrius melodus)*	Endangered	Bird	Yes
TERN, INTERIOR (POPULATION) LEAST *(Sterna antillarum)*	Endangered	Bird	No
Nebraska (4) species affected		**Taxa**	Critical Habitat
CRANE, WHOOPING *(Grus americana)*	Endangered	Bird	Yes
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
PLOVER, PIPING *(Charadrius melodus)*	Endangered	Bird	Yes
TERN, INTERIOR (POPULATION) LEAST *(Sterna antillarum)*	Endangered	Bird	No
Nevada (2) species affected		**Taxa**	Critical Habitat
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
RAIL, YUMA CLAPPER *(Rallus longirostris yumanensis)*	Endangered	Bird	No
New Hampshire (1) species affected		**Taxa**	Critical Habitat
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
New Jersey (3) species affected		**Taxa**	Critical Habitat

CURLEW, ESKIMO *(Numenius borealis)*	Endangered	Bird	No
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
PLOVER, PIPING *(Charadrius melodus)*	Endangered	Bird	Yes

New Mexico (6) species affected		**Taxa**	Critical Habitat
CRANE, WHOOPING *(Grus americana)*	Endangered	Bird	Yes
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
FALCON, NORTHERN APLOMADO *(Falco femoralis septentrionalis)*	Endangered	Bird	No
FLYCATCHER, SOUTHWESTERN WILLOW *(Empidonax traillii extimus)*	Endangered	Bird	Yes
OWL, MEXICAN SPOTTED *(Strix occidentalis lucida)*	Threatened	Bird	Yes
TERN, INTERIOR (POPULATION) LEAST *(Sterna antillarum)*	Endangered	Bird	No

New York (5) species affected		**Taxa**	Critical Habitat
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
PLOVER, PIPING *(Charadrius melodus)*	Endangered	Bird	Yes
TERN, ROSEATE *(Sterna dougallii dougallii)*	Endangered	Bird	No

North Carolina (5) species affected		**Taxa**	Critical Habitat
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
PLOVER, PIPING *(Charadrius melodus)*	Endangered	Bird	Yes
STORK, WOOD *(Mycteria americana)*	Endangered	Bird	No
TERN, ROSEATE *(Sterna dougallii dougallii)*	Endangered	Bird	No
WOODPECKER, RED-COCKADED *(Picoides borealis)*	Endangered	Bird	No

North Dakota (4) species affected		**Taxa**	Critical Habitat
CRANE, WHOOPING *(Grus americana)*	Endangered	Bird	Yes

EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
PLOVER, PIPING *(Charadrius melodus)*	Endangered	Bird	Yes
TERN, INTERIOR (POPULATION) LEAST *(Sterna antillarum)*	Endangered	Bird	No

Ohio (2) species affected		**Taxa**	Critical Habitat
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
PLOVER, PIPING *(Charadrius melodus)*	Endangered	Bird	Yes

Oklahoma (7) species affected		**Taxa**	Critical Habitat
CRANE, WHOOPING *(Grus americana)*	Endangered	Bird	Yes
CURLEW, ESKIMO *(Numenius borealis)*	Endangered	Bird	No
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
PLOVER, PIPING *(Charadrius melodus)*	Endangered	Bird	Yes
TERN, INTERIOR (POPULATION) LEAST *(Sterna antillarum)*	Endangered	Bird	No
VIREO, BLACK-CAPPED *(Vireo atricapilla)*	Endangered	Bird	No
WOODPECKER, RED-COCKADED *(Picoides borealis)*	Endangered	Bird	No

Oregon (5)species affected		**Taxa**	Critical Habitat
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
MURRELET, MARBLED *(Brachyramphus marmoratus marmoratus)*	Threatened	Bird	Yes
OWL, NORTHERN SPOTTED *(Strix occidentalis caurina)*	Threatened	Bird	Yes
PELICAN, BROWN *(Pelecanus occidentalis)*	Endangered	Bird	No
PLOVER, WESTERN SNOWY *(Charadrius alexandrinus nivosus)*	Threatened	Bird	No

Pennsylvania (2) species affected		**Taxa**	Critical Habitat
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
PLOVER, PIPING	Endangered	Bird	Yes

(Charadrius melodus)

Rhode Island	(1) species affected		**Taxa**	Critical Habitat
PLOVER, PIPING *(Charadrius melodus)*		Endangered	Bird	Yes
South Carolina	(4) species affected		**Taxa**	Critical Habitat
EAGLE, BALD *(Haliaeetus leucocephalus)*		Threatened	Bird	No
PLOVER, PIPING *(Charadrius melodus)*		Endangered	Bird	Yes
STORK, WOOD *(Mycteria americana)*		Endangered	Bird	No
WOODPECKER, RED-COCKADED *(Picoides borealis)*		Endangered	Bird	No
South Dakota	(4) species affected		**Taxa**	Critical Habitat
CRANE, WHOOPING *(Grus americana)*		Endangered	Bird	Yes
EAGLE, BALD *(Haliaeetus leucocephalus)*		Threatened	Bird	No
PLOVER, PIPING *(Charadrius melodus)*		Endangered	Bird	Yes
TERN, INTERIOR (POPULATION) LEAST *(Sterna antillarum)*		Endangered	Bird	No
Tennessee	(3) species affected		**Taxa**	Critical Habitat
EAGLE, BALD *(Haliaeetus leucocephalus)*		Threatened	Bird	No
TERN, INTERIOR (POPULATION) LEAST *(Sterna antillarum)*		Endangered	Bird	No
WOODPECKER, RED-COCKADED *(Picoides borealis)*		Endangered	Bird	No
Texas	(13) species affected		**Taxa**	Critical Habitat
CRANE, WHOOPING *(Grus americana)*		Endangered	Bird	Yes
CURLEW, ESKIMO *(Numenius borealis)*		Endangered	Bird	No
EAGLE, BALD *(Haliaeetus leucocephalus)*		Threatened	Bird	No
FALCON, NORTHERN APLOMADO *(Falco femoralis septentrionalis)*		Endangered	Bird	No
FLYCATCHER, SOUTHWESTERN WILLOW *(Empidonax traillii extimus)*		Endangered	Bird	Yes

PELICAN, BROWN *(Pelecanus occidentalis)*	Endangered	Bird	No
OWL, MEXICAN SPOTTED *(Strix occidentalis lucida)*	Endangered	Bird	Yes
PLOVER, PIPING *(Charadrius melodus)*	Endangered	Bird	Yes
PRAIRIE-CHICKEN, ATTWATER'S GREATER *(Tympanuchus cupido attwateri)*	Endangered	Bird	No
TERN, INTERIOR (POPULATION) LEAST *(Sterna antillarum)*	Endangered	Bird	No
VIREO, BLACK-CAPPED *(Vireo atricapilla)*	Endangered	Bird	No
WARBLER (WOOD), GOLDEN-CHEEKED *(Dendroica chrysoparia)*	Endangered	Bird	No
WOODPECKER, RED-COCKADED *(Picoides borealis)*	Endangered	Bird	No
Utah (4) species affected		**Taxa**	Critical Habitat
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
OWL, MEXICAN SPOTTED *(Strix occidentalis lucida)*	Threatened	Bird	Yes
Vermont (1) species affected		**Taxa**	Critical Habitat
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
Virginia (3) species affected		**Taxa**	Critical Habitat
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
PLOVER, PIPING *(Charadrius melodus)*	Endangered	Bird	Yes
WOODPECKER, RED-COCKADED *(Picoides borealis)*	Endangered	Bird	No
Washington (5) species affected		**Taxa**	Critical Habitat
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
MURRELET, MARBLED *(Brachyramphus marmoratus marmoratus)*	Threatened	Bird	Yes
OWL, NORTHERN SPOTTED *(Strix occidentalis caurina)*	Threatened	Bird	Yes
PELICAN, BROWN *(Pelecanus occidentalis)*	Endangered	Bird	No
PLOVER, WESTERN SNOWY	Threatened	Bird	No

(Charadrius alexandrinus nivosus)			
West Virginia (1) species affected		**Taxa**	Critical Habitat
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
Wisconsin (3) species affected		**Taxa**	Critical Habitat
EAGLE, BALD *(Haliaeetus leucocephalus)*	Threatened	Bird	No
PLOVER, PIPING *(Charadrius melodus)*	Endangered	Bird	Yes
WARBLER (WOOD), KIRTLAND'S *(Dendroica kirtlandii)*	Endangered	Bird	No
Wyoming (1) species affected		**Taxa**	Critical Habitat
EAGLE, BALD (Haliaeetus leucocephalus)	Threatened	Bird	No