Risks of DCPA Use to Federally Threatened California Red-legged Frog
(*Rana aurora draytonii*)

Pesticide Effects Determination

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1.0 Executive Summary

The purpose of this assessment is to evaluate potential direct and indirect effects on the California red-legged frog *(Rana aurora draytonii*) (CRLF) arising from Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) regulatory actions regarding use of DCPA on agricultural and non-agricultural sites. In addition, this assessment evaluates whether these actions can be expected to result in modification of the species' designated critical habitat. This assessment was completed in accordance with the U.S. Fish and Wildlife Service (U.S. FWS) and National Marine Fisheries Service (NMFS) *Endangered Species Consultation Handbook* (U.S. FWS/NMFS, 1998 and procedures outlined in the Agency's Overview Document (U.S. EPA, 2004).

The CRLF was listed as a threatened species by U.S. FWS in 1996. The species is endemic to California and Baja California (Mexico) and inhabits both coastal and interior mountain ranges. A total of 243 streams or drainages are believed to be currently occupied by the species, with the greatest numbers in Monterey, San Luis Obispo, and Santa Barbara counties (U.S. FWS, 1996) in California.

Chlorthal dimethyl (DCPA) is a non-systemic pre-emergence herbicide for control of annual grasses and broadleaf weeds. It has a variety of agricultural and non-agricultural uses. Currently, there are 13 national labels registered with the EPA with three of those being technical labels. An extensive list of these uses is provided in Section 2.4.4. The following uses are considered as part of the federal action evaluated in this assessment and are current labeled uses of DCPA:

Terrestrial food crops
Arrowroot, dried-type succulent (snap) beans, *brassica* (head and stem vegetables), Broccoli, broccoli raab, Brussels sprouts, cabbage, chinese cabbage, canola/rape, cauliflower, chayote, collards, cucumber, eggplant, garlic, gherkin, medicinal ginseng, gourd, Chinese (wax) gourd, groundcherry (strawberry tomato/tomatillo), hanover salad, horseradish, kale, head and leaf lettuce (black seeded simpson, salad bowl, etc.), manioc (cassava), melons, watermelons, cantaloupe, honeydew, musk melons, Momordica spp., mustard, onion (including green and scallions), onion, southern peas, pepino (melon pear), pepper, white/Irish potato, radish, shallot, all or unspecified squash, summer squash, winter squash, hubbard squash, sweet potato, strawberry, taro, tomatillo, tomato, tumeric, turnip, yam

Terrestrial non-food crop
Gulf course turf, nursery stock, ornamental and/or shade trees, ornamental ground cover, ornamental herbaceous plants, ornamental lawns and turf ornamental sod farm (turf), ornamental lawns and turf, ornamental nonflowering plants, ornamental woody shrubs and vines, residential lawns

DCPA is slightly soluble (0.5 mg/L), semi-volatile (vapor pressure = 0.21 – 0.33 mPa), and has a moderate log K_{OW} (4.28-4.4) (Table 2-2). The primary route of degradation is aerobic metabolism. It is stable to hydrolysis and photolysis and biotic half-lives range from 27 - 66 days (Table 2-3). Organic-carbon water partition coefficients (K_{OC}s) ranging from 1863-3503

L/kg, indicate it is slightly mobile (according to the FAO classification system, Table 2-4; FAO, 2000; U.S. EPA, 2006a). Potential transport mechanisms include spray drift, runoff, volatization, and atmospheric transport. Substantial fractions of applied DCPA could be available for runoff for several months post-application. The moderate K_{OC}, indicates that DCPA may be present in runoff both dissolved in water or bound to organic carbon in soil or sediment. A complete discussion of the environmental fate of DCPA is available in Section 2.4.1.

Two major degradates were observed in laboratory studies, tetrachloroterephthalic acid (TPA) and monomethyl tetrachloroterephthalic acid (MTP). TPA reached maximums of 100% applied radioactivity and MTP maximums of 16% applied radioactivity in aerobic soil metabolism studies. TPA was also a major degradate in an anaerobic soil metabolism study. MTP is an intermediate between DCPA and TPA. TPA is stable to aerobic and anaerobic soil metabolism (Table 2-3). MTP is short lived and degraded to TPA. Exposure to DCPA and TPA is expected to be much greater than to MTP. Therefore, the risk assessment of degradates focuses on exposure to TPA.

The manufacturing process of DCPA produces several known contaminants. Of toxicological concern are hexachlorobenzene (HCB), congeners (structurally related chemicals) of polyhalogenated dibenzo-p-dioxins/dibenzofurans (dioxins/furans), and other possible organochlorine contaminants. Although dibenzofurans and dibenzodioxins other than 2,3,7,8-TCDD are a possible manufacturing by-products and were reported as a contaminant in the RED, no residues were reported to be found in the most recent Confidential Statement of Formula (U.S. EPA, 1998b). Therefore, the risk assessment of impurities focuses on HCB and 2,3,7,8-TCDD.

Since CRLFs exist within aquatic and terrestrial habitats, exposure of the CRLF, its prey and its habitats to DCPA are assessed separately for the two habitats. Tier-II aquatic exposure models (PRZM/EXAMs) were used to estimate high-end exposures of DCPA in aquatic habitats resulting from runoff and spray drift from different uses. Peak model-estimated environmental concentrations resulting from different DCPA uses range from 37 to 500 µg/L (Table 3-6). These estimates are supplemented with analysis of available California surface water monitoring data from U. S. Geological Survey's National Water Quality Assessment (NAWQA) program and the California Department of Pesticide Regulation. The maximum concentration of DCPA reported by NAWQA for California surface waters with agricultural watersheds is 0.7 µg/L. This value is approximately 714 times *less than* the maximum model-estimated environmental concentration. The maximum concentration of DCPA reported by the California Department of Pesticide Regulation surface water database (5.2 µg/L) is roughly 96 times *lower* than the highest peak model-estimated environmental concentration. The maximum concentration of DCPA measured in surface water elsewhere in the U.S. was 100 µg/L (Section 3.2.4.1).

The Tier I GENEEC aquatic exposure model was used to estimate high-end exposures to the degradate TPA in aquatic habitats resulting from runoff and spray drift from different uses. Tier II modeling was also used to characterize possible accumulation of TPA in the aquatic environment. GENEEC TPA peak EECs resulting from different DCPA uses ranged from 3.09 - 23.14 mg/L (Table 3-7).

The NAWQA water monitoring program did not analyze samples for TPA, the stable end-degradate of DCPA, but did evaluate samples for the concentration of MTP, the intermediate degradate. TPA is the more stable degradate and if it were included in the NAWQA monitoring program, it would likely be found more frequently and at higher concentrations than MTP. The maximum concentration of MTP detected in surface water in the United States was 1.2 μg/L (Section 3.2.4.1). No surface water monitoring data were available for TPA; however, ground water monitoring data are available and results are summarized in Section 3.2.4.

Aquatic exposure to the impurities, HCB and 2,3,7,8-TCDD, was not characterized. The net effect from the additional exposure of aquatic organisms to the impurities would be to increase the risk from that expected to result from exposure to DCPA and its degradates.

To estimate DCPA exposures to the terrestrial-phase CRLF, and its potential prey resulting from uses involving DCPA applications, the T-REX model was used for foliar and broadcast applications of wettable powder and flowable concentrate formulations. Risk to terrestrial organisms exposed to granular formulations were assumed to be similar to risk based on wettable powder and flowable concentrate formulations because the weight of one granule was not available to estimate exposure using standard methods. AgDRIFT and AGDISP models are also used to estimate deposition of DCPA on terrestrial and aquatic habitats from spray drift. The TerrPlant model is used to estimate DCPA exposures to terrestrial-phase CRLF habitat, including plants inhabiting semi-aquatic and dry areas, resulting from uses involving foliar DCPA applications. The T-HERPS model is used to allow for further characterization of dietary exposures of terrestrial-phase CRLFs relative to birds.

Toxicity of the degradates to mammals was shown to be than than toxic than the parent (Section 4.2.2). Therefore, risk to terrestrial organsisms (birds, mammals, and invertebrates) was estimated from exposure to parent alone. Exposure of terrestrial organisms to DCPA was adequate to assess risk from the degradate as it is less toxic than DCPA.

Terrestrial exposure to HCB and 2,3,7,8-tetrachlorodebenzo-*p*-dioxin (TCDD) was estimated using TREX. The application rate input value was either the maximum allowed amount of the impurity in the final formulation or an upper estimate of the amount in the final formulation, respectively.

The effects determination assessment endpoints for the CRLF include direct toxic effects on the survival, reproduction, and growth of the CRLF itself, as well as indirect effects, such as reduction of the prey base or modification of its habitat. Direct effects to the CRLF in the aquatic habitat are based on toxicity information for freshwater fish, which are generally used as a surrogate for aquatic-phase amphibians. In this assessment, chronic effects to birds and mammals were also considered in the aquatic assessment because no chronic data were available for aquatic organisms. In the terrestrial habitat, direct effects are based on toxicity information for birds, which are used as a surrogate for terrestrial-phase amphibians. Given that the CRLF's prey items and designated critical habitat requirements in the aquatic habitat are dependant on the availability of freshwater aquatic invertebrates and aquatic plants, toxicity information for these taxonomic groups is also discussed. In the terrestrial habitat, indirect effects due to depletion of prey are assessed by considering effects to terrestrial insects, small terrestrial mammals, and frogs. Indirect effects due to modification of the terrestrial habitat are characterized by available data for terrestrial monocots and dicots.

Risk quotients (RQs) are derived as quantitative estimates of potential high-end risk. Acute and chronic RQs are compared to the Agency's levels of concern (LOCs) to identify instances where DCPA use within the action area has the potential to adversely affect the CRLF and its designated critical habitat via direct toxicity or indirectly based on direct effects to its food supply (*i.e.*, freshwater invertebrates, algae, fish, frogs, terrestrial invertebrates, and mammals) or habitat (*i.e.*, aquatic plants and terrestrial upland and riparian vegetation). When RQs for each particular type of effect are below LOCs, the pesticide is determined to have "no effect" on the CRLF. Where RQs exceed LOCs, a potential to cause adverse effects is identified, leading to a conclusion of "may affect." If a determination is made that use of DCPA within the action area "may affect" the CRLF and its designated critical habitat, additional information is considered to refine the potential for exposure and effects, and the best available information is used to distinguish those actions that "may affect, but are not likely to adversely affect" (NLAA) from those actions that are "likely to adversely affect" (LAA) the CRLF. Similarly for critical habitat additional information is considered to refine the potential for exposure and effects to distinguish those actions that do or do not result in modification of its critical habitat.

EPA is required under the Federal Food Drug and Cosmetic Act (FFDCA), as amended by Food Quality Protection Act (FQPA), to develop a screening program to determine whether certain substances (including all pesticide active and other ingredients) *"may have an effect in humans that is similar to an effect produced by a naturally occurring estrogen, or other such endocrine effects as the Administrator may designate."* Following the recommendations of its Endocrine Disruptor Screening and Testing Advisory Committee (EDSTAC), EPA determined that there were scientific bases for including, as part of the program, androgen and thyroid hormone systems, in addition to the estrogen hormone system. EPA also adopted EDSTAC's recommendation that the Program include evaluations of potential effects in wildlife. When the appropriate screening and/or testing protocols being considered under the Agency's Endocrine Disrupter Screening Program (EDSP) have been developed and vetted, DCPA may be subjected to additional screening and/or testing to better characterize effects related to endocrine disruption.

Based on the best available information, the Agency makes a **May Affect and Likely to Adversely Affect** determination for the CRLF from the use of DCPA. Additionally, the Agency has determined that there **is the potential for modification** of CRLF designated critical habitat from the use of the chemical. The effects determinations are based on the following predicted risks:

1) Risk of acute effects to freshwater fish exposed to TPA, for all uses
2) Risk of acute effects to freshwater invertebrates exposed to TPA, for all uses
3) Risk of chronic effects to freshwater fish and invertebrates exposed to DCPA and TPA, for all uses
4) Risk of effects to freshwater plants exposed to DCPA and TPA, for all uses

5) Risk of acute effects to small birds exposed to hexachlorobenzene (HCB) for uses with multiple applications
6) Risk of chronic effects to small birds and small mammals exposed to DCPA and HCB, for all uses
7) Risk of effects to terrestrial plants exposed to DCPA, for all uses

A summary of the risk conclusions and effects determinations for the CRLF and its critical habitat is presented in Table 1-1 and Table 1-2. Further information on the results of the effects determination is included as part of the Risk Description in Section 5.2. Given the LAA determination for the CRLF and potential modification of designated critical habitat, a description of the baseline status and cumulative effects for the CRLF is provided in Attachment 2**.**

Table 1-1. Effects Determination Summary for DCPA Use and the CRLF

Assessment Endpoint	Effects Determination [1]	Basis for Determination
Survival, growth, and/or reproduction of CRLF individuals	May affect, likely to adversely affect (LAA)[1]	**Potential for Direct Effects** ***Aquatic-phase (Eggs, Larvae, and Adults)***: Direct effects to aquatic phase CRLF resulting from acute exposure to TPA and chronic exposure to TPA and DCPA are expected. - TPA RQs exceed the acute listed species LOC for turf, nursery, and ornamental uses with multiple applications and for food crops with five or more applications. - Chronic exposures to DCPA and TPA may result in chronic effects to the aquatic CRLF based on chronic effects observed in birds and mammals. No chronic data are available for aquatic organisms.
		Terrestrial-phase (Juveniles and Adults): Direct effects to the terrestrial phase CRLF resulting from chronic exposure to DCPA are expected. - Acute RQs for birds, the terrestrial surrogate for the CRLF, exceed the LOC for uses with multiple applications of DCPA due to the presence of the impurity HCB. - Chronic RQs for birds, the terrestrial surrogate for the CRLF, exceed the LOC for all uses of DCPA. - Although no mortality was observed at the highest DCPA test concentrations in the available avian acute toxicity data, which is used as a surrogate for terrestrial-phase amphibians, predicted EECs are greater than highest test concentrations. Toxicity is unknown at these exposure levels.
		Potential for Indirect Effects ***Aquatic prey items, aquatic habitat, cover and/or primary productivity*** Indirect effects to the CRLF through effects to its prey in the aquatic habitat are expected. - TPA RQs exceed the acute listed invertebrate LOC for turf, ornamental, and nursery uses with multiple applications and for food uses with more than six applications. - A NOAEC could not be determined for aquatic non-vascular plants at or above

Assessment Endpoint	Effects Determination [1]	Basis for Determination
		the solubility limit of DCPA; however, effects were observed in the submitted studies and data are not available to discount risk for DCPA. All TPA RQs for aquatic non-vascular plants exceed the aquatic plant LOC. - An EC_{50} could not be determined for aquatic vascular plants at or above the solubility limit of DCPA; however, effects were observed in the submitted studies and data are not available to discount risk for DCPA. All TPA RQs were below the LOCs for aquatic vascular plants; however, the LOEC was exceeded by all TPA EECs and the calculated TPA RQs are uncertain because they are based on toxicity data for a surrogate compound, dicamba. - Based on chronic effects observed for birds and mammals, chronic effects in aquatic organism may occur as a result of exposure to DCPA and TPA. No chronic data are available for aquatic organisms. - Effects to terrestrial plants, fish, and frogs are expected.
		Terrestrial prey items, riparian habitat Indirect effects to the CRLF through effects to its prey in the terrestrial habitat are expected. - Acute effects to small birds are expected with multiple applications of DCPA due to the presence of the impurity HCB, LOCs were exceeded. - Although no mortality was observed at the highest test concentrations in the available avian acute toxicity data and acute mammalian toxicity data, predicted EECs are greater than highest test concentrations. Toxicity is unknown at these exposure levels. - Chronic RQs for small mammals and birds exceed the LOC for all uses of DCPA. . - Estimated EECs for terrestrial invertebrates exceed the acute contact LD_{50} where no effects were observed and the result of this exposure is uncertain. Toxicity is unknown at these exposure levels. - Effects to terrestrial plants are expected but not quantifiable.

[1] No effect (NE); May affect, but not likely to adversely affect (NLAA); May affect, likely to adversely affect (LAA)

Table 1-2. Effects Determination Summary for DCPA Use and CRLF Critical Habitat Impact Analysis

Assessment Endpoint	Effects Determination [1]	Basis for Determination
Modification of aquatic-phase PCE	Habitat Modification	Modification of the aquatic-phase PCE is expected. - Acute exposure to TPA and chronic exposure to TPA and DCPA as a result of all uses of DCPA may directly affect the CRLF based on EECs exceeding estimated toxicity values in the aquatic environment. -LOCs were exceeded for non-vascular plants and the LOEC of vascular plants was lower than EECs. - Acute LOCs were exceeded for freshwater fish, a surrogate for the CRLF, and

		freshwater invertebrates. - Chronic effects in aquatic organisms are likely. No chronic data on aquatic organisms is available. - Effects to terrestrial plants are expected.
Modification of terrestrial-phase PCE		<u>Modification of the terrestrial-phase PCE is expected.</u> - Acute effects to small birds are expected with multiple applications of DCPA due to the presence of the impurity HCB. LOCs were exceeded. - Although no mortality was observed at the highest DCPA test concentrations in the available avian acute toxicity data, which is used as a surrogate for terrestrial-phase amphibians, predicted EECs are greater than highest test concentrations. Toxicity is unknown at these exposure levels - Chronic RQs for small mammals and birds exceed the LOC for all uses of DCPA. - Estimated DCPA EECs for terrestrial invertebrates exceed the acute contact LD_{50} where no effects were observed and the result of this exposure is uncertain. Toxicity is unknown at these exposure levels. - Effects to terrestrial plants are expected but not quantifiable.

[1] Habitat Modification or No effect (NE)

Based on the conclusions of this assessment, a formal consultation with the U. S. Fish and Wildlife Service under Section 7 of the Endangered Species Act should be initiated.
When evaluating the significance of this risk assessment's direct/indirect and adverse habitat modification effects determinations, it is important to note that pesticide exposures and predicted risks to the species and its resources (*i.e.*, food and habitat) are not expected to be uniform across the action area. In fact, given the assumptions of drift and downstream transport (*i.e.*, attenuation with distance), pesticide exposure and associated risks to the species and its resources are expected to decrease with increasing distance away from the treated field or site of application. Evaluation of the implication of this non-uniform distribution of risk to the species would require information and assessment techniques that are not currently available. Examples of such information and methodology required for this type of analysis would include the following:

- Enhanced information on the density and distribution of CRLF life stages within specific recovery units and/or designated critical habitat within the action area. This information would allow for quantitative extrapolation of the present risk assessment's predictions of individual effects to the proportion of the population extant within geographical areas where those effects are predicted. Furthermore, such population information would allow for a more comprehensive evaluation of the significance of potential resource impairment to individuals of the species.
- Quantitative information on prey base requirements for individual aquatic- and terrestrial-phase frogs. While existing information provides a preliminary picture of the types of food sources utilized by the frog, it does not establish minimal requirements to sustain healthy individuals at varying life stages. Such information could be used to establish biologically relevant thresholds of effects

on the prey base, and ultimately establish geographical limits to those effects. This information could be used together with the density data discussed above to characterize the likelihood of adverse effects to individuals.

- Information on population responses of prey base organisms to the pesticide. Currently, methodologies are limited to predicting exposures and likely levels of direct mortality, growth or reproductive impairment immediately following exposure to the pesticide. The degree to which repeated exposure events and the inherent demographic characteristics of the prey population play into the extent to which prey resources may recover is not predictable. An enhanced understanding of long-term prey responses to pesticide exposure would allow for a more refined determination of the magnitude and duration of resource impairment, and together with the information described above, a more complete prediction of effects to individual frogs and potential modification to critical habitat.

2.0 Problem Formulation

Problem formulation provides a strategic framework for the risk assessment. By identifying the important components of the problem, it focuses the assessment on the most relevant life history stages, habitat components, chemical properties, exposure routes, and endpoints. The structure of this risk assessment is based on guidance contained in U.S. EPA's Guidance for Ecological Risk Assessment (U.S. EPA 1998a), the Services' Endangered Species Consultation Handbook (U.S. FWS/NMFS 1998) and is consistent with procedures and methodology outlined in the Overview Document (U.S. EPA, 2004) and reviewed by the U.S. Fish and Wildlife Service and National Marine Fisheries Service (U.S. FWS/NMFS 2004).

2.1 Purpose

The purpose of this endangered species assessment is to evaluate potential direct and indirect effects on individuals of the federally threatened California red-legged frog (*Rana aurora draytonii*) (CRLF) arising from FIFRA regulatory actions regarding use of DCPA on a variety of agricultural (vegetables, cole crops, fruit, melons, and others) and non agricultural uses (turf, ornamentals, nurseries, and residential lawns). See Table 2-8 for a detailed list of uses. In addition, this assessment evaluates whether use on these sites is expected to result in modification of the species' designated critical habitat. This ecological risk assessment has been prepared consistent with a settlement agreement in the case Center for Biological Diversity (CBD) vs. EPA *et al.* (Case No. 02-1580-JSW(JL)) settlement entered in Federal District Court for the Northern District of California on October 20, 2006.

In this assessment, direct and indirect effects to the CRLF and potential modification to its designated critical habitat are evaluated in accordance with the methods described in the Agency's Overview Document (U.S. EPA, 2004). Screening level methods include use of standard models such as GENEEC, PRZM-EXAMS, and T-REX, all of which are described at length in the Overview Document. Additional refinements include an analysis of the usage data, a spatial analysis, and use of the T-HERPS model to predict concentrations of DCPA in terrestrial invertebrate food items for terrestrial-phase CRLFs and mammals. Use of such information is consistent with the methodology described in the Overview Document (U.S. EPA, 2004), which specifies that "the assessment process may, on a case-by-case basis, incorporate additional methods, models, and lines of evidence that EPA finds technically appropriate for risk management objectives" (Section V, page 31 of U.S. EPA, 2004).

In accordance with the Overview Document, provisions of the Endangered Species Act (ESA), and the Services' Endangered Species Consultation Handbook, the assessment of effects associated with registrations of DCPA is based on an action area. The action area is the area directly or indirectly affected by the federal action, as indicated by the exceedance of the Agency's Levels of Concern (LOCs). It is acknowledged that the action area for a national-level FIFRA regulatory decision associated with a use of DCPA may potentially involve numerous areas throughout the United States and its Territories. However, for the purposes of this assessment, attention will be focused on relevant sections of the action area including those geographic areas associated with locations of the CRLF and its designated critical habitat within the state of California. As part of the "effects determination," one of the following three conclusions will be reached regarding the potential use of DCPA in accordance with current labels:

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

Designated critical habitat identifies specific areas that have the physical and biological features, (known as primary constituent elements or PCEs) essential to the conservation of the listed species. The PCEs for CRLFs are aquatic and upland areas where suitable breeding and non-breeding aquatic habitat is located, interspersed with upland foraging and dispersal habitat.

If the results of initial screening-level assessment methods show no direct or indirect effects (*e.g.*, no LOC exceedances) upon individual CRLFs or upon the PCEs of the species' designated critical habitat, a "no effect" determination is made for use of DCPA as it relates to this species and its designated critical habitat. If, however, potential direct or indirect effects to individual CRLFs are anticipated or effects may impact the PCEs of the CRLF's designated critical habitat, a preliminary "may affect" determination is made for the FIFRA regulatory action regarding DCPA.

If a determination is made that use of DCPA within the action area(s) associated with the CRLF "may affect" this species or its designated critical habitat, additional information is considered to refine the potential for exposure and for effects to the CRLF and other taxonomic groups upon which these species depend (*e.g.*, aquatic and terrestrial vertebrates and invertebrates, aquatic plants, riparian vegetation, *etc.*). Additional information, including spatial analysis (to determine the geographical proximity of CRLF habitat and DCPA use sites) and further evaluation of the potential impact of DCPA on the PCEs is also used to determine whether modification of designated critical habitat may occur. Based on the refined information, the Agency uses the best available information to distinguish those actions that "may affect, but are not likely to adversely affect" from those actions that "may affect and are likely to adversely affect" the CRLF or the PCEs of its designated critical habitat. This information is presented as part of the Risk Characterization in Section 5 of this document.

The Agency believes that the analysis of direct and indirect effects to listed species provides the basis for an analysis of potential effects on the designated critical habitat. Because DCPA is expected to directly impact living organisms within the action area (defined in Section 2.7), critical habitat analysis for DCPA is limited in a practical sense to those PCEs of critical habitat that are biological or that can be reasonably linked to biologically mediated processes (*i.e.*, the biological resource requirements for the listed species associated with the critical habitat or important physical aspects of the habitat that may be reasonably influenced through biological processes). Activities that may modify critical habitat are those that alter the PCEs and appreciably diminish the value of the habitat. Evaluation of actions related to use of DCPA that may alter the PCEs of the CRLF's critical habitat form the basis of the critical habitat impact analysis. Actions that may affect the CRLF's designated critical habitat have been identified by the Services and are discussed further in Section 2.6.

2.2 Scope

The end result of the EPA pesticide registration process (*i.e.*, the FIFRA regulatory action) is an approved product label. The label is a legal document that stipulates how and where a given pesticide may be used. Product labels (also known as end-use labels) describe the formulation type (*e.g.*, liquid or granular), acceptable methods of application, approved use sites, and any restrictions on how applications may be conducted. Thus, the use or potential use of DCPA in accordance with the approved product labels for California is "the action" relevant to this ecological risk assessment.

DCPA is an herbicide currently registered for use on a variety of fruits, vegetables, and non-agricultural sites, including numerous ornamentals and turf. Uses that will be assessed in this document are shown in Table 2-8. Formulations include granular, wettable powder, and flowable concentrates that may be applied via ground or air using various sprayers, sprinkler irrigation, soil treatments, broadcast, spreader, soil band treatment, and soil incorporation equipment.

Although current registrations of DCPA allow for use nationwide, this ecological risk assessment and effects determination addresses currently registered uses of DCPA in portions of the action area that are reasonably assumed to be biologically relevant to the CRLF and its designated critical habitat. Further discussion of the action area for the CRLF and its critical habitat is provided in Section 2.7.

Two major degradates were observed in laboratory studies, tetrachloroterephthalic acid (TPA) and monomethyl tetrachloroterephthalic acid (MTP). TPA reached maximums of 100% applied radioactivity and MTP maximums of 16% applied radioactivity in aerobic soil metabolism studies. TPA was also a major degradate in an anaerobic soil metabolism study. MTP is an intermediate between DCPA and TPA. TPA is stable to aerobic and anaerobic soil metabolism.

Exposure of aquatic organisms to TPA was estimated using GENEEC and converting the application rate for DCPA to TPA equivalents for a few representative scenarios. Potential for aquatic toxicity due to exposure to TPA was estimated using toxicity endpoints for compounds with similar structures. Mammalian toxicity was determined to be less than that of DCPA (see Section 4.2.2), so terrestrial toxicity was evaluated only for DCPA. Exposure to TPA and MTP is not expected to alter risk conclusions that are based on the fate, transport, and toxicity of the parent compound alone in the terrestrial environment.

The manufacturing process of DCPA produces several known contaminants. Of toxicological concern are hexachlorobenzene (HCB), congeners (structurally related chemicals) of polyhalogenated dibenzo-p-dioxins/dibenzofurans (dioxins/furans), and other possible organochlorine contaminants. Although dibenzofurans and dibenzodioxins, other than 2,3,7,8-TCDD are possible manufacturing by-products and were reported as a contaminant in the re-eligibility decision (RED), no residues were reported to be found in the most recent Confidential Statement of Formula (U.S. EPA, 1998b). Therefore, the risk assessment of impurities focuses on HCB and 2,3,7,8-TCDD. The maximum level of HCB that is allowed in formulations of DCPA is 0.3 percent. Dioxin/furans do not have a maximum allowable level in formulations. The RED reported that dioxin/furans in submitted samples were below 0.1 parts per billion (U.S.

EPA, 1998b) and the most recent Confidential Statement of Formulations are consistent with this previously assessed level of 2,3,7,8-TCDD.

The Agency does not routinely include, in its risk assessments, an evaluation of mixtures of active ingredients, either those mixtures of multiple active ingredients in product formulations or those in the applicator's tank. In the case of the product formulations of active ingredients (that is, a registered product containing more than one active ingredient), each active ingredient is subject to an individual risk assessment for regulatory decision regarding the active ingredient on a particular use site. If effects data are available for a formulated product containing more than one active ingredient, they may be used qualitatively or quantitatively in accordance with the Agency's Overview Document and the Services' Evaluation Memorandum (U.S. EPA 2004; U.S. FWS/NMFS, 2004). DCPA does not have any registered products that contain multiple active ingredients.

2.3 Previous Assessments

DCPA was first registered under FIFRA in 1958 for use on turf grasses as an herbicide for the selective preemergence control of crabgrass and other assorted weeds (U.S. EPA, 1998b). Since that time more than 60 products were registered with the Agency. Currently, 13 Section 3 labels are registered under FIFRA. The most recent ecological risk assessment was completed in support of the RED published in 1998 (U.S. EPA, 1998b). In the RED assessment for DCPA (U.S. EPA, 1998b), the Agency was unable to make an eligibility decision for the use of DCPA on turf. The Agency identified several risks of regulatory concern, and planned to undertake a full benefits assessment before determining whether such use would be eligible for re-registration. The risks of concern included chronic risks to wild mammalian species and acute risks to freshwater and estuarine mollusks. The Agency determined that all remaining uses of DCPA did not pose an unreasonable risk to humans or the environment and were eligible for re-registration.

To mitigate potential risks, the RED required:

- The registrants to establish a certified upper limit for each impurity of toxicological significance (*e.g.*, 15 dioxin/furan congeners) associated with the active ingredient and found to be present in any sample of the product.
- The registrant to produce no more than an agreed upon limit every three calendar years, beginning in January, 1997.
- All fall turf uses to be dropped from the label and the maximum application rate to be reduced to 12 lbs a.i./A.
- All labels to contain surface water, ground water, and spray drift label advisories.

However, a certified upper limit of the 15 dioxin/furan congeners has not been established[1], some fall uses on turf are still allowed on some labels, and some labels still allow for use at 15 lbs a.i./A.

The following ecological toxicity studies were required in the RED.

1 The most recent Confidential Statements of Formulation have an upper limit established for 2,3,7,8-TCDD.

- Dietary study with mallard ducks
- Avian reproduction study using the mallard duck and bobwhite quail.
- Vegetative vigor and seedling emergence studies for sensitive terrestrial plants

Avian reproduction studies have been submitted and used in this assessment, while the other studies have not been submitted.

In 2005, the Agency ordered that several uses be terminated, effective July 31, 2005, in response to concerns of contamination of ground water with TPA.[2] The uses that were to be terminated included: alfalfa, arracacha, artichokes (Chinese and Jerusalem), beans, bean yam (yam bean), beets, chestnuts (soil treatment and nursery stock), chufa, citron melon, cotton, crabapples (soil treatment and nursery stock), cucumber, edible canna, garlic, ginger, leren, peas, pepper, potatoes, residential uses (turf and ornamentals), squash (including pumpkin), tanier, walnuts (non-bearing and nursery stock), and yam. Some labels still list uses on beans, nursery stock, garlic, peas, peppers, potatoes, residential uses on turf and ornamentals, squash, and yam. As these uses are still allowed in California, they were assessed in this document.

2.4 Stressor Source and Distribution

2.4.1 Environmental Fate Assessment

2.4.1.1 Identity of Active Ingredient and Related Compounds

Chlorthal dimethyl (dimethyl 2,3,5,6-tetrachloroterephthalate, abbreviated DCPA) is the active ingredient assessed in this document. It has two major degradates[3] that result from the loss of one methyl group, monomethyl tetrachloroterephthalic acid (MTP) or two methyl groups tetrachloroterephthalic acid (TPA). The chemical identity information for these compounds is shown in Table 2-1 and the structures are shown in Figure 2-1.

Table 2-1. Identification Information for DCPA and its Degradates, TPA, and MTP[1]

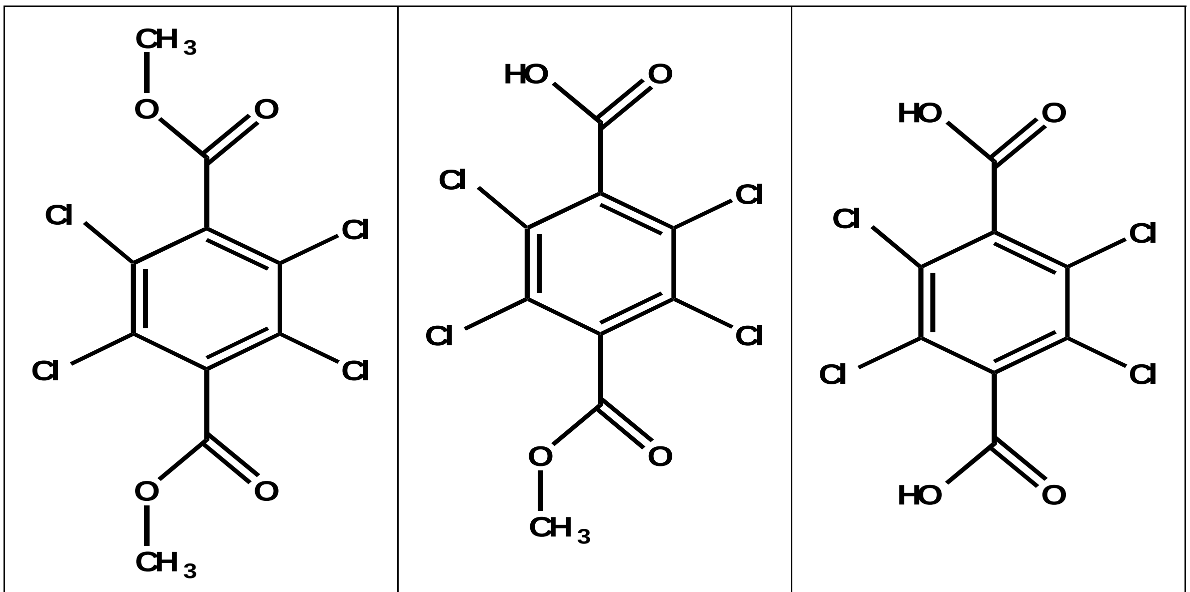
Parameter	DCPA	MTP	TPA
Common Name	Chlorthal dimethyl	Tetrachloroterephthalic acid, monomethyl; chlorthal monomethyl, monomethyl 2,3,5,6tetrachloroterephthalate	Tetrachloroterephthalic acid; chlorthal; perchloroterephthalic acid
Chemical Abstract Service (CAS) Number	1861-32-1	887-54-7	2136-79-0
International Union of Pure and Applied Chemistry (IUPAC) Name	Dimethyl 2,3,5,6-tetrachloroterephthalate		

2 U.S. EPA. 2005a. DCPA: Order to amend to terminate uses. Fed Reg 70 (143): 43408-43410. Available at http://www.epa.gov/EPA-PEST/2005/July/Day-27/p14737.htm

3 A major degradate makes up greater than 10% of applied radioactivity or is a toxicologically significant degradate.

Parameter	DCPA	MTP	TPA
CAS Name	Dimethyl 2,3,5,6-tetrachloro-1,4-benzenedicarboxylate		2,3,5,6-Tetrachloro-1,4-benzenedicarboxylic acid
Synonyms	Dacthal, Dacthalor, chlorothal, chlorothal dimethyl; Chlorothal dimethyl ester	Chlorthal monomethyl	Chlorthal
Empirical Formula	$C_{10}H_6Cl_4O_4$	$C_9H_4Cl_4O_4$	$C_8H_2Cl_4O_4$
SMILES Notation	c1(c(c(c(C(OC)=O)c(c1Cl)Cl)Cl)Cl)C(OC)=O	c1(c(c(c(C(O)=O)c(c1Cl)Cl)Cl)Cl)C(OC)=O	c1(c(c(c(C(O)=O)c(c1Cl)Cl)Cl)Cl)C(O)=O

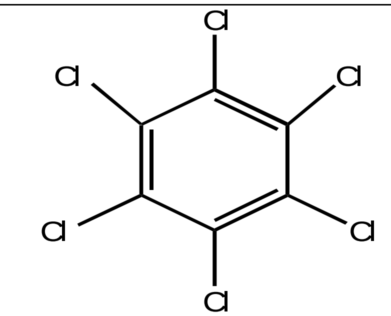
1 Data from U.S. EPA, 1998b, U.S. EPA, 2008, and the U.S. National Library of Medicine CHEMIDplus Lite Online Database available at http://toxnet.nlm.nih.gov/cgi-bin/sis/search.



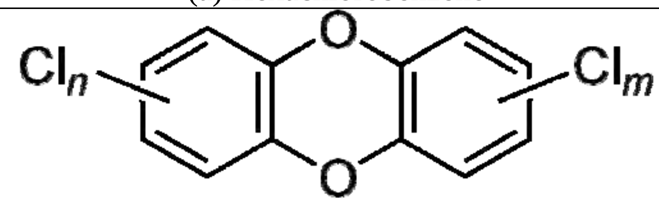
(a) DCPA	(b) MTP	(c) TPA

Figure 2-1. Chemical structure of (a) chlorthal dimethyl (DCPA), (b) monomethyl tetrachloroterephthalic acid (MTP), and (c) tetrachloroterephthalic acid (TPA)(US EPA, 1998a)

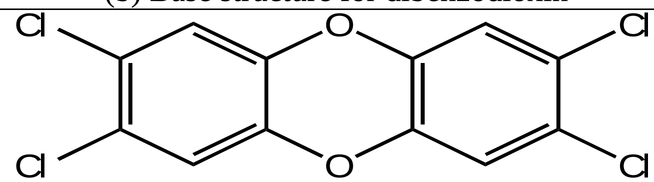
Hexachlorobenzene and polychlorinated dibenzo-p-dioxins (dioxins) are impurities identified to be of toxicological concern. The structure of hexachlorobenzene, 2,3,7,8-TCDD, and base structures of dibenzodioxins are shown in Figure 2-2. Polychlorinated dioxins have a triple ring structure that consists of two benzene rings connected by a ring with two oxygens. One to four chlorine atoms may be present on each benzene ring.



(a) Hexachlorobenzene



(b) Base structure for dibenzodioxin



(c) 2,3,7,8-TCDD

Figure 2-2. Structure of (a) Hexachlorobenzene, (b) Dibenzodioxins, and (c) 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (2,3,7,8-TCDD)

2.4.1.2 Physico-chemical Properties

Physical and chemical properties can be used to identify a *priori* the potential behavior of a chemical in the environment. DCPA has a vapor pressure of 0.21-0.33 mPa and estimated Henry's law constants ranging from 0.001042 - $2.2x10^{-6}$ atm-m^3/mole, indicating it is semi-volatile.[4] It is slightly soluble with a water solubility of 0.5 mg/L and has a moderate log K_{OW} ranging from 4.28-4.4 (based on FAO classification system), indicating that it has a higher affinity for organics than for water and has the potential to accumulate in organisms. Tetrachloroterephthalic acid (TPA) is much more soluble than DCPA with a water solubility of 5780 mg/L. The air-water partition coefficient (K_{AW}) or unitless Henry's law constant at 25°C was reported to be 10^{-4} (Daly *et al*., 2007a). According to Daly *et al.* (2007a), "This is the K_{AW} range where precipitation scavenging is starting to become important, and where a drop in temperature (causing a drop in K_{AW}) is thus expected to greatly increase the efficiency of rain scavenging." Scavenging refers to the washing out/removing of the pollutant from the air by rain or precipitation. More scavenging may occur at high altitudes and in areas with low

4 DCPA is considered non-volatile based on criteria described in Corbin *et al.* 2006; however, pesticides with vapor pressures of 0.83 and 0.024 mPa, near the vapor pressure of DCPA, have been found in remote environments, indicating that they underwent atmospheric transport and are semi-volatile (Daly *et al*. 2007; Gouin *et al.* 2004). Additionally, DCPA has been shown to be volatile and to undergo atmospheric transport (see Section 3.2.4.4 and 3.2.4.5).

temperatures. Table 2-2 provides a summary of the physico-chemical properties of DCPA, MTP, TPA, and the impurities, HCB and 2,3,7,8-TCDD.

Table 2-2. Summary of Physico-Chemical Properties of DCPA, Its Degradates, and Impurities

Property	DCPA	MTP	TPA	HCB	2,3,7.8-TCDD
Molecular Weight	331.97 g/mol (2)	317.94 g/mol (2)	303.91 g/mol (2)	284.79 (14)	321.9709 g/mol
Melting Point	155°C (1,2)	158.62°C (5)	178.10°C (5)	230 °C (14)	305-306 °C (13)
Boiling Point	Not determinable	393.09 °C (5)	426.15 °C (5)	322 °C (14)	NA
Bulk Density	0.75 g/cm^3 (1)	NA	NA	NA	NA
Vapor Pressure at 25°C	0.33 mPa or 2.5 x 10^{-6} torr (1,2) 0.21 mPa or 1.6x 10^{-7} torr (4)	5.23 x 10^{-7} mm Hg (5)	4.89 x 10^{-8} mm Hg (5)	1089 x 10^{-5} mm Hg at 20 °C (14)	1.5 x 10^{-9} mm Hg (12)
Henry's Law Constant	2.2 x 10^{-6} atm-m^3/mol, measured (1, 7) 0.001042 atm-m^3/mol (4)	2.11 x 10-10 atm-m^3/mole (5)	6.58 x 10^{-13} atm-m^3/mole (5)	6.84 x 10-4 atm-m3/mol (14) 1.30 x 10-3 atm-m3/mol (14)	1.62 x 10^{-5} at-m^3/mol (13)
Water Solubility	0.5 mg/L (1,2)	18.26 mg/L (5)	175.4 mg/L (5) 5780 mg/L (6)	3.5-20 µg/L (14)	19.3 ng/L (12)
Log Octanol – water partition coefficient (K_{OW})	4.28 (1, 4) 4.40 (2)	3.19 (5)	2.13 (5)	6.18 (14)	6.80 (12)
pKa	No dissociation constant at pH 2-12 (11)	NA	NA	NA	NA
Air-water partition coefficient (K_{AW})	10^{-4} at 25°C (8)	NA	NA	NA	NA
Log Octanol-air Partition Coefficient (K_{OA})	8.28 at 25°C (9) 8.45 at 25°C (10) 8.51 at 20°C (10)	NA	NA	NA	NA
Log Particle-gas Partitioning Coefficient (Kp)	-4.1 (10)	NA	NA	NA	NA

Abbreviations: NA = not available

(1) Data from U.S. EPA, 1998b; (2) Data from U.S. EPA, 2008a; (3) Data from ChemBioFinder.com; (4) Data from Health Canada, 2008; (5) Data estimated from EPI Suite version 3.20 using the SMILES string from Table 2-1 as input; (6) Data from Wettasinghe and Tinsley, 1993 as reported by U.S. EPA, 1994; (7) Data from U.S. EPA, 1994 (8) Data from Muir *et al.*, 2004 as reported by Daly *et al.*, 2007a; (9) Data from Muir *et al.*, 2004 (10) Data from Yao *et al.*, 2007; (11) Data from U.S. EPA, 2001; (12) Data from U.S. EPA, 2003; The most reliable or definitive value reported by the review is reported; (13) Data from U.S. EPA, 2006b; (14) Data from U.S. EPA, 1998c

2.4.1.3 Environmental Fate

a) Abiotic Degradation

DCPA is stable to hydrolysis and photolysis (Table 2-3). No significant hydrolysis occurred at pH 5, 7, and 9 over 36 days (MRID 00114648). No acceptable studies examining photolysis in water were submitted. When DCPA was exposed to a black light and fluorescent lamps with wavelengths of 255-360 nm data on photolysis on soil, little degradation occurred (MRID 41508608). Based on the data on photolysis on soil, it can be assumed DCPA is also stable to photolysis in water.

b) Biotic Degradation

Aerobic soil metabolism. The primary mechanism of degradation of DCPA is via aerobic metabolism, with rates being highly dependent on temperature and level of moisture. Aerobic soil metabolism half-lives measured at 30^{o}C and at a moisture level of 95% of 1/3 bar ranged from 27-66 days (single first order, LN/linear fit; MRID 00114649, 00114652, 41648801). After 197 days, virtually all of the parent DCPA had been converted into TPA, although small amounts of monomethyl tetrachloroterephthalic acid (MTP) were also identified. DCPA did not degrade in steam-sterilized soil. Open literature degradation rates are slightly faster than those reported in submitted studies and ranged from 17-18 days for 25^{o}C (Choi *et al.*, 1988; Wettasinghe and Tinsley, 1993).[5] Walker (1978) reported that the DCPA half-life decreased by a factor of 17.9 with a soil temperature increase from 10^{o}C to 30^{o}C (as reported by Choi *et al*. 1988). Choi *et al*.'s (1988) research indicated that degradation rates for DCPA reached maximums between 25-30^{o}C and then declined at higher temperatures and lower temperatures (*e.g*., an optimum temperature existed for maximum degradation rates). This suggests that for DCPA, the high temperature of the submitted studies did not significantly change the rate of degradation from that expected at a temperature of 25^{o}C, the temperature of most degradation studies. Degradation rates of DCPA at low soil moisture levels were much lower than the medium and high moisture levels while medium and high moisture levels had similar degradation rates. This suggests that once a sufficient level of moisture is reached to support aerobic metabolism, more moisture would have little effect on the rate of degradation (Choi *et al*., 1988). TPA was stable to aerobic soil metabolism. The observed half-life for MTP was between 1 to 14 days in the sandy loam soil (MRID 00114649, 41648801). No data are available on aerobic aquatic metabolism.

c) Anaerobic soil metabolism

Following aerobic soil metabolism studies, an 8-g portion of soil was removed and placed in an empty brown glass jar and purged with water-saturated nitrogen gas. Soils were sampled at 0, 30, and 60 days. The reported anaerobic soil conditions had little effect on degradation rates

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5 The average half-life in Choi *et al*.'s (1988) work was 18 days at both 25^{o}C and 30^{o}C, indicating that the difference in measured degradation rates between submitted and open literature studies is not due to the differences in temperature.

with estimated half-lives of 28-38 days at 30^{o}C and 95% of 1/3 bar. The high temperature and moisture level may have resulted in higher rates of degradation and reasonable anaerobic half-lives assuming 50% slower degradate rates at 25^{o}C were estimated to range from 37-59 days (DER 2, 1/17/1991). Additionally, redox potential and dissolved oxygen levels were not measured/reported in the study and it cannot be confirmed whether anaerobic conditions were obtained. The similarity of the anaerobic degradation rates to the aerobic degradation rates, suggest that anaerobic conditions were not achieved. TPA was the final degradate under the reported anaerobic conditions (MRID 00114651, 41648802). No data are available on anaerobic aquatic metabolism.

Table 2-3. Summary of DCPA Environmental Fate Properties

Study	**Value (units)**			**Major Deg. (maximum %)** ***Minor Deg.***[1]	**MRID # (Year) or Source**	**Study Status or Comments**
Hydrolysis	Stable at pH 5, 7, and 9			None	00114648 (1987)	Acceptable
Direct Aqueous Photolysis	No data available				143063 (1976) 41508607 (1990)	Unacceptable
Soil Photolysis	Stable TPA was Stable			*MTP (5.2%)*	41508608 (1990)	Acceptable, artificial light source was black light and fluorescent lamps with wavelength of 255-360 nm (Response to DER comments 9/9/1991).
Aerobic Soil Metabolism	Single First Order (LN/Linear Fit) Half-life (days)			TPA (100%)[2] *MTP (6.9%)*	00114649 (1976) Supplemented by 41648801 (1990)	Supplemental due to insufficient mass balance (70-114% on day 0), moisture 95% of 1/3 bar, and temperatures were 30^{o}C. Half-lives may be higher than predicted at 75% 1/3 bar and at 25^{o}C. Additionally, soils were not completely characterized. See DER Addendum (02/10/2009)
	Soil	With Unextract.	Without Unextract.			
	Sand Loam	55	29			
	Sandy Clay Loam	66	48			
	Clay	57	31			
	TPA stable in all soils					
	Single First Order (LN/Linear Fit) Half-life (days)			TPA (100%)[3] MTP (16%)	00114652 (1976)	Supplemental due to insufficient mass balance (70-84% on day 0), moisture 95% of 1/3 bar, and temperatures were 30^{o}C Half-lives may be higher than
	Soil	With Unextract.	Without Unextract			
	Sandy	38	27			

Study	Value (units)	Major Deg. (maximum %) *Minor Deg.*[1]	MRID # (Year) or Source	Study Status or Comments
	Loam | | Sandy Clay Loam | 61 | 47 Clay | 41 | 29 TPA stable in all soils			predicted at 75% 1/3 bar and at 25^{o}C. Additionally, soils were not completely characterized. See DER Addendum (02/10/2009)
	Half life (days) = 92 days at 10^{o}C 18 days at 25^{o}C and 30^{o}C		Choi *et al*., 1988	Not applicable
	Half life (days)= 16.6 days at 25^{o}C		Wettasinghe and Tinsley, 1993	Not applicable
Anaerobic Soil Metabolism	Half-life (days) at 30^{o}C = 28 clay 38 sandy clay loam 23 sandy loam	TPA (26%)[4] *MTP (<10%)*	00114651 (1976) Supplemented by 41648802 (1990)	Supplemental, only 3 points sampled, conducted at 30^{o}C, and at moisture levels with 95% of 1/3 bar. Dissolved oxygen and redox potential were not reported. This study is not upgradeable. See DER update (1/17/1991)
Anaerobic Aquatic Metabolism	No data available			
Aerobic Aquatic Metabolism	No data available			
$K_{d\text{-}ads}$ / $K_{d\text{-}des}$ (mL/g) $K_{oc\text{-}ads}$ / $K_{oc\text{-}des}$ (mL/g)	DCPA, not used in modeling		41648803 (1988)	Supplemental due to supernatant incompletely removed and finely sieved. See DER Addendum (02/10/2009)
	MTP and TPA see Table 2-5 and Table 2-6		41648804 (1988) 41648805 (1988)	Acceptable. Supernatant was incompletely removed but due to low values, it was assumed to have little influence on the data. Finely sieved.
	DCPA see Table 2-4		43661101 (1995)	Acceptable
Terrestrial Field Dissipation	No half-life could be determined	Not determined	41508609 (1989)	Supplemental due to variability in data and low recoveries of analytical method. See DER Addendum (102/10/2009)
	No half-life could be determined	Not determined	41508610 (1990)	Supplemental due to data too erratic to allow assessment of dissipation. See DER Addendum (02/10/2009)

Study	Value (units)	Major Deg. (maximum %) *Minor Deg.*[1]	MRID # (Year) or Source	Study Status or Comments
	Log-linear dissipation half-life = 54 days (silt loam soil)	TPA	Ross *et al.*, 1989	Circular plot planted with onion and then parsley.
Aquatic Field Dissipation	No data available			
Bioconcentration Factor (BCF)	Bluegill Sunfish 1894 (whole fish) 777 (fillet) 2574 (viscera) Depuration complete in 14d		41155716 (1980) and 41197602 (1981)	Acceptable, aquarium water DCPA concentration increased over time.
	Clam, lipid and organic carbon normalized 126 (whole clam)		Pereira *et al.*, 1996	Based on concentrations measured in field.
Biota-Sediment-Accumulation-Factor (BSAF) – lipid normalized	Fish median = 0.1 Bivalve median = 4.5		Wong *et al.*, 2001	Based on concentrations measured in field

Abbreviations: Unextract.= unextractables; Deg.= degradate

1. A major degradate made up more than 10% of applied radioactivity equivalents or is toxicologically significant. The maximum reported percent of applied equivalents is reported in parenthesis.
2. Approximately 80% of applied radioactivity was detected at time zero and 77% as TPA at later time points. Based on this, TPA may be assumed to make reach a maximum of 100% applied radioactivity (DER 5/27/1987).
3. Approximately, 83.6% of applied radioactivity was detected at time zero and 85.0% as TPA at 96 days. Based on this, TPA may be assumed to reach a maximum of 100% applied radioactivity (DER 5/27/1987).
4. Based on the percent radioactivity measured as TPA on day zero subtracted from the percent radioactivity measured after the environment was flooded.

d) Volatility

Based on a relatively low Henry's constant (2.2 x 10^{-6} atm-m^3/mol) and moderately to relatively high soil/water partitioning, DCPA does not appear to have a high volatilization potential from soil (Corbin *et al*., 2006). However, several published studies have shown that parent DCPA is volatile, especially from moist or wet soil (Glotfelty *et al*., 1984; Ross *et al.*, 1989; Majewski *et al*. 1991; Nash and Gish 1989). In the vapor phase, it may react slowly with hydroxyl radicals (Meylan and Howard, 1993). It may be deposited in nearby fields, areas with lower temperatures, or with wet and dry deposition. The measured log octanol-air partitioning coefficient (K_{OA}) is 8.51 at 20°C and the estimated log particle-gas partitioning coefficient was -4.1, indicating that DCPA is likely to remain in the gas phase in air (Yao *et al*., 2007).

Ross *et al*. (1989) reported that DCPA was found on 10% of daikon, 37% of dill, and 11% of kohlrabi samples and it was also found in parsley. DCPA was not registered for use on these crops at the time and did not have a tolerance, resulting in restrictions of these crops in commerce. A study was conducted to determine the source of the DCPA contamination with possible sources including volatization and carry over on plots where crops are commonly rotated. DCPA was sprayed on a circular plot at 7.08 kg/hectare (ha) using a tractor mounted boom sprayer. Crops were sprinkler irrigated. Plots were planted with onions and then parsley. Air samples showed that 10% of DCPA applied moved off site as a vapor and on particles for up to 21 days after application. The volatization flux reached a maximum rate of 5.6 g/ha/hour (measured using the aerodynamic method). Based on flux data, 29% of DCPA was lost due to volatization. Parsley planted on the plot 126 days after legal application of DCPA did not contain DCPA.

Majewski *et al*. (1991) measured air and soil concentrations of DCPA after it was applied at a rate of 7 kg/ha to a circular plot planted with white Lisbon onion. Fluxes were greatest after/during irrigation. They measured a total DCPA loss of between 1.27 and 1.59 kg per hectare out of 7 kg per hectare applied. They also found that DCPA volatilization flux was very dependent upon the soil surface moisture content. High fluxes occurred immediately following irrigation. Approximately 36 to 52 percent of the total measured DCPA loss from soil was accounted for by volatilization and 26 percent by breakdown in soil during the 21 days of air sampling.

Nash and Gish (1989) measured pesticide decline in the atmosphere and the dissipation rate of DCPA from moist soil at different temperatures after application at 2.5 kg/ha. Volatization increased 1.8 times for each 10^oC increase in temperature and dissipation increased 1.4 times. At temperature of 35^oC (95^oF), volatility accounted for the loss of most of the DCPA applied.

Seiber *et al.* (1991) measured air residues of DCPA after it was applied at 11.2 kg/ha to a circular plot planted with white Lisbon onion in California. Downwind concentrations in air ranged from 910 ng/m^3 on day one to 22 ng/m^3 on day three based on XAD resin samples. Glass fiber filters contained 420 ng/m^3 on day one and were at a minimum of 5.8 ng/m^3 on day 11. Small amounts of DCPA were measured up-wind.

e) <u>Mobility</u>

Based on McCall's classification and FAO classifications of K_{OC} values, DCPA is slightly mobile (Corbin *et al*., 2006; FAO 2000). Sorption of DCPA was measured in one acceptable study in four different soils at 25^oC (Table 2-4). Freundlich sorption coefficients (K_F) ranged from 7-57 L/kg and the Freundlich exponent ranged from 0.94-0.99. Organic-carbon-water partition coefficients (K_{OC}s) ranged from 1863 - 3503 L/Kg. Solid-water distribution coefficients (K_d) calculated by the study author ranged from 8 – 60 L/kg and are near the K_F values as the Freundlich exponents were all near one and the isotherms were almost linear. The variability in K_{OC} values was much lower than K_F values and the linear relationship between K_F and organic matter had an r^2 value of 0.86.[6] This suggests that sorption of DCPA is strongly influenced by organic carbon.

Pereira *et al.* (1996) measured log K_{OC}s in sediments of the San Joaquin River and Tributaries. Field K_{OC} values ranged from 316 L/kg in bed sediment ($10^{2.5}$ L/kg) to 851 L/kg in suspended sediment ($10^{2.93}$ L/kg).

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6 The coefficient of variation (standard deviation/mean) for K_{OC} values was 26% versus 65% for K_F values.

Table 2-4. Summary of Sorption Coefficients measured for DCPA (MRID 43661101)[1]

Soil	%OC	K_F (L/kg)	1/N	K_d (L/kg)	K_{OC} (L/kg)	Ce range (mg/L)
Silt Loam	2.2	57	0.99	60	2577	0.001 – 0.01
Loamy Sand	0.86	30	0.94	38	3503	0.001 – 0.02
Sandy Loam	0.26	7	0.96	8	2563	0.005 – 0.05
Silt Clay Loam	1.77	33	0.96	39	1863	0.002 – 0.02
Average		32	0.96	36	2627	
Standard Deviation		20	0.02	21	673	
Coefficient of Variation		65%	2%	59%	26%	
Lowest Value		7	0.94	8	1863	

1 Ce range is the range of DCPA concentrations in water at equilibrium. This is the range of DCPA concentrations in water that the sorption coefficients may be confidently used to predict sorption.

Sorption was measured for the parent and degradates, MTP and TPA, in one other study. The study was determined to be supplemental for DCPA because only half of the supernatant was removed prior to desorption steps and the soils were sieved with a 0.25 mm or 0.60 mm mesh sieve. This is a finer sieve than is typically used in batch equilibrium studies.[7] However, these are the only data available for the degradates and the results are presented here. The K_{OC} values measured for DCPA have a wider range than those measured in the acceptable study but the values are similar, indicating that the values are a good preliminary estimate of sorption coefficients for the degradates (Table 2-4 and Table 2-5).[8] Based on the results of measured K_{OC} values in finely sieved soils ranging from 4 - 90 L/kg, TPA and MTP are both highly mobile and will leach into ground water (Table 2-6 and Table 2-7; FAO, 2000; U.S. EPA, 2001). Organic-carbon water partition coefficients (K_{OC}) values are the values that are used in the classification system. MTP and TPA K_d values ranged from 0.1 – 0.3 L/kg (Table 2-6 and Table 2-7). Coefficients of variation (standard deviation/mean x 100) for MTP were approximately the same for K_d and K_{OC} values (49% versus 50%) and there was a linear relationship between the percent organic carbon and K_d values ($r^2 = 0.9537$). This indicates that organic carbon played a role in the sorption of MTP in these soils. Coefficients of variation for TPA were lower for K_d values than for K_{OC} values (41% versus 102%) and there was not a linear relationship between the percent organic carbon and K_d values. This indicates that sorption of TPA was not greatly influenced by the percent of organic carbon in these soils.

Sorption of acidic compounds is influenced by pH and the dissociation state of the compound. The anion exchange capacity of most soils is small compared to their cation exchange capacity. Thus, anions (negatively-charged ions) tend to be weakly sorbed to most soils (in effect, repelled by soil matrix surfaces which are generally negatively charged). Generally speaking, other factors being the same, mobility is expected to decrease with pH for weak acids as more of the compound will be present in its neutral form at lower pH. Additionally, the pH-dependent anion exchange capacity increases as pH decreases. TPA has two COOH groups and MTP has one COOH group, indicating that TPA's sorption will be more influenced by pH than sorption of MTP. Several leaching studies performed for pesticide registration or re-registration of DCPA

7 Soils are generally sieved to < 2mm; the finer sieve likely eliminated the coarse/medium sand from the soil, increasing the relative proportion of finer particles and thus the effective surface area available for sorption.
8 These supplemental DCPA sorption values were not used in modeling.

illustrated that TPA is very mobile and more mobile in higher pH soils (U.S. EPA, 1994, MRID 00114650). The pKa values of MTP and TPA are not known.

Table 2-5. Summary of Sorption Coefficients measured for DCPA in a finely sieved soil (MRID 41648803)

Soil	%OC	K_F (L/kg)	1/N	K_d (L/kg)	K_{OC} (L/kg)	Ce range (mg/L)
Silt Clay	1.6	70.31	0.95	90.2	5640	0.002 - 0.02
Silt Loam	0.4	9.4	0.91	12.8	3200	0.01-0.095
Sandy Loam	1.8	32.14	0.94	41.6	2310	0.004-0.04
Sand	0.2	5.56	0.94	6.8	3400	not in DER
Average		29.35	0.93	37.9	29.35	
Standard Deviation		29.72	0.02	38.1	29.72	
Lowest Value		5.56	0.91	6.8	5.56	

1 Ce range is the range of DCPA concentrations in water at equilibrium. This is the range of DCPA concentrations in water that the sorption coefficients may be confidently used to predict sorption.

Table 2-6. Summary of Sorption Coefficients measured for MTP in a finely sieved soil (MRID 41648804)

Soil	%OC	K_F (L/kg)	1/N	K_d (L/kg)	K_{OC} (L/kg)	Ce range (mg/L)
Silt Clay	1.6	0.29	1.103	0.289	18	0.09 - 2.9
Silt Loam	0.4	0.17	0.9552	0.162	41	0.09 - 3.0
Sandy Loam	1.8	0.23	0.8226	0.296	16	0.09 - 2.9
Sand	0.2	0.11	0.9907	0.087	44	0.09 - 3.0
Average		0.20	0.9679	0.209	30	
Standard Deviation		0.08	0.1155	0.102	15	
Lowest Value		0.11	0.8226	0.087	16	

1 Ce range is the range of MTP concentrations in water at equilibrium. This is the range of MTP concentrations in water that the sorption coefficients may be confidently used to predict sorption.

Table 2-7. Summary of Sorption Coefficients measured for TPA in a finely sieved soil (MRID 41648805)

Soil	%OC	K_F (L/kg)	1/N	K_d (L/kg)	K_{OC} (L/kg)	Ce range (mg/L)
Silt Clay	1.6	0.08	0.6842	0.07	4	0.1 - 9.89
Silt Loam	0.4	0.16	0.5869	0.18	45	not in DER
Sandy Loam	1.8	0.19	0.8545	0.23	13	0.1 - 9.74
Sand	0.2	0.16	0.707	0.18	90	0.1 - 9.92
Average		0.15	0.7082	0.17	38	
Standard Deviation		0.05	0.1106	0.07	39	
Lowest Value		0.08	0.5869	0.07	4	

1 Ce range is the range of TPA concentrations in water at equilibrium. This is the range of TPA concentrations in water that the sorption coefficients may be confidently used to predict sorption.

f) ***Degradates***

Two major degradates were observed in laboratory studies tetrachloroterephthalic acid (TPA) and monomethyl tetrachloroterephthalic acid (MTP). TPA reached maximums of 100% applied radioactivity and MTP maximums of 16% applied radioactivity in aerobic soil metabolism studies. TPA was also a major degradate in a supplemental anaerobic metabolism study (reached a maximum of 26% applied radioactivity) and MTP was a minor degradate in anaerobic soil metabolism studies. MTP is an intermediate between DCPA and TPA.

g) ***Accumulation***

DCPA has been detected in fish at several locations in the United States (DeVault, 1985; DeVault *et al.*, 1988; Jaffé *et al.*, 1985; Leiker *et al.*, 1991; Miller and Gomes, 1974; Pereira *et al.*, 1994; Saiki and Schmitt, 1986; Schmitt *et al.*, 1985, 1990). DCPA bioconcentration factors (BCFs) in bluegill sunfish were 1894, 777, and 2574 in whole fish, edible tissue, and viscera, respectively. Depuration appears to be complete after 14 days. Little metabolism or degradation of DCPA occurred in fish tissues, although there was a detectable amount of demethylation (MRID 41155716, 41197602).

Pereira *et al.* (1996) estimated organic-carbon and lipid normalized bioconcentration factors for clams based on concentrations measured in field samples. The observed bioconcentration factor was $10^{2.1}$ or 125.9 and was lower than that predicted based on the K_{OW} (predicted BCF = $10^{3.02}$).

Wong *et al.* (2001) measured biota-sediment accumulation factors (BSAF) for DCPA in fish and bivalves based on samples collected in the NAWQA program. Median BSAF values were 0.1 in fish and 4.5 in bivalves.

h) ***Terrestrial Field Dissipation***

Gilroy, CA: Bare ground plots of loam soil were treated up to three times with DCPA at 7.0-10.5 lbs. a.i. per acre (lbs a.i./A). DCPA was detected down to the maximum sampling depth of 18-inches in all of the plots, while the mono-acid was not detected below 6 inches in any plot. TPA was detected as deep as 60 inches 552 days after the first treatment and up to 96 inches 552 days after the second treatment. TPA was found at 0.03 ppm at the 72 inch depth 552 days after the third treatment (MRID 41508609).

Several flaws in the study limit the extent to which the study can be used. There was a large variation of DCPA concentrations with time. DCPA did not degrade steadily with time, but increased and decreased erratically until a significant reduction in concentration was noted in all experiments after about 185 days. The study was considered supplemental.

Greenfield, CA: Bare ground plots of sandy loam soil were treated up to three times with DCPA at 7.0-10.5 lbs. a.i./A. DCPA was detected at the maximum sampling depth of 18-inches in all of the plots, while the mono-acid was not detected below six inches in any plot. TPA was detected at 48 inches. In the plot treated three times, parent DCPA was again detected in the 15-18 inch layer. The mono-acid was not found below 6 inches and TPA was found at 18 inches (the lowest layer sampled).

Several flaws in the study limit the extent to which the study can be used. There was a large variation of DCPA concentrations with time. DCPA did not degrade steadily with time, but increased and decreased erratically until a significant reduction in concentration was noted in all experiments between about 60 and about 120 days. The study was considered supplemental. The data requirement is not satisfied (MRID 41508610).

Carry Over of Residues: Studies show that residues of DCPA can carry over from year to year. DCPA and its two major degradates were detected on land that had five years of application (cumulative total of 94 lb/acre) and was then untreated for three years (Gershon and McClure, 1966; as reported by U.S. EPA, 2008). This is also supported by the results observed in terrestrial field dissipation studies (MRID 41508609, 4158610).

i) ***Impurities***

Dioxins. Dibenzodioxins have been found as contaminants in DCPA formulations (U.S. EPA, 1998b). 2,3,7,8-TCDD is the only dioxin most recently found in DCPA formulations and this summary focuses on the properties reported for 2,3,7,8-TCDD. It summarizes information obtained from a complete review of the environmental fate properties completed by the U.S. EPA in 2003 (U.S. EPA, 2003). Dibenzodioxins are lipophilic and have very low water solubility (Table 2-2). They will be found primarily sorbed to organic materials in water, soil, and sediment. They are very stable under most environmental conditions with the only possible significant transformation process being atmospheric photooxidation and photolysis of nonsorbed species. Anaerobic degradation in soil may occur at a very slow rate. The main fate in the aquatic environment is believed to be burial in-place or erosion of soil to water bodies. Some volatization or uptake in organisms may also occur. Dioxins may be transported via long range transport. There are numerous sources of dibenzodioxins in the environment, including from combustion and exhausts from leaded gasoline engines (U.S. EPA, 2006b). 2,3,7,8-TCDD is one of the most stable compounds in its structural class (U.S. EPA, 2006b). 2,3,7,8-TCDD log bioconcentration factors range from 3.97 – 5.20 on a whole body basis and 4.91 - 6.63 with lipid normalization. Average log K_{OC} values for 2,3,7,8-TCDD were 6.6, 6.66, and 6.4 L/kg.

HCB. HCB is very stable and is resistant to degradation in water, soil, and air. Abiotic degradation is minimal and biotic degradation is also very slow. Soil half-lives ranged from three to six years (U.S. EPA, 1998c). It volatizes rapidly from soil surfaces and will strongly sorb to organic materials (K_{OC} values range from 3890 – 1,202,264 L/kg) (U.S. EPA, 1998c). It may also volatize from water; however, its high K_{OC} values indicate it may sorb into organic materials into the sediment before volatization occurs. In air, half-lives ranged from 0.6 – 6 years (U.S. EPA, 1998c). HCB may undergo long range transport and be deposited in wet and dry deposition. It also may be taken up into organisms. There are numerous sources of HCB in the environment.

2.4.2 Environmental Transport Assessment

Potential transport mechanisms include pesticide surface water runoff, spray drift, and secondary drift of volatilized or soil-bound residues leading to deposition onto nearby or more distant ecosystems. All of these transport mechanisms are important for DCPA.

A number of studies have documented atmospheric transport and re-deposition of pesticides from the Central Valley to the Sierra Nevada Mountains (Fellers *et al*., 2004, Sparling *et al*., 2001, LeNoir *et al*., 1999, and McConnell *et al*., 1998). Prevailing winds blow across the Central Valley eastward to the Sierra Nevada Mountains, transporting airborne industrial and agricultural pollutants into the Sierra Nevada ecosystems (Fellers *et al.*, 2004, LeNoir *et al.*, 1999, and McConnell *et al.*, 1998). Several sections of critical habitat for the CLRF are located east of the Central Valley. The magnitude of transport via secondary drift depends on DCPA's ability to be mobilized into air and its eventual removal through wet and dry deposition of gases/particles and photochemical reactions in the atmosphere. Therefore, physicochemical properties of DCPA that describe its potential to enter the air from water or soil (*e.g.*, Henry's Law constant and vapor pressure), pesticide use data, modeled estimated concentrations in water and air, and available air monitoring data from the Central Valley and the Sierra Nevadas are considered in evaluating the potential for atmospheric transport of DCPA to locations where it could impact the CRLF.

In general, deposition of drifting or volatilized pesticides is expected to be greatest close to the site of application. Computer models of spray drift (AgDRIFT and/or AGDISP) are used to determine potential exposures to aquatic and terrestrial organisms via spray drift. The distance of potential impact away from the use sites (action area) is determined by the distance required to fall below the LOC for chronic effects to small mammals consuming short grass.

2.4.3 Mechanism of Action

DCPA is a selective phthalic acid herbicide (Wood, 2007) and chlorinated benzoic acid herbicide (Cox, 1991). DCPA inhibits both root and shoot growth of emerging seedlings of annual grasses and certain annual broadleaf weeds (Holmesen and Hess, 1984). It is non-systemic and is absorbed by the roots but not foliage and does not translocate in the plant (OMAFRA, 2008). DCPA disrupts mitosis resulting in abnormal cell division in the root tip meristem areas. It causes significant disruption of cell wall formation and disrupts microtubule formation and function (Monaco *et al.*, 2002). The direction of cell wall formation during mitosis is random within the cell, rather than the usual straight walls formed between two daughter nuclei (Holmesen and Hess, 1984).

2.4.4 Use Characterization

Analysis of labeled use information is the critical first step in evaluating the federal action. The current label for DCPA represents the FIFRA regulatory action; therefore, labeled use and application rates specified on the label form the basis of this assessment. The assessment of use information is critical to the development of the action area and selection of appropriate modeling scenarios and inputs.

DCPA was first registered under FIFRA in 1958 for use on turf grasses as an herbicide for the selective preemergence control of crabgrass and other assorted weeds. It is now registered for use on a variety of food (vegetables, cole crops, herbs, melons, and others) and a variety of non-food uses (turf, residential lawns, ornamentals, nurseries, and sod farms). The formulations currently registered include granular, wettable powders, and flowable concentrates. DCPA may be applied via ground, chemigation, and aerial applications. Application methods include broadcast spray, soil incorporation, soil band treatments, layby treatments, spreader, sprinkler irrigation, and soil broadcast treatment and, in general, it is applied at seeding or transplanting or after cultivation to prevent germination of weeds. Depending on the crop, it may be applied pre-plant, preemergence, post emergence, or post transplant to the crop (OMAFRA, 2008).

National uses are similar to those allowed in California. Some labels require banded applications for most California food uses (see EPA Registration Numbers 5481-487 and 5481-490). Broadcast applications to onions are permitted in certain counties[9] in August through December on these labels. However, other labels do not require banded applications for food uses (see EPA Registration Numbers 5481-488 and 5481-489). None of the uses listed on the labels are strictly indoor uses, although some nursery uses may occur outdoors and indoors. Thus, all uses have the potential to result in environmental exposure.

Table 2-8 presents the uses and corresponding application rates and methods of application considered in this assessment. A number of uses listed on the labels should have been terminated according to the re-registration eligibility decision and the 2005 final rule (see Section 2.3). However, those that have not yet been terminated are included in this assessment. There is no further pending mitigation (*i.e.*, reduction in application rates, cancellation of uses, label language on buffers and spray drift requirements, etc.) that may impact the conclusions of this assessment in the near future.

Table 2-8. DCPA Uses Assessed for the CRLF[1,2]

Use Site	Form	Rate as lb a.i./Acre	Application Method
Food Uses			
Arrowroot	WP	10.5	Ground, Banded
	G	10.5	Aircraft, Banded, Ground
Beans, dried-type succulent (snap)	G	10.4	Ground
Brassica (head and stem) vegetables	FlC WP	10.5	Ground, Banded, Incorporated
	G	10.5	Aircraft, Ground, Banded, Incorporated,
Broccoli	FlC WP	10.5	Ground, Banded, Incorporated
	G	10.5	Aircraft, Ground, Banded, Incorporated,
Broccoli raab	FlC WP	10.5	Ground, Banded, Incorporated
	G	10.5	Aircraft, Ground, Banded, Incorporated,

9 Fresno, Tulare, Kern, San Bernardino, Los Angeles, Riverside, San Diego, and Imperial counties allow broadcast applications from August 1 through December 31 on the specified labels.

Use Site	Form	Rate as lb a.i./Acre	Application Method
Brussels sprouts	FlC WP	10.5	Ground, Banded, Incorporated
	G	10.5	Aircraft, Ground, Banded, Incorporated,
Cabbage	FlC WP	10.5	Ground, Banded, Incorporated
	G	10.5	Aircraft, Ground, Banded, Incorporated
Chinese Cabbage	WP	10.5	Ground, Banded, Incorporated
Canola\rape	WP	10.5	Ground, Banded, Incorporated
Cauliflower	FlC WP	10.5	Ground, Banded, Incorporated
	G	10.5	Aircraft, Ground, Banded, Incorporated
Chayote	WP	10.5	Ground, Banded, Incorporated
	G	10.5	Aircraft, Ground, Banded, Incorporated
Collards	FlC WP	10.5	Ground, Banded, Incorporated
	G	10.5	Aircraft, Ground, Banded, Incorporated,
Cucumber	G	10.4	Ground
Eggplant	FlC WP	10.5	Ground, Banded, Incorporated
	G	10.5	Aircraft, Ground
Garlic	G	10.4	Ground
Gherkin	WP	10.5	Ground, Banded, Incorporated
	G	10.5	Aircraft, Ground, Banded, Incorporated,
Ginseng (medicinal)	WP	10.5	Ground
Gourd	WP	10.5	Ground, Banded, Incorporated
	G	10.5	Aircraft, Ground, Banded, Incorporated
Chinese Gourd (wax)	WP	10.5	Ground, Banded, Incorporated
	G	10.5	Aircraft, Ground, Banded, Incorporated
Groundcherry (strawberry tomato/tomatillo)	WP	10.5	Ground, Banded, Incorporated
	G	10.5	Aircraft, Banded, Ground
Hanover salad	FlC WP	10.5	Ground, Banded, Incorporated
	G	10.5	Aircraft, Ground, Banded, Incorporation
Horseradish	FlC WP	10.5	Ground, Banded, Incorporated
	G	10.5	Aircraft, Ground, Banded, Incorporation
Kale	FlC WP	10.5	Ground, Banded, Incorporated
	G	10.5	Aircraft, Ground, Banded, Incorporation
Lettuce, head and leaf (black seeded simpson, salad bowl, etc.)	WP	10.2	Ground
	G	10.5	Ground
Manioc (cassava)	WP	10.5	Ground, Banded, Incorporated
	G	10.5	Aircraft, Banded, Ground
Melons	WP	10.2	Ground
Melons, including Watermelons, Cantaloupe, Honeydew, Musk Melons	WP FlC	10.5	Ground, Banded, Incorporated

Use Site	Form	Rate as lb a.i./Acre	Application Method
	G	10.5	Aircraft, Ground, Banded, Incorporated
Momordica spp.[3]	WP	10.5	Ground, Banded, Incorporated
	G	10.5	Aircraft, Ground, Banded, Incorporated
Mustard	FlC WP	10.5	Ground, Banded, Incorporated
	G	10.5	Aircraft, Ground, Banded, Incorporated
Onion (including green and scallions)	FlC WP	10.5	Ground, Banded, Incorporated
Onion	G	10.5	Aircraft, Ground
Peas, southern	G	10.4	Ground
Pepino	WP	10.5	Ground, Banded, Incorporated
Pepino (melon pear)	G	10.5	Aircraft, Banded, Ground
Pepper	G	10.4	Ground
Potato, white/Irish	G	10.4	Ground
Radish	FlC WP	10.5	Ground, Banded, Incorporated
Shallot	G	10.5	Ground
Squash (all or unspecified)	WP	10.2	Ground
Squash (summer) (winter) (hubbard)	G	10.4	Ground
Sweet potato	FlC WP	10.5	Ground, Banded, Incorporated
Strawberry	G	10.5	Ground
Taro	WP	10.5	Ground, Banded, Incorporated
	G	10.5	Aircraft, Banded, Ground
Tomatillo	FlC	10.5	Ground, Banded, Incorporated
Tomato	FlC	10.5	Ground, Banded, Incorporated
	G	9.1	Aircraft, Ground
Tumeric	WP	10.5	Ground, Banded, Incorporated
	G	10.5	Aircraft, Banded, Ground
Turnip (greens and root)	FlC WP	10.5	Ground, Banded, Incorporated
Yam	G	10.4	Ground
Non-Food Uses			
Golf course turf	FlC	15.0	Chemigation, Ground
Nursery stock	FlC WP	12.0	Aircraft, Ground, Chemigation
Ornamental and/or shade trees	G	11.4	Aircraft, Ground
Ornamental ground cover	G	11.4	Aircraft, Ground
Ornamental herbaceous plants	G	11.4	Aircraft, Ground
Ornamental lawns and turf ornamental sod farm (turf)	FlC	15.0	Aircraft, Chemigation, Ground
Ornamental lawns and turf	G	15.2	Aircraft, Ground
Ornamental nonflowering plants	G	11.4	Aircraft, Ground
Ornamental woody shrubs and vines	G	11.4	Aircraft, Ground
Residential lawns	G	15.2	Ground

Use Site	Form	Rate as lb a.i./Acre	Application Method
	FlC	15.0	Ground

1. Abbreviations: Form. = formulation; WP = wettable powder; FlC = flowable concentrate; sp. = species; a.i. = active ingredient
2. The maximum annual or seasonal application rate, maximum number of applications, and minimum application interval was not specified for any crop except lettuce. For lettuce, head and lettuce, leaf (black seeded, simpson, salad bowl etc.) the labels specified that one application was allowed per crop cycle.
3. *Momordica spp*. includes (balsam apple, balsam pear, cantaloupe, casaba, santa claus melon, Crenshaw melon, honeydew melon, honey balls, Persian melon, golden pershaw melon, mango melon, pineapple melon, and snake melon)

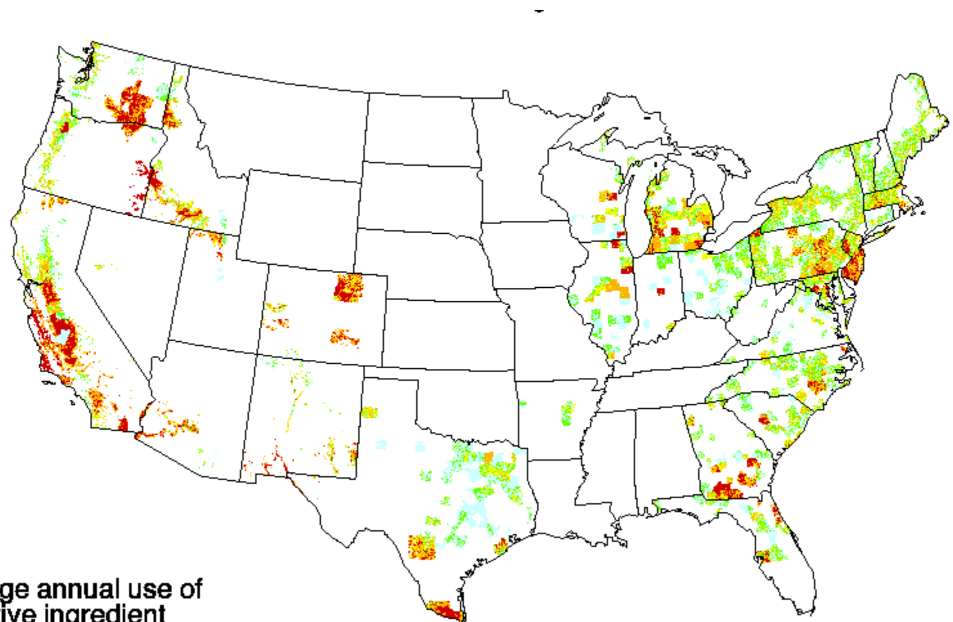
A national map **(**Figure 2-3**)** showing the estimated poundage of DCPA agricultural uses across the United States between 1999 and 2004 is provided below. National usage was most concentrated on the east and west coasts, Texas. Colorado, and the Great Lakes area. The map was downloaded from a U.S. Geological Survey (USGS), National Water Quality Assessment Program (NAWQA) website (http://water.usgs.gov/nawqa/pnsp/usage/maps/compound_listing.php?year=02)

California PUR Usage Data

The Agency's Biological and Economic Analysis Division (BEAD) provides an analysis of both national- and county-level usage information using state-level usage data obtained from USDA-NASS[10], Doane (www.doane.com; the full dataset is not provided due to its proprietary nature) and the California's Department of Pesticide Regulation Pesticide Use Reporting (CDPR PUR) database.[11] CDPR PUR is considered a more comprehensive source of usage data than USDA-NASS or EPA proprietary databases, and thus the usage data reported for DCPA by county in this California-specific assessment were generated using CDPR PUR data. Eight years (1999-2006) of usage data were included in this analysis. Data from CDPR PUR were obtained for every pesticide application made on every use site at the section level (approximately one square mile) of the public land survey system. BEAD summarized these data to the county level by site, pesticide, and unit treated. Calculating county-level usage involved summarizing across all applications made within a section and then across all sections within a county for each use site and for each pesticide. The county level usage data that were calculated include: average annual pounds applied, average annual area treated, and average and maximum application rate across all eight years. The units of area treated are also provided where available. Application dates from the CA PUR data were used later in the assessment to determine application dates for modeling and which RLF life cycle is occurring when DCPA is likely applied.

10 United States Depart of Agriculture (USDA), National Agricultural Statistics Service (NASS) Chemical Use Reports provide summary pesticide usage statistics for select agricultural use sites by chemical, crop and state. See http://www.usda.gov/nass/pubs/estindx1.htm#agchem.

11 The California Department of Pesticide Regulation's Pesticide Use Reporting database provides a census of pesticide applications in the state. See http://www.cdpr.ca.gov/docs/pur/purmain.htm.



Crops	Total pounds applied	Percent national use
dry onions	233865	52.08
broccoli	94487	21.04
sod harvested	28200	6.28
cabbage	25590	5.70
cauliflower	14367	3.20
squash	13439	2.99
green onions	7272	1.62
collards	6920	1.54
dry beans	6771	1.51
strawberries	5905	1.31

Figure 2-3. DCPA Agricultural Use in Total Pounds per County[12]

The state of California requires that all pesticide applications (excluding private homeowner uses) be reported. This data is collected in the PUR (pesticide use reporting) database. The Office of Pesticide Programs' (OPP) Biological and Economic Analysis Division (BEAD) performed an analysis (J. Carter and A. Grube , October 2, 2007) of the PUR data for years 1999 to 2006, including data for DCPA. Use of DCPA was reported in a total of 31 counties over that time. DCPA is registered for non-agricultural uses and products are manufactured for use by homeowners. This analysis does not include usage by homeowners because a reliable data source for this information is not available.

12 (from http://water.usgs.gov/nawqa/pnsp/usage/maps/show_map.php?year=02&map=m6045)
[The pesticide use maps available from this site show the average annual pesticide use intensity expressed as average weight (in pounds) of a pesticide applied to each square mile of agricultural land in a county. The area of each map is based on state-level estimates of pesticide use rates for individual crops that were compiled by the CropLife Foundation, Crop Protection Research Institute during based on information collected during 1999 through 2004 and on 2002 Census of Agriculture county crop acreage. The maps do not represent a specific year, but rather show typical use patterns over the five year period 1999 through 2004.]

Some uses reported in the CDPR PUR database are different than those considered in the assessment (beet, carrot, chicory, chive, corn, endive (Escarole), grape, wine grape, spice herb, mint, pecan, spice pepper, pimento, plum, research commodity, preplant soil fumigation, structural pest control, and vertebrate control). The uses considered in this risk assessment represent all currently registered uses according to a review of all current labels. No other uses are relevant to this assessment. Any other reported use, such as may be seen in the CDPR PUR database, represent either historic uses that have been canceled, mis-reported uses, or mis-use. Historical uses, mis-reported uses, and misuse are not considered part of the federal action and, therefore are not considered in this assessment

According to the CDPR PUR database, a total of 132,933 to 237,001 pounds of DCPA were applied annually to registered crops in California between 1999 and 2006 (Figure 2-4). The average total annual number of pounds applied by county over that eight year period was 200,365. Figure 2-5 shows the reported average annual number of pounds used in each county between 1999 and 2006. Many counties did not have any usage in some years, so the average annual applied was much lower than the maximum annual amount applied. Sixty-three percent of the average annual pounds applied were applied in two counties: Monterey and Imperial. Ventura, Riverside, Santa Barbara, Fresno, San Benito, and San Luis Obispo also used on average greater than 5000 pounds DCPA a year.

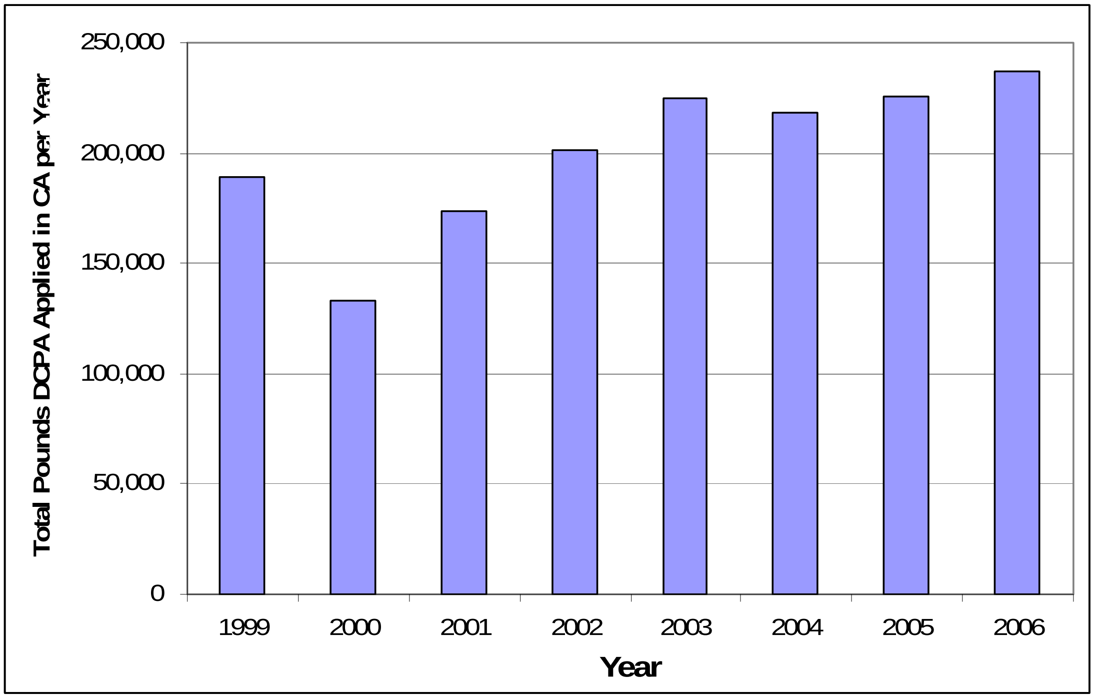


Figure 2-4. Total Pounds DCPA Applied in California per Year Between 1999 and 2006. Only non-homeowner usage on registered use sites (as listed in Table 2-9) were included in the totals.

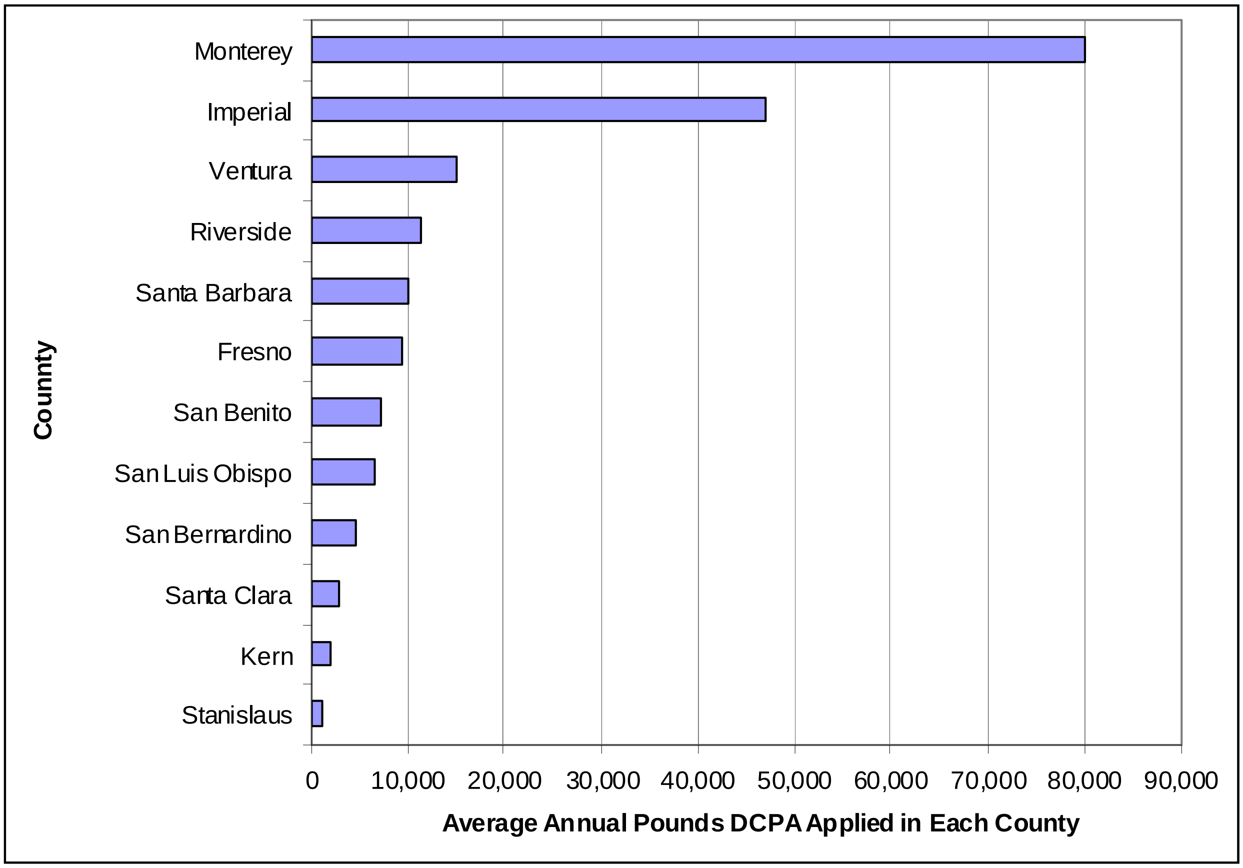


Figure 2-5. Average Annual Pounds DCPA Applied in Each County for the Years 1999-2006. Counties applying a maximum of more than 1000 pounds per year were included in the figure. See Appendix A for additional information.

Usage of DCPA for each use site or crop is summarized in Table 2-9. Many crops did not have any usage in some years, so the average annual applied was much lower than the maximum annual amount applied. Based on the average annual pounds applied between 1999 and 2006, greater than 1000 pounds of DCPA is applied to fourteen crops annually: broccoli, dry onions, cauliflower, cabbage, green onion, rappini, Chinese cabbage, turf/sod, radish, bok choy, outdoor grown flowers, kale, fruiting pepper, and gai lon. Approximately 47 percent of average annual DCPA applied is applied to broccoli, 22 percent is applied to dry onion, and seven percent is applied to cauliflower.[13] All other uses accounted for less than four percent of the total DCPA used in California.

13 The total average annual number of pounds applied by use over that seven year period was 200,364 pounds. This value was used to estimate percentage of DCPA applied to each crop.

Table 2-9. Summary of California Department of Pesticide Registration (CDPR) Pesticide Use Reporting (PUR) Data from 1999 to 2006 for Currently Registered DCPA Uses[1,2]

Site Name	Average Annual Pounds Applied	Percent of Average Annual Pounds Applied	Maximum Annual Pounds Applied	Average Application Rate Across All Counties (lbs a.i./A)	Maximum Application Rate (lbs a.i./A)
Broccoli	94,673.6	47.25%	110,156.7	2.75	24.75
Onion, Dry	44,396.5	22.16%	59,120.1	6.17	83.02
Cauliflower	14,871.2	7.42%	17,840.6	2.58	22.70
Cabbage	6,732.0	3.36%	10,169.7	3.83	29.61
Onion, Green	6,679.2	3.33%	9,524.7	5.17	90.00
Rappini[5]	6,290.0	3.14%	8,381.4	3.53	22.64
Chinese Cabbage (Nappa)	4,830.8	2.41%	8,250.4	3.70	15.00
Turf/Sod	3,899.5	1.95%	9,457.9	9.53	15.00
Radish	3,637.6	1.82%	7,193.8	5.88	90.25
Bok Choy[5]	3,228.0	1.61%	6,868.8	4.14	18.00
Outdoor Grown Flowers[6]	3,113.1	1.55%	5,058.1	5.31	121.15
Kale	1,658.8	0.83%	3,191.4	3.73	13.64
Pepper, Fruiting	1,174.4	0.59%	3,850.8	4.98	9.00
Gai Lon[5]	1,066.2	0.53%	2,325.4	4.91	9.00
Turnip	494.2	0.25%	1,223.1	5.23	10.50
Leek[7]	324.4	0.16%	622.1	5.01	10.76
Garlic	324.2	0.16%	1,159.6	6.58	9.06
Mustard	320.8	0.16%	864.0	5.27	10.50
Collard	283.9	0.14%	693.0	5.36	10.50
Chinese Greens	271.1	0.14%	907.9	4.79	9.00
Vegetables, Leafy[8]	248.9	0.12%	1,811.2	7.68	9.00
Outdoor Grown Transplants[9]	200.5	0.10%	1,038.7	4.98	0.75
Canola (Rape)	178.1	0.09%	810.1	3.45	10.50
Tomato and Tomato, Processing	177.7	0.09%	783.7	4.42	7.50
Outdoor Grown Plants in Containers[9]	144.7	0.07%	397.1	5.17	90.00
Brussels Sprout	139.6	0.07%	360.5	3.12	5.25
Gai Choy[5]	122.2	0.06%	716.0	6.14	7.55
Cantaloup	117.7	0.06%	617.7	2.23	5.00
Eggplant	86.7	0.04%	432.0	6.92	9.00
Watermelon	85.2	0.04%	400.7	3.52	3.52
Bean, Succulent	84.9	0.04%	241.5	5.32	9.00
Landscape Maintenance[10]	81.2	0.04%	239.5	NA	NA
Rights of Way[11]	55.8	0.03%	159.1	NA	NA

Site Name	Average Annual Pounds Applied	Percent of Average Annual Pounds Applied	Maximum Annual Pounds Applied	Average Application Rate Across All Counties (lbs a.i./A)	Maximum Application Rate (lbs a.i./A)
Melon	45.5	0.02%	330.8	4.10	9.00
Shallot	40.1	0.02%	321.2	4.59	6.04
Kohlrabi[5]	39.9	0.02%	67.2	3.92	48.30
Squash, Summer	35.4	0.02%	177.8	2.68	4.54
Strawberry	28.7	0.01%	137.9	3.08	4.53
Greenhouse Grown Plants in Containers[12]	28.4	0.01%	225.0	6.84	13.69
Lettuce, Leaf	24.5	0.01%	63.7	3.53	7.50
Squash	21.3	0.01%	66.9	3.51	6.00
Peas	14.9	0.01%	108.0	2.37	9.00
Greenhouse Grown Flowers[12]	12.1	0.01%	67.7	1.31	4.80
Lettuce, Head	11.0	0.01%	37.4	2.72	9.00
Bean, Unspecified	7.8	<0.01%	41.7	4.75	7.50
Cole Crop[5]	6.1	<0.01%	32.5	5.94	8.13
Yam	3.8	<0.01%	30.0	6.00	6.00
Cucumber	3.4	<0.01%	27.1	4.51	4.53
Greenhouse Grown Transplants[12]	0.3	<0.01%	1.3	0.97	1.13

1-Based on data supplied by BEAD
2- Commodities with DCPA usage reported in the database that are not listed on labels include: beet, carrot, chicory, corn, daikon, dill, endive (Escarole), grape, wine grape, spice herb, mint, pecan, spice pepper, pimento, plum, research commodity, preplant soil fumigation, structural pest control, spinach, uncultivated agriculture, uncultivated non-agricultural, vegetable, and vertebrate control. Some reported application rates are higher than the maximum allowed rate.
3- Average annual pounds applied were calculated from the total pounds applied for each commodity between 1999 and 2006. Years with zero pounds applied were included in the average.
4- The average application rate across all counties was calculated as the weighted average of the average application rate for each county.
5- This falls under the registered use for *Brassica* species.
6- This falls under the registered use for ornamentals.
7- This falls under the registered use for onion.
8- This falls under the registered use for *Brassica* species, head and leaf lettuce, and hanover salad.
9 – This falls under the registered use for many different crops that are planted as transplants, including nursery stock.
10 – This falls under the registered use for ornamentals, ornamental lawns and turf, and residential lawns.
11- Rights of way that are planted with turf could fall under the registered uses for residential lawns and turf.
12 – This falls under the registered use for nurseries.

2.5 Assessed Species

The CRLF was federally listed as a threatened species by U.S. FWS effective June 24, 1996 (U.S. FWS, 1996). It is one of two subspecies of the red-legged frog and is the largest native frog in the western United States (U.S. FWS, 2002). A brief summary of information regarding CRLF distribution, reproduction, diet, and habitat requirements is provided in Sections 2.5.1

through 2.5.4, respectively. Further information on the status, distribution, and life history of and specific threats to the CRLF is provided in Attachment 1.

Final critical habitat for the CRLF was designated by U.S. FWS on April 13, 2006 (U.S. FWS, 2006; 71 FR 19244-19346). Further information on designated critical habitat for the CRLF is provided in Section 2.6.

2.5.1 Distribution

The CRLF is endemic to California and Baja California (Mexico) and historically inhabited 46 counties in California including the Central Valley and both coastal and interior mountain ranges (U.S. FWS, 1996). Its range has been reduced by about 70%, and the species currently resides in 22 counties in California (U.S. FWS, 1996). The species has an elevational range of near sea level to 1,500 meters (5,200 feet) (Jennings and Hayes 1994); however, nearly all of the known CRLF populations have been documented below 1,050 meters (3,500 feet) (U.S. FWS, 2002).

Populations currently exist along the northern California coast, northern Transverse Ranges (U.S. FWS, 2002), foothills of the Sierra Nevada (5-6 populations), and in southern California south of Santa Barbara (two populations) (Fellers 2005a). Relatively larger numbers of CRLFs are located between Marin and Santa Barbara Counties (Jennings and Hayes 1994). A total of 243 streams or drainages are believed to be currently occupied by the species, with the greatest numbers in Monterey, San Luis Obispo, and Santa Barbara counties (U.S. FWS, 1996). Occupied drainages or watersheds include all bodies of water that support CRLFs (*i.e.*, streams, creeks, tributaries, associated natural and artificial ponds, and adjacent drainages), and habitats through which CRLFs can move (*i.e.*, riparian vegetation, uplands) (U.S. FWS, 2002).

The distribution of CRLFs within California is addressed in this assessment using four categories of location including recovery units, core areas, designated critical habitat, and known occurrences of the CRLF reported in the California Natural Diversity Database (CNDDB) that are not included within core areas and/or designated critical habitat (see Figure 2-6). Recovery units, core areas, and other known occurrences of the CRLF from the CNDDB are described in further detail in this section, and designated critical habitat is addressed in Section 2.6. Recovery units are large areas defined at the watershed level that have similar conservation needs and management strategies. The recovery unit is primarily an administrative designation, and land area within the recovery unit boundary is not exclusively CRLF habitat. Core areas are smaller areas within the recovery units that comprise portions of the species' historic and current range and have been determined by U.S. FWS to be important in the preservation of the species. Designated critical habitat is generally contained within the core areas, although a number of critical habitat units are outside the boundaries of core areas, but within the boundaries of the recovery units. Additional information on CRLF occurrences from the CNDDB is used to cover the current range of the species not included in core areas and/or designated critical habitat, but within the recovery units.

Other Known Occurrences from the CNDBB

The CNDDB provides location and natural history information on species found in California. The CNDDB serves as a repository for historical and current species location sightings. Information regarding known occurrences of CRLFs outside of the currently occupied core areas and designated critical habitat is considered in defining the current range of the CRLF. See: http://www.dfg.ca.gov/bdb/html/cnddb_info.html for additional information on the CNDDB.

Recovery Units

1. Sierra Nevada Foothills and Central Valley
2. North Coast Range Foothills nd Western Sacramento River Valley
3. North Coast and North San Francisco Bay
4. South and East San Francisc Bay
5. Central Coast
6. Diablo Range and Salinas Valley
7. Northern Transverse Rang nd Tehachapi Mountains
8. Southern Transverse and Peninsular Ranges

Core Areas

1. Feather River
2. Yuba River- S. Fork Feather River
3. Traverse Creek/ Middle Fork/ American R. Rubicon
4. Cosumnes River
5. South Fork Calaveras River*
6. Tuolumne River*
7. Piney Creek*
8. Cottonwood Creek
9. Putah Creek – Cache Creek*
10. Lake Berryessa Tributaries
11. Upper Sonoma Creek
12. Petaluma Creek – Sonoma Creek
13. Pt. Reyes Peninsula
14. Belvedere Lagoon
15. Jameson Canyon – Lower Napa River
16. East San Francisco Bay
17. Santa Clara Valley
18. South San Francisco Bay
19. Watsonville Slough-Elkhorn Slough
20. Carmel River – Santa Lucia
21. Gablan Range
22. Estero Bay
23. Arroyo Grange River
24. Santa Maria River – Santa Ynez River
25. Sisquoc River
26. Ventura River – Santa Clara River
27. Santa Monica Bay – Venura Coastal Streams
28. Estrella River
29. San Gabriel Mountain*
30. Forks of the Mojave*
31. Santa Ana Mountain*
32. Santa Rosa Plateau
33. San Luis Ray*
34. Sweetwater*
35. Laguna Mountain*

* Core areas that were historically occupied by the California red-legged frog are not included in the map

Figure 2-6. Recovery Unit, Core Area, Critical Habitat, and Occurrence Designations for CRLF

2.5.2 Reproduction

CRLFs breed primarily in ponds; however, they may also breed in quiescent streams, marshes, and lagoons (Fellers 2005a). According to the Recovery Plan (U.S. FWS, 2002), CRLFs breed from November through late April. Peaks in spawning activity vary geographically; Fellers (2005b) reports peak spawning as early as January in parts of coastal central California. Eggs are fertilized as they are being laid. Egg masses are typically attached to emergent vegetation, such as bulrushes (*Scirpus* spp.) and cattails (*Typha* spp.) or roots and twigs, and float on or near the surface of the water (Hayes and Miyamoto, 1984). Egg masses contain approximately 2000 to 6000 eggs ranging in size between 2 and 2.8 mm (Jennings and Hayes 1994). Embryos hatch 10 to 14 days after fertilization (Fellers 2005a) depending on water temperature. Egg predation is reported to be infrequent and most mortality is associated with the larval stage (particularly through predation by fish); however, predation on eggs by newts has also been reported (Rathburn, 1998). Tadpoles require 11 to 28 weeks to metamorphose into juveniles (terrestrial-phase), typically between May and September (Jennings and Hayes, 1994, U.S. FWS, 2002); tadpoles have been observed to over-winter (delay metamorphosis until the following year) (Fellers, 2005b, U.S. FWS, 2002). Males reach sexual maturity at 2 years, and females reach sexual maturity at 3 years of age; adults have been reported to live 8 to 10 years (U.S. FWS, 2002). Figure 2-7 depicts CRLF annual reproductive timing.

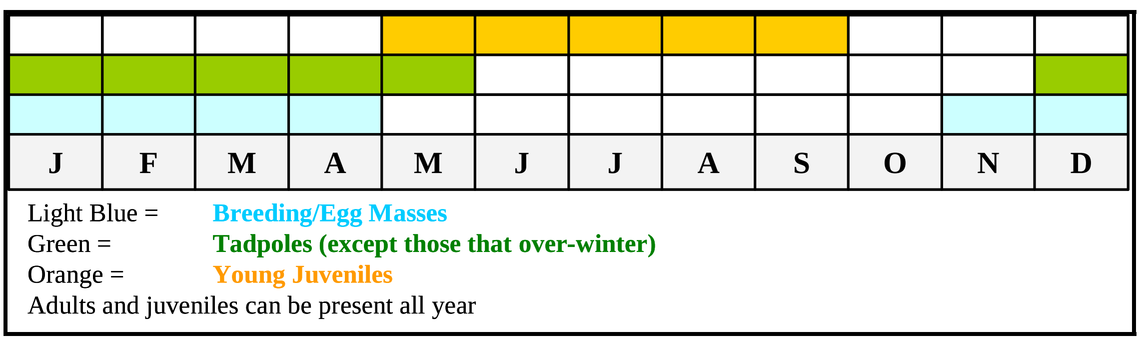


Figure 2-7. CRLF Reproductive Events by Month

2.5.3 Diet

Although the diet of CRLF aquatic-phase larvae (tadpoles) has not been studied specifically, it is assumed that their diet is similar to that of other frog species, with the aquatic phase feeding exclusively in water and consuming diatoms, algae, and detritus (U.S. FWS, 2002). Tadpoles filter and entrap suspended algae (Seale and Beckvar, 1980) via mouthparts designed for effective grazing of periphyton (Wassersug, 1984, Kupferberg *et al.*; 1994; Kupferberg, 1997; Altig and McDiarmid, 1999).

Juvenile and adult CRLFs forage in aquatic and terrestrial habitats, and their diet differs greatly from that of larvae. The main food source for juvenile aquatic- and terrestrial-phase CRLFs is thought to be aquatic and terrestrial invertebrates found along the shoreline and on the water surface. Hayes and Tennant (1985) report, based on a study examining the gut content of 35 juvenile and adult CRLFs, that the species feeds on as many as 42 different invertebrate taxa, including Arachnida, Amphipoda, Isopoda, Insecta, and Mollusca. The most commonly observed prey species were larval alderflies (*Sialis* cf. *californica*), pillbugs (*Armadilliadrium vulgare*), and water striders (*Gerris* sp). The preferred prey species, however, was the sowbug (Hayes and Tennant, 1985). This study suggests that CRLFs forage primarily above water, although the authors note other data reporting that adults also feed under water, are cannibalistic, and consume fish. For larger CRLFs, over 50% of the prey mass may consists of vertebrates such as mice, frogs, and fish, although aquatic and terrestrial invertebrates were the most numerous food items (Hayes and Tennant, 1985). For adults, feeding activity takes place primarily at night; for juveniles feeding occurs during the day and at night (Hayes and Tennant, 1985).

2.5.4 Habitat

CRLFs require aquatic habitat for breeding, but also use other habitat types including riparian and upland areas throughout their life cycle. CRLF use of their environment varies; they may complete their entire life cycle in a particular habitat or they may utilize multiple habitat types. Overall, populations are most likely to exist where multiple breeding areas are embedded within varying habitats used for dispersal (U.S. FWS, 2002). Generally, CRLFs utilize habitat with perennial or near-perennial water (Jennings *et al*., 1997). Dense vegetation close to water, shading, and water of moderate depth are habitat features that appear especially important for CRLF (Hayes and Jennings, 1988).

Breeding sites include streams, deep pools, backwaters within streams and creeks, ponds, marshes, sag ponds (land depressions between fault zones that have filled with water), dune ponds, and lagoons. Breeding adults have been found near deep (0.7 m) still or slow moving water surrounded by dense vegetation (U.S. FWS, 2002); however, the largest number of tadpoles have been found in shallower pools (0.26 – 0.5 m) (Reis, 1999). Data indicate that CRLFs do not frequently inhabit vernal pools, as conditions in these habitats generally are not suitable (Hayes and Jennings, 1988).

CRLFs also frequently breed in artificial impoundments such as stock ponds, although additional research is needed to identify habitat requirements within artificial ponds (U.S. FWS, 2002). Adult CRLFs use dense, shrubby, or emergent vegetation closely associated with deep-water pools bordered with cattails and dense stands of overhanging vegetation (http://www.fws.gov/endangered/features/rl_frog/rlfrog.html#where).

In general, dispersal and habitat use depends on climatic conditions, habitat suitability, and life stage. Adults rely on riparian vegetation for resting, feeding, and dispersal. The foraging quality of the riparian habitat depends on moisture, composition of the plant community, and presence of pools and backwater aquatic areas for breeding. CRLFs can be found living within streams at distances up to 3 km (2 miles) from their breeding site and have been found up to 30 m (100 feet) from water in dense riparian vegetation for up to 77 days (U.S. FWS, 2002).

During dry periods, the CRLF is rarely found far from water, although it will sometimes disperse from its breeding habitat to forage and seek other suitable habitat under downed trees or logs, industrial debris, and agricultural features (U.S. FWS, 2002). According to Jennings and Hayes (1994), CRLFs also use small mammal burrows and moist leaf litter as habitat. In addition, CRLFs may also use large cracks in the bottom of dried ponds as refugia; these cracks may provide moisture for individuals avoiding predation and solar exposure (Alvarez, 2000).

2.6 Designated Critical Habitat

In a final rule published on April 13, 2006, 34 separate units of critical habitat were designated for the CRLF by U.S. FWS (U.S. FWS, 2006; FR 51 19244-19346). A summary of the 34 critical habitat units relative to U.S. FWS-designated recovery units and core areas (previously discussed in Section 2.5.1) is provided in Attachment 1.

'Critical habitat' is defined in the ESA as the geographic area occupied by the species at the time of the listing where the physical and biological features necessary for the conservation of the species exist, and there is a need for special management to protect the listed species. It may also include areas outside the occupied area at the time of listing if such areas are 'essential to the conservation of the species.' All designated critical habitat for the CRLF was occupied at the time of listing. Critical habitat receives protection under Section 7 of the ESA (Section 7) through prohibition against destruction or adverse modification with regard to actions carried out, funded, or authorized by a federal Agency. Section 7 requires consultation on federal actions that are likely to result in the destruction or adverse modification of critical habitat.

To be included in a critical habitat designation, the habitat must be 'essential to the conservation of the species.' Critical habitat designations identify, to the extent known using the best scientific and commercial data available, habitat areas that provide essential life cycle needs of the species or areas that contain certain primary constituent elements (PCEs) (as defined in 50 CFR 414.12(b)). PCEs include, but are not limited to, space for individual and population growth and for normal behavior; food, water, air, light, minerals, or other nutritional or physiological requirements; cover or shelter; sites for breeding, reproduction, rearing (or development) of offspring; and habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species. The designated critical habitat areas for the CRLF are considered to have the following PCEs that justify critical habitat designation:

- Breeding aquatic habitat;
- Non-breeding aquatic habitat;
- Upland habitat; and
- Dispersal habitat.

Further description of these habitat types is provided in Attachment 1.

Occupied habitat may be included in the critical habitat only if essential features within the habitat may require special management or protection. Therefore, U.S. FWS does not include areas where existing management is sufficient to conserve the species. Critical habitat is designated outside the geographic area presently occupied by the species only when a designation limited to its present range would be inadequate to ensure the conservation of the species. For the CRLF, all designated critical habitat units contain all four of the PCEs, and were occupied by the CRLF at the time of FR listing notice in April 2006. The FR notice designating critical habitat for the CRLF includes a special rule exempting routine ranching activities associated with livestock ranching from incidental take prohibitions. The purpose of this exemption is to promote the conservation of rangelands, which could be beneficial to the CRLF, and to reduce the rate of conversion to other land uses that are incompatible with CRLF conservation. Please see Attachment 1 for a full explanation on this special rule.

U.S. FWS has established adverse modification standards for designated critical habitat (U.S. FWS, 2006). Activities that may destroy or adversely modify critical habitat are those that alter the PCEs and jeopardize the continued existence of the species. Evaluation of actions related to use of DCPA that may alter the PCEs of the CRLF's critical habitat form the basis of the critical habitat impact analysis. According to U.S. FWS (2006), activities that may affect critical habitat and therefore result in adverse effects to the CRLF include, but are not limited to the following:

(1) Significant alteration of water chemistry or temperature to levels beyond the tolerances of the CRLF that result in direct or cumulative adverse effects to individuals and their life-cycles.
(2) Alteration of chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs.
(3) Significant increase in sediment deposition within the stream channel or pond or disturbance of upland foraging and dispersal habitat that could result in elimination or reduction of habitat necessary for the growth and reproduction of the CRLF by increasing the sediment deposition to levels that would adversely affect their ability to complete their life cycles.
(4) Significant alteration of channel/pond morphology or geometry that may lead to changes to the hydrologic functioning of the stream or pond and alter the timing, duration, water flows, and levels that would degrade or eliminate the CRLF and/or its habitat. Such an effect could also lead to increased sedimentation and degradation in water quality to levels that are beyond the CRLF's tolerances.
(5) Elimination of upland foraging and/or aestivating habitat or dispersal habitat.
(6) Introduction, spread, or augmentation of non-native aquatic species in stream segments or ponds used by the CRLF.
(7) Alteration or elimination of the CRLF's food sources or prey base (also evaluated as indirect effects to the CRLF).

As previously noted in Section 2.1, the Agency believes that the analysis of direct and indirect effects to listed species provides the basis for an analysis of potential effects on the designated critical habitat. Because DCPA is expected to directly impact living organisms within the action area, critical habitat analysis for DCPA is limited in a practical sense to those PCEs of critical habitat that are biological or that can be reasonably linked to biologically mediated processes.

2.7 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 (50 CFR 402.02). It is recognized that the overall action area for the national registration of DCPA is likely to encompass considerable portions of the United States based on the large array of agricultural uses. However, the scope of this assessment limits consideration of the overall action area to those portions that may be applicable to the protection of the CRLF and its designated critical habitat within the state of California. The Agency's approach to defining the action area under the provisions of the Overview Document (U.S. EPA, 2004) considers the results of the risk assessment process to establish boundaries for that action area with the understanding that exposures below the Agency's defined Levels of Concern (LOCs) constitute a no-effect threshold. For the purposes of this assessment, attention will be focused on the footprint of the action (*i.e.*, the area where pesticide application occurs), plus all areas where offsite transport (*i.e.*, spray drift, downstream dilution, etc.) may result in potential exposure within the state of California that exceeds the Agency's LOCs.

Deriving the geographical extent of this portion of the action area is based on consideration of the types of effects that DCPA may be expected to have on the environment, the exposure levels to DCPA that are associated with those effects, and the best available information concerning the use of DCPA and its fate and transport within the state of California. Specific measures of ecological effect for the CRLF that define the action area include any direct and indirect toxic effect to the CRLF and any potential modification of its critical habitat, including reduction in survival, growth, and fecundity as well as the full suite of sublethal effects available in the effects literature. Therefore, the action area extends to a point where environmental exposures are below any measured lethal or sublethal effect threshold for any biological entity at the whole organism, organ, tissue, and cellular level of organization. In situations where it is not possible to determine the threshold for an observed effect, the action area is not spatially limited and is assumed to be the entire state of California.

The definition of action area requires a stepwise approach that begins with an understanding of the federal action. The federal action is defined by the currently labeled uses for DCPA. An analysis of labeled uses and review of available product labels was completed. Several of the currently labeled uses are special local needs (SLN) uses or are restricted to specific states and are excluded from this assessment. In addition, a distinction has been made between food use crops and those that are non-food/non-agricultural uses. For those uses relevant to the CRLF, the analysis indicates for DCPA, that the uses listed in Table 2.8 are considered the federal action evaluated in this assessment.

Following a determination of the assessed uses, an evaluation of the potential "footprint" of DCPA use patterns (*i.e.*, the area where pesticide application occurs) is determined. This "footprint" represents the initial area of concern, based on an analysis of available land cover data for the state of California. The initial area of concern is defined as all land cover types and the stream reaches within the land cover areas that represent the labeled uses indicated in Table 2.8. A map representing all the land cover types that make up the initial area of concern for DCPA is presented in Figure 2-8.

DCPA may be used in residential, commercial, and rural areas. Land cover types (NLCD and CA GAP) used to represent usage of DCPA include cultivated crops and turf. More information regarding which specific uses are represented for each land cover types can be found in Appendix B.

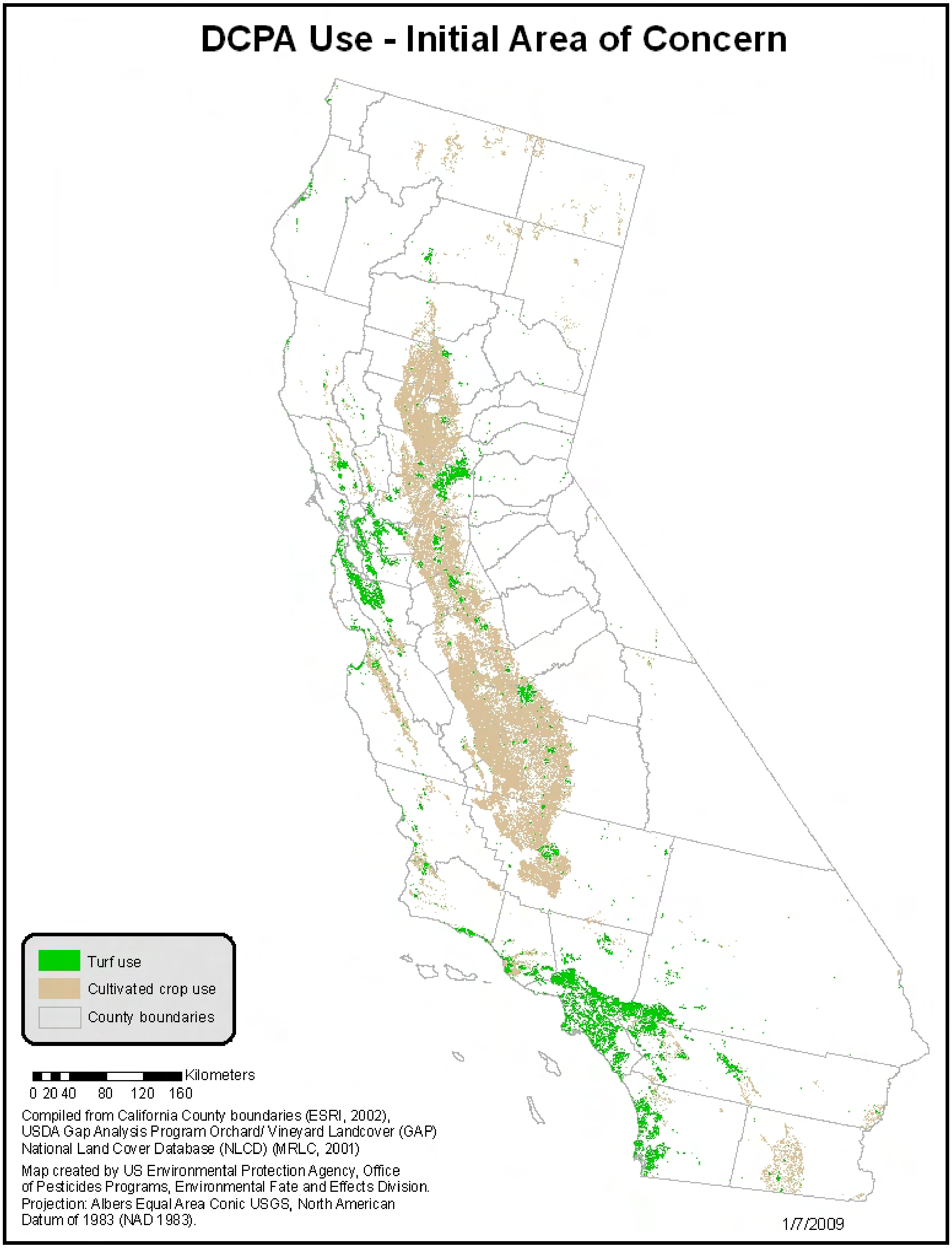


Figure 2-8. Initial area of concern, or "footprint" of potential use, for DCPA

Once the initial area of concern is defined, the next step is to define the potential boundaries of the action area by determining the extent of offsite transport via spray drift and runoff where exposure of one or more taxonomic groups to the pesticide exceeds the listed species LOCs.

As previously discussed, the action area is defined by the most sensitive measure of direct and indirect ecological toxic effects including reduction in survival, growth, reproduction, and the entire suite of sublethal effects from valid, peer-reviewed studies.

Due to a positive result in a mutagenicity test, the spatial extent of the action area (*i.e.*, the boundary where exposures and potential effects are less than the Agency's LOC) for DCPA cannot be determined. Also, the Agency Carcinogenicity Peer Review Committee [CPRC] concluded that DCPA should be classified as a possible human carcinogen, based on evidence of increased incidences of thyroid tumors in both sexes of rat [although only at an excessive dose in the female] and liver tumors in two species [both female rat and mouse] at doses that were not excessive (Memorandum from HED dated July 8, 2002, DP Barcode D281320). This study is further discussed in 4.2.2. Additionally, both the terrestrial and aquatic plant NOAEC values could not be determined. Therefore, it is assumed that the action area encompasses the entire state of California, regardless of the spatial extent (*i.e.*, initial area of concern or footprint) of the pesticide use(s).

Review of the environmental fate data and physico-chemical properties of DCPA indicate that spray drift, runoff, and volatization are likely to be the dominant routes of exposure. Additionally, given the physico-chemical profile for DCPA and observed detections of DCPA in both air, rainfall, and snow samples (see Section 3.2.4), the potential for long range transport outside of the defined action area cannot be precluded; however, these exposure concentrations are not expected to approach those predicted by modeling using the agricultural and residential scenarios (see Section 3.2.3 and Section 3.3). DCPA and especially, the degradate TPA have the potential to reach ground water. This is discussed as an uncertainty in Section 6.1.3 and was not quantitatively assessed because exposure due to travel to ground water and the subsequent movement of the ground water into surface water is expected to be lower than exposure estimated in surface water.

The AgDRIFT model (Version 2.01) is used to define how far from the initial area of concern an effect to a given species may be expected via spray drift. The spray drift analysis for DCPA using the most sensitive endpoint (chronic mammal) results in a estimated buffer of 85.3 feet needed to mitigate risk based on modeling using the AgDrift model for the Tier I ground mode.[14] The maximum spray drift distance needed to mitigate risk with aerial applications is greater than 1000 feet based on modeling using the AgDrift model for the Tier I aerial mode. Further detail on the spray drift analysis is provided in Section 5.1.5.

An evaluation of usage information was conducted to determine the area where use of DCPA may impact the CRLF. This analysis is used to characterize where predicted exposures are most

14 This was calculated by assuming a high boom height, drop size distribution of ASAE very fine to fine, and the 90th percentile data. The lowest LOC to RQ ratio available for one application was for chronic exposure to mammals (LOC/RQ = 1.0/31.23=0.03). This ratio was assumed to be the fraction applied, resulting in an estimated distance to the edge of field of 85.3 feet.

likely to occur, but does not preclude use in other portions of the action area. A more detailed review of the county-level use information was also completed. These data suggest that the usage of DCPA occurs in counties where the CRLF is commonly found. For example, the greatest number of CRLF are found in Monterey, San Luis Obispo, and Santa Barbara Counties (see Section 2.5.1). The average annual pounds DCPA applied in Monterey, San Luis Obispo, and Santa Barbara Counties between 1999 and 2006 was 80,070, 6,464, and 10,197. Clearly, use of DCPA occurs in areas where the CRLF are commonly found.

2.8 Assessment Endpoints and Measures of Ecological Effect

Assessment endpoints are defined as "explicit expressions of the actual environmental value that is to be protected."[15] Selection of the assessment endpoints is based on valued entities (*e.g.*, CRLF, organisms important in the life cycle of the CRLF, and the PCEs of its designated critical habitat), the ecosystems potentially at risk (*e.g.*, water bodies, riparian vegetation, and upland and dispersal habitats), the migration pathways of DCPA (*e.g.*, runoff, spray drift, etc.), and the routes by which ecological receptors are exposed to DCPA (*e.g.*, direct contact, etc.).

2.8.1 Assessment Endpoints for the CRLF

Assessment endpoints for the CRLF include direct toxic effects on the survival, reproduction, and growth of the CRLF, as well as indirect effects, such as reduction of the prey base or modification of its habitat. In addition, potential modification of critical habitat is assessed by evaluating potential effects to PCEs, which are components of the habitat areas that provide essential life cycle needs of the CRLF. Each assessment endpoint requires one or more "measures of ecological effect," defined as changes in the attributes of an assessment endpoint or changes in a surrogate entity or attribute in response to exposure to a pesticide. Specific measures of ecological effect are generally evaluated based on acute and chronic toxicity information from registrant-submitted guideline tests that are performed on a limited number of organisms. Additional ecological effects data from the open literature are also considered. It should be noted that assessment endpoints are limited to direct and indirect effects associated with survival, growth, and fecundity, and do not include the full suite of sublethal effects used to define the action area. According the Overview Document (U.S. EPA 2004), the Agency relies on acute and chronic effects endpoints that are either direct measures of impairment of survival, growth, or fecundity or endpoints for which there is a scientifically robust, peer reviewed relationship that can quantify the impact of the measured effect endpoint on the assessment endpoints of survival, growth, and fecundity.

A complete discussion of all the toxicity data available for this risk assessment, including resulting measures of ecological effect selected for each taxonomic group of concern, is included in Section 4.0 of this document. A summary of the assessment endpoints and measures of ecological effect selected to characterize potential assessed direct and indirect CRLF risks associated with exposure to DCPA is provided in Table 2-10.

15 From U.S. EPA (1992). *Framework for Ecological Risk Assessment.* EPA/630/R-92/001.

Table 2-10. Assessment Endpoints and Measures of Ecological Effects

Assessment Endpoint	Measures of Ecological Effects[16]
Aquatic-Phase CRLF (Eggs, larvae, juveniles, and adults)[a]	
Direct Effects	
1. Survival, growth, and reproduction of CRLF	1a. Most sensitive freshwater fish acute LC_{50} 1b. Most sensitive freshwater fish chronic NOAEC 1c. Most sensitive fish early-life stage NOAEC
Indirect Effects and Critical Habitat Effects	
2. Survival, growth, and reproduction of CRLF individuals via indirect effects on aquatic prey food supply (*i.e.*, fish, freshwater invertebrates, non-vascular plants)	2a. Most sensitive freshwater fish, aquatic invertebrate or aquatic plants: EC_{50} or LC_{50} 2b. Most sensitive freshwater aquatic invertebrate and fish chronic NOAEC
3. Survival, growth, and reproduction of CRLF individuals via indirect effects on habitat, cover, food supply, and/or primary productivity (*i.e.*, aquatic plant community)	3a. Vascular plant acute EC_{50} 3b. Non-vascular plant acute EC_{50} (freshwater algae or diatom) EC_{50}
4. Survival, growth, and reproduction of CRLF individuals via effects to riparian vegetation	4a. Distribution of EC_{25} values for monocots (seedling emergence, vegetative vigor, or ECOTOX) 4b. Distribution of EC_{25} values for dicots (seedling emergence, vegetative vigor, or ECOTOX)
Terrestrial-Phase CRLF (Juveniles and adults)	
Direct Effects	
5. Survival, growth, and reproduction of CRLF individuals via direct effects on terrestrial phase adults and juveniles	5a. Most sensitive bird[b] or terrestrial-phase amphibian acute LC_{50} or LD_{50} 5b. Most sensitive bird[b] or terrestrial-phase amphibian chronic NOAEC
Indirect Effects and Critical Habitat Effects	
6. Survival, growth, and reproduction of CRLF individuals via effects on terrestrial prey (*i.e.*,terrestrial invertebrates, small mammals , and frogs)	6a. Most sensitive terrestrial vertebrate acute LC_{50} 6b. Most sensitive terrestrial vertebrate chronic NOAEC
7. Survival, growth, and reproduction of CRLF individuals via indirect effects on habitat (*i.e.*, riparian and upland vegetation)	7a. Distribution of EC_{25} for monocots (seedling emergence, vegetative vigor, or ECOTOX 7b. Distribution of EC_{25} for dicots (seedling emergence, vegetative vigor, or ECOTOX)

Abbreviations: bw=body weight; a.i.= active ingredient
a Adult frogs are no longer in the "aquatic phase" of the amphibian life cycle; however, submerged adult frogs are considered "aquatic" for the purposes of this assessment because exposure pathways in the water are considerably different that exposure pathways on land.
b Birds are used as surrogates for terrestrial phase amphibians.

2.8.2 Assessment Endpoints for Designated Critical Habitat

As previously discussed, designated critical habitat is assessed to evaluate actions related to the use of DCPA that may alter the PCEs of the CRLF's critical habitat. PCEs for the CRLF were previously described in Section 2.6. Actions that may modify critical habitat are those that alter the PCEs and jeopardize the continued existence of the CRLF. Therefore, these actions are

16 All registrant-submitted and open literature toxicity data reviewed for this assessment are included in Appendix A.

identified as assessment endpoints. It should be noted that evaluation of PCEs as assessment endpoints is limited to those of a biological nature (*i.e.*, the biological resource requirements for the listed species associated with the critical habitat) and those for which DCPA effects data are available. Adverse modification to the critical habitat of the CRLF includes, but is not limited to, those listed in Section 2.6.

Measures of such possible effects by labeled use of DCPA on critical habitat of the CRLF are described in Table 2-11**.** Some components of these PCEs are associated with physical abiotic features (*e.g.*, presence and/or depth of a water body, or distance between two sites), which are not expected to be measurably altered by use of pesticides. Assessment endpoints used for the analysis of designated critical habitat are based on the adverse modification standard established by U.S. FWS (2006).

Table 2-11. Summary of Assessment Endpoints and Measures of Ecological Effect for Primary Constituent Elements of Designated Critical Habitat[a]

Assessment Endpoint	Measures of Ecological Effect
Aquatic-Phase CRLF PCEs (Aquatic Breeding Habitat and Aquatic Non-Breeding Habitat)	
Alteration of channel/pond morphology or geometry and/or increase in sediment deposition within the stream channel or pond: aquatic habitat (including riparian vegetation) provides for shelter, foraging, predator avoidance, and aquatic dispersal for juvenile and adult CRLFs.	a. Most sensitive aquatic plant EC_{50} (guideline or ECOTOX) b. Distribution of EC_{25} values for terrestrial monocots (seedling emergence, vegetative vigor, or ECOTOX) c. Distribution of EC_{25} values for terrestrial dicots (seedling emergence, vegetative vigor, or ECOTOX)
Alteration in water chemistry/quality including temperature, turbidity, and oxygen content necessary for normal growth and viability of juvenile and adult CRLFs and their food source.	a. Most sensitive EC_{50} values for aquatic plants (guideline or ECOTOX) b. Distribution of EC_{25} values for terrestrial monocots (seedling emergence or vegetative vigor, or ECOTOX) c. Distribution of EC_{25} values for terrestrial dicots (seedling emergence, vegetative vigor, or ECOTOX)
Alteration of other chemical characteristics necessary for normal growth and viability of CRLFs and their food source.	a. Most sensitive EC_{50} or LC_{50} values for fish or aquatic-phase amphibians and aquatic invertebrates (guideline or ECOTOX) b. Most sensitive NOAEC values for fish or aquatic-phase amphibians and aquatic invertebrates (guideline or ECOTOX)
Reduction and/or modification of aquatic-based food sources for pre-metamorphs (*e.g.*, algae)	a. Most sensitive aquatic plant EC_{50} (guideline or ECOTOX)
Terrestrial-Phase CRLF PCEs (Upland Habitat and Dispersal Habitat)	
Elimination and/or disturbance of upland habitat; ability of habitat to support food source of CRLFs: Upland areas within 200 ft of the edge of the riparian vegetation or dripline surrounding aquatic and riparian habitat that are comprised of grasslands, woodlands, and/or wetland/riparian plant species that provides the CRLF shelter, forage, and predator avoidance	a. Distribution of EC_{25} values for monocots (seedling emergence, vegetative vigor, or ECOTOX) b. Distribution of EC_{25} values for dicots (seedling emergence, vegetative vigor, or ECOTOX c. Most sensitive food source acute EC_{50}/LC_{50} and NOAEC values for terrestrial vertebrates (mammals) and invertebrates, birds or terrestrial-phase amphibians, and freshwater fish.
Elimination and/or disturbance of dispersal habitat: Upland or riparian dispersal habitat within designated units and between occupied locations within 0.7 mi of each other that allow for movement between sites including both natural and altered sites which do not contain barriers to dispersal	
Reduction and/or modification of food sources for terrestrial phase juveniles and adults	
Alteration of chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs and their food source.	

[a] Physico-chemical water quality parameters such as salinity, pH, and hardness are not directly evaluated; however, these factors are indirectly evaluated. Major changes in these parameters from the proposed uses would primarily result from changes in plant communities which are evaluated as habitat for the CRLF.

2.9 Conceptual Model

2.9.1 Risk Hypotheses

Risk hypotheses are specific assumptions about potential adverse effects (*i.e*., changes in assessment endpoints) and may be based on theory and logic, empirical data, mathematical models, or probability models (U.S. EPA, 1998b). For this assessment, the risk is stressor-linked, where the stressor is the release of DCPA to the environment. The following risk hypotheses are presumed for this endangered species assessment:

The labeled use of DCPA within the action area may[17]:

- directly affect the CRLF by causing mortality or by adversely affecting growth or fecundity;
- indirectly affect the CRLF by reducing or changing the composition of food supply;
- indirectly affect the CRLF or modify designated critical habitat by reducing or changing the composition of the aquatic plant community in the ponds and streams comprising the species' current range and designated critical habitat, thus affecting primary productivity and/or cover;
- indirectly affect the CRLF or modify designated critical habitat by reducing or changing the composition of the terrestrial plant community (*i.e.*, riparian habitat) required to maintain acceptable water quality and habitat in the ponds and streams comprising the species' current range and designated critical habitat;
- modify the designated critical habitat of the CRLF by reducing or changing breeding and non-breeding aquatic habitat (via modification of water quality parameters, habitat morphology, and/or sedimentation);
- modify the designated critical habitat of the CRLF by reducing the food supply required for normal growth and viability of juvenile and adult CRLFs;
- modify the designated critical habitat of the CRLF by reducing or changing upland habitat within 200 ft of the edge of the riparian vegetation necessary for shelter, foraging, and predator avoidance;
- modify the designated critical habitat of the CRLF by reducing or changing dispersal habitat within designated units and between occupied locations within 0.7 mi of each other that allow for movement between sites including both natural and altered sites which do not contain barriers to dispersal;
- modify the designated critical habitat of the CRLF by altering chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs.

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17 These effects and habitat modifications may result from exposure to 1) the parent compound (DCPA), 2) its degradates (MTP and TPA), or 3) impurities present in the DCPA formulation (HCB and 2,3,7,8-TCDD).

2.9.2 Diagram

The conceptual model is a graphic representation of the structure of the risk assessment. It specifies the DCPA release mechanisms, biological receptor types, and effects endpoints of potential concern. The conceptual models for terrestrial and aquatic exposures are shown in Figure 2-9 and Figure 2-10, respectively, which include the conceptual models for the aquatic and terrestrial PCE components of critical habitat. Exposure routes shown in dashed lines are not quantitatively considered because the contribution of those potential exposure routes to potential risks to the CRLF and modification to designated critical habitat is expected to be negligible.

Based on available fate and transport data for DCPA (described in Section 2.4.1), potential transport mechanisms of this pesticide include surface water runoff, movement into ground water and subsequent recharge into surface water, spray drift, and volatization and deposition to nearby fields, and long range transport in air. Significant amounts of DCPA have been shown to volatize off the field and be deposited to nearby fields (see Section 2.4.1). This could lead to exposure via inhalation or deposition of DCPA on nearby areas. Exposure due to inhalation was not directly assessed because the methods and data needed to assess this exposure pathway are not available. Volatization and deposition on nearby fields is expected to result in lower exposure than that estimated for runoff and spray drift for the field that DCPA is applied to and therefore, was not assessed separately. Exposure to DCPA due to long range transport of DCPA and due to movement into ground water are also discussed qualitatively. The other compounds, other than DCPA, that organisms may be exposed to as a result of the use of DCPA include, the degradate TPA, and impurities hexachlorobenzene and dioxins/furans.

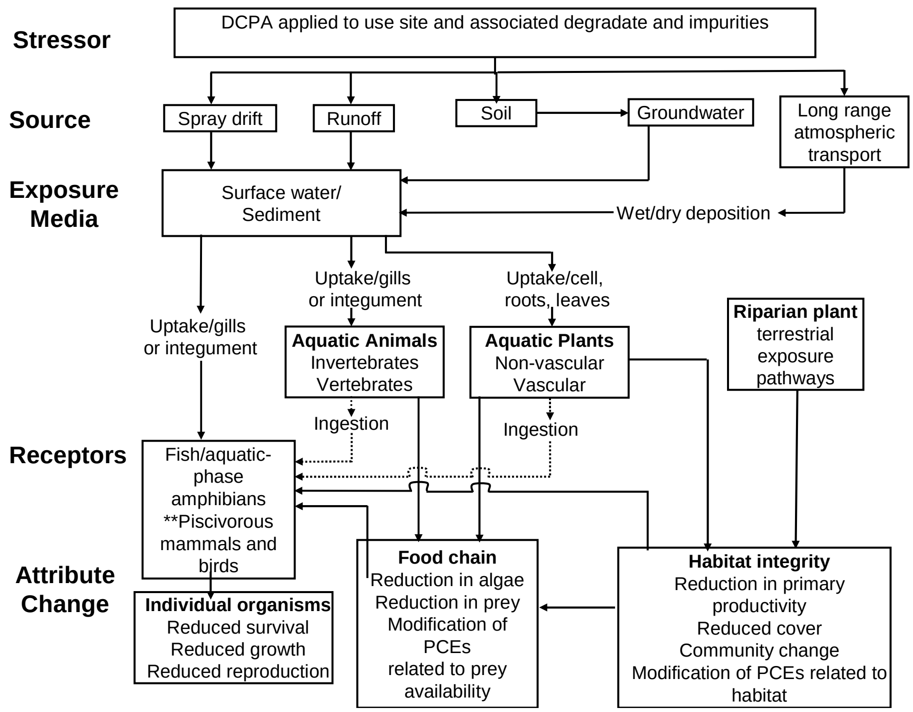


Figure 2-9. Conceptual Model for Pesticide Effects on Aquatic Phase of the CRLF

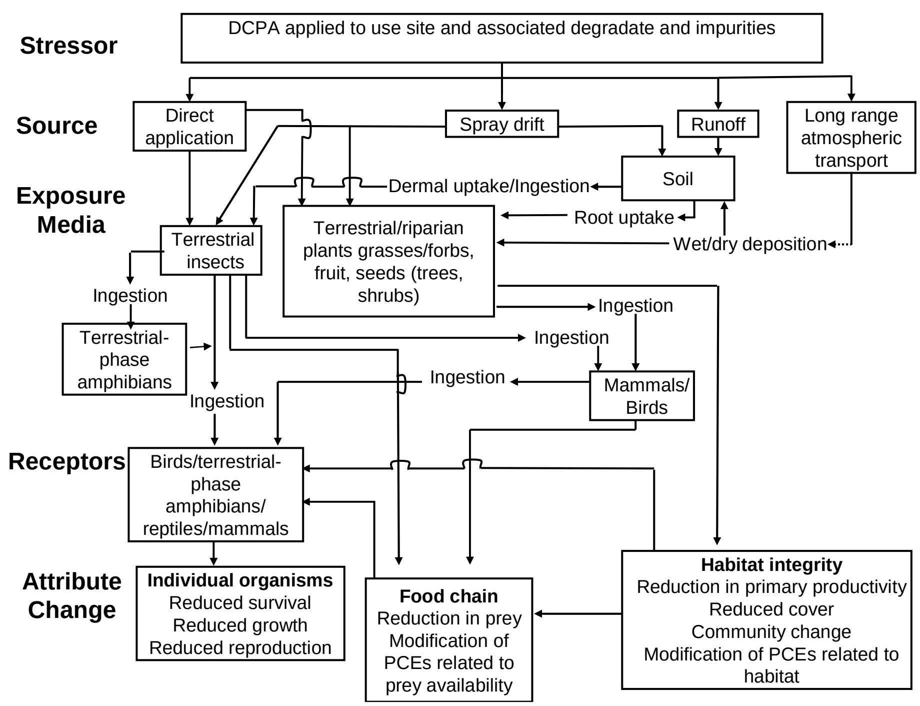


Figure 2-10. Conceptual Model for Pesticide Effects on Terrestrial Phase of the CRLF

2.10 Analysis Plan

In order to address the risk hypothesis, the potential for direct and indirect effects to the CRLF, its prey, and its habitat is estimated. In the following sections, the use, environmental fate, and ecological effects of DCPA are characterized and integrated to assess the risks. This is accomplished using a risk quotient (ratio of exposure concentration to effects concentration) approach. Although risk is often defined as the likelihood and magnitude of adverse ecological effects, the risk quotient-based approach does not provide a quantitative estimate of likelihood and/or magnitude of an adverse effect. However, as outlined in the Overview Document (U.S. EPA, 2004), the likelihood of effects to individual organisms from particular uses of DCPA is estimated using the probit dose-response slope and either the level of concern (discussed below) or actual calculated risk quotient value.

2.10.1 Measures to Evaluate the Risk Hypothesis and Conceptual Model

2.10.1.1 Measures of Exposure

The environmental fate properties of DCPA along with available monitoring data indicate that runoff and spray drift are the principle potential transport mechanisms of DCPA to the aquatic and terrestrial habitats of the CRLF. DCPA is also volatile and may travel to nearby fields in the air or to remote areas via long range transport. In this assessment, transport of DCPA through runoff and spray drift is considered in deriving quantitative estimates of DCPA exposure to CRLF, its prey and its habitats. Additionally, exposure due to deposition of DCPA in precipitation and movement of DCPA and TPA into ground water were qualitatively assessed. Bioaccumulation may occur; however, rapid depuration was observed in fish and residues measured in organisms are very low (see Section 2.4.1.3g and 3.2.4.6) (MRID 41155716, 41197602). Therefore, we do not expect bioaccumulation of DCPA to be a major exposure pathway for the red legged frog.

Measures of exposure are based on aquatic and terrestrial models that predict estimated environmental concentrations (EECs) of DCPA using maximum labeled application rates and methods of application. The models used to predict aquatic EECs are the Tier I model GENeric Estimated Environmental Concentration (GENEEC) and the Tier II Pesticide Root Zone Model coupled with the Exposure Analysis Model System (PRZM/EXAMS). The model used to predict terrestrial EECs on food items is T-REX. The model used to derive EECs relevant to terrestrial and wetland plants is TerrPlant. These models are parameterized using relevant reviewed registrant-submitted environmental fate data.

The GENEEC model uses the soil/water partition coefficient and degradation kinetic data to estimate runoff from a ten hectare field into a one hectare by two meter deep “standard” pond. This first tier is designed as a coarse screen and estimates conservative pesticide concentrations in surface water from a few basic chemical parameters and pesticide label use and application information. Tier 1 is used to screen chemicals to determine which ones potentially pose sufficient risk to warrant higher level modeling. Chemicals exceeding levels of concern with this program move on to the tier-two modeling. GENEEC is a program to calculate acute as well as longer-term EEC values. It considers reduction in dissolved pesticide concentration due to adsorption of pesticide to soil or sediment, incorporation, degradation in soil before runoff to a water body, direct deposition of spray drift into the water body, and degradation of the pesticide within the water body. It is designed to mimic a PRZM-EXAMS simulation.

PRZM (v3.12.2, May 2005) and EXAMS (v2.98.4.6, April 2005) are screening simulation models coupled with the input shell pe5.pl (Aug 2007) to generate daily exposures and 1-in-10 year EECs of DCPA that may occur in surface water bodies adjacent to application sites receiving DCPA through runoff and spray drift. PRZM simulates pesticide application, movement and transformation on an agricultural field and the resultant pesticide loadings to a receiving water body via runoff, erosion and spray drift. EXAMS simulates the fate of the pesticide and resulting concentrations in the water body. The standard scenario used for ecological pesticide assessments assumes application to a 10-hectare agricultural field that drains into an adjacent 1-hectare water body, 2-meters deep (20,000 m^3 volume) with no outlet. PRZM/EXAMS was used to estimate screening-level exposure of aquatic organisms to DCPA. The measure of exposure for aquatic species is the 1-in-10 year return peak or rolling mean concentration. The 1-in-10 year peak is used for estimating acute exposures of direct effects to the CRLF, as well as indirect effects to the CRLF through effects to potential prey items, including: algae, aquatic invertebrates, fish and frogs. The 1-in-10-year 60-day mean is used for assessing chronic exposure to the CRLF and fish and frogs serving as prey items; the 1-in-10-year 21-day mean is used for assessing chronic exposure for aquatic invertebrates, which are also potential prey items. EPI Suite (version 3.20) was also used to estimate environmental fate properties of the degradate TPA.

Exposure estimates for the terrestrial-phase CRLF and terrestrial invertebrates and mammals (serving as potential prey) assumed to be in the target area or in an area exposed to spray drift are derived using the T-REX model (version 1.3.1, 12/07/2006). This model incorporates the Kenega nomograph, as modified by Fletcher *et al.* (1994), which is based on a large set of actual field residue data. The upper limit values from the nomograph represented the 95th percentile of residue values from actual field measurements (Hoerger and Kenega, 1972). For modeling purposes, direct exposures of the CRLF to DCPA through contaminated food are estimated using the EECs for the small bird (20 g) which consumes small insects. Dietary-based and dose-based exposures of potential prey (small mammals) are assessed using the small mammal (15 g) which consumes short grass. The small bird (20g) consuming small insects and the small mammal (15g) consuming short grass are used because these categories represent the largest RQs of the size and dietary categories in T-REX that are appropriate surrogates for the CRLF and one of its prey items. Estimated exposures of terrestrial insects to DCPA are bound by using the dietary based EECs for small insects and large insects. Toxicity of TPA to terrestrial organisms is assumed to be the same as or less than that of DCPA based on effects observed in acute mammalian studies that were less severe than those observed with DCPA.

Birds are currently used as surrogates for terrestrial-phase CRLF. However, amphibians are poikilotherms (body temperature varies with environmental temperature) while birds are homeotherms (temperature is regulated, constant, and largely independent of environmental temperatures). Therefore, amphibians tend to have much lower metabolic rates and lower caloric intake requirements than birds or mammals. As a consequence, birds are likely to consume more food than amphibians on a daily dietary intake basis, assuming similar caloric content of the food items. Therefore, the use of avian food intake allometric equation as a surrogate to amphibians is likely to result in an over-estimation of exposure and risk for reptiles and terrestrial-phase amphibians. Therefore, T-REX (version 1.3.1) has been refined to the T-HERPS model (v. 1.0), which allows for an estimation of food intake for poikilotherms using the same basic procedure as T-REX to estimate avian food intake.

EECs for terrestrial plants inhabiting dry and wetland areas are derived using TerrPlant (version 1.2.2, 12/26/2006). This model uses estimates of pesticides in runoff and in spray drift to calculate EECs. EECs are based upon solubility, application rate and minimum incorporation depth.

AgDRIFT is used to assess exposures of terrestrial phase CRLF and its prey to DCPA deposited on terrestrial habitats by spray drift. In addition to the buffered area from the spray drift analysis, the downstream extent of DCPA that exceeds the LOC for the effects determination is also considered.

2.10.1.2 Measures of Effect

Data identified in Section 2.8 are used as measures of effect for direct and indirect effects to the CRLF. Data were obtained from registrant submitted studies or from literature studies identified by ECOTOX and from web based searches of the open literature. The ECOTOXicology database (ECOTOX) was searched in order to provide more ecological effects data and in an attempt to bridge existing data gaps. ECOTOX is a source for locating single chemical toxicity data for aquatic life, terrestrial plants, and wildlife. ECOTOX was created and is maintained by the U.S. EPA, Office of Research and Development, and the National Health and Environmental Effects Research Laboratory's Mid-Continent Ecology Division. The toxicity of DCPA is often limited by its solubility. The degradate TPA is persistant and potentially toxic but little to no toxicity data are available, depending on the taxa of concern. Structurally similar herbicides to TPA were identified and data were used as a surrogate as necessary. Additionally, the public ECOTOX database was searched to find supporting toxicity information for 2,3,6-trichlorobenzoic acid and dicamba. While these data were not subject to the OPP screening process, the endpoints listed in ECOTOX offer additional lines of evidence towards making an effects determination.

The assessment of risk for direct effects to the terrestrial-phase CRLF makes the assumption that toxicity of DCPA to birds is similar to or less than the toxicity to the terrestrial-phase CRLF. The same assumption is made for fish and aquatic-phase CRLF. Algae, aquatic invertebrates, fish, and amphibians represent potential prey of the CRLF in the aquatic habitat. Terrestrial invertebrates, small mammals, and terrestrial-phase amphibians represent potential prey of the CRLF in the terrestrial habitat. Aquatic, semi-aquatic, and terrestrial plants represent habitat of CRLF.

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

Toxicity data for chemicals with a similar structure to DCPA were also reviewed and incorporated into the assessment as needed depending on the completeness of the toxicity data set for DCPA. Chemicals with a similar structure include other benzoic acid herbicides. The structure of TPA is similar to benzoic acid herbicides dicamba and 2,3,6-trichlorobenzoic acid (2,3,6-TBA).

Another possible source of toxicity from the use of DCPA products are impurities that result from the manufacturing process. Both hexachlorobenzene and dioxin/furans have been found in the DCPA herbicide formulations. The risk associated with these potentially toxic impurities will be evaluated when a finding of No Effect is reached based on all other lines of evidence in an effort to be conservative with our risk estimations and account for all sources of risk.

It is important to note that the measures of effect for direct and indirect effects to the CRLF and its designated critical habitat are associated with impacts to survival, growth, and fecundity, and do not include the full suite of sublethal effects used to define the action area. According the Overview Document (U.S. EPA, 2004), the Agency relies on effects endpoints that are either direct measures of impairment of survival, growth, or fecundity or endpoints for which there is a scientifically robust, peer reviewed relationship that can quantify the impact of the measured effect endpoint on the assessment endpoints of survival, growth, and fecundity.

2.10.1.3 Integration of Exposure and Effects

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

For this endangered species assessment, listed species LOCs are used for comparing RQ values for acute and chronic exposures of DCPA directly to the CRLF. If estimated exposures directly to the CRLF of DCPA resulting from a particular use are sufficient to exceed the listed species LOC, then the effects determination for that use is "may affect". When considering indirect effects to the CRLF due to effects to animal prey (aquatic and terrestrial invertebrates, fish, frogs, and mice), the listed species LOCs are also used. If estimated exposures to CRLF prey of DCPA resulting from a particular use are sufficient to exceed the listed species LOC, then the effects determination for that use is a “may affect.” If the RQ being considered also exceeds the non-listed species acute risk LOC, then the effects determination is a LAA. If the acute RQ is between the listed species LOC and the non-listed acute risk species LOC, then further lines of evidence (*i.e*. probability of individual effects, species sensitivity distributions) are considered in distinguishing between a determination of NLAA and a LAA. When considering indirect effects to the CRLF due to effects to algae as dietary items or plants as habitat, the non-listed species LOC for plants is used because the CRLF does not have an obligate relationship with any particular aquatic and/or terrestrial plant. If the RQ being considered for a particular use exceeds the non-listed species LOC for plants, the effects determination is “may affect”. Further information on LOCs is provided in Appendix C.

2.10.2 Data Gaps

The available aquatic toxicity data for DCPA are limited. Chronic toxicity data are not available for aquatic organisms. Therefore, chronic toxicity to aquatic organisms was presumed likely because no evidence is available to suggest otherwise. The acute aquatic toxicity endpoints were not defined because no toxicity was observed at the level of DCPA’s solubility (0.5 mg/L).

The degradate, TPA, is much more soluble, relative to the parent DCPA and has been found in ground water. The presence of DCPA and MTP in surface water indicate TPA is also likely to be found in surface water. There are no available aquatic toxicity data for TPA. Use of the non-definitive endpoints for DCPA to estimate TPA toxicity does not make sense because exposure to TPA can exceed the exposure to DCPA, based on the compounds’ solubilities. As TPA is commonly found in the environment at high concentrations (see Section 3.2.4), aquatic toxicity data on TPA would greatly decrease uncertainties of this risk assessment.

A revised terrestrial plant study was requested by the Agency at publication of the RED in 1996. At the date of this effects determination, these studies have not been submitted and therefore, we will make conservative assumptions based on the existing, supplemental terrestrial plant toxicity tests.

A number of standard environmental fate studies have not been completed. Acceptable studies on the photolysis of DCPA in water, aerobic aquatic metabolism, anaerobic soil metabolism, and anaerobic aquatic metabolism have not been submitted. Additionally, anaerobic soil metabolism studies and terrestrial field dissipation studies were supplemental and the value of the information provided in the studies is limited. The photolysis data for soil indicate that DCPA is most likely stable to photolysis in water and an assumption that DCPA is stable was made. Metabolism in the aerobic aquatic environment was estimated using the aerobic soil study which was conducted under very moist conditions and at high temperatures ($30^{o}C$). DCPA was assumed to be stable to anaerobic metabolism because it is not known if an anaerobic environment was present in the submitted study. While data from terrestrial field dissipation studies do not allow the calculation of dissipation rates, they do provide some information on the degradates of concern likely to be found in the environment and on the mobility of DCPA and TPA. Any future terrestrial field dissipation study should include measurement of the volatization of DCPA. Finally, as DCPA and TPA are commonly found in surface and ground water, aquatic field dissipation studies would decrease uncertainty on the behavior of DCPA and TPA in the aquatic environment. Most importantly, this data would provide information on how the environmental fate of DCPA in the field compares to the environmental fate of DCPA and its degradates predicted by laboratory studies. For example, these studies would provide information on whether the degradates observed in the laboratory are the same degradates observed in the aquatic field environment.

A major uncertainty of this risk assessment is the short range transport of DCPA. Data indicates that DCPA will volatize and then undergo deposition on a nearby field. Under these circumstances, exposure to terrestrial organisms via inhalation could occur; however, this exposure is likely to be less than exposure with direct application of DCPA. Therefore, a separate assessment for this route of exposure was not completed.

TPA, a major degradate of DCPA, did not undergo any degradation in the aerobic soil metabolism study. It is more stable and more water soluble than DCPA and thus, higher exposure concentrations are likely. Little data are available on the environmental fate or toxicity of TPA. We assumed either similar toxicity values to the parent or similar compounds to get a preliminary estimate of risk due to exposure to TPA. However, this preliminary evaluation of risk is highly uncertain as it is based almost entirely on estimated values.

The final data gaps involve label information. The labels do not specify a maximum number of applications or a minimum application interval. Assumptions were made using the best information available for each use scenario and are fully discussed in Section 3.1.

3.0 Exposure Assessment

DCPA is formulated as flowable concentrate, wettable powder, and granular formulations. Application methods include ground application, aerial application, band treatment, and incorporated treatment. Risks from ground boom and aerial applications are expected to result in the highest off-target levels of DCPA due to generally higher spray drift levels. Ground boom and aerial modes of application tend to use lower volumes that are applied in finer sprays than applications coincident with sprayers and spreaders and thus have a higher potential for off-target movement via spray drift.

3.1 Label Application Rates and Intervals

DCPA labels may be categorized into two types: labels for manufacturing uses (including technical grade DCPA and its formulated products) and end-use products. While technical products, which contain DCPA of high purity, are not used directly in the environment, they are used to make formulated products, which can be applied in specific areas to control annual grasses and broadleaf weeds. The formulated product labels legally limit DCPA’s potential use to only those sites that are specified on the labels.

Currently registered uses of DCPA within California include uses on a variety of agricultural (vegetables, cole crops, fruit, melons, garlic, row crops, and others) and non agricultural uses (turf, ornamentals, nurseries, and residential lawns). A complete list of all uses being assessed is available in Table 3-1.

Application Rate. The maximum application rate on the labels was used to estimate exposure. When some labels had a lower maximum application rate relative to other labels, both rates were included in Table 3-1.

Type of application. DCPA may be applied at planting, transplant, post-emergence, or post-transplant and as a broadcast, foliar, layby, banded, or soil incorporated application. For example, it is recommended for use after cultivation to prevent germination of weeds. The most conservative EECs resulting from the possible types of applications were reported.

Most agricultural labels indicate that applications of DCPA in California must be banded for most crops (see EPA registration number 5481-487). Some crops also require soil incorporation (at no more than 2 inches). However, labels that allow use on all crops in home, garden, nurseries, and commercial vegetable crops allow broadcast applications (EPA registration numbers 961-273, 5481-488, 33955-474; 33955-509). Agricultural labels also allow broadcast applications to onion in California from August 1 through December 31 in Fresno, Tulare, Kern, San Bernardino, Los Angeles, Riverside, San Diego, and Imperial Counties.

Application Interval and Maximum Applied per Season. The maximum amount of DCPA applied per season was not specified on the labels for most uses. Some labels specified one application of DCPA per crop cycle for lettuce but no other labels specified a maximum number of applications for any of the crops. In modeling, the number of applications were assumed from a use report from Rick Melnicoe of the University of California to Harlod Coble of North Carolina State University and published on the web by the Western IPM Center at http://www.wripmc.org/newsalerts/dacthal03.html. The maximum number of applications per field were used as the number of applications. If the information was not available in the use report it was taken from a crop profile or assumed from that shown for similar crops. Single applications were also modeled as DCPA is often applied only once and it would thus be useful to understand risk for this scenario.

Minimum application intervals were not specified on any of the labels. A few different application intervals were assumed. A seven day application interval was assumed because it is a standard default assumption when the information is not available. Additionally, application intervals of 30 and 60 days were also assumed as these application intervals are more realistic with the long half-life of DCPA in soil and some labels recommend reapplication in two months (EPA Registration number 5481-487). The long residence time of DCPA in soil is supported by the label advisories stating, "replanting within 8 months of application may result in crop injury" (EPA Registration number 5481-487). Finally, an application interval of 183 days was assumed in the terrestrial assessment to reflect use for crops with multiple crop cycles.

Table 3-1. DCPA Uses and Application Information for the CRLF risk assessment[1]

Use Sites	Type of Application	Maximum Single Application Rate (lbs a.i./A) (Formulation)	No. of App.[2,4]	Application Interval (days)	Crops Cycles per Year[5]	App. Date[6,7]
Brassica (head and stem vegetables), Broccoli, Broccoli raab, Cabbage, Chinese Cabbage, Canola\rape, Cauliflower, Collards, Horseradish, Kale, Mustard	Aerial (G only) Ground	10.5 (WP, FlC, G)	1 to 7	7, 30, NA	1 to 3	April, May, and August through December
Canola/rape	Aerial (G only) Ground	10.5 (WP, FlC, G)	1	7	1 (assumed)	February – August, October - December
Garlic, Leek	Aerial (G only) Ground (G)	10.4 (G)	1 - 3	7	1-2	Early October
Head and Leaf Lettuce, Brussels Sprouts, Hanover Salad	Aerial (G only) Ground	10.5 (WP, FlC, G)	1	183	1-2	Mid March, Mid April, Late June and July, Early September, and November
	Ground	10.2 (WP)	1	183	1-2	
Chayote, Cucumber, Gherkin, Gourd, Chinese Gourd, Bitter Melon, Cantaloup, Honeydew, Watermelon, Musk Melon, *Mormordica* spp.[3], Pepino, Pear Melon, Summer Squash, Melon, Winter Squash, Hubbard Squash	Aerial (G only) Ground	10.5 (WP, FlC, G)	1	NA	1	Late March, Late April, October
	Aerial Ground	10.4 (G)	1	NA	1	
Onion, Green Onion, Scallions, Radish, Shallot, Taro, Ginseng, Arrowroot, Manioc, Tumeric	Aerial (restrictions)[8] Ground	10.5 (WP, FlC, G)	3-11	7	Often rotated with lettuce	Applications Throughout year
Irish Potato, Sweet Potato, Turnip, Yam, Taro, Ginseng, Arrowroot, Manioc, Tumeric	Aerial (G only) Ground	10.5 (WP, FlC, G)	3	7	1	July through December
	Ground	10.4 (G)	3	7	1	

Use Sites	Type of Application	Maximum Single Application Rate (lbs a.i./A) (Formulation)	No. of App.[2,4]	Application Interval (days)	Crops Cycles per Year[5]	App. Date[6,7]
Dried type beans, succulent beans, snap beans, southern peas, pepper	Ground	10.4 (G)	1	NA	1	February, August, and September
Strawberry	Ground	10.5 (G)	1	NA	1	
Eggplant, Groundcherry, strawberry tomato, Tomatillo, Tomato	Aerial (G only) Ground	10.5 (FlC) 9.1 (G)	1	1	1	Early August and September
Nursery Stock and ornamentals	Aerial Ground	11.4 (G) 12 (FlC, WP) 15.2 (G) 15 (FlC)	6	7	1 (assumed)	August through November
Ornamentals lawns, residential lawns, turf, ornamental sod farm, shade trees, ground cover herbaceous plants, nonflowering plants, woody shrubs and vines, golf course turf, residential lawns	Aerial Ground	11.4 (G) 15 (FlC) 15.2 (G)	6	7, 30, 60	1 (assumed)	April through July

Abbreviations: App. = application; Form. = formulation; WP = wettable powder; FlC = flowable concentrate; G = granular; a.i./A = active ingredient/acre

1- Uses assessed based on memorandum from SRRD dated November 25, 2008

2- The maximum annual or seasonal application rate, maximum number of applications, and minimum application interval was not specified for any crop except lettuce. For lettuce, head and lettuce, leaf (black seeded, simpson, salad bowl etc.) the labels specified that one application was allowed per crop cycle.

3- *Momordica* spp includes (balsam apple, balsam pear, cantaloupe, casaba, santa claus melon, Crenshaw melon, honeydew melon, honey balls, Persian melon, golden pershaw melon, mango melon, pineapple melon, and snake melon)

4- Many of the number of applications were assumed from a use report from Rick Melnicoe of the University of California to Harold Coble of North Carolina State University and published on the web by the Western IPM Center at http://www.wripmc.org/newsalerts/dacthal03.html. If the information was not available in the use report it was taken from a crop profile or assumed from that shown for similar crops.

5- Seasons per year were obtained from Memorandum from Monisha Kaul in BEAD to Melissa Panger in EFED dated 2/28/2007, unless stated otherwise.

6- Application dates were obtained by examining the CA PUR usage data and information available from crop profiles. When crops showed application throughout the year, the application date was assumed to begin at different time points.

7 Some labels (EPA Registration Numbers 5481-487 and 5481-490) allow broadcast aerial applications from August 1 through December 31 in Fresno, Tulare, Kern, San Bernardino, Los Angeles, Riverside, San Diego, and Imperial counties.

3.2 Aquatic Exposure Assessment

3.2.1 Modeling Approach

Aquatic exposures are quantitatively estimated for all assessed uses with scenarios that represent high exposure sites for DCPA use. Each of these sites represents a 10 hectare field that drains into a 1-hectare pond that is 2 meters deep and has no outlet. Exposure estimates generated using the standard pond are intended to represent a wide variety of vulnerable water bodies that occur at the top of watersheds including prairie pot holes, playa lakes, wetlands, vernal pools, man-made and natural ponds, and intermittent and first-order streams. As a group, there are factors that make these water bodies more or less vulnerable than the standard surrogate pond. Static water bodies that have larger ratios of drainage area to water body volume would be expected to have higher peak EECs than the standard pond. These water bodies will be either shallower or have large drainage areas (or both). Shallow water bodies tend to have limited additional storage capacity, and thus, tend to overflow and carry pesticide in the discharge whereas the standard pond has no discharge. As watershed size increases beyond 10 hectares, at some point, it becomes unlikely that the entire watershed is planted to a single crop, which is all treated with the pesticide. Headwater streams can also have peak concentrations higher than the standard pond, but they tend to persist for only short periods of time and are then carried downstream.

Crop-specific management practices for all of the assessed uses of DCPA were used for modeling, including application rates, number of applications per year, application intervals, and the first application date for each crop. The date of first application was developed based on several sources of information including data provided by BEAD, a summary of individual applications from the CDPR PUR data, and Crop Profiles maintained by the USDA. A sample of the distribution of DCPA applications to broccoli from the CDPR PUR data for 2006 used to pick application dates is shown in Figure 3-1. Similar tables for the different uses reported in the CDPR PUR database are available in Appendix C. The figure indicates that DCPA could be applied to broccoli at any time of the year. Therefore, application dates were chosen to coincide with the time of year with the highest rainfall.

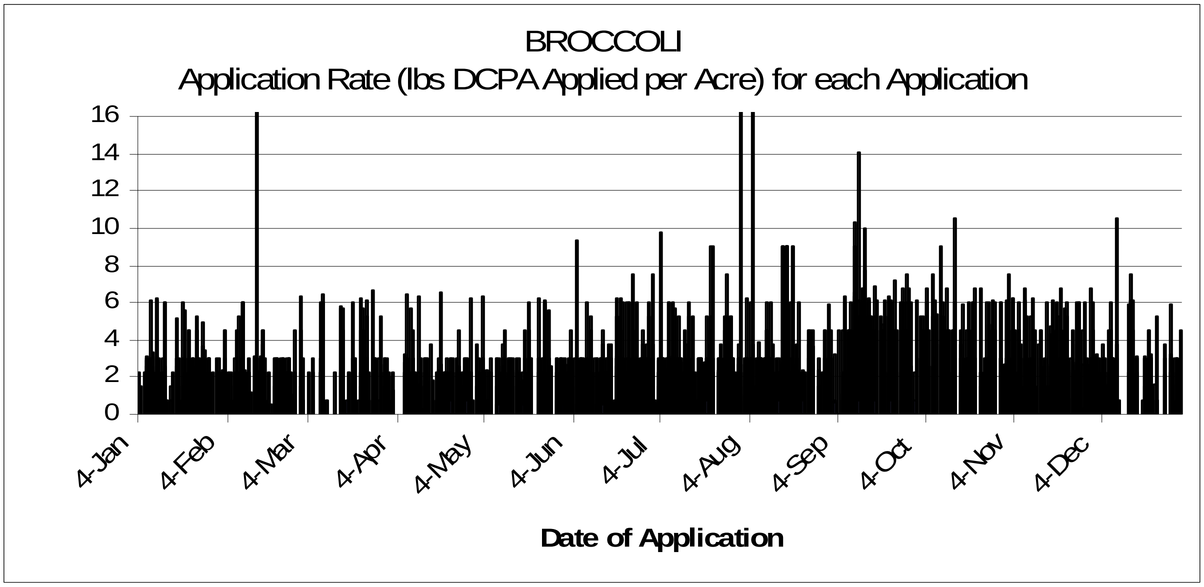


Figure 3-1. Summary of Applications of DCPA to Broccoli in 2006 from CDPR PUR data.

More detail on the crop profiles and the previous assessments may be found at:

http://www.ipmcenters.org/cropprofiles/

3.2.2 Model Inputs

The appropriate GENEEC, PRZM, and EXAMS input parameters for DCPA and related compounds were selected from the environmental fate data submitted by the registrant and in accordance with US EPA-OPP EFED water model parameter selection guidelines, *Guidance for Selecting Input Parameters in Modeling the Environmental Fate and Transport of Pesticides*, Version II, February 28, 2002 and *PE5 User's Manual. (P)RZM (E)XAMS Model Shell*, *Version (5).*, November 15, 2006. Input parameters can be grouped by physico-chemical properties and environmental fate data, application information, and use scenarios.

Physical and chemical properties relevant to assess the behavior of DCPA and related compounds in the environment are presented in Table 2-2 and application information from the label in Table 2-8 and Table 3-1. The input parameters for PRZM and EXAMS are in Table 3-2. The input parameters for GENEEC are shown in Table 3-3. Appendix E contains example model output files and tables showing the data used to calculate input values.

Table 3-2. Summary of PRZM/EZAMS Environmental Fate Inputs Used to Estimate Aquatic Exposure to DCPA and TPA

Fate Property	DCPA Value	TPA Value	MRID (or source)
Molecular Weight	331.97 g/mole	303.91 g/mole	U.S. EPA, 1998b

Fate Property	DCPA Value	TPA Value	MRID (or source)
Henry's constant	2.2×10^{-6} atm-m^3/mole	6.58×10^{-13} atm-m^3/mole (EPI Suite)	U.S. EPA, 1998b and EPI Suite
Vapor Pressure	2.5×10^{-6} torr	4.89×10^{-8} mm Hg (EPI Suite)	U.S. EPA, 1998b and EPI Suite v3.12
Solubility in Water	5.0 mg/L	57,800 mg/L	The value is the water solubility times 10. Water solubilities were reported in U.S. EPA, 1998b and Wettasinghe and Tinsley, 1993.
Photolysis in Water	0 (Stable)	0 (Stable)	MRID 143063, 41508607
Aerobic Soil Metabolism Half-lives	60 days	0 (Stable)	MRID 00114649, 41648801, 00114652. 90% upper confidence bound of the mean of 6 half-lives for DCPA with unextractables (see Appendix E). TPA was stable in all soils.
Hydrolysis	0 (Stable)	0 (Stable)	MRID 00114648
Aerobic Aquatic Metabolism (water column)	120 days	0 (Stable)	No data were available. The value was calculated as 2 x the aerobic soil metabolism half-life
Anaerobic Aquatic Metabolism (benthic)	0 (Stable)	0 (Stable)	No reliable data were available as the reported half-lives were based on three data points and were similar to aerobic degradation rates. Stability was assumed per Guidance document[1].
Organic-carbon water partition coefficient (K_{OC}, L/kg OC) or Solid-water distribution coefficient (Kd, L/kg soil)	K_{OC} = 2627 L/kg	K_d = 4 L/kg	Average K_{OC} value for DCPA was from MRID 43661101. The value for TPA was the lowest nonsand K_d value measured in finely sieved soils (MRID 41648805).
Application rate and frequency	See Table 3-1	DCPA application rate x 0.91	Calculated from lbs a.i./A using the following equation: (lbs a.i./A) x (1 kg/2.205 lbs) x (2.47 A/hectare)=kg a.i./ha. TPA rate converted from DCPA application rate by multiplying by 0.91 (TPA Molecular weight/DCPA molecular weight)
Chemical Application Method (CAM)	1 for surface applied 2 for foliar applied	1 for surface applied 2 for foliar applied	Determined by label instructions. When DCPA could be applied to soil or foliage, foliar application was assumed because this is the most conservative assumption.
Application Efficiency	0.95 for aerial 0.99 for ground 0.99 for granular	0.95 for aerial 0.99 for ground 0.99 for granular	The application efficiency for granular formulations is not specified in the input parameter guidance. This value was assumed.
Spray Drift Fraction	0.05 for aerial 0.01 for ground 0 for granular formulations	0.05 for aerial 0.01 for ground 0 for granular formulations	The spray drift fraction for granular formulations is not specified in the input parameter guidance. This value was assumed.

Fate Property	DCPA Value	TPA Value	MRID (or source)
Incorporation Depth	0 and 4 cm	0 and 4 cm	Based on label instructions. Applications with soil incorporation are sometimes recommended. However, broadcast applications are allowed and were modeled as this application is expected to result in higher EECs.
Post-harvest foliar pesticide disposition IPSCND	1 for surface applied	1 for surface applied	Guidance document[1]

1 – Inputs determined in accordance with EFED "Guidance for Chemistry and Management Practice Input Parameters for Use in Modeling the Environmental Fate and Transport of Pesticides" dated February 28, 2002.
2 – A value of 0 was used for input for the soil incorporation depth for both CAM 1 and CAM 2. CAM 1 has a default soil incorporation depth of 4 cm.

Table 3-3. Summary of GENEEC Inputs Used to Estimate Aquatic Exposure to TPA

Fate Property	TPA Value	MRID (or source)
Aerobic Soil Metabolism Half-life	0 (Stable)	MRID 00114649, 41648801, 00114652. TPA was stable in all soils.
Wetted In?	No	Labels
Method of Application	A = Aerial B = Ground D = Granular	Label
Droplet Size Distribution	Fine to Medium	EFED Default value
Spray Zone	None (0)	Label
Solubility in Water	5,780 mg/L	Wettasinghe and Tinsley, 1993
Aerobic Aquatic Metabolism (water column)	0 (Stable)	No data
Photolysis in Water	0 (Stable)	No data
Hydrolysis	0 (Stable)	No data
Organic-carbon water partition coefficient (K_{OC}, L/kg OC) or Solid-water distribution coefficient (Kd, L/kg soil)	K_d = 4 L/kg	The value is the lowest nonsand K_d value measured in finely sieved soils (MRID 41648805).
Application rate and frequency	DCPA application rate x 0.91	TPA rate converted from DCPA application rate by multiplying by 0.91 (TPA Molecular weight/DCPA molecular weight)

Scenarios are used to input soil, climatic, and agronomic data into PRZM/EXAMS and are designed to result in a high-end exposure estimate for a particular crop or pesticide within a geographic region. Each PRZM scenario is specific to a location. Soil and agronomic data specific to the location are available in the scenario and a specific climatic weather station providing 30 years of daily weather values is associated with that location. Applications may occur outside of the time the crop is planted; however, this should not affect results as DCPA may be applied as a soil or foliar application and before, during, or after planting. Table 3-4 identifies the use sites associated with each PRZM scenario and Table 3-5 specifies the location, soil type, curve number, and time of year with the most rainfall for each PRZM scenario. The scenarios that included irrigation were the scenario for onions and tomato.

Table 3-4. Summary of Use Sites Associated with Each PRZM Scenario

PRZM Scenario	Use Sites
CA Cole Crop RLF_V2	Broccoli, Cabbage, Chinese Cabbage, Cauliflower, Collards, Horseradish, Kale, Mustard
CA Garlic RLF_V2	Garlic, Leek
CA Lettuce STD	Lettuce, head and leaf, Brussels Sprouts
CA Melons RLF_V2	Chayote, Cucumber, Gherkin, Gourd, Chinese Gourd, Bitter Melon, Cantaloupe, Honeydew, Watermelon, Musk Melon, *Mormordica* spp. Pepino, Pear Melon, Squash
CA Onion WirrigSTD	Onion, Green Onion, Scallions, Radish, Shallot, Taro, Ginseng, Arrowroot, Manioc, Tumeric
CA Potato RLF V2	Irish Potato, Sweet Potato, Turnip, Yam, Taro, Ginseng, Arrowroot, Manioc, Tumeric
CA Row Crop RLF V2	Dried type beans, Succulent Beans, Snap Beans, Southern Peas, Pepper
CA Strawberry-no plasticRLF V2	Strawberry
CA Tomato Wirrig STD	Eggplant, Groundcherry, Strawberry Tomato, Tomatillo, Tomato
CAnurserySTD_V2	Nursery Stock and Ornamentals
CAwheatRLF _V2	Canola\rape
CA Residential RLF and CA Turf RLF	Ornamentals lawns, Residential Lawns, Turf, Ornamental Sod Farm, Shade Trees, Ground Cover Herbaceous Plants, Nonflowering Plants, Woody Shrubs and Vines, Golf Course Turf, Residential Lawns

Table 3-5. Characteristics of PRZM/EXAMS Scenarios Used to Estimate Concentrations of DCPA in the Aquatic Environment.[1]

Modeling Scenario	Location Modeled	Soil	Hydrologic Group of Soil (SCS Curve Number)	Most Rainfall occurs in (average annual precipitation)
CA Cole Crop RLF_V2	Central California Coast/Coastal Valleys Range (Monterey County)	Marimel Series, Silty Clay Loam	C (92, 88, 89)	November – March (14.01 inches)
CA Garlic RLF_V2	Fresno and Kern Counties located within the San Joaquin Valley	Cerini Series	C (91, 87, 88)	January – March (11.23 inches)
CA Lettuce STD	Near Salinas in Monterey	Placentia	D (94, 89, 94)	November – March

Modeling Scenario	Location Modeled	Soil	Hydrologic Group of Soil (SCS Curve Number)	Most Rainfall occurs in (average annual precipitation)
	County	Series, Sandy loam		(14.01 inches)
CA Melons RLF_V2	Southern San Joaquin Valley (*primarily Fresno County*)	Cerini Series	C (91, 87, 88)	January – March (11.23 inches)
CA Onion WirrigSTD	Kern County in the San Joaquin Valley	Cievo Clay	D (92, 85, 86)	October - April (6.49 inches)
CA Potato RLF V2	Kern County	Lewkalb Series, Coarse-loamy mix	C (86, 81, 85)	October - April (6.49 inches)
CA Row Crop RLF V2	Central California Coast/Coastal Valleys Range	Mocho Series, fine-loamy mix	B (86, 78, 82)	November – March (14.01 inches)
CA Strawberry-no plasticRLF V2	Santa Maria Valley region	Oceano Series	A (92, 89, 90)	November – March (14.01 inches)
CA Tomato Wirrig STD	San Joaquin County	Stockton clay	D (91, 87, 88)	January – March (11.23 inches)
CAnurserySTD_V2	San Diego County, CA	Cieneba Series. Sandy Loam	C (82, 82, 87)	November – March (10.8 inches)
CAwheatRLF_V2	San Joaquin Valley	Abruptic Durixeralfs	D (92, 89, 90)	January – March (11.23 inches)
CA Residential RLF	San Franscisco Bay Area	Tierra series	D (83, 83, 83)	January - March (20.11 inches)
CA Turf RLF	Central/northern California	Capay Series,	D (80, 80, 80)	January - March (20.11 inches)

1- Information on the scenarios was obtained from *Pesticide Root Zone Model Field and Orchard Crop Scenario Metadata (*April 5, 2006) and Metatdata files for RLF Scenarios.

3.2.3 Results

The aquatic DCPA EECs were estimated for cole crops, onions, nursery, wheat, and turf scenarios. These scenarios show the range of expected aquatic EECs and also show the results for the crops with high DCPA usage based on the CA PUR data. As no definitive DCPA toxicity endpoints were available, EECs were not determined for all scenarios. DCPA peak EECs ranged from 37 - 500 μg/L (Table 3-6).

Table 3-6. Aquatic Estimated Environmental Concentrations (EECs) for DCPA (µg/L) (Estimated Using PRZM/EXAMs)

Scenario (Formulation; type of app.)	App. Rate lbs a.i./A	Date of First App. (Day-Month)	Use Represented	# of App.	App. Interval (days)	Estimated Environmental Concentration (µg/L)		
						Peak	21-Day	60-Day
CA Cole Crop RLF_V2 (WP, FlC; Ground)	10.5	01-01	Broccoli, Cabbage, Chinese Cabbage, Cauliflower, Collards, Horseradish, Kale, Mustard	7	7	303	240	204
		01-01		3	30	97	83	72
		01-01		1	NA	53	44	38
CA Cole Crop RLF_V2 (G; aerial and ground)	10.5	01-01		7	7	50	41	35
CA Wheat RLF_V2 (WP, FlC; Ground)	10.5	01-02	Canola/rape	1	NA	84	64	47
CA Onion WirrigSTD (WP, FlC; aerial)	10.5	15-10	Onion, Green Onion, Scallions, Radish, Shallot, Taro, Ginseng, Arrowroot, Manioc, Tumeric	11	7	274	226	190
	10.5	15-10		1	1	37	26	20
CA Onion WirrigSTD (WP, FlC; ground)	10.5	15-10		11	7	147	96	74
CA Onion WirrigSTD (G; aerial and ground)	10.5	15-10		11	7	114	63	49
CA NurserySTD V2 (FlC; aerial)	15.0	15-10	Nursery Stock and ornamentals	6	7	500*	452	360
CA NurserySTD V2 (FlC; ground)	15.0	15-10		6	7	463	359	279
CA Turf RLF (FlC, aerial)	15.0	01-07	Turf and Sod Farms	6	7	170	143	121
CA Turf RLF (FlC, ground)	15.0	01-07		6	7	39	34	30

Abbreviations: G=Granular; WP = wettable powder; FlC = flowable concentrate; App.= application
*PRZM/EXAMS estimated an EEC above the solubility of DCPA. Therefore, the EEC was reported as the solubility of DCPA.

Table 3-7 shows estimated EECs of TPA for some representative uses using GENEEC version 2.0. The only measured physico-chemical properties available for TPA were the K_d and water solubility. Other properties were estimated using EPI-Suite version 3.20. Also, the only data available on the stability of TPA were from the DCPA degradation studies. Thus, data are only available in the studies where DCPA degraded, *e.g.* aerobic soil metabolism and anaerobic soil metabolism. In both of these studies, no degradation of TPA was observed, indicating that the assumed stability may not be overly conservative. However, it is possible that degradation could be enhanced with photolysis. It was assumed that all DCPA was applied as TPA in the EEC estimation. This is also not overly conservative, as virtually all DCPA measured on day zero in aerobic soil metabolism studies was present as TPA at the end of the study. GENEEC peak EECs ranged from 0.34 - 4.07 mg/L and were much higher than DCPA EECs (Table 3-6).

Table 3-7. Preliminary Estimate of Aquatic EECs for TPA Based on Estimated Physico-chemical Properties and GENEEC

Use	Formulation	Ground or Aerial	DCPA App. Rate (TPA App. Rate) lbs a.i./A	# of App.	App. Interval (days)	Estimated Environmental Concentration (EEC) in mg/L		
						Peak	21-Day	60-Day
Turf, Nursery, and Ornamentals	G	Ground or Aerial	15.2 (13.8)	6	7	2.96	2.92	2.85
	FlC or WP	Aerial	15 (14)	6	7	3.42	3.38	3.3
	FlC or WP	Ground	15 (14)	6	7	3.24	3.2	3.12
	FlC or WP	Aerial	15 (14)	1.0	NA	0.57	0.56	0.55
	G	Aerial or Ground	11.4 (10.4)	6	7	2.2	2.17	2.12
Nursery and ornamentals	FlC or WP	Aerial	12 (11)	6	7	2.69	2.65	2.59
	FlC or WP	Ground	12 (11)	6	7	2.54	2.51	2.45
All Food Crops[1,2]	WP or FlC	Ground	10.5 (9.6)	1.	NA	0.37	0.37	0.36
	G	Aerial or Ground	10.5 (9.6)	1	NA	0.34	0.33	0.33
	FlC or WP	Ground	10.5 (9.6)	2	7	0.74	0.73	0.71
	FlC or WP	Ground	10.5 (9.6)	3	7	1.11	1.1	1.07
	FlC or WP	Ground	10.5 (9.6)	4	7	1.48	1.46	1.4
	FlC or WP	Ground	10.5 (9.6)	5	7	1.85	1.83	1.78
	FlC or WP	Ground	10.5 (9.6)	6	7	2.22	2.19	2.14
	FlC or WP	Ground	10.5 (9.6)	7	7	2.59	2.56	2.5
	FlC or WP	Ground	10.5 (9.6)	8	7	2.96	2.92	2.85
	FlC or WP	Ground	10.5 (9.6)	9	7	3.33	3.29	3.21
	FlC or WP	Ground	10.5 (9.6)	10	7	3.7	3.65	3.57
	FlC or WP	Ground	10.5 (9.6)	11	7	4.07	4.02	3.93
	G	Aerial or Ground	10.5 (9.6)	11	7	3.72	3.67	3.58

Abbreviations: WP=Wettable powder; FlC = flowable concentrate; G=Granular; App.= application

1- All food uses except garlic have a 10.5 lb a.i./A application rate. Garlic's application rate is 10.4 and is close enough to 10.5 to also be represented by this rate. See Table 3-1 for a list of food crops and application rates.

2- All food crops could have more than one application as a maximum number of applications is not specified on any of the labels.

Typically, if RQs estimated using the EECs generated from GENEEC exceed LOCs, PRZM/EXAMs is used to refine the exposure estimate. GENEEC peak TPA EECs could result in LOC exceedances for non-vascular aquatic plants for all uses. Therefore, PRZM/EXAMS was used to estimate the EECs for TPA (Table 3-8). Estimated TPA concentrations using PRZM/EXAMs were greater than those estimated using GENEEC. For example, granular applications to cole crops with seven applications resulted in a TPA peak EEC of 22.4 mg/L while the same scenario for TPA using GENEEC resulted in an estimated EEC of 2.59 mg/L. GENEEC is simpler than PRZM/ EXAMS models in its treatment of hydrology. The linked PRZM/EXAMS models simulate the impact of daily weather on the treated agricultural field over a period of thirty years. During this time, pesticide is washed-off of the field into the water-body by twenty to forty rainfall/runoff events per year. Each new addition of pesticide to the water-body adds to the pesticide which has arrived earlier either through previous runoff events or through spray-drift and begins degrading on the day it reaches the water. GENEEC, on the other hand, is a single event model. It assumes one single large rainfall/runoff event occurs that removes a large quantity of pesticide from the field to the water all at one time. Longer-term, multiple-day average concentration values are calculated based on the peak day value and subsequent values considering degradation processes. So PRZM/EXAMs allows for accumulation of pesticides in the pond with year after year applications while GENEEC does not. As TPA was assumed to be stable under all conditions, none of the TPA in the pond was lost in the PRZM/EXAMS model. This may result in a very high estimate of EECs because some loss of TPA is expected due to burial of sediment , overflow of the pond during heavy runoff events, and other processes that would result in dilution (for instance, when fresh rain falls in the pond), flushing of excess chemical and turnover of the water in the pond. Additionally, because of this accumulation the generated EECs do not represent a 1 in 10 year value but a maximum value if TPA were applied every year to the same plot with the same amounts for 30 years with none of the TPA entering the pond being lost. This is illustrated in Figure 3-2, which shows the estimated TPA EECs increase every year in a manner that is not likely to occur in nature. For this reason, RQs were calculated using the results from GENEEC. These RQs could underestimate risk in some cases where DCPA is applied frequently and yearly over many years. The results from PRZM/EXAMS are shown in Table 3-8.

Table 3-8. Preliminary Estimate of Aquatic EECs for TPA After 30 Years of DCPA Applications to the Same Location (Based on Estimated Physico-chemical Properties and PRZM/EXAMS).

Scenario (Formulation; type of app.)	DCPA App. Rate lbs a.i./A	Date of First App. (Day-Month)	Use Represented	# of App.	App. Interval (days)	Estimated Environmental Concentration (mg/L)		
						Peak	21-Day	60-Day
CA Cole Crop RLF_V2 (G; aerial and ground)	10.5	01-01	Broccoli, Cabbage, Chinese Cabbage, Cauliflower, Collards, Horseradish, Kale, Mustard	7	7	22.24	22.24	22.24
		01-01		3	30	8.77	8.76	8.75
		01-01		1	NA	3.09	3.09	3.09
CA Cole Crop RLF_V2 (WP, FlC; Ground)	10.5	01-01		7	7	23.14	23.14	23.14
CA	15.0	15-10	Nursery and	6	7	15.96	15.95	15.85

NurserySTD V2 (FlC; aerial)								
CA NurserySTD V2 (FlC; ground)	15.0	15-10	ornamentals	6	7	11.87	11.87	11.77
CA NurserySTD V2 (G; aerial and ground)	15.0	01-08		6	30	9.48	9.45	9.39

Abbreviations: G=Granular; WP = wettable powder; FlC = flowable concentrate; App.= application

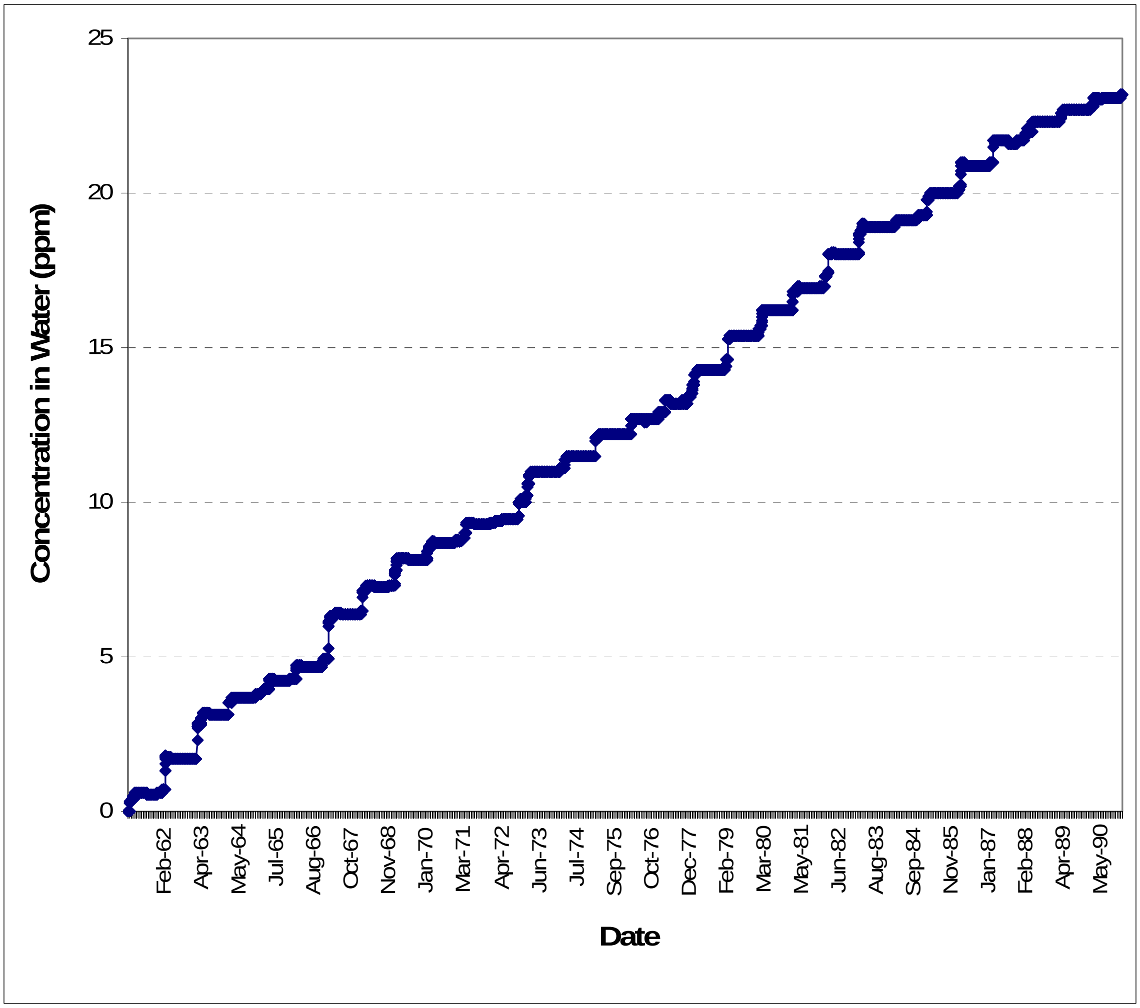


Figure 3-2. PRZM/EXAMS EECs for TPA by Year for Seven Granular Applications of DCPA to Cole Crops with the First Application on January 1st and a seven day application interval.

3.2.4 Existing Monitoring Data

There are a large number of studies and data available on DCPA and degradate residues in air, surface water, drinking water, ground water, tissue, rain, and snow. No prospective surface water monitoring studies which specifically targeted DCPA use (application period and/or sites) were available for analysis as part of this assessment. Two prospective ground water monitoring studies were conducted in support of the reregistration of DCPA, including one in California. Generally, targeted monitoring data are collected with a sampling program designed to capture, both spatially and temporally, the maximum use of a particular pesticide. Typically, sampling frequencies employed in monitoring studies are insufficient to document peak exposure values. The lack of targeted data coupled with the fact that these data are not temporally or spatially correlated with pesticide application times and/or areas limit the utility of these data in estimating exposure concentrations for risk assessment purposes. Therefore, model-generated values are used for estimating acute and chronic exposure values, and the non-targeted monitoring data are typically used for qualitative characterizations. Included in this assessment are DCPA summaries of studies available from the open literature, data from the USGS NAWQA program (http://water.usgs.gov/nawqa), and data from the California Department of Pesticide Regulation (CDPR).

The most recent review of monitoring data was completed in May 2008, see *Health Effects Support Document for Dacthal Degradates: Tetrachloroterephthalic acid (TPA) and Monomethyl Tetrachloroterephthalic Acid (MTP)* (U.S. EPA, 2008a). This assessment examined monitoring data relevant to drinking water, food, fish, shellfish, air, and soil. We did not repeat this complete analysis but summarized some open literatures studies and monitoring data. The major conclusions resulting from the previous assessments are outlined below.

- Monitoring data indicate widespread occurrence of DCPA in surface water, ground water, drinking water, and air. DCPA and TPA are one of the most commonly found pesticides/degradates found in water samples (U.S. EPA, 2008a). DCPA is typically detected at low concentrations in remote areas where it is not used and at higher concentrations near where it is used. DCPA concentrations in water are typically well below the lifetime Health Advisory of 4000 µg/L for DCPA (U.S. EPA, 2008a). Additionally, the solubility of DCPA (0.5 mg/L) is well below the advisory level.
- Non-agricultural uses of DCPA, *e.g.* use in urban areas, can be a significant source of DCPA in water. Higher frequencies of DCPA detections occurred in urban areas in the midwest and higher frequencies of detection were reported in some urban areas in NAWQA surface water samples (Kolpin *et al*., 1996; U.S. EPA, 2008a)
- DCPA's degradates, TPA and MTP are more commonly detected in ground water samples than DCPA. TPA is typically found at higher concentrations.
- TPA was the most commonly detected pesticide in the National Survey of Pesticides in Drinking Water Wells Survey (U.S. EPA, 1998b).
- Degradation rates are slower at lower temperatures and DCPA residues are commonly detected in cooler states. The re-registration eligibility decision for DCPA stated, "Seventeen states with DCPA residue detections could be classified as states with cooler temperatures (AK, CT, IA, IL, IN, MA, MI, MNH, NH, NJ, NY, OH, OR, PA , RI, SD, and WI). States considered "warm" states with detections were California, Colorado, and New Mexico." (U.S. EPA, 1998b)
- Food was the major source of exposure to DCPA for humans (U.S. EPA, 2008a).

3.2.4.1 Surface Water Monitoring Results

DCPA and MTP have been found in surface water samples throughout the United States, including in California. The maximum reported concentration of DCPA was 100 µg/L and the maximum reported concentration of MTP was 1.2 µg/L (Table 3-9). While sampling has not been conducting examining the occurrence of TPA in surface water, the presence of DCPA and MTP indicate it would be found in surface water samples.

National Water-Quality Assessment Program (NAWQA) Database. Surface water monitoring data from the United States Geological Survey (USGS) NAWQA program were obtained on December 16, 2008. A total of 25,858 water samples across various sites throughout the US were analyzed for DCPA. There were 1,461 detections of DCPA in the United States and concentrations ranged from 0.0012 to 100 µg/L. Sites with detections were classified as agricultural land use (490 sites), mixed land use (463 sites), urban (302 sites), cropland (50 sites), residential (39 sites), forest (two sites), pasture (1 site), rangeland (1 site), and other (112 sites). In California, there were detections in 20% of samples (431 of 2123) collected at 33 sites located in 9 counties (Merced, Orange, Riverside, Sacramento, San Bernardino, San Joaquin, Stanislaus, Sutter, and Yolo) between April 1992 and April 2007. In California, measured concentrations ranged from 0.002 - 0.7 µg/L. The highest concentrations were detected in urban, agricultural, and mixed land use sites. The long term method detection level is 0.002 µg/L (Gilliom *et al.*, 2007).

A total of 7,362 water samples across various sites throughout the US were analyzed for MTP. Of these samples, 11 had positive detections with estimated concentrations ranging from 0.04 to 1.2 µg/L. Reporting limits ranged from 0.0116 - 0.237 µg/L. Detections of MTP occurred at agricultural, cropland, and mixed land use sites. The long term method detection level is 0.04 µg/L (Gilliom *et al*., 2007).

National Stream Quality Accounting Network (NASQAN) Statistical Summaries (1996-2005) available at http://water.usgs.gov/nasqan/data/statsumtxt.html.[18] The USGS monitored residues of 47 common water-soluble pesticides in rivers in the United States. DCPA was detected in 17% of samples (323 out of 1931) with a maximum concentration of 0.59 µg/L. The highest concentrations were measured in the Rio Grande Basin-Arroyo Colorado at Harlingen, TX (Station Number 0847040). The stations with greater than 50% detection frequencies included the St. Lawrence River (near NY, 77% of samples), Colorado River near Hoover Dam (AZ, NV, 76% of samples), Colorado River at Diamond Creek (AZ, 70% of samples), Colorado River near Cisco (UT, 56% of samples), and Arroyo Colorado (TX, 54% of samples). Figure 3-3 shows the areas percentage of water samples where DCPA was detected above the reporting limit (0.002 µg/L). The highest frequencies of detection occurred in the Western United States.

[18] NASQAN data is also in the NAWQA data. It is presented here as it reflects detections in rivers and streams. The NAWQA data reflects data in all surface waters.

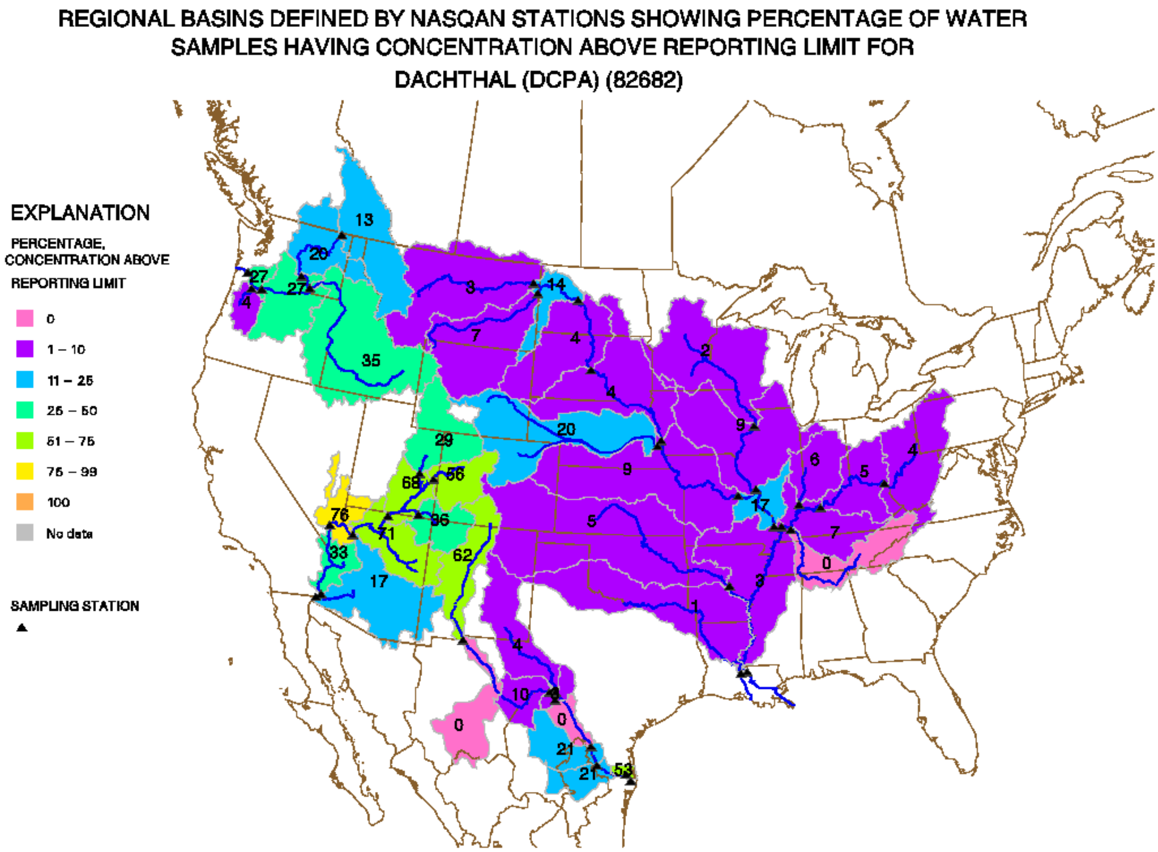


Figure 3-3. Percentage of water samples having concentrations above the reporting limit (0.002 μg/L) for DCPA in various regional basins measured in the USGS National Stream Quality Accounting Network (NASQAN), based on data collected between 1996-2000. Downloaded from http://pubs.usgs.gov/wri/wri014255/results/detect/pd82682.png

California Department of Pesticide Regulation (CDPR Database). CDPR maintains a database of monitoring data of pesticides in CA surface waters. Data are available from 1990-2005 for 27 counties for several pesticides and degradates. The sampled water bodies include rivers, creeks, urban streams, agricultural drains, the San Francisco Bay delta region and storm water runoff from urban areas. The database contains data from 51 different studies by federal, state and local agencies as well as groups from private industry and environmental interests. Some data reported in this database are also reported by USGS in NAWQA; therefore, there is some overlap between these two data sets. Unlike NAWQA data, the land use (*e.g.* agriculture, urban) associated with the watershed of the sampled surface waters is not defined in the CDPR database; therefore, the available data do not allow for a link of the general use pattern and the individual data.

Surface water monitoring data were obtained from the California Department of Pesticide regulation (CDPR) and all data with analysis for chlorthal dimethyl were extracted. A total of 2117 water samples were analyzed for DCPA. There were 326 detections (15% detection frequency), ranging from 0.002 and 5.2 µg/L. Detections of DCPA were reported from Imperial, Merced, Orange, Riverside, Sacramento, San Bernardino, San Joaquin, Stanislaus, and Yolo counties. Samples with detections were collected between April 1992 and May 2003. The limit of quantitation ranged from 0.0001 – 0.063 µg/L.

Muir *et al.* 2004. Muir *et al.* (2004) measured concentrations of 27 current-use pesticides in 30 lakes in Canada and the Northeastern United States between 1998-2001. The sites were located in arctic, sub-arctic, remote mid latitudes, and in agricultural areas. DCPA, a minor use pesticide in the United States and not used in Canada, was the only pesticide detected in all lakes at levels below ng/L concentrations. Concentrations declined with latitude. Half-distances were calculated based on the slope of the log water concentrations versus latitude. DCPA had the highest estimated half-distance of 18.21±507 km.

Table 3-9. Summary of Surface Water Monitoring Studies for DCPA and Its Metabolites

Location	Mean Concentration (µg/L)	Maximum Concentration (µg/L)	Frequency of Detections	Limit of Det. (µg/L)	Date	Source
United States	NR	100	6%	0.002	1992-2007	NAWQA
California	NR	0.7	20	0.002	1992-2007	NAWQA
California	NR	5.2	15%	0.0001-0.063	1992-2003	CADPR
Lakes near agricultural areas	0.21	0.27	100%	NR	1998-2001	Muir *et al*., 2004
Remote mid-latitude lakes	0.11	0.26	100%	NR	NR	Muir *et al*., 2004
Sub-arctic lakes	0.05	0.11	100%	NR	NR	Muir *et al*., 2004
Arctic lakes	0.03	0.07	100%	NR	NR	Muir *et al*., 2004
San Joaquin River and Tributaries, CA	0.26	1.14	80%	0.001	1992	Pereira *et al*., 1996

Abbreviations: NR= not reported; Det.=detection detection or reporting limit

3.2.4.2 Comparison of Water Monitoring Data and Modeled Aquatic EECs

Overall, modeled concentrations were similar to (within a factor of 10) measured concentrations of DCPA. Modeled aquatic concentrations of DCPA in surface water ranged from 20 to 500 µg/L (Table 3-6). The maximum DCPA concentration measured in surface water was 100 µg/L (Table 3-9). The monitoring results are near levels measured in monitoring studies which were not targeted monitoring data. NAWQA and CADPR studies monitor MTP and not TPA and data on surface water were not available for TPA.

3.2.4.3 Ground Water Monitoring Results

DCPA, MTP, and TPA have been found in ground water samples throughout the United States, including in California. The maximum reported concentrations of DCPA, MTP, and TPA in ground water were 986, 1.1, and 3081 μg/L, respectively (Table 3-10), although maximum detections in California were orders of magnitude lower.

NAWQA Database. Ground water monitoring data from the United States Geological Survey (USGS) NAWQA program were obtained on December 16, 2008. The frequency of detection was 0.2% for DCPA (20 detections out of 10,728 samples) in the United States and British Columbia and concentrations ranged from 0.002 to 0.011 μg/L. Sites with detections were classified as agricultural land use (2 sites), mixed land use (5 sites), Orchard/Vineyard (4 sites), cropland (2 sites), and other (7 sites). In California, there were detections in 0.54% of samples (4 of 747) taken Fresno county between September 1993 and September 1994. In California, measured concentrations ranged from 0.002 - 0.004 μg/L. The highest concentrations were detected in site designated as Orchard/Vineyard sites. The long term method detection level is 0.002 μg/L (Gilliom *et al.*, 2007).

A total of 6,026 water samples across various sites throughout the US were analyzed for MTP. Of these samples, two samples had positive detections with concentrations ranging from 0.04 to 1.1 μg/L. None of the detections were from sites in California. Detections of MTP occurred at agricultural and mixed land use sites. The long term method detection level is 0.04 μg/L (Gilliom *et al*., 2007).

National Pesticide Survey (NPS). DCPA and TPA were included in the suite of pesticides analyzed in the National Pesticide Survey (NPS). Parent DCPA was not detected in the NPS. However, TPA was the most commonly detected pesticide residue in the NPS. There were 31 community water systems (5.5 percent of 564 systems) and 18 rural drinking water wells (2.3 percent of the 783 rural drinking water wells) with detections. TPA had detections in 3.7 percent of wells in 22 states (49 of 1347 wells). States with confirmed detections were AK, CA, CO, CT, IA, IL, IN, MA, MI, MN, MO, NH, NJ, NM, NY, OH, PA, RI, SD, VA, and WI. Maximum values of TPA were 7.2 ppb in community water system wells and 2.4 ppb in rural drinking water wells. The median of the detectable values were 0.34 ppb and 0.38 ppb for the community water systems wells and rural drinking water wells, respectively (U.S. EPA, 1990).

Prospective Ground Water Monitoring. Two small-scale ground water monitoring studies (MRID# 43646401) were submitted by the registrant on onion in California and on turf in New York. In California, DCPA was applied to a field planted with onion in Tulare County. Two applications of DCPA were made (7.6 lbs a.i./A in July 1992 and 10.645 lbs a.i./A in September of 1992). Soil lysimeters were located adjacent to wells and residues of DCPA, MTP, and TPA were detected in lysimeters and wells. Wells did not contain residues of DCPA, MTP, or TPA prior to the treatment. The maximum concentrations of DCPA and TPA in ground water wells were 0.2 and 416 μg/L, respectively. In New York, DCPA was applied to a turf in Saratoga County. Three applications of DCPA were made (14.5 lbs a.i./A in September 1992, 12.81 lbs a.i./A in May 1993, and 6.54 lbs a.i./A in July 1993). Soil lysimeters were located adjacent to wells and residues of DCPA, MTP, and TPA were detected in lysimeters. Wells did not contain residues of DCPA or TPA prior to the treatment. The maximum concentrations of DCPA and TPA in ground water wells were 0.35 and 3,081 μg/L, respectively.

First Unregulated Contaminant Monitoring Regulation (UCMR 1). Data are available on the presence of DCPA and its degradates in drinking water (see U.S. EPA, 2008a).

Pesticides in Ground Water Database (PGWDB). Data are available on the presence of DCPA and its degradates in the PGWDB (see U.S. EPA, 1992).

Kolpin *et al*. 1996. Kolpin *et al.* (1996) summarized data on pesticide residues in 837 water samples collected from 303 wells in the Midwest United States between 1991 and 1994. Samples were collected by the USGS. DCPA was not detected in any samples; however, DCPA acid was detected in 15.6% of samples, with a maximum measured concentration of 2.22 μg/L. For wells that had > 25% of the area within a 400-m radius of urban-residential land use, five out of eight wells contained DCPA acid (62.5%). The study concluded that nonagricultural use contributed to detections of DCPA and its metabolites.

Istok and Rautman 1996. Ground water sampling programs in 1983 and 1985 of a shallow aquifer in the Ontario, Oregon showed contamination with nitrogen and DCPA metabolites. In 1986, 54 of 81 wells sampled had DCPA concentrations above the detection limit of 0.05 μg/L with some levels approaching 500 μg/L. Samples collected between 1988 and 1990 had DCPA concentrations ranging from 0 - 986 μg/L with a mean concentration of 58 μg/L. In the 1996 study, DCPA concentrations in 32 wells ranged from 0.5-431 μg/L with a mean concentration in wells of 118.7 μg/L.

Monohan *et al.* 1995. Monohan *et al*. (1995) evaluated methods of extraction of DCPA and its metabolites in water samples. The methods were used to detect DCPA and its metabolites in 9 ground water samples collected from taps of domestic wells of private homes in the Malheur River Basin in eastern Oregon. DCPA was not detected in the samples. Acid metabolites were detected in 8 of 9 samples at a maximum concentration of 158.2 μg/L.

Table 3-10. Summary of Ground Water Monitoring Studies for DCPA and Its Metabolites

Location	Mean Concentration (μg/L)	Maximum Concentration (μg/L)	Frequency of Detections	Limit of Det. (μg/L)	Date	Source
United States	Not determined	0.011	0.2%	0.002	1993-2006	NAWQA
California	Not determined	0.004	0.54%	0.002	1993-2006	NAWQA
Oregon/Ontario aquifer wells	118.7	431	100%	0.05	1996	Istok and Rautman, 1996
Oregon/Ontario aquifer wells	NR	500	67%	0.05	1984	Istok and Rautman, 1996
Oregon/Ontario aquifer wells	58	986	NR	0.05	1988	Istok and Rautman, 1996

Location	Mean Concentration (μg/L)	Maximum Concentration (μg/L)	Frequency of Detections	Limit of Det. (μg/L)	Date	Source
Midwestern U.S.	NR	2.22 TPA	16% TPA	0.01	1991-1994	Kolpin *et al.* 1996
Midwestern U.S.	NR	Not applicable	0%	0.002	1991-1994	Kolpin *et al.* 1996
Malheur River Basin in Easter, OR (DCPA)	NR	Not applicable	0% of 9 samples	0.05	NR	Monohan *et al.*, 1995
Malheur River Basin in Easter, OR (MTP and TPA)	55.16	158.2 MTP and TPA	88% of 9 samples	0.05	NR	Monohan *et al.*, 1995
Connecticut	NR	124 DCPA and metabolites	85% of 13 samples	NR	1989	Mullaney *et al.*, 1991
Prospective Ground Water Monitoring Study-California	12.75 DCPA and metabolites	0.2 DCPA 416 TPA	NR	0.1	1992-1994	MRID 43646401
Prospective Ground Water Monitoring Study - New York	50.36 DCPA and metabolites	0.35 DCPA 3081 TPA	NR	0.1	1992-1994	MRID 43646401

Abbreviations: NR= not reported; Det.=detection or reporting limit

3.2.4.4 Atmospheric Monitoring Data

DCPA has been found in atmospheric samples throughout the United States and Canada, including in California. The maximum reported concentration of DCPA was 14.2 ng/m^3 (Table 3-11).

Wofford *et al*. 2003. CADPR monitored for 22 pesticides in air between May 31 and August 3, 2000 in Santa Barbara County, California (Segawa *et al*., 2003). The five major crops grown in the area included cole crops (broccoli, cabbage, and cauliflower), lettuce, dried beans, celery, and flowers. Twenty-four hour samples were collected four consecutive days per week at four monitoring locations. Chlorthal dimethyl was detected in 91% of air samples with maximum air concentrations of 14.2, 4.43, and 2.12 ng/m^3 for 1-day, 14-day, and 10-week concentrations, respectively. The method detection limit was 0.29 ng/m^3.

Daly *et al*. 2007a. Monitoring of DCPA in soil and air was conducted at 23 sampling sites throughout Costa Rica. Low levels of DCPA are used in Costa Rica and DCPA was only present at low levels in soil and was not detected in air at six of the sites. DCPA was fairly evenly distributed, except at one site were soil concentrations were higher. The maximum concentration of DCPA detected in air was 73.8 pg/m^3.

Daly *et al.* 2007b. Residues of organochlorine pesticides, including DCPA, were measured at three mountains (Revelstoke, Observation, and Yoho) in western Canada in samples of air, soil, and lichen in 2003 and 2004. DCPA was found consistently in air at concentrations between 1 - 10 pg/m^3 at all three mountains. Median (range reported in parenthesis) were 4 pg/m^3 (3-7) at Revelstoke, 4 pg/m^3 (1-5) at Yoho, and 4 pg/m^3 (1-11) at Observation. Soil concentrations ranged from 1.0 - 365 pg/g dry weight.

Majewski *et al*. 1998. Concentrations of agricultural pesticides were measured in air over the Mississippi River from New Orleans, LA to St. Paul, MN, during early June 1994. Samples were collected using polyurethane foam plugs on a research vessel. The maximum measured concentration of DCPA was 0.33 ng/m^3, the median concentration was 0.06 ng/m^3 and it was detected in 60% of samples.

Primbs *et al*. 2008. Historic and current use pesticides were measured in trans-Pacific and regional air masses at Mt. Bachelor Observatory, a remote high elevation mountain in Oregon's Cascade Range between 2004 and 2006. It was concluded that the western United States is a significant source region for DCPA because concentrations were significantly correlated with increased air mass time in the Western U.S. agricultural areas.

Yao *et al*., 2007. Residues of DCPA were measured in air across Canada in the spring and summer of 2004 and 2005. High volume samples were also collected in North Toronto when air flow was predicted from the United States. In agricultural regions, the highest detected air concentration was 50 pg/m^3. The highest air concentration collected in high volume samples during air flow from the United States was 319 pg/m^3.

Table 3-11. Summary of Air Monitoring Studies for DCPA and Its Metabolites

Location	Median Concentration (ng/m^3)	Maximum Concentration (ng/m^3)	Frequency of Detections	Limit of Det.	Date	Source
Mountains in western Canada	0.004	0.011	100%	NR	2003-2004	Daly *et al.*, 2007b
Santa Barbara County, CA	NR	14.2 (1-day), 4.43 (14-day), 2.12 (10 week)	91%	NR	2003	Segawa *et al*., 2003
Costa Rica	NR	0.0738	70%	NR	2004	Daly *et al.*, 2007a
Mississippi River	0.06	0.33	60%	0.10 ng/m^3	1994	Majewski *et al*, 1998
Canadian Prairie	NR	0.08	NR	NR	1994-1996	Rawn and Muir, 1999
Canada	NR	0.319	NR	NR	2004-2005	Yao *et al.*, 2007

Abbreviations: NR= not reported; Det.=detection or reporting limit

3.2.4.5 Precipitation Monitoring Results

Five studies reported on DCPA concentrations measured in snow and rain (Table 3-12). The highest concentration measured in seasonal snowpack at national parks was 0.0053 µg/L and the concentration in deposited snowpack was 5100 ng/m^2 in melted snow (Hageman *et al*., 2006). Maximum concentrations reported in rain ranged from 0.0044 - 0.03 µg/L (Table 3-12).

Hageman *et al*. 2006. Seasonal snowpack samples were collected in spring 2003 from seven national parks and analyzed for the presence of 47 pesticides and degradation products. DCPA was one of the most frequently detected pesticides in snow. Correlations were statistically significant between log latitude and pesticide concentration. Log pesticide concentrations increased with site elevation. The highest pesticide concentrations were found at the warmest temperatures, elevation and latitudes and at the sites with the lowest concentrations of particulate matter. The study concluded that regional pesticide use influenced the distribution of pesticides at the parks.

Vogel *et al.* 2008. Vogel *et al*. (2008) measured residues of 42 pesticides and 40 degradates in rainfall collected during the 2003 and 2004 growing season in Maryland, Indiana, Nebraska, and California. DCPA was detected in greater than 67-68% of all samples and in 100% of samples in California. The highest concentrations were measured in California. The author reported that, "The low concentrations observed at all study sites throughout each sampling season indicate that dacthal is well mixed in the atmosphere and likely undergoing long range transport."

Table 3-12. Summary of Monitoring Studies for DCPA and Its Metabolites Measuring Residues in Precipitation

Location	Median Concentration	Maximum Concentration	Frequency of Detections	Limit of Det.	Date	Source
Seasonal Snowpack Concentration in National Parks in Western U.S.	NR	0.0053 µg/L	NR	NR	2002-2005	Hageman *et al*., 2006
Depositions in seasonal snowpack samples in National Parks in Western U.S.	NR	5100 ng/m^2 in melted snow	NR	NR	2002-2005	Hageman *et al*., 2006
Precipitation in Canadian Prairie		0.0044 µg/L	NR	0.013 ng/L	1994-1996	Rawn and Muir, 1999
Rain, MD	0.002 µg/L	0.009 µg/L	74% of 27 samples	0.003 µg/L	2003-2004	Vogel *et al*., 2008
Rain, IN	<0.003 µg/L	0.005 µg/L	31% of 26 samples	0.003 µg/L	2003-2004	Vogel *et al*., 2008
Rain, NB	0.003 µg/L	0.009 µg/L	69% of 32 samples	0.003 µg/L	2003-2004	Vogel *et al*., 2008
Rain, CA	0.009 µg/L	0.022 µg/L	100% of 23 samples	0.003 µg/L	2003-2004	Vogel *et al*., 2008
Rain	Mean = 0.011 µg/L	0.030 µg/L	100% of 137 samples		2002-2004	Majewski *et al*., 2006

Abbreviations: NR= not reported; Det.=detection or reporting limit

3.2.4.6 Residues Measured in Sediment and Tissue

DCPA has been found sediment and tissue throughout the United States, including in California. The maximum reported concentrations of DCPA were 33.7 µg/kg dry wt in sediment and 1220 µg/kg wet weight in composite fish samples (Table 3-13).

NAWQA Database. Sediment monitoring data from the United States Geological Survey (USGS) NAWQA program were obtained on December 17, 2008. The frequency of detection was 0.76% for DCPA (9 detections out of 1,177 samples) in the United States and concentrations ranged from 1.1 to 33.7 µg/kg dry weight. Sites were classified as agricultural land use (4 sites), mixed land use (3 sites), forest (1 sites), and urban (1 sites). In California, there were detections in 3.8% of samples (2 of 52) taken in CA. Samples with detections were collected in San Bernardino and Stanislaus counties between September 1992 and November 1998. In California, measured concentrations ranged from 32 – 33.7 µg/kg dry weight. Detections occurred at mixed and agricultural land use sites. The long term method detection level is 5 µg/kg dry weight (Gilliom *et al.,* 2007).

The frequency of occurrence of DCPA in sediment may be more prevalent than reported here as the frequency of detection depends and the limit of detection. Research has documented an inverse relationship between analytical reporting limits and the frequency of pesticide detection (Kolpin *et al*., 1996).

Tissue monitoring data from the United States Geological Survey (USGS) NAWQA program were obtained on December 17, 2008. The frequency of detection was 3% for DCPA (31 detections out of 1048 samples) in the United States and concentrations ranged from 5 to 78 µg/kg dry weight. Sites with detections were classified as agricultural land use (8 sites), mixed land use (16 sites), cropland (2 sites), urban (1 sites) and other (4 sites). In California, there were detections in 0% of samples (0 of 5) taken in CA. Samples (signal crayfish and Sacramento sucker) were collected in 5 counties (Alpine, El Dorado, Mariposa, Nevada, and Shasta) between September 1992 and October 1995. The long term method detection level is 5 µg/kg dry weight (Gilliom *et al.,* 2007).

Chu *et al.* 2007. Osprey (*Pandion haliaetus*) eggs were collected from 15 sites near Puget Sound/Seattle of Washington State. DCPA concentrations ranged from 2-10.3 pg/g fresh weight in the eggs. A structural isomer of DCPA, dimethyl tetrachlorophthalate (diMe-TCP) was found at higher levels (6.9-85.5 pg/g fresh weight) than DCPA.

Munn and Gruber 1997. Munn and Gruber (1997) analyzed streambed sediment and fish in the central Columbia Plateau in eastern Washington and Idaho for organochlorine pesticides. Land use areas (forest, dryland, irrigated farming, and urban) were examined in relation to detections. The forest land use site was the only area with no detections in fish and bed sediment. All detections were in the irrigation streams of the Quincy-Pasco Basin, an area where DCPA is commonly used. The highest DCPA concentration measured in streambed sediment was 1300 µg/kg OC and in composite samples of whole fish was 8.6 µg/kg wet weight.

Pereira *et al*., 1994. Pereira *et al*. (1994) examined concentrations of organochlorine compounds in sediment and livers of striped bass (*Morone saxatilis*) from the San Francisco Bay-Delta Estuary. DCPA residues were detected at concentrations ranging from <0.1 ng/g - 8.7 ng/g wet weight in the livers of striped bass.

Pereira *et al*., 1996. Pereira *et al.* (1996) examined concentrations of organic compounds in surface water, sediment, and clams (*Corbicula fluminea*) from the San Joaquin River and tributaries in California. DCPA was detected in surface water at concentrations of 0.9 - 1140 ng/L with the highest concentration measured in Orestimba Creek. In sediment, DCPA was detected at concentrations ranging from <0.5 - 7.3 ng/L (units as reported in original paper). Higher concentrations were found in suspended sediment (<0.5 - 48 ng/L) which had a higher organic carbon content. When bed sediment and suspended sediment concentrations were normalized to organic carbon content, concentrations were comparable. DCPA concentrations in clams ranged from <0.5 - 150 ng/g and the observed log bioconcentration factor (normalized to organic carbon and lipid content) was 2.10, lower than what would be predicted based on the K_{OW} (predicted log BCF = 3.02). This suggests that clams have a mechanism to excrete or metabolize DCPA.

Schmitt *et al.* 1990. The U.S. Fish and Wildlife Service monitored residues of organochlorine concentrations in fish as part of the National Contaminant Biomonitoring Program. Fish (321 composite samples of 3-5 fish) were collected from 112 stations across the United States. DCPA residues were detected in 28-46% of samples at low concentrations. Maximum concentrations ranged from 0.4 - 1.22 μg/g wet weight.

Swackhammer and Hites 1988. Swackhammer and Hites (1988) measured residues of chlorinated organic compounds in lake trout (*Salvelinus namaycush namaycush*) and white fish (*Coregonus culpeaformis neohantoniensus*) obtained from Siskiwit Lake. Siskiwit Lake is located near the south shore of Isle Royale National Park in Lake Superior. Mean concentrations of DCPA were 38 ng/g lipid in lake trout and 46 ng/g lipid in whitefish. The author reported that Siskiwit Lake was located far from any point sources and speculated that DCPA was transported to the Lake via atmospheric transport.

Saiki and Schmitt 1986. Bluegill and carp collected from the San Joaquin River and two tributaries, Merced River and Salt Slough, in California were analyzed for 21 organochlorine compounds. Mean DCPA concentrations in bluegill ranged from <0.01 - 0.01 mg/kg wet weight and <0.01 - 0.498 mg/kg lipid weight. Mean concentrations in carp ranged from <0.01 - 0.054 mg/kg wet weight and <0.01 - 0.707 mg/kg lipid weight.

In a 1993 aquaculture survey, eight catfish samples out of 308 samples contained 10-90 μg/kg DCPA (U.S. EPA, 2008a).

Table 3-13. Summary of Sediment Monitoring Studies for DCPA and Its Metabolites

Location	Mean Conc.	Maximum Conc.	Frequency of Detections	Limit of Det.	Date	Source

Location	Mean Conc.	Maximum Conc.	Frequency of Detections	Limit of Det.	Date	Source
Sediment						
United States	Not determined	33.7 µg/kg dry wt	0.76	5 µg/kg dry wt	1992 - 1998	NAWQA
California	Not determined	33.7 µg/kg dry wt	3.8	5 µg/kg dry wt	1992-1998	NAWQA
San Joaquin River and Tributaries, CA	NR	1300 µg/kg OC dry wt	13%	5 ug/kg dry weight	1992-1994	Munn *et al*., 1997
Bed sediment San Joaquin River and Tributaries, CA	NR	7.3 ng/L	71%	0.5 ng/L	1992	Pereira *et al*., 1996
Suspended sediment of San Joaquin River and Tributaries, CA	NR	48 ng/L	80%	0.5 ng/L	1992	Pereira *et al*., 1996
Tissue						
United States	Not determined	78 µg/kg dry wt	3%	5 µg/kg dry wt	1992-2001	NAWQA
California	Not determined	0	0	5 µg/kg dry wt	1992-1995	NAWQA
Osprey eggs in WA	NR	10.3 ng/kg fresh weight	40% (6 of 15 samples)		2003	Chu *et al*., 2007
Carp in San Joaquin River and Tributaries	NR	67 µg/kg wet wt	19%	5 µg/kg wet weight	1992-1994	Munn *et al*., 1997
Clam in San Joaquin River and Tributaries, CA	NR	150 µg/kg	25%	0.5 ng/g	1992	Pereira *et al*., 1996
Catfish along Mississippi River and Tributaries	NR	9 µg/kg wet wt			1987	Leiker *et al*., 1991
Mature Striped Bass livers from Sacramento and San Joaquin Rivers	3.2 ng/g wet wt.	8.7 µg/kg wet wt	86%	0.1 ng/g	1992	Pereira *et al*., 1994
Bluegill from San Joaquin River, Merced River, and Salt Slough in CA	NR	0.01 mg/kg wet wt 0.498 mg/kg lipid wt	NR	0.004 mg/kg wet wt	1981	Saiki and Schmitt, 1986
Carp from San Joaquin River, Merced River, and Salt Slough in CA	NR	0.054 mg/kg wet wt 0.707 mg/kg lipid wt	NR	0.004 mg/kg wet wt	1981	Saiki and Schmitt, 1986
Sea trout, perch, speckled trout, mullet, red drum, and menhaden from Rio Grand River in TX	NR	555 ppb	NR	NR	1971-1972	Miller and Gomes, 1974

Location	Mean Conc.	Maximum Conc.	Frequency of Detections	Limit of Det.	Date	Source
Composite sample of indigenous fish in Great Lakes Harbors and tributaries	NR	0.12 mg/kg	NR	NR		Devault, 1985
National Contaminant Biomonitoring Program (NCPB) composite fish samples	Geometric mean 0.01 µg/g	1220 µg/kg wet wt and 18.8 µg/g lipid wt	34% of stations	NR	1978-1979	Schmitt *et al.*, 1990
NCPB composite fish samples	Geometric mean <0.01 µg/g	400 µg/kg wet wt and 6100 µg/kg lipid wt	28% of stations	NR	1980-1981	Schmitt *et al.*, 1990
NCPB composite fish samples	Geometric mean <0.01 µg/g	450 µg/kg wet wt.	46% of stations	NR	1984	Schmitt *et al.*, 1990
Composite fish samples from tributaries and embayments of Lake Superior and Lake Huron	NR	2.2-17 ng/g fish fat	NR	NR	NR	Jaffe *et al.*, 1985
Carp from tributaries to Lake Ontario and the Niagara River	NR	93-2300 ng/g fish fat	NR	NR	NR	Jaffe and Hites, 1986
Fall-run coho salmon from each of the great Lakes	NR	<0.05 µg/g	NR	NR	NR	DeVault *et al.*, 1988
Composite samples of Lake trout in Siskiwit Lake, Ontario	38 ng/g lipid	43 µg/kg lipid	100%	NR	NR	Swackhammer and Hites, 1988
Composite samples of Whitefish in Siskiwit Lake, Ontario	46 ng/g lipid	70 µg/kg lipid	100%	NR	NR	Swackhammer and Hites, 1988

Abbreviations: Conc. = Concentration; wt = weight; NR= not reported; Det.=detection or reporting limit

3.3 Terrestrial Exposure Assessment

3.3.1 Terrestrial Animal Exposure Assessment

T-REX (Version 1.3.1) is used to calculate dietary and dose-based EECs of DCPA for the CRLF and its potential prey (*e.g.* small mammals and terrestrial insects) inhabiting terrestrial areas. EECs used to represent the CRLF are also used to represent exposure values for frogs serving as potential prey of CRLF adults. T-REX simulates a 1-year time period. For this assessment, spray and granular applications of DCPA are considered, as discussed below.

3.3.1.1 Terrestrial EECs

a) ***Estimated EECs using TREX***

Terrestrial EECs for applications of wettable powder and flowable concentrate formulations of DCPA were derived for the uses summarized in Table 3-1. Given that no data on interception and subsequent dissipation from foliar surfaces is available for DCPA, a default foliar dissipation half-life of 35 days is used based on the work of Willis and McDowell (1987). Use specific input values, including number of applications, application rate and application interval are provided in Table 3-14. An example output from T-REX is available in Appendix I.

Table 3-14. TREX Input Parameters for Spray Applications (Wettable Powder and Flowable Concentrate; Air or Ground) Used to Derive Terrestrial EECs for DCPA

Use (Number of applications, application interval)	App. Rate lbs a.i./A	# of App.	App. Interval (days)
Turf and Ornamental (6 app., 7 day)[1]	15	6	7
Nursery and ornamentals (6 app., 7 day)[2]	12	6	7
All Food Crops (1 app.)[3]	10.5	1	NA
All Food Crops (2 app., 183 days)[4]	10.5	2	183
All Food Crops (2 app. 30 days)[4]	10.5	3	7
All Food Crops (2 app. 60 days)[4]	10.5	2	60
Radish (11 app., 30 days)[5]	10.5	2	30
Cole Crops (7 app., 30 days)[6]	10.5	11	30
Turf and Ornamental (6 app., 7 day)	10.5	7	30

Abbreviations: App.= applications, bw = body weight

1-Turf and Ornamental, 15 lbs a.i./A, 6 applications, 7 day interval

2-Nursery and Ornamental, 12 lbs a.i./A, 6 applications, 7 day interval

3-All food crops except garlic have a 10.5 lb a.i./A application rate. Garlic's application rate is 10.4 and is close enough to 10.5 to also be represented by this rate. See Table 3-1 for a list of food crops.

4-All food crops could have two applications as a maximum number of applications is not specified on any of the labels.

5- All food crops could have eleven applications as a maximum number of applications is not specified on any of the labels; however, an extension agent reported this a maximum usage for radish (http://www.wripmc.org/newsalerts/dacthal03.html).

6- All food crops could have seven applications; however, cole crops have a reported maximum number of seven uses (http://www.wripmc.org/newsalerts/dacthal03.html).

For modeling purposes, exposures of the CRLF to DCPA through contaminated food are estimated using the EECs for the small bird (20 g) which consumes small insects. Dietary-based and dose-based exposures of potential prey are assessed using the small mammal (15 g) which consumes short grass. Upper-bound Kenega nomogram values reported by T-REX for these two organism types are used for derivation of EECs for the CRLF and its potential prey (Table 3-15). Dietary-based EECs for small and large insects reported by T-REX as well as the resulting adjusted EECs are available in Table 3-16.

T-REX is also used to calculate EECs for terrestrial insects exposed to DCPA. Dietary-based EECs calculated by T-REX for small and large insects (units of a.i./g) are used to bound an estimate of exposure to bees. Available acute contact toxicity data for bees exposed to DCPA (in units of µg a.i./bee), are converted to µg a.i./g (of bee) by multiplying by 1 bee/0.128 g. The EECs are later compared to the adjusted acute contact toxicity data for bees in order to derive RQs.

Table 3-15. Upper-bound Kenega Nomogram EECs for Dietary- and Dose-based Exposures of the CRLF and its Prey to DCPA for Applications of Wettable Powder and Flowable Concentrate Formulations

Use (Number of Applications)	EECs for CRLF		EECs for Prey (small mammals)	
	Dose-based EEC (mg/kg-bw)	Dietary-based EEC (ppm)	Dose-based EEC (mg/kg-bw)	Dietary-based EEC (ppm)
Turf and Ornamental (6 app., 7 day)[1]	10061	8834	14974	15705
Nursery and ornamentals (6 app., 7 day)[2]	8049	7067	11979	12564
All Food Crops (1 app.)[3]	1614	1418	2403	2520
All Food Crops (2 app., 183 days)[4]	1658	1455	2467	2587
All Food Crops (2 app. 30 days)[4]	2506	2200	3729	3911
All Food Crops (2 app. 60 days)[4]	2106	1849	3135	3288
Radish (11 app., 30 days)[5]	3599	3160	5356	5617
Cole Crops (7 app., 30 days)[6]	3548	3115	5280	5538

Abbreviations: App.= applications, bw = body weight
1-Turf and Ornamental, 15 lbs a.i./A, 6 applications, 7 day interval
2-Nursery and Ornamental, 12 lbs a.i./A, 6 applications, 7 day interval
3-All food except garlic have a 10.5 lb a.i./A application rate. Garlic's application rate is 10.4 and is close enough to 10.5 to also be represented by this rate. See Table 3-1 for a list of food crops.
4-All food crops could have two applications as a maximum number of applications is not specified on any of the labels.
5- All food crops could have eleven applications as a maximum number of applications is not specified on any of the labels; however, an extension agent reported this a maximum usage for radish (http://www.wripmc.org/newsalerts/dacthal03.html).
6- All food crops could have seven applications; however, cole crops have a reported maximum number of seven uses (http://www.wripmc.org/newsalerts/dacthal03.html).

Table 3-16. EECs (ppm) for Indirect Effects to the Terrestrial-Phase CRLF via Effects to Terrestrial Invertebrate Prey Items

Use, Application rate, Number of Apps., Application Interval	Small Insect	Large Insect

All food crops, 10.5 lbs a.i./A, One app,[1]	1418	158
Turf and Ornamentals; 15 lbs a.i./A, 6 apps, 7 days	8834	982
Nursery and Ornamentals; 12 lbs a.i./A, 6 apps, 7 days	7067	785
All food crops. 10.5 lbs a.i./A, 2 apps, 183 days[2]	1455	162

Abbreviations: App.= application

1-All food except garlic have a 10.5 lb a.i./A application rate. Garlic's application rate is 10.4 and is close enough to 10.5 to also be represented by this rate. See Table 3-1 for a list of food crops.

2-All food crops could have two applications as a maximum number of applications is not specified on any of the labels.

b) ***Limitations of TREX for Granular Formulations and Applications to Bare Ground***

For granular applications of DCPA the TREX model provides limited utility. Typically, for granular applications, risk is assessed by calculating "LD_{50} per square foot" in TREX. This is an assessment of acute risk which estimates the number of granules per square foot and the resulting concentration of DCPA in the soil relative to the concentration expected to cause effects. However, for DCPA, neither avian nor mammalian toxicity tests resulted in acute effects and therefore no LD_{50} is available for these calculations. Additionally, the weight of one granule is not available and so the estimated exposure cannot be compared to the concentrations where no effects were observed in the acute toxicity studies.

Due to lack of acute toxicity endpoints as inputs for the granular specific exposure model, it is assumed that small and large insect EECs for granular applications are the same as those for spray applications. Foliar EECs, however, will not be the same. Foliar granular applications will not lead to foliar residues equivalent to residues expected when a spray is foliarly applied. Granular applications will result in much lower foliar EECs. Thus, foliar residue EECs (short grass, tall grass, broad leaf plants) will not be considered as an exposure route for granular applications to bare ground or foliarly applied agricultural uses. However, for granular applications to turf (*i.e*., golf courses), foliar residues are relevant.

Spray applications to bare ground lead to uncertainty similar to that with granular applications. Residues on insects and seeds in a bare ground application scenario are expected to be the same as those from a foliar application but foliar residues will not be relevant as only plant material that comes in contact with DCPA during application will carry residues. Thus avian and mammalian RQs for applications to bare ground and granular applications are only calculated from EECs for small mammals and birds consuming insects and seeds.

3.3.2 Terrestrial Plant Exposure Assessment

TerrPlant (Version 1.1.2) is used to calculate EECs for non-target plant species inhabiting dry and semi-aquatic areas. Parameter values for application rate, drift assumption and incorporation depth are based upon the use and related application method (Table 3-17). A runoff value of 0.01 is utilized based on DCPA's solubility (0.5 mg/L), which is classified by TerrPlant as <10 mg/L. For aerial and ground application methods, drift is assumed to be 5% and 1%, respectively. EECs relevant to terrestrial plants consider pesticide concentrations in drift and in runoff. These EECs are listed by use in Table 3-17.

Table 3-17. TerrPlant Inputs and Resulting EECs for Plants Inhabiting Dry and Semi-aquatic Areas Exposed to DCPA via Runoff and Drift[1]

Use	Application rate (lbs a.i./A)	Application method	Drift Value (%)	Spray drift EEC (lbs a.i./A)	Dry area EEC (lbs a.i./A)	Semi-aquatic area EEC (lbs a.i./A)
Turf and Ornamental	15	Foliar-aerial	5	0.75	0.9	2.25
Turf and Ornamental	15	Foliar - ground	1	0.15	0.30	1.65
Nursery and ornamentals	12	Foliar - ground	1	0.12	0.24	1.32
All Food Crops[1]	10.5	Foliar - aerial	5	0.525	0.63	1.58
All Food Crops[2]	10.5	Foliar - ground	1	0.105	0.21	1.12
All Food Crops (incorporated two inches.)[2]	10.5	Foliar-ground	1	0.105	0.1575	0.63

Abbreviations: App.= applications

1- Only one application can be modeled using TerrPlant

2- All food except garlic have a 10.5 lb a.i./A application rate. The garlic maximum application rate is 10.4 and is close enough to 10.5 to also be represented by this rate. See Table 3-1 for a list of food crops.

4.0 Effects Assessment

This assessment evaluates the potential for DCPA to directly or indirectly affect the CRLF or modify its designated critical habitat. As previously discussed in Section 2.7, assessment endpoints for the CRLF effects determination include direct toxic effects on the survival, reproduction, and growth of CRLF, as well as indirect effects, such as reduction of the prey base or modification of its habitat. In addition, potential modification of critical habitat is assessed by evaluating effects to the PCEs, which are components of the critical habitat areas that provide essential life cycle needs of the CRLF. Direct effects to the aquatic-phase of the CRLF are based on toxicity information for freshwater fish, while terrestrial-phase effects are based on avian toxicity data, given that birds are generally used as a surrogate for terrestrial-phase amphibians. Because the frog's prey items and habitat requirements are dependent on the availability of freshwater fish and invertebrates, small mammals, terrestrial invertebrates, and aquatic and terrestrial plants, toxicity information for these taxa are also discussed. Acute (short-term) and chronic (long-term) toxicity information is characterized based on registrant-submitted studies and a comprehensive review of the open literature on DCPA.

As described in the Agency's Overview Document (U.S. EPA, 2004), the most sensitive endpoint for each taxon is used for risk estimation. For this assessment, evaluated taxa include aquatic-phase amphibians, freshwater fish, freshwater invertebrates, aquatic plants, birds (surrogate for terrestrial-phase amphibians), mammals, terrestrial invertebrates, and terrestrial plants.

Toxicity endpoints are established based on data generated from guideline studies submitted by the registrant, and from open literature studies that meet the criteria for inclusion into the ECOTOX database maintained by EPA/Office of Research and Development (ORD) (U.S. EPA, 2004). Open literature data presented in this assessment were obtained on August 3, 2008 from

ECOTOX information.   In order to be included in the ECOTOX database, papers must meet the following minimum criteria:

(1) the toxic effects are related to single chemical exposure;
(2) the toxic effects are on an aquatic or terrestrial plant or animal species;
(3) there is a biological effect on live, whole organisms;
(4) a concurrent environmental chemical concentration/dose or application rate is reported; and
(5) there is an explicit duration of exposure.

Data that pass the ECOTOX screen are evaluated along with the registrant-submitted data, and may be incorporated qualitatively or quantitatively into this endangered species assessment. In general, effects data in the open literature that are more conservative than the registrant-submitted data are considered. The degree to which open literature data are quantitatively or qualitatively characterized for the effects determination is dependent on whether the information is relevant to the assessment endpoints (*i.e.*, maintenance of CRLF survival, reproduction, and growth) identified in Section 2.8. For example, endpoints such as behavior modifications are likely to be qualitatively evaluated, because quantitative relationships between modifications and reduction in species survival, reproduction, and/or growth are not available. Although the effects determination relies on endpoints that are relevant to the assessment endpoints of survival, growth, or reproduction, it is important to note that the full suite of sublethal endpoints potentially available in the effects literature (regardless of their significance to the assessment endpoints) are considered to define the action area for DCPA.

Citations of all open literature not considered as part of this assessment because they were either rejected by the ECOTOX screen or accepted by ECOTOX but not used (*e.g.,* the endpoint is less sensitive) are included in Appendix H. Appendix H also includes a rationale for rejection of those studies that did not pass the ECOTOX screen and those that were not evaluated as part of this endangered species risk assessment. A detailed spreadsheet of the available ECOTOX open literature data, including the full suite of lethal and sublethal endpoints is presented in Appendix G which also includes a summary of the human health effects data for DCPA.

In addition to registrant-submitted and open literature toxicity information, other analyses including use of the acute probit dose response relationship to establish the probability of an individual effect and reviews of the Ecological Incident Information System (EIIS), are conducted to further refine the characterization of potential ecological effects associated with exposure to DCPA. A summary of the available aquatic and terrestrial ecotoxicity information, use of the probit dose response relationship, and the incident information for DCPA are provided in Section 4.3 and 4.4, respectively.

As described in Sections 2.2, 2.3, 2.4.1.1, 2.4.1.3, 2.10.1.1, and Section 3, the major degradates of DCPA are TPA and MTP. The toxicity data for these chemicals are limited to mammals. The available data indicate that the adverse effects associated with TPA are much milder than those for the parent and tend to occur at doses that are lower by approximately an order of magnitude (U.S. EPA, 2008). Aquatic toxicity of the degradate TPA was estimated by data for a similar herbicide, diacamba.

4.1 Evaluation of Aquatic Ecotoxicity Studies

Table 4-1 summarizes the most sensitive aquatic toxicity endpoints for the CRLF, based on an evaluation of both the submitted studies and the open literature, as previously discussed. A brief summary of submitted and open literature data considered relevant to this ecological risk assessment for the CRLF is presented below. Additional information is provided in Appendix F.

Table 4-1. Freshwater Aquatic Toxicity Profile for DCPA

Assessment Endpoint	Species	Toxicity Value Used in Risk Assessment	Citation MRID #	Comment
Acute Direct Toxicity to Aquatic-Phase CRLF	Blue gill	LC_{50}>500 µg a.i./L	41054827	Supplemental: only one exposure level tested. 1 mortality out of 30 fish (3 replicates of 10 fish each)
Chronic Direct Toxicity to Aquatic-Phase CRLF	No Data	No Data	No Data	No Data
Indirect Toxicity to Aquatic-Phase CRLF via Acute Toxicity to Freshwater Invertebrates (*i.e.* prey items)	*Daphnia magna*	LC_{50}>500 µg a.i./L	40226901	Supplemental
Indirect Toxicity to Aquatic-Phase CRLF via Chronic Toxicity to Freshwater Invertebrates (*i.e.* prey items)	No Data	No Data	No Data	No Data
Indirect Toxicity to Aquatic-Phase CRLF via Toxicity to Non-vascular Aquatic Plants	*Navicula pelliculosa, Skeletonema costatum*	NOAEC ≤500 µg a.i./L	MRID 42882401, MRID 42836103	Supplemental
Indirect Toxicity to Aquatic-Phase CRLF via Toxicity to Vascular Aquatic Plants	*Lemna gibba*	NOAEC ≤500 µg a.i./L	MRID 42836101	Supplemental

Toxicity to aquatic fish and invertebrates is categorized using the system shown in Table 4-2 (U.S. EPA, 2004). Toxicity categories for aquatic plants have not been defined.

Table 4-2. Categories of Acute Toxicity for Aquatic Organisms

LC_{50} (ppm)	Toxicity Category
< 0.1	Very highly toxic
> 0.1 - 1	Highly toxic
> 1 - 10	Moderately toxic
> 10 - 100	Slightly toxic
> 100	Practically nontoxic

4.1.1 Toxicity to Freshwater Fish

Given that no DCPA toxicity data are available for aquatic-phase amphibians, freshwater fish data were used as a surrogate to estimate direct acute and chronic risks to the CRLF. Freshwater fish toxicity data were also used to assess potential indirect effects of DCPA to the CRLF. Effects to freshwater fish resulting from exposure to DCPA may indirectly affect the CRLF via reduction in available food. As discussed in Section 2.5.3, over 50% of the prey mass of the CRLF may consist of vertebrates such as mice, frogs, and fish (Hayes and Tennant, 1985).

A summary of acute and chronic freshwater fish data, including data from the open literature, is provided below. No aquatic toxicity data are available for TPA. Effects of TPA to aquatic organisms will be estimated by using toxicity data for dicamba, another benzoic acid herbicide with a structure similar to TPA.

4.1.1.1 Amphibians and Freshwater Fish: Acute Exposure (Mortality) Studies

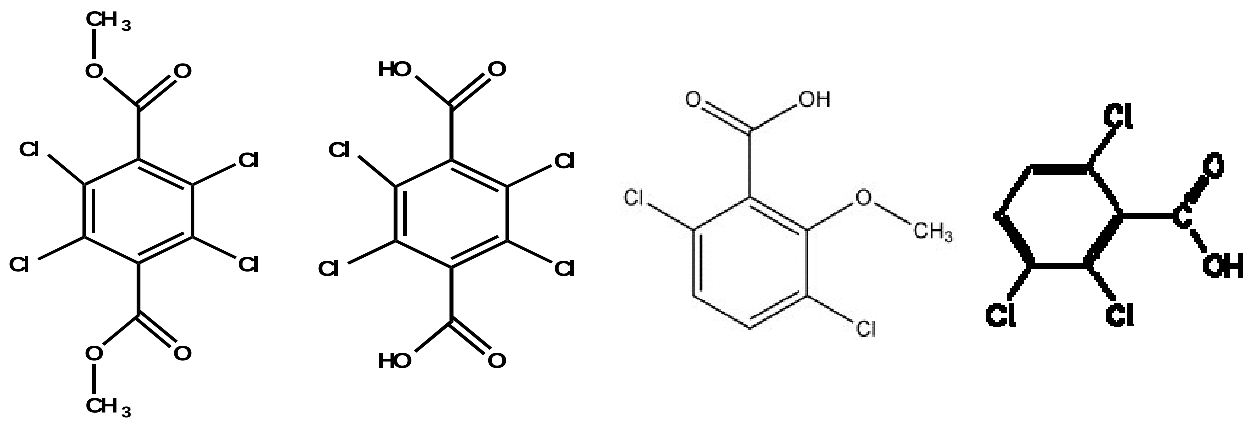
Parent DCPA

There are several submitted fresh water fish acute toxicity studies. However, the data for the studies are not usable for a quantitative assessment. In each study, the fish were exposed to DCPA and a solvent, intended to increase the solubility of the active ingredient. Regardless of the use of solvent, precipitate was present in each study and exposure analysis did not include centrifugation or filtration and the actual exposure concentration was unknown. It can be gleaned from the studies that there is no toxicity at the limit of solubility (0.5 mg/L) as no effects were observed. Given that one can assume the exposure was at least at the level of solubility and fish may have consumed or had contact with the precipitate, it is reasonable to conclude that DCPA is relatively non-toxic to fish at the limit of solubility (0.5 ppm).

Degradate TPA

No aquatic toxicity data are available for TPA. TPA has a similar structure to benzoic acid herbicides, dicamba (3,6-dichloro-2-methoxybenzoic acid; PC Code 029801) and 2,3,6-trichlorobenzoic acid (2,3,6-TBA; PC Code 017301) and toxicity data for these compounds can be used to predict toxicity endpoints for TPA (Figure 4-1). Available acute toxicity data indicates that the toxicity of dicamba varies with the salt forms tested (U.S. EPA, 2005). Study results show that the salt forms appeared to be practically non-toxic to freshwater fishes (LC_{50} >100 mg/L); however, dicamba acid (LC_{50} = 28 mg a.e./L; 88% a.i.; MRID 40098001) was slightly toxic to rainbow trout (U.S. EPA, 2005). Toxicity to bluegill was similar. A 48-hour LC_{50} of 166 mg/L for the brown striped marsh frog was reported in the public ECOTOX database. This value is above the lowest values available and was not used in the RQ estimates because the data were not available for review.

No toxicity data for 2,3,6-TBA were submitted to the Agency; however, the lowest endpoints reported in the public ECOTOX database were a 4 day LC_{50} of 8.5 mg/L and a 24 hour LC_{50} of 13.5 mg/L for the fathead minnow. These endpoints can only be used qualitatively as the data were not available to the Agency for review.



(a) DCPA **(b) TPA** **(c) Dicamba** **(d) 2,3,6-TBA**

Figure 4-1. Chemical structure of (a) chlorthal dimethyl (DCPA), (b) tetrachlorterephthalic acid (TPA), (c) 3,6-dichloro-2-methoxybenzoic acid (dicamba), and (d) 2,3,6-trichlorobenzoic acid (2,3,6-TBA) (U.S. EPA, 1998b; Wood, 2007)

4.1.1.2 Freshwater Fish: Chronic Exposure (Early Life Stage and Reproduction) Studies

Parent DCPA
No data are available to assess effects to freshwater fish from chronic DCPA exposure.

Degradate TPA
No chronic freshwater fish toxicity data were available for TPA. Additionally, no chronic data were available in the public ECOTOX database for other benzoic acid herbicides similar in structure to DCPA, dicamba and 2,3,6-trichlorobenzoic acid.

4.1.2 Toxicity to Freshwater Invertebrates

Freshwater aquatic invertebrate toxicity data were used to assess potential indirect effects of DCPA to the CRLF. Effects to freshwater invertebrates resulting from exposure to DCPA may indirectly affect the CRLF via reduction in available food items. As discussed in Section 2.5.3, the main food source for juvenile aquatic- and terrestrial-phase CRLFs is thought to be aquatic invertebrates found along the shoreline and on the water surface, including aquatic sowbugs, larval alderflies and water striders.

A summary of acute and chronic freshwater invertebrate data, including data published in the open literature, is provided below in Sections 4.1.2.1 through 4.1.2.2.

4.1.2.1 Freshwater Invertebrates: Acute Exposure (Mortality) Studies

Parent DCPA
Freshwater invertebrate acute toxicity study with *Daphnia magna* was submitted (MRID 40226901). Exposure concentrations were above the limit of solubility and the analysis of the exposure medium did not provide enough information to determine the actual exposure concentration. No mortality was observed in any of the studies. Given that one can assume the exposure was at least at the level of solubility, it is reasonable to conclude that DCPA is relatively non-toxic to invertebrates at the limit of solubility (0.5 ppm).

Degradate TPA
No aquatic toxicity data were available for TPA. Therefore, toxicity data for dicamba were used to predict the toxicity of TPA. The sodium salt of dicamba (26.5% a.i.) was slightly toxic to daphnids with an EC_{50} of 34.6 mg acid equivalence (a.e.)/L (MRID 00233292; U.S. EPA, 2005). The lowest endpoint available for dicamba acid and daphnids was a 48-hour EC_{50} of 110.7 mg/L (MRID 00052126; U.S. EPA, 2005). The lowest effects endpoint (34.6 mg/L) will be compared to EECs for TPA to calculate RQ values.

4.1.2.2 Freshwater Invertebrates: Chronic Exposure (Reproduction) Studies

Parent DCPA
No data are available to assess effects to freshwater invertebrates from chronic DCPA exposure.

Degradate TPA
No data are available on the chronic toxicity of TPA to freshwater invertebrates. Additionally, no chronic data were available in the public ECOTOX database for other benzoic acid herbicides similar in structure to DCPA, dicamba and 2,3,6-trichlorobenzoic acid.

4.1.3 Toxicity to Aquatic Plants

Aquatic plant toxicity studies were used as one of the measures of effect to evaluate whether DCPA may affect primary production and the availability of aquatic plants as food for CRLF tadpoles. Primary productivity is essential for indirectly supporting the growth and abundance of the CRLF.

Parent DCPA
Laboratory studies were used to evaluate the potential of DCPA to affect aquatic plants and to determine whether DCPA may cause direct effects to aquatic plants. A summary of the laboratory data for aquatic plants is provided below.

As with the other aquatic taxa, DCPA toxicity data are limited by solubility. Tier I testing was conducted with *Lemna gibba, Skeletonema costatum, Navicula pelliculosa,* and *Anabaena. flos-aquae*. Each species was exposed to DCPA at 11 ppm with Tween-80 as the solvent. In nearly every test, a solvent effect was observed in the solvent control (*i.e.*, growth or inhibition relative to the negative control). Three of the four studies were determined to be supplemental, while the study with *A. flos-aquae* is unacceptable. Tier II testing is necessary and recommended for an accurate assessment of DCPA's affect on aquatic plants.

At 11 ppm a yield, growth rate and area under the curve were inhibited in the *Lemna gibba* (MRID 42836101) study by 32, 9 and 36%, respectively.

In a toxicity study with *Navicula pelliculosa* (MRID 42882401) there were two groups treated at 11 ppm, three replicates within each group. Based on effects observed in the solvent control, the solvent appears to promote growth. However, in both treatment groups, yield, growth rate and area were inhibited relative to the negative control. If the solvent truly does promote growth, the inhibition observed in the treatment groups is an underestimate of effects from DCPA.

The solvent also appeared to promote growth in the *Skeletonema costatum* study (MRID 42836103) although the difference between the negative and solvent control was not statistically significant. Yield, growth rate and the area under the curve were all inhibited relative to the negative control at >10, >3, and >26% respectively. Based on these effects a Tier II study should have been completed.

DCPA is an herbicide effective against a wide variety of plant species. Based on the number of target species and the adverse effects observed in the submitted aquatic plant toxicity studies, effects to aquatic plants can be expected at or below solubility. Without a Tier II study, it is not possible to determine the level at which no effects will occur. Based on the observed effects (promoted growth) in the solvent control it is determined that the solvent could potentially influence the toxicity of DCPA. Therefore, the studies cannot be used to discount risk.

Degradate TPA

Toxicity studies with algae exposed to dicamba acid indicate that cell densities were significantly reduced in blue-green algae at test concentrations as low as 0.061 mg a.i./L (U.S. EPA, 2005). Aquatic vascular plant species were not as sensitive to dicamba acid with 14-day EC_{50} values of >3.25 mg a.i./L (U.S. EPA, 2005). However, duckweed frond chlorosis occurred at mean measured concentrations as low as 0.39 mg a.i./L (U.S. EPA, 2005).

4.2 Toxicity of DCPA to Terrestrial Organisms

Table 4-3 summarizes the most sensitive terrestrial toxicity endpoints for the CRLF, based on an evaluation of both the submitted studies and the open literature. A brief summary of submitted and open literature data considered relevant to this ecological risk assessment for the CRLF is presented below.

Table 4-3. Terrestrial Toxicity Profile for DCPA

Endpoint	Species	Toxicity Value Used in Risk Assessment	Citation MRID# (Study Classification)	Comment
Acute Direct Toxicity to Terrestrial-Phase CRLF (LD_{50})	Northern Bobwhite Quail	LD_{50}>2,250 mg a.i./kg-bw	41155705, Acceptable	No treatment related mortality

Endpoint	Species	Toxicity Value Used in Risk Assessment	Citation MRID# (Study Classification)	Comment
Acute Direct Toxicity to Terrestrial-Phase CRLF (LC_{50})	Northern Bobwhite Quail	LC_{50}>5620 mg a.i./kg-bw	41155706, Acceptable	No Mortality
Chronic Direct Toxicity to Terrestrial-Phase CRLF	Northern Bobwhite Quail	NOAEC = 1280 mg a.i./kg-diet;	475500-01, Acceptable	LOAEC = 3170 mg a.i./kg-diet Affected endpoints include: mortality, signs of toxicity, and effects on reproduction and offspring.
Indirect Toxicity to Terrestrial-Phase CRLF (via acute toxicity to mammalian prey items)	Sprague-Dawley rats,	LD_{50}>5000 mg a.i./kg -bw	41054808, Acceptable	14-day observation period, study with TGAI
Indirect Toxicity to Terrestrial-Phase CRLF (via chronic toxicity to mammalian prey items)	Sprague-Dawley rats	NOAEL=50 mg/kg/day	41750103, Acceptable	LOAEL= 250 mg/kg/day Offspring effects: pup weight decrements
Indirect Toxicity to Terrestrial-Phase CRLF (via acute toxicity to terrestrial invertebrate prey items)	Honey bee	LD_{50}>230 μg/bee	400018842, Acceptable	
Indirect Toxicity to Terrestrial- and Aquatic-Phase CRLF (via toxicity to terrestrial plants)	Seedling Emergence	Tomato EC_{25}=5.6	415649-01, supplemental	

Acute toxicity to terrestrial animals is categorized using the classification system shown in Table 4-4 (U.S. EPA, 2004). Toxicity categories for terrestrial plants have not been defined.

Table 4-4. Categories of Acute Toxicity for Avian and Mammalian Studies

Toxicity Category	Oral LD_{50}	Dietary LC_{50}
Very highly toxic	< 10 mg/kg	< 50 ppm
Highly toxic	10 - 50 mg/kg	50 - 500 ppm
Moderately toxic	51 - 500 mg/kg	501 - 1000 ppm
Slightly toxic	501 - 2000 mg/kg	1001 - 5000 ppm
Practically non-toxic	> 2000 mg/kg	> 5000 ppm

4.2.1 Toxicity to Birds

As specified in the Overview Document, the Agency uses birds as a surrogate for terrestrial-phase amphibians when amphibian toxicity data are not available (U.S. EPA, 2004). No terrestrial-phase amphibian data are available for DCPA; therefore, acute and chronic avian toxicity data are used to assess the potential direct effects of DCPA to terrestrial-phase CRLFs.

4.2.1.1 Birds: Acute Exposure (Mortality) Studies

One avian acute oral toxicity study is available for DCPA exposure to Northern bobwhite quail (MRID 41155705). No treatment related effects were observed during the study and the LD_{50} value was determined to be *greater than* 2250 mg/kg-body weight (bw). DCPA is therefore classified as practically non-toxic to birds on an acute basis.

4.2.1.2 Birds: Sub-Acute (Dietary) Exposure (Mortality) Studies

An avian sub-acute dietary toxicity study was submitted for Northern bobwhite quail (MRID 41155706). Bobwhite chicks were exposed to 560, 1000, 1780, 3160, and 5620 ppm in their diet for five days. There were no treatment related mortalities at any exposure level and therefore the LC_{50} is *greater than* 5620 ppm.

4.2.1.3 Birds: Chronic Exposure (Growth, Reproduction) Studies

Avian reproductive toxicity studies were submitted for two species, mallard duck (MRID 47550002) and Northern bobwhite quail (MRID 475500-01). Both studies followed the same DCPA exposure scheme: 0 (control), 1280, 3170, and 8020 mg a.i./kg-diet. Mallard duck appeared to be the less sensitive of the species with a NOAEC= 3170 mg a.i./kg-diet and no mortality observed throughout the study. Bobwhite quail were more sensitive and thirteen treatment related mortalities were observed during the study. A NOAEC of 1280 mg a.i./kg-diet and a LOAEC of 3170 mg a.i./kg-diet were found, based on mortality, signs of toxicity, and effects on reproduction and offspring. Treatment related reductions in multiple reproductive parameters were detected at the top two treatment levels. More specifically, reproductive and offspring effects included ratios of live 3-week embryos to viable embryos, number hatched to live 3-week embryos, hatchling survivors to eggs set and to number hatched, as well as survivor weights. Some animals at the higher treatment levels were so debilitated that they were sacrificed after week 18, three weeks prior to the end of the 21-week observation period.

4.2.2 Toxicity to Mammals

Mammalian toxicity data are used to assess potential indirect effects of DCPA to the terrestrial-phase CRLF. Effects to small mammals resulting from exposure to DCPA may also indirectly affect the CRLF via reduction in available food. As discussed in Section 2.5.3 over 50% of the prey mass of the CRLF may consist of vertebrates such as mice, frogs, and fish (Hayes and Tennant, 1985).

The Agency Carcinogenicity Peer Review Committee (CPRC) concluded that DCPA should be classified as a possible human carcinogen, based on evidence of increased incidences of thyroid tumors in both sexes of rat (although only at an excessive dose in the female) and liver tumors in two species (both female rat and mouse) at doses that were not excessive (U.S. EPA, 2002).

4.2.2.1 Mammals: Acute Exposure (Mortality) Studies

Parent DCPA

Acute mammalian toxicity studies resulted in no observable effects to rats exposed to DCPA. In an acute oral toxicity study with Sprague-Dawley rats, no effects were observed at 5000 mg/kg-bw throughout the 14-day observation period and therefore, the acute LC_{50} is *greater than* 5000 mg/kg-bw for mammals (MRID: 410548-10).

4.2.2.2 Mammals: Chronic Exposure (Growth, Reproduction) Studies

Parent DCPA

In a 2-generation reproduction study in rats (MRID 41750103), DCPA was administered in the feed to Sprague-Dawley rats. The F0 parental generation produced two litters, F1a and F1b. The F1b generation was mated to produce two litters, F2a and F2b. There were 35 rats/sex/dose group in the F0 and F1 generations with a ten week growth phase for the F0 generation before the first mating and a ten week growth phase for the F1b generation before the first mating. There were 20 rats/sex/dose group in the F2b generation which were observed for a six week growth period.

Dietary concentrations were 0, 1000, 5000, or 20000 ppm (equivalent to 0, 50, 250, or 1000 mg/kg/day using a 0.05 mg/kg/day per ppm conversion factor). Doses were changed to 0, 200, 500, or 20000 ppm on day 0 of lactation for the F2b litters (equivalent to 10, 25, or 1000 mg/kg/day using a 0.05 conversion factor) in order to ensure a NOAEL for F2 pup body weight decrements.

The parental NOAEL is 50 mg/kg/day and the parental LOAEL is 250 mg/kg/day based upon body weight decrements, gross and microscopic changes in kidneys and lungs, and microscopic changes in liver and thyroids. (MRID 41750103)

Reproductive toxicity: There were no treatment-related effects upon reproductive indices. Mating index, fertility index, pregnancy rates, and litter size were not affected by treatment. The stillborn index was increased in the 20000 ppm F2b group, but was comparable to historical control ranges and was not attributed to treatment. The reproductive NOAEL is ≥1000 mg/kg/day, the highest dose tested.

Offspring toxicity: On day 21 of lactation there were body weight decrements in the 5000 ppm F1a and F1b groups (92 and 89% of controls, respectively) and the 20000 ppm F1a and F1b groups (81 and 84%) of controls. On lactation day 21, there were body weight decrements in 5000 ppm F2a pups (89% of controls) and in 20000 ppm F2a and F2b pups (76-77% of controls). Pup body weights in the 500 ppm F2b litters were not affected by treatment. Body weight decrements in weaned pups were accompanied by decreased food consumption in F1 animals but not in F2 animals.

There were no treatment-related effects seen at pup necropsy. The offspring NOAEL is 50 mg/kg/day and the offspring LOAEL is 250 mg/kg/day based upon pup body weight decrements. This study is classified acceptable/guideline and satisfies requirements for a reproduction toxicity study, OPPTS 870.3800 (§83-4).

Degradate TPA

The *Health Effects Support Document for Dacthal Degradates: Tetrachloroterephthalic Acid (TPA) and Monomethyl Tetrachloroterephthalic Acid (MTP)* summarized the data for the degradates for TPA and MTP in the following excerpts (U.S. EPA, 2008a).

> "Both DCPA and TPA do cause adverse health effects in laboratory animals. Currently, no toxicological studies are available to assess the toxicological effects of MTP (the mono-acid degradate). Three studies in rats (30- and 90-day feeding studies and a developmental study) are available for TPA. The effects of exposure were mild (weight loss and diarrhea) and occurred at doses greater than or equal to 2000 mg/kg/day. No reproductive effects were observed. The critical effects for DCPA, the parent compound, include effects on the lung, liver, kidney, and thyroid in male and female rats in a 2-year chronic bioassay (ISK Biotech, 1993). The available data indicate that the adverse effects associated with TPA are much milder than those for the parent and tend to occur at doses that are lower by approximately an order of magnitude." Page 1-2
>
> "The only noncancer health effects noted with TPA were soft stools and occult blood in urine at doses of greater than 2000 mg/kg/day (Major, 1985). Doses of 2500 mg/kg/day administered during gd 6-15 also caused soft stools, increased salivation, decreased body weight gain, and decreased food consumption (Mizen, 1985). No effects were observed in the single study of MTP (Hazelton, 1961)." Page 7-7
>
> "The results from the short-term TPA study differed from those for DCPA in a 28-day dietary study in groups of five male and female Sprague-Dawley rats given doses of 0, 250, 1000, or 2000 mg/kg/day (ISK Biotech Corp., 1990b). In the DCPA study, there was a dose-related increase in liver weight and centrilobular hypertrophy of hepatocytes. The lowest dose tested (250 mg/kg/day) was the LOAEL for these effects (U.S. EPA, 1994c). The difference in the effect levels suggests that the parent DCPA is more acutely toxic than the TPA degradate. The results of a 28-day study of MTP by Hazleton Laboratory (1961), comparable to Hazleton's TPA study described above, did not identify any signs of toxicity at the 1% (860 mg/kg/day) dietary dose tested."Page 7-2

Based on this analysis, we concluded that TPA was less toxic than DCPA and therefore, terrestrial risk from exposure to DCPA is considered to encompass potential sources of risk from degradates.

4.2.3 Toxicity to Terrestrial Invertebrates

Terrestrial invertebrate toxicity data are used to assess potential indirect effects of DCPA to the terrestrial-phase CRLF. Effects to terrestrial invertebrates resulting from exposure to DCPA may also indirectly affect the CRLF via reduction in available food.

4.2.3.1 Terrestrial Invertebrates: Acute Exposure (Mortality) Studies

A honey bee acute contact study (99.6% a.i.) resulted in honey bee LD_{50}>230 μg a.i./bee (MRID 400018842). DCPA is classified as practically nontoxic to bees.

4.2.4 Toxicity to Terrestrial Plants

Terrestrial plant toxicity data are used to evaluate the potential for DCPA to affect riparian zone and upland vegetation within the action area for the CRLF. Impacts to riparian and upland (*i.e.*, grassland, woodland) vegetation may result in indirect effects to both aquatic- and terrestrial-phase CRLFs, as well as modification to designated critical habitat PCEs via increased sedimentation, alteration in water quality, and reduction in of upland and riparian habitat that provides shelter, foraging, predator avoidance and dispersal for juvenile and adult CRLFs.

Plant toxicity data from both registrant-submitted studies and studies in the scientific literature were reviewed for this assessment. Registrant-submitted studies are conducted under conditions and with species defined in EPA toxicity test guidelines. Sub-lethal endpoints such as plant growth, dry weight, and biomass are evaluated for both monocots and dicots, and effects are evaluated at both seedling emergence and vegetative life stages. Guideline studies generally evaluate toxicity to ten crop species. A drawback to these tests is that they are conducted on herbaceous crop species only, and extrapolation of effects to other species, such as the woody shrubs and trees and wild herbaceous species, contributes uncertainty to risk conclusions.

Commercial crop species have been selectively bred, and may be more or less resistant to particular stressors than wild herbs and forbs. The direction of this uncertainty for specific plants and stressors, including DCPA, is largely unknown. Homogenous test plant seed lots also lack the genetic variation that occurs in natural populations, so the range of effects seen from tests is likely to be smaller than would be expected from wild populations.

At the time the terrestrial plant studies were reviewed (MRID: 41440101, 41564901)it was recommended that the studies not be used for risk assessment purposes because EC_{25}'s could not be determined for nearly all species and tolerant plant species were used.

It was recommended that the studies not be repeated using the same species. Alternatively, special testing was outlined and recommended as below.

Both seedling emergence and vegetative vigor test should be conducted for a minimum of 28 days to accommodate the delayed mode of action of DCPA, mitotic disruption. In mitotic disruption, the chemical first will stop the growth of roots and shoots of seedlings. Then after a period of time it causes deterioration. This delay may be several weeks depending on environmental conditions and species tested.

The following information should be required from each replicate of the seedling emergence tests:

- Percentage of emergence and survival of seedlings every seven days;
- Height of shoots every seven days; and

- Fresh weights and dry weights of shoots at study termination

The following information should be required from each replicate of the Vegetative vigor tests:

- Plant height every seven days
- Phyotoxicity rating every seven days; and
- Fresh weight of foliage, dried weight of foliage, fresh weight of roots, dried weight of roots at test termination.

The above review of the plant toxicity data was supplied in 1993. Since that time, new data have not been submitted. Therefore, given the weaknesses in the available data, effects to plants from the herbicide DCPA are assumed.

4.3 Use of Probit Slope Response Relationship to Provide Information on the Endangered Species Levels of Concern

The Agency uses the probit dose response relationship as a tool for providing additional information on the potential for acute direct effects to individual listed species and aquatic animals that may indirectly affect the listed species of concern (U.S. EPA, 2004). No definitive acute endpoints were available in this assessment and therefore, this analysis was not performed. The table below lists the range of individual effects that result from default assumtions (LOC compared to default slopes).

Probit Slope and Odds of Mortality for an Individual at the LOC

Listed Species	Birds and Mammals	Fish and Aq Invertebrates
LOC	0.1	0.05
Slope	4.5	4.5
Slope 95% CL	2, 9	2, 9
Odds of individual effect	1 in 294,000	1 in 418,000,000
95% CL	1 in 44, <1 in 10^{18}	1 in 216, 1 in 1.75 $x10^{31}$

*Default mean slope value (4.5) and 95% CL (2, 9) is used due to specific dose-response information for this group.
**The probit model is a poor fit for the tested doses and response, therefore the lower 95% CL for the data was not a valid slope and the default lower 95% CL of 2 was use

4.4 Incident Database Review

A review of the EIIS database for ecological incidents involving DCPA was completed on December 1, 2008. The results of this review for terrestrial, plant, and aquatic incidents are discussed below.

A fish kill of unknown magnitude to unknown species (I000636-014) was reported in April 1984 after DCPA was applied to golf course turf in Iron County Missouri.   According to the incident report, DCPA is considered a possible cause of the incident and it is unknown if the incident was caused by a legal use.

In an agricultural area in Imperial County California, both fish and bird kills were reported after a misuse in May 1988 that resulted in runoff to a nearby stream. The certainty classification applied to the incident is highly probable DCPA. Species affected included catfish (50), egret (12), and shad (50).

5.0 Risk Characterization

Risk characterization is the integration of the exposure and effects characterizations. Risk characterization is used to determine the potential for direct and/or indirect effects to the CRLF or for modification to its designated critical habitat from the use of DCPA in CA. The risk characterization provides an estimation (Section 5.1) and a description (Section 5.2) of the likelihood of adverse effects; articulates risk assessment assumptions, limitations, and uncertainties; and synthesizes an overall conclusion regarding the likelihood of adverse effects to the CRLF or its designated critical habitat (*i.e*., "no effect," "likely to adversely affect," or "may affect, but not likely to adversely affect").

5.1 Risk Estimation

Risk is estimated by calculating the ratio of exposure to toxicity. This ratio is the risk quotient (RQ), which is then compared to pre-established acute and chronic levels of concern (LOCs) for each category evaluated (Appendix C). For acute exposures to the CRLF and its animal prey in aquatic habitats, as well as terrestrial invertebrates, the LOC is 0.05. For acute exposures to the CRLF and mammals, the LOC is 0.1. The LOC for chronic exposures to CRLF and its prey, as well as acute exposures to plants is 1.0.

Risk to the aquatic-phase CRLF is estimated by calculating the ratio of exposure to toxicity using 1-in-10 year EECs based on the label-recommended DCPA usage scenarios summarized in Table 3-1 and the appropriate aquatic toxicity endpoint from Table 4-1. For TPA, the peak values estimated using GENEEC was used to evaluate risk.[19] Risks to the terrestrial-phase CRLF and its prey (*e.g*. terrestrial insects, small mammals and terrestrial-phase frogs) are estimated based on exposures resulting from applications of DCPA (3.3.1 through 3.3.1.1b)) and the appropriate toxicity endpoint from Table 4-3. Exposures are also derived for terrestrial plants, as discussed in Section 3.3 and summarized in Table 3-17, based on the highest application rates of DCPA use within the action area.

5.1.1 Exposures in the Aquatic Habitat

5.1.1.1 Direct Effects to Aquatic-Phase CRLF

Direct effects to the aquatic-phase CRLF are based on peak DCPA EECs in the standard pond and the lowest acute toxicity value for freshwater fish. Peak EECs for DCPA ranged from 37 – 500 µg/L (Table 3-6). As described in Section 4, the only suitable toxicity data for freshwater fish showed no effects of acute exposure at the limit of DCPA solubility (500 µg/L) and therefore RQ values were not calculated. The ratio of the peak EEC to the solubility limit ranges from 0.07 - 1.00. The ratio is 0.01 for one application (10.5 a.i./A applied January 1) to cole crops with 2 inches soil incorporation.[20]

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19 GENEEC does not estimated 1 in 10 year values.

20 The peak, 21-day, and 60-day aquatic EECs with two inches soil incorporation were 7, 5, and 3 µg/L with one application of DCPA to cole crops (CA Cole Crop RLF_V2) at 10.5 a.i./A applied on January 1 is modeled.

TPA is much more soluble (TPA solubility = 5780 mg/L) than DCPA (0.5 mg/L). This is reflected in the high TPA EECs calculated with PRZM-EXAMS. TPA's aquatic EECs ranged from 0.33 - 4.07 mg/L, based on GENEEC, while DCPA's aquatic EECs ranged from 0.02 - 0.5 mg/L. TPA aquatic effects data are not available. To estimate the potential risk from TPA exposure two approaches are possible. First, assume that the parent and degradate exhibit similar toxicity. This does not offer very much information because the data for DCPA are limited by the very low solubility of DCPA. The other option is to use toxicity data from chemicals with a similar structure to TPA. The structure of TPA is similar to benzoic acid herbicides dicamba and 2,3,6-trichlorobenzoic acid (2,3,6-TBA). Toxicity data for dicamba were used as a surrogate to estimate aquatic toxicity of TPA. Risk quotients ranged from 0.01 - 0.11 and LOCs of 0.05 were exceeded for turf, nursery, and ornamental uses with multiple applications and for food crops with five or more applications. This indicates that direct acute effects to the red legged frog are likely.

Data that can be used qualitatively are available for the brown striped marsh frog (48-hour LC_{50} = 166 mg/L, dicamba) and the fathead minnow (24-hour LC_{50} = 13.5 mg/L, 2,3,6-TBA) (ECOTOX database). These endpoints are all lower than or near the highest TPA peak aquatic EECs (0.34 - 4.07 mg/L; Table 3-7). The ratio of EECs to the endpoints of similar compounds converted to TPA equivalents range from <0.01 – 0.22. This indicates that direct acute effects to the red legged frog are likely.

Table 5-1. Summary of Risk Quotients and Ratios of EECs to Toxicity Endpoints for TPA Based on Surrogate Toxicity Data – Used to Evaluate the Potential for Direct Effects for the Aquatic Phase CRLF

Use (Number of applications, application interval)	Formulation	Ground or Aerial	DCPA App. Rate (TPA App. Rate)lbs a.i./A	Risk Quotient	Ratio of EEC/ LC_{50}	
				Rainbow Trout 96-hr EC_{50} = 38 mg/L TPA equivalents[1,2]	Brown striped marsh frog 48 hr LC_{50} = 228 mg/L TPA Equivalents[1,3]	Fathead Minnow 24-hr LC_{50} = 18 mg/L TPA equivents[1,4]
Turf, Nursery, and Ornamentals, 6 app., 7 days	G	Ground or Aerial	15.2 (13.8)	**0.08**	0.01	**0.16**
Turf, Nursery, and Ornamentals, 6 app., 7 days	FlC or WP	Aerial	15 (14)	**0.09**	0.02	**0.19**
Turf, Nursery, and Ornamentals, 6 app., 7 days	FlC or WP	Ground	15 (14)	**0.09**	0.01	**0.18**
Turf, Nursery, and Ornamentals, 1 app.	FlC or WP	Aerial	15 (14)	0.01	0.00	0.03
Turf, Nursery, and Ornamentals, 6 app., 7 days	G	Aerial or Ground	11.4 (10.4)	**0.06**	0.01	**0.12**

Use (Number of applications, application interval)	**Formulation**	**Ground or Aerial**	**DCPA App. Rate (TPA App. Rate)lbs a.i./A**	**Risk Quotient**	**Ratio of EEC/ LC_{50}**	
				Rainbow Trout 96-hr EC_{50} = 38 mg/L TPA equivalents[1,2]	**Brown striped marsh frog 48 hr LC_{50} = 228 mg/L TPA Equivalents[1,3]**	**Fathead Minnow 24-hr LC_{50} = 18 mg/L TPA equivents[1,4]**
Nursery and ornamentals, 6 app., 7 days	FlC or WP	Aerial	12 (11)	**0.07**	0.01	**0.15**
Nursery and ornamentals, 6 app., 7 days	FlC or WP	Ground	12 (11)	**0.07**	0.01	**0.14**
All Food Crops, 1 app.[5]	WP and FlC	Ground	10.5 (9.6)	0.01	0.00	0.02
All Food Crops, 1 app.[5]	G	Aerial or Ground	10.5 (9.6)	0.01	0.00	0.02
All Food Crops, 2 app., 7 days[5]	WP and FlC	Ground	10.5 (9.6)	0.02	0.00	0.04
All Food Crops, 3 app., 7 days[5]	WP and FlC	Ground	10.5 (9.6)	0.03	0.00	**0.06**
All Food Crops, 4 app., 7 day[5]	WP and FlC	Ground	10.5 (9.6)	0.04	0.01	**0.08**
All Food Crops, 5 app., 7 days[5]	WP and FlC	Ground	10.5 (9.6)	**0.05**	0.01	**0.10**
All Food Crops, 6 app., 7 days[5]	WP and FlC	Ground	10.5 (9.6)	**0.06**	0.01	**0.12**
All Food Crops, 7 app., 7 days[3]	WP and FlC	Ground	10.5 (9.6)	**0.07**	0.01	**0.14**
All Food Crops, 8 app., 7 days[5]	WP and FlC	Ground	10.5 (9.6)	**0.08**	0.01	**0.16**
All Food Crops, 9 app., 7 days[5]	WP and FlC	Ground	10.5 (9.6)	**0.09**	0.01	**0.18**
All Food Crops, 10 app., 7 days[5]	WP and FlC	Ground	10.5 (9.6)	**0.10**	0.02	**0.20**
All Food Crops, 11 app., 7 days[5]	WP and FlC	Ground	10.5 (9.6)	**0.11**	0.02	**0.22**
All Food Crops, 11 app., 7 days[5]	G	Aerial or Ground	10.5 (9.6)	**0.10**	0.02	**0.20**

Abbreviations: App.= application; hr=hour
Bold values are equal to or greater than the LOC of 0.05.
1- TPA equivalents were determined using the following equation. Endpoint in TPA equivalents = Compound X Endpoint x (TPA molecular weight, 303.91/Compound X Molecular weight). Dicamba's molecular weight is 221.04 daltons and 2,3,6-TBA's is 225.45 daltons.
2- The LC_{50} was estimated using the rainbow trout 96-hr LC_{50} of 28 mg acid equivalents a.e./L for dicamba (MRID 0041272).

3- The LC_{50} was estimated using the brown striped marsh frog 48-hr LC_{50} of 166 mg a.i./L for dicamba acid (ECOTOX database).
4- The LC_{50} was estimated using the fathead minnow 24-hr LC_{50} of 13.5 mg a.i./L for 2,3,6-TBA (ECOTOX database).
5- All food uses except garlic have a 10.5 lb a.i./A application rate. Garlic's application rate is 10.4 and is close enough to 10.5 to also be represented by this rate. See Table 3-1 for a list of food crops and application rates. All food crops could have more than one application as a maximum number of applications is not specified on any of the labels.

Typically, in order to assess direct chronic risks to the CRLF, 60-day EECs and the lowest chronic toxicity value for freshwater fish are used. For DCPA, no chronic aquatic effects data are available. Without acute endpoints or chemicals of a similar class from which to extrapolate a chronic endpoint, toxicity endpoints cannot be estimated. Both avian and mammalian toxicity data showed no acute effects while chronic effects were observed. Therefore, in light of the pattern shown with terrestrial species, it is reasonable to conclude that chronic effects to fish are possible. Additionally, because DCPA has the potential to remain in the environment, chronic exposure is possible. The same conclusion can be made for the degradate TPA.

Additional evidence to support possible affects to the aquatic phase CRLF are the fish kills reported in the incident database and described in Section 4.

Based on potential acute and chronic effects and exposure to the degradate TPA, DCPA use **May Affect** the aquatic-phase of the CRLF.

5.1.1.2 Indirect Effects to Aquatic-Phase CRLF via Reduction in Prey (non-vascular aquatic plants, aquatic invertebrates, fish, and frogs)

a) __Non-vascular Aquatic Plants__

Indirect effects of DCPA to the aquatic-phase CRLF (tadpoles) via reduction in non-vascular aquatic plants in its diet are based on peak EECs (37-500 µg/L) from the standard pond and the lowest toxicity value (EC_{50}) for aquatic non-vascular plants. Based on aquatic plant toxicity studies where effects were observed at or above solubility, parent DCPA appears to affect aquatic plants. Thus, use of DCPA has the potential to effect non-vascular plants in the aquatic environment.

Toxicity endpoints for dicamba were used to evaluate risk to non-vascular plants as a result of exposure to TPA. Toxicity studies with algae exposed to dicamba acid indicate that cell densities were significantly reduced in blue-green algae, the EC_{50} was 0.061 mg/L (0.08 mg/L in TPA equivalents) (U.S. EPA, 2005). The resulting RQs range from 4.22 - 50.88 and all exceed the LOC of 1.0 for plants (Table 5-2). Thus, it is likely that exposure to TPA will result in effects on non-vascular plants due to use of DCPA.

Table 5-2. Summary of Risk Quotients and Ratios of EECs to Toxicity Endpoints for TPA Based on Surrogate Toxicity Data- Used to Evaluate the Potential for Indirect Effects to the Aquatic Phase CRLF

Use (Number of applications, application interval)	Form.	Ground or Aerial	DCPA App. Rate (TPA App. Rate) lbs a.i./A	Risk Quotients		Ratio of EEC/Toxicity Endpoint
				Freshwater Invertebrate LC_{50} = 47 mg/L TPA equivalents[1,2]	Non-vascular Plants EC_{50} = 0.08 mg/L TPA equivalents[1,4]	Vascular Plants EC_{50} = >4.47 mg/L TPA equivalents[1,3]
Turf, Nursery, and Ornamentals, 6 app., 7 days	G	Ground or Aerial	15.2 (13.8)	**0.06**	**37.00**	<0.66
Turf, Nursery, and Ornamentals, 6 app., 7 days	FlC or WP	Aerial	15 (14)	**0.07**	**42.75**	<0.77
Turf, Nursery, and Ornamentals, 6 app., 7 days	FlC or WP	Ground	15 (14)	**0.07**	**40.50**	<0.72
Turf, Nursery, and Ornamentals, 1 app.	FlC or WP	Aerial	15 (14)	0.01	**7.12**	<0.13
Turf, Nursery, and Ornamentals, 6 app., 7 days	G	Aerial or Ground	11.4 (10.4)	**0.05**	**27.50**	<0.49
Nursery and ornamentals, 6 app., 7 days	FlC or WP	Aerial	12 (11)	**0.06**	**33.63**	<0.60
Nursery and ornamentals, 6 app., 7 days	FlC or WP	Ground	12 (11)	**0.05**	**31.75**	<0.57
All Food Crops, 1 app.[5]	WP and FlC	Ground	10.5 (9.6)	0.01	**4.63**	<0.08
All Food Crops, 1 app.[5]	G	Aerial or Ground	10.5 (9.6)	0.01	**4.22**	<0.08
All Food Crops, 2 app., 7 days[5]	WP and FlC	Ground	10.5 (9.6)	0.02	**9.25**	<0.17
All Food Crops, 3 app., 7 days[5]	WP and FlC	Ground	10.5 (9.6)	0.02	**13.88**	<0.25
All Food Crops, 4 app., 7 day[5]	WP and FlC	Ground	10.5 (9.6)	0.03	**18.50**	<0.33
All Food Crops, 5 app., 7 days[5]	WP and FlC	Ground	10.5 (9.6)	0.04	**23.13**	<0.41
All Food Crops, 6 app., 7 days[5]	WP and FlC	Ground	10.5 (9.6)	**0.05**	**27.75**	<0.50

Use (Number of applications, application interval)	Form.	Ground or Aerial	DCPA App. Rate (TPA App. Rate) lbs a.i./A	Risk Quotients		Ratio of EEC/Toxicity Endpoint
				Freshwater Invertebrate LC_{50} = 47 mg/L TPA equivalents[1,2]	Non-vascular Plants EC_{50} = 0.08 mg/L TPA equivalents[1,4]	Vascular Plants EC_{50} = >4.47 mg/L TPA equivalents[1,3]
All Food Crops, 7 app., 7 days[3]	WP and FlC	Ground	10.5 (9.6)	**0.06**	**32.38**	<0.58
All Food Crops, 8 app., 7 days[5]	WP and FlC	Ground	10.5 (9.6)	**0.06**	**37.00**	<0.66
All Food Crops, 9 app., 7 days[5]	WP and FlC	Ground	10.5 (9.6)	**0.07**	**41.63**	<0.74
All Food Crops, 10 app., 7 days[5]	WP and FlC	Ground	10.5 (9.6)	**0.08**	**46.25**	<0.83
All Food Crops, 11 app., 7 days[5]	WP and FlC	Ground	10.5 (9.6)	**0.09**	**50.88**	<0.91
All Food Crops, 11 app., 7 days[5]	G	Aerial or Ground	10.5 (9.6)	**0.08**	**46.50**	<0.83

Abbreviations: App.= application; G=granular; WP = wettable powder; FlC = flowable concentrate; app.=applications

1- TPA equivalents were determined using the following equation. Endpoint in TPA equivalents = Compound X Endpoint x (TPA molecular weight, 303.91/Compound X Molecular weight). Dicamba's molecular weight is 221.04 daltons and 2,3,6-TBA's is 225.45 daltons.

2- The EC_{50} was estimated using the daphnid 48-hr EC_{50} of 34.6 mg a.e./L for dicamba (MRID 00233292). Bold values are equal to or greater than the LOC of 0.05 for acute listed invertebrates.

3- The toxicity value was estimated using the duckweed EC_{50} of >3.25 mg a.e./L for dicamba (MRID 42774111). The LOEC of the study was 0.39 mg/L and the NOEC was 0.20 mg a.e./L. Bold values are equal to or greater than the LOC of 1.0 for aquatic plants.

4- The EC_{50} was estimated using the blue-green algae EC_{50} of 0.061 mg a.e./L for dicamba (MRID 42774109). The NOEC was 0.005 mg a.e./L and the effect observed was on cell density. Bold values are equal to or greater than the LOC of 1.0 for aquatic plants.

5- All food uses except garlic have a 10.5 lb a.i./A application rate. Garlic's application rate is 10.4 and is close enough to 10.5 to also be represented by this rate. See Table 3-1 for a list of food crops and application rates. All food crops could have more than one application as a maximum number of applications is not specified on any of the labels.

b) Aquatic Invertebrates

Indirect acute effects to the aquatic-phase CRLF via effects to aquatic invertebrates (prey of juvenile and adult aquatic-phase CRLF) are based on 1-in-10-year peak EECs in the standard pond and the lowest acute toxicity value for freshwater invertebrates. For chronic risks, 1-in-10-year 21-day-mean EECs and the lowest chronic toxicity value for invertebrates are used to derive RQs. Aquatic risk due to exposure to TPA was evaluated using peak EECs generated using GENEEC.

Toxicity data for freshwater invertebrates was limited by DCPA solubility and RQ values could not be calculated. Because no mortality was observed in the *daphnid* study, acute effects to freshwater invertebrates are not expected from exposure to DCPA. The ratio of the peak EEC to the solubility limit ranges from 0.07 - 1.00. No chronic freshwater invertebrate data on DPCA or other benzoic acid herbicides are available. TPA, however, has a much higher solubility and EECs (0.34 - 4.07 mg/L) are greater than dicamba's acute 48-hr LC_{50} of 34.6 mg/L (47.57 mg/L in TPA equivalents) for freshwater invertebrates (U.S. EPA, 2005). Risk quotients based on this endpoint range from 0.01 - 0.09 (Table 5-2). RQs exceed the acute listed invertebrate LOC for turf, ornamental, and nursery uses with multiple applications and for food uses with more than six applications. This indicates that it is possible that effects to invertebrates may occur with exposure to TPA.

Typically, in order to assess indirect chronic risks to the CRLF, 21-day EECs and the lowest chronic toxicity value for freshwater invertebrates are used. For DCPA, no chronic aquatic effects data are available. Without acute endpoints or chemicals of a similar class from which to extrapolate a chronic endpoint, toxicity endpoints cannot be estimated. Both avian and mammalian toxicity data showed no acute effects while chronic effects were observed. Therefore, in light of the pattern shown with terrestrial species, it is reasonable to conclude that chronic effects to invertebrates are possible. Additionally, because DCPA has the potential to remain in the environment, chronic exposure is possible. The same conclusion can be made for the degradate TPA.

Based on potential for 1) effects on non-vascular plants, 2) acute effects due to exposure to TPA, and 3) chronic effects due to exposure to TPA and DCPA, DCPA use **May Affect,** indirectly, the aquatic-phase of the CRLF.

c) Fish and Frogs

Fish and frogs also represent potential prey items of adult aquatic-phase CRLFs. RQs associated with acute and chronic direct toxicity to the CRLF (section 5.1.1.1) are used to assess potential indirect effects to the CRLF based on a reduction in freshwater fish and frogs as food items.

Based on uncertainty associated with aquatic toxicity of DCPA and TPA, use of DCPA **May Affect**, indirectly, the CRLF via reduction in freshwater fish and frogs as food items.

5.1.1.3 Indirect Effects to CRLF via Reduction in Habitat and/or Primary Productivity (Freshwater Aquatic Plants)

Indirect effects of the aquatic-phase CRLF via reduction in habitat resulting from DCPA exposures are based on 1-in-10-year peak EECs from the standard pond and the lowest toxicity value (EC_{50}) for aquatic non-vascular and vascular plants. Because there are no obligate relationships between the CRLF and any aquatic plant species, the most sensitive EC_{50} values, rather than NOAEC values, are used to derive RQs. Effects to nonvascular plants are presented in Section 5.1.1.2.a. Based on effects to vascular aquatic plants from DCPA at the limit of solubility, and estimated EECs at the limit of solubility, use of DCPA is likely to result in effects to vascular plants.

Toxicity endpoints for dicamba were used to evaluate risk to vascular plants as a result of exposure to TPA. Aquatic vascular plant species were not as sensitive to dicamba acid with 14-day EC_{50} values of >3.25 mg a.i./L (> 4.47 TPA equivalents; U.S. EPA, 2005). The ratio of peak TPA EECs over >4.47 mg/L TPA equivalents ranges from <0.08 – <0.91 (Table 5-2). These ratios are all below the LOC of 1.0 for aquatic plants. This indicates that effects to vascular plants are unlikely as a result of exposure to TPA. However, this is based on surrogate data and the conclusion that effects are not expected to occur is uncertain. Additionally, effects on frond chlorosis were observed at concentrations of 0.39 mg a.e./L and all peak TPA EECs exceed the TPA equivalent concentration of 0.53 mg/L.

Based on potential effects on 1) non-vascular plants due to exposure to DCPA or TPA and vascular plants due to exposure to DCPA, DCPA use **May Affect,** indirectly, the aquatic-phase of the CRLF.

5.1.2 Exposures in the Terrestrial Habitat

5.1.2.1 Direct Effects to Terrestrial-phase CRLF

As previously discussed in Section 3.3, potential direct effects to terrestrial-phase CRLFs are based on broadcast (foliar and bare ground), granular, banded, and soil incorporated applications, of DCPA.

Potential direct acute effects to the terrestrial-phase CRLF are derived by considering dose- and dietary-based EECs modeled in T-REX for a small bird (20 g) consuming small invertebrates (Table 3-15) and acute oral and subacute dietary toxicity endpoints for avian species.

The avian acute and subacute endpoints are not definitive (*i.e.* greater than values), therefore, definitive RQs cannot be calculated. There was no mortality in any of the studies, and the potential for direct acute or subacute effects to the CRLF are presumed low. However, comparing the highest dose tested in toxicity studies to the EECs can provide insight into the potential for direct effects to the CRLF. The dose-based endpoint, LD_{50} >2250 mg a.i./kg-bw (bobwhite quail), is lower than the dose based EECs that range from 1614 – 10061 mg/kg-bw (Table 3-15). The ratio of the EECs to the highest dose tested ranges from 0.72 - 4.47. The subacute dietary endpoint, LC_{50} >5620 mg a.i./kg-bw is in the range of predicted EECs (1418 – 8834 mg/kg-diet). The ratio of the EECs to the highest dietary concentration tested ranges from 0.29 - 1.8. If toxicity were observed slightly above the highest levels tested, there is a potential that the LOC for listed species (0.1) could be exceeded. RQ values were not calculated because a definitive endpoint was not available.

Potential direct chronic effects of DCPA to the terrestrial-phase CRLF are derived by considering dietary-based exposures modeled in T-REX for a small bird (20g) consuming small invertebrates. Chronic effects are estimated using the lowest available toxicity data for birds. EECs are divided by toxicity values to estimate chronic dietary-based RQs.

Chronic reproductive effects to birds were observed at 3170 mg a.i./kg-diet (LOAEC), with an associated NOAEC of 1280 mg a.i./kg-diet. TREX modeled EECs and RQ values results in chronic RQs (1.11-6.9) that exceed the chronic LOC of 1.0 for all use scenarios. Based on potential direct chronic effects, DCPA **May Affect** the terrestrial-phase of the CRLF.

Table 5-3. Summary of Chronic RQs* Used to Estimate Direct Effects to the Terrestrial-phase CRLF TREX

Use	Dietary-based Chronic RQ[5]
Turf and Ornamentals, 6 applications[1]	**6.9**
Nursery and Ornamentals[2]	**5.52**
All Food Crops [3]	**1.11**
Turf and Ornamentals, 1 application[4]	**1.58**

* LOC exceedances (chronic RQ $\geq$ 1) are bolded.
1-Turf and Ornamentals, 15 lbs a.i./A, 6 applications, 7 day interval
2-Nursery and Ornamentals, 12 lbs a.i./A, 6 applications, 7 day interval
3-All Food Crops, 10.5 lbs a.i./A, 1 application
4- Turf, 1 application at 15 lbs a.i./A
5 Based on dietary based EEC and DCPA NOAEC of 1280 mg/kg-bw for the bobwhite quail

5.1.2.2 Indirect Effects to Terrestrial-Phase CRLF via Reduction in Prey (terrestrial invertebrates, mammals, and frogs)

a) Terrestrial Invertebrates

In order to assess the risks of DCPA to terrestrial invertebrates, which are considered prey of CRLF in terrestrial habitats, the honey bee is used as a surrogate for terrestrial invertebrates. The toxicity value for terrestrial invertebrates is calculated by multiplying the lowest available acute contact LD_{50} greater than 230 µg a.i./bee by 1 bee/0.128g, which is based on the weight of an adult honey bee. EECs (µg a.i./g of bee) calculated by T-REX for small and large insects are divided by the calculated toxicity value for terrestrial invertebrates, which is greater than 1797 µg a.i./g of bee. Based on the ratio between EECs and the LD_{50} for bees, some DCPA uses **May Affect,** indirectly, the CRLF via reduction in terrestrial invertebrate prey items.

Table 5-4. Summary of RQs Used to Estimate Indirect Effects to the Terrestrial-phase CRLF via Direct Effects on Terrestrial Invertebrates as Dietary Food Items*

Use	Small Insect EEC /LD_{50} ; ratio	Large Insect EEC/LD_{50}; ratio
One app, 10.5lbs a.i./A	1418/>1797; <0.79	158/>1797; <0.09
15 lbs, 6 apps, 7 days	**8834/>1797; <4.9**	982/>1797; <0.55
12 lbs, 6 apps, 7 days	**7067/>1797; <3.93**	785/>1797; <0.44
10.5, 2 apps, 183 days	1455/>1797; <0.81	162/>1797; <0.09

* = Ratios greater than 1 are bolded . Because a definitive endpoint was not established for terrestrial invertebrates (*i.e.*, the value is greater than the highest test concentration), the ratio represents an upper bound value

b) Mammals

Risks associated with ingestion of small mammals by large terrestrial-phase CRLFs are derived for dietary-based and dose-based exposures modeled in T-REX for a small mammal (15g) consuming short grass. Acute and chronic effects are estimated using the most sensitive mammalian toxicity data. EECs are divided by the toxicity value to estimate acute and chronic dose-based RQs as well as chronic dietary-based RQs.

The mammalian acute endpoints are not definitive (*i.e.* greater than values), therefore definitive RQs cannot be calculated. There was no mortality in any of the studies, and the potential for direct acute risks to mammals are presumed low. However, comparing the highest dose tested in toxicity studies to the EECs can provide insight into the potential for indirect effects to the CRLF via reduction in prey. The dose-based endpoint, LD_{50} >5000 mg a.i./kg-bw (Sprague Dawley rat), is in the range of the dose based EECs that range from 2403 – 14974 mg/kg-bw (Table 3-15). The ratio of the EECs to the highest dose tested ranges from 0.48 - 2.99. If toxicity were observed slightly above the highest levels tested, there is a potential that the LOC for listed species (0.1) could be exceeded. RQ values were not calculated because a definitive endpoint was not available. A statistical analysis of the probability of mortality based on the sample size of the test organisms is provided in the Risk Characterization section.

Effects to parent and offspring were observed at 50 mg a.i./kg-bw in a chronic reproductive test and chronic RQ values based on this endpoint exceed the chronic LOC (1). RQ values for each use are presented in Table 5-5 below and range from 3-136. Values in bold exceed the chronic LOC of 1.0. Based on potential for direct chronic effects to mammals, as indicated by RQs greater than the LOC (1), DCPA **May Affect**, indirectly, the CRLF via reduction in small mammal prey items.

Table 5-5. Summary of Chronic RQs* Used to Estimate Indirect Effects to the Terrestrial-phase CRLF via Direct Effects on Small Mammals as Dietary Food Items (from TREX—conservative NOAEC)

Use	Chronic RQ	
	Dose-based Chronic RQ[1]	Dietary-based Chronic RQ[2]
Turf and Ornamental, 1 application[3]	**31.23**	**3.60**
Turf and Ornamental, 6 applications[4]	**136.26**	**15.71**
Turf and Ornamental[5]	**109.01**	**12.56**
All food crops [6]	**21.86**	**2.52**
All food crops[7]	**22.45**	**2.59**

* = LOC exceedances (acute RQ $\geq$ 0.1 and chronic RQ $\geq$ 1) are bolded.
1-Based on dose-based EEC and DCPA rat NOAEL = 50 mg/kg-bw.
2-Based on dietary-based EEC and DCPA rat NOAEC = 50 mg/kg-bw.
3-Turf and Ornamental, 15 lbs a.i./A, 1 application.
4-Turf and Ornamental, 15 lbs a.i./A, 6 applications, 7 day interval
5-Turf and Ornamental, 12 lbs a.i./A, 6 applications, 7 day interval
6-All food crops, 10.5 lbs a.i./A, 1 application

7-All food crops, 10.5 lbs a.i./A, 2 applications, 183 day interval

c) <u>Frogs</u>

An additional prey item of the adult terrestrial-phase CRLF is other species of frogs. In order to assess risks to these organisms, dietary-based and dose-based exposures modeled in T-REX for a small bird (20g) consuming small invertebrates are used. See Section 5.1.2.1 and associated table (Table 5-3) for results. Based on the potential for chronic risks to avian species (measurement endpoint for effects to amphibians), indirectly, DCPA **May Affect** the CRLF via reduction in frogs as prey items.

5.1.2.3 Indirect Effects to CRLF via Reduction in Terrestrial Plant Community (Riparian and Upland Habitat)

Potential indirect effects to the CRLF resulting from direct effects on riparian and upland vegetation are typically assessed using data from terrestrial plant seedling emergence and vegetative vigor EC_{25} data as a screen. While only one terrestrial plant EC_{25} was available (seedling emergence, tomato fresh weight EC_{25}=5.6 lbs a.i./A) and the resultant RQ calculated from this singular endpoint did not exceed the LOC, several lines of evidence lend support to a qualitative assumption of effects to non-target plants from DCPA use.

Additional evidence is provided by warnings and directions on the product labels. The product labels give very specific instructions regarding application timing and methodology. This language indicates that damage to crops may occur if the directions are not closely followed. Examples include:

- Turf: “Do not try to reseed bare areas for at least 60 days. Do not use on bentgrass. Chewings fescue may be thinned by this treatment.”

- Shrubs, Flower Beds: “Use only on established shrubs and flowers or transplants.”

- Strawberries: “Do not apply after first bloom”

- Replanting: Replanting crops other than those included on this label in Dacthal treated soil within eight months of application may result in crop injury. If replanting is required because of an early crop failure, the planting of onions, seeded melons, potatoes, tomatoes, eggplants, or peppers at this time may result in crop injury. However, all crops on this label may be planted following harvest of a Dacthal treated crop.

- Special Precautions: Applied according to directions and under conditions favorable to good plant growth, product will not harm crops for which its use is recommended; however, conditions such as high salt concentration, seedling disease, cold weather, deep planting, excessive moisture or drought may injure or weaken crops normally tolerant to product, thereby increasing the possibility of herbicide damage. Under any of these conditions, one or more of the following may result: delayed crop development, reduced yields or reduced quality.

- Where some spring seeding is necessary, there should be a delay of approximately 60 days after the application of most preemergence herbicides, including dacthal flowable. This delay increases the survival of desirable grasses.

- Apply only when plants have 4-5 true leaves, are well- established, and growing conditions are favorable for good plant growth. (If applied earlier than recommended and/or growing conditions are unfavorable, crop injury may result.) If weeds have emerged, crop should be cultivated and weeded prior to the product application. Incorporation not recommended. In California, applications must be banded.

The warnings indicate that under certain conditions, the herbicide will not be effective against the target species, but that under other environmental scenarios it will damage the target plant. Different instructions are provided for different types of uses and crop species.

Although only minimal data are available for a quantitative analysis of potential effects to terrestrial plants, there is likely to be exposure and effects to off-target plant species based on the application methodologies (especially aerial), fate characteristics, and phytoxic properties inherent in this broad spectrum herbicide. Based on label warning of potential for crop damage and effects on target plants and the use of tolerant plant species in phytotoxicity tests, DCPA **May Affect** the CRLF indirectly via reduction in terrestrial plants.

5.1.3 Primary Constituent Elements of Designated Critical Habitat

For DCPA use, the assessment endpoints for designated critical habitat PCEs involve a reduction and/or modification of food sources necessary for normal growth and viability of aquatic-phase CRLFs, and/or a reduction and/or modification of food sources for terrestrial-phase juveniles and adults. Because these endpoints are also being assessed relative to the potential for indirect effects to aquatic- and terrestrial-phase CRLF, the effects determinations for indirect effects from the potential loss of food items are used as the basis of the effects determination for potential modification to designated critical habitat.

5.1.3.1 Aquatic-Phase (Aquatic Breeding Habitat and Aquatic Non-Breeding Habitat)

Three of the four assessment endpoints for the aquatic-phase primary constituent elements (PCEs) of designated critical habitat for the CRLF are related to potential effects to aquatic and/or terrestrial plants:

- Alteration of channel/pond morphology or geometry and/or increase in sediment deposition within the stream channel or pond: aquatic habitat (including riparian vegetation) provides for shelter, foraging, predator avoidance, and aquatic dispersal for juvenile and adult CRLFs.

- Alteration in water chemistry/quality including temperature, turbidity, and oxygen content necessary for normal growth and viability of juvenile and adult CRLFs and their food source.
- Reduction and/or modification of aquatic-based food sources for pre-metamorphs (*e.g.*, algae).

Based on the risk estimation for potential effects to aquatic and terrestrial plants provided in Sections 5.1.1.2, 5.1.1.3, and 5.1.2.3, DCPA has the potential to affect aquatic-phase PCEs of designated habitat related to effects on aquatic and terrestrial plants. Label warnings of potential for crop damage and effects on target plants support the assumption of effects to terrestrial plants. Effects observed in submitted aquatic plant studies indicate that DCPA has the potential to affect aquatic habitat.

The remaining aquatic-phase PCE is "alteration of other chemical characteristics necessary for normal growth and viability of CRLFs and their food source." To assess the impact of DCPA on this PCE (*i.e.*, alteration of food sources), acute and chronic freshwater fish and invertebrate toxicity endpoints, as well endpoints for aquatic non-vascular plants, are used as measures of effects. Based on the risk estimation for potential effects to aquatic organisms provided in Sections 5.1.1.1 and 5.1.1.2, DCPA has the potential to affect aquatic-phase PCEs of designated habitat related to effects of alteration of other chemical characteristics necessary for normal growth and viability of CRLFs and their food source.

5.1.3.2 Terrestrial-Phase (Upland Habitat and Dispersal Habitat)

Two of the four assessment endpoints for the terrestrial-phase PCEs of designated critical habitat for the CRLF are related to potential effects to terrestrial plants.

- Elimination and/or disturbance of upland habitat: Ability of habitat to support food source of CRLFs: Upland areas within 200 ft of the edge of the riparian vegetation or drip line surrounding aquatic and riparian habitat that are comprised of grasslands, woodlands, and/or wetland/riparian plant species that provides the CRLF shelter, forage, and predator avoidance
- Elimination and/or disturbance of dispersal habitat: Upland or riparian dispersal habitat within designated units and between occupied locations within 0.7 mi of each other that allow for movement between sites including both natural and altered sites which do not contain barriers to dispersal

The risk estimation for terrestrial-phase PCEs of designated habitat related to potential effects on terrestrial plants is provided in Section 5.1.2.3. These results will inform the effects determination for modification of designated critical habitat for the CRLF.

The third terrestrial-phase PCE is "reduction and/or modification of food sources for terrestrial phase juveniles and adults." To assess the impact of DCPA on this PCE, acute and chronic toxicity endpoints for birds, mammals, and terrestrial invertebrates are used as measures of effects. RQs for these endpoints were calculated in Section 5.1.2.2. Chronic RQs for birds and mammals exceed the LOC of 1.0 for all uses of DCPA. It is uncertain whether effects to terrestrial invertebrates or acute effects to birds and mammals will occur because predicted exposure exceeded the highest toxicity level tested where no mortality occurred. Based on chronic effect to birds and mammals, all uses of DCPA are likely to affect terrestrial food sources for juvenile and adult RLFs.

The fourth terrestrial-phase PCE is based on alteration of chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs and their food source. Direct acute and chronic RQs for terrestrial-phase CRLFs are presented in Section 5.2.1.2. Chronic RQs for birds exceed the LOC for all uses of DCPA (Table 5-3).

5.1.4 Impurities

Hexachlorobenzene (HCB) and dioxin/furans are impurities or manufacturing by-products of DCPA. The maximum allowable concentration of HCB in formulations is 0.3 percent (U.S. EPA, 1998b). Dioxins/furans do not have a maximum allowable concentration in formulations. However, the amount measured in formulations is below 0.1 ppb, and this level was used in the re-eligibility decision and in this document to estimate the maximum amount that may be found in formulations (U.S. EPA, 1998b). The 2,3,7,8-TCDD equivalency of dioxin/furans reported to the Agency is approximately 0.1 ppb, which would equal 0.00000001% of the DCPA formulations (U.S. EPA, 1998b). Actual concentrations of HCB and dioxin/furans are expected to be lower than these upper limits.

The assessment of impurities focuses on risk to taxa that were not a concern or are uncertain based on consideration of potential effects by the parent and/or degradates of DCPA. The presence of impurities will only increase or maintain the original estimation of risk and would not reduce risk for any taxa. The taxa with uncertainty in the risk concern based on the assessment for the parent and degradate are 1) birds and mammals (acute) and 2) terrestrial invertebrates. Risk to terrestrial invertebrates was not assessed for impurities because terrestrial invertebrate toxicity endpoints were not available for HCB and dioxins/furans (ECOTOX database). A very brief description of toxicity data for hexachlorobenzene is also provided as the information provides additional support for the potential for risk to other taxa.

5.1.4.1 Presence of Hexachlorobenzene in DCPA Formulations

The maximum allowable concentration of HCB in formulations is 0.3 percent (U.S. EPA, 1998b). The concentration of DCPA in technical formulations ranges from 20.7 – 98.8% (Table 5-6). The concentration of DCPA is approximately 69-329 times the concentration of HCB. Assuming they behave in a similar manner in the environment, HCB would need to be 69 – 329 times more toxic than DCPA to result in risk equivalent to DCPA. Alternatively, it would need to be found in the environment at 69-329 times higher concentrations than DCPA to result in risk equivalent to DCPA.

Table 5-6. Summary of percent DCPA in the pesticides products registered with EPA

Product Name	EPA Registration Number	Formulation	Percent Active Ingredient

Lebanon Preemergence Weed Control	961-273	Granular	5.0%
Garden Weeder	2217.617	Granular	2.5%
Dacthal Flowable Herbicide	5481-487	Flowable Concentrate	54.9%
Dacthal G-2.5	5481-488	Granular	2.5%
Dacthal G-5 Herbicide	5481-489	Granular	5.0%
Dacthal W-75	5481-490	Wettable Powder	75.0%
Dacthal W-75	5481-491	Wettable Powder	75.0%
Ferti-Loam Weed and Grass Preventer	7401-27	Not specified	2.41%
Garden Weed Preventer Granules	33955-474	Granular	2.5%
Garden Weed Preventer Spray	33955-509	Wettable Powder	75.0%
Technical Chlorthal Dimethyl	5481-495	Technical	98.8%
90% Dimethyl-T	5481-485	Technical	90%
Dacthal 1.92F	5481-486	Technical	20.7%

Acute toxicity endpoints for freshwater fish and invertebrates were all greater than the solubility (0.004 - 0.005 mg/L) of hexachlorobenzene (WHO, 1998; Euro Chlor 2002). No observable effects concentrations in chronic studies for freshwater fish ranged from 0.0037 - >0.004 mg/L and for freshwater invertebrates 0.0018 - >0.004 mg/L (Euro Chlor 2002). Reduced production of chlorophyll, dry matter, carbohydrate, and nitrogen have been observed in *Chloroella pyrenoidosa* at 1 μg/L (WHO, 1997). Other effects were reported in the public ECOTOX database for aquatic plants at concentrations of 1-2 μg/L. Based on this brief overview of aquatic toxicity endpoints for hexachlorobenzene, there is a possibility for chronic risk for aquatic organisms and a risk for aquatic plants as a result of exposure to hexachlorobenzene.

Table 5-7 summarizes the avian and mammalian effects endpoints reported for HCB. The World Health Organization (WHO, 1998) reports LD_{50}s in mammals ranging from 1700-4000 mg/kg-bw for HCB. Acute LD_{50}s for birds ranged from > 500 mg/kg-bw to 575 mg/kg-bw (Table 5-7). LC_{50}s in birds were 617 ppm in ring-necked pheasants and 568 ppm in Japanese quail (WHO, 1998). Effects on reproduction from HCB exposure were observed at levels as low as 20 ppm-diet in Japanese quail with no reproductive impairment occurring at 5 ppm-diet. A NOAEC of 20 ppm (1 mg/kg-bw) was reported in a 4-generation reproduction toxicity study in rats (WHO, 1998). No data are available for terrestrial invertebrates. HCB is a mixed cyto-chrome P-450-inducing compound and is known to bind to the aryl hydrocarbon receptor (WHO, 1998).

Table 5-7. Avian and Mammal Toxicity Profile for Hexachlorobenzene[1]

Endpoint	Species	Toxicity Value
Acute Direct Toxicity to Terrestrial-Phase CRLF (LD_{50})	Japanese Quail Mallard Duck	LD_{50} = 575 mg/kg-bw LD_{50} >5000 mg/kg-bw
Acute Direct Toxicity to	Japanese Quail	5 day LC_{50} = 568 ppm

Endpoint	**Species**	**Toxicity Value**
Terrestrial-Phase CRLF (LC_{50})	Ring-Necked Pheasants	LC_{50} = 617 ppm
Chronic Direct Toxicity to Terrestrial-Phase CRLF	Japanese Quail	LOAEC = 20 mg/kg-diet NOAEC = 5 mg/kg-diet NOEC = 1 mg/kg-diet[2]
Indirect Toxicity to Terrestrial-Phase CRLF (via acute toxicity to mammalian prey items)	Rat Mouse Rabbit Cat	Acute oral LD_{50} = 3500 mg/kg -bw 4000 mg/kg-bw 2600 mg/kg-bw 1700 mg/kg-bw
Indirect Toxicity to Terrestrial-Phase CRLF (via chronic toxicity to mammalian prey items)	Rat Monkey Rat Mink Rat	LOAEL = 5 mg/kg/day (total hemoglobin and blood enzymes decreased, increased liver weight) 4 mg/kg/day monkey (blocked ovulation of 1 female) 2 mg/kg/day (decreased survival of pups) 1 mg/kg-diet (mortality of weanlings) NOAEC = 20 mg/kg-diet or 1 mg/kg-bw

1 - Data from EXTOXNET, WHO, 1998, and Euro Chlor, 2002.
2- Increased liver weights were observed at 5 mg/kg-diet.

Table 5-8 shows the input parameters modeled in TREX to assess the risk to birds and mammals due to exposure of hexachlorobenzene. A default foliar half-life of 35 days was assumed. The lowest toxicity endpoint for the rat was used because the body weight of the other organisms in the studies was not known. For birds, the lowest endpoint reported for each toxicity category was used to assess risk. The body weight of Japanese quail was assumed to be 114 g, as reported for a study conducted by Macajova *et al.* (2003).

Table 5-8. Input Parameters Used to Derive Terrestrial EECs for HCB in TREX.

Use (number of app., app. interval)	**DCPA App. Rate lbs a.i./A**	**HCB App. Rate lbs a.i./A[1]**	**# of App.**	**App. Interval (days)**
All Food Uses (1 app., NA) [2]	10.5	0.15	1	NA
All Food Uses (2 app., 7 days)[3]	10.5	0.15	2	7
All Food Uses (3 app., 7 days)[3]	10.5	0.15	3	7

Use (number of app., app. interval)	DCPA App. Rate lbs a.i./A	HCB App. Rate lbs a.i./A[1]	# of App.	App. Interval (days)
Cole Crops (7 app., 30 days)[3]	10.5	0.15	7	30
Radish (11 app., 30 days)[3]	10.5	0.15	11	30
Nursery and ornamentals (1 app.)	12	0.17	1	NA
Nursery and ornamentals (6 app., 7 days)	12	0.17	6	7
Turf and ornamentals (1 app.)	15	0.22	1	NA
Turf and Ornamental (6 app., 7 days)	15	0.22	6	7

Abbreviations: App. = application

1- Calculated as DCPA application rate divided by 69 based on concentrations of HCB being 69 -329 times lower than concentrations of DCPA in technical formulations.

2- All food uses except garlic have a 10.5 lb a.i./A application rate. Garlic's application rate is 10.4 and is close enough to 10.5 to also be represented by this rate. Application rates of 10.2 (one rate for lettuce) to 10.5 lbs a.i./A round to an HCB application rate of 0.15 lbs HCB/A. See Table 3-1 for a list of food crops and application rates.

3- All food crops could have more than one application as a maximum number of applications is not specified on any of the labels.

Table 5-9 shows the RQs from TREX for dose and diet related exposure for small birds (a surrogate for the terrestrial phase CRLF) consuming small invertebrates. Acute dose-based RQs of small birds ranged from 0.06 – 0.49 and all uses with multiple applications were equal to or greater than the listed species LOC of 0.1. Subacute-dietary RQs ranged from 0.04 – 0.23 and RQs exceeded the LOC of 0.1 for nursery, turf, and ornamental uses with multiple applications. Chronic avian dietary-based RQs ranged from 4.05 – 25.91 and all RQs exceeded the LOC of 1.0.

Table 5-9. Summary of Acute Avian Dose-Based RQs for Small Birds (20g) Consuming Small Invertebrates- Used to Estimate Direct Effects to the Terrestrial-phase CRLF Exposed to HCB (Derived using TREX)

Use (number of app., app. interval)	Acute Dose Based, EECs (mg/kg-bw) and RQs[1,2]		Subacute Dietary, EECs (mg/kg-diet) and RQs[1,3]		Chronic Dietary Based, EECs (mg/kg-diet) and RQs[1,4]	
	EEC	RQ	EEC	RQ	EEC	RQ
All Food Uses (1 app., NA) [5]	23.06	0.06	20.25	0.04	20.25	**4.05**
All Food Uses (2 app., 7 days)[6]	43.14	**0.10**	37.88	0.07	37.88	**7.58**
All Food Uses (3 app., 7 days)[6]	60.62	**0.15**	53.23	0.09	53.23	**10.65**
Cole Crops (7 app., 30 days)[6]	50.68	**0.12**	44.50	0.08	44.50	**8.90**
Radish (11 app., 30 days)[6]	51.41	**0.12**	45.14	0.08	45.14	**9.03**
Nursery and Ornamentals (1 app.)	26.14	0.06	22.95	0.04	22.95	**4.59**
Nursery and Ornamentals (6 app., 7 days)	114.03	**0.28**	100.12	**0.18**	100.12	**20.02**
Turf and Ornamentals (1 app.)	33.83	0.08	29.70	0.05	29.70	**5.94**
Turf and Ornamental (6 app., 7 days)	147.56	**0.36**	129.57	**0.23**	129.57	**25.91**

Abbreviations: Application = App.; bw = body weight

1- Bold values are equal to or greater than the acute LOC for listed avian species of 0.1 or the chronic LOC of 1.0.
2- The adjusted LD_{50} from TREX was 414.25 mg/kg-bw based on the LD_{50} of 575 mg/kg-bw for the bobwhite quail.
3- The RQ was calculated using the LC_{50} of 568 mg/kg-diet for the Japanese Quail.
4- The RQ was calculated using an NOAEC of 5 mg/kg-diet for the Japanese quail.
5- All food uses except garlic have a 10.5 lb a.i./A application rate. Garlic's application rate is 10.4 and is close enough to 10.5 to also be represented by this rate. Application rates of 10.2 (one rate for lettuce) to 10.5 lbs a.i./A round to an HCB application rate of 0.15 lbs HCB/A. See Table 3-1 for a list of food crops and application rates.
6- All food crops could have more than one application as a maximum number of applications is not specified on any of the labels.

Table 5-10 shows the results for acute mammalian dose based and chronic dietary based RQs for small mammals (15g) consuming short grass and used to assess indirect risk to the CRLF based on reduction in prey items. Acute-dose based RQs ranged from <0.01 – 0.01 and did not exceed the listed species LOC of 0.1. Chronic dietary based RQs ranged from 18.00 – 115.17 and all exceed the LOC of 1.0.

Table 5-10. Summary of Acute Mammalian Dose Based RQs for Small Mammals (15g) Consuming Short Grass - Used to Estimate Indirect Effects to the Terrestrial-phase CRLF Exposed to HCB (Derived using TREX)

Use (number of app., app. interval)	Acute Dose Based, EECs (mg/kg-bw) and RQs[1]		Chronic-Dietary Based, EECs (mg/kg-diet) and RQs[2]	
	EEC	RQ	EEC	RQ
All Food Uses (1 app., NA) [3]	34.32	<0.01	36.00	**18.00**
All Food Uses (2 app., 7 days)[4]	64.20	0.01	67.34	**33.67**
All Food Uses (3 app., 7 days)[4]	90.22	0.01	94.62	**47.31**
Cole Crops (7 app., 30 days)	75.42	0.01	79.11	**39.55**
Radish (11 app., 30 days)	76.51	0.01	80.25	**40.12**
Nursery and Ornamentals (1 app.)	38.90	0.01	40.80	**20.40**
Nursery and Ornamentals (6 app., 7 days)	169.70	0.02	177.99	**89.00**
Turf and Ornamentals (1 app.)	50.34	0.01	52.80	**26.40**
Turf and Ornamental (6 app., 7 days)	219.61	0.03	230.34	**115.17**

1- The acute listed species LOC for mammalian species is 0.1 and RQs were calculated using the adjusted LD_{50} for the rat of 7692.41 mg/kg-bw.
2- Bold values exceed the chronic risk LOC (RQ $\geq$ 1.0) for non-listed and listed mammalian species. RQs were calculated using the NOAEC of 2 mg/kg-diet for the rat.
3- All food uses except garlic have a 10.5 lb a.i./A application rate. Garlic's application rate is 10.4 and is close enough to 10.5 to also be represented by this rate. Application rates of 10.2 (one rate for lettuce) to 10.5 lbs a.i./A round to an HCB application rates of 0.15 lbs HCB/A. See Table 3-1 for a list of food crops and application rates.
4- All food crops could have more than one application as a maximum number of applications is not specified on any of the labels.

A primary concern for HCB is its persistence and potential for bioaccumulation and biomagnification. Measured bioconcentration factors range from 300 – 35,000 L/kg (Euro Chlor, 2002). Higher species of birds and mammals can metabolize and excrete HCB (Euro Chlor, 2002). Risk due to bioaccumulation and biomagnifications was not assessed.

Overall, the analysis of potential effects to birds and mammals indicates that the presence of hexachlorobenzene may cause acute risk to birds and amphibians. Effects from HCB and other organochlorine impurities also contribute to the already expected chronic risk to birds and mammals.

5.1.4.2 Presence of Dioxin/Furans in DCPA Formulations

Toxic effects on reproduction, development, endocrine functions, wasting syndrome, immunotoxicity, and mortality have been observed in fish, birds, and mammals exposed to 2,3,7,8-TCDD (U.S. EPA 2008b). Dioxins, like hexachlorobenzene, are aryl hydrocarbon receptor agonists (U.S. EPA, 2008b).

Acute dose-based risk to mammals consuming short grass was examined for dioxin/furans. The 2,3,7,8-TCDD toxic equivalency factor of dioxin/furans reported to the Agency for mammals is approximately 0.1 ppb, which would equal 0.00000001% of the DCPA formulations (U.S. EPA, 1998b). The concentration of DCPA in the technical formulations ranges from 20.7 – 98.8%. The concentration of DCPA is 2 x 10^9 to 9 x 10^9 times the concentration of dioxin/furan equivalents. The lowest acute oral LD_{50} was reported for the Hartley guinea pig at 0.6 μg/kg-bw (ATSDR, 1998). TREX was used to examine possible acute risk to mammals for dioxin/furans using the default half-life of 35 days and assuming an adult body weight of 1000 g for the guinea pig (National Laboratory Animal Centre; http://www.nlac.mahidol.ac.th/nlacmuEN/p_animals.htm). The use scenario with the highest application rate and number of applications was modeled (Table 5-11). Calculated risk quotients were far below the level of concern (0.1) for acute risk to listed mammals (Table 5-12). Thus acute risk to small mammals is not expected to result from ingestion of dioxin residues on short grass.

Bioaccumulation is also an important risk concern for dioxin/furans. Bioconcentration factors in aquatic organisms range from 34 - 128,000 (ATSDR, 1998). Risks due to bioaccumulation and biomagnification were not accessed.

Table 5-11. Input Parameters Used to Derive Terrestrial EECs for Dioxin/furans in TREX.

Use[1]	DCPA App. Rate lbs a.i./A	Dioxin/ App. Rate lbs a.i./A[1]	Number of App.	App. Interval (days)
Turf and Ornamental	15	7.25 x 10^{-9}	6	7

1- Calculated as DCPA application rate divided by 2 x 10^9 based on concentrations of DCPA being 2 x 10^9 to 9 x 10^9 times the concentration of dioxin/furan equivalents.

Table 5-12. Summary of Acute Dose Based RQs for Small Mammals (15g) Consuming Short Grass- Used to Estimate Indirect Effects to the Terrestrial-phase CRLF Exposed to Dioxins/furans (Derived using TREX)

Use[1]	Acute Dose Based, EECs (mg/kg-bw) and RQs[2,3]	
	EEC	RQ

Turf and Ornamentals (6 applications)	7.0×10^{-6}	0.004

Abbreviation: bw = body weight

1- Use on turf and ornamentals results in the highest EECs. Thus, risks for all uses can be ruled out based on evaluation of RQs for turf and ornamentals when LOCs are not exceeded.

2- The acute listed species LOC for mammalian species is RQ $\geq$ 0.1.

3- The adjusted LD_{50} of 1.32×10^{-3} mg/kg-bw was calculated based on the endpoint of 0.06 µg/kg-bw for a 1000 g Hartley guinea pig.

5.1.5 Spatial Extent of Potential Effects

An LAA effects determination applies to those areas where it is expected that the pesticide's use will directly or indirectly affect the CRLF or its designated critical habitat.
To determine this area, the footprint of DCPA's use pattern is identified, using land cover data that correspond to DCPA's use pattern. The spatial extent of the effects determination also includes areas beyond the initial area of concern that may be impacted by runoff and/or spray drift. The identified direct and indirect effects and/or modification to critical habitat are anticipated to occur only for those currently occupied core habitat areas, CNDDB occurrence sections, and designated critical habitat for the CRLF that overlap with the initial area of concern plus greater than 1000 feet from its boundary. It is assumed that non-flowing waterbodies (or potential CRLF habitat) are included within this area.

In addition to the spray drift buffer, the results of the downstream dilution extent analysis result in a distance of 268 kilometers which represents the maximum continuous distance of downstream dilution from the edge of the initial area of concern. If any of these streams reaches flow into CRLF habitat, there is potential to affect either the CRLF or modify its habitat. These lotic aquatic habitats within the CRLF core areas and critical habitats potentially contain concentrations of DCPA sufficient to result in LAA determinations or modification of critical habitat.

The determination of the buffer distance and downstream dilution for spatial extent of the effects determination is described below.

5.1.4.1 Spray Drift

In order to determine terrestrial and aquatic habitats of concern due to DCPA exposures through spray drift, it is necessary to estimate the distance that spray applications can drift from the treated area and still be present at concentrations that exceed levels of concern. An analysis of spray drift distances was completed using AgDrift.

For DCPA use relative to the terrestrial-phase CRLF, the results of the screening-level risk assessment indicate that spray drift using the most sensitive endpoints for chronic exposure to terrestrial small mammals results in a estimated buffer of 85.3 feet needed to mitigate risk based on modeling using the AgDrift model for the Tier I ground mode.[21]

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21 This was calculated by assuming a high boom height, drop size distribution of ASAE very fine to fine, and the 90th percentile data. The lowest LOC to RQ ratio available for one application was for chronic exposure to

For DCPA use relative to the terrestrial-phase CRLF, the results of the screening-level risk assessment indicate that spray drift using the most sensitive endpoints for chronic exposure to terrestrial small mammals exceeds the 1,000 foot range of the AgDrift model for the Tier I aerial model.

5.1.4.2 Downstream Dilution Analysis

The downstream extent of exposure in streams and rivers where the EEC could potentially be above levels that would exceed the most sensitive LOC. To complete this assessment, the greatest ratio of aquatic RQ to LOC was estimated. Using an assumption of uniform runoff across the landscape, it is assumed that streams flowing through treated areas (*i.e.*, the initial area of concern) are represented by the modeled EECs; as those waters move downstream, it is assumed that the influx of non-impacted water will dilute the concentrations of DCPA present.

Using a EC_{50} value of 0.08 mg/L TPA equivalents for non-vascular aquatic plants (the most sensitive species) and a maximum peak EEC, for 11 applications to all food crops, of 4.07 mg/L yields an RQ/LOC ratio of 50.88 (50.88/1). Using the downstream dilution approach (described in more detail in Appendix B) yields a target percent crop area (PCA) of 2%. This value has been input into the downstream dilution approach and results in a distance of 268 kilometers which represents the maximum continuous distance of downstream dilution from the edge of the initial area of concern. Similar to the spray drift buffer described above, the LAA/NLAA determination is based on the area defined by the point where concentrations exceed the EC_{50} value.

5.1.5.3 Overlap between CRLF habitat and Spatial Extent of Potential Effects

An LAA effects determination is made to those areas where it is expected that the pesticide's use will directly or indirectly affect the CRLF or its designated critical habitat and the area overlaps with the core areas, critical habitat and available occurrence data for CRLF.

For DCPA, the use pattern in the land cover classes of cultivated crops and turf are included in the area of effects. Areas of effects may also include areas beyond the initial area of concern that may be impacted by runoff and/or spray drift that overlaps with CRLF habitat. Appendix B provides maps of the initial area of concern, along with CRLF habitat areas, including currently occupied core areas, CNDDB occurrence sections, and designated critical habitat. It is expected that any additional areas of CRLF habitat that are located within 1000 ft of a treated area (to account for offsite migration via spray drift) and 268 kilometers of stream reach (to account for downstream dilution) outside the initial area of concern may also be impacted and are part of the full spatial extent of the LAA/modification of critical habitat effects determination.

In order to confirm that uses of DCPA have the potential to affect CRLF through direct applications to target areas and runoff and spray drift to non-target areas, it is necessary to

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mammals (LOC/RQ = 1.0/31.23=0.03). This ratio was assumed to be the fraction applied, resulting in an estimated distance to the edge of field of 85.3 feet.

determine whether or not the spatial extent of potential effects based on agricultural crops and turf use of DCPA overlap with CRLF habitats. Spatial analysis using ArcGIS 9.1 indicates that aquatic habitats within the CRLF core areas and critical habitats potentially contain concentrations of DCPA sufficient to result in RQ values that exceed LOCs. In addition, terrestrial habitats (and potentially lentic aquatic habitats) of the final action areas for agricultural and turf uses of DCPA overlap with the core areas, critical habitat and available occurrence data for CRLF. Thus, uses of DCPA on agricultural crops and turf use could result in exposures of DCPA to CRLF in aquatic and terrestrial habitats (Appendix B).

5.2 Risk Description

The risk description synthesizes an overall conclusion regarding the likelihood of adverse impacts leading to an effects determination (*i.e*., "no effect," "may affect, but not likely to adversely affect," or "likely to adversely affect") for the CRLF and its designated critical habitat.

If the RQs presented in the Risk Estimation (Section 5.1) show no direct or indirect effects for the CRLF, and no modification to PCEs of the CRLF's designated critical habitat, a "no effect" determination is made, based on DCPA's use within the action area. However, if direct or indirect effect LOCs are exceeded or effects may modify the PCEs of the CRLF's critical habitat, the Agency concludes a preliminary "may affect" determination for the FIFRA regulatory action regarding DCPA. A summary of the results of the risk estimation is provided in Table 5-13 for direct and indirect effects to the CRLF and in Table 5-14 for the PCEs of designated critical habitat for the CRLF.

Based on the RQs presented in the Risk Estimation (Section 5.1) a preliminary effects determination is **May Affect** for the CRLF and critical habitat.

Table 5-13. Risk Estimation Summary for DCPA - Direct and Indirect Effects to CRLF

Assessment Endpoint	LOC Exceedances (Y/N)	Description of Results of Risk Estimation
Aquatic Phase (eggs, larvae, tadpoles, juveniles, and adults)		
Direct Effects Survival, growth, and reproduction of CRLF individuals via direct effects on aquatic phases	Yes	TPA RQs exceed the acute listed species LOC for turf, nursery, and ornamental uses with multiple applications and for food crops with five or more applications. Chronic exposures to DCPA and TPA may result in chronic effects to the aquatic CRLF based on chronic effects observed in birds and mammals. No chronic data are available for aquatic organisms.
Indirect Effects Survival, growth, and reproduction of CRLF individuals via effects to food supply (*i.e.*, freshwater invertebrates, non-vascular plants)	Yes	<u>Invertebrates</u> TPA RQs exceed the acute listed invertebrate LOC for turf, ornamental, and nursery uses with multiple applications and for food uses with more than six applications.. Based on chronic effects observed for birds and mammals, chronic effects to aquatic invertebrates may occur as a result of

Assessment Endpoint	LOC Exceedances (Y/N)	Description of Results of Risk Estimation
		exposure to DCPA and TPA. No chronic data are available for aquatic organisms. <u>Non-vascular Plants</u> A NOAEC could not be determined for aquatic non-vascular plants at or above the solubility limit of DCPA; however, effects were observed in the submitted studies and data are not available to discount risk for DCPA. All TPA RQs for aquatic non-vascular plants exceed the aquatic plant LOC.
Indirect Effects Survival, growth, and reproduction of CRLF individuals via effects on habitat, cover, and/or primary productivity (*i.e.*, aquatic plant community)	Yes	<u>Non-vascular Plants</u> An EC_{50} could not be determined for aquatic non-vascular plants at or above the solubility limit of DCPA; however, effects were observed in the submitted studies and data are not available to discount risk for DCPA. All TPA RQs for aquatic non-vascular plants exceed the aquatic plant LOC. <u>Vascular Plants</u> An EC_{50} could not be determined for aquatic vascular plants at or above the solubility limit of DCPA; however, effects were observed in the submitted studies and data are not available to discount risk for DCPA. All TPA RQs were below the LOCs for aquatic vascular plants; however, the LOEC was exceeded by all TPA EECs and the calculated TPA RQs are uncertain because they are based on toxicity data for a surrogate compound, dicamba.
Indirect Effects Survival, growth, and reproduction of CRLF individuals via effects to riparian vegetation, required to maintain acceptable water quality and habitat in ponds and streams comprising the species' current range.	May Effect RQs were not calculated	Effects to terrestrial plants could not be quantified with the available studies. Numerous lines of evidence support the qualitative assumption of effects to terrestrial plants from the use of DCPA.
Terrestrial Phase (Juveniles and adults)		
Direct Effects Survival, growth, and reproduction of CRLF individuals via direct effects on terrestrial phase adults and juveniles	Yes	Chronic RQs for birds, the terrestrial surrogate for the CRLF, exceed the LOC for all uses of DCPA. Acute RQs for birds for exposure to HCB exceed the LOC for uses with multiple applications of DCPA.
Indirect Effects Survival, growth, and reproduction of CRLF individuals via effects on prey (*i.e.*, terrestrial invertebrates, small terrestrial mammals and terrestrial phase amphibians)	Yes	Chronic RQs for small mammals exceed the LOC for all uses of DCPA. Chronic RQs for small mammals exposed to HCB exceed the LOC for all uses of DCPA. Estimated EECs for terrestrial invertebrates, birds, and mammlas exceed the highest dose tested where no effects were

Assessment Endpoint	LOC Exceedances (Y/N)	Description of Results of Risk Estimation
		observed and the result of this exposure is uncertain.
Indirect Effects Survival, growth, and reproduction of CRLF individuals via effects on habitat (*i.e.*, riparian vegetation)	May Effect RQs were not calculated	Effects to terrestrial plants could not be quantified with the available studies. Numerous lines of evidence support the qualitative assumption of effects to terrestrial plants from the use of DCPA.

Abbreviations: LAA = likely to adversely affect

Table 5-14. Risk Estimation Summary for DCPA – PCEs of Designated Critical Habitat for the CRLF

Assessment Endpoint	Habitat Modification (Y/N)	Description of Results of Risk Estimation
Aquatic Phase PCEs (Aquatic Breeding Habitat and Aquatic Non-Breeding Habitat)		
Alteration of channel/pond morphology or geometry and/or increase in sediment deposition within the stream channel or pond: aquatic habitat (including riparian vegetation) provides for shelter, foraging, predator avoidance, and aquatic dispersal for juvenile and adult CRLFs.	Yes	<u>Non-vascular Plants</u> An EC_{50} could not be determined for aquatic non-vascular plants at or above the solubility limit of DCPA; however, effects were observed in the submitted studies and data are not available to discount risk for DCPA. All TPA RQs for aquatic non-vascular plants exceed the aquatic plant LOC. <u>Vascular Plants</u> An EC_{50} could not be determined for aquatic vascular plants at or above the solubility limit of DCPA; however, effects were observed in the submitted studies and data are not available to discount risk for DCPA. All TPA RQs were below the LOCs for aquatic vascular plants; however, the LOEC was exceeded by all TPA EECs and the calculated TPA RQs are uncertain because they are based on toxicity data for a surrogate compound, dicamba. <u>Riparian Vegetation</u> Effects to terrestrial plants could not be quantified with the available studies. Numerous lines of evidence support the qualitative assumption of effects to terrestrial plants from the use of DCPA.

Assessment Endpoint	Habitat Modification (Y/N)	Description of Results of Risk Estimation
Alteration in water chemistry/quality including temperature, turbidity, and oxygen content necessary for normal growth and viability of juvenile and adult CRLFs and their food source.	Yes	Effects to terrestrial plants could not be quantified with the available studies. Numerous lines of evidence support the qualitative assumption of effects to terrestrial plants from the use of DCPA. Acute LOCs were exceeded for freshwater fish and invertebrates exposed to TPA. Chronic effects are expected with exposure to TPA and DCPA. All LOCs for non-vascular plants were exceeded with exposure to TPA. Effects to vascular plants are possible based on qualitative evidence of effects in DCPA studies and on TPA EECs exceeding estimated LOECs.
Alteration of other chemical characteristics necessary for normal growth and viability of CRLFs and their food source.	Yes	All LOCs for non-vascular plants were exceeded with exposure to TPA. Effects to vascular plants are possible based on qualitative evidence of effects in DCPA studies and on TPA EECs exceeding estimated LOECs. Effects to terrestrial plants could not be quantified with the available studies. Numerous lines of evidence support the qualitative assumption of effects to terrestrial plants from the use of DCPA.
Reduction and/or modification of aquatic-based food sources for pre-metamorphs (*e.g.*, algae)	Yes	An EC_{50} could not be determined for aquatic non-vascular plants at or above the solubility limit of DCPA; however, effects were observed in the submitted studies and data are not available to discount risk for DCPA. All TPA RQs for aquatic non-vascular plants exceed the aquatic plant LOC.
Terrestrial Phase PCEs (Upland Habitat and Dispersal Habitat)		
Elimination and/or disturbance of upland habitat; ability of habitat to support food source of CRLFs: Upland areas within 200 ft of the edge of the riparian vegetation or dripline surrounding aquatic and riparian habitat that are comprised of grasslands, woodlands, and/or wetland/riparian plant species that provides the CRLF shelter, forage, and predator avoidance	Yes RQs were not calculated	Effects to terrestrial plants could not be quantified with the available studies. Numerous lines of evidence support the qualitative assumption of effects to terrestrial plants from the use of DCPA.
Elimination and/or disturbance of dispersal habitat: Upland or riparian dispersal habitat within designated units and between occupied locations within 0.7 mi of each other that allow for movement between sites	Yes RQs were not calculated	Effects to terrestrial plants could not be quantified with the available studies. Numerous lines of evidence support the qualitative assumption of effects to terrestrial plants from the use of DCPA.

Assessment Endpoint	Habitat Modification (Y/N)	Description of Results of Risk Estimation
including both natural and altered sites which do not contain barriers to dispersal		
Reduction and/or modification of food sources for terrestrial phase juveniles and adults	Yes	Chronic RQs for small birds and small mammals exceed the LOC for all uses of DCPA. Acute RQs for small birds exposed to HCB exceed the LOC for uses with multiple applications of DCPA.
Alteration of chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs and their food source.	Yes RQs were not calculated	Effects to terrestrial plants could not be quantified with the available studies. Numerous lines of evidence support the qualitative assumption of effects to terrestrial plants from the use of DCPA.

Following a "may affect" determination, additional information is considered to refine the potential for exposure at the predicted levels based on the life history characteristics (*i.e.*, habitat range, feeding preferences, etc.) of the CRLF. Based on the best available information, the Agency uses the refined evaluation to distinguish those actions that "may affect, but are not likely to adversely affect" from those actions that are "likely to adversely affect" the CRLF and its designated critical habitat.

The criteria used to make determinations that the effects of an action are "not likely to adversely affect" the CRLF and its designated critical habitat include the following:

- Significance of Effect: Insignificant effects are those that cannot be meaningfully measured, detected, or evaluated in the context of a level of effect where "take" occurs for even a single individual. "Take" in this context means to harass or harm, defined as the following:
    - Harm includes significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering.
    - Harass is defined as actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering.
- Likelihood of the Effect Occurring: Discountable effects are those that are extremely unlikely to occur.
- Adverse Nature of Effect: Effects that are wholly beneficial without any adverse effects are not considered adverse.

A description of the risk and effects determination for each of the established assessment endpoints for the CRLF and its designated critical habitat is provided in Sections 5.2.1 through 5.2.3.

5.2.1 Direct Effects

5.2.1.1 Aquatic-Phase CRLF

The aquatic-phase considers life stages of the frog that are obligatory aquatic organisms, including eggs and larvae. It also considers submerged terrestrial-phase juveniles and adults, which spend a portion of their time in water bodies that may receive runoff and spray drift containing DCPA. The following sections describe the potential for effects from exposure to various compounds expected in the environment following the use of DCPA.

a) Exposure to Parent DCPA

Acute exposure to DCPA is not expected to result in risk to the CRLF because all toxicity endpoints for fish were above the limit of solubility for DCPA. No chronic effects data on aquatic species are available for DCPA.

b) Exposure to Degradate TPA

Endpoints from other benzoic acid herbicides were used to assess risk from exposure to the degradate TPA. Risk quotients ranged from 0.01 - 0.11 and LOCs of 0.05 were exceeded for turf, nursery, and ornamental uses with multiple applications and for food crops with five or more applications. This indicates that direct acute effects to the red legged frog are likely. No chronic effects data on aquatic species are available for TPA.

c) Effects Determination for Aquatic Phase Direct Effects

Based on the evidence discussed above, a "Likely to Adversely Affect" determination is made for direct effects to the aquatic-phase CRLF.

As this determination is based on modeled data, it is difficult to further speculate how this risk could be reduced. Further refinement would be an exercise in further speculation. Aquatic toxicity data on the degradate TPA and chronic aquatic toxicity data for DCPA and TPA are needed before definitive analysis can be completed.

Usage data indicate that, although single application rates are generally lower than the maximum allowable rate, average annual usage is high for several uses (*i.e.*, in the 1,000's of pounds per year). Therefore, DCPA usage is either very widespread or frequent or both. Figure 3-1 indicates high usage in California during the time of year in which eggs and tadpoles are relevant. Additionally, usage is high in counties with CRLF habitat.

The incidents described in Section 4.4 further support the LAA call. Fish kills occurred in two separate incidents related to DCPA use. An exposure analysis of the affected organisms was not available; however, it was considered highly probable that DPCA exposure led to mortality of catfish and shad.

Many labels do require banded applications and soil incorporation of up to one to two inches for most food uses. This has the potential to reduce exposure of aquatic organisms. EECs were calculated using PRZM/EXAMs for cole crops with one application and 2 inches of soil incorporation. When compared to foliar applications, EECs were 8 – 13 times lower. Considering the uncertainty in the use of surrogate toxicity endpoints, this is not low enough to rule out the possibility that acute and chronic effects to aquatic organisms may occur. Similar results may be expected for other crops. While the label accurately states that banding could result in a lower application rate, the label does not require a lower application rates when banding is used. Thus, the reduction in aquatic exposure cannot be estimated.

5.2.1.2 Terrestrial-Phase CRLF

Based on the weight-of-evidence, DCPA is Likely to Adversely Affect the terrestrial-phase of the CRLF based on direct chronic effects. Treatment related reductions in multiple reproductive parameters were detected in avian toxicity studies. More specifically, reproductive and offspring effects included ratios of number hatched to live 3-week embryos, live 3-week embryos to viable embryos, hatchling survivors to eggs set and to number hatched, as well as survivor weights. Some animals at the higher treatment levels were so debilitated that they were sacrificed after week 18, three weeks prior to the end of the 21-week observation period. Additionally, treatment related mortality was observed. These effects are biologically significant and exposures occurring at levels higher than those that caused reproductive effects lead to concern for the CRLF.

RQs representing chronic dose-based and chronic dietary-based exposures to the terrestrial-phase CRLF exceeded the LOC of 1.0, resulting in a “may affect” determination for all uses (Table 5-5). These RQs were derived using the T-REX model, which estimates exposures that are specific to food intake equations for birds. RQs generated for birds are used as surrogates to represent RQs for the terrestrial-phase CRLF. The RQs generated by T-REX based on the maximum application rates ranged from 1.58-5.52 and exceed the LOC of 1.0.

In order to explore influences of amphibian-specific food intake equations on potential dose-based and dietary-based exposures of the terrestrial phase CRLF to DCPA, T-HERPS is used. Modeling with T-HERPS incorporates the same application rates, intervals and number of applications for each use as defined for modeling using T-REX (Table 3-14). The dietary-based EECs and RQs generated by T-HERPS are provided in Table 5-15. An example output from T-HERPS is available in Appendix I.

Refined chronic dietary-based RQs for CRLFs consuming insects and small herbivore mammals exceed the chronic listed species LOC (1.0) for all uses of DCPA (Table 5-15**)**. Refined chronic dietary-based RQs for CRLFs consuming small insectivore mammals and small terrestrial phase amphibians do not exceed the chronic listed species LOC (1.0) for all uses of DCPA.

Terrestrial toxicity data for TPA are confined to sublethal effects to mammals from acute exposures. The effects endpoints are not relevant for acute RQ calculations (usually based on mortality). Risk is expected from exposure to parent DCPA. Therefore, potential effects associated with TPA exposure would only increase certainty in the risk estimation. Terrestrial exposure to TPA is not quantitatively assessed but assumed to increase risk to terrestrial phase CRLFs compared to exposure to parent alone.

The evidence described above supports the conclusion that all uses of DCPA are ***likely to adversely affect*** the CRLF via direct effects.

Table 5-15. Upper Bound Kenaga Nomogram, Chronic Terrestrial Herpetofauna Dietary Based DCPA EECs (ppm) and Risk Quotients (THERPS) for the CRLF Consuming Different Food Items

Use	Food Item									
	Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects		Small Herbivore Mammals		Small Insectivore Mammals		Small Terrestrial Phase Amphibians	
	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
Turf and Ornamental[1]	2052.00	**1.60**	228.00	0.18	2403.82	**1.88**	150.24	0.12	71.23	0.06
Turf and Ornamental[2]	8951.87	**6.99**	994.65	0.78	10486.71	**8.19**	655.42	0.51	310.73	0.24
Turf and Ornamental[3]	7067.27	**5.52**	785.25	0.61	8278.98	**6.47**	517.44	0.40	245.31	0.19
All Food Crops [4]	1417.50	**1.11**	157.50	0.12	1660.54	**1.30**	103.78	0.08	49.20	0.04
All Food Crops[5]	1455.31	**1.14**	161.70	0.13	1704.83	**1.33**	106.55	0.08	50.52	0.04

1-Turf and Ornamental[1] 15.2 lbs a.i./A, 1, NA
2-Turf and Ornamental[2] 15 lbs a.i./A, 6 applications, 7 day interval
3-Turf and Ornamental[3] 12 lbs a.i./A, 6 applications, 7 day interval
4- One application of 10.5 lbs a.i./A was modeled. All food uses except garlic have a 10.5 lb a.i./A application rate. Garlic's application rate is 10.4 and is close enough to 10.5 to also be represented by this rate. See Table 3-1 for a list of food crops and application rates.
5- Two applications of 10.5 lbs a.i./A with a 183 day interval was modeled, All food crops could have more than one application as a maximum number of applications is not specified on any of the labels.

Most agricultural labels require banding and incorporation when DCPA is use in California. The available modeling tools can be used to assess acute risk from granular or banded applications but not chronic risk. The DCPA toxicity dataset does not include acute terrestrial endpoints and the weight of one granule is not available. Therefore, the effect of banding and soil incorporation on RQ values cannot be quantitatively determined.

The highest acute dose and dietary concentrations tested with both mallard ducks and bobwhite quail did not result in any mortality or sublethal effect in exposed birds (sample size = 10 in each test). A provisional method described in Appendix J was used to extrapolate subacute dietary LC_{50} values for this data (Table 5-16). Because no concentration-response relationship data is available from a limit toxicity study, LC_{50} values were modeled for a minimum slope of 2, a maximum slope of 9, and typical slope of 4.5 observed for pesticides in general (U.S. EPA, 1986; U.S. EPA, 2004). The acute toxicity LOC for an endangered avian species is 0.1 (U.S. EPA, 2004). The EEC residue levels were compared to one-tenth of each modeled LC_{50} value (0.1 x LC_{50}) to estimate if the LOC would be exceeded.

Table 5-16. Back Calculation of Acute LD_{50} and LC_{50} Values for No Mortality Test Results for DCPA

Test Species	Test dose	Number of organisms tested	95% UCL on $\hat{p}$ x 100[1]	Probit for 95% UCL on $\hat{p}$ x 100[2]	Back-calculated LD_{50} or LC_{50} at Slope 9	Back-calculated LD_{50} LC_{50} at Slope 4.5	Back-calculated LD_{50} or LC_{50} at Slope 2
Bobwhite quail	2250 mg/kg bw	10	31	4.504	2554 mg/kg bw	2900 mg/kg	3983 mg/kg bw
Bobwhite quail dietary	5000 ppm	10	31	4.504	5677 ppm	6445 ppm	8851 ppm
Mallard duck dietary	5620 ppm	10	31	4.504	6380 ppm	7244 ppm	9948 ppm

Abbreviations: UCL = upper confidence limit
[1] Obtained 95% confidence limits on binomial from Table 4 in Conover (1980) for the number of organisms tested and $p = 0$ (*i.e.*, no mortality).
[2] Obtained from Table I of Finney (1977) for transformation of percentages to probits.

Table 5-17. Body Weight Adjusted Acute Oral LD_{50} Values Based on Extrapolated Mallard Duck LD_{50} Values for DCPA from Limit Test Results

Body weight	Body Weight Adjusted Acute Oral LD_{50} (mg/kg-bw) Values Using Extrapolated Mallard Duck Assuming Probit Response Slopes of 2, 4.5, and 9		
	Slope 2	Slope 4.5	Slope 9
20 g Bird	2869	2089	1840

The following tables include the TREX estimated EECs for small birds consuming small insects. Based on the back calculated LD_{50} values, it is apparent that even though mortality was not observed in the submitted toxicity tests, risk to birds and amphibians is still possible. For a more detailed explaination of the probit methodology for back calculating LD_{50}'s, see Appendix J.

The values in bold indicate that 1/10th or 1/5th (listed or non-listed species LOC, respectively) of the LD_{50} values are exceed by the EECs. If the EEC is greater than one tenth of the LD_{50} it is similar to an RQ value that exceeds 0.1 (the ES LOC for birds).

Table 5-18. Upper-bound Kenega Nomogram EECs for Dietary- and Dose-based Exposures of the CRLF and its Prey for DCPA Compared to 1/10 Back Calculated Avian LD_{50} Values – Used to Evaluate Direct Effects to Terrestrial CRLF

Use (Number of Applications, application interval)	EECs for CRLF			
	Dose-based EEC (mg/kg-bw)	1/10 LD_{50}=209 mg/kg-bw	Dietary-based EEC (ppm)	1/10 LC_{50}=645 ppm
Turf and Ornamental (6 app., 7 day)[1]	**10061**	>	**8834**	>
Nursery and ornamentals (6 app., 7 day)[2]	**8049**	>	**7067**	>
All Food Crops (1 app.)[3]	**1614**	>	**1418**	>

Use (Number of Applications, application interval)	EECs for CRLF			
	Dose-based EEC (mg/kg-bw)	1/10 LD_{50}=209 mg/kg-bw	Dietary-based EEC (ppm)	1/10 LC_{50}=645 ppm
All Food Crops (2 app., 183 days)[4]	**1658**	>	**1455**	>
All Food Crops (2 app. 30 days)[4]	**2506**	>	**2200**	>
All Food Crops (2 app. 60 days)[4]	**2106**	>	**1849**	>
Radish (11 app., 30 days)[5]	**3599**	>	**3160**	>
Cole Crops (7 app., 30 days)[6]	**3548**	>	**3115**	>

Abbreviations: App.= applications, bw = body weight
1-Turf and Ornamental, 15 lbs a.i./A, 6 applications, 7 day interval
2-Nursery and Ornamental, 12 lbs a.i./A, 6 applications, 7 day interval
3-All food except garlic have a 10.5 lb a.i./A application rate. Garlic's application rate is 10.4 and is close enough to 10.5 to also be represented by this rate. See Table 3-1 for a list of food crops.
4-All food crops could have two applications as a maximum number of applications is not specified on any of the labels.
5- All food crops could have eleven applications as a maximum number of applications is not specified on any of the labels; however, an extension agent reported this a maximum usage for radish (http://www.wripmc.org/newsalerts/dacthal03.html).
6- All food crops could have seven applications; however, cole crops have a reported maximum number of seven uses (http://www.wripmc.org/newsalerts/dacthal03.html).

The analysis lends additionally evidence for the conclusion of likely effects to the CRLF based on direct effects to the terrestrial phase. Even if the least conservative value (derived assuming a slope of 2) was used to estimate toxicity, the EEC for every use scenario is much greater than 1/10 the estimated LD_{50} value.

Based on the evidence discussed above, a "Likely to Adversely Affect" determination is made for direct effects to the terrestrial-phase CRLF.

5.2.2 Indirect Effects (via Reductions in Prey Base)

5.2.2.1 Algae (non-vascular plants)

As discussed in Section 2.5.3, the diet of CRLF tadpoles is composed primarily of unicellular aquatic plants (*i.e.*, algae and diatoms) and detritus. No aquatic plant RQs for DCPA were calculated due to lack of definitive data; however, effects were observed at or above solubility. Inhibition of yield and growth were seen in all non-vascular species tested. Effects to lake phytoplankton were assessed by measure inhibition of photosynthesis compared with rates of phosphate and ammonium uptake. According to the study (Brown and Lean, 1995), Dacthal exposure leads to photosynthesis inhibition with an EC_{50} of 7.9 mg/L.

Toxicity endpoints for dicamba were also used to evaluate risk to nonvascular plants as a result of exposure to TPA. Toxicity studies with algae exposed to dicamba acid indicate that cell densities were significantly reduced in blue-green algae at test concentrations as low as 0.061 mg a.i./L (U.S. EPA, 2005). TPA RQs range from 4.22 - 50.88 and all exceed the LOC of 1.0 for plants (Table 5-2). Thus, it is likely that exposure to TPA will result in effects on non-vascular plants due to use of DCPA.

Based on the weight-of-evidence, there is potential indirect impact to the CRLF based on this endpoint.

5.2.2.2 Aquatic Invertebrates

The potential for DCPA to elicit indirect effects to the CRLF via effects on freshwater invertebrate food items is dependent on several factors including: (1) the potential magnitude of effect on freshwater invertebrate individuals and populations; and (2) the number of prey species potentially affected relative to the expected number of species needed to maintain the dietary needs of the CRLF. Together, these data provide a basis to evaluate whether the number of individuals within a prey species is likely to be reduced such that it may indirectly affect the CRLF.

Acute exposure to DCPA is not expected to result in risk to the aquatic invertebrates because all toxicity endpoints for freshwater invertebrates were above the limit of solubility for DCPA. Acute exposure of the eastern oyster resulted in a 48- hr EC_{50} of 250 μg/L; however, this is a salt water species and was not used in this assessment. No chronic effects data on aquatic species are available for DCPA. Based on chronic effects observed for mammals and birds and the lack of data to preclude chronic effects to invertebrates, we assumed that chronic effects to invertebrates may occur.

Modeled effects endpoints and endpoints from other benzoic acid herbicides were used to assess risk from exposure to the degradate TPA. Exposure concentrations modeled based on TPA properties indicated that acute effects to the freshwater invertebrates are possible. TPA RQs for freshwater invertebrates range from 0.01 - 0.09 (Table 5-2). RQs exceed the acute listed invertebrate LOC for turf, ornamental, and nursery uses with multiple applications and for food uses with more than six applications. Based on chronic effects observed for mammals and birds and the lack of data to preclude chronic effects to invertebrates exposed to TPA, we assumed that chronic effects to invertebrates may occur.

As this determination is based on modeled data, it is difficult to further speculate how this risk could be reduced. Further refinement would be an exercise in further speculation. Aquatic toxicity data on the degradate TPA and chronic aquatic toxicity data for DCPA and TPA are needed before definitive analysis can be completed.

Based on the weight-of-evidence, there is potential indirect impact to the CRLF based on this endpoint.

5.2.2.3 Fish and Aquatic-phase Frogs

Based on the results from Section 5.2.1.1, indirect effects to CRLF via effects to fish and frogs as food items are expected due to 1) effects resulting from acute TPA exposure, and 2) chronic effects resulting from exposure to TPA and DCPA.

5.2.2.4 Terrestrial Invertebrates

When the terrestrial-phase CRLF reaches juvenile and adult stages, its diet is mainly composed of terrestrial invertebrates. No mortality occurred in the acute contact toxicity study and RQs were not calculated; however, EECs were compared to the highest concentration tested. The EECs for turf, nursery and, ornamental uses (7067-8834 μg/g-bee) exceeded the highest concentration tested (1797 μg/g-bee, adjusted by bee body weight) by a factor of three to five and EEC for the food uses were just below the highest level tested (EEC = 1418 - 1455 μg/g-bee). Because no toxicity data are available at the level of estimated exposure for turf, nursery, and ornamental uses, we are not able to definitively conclude that no effect will occur. However, when DCPA is applied twice to food crops the EECs do not exceed the highest level tested. It was therefore assumed that toxicity to terrestrial invertebrates is uncertain but possible.

5.2.2.5 Mammals

Life history data for terrestrial-phase CRLFs indicate that large adult frogs consume terrestrial vertebrates, including mice. No effects were observed in the highest treatment level in acute toxicity tests with mammals. The acute exposure EECs ranged from <0.29 to <4.4 times that of the test levels. A probit analysis to estimate the likely LD_{50} based on the number of test organisms in the study was completed and is presented below. The method used in Section 5.2.1.2 was used to generate estimated mammalian LD_{50} values. The Table 5-19 below shows the input and results for the estimation for toxicity to mammals.

Table 5-19. Back Calculation of Acute LD_{50} and LC_{50} Values for No Mortality Test Results for DCPA

Test Species	Test dose	Number of organisms tested	95% UCL on $\hat{p}$ x 100[1]	Probit for 95% UCL on $\hat{p}$ x 100[2]	Back-calculated LD_{50} (or LC_{50}) at Slope 9	Back-calculated LD_{50} (or LC_{50}) at Slope 4.5	Back-calculated LD_{50} (or LC_{50}) at Slope 2
Rat acute	5000mg/kg-bw	10	31	4.504	5677 mg/kg bw	6445 mg/kg-bw	8851 mg/kg bw

Abbreviations: UCL=upper confidence limit

[1] Obtained 95% confidence limits on binomial from Table 4 in Conover (1980) for the number of organisms tested and *p* = 0 (*i.e.*, no mortality).

[2] Obtained from Table I of Finney (1977) for transformation of percentages to probits.

TREX was used to generate body weight adjusted mammalian LD_{50} values.

Table 5-20. Body Weight Adjusted Acute Oral LD_{50} Values Based on Extrapolated Mammalian LD_{50} Values from Limit Test Results for DCPA

Body weight	Body Weight Adjusted Acute Oral LD_{50} (mg/kg-bw) Values Using Extrapolated for Rat Assuming Probit Response Slopes of 2, 4.5, and 9

	Slope 2	Slope 4.5	Slope 9
15 g Mammal	19453	14165	12477

In Table 5-21 below, the values in bold indicate that 1/5[th] (non-listed species LOC) of the LD_{50} value is exceed by the EEC. EECs greater than one fifth of the LD_{50} are similar to RQ values that exceed the non-listed LOC for mammals (0.5). The EECs are greater than the one fifth LD_{50} for all uses except food uses with applications only once a year or once per seaon (1 application, or 2 applications with a 183 day interval). While there is uncertainty associated with estimated LD_{50} values, the results indicate that acute effects to small mammals are possible even though mortality was not observed. Because environmental exposure levels are estimated to be much higher than the level which may cause acute effets to mammals, the CRLF may be indirectly affected by acute exposure to DCPA.

Table 5-21. Upper-bound Kenega Nomogram EECs for Dietary- and Dose-based Exposures of the CRLF and its Prey to DCPA

Use (Number of Applications)	EECs for Prey (small mammals)	
	Dose-based EEC (mg/kg-bw)	1/5 LD_{50}=2833 mg/kg-bw
Turf and Ornamental (6 app., 7 day)[1]	**14974**	>
Nursery and ornamentals (6 app., 7 day)[2]	**11979**	>
All Food Crops (1 app.)[3]	2403	<
All Food Crops (2 app., 183 days)[4]	2467	<
All Food Crops (2 app. 30 days)[4]	**3729**	>
All Food Crops (2 app. 60 days)[4]	**3135**	>
Radish (11 app., 30 days)[5]	**5356**	>
Cole Crops (7 app., 30 days)[6]	**5280**	>

Abbreviations: App.= applications, bw = body weight
1-Turf and Ornamental, 15 lbs a.i./A, 6 applications, 7 day interval
2-Nursery and Ornamental, 12 lbs a.i./A, 6 applications, 7 day interval
3-All food except garlic have a 10.5 lb a.i./A application rate. Garlic's application rate is 10.4 and is close enough to 10.5 to also be represented by this rate. See Table 3-1 for a list of food crops.
4-All food crops could have two applications as a maximum number of applications is not specified on any of the labels.
5- All food crops could have eleven applications as a maximum number of applications is not specified on any of the labels; however, an extension agent reported this maximum usage for radish (http://www.wripmc.org/newsalerts/dacthal03.html).
6- All food crops could have seven applications; however, cole crops have a reported maximum number of seven uses (http://www.wripmc.org/newsalerts/dacthal03.html).

As described in the Risk Estimation section, reproductive effects were observed in chronic mammalian studies and resulted in RQ values that exceeded the LOC with RQ values ranging from 2.5 - 136. DCPA is persistent and can be used in high frequency and therefore chronic exposure is likely.

Based on effects to small mammals, there is a potential indirect impact to the CRLF via reduction in small mammal prey items.

5.2.2.6 Terrestrial-phase Amphibians

Terrestrial-phase adult CRLFs also consume frogs. RQ values representing direct exposures of DCPA to terrestrial-phase CRLFs are used to represent exposures of DCPA to frogs in terrestrial habitats. To estimate risk to CRLF from loss of frogs as prey items, effects of DCPA to terrestrial and aquatic phase amphibians are considered. As described in Section (5.2.1.2), chronic effects to terrestrial phase amphibians are expected and therefore use of DCPA has the potential to impact the CRLF via reduction in amphibian prey items.

Based on the evidence discussed above, a "Likely to Adversely Affect" determination is made for indirect effects via Reductions in Prey Base to the aquatic and terrestrial Phase CRLF.

5.2.3 Indirect Effects (via Habitat Effects)

5.2.3.1 Aquatic Plants (Vascular and Non-vascular)

Aquatic plants serve several important functions in aquatic ecosystems. Non-vascular aquatic plants are primary producers and provide the autochthonous energy base for aquatic ecosystems. Vascular plants provide structure as attachment sites and refugia for many aquatic invertebrates, fish, and juvenile organisms, such as fish and frogs. In addition, vascular plants also provide primary productivity and oxygen to the aquatic ecosystem. Rooted plants help reduce sediment loading and provide stability to nearshore areas and lower streambanks. In addition, vascular aquatic plants are important as attachment sites for egg masses of CRLFs.

Potential indirect effects to the CRLF based on impacts to habitat and/or primary production were assessed using RQs from dicamba freshwater aquatic vascular plant data. Risk to aquatic plants (Section 5.1.1.3) is expected as a result of exposure to DCPA and TPA in the aquatic environment. Based on the weight-of-evidence, there is potential indirect impact to the CRLF.

5.2.3.2 Terrestrial Plants

Terrestrial plants serve several important habitat-related functions for the CRLF. In addition to providing habitat and cover for invertebrate and vertebrate prey items of the CRLF, terrestrial vegetation also provides shelter for the CRLF and cover from predators while foraging. Terrestrial plants also provide energy to the terrestrial ecosystem through primary production. Upland vegetation including grassland and woodlands provides cover during dispersal. Riparian vegetation helps to maintain the integrity of aquatic systems by providing bank and thermal stability, serving as a buffer to filter out sediment, nutrients, and contaminants before they reach the watershed, and serving as an energy source.

Definitive toxicity data was available for only one plant species (dicot). Terrestrial plant RQs do not provide enough certainty to preclude risk based on the lack of monocot data and the use of tolerant plant species in the phytotoxicty test. In lieu of the LOC approach, effects on terrestrial plants were assessed qualitatively. Based on numerous lines of evidence, DCPA has the potential to affect the CRLF via effects to terrestrial habitat.

Based on the evidence discussed above, a "Likely to Adversely Affect" determination is made for indirect effects to the CRLF via changes in terrestrial and aquatic habitat.

5.2.4 Modification to Designated Critical Habitat

Risk conclusions for the designated critical habitat are the same (LAA) as those for indirect effects via effects on terrestrial and aquatic plants.

5.2.4.1 Aquatic-Phase PCEs

Three of the four assessment endpoints for the aquatic-phase primary constituent elements (PCEs) of designated critical habitat for the CRLF are related to potential effects to aquatic and/or terrestrial plants:

- Alteration of channel/pond morphology or geometry and/or increase in sediment deposition within the stream channel or pond: aquatic habitat (including riparian vegetation) provides for shelter, foraging, predator avoidance, and aquatic dispersal for juvenile and adult CRLFs.
- Alteration in water chemistry/quality including temperature, turbidity, and oxygen content necessary for normal growth and viability of juvenile and adult CRLFs and their food source.
- Reduction and/or modification of aquatic-based food sources for pre-metamorphs (*e.g.,* algae).

Conclusions for potential indirect effects to the CRLF via direct effects to aquatic and terrestrial plants are used to determine whether modification to critical habitat may occur. There is a potential for habitat modification via impacts to **aquatic plants** (Sections 5.2.2.1 and 5.2.3.1**) and terrestrial plants** (5.2.3.2) from use of DCPA**.**

The remaining aquatic-phase PCE is "alteration of other chemical characteristics necessary for normal growth and viability of CRLFs and their food source." Other than impacts to algae as food items for tadpoles (discussed above), this PCE is assessed by considering direct and indirect effects to the aquatic-phase CRLF via acute and chronic freshwater fish and invertebrate toxicity endpoints as measures of effects. There is a potential for habitat modification via impacts to **aquatic-phase CRLFs (Sections** 5.2.1.1**) and effects to freshwater invertebrates and fish as food items (Sections** 5.2.2.2 **and** 5.2.2.3) from DCPA use.

5.2.4.2 Terrestrial-Phase PCEs

Two of the four assessment endpoints for the terrestrial-phase PCEs of designated critical habitat for the CRLF are related to potential effects to terrestrial plants:

- Elimination and/or disturbance of upland habitat; ability of habitat to support food source of CRLFs: Upland areas within 200 ft of the edge of the riparian vegetation or drip line surrounding aquatic and riparian habitat that are comprised of grasslands, woodlands, and/or wetland/riparian plant species that provides the CRLF shelter, forage, and predator avoidance.

- Elimination and/or disturbance of dispersal habitat: Upland or riparian dispersal habitat within designated units and between occupied locations within 0.7 miles of each other that allow for movement between sites including both natural and altered sites which do not contain barriers to dispersal.

There is potential for habitat modification via impacts to **terrestrial plants (5.2.3.2)** from DCPA use.

The third terrestrial-phase PCE is "reduction and/or modification of food sources for terrestrial phase juveniles and adults." To assess the impact of DCPA on this PCE, acute and chronic toxicity endpoints for terrestrial invertebrates, mammals, and terrestrial-phase frogs are used as measures of effects. There is potential for habitat modification via **indirect effects to terrestrial-phase CRLFs via reduction in prey base (Section 5.2.2.4 for terrestrial invertebrates, Section 5.2.2.5 for mammals, and 5.2.2.6 for frogs)** from DCPA use**.**

The fourth terrestrial-phase PCE is based on alteration of chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs and their food source. There is potential for habitat modification via **direct (Section 5.2.1.2) and indirect effects (Sections 5.2.2.4, 5.2.2.5, and 5.2.2.6) to terrestrial-phase CRLFs** from DCPA use.

6.0 Uncertainties

6.1 Exposure Assessment Uncertainties

6.1.1 Maximum Use Scenario

The screening-level risk assessment focuses on characterizing potential ecological risks resulting from a maximum use scenario, which is determined from labeled statements of maximum application rate and number of applications with the shortest time interval between applications. The frequency at which actual uses approach this maximum use scenario may be dependant on pest resistance, timing of applications, cultural practices, and market forces.

6.1.2 Aquatic Exposure Modeling of DCPA and TPA

The standard ecological water body scenario (EXAMS pond) used to calculate potential aquatic exposure to pesticides is intended to represent conservative estimates, and to avoid underestimations of the actual exposure. The standard scenario consists of application to a 10-hectare field bordering a 1-hectare, 2-meter deep (20,000 m^3) pond with no outlet. Exposure estimates generated using the EXAMS pond are intended to represent a wide variety of vulnerable water bodies that occur at the top of watersheds including prairie pot holes, playa lakes, wetlands, vernal pools, man-made and natural ponds, and intermittent and lower order streams. As a group, there are factors that make these water bodies more or less vulnerable than the EXAMS pond. Static water bodies that have larger ratios of pesticide-treated drainage area to water body volume would be expected to have higher peak EECs than the EXAMS pond. These water bodies will be either smaller in size or have larger drainage areas. Smaller water bodies have limited storage capacity and thus may overflow and carry pesticide in the discharge, whereas the EXAMS pond has no discharge. As watershed size increases beyond 10-hectares, it becomes increasingly unlikely that the entire watershed is planted with a single crop that is all treated simultaneously with the pesticide. Headwater streams can also have peak concentrations higher than the EXAMS pond, but they likely persist for only short periods of time and are then carried and dissipated downstream.

The Agency acknowledges that there are some unique aquatic habitats that are not accurately captured by this modeling scenario and modeling results may, therefore, under- or over-estimate exposure, depending on a number of variables. For example, aquatic-phase CRLFs may inhabit water bodies of different size and depth and/or are located adjacent to larger or smaller drainage areas than the EXAMS pond. The Agency does not currently have sufficient information regarding the hydrology of these aquatic habitats to develop a specific alternate scenario for the CRLF. CRLFs prefer habitat with perennial (present year-round) or near-perennial water and do not frequently inhabit vernal (temporary) pools because conditions in these habitats are generally not suitable (Hayes and Jennings, 1988). Therefore, the EXAMS pond is assumed to be representative of exposure to aquatic-phase CRLFs. In addition, the Services agree that the existing EXAMS pond represents the best currently available approach for estimating aquatic exposure to pesticides (U.S. FWS/NMFS 2004).

In general, the linked PRZM/EXAMS model produces estimated aquatic concentrations that are expected to be exceeded once within a ten-year period. The Pesticide Root Zone Model is a process or "simulation" model that calculates what happens to a pesticide in an agricultural field on a day-to-day basis. It considers factors such as rainfall and plant transpiration of water, as well as how and when the pesticide is applied. It has two major components: hydrology and chemical transport. Water movement is simulated by the use of generalized soil parameters, including field capacity, wilting point, and saturation water content. The chemical transport component can simulate pesticide application on the soil or on the plant foliage. Dissolved, adsorbed, and vapor-phase concentrations in the soil are estimated by simultaneously considering the processes of pesticide uptake by plants, surface runoff, erosion, decay, volatilization, foliar wash-off, advection, dispersion, and retardation.

Uncertainties associated with each of these individual components add to the overall uncertainty of the modeled concentrations. Additionally, model inputs from the environmental fate degradation studies are chosen to represent the upper confidence bound on the mean values that are not expected to be exceeded in the environment approximately 90 percent of the time. Mobility input values are chosen to be representative of conditions in the environment. The natural variation in soils adds to the uncertainty of modeled values. Factors such as application date, crop emergence date, and canopy cover can also affect estimated concentrations, adding to the uncertainty of modeled values. Factors within the ambient environment such as soil temperatures, sunlight intensity, antecedent soil moisture, and surface water temperatures can cause actual aquatic concentrations to differ for the modeled values.

Unlike spray drift, tools are currently not available to evaluate the effectiveness of a vegetative setback on runoff and loadings. The effectiveness of vegetative setbacks is highly dependent on the condition of the vegetative strip. For example, a well-established, healthy vegetative setback can be a very effective means of reducing runoff and erosion from agricultural fields. Alternatively, a setback of poor vegetative quality or a setback that is channelized can be ineffective at reducing loadings. Until such time as a quantitative method to estimate the effect of vegetative setbacks on various conditions on pesticide loadings becomes available, the aquatic exposure predictions are likely to overestimate exposure where healthy vegetative setbacks exist and underestimate exposure where poorly developed, channelized, or bare setbacks exist.

In order to account for uncertainties associated with modeling, available monitoring data were compared to PRZM/EXAMS estimates of peak EECs for the different uses. As discussed above, several data values were available from NAWQA for DCPA concentrations measured in surface waters receiving runoff from agricultural areas. The specific use patterns (*e.g.*, application rates and timing, crops) associated with the agricultural areas are unknown, however, they are assumed to be representative of potential DCPA use areas. Overall, modeled concentrations were similar to (within a factor of 10) measured concentrations of DCPA. Modeled aquatic concentrations of DCPA ranged from 20 to 500 μg/L (Table 3-6). The maximum DCPA concentration measured in surface water was 100 μg/L (Table 3-9). The monitoring results are near levels measured in monitoring studies which were not targeted monitoring data. Modeled aquatic concentrations of TPA using GENEEC ranged from 0.33-4.07 mg/L. NAWQA and CADPR studies monitor MTP and not TPA and data on surface water were not available for TPA. As the monitoring data were not targeted and therefore likely do not capture peak DCPA concentrations, the results indicate that the PRZM/EXAMs EECs may not be conservative. The ground water monitoring results for DCPA (maximum concentration = 986 μg/L) are similar to the surface water monitoring results (maximum concentration = 100 μg/L) (see Table 3-6 and Table 3-9).

Risk to aquatic organisms from exposure to TPA was estimated using GENEEC EECs. GENEEC is a single event model. It assumes one single large rainfall/runoff event occurs that removes a large quantity of pesticide from the field to the water all at one time. Longer-term, multiple-day average concentration values are calculated based on the peak day value and subsequent values considering degradation processes. PRZM/EXAMS estimated EECs exceed those estimated using GENEEC. The linked PRZM/EXAMS models simulate the impact of daily weather on the treated agricultural field over a period of thirty years. During this time, pesticide is washed-off of the field into the water-body by twenty to forty rainfall/runoff events per year. Each new addition of pesticide to the water-body adds to the pesticide which has arrived earlier either through previous runoff events or through spray-drift and begins degrading on the day it reaches the water. So PRZM/EXAMs allows for accumulation of pesticides in the pond with year after year applications while GENEEC does not. As TPA was assumed to be stable under all conditions, none of the TPA in the pond was lost in the PRZM/EXAMS model. This may result in a very high estimate of EECs because some loss of TPA over thirty years is expected due to burial of sediment and other dissipation processes. Additionally, because of this accumulation the generated EECs do not represent a 1 in 10 year value but a maximum value if TPA were applied every year to the same plot with the same amounts for 30 years with none of the TPA entering the pond being lost. The risk estimated using GENEEC may be slightly underestimated in areas where TPA is applied frequently to the same area for many years. However, the change in the risk conclusions would be small. The GENEEC EECs are only slightly lower than PRZM/EXAMs EECs (the maximum GENEEC TPA EEC = 4.07 mg/L and the maximum PRZM/EXAMs EECs = 22 mg/L).

6.1.3 Exposure Resulting from Atmospheric Transport

DCPA has been detected in precipitation samples in California. According to Majewski *et al.* (2006), DCPA was detected in 100% of rainfall samples (n=137) at a maximum concentration of 0.030 μg/L. Based on these data, it is possible that DCPA can be deposited on land in precipitation. Estimates of exposure of the CRLF, its prey and its habitat to DCPA included in this assessment are based only on transport of DCPA through runoff and spray drift from application sites. Current estimates of exposures of CRLF and its prey to DCPA through runoff and spray drift would be greater if consideration is given to deposition in precipitation. In the aquatic environment, the concentration in precipitation (0.03 μg/L) is a fraction of the aquatic EECs (20-500 μg/L) predicted based on modeling. These concentrations are also a fraction of the terrestrial EECs (1849 - 8834 ppm, for dietary exposure to birds and mammals) based on modeling. Therefore, precipitation is not expected to be a significant source of exposure. It was assumed that exposure due to the presence of DCPA in precipitation would have a minor impact on risk conclusions.

6.1.4 Potential Ground Water Contributions to Surface Water Chemical Concentrations

Although the potential impact of discharging ground water on CRLF populations is not explicitly delineated, it should be noted that, in some areas of the country, ground water could provide a source of pesticide to surface water bodies – especially low-order streams, headwaters, and ground water-fed pools. This is particularly likely if the chemical is persistent and mobile, the pesticide is applied to highly permeable soils overlying shallow unconfined ground water, and rainfall is sufficient to drive the chemical through the soil to ground water. Soluble chemicals that are primarily subject to photolytic degradation will be very likely to persist in ground water, and can be transportable over long distances. Similarly, many chemicals degrade slowly under anaerobic conditions (common in aquifers) and are thus more persistent in ground water. Under the right hydrologic conditions, this ground water may eventually be discharged to the surface – often supporting stream flow in the absence of rainfall. Continuously flowing low-order streams in particular are sustained by ground water discharge, which can constitute 100% of stream flow during baseflow (no runoff) conditions. Thus, it is important to keep in mind that pesticides in ground water may impact surface water quality during base flow conditions with subsequent impact on CRLF habitats. However, many smaller streams in CA are net dischargers of water to ground water that go dry during portions of the year and are not supplied by baseflow from ground water.

Although concentrations in a receiving water body resulting from ground water discharge cannot be explicitly quantified, it should be assumed that significant attenuation and retardation of the chemical will have occurred prior to discharge. Nevertheless, where DCPA is applied to highly permeable soils over shallow ground water where there is a net recharge to adjacent streams, ground water could still be a consistent source of chronic background concentrations in surface water, and may also add to surface runoff during storm events (as a result of enhanced ground water discharge typically characterized by the 'tailing limb' of a storm hydrograph).

6.1.5 Usage Uncertainties

County-level usage data were obtained from California's Department of Pesticide Regulation Pesticide Use Reporting (CDPR PUR) database. Eight years of data (1999 – 2006) were included in this analysis because statistical methodology for identifying outliers, in terms of area treated and pounds applied, was provided by CDPR for these years only. CDPR PUR documentation indicates that errors in the data may include the following: a misplaced decimal; incorrect measures, area treated, or units; and reports of diluted pesticide concentrations. In addition, it is possible that the data may contain reports for pesticide uses that have been cancelled. The CPDR PUR data does not include home owner applied pesticides; therefore, residential uses are not likely to be reported. As with all pesticide usage data, there may be instances of misuse and misreporting. The Agency made use of the most current, verifiable information; in cases where there were discrepancies, the most conservative information was used.

6.1.6 Terrestrial Exposure Modeling of DCPA

The Agency relies on the work of Fletcher *et al.* (1994) for setting the assumed pesticide residues in wildlife dietary items. These residue assumptions are believed to reflect a realistic upper-bound residue estimate, although the degree to which this assumption reflects a specific percentile estimate is difficult to quantify. 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.

It was assumed that ingestion of food items in the field occurs at rates commensurate with 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 differences. Direct comparison of a laboratory dietary concentration-based effects threshold to a fresh-weight pesticide residue estimate would result in an underestimation of field exposure by food consumption by a factor of 1.25 – 2.5 for most food items.

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's assimilation ranges from 41 – 85% (U.S. 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.

For the terrestrial exposure analysis of this risk assessment, a generic bird or mammal was assumed to occupy either the treated field or adjacent areas receiving a treatment rate on the field. Actual habitat requirements of any particular terrestrial species were not considered, and it was assumed that species occupy, exclusively and permanently, the modeled treatment area. Spray drift model predictions suggest that this assumption leads to an overestimation of exposure to species that do not occupy the treated field exclusively and permanently.

6.1.7 Spray Drift Modeling

Although there may be multiple DCPA applications at a single site, it is unlikely that the same organism would be exposed to the maximum amount of spray drift from every application made. In order for an organism to receive the maximum concentration of DCPA from multiple applications, each application of DCPA would have to occur under identical atmospheric conditions (*e.g.*, same wind speed and – for plants – same wind direction) and (if it is an animal) the animal being exposed would have to be present directly downwind at the same distance after each application. Although there may be sites where the dominant wind direction is fairly consistent (at least during the relatively quiescent conditions that are most favorable for aerial spray applications), it is nevertheless highly unlikely that plants in any specific area would receive the maximum amount of spray drift repeatedly. It appears that in most areas (based upon available meteorological data) wind direction is temporally very changeable, even within the same day. Additionally, other factors, including variations in topography, cover, and meteorological conditions over the transport distance are not accounted for by the AgDRIFT/AGDISP model (*i.e*., it models spray drift from aerial and ground applications in a flat area with little to no ground cover and a steady, constant wind speed and direction). Therefore, in most cases, the drift estimates from AgDRIFT/AGDISP may overestimate exposure even from single applications, especially as the distance increases from the site of application, since the model does not account for potential obstructions (*e.g*., large hills, berms, buildings, trees, *etc*.). Furthermore, conservative assumptions are often made regarding the droplet size distributions being modeled ('ASAE Very Fine to Fine' for orchard uses and 'ASAE Very Fine' for agricultural uses), the application method (*e*.g., aerial), release heights and wind speeds. Alterations in any of these inputs would change the area of potential effect.

6.2 Effects Assessment Uncertainties

6.2.1 Age Class and Sensitivity of Effects Thresholds

It is generally recognized that test organism age may have a significant impact on the observed sensitivity to a toxicant. The acute toxicity data for fish are collected on juvenile fish between 0.1 and 5 grams. Aquatic invertebrate acute testing is performed on recommended immature age classes (*e.g*., first instar for daphnids, second instar for amphipods, stoneflies, mayflies, and third instar for midges).

Testing of juveniles may overestimate toxicity at older age classes for pesticide active ingredients that act directly without metabolic transformation because younger age classes may not have the enzymatic systems associated with detoxifying xenobiotics. In so far as the available toxicity data may provide ranges of sensitivity information with respect to age class, this assessment uses the most sensitive life-stage information as measures of effect for surrogate aquatic animals, and is therefore, considered as protective of the CRLF.

6.2.2 Use of Surrogate Species Effects Data

Guideline toxicity tests and open literature data on DCPA are not available for frogs or any other aquatic-phase amphibian; therefore, freshwater fish are used as surrogate species for aquatic-phase amphibians. Although no data are available for DCPA, endpoints based on freshwater fish ecotoxicity data are assumed to be protective of potential direct effects to aquatic-phase amphibians including the CRLF. Extrapolation of the risk conclusions from the most sensitive tested species to the aquatic-phase CRLF is presumed to overestimate the potential risks to those species. Efforts are made to select the organisms most likely to be affected by the type of compound and usage pattern; however, there is an inherent uncertainty in extrapolating across phyla. In addition, the Agency's LOCs are intentionally set very low, and conservative estimates are made in the screening level risk assessment to account for these uncertainties.

6.2.3 Sublethal Effects

When assessing acute risk, the screening risk assessment relies on the acute mortality endpoint as well as a suite of sublethal responses to the pesticide, as determined by the testing of species response to chronic exposure conditions and subsequent chronic risk assessment. Consideration of additional sublethal data in the effects determination t is exercised on a case-by-case basis and only after careful consideration of the nature of the sublethal effect measured and the extent and quality of available data to support establishing a plausible relationship between the measure of effect (sublethal endpoint) and the assessment endpoints. However, the full suite of sublethal effects from valid open literature studies is considered for the purposes of defining the action area.

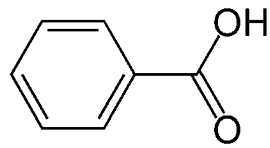
To the extent to which sublethal effects are not considered in this assessment, the potential direct and indirect effects of DCPA on CRLF may be underestimated.

6.2.4 Location of Wildlife Species

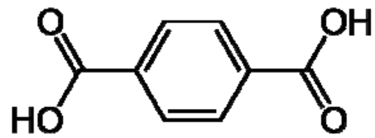
For the terrestrial exposure analysis of this risk assessment, a generic bird or mammal was assumed to occupy either the treated field or adjacent areas receiving a treatment rate on the field. Actual habitat requirements of any particular terrestrial species were not considered, and it was assumed that species occupy, exclusively and permanently, the modeled treatment area. Spray drift model predictions suggest that this assumption leads to an overestimation of exposure to species that do not occupy the treated field exclusively and permanently.

6.2.5 Compounds with Stuctures Similar to DCPA and TPA

Figure 6-1 shows the structures of both benzoic acid and terphthalic acid. DCPA and TPA can be classified as both benzoic acids and phthalic acids. The benzoic acid (aromatic carboxylic acids) herbicides dicamba and 2,3,6-TBA are similar to DCPA and TPA in that they all have chlorine and COOH groups attached to benzene. Phthalic acids or dicarboxylic acids also have COOH groups attached to benzene. Toxicity data available for phthalic acids are also relevant in the evaluation of the toxicity of DCPA and TPA. Acute aquatic toxicity values of terephthalic acid were greater than the solubility of 15 mg/L (OECD, 2001). No chronic data were available (OECD, 2001). As the benzoic acid herbicides have aquatic toxicity endpoints and the solubility is high enough to measure toxicity endpoints for aquatic organisms, the data for benzoic acid herbicides were used as a surrogate for TPA.



(a) Benzoic Acid



(b) Terephthalic Acid

Figure 6-1. Structure of (a) benzoic acid and (b) terephthalic acid

6.2.6 Cumulative Exposure to Organochlorines

DCPA formulations have impurities, HCB and 2,3,7,8-TCDD, and other organochlorines of toxicological concern. Exposure to multiple stressors at once may result in increased risk that is not reflected in risk evaluated for individual compounds. For example, both HCB and 2,3,7,8-TCDD act as aryl hydrocarbon agonists, and cumulative exposure could be evaluated by using toxic equivalency factors (U.S. EPA, 2008b; WHO, 1998; van Birgelen, 1998).

6.2.7 Benzoic Acid Herbicides

The toxicity datasets for DCPA and TPA have significant gaps, especially for aquatic data. To overcome this void, data from compounds that are similar in structure to TPA were used to estimate potential toxicity. Dicamba was found to be most similar with the appropriate data necessary to fill in data gaps. Estimating risk of DCPA use from dicamba data adds additional uncertainty to the effects determinations. These data are used because they are the best data available. However, conclusions based on these data could either over- or underestimate risk.

DCPA's low solubility is the major limiting factor for directly testing toxicity to aquatic organisms, including aquatic plants. Low solubility also limits the estimated environmental concentrations. Modeled concentrations of DCPA in the environment reach the limit of solubility. Because no mortality was observed at this level in toxicity tests with fish and invertebrates, it was concluded that the parent compound, DCPA, would not lead to effects in the aquatic environment.

As described in the Fate and Exposure assessment (Section 2.4.1) DCPA readily degrades to TPA, a much more soluble compound for which no toxicity data are available. Both DCPA and TPA have been found in the aquatic environment and both are persistent. Modeled and observed values of TPA are much higher than DCPA values and therefore limiting the aquatic effects assessment to the parent data set will not adequately assess risk. Therefore, toxicity data from surrogate chemicals that are similar to TPA are necessary to describe the potential for effects. Using these data may over- or underestimate risk but are the best data available.

6.2.8 Endocrine Disruption Screening Program

EPA is required under the Federal Food Drug and Cosmetic Act (FFDCA), as amended by Food Quality Protection Act (FQPA), to develop a screening program to determine whether certain substances (including all pesticide active and other ingredients) *"may have an effect in humans that is similar to an effect produced by a naturally occurring estrogen, or other such endocrine effects as the Administrator may designate."* Following the recommendations of its Endocrine Disruptor Screening and Testing Advisory Committee (EDSTAC), EPA determined that there were scientific bases for including, as part of the program, androgen and thyroid hormone systems, in addition to the estrogen hormone system. EPA also adopted EDSTAC's recommendation that the Program include evaluations of potential effects in wildlife. When the appropriate screening and/or testing protocols being considered under the Agency's Endocrine Disrupter Screening Program (EDSP) have been developed and vetted, DCPA may be subjected to additional screening and/or testing to better characterize effects related to endocrine disruption.

7.0 Risk Conclusions

In fulfilling its obligations under Section 7(a)(2) of the Endangered Species Act, the information presented in this endangered species risk assessment represents the best data currently available to assess the potential risks of DCPA to the CRLF and its designated critical habitat.

Based on the best available information, the Agency makes a **May Affect and Likely to Adversely Affect** determination for the CRLF from the use of DCPA. Additionally, the Agency has determined that there **is the potential for modification** of CRLF designated critical habitat from the use of the chemical. The effects determinations are based on the following predicted risks:

1) Risk of acute effects to freshwater organisms exposed to TPA, for all uses
2) Risk of chronic effects to freshwater organisms exposed to DCPA and TPA, for all uses
3) Risk of effects to freshwater plants exposed to DCPA and TPA, for all uses
4) Risk of acute effects to small birds exposed to hexachlorobenzene (HCB) for uses with multiple applications
5) Risk of chronic effects to small birds and small mammals exposed to DCPA and HCB, for all uses
6) Risk of effects to terrestrial plants exposed to DCPA, for all uses

A summary of the risk conclusions and effects determinations for the CRLF and its critical habitat is presented in Table 7-1 and Table 7-2. This determination applies to all formulations and uses of DCPA on food, turf, and ornamentals.

Given the LAA determination for the CRLF and potential modification of designated critical habitat, a description of the baseline status and cumulative effects for the CRLF is provided in Attachment 2.

Table 7-1. Effects Determination Summary for DCPA Use and the CRLF

Assessment Endpoint	Effects Determination [1]	Basis for Determination
Survival, growth, and/or reproduction of CRLF individuals	May affect, likely to adversely affect (LAA)[1]	**Potential for Direct Effects**
		Aquatic-phase (Eggs, Larvae, and Adults): Direct effects to aquatic phase CRLF resulting from acute exposure to TPA and chronic exposure to TPA and DCPA are expected. - TPA RQs exceed the acute listed species LOC for turf, nursery, and ornamental uses with multiple applications and for food crops with five or more applications. - Chronic exposures to DCPA and TPA may result in chronic effects to the aquatic CRLF based on chronic effects observed in birds and mammals. No chronic data are available for aquatic organisms.
		Terrestrial-phase (Juveniles and Adults): Direct effects to the terrestrial phase CRLF resulting from chronic exposure to DCPA are expected. - Acute RQs for birds, the terrestrial surrogate for the CRLF, exceed the LOC for uses with multiple applications of DCPA due to the presence of the impurity HCB. - Chronic RQs for birds, the terrestrial surrogate for the CRLF, exceed the LOC for all uses of DCPA. - Although no mortality was observed at the highest DCPA test concentrations in the available avian acute toxicity data, which is used as a surrogate for terrestrial-phase amphibians, predicted EECs are greater than highest test concentrations. Toxicity is unknown at these exposure levels.
		Potential for Indirect Effects
		Aquatic prey items, aquatic habitat, cover and/or primary productivity Indirect effects to the CRLF through effects to its prey in the aquatic habitat are expected. - TPA RQs exceed the acute listed invertebrate LOC for turf, ornamental, and nursery uses with multiple applications and for food uses with more than six applications. - A NOAEC could not be determined for aquatic non-vascular plants at or above the solubility limit of DCPA; however, effects were observed in the submitted studies and data are not available to discount risk for DCPA. All TPA RQs for aquatic non-vascular plants exceed the aquatic plant LOC. - An EC_{50} could not be determined for aquatic vascular plants at or above the

Assessment Endpoint	Effects Determination [1]	Basis for Determination
		solubility limit of DCPA; however, effects were observed in the submitted studies and data are not available to discount risk for DCPA. All TPA RQs were below the LOCs for aquatic vascular plants; however, the LOEC was exceeded by all TPA EECs and the calculated TPA RQs are uncertain because they are based on toxicity data for a surrogate compound, dicamba. - Based on chronic effects observed for birds and mammals, chronic effects in aquatic organism may occur as a result of exposure to DCPA and TPA. No chronic data are available for aquatic organisms. - Effects to terrestrial plants, fish, and frogs are expected.
		Terrestrial prey items, riparian habitat Indirect effects to the CRLF through effects to its prey in the terrestrial habitat are expected. - Acute effects to small birds are expected with multiple applications of DCPA due to the presence of the impurity HCB, LOCs were exceeded. - Although no mortality was observed at the highest test concentrations in the available avian acute toxicity data and acute mammalian toxicity data, predicted EECs are greater than highest test concentrations. Toxicity is unknown at these exposure levels. - Chronic RQs for small mammals and birds exceed the LOC for all uses of DCPA. . - Estimated EECs for terrestrial invertebrates exceed the acute contact LD_{50} where no effects were observed and the result of this exposure is uncertain. Toxicity is unknown at these exposure levels. - Effects to terrestrial plants are expected but not quantifiable.

[1] No effect (NE); May affect, but not likely to adversely affect (NLAA); May affect, likely to adversely affect (LAA)

Table 7-2. Effects Determination Summary for DCPA Use and CRLF Critical Habitat Impact Analysis

Assessment Endpoint	Effects Determination [1]	Basis for Determination
Modification of aquatic-phase PCE	Habitat Modification	Modification of the aquatic-phase PCE is expected. - Acute exposure to TPA and chronic exposure to TPA and DCPA as a result of all uses of DCPA may directly affect the CRLF based on EECs exceeding estimated toxicity values in the aquatic environment. -LOCs were exceeded for non-vascular plants and the LOEC of vascular plants was lower than EECs. - Acute LOCs were exceeded for freshwater fish, a surrogate for the CRLF, and freshwater invertebrates. - Chronic effects in aquatic organisms are likely. No chronic data on aquatic

		organisms is available. - Effects to terrestrial plants are expected.
Modification of terrestrial-phase PCE		<u>Modification of the terrestrial-phase PCE is expected.</u> - Acute effects to small birds are expected with multiple applications of DCPA due to the presence of the impurity HCB. LOCs were exceeded. - Although no mortality was observed at the highest DCPA test concentrations in the available avian acute toxicity data, which is used as a surrogate for terrestrial-phase amphibians, predicted EECs are greater than highest test concentrations. Toxicity is unknown at these exposure levels - Chronic RQs for small mammals and birds exceed the LOC for all uses of DCPA. - Estimated DCPA EECs for terrestrial invertebrates exceed the acute contact LD_{50} where no effects were observed and the result of this exposure is uncertain. Toxicity is unknown at these exposure levels. - Effects to terrestrial plants are expected but not quantifiable.

[1] Habitat Modification or No effect (NE)

Based on the conclusions of this assessment, a formal consultation with the U. S. Fish and Wildlife Service under Section 7 of the Endangered Species Act should be initiated.

When evaluating the significance of this risk assessment's direct/indirect and adverse habitat modification effects determinations, it is important to note that pesticide exposures and predicted risks to the species and its resources (*i.e.*, food and habitat) are not expected to be uniform across the action area. In fact, given the assumptions of drift and downstream transport (*i.e.*, attenuation with distance), pesticide exposure and associated risks to the species and its resources are expected to decrease with increasing distance away from the treated field or site of application. Evaluation of the implication of this non-uniform distribution of risk to the species would require information and assessment techniques that are not currently available. Examples of such information and methodology required for this type of analysis would include the following:

- Enhanced information on the density and distribution of CRLF life stages within specific recovery units and/or designated critical habitat within the action area. This information would allow for quantitative extrapolation of the present risk assessment's predictions of individual effects to the proportion of the population extant within geographical areas where those effects are predicted. Furthermore, such population information would allow for a more comprehensive evaluation of the significance of potential resource impairment to individuals of the species.
- Quantitative information on prey base requirements for individual aquatic- and terrestrial-phase frogs. While existing information provides a preliminary picture of the types of food sources utilized by the frog, it does not establish minimal

requirements to sustain healthy individuals at varying life stages. Such information could be used to establish biologically relevant thresholds of effects on the prey base, and ultimately establish geographical limits to those effects. This information could be used together with the density data discussed above to characterize the likelihood of adverse effects to individuals.

- Information on population responses of prey base organisms to the pesticide. Currently, methodologies are limited to predicting exposures and likely levels of direct mortality, growth or reproductive impairment immediately following exposure to the pesticide. The degree to which repeated exposure events and the inherent demographic characteristics of the prey population play into the extent to which prey resources may recover is not predictable. An enhanced understanding of long-term prey responses to pesticide exposure would allow for a more refined determination of the magnitude and duration of resource impairment, and together with the information described above, a more complete prediction of effects to individual frogs and potential modification to critical habitat.

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9.0 MRID Fate Studies

MRID Number	Study Citation
00114648	Szalkowski, M. (1975) The Effect of Light, Temperature, and pH on the Hydrolysis of Dacthal. (Unpublished study received Mar 23, 1976 under 3F1417; submitted by Diamond Shamrock Chemical Co., Cleveland, OH; CDL:095189-D)
00114649	Duane, W. (1976) Aerobic Soil Metabolism of Dacthal. (Unpublished study received Mar 23, 1976 under 3F1417; submitted by Diamond Shamrock Chemical Co., Cleveland, OH; CDL:095189-F)

00114651	Duane, W. (1976) Anaerobic Soil Metabolism of Dacthal. (Unpublished study received Mar 23, 1976 under 3F1417; submitted by Diamond Shamrock Chemical Co., Cleveland, OH; CDL:095189-H)
00114652	Duane, W. (1976) The Effect of Steam Sterilization on the Metabolism of Dacthal in Soils. (Unpublished study received Mar 23, 1976 under 3F1417; submitted by Diamond Shamrock Chemical Co., Cleveland, OH; CDL:095189-I)
00143063	Szalkowski, M. (1976) Photohydrolysis of Dacthal. Unpublished study prepared by Diamond Shamrock Corp. 10 p.
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Appendix A. Summarized Data from the California PUR Database

Appendix B. Spatial Summary for DCPA Uses

Appendix C. Risk Quotient (RQ) Method and Levels of Concern (LOCs)

Appendix D. CA PUR Data Graphs Presented as Pounds DCPA Applied per Application Over One Year and Application Rate (lbs a.i./A) per Application over one year.

Appendix E. Calculation of Input Parameters for PRZM/EXAMS and Example GENEEC and PRZM/EXAMS Output Files

Appendix F. Ecological Effects Data

Appendix G. ECOTOX Chlorthal-Dimethyl Effects Endpoints

Appendix H. Bibliography of ECOTOX Open Literature Not Evaluated

Appendix I. T-REX and T-HERPS Output

Appendix J. Back calculating LD50s