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

Pesticide Effects Determination

Environmental Fate and Effects Division
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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), from FIFRA regulatory actions regarding use of propanil on rice. 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 (USFWS) and National Marine Fisheries Service (NMFS) *Endangered Species Consultation Handbook* (USFWS/NMFS, 1998) and procedures outlined in the Agency's Overview Document (U.S. EPA, 2004).

The CRLF was listed as a threatened species by USFWS 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 (USFWS, 1996) in California.

Propanil is an amide herbicide that inhibits photosynthesis in a variety of broadleaf and grass plants (PC code 028201). In California, the only use site for propanil is on rice. Propanil quickly degrades in the environment to 3,4-dichloroaniline (3,4-DCA). The resulting exposures in rice paddies and waters receiving rice paddy discharges are to a mixture of propanil and its degradate 3,4-DCA. Monitoring data for surface water in rice growing areas (Sacramento and San Joaquin-Tulare river basins) show that contamination with propanil and its degradate is common, with concentrations up to 20 ppb for propanil and 0.626 ppb for 3,4-DCA, but generally both the degradate and the parent were seen with concentrations less than 1 ppb.

The toxicity of both the parent propanil and 3,4-DCA has been studied in a variety of aquatic animals and plants. A review of the ECOTOX database was conducted for both the parent compound (propanil) and the degradate (3,4-DCA). From the review of the ECOTOX database it was determined that the 3,4-DCA degradate may be approximately 11 and 7 times more toxic than the parent compound to freshwater invertebrates on an acute and chronic basis, respectively. These open literature studies from ECOTOX were reviewed and it was determined that data from both an acute and chronic freshwater invertebrate study could be used quantitatively within the assessment. The indirect toxicity effects of propanil on the aquatic-phase CRLF were examined using both registrant submitted studies for propanil, and open literature studies for 3,4-DCA. For the terrestrial-phase CRLF, no additional terrestrial toxicity data were available within ECOTOX for either the parent propanil or the degradate 3,4-DCA. As a result, registrant submitted studies for propanil (alone) were used to examine the direct and indirect toxicity effects of propanil exposure to the terrestrial-phase CRLF.

Since CRLFs exist within aquatic and terrestrial habitats, exposure of the CRLF, its prey and its habitats to propanil are assessed separately for the two habitats. For this assessment the habitat being considered is both the actual rice paddy, and surrounding habitats. The EFED Tier 1 Rice Model calculates high-end aquatic exposure concentrations for pesticides applied to flooded rice paddies. Only the aquatic concentration resulting from dissolution paddy water and partitioning into soil of the paddy are considered with this model. Other exposure concentrations are calculated using laboratory half-life values for the relevant time periods. The peak model-estimated environmental concentrations resulting from propanil use on rice is 5323 ppb. The minimum required holding time for rice paddy water treated with propanil, as specified on the label, is 7 days in California. Therefore, chronic exposures in the paddy water are calculated with a 7-day averaging period rather than the usual 21 to 60 day averaging period. Furthermore, the metabolite 3,4-DCA reaches its maximum concentration on day 7 of the aerobic aquatic metabolism experiment. As a result, the acute exposure to this metabolite is calculated on day 7 as well, the day of paddy water release. By using a 7 day exposure instead of a 21-day or 60-day exposure results in a larger concentration of propanil in the paddy water due to a shorter period of time for the chemical to degrade. As a result, this approach is considered to be very conservative. Furthermore, concentrations in release water are expected to be considerably lower than concentrations in paddy water due to dilution of the paddy water when it is released.

To estimate on-site dietary exposures to the terrestrial-phase CRLF, and its potential prey resulting from propanil use on rice, the T-REX model is used for ground and aerial spray treatment. Also, the AgDRIFT model is used to estimate deposition of propanil from spray drift on off-site terrestrial habitats. The T-HERPS model is used as a refinement tool to explore amphibian-specific food intake on potential exposures to the terrestrial phase CRLF.

The assessment endpoints for the CRLF include direct toxic effects on the survival, reproduction, and growth of the CRLF itself. 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 the terrestrial habitat, direct effects to the CRLF 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 from effects to the terrestrial habitat are characterized by available data for terrestrial monocotyledonous (monocot) and dicotyledonous (dicot) plants.

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 propanil 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 propanil use within the action area "may affect" the CRLF or 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.

Based on the best available information, the Agency makes a May Affect and Likely to Adversely Affect determination for propanil relative to the CRLF based on direct and indirect effects to the aquatic- and terrestrial-phase CRLF. Further, the use of propanil on rice is anticipated to result in effects to critical habitat of the CRLF.

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. Use-specific determinations for direct and indirect effects to the CRLF are provided in Table 1-3 and Table 1-4. 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 effects to 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 Effects of Propanil on the CRLF

Assessment Endpoint	Effects Determination [1]	Basis for Determination
Survival, growth, and/or reproduction of CRLF individuals		**Potential for Direct Effects**
	LAA	***Aquatic-phase (Eggs, Larvae, and Adults)*:** The aquatic-phase amphibian acute risk LOCs for listed species (0.05) are exceeded for the use of propanil on rice in California from use within the paddy. The acute RQ is 2.3 for the parent propanil based on the concentration in the paddy water, the acute RQ is 0.21 for the parent compound based on the concentration in the release water and 1.32 for the degradate 3,4-DCA based on the concentration in the release water. The probability for individual effect is 95% for propanil based on the concentration in the paddy water, 0.11% for propanil based on the concentration in the release water, and 70% for 3,4-DCA based on the concentration in the release water, and 1.3 for degradate 3,4-DCA. The aquatic-phase amphibian chronic risk LOC (1.0) is exceeded; the chronic RQ is 521.
	LAA	***Terrestrial-phase (Juveniles and Adults)*:** From propanil use, the acute dietary-based RQ exceeds the acute risk LOC (0.1) at 0.47. The acute-dose based RQ exceeds the acute risk LOC (0.1) at 8.5. The dietary-based probability of individual effect for propanil use is 0.70%, and the dose-based probability of individual effect for propanil use is 100%. Refined acute dietary-based RQs for CRLFs consuming small insects and small herbivore mammals exceed the acute risk to listed species LOC (0.1) with RQs of 0.47 and 0.79, respectively. The estimated probability of individual effect ranges from approximately 7% to 32% for the refined acute

Assessment Endpoint	Effects Determination [1]	Basis for Determination
		dietary-based RQs. Refined acute dose-based RQs for CRLFs consuming small insects exceed the acute risk to listed species LOC (0.1) across all size classes evaluated with RQ's of 0.21, 0.21, and 0.13 for 1.4-g, 37.0-g and 238-g, respectively. Refined acute dose-based RQs for CRLFs consuming small herbivore mammals exceed the acute risk to listed species LOC (0.1) for 37-g and 238-g frogs (RQ's of 3.69 and 0.57, respectively), and the dose-based RQs for CRLFs consuming small insectivore mammals exceed the acute risk to listed species LOC (0.1) for 37-g frogs, with an RQ of 0.23. The estimated probability of an individual effect ranges from approximately 0.11% to 100% for the refined acute dose-based RQs.
		Potential for Indirect Effects
	LAA	***Aquatic prey items, aquatic habitat, cover and/or primary productivity*:** From propanil use, the aquatic invertebrate's acute risk LOC (0.05) is exceeded. For the registrant submitted propanil data, the acute RQ is 10.1 for the parent propanil based on the concentration in the paddy water, the acute RQ is 0.91 for the parent compound based on the concentration in the release water and 5.7 for the degradate 3,4-DCA based on the concentration in the release water. For the degradate (3,4-DCA) ECOTOX data, the acute RQ is 113.2 for the parent propanil based on the concentration in the paddy water, the acute RQ is 10.2 for the parent compound based on the concentration in the release water and 64.5 for the degradate 3,4-DCA based on the concentration in the release water.(both expressed as the parent propanil). The estimation of population reduction is 100% for propanil based on the concentration in the paddy, and 100% for 3,4-DCA based on the concentration within the release water. The aquatic invertebrate chronic risk LOC (1.0) is also exceeded at 55 (propanil), and 364.8 (3,4-DCA expressed as propanil). The acute RQ is 2.3 for the parent propanil based on the concentration in the paddy water, the acute RQ is 0.21 for the parent compound based on the concentration in the release water and 1.32 for the degradate 3,4-DCA based on the concentration in the release water. The probability for individual effect is 95% for propanil based on the concentration in the paddy water, 0.11% for propanil based on the concentration in the release water, and 70% for 3,4-DCA based on the concentration in the release water, and 1.3 for degradate 3,4-DCA. The aquatic-phase amphibian chronic risk LOC (1.0) is exceeded; the chronic RQ is 521 From propanil use, the LOC for risk to non-vascular aquatic plants (1.0) is exceeded. The RQs are 184 for the parent propanil based on the concentration in the paddy water, the acute RQ is 16.5 for the parent compound based on the concentration in the release water and 105 for the degradate 3,4-DCA based on the concentration in the release water, From propanil use, the LOC for risk to vascular aquatic plants (1.0) is exceeded. The RQ is 48 for the parent propanil based on the concentration in the paddy water, the acute RQ is 4.35 for the parent compound based on the concentration in the release water and 28 for the degradate 3,4-DCA based on the concentration in the release water. In addition, aquatic plants in neighboring water bodies within 33 feet of the treated paddy may be exposed to spray drift in which concentrations exceed the levels of concern.
	LAA	***Terrestrial prey items, riparian habitat*:** From propanil use, the acute and chronic dose-based mammalian RQs exceed the Agency's acute and chronic risk to listed species LOCs (0.1

Assessment Endpoint	Effects Determination [1]	Basis for Determination
		acute, 1.0 chronic) with RQ's of 0.77 and 5.55, respectively. The chronic dietary-based RQs do not exceed the chronic risk to listed species LOC of 1.0. The estimation of population reduction is 30%. For terrestrial invertebrates, the calculated small insect EEC (1080 ppm) exceeds the highest levels tested for the terrestrial invertebrate study, therefore risk can not be discounted for these species. From propanil use, the refined acute dietary-based RQs for CRLFs consuming small insects and small herbivore mammals exceed the acute risk to listed species LOC (0.1) with RQs of 0.47 and 0.79, respectively. The estimated probability of individual effect ranges from approximately 7% to 32% for the refined acute dietary-based RQs. Refined acute dose-based RQs for CRLFs consuming small insects exceed the acute risk to listed species LOC (0.1) across all size classes evaluated with RQ's of 0.21, 0.21, and 0.13 for 1.4-g, 37.0-g and 238-g, respectively. Refined acute dose-based RQs for CRLFs consuming small herbivore mammals exceed the acute risk to listed species LOC (0.1) for 37-g and 238-g frogs (RQ's of 3.69 and 0.57, respectively), and the dose-based RQs for CRLFs consuming small insectivore mammals exceed the acute risk to listed species LOC (0.1) for 37-g frogs, with an RQ of 0.23. The estimated probability of an individual effect ranges from approximately 0.11% to 100% for the refined acute dose-based RQs. The main route of terrestrial exposure for terrestrial plants is spray drift via aerial application of propanil on rice. Based on a buffer zone of 584 feet in which concentrations exceed the levels of concern on the non-target terrestrial plants,

[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 the Critical Habitat Impact Analysis

Assessment Endpoint	Effects Determination	Basis for Determination
Modification of aquatic-phase PCE	**Habitat Modification**	Due to expected aquatic vascular and terrestrial plant communities being affected from propanil use, there is potential for alteration of channel/pond morphology or geometry and/or increase in sediment deposition within the stream channel or pond. These plant communities provide for shelter, foraging, predator avoidance, and aquatic dispersal for juvenile and adult CRLFs. In addition, there is potential for 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. The main route of terrestrial exposure for terrestrial plants is spray drift via aerial application of propanil on rice. Based on a buffer zone of 584 feet in which concentrations exceed the levels of concern on the non-target terrestrial plants. Aquatic vascular plants from exposure to propanil (RQs of 48 for the parent propanil based on the concentration in the paddy water, the acute RQ is 4.35 for the parent compound based on the concentration in the release water and 28 for the degradate 3,4-DCA based on the concentration in the release water). LOCs for non-vascular aquatic plants are also exceeded (RQs of 184 for the parent propanil based on the concentration in the paddy water, the acute RQ is 16.5 for the parent compound based on the concentration in the release water and 105 for the degradate 3,4-DCA based on the concentration in the release water). Aquatic exposure to neighboring water bodies may occur via spray drift from aerial application of propanil on rice. Based on a buffer zone of 33 feet in which concentrations exceed the levels of concern on the non-target aquatic plants.

Modification of terrestrial-phase PCE	**Habitat Modification**	The use of propanil on rice may create the following modification of PCE: elimination and/or disturbance of upland habitat; ability of habitat to support food source of CRLFs, Elimination and/or disturbance of dispersal habitat, reduction and/or modification of food sources for terrestrial-phase juveniles and adults, and alteration of chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs and their food source. The RQs for vascular aquatic plants exceed the Agency's risk to aquatic plant LOC (1.0) for use of propanil on rice in California with RQs of 48 for the parent propanil based on the concentration in the paddy water, the acute RQ is 4.35 for the parent compound based on the concentration in the release water and 28 for the degradate 3,4-DCA based on the concentration in the release water Acute dietary- and dose-based RQ values exceed the LOC for prey food items of small mammals and frogs, and because the calculated small insect EECs (1080 ppm) are greater than the highest levels tested in the inconclusive terrestrial invertebrate surrogate study. Food source for CRLF are expected to be reduced and CRLF is expected to be indirectly affected.

Table 1-3 Propanil Use-specific Direct Effects Determinations[1] for the CRLF

Use(s)	Aquatic Habitat		Terrestrial Habitat	
	Acute	Chronic	Acute	Chronic*
Rice Ground Applications	LAA	LAA	LAA	LAA
Rice Aerial Applications	LAA	LAA	LAA	LAA

[1] NE = No effect; MA/NLAA = May affect, but not likely to adversely affect; LAA = May affect and likely to adversely affect

* No chronic data are available for amphibians or their avian surrogates by which to determine chronic direct risks to the CRLF, therefore an LAA determination is made in the absence of these data as we cannot preclude chronic direct risks to the CRLF. There is also supporting information indicating a historical parallel between avian and mammalian toxicity thus suggesting a potential for risk to birds associated with chronic exposure since there is a risk to terrestrial mammals.

Table 1-4 Propanil Use-specific Indirect Effects Determinations[1] Based on Effects to Prey

Use(s)	Algae	Aquatic Invertebrates		Terrestrial Invertebrates (Acute)	Aquatic-phase frogs and fish		Terrestrial-phase frogs		Small Mammals	
		Acute	Chronic		Acute	Chronic	Acute	Chronic*	Acute	Chronic
Rice Ground Applications	LAA	LAA	LAA	LAA	LAA	LAA	LAA	LAA	LAA	LAA
Rice Aerial Applications	LAA	LAA	LAA	LAA	LAA	LAA	LAA	LAA	LAA	LAA

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

* No chronic data are available for amphibians or their avian surrogates by which to determine chronic direct risks to the CRLF, therefore an LAA determination is made in the absence of these data as we cannot preclude chronic direct risks to the CRLF. There is also supporting information indicating a historical parallel between avian and mammalian toxicity thus suggesting a potential for risk to birds associated with chronic exposure since there is a risk to terrestrial mammals.

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 risk assessment, 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 1998), the Services' *Endangered Species Consultation Handbook* (USFWS/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 (USFWS/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 propanil on rice. In addition, this assessment evaluates whether propanil use on rice is expected to result in effects to 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 the tier I Rice Model, T-REX, and AgDRIFT, all of which are described at length in the Overview Document. Additional refinements include use of the T-HERPS model. 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 ESA, and the Services' *Endangered Species Consultation Handbook*, the assessment of effects associated with registrations of propanil is based on an action area. The action area is the area directly or indirectly affected by the federal action. It is acknowledged that the action area for a national-level FIFRA regulatory decision associated with a use of propanil 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 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 propanil 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 habitats are located, interspersed with upland foraging and dispersal habitats.

If the results of initial screening-level assessment methods show no direct or indirect effects (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 propanil 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 propanil.

If a determination is made that use of propanil 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 propanil use sites) and further evaluation of the potential impact of propanil 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 5.0 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 propanil is expected to directly impact living organisms within the action area (defined in Section 2.7), critical habitat analysis for propanil 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 propanil 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

Propanil is registered in California for use on rice only. Thus, its use area will mainly be in the Sacramento and San Joaquin-Tulare river valleys of northern California. However, the "effect area" from exceedance of levels of concern for direct or indirect risks to the CRLF will be based on cultivated crops in the state. This is to account for areas into which rice production could theoretically expand in the future.

Propanil is a post-emergence, contact (requires adequate foliar coverage for good weed control), non-residual, selective, broad-spectrum herbicide with activity on both broadleaf and grass weeds (barnyard grass). California produces water seeded rice. The production practices, herbicide application method, and water management in water-seeded rice is different from that for dry seeded rice which occurs in other states. The rice fields are drained a few days (typically two) before propanil application in order to promote the germination of weed flushes. Propanil is foliar active. It is then applied on the germinated weeds and within 2 days of application flood water is brought back on and maintained until the application of another post-emergence herbicide is needed. At this time or a few weeks before harvest, the water is drained again from the paddy.

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 propanil in accordance with the approved product labels for California is "the action" relevant to this ecological risk assessment.

Although current registrations of propanil allow for use on rice nationwide, this ecological risk assessment and effects determination addresses currently registered uses (rice only) of propanil 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.

As explained below (section 2.4), environmental exposures resulting from the use of propanil on rice include both the parent and its degradate 3,4-DCA.

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; USFWS/NMFS 2004).

An analysis of the available open literature and acute mammalian toxicity data for multiple active ingredient products relative to the single active ingredient (propanil) is provided in Appendix A. The resulting analysis of the LD_{50} values and associated 95% confidence intervals (CIs) that are available for multiple active ingredient products containing propanil, found that toxicity of these compounds was not significantly different than the single active ingredient products of propanil alone. Therefore, the assessment is based on the toxicity of the single active ingredient of propanil.

As discussed in USEPA (2000) a quantitative component-based evaluation of mixture toxicity requires data of appropriate quality for each component of a mixture. In this mixture evaluation, an LD_{50} with associated 95% CI is needed for the formulated product. The same quality of data is also required for each component of the mixture. Given that the formulated products for propanil do not have LD_{50} data available it is not possible to undertake a quantitative or qualitative analysis for potential interactive effects. However, because the active ingredients are not expected to have similar mechanisms of action, metabolites, or toxicokinetic behavior, it is reasonable to conclude that an assumption of dose-addition would be inappropriate. Consequently, an assessment based on the toxicity of propanil is the only reasonable approach that employs the available data to address the potential acute risks of the formulated products.

2.3 Previous Assessments

Propanil is registered in the United States for use as an herbicide in rice. The March 2006 Amendment to the Reregistration Eligibility Decision (RED) for Propanil and the September 2003 RED for propanil concluded that, “The uses of propanil on rice may cause adverse ecological effects at the maximum seasonal application rate of 8 lbs. a.i./A/yr (from two 4 lbs. a.i./A applications) in areas where rice is produced, specifically California, Arkansas, Louisiana, Missouri, Mississippi and Texas. The expected risks are: (1) acute risk to birds (including endangered species); (2) acute and chronic risk to mammals (including endangered species); (3) risk to non-target aquatic nonvascular plants; and (4) potential risk to non-target terrestrial plants.”

The 2003 RED established a 7-day water holding (discharge) interval for the Mississippi Delta (Arkansas, Mississippi, Missouri and Northern Louisiana) and California. This was established to address concerns for both endangered and nonendangered aquatic species. Spray drift management practices were made consistent with best management practices for rice. Likewise, all labels with use directions on rice were amended to specify restrictions against application to fields where catfish farming is practiced and draining water from treated fields into areas where catfish farming is practiced. All registered propanil labels were to be revised to specify a 60 day plant-back interval for all rotational crops. In addition, it was suggested that the registrant voluntarily cancel the registrations of propanil on small grains, wheat, oats, spring barley, and durum wheat. For turf, the registrant had agreed to reduce the maximum application rate to 5 lbs a.i./A and eliminate aerial application. The maximum signal application rate on rice is 6 lbs a.i./A, and the seasonal maximum rate was 8 lbs a.i./A on rice. The RED also reduced the maximum number of rice acres an aerial applicator could treat in 1 day, to 500.

(URL: http://www.epa.gov/pesticides/reregistration/REDs/propanil_red_combined.pdf)

2.4 Stressor Source and Distribution

2.4.1 Environmental Fate Properties

Propanil is stable to both hydrolysis, and aqueous photolysis. While degradation by soil photolysis is reported (MRID 42820401; $t_{1/2} \leq 11$ days), it appears to be microbially mediated. The degradation of propanil via aerobic soil metabolism is rapid ($t_{1/2} = 0.5$ days). Anaerobic soil metabolism and anaerobic aquatic metabolism ($t_{1/2}$ =2 - 3 days) are also rapid, and are the important routes of degradation for propanil for the rice use pattern. Likewise, the aerobic aquatic metabolism ($t_{1/2}$ =2 days) results in rapid degradation of the parent compound (propanil).

Propanil is considered moderately mobile in the environment (K_d= 0.54 – 11.7), and has limited potential to leach to groundwater. Vapor pressure is low enough (9.08×10^{-7} mm Hg) to preclude volatilization as a major route of dissipation for propanil in the open environment.

An aerobic soil metabolism half-life ($t_{1/2}$ = 30 days) for the major degradate 3,4-DCA indicates a greater persistence than for the parent compound. A separate batch equilibrium study reports that 3,4-DCA is less mobile (K_d = 1.38 – 32.8) than the parent compound in water.

The major degradate (77%) formed in the decomposition of propanil in the aerobic aquatic metabolism study, was 3,4-DCA. The peak concentration of 3,4-DCA was on day 7 of the experiment. From day 7 to day 30 (end of the study), 3,4-DCA degraded with a half-life of 18 days. Combined propanil and 3,4-DCA residues in water and sediment degraded with a half-life of 21 days. Minor metabolites (< 2%) included: 3,4-dichloronitrobenzene, and 3,3’,4,4’-tetra chloroazobenzene.

In aquatic field dissipation studies conducted in Arkansas clay loam and Louisiana loam soils, propanil dissipated with half-lives of 1.5 and 1.3 days, respectively. The major degradate, 3,4-DCA, dissipated in the same plots with half-lives of 9.4 and 6.5 days, respectively. These studies were conducted in paddies with aqueous outflow where each paddy was separated by a bank of earth used as a barrier between them (berms), and thus should only be compared qualitatively to laboratory studies.

Laboratory and field physical/chemical data for propanil are presented in Table 2-1 and for 3,4-DCA are presented in Table 2-2. The chemical structures of propanil and the metabolite 3,4-DCA are presented in Appendix B.

Table 2-1 Summary of physical/chemical and environmental fate and transport properties of propanil.

PARAMETER	VALUE(S) (units)	SOURCE	COMMENT
Chemical Name	3,4-dichloropropionanilide		
Molecular Weight	218.1 amu	Calculated	
Aqueous Solubility (25^{o} C)	152 mg/L or ppm	MRID 47164603	
Vapor Pressure (25^{o} C)	9.08 X 10^{-7} mm Hg	EPiSuite citing USDA Pesticide properties database	
Henry's Law constant	7.96 X 10^{-9} atm m^3 mol^{-1}	http://sitem.herts.ac.uk/aeru/footprint/en/Reports/545.htm	
pKa (20 ^{o}C)	No dissociation constant.	MRID 47164603	
Octanol-Water Partition Coefficient	2.2	MRID 47164603	At 23°C.
Hydrolysis Half-life	$t_{1/2}$ = stable	MRID 41070701 MRID 4066601 MRID 00111395	Stable at 30 days (pH 5, 7, 9)
Aqueous Photolysis Half-life	$t_{1/2}$ = 144.4 days based upon a 12 hour light/12 hour dark cycle *stable for 30 days	MRID 47164603 MRID 41070701	
Soil Photolysis Half-life	$t_{1/2} \leq$ 11 days (uncorrected)	MRID 42820401	$t_{1/2}$ = 2 days in dark (Supplemental Study)
Aerobic Soil Metabolism Half-life	$t_{1/2}$ = 0.5 days	MRID 41538701	$t_{1/2}$ = 30 days (3,4-DCA 44%)
Anaerobic Aquatic Metabolism	$t_{1/2}$ = 2-3 days	MRID 41872601 MRID 41848701	
Anaerobic Soil Metabolism	$t_{1/2}$ = 2-3 days	MRID 41872601	
Aerobic Aquatic Metabolism	$t_{1/2}$ = 2 days (parent only)	MRID 41872601 MRID 41848701	3,4-DCA at 78% of applied radioactivity 3,4-DCA t1/2 = 18 days (total system) Total toxic residues t1/2 = 21 days
Organic Carbon Partition Coefficient (K_{OC})	306, 239, 703, 800, 389 mL/g_{OC}	MRID 42780401 MRID 47165601	
Soil Partition Coefficient (K_d)	0.54, 2.3, 5.8, 8.0, 11.7 mL/g	MRID 42780401 MRID 47165601	

PARAMETER	VALUE(S) (units)	SOURCE	COMMENT
Bioconcentration in Fish	BFC = 60 X and 111 X with 95% depuration	Waived (04/26/89) Adler, Rohm & Haas, 10/4/1979	Data for patent and fathead minnows
Aquatic Field Dissipation	$t_{1/2}$ = 2-3 days (soil) $t_{1/2}$ = <1 day (water)	MRID 42200401 MRID 40022501	$t_{1/2}$ = < 1 week (3,4-DCA soil) $t_{1/2}$ = 2-3 days (3,4-DCA water)

Table 2-2 Physical-Chemical and Fate Properties of 3,4-dichloroaniline (3,4-DCA)

Property	Value	Reference/Comment
Molecular formula	C6H5Cl2N	Merck Index, 1983 (1)
Molecular weight	162.03 g/mol	
Melting point	71-72°C	
Boiling point	272°C	
Log Kow	2.69	Hansch et al., 1995 (2)
Aqueous solubility	92 mg/L @ 20°C	Crossland, 1986 (3)
Vapor Pressure	6.32 E-3 mmHg @ 25°C	Dauber & Danner, 1989 (4)
Henry's Law Constant	1.47E-5 atm-m3/mol	Calculated from VP and solubility
Aerobic Aquatic Half-life	18 days (3,4-DCA alone) 21 days (propanil + 3,4-DCA)	MRID 418487-01
Organic Carbon Partition Coefficient (Koc)	K_{FOC} = 585, 325, 543 K_d = 32.8, 1.38, 2.9	MRID 471656-01

References: (1) The Merck Index, 10th Ed., M. Windholz, ed., Merck & Co., Rahway, NJ, 1983. (2) Hansch, C, Leo, A., and Hoekman, D. Exploring QSAR – Hydrophobic, Electronic, and Steric Constants. Washington, DC: American Chemical Society, 1985, p. 18. (3) Crossland, N.O.; Chem. Ind. 21: 740-44 (1986). (4) Daubert, T.E. and R.P. Danner. Physical and Thermodynamic Properties of Pure Chemicals Data Compilation. Washington D.C.: Taylor & Francis, 1989.

2.4.2 Environmental Transport Mechanisms

AIR

Propanil is applied by broadcast directly to the foliage in the paddy using ground or aerial equipment, suggesting that there is a possibility of drift. Drift is quantitatively considered in the exposure assessment. Propanil is relatively non-volatile, as indicated by its low vapor pressure of 9.08 X 10^{-7} mm Hg, and a low Henry's law constant of 7.96 x 10^{-9} atm m^3 mol^{-1}. These properties indicate that propanil is unlikely to be dispersed in air over a large area, and has a low tendency to volatilize from water or moist soils. Volatilization is insignificant except when propanil is exposed on the soil surface for several days or weeks under hot, dry conditions (Hess and Warren, 2002).

WATER

Propanil is applied directly to the un-desired foliage located within the rice paddy. It can be applied in a flooded paddy as long as the foliage is present. Since propanil is foliar active, partial, if not complete, drainage is needed for efficacy. Likewise, since propanil can be applied to partially drained paddies, exposure in water is expected, especially if rice paddies and receiving waters are used as CRLF habitat. Monitoring data indicate that both propanil and its degradate 3,4-DCA are frequently detected in receiving waters.

SOIL
Propanil is applied only to wet-seeded rice in California. When rice is harvested it is at 18 to 24 percent moisture, wet-seeded. However, since propanil has no residual activity, weed re-growth from poor coverage or newly germinated weeds will survive unless re-treated. Therefore, runoff to terrestrial habitats does not appear to be a major route. The most likely route to terrestrial plants and animals is via spray drift. As a result, the only residues on soils outside the rice paddy are expected to occur from spray drift during application.

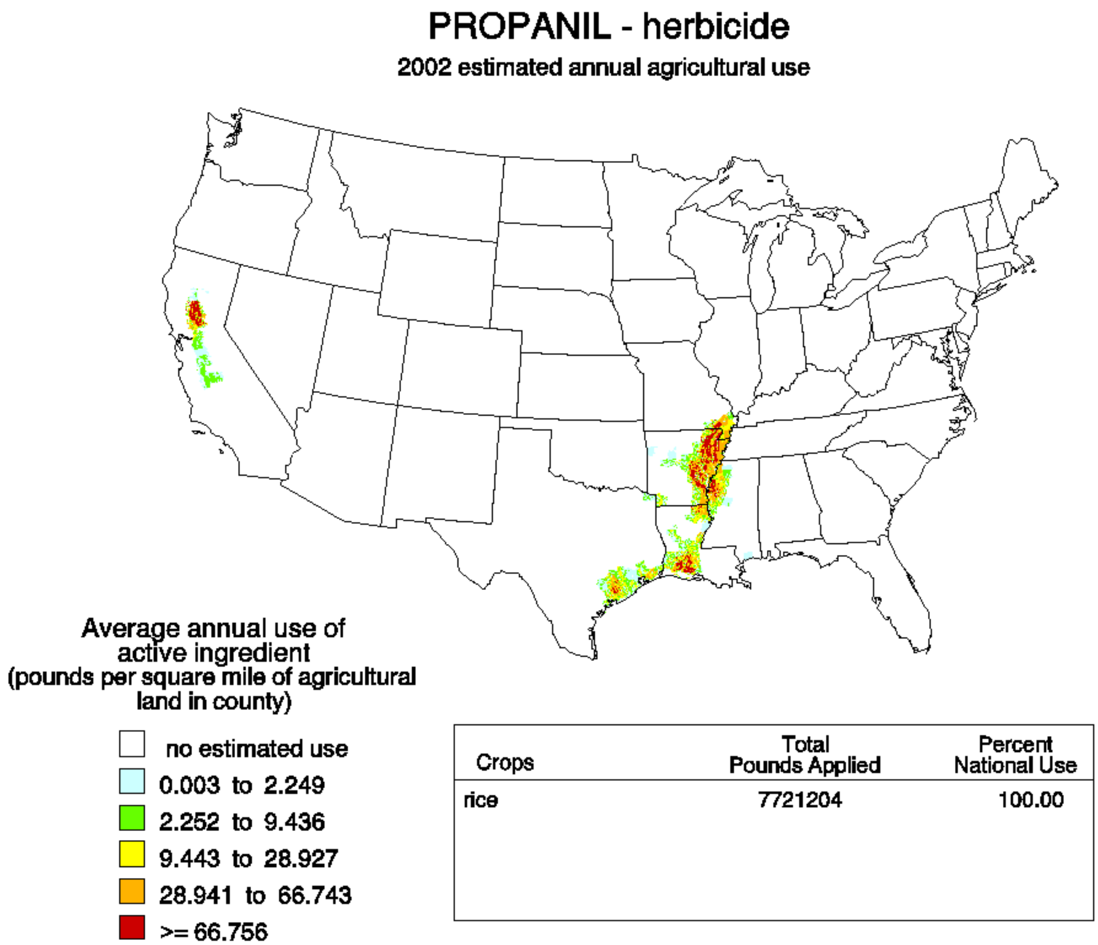
2.4.3 Mechanism of Action

Propanil is an amide herbicide which inhibits photosynthesis in a variety of broadleaf and grass plants. The mechanism of action is not completely understood, but may be inhibition of photosystem II electron transport. Other reported effects include inhibition of the syntheses of anthocyanin, RNA, and protein, as well as effects on the plasmalemma [cell membrane] (Ahrens, 1994, p. 253).

2.4.4 Use Characterization

A national map showing the estimated poundage of propanil used for agricultural purposes in 2002 by county is presented in Figure 2-1 The map was obtained from the U.S. Geological Survey (USGS), National Water Quality Assessment Program (NAWQA) website (URL: http://water.usgs.gov/nawqa/pnsp/usage/maps/show_map.php?year=02&map=m1282). The use areas on the map (California, Mississippi Valley, Louisiana and Texas) reflect the fact that propanil is used only on rice. Use in California is most intense in the northern part of the Central Valley (i.e., Sacramento and San Joaquin river basins) which are the principal rice growing areas in the state.

Based on a crop profile for rice in California prepared in October 1998 by NSF Center for Integrated Pest Management, rice in California is grown primarily in a continuously flooded, flow-through system. However, since propanil is foliar active and has no residual activity, weed re-growth from poor coverage or newly germinated weeds will survive. As a result, propanil is applied when the paddy is drained partially, if not completely, in order to ensure direct contact with the foliage.



Source: USGS, 2002

Figure 2-1 Propanil Agricultural Use in Total Pounds per County

Analysis of labeled use information is the critical first step in evaluating the federal action. The current label for propanil 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.

Currently, propanil is registered as an herbicide for ground and aerial applications for rice only. The maximum labeled use rate is 8 lb/acre/yr. The minimum required rice paddy water holding time is 7 days, per the 2003 RED. Please see Section 3.0 for further explanation.

The Agency's Biological and Economic Analysis Division (BEAD) provides an analysis of both national- and county-level usage information (Kaul and Jones, 2006) using state-level usage data obtained from USDA-NASS[1]; Doane (www.doane.com) (the full dataset is not provided due to its proprietary nature); and the California Department of Pesticide Regulation Pesticide Use Reporting (CDPR PUR) database[2] . 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 propanil by county in this California-specific assessment were generated using CDPR PUR data. Thirteen years (periods 1994 to 1998 and 1999 to 2006,) of usage data were included in this analysis. Available 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. The units of area treated are also provided where available.

[1] 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.

[2] 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.

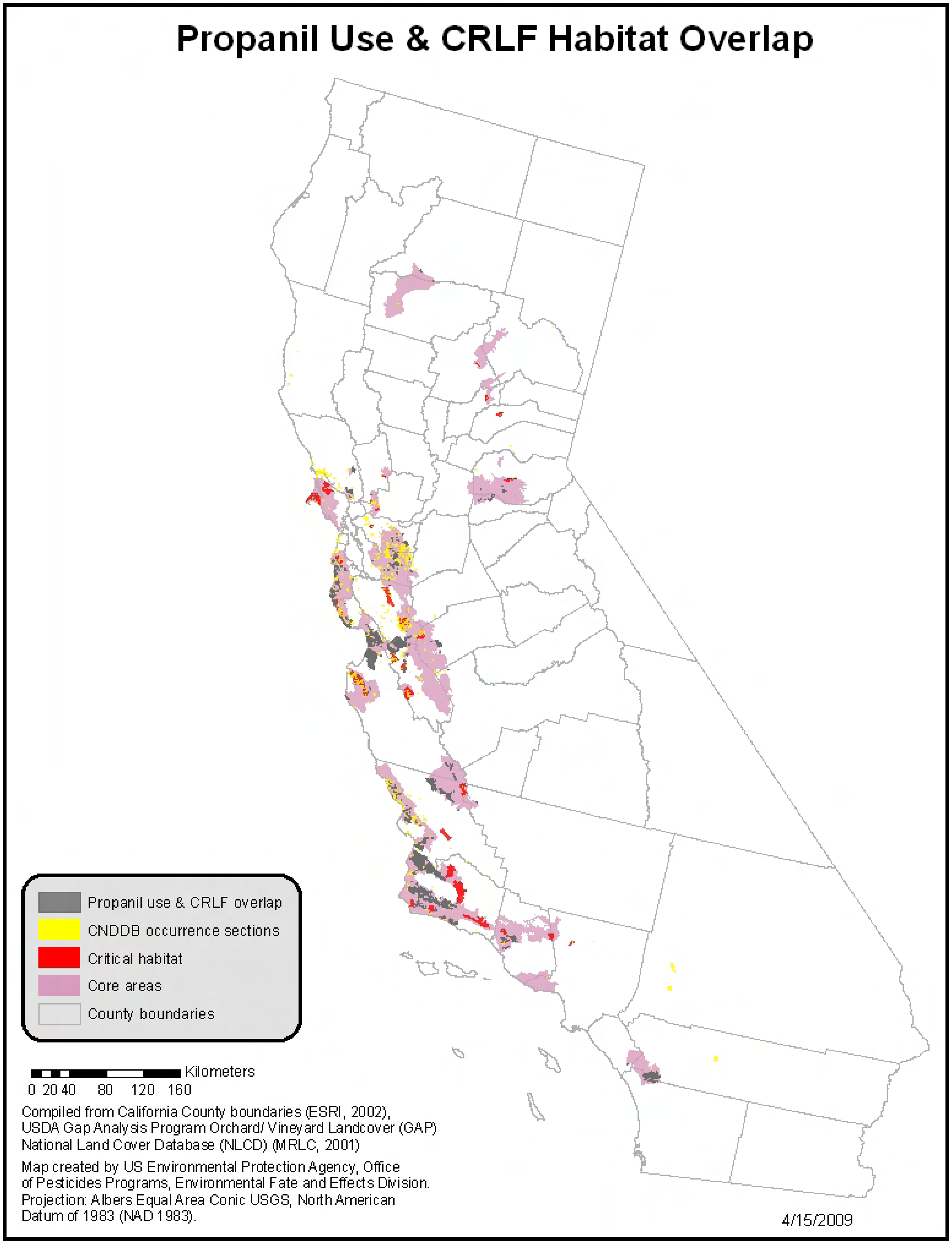


Figure 2-2 Overlap Map: CRLF Habitat and propanil Initial Area of Concern

Table 2-3 Application Rates for Propanil Based on California PUR Data, 1994-1998

County	AVG Annual Pounds Applied	AVG Annual Area Treated (acres)	AVG Application Rate (lb/acre)	95 Percentile Application Rate (lb/acre)	99 Percentile Application Rate (lb/acre)	MAX Application Rate (lb/acre)
BUTTE	17,498.17	3,242.77	4.99	5.00	6.00	300.57
COLUSA	51,618.56	12,963.96	4.32	6.01	7.75	397.84
FRESNO	124.63	31.00	4.02	4.09	4.09	4.09
GLENN	20,698.97	4,824.19	4.31	5.60	8.88	31.73
MERCED	1,777.67	445.25	3.55	4.00	4.00	4.00
PLACER	5,871.62	1,405.64	4.16	5.50	6.01	6.01
SACRAMENTO	20,826.64	5,231.30	4.36	6.13	8.00	55.06
SAN JOAQUIN	17,038.81	4,504.65	3.77	5.01	6.01	45.98
STANISLAUS	5,814.74	1,589.11	3.73	4.09	5.11	5.11
SUTTER	21,988.93	5,229.68	4.35	6.13	6.17	26.65
YOLO	10,258.66	2,509.22	4.89	6.00	49.48	49.48
YUBA	3,636.52	1,023.14	3.57	4.00	6.00	6.00

Table 2-4 Application Rates for Propanil Based on California PUR Data, 1999-2006

County	AVG Annual Pounds Applied	AVG Annual Area Treated (acres)	AVG Application Rate	95 Percentile Application Rate	99 Percentile Application Rate	MAX Application Rate
BUTTE	240,611.46	57,563.16	4.20	6.00	6.08	19.99
COLUSA	356,761.77	79,030.44	4.54	6.02	6.23	31.99
FRESNO	3,611.25	763.40	4.61	6.00	6.00	6.00
GLENN	270,592.70	60,049.00	4.54	6.00	6.08	35.98
IMPERIAL	44.98	7.50	6.00	6.00	6.00	6.00
MERCED	11,299.41	2,578.64	4.45	6.00	6.00	6.02
PLACER	36,006.31	8,707.86	4.12	5.01	6.00	7.02
RIVERSIDE	0.10	0.25	0.41	0.41	0.41	0.41
SACRAMENTO	28,722.72	7,469.88	3.86	6.00	6.08	8.33
SAN JOAQUIN	18,533.51	4,288.71	4.31	5.39	20.44	41.00
SAN LUIS OBISPO	0.09	0.04	1.94	3.20	3.20	3.20
SOLANO	25.16	6.21	4.05	4.05	4.05	4.05
STANISLAUS	7,297.49	1,847.31	4.01	5.00	6.00	7.66
SUTTER	257,488.81	61,371.17	4.20	6.00	6.08	42.17
YOLO	75,487.46	17,114.20	4.40	6.00	6.08	21.99
YUBA	69,815.44	17,435.13	4.07	5.00	6.08	35.74

Table 2-3 and Table 2-4 show the average, 95th percentile 99th percentile, and maximum application rates for propanil over the periods 1994 to 1998 and 1999 to 2006, respectively. The average application rate in all counties is approximately 4 lb/acre, and the 95th and 99th percentile rates are about 6 lb/acre. Where the maximum application rate (8 lb/acre/year) is significantly exceeded, this could be misuse which is not part of the federal action but is more likely to be reporting errors.

Table 2-3 and Table 2-4 also show that propanil is used in a limited number of counties in California (12 in 1994-8, and 16 in 1999-2006). Nine of the counties are north of the San Francisco Bay (Glenn, Butte, Colusa, Yuba, Placer, Sutter, Yolo, Sacramento, Solano), four are south of the bay (San Joaquin, Stanislaus, Merced, Fresno), and the remaining three are further south (Imperial, Riverside, San Luis Obispo). The last three counties account for very little of the total propanil use. Thus, the great majority of the use was between Glenn and Butte counties in the north, and Fresno County in the south.

2.5 Assessed Species

The CRLF was federally listed as a threatened species by USFWS effective June 24, 1996 (USFWS 1996). It is one of two subspecies of the red-legged frog and is the largest native frog in the western United States (USFWS 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 USFWS on April 13, 2006 (USFWS 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 (USFWS 1996). Its range has been reduced by about 70%, and the species currently resides in 22 counties in California (USFWS 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) (USFWS 2002).

Populations currently exist along the northern California coast, northern Transverse Ranges (USFWS 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 (USFWS 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) (USFWS 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 2-2**). Recovery units, core areas, and other known occurrences of the CRLF from the CNDDB are described in further detail in Attachment I, 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 USFWS 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 and Western Sacramento River Valley
3. North Coast and North San Francisco Bay
4. South and East San Francisco Bay
5. Central Coast
6. Diablo Range and Salinas Valley
7. Northern Transverse Ranges and 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 2-3 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 (USFWS 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, USFWS 2002); tadpoles have been observed to over-winter (delay metamorphosis until the following year) (Fellers 2005b, USFWS 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 (USFWS 2002). Figure 2.3 depicts CRLF annual reproductive timing.

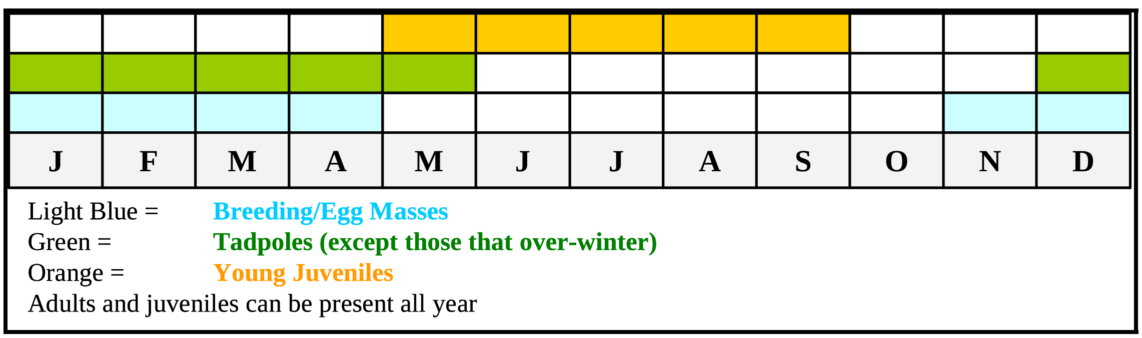


Figure 2-4 CRLF Reproductive Events by Month

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 (USFWS 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 (USFWS 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 (USFWS 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 (USFWS 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 (USFWS 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 (UWFWS 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 refuge; 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 USFWS (USFWS 2006; FR 51 19244-19346). A summary of the 34 critical habitat units relative to USFWS-designated recovery units and core areas (previously discussed in Section 2.5.1) is provided in Table 2-4.

'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 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, USFWS 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.

USFWS has established adverse modification standards for designated critical habitat (USFWS 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 propanil 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 propanil is expected to directly impact living organisms within the action area, critical habitat analysis for propanil 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). 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 (USEPA 2004) considers the results of the risk assessment process to establish boundaries for that action area with the understanding that exposures below the Agency's defined LOCs constitute a no-effect threshold. For the purposes of this assessment, attention 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 propanil may be expected to have on the environment, the exposure levels to propanil that are associated with those effects, and the best available information concerning the use of propanil and its fate and transport within the State of California. Specific measures of ecological effect that define the action area include any direct and indirect toxic effect 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 propanil. An analysis of labeled uses and review of available product labels was completed. For those uses relevant to the CRLF, the analysis indicates that rice is the only use (Table 3-1) considered part of the federal action evaluated in this assessment.

Following a determination of the assessed uses, an evaluation of the potential "footprint" of propanil use pattern (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 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 use on rice described above. A map representing all the land cover types related to agricultural uses where rice is grown and/or could be grown that make up the initial area of concern for propanil is presented in Figure 2-5.

It is important to note that propanil is only used on rice in a limited number of counties in California (12 in 1994-8, and 16 in 1999-2006). Nine of the counties are north of the San Francisco Bay (Glenn, Butte, Colusa, Yuba, Placer, Sutter, Yolo, Sacramento, Solano), four are south of the bay (San Joaquin, Stanislaus, Merced, Fresno), and the remaining three are further south (Imperial, Riverside, San Luis Obispo). The last three counties account for very little of the total propanil use. Thus, the great majority of the use was between Glenn and Butte counties in the north, and Fresno County in the south. Therefore, Figure 2-5 is very conservative since rice is represented as all agricultural uses and not just rice alone.

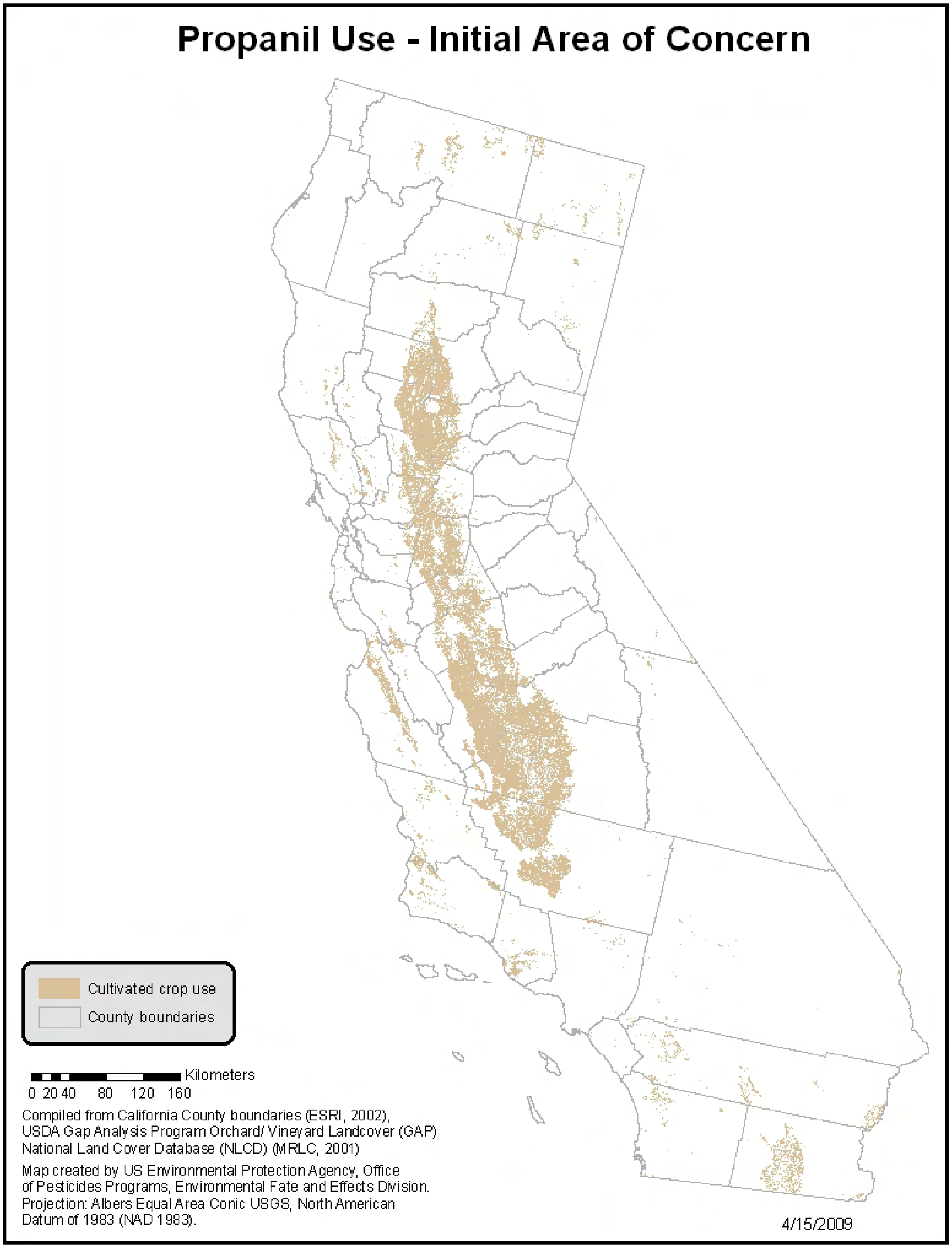


Figure 2-5 Initial area of concern, or "footprint" of potential use for propanil

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 the paddy release water where exposure of one or more taxonomic groups to the pesticide exceeds the listed species LOCs.

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 propanil using the most sensitive endpoint (most sensitive plant toxicity study: a seedling emergence study using cabbage (*Brassica oleracea*)) suggests that a maximum spray drift distance of 584 feet is necessary. Further detail on the spray drift analysis is provided in Section 3.2.5.

In addition to the buffered area from the spray drift analysis, the final action area also considers the downstream extent of propanil that exceeds the LOC (discussed in Section 3.2.5). The action area will be the entire state of California based on the "suggestive evidence of carcinogenic potential by all routes of exposure" (HED Cancer Review Panel, 2002).

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."[3] 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 propanil (*e.g.,* paddy release water, spray drift, etc.), and the routes by which ecological receptors are exposed to propanil *(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 (USEPA 2004), the Agency relies on acute and chronic effects endpoints that are either direct measures of

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

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 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 propanil is provided in Table 2-5.

Table 2-5 Assessment Endpoints and Measures of Ecological Effects

Assessment Endpoint	Measures of Ecological Effects[4]
Aquatic-Phase CRLF (Eggs, larvae, juveniles, and adults)[a]	
Direct Effects	
1. Survival, growth, and reproduction of CRLF	1a. Rainbow trout (*Oncorhynchus mykiss*)LC_{50} 1b. Fathead Minnows (*Pimephales promelas*) 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. Rainbow trout (*O. mykiss*)LC_{50} 2b. Fathead Minnows (*P. promelas*) NOAEC 3a. Water Flea (*Daphnia magna*) EC_{50} 3b. Water Flea (*D. magna*) NOAEC 4a. Green Algae (*Pseudokirchneriella subcapitata*) EC_{50}
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. Duckweed (*Lemna gibba*) EC_{50} 3b. Green Algae (*P. subcapitata*) EC_{50}
4. Survival, growth, and reproduction of CRLF individuals via effects to riparian vegetation	4a. Onion (*Allium cepa*) EC_{25} (seedling emergence) 4b. Lettuce (*Lactuca sativa*) EC_{25} (seedling emergence) 4c. Onion EC_{25} (vegetative vigor) 4d. Cabbage EC_{25} (vegetative vigor)
Terrestrial-Phase CRLF (Juveniles and adults)[b]	
Direct Effects	
5. Survival, growth, and reproduction of CRLF individuals via direct effects on terrestrial phase adults and juveniles	5a. Northern Bobwhite Quail (*Colinus virginianus*) LC_{50} 5b. Northern Bobwhite Quail LD_{50} 5c. No Chronic Avian Data
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. Northern Bobwhite Quail LC_{50} 6b. Northern Bobwhite Quail LD_{50} 6c. Laboratory Rat (*Rattus norvegicus*) LD_{50} 6d. Honey Bee (*Apis mellifera*) LD_{50} 6e. Laboratory Rat NOAEC 6f. No Chronic Avian Data
7. Survival, growth, and reproduction of CRLF individuals via indirect effects on habitat (*i.e.*, riparian and upland vegetation)	7a. Onion EC_{25} (seedling emergence) 7b. Lettuce EC_{25} (seedling emergence) 7c. Onion EC_{25} (vegetative vigor) 7d. Cabbage EC_{25} (vegetative vigor)

[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.

[4] Citations for registrant-submitted and open literature toxicity data reviewed for this assessment are included in Appendix I and J.

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 propanil that may alter the PCEs of the CRLFs 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 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 propanil effects data are available.

Adverse modification to the critical habitat of the CRLF includes, but is not limited to, the following, as specified by USFWS (2006):

1. Alteration of water chemistry/quality including temperature, turbidity, and oxygen content necessary for normal growth and viability of juvenile and adult CRLFs.
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.
4. Significant alteration of channel/pond morphology or geometry.
5. Elimination of upland foraging and/or aestivating habitat, as well as 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.

Measures of such possible effects by labeled use of propanil on critical habitat of the CRLF are described in Table 2-6. 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 USFWS (2006).

Table 2-6 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.	1a. Duckweed (*Lemna gibba*) EC_{50} 1b. Green Algae (*Pseudokirchneriella subcapitata*) EC_{50} 1c. Onion (*Allium cepa*) EC_{25} (seedling emergence) 1d. Lettuce (*Lactuca sativa*) EC_{25} (seedling emergence) 1e. Onion EC_{25} (vegetative vigor) 1f. Cabbage EC_{25} (vegetative vigor)
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.	2a. Duckweed EC_{50} 2b. Green Algae EC_{50} 2c. Onion EC_{25} (seedling emergence) 2d. Lettuce EC_{25} (seedling emergence) 2e. Onion EC_{25} (vegetative vigor) 2f. Cabbage EC_{25} (vegetative vigor)
Alteration of other chemical characteristics necessary for normal growth and viability of CRLFs and their food source.	3a. Rainbow trout (*Oncorhynchus mykiss*)LC_{50} 3b. Water Flea (*Daphnia magna*) EC_{50} 3c. Fathead Minnows (*Pimephales promelas*) NOAEC 3d. Water Flea NOAEC
Reduction and/or modification of aquatic-based food sources for pre-metamorphs (*e.g.*, algae)	4a. Duckweed EC_{50} 4b. Green Algae EC_{50}
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	5a. Onion EC_{25} (seedling emergence) 5b. Lettuce EC_{25} (seedling emergence) 5c. Onion EC_{25} (vegetative vigor) 5d. Cabbage EC_{25} (vegetative vigor) 5e. Northern Bobwhite Quail (*Colinus virginianus*) LC_{50} 5f. Northern Bobwhite Quail *virginianus*LD_{50} 5g. Laboratory Rat (*Rattus norvegicus*) LD_{50} 5h. Honey Bee (*Apis mellifera*) LD_{50} 5i. Laboratory Rat NOAEC 5j. No Chronic Avian Data
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] Physio-chemical water quality parameters such as salinity, pH, and hardness are not evaluated because these processes are not biologically mediated and, therefore, are not relevant to the endpoints included in this assessment.

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, 1998). For this assessment, the risk is stressor-linked, where the stressor is the release of propanil and its 3,4-DCA degradate to the environment. The following risk hypotheses are presumed for this endangered species assessment:

The labeled use of propanil on rice within the action area may:

- 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 affect 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 affect 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;
- Affect 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);
- Affect the designated critical habitat of the CRLF by reducing the food supply required for normal growth and viability of juvenile and adult CRLFs;
- Affect 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.
- Affect 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.
- Affect the designated critical habitat of the CRLF by altering chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs.

2.9.2 Diagram

The conceptual model is a graphic representation of the structure of the risk assessment. It specifies the propanil release mechanisms, biological receptor types, and effects endpoints of potential concern. The conceptual models for aquatic and terrestrial phases of the CRLF are shown in Figure 2-6 and Figure 2-7, respectively. 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.

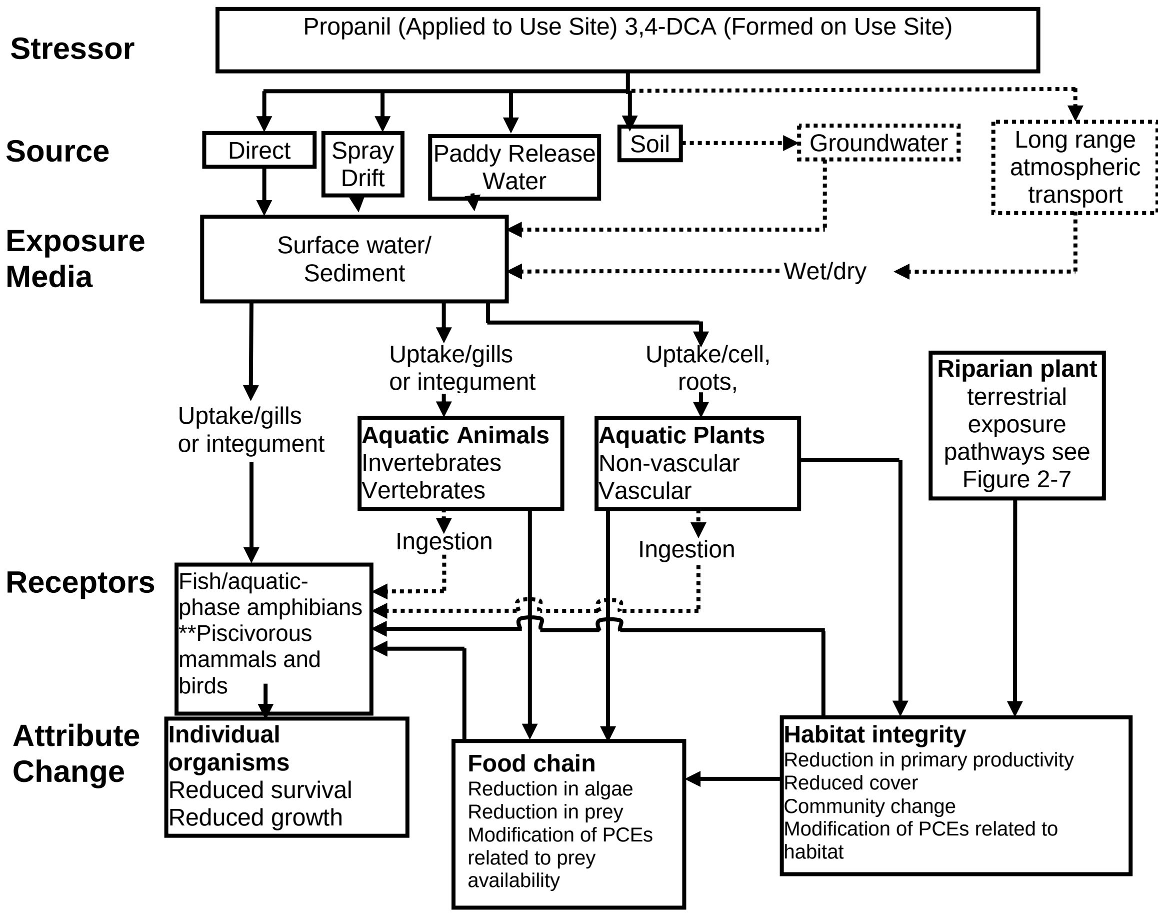


Figure 2-6 Conceptual Model for the Potential Risk to the Aquatic-Phase of the CRLF from the Use of Propanil on Rice.

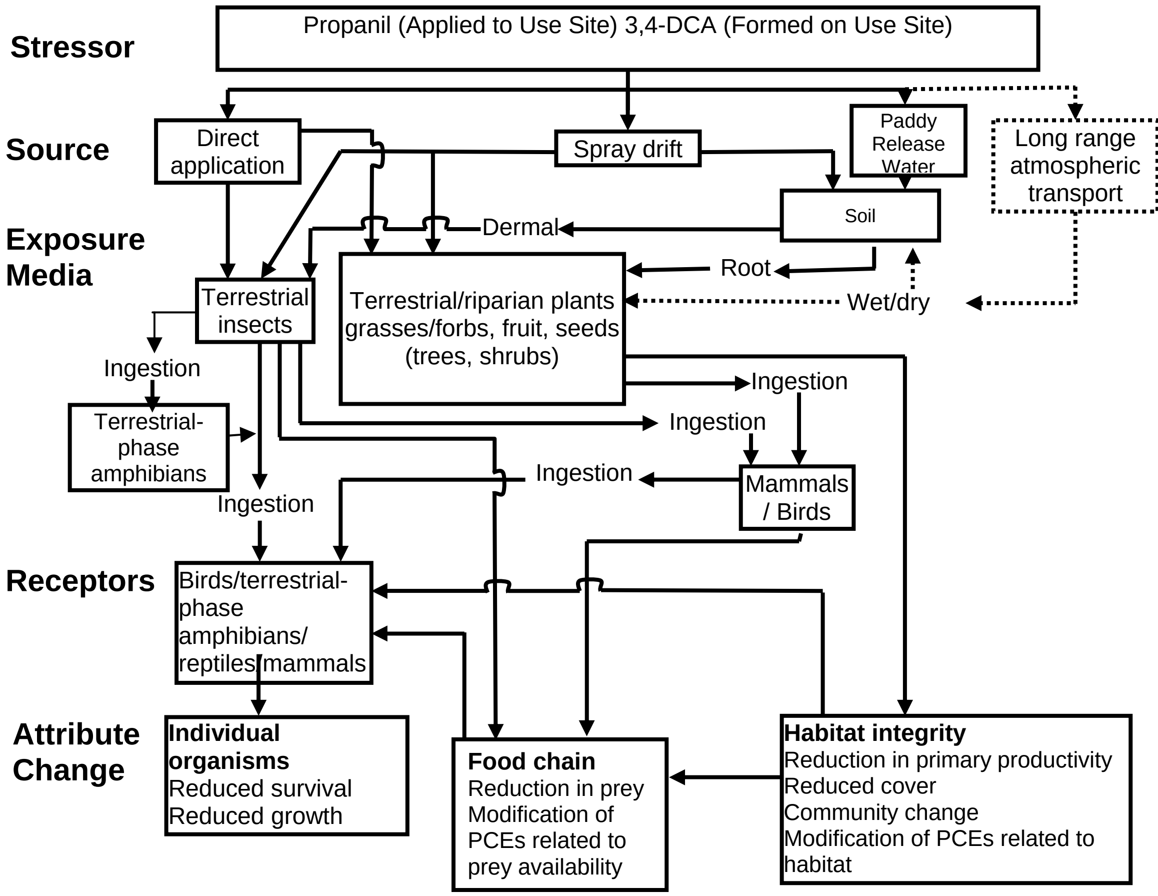


Figure 2-7 Conceptual Model for the Potential Risks to the Terrestrial-Phase of the CRLF from the Use of Propanil on Rice.

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 propanil 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 propanil 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 propanil along with available monitoring data indicate that direct application in rice paddies (used as habitat), spray drift, and release of rice paddy water to receiving waters are the principle potential transport mechanisms of propanil to the aquatic and terrestrial habitats of the CRLF. The reported vapor pressure of propanil is 9.08 X 10^{-7} mm Hg; therefore, volatilization is not considered a probable route of dissipation.

Measures of exposure are based on aquatic and terrestrial models that predict estimated environmental concentrations (EECs) of propanil using maximum labeled application rates and methods of application. The model used to predict aquatic EECs is the EFED Tier 1 Rice Model (v.1, May 8, 2007). T-REX is used to predict terrestrial EECs on food items. These models are parameterized using relevant, reviewed, registrant-submitted environmental fate data.

The EFED Tier 1 Rice Model (v1.0) is a screening simulation model which generates a maximum exposure value for rice paddies based upon the maximum rate of application to the surface of the paddy water (10 cm), the volume of water in the paddy, and an assumption of instantaneous partitioning into 1 cm sediment through sorption to the soil calculated using the average laboratory K_d value. The Tier 1 Rice Model does not take into consideration movement or transformation on or in the agricultural rice paddy, or the resultant pesticide loadings to a receiving water body via paddy release water, erosion and spray drift. Therefore, actual concentrations in release water would be considerably less than estimated concentrations. This model was used to estimate conservative screening-level exposure of aquatic organisms to propanil. In the Tier 1 Rice Model, the measure of acute exposure for propanil is considered to be the concentration on the day of application and it degrades at the rate determined in the aerobic aquatic metabolism study. For the degradate, 3,4-DCA, the measure of acute exposure is considered to be the concentration on day 7. This is also when 3,4-DCA reaches its maximum in the aerobic aquatic metabolism study.

The measure of chronic exposure to propanil and 3,4-DCA combined for aquatic species is taken as the 7-day average for this assessment. This is because the minimum required holding time for paddy water treated with propanil is 7 days in California. This assumes that CRLF adults and tadpoles (aquatic-phase) occupy rice paddies as their habitat, and are directly exposed to the paddy water. These values are 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. Although practice dictates using a 21-day exposure value for freshwater invertebrates and 60 days for freshwater fish, there is only a possible 7 day exposure due to the nature of rice paddies, the 7-day mean is used for assessing chronic exposure involving CRLF along with fish and frogs serving as prey items, as well as for assessing chronic exposure for aquatic invertebrates, which are also potential prey items. Please note that due to the nature of the rice paddy, the approach used is considered to be very conservative.

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 direct application and/or 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 propanil 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 propanil are bound by using the dietary-based EECs for small insects and large insects.

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.

For propanil use on rice the main route of terrestrial exposure for terrestrial plants is spray drift via aerial application. The spray drift model, AgDRIFT is used to assess exposures of terrestrial-phase CRLF and its prey to propanil deposited on terrestrial habitats by spray drift. In addition to the buffered area from the spray drift analysis, the downstream extent of propanil and 3,4 DCA combined 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 direct and indirect effects to the CRLF. Data were obtained from registrant-submitted studies or from literature studies identified by the ECOTOXicology database (ECOTOX) ECOTOX is a source for locating single chemical toxicity data for aquatic life, terrestrial plants, and wildlife.

ECOTOX was created and is maintained by the USEPA, Office of Research and Development, and the National Health and Environmental Effects Research Laboratory's Mid-Continent Ecology Division.

The assessment of risk for direct effects to the terrestrial-phase CRLF makes the assumption that toxicity of propanil 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).

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 to the Overview Document (USEPA 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 the use of propanil, 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 propanil 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) (USEPA, 2004) (see Appendix C).

For this endangered species assessment, listed species LOCs are used for comparing RQ values for acute and chronic exposures of propanil directly to the CRLF. If estimated exposures directly to the CRLF of propanil resulting from its use on rice 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 on animal prey items (aquatic and terrestrial invertebrates, fish, frogs, and mice), the listed species LOCs are also used. If estimated exposures to CRLF prey of propanil resulting from its use on rice 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 Limitations

No acceptable toxicity studies have been submitted to the Agency, nor were any acceptable studies found in the open literature for the chronic effects of propanil on avian or terrestrial-phase amphibian species.

3.0 Exposure Assessment

California produces approximately 25% of the rice grown in the United States. The Sacramento Valley of California (comprised of Colusa, Butte, Sutter, and Glenn counties) contains 96.4% of the rice acreage.

Propanil is a selective post-emergent general use herbicide registered to control dicots and grass weeds on rice. Nationwide, approximately eight million pounds of active ingredient are used annually on rice. In 1998, based on a crop profile for rice in California prepared in October 1998 by NSF Center for Integrated Pest Management, 30-40% of the reported 465,000 acres in California containing rice used propanil. Per the CA PUR data (as seen in Section 2), approximately 1.4 million pounds of propanil was used on average in California yearly between 1999 and 2006.

3.1 Label Application Rates and Intervals

The only currently registered use of propanil within California is on rice. For a list of the application rates and intervals used in modeling exposure to propanil, please refer to Table 3-1 below.

3.2 Aquatic Exposure Assessment

3.2.1 Modeling Approach

As discussed in Section 2.1.1, the model used to predict aquatic EECs is the EFED Tier 1 Rice Model (v1.0, May 8, 2007). Using the Tier 1 Rice Model, aquatic exposures are quantitatively estimated for rice use with conservative, maximum values that represent high exposure sites for propanil use within the rice paddy. Each of these sites represents a rice paddy holding a 10 cm water depth. When a pesticide is applied to a rice paddy, the model assumes that it will instantaneously partition between a water phase and a sediment phase based on the partition coefficients of the chemical. The formula of the Tier I Rice Model v1.0 is as follows:

$$C_w = \frac{m_{ai}'}{0.00105 + 0.00013K_d}$$

and, if appropriate:

$$K_d = 0.01K_{oc}$$

where:

C_w = water concentration [µg/L]
m_{ai}' = mass applied per unit area [kg/ha]
K_d = water-sediment partitioning coefficient [L/kg]
K_{oc} = organic carbon partitioning coefficient [L/kg]

The other assumptions used for propanil and 3,4-DCA exposure were that (1) the paddy water holding time is 7 days, (2) 3,4-DCA reaches its maximum concentration on day 7, and (3) the total system half-life for parent plus 3,4-DCA is 21 days (from recalculation of the data in the aerobic aquatic metabolism study (MRID 418487-01).

When using the rice model, the aquatic exposure within the rice paddy is focused on over the exposure outside of the paddy in ponds, streams, or creeks from spray drift. The exposure within the paddy would be greater due to being a direct application and is thus more conservative than spray drift. Exposure due to a direct application would contain more of the active ingredient per acre than the exposure from spray drift which would be an indirect application method resulting in less of the active ingredient per acre.

The acute aquatic exposure in release water is characterized using monitoring data, and the Tier I rice model using the 7-day average concentration in the paddy for propanil and 3,4-DCA. The chronic exposure in the release water can be characterized using the monitoring data.

3.2.2 Model Inputs The input parameters for the Tier 1 Rice Model are presented in Table 3-1.

Table 3-1 Summary of Tier 1 Rice Model Environmental Fate Data Used for Aquatic Exposure Inputs for Propanil, 3,4-DCA Endangered Species Assessment for the CRLF

Fate Property	Value (unit)	MRID (or source)
Maximum application rate	8 lbs / 1 application / year	RD and BEAD provided data
K_{oc} for propanil	487 (avg. of 306, 239, 703, 800, and 289)	MRID 42780401
Rice Paddy Water Holding time (minimum)	7 days	2003 RED

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

3.2.3 Results

The Tier 1 Rice Model estimated maximum aquatic EEC for propanil alone is 5323 ppb. The 7-day average concentration for propanil plus 3,4-DCA using a 21-day total-system half-life is 4742 ppb. The peak 3,4-DCA concentration is 77% of the peak concentration for propanil, adjusted for molecular weight (162.02/218.1 = 0.74), or 3033 ppb. These values represent what is going on within the paddy and are listed in Table 3-2. This approach is considered to be very conservative.

Table 3-2 Aquatic EECs (ppb) for Propanil and 3,4-DCA from Use on Rice in California

Chemical	Peak EEC ppb	7-Day EEC ppb (total residues)
Propanil	5,323 (day 0) 479 (day 7)	4,742

3,4-DCA	3,033 (day 7)	

The peak model-estimated environmental concentrations resulting from propanil use on rice is 5323 ppb. The minimum required holding time for rice paddy water treated with propanil, as specified on the label, is 7 days in California. Therefore, chronic exposures in the paddy water are calculated with a 7-day averaging period rather than the usual 21 to 60 day averaging period. Furthermore, the metabolite 3,4-DCA reaches its maximum concentration on day 7 of the aerobic aquatic metabolism experiment. As a result, the acute exposure to this metabolite is calculated on day 7 as well, the day of paddy water release. Moreover, since the label states at least a 7 day holding period in the paddy, by assuming the water is released using the minimum period of time allowed for holding the paddy would contain the highest concentration that could be present in the release water. In return, this approach is plausible and would be the most conservative.

Although practice dictates using a 21-day exposure value for freshwater invertebrates and 60 days for freshwater fish, there is only a possible 7 day exposure due to the nature of rice paddies. The 7-day mean is used for assessing chronic exposure involving CRLF along with fish and frogs serving as prey items, as well as for assessing chronic exposure for aquatic invertebrates, which are also potential prey items. An example output from the EFED Tier 1 Rice Model (v1.0, May 8, 2007) is available in Appendix E.

The acute exposure in the water paddy was found to be 5323 ppb for the parent propanil. The acute exposure in the release water was found to be 479 ppb and 3033 ppb for propanil and 3,4-DCA respectively.

3.2.4 Existing Monitoring Data

Extensive monitoring data for propanil and 3,4-DCA (propanil is a major source of 3,4-DCA) are available from rice-growing areas of California. While these data show that both propanil and 3,4-DCA are commonly detected in receiving waters (Sacramento River and San Joaquin River) in the rice-growing areas, the detected concentration are much lower than predicted by the modeling presented above.

The quantitative difference may be accounted for by (1) the conservative nature of the Rice Model, (2) further degradation if paddy water is held longer than 7 days, (3) dilution in the receiving water, and (4) sampling on days other than the day of paddy water release.

3.2.4.1 California Department of Pesticide Regulation Data

The California surface water database website (http://www.cdpr.ca.gov/docs/emon/surfwtr/surfcont.htm) was searched for data on propanil in California surface waters. The data for the four sites of most frequent propanil detection, and highest concentration, all of which are in the rice-growing area of the Sacramento River valley or downstream of it, are listed below in Figures 3-1 to 3-4. The site with the highest concentration is Colusa Basin Drain #5, where water discharged from rice paddies enters the Sacramento River. This site has also shown the highest concentrations for other rice-only chemicals such as thiobencarb. The highest concentration of propanil observed was just over 20 ppb at Colusa Basin drain #5 in 2001. This is significantly less than the calculated acute exposure in the release water determined by the rice model (479 ppb). The average concentration, chronic exposure outside of the rice paddy, seen in 1998 and 2001 (the two years where monitoring data was taken at the Colusa Basin Drain #5) were 2.09 ppb and 3.07 ppb respectively.

Both the acute and chronic concentration are well below the Tier I Rice Model estimated peak concentration of 5323 ppb in rice paddy water, however they are closer to the estimated propanil concentration on day 7 (the water release date) of 479 ppb (assuming a 2-day half-life for parent propanil). The remaining difference may be accounted for by dilution in the receiving water (Sacramento River) and by additional decay if the water is held for longer than 7 days. It is important to note that the Sacramento River is at least a 4th order river that supports major shipping, and as such its volume and flow rate are substantial.

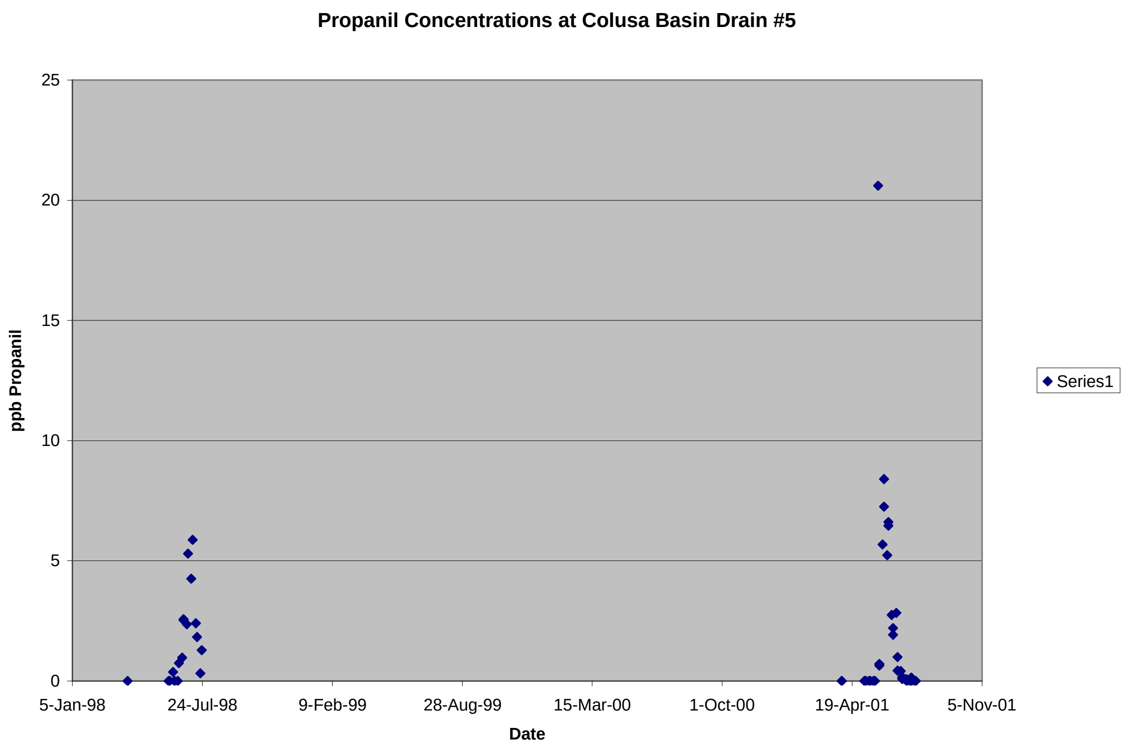


Figure 3-1 Propanil Concentrations at Columbia basin Drain #5.

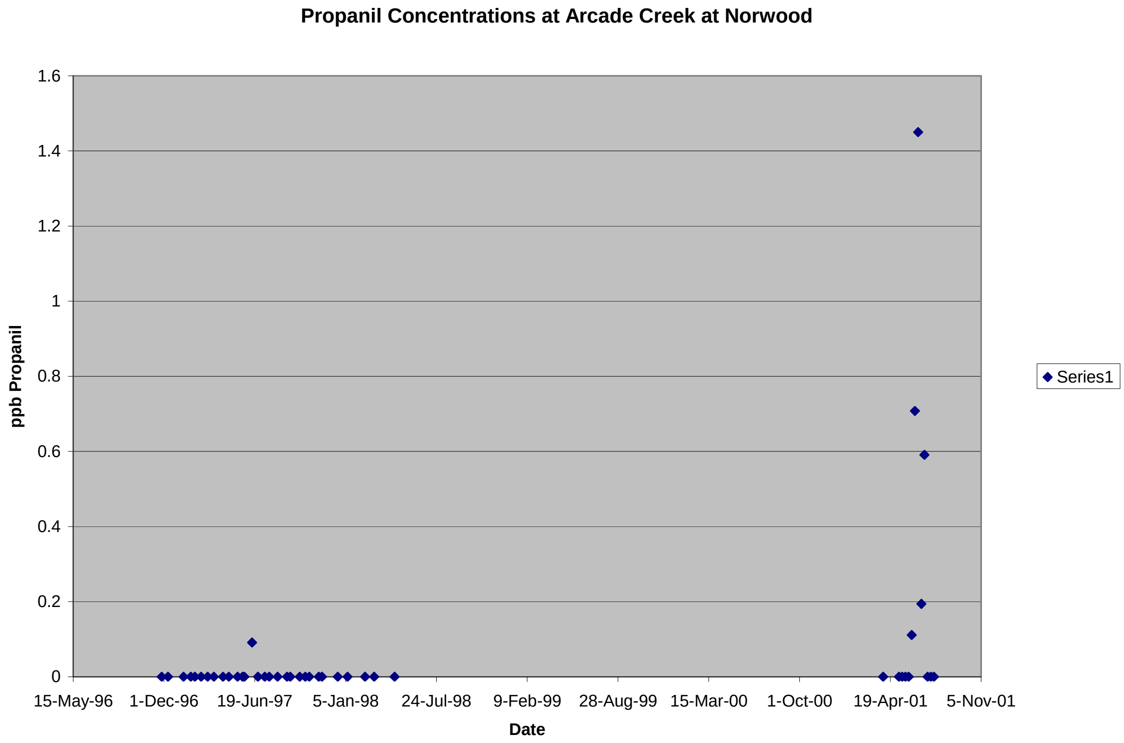


Figure 3-2 Propanil Concentrations at Arcade Creek at Norwood.

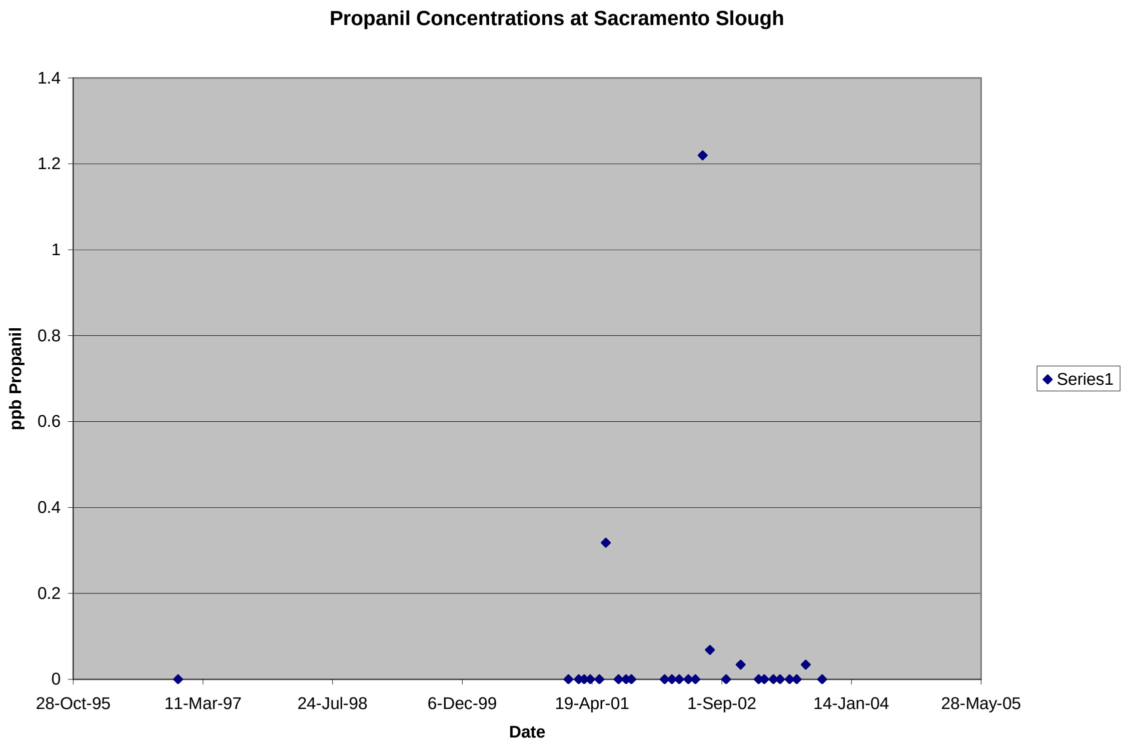


Figure 3-3 Propanil Concentrations at Sacramento Slough.

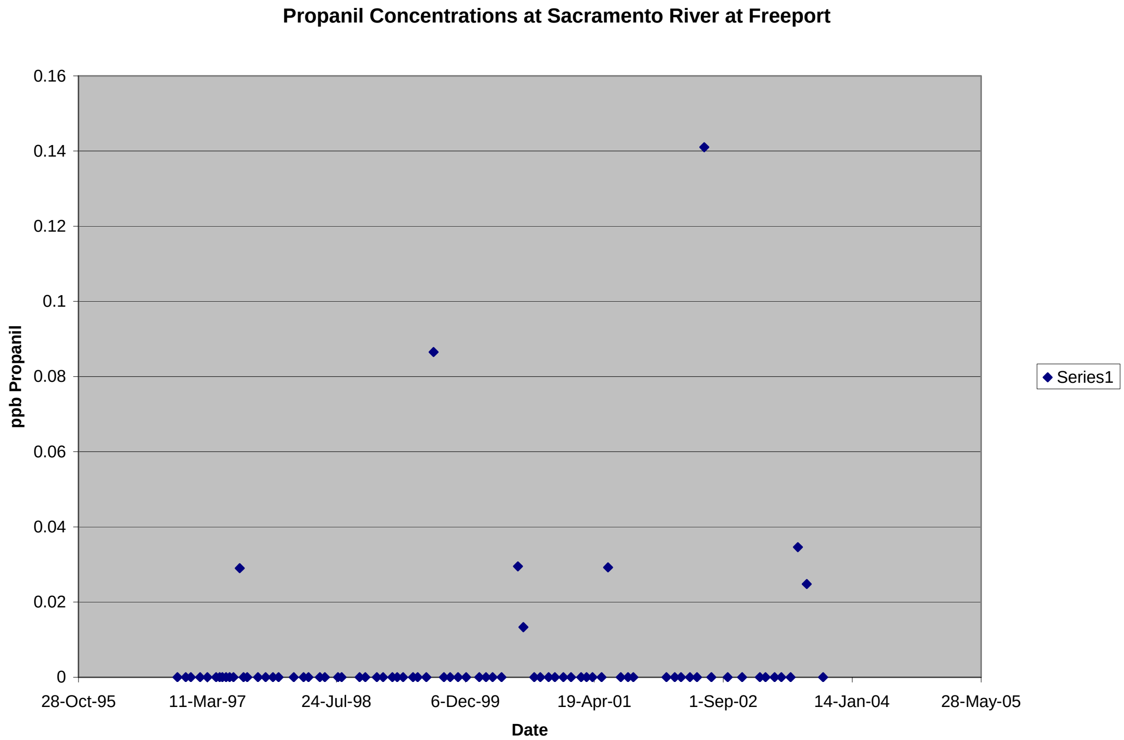


Figure 3-4 Propanil Concentrations at Sacramento River at Freeport

3.2.4.2 USGS NAWQA Groundwater Data

The USGS NAWQA data (http://water.usgs.gov/nawqa/) warehouse website was searched for propanil data on April 14, 2009. Out of 504 measurements of propanil retrieved in ground water, all but two (2) of these samples were non-detects (<0.011 or <0.004 ppb). The two detects (0.00146 to 0.00151 ppb) were in Riverside County.

The basins measured for propanil included: Sacramento River basin, San Joaquin-Tulare river basin, Santa Ana river basin, and Nevada basin and Range.

3.2.4.3 USGS NAWQA Surface Water Data

The remaining 170 NAWQA samples were of surface water. 116 (66%) of these were non-detects (<0.011 to <0.004 ppb). The highest concentrations were found in rice-growing areas (Sutter, Sacramento, and Yolo counties). The highest concentrations at one site were at Sacramento Slough near Knights Landing in Sutter County (8 detects in 10 samples). The detected concentrations at this site ranged from 0.0151 to 1.22 ppb. The site with the next highest concentration was the Sacramento River at Freeport (26 of 28 samples were positive); measured concentrations ranged from 0.00289 to 0.301 ppb.

Because the detected concentrations reported in the California surface water database were higher (<0.004 ppb to over 20 ppb), they will be used as the highest observed concentrations in receiving waters. However, the NAWQA data do confirm that the highest propanil concentrations occur in the same general area (Sacramento River basin).

NAWQA data for the propanil degradate 3,4-dichloroaniline (3,4-DCA) were downloaded on May 11, 2009. 3,4-DCA was determined in 307 surface water and 291 ground water samples. General sampling locations were in the Sacramento, San Joaquin-Tulare and Santa Ana river basins; these are the same general areas as the propanil samples, and the former two represent rice growing areas of California. 3,4-DCA was detected in 48 (16%) ground water samples, with a maximum concentration of 0.091 ppb. All detections were in the Sacramento and San Joaquin-Tulare basins.

Table 3-3 summarizes the surface water data for stations with at least 5 samples. 3,4-DCA is commonly detected (66-100%) at these stations. Single-sample concentrations were as high as 0.626 ppb (Mustang C A Monte Vista Ave Near Montpelier, Ca), and average concentrations were as high as 0.170 ppb (Highline Canal Spill near Hilmar, Ca), both of which are in Merced County.

It is likely that the observed 3,4-DCA concentrations are due to propanil use, due to the co-location with propanil detections. While other pesticides share 3,4-DCA as a degradate with propanil, it is only considered a major degradate for propanil. The observed concentrations are much lower than the Tier I Rice Model EEC for day-7 rice paddy water (3033 ppb). This may be due to longer holding times, and further degradation and dilution in the receiving waters.
There are no other degradates.

Table 3-3 Summary of NAWQA Data for 3,4-dichloroaniline (3,4-DCA) in California Surface Water Monitoring.

County	Station	Number of Samples	No. Samples Above DL	High Conc. (ppb)	Low conc. (ppb)	Average conc. (ppb)
Sacramento	Arcade C Nr Del Paso Heights Ca	21	15	0.018	0.005	0.008
Merced	Culvert Discharge to Mustang C A Monte Vista Ave	12	9	0.024	0.004	0.010
Merced	Highline Cn Spill Nr Hilmar Ca	5	5	0.295	0.065	0.170
Merced	Merced R A River Road Bridge Nr Newman Ca	12	8	0.022	0.005	0.010
Merced	Mustang C A Bifurcation Structure Nr Ballico Ca	19	17	0.089	0.012	0.030
Merced	Mustang C A	22	20	0.626	0.009	0.113

	Monte Vista Ave Nr Montpelier Ca					
Merced	Mustang C A Newport Rd Nr Ballico Ca	7	7	0.134	0.039	0.070
Stanislaus	Orestimba Cr at River Rd Nr. Crows Landing Ca	27	24	0.042	0.005	0.013
Sacramento	Sacramento R A Freeport Ca	59	58	0.373	0.004	0.046
San Joaquin	San Joaquin R Nr Vernalis Ca	70	66	0.148	0.002	0.017
Riverside	Santa Ana R Bl Prado Dam Ca	47	43	0.048	0.003	0.017

3.2.4.4 Atmospheric Monitoring Data

Per samples collected by NAWQA, no propanil was detected in the 3 samples from the Nevada Basin and Range area (Alpine, Nevada and El Dorado counties). In the Santa Ana River basin of southern California, only 1 of 28 samples was positive for propanil (0.0143 ppb at Santa Ana R Bl Prado Dam Ca). These results suggest that propanil is not prone to atmospheric transport.

Propanil was not among those pesticides included in air monitoring by the state of California (http://www.cdpr.ca.gov/docs/empm/pubs/tac/tacstdys.htm).

3.3 Terrestrial Animal Exposure Assessment

T-REX (Version 1.3.1) is used to calculate dietary and dose-based EECs of propanil for the terrestrial-phase CRLF and its potential prey (*e.g*. small mammals and terrestrial insects) inhabiting terrestrial areas. EECs used to calculate direct risks to the terrestrial-phase 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, ground spray applications of propanil are considered, as discussed below.

Terrestrial EECs were derived for aerial and ground spray applications of propanil to rice. Given that no data on interception and subsequent dissipation from foliar surfaces is available for propanil, a default foliar dissipation half-life of 35 days is used based on the work of Willis and McDowell (1987). Input values for rice, including number of applications, and application rate are shown in Table 3-4. An example output from T-REX is available in Appendix F.

Table 3-4 T-REX Model Input Parameters

Use	Application Rate per Crop Scenario (lbs/A/yr)	Number of Applications	Application interval (days)
Rice	8	1	n/a
n/a not applicable			

T-REX is also used to calculate EECs for terrestrial insects exposed to propanil. 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 terrestrial insects. Available acute contact toxicity data for bees exposed to propanil (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.

For modeling purposes, exposures of the CRLF to propanil 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 3-5). Dietary-based EECs for small and large insects reported by T-REX as well as the resulting adjusted EECs are available in Table 3-6. Terrestrial-phase CRLF's and prey could be exposed to direct ground or aerial applications of propanil in the paddy when the paddy is drained for application, this is a very conservative estimation of risk. Terrestrial-phase CRLFs and prey could also be exposed to propanil via spray drift, off the field during aerial application of propanil, and risk from spray drift will be estimated using AgDRIFT.

Table 3-5 Upper-bound Kenega Nomogram EECs for Dietary- and Dose-based Exposures of the CRLF and its Prey to Propanil

Use	EECs for CRLF		EECs for Prey (small mammals)	
	Dietary-based EEC (ppm)	Dose-based EEC (mg/kg-bw)	Dietary-based EEC (ppm)	Dose-based EEC (mg/kg-bw)
Rice	1080	1230	1920	1830

Table 3-6 EECs (ppm) for Indirect Effects to the Terrestrial-Phase CRLF via Effects to Terrestrial Invertebrate Prey Items

Use	Small Insect	Large Insect
Rice	1080	120

3.4 Terrestrial Plant Exposure Assessment

Spray drift is the main route of exposure to terrestrial plants. AgDRIFT (Version 2.01) is used to calculate spray drift; it was also used to estimate terrestrial plant exposure. The spray drift analysis uses the most sensitive endpoint. AgDRIFT was used to estimate the distance that spray applications can drift from the treated area and still be present in concentrations that exceed the levels of concern. See section 3.4.1 for the spray drift buffer analysis.

3.4.1 Spray Drift Buffer Analysis

In order to determine terrestrial and aquatic habitats of concern due to propanil 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 and can be found in Table 3-7.

AgDRIFT was run for terrestrial analysis and aquatic analysis.

Terrestrial Analysis:
The model was run as a Tier I ground analysis, as well as Tier II aerial analysis focusing on determining a buffer zone for non-listed and listed plant species. The following settings beyond the standard default settings were implemented:

- 8 lb ai/A/year
- Dicot (Cabbage, *Brassica oleracea*) Vegetative Vigor EC_{25}= 0.09 lb ai/A
- Monocot (Onion, *Allium cepa*) Vegetative Vigor EC_{25} = 0.13 lb ai/A

Aquatic Analysis:
The model was run as a Tier I ground analysis, as well as Tier I aerial analysis focusing on determining a buffer zone for direct toxicity to the aquatic phase CRLF (fish), indirect toxicity to the aquatic phase CRLF (invertebrates), and aquatic plants. The following settings beyond the standard default settings were implemented:

- 8 lb ai/A/year
- Rainbow Trout (*Oncorhynchus mykiss*) 96-h LC_{50} = 2300 ppb
- Water Flea (*Daphnia magna*) 48-h EC_{50} = 528 ppb
- Green Algae (*Pseudokirchneriella subcapitata*) 5-d EC_{50} = 29 ppb

The AgDRIFT model was used to evaluate potential distances beyond which exposures would be expected to be below LOC. The terrestrial assessment evaluates the maximum distance needed for there to be no exposure assuming direct exposure. The aquatic assessment evaluated the maximum distance needed from the rice paddy being treated to a neighboring water body that is not being treated.

Table 3-7 Summary of AgDRIFT Predicted Spray Drift Buffer for Terrestrial and Aquatic Habitats

Terrestrial Assessment on Terrestrial Plants				
Tier I Ground Application				
Risk Class	Risk Description	Application Rate	Toxicity Value Used	Distance
Dicot	Potential for effects to non-target, non-listed plants from	8	EC_{25} = 0.09lb ai/A	213 ft

Risk Class	Risk Description	Application Rate	Toxicity Value Used	Distance
Monocot	exposures		EC_{05} = 0.13 lb ai/A	151 ft
Tier II Aerial Application				
Risk Class	Risk Description	Application Rate	Toxicity Value Used	Distance
Dicot	Potential for effects to non-target, non-listed plants from exposures	8	EC_{25} = 0.09lb ai/A	584 ft
Monocot			EC_{05} = 0.13 lb ai/A	397 ft
Aquatic Assessment				
Tier I Ground Application				
Risk Class	Risk Description	Application Rate	Toxicity Value Used	Distance
Rainbow Trout (Oncorhynchus mykiss)	Direct toxicity to the aquatic phase CRLF (fish)	8	96-h LC50 = 2300 ppb	0 ft
Water Flea (Daphnia magna)	Indirect toxicity to the aquatic phase CRLF (invertebrates)		48-h EC50 = 528 ppb	0 ft
Green Algae (Pseudokirchneriella subcapitata)	Aquatic Plants, habitat and food source		5-d EC50 = 29 ppb	0 ft
Tier I Aerial Application				
Risk Class	Risk Description	Application Rate	Toxicity Value Used	Distance
Rainbow Trout (Oncorhynchus mykiss)	Direct toxicity to the aquatic phase CRLF (fish)	8	96-h LC50 = 2300 ppb	0 ft
Water Flea (Daphnia magna)	Indirect toxicity to the aquatic phase CRLF (invertebrates)		48-h EC50 = 528 ppb	0 ft
Green Algae (Pseudokirchneriella subcapitata)	Aquatic Plants, habitat and food source		5-d EC50 = 29 ppb	33 ft

4.0 Effects Assessment

This assessment evaluates the potential for propanil to directly or indirectly affect the CRLF or affect its designated critical habitat. As 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 effects to 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 propanil, and its degradate 3,4-DCA.

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 from ECOTOX information searched on October 31, 2008. 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, unless quantitative relationships between modifications and reduction in species survival, reproduction, and/or growth are 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 propanil.

A detailed spreadsheet of the open literature data available within the ECOTOX database for both the parent propanil and degradate 3,4-DCA can be found in Appendix G. The endpoints from the studies were classified as being more or less sensitive (toxic) than the registrant studies. Those that were found to be more sensitive than the registrant submitted studies were reviewed even further, and studies were determined to be acceptable for use within this assessment. The open literature studies from the ECOTOX database with endpoints that were more sensitive than registrant submitted studies included two 3,4-DCA studies that could be used quantitatively in the assessment, they were used to provide more information concerning the potential variation in toxicity seen with the degradate as compared to the parent compound. These studies are presented below in Table 4-3.

Citations of all open literature that were not considered as part of this assessment because they were either rejected by the ECOTOX screen (excluded from ECOTOX entirely, not acceptable for ECOTOX, or efficacy papers examining the target species) are included in Appendix H. Open literature toxicity data for 'target' terrestrial plant species, which include efficacy studies, are not currently considered in deriving the most sensitive endpoint for terrestrial plants. Efficacy studies do not typically provide endpoint values that are useful for risk assessment (e.g., NOAEC, EC50, etc.), but rather are intended to identify a dose that maximizes a particular effect (e.g., EC100). Therefore, efficacy data and non-efficacy toxicological target data are not included in the ECOTOX open literature summary table provided in Appendix G. The list of citations including toxicological and/or efficacy data on target plant species not considered in this assessment is provided in Appendix H. Also included is 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 for both the parent propanil and the 3,4-DCA degradate. Citations of all open literature data, including studies accepted by ECOTOX but not used (e.g., the endpoint is less sensitive), studies that have been reviewed accepted by ECOTOX but not OPP, and those studies that are more sensitive and used or not used within the assessment are found in Appendix I.

In addition to registrant-submitted and open literature toxicity information, other sources of information, 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 propanil. A summary of the available aquatic and terrestrial ecotoxicity information, use of the probit dose-response relationship, and the incident information for propanil are provided in Sections 4.1 through 4.4, respectively.

The terminal residues of concern in plants and animals are propanil (parent) and metabolites convertible to 3, 4-DCA. This risk assessment considers the parent propanil and degradate 3,4-DCA separately for acute toxicity, and the combined total residues of parent propanil and 3,4-DCA for chronic toxicity. A detailed summary of the available ecotoxicity information for propanil, 3,4-DCA and formulated products are presented in Appendix J.

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[5, 6].

There are nine registered multiple active ingredient formulations that contain propanil as part of the formulation. Seven have definitive LD_{50} values with associated confidence intervals from mammalian studies. In the case of EPA Reg. No. 5905-495, the toxicity can be attributed to propanil. When the LD_{50} for this product (1110 mg/kg) and its confidence interval (913-1360 mg/kg) are adjusted for the percent propanil (33.7%), the adjusted LD_{50} value of 374 mg/kg (CI: 308-458 mg/kg) is within a factor of two of the confidence interval for the technical grade propanil (1080 mg/kg; CI: 868-1343 mg/kg) and the difference is not considered to be significant. Similarly, in the case of EPA Reg. Nos. 71085-09, 71085-16 and 71085-23, the product values can be attributed solely to the toxicity of propanil. When the LD_{50}s and associated confidence intervals for these three products are adjusted for percent propanil (41.2, 80 and 60%, respectively), the adjusted LD_{50} and CI values for the products (EPA Reg. No. 71085-09: 1943 mg/kg, CI: 1126-3355 mg/kg; EPA Reg. No. 71085-16: 978 mg/kg, CI: 534-1792; and EPA Reg. No. 71085-23: 734 mg/kg, CI: 401-1344 mg/kg) fall within the confidence interval for propanil (868-1343 mg/kg). Likewise, the product LD_{50} values for EPA Reg. Nos. 71085-25, 71085-26 and 71085-29 can be attributed to the toxicity of propanil. The adjusted LD_{50} and CI values for these products are 463 mg/kg (CI: 391-567 mg/kg), 1345 mg/kg (CI: 753-2150 mg/kg) and 639 mg/kg (452-1624 mg/kg), respectively, and the values fall within the confidence interval for the propanil technical (868-1343 mg/kg). From the analysis of the multiple active ingredient products containing propanil, the toxicity of these compounds was not significantly different than the single active ingredient products of propanil alone.

Given that the active and inert ingredients would not be expected to have similar mechanisms of action, metabolites or toxicokinetic behavior it is also reasonable to

[5] Overview of the Ecological Risk Assessment Process in the Office of Pesticide Programs, Environmental Protection Agency (January 2004) (Overview Document).
[6] Memorandum to Office of Prevention, Pesticides and Toxic Substance, US EPA conveying an evaluation by the U.S. Fish and Wildlife Service and National Marine Fisheries Service of an approach to assessing the ecological risks of pesticide products (January 2004).

conclude that an assumption of dose-addition would be inappropriate. Consequently, an assessment of propanil's potential effect on the CRLF when it is co-formulated with other active ingredients can be based on the toxicity of propanil. The data are presented in Appendix A.

An evaluation of studies that involved mixtures from ECOTOX was completed. Two of these studies were not usable as the exposure was via injection, and that is a route that is not part of our assessment[7,8]. One of the other studies was an efficacy study on the target species. There was one mixture study using a mixture of 3,4-DCA and lindane which documented a significant decrease in growth of zebrafish larvae[9]. There was also an overall decrease in the survival of larvae, but it was not significantly different than controls. However, lindane is no longer a registered chemical; therefore the mixture tested is no longer relevant to be addressed within the assessment. More information can be found in the ECOTOX bibliography in Appendix M.

4.1. Toxicity of Propanil to Aquatic Organisms

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

Table 4-1 Freshwater Aquatic Toxicity Profile for Propanil

Assessment Endpoint	**Species**	**Toxicity Value Used in Risk Assessment**	**Describe effect (i.e. mortality, growth, reproduction)**	**Citation MRID # or Acc. #**	**Study Classification**
Direct Toxicity to Aquatic-Phase CRLF					
Acute	Rainbow Trout (*Oncorhynchus mykiss*)	96-h LC_{50} = 2300 ppb	Mortality	Acc. 246087	Acceptable
Chronic	Fathead Minnows (*Pimephales promelas*)	NOAEC = 9.1 ppb LOAEC = 21 ppb	Growth (length)	42475301	Acceptable
Indirect Toxicity to Aquatic-Phase CRLF					
via Acute Toxicity to Freshwater Invertebrates (i.e. prey items)	Water Flea (*Daphnia magna*)	48-h EC_{50} = 528 ppb	Mortality	41776801	Acceptable

[7] De la Rosa, P., Barnett, J. B., & Schafer, R. Characterization of Thymic Atrophy and the Mechanism of Thymocyte Depletion After In Vivo Exposure to a Mixture of Herbicides. J. Toxicol. Environ. Health A 68[2], 81-98. 2005 (E79428)
[8] De la Rosa, P., Barnett, J. B., & Schafer, R. Loss of Pre-B and IgM^+ B Cells in the Bone Marrow After Exposure to a Mixture of Herbicides. J. Toxicol. Environ. Health A 66[24], 2299-2313. 2003. (E93382)
[9] Ensenbach, U. & Nagel, R. Toxicity of Complex Chemical Mixtures: Acute and Long-Term Effects on Different Life Stages of Zebrafish (*Brachydanio rerio*). Ecotoxicol. Environ. Saf. 30[2], 151-157. 1995. (E15345)

via Chronic Toxicity to Freshwater Invertebrates (i.e. prey items)	Water Flea (*Daphnia magna*)	28-d NOAEC = 86 ppb LOAEC = 160 ppb	Reproduction: # of offspring per female	41776601	Acceptable
via Acute Toxicity to Freshwater Fish (i.e. prey items)	Rainbow Trout (*Oncorhynchus mykiss*)	96-h LC_{50} = 2300 ppb	Mortality	Acc. 246087	Acceptable
via Chronic Toxicity to Freshwater Fish (i.e. prey items)	Fathead Minnows (*Pimephales promelas*)	NOAEC = 9.1 ppb LOAEC = 21 ppb	Growth (length)	42475301	Acceptable
via Toxicity to Non-Vascular Aquatic Plants	Green Algae (*Pseudokirchneriella subcapitata*)	5-d EC_{50} = 29 ppb	Growth and Reproduction	41777301	Acceptable
via Toxicity to Vascular Aquatic Plants	Duckweed (*Lemna gibba*)	14-d EC_{50} = 110 ppb	Growth and Reproduction	41777201	Supplemental[1]

[1]This study is considered to be supplemental due to lack of raw data and replicates.

Toxicity to aquatic fish and invertebrates is categorized using the system shown in Table 4-2 (U.S. EPA, 2004). Propanil falls in the range of "moderately toxic" (1 to 10 ppm or 1000 to 10,000 ppb) for freshwater fish and invertebrates on an acute exposure basis. 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

Table 4-3 Comparison of Freshwater Aquatic Toxicity for Propanil and 3,4-DCA

Assessment Endpoint	Species	Propanil (parent)	3,4-DCA* (expressed as parent)
Acute Freshwater Fish	Rainbow Trout (*Oncorhynchus mykiss*)	96-h LC_{50} = 2,300 ppb Acc. 246087	No Data
Chronic Freshwater Fish	Fathead Minnows (*Pimephales promelas*)	NOAEC = 9.1 ppb 42475301 endpoint: Growth (length)	Not scientifically valid
Acute Freshwater Invertebrate	Water Flea (*Daphnia magna*)	48-h EC_{50} = 528 ppb 41776801	48-h EC_{50} = 34.9 ppb **(47.0 ppb)** E55961

Assessment Endpoint	Species	Propanil (parent)	3,4-DCA* (expressed as parent)
Chronic Freshwater Invertebrate	Water Flea (*Daphnia magna*)	28-d NOAEC = 86 ppb 41776601 endpoint: # of offspring per female	21-d NOAEC = 10 ppb **(13 ppb)** E102280 endpoint: # of live young produced per live adult

* Studies from the Open Literature, found using ECOTOX, expressed as parent compound (propanil), for toxicity comparisons. Conversions were completed using the molecular weights of propanil (218.1g/mol) and dividing by the molecular weight of 3,4-DCA (162.03g/mol) and then multiplying by the corresponding degradate toxicity endpoint to determine what it would be in terms of the parent compound.

4.1.1 Toxicity to Freshwater Fish

Propanil is moderately toxic to freshwater fish on an acute exposure basis. The most sensitive freshwater species tested was the rainbow trout (*Oncorhynchus mykiss*), which exhibited a 96-hour LC_{50} of 2,300 ppb (Acc. 246087) for propanil (88% active ingredient). The 96-hour LC_{50} value for the formulated product (Propanil®-4,,44% a.i.) in test with rainbow trout was 5,632 ppb (MRID 4136201). Bluegill sunfish (*Lepomis macrochirus*) exhibited a 96-hour LC_{50} value of 5,400 ppb (Acc. 249347) with technical grade propanil (86.2% a.i), and a 96-hour LC_{50} value with formulated product (Propanil®-4, 44% a.i.) of 6,160 ppb (41359801). Chronically, the fathead minnow (*Pimephales promelas)* exhibited a NOAEC of 9.1 ppb and a LOAEC of 21 ppb based on growth (length), and a NOAEC of 9.3 ppb and a LOAEC of 19 ppb based on survival (MRID 42475301, 41776501, and 42259601).

As stated above, the most sensitive acute toxicity study for freshwater fish from registrant-submitted studies using propanil is the rainbow trout (96-h LC_{50} = 2,300 ppb). There were open literature studies conducted with propanil available through ECOTOX, which reported more sensitive values for channel catfish (*Ictalurus punctatus*) with 96-hr LC_{50} values of 1,672[10] and 378[11] ppb. However, these studies were conducted at unusually low pH values (pH = 6.4) that are below the EPA-recommended range of 7.2 – 7.6 and it is unclear whether the low pH conditions of the study may have affected the sensitivity of the test species. Because of this uncertainty, the two values were not used. None of the other data available through ECOTOX for freshwater fish were more sensitive than the values used in this assessment.

No registrant-submitted or scientifically valid open-literature studies were available for determining acute or chronic toxicity of 3,4-DCA (the degradate) to freshwater fish.

One study was found within ECOTOX that used aquatic-phase amphibians as study organisms. The effects of propanil to 6 day old African clawed frogs (*Xenopus laevis*)

[10] Brown, K. W., D. C. Anderson, S. G. Jones, L E. Duel and J. D. Prince. 1979. The Relative Toxicity of 4 Pesticides in Tap Water and Water From Flooded Rice Paddies. Int. J. Environ. Study 14(1): 49 – 53. (E5722)
[11] *Ibid* Brown *et a*l. 1979. (E5722)

were examined and showed a 48-h LC_{50} of 3577 ppb (43.5% a.i.)[12]. However, upon further review, not enough information was provided within the study to determine its scientific validity; therefore, this study could not be used in this risk assessment. No scientifically valid data are available for aquatic-phase amphibians as study organisms. As a result, freshwater fish data were used as surrogates to estimate direct and indirect acute and chronic risks to the CRLF. Freshwater fish toxicity data were also used to assess potential indirect effects of propanil to the CRLF. Effects to freshwater fish resulting from exposure to propanil 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).

4.1.2 Toxicity to Freshwater Invertebrates

Freshwater invertebrate toxicity data were used to assess potential indirect effects of propanil to the CRLF. Effects to freshwater invertebrates resulting from exposure to propanil could 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.

Propanil is moderately toxic to freshwater invertebrates on an acute exposure basis based on acceptable studies on the water flea (*Daphnia magna*). This species exhibited a 48-hour EC_{50} value of 528 ppb for the formulated product Propanil®-4, (44% a.i.) (MRID 41776801). Chronic toxicity studies show the water flea exhibiting a 28-d NOAEC of 86 ppb and a LOAEC of 160 ppb based on a reproduction endpoint of the number of offspring per female (MRID 41776601).

For freshwater invertebrates, none of the acute or chronic toxicity values reported through ECOTOX are more sensitive than the registrant-submitted data on *Daphnia magna* (48-hr EC_{50}=1,200 ppb) using either the technical grade or formulated active ingredient for the parent propanil.

A considerable amount of data are available through ECOTOX on the acute toxicity of the degradate 3,4-DCA to freshwater invertebrates. For *D. magna*, the most sensitive 48-hr EC_{50} for the degradate 3,4-DCA is 47.0 ppb ai (expressed as propanil)[13]. When the toxicity values are converted, so that all values are represented in terms of the parent compound, the degradate is about 11 times more toxic than the parent compound to freshwater invertebrates on an acute exposure basis (see Table 4-3). There are some uncertainties associated with the stability of the chemical over time, as only two treatment levels had measured concentrations of 3,4-DCA. The other treatment

[12] Moore, M. T., Pierce, J. R., Milam, C. D., Farris, J. L., & Winchester, E. L. Responses of Non-target Aquatic Organisms to Aqueous Propanil Exposure. Bull.Environ.Contam.Toxicol. 61, 169-174. 1998. (E19808)
[13] Pedersen, F. E. Bjomestad, T. Vulpius, N. B. Rasmussen. 1998. Immobilization Test of Aniline Compounds with the Crustacean *D. magna*. Proj. No. 303587 Report to the Danish EPA, Copenhagen, Denmark: 93 pp. (E55961)

concentrations were below the level of detection for 3,4-DCA, after just 24 hours[14]. There maybe some differences or conflicting information regarding the measurement of the concentrations of 3,4-DCA, and creates uncertainty with the actual concentrations of the compound that the organisms were exposed to. Thus, resulting in an underestimation of the exposure concentration, and an overestimation of risk, as the concentrations of 3,4-DCA experienced in the treatments may be lower than the nominal concentrations.

Upon additional review and recalculation of the statistics using TOXANAL, the 48-hr EC_{50} (47 ppb expressed as propanil) is based on two treatment levels with measured results[15]. Only two treatment levels had measured concentrations, as the other concentrations were below the level of detection. As a result, time-weighted average concentrations were calculated for the treatment levels to be used in the statistical analysis. The missing 24-hr value was set to 80.8% of the initial concentration; this was a calculation as the other replicate of the same nominal concentration was 80.8% of the initial measured concentration. A binomial analysis was used as both the probit and moving average methods could not be used because this reduced data set of two concentrations did not contain partial kills[13]. From the review of the acute freshwater invertebrate 3,4-DCA study, it was determined that it could be used quantitatively within the assessment.

The most sensitive chronic toxicity value reported in ECOTOX for 3,4-DCA was for the aquatic invertebrate *Daphnia magna*, with a 21-day NOAEC of 13 ppb ai (expressed as propanil)[16] based on the number of live young produced per live adult. Other endpoints within the study that also reported a NOAEC of 13 ppb ai (expressed as propanil) included time to first brood release, total number of live young produced, and the proportion of surviving young produced[14]. These endpoints were approximately seven times more toxic than both the registrant-submitted and open literature data reported for the parent compound (3,4-DCA expressed as propanil). Consequently, the endpoint suggests that the 3,4-DCA degradate can be considerably more toxic on a chronic exposure basis than the parent compound. After a thorough review of this study it was determined that endpoint for the number of live young produced per live adult can be used quantitatively within the assessment.

4.1.3 Toxicity to Aquatic Plants

Aquatic plant toxicity studies were used as one of the measures of effect to evaluate whether propanil 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 aquatic-phase CRLF.

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[14] *Ibid* Pedersen *et al*. 1998. (E55961)
[15] *Ibid* Pedersen *et al*. 1998. (E55961)
[16] Shell Oil Co. 3,4-Dichloroaniline: Chronic Toxicity to *Daphnia magna* - Submission of Lists and Copies of Health and Safety Studies (FR 47 38780). EPA/OTS Doc. # 40-8376327, 28 p. (NTIS/OTS 0516827). 2000. E102280 and Guilhermino, L., Sobral, O., Chastinet, C., Ribeiro, R., Goncalves, F., Silva, M. C., & Soares, A. M. V. M. A *Daphnia magna* First-Brood Chronic Test: An Alternative to the Conventional 21-Day Chronic Bioassay? Ecotoxicol. Environ. Saf. 42[1], 67-74. 1999. (E20061)

Laboratory studies only were used to determine whether propanil may cause direct effects to aquatic plants, as there were no registrant submitted field studies for aquatic plants. A summary of the laboratory data for aquatic plants is provided below.

The green algae *Pseudokirchneriella subcapitata* (formerly *Selenastrum capricornutum*) exhibited the most sensitive non-vascular plant toxicity endpoint with an EC_{50} of 29 ppb (MRID 41777301). The aquatic vascular plant duckweed (*Lemna gibba*) exhibited the most sensitive vascular plant toxicity endpoint with a 7-d EC_{50} of 110 ppb ai (MRID 41777201). Growth and reproduction were used as the endpoints for both the non-vascular and vascular aquatic plant toxicity tests. Table 4-1 shows the most sensitive endpoints among the acceptable studies submitted by the registrant.

4.2 Toxicity of Propanil to Terrestrial Organisms

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

Table 4-4 Terrestrial Toxicity Profile for Propanil

Assessment Endpoint	Species	Toxicity Value Used in Risk Assessment	Describe effect (i.e. mortality, growth, reproduction)	Citation MRID # or Acc. #	Study Classification
Direct Toxicity to Terrestrial-phase CRLF					
Acute Dose-based	Northern Bobwhite Quail (*Colinus virginianus*)	14d LD_{50} = 201 mg/kg-bw	Mortality	41361001	Acceptable
Acute Dietary-based	Northern Bobwhite Quail (*Colinus virginianus*)	8d LC_{50} = 2311 mg/kg diet	Mortality	Acc. 246413	Acceptable
Chronic	No Acceptable Study Available	--	--	--	--
Indirect Toxicity to Terrestrial-Phase CRLF					
via acute toxicity to mammalian prey items	Laboratory Rat (*Rattus norvegicus*)	LD_{50} = 1080 mg/kg-bw	Mortality	41360801	Acceptable
via chronic toxicity to mammalian prey items	Laboratory Rat (*Rattus norvegicus*)	NOAEL = 150 mg/kg bw	neonatal toxicity decreased pup weight	44604301	Acceptable
via acute toxicity to terrestrial invertebrate prey items	Honeybee (*Apis mellifera*)	LD_{50} >24.17 µg/bee (>188.83 ppm)	Mortality	00009181	Acceptable
via acute toxicity to terrestrial	Northern Bobwhite Quail (*Colinus virginianus*)	14d LD_{50} = 201 mg/kg-bw	Mortality	41361001	Acceptable

prey items					
via acute toxicity to terrestrial prey items	Northern Bobwhite Quail (*Colinus virginianus*)	8d LC_{50} = 2311 mg/kg diet	Mortality	Acc. 246413	Acceptable
via chronic toxicity to terrestrial prey items	No Acceptable Study Available	--	--	--	--

Acute toxicity to terrestrial animals is categorized using the classification system shown in Table 4-5 (U.S. EPA, 2004). Toxicity categories for terrestrial plants have not been defined.

Table 4-5 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 propanil; therefore, acute and chronic avian toxicity data are used to assess the potential direct effects of propanil to terrestrial-phase CRLFs. Propanil is considered moderately toxic to birds on an acute oral basis, and slightly toxic to birds on a subacute dietary exposure basis. The Northern Bobwhite Quail (*Colinus virginianus*) exhibited an acute oral 14-d LD_{50} of 201 ppm (MRID 41361001) and a subacute dietary 8-d LC_{50} = 2311 ppm (Acc. 246413). A review of the ECOTOX database found no acute avian toxicity data more sensitive than the registrant-submitted data for either the parent or the degradate compounds.

There is no registrant submitted avian reproduction toxicity studies for either the mallard duck or the northern bobwhite quail using propanil. Therefore, there is no data by which to assess chronic toxicity of propanil to avian species (surrogates for the terrestrial-phase CRLF) either submitted by the registrants or in the open literature for either the parent propanil or the degradate 3,4-DCA. Due to the absence of chronic toxicity data for propanil, a structurally similar chemical Solan, (pentanachlor) was used to estimate potential risk to birds (surrogates for the terrestrial-phase CRLF) based on chronic exposure. However, no chronic toxicity data was available for Solan (pentanachlor) therefore; toxicity based on chronic exposure was unable to be calculated for the terrestrial-phase CRLF.

4.2.2 Toxicity to Mammals

Mammalian toxicity data are used to assess potential indirect effects of propanil to the terrestrial-phase CRLF. Effects to small mammals resulting from exposure to propanil could 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). Propanil is considered slightly toxic to mammals on an acute exposure basis. An acute oral LD_{50} of 1080 mg/kg-bw was observed in the laboratory rat (*Rattus norvegicus*) (MRID 41360801).

The laboratory rat NOAEL is 150 ppm and LOAEL 600 ppm, for neonatal toxicity and parental systemic toxicity (MRID 44604301). Chronic toxicity data for mammals from a 2-generation rat reproduction study documented parental effects (F0 and F1) including inhibition of body weight gain, reduced food consumption, increased spleen weights (females only) and increased severities of spleenic pigmented macrophages (MRID 44604301). Documented neonatal toxicity effects included reduced F1 and F2 pup weights, and an increase in the age at which balanopreputial separation was observed (MRID 44604301). Both parental systemic and neonatal toxicity was expressed at a concentration of 600 ppm. The LOAEL for reproductive performance was 600 ppm. The HED Cancer Assessment Summary from 2002 indicated that propanil was not a mutagen, but there was evidence that it was a carcinogen Appendix M (HED 2002).

No acute LC_{50} or LD_{50} values were available through ECOTOX that are more sensitive than the registrant-submitted values. None of the NOAEC values reported for mammals in ECOTOX are more sensitive than the registrant-submitted data used in this assessment.

4.2.3 Toxicity to Terrestrial Invertebrates

Terrestrial invertebrate toxicity data are used to assess potential indirect effects of propanil to the terrestrial-phase CRLF. Effects to terrestrial invertebrates resulting from exposure to propanil could also indirectly affect the CRLF via reduction in available food. Propanil is classified as practically non-toxic to the honeybee (*Apis mellifera*) on an acute contact exposure basis; the acute contact LD_{50} for honeybees is >188.83 ppm (MRID 00009181). From review of the study it was not clear if mortality occurred in any of the treatment groups. The test was therefore not definitive and RQs were not calculated. There were no additional acceptable terrestrial invertebrate data from registrant submitted studies or from the open literature by which to calculate RQ values.

4.2.4 Toxicity to Terrestrial Plants

Terrestrial plant toxicity data are used to evaluate the potential for propanil to affect riparian zone and upland vegetation within the action area for the CRLF. Impacts to riparian and upland (i.e., grassland, woodland) vegetation could result in indirect effects to both aquatic- and terrestrial-phase CRLFs. Indirect effects could also occur through modification of 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 open 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 agricultural 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 propanil, 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.

Tier 2 phytotoxicity tests (MRID's 43069901 and 47144702) were used to measure the response of terrestrial plants to propanil, relative to a control, and five or more test concentrations. For dicot plants, the most sensitive endpoint for the seedling emergence study was an EC_{25} value of 0.53 lb ai/A and a NOAEC value of 0.11 lb ai/A reported for lettuce (*Lactuca sativa*), based on shoot length (MRID 43069901). For monocot plants, the most sensitive endpoint for the seedling emergence study was an EC_{25} value of 1.4 lb ai/A and a NOAEC value of 0.61 lb ai/A reported for the onion (*Allium cepa*), based on shoot length (MRID 43069901). For dicot plants, the most sensitive endpoint for the vegetative vigor study was an EC_{25} value of 0.09 lb ai/A and a NOAEC value of 0.03 lb ai/A for cabbage (*Brassica oleracea*) based on fresh weight (MRID 47144702). For monocot plants, the most sensitive endpoint for the vegetative vigor study was an EC_{25} value of 0.13 lb ai/A and a NOAEC value of 0.03 lb ai/A for the onion (*Allium cepa*) based on fresh weight (MRID 47144702). The most sensitive results of the Tier II seedling emergence and vegetative vigor toxicity tests on non-target plants are summarized below in Table 4-6**.**

Table 4-6 Terrestrial Plant Toxicity Profile for Propanil

Endpoint	Species	Toxicity Value Used in Risk Assessment	Citation MRID#	Study Classification
Indirect Toxicity to Terrestrial- and Aquatic-Phase CRLF (via toxicity to terrestrial plants)	Dicot Seedling Emergence Lettuce (*Lactuca sativa*)	EC_{25} = 0.53 lb ai/A NOAEC = 0.11 lb ai/A	43069901	Acceptable
	Dicot Vegetative Vigor cabbage (*Brassica oleracea*)	EC_{25} = 0.09 lb ai/A NOAEC = 0.03 lb ai/A	47144702	Acceptable

Endpoint	Species	Toxicity Value Used in Risk Assessment	Citation MRID#	Study Classification
	Monocot Seedling Emergence Onion (*Allium cepa*)	EC_{25} = 1.4 lb ai/A NOAEC = 0.61 lb ai/A	43069901	Acceptable
	Monocot Vegetative Vigor Onion (*Allium cepa*)	EC_{25} = 0.13 lb ai/A NOAEC = 0.03 lb ai/A	47144702	Acceptable

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). As part of the risk characterization, an interpretation of acute RQ values for listed species is discussed. This interpretation is presented in terms of the chance of an individual event (i.e., mortality or immobilization) should exposure at the EEC actually occur for a species with sensitivity to propanil on par with the acute toxicity endpoint selected for RQ calculation. To accomplish this interpretation, the Agency uses the slope of the dose-response relationship available from the acute toxicity study used to establish the measures of effect for each taxonomic group that is relevant to this assessment. The individual effects probability associated with the acute RQ is based on the mean estimate of the slope and an assumption of a probit dose-response relationship. In addition to a single effects probability estimate based on the mean, upper and lower estimates of the effects probability are also provided to account for variance in the slope, if available.

Individual effect probabilities are calculated based on an Excel spreadsheet tool IECV1.1 (Individual Effect Chance Model Version 1.1) developed by the U.S. EPA, OPP, Environmental Fate and Effects Division (June 22, 2004). The model allows for such calculations by entering the mean slope estimate (and the 95% confidence bounds of that estimate) as the slope parameter for the spreadsheet. In addition, the acute RQ is entered as the desired threshold.

4.4 Incident Database Review

A review of the Ecological Incident Information System database for incidents involving propanil was completed on April 4, 2009. Three incidents involving propanil have been reported; these were all a result of registered uses of propanil to rice. Two of these incidents damaged the rice crop. One incident reported 80 acres of 160 acres of rice injured from the application of propanil (I015748-035), and the second incident reported 70 out of 405 acres of rice were injured (i.e., tillers erupting from the stalk, I016962-043). Both of these incidents were classified as possibly resulting from the use of propanil on the rice. The third incident occurred after the aerial application of propanil to 150 acres of rice, adjacent to an area of trees, which resulted in a lack of leaf growth on the trees (I000543-001). This incident classified propanil as probably responsible for the damage sustained to the trees. A detailed description of incidents relating to propanil use is presented in Appendix K.

The absence of additional documented incidents does not necessarily mean that other incidents did not occur. Mortality incidents must be seen, reported, investigated, and submitted to the Agency in order to be recorded in the incident database. Incidents may not be noticed because the carcasses decayed, were removed by scavengers, or were in out-of-the-way or hard-to-see locations. Due to the voluntary nature of incident reporting, an incident may not be reported to appropriate authorities capable of investigating it.

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 propanil in California. 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 potential 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 peak EECs. The acute exposure in the water paddy for the parent compound alone was found to be 5323 ppb. The acute exposure in the release water was found to be 479 ppb for the propanil alone and 3033 ppb for the degradate 3,4-DCA. These were based on the maximum label-recommended propanil use on rice summarized in Table 3-2 and the appropriate aquatic toxicity endpoint from Table 4-1. Risks to the terrestrial-phase CRLF and its prey (*e.g*. terrestrial insects, small mammals and terrestrial-phase frogs) are estimated based on exposures from applications of propanil resulting in residues on prey/forage (Tables 3.5 through 3.6) and the appropriate toxicity endpoint from Table 4-6. Exposures are also derived for terrestrial plants, as discussed in Section 3.4 and summarized in Table 3-7, based on the highest application rate of propanil use on rice within the action area.

Observed concentrations from monitoring data (peak of 20 ppb for propanil at Colusa Basin drain #5 in 2001. Section 3.2.4) are much lower than calculated for day-7 rice paddy water (479 ppb for propanil alone, 3033 for the degradate 3,4-DCA alone, 4742 ppb as the combined propanil and 3,4-DCA residues). This may be due to longer holding times, and further degradation and dilution in the receiving waters. However, the frequent detection of 3,4-DCA is evidence that receiving waters contain discharges of propanil-treated rice paddy water indicating that risk to aquatic organisms could still exist.

The average concentration, chronic exposure outside of the rice paddy, seen in 1998 and 2001 (the two years where monitoring data was taken at the Colusa Basin Drain #5) were 2.09 ppb and 3.07 ppb respectively.

5.1.1 Exposures in the Aquatic Habitat

5.1.1.1 Direct Effects to Aquatic-Phase CRLF

Direct acute effects to the aquatic-phase CRLF are based on peak EECs in the rice paddy, (propanil day 0, 5323 ppb), and in the release water (propanil, day 7, 479 ppb) as well as the degradate 3,4-DCA in the paddy and in the release water (day 7, 3033 ppb) and the lowest acute toxicity value for freshwater fish. In order to assess direct chronic risks to the CRLF, 7-day EECs and the lowest chronic toxicity value for freshwater fish are used. Usually, 60-day EECs are used for evaluating chronic risk to fish, however in this case the paddy water holding time is only 7 days, so that is the averaging time of the highest chronic exposure for total residues (4742 ppb).

The RQs for direct application of propanil to the rice paddy results in exceedances of the Agency's acute risk LOCs for freshwater fish which are surrogates for the aquatic-phase CRLF. The aquatic-phase amphibian acute risk LOC for listed species (0.05) is exceeded by the acute RQ of 2.31 based on the concentration in the paddy water, the acute RQ is 0.21 for the parent compound based on the concentration in the release water and 1.32 for the degradate 3,4-DCA based on the concentration in the release water. A probit slope value for the rainbow trout acute toxicity test is not available; therefore, the individual effect probability was estimated based on a default slope assumption of 4.5 with upper and lower 95% confidence intervals of 2 and 9 (Urban and Cook, 1986). The estimated probability of an individual effect from propanil use based on a default slope of 4.5 and an acute RQ of 0.21 is approximately 1 in 874 (95% CI 1 in 11.4 to 1 in $1.89* 10^{9}$ for the parent propanil compound in the paddy water). For the degradate 3,4-DCA the estimated probability of an individual effect from propanil use based on a default slope of 4.5 and an acute RQ of 1.32 is approximately one in 1.42 (95% CI 1 in 1.16 to 1 in 1.68). The estimated probability of individual effect is approximately 95% for the parent propanil concentration in the paddy water, 0.11% for the parent propanil concentration in the release water, and 70% for the degradate 3,4-DCA based on the concentration in the release water.

The RQs for direct application of propanil to the rice paddy results in exceedances of the Agency's chronic risk LOCs for freshwater fish which are surrogates for the aquatic-phase CRLF. The chronic RQ of 521 exceeds the Agency's chronic risk LOC (1.0). Results are presented in Table 5-1. **Based on both acute and chronic risk LOC exceedances, the probability of individual effect propanil May Directly Affect the CRLF.**

Table 5-1 Summary of Direct Effect RQs for the Aquatic-phase CRLF in the Paddy from Use of Propanil in the Paddy and Subsequent Release Water

Use	Direct Effects to CRLF[a]	Surrogate Species	Toxicity Value (µg/L)	EEC Peak/60d (µg/L)	RQ	Probability of Individual Effect*	LOC Exceedance and Risk Interpretation
Rice	Acute Direct Toxicity	Rainbow Trout	LC_{50} = 2300	5323 (parent)	**2.31**	95% 1 in 1.05 (1 in 1.3 to 1 in 1)	**Yes**[c]
				479 (parent, release water)	**0.21**	0.11% 1 in 874 (1 in 11.4 to 1 in $1.89 * 10^9$)	
				3033 (3,4-DCA)	**1.32**	70% 1 in 1.42 (1 in 1. 68 to 1 in 1.16)	
	Chronic Direct Toxicity	Fathead Minnow	NOAEC = 9.1	4742	**521**	*Not applicable for chronic endpoints*	**Yes**[d]

[a] RQs associated with acute and chronic direct toxicity to the CRLF are also used to assess potential indirect effects to the CRLF based on a reduction in freshwater fish and frogs as food items.
[b] A probit slope value for the acute rainbow trout toxicity test is not available; therefore, the effect probability was calculated based on a default slope assumption of 4.5 with upper and lower 95% confidence intervals of 2 and 9 (Urban and Cook, 1986).
[c] Acute risk to endangered species LOC of 0.05. (Acute RQ = use-specific peak EEC/ [rainbow trout 96-h LC_{50} = 2300 ppb ai])
[d] Chronic risk LOC of 1.0. (Chronic RQ = use-specific 7-d EEC/ [fathead minnow NOAEC = 9.1 ppb ai])

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

Non-vascular Aquatic Plants

Indirect effects of propanil to the aquatic-phase CRLF (tadpoles) via reduction in non-vascular aquatic plants in its diet are based on peak EECs, i.e., 5323 ppb for the propanil parent in the paddy water, 479 ppb for the propanil parent in the release water, and 3033 ppb for its 3,4-DCA degradate in the release water, from the rice model and the lowest acute toxicity value for aquatic non-vascular plants (green algae EC_{50} = 29 ppb). The Agency's risk to non-vascular aquatic plants LOC (1.0) are exceeded for the parent propanil concentration in the paddy and release water, and the degradate concentration in the release water with RQs of 184, 16.5 and 105, respectively. Results are presented in Table 5-2. **Based on this exceedance and** the buffer zone of 33 feet in which concentrations exceed the levels of concern on non-target aquatic plants**, propanil May Indirectly Affect the CRLF via reduction of non-vascular plants as food items.**

Table 5-2 Summary of Acute RQs Used to Estimate Indirect Effects to the CRLF via Effects to Non-Vascular Aquatic Plants from Use of Propanil in the Paddy and Subsequent Release Water (diet of CRLF in tadpole life stage and habitat of aquatic-phase CRLF)*

Use	Indirect Effects to CRLF	Test Species	Toxicity Value (µg/L)	EEC Peak/60d (µg/L)	RQ
Rice	Indirect Toxicity (diet and habitat)	Green Algae *Pseudokirchneriella subcapitata*	EC_{50} = 29.0	5323 (parent)	**184**
				479 (parent, release water)	**16.5**
				3033 (3,4-DCA)	**105**

* Risk to aquatic plant LOC exceedances (RQ > 1.0) are bolded and shaded. RQ = use-specific peak EEC/ [*Pseudokirchneriella subcapitata* EC_{50} = 29.0 ppb].

Aquatic Invertebrates

Indirect acute effects to the aquatic-phase CRLF via effects to prey (invertebrates) in aquatic habitats are based on peak EECs in the rice model and the lowest acute toxicity value for freshwater invertebrates (*Daphnia magna* 48-h EC_{50} = 528 ppb (propanil) and 47 ppb (3,4-DCA expressed as propanil). For chronic risks, the 7-day EEC for total residues (4742 ppb) and the lowest chronic toxicity value for invertebrates (*Daphnia magna* NOAEC = 86 ppb (propanil) and 13 ppb (3,4-DCA expressed as propanil)) are used to derive RQs. Usually, 21-day EECs are used for invertebrates, however in this case the paddy water holding time is only 7 days (very conservative), so that is the averaging time of the highest chronic exposure. The Agency's acute risk to listed species LOC (0.05) is exceeded. For the propanil registrant submitted data, the acute RQ is 10.1 for the parent compound based on the concentration in the paddy water, the acute RQ is 10.2 for the parent compound based on the concentration in the release water and 5.7 for the degradate 3,4-DCA based on the concentration in the release water. For the ECOTOX degradate data (3,4-DCA), the acute RQ is 113.2 for the parent compound based on the concentration in the paddy water, the acute RQ is 0.91 for the parent compound based on the concentration in the release water, and 64.5 for the degradate 3,4-DCA based on the concentration in the release water. The RQ for chronic exposures also exceeds the Agency's LOC (1.0). For the propanil registrant submitted data, the chronic RQ for *Daphnia magna* is 55, and for the ECOTOX degradate (3,4-DCA) data the chronic RQ is 364.8 based on the total residue of the parent and degradate compounds.

The estimated probability of an individual effect for propanil use on rice based on the parent compound concentration in the paddy water, a default slope of 4.5, and an acute RQ of 10.1 is approximately 1 in 1 (95% CI 1 in 1 to 1 in 1.02 for the parent propanil). The estimated probability of an individual effect for propanil use on rice based on the parent compound concentration in the release water, a default slope of 4.5, and an acute RQ of 0.91 is approximately 1 in 2.34 (95% CI 1 in 2.14 to 1 in 2.81 for the parent propanil). For the degradate 3,4-DCA the estimated probability of an individual effect from propanil use based on the parent compound, a default slope of 4.5, and an acute RQ of 5.7 is approximately 1 in 1 (95% CI 1 in 1 to 1 in 1.07 for the degradate 3,4-DCA concentration in the release water). The effect probability is 100% for the parent propanil concentration in the paddy and release water and 100% degradate 3,4-DCA based on the concentration in the release water.

The estimated probability of an individual effect for propanil use on rice based on the degradate (3,4-DCA), a default slope of 4.5, and an acute RQ of 113.2 is approximately 1 in 1 (95% CI 1 in 1 to 1 in 1 for the parent propanil concentration in the paddy water). The estimated probability of an individual effect for propanil use on rice based on the parent compound concentration in the release water, a default slope of 4.5, and an acute RQ of 10.2is approximately 95% CI 1 in 1 to 1 in 1.02 for the parent propanil). For the degradate 3,4-DCA the estimated probability of an individual effect from propanil use based on the degradate (3,4-DCA concentration in the paddy water), a default slope of 4.5, and an acute RQ of 64.5 is approximately 1 in 1 (95% CI 1 in 1 to 1 in 1). The effect probability is 100% for the parent propanil concentration in the paddy water, 42.7% for the parent propanil concentration in the release water, and 100% for the degradate 3,4-DCA based on the concentration in the release water.

A summary of the acute and chronic RQ values for exposure to aquatic invertebrates (as prey items of aquatic-phase CRLFs) is provided in Table 5-3. **Based on acute risk to listed species LOC exceedances for aquatic invertebrates and the probability of effect, propanil May Affect the CRLF indirectly via reduction in freshwater invertebrate prey items.**

Table 5-3 Summary of Acute and Chronic RQs Used to Estimate Indirect Effects to the CRLF via Direct Effects on Aquatic Invertebrates as Dietary Food Items (prey of CRLF juveniles and adults in aquatic habitats)* from Use of Propanil in the Paddy and Subsequent Release Water

Use	Indirect Effects to CRLF	Test Species	Toxicity Value (µg/L) (expressed as propanil)	EEC Peak/60d (µg/L)	RQ	Probability of % Effect*	LOC Exceedance and Risk Interpretation**
Rice	Acute Indirect Toxicity	Water flea (*Daphnia magna*) [3,4-DCA expressed as propanil]	EC_{50} = 47	5323 (parent)	**113.2**	100% 1 in 1 (1 in 1 to 1 in 1)	**Yes**[a]
				479 (parent, release water)	**10.2**	100% 1 in 1 (1 in 1.02 to 1 in 1)	
				3033 (3,4-DCA)	**64.5**	100% 1 in 1 (1 in 1 to 1 in 1)	

	Acute Indirect Toxicity	Water flea (*Daphnia magna*)	EC_{50} = 528	5323 (parent) 479 (parent, release water) 3033 (3,4-DCA)	**10.1** **0.91** **5.7**	100% 1 in 1 (1 in 1.02 to 1 in 1) 42.7% 1 in 2.34 (1 in 2.14 to 1 in 2.81) 100% 1 in 1 (1 in 1.07 to 1 in 1)	**Yes**[a]
	Chronic Indirect Toxicity	Water flea (*Daphnia magna*) [3,4-DCA expressed as propanil]	NOAEC = 10	4742 (total residue)	**364.8**	*Not applicable for chronic endpoints*	**Yes**[b]
	Chronic Indirect Toxicity	Water flea (*Daphnia magna*)	NOAEC = 86	4742 (total residue)	**55**	*Not applicable for chronic endpoints*	**Yes**[b]

* A probit slope value for the acute (*Daphnia magna*) toxicity test is not available; therefore, the effect probability was calculated based on a default slope assumption of 4.5 with upper and lower 95% confidence intervals of 2 and 9 (Urban and Cook, 1986).
** LOC exceedances (acute RQ > 0.05, chronic RQ > 1.0) are bolded and shaded.
[a] Acute risk to endangered species LOC of 0.05. (Acute RQ = use-specific peak EEC/ [Water Flea (*Daphnia magna*) 48h EC_{50} = 528 ppb ai (propanil) and 47 ppb ai (3,4-DCA expressed as propanil)])
[b] Chronic risk LOC of 1.0. (Chronic RQ = use-specific 7-d EEC/ [Water Flea (*Daphnia magna*) 28-d NOAEC = 86 ppb ai (propanil) and 13 ppb ai (3,4-DCA expressed as propanil)])

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 (Table 5-1) are used to assess potential indirect effects to the CRLF based on a reduction in freshwater fish and frogs as food items. The estimated probability of individual effect is approximately 95% for the parent propanil concentration in the paddy water, 0.11% for the parent propanil concentration in the release water, and 70% for the degradate 3,4-DCA concentration in the release water. **Based on both acute and chronic risk LOC exceedances described in Section 5.1.1.1, the probability of individual effect, propanil May Affect the CRLF indirectly via reduction in freshwater fish and frogs as food items.**

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

Indirect effects to the CRLF via direct toxicity to aquatic plants are estimated using the most sensitive non-vascular and vascular plant toxicity endpoints. The RQ for vascular aquatic plants exceeds the Agency's risk to aquatic plants LOC (1.0) for the parent propanil concentration in the paddy and release water, and the degradate concentration in the release water with RQs of 48, 4.35 and 28, respectively. A summary of the acute RQ used to estimate indirect effects to the CRLF via effects to vascular aquatic plants is presented in Table 5-4. **Because of the risk to vascular aquatic plants LOC exceedance, it is determined that propanil May Affect the CRLF indirectly via reduction in vascular aquatic plants.**

Table 5-4 Summary of Acute RQs Used to Estimate Indirect Effects to the CRLF via Effects to Vascular Aquatic Plants (habitat of aquatic-phase CRLF)[a] from Use of Propanil in the Paddy and Subsequent Release Water

Use	Indirect Effects to CRLF	Test Species	Toxicity Value (µg/L)	EEC Peak/60d (µg/L)	RQ
Rice	Indirect Toxicity (habitat)	Duckweed *Lemna gibba*	EC_{50} = 110	5323 (parent)	**48**
				479 (parent, release water)	**4.35**
				3033 (3,4-DCA)	**28**

[a] Risk to aquatic vascular plant LOC exceedances (RQ > 1) are bolded and shaded.
RQ = use-specific peak EEC/ [*Lemna gibba* EC_{50} = 110 ppb].

5.1.2 Exposures in the Terrestrial Habitat

5.1.2.1 Direct Effects to Terrestrial-phase CRLF

As discussed in Section 3.3, potential direct effect determinations to terrestrial-phase CRLFs are based on ground and aerial foliar applications of propanil. 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 and acute oral and subacute dietary toxicity endpoints for avian species. The Bobwhite quail exhibited the greatest acute sensitivity to propanil and was therefore selected to serve as a surrogate for the CRLF. This is a conservative estimate for risk for the terrestrial-phase CRLF.

Resulting acute dietary and dose-based RQs for propanil exceed the Agency's acute endangered species LOC of 0.1 for the CRLF (Table 5-5). The probability of individual effect at the endangered species LOC (0.1) is 1 in 14.3 (95% CI: 1 in 3.91 to 1 in 632) for the dietary-based acute RQ, and 1 in 1 (95% CI: 1 in 1.03 to 1 in 1) for the dose-based acute RQ. The effect probability was calculated based on a default slope assumption of 4.5 with upper and lower 95% confidence intervals of 2 and 9 (Urban and Cook, 1986). The dietary-based probability of individual effect for propanil use is 0.70%, and the dose-based probability of individual effect for propanil use is 100%.

Potential direct chronic effects of propanil 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. As mentioned previously, there are no chronic effects data available for propanil or the degradate 3,4-DCA for amphibians or their avian surrogates in open literature or in registrant-submitted studies. Therefore, RQs could not be calculated to determine chronic risk potential to terrestrial-phase amphibians via surrogate bird species for either the parent propanil or the degradate 3,4-DCA. However, there is supporting information indicating a historical parallel between avian and mammalian toxicity thus suggesting a potential for risk to birds associated with chronic exposure since there is a risk to terrestrial mammals from exposure to propanil (Section 5.1.2.2.2). There is exposure to the terrestrial-phase CRLF; however, due to the lack of chronic effects data we cannot preclude risk to the terrestrial-phase CRLF.

The acute dietary and dose-based RQs exceed the acute risk LOC. These results are summarized in Table 5-5. **Based on acute oral and subacute dietary risk LOC exceedances for birds serving as surrogates for terrestrial-phase amphibians, and the probability of individual effect, and the lack of chronic data for amphibians or their avian surrogates by which to determine chronic direct risks to the CRLF, propanil May Affect the terrestrial-phase of the CRLF.**

Table 5-5 Summary of Acute RQs Used to Estimate Direct Effects to the Terrestrial-phase CRLF*

Use (Application Rate)	Dietary-based Acute RQ[2]	Dose -based Acute RQ[3]	Dietary-based Acute Probability of Individual Effect at RQ[a]	Dose-based Acute Probability of Individual Effect at RQ[a]
Rice (8 lbs ai/A)	**0.47**	**8.5**	0.70% 1 in 14.3 (95% CI: 1 in 3.91 to 1 in 632)	100% 1 in 1 (95% CI: 1 in 1.03 to 1 in 1)

* LOC exceedances (acute RQ $\geq$ 0.1) are bolded and shaded.
[2]Based on Bobwhite quail LC_{50} =2311 ppm
[3]Based on Bobwhite quail LD_{50} =201 ppm
[a] A probit slope value for the acute avian toxicity test is not available; therefore, the effect probability was calculated based on a default slope assumption of 4.5 with upper and lower 95% confidence intervals of 2 and 9 (Urban and Cook, 1986).

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

5.1.2.2.1 Terrestrial Invertebrates

In order to assess the risks of propanil to terrestrial invertebrates, which are considered prey of CRLF in terrestrial habitats, the honeybee is used. The toxicity value for terrestrial invertebrates is calculated by multiplying the lowest available acute contact LD_{50} of >24.17 µg a.i./bee by 1 bee/0.128g, which is based on the average weight of an adult honey bee. The toxicity value is thus calculated to be >189 µg/g (ppm). From review of the study it was not clear if mortality occurred in any of the treatment groups. The test was not definitive and RQs were not calculated. There were no additional acceptable terrestrial invertebrate data from registrant submitted studies or from the open literature by which to calculate RQ values. This is a conservative estimate for risk for the terrestrial-phase CRLF. **However, because the calculated terrestrial small insect**

EEC's exceed the highest levels tested, it is determined that propanil May Affect the CRLF indirectly via reduction in terrestrial invertebrate prey items.

5.1.2.2.2 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. Terrestrial-phase CRLF prey could be exposed to propanil via spray drift, off the field during aerial application of propanil.

Acute and chronic dose-based RQs exceed the Agency's acute and chronic LOCs (0.1 acute, 1.0 chronic). The probability of effect at the endangered species LOC (0.1) is 1 in 3.28 (95%CI: 1 in 2.44 to 1 in 6.52), with a probability effect of 30%. The effect probability was calculated based on a default slope assumption of 4.5 with upper and lower 95% confidence intervals of 2 and 9 (Urban and Cook, 1986). The dietary based RQs do not exceed the LOC (Table 5-6). However, it should be noted that dietary-based RQ values do not take into account that different-sized animals consume differing amounts and varieties of food. This means that an animal might have to consume varying amounts of exposed food items due to varying nutrition levels. The dose-based value controls for this uncertainty. This is a conservative estimate for risk for the terrestrial-phase CRLF. **Based on acute and chronic LOC exceedances on small mammal prey items, and the probability of effect, propanil May Affect the CRLF indirectly via reduction in small mammal prey items.**

Table 5-6 Summary of Acute and Chronic RQs* Used to Estimate Indirect Effects to the Terrestrial-phase CRLF via Direct Effects on Small Mammals as Dietary Food Items*

Use (Application rate)	Chronic RQ[1]		Acute RQ[2]	Probability of % Effect at Acute RQ[a]
	Dose-based Chronic RQ	Dietary-based Chronic RQ	Dose-based Acute RQ	
Rice (8 lbs ai/A)	**5.55**	0.64	**0.77**	30% 1 in 3.28 (95% CI: 1 in 2.44 to 1 in 6.52)

* = Risk LOC exceedances (acute RQ $\geq$ 0.1 and chronic RQ $\geq$ 1) are bolded and shaded.
[1] Based on dose-based EEC and propanil rat NOAEC = 150.00 mg/kg-bw.
[2] Based on dose-based EEC and propanil rat acute oral LD_{50} = 1080.00 mg/kg-bw.
[a] A probit slope value for the acute avian toxicity test is not available; therefore, the effect probability was calculated based on a default slope assumption of 4.5 with upper and lower 95% confidence intervals of 2 and 9 (Urban and Cook, 1986).

5.1.2.2.3 Frogs

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 for results. The acute dietary and dose-based RQs exceed the acute risk LOC. This is a conservative estimate for risk for the terrestrial-phase CRLF. These results are summarized in Table 5-5. **Based on the acute dietary- and dose-based LOC exceedances, and the lack of chronic data for amphibians or their avian surrogates by which to determine chronic direct risks to the CRLF, propanil May Affect the CRLF indirectly via reduction of 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 assessed using RQs from terrestrial plant seedling emergence and vegetative vigor EC_{25} data as a screen. Propanil is an amide herbicide which inhibits photosynthesis in a variety of broadleaf and grass plants. The main route of terrestrial exposure for terrestrial plants is spray drift via aerial application of propanil on rice. AgDRIFT was used to estimate the distance that spray applications can drift from the treated area and still be present in concentrations that exceed the levels of concern. See section 3.4.1 for the spray drift buffer analysis.

Based on a buffer zone of 584 feet for terrestrial habitats and 33 feet for aquatic habitats , distances that fall within these buffer zones will have concentrations that exceed the levels of concern, and propanil May Affect the terrestrial phase CRLF indirectly via effects to riparian and upland habitat.

5.1.3 Primary Constituent Elements of 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 vascular and non-vascular aquatic and terrestrial plants provided in Sections 5.1.1.2, 5.1.1.3, and 5.1.2.3,

propanil may result in Habitat Modification of aquatic-phase PCEs of designated habitat related to effects on aquatic and/or terrestrial plants.

- Aquatic non-vascular plants used as food source and habitat for CRLF may be potentially affected from all propanil uses.
- Reduction of aquatic based food sources may occur from most use sites.
- Due to aquatic vascular and terrestrial plant communities being reduced from most use sites, there is potential for alteration of channel/pond morphology or geometry and/or increase in sediment deposition within the stream channel or pond.
- Due to aquatic vascular and terrestrial plant communities being reduced from most use sites, there is potential for 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.

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 propanil on this PCE, acute and chronic freshwater fish and invertebrate toxicity endpoints, as well endpoints for aquatic non-vascular plants are used as measures of effects. RQs for these endpoints were calculated in Sections 5.1.1.1 and 5.1.1.2. **Based on acute and chronic LOC exceedances for freshwater fish and aquatic invertebrates, propanil may result in Habitat Modification of aquatic-phase PCEs 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 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
- 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 propanil 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. **Based on acute and chronic LOC exceedances for CRLF prey items of small mammals and other frogs, and because the calculated small insect EECs are greater than the highest levels tested in the terrestrial invertebrate study, propanil may result in Habitat Modification of the first three terrestrial-phase PCEs.**

The fourth terrestrial-phase PC 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. **Due to LOC exceedances for aquatic, terrestrial and semi-aquatic plants, which modify the water chemistry to conditions for which the CRLF is adapted, propanil may result in Habitat Modification of the fourth terrestrial phase PCE.**

5.1.4 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 propanil's use pattern is identified, using land cover data that correspond to propanil's use pattern. The spatial extent of the effects determination also includes areas beyond the initial area of concern that may be impacted by spray drift. The identified direct/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 a **584 feet** from its boundary. It is assumed that non-flowing water bodies (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 **285 kilometers** which represents the maximum continuous distance of downstream dilution from the edge of the initial area of concern. This is a very conservative estimate based on all agricultural usage and not just rice.

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 propanil sufficient to result in LAA determination and modification of critical habitat.

The determination of the buffer distance is described in Section 3.4.1 and the downstream dilution for spatial extent of the effects determination is described below.

5.1.4.1 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 was calculated. To complete this assessment, the greatest ratio of aquatic RQ to LOC was estimated. Using an assumption of uniform runoff (in the form of the paddy release water) 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 and that the influx of non-impacted water will dilute the concentrations of propanil present.

The result of this analysis is that waters as far as **285 kilometers** downstream could potentially be above levels that would exceed the most sensitive LOC and as such could be subject to an LAA determination (see Appendix D). It is important to note that the downstream dilution estimates are extremely conservative since the source being used to determine the downstream dilution assumes total agriculture acreage and not just the acreage for rice alone as the input into the downstream dilution model. Based on a crop profile for rice in California prepared in October 1998 by NSF Center for Integrated Pest Management, 30-40% of the reported 465,000 acres in California containing rice used propanil. Likewise, since propanil is only used on rice in a limited number of counties in California (12 in 1994-8, and 16 in 1999-2006), the downstream dilution analysis is very conservative because rice is represented as all agricultural uses and not just rice alone.

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 propanil's use within the action area. However, if direct or indirect effects LOCs are exceeded, or if 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 propanil. **Based on direct and indirect risk LOC exceedances for CRLF, the Agency concludes a preliminary May Affect determination for the CRLF and critical habitat.** This is a conservative estimate for risk for the terrestrial-phase CRLF. A summary of the results of the risk estimation is provided in Table 5-7 for direct and indirect effects to the CRLF and in Table 5-8 for the PCEs of designated critical habitat for the CRLF.

Table 5-7 Risk Estimation Summary for Propanil - 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	The aquatic-phase amphibian acute risk LOCs for listed species (0.05) are exceeded for the use of propanil on rice in California. The acute RQ is 2.3 for the parent propanil and 1.3 for degradate 3,4-DCA. The aquatic-phase amphibian chronic risk LOC is also exceeded; the chronic RQ is 521.
Indirect Effects Survival, growth, and reproduction of CRLF individuals via effects to food supply (*i.e.*, freshwater invertebrates, non-vascular plants)	YES	LOC for risks to non-vascular aquatic plants (1.0) is exceeded. The RQs is 184 for the parent propanil, and 105 for the degradate 3,4-DCA. Aquatic invertebrate's acute risk LOC (0.05) is exceeded. For the registrant submitted propanil data, the acute RQ is 10.1 for the parent propanil and 5.7 for the degradate 3,4-DCA. For the degradate (3,4-DCA) ECOTOX data, the acute RQ is 113.2 for the parent propanil and 64.5 for the degradate 3,4-DCA (both expressed as the parent propanil). The aquatic invertebrate chronic risk LOC (1.0) is also exceeded at 55 (propanil), and 364.8 (3,4-DCA expressed as propanil).
Indirect Effects Survival, growth, and reproduction of CRLF individuals via effects on habitat, cover, and/or primary productivity (*i.e.*, aquatic plant community)	YES	LOC for risk to vascular aquatic plants (1.0) is exceeded. The RQ is 48 for the parent propanil, and 28 for the degradate 3,4-DCA. Spray drift via aerial application of propanil on rice affects aquatic plants within 33 feet of the paddy being treated.
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.	YES	The main route of terrestrial exposure for terrestrial plants is spray drift via aerial application of propanil on rice. Based on a buffer zone of 584 feet in which concentrations exceed the levels of concern on the non-target terrestrial plants,
Terrestrial-Phase *(Juveniles and adults)*		
Direct Effects Survival, growth, and reproduction of CRLF individuals via direct effects on terrestrial phase adults and juveniles	YES	The sub-acute dietary based RQ exceeds the acute risk LOC (0.1) at 0.47. The acute dose based RQ exceeds the acute risk LOC (0.1) at 8.5.
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	For terrestrial invertebrates, the calculated small insect EEC (1080 ppm) exceeds the terrestrial invertebrate toxicity estimate (188 ppm) and risk is assumed for these species in the absence of definitive data. For small terrestrial mammals, the acute dietary-based RQ exceeds the acute risk LOC (0.1) at 5.6. The acute dose-based RQ exceeds the acute risk LOC (0.1) at 0.77. For terrestrial-phase amphibians, the acute dietary-based RQ exceeds the acute risk LOC (0.1) at 0.47. The acute dose-based RQ exceeds the acute risk LOC (0.1) at 8.5.
Indirect Effects Survival, growth, and reproduction of CRLF individuals via effects on habitat (*i.e.*, riparian vegetation)	YES	The main route of terrestrial exposure for terrestrial plants is spray drift via aerial application of propanil on rice. Based on a buffer zone of 584 feet in which concentrations exceed the levels of concern on the non-target terrestrial plants,

Table 5-8 Risk Estimation Summary for Propanil – PCEs of Designated Critical Habitat for the CRLF

Assessment Endpoint	LOC Exceedances (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	LOCs are exceeded for terrestrial riparian plants and for aquatic vascular plants from exposure to propanil from paddy release water or spray drift.
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	LOCs are exceeded for terrestrial riparian plants and for aquatic plants from exposure to propanil from paddy release water or spray drift (within 33 feet of the treated paddy). Alteration of riparian and vascular aquatic plants may result in alteration of temperature, turbidity, and oxygen content.
Alteration of other chemical characteristics necessary for normal growth and viability of CRLFs and their food source.	YES	LOC is exceeded for indirect effects on terrestrial and aquatic-phase CRLF from propanil applications.
Reduction and/or modification of aquatic-based food sources for pre-metamorphs (e.g., algae)	YES	LOCs for non-vascular aquatic plants, fish and invertebrates are exceeded.
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	The AgDRIFT model was used to evaluate potential distances beyond which exposures would be expected to be below LOC. The buffer needed for exposures to be below the LOC is approximately 584 ft. for aerial applications and 213 ft. for ground applications based on monocot plants.
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	YES	Effects are expected to non-target terrestrial plants up to 584 ft from use site from aerial application of propanil.
Reduction and/or modification of food sources for terrestrial phase juveniles and adults	YES	LOC is exceeded for indirect effects on terrestrial-phase CRLF and its food sources from propanil application to rice
Alteration of chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs and their food source.	YES	LOC is exceeded for direct effects on aquatic-phase CRLF and its food sources from propanil applications to rice.

Following a preliminary “may affect” or “habitat modification” 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 paddy release water and spray drift containing propanil.

Propanil is considered "moderately toxic" to freshwater fish, which are surrogates for the aquatic-phase CRLF. The aquatic animal acute LOCs for listed species (0.05) are exceeded for use of propanil on rice in California. Exceedances occur with both the parent compound as well as the degradate. The aquatic-phase amphibian chronic RQs also exceed the chronic risk LOC (1.0) for the use of propanil on rice in California.

Although there are no reported incidents involving propanil impacts to aquatic animal species, it is important to note that the absence of documented incidents does not necessarily mean that such incidents did not occur. Mortality incidents must be seen, reported, investigated, and submitted to the Agency in order to be recorded in the incident database. Incidents may not be noticed because the carcasses decayed, were removed by scavengers, or were in out-of-the-way or hard-to-see locations. Due to the voluntary nature of incident reporting, an incident may not be reported to appropriate authorities capable of investigating it.

Review of the ECOTOX database did not find any scientifically valid studies that examined the effects of propanil or its degradate 3,4-DCA on freshwater fish or amphibians. Therefore, RQs were calculated using the registrant-submitted data, which exceed the acute risk to listed species LOC (0.05), and the chronic risk LOC (1.0). The estimated probability of an individual effect from propanil use is approximately 95% for the parent propanil compound, and 70% for the degradate 3,4-DCA.

Based on both acute and chronic LOC exceedances to the aquatic-phase CRLF, estimated probability of individual effects, the Agency concludes that there is a potential for direct effects to the CRLF. A "May Affect and Likely to Adversely Affect (LAA)" determination is made for propanil use in California.

5.2.1.2 Terrestrial-Phase CRLF

The RQs representing acute dietary-based exposures exceed the Agency's acute LOC for the use of propanil on rice (Section 5.1.2.1.). 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. Based on these exceedances to the terrestrial-phase CRLF, a "May Affect" determination was made.

The T-HERPS model was therefore employed as a refinement tool to explore amphibian-specific food intake on potential exposures to the terrestrial-phase CRLF. The T-HERPS model incorporates the same inputs as T-REX with equations adjusted for poikilotherm food intake. The weight values of 1.4g and 37g in T-HERPS are bounding the exposure of indirect effects to the CRLF for amphibian prey (the pacific tree frog 2.3g). The EECs generated by T-HERPS are found in Table 5-9 and Table 5-10. An example output from T-HERPS is available in Appendix L.

Table 5-9 Upper-bound Kenega Nomogram Dietary Based T-HERPS EECs (mg/kg-diet) for Dietary-based Exposures of the CRLF and its Prey to Propanil[1].

Scenario	Small Insects	Large Insects	Small Herbivore Mammals	Small Insectivore Mammals	Small Terrestrial Phase Amphibians
Rice	1080	120	1831	114	37

[1]weights of small herbivore and insectivore mammals are 15g

Table 5-10 Upper-bound Kenega Nomogram Dose Based T-HERPS EECs (ppm) for Dose-based Exposures of the CRLF and its Prey to Propanil[1].

Scenario	Small Insects	Large Insects	Small Herbivore Mammals	Small Insectivore Mammals	Small Terrestrial Phase Amphibians
Rice[a] (1.4g CRLF)	42	4.7	--	--	--
Rice (37.0g CRLF)	41	4.6	742	46	1.4
Rice (238.0g CRLF)	27	3.0	115	7.2	0.94

[1]weights of small herbivore and insectivore mammals are 15g
[a] EECs for mammal and amphibian prey items are not calculated due to the fact that the 1.4g frog is too small to consume these items

Acute exposures

Refined acute dietary-based RQs for CRLFs consuming small insects and small herbivore mammals exceed the acute risk to listed species LOC (0.1). Refined acute dose-based RQs for CRLFs consuming small insects exceed the acute LOC for listed species across all size classes. Refined acute dose-based RQs for CRLFs consuming small herbivore mammals exceed the acute LOC to listed species for 37g and 238g frogs and the RQ for CRLFs consuming small insectivore mammals is exceeded for 37g frogs. Results are presented in Table 5-11 and Table 5-12.

Table 5-11 Refined Acute Dietary-based RQs for CRLF consuming different food items (RQs calculated using T-HERPS)*.

Scenario	Small Insects	Large Insects	Small Herbivore Mammals	Small Insectivore Mammals	Small Terrestrial Phase Amphibians
Rice	**0.47**	0.05	**0.79**	0.05	0.02

*RQs exceeding the Listed LOC (0.10) are bolded and shaded

Table 5-12 Refined Acute Dose-based RQs for the CRLF consuming different food items (RQs calculated using T-HERPS)*.

Scenario	Small Insects	Large Insects	Small Herbivore Mammals	Small Insectivore Mammals	Small Terrestrial Phase Amphibians
Rice[a] (1.4g CRLF)	**0.21**	0.02	--	--	--
Rice (37.0g CRLF)	**0.21**	0.02	**3.69**	**0.23**	0.01
Rice (238.0g CRLF)	**0.13**	0.01	**0.57**	0.04	<0.01

*RQs exceeding the Listed LOC (0.10) are bolded and shaded

[a]RQs for mammal and amphibian prey items are not calculated due to the fact that the 1.4g frog is too small to consume these items.					

Based on the refined dietary-based RQ's for a CRLF feeding on small insects or small herbivore mammals, and a probit dose-response default slope of 4.5, the estimated probability of individual effect ranges from approximately 7% to 32%. Based on the refined dose-based RQ's for a CRLF feeding on small insects, small insectivore mammals, or small herbivore mammals, and a probit dose-response default slope of 4.5 the estimated probability of an individual effect ranges from approximately 0.11% to 100%. Therefore, this is a conservative estimate for risk for the terrestrial-phase CRLF

Chronic exposure direct effects could not be calculated as there are no acceptable chronic toxicity data for propanil to amphibians or their avian surrogates. As mentioned previously, there are no chronic effects data available for propanil or the degradate 3,4-DCA for amphibians or their avian surrogates in open literature or in registrant-submitted studies. Therefore, RQs could not be calculated to determine chronic risk potential to terrestrial-phase amphibians via surrogate bird species for either the parent propanil or the degradate 3,4-DCA. However, there is supporting information indicating a historical parallel between avian and mammalian toxicity thus suggesting a potential for risk to birds associated with chronic exposure since there is a risk to terrestrial mammals from exposure to propanil (Section 5.1.2.2.2). There is exposure to the terrestrial-phase CRLF; however, due to the lack of chronic effects data we cannot preclude risk to the terrestrial-phase CRLF.

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However, based on the refined dietary and dose-based acute risk quotients and their exceedances of the Agency's acute risk LOC for terrestrial-phase CRLF, the estimated probability of individual effect, and the lack of chronic data for amphibians or their avian surrogates by which to determine chronic direct risks to the CRLF, a "May Affect and Likely to Adversely Affect (LAA)" determination is made for propanil use in California.

5.2.2 Indirect Effects (via Reductions in Prey Base)

5.2.2.1 Algae (non-vascular plants)

Indirect effects of propanil to the aquatic-phase CRLF (tadpoles) via reduction in non-vascular aquatic plants in its diet are based on EECs from the RICE model and the lowest acute toxicity value for aquatic non-vascular plants. The Agency's risk to aquatic plant LOC (1.0) is exceeded. Non-vascular aquatic plants are a primary food source for aquatic-phase CRLF. The application of propanil to rice in California is anticipated to be in early spring, March to May. The timing of the application would coincide with reproduction of CRLF in aquatic environments as well as for when the tadpoles would feed on non-vascular aquatic plants.

Based on multiple lines of evidence, (e.g. risk non-vascular plant LOC exceedances), the Agency concludes that there is a potential indirect impact to the aquatic-phase

of the CRLF from reduction of aquatic plant food items and therefore propanil is Likely to Adversely Affect (LAA) the CRLF.

5.2.2.2 Aquatic Invertebrates

As discussed in Section 2.5.3, the diet of CRLF also includes aquatic invertebrates. The potential for propanil 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.

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. The application of propanil to rice paddies in California is anticipated to be in Spring. The timing of the application would coincide with when juvenile aquatic- and terrestrial-phase CRLFs would be feeding on aquatic and terrestrial invertebrates.

Indirect acute effects to the aquatic-phase CRLF via effects to prey (invertebrates) in aquatic habitats are based on EECs from the RICE model and the lowest acute toxicity value for freshwater invertebrates. For chronic risks, 7-day EECs and the lowest chronic toxicity value for invertebrates are used to derive RQs. The Agency's acute risk to listed species LOC (0.05) and chronic risk LOC (1.0) are both exceeded for propanil use on rice in California for both registrant submitted parent (propanil) data and ECOTOX degradate (3,4-DCA) data. A summary of the acute and chronic RQ values for exposure to aquatic invertebrates (as prey items of aquatic-phase CRLFs) is provided in Table 5-3. Based on the acute listed species LOC exceedances for aquatic invertebrates' propanil May Affect the CRLF indirectly via reduction in freshwater invertebrate prey items.

A probit slope value for the acute *D. magna* toxicity test is not available; therefore, based on a probit dose-response default slope of 4.5, the estimated population reduction of this species (*Daphnia magna*) is estimated to be approximately 100% for the parent compound propanil and 93% for the degradate 3,4-DCA.

After a review of the ECOTOX database no scientifically valid open literature studies for the parent propanil were found examining the effects of propanil on aquatic invertebrates. There were however, studies that examined the effects of its degradate (3,4-DCA) on aquatic invertebrates. After a review of the studies, one acute and one chronic exposure study can be used quantitatively within the assessment, to provide additional information and support. These data also suggest that the degradate is more toxic than the parent compound (approximately 11 and 7 times more toxic on an acute and chronic exposure basis, respectively). The RQs were calculated using both the propanil registrant submitted data, and the ECOTOX degradate (3,4-DCA) data, and found that both exceed the acute risk to listed species LOC (0.05), and the chronic risk LOC (1.0). Even though both the registrant submitted propanil data and ECOTOX degradate (3,4-DCA) data exceed the acute and chronic listed species LOC for aquatic invertebrates, the degradate is more toxic on both an acute and chronic exposure basis (approximately 11 and 7 times, respectively). The aquatic-phase CRLF's prey items can potentially be exposed to both the parent propanil and its degradate 3,4-DCA within rice paddies in conjunction with propanil's use on rice.

Because aquatic invertebrate populations are expected to be impacted from registered uses of propanil and its subsequent degradation to 3,4-DCA in California, the estimated population reduction, the Agency concludes that there is a potential indirect impact to the aquatic-phase of the CRLF from a reduction of aquatic invertebrate food items. Therefore, propanil is Likely to Adversely Affect (LAA) the CRLF.

5.2.2.3 Fish and Aquatic-phase Frogs

As discussed in Section 2.5.3, the diet of CRLF also includes small fish and other aquatic-phase frogs. Direct effects to the aquatic-phase CRLF are based on peak EECs from the RICE model and the lowest acute toxicity value for freshwater fish. In order to assess direct chronic risks to the CRLF, 7-day EECs and the lowest chronic toxicity value for freshwater fish are used. The RQs for propanil use on rice results in exceedances of the Agency's acute risk LOC for freshwater fish which are surrogates for the aquatic-phase amphibians. The aquatic-phase amphibian chronic RQs also exceeded the chronic risk LOC (1.0) for the use of propanil on rice in California.

A probit slope value for the acute fathead minnow toxicity test is not available; therefore, the individual effect probability was estimated based on a default slope assumption of 4.5 with upper and lower 95% confidence intervals of 2 and 9 (Urban and Cook, 1986). The estimated reduction in aquatic vertebrate populations for propanil use based on a default slope of 4.5 and acute RQ's of 2.3 and 1.32 are approximately 95% for the parent propanil compound, and 70% for the degradate 3,4-DCA respectively. Results are presented in Table 5-1. The application of propanil on rice in California is anticipated to be in Spring. The timing of the application would coincide with the juvenile aquatic- and terrestrial-phase CRLFs would be feeding on small fish, small frogs or tadpoles.

Because fish and aquatic-phase amphibian populations are expected to be impacted from the use of propanil on rice in California, the estimated reduction in aquatic vertebrate populations, the Agency concludes that there is a potential indirect impact to the aquatic-phase CRLF from a reduction of fish and aquatic-phase amphibian food items and therefore propanil is Likely to Adversely Affect (LAA) the CRLF.

5.2.2.4 Terrestrial Invertebrates

When the terrestrial-phase CRLF reaches juvenile and adult stages, its diet is mainly composed of terrestrial invertebrates. Terrestrial invertebrate toxicity data are used to assess potential indirect effects of propanil to the terrestrial-phase CRLF. Effects to terrestrial invertebrates resulting from exposure to propanil may also indirectly affect the CRLF via reduction in available food.

In order to assess the risks of propanil to terrestrial invertebrates, which are considered prey of CRLF in terrestrial habitats, the honeybee 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} of >24 µg a.i./bee by 1 bee/0.128g, which is based on the average weight of an adult honey bee. The toxicity value is thus calculated to be >189 ppm. The test did not provide a definitive endpoint and RQs were not calculated. There were no additional acceptable terrestrial invertebrate data from registrant-submitted studies or from the open literature with which to calculate RQ values. It is not known what level of mortality was observed from this study.

Because the calculated terrestrial small insect EEC's exceed the highest levels tested, the Agency concludes that there is a potential indirect impact to the terrestrial-phase CRLF from a reduction of invertebrate food items and therefore propanil is Likely to Adversely Affect (LAA) the CRLF.

5.2.2.5 Mammals

Life history data for terrestrial-phase CRLFs indicate that large adult frogs consume terrestrial vertebrates, including mice. Small mammals can make up to 50% of the CRLF food intake. Acute and chronic dose-based RQs exceed the Agency's acute and chronic risk LOCs (0.1 acute, 1.0 chronic). The chronic dietary-based RQs do not exceed the chronic risk LOC (1.0) (Table 5-6). However, it should be noted that dietary-based RQ values do not take into account that different-sized animals consume differing amounts and varieties of food. This means that an animal might have to consume varying amounts of exposed food items due to varying nutrition levels. The dose-based value better accounts for this uncertainty.

Based on the mammalian dose-based acute RQ of 5.6 and a probit dose-response default slope of 4.5 the estimated mammalian prey item population reduction is approximately 100%.

Because mammalian prey items are expected to be impacted from registered uses of propanil on rice in California, and estimated mammalian prey item population reduction, the Agency concludes that there is a potential indirect impact to the terrestrial-phase CRLF from a reduction of mammalian food items and therefore propanil is Likely to Adversely Affect (LAA) the CRLF.

5.2.2.6 Terrestrial-phase Amphibians

Terrestrial-phase adult CRLFs also consume frogs. RQ values representing direct exposures of propanil to terrestrial-phase CRLFs are used to represent exposures of propanil to frogs in terrestrial habitats. The T-HERPS model was employed as a refinement tool to explore amphibian-specific food intake on potential exposures to terrestrial-phase amphibian food items for the CRLF. The T-HERPS model incorporates the same inputs as T-REX with equations adjusted for poikilotherm food intake.

Refined acute dietary-based RQs for CRLFs consuming small insects and small herbivore mammals exceed the acute risk to listed species LOC (0.1) for propanil use on rice in California. Refined acute dose-based RQs for CRLFs consuming small insects exceed the acute risk to listed species LOC across all size classes evaluated. Refined acute dose-based RQs for CRLFs consuming small herbivore mammals exceed the acute risk to listed species LOC for 37-g and 238-g frogs and the RQ for CRLFs consuming small herbivore mammals exceeds the acute risk to listed species LOC for 37-g frogs. The refined dietary- and dose-based RQs for CRLFs consuming small terrestrial-phase amphibians did not exceed the acute risk to listed species LOC (0.1) for either 37-g or 238-g frogs. Based on the refined dietary-based RQ's for a CRLF feeding on small insects or small herbivore mammals, and a probit dose-response default slope of 4.5, the estimated probability of individual effect ranges from approximately 7% to 32%. Based on the refined dose-based RQ's for a CRLF feeding on small insects, small insectivore mammals, or small herbivore mammals, and a probit dose-response default slope of 4.5 the estimated probability of an individual effect ranges from approximately 0.11% to 100%. Results are presented in Table 5-11 and Table 5-12.

Based on these refined dietary- and dose-based risk quotients, terrestrial-phase amphibian populations are expected to be impacted from registered uses of propanil on rice in California. Therefore the Agency concludes that there is a potential indirect impact to the terrestrial-phase CRLF from a reduction of terrestrial-phase amphibian food items and therefore propanil is Likely to Adversely Affect (LAA) the 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 refuge 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 near shore areas and lower stream banks. 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 freshwater aquatic vascular and non-vascular plant data.

Indirect effects of propanil to the aquatic-phase CRLF (tadpoles) via reduction in non-vascular aquatic plants in its diet are based on peak EECs from the RICE model and the lowest acute toxicity value for aquatic non-vascular plants. The Agency's risk to aquatic plant LOC (1.0) is exceeded for propanil use on rice in California. Results are presented in Table 5-2. Indirect effects of propanil to aquatic-phase CRLF (tadpoles) are possible via reduction in the habitat provided by vascular plants based on peak EECs from the RICE model and the lowest acute toxicity value for aquatic vascular plants. The RQ for vascular aquatic plants exceeds the Agency's risk to aquatic plant LOC (1.0) for propanil use on rice in California. A summary of acute RQs used to estimate indirect effects to the CRLF via effects to vascular aquatic plants is presented in Table 5-4.

Based on risk to aquatic plant LOC exceedances in vascular and non-vascular plants, propanil is Likely to Adversely Affect (LAA) the CRLF indirectly via habitat degradation through reduction in vascular and non-vascular aquatic plants.

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.

Propanil is an amide herbicide which inhibits photosynthesis in a variety of broadleaf and grass plants. The main route of terrestrial exposure for terrestrial plants is spray drift via aerial application of propanil on rice. AgDRIFT was used to estimate the distance that spray applications can drift from the treated area and still be present in concentrations that exceed the levels of concern. The distance to which there were still exceedances in the levels of concern was 584 feet from the edge of the field for terrestrial habitats and 33 feet from the treated paddy for neighboring aquatic habitats (Table 3.7). In addition, three ecological incidents have been reported from registered use that resulted in plant damage. Of the three reported incidents, two incidents reported injury to the rice crop itself, and one incident reported non-target plant damage due to spray drift following an aerial application of propanil to rice in Arkansas. Risk to non-target plants from propanil use on rice is based on its herbicidal mode of action and the amount of spray drift that occurs from aerial applications.

Based on a buffer zone of 584 feet for terrestrial habitats in which concentrations exceed the levels of concern on the non-target terrestrial plants, and the reported incidents that resulted in plant damage, propanil is Likely to Adversely Affect (LAA) the CRLF indirectly via habitat degradation through reduction in terrestrial plants up to 584 feet. Past the 584 foot buffer zone propanil would Not Likely

Adversely Affect (NLAA) the CRLF indirectly via habitat degradation through reduction terrestrial plants.

5.2.4 Modification to Designated Critical Habitat

Risk conclusions for the designated critical habitat are the same as those for indirect effects. Agency concludes that there is a potential indirect impact to CRLF by terrestrial habitat degradation from propanil exposure.

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).

Based on the risk estimation for potential effects to aquatic and/or terrestrial plants provided in Sections 5.1.1.2, 5.1.1.3, and 5.1.2.3, propanil is likely to result in habitat modification based on effects to aquatic-phase PCEs of designated critical habitat.

- Aquatic non-vascular plants used as food source and habitat for CRLF may be potentially affected from propanil use on rice.
- Reduction of aquatic-based food sources may occur from use on rice.
- Due to aquatic vascular and terrestrial plant communities being affected from use on rice, there is potential for alteration of channel/pond morphology or geometry and/or increase in sediment deposition within the stream channel or pond.
- Due to aquatic vascular and terrestrial plant communities being affected from use on rice, there is potential for 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.

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 propanil on this PCE, acute and chronic freshwater fish and invertebrate toxicity endpoints, as well endpoints for aquatic non-vascular plants are used as measures of effects. RQs for these endpoints were calculated in Sections 5.1.1.1 and 5.1.1.2.

Based on acute and chronic risk LOC exceedances for freshwater fish and aquatic invertebrates, propanil is likely to result in habitat modification based on effects to aquatic-phase PCEs of designated critical habitat related to effects of alteration of other chemical characteristics necessary for normal growth and viability of CRLFs and their food source.

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 mi of each other that allow for movement between sites including both natural and altered sites which do not contain barriers to dispersal.

Based on a buffer zone of 584 feet in which concentrations exceed the levels of concern on the non-target terrestrial plants, there is a potential for habitat modification via impacts to terrestrial plants (Section 5.2.3.2).

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 propanil 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. **Based on acute risk LOC exceedances for CRLF prey items of small mammals and other frogs, and because the calculated small insect EECs are greater than the highest levels tested in the inconclusive terrestrial invertebrate surrogate study, it is determined that propanil is likely to result in habitat modification based on effects to the terrestrial PCE relative to reduction in food sources.**

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. **Based on RQ exceedances for acute exposure to terrestrial-phase amphibians and mammals, and because the calculated small insect EECs are greater than the highest levels tested in the inconclusive terrestrial invertebrate**

surrogate study, it is determined that propanil use on rice in California will result in habitat modification based on effects to the terrestrial PCE related to alteration of chemical characteristics necessary for normal growth and viability.

5.2.5 Downstream Dilution

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 propanil's use pattern is identified, using land cover data that correspond to propanil's use pattern. The spatial extent of the effects determination also includes areas beyond the initial area of concern that may be impacted by spray drift. The identified direct and indirect effects 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 584 feet from its boundary. It is assumed that non-flowing water bodies (or potential CRLF habitat) are included within this area.

Using the conservative downstream dilution approach (described in more detail in Appendix D) yields a distance of **285 kilometers** which represents the maximum continuous distance of downstream dilution from the edge of the initial area of concern. Lotic (*i.e.*, flowing) water bodies that overlap with the CRLF habitat potentially contain concentrations of propanil sufficient to result in LAA determination and modification of critical habitat.
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 NOAEC value.

For propanil the use on rice also includes areas beyond the initial area of concern that may be impacted by paddy release water and/or spray drift overlaps with CRLF habitat. It is expected that any additional areas of CRLF habitat that are located **584 ft** (to account for offsite migration via spray drift) and **285 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.

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 Propanil

The Tier 1 Rice Model used to calculate potential aquatic exposure to pesticides is intended to represent conservative screening estimates, and to avoid underestimations of the actual exposure. The standard scenario consists of application to a 10 cm deep rice paddy. This model represents peak concentrations for rice paddies after partitioning into sediment. The other assumptions used for propanil and 3,4-DCA exposure were that (1) the paddy water holding time is 7 days, (2) 3,4-DCA reaches its maximum concentration on day 7, and (3) the total system half-life for parent plus 3,4-DCA is 21 days (from recalculation of the data in the aerobic aquatic metabolism study (MRID 418487-01). These concentrations are likely persist for only short periods of time, and are then carried away by tail water to be dissipated downstream into the Water Management System.

In general, the Tier 1 Rice Model produces estimated aquatic concentrations that are expected to be peak concentrations. It does not consider factors beyond initial concentration assumed instantaneous partitioning. Chemical transport is not factored into the Tier 1 Rice Model results.

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 paddy release water and loadings. The effectiveness of vegetative setbacks applied to rice paddy berms (a bank of earth used as a barrier between paddies) is highly dependent on the width of the berms and the condition of the vegetative strip. For example, a well-established, healthy vegetative setback can be a very effective means of reducing flow of paddy release water and erosion from agricultural fields.

In order to account for uncertainties associated with modeling, available monitoring data were compared to Tier 1 Rice Model estimates of peak EECs for the different uses. 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 propanil use areas.

Extensive monitoring data for propanil and 3,4-DCA (presumably from the use of propanil) are available from rice-growing areas of California. While these data show that both propanil and 3,4-DCA are commonly detected in receiving waters (Sacramento river and San Joaquin river) in the rice-growing areas, the detected concentrations are much lower than predicted by the modeling. The highest concentration of propanil observed was just over 20 ppb at Colusa Basin drain #5 in 2001. The highest concentration of 3,4-DCA observed in California from single-sample were as high as 0.626 ppb (Mustang C A Monte Vista Ave Nr Montpelier Ca), and the average concentrations were as high as 0.170 ppb (Highline Cn Spill Nr Hilmar Ca). It is likely that the observed 3,4-DCA concentrations are due to propanil use, due to the co-location with propanil detections.

Monitoring data available for both propanil and 3,4-DCA are well below the Tier 1 Rice Model predictions. The Rice Model prediction estimated propanil to be in the surface waters at peak concentrations from 5323 ppb (day 0) to 459 ppb (day 7 – water release date, assuming a 2-day half-life for parent propanil). The highest concentration observed is much lower than the peak concentration of propanil in the rice paddy water, but it is much closer (only one order instead of two orders or magnitude different) to the expected concentration of propanil on day 7 (the water release date). The Rice Model prediction estimated 3,4-DCA to be in the surface waters at peak concentrations that are 77% of the peak concentration for propanil, adjusted for the molecular weight (162.02/218.1 = 0.74), or 3033 ppb. The observed monitoring concentrations are much lower than calculated for day-7 rice paddy water (3033 ppb).

The quantitative differences between the modeling and monitoring data may be accounted for by (1) the conservative nature of the Rice Model, (2) further degradation if paddy water is held longer than 7 days, (3) dilution in the receiving water, (4) further degradation within the receiving waters prior to sampling (5) sampling on days other than the day of paddy water release, and (6) the distance from use site to the monitoring station. However, the frequent detection of 3,4-DCA is evidence that receiving waters are contaminated with discharges of propanil-treated rice paddy water.

When using the monitoring data to calculate the RQs for direct effects of propanil and 3,4-DCA on the aquatic-phase CRLF, there is no longer an acute listed species LOC (0.05) exceedance, but there is still a chronic LOC (1.0) exceedance. Although the monitoring data is a magnitude lower than the modeling predictions, there are still exceedances indicating potential chronic direct effects to the aquatic-phase CRLF. The monitoring concentrations that are seen potentially are lower than the actual concentrations present, due to degradation, dilution, and other factors associated with the sampling dates and location from the use site.

6.1.3 Usage Uncertainties

County-level usage data were obtained from California's Department of Pesticide Regulation Pesticide Use Reporting (CDPR PUR) database. Four years of data (2002 – 2005) 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. No methodology for removing outliers was provided by CDPR for 2001 and earlier pesticide data; therefore, this information was not included in the analysis because it may misrepresent actual usage patterns. 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. 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.

6.1.4 Terrestrial Exposure Modeling of Propanil

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. Environmental Protection Agency, 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 the adjacent areas receiving a treatment rate to the rice paddy. 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.

The terrestrial exposure modeling in this assessment is very conservative, as it is modeling direct exposure to the terrestrial organisms using the maximum application rate per year (8 lbs ai/A/yr) as opposed to using the maximum single application rate of 6 lb ai/A. Since, T-REX accounts for direct application to the field, and the main route of potential exposure is via spray drift, using the maximum application rate per year of 8 lb ai/A/yr would result in a very conservative estimate. The rate would be 8 lb ai/A/yr for areas receiving direct contact (which is only going to occur in the rice paddy water), the areas surrounding receiving spray drift would be receiving a much lower application rate since it is indirect contact. This indicates that the actual exposure to the terrestrial-phase CRLF is potentially lower in the environment, therefore the RQs and LOC exceedances are very conservative in describing potential risk to the terrestrial-phase CRLF.

6.1.5 Spray Drift Modeling

It is unlikely that the same organism would be exposed to the maximum amount of spray drift from every application made. Variations in topography, cover, and meteorological conditions over the transport distance are not accounted for by the AgDRIFT 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 may overestimate exposure, 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 made regarding the droplet size distributions being modeled (was set to the default 'ASAE Very Fine to Fine'), the application method (*i.e*., aerial), release heights and wind speeds (also set to the default values of 10 ft and 10 mph respectively for aerial application; the height for ground application was set to the default 'high boom'). Alterations in any of these inputs would decrease 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

CRLF

No scientifically valid guideline toxicity tests and open literature data on propanil are available for frogs or any other aquatic-phase amphibian; therefore, freshwater fish are used as surrogate species for aquatic-phase amphibians. Therefore, endpoints based on freshwater fish ecotoxicity data are assumed to be protective of potential direct effects to aquatic-phase amphibians including the CRLF, and extrapolation of the risk conclusions from the most sensitive tested species to the aquatic-phase CRLF is likely 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.

Terrestrial Plants

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 agricultural 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 propanil, 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.

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.

6.3.4 ECOTOX Database

Both freshwater fish and invertebrate studies have been found within ECOTOX for both the parent compound and the degradate 3,4-DCA. The studies from ECOTOX were reviewed by OPP and two studies, one examining the effects of acute exposure and another examining chronic exposure of 3,4-DCA on *Daphnia magna* were used quantitatively in this assessment. These endpoints suggest that the 3,4-DCA degradate may be considerably more toxic than the parent compound to freshwater invertebrates on both an acute and chronic exposure basis. When the endpoints are expressed in terms of the parent compound (propanil), they are still more sensitive than the registrant submitted studies endpoints for the same species (approximately 11 to 7 times more toxic). There is some uncertainty associated with the calculation of the endpoint for the acute *Daphnia magna* study. Specifically, there were only two treatments with measured concentrations in which an analysis could be completed with. However, even with additional measurements of treatment concentrations the toxicity resulting from exposure to 3,4-DCA would be between the re-calculated EC_{50} (47 ppb, in terms of propanil) and the reported EC_{50} (106.7 ppb in terms of propanil) from the study.

The RQs calculated using the registrant-submitted parent (propanil) data, which were less sensitive than the ECOTOX data, still exceeded both the acute risk to listed species LOC (0.05), and the chronic risk LOC (1.0). The additional information gathered from ECOTOX for the degradate (3,4-DCA) was used as additional support of the risk description associated with the use of propanil, and its degradation to 3,4-DCA. Even though both the registrant submitted propanil data and ECOTOX degradate (3,4-DCA) data exceed the acute and chronic listed species LOC for aquatic invertebrates, the degradate is more toxic on both an acute and chronic exposure basis (approximately 11 and 7 times, respectively). The aquatic-phase CRLF's prey items can potentially be exposed to both the parent propanil and its degradate 3,4-DCA within rice paddies in conjunction with propanil's use on rice.

6.2.5 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.

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 propanil to the CRLF and its designated critical habitat.

The Agency makes a **Likely to Adversely Affect** determination for the CRLF from the use of propanil on rice in California. The Agency has determined that there is the potential for modification of CRLF designated critical habitat from the use of the chemical. The direct effects and habitat modification effects determinations are summarized in Table 7-1 and Table 7-2, respectively. 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 II.

The AgDRIFT model was used to evaluate potential distances beyond which exposures would be expected to be below LOC. However, due to the limitations imposed by the Tier 1 ground analysis (allows users to evaluate off-site deposition and exposure out to **584 ft** downwind from the location of the application), the exact buffer needed for exposures to be below the LOC is uncertain.

The 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 propanil's use pattern is identified, using land cover data that correspond to propanil's use pattern. The spatial extent of the LAA effects determination also includes areas beyond the initial area of concern that may be impacted by paddy release water and/or spray drift. The identified direct and indirect effects and 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 **584 feet** from its boundary for terrestrial habitats and 33 feet for aquatic habitats (see Section 5.1.4). It is assumed that non-flowing water bodies (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 **285 kilometers** which represents the maximum continuous distance of downstream dilution from the edge of the initial area of concern (see Section 5.1.4). 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 propanil sufficient to result in LAA determination or modification of critical habitat.

Appendix D 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 **285 kilometers** of stream distance (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.

Table 7-1 Effects Determination Summary for Effects of Propanil on the CRLF

Assessment Endpoint	Effects Determination [1]	Basis for Determination
Survival, growth, and/or reproduction of CRLF individuals		**Potential for Direct Effects**
	LAA	***Aquatic-phase (Eggs, Larvae, and Adults)*:** The aquatic-phase amphibian acute risk LOCs for listed species (0.05) are exceeded for the use of propanil on rice in California from use within the paddy. The acute RQ is 2.3 for the parent propanil based on the concentration in the paddy water, the acute RQ is 0.21 for the parent compound based on the concentration in the release water and 1.32 for the degradate 3,4-DCA based on the concentration in the release water. The probability for individual effect is 95% for propanil based on the concentration in the paddy water, 0.11% for propanil based on the concentration in the release water, and 70% for 3,4-DCA based on the concentration in the release water, and 1.3 for degradate 3,4-DCA. The aquatic-phase amphibian chronic risk LOC (1.0) is exceeded; the chronic RQ is 521.
	LAA	***Terrestrial-phase (Juveniles and Adults)*:** From propanil use, the acute dietary-based RQ exceeds the acute risk LOC (0.1) at 0.47. The acute-dose based RQ exceeds the acute risk LOC (0.1) at 8.5. The dietary-based probability of individual effect for propanil use is 0.70%, and the dose-based probability of individual effect for propanil use is 100%. Refined acute dietary-based RQs for CRLFs consuming small insects and small herbivore mammals exceed the acute risk to listed species LOC (0.1) with RQs of 0.47 and 0.79, respectively. The estimated probability of individual effect ranges from approximately 7% to 32% for the refined acute dietary-based RQs. Refined acute dose-based RQs for CRLFs consuming small insects exceed the acute risk to listed species LOC (0.1) across all size classes evaluated with RQ's of 0.21, 0.21, and 0.13 for 1.4-g, 37.0-g and 238-g, respectively. Refined acute dose-based RQs for CRLFs consuming small herbivore mammals exceed the acute risk to listed species LOC (0.1) for 37-g and 238-g frogs (RQ's of 3.69 and 0.57, respectively), and the dose-based RQs for CRLFs consuming small insectivore mammals exceed the acute risk to listed species LOC (0.1) for 37-g frogs, with an RQ of 0.23. The estimated probability of an individual effect ranges from approximately 0.11% to 100% for the refined acute dose-based RQs.
		Potential for Indirect Effects
	LAA	***Aquatic prey items, aquatic habitat, cover and/or primary productivity*:** From propanil use, the aquatic invertebrate's acute risk LOC (0.05) is exceeded. For the registrant submitted propanil data, the acute RQ is 10.1 for the parent propanil based on the concentration in the paddy water, the acute RQ is 0.91 for the parent compound based on the concentration in the release water and 5.7 for the degradate 3,4-DCA based on the concentration in the release water. For the degradate (3,4-DCA) ECOTOX data, the acute RQ is 113.2 for the parent propanil based on the concentration in the paddy water, the acute RQ is 10.2 for the parent compound based on the concentration in the release water and 64.5 for the degradate 3,4-DCA based on the concentration in the release water.(both expressed as the parent propanil). The estimation of population reduction is 100% for propanil based on the concentration in the paddy, and 100% for 3,4-DCA based on the concentration within the release water. The aquatic invertebrate chronic risk LOC (1.0) is also exceeded at 55

Assessment Endpoint	Effects Determination [1]	Basis for Determination
	LAA	(propanil), and 364.8 (3,4-DCA expressed as propanil). The acute RQ is 2.3 for the parent propanil based on the concentration in the paddy water, the acute RQ is 0.21 for the parent compound based on the concentration in the release water and 1.32 for the degradate 3,4-DCA based on the concentration in the release water. The probability for individual effect is 95% for propanil based on the concentration in the paddy water, 0.11% for propanil based on the concentration in the release water, and 70% for 3,4-DCA based on the concentration in the release water, and 1.3 for degradate 3,4-DCA. The aquatic-phase amphibian chronic risk LOC (1.0) is exceeded; the chronic RQ is 521 From propanil use, the LOC for risk to non-vascular aquatic plants (1.0) is exceeded. The RQs are 184 for the parent propanil based on the concentration in the paddy water, the acute RQ is 16.5 for the parent compound based on the concentration in the release water and 105 for the degradate 3,4-DCA based on the concentration in the release water, From propanil use, the LOC for risk to vascular aquatic plants (1.0) is exceeded. The RQ is 48 for the parent propanil based on the concentration in the paddy water, the acute RQ is 4.35 for the parent compound based on the concentration in the release water and 28 for the degradate 3,4-DCA based on the concentration in the release water. In addition, aquatic plants in neighboring water bodies within 33 feet of the treated paddy may be exposed to spray drift in which concentrations exceed the levels of concern. ***Terrestrial prey items, riparian habitat*:** From propanil use, the acute and chronic dose-based mammalian RQs exceed the Agency's acute and chronic risk to listed species LOCs (0.1 acute, 1.0 chronic) with RQ's of 0.77 and 5.55, respectively. The chronic dietary-based RQs do not exceed the chronic risk to listed species LOC of 1.0. The estimation of population reduction is 30%. For terrestrial invertebrates, the calculated small insect EEC (1080 ppm) exceeds the highest levels tested for the terrestrial invertebrate study, therefore risk can not be discounted for these species. From propanil use, the refined acute dietary-based RQs for CRLFs consuming small insects and small herbivore mammals exceed the acute risk to listed species LOC (0.1) with RQs of 0.47 and 0.79, respectively. The estimated probability of individual effect ranges from approximately 7% to 32% for the refined acute dietary-based RQs. Refined acute dose-based RQs for CRLFs consuming small insects exceed the acute risk to listed species LOC (0.1) across all size classes evaluated with RQ's of 0.21, 0.21, and 0.13 for 1.4-g, 37.0-g and 238-g, respectively. Refined acute dose-based RQs for CRLFs consuming small herbivore mammals exceed the acute risk to listed species LOC (0.1) for 37-g and 238-g frogs (RQ's of 3.69 and 0.57, respectively), and the dose-based RQs for CRLFs consuming small insectivore mammals exceed the acute risk to listed species LOC (0.1) for 37-g frogs, with an RQ of 0.23. The estimated probability of an individual effect ranges from approximately 0.11% to 100% for the refined acute dose-based RQs. The main route of terrestrial exposure for terrestrial plants is spray drift via aerial application of propanil on rice. Based on a buffer zone of 584 feet in which concentrations exceed the levels of concern on the non-target terrestrial plants,

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 the Critical Habitat Impact Analysis

Assessment Endpoint	Effects Determination	Basis for Determination
Modification of aquatic-phase PCE	**Habitat Modification**	Due to expected aquatic vascular and terrestrial plant communities being affected from propanil use, there is potential for alteration of channel/pond morphology or geometry and/or increase in sediment deposition within the stream channel or pond. These plant communities provide for shelter, foraging, predator avoidance, and aquatic dispersal for juvenile and adult CRLFs. In addition, there is potential for 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. The main route of terrestrial exposure for terrestrial plants is spray drift via aerial application of propanil on rice. Based on a buffer zone of 584 feet in which concentrations exceed the levels of concern on the non-target terrestrial plants. Aquatic vascular plants from exposure to propanil (RQs of 48 for the parent propanil based on the concentration in the paddy water, the acute RQ is 4.35 for the parent compound based on the concentration in the release water and 28 for the degradate 3,4-DCA based on the concentration in the release water). LOCs for non-vascular aquatic plants are also exceeded (RQs of 184 for the parent propanil based on the concentration in the paddy water, the acute RQ is 16.5 for the parent compound based on the concentration in the release water and 105 for the degradate 3,4-DCA based on the concentration in the release water). Aquatic exposure to neighboring water bodies may occur via spray drift from aerial application of propanil on rice. Based on a buffer zone of 33 feet in which concentrations exceed the levels of concern on the non-target aquatic plants.
Modification of terrestrial-phase PCE	**Habitat Modification**	The use of propanil on rice may create the following modification of PCE: elimination and/or disturbance of upland habitat; ability of habitat to support food source of CRLFs, Elimination and/or disturbance of dispersal habitat, reduction and/or modification of food sources for terrestrial-phase juveniles and adults, and alteration of chemical characteristics necessary for normal growth and viability of juvenile and adult CRLFs and their food source. The RQs for vascular aquatic plants exceed the Agency's risk to aquatic plant LOC (1.0) for use of propanil on rice in California with RQs of 48 for the parent propanil based on the concentration in the paddy water, the acute RQ is 4.35 for the parent compound based on the concentration in the release water and 28 for the degradate 3,4-DCA based on the concentration in the release water Acute dietary- and dose-based RQ values exceed the LOC for prey food items of small mammals and frogs, and because the calculated small insect EECs (1080 ppm) are greater than the highest levels tested in the inconclusive terrestrial invertebrate surrogate study. Food source for CRLF are expected to be reduced and CRLF is expected to be indirectly affected.

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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