SCIENCE INTEGRITY KNOWLEDGE

CHEMINOVA'S COMMENTS ON EPA'S DIMETHOATE EFFECTS DETERMINATION FOR THE CALIFORNIA RED-LEGGED FROG

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Statement of Good Laboratory Practice Compliance

This document is a response to EPA's Dimethoate Effects Determination for the California Red-legged Frog. As such, it is not required to comply with 40CFR Part 160.

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COMMENTS OF EPA'S DIMETHOATE EFFECTS DETERMINATION FOR CALIFORNIA RED-LEGGED FROG

1.0 INTRODUCTION

The following comments are in response to the California Red-legged Frog (CRLF) effects determination that was issued for dimethoate by the U.S. Environmental Protection Agency (EPA, 2008). The EPA (2008) effects determination concluded that dimethoate was likely to adversely affect terrestrial-phase CRLF, CRLF prey, and CRLF habitat including aquatic and terrestrial designated critical habitats. The overall CRLF effects determination for dimethoate use was "likely to adversely affect". The Agency's effects determination for the CRLF and subsequent request for consultation with the U.S. Fish and Wildlife Service (FWS) were made pursuant to the October 20, 2006 Settlement Agreement in *Center for Biological Diversity (CBD) vs. EPA et al*. (US District Court, ND California, Case No. 02-1580-JSW(JL)).

Cheminova A/S is the primary registrant in the United States for the technical form of dimethoate (EPA Reg. 4787-7) and Cheminova, Inc. holds one registration of an end-use product containing dimethoate as the active ingredient. For purposes of the consultation process for dimethoate under Section 7 of the Endangered Species Act, Cheminova A/S and Cheminova Inc. (together "Cheminova") are considered "applicants" entitled to fully participate in the consultation process.

Cheminova has a number of concerns with regard to the CRLF effects determination for dimethoate. The following report outlines these concerns. The report is organized into three sections: major comments, specific comments, and conclusions and recommendations.

2.0 MAJOR COMMENTS

Use Scenarios

Maximum application rates, application timing, and type of application influence estimated exposures for CRLFs, their prey and their critical habitats. Therefore, it is extremely important that the use patterns approved in the Reregistration Eligibility Decision (RED) document for dimethoate be the basis for risk assessments conducted for registration review. Cheminova has compared the use patterns listed in the RED (including revised versions) with those included in Table 1 of the Agency's Problem Formulation document and noted several inconsistencies. We have notified EPA's Chemical Review Manager of our findings (e-mails to Jude Andreasen dated May 8 and May 11, 2009). It is important that these issues be resolved before the Agency proceeds further with its consultation process with the FWS, and before the Agency conducts risk assessments as part of its registration review program.

PRZM Scenarios

Eight PRZM scenarios for California were developed specifically for the CRLF effects determinations including CA cole crop, CA forestry, CA melon, CA potato, CA row crop, CA turf, CA wheat and CA wine grapes. However, the dimethoate effects determination provides no details for the eight crop scenarios (e.g., PRZM input parameters). The details for the eight CRLF-specific PRZM scenarios should be provided in a revised effects determination for dimethoate or in a report that is available to the registrants and the public for review.

Table 11 indicates that CA lettuce is the scenario used for endive, lettuce and Swiss chard. It is unclear whether CA lettuce is a CRLF-specific scenario or an existing California crop scenario. The text on page 53 does not mention this scenario.

Initial Area of Concern

EPA considered all potential agricultural areas in California using land cover data to derive the initial area of concern and ultimately the Action Area for dimethoate. Dimethoate is not used on every field for the crops included on the available labels. Many fields will not experience the pests for which dimethoate is effective. In addition, other pesticides may be used to treat pests. The approach by EPA considerably overestimates the extent of dimethoate use in California. Rather than rely on land cover data to define the initial area of concern, EPA should use the California Pesticide Use Reporting Database (CA PUR) as the best available data to identify where dimethoate may be used in California. The text below describes how to make use of the CA PUR data in defining the initial area of concern for dimethoate.

A spatial analysis was conducted to characterize an initial area of concern based upon actual use of dimethoate in California from 2005-2007 (see Appendix A for details). To determine the initial area of concern, public land survey mapping system data were linked to CA PUR data for dimethoate (2005-2007; CA PUR, 2008). The total area of dimethoate application in 2005, 2006 and 2007 combined was approximately 3.9 million acres or approximately 4% of the total area of California. Most fields treated with dimethoate were in the Central Valley region (Figure 1 and Table 1 in Appendix A). EPA did not specify the total area represented by the dimethoate use pattern footprint (which did not consider actual use data), but visual inspection of Figures 4 and 5 in the effects determination indicates a footprint of approximately 20% of the total area of California). Thus, EPA's initial area of concern is over-estimated approximately 5-fold because they did not consider recent actual use data.

In the next step of our analysis, the public land survey-CA PUR spatial layer for dimethoate was overlain with the California Natural Diversity Database (CNDDB) CRLF observation data (1919-2008; CNDDB, 2009) and the critical habitat polygons provided by FWS (2006). The CRLF observation data and critical habitat polygons constitute 0.5% and 0.4% of the total area of California, respectively, with areas concentrated in the Central Coast and San Francisco Bay regions (Figures 2 and 3 in Appendix A). The initial area of concern was further refined to include only the intersection of the occurrence and critical habitat areas with the areas of dimethoate application in 2005-2007 (Figure 4 in Appendix A). The refined total initial area of concern is 24,695 acres (or approximately 0.02% of the total area of California). Most of the area is concentrated in the Central Coast region (20,069 acres), followed by the San Francisco Bay (2,489 acres), Central Valley (1,583 acres) and North Coast (555 acres) regions (Figure 4 in Appendix A). All of the initial area of concern occurs within 85 km of the Pacific coast.

To derive an appropriate Action Area, further spatial analysis would need to be conducted to account for off-field movement of dimethoate from fields in the refined area of initial concern via spray drift, erosion, flow of water and movement of contaminated prey items. For the reasons outlined below, the analyses conducted by EPA to define off-field movement of dimethoate were seriously flawed and cannot be used to define the Action Area.

Use of Spray Drift Models in Defining the Action Area

AGDISP and AgDRIFT were used by EPA to define the Action Area and to estimate off-field exposure for CRLF and their prey and habitat. Drift deposition at distances up to 3 kilometers was predicted for aerial uses with AGDISP in the Gaussian extension mode. The AGDISP ground model was used to estimate drift from ground application. AgDRIFT was used for airblast applications on orchard crops.

AGDISP is a single source, steady-state model that predicts drift from agricultural applications onto uniform, flat downwind environments under constant meteorological conditions. The model has been accepted for use in predicting drift deposition from aerial applications onto near-field environments within approximately 300 m of the treated area (EPA, 2004a). The AGDISP ground model is experimental and has been shown to produce artifacts in output and has not been accepted as a valid model by reviewers. The Gaussian extension has not been verified for the far distances at which EPA calculated deposition in the dimethoate effects determination.

Bird et al. (2002) compared the AGDISP aerial model to experimental data obtained by the Spray Drift Task Force and reported that the model overestimated deposition at the farthest sampling point (305 m) by a factor of 2, and under highly evaporative conditions overestimated deposition by a factor of 4. Changes in wind speed and direction, variable topography, interception by crop canopies, structures, and vegetation are not considered by AGDISP. These factors will generally decrease predicted concentrations relative to the model predictions. The Gaussian extension is a recent addition to the AGDISP model. EPA has not evaluated nor accepted its use. The Gaussian extension models dispersion under conditions of constant wind direction and speed and assumes a constant source. It does not account for variability in wind conditions that can be expected during the travel time over the distances that EPA has chosen to model. In the dimethoate effects determination, AGDISP (Gaussian extension) was used to calculate exposure concentrations at distances up to approximately 3000 m from agricultural use areas. The predictions go an order of magnitude beyond any reasonable distance at which the model has been shown to be valid or are likely to be an appropriate representation of the movement of spray droplets. Because AgDRIFT makes use of the AGDISP mechanistic model for aerial applications, both models should not be used in a regulatory context for estimating deposition outside the accepted range of 300 m downwind.

The spray drift model inputs selected by EPA maximize estimates of drift and do not acknowledge applicator practices that are routinely used to minimize drift. The principal factors affecting drift are wind speed, wind direction, spray quality (e.g., drop size distribution), and release height. In Section 3.2.3 of the effects determination, EPA acknowledged that when information relevant to input parameters was not available on the dimethoate labels, default AGDISP input values or input values recommended by the current draft EFED guidance for AgDISP were used (EPA, 2005). For example, EPA assumed a wind speed of 15 mph, a droplet size of fine to very fine, and a release height of 15 feet in the modeling conducted with AgDISP. According to the Dimethoate 4E and Dimethoate 400 labels, the product should only be applied when wind speed is less than or equal to 10 mph. For ground boom and aerial applications, spray nozzles producing medium or coarse droplet size are recommended for dimethoate. There is no justification for not using the label requirements as input parameter values. Moreover, the default release height value in AgDISP is 10 feet, and no explanation was offered for not using this value.

The input parameters used by EPA in the AGDISP modeling produced greater estimates of drift than what occurs in practice. As a result, Cheminova recommends that EPA:

- Provide a discussion of the uncertainties and limitations of the drift models,
- Conduct the exposure assessment only at distances considered acceptable by EPA (2004a, 2005),
- Apply a correction factor to the predicted deposition based on the known overestimation of AGDISP and AgDRIFT at and beyond 300 m,
- Use AgDRIFT for ground applications of dimethoate, and
- Select model input parameters that reflect labeled use conditions and best management practices, instead of worst case assumptions.

The use of the AgDISP model along with the input parameters that were selected have produced exaggerated values for off-site movement of pesticide spray droplets in air. The result for dimethoate is an expansion of the Action Area well beyond the expected use areas for dimethoate and the inclusion of large areas of California that are non-agricultural and urban.

Indirect Effects to CRLF Prey

EPA used a conservative Tier 1 approach to assess the potential for indirect effects to the CRLF. The effects determination for indirect effect to prey relied on toxicity endpoints for direct effects on the most sensitive individual aquatic and terrestrial plants, invertebrates and vertebrates. However, as documented by EPA in Section 2.5, adult CRLFs feed on a wide variety of prey and thus would not be expected to feed exclusively on prey items that are highly sensitive to dimethoate exposure. Further, EPA estimated risk to terrestrial prey assuming that such prey were on-field at time of application. Given that adult CRLFs spend the vast majority of their time foraging in riparian vegetation, it seems likely that most of their prey would be from riparian areas, not treated fields. Both worst-case exposure and effects measures were used to calculate risk quotients that were then compared to levels of concern (LOC) to determine risk. The effects determination for dimethoate grossly overestimates the actual risks likely to be experienced by CRLFs as a result of dimethoate impacts to their prey.

A more refined analysis should be undertaken to assess the risks of prey reduction to CRLFs. We suggest that the refined analysis incorporate the following:

- Rather than estimate risks to prey that only occur on treated fields, risks should be estimated for prey occurring in riparian areas. A spatial analysis could be conducted to determine conservative and typical distances of treated fields from riparian areas. With this information, spray drift modeling could be conducted to determine likely exposures for CRLF prey.
- Instead of relying on highly conservative exposure estimates (e.g., 1-in-10 year surface water concentrations for aquatic prey, upper bounds from Kenaga nomograms), distributions should be derived that represent the entire range of exposures likely to be experienced by CRLF prey. For terrestrial food items, there are sufficient data available for dimethoate to use measured concentration results rather than rely on the predictive and highly conservative Kenaga nomograms. The results of numerous monitoring studies in Europe and United States conducted on behalf of the registrant and submitted to the EPA (Wilson, 2000, 2001a-l) are summarized in Table 1. For comparison, the Kenaga upper bounds used in EPA's effects determination for dimethoate are also presented. Clearly, relying on nomogram values in the effects determination resulted in an overly conservative assessment of risks to California red-legged frogs and their prey.

Using distributions based on measured results for dimethoate would permit a much more realistic and defensible assessment of risks.

Table 1. Normalized dimethoate concentrations in various food items immediately after application.

Category	Normalized Dimethoate Concentration (mg ai/kg/lb ai/acre)					Nomogram Upper Bound (mg ai/kg/lb ai/acre)
	N	Minimum	Maximum	Mean	Standard Deviation	
Short grass	4	12.0	95.5	47.1	35.1	240
Long grass	20	10.4	34.0	19.4	6.32	110
Leaves, leafy crops, forage	22	4.27	86.3	38.9	28.1	135
Pods, seeds and small fruit	16	5.09	30.3	13.3	7.92	15
Large fruit	16	0.04	1.55	0.541	0.362	

- Because CRLFs are generalist feeders, the effects characterization should not be restricted to the most sensitive species. As long as overall productivity of prey species is protected, indirect effects to CRLFs are not expected. A review of the acute toxicity studies considered acceptable by the California Department of Fish and Game (CDFG, 1996) indicates that aquatic invertebrates have a wide range of sensitivities to dimethoate. Ninety-six hour LC50s range from 43 μg/L for the stonefly to 15,000 μg/L for juvenile mysids. Thus, concentrations of dimethoate that only affect the most sensitive species are unlikely to have any effect on overall productivity of prey species in aquatic environments. The recommended approach for the effects characterization is to derive a species sensitivity distribution for each prey group where data permit (i.e., eight or more toxicity values are available). An example of a prey group SSD for dimethoate is shown in Figure 1. In this analysis, available acute LC50s and EC50s for surrogate aquatic algal and invertebrate prey (n=8) (Table 2) were fit with five models in log space: normal, logistic, Gompertz, Weibull and Fisher-Tippett. The best-fitting model was the Weibull model (Anderson-Darling test statistic = 0.258, p>0.05). Graphical and statistical tests indicated that the homogeneity of variance and normality assumptions of a parametric regression analysis were not violated. All input data were based on tests with the technical product (i.e., tests with formulations were excluded) and were screened to ensure that they came from studies of acceptable quality. The fitted model parameters were: λ=3.296 and κ=2.571.

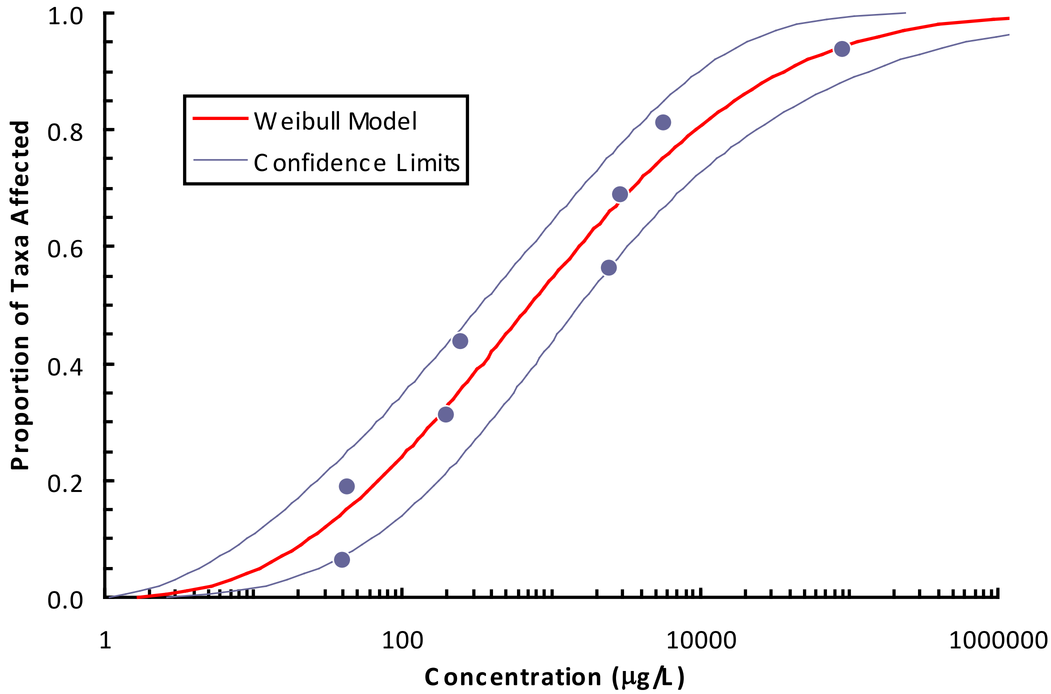


Figure 1. Acute species sensitivity distribution for invertebrate and algal species exposed to dimethoate.

Table 2. Input values for acute aquatic prey species sensitivity distribution for dimethoate.

Species	LC/EC50 (mg/L)	SSD Input (Geometric Mean)	Reference
Stonefly (*Pteronarcys californica*)	0.043	0.043	Sanders and Cope, 1968
Isopod (*Asellus aquaticus*)	2.96	2.96	Thybaud et al., 1987
Water flea (*Daphnia magna*)	2.0	2.47	Hertl, 2002
	1.1		Andersen et al., 2006
	6.4		Canton et al., 1980
	6.4		Hermens et al., 1984
	1.5		Beusen and Neven, 1989
	1.8		
	1.7		
	2.0		
	3.32		Song et al., 1997
	3.12		
Scud (*Gammarus lacustris*)	0.2	0.2	Johnson and Finley, 1980
Midge (*Chironomus tentans*)	0.249	0.249	Anderson and Zhu, 2004
Yellow fever mosquito (*Aedes aegypti*)	5.0	5.66	Song et al., 1997
	6.4		
Green alga (*Pseudokirchneriella subcapitata*)	90.4	90.4	Caley et al., 1992
Diatom (*Coscinodiscus concinnus*)	0.04	0.04	Ramachandran et al., 1980

- In situations where there are insufficient toxicity data (e.g., terrestrial mammals), risk could be estimated assuming the most sensitive toxicity endpoint as well as the least sensitive toxicity endpoint. The latter approach can be used to estimate the risk range for indirect effects to prey.
- Rather than calculate conservative, deterministic risk quotients, risk curves should be derived by integrating the exposure and species sensitivity distributions (SSDs). If an SSD cannot be derived for a prey group, then probabilities of exceeding the most and least sensitive endpoints should be calculated.

A risk curve is a plot of probability of exceedence versus magnitude of effect. The Ecological Committee on FIFRA Risk Assessment Methods (ECOFRAM, 1999) referred to such plots as "joint probability curves" while others refer to these plots as "risk curves" (e.g., EPA, 2004b; Giddings et al., 2005). Risk curves have been used in ecological risk assessments performed for EPA at the Calcasieu Estuary, Louisiana and the Housatonic River, Massachusetts (EPA, 2002a; EPA, 2004b) and by others in ecological risk assessments of pesticides (Giesy et al., 1999; Giddings et al., 2005; Moore et al., 2006a,b, 2007).

For each exposure scenario, risk of indirect effects may be categorized as *de minimis*, low, intermediate, or high as follows:

- If the *maximum risk product* (risk product = exceedence probability x magnitude of effect) is less than 0.25%, then the risk is categorized as *de minimis*;
- If the *maximum risk product* is equal to or greater than 0.25% but less than 2%, then the risk is categorized as low;
- If the *maximum risk product* is equal to or greater than 2% but less than 10%, then the risk is categorized as intermediate; and
- If the *maximum risk product* is equal to or greater than 10%, then the risk is categorized as high.

Maximum risk products less than 2% indicate that the use scenario poses little or no risk to prey and habitat and, by extension, little or no risk to the CRLF that rely on these for food and shelter. Otherwise, there is a potential risk of indirect effects to the CRLF.

The above risk category boundaries are shown in Figure 2. Justification for the risk category boundaries are provided in Appendix B.

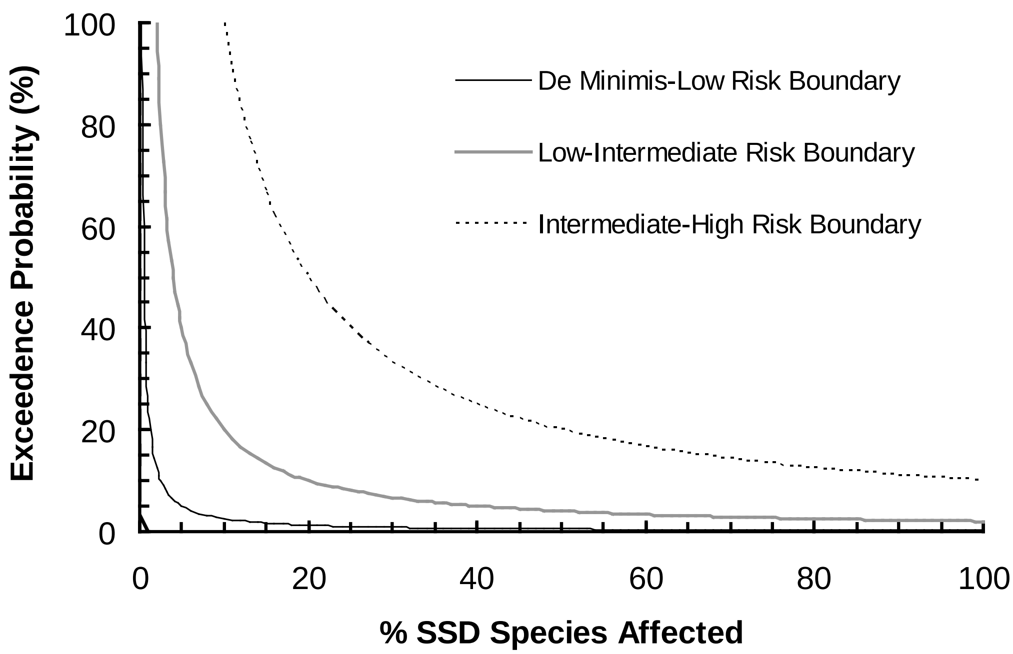


Figure 2. Boundaries for risk categories for effects to prey items and habitat of the California red-legged frog.

Dietary Exposure for Adult CRLFs

It is unlikely that terrestrial vertebrate prey species of CRLFs will be directly exposed to dimethoate. The Effects Determination used the Pacific tree frog to represent amphibian prey species. Pacific tree frogs inhabit areas near water (e.g., springs, ponds, streams, swamps) or in moist environments (e.g., wells, rotting logs, burrows) (Owen, 2000; Morey, 2005). Resident Pacific tree frogs have an average home range of 33 m and migratory frogs can range up to 400 m (Morey, 2005). Based on their habitat and home range preferences, it is unlikely that Pacific tree frogs would frequent dimethoate-treated fields. The more likely routes of exposure for this species are similar to the CRLF, i.e., through direct contact with their integument and ingestion of contaminated prey. Thus, risks to the Pacific tree frog should be estimated using a total daily intake (TDI) model that recognizes that most of their prey will come from riparian areas rather than treated fields.

Small mammals such as mice that occur on fields treated with dimethoate are not likely to be ingested by adult CRLFs. The maximum home range reported for the California mouse is 35 m (Appendix C). Thus, mice exposed to dimethoate on-field, as was assumed in the EPA effects determination, are unlikely to be consumed by CRLFs because their home range from treated fields would rarely overlap with the home range of CRLFs. Thus, CRLFs are unlikely to forage or be dependent on dimethoate-contaminated mice.

Estimated Exposure Concentrations

As typically done in screening-level assessments for pesticides, EPA (2008) relied on the outputs of the PRZM/EXAMS modeling efforts to estimate risk. The effects determination noted that monitoring data were available for the San Joaquin River watershed and that the maximum concentration detected in the watershed was 2.4 μg/L in 1991-1993 (the actual reported value was 2.44 μg/L, CDFG, 1996). What the effects determination failed to mention was that over 75% of the 35 positive samples had concentrations of <0.36 μg/L. The latter concentration is far below the NOAEC for chronic toxicity to the CRLF surrogate (96-day NOAEC for rainbow trout = 430 μg/L), the lowest acute toxicity value for aquatic invertebrates (48-hour EC50 for stonefly = 43 μg/L), and the lowest measured chronic toxicity value for aquatic invertebrates (21-day NOAEC for *Daphnia magna* = 40 μg/L). As a result, the California Department of Fish and Game (CDFG, 1996) concluded that, "dimethoate does not appear to present an acute or chronic hazard to aquatic organisms at this time." The Sacramento-San Joaquin river system drains an area of intense agriculture and high dimethoate usage. Thus, the monitoring data from this system should have been given more weight in the effects determination for estimating risk.

Estimated exposure concentrations (EECs) for insects consumed by terrestrial-phase CRLFs were estimated using 95th percentile Kenaga nomogram values included in T-REX. The exposure estimates for insects assume that the insect residue per unit dose (RUD) is 135 ppm/lb ai/A (Hoerger and Kenaga, 1972; Fletcher et al., 1994). Multiple applications and minimum treatment intervals were also assumed. This approach grossly overestimates exposure for terrestrial invertebrates in the treated area. We have already commented on the inappropriateness of using the 95th percentile Kenaga nomogram values. Further the approach does not consider the residue levels in the riparian invertebrates that CRLFs are much more likely to consume. A more realistic insect RUD for on-field invertebrates may be found in the Fischer and Bowers (1997) dataset (small insect RUD = 5.1 $\pm$ 8.2 ppm/lb ai/A) and in the Schabacker (2005) dataset (insect RUD ranges from 1.4 $\pm$ 6.6 to 9.5 $\pm$ 47.8 ppm/lb ai/A).

Omethoate Risks

On page 125 of the dimethoate effects determination, EPA makes the case that the risk estimates derived for terrestrial-phase CRLF and their amphibian and mammalian prey would be greater had the risks posed by the dimethoate degradate, omethoate, been factored into the calculations. As noted in the European Union Draft Assessment Report, however, there are several factors that indicate that the risks posed by omethoate to mammals are minimal:

- Details submitted for crop metabolism studies in wheat and potatoes indicate that a maximum of 15% of the applied dimethoate may be metabolized to omethoate on the foliar surfaces (U.S. EPA, 2002b). Additional data from foliar residue studies in Spain, Greece, Italy, Germany and the United Kingdom (Wilson, 2000, 2001a-l) indicate that all but one field had maxima of less than 20% for omethoate on foliar surfaces as a percentage of dimethoate residue levels at time zero (Figure 3). Each of the fields included in Figure 3 had at least weekly measurements of foliar residue levels of dimethoate and omethoate for at least four weeks following application. The residue decline studies indicate that omethoate residues decline rapidly, often falling below the LOQ (0.01 mg/kg) within 7-14 days. A study conducted on an olive tree in California involving four applications of a foliar spray at a nominal rate of 720 g ai/ha (0.642 lb ai/acre) indicated that that the percent omethoate of applied dimethoate in the olive flesh ranged from 0.4 to 3.2% in samples taken immediately before the third application to four weeks after the fourth application (Huntingdon Life Sciences, 2005).

- Initial time zero foliar residue levels of omethoate are not significant. Using data from the same studies as used in Table 1, it was found that omethoate concentrations are 1 to >2 orders of magnitude lower in concentration than are dimethoate concentrations immediately after application (see Table 3).

Table 3. Mean normalized dimethoate and omethoate concentrations in various food items immediately after application.

Category	N	Mean Normalized Concentration (mg ai/kg/lb ai/acre)[1]	
		Dimethoate	Omethoate
Short grass	4	47.1	0.36
Long grass	20	19.4	0.28
Leaves, leafy crops, forage	22	38.9	0.34
Pods, seeds and small fruit	16	13.3	0.68
Large fruit	16	0.5	0.04

[1]The means were calculated for samples with concentrations above the detection limit. The concentration of omethoate was below the detection limit in one sample of small fruit and five samples of large fruit.

- In field studies conducted in three states for each of four crops (n=12), the foliar dissipation half-life for dimethoate ranged from 0.23 days on tomatoes in Florida to 5.13 days on apples in Washington state (EN-CAS Laboratories, 1998a,b; Wildlife International, 1999a,b). Although the half life of omethoate was somewhat longer (0.81 to 34.6 days), peak foliar residue levels of omethoate were two or more orders of magnitude lower than the corresponding peak residue levels of dimethoate. Thus, the additional risk posed by the presence of omethoate on crop foliage is negligible.

- Considering the above information, the EU DAR analysis demonstrated that the combined acute and chronic risks of dimethoate to mammals “are sufficiently precautionary to cover the additional risk from exposure to omethoate residues and no further consideration is required.”

The arguments above for mammals also apply to the risks posed by omethoate to terrestrial-phase amphibians. A number of toxicity studies with birds, which were used by EPA as surrogates for terrestrial life stages of California red-legged frog, indicate that dimethoate and omethoate are approximately equally toxic (Table 4).

Based on the above considerations, the effects determination should be revised to state that the risks of omethoate to terrestrial biota are not of concern.

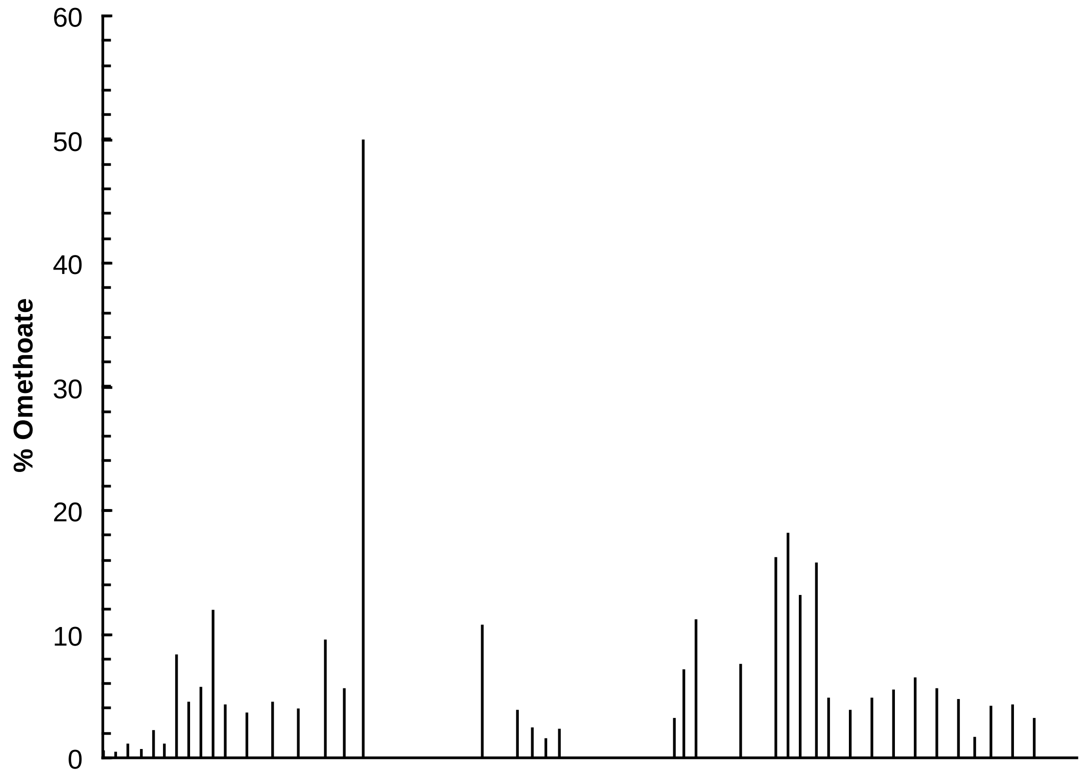


Figure 3. Maximum percent omethoate on foliar surfaces compared to time zero combined concentrations of dimethoate and omethate. The reported results are for fields with at least weekly measurements for at least four weeks following application.

Table 4. Avian studies that can be used to compare toxicity of dimethoate and omethoate.

Test	Species	Test Substance	Endpoint	Reference	Ratio Parent/Oxon
Acute Oral Toxicity Studies (OPPTS 850.2100)	Northern Bobwhite Quail *(Colinus virginianus*)	Dimethoate	LD50 = 10.5 mg ai/kg bw	Zok, 2001a	1.1
		Omethoate	LD50 = 9.9 mg ai/kg bw	Gallagher et al., 2003a	
	Ring-necked Pheasant *(Phasianus colchicus)*	Dimethoate	LD50 = 20 mg ai/kg bw	Hudson et al. 1984	0.69 and 0.49
		Dimethoate	LD50 = 14.1 mg ai/kg bw	Zok, 2001b	
		Omethoate	LD50 = 29 mg ai/kg bw	Gallagher et al., 2003b	
Subacute Dietary Toxicity Studies (OPPTS 850.2200)	Northern Bobwhite Quail *(Colinus virginianus*)	Dimethoate	LC50 = 154 mg ai/kg diet	Zok, 2001c	1.7
		Omethoate	LC50 = 90 mg ai/kg diet	Hubbard et al. 2009a	
	Mallard Duck *(Anas platyrhynchos)*	Dimethoate	LC50 = 1066 mg ai/kg diet	Hubbard et al. 2009c	0.78
		Omethoate	LC50 = 1374	Hubbard et	

Test	Species	Test Substance	Endpoint	Reference	Ratio Parent/Oxon
			mg ai/kg diet	al., 2009b	

3.0 SPECIFIC COMMENTS

Table 3. The source for the foliar dissipation half-life in this table is cited as "Table 5." Table 5 has no information on the foliar dissipation half-life.

Figure 7. It is not clear why ingestion of prey is considered an important pathway of exposure for terrestrial CRLFs, but not aquatic CRLFs. The text should provide justification for this apparent discrepancy.

Page 46. The text in the Analysis Plan notes that the likelihood of effects to individual organisms were estimated using the probit dose-response slope. This refinement to the risk quotient approach is laudable, but only addresses the effects portion of the risk calculation. The exposure estimate remains conservative and deterministic. The unfortunate outcome is probabilistic statements of risk (e.g., 1 in 180 chance of individual mortality) that are very misleading. For a number of uses, the text indicates a 1 in 1 chance of individual mortality. This statement implies absolute certainty of 100% mortality. In the case of adult CRLFs, there were a number of highly conservative assumptions in deriving the exposure estimates, e.g., that 100% of their prey would be from treated fields even though frogs rarely leave riparian areas. Thus, the 1 in 1 chance of individual mortality statement dramatically overstates risk and, potentially worse, misleads the reader into believing that the overstated risk is absolutely certain. Although we support the use of probabilistic risk assessment for the CRLF effects determination for dimethoate, use of such an approach must address both exposure and effects when estimating risk. Such assessments are routinely conducted for aquatic and wildlife receptors. For example, risks to prey of aquatic CRLF could be estimated by integrating the species sensitivity distribution for aquatic prey species with the exposure distribution derived from the 30-year output of a PRZM-EXAMS model run. For direct effects to adult CRLF, the exposure distribution derived from a probabilistic total daily intake model could be integrated with the dose-response distribution derived on the appropriate surrogate species.

Page 47. The text in the first paragraph implies that volatilization could be an important route of atmospheric transport. However, given the very low Henry's Law Constant for dimethoate and its limited persistence in the environment, it is highly unlikely that dimethoate is subject to atmospheric transport followed by wet and dry deposition.

Page 48. Here and elsewhere, it is unclear why T-REX, which was developed to estimate risk to birds and mammals, was used to estimate risk to CRLFs. T-HERPS was specifically developed to estimate risk to amphibians and reptiles. Although the effects determination mentions use of T-HERPS in several places, the majority of the text focuses on the results using T-REX. We would expect risk to CRLFs to be overestimated with T-REX versus T-HERPS because CRLFs are poikilotherms and thus have a lower rate of metabolism than do homeotherms such as birds and mammals. We recommend that all exposure analyses for adult CRLFs be conducted with T-HERPS. The T-REX materials should be removed from the effects determination because they give misleading results.

Table 12. The input values used in the PRZM/EXAMS modeling are highly conservative, often without any justification. For example, the measured aerobic soil metabolism half-life is arbitrarily multiplied by a factor of 3. Similarly, the measured aerobic and anaerobic aquatic metabolism half-lives are arbitrarily multiplied by factors of 2. An upper 90th percentile is used for the foliar degradation rate for all use scenarios even though crop-specific values are available for many of the uses considered in the effects determination (see Table 4 in EPA effects determination). Finally, the Kd value is the lowest non-sand value. It would seem reasonable and less hyperconservative to use the Kd values that most closely match the soil type for the crop under consideration. Collectively, the use of multiple conservative input values leads to compounded conservativism in the PRZM/EXAMS outputs. This approach is reasonable for a screening-level assessment, but should be considerably refined for use scenarios that indicate a potential risk to CRLFs. No such refinements were conducted as part of EPA's effects determination.

Page 63. The T-REX modeling approach discussed here indicates that the Mineau scaling factor of 1.15 was used to adjust toxicity values for tested birds to the bird size ranges of interest. The use of this adjustment factor has no scientific support because: (1) the scaling factor was derived for birds and there is no evidence suggesting that the factor can be extrapolated to amphibians, and (2) for most of the pesticides included in the Mineau study published in 1996, there was no relationship between toxicity and bird body size, indicating that the factor has limited support even for birds.

Page 65. The results of the terrestrial CRLF exposure modeling results are provided here. However, the results are only provided for the T-REX modeling effort, which is an inappropriate model for the CRLF (see page 48 comment above). Results from the more appropriate T-HERPS modeling effort should be included.

Table 17. The results for the dose-based EECs for CRLFs assume that all their prey arise from treated fields even though CRLFs are expected to forage almost exclusively in riparian areas.

Page 73. The text indicates that 48-hour EC50s for invertebrates range from 0.043 to 5.04 mg/L. A review of the toxicity literature for dimethoate conducted by the California Department of Fish and Game (CDFG, 1996) indicated that LC/EC50s for invertebrates from studies considered acceptable in their review ranged from 0.043 to 15 mg/L for dimethoate.

Page 73. The acute-to-chronic ratio (ACR) used to convert the stonefly EC50 to a chronic NOAEC was 83. This ACR was based on acute and chronic studies with *Daphnia magna*. Insufficient information was provided in the effects determination to judge the reliability and utility of the ACR derived for stoneflies. For example, was the daphnid ACR of 83 from one study that was designed to determine an ACR? If not, then the reliability of the derived ACR is much reduced and this source of uncertainty should be discussed in the effects determination. It would appear that the chronic value used in the ACR calculation is the most sensitive result from a study by Wuttrich (1990). It is not clear where the acute value came from, however. Are there other ACRs available for aquatic invertebrates? If so, are the ACR values similar to that derived for daphnids? The ACR of 83 would be more reliable if there were similar values for other invertebrates. The only other ACR that could be calculated from Table 21 is for rainbow trout and is much lower than that derived for daphnids (i.e., ACR = 14.4 for rainbow trout). Thus, the reliability of the daphnid ACR of 83 can certainly be questioned. Finally, for such a critical piece of information, it is a serious shortcoming that EPA did not provide a reference(s?) for the daphnid-based ACR.

Page 77. The toxicity value used for mammals potentially consumed by CRLFs was based on the results for male rats only (LD50 = 358 mg/kg), despite a value being available for females (LD50 = 414 mg/kg). It seems absurd that adult CRLFs would only forage on male small mammals. A more reasonable toxicity value would be an LD50 of 386 mg/kg which is the average of the male and female values.

Page 77. The chronic NOAEL of 0.1 mg/kg bw/day used in estimating risks to small mammal prey "was established based on observed decrease in pup deaths." How can a decrease in pup deaths be considered an adverse effect? More importantly, the chronic NOAEL of 0.1 mg/kg bw/day was based on a flawed statistical analysis of the data from a developmental neurotoxicity study (MRID 45529703) as has been noted in several peer-reviewed publications (Reiss and Gaylor, 2005; DeSesso et al., 2009). A meta-analysis of available rat developmental toxicity studies for dimethoate indicated a benchmark dose that would cause 1% mortality (BMD1) in one-day old pups (the most sensitive endpoint for mortality) of 3.9 mg/kg bw/day. The corresponding 95% lower bound on the BMD1 (i.e., the BMDL1) was 2.4 mg/kg bw/day (Hauswirth et al., 2004). One percent mortality is an ecologically insignificant effect (see Appendix B) and would have no impact on prey availability for terrestrial California red-legged frogs, particularly given that most mammalian prey for the frogs would come from riverine areas rather than treated fields. Further, the oral gavage dosing used in the developmental neurotoxicity study is not relevant to how small mammals forage in the field. In the field, small mammals feed throughout the day. Thus, their exposure would be to a series of small doses, some of which canbe metabolized between foraging events. This is not the case with the unrealistic oral gavage method of dosing, resulting in an overestimate of the toxicity of dimethoate to small mammals. The more relevant studies from an ecological perspective would be to use the rodent multiple generation dietary reproduction studies that have been conducted with dimethoate. Clearly, EPA is being hyperconservative in using a chronic NOAEL of 0.1 mg/kg bw/day as the basis for assessing risk due to reduction in availability of mammalian prey for terrestrial California red-legged frogs.

Page 82. On page 82, EPA states, "No data are available to assess the risks of dimethoate to vascular aquatic plants. Given the lack of data, RQ values could not be derived to represent the risks of dimethoate exposure to vascular aquatic plants." On behalf of the registrant, Porch et al. (2009) recently conducted a 7-day static renewal toxicity test on duckweed (Lemna gibba) exposed to dimethoate. The results for the technical product indicated EC50 values for frond number and biomass that were >41.5 mg a.i./L, the highest concentration treatment included in the test. The same results were observed with the formulation product (Dimethoate 400). Given the concentrations observed in monitoring studies and predicted with PRZM/EXAMS, it is clear that dimethoate poses no risk to aquatic vascular plants.

Page 84. Again, only T-REX risk estimates are provided here, rather than the results from the more appropriate T-HERPS model.

Table 34. Finally, the risk outputs from T-HERPS are presented to the reader. As expected, the RQs are much lower than those from T-REX, generally by several orders of magnitude depending on the prey item and size of the CRLF assumed. Again, there is no reason to include the T-REX results in the CRLF effects determination for dimethoate.

Page 96. The likelihood of individual mortality estimates derived from the dose-based CRLF risk estimates were based on a "probit dose-response of 2.54." It is not clear whether this is a typical probit slope value for birds or a conservative one. Although values are available for other bird species, they are not discussed in the text or provided in tables. The text indicates that the probit slope value of 2.54 comes from a study by Schafer et al. (1973). This study is of dubious quality as it involved wild caught birds and very low numbers of birds per treatment level. Thus, probit slopes from better conducted studies should have been considered in the effects determination.

Page 97. As with the dose-based probit slope of 2.54, the dietary-based probit slope of 10.1 was not discussed as to reliability or how it compared to values derived for other bird species.

Page 112. The case for effects to CRLFs as a result of effects to terrestrial habitat is very weak. One study is cited as the basis for assessing effects to terrestrial plants. In this study, an application of 0.02 lb ai/A caused a "decreased biomass" to two species of dicots. No indication is provided in the text as to whether there was a monotonic application rate-response relationship or what magnitude of decreased biomass was experienced by the plants. The effects determination also ignores the obvious … dimethoate is routinely applied to a wide variety of crops at rates that are orders of magnitude higher than the rate of 0.02 lb ai/A. Clearly, if adverse impacts to crops were occurring as a result of dimethoate application at the label application rates, farmers would not use the product. Two recent studies by Wildlife International (2009a,b) that were submitted to EPA back this point up. The studies involved application of Dimethoate 400 and dimethoate technical at rates of 1 lb ai/acre to 4 monocot and 6 dicot crop species. No adverse effects were observed at this application rate for 21-day seedling emergence, survival, height, dry weight or condition of any the 10 terrestrial plant species tested. The application rate in the Wildlife International studies is 50-fold greater than the rate used by EPA to estimate impacts to CRLF terrestrial habitat. Thus, it seems highly unlikely that terrestrial plants are experiencing adverse impacts at anywhere close to the distances predicted by EPA in the effects determination.

Table 46. Downstream dilution factors to reduce RQs to levels equal to the LOC are provided in this table for agricultural lands (dilution factor = 27.3) and orchard, vineyard and forests (dilution factor = 37.3). However, no information was provided in the text detailing how the dilution factors were calculated. It seems intuitively obvious that one dilution factor for each of the use groups cannot possibly be applicable to all aquatic systems in California. Stream flow rates near agricultural fields will vary from seasonally dry (i.e., zero) to very high for large rivers during spring. Similarly, flow rates from fields and distances to streams will have a large impact on the dimethoate

flow rates into aquatic systems. As the dilution factors are used to estimate the extent of the Action Area, this is a serious deficiency in the effects determination.

Table 47. As with the downstream dilution factors, the procedures used to calculate "downstream distance added" to include in the Action Area beyond the initial area of concern are not described. This is unacceptable scientific practice for such an important piece of information.

Table 48. The spray drift distances for not exceeding the LOC are presented here for agricultural lands (all non-woody crops) and orchards, vineyards and forests. Although the text notes that AGDISP was used to derive the distances, no other information is provided in the text. For example, which non-woody and woody crops were used to calculate the spray drift distances? Was aerial or ground application assumed? What size were the droplets? As the RQs are quite variable between crops, it would make much more sense to use crop-specific spray drift distances. This would have the effect of likely reducing the size of the Action Area. Further, the spray drift distances of over 10,500 feet for non-woody and woody crops are orders of magnitude beyond the distance for which AGDISP is considered reliable (300 m). Clearly, the calculated spray drift distances are highly unreliable. Yet these distances are a central piece in estimating the Action Area.

Page 124. The estimated exposures in aquatic habitat due to precipitation grossly exceed what likely occurs in the real world. First, the maximum concentration measured in precipitation was used in all calculations. Second, the calculations assume that, "the entire mass of dimethoate contained in the precipitation runs off from the [10 ha] field to the [1 ha] pond or is deposited directly into the pond." Third, "there is no degradation of dimethoate between the time it leaves the air and the time it reaches the pond." It is inconceivable that more than a small fraction of the rain contacting a 10 ha field would reach a 1 ha pond because much of the water would be absorbed by plants and soil, evaporate to air, or leach to groundwater. In the end, these extreme assumptions are used to predict concentrations of dimethoate in aquatic habitat as a result of deposition in rain (Table 52 in the effects determination). No context is, however, provided in the text as to what these extreme exposure estimates could mean in terms of risk to CRLF. What was the point of this exercise?

4.0 CONCLUSIONS AND RECOMMENDATIONS

The CRLF effects determination for dimethoate makes the case that the pesticide potentially poses a risk to CRLFs either directly or indirectly via effects to their prey and habitat. This is not an uncommon outcome for screening-level assessments that rely on highly conservative methods and assumptions, as was the case with the dimethoate effects determination. The normal practice in risk assessment is to then conduct more refined analyses to determine the likelihood, magnitude and ecological consequences of effects for those use scenarios that passed through the initial screen. In fact, the EPA Scientific Advisory Panel endorsed such a tiered approach for ecological risk assessments of pesticides conducted by EFED. Clearly, refined analyses are required for the CRLF effects determination to better understand potential risks of dimethoate and to then enact risk mitigation measures that are protective of CRLFs while also not unduly affecting agricultural stakeholders. Such refined analyses were not part of EPA's CRLF effects determination for dimethoate.

5.0 REFERENCES

Allen, T.F.H. and T.B. Starr. 1982. Hierarchy. Perspectives for Ecological Complexity. The University of Chicago Press, Chicago, IL.

Andersen, T.H., R. Tjørnhøj, L. Wollenberger, T. Slothuus and A. Baun. 2006. Acute and chronic effects of pulse exposure of *Daphnia magna* to dimethoate and pirimicarb. Environmental Toxicology and Chemistry 25: 1187-1195.

Anderson, T. D. and K.Y. Zhu. 2004. Synergistic and antagonistic effects of atrazine on the toxicity of organophosphorodithionate and organophosphorothionate insecticides to *Chironomus tentans* (Diptera:Chironomidae). Pestic. Biochem. Physiol. 80: 54-64.

Barnthouse, L.W. 2004. Quantifying population recovery rates for ecological risk assessment. Environmental Toxicology and Chemistry 23:500-508.

Beusen, J.M. and B. Neven. 1989. Toxicity of dimethoate to *Daphnia magna* and freshwater Fish. Bulletin of Environmental Contamination and Toxicology 42:126-133.

Bird, S L., S.G. Perry, S.L. Ray and M. E. Teske. 2002. Evaluation of the AgDISP aerial spray algorithms in the AgDRIFT Model. Environmental Toxicology and Chemistry 21: 672-681.

Bunker, A. 2001. *Peromyscus maniculatus*. Animal Diversity Web. Accessed January 17, 2007 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Peromyscus_maniculatus.html

CA PUR (California Pesticide Use Reporting Database). 2008. 2005, 2006 and 2007 dimethoate use data downloaded via CalPIP. http://calpip.cdpr.ca.gov/main.cfm

Caley, C.Y., B.D. Cameron, B. Knight, B. Hall and K. Armstrong. 1992. Alga, Growth Inhibition Test (72 h, EC50) with Technical Dimethoate. Inveresk Research International Study No. 381038; Report No. 8077. Unpublished report, CHA Doc. No. 123 DMT.

Canton, J.H., R.C.C. Wegman, A. Van Oers, A.H.M. Tammer, E.A.M. Mathijssen-Spiekman and H.H. Van den Broek. 1980. Environmental Toxicological Research with Dimethoate and Omethoate Rep.No.121/80, Natl. Inst. Public Health Environ. Hyg.

CDFG (California Department of Fish and Game). 1996. Hazard Assessment of the Insecticide Dimethoate to Aquatic Organisms in the Sacramento-San Joaquin River System. Pesticide Investigations Unit, Rancho Cordova, CA. Environmental Services Division Administrative Report 96-4.

CNDDB (California Natural Diversity Database). 2009. Biogeographic Data Branch, Department of Fish and Game. May 3rd, 2009. California Red-Legged Frog occurrence data.

DeSesso, J.M., R.E. Watson, C.L. Keen, K.P. Hazelden, L.C. Haws and A.A. Li. 2009. Analysis and integration of developmental neurotoxicity and ancillary data into risk assessment: A case study of dimethoate. Journal of Toxicology and Environmental Health 72: 94-109.

DOI (U.S. Department of the Interior Fish and Wildlife Service). 2006. Federal Register Part II – 50 CFR Part 17. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the California Red-Legged Frog, and Special Rule Exemption Associated With Final Listing for Existing Routine Ranching Activities. Final Rule. April 13, 2006.

ECOFRAM. 1999. Terrestrial Draft Report. http://www.epa.gov/oppefed1/ecorisk/terrreport.pdf

EN-CAS Laboratories. 1998a. Dissipation of Foliar Dislodgeable Residues of Dimethoate (O,O-dimethyl S-[N-[methylcarbamoyl]methyl] phosphorodithioate) and its Metabolite Omethoate (O,O-dimethyl S-[2-(methylamino)-2-oxoethyl] phosphorothioate) After Application of CLEAN CROP® Dimethoate 400 Insecticide to Tomato Plants. Prepared for: Cheminova Agro A/S. EN-CAS Laboratories, Winston-Salem, NC. Project Number 97-0023.

EN-CAS Laboratories. 1998b. Dissipation of Foliar Dislodgeable Residues of Dimethoate (O,O-dimethyl S-[N-[methylcarbamoyl]methyl] phosphorodithioate) and its Metabolite Omethoate (O,O-dimethyl S-[2-(methylamino)-2-oxoethyl] phosphorothioate) After Application of CLEAN CROP® Dimethoate 400 Insecticide to Leaf Lettuce. Prepared for: Cheminova Agro A/S. EN-CAS Laboratories, Winston-Salem, NC. Project Number 97-0068.

EPA (United States Environmental Protection Agency). 1993. Wildlife Exposure Factors Handbook. Volumes I and II. Office of Research and Development. Washington, DC. EPA EPA/600/R-93/187a, EPA/600/R-93/187b.

EPA (United States Environmental Protection Agency). 1995. Final Water Quality Guidance for Great Lakes System. Federal Register 60: 15366-15425.

EPA (United States Environmental Protection Agency). 2002a. Calcasieu Estuary Remedial Investigation/Feasibility Study (RI/FS): Baseline Ecological Risk Assessment (BERA). DCN: 3282-941-RTZ-RISKZ-14858. Region 6, Dallas, TX.

EPA (United States Environmental Protection Agency). 2002b. Memorandum dated July 1, 2002: Dimethoate (035001): Dietary exposure estimates for dimethoate metabolites of concern (excluding omethoate) in food crops. DP Barcode: D283889. Reregistration Case: 0088

EPA (U.S. Environmental Protection Agency). 2004a. Overview of the Ecological Risk Assessment Process in the Office of Pesticide Programs. Office of Prevention, Pesticides and Toxic Substances, Office of Pesticide Programs. Washington, D.C.

EPA (United States Environmental Protection Agency). 2004b. Ecological Risk Assessment for General Electric (GE)/Housatonic River Site, Rest of River. DCN: GE-100504-ACJS. New England Region, Boston, MA.

EPA (United States Environmental Protection Agency). 2005. General instructions for using AGDISP (v.8.13) to determine distance off field needed to be below the LOC (to estimate terrestrial action area for endangered species/to develop potential mitigation measures–buffers. Internal EPA draft guidance, Environmental Fate and Effects Division, dated October 2005.

EPA (U.S. Environmental Protection Agency). 2008. Risks of dimethoate use to the Federally-listed California red legged frog (*Rana aurora draytonii*) – Pesticide Effects Determination. Environmental Fate and Effects Division, Office of Pesticide Programs, Washington, D.C.

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

Fischer, D.L. and L.M. Bowers. 1997. Summary of field measurements of pesticide concentrations in invertebrate prey of birds. Poster presentation at the Society of Environmental Toxicology and Chemistry 18th annual meeting, San Francisco, USA.

FWS (Fish and Wildlife Service). 2006. Final Critical Habitat for the California Red-legged Frog (*Rana aurora draytonii*). April 13th, 2006. U.S. Fish and Wildlife Service, 2800 Cottage Way, Room W-2605, Sacramento CA 95825.

Gallagher, S.P., J. Grimes and J.B. Beavers. 2003a. Omethoate: An Acute Oral Toxicity Study With the Northern Bobwhite. Wildlife International, Ltd. Study No.: 542-101. Unpublished report, CHA Doc. No.: 581 DMT. Final report submitted to EPA on May 15, 2009. U.S. EPA MRID 47769703.

Gallagher, S.P., J. Grimes and J.B. Beavers. 2003b. Omethoate: An Acute Oral Toxicity Study With the Ring-necked Pheasant. Wildlife International, Ltd. Study No.: 542-102. Unpublished report, DTF – Omethoate Doc. No. O811-001. CHA Doc. No.: 580 DMT. Final report submitted to EPA on May 15, 2009. U.S. EPA MRID 47769704.

Giddings, J.M., R.C. Biever, M.F. Annunziato and A.J. Hosmer. 1996. Effects of diazinon on large outdoor pond microcosms. Environmental Toxicology and Chemistry 15: 618-629.

Giddings, J.M., L. Hall Jr., K. Solomon, W. Adams, D. Vogel, L. Davis and R. Smith. 1997. An ecological risk assessment of diazinon in the Sacramento and San Joaquin River Basins. Novartis Crop Protection Technical Report 11/97, Greensboro, NC.

Giddings, J.M., T.A. Anderson, L.W. Hall, A.J. Hosmer, R.J. Kendall, R.P. Richards, K.R. Soloman and W.M. Williams. 2005. Atrazine in North American Surface Waters: A Probabilistic Aquatic Ecological Risk Assessment. Society of Environmental Toxicology and Chemistry (SETAC), Pensacola, FL.

Giesy, J.P., K.R. Soloman, J.R. Coats, K.R. Dixon, J.M. Giddings and E.E. Kenaga. 1999. Chlorpyrifos: Ecological risk assessment in North American aquatic environments. Reviews of Environmental Contamination and Toxicology 160: 1-129.

Hauswirth, J., J.W. Hauswirth, D. O'Shaughnessy and R. Reiss. 2005. Dimethoate: Cheminova's Response to Issues Raised by the FIFRA Scientific Advisory Panel Discussions of November 30 and December 1, 2004.

Hayes, M.P. and M.R. Tennant. 1985. Diet and feeding behavior of the California red-legged frog. The Southwestern Naturalist 30: 601-605.

Hermens J, H. Canton, N. Steyger and R. Wegman. 1984. Joint effects of a mixture of 14 chemicals on mortality and inhibition of reproduction of *Daphnia magna*. Aquatic Toxicology 5: 315-322.

Hertl, J. 2002. Acute Toxicity of Dimethoate to *Daphnia magna* in a 48-hour Immobilization Test. IBACON - Institut für Biologische Analytik und Consulting. IBACON GmbH Study No. 10591220, 10591220A; Unpublished report, CHA Doc. No. 482 DMT.

Hoerger, F. and E.E. Kenaga. 1972. Pesticide residues on plants: Correlation of representative data as a basis for estimation of their magnitude in the environment. In: F. Coulston and F. Korte, eds., Environmental Quality and Safety: Chemistry, Toxicology, and Technology. George Thieme Publ, Stuttgart, West Germany.

Hubbard, P.M., K.H. Martin, J.B. Beavers. 2009a. Omethoate: A Dietary LC50 Study With the Northern Bobwhite. Wildlife International, Ltd. Project Number 232-141. U.S. EPA MRID 47709501.

Hubbard, P.M., K.H. Martin, J.B. Beavers. 2009b. Omethoate: A Dietary LC50 Study With the Mallard. Wildlife International, Ltd. Project Number 232-142. U.S. EPA MRID 47709502.

Hubbard, P.M., K.H. Martin, J.B. Beavers. 2009c. Dimethoate: A Dietary LC50 Study With the Mallard. Wildlife International, Ltd. Project Number 232-148. U.S. EPA MRID 47744401.

Hudson, R. H., R. K. Tucker and K. Haegele. 1984. Handbook of Acute Toxicity of Pesticides to Wildlife, Resource Publication 153. U.S. Department of Interior, Fish and Wildlife Service, Washington, DC. U.S. EPA MRID 00160000.

Huntingdon Life Sciences. 2005. 14C-Dimethoate Metabolism in Olives. Report prepared for Dimethoate Task Force, Mannheim, Germany by Huntingdon Life Sciences, Ltd., Cambridgeshire, United Kingdom. Project Identity: SCI/088.

Janssen, M.P.M., T.P. Traas, J.-P. Rila and P.L.A. van Vlaardingen. 2004. Guidance for Deriving Dutch Environmental Risk Limits from EU-Risk Assessment Reports of Existing Substances. RIVM report 601501020/2004. http://www.rivm.nl/bibliotheek/rapporten/601501020.pdf.

Johnson, W. and M. Finley. 1980. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication 137. U.S. Fish and Wildlife Service, Washington, D.C. MRID 40094602.

Kimmerer, R.W. and T.F.H. Allen. 1982. The role of disturbance in the pattern of a riparian bryophyte community. American Midland Naturalist 107: 370-383.

Liess, M. and R. Schulz. 1999. Linking insecticide contamination and population response in an agricultural stream. Environmental Toxicology and Chemistry 18: 1948-1955.

Moore, D.R.J. 1998. The ecological component of ecological risk assessment: Lessons from a field experiment. Human and Ecological Risk Assessment 3: 1-21.

Moore, D.R.J., R.P. Thompson and S.I. Purbrick. 2006a. Refined Aquatic Risk Assessment for Aldicarb. Prepared For: Bayer CropScience, Research Triangle Park, NC.

Moore, D.R.J., R.P. Thompson and S.I. Purbrick. 2006b. Refined Wildlife Risk Assessment for Aldicarb. Prepared For: Bayer CropScience, Research Triangle Park, NC.

Moore, D.R.J., R.L. Breton, T.M. Delongchamp, R.S. Teed and R.P. Thompson. 2007. Refined Avian Risk Assessment For Carbofuran. Prepared For: FMC Corporation, Philadelphia, PA.

Morey, S. 2005. California Wildlife Habitat Relationships System. California Department of Fish and Game. http://www.dfg.ca.gov/whdab/html/A039.html.

Owen, P. 2000. *Hyla regilla*. Animal Diversity Web. Accessed January 29, 2007 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Hyla_regilla.html

Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross and R.M. Hughes. 1989. Rapid Bioassessment Protocols for Use in Streams and Rivers: Benthic Macroinvertebrates and Fish.

Porch, J.R., T.Z. Kendall and H.O. Krueger. 2009. Dimethoate: A 7-day Static-Renewal Toxicity Test With Duckweed (Lemna gibba G3). Wildlife International Project Number 232A-118. Wildlife International, Easton, MD.

Ramachandran S, N. Rajendran and V.K. Venugopalan. 1980. Effect of pesticides DDT, dimethoate and sevin on the growth of marine diatom *Coscinodiscus concinnus* in culture. Mahasagar-Bulletin of the National Institute of Oceanography 13: 235-238.

Reiss, R. and D. Gaylor. 2005. Use of benchmark dose and meta-analysis to determine the most sensitive endpoint for risk assessment for dimethoate. Regulatory Toxicology and Pharmacology 43: 55-65.

Ribble, D.O. and M. Salvioni. 1990. Social organization and nest co-occupancy in *Peromyscus californicus*, a monogamous rodent. Behavioral Ecology and Sociology 26: 1-15.

Sanders, H.O. and O.B. Cope. 1968. The relative toxicities of several pesticides to naiads of three species of stoneflies. Limnol. Oceanogr. 13:112-117.

Schabacker, J. 2005. Review on initial residue levels of pesticides in arthropods sampled in field studies. RIFCON GmbH Report. Report No.: RC05-029.

Schafer, E.W., Jr., R.B. Brunton, N.F. Lockyer and J.W. DeGrazio. 1973. Comparative toxicity of seventeen pesticides to the Quelea, house sparrow, and red-winged blackbird. Toxicology and Applied Pharmacology 26: 156-157.

Schindler, D.W. 1990. Experimental perturbations of whole lakes as tests of hypotheses concerning ecosystem structure and function. OIKOS 57: 25-41.

Sherratt, T.N., G. Roberts, P. Williams, M. Whitfield, J. Biggs, N. Shillabeer and S.J. Maund. 1999. A life-history approach to predict the recovery of aquatic invertebrate populations after exposure to xenobiotic chemicals. Environmental Toxicology and Chemistry 18: 2512-2518.

Solomon, K.R., D.B. Baker, R.P. Richards, K.R. Dixon, S.J. Klaine, T.W. La Point, R.J. Kendall, C.P. Weisskopf, J.M. Giddings, J.P. Giesy, L.W. Hall Jr. and W.M. Williams. 1996. Ecological risk assessment of atrazine in North America surface waters. Environmental Toxicology and Chemistry 15: 31-76.

Song, M.Y., J.D. Stark and J.I. Brown. 1997. Comparative toxicity of four insecticides, including imidacloprid and tebufenozide, to four aquatic arthropods. Environmental Toxicology and Chemistry 16: 2494-2500. ECOTOX Reference # 18476.

Stephan, C.E., D.I. Mount, D.J. Hansen, J.H. Gentile, G.A. Chapman and W.A. Brungs. 1985. Guidelines for Deriving Numerical Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses. U.S. Environmental Protection Agency, Duluth, MN. PB 85-227049.

Suter II, G.W., R.A. Efroymson, B.E. Sample and D.S. Jones. 2000. Ecological Risk Assessment for Contaminated Sites. Lewis Publishers, Boca Raton, FL.

Thybaud E., S. Le Bras and R.P. Cosson. 1987. Étude comparée de la sensitivité *d'Asellus aquaticus* L. (Crustacé, Isopode) vis-á-vis de quelques insecticides et de divers métaux lourds. Acta Oecologica, Oecol. Applic. Vol 8 : 355-361.

USC (University of South Carolina). 2006. *Pero*base - A comprehensive database for *Peromyscus.* University of South Carolina. Accessed January 17, 2007 at http://wotan.cse.sc.edu/perobase/index.html.

Van den Brink, P.J., R.P.A. Van Wijngaarden, W.G.H. Lucassen, T.C.M. Brock and P. Leeuwangh. 1996. Effects of the insecticide Dursban 4E (active ingredient chlorpyrifos) in outdoor experimental ditches: II. Invertebrate community responses and recovery. Environmental Toxicology and Chemistry 15:1143-1153.

Versteeg, D.J., S.E. Belanger and G.J. Carr. 1999. Understanding single species and model ecosystem sensitivity: A data-based comparison. Environmental Toxicology and Chemistry 18:329-1346.

Wildlife International. 1999a. Dissipation of Dimethoate and its Metabolite Omethoate. Dislodgeable Foliar Residues on Apples Treated With Clean Crop® Dimethoate 400. Prepared for Cheminova Agro A/S. Wildlife International Ltd., Easton, MD. Project Number 232-118.

Wildlife International. 1999b. Dissipation of Dimethoate and its Metabolite Omethoate. Dislodgeable Foliar Residues on Grapes Treated With Clean Crop® Dimethoate 400. Prepared for Cheminova Agro A/S. Wildlife International Ltd., Easton, MD. Project Number 232-117.

Wildlife International. 2009a. Dimethoate: A Toxicity Test to Determine the Effects of the Test Substance on Seedling Emergence of Ten Species of Plants. Report prepared for Cheminova A/S. Easton, Maryland. US EPA OPPTS Number 850-4100.

Wildlife International. 2009b. Dimethoate: A Toxicity Test to Determine the Effects of the Test Substance on Vegetative Vigour of Ten Species of Plants. Report prepared for Cheminova A/S. Easton, Maryland. US EPA OPPTS Number 850-4150.

Wilson, A. 2000. Residue Decline Curve Study With an EC Formulation Containing 400 g/L Dimethoate Applied to Cherries in Spain and Italy, 1999. Project Number: SCI/024. Unpublished study prepared by Huntingdon Life Sciences, Ltd. 94 p. DMT 426.

Wilson, A. 2001a. Residue Study (Decline Curve) With an EC Formulation Containing 400 g/L Dimethoate Applied to Wheat in Spain and Italy in 2002. Project Number: SCI/046. Unpublished study prepared by Huntingdon Life Sciences, Ltd. 133 p. DMT 453. MRID 46678001.

Wilson, A. 2001b. Residue Study (Decline Curve) With an EC Formulation Containing 400 g/L Dimethoate Applied to Wheat in Spain and Italy in 2002. Project Number: SCI/037. Unpublished study prepared by Huntingdon Life Sciences, Ltd. 144 p. DMT 459. MRID 46678010.

Wilson, A. 2001c. Residue Study (Decline Curve) With an EC Formulation Containing 400 g/L Dimethoate Applied to Wheat in United Kingdom and Germany in 2001. Project Number: SCI/080. Unpublished study prepared by Huntingdon Life Sciences, Ltd. 133 p. DMT 484.

Wilson, A. 2001d. Residue Decline Curve Study With an EC Formulation Containing 400 g/L Dimethoate Applied to Lettuce in Italy, Spain and Greece in 2000. Project Number: SCI/041. Unpublished study prepared by Huntingdon Life Sciences, Ltd. 112 p. DMT 438. MRID 46678007.

Wilson, A. 2001e. Residue Study (Decline Curve) With an EC Formulation Containing 400 g/L Dimethoate Applied to Tomatoes in Spain and Italy in 2000. Project Number: SCI/040. Unpublished study prepared by Huntingdon Life Sciences, Ltd. 112 p. DMT 448. MRID 46678008.

Wilson, A. 2001f. Residue Study (Decline Curve) With an EC Formulation Containing 400 g/L Dimethoate Applied to Celery in Italy in 2000. Project Number: SCI/043. Unpublished study prepared by Huntingdon Life Sciences, Ltd. 91 p. DMT 439.

Wilson, A. 2001g. Residue Decline Curve Study With and EC Formulation Containing 400 g/L Dimethoate Applied to Sugar Beet in Italy and Spain in 2000. Project Number: SCI/045. Unpublished study prepared by Huntingdon Life Sciences, Ltd. 109 p. DMT 541. MRID 46678004.

Wilson, A. 2001h. Residue Study (Decline Curve) With an EC Formulation Containing 400 g/L Dimethoate Applied to Asparagus in Spain in 2001. Project Number: SCI/076. Unpublished study prepared by Huntingdon Life Sciences, Ltd. 76 p. DMT 479.

Wilson, A. 2001i. Residue Decline Curve Study With an EC Formulation Containing 400 g/L Dimethoate Applied to Citrus in Spain, Italy and Greece in 1999. Project Number: SCI/022. Unpublished study prepared by Huntingdon Life Sciences, Ltd. 291 p. DMT 460.

Wilson, A. 2001j. Residue Study (Decline Curve and at Harvest) With an EC Formulation Containing 400 g/L Dimethoate Applied to Citrus in Spain, Italy and Greece in 2000. Project Number: SCI/039. Unpublished study prepared by Huntingdon Life Sciences, Ltd. 186 p. DMT 467.

Wilson, A. 2001k. Residue Study (Decline Curve) With an EC Formulation Containing 400 g/L Dimethoate Applied to Melons in Italy, Spain and Greece in 2000. Project Number: SCI/047. Unpublished study prepared by Huntingdon Life Sciences, Ltd. 131 p. DMT 456. MRID 46678002.

Wilson, A. 2001l. Residue Study (Decline Curve) With an EC Formulation Containing 400 g/L Dimethoate Applied to Globe Artichokes in Italy in 2000. Project Number: SCI/044. Unpublished study prepared by Huntingdon Life Sciences, Ltd. 100 p. DMT 472.

Wuttrich, V. 1990. Influence of dimethoate on the reproduction of *Daphnia magna*. Department of Pesticide Regulation Document 204-097, California Environmental Protection Agency.

Zok, S. 2001a. Dimethoate: Acute Toxicity in the Northern Bobwhite Quail (*Colinus virginianus*) Aafter Single Oral Administration (LD50). BASF - Experimental Toxicology and Ecology Study No.: 11W0466/99128. DTF Doc. No. 441-008. Unpublished report, CHA Doc. No.: 470 DMT. Final report submitted to EPA on May 15, 2009. U.S. EPA MRID 47769701.

Zok, S. 2001b. Dimethoate: Acute Toxicity in the Ring-necked Pheasant (*Phasianus colchicus*) After Single Oral Administration (LD50). BASF - Experimental Toxicology and Ecology Study No.: 12W0466/99126. Unpublished report, DTF Doc. No. 441-007. CHA Doc. No.: 471 DMT. Final report submitted to EPA on May 15, 2009. U.S. EPA MRID 47769702.

Zok, S. 2001c. Dimethoate: Avian Dietary LC50 Test in Chicks of the Bobwhite Quail (*Colinus virginianus*). BASF - Experimental Toxicology and Ecology Study No.: 31W0466/99127. DTF Doc. No. 445-010. Unpublished report, CHA Doc. No.: 469 DMT. Final report submitted to EPA on May 15, 2009. U.S. EPA MRID 47769705.

APPENDIX A

SPATIAL ANALYSIS FOR DETERMINING AREA OF INITIAL CONCERN

Appendix A: Spatial Analysis for Determining Area of Initial Concern

An initial area of concern can be defined by the geographic intersection of areas of dimethoate use and CRLF habitat (as defined by occurrence or specific features of the landscape). The data elements required to derive the initial area of concern for CRLF include:

1. Locations where the pesticide has been applied, and

2. Locations of CRLF observations and critical habitat.

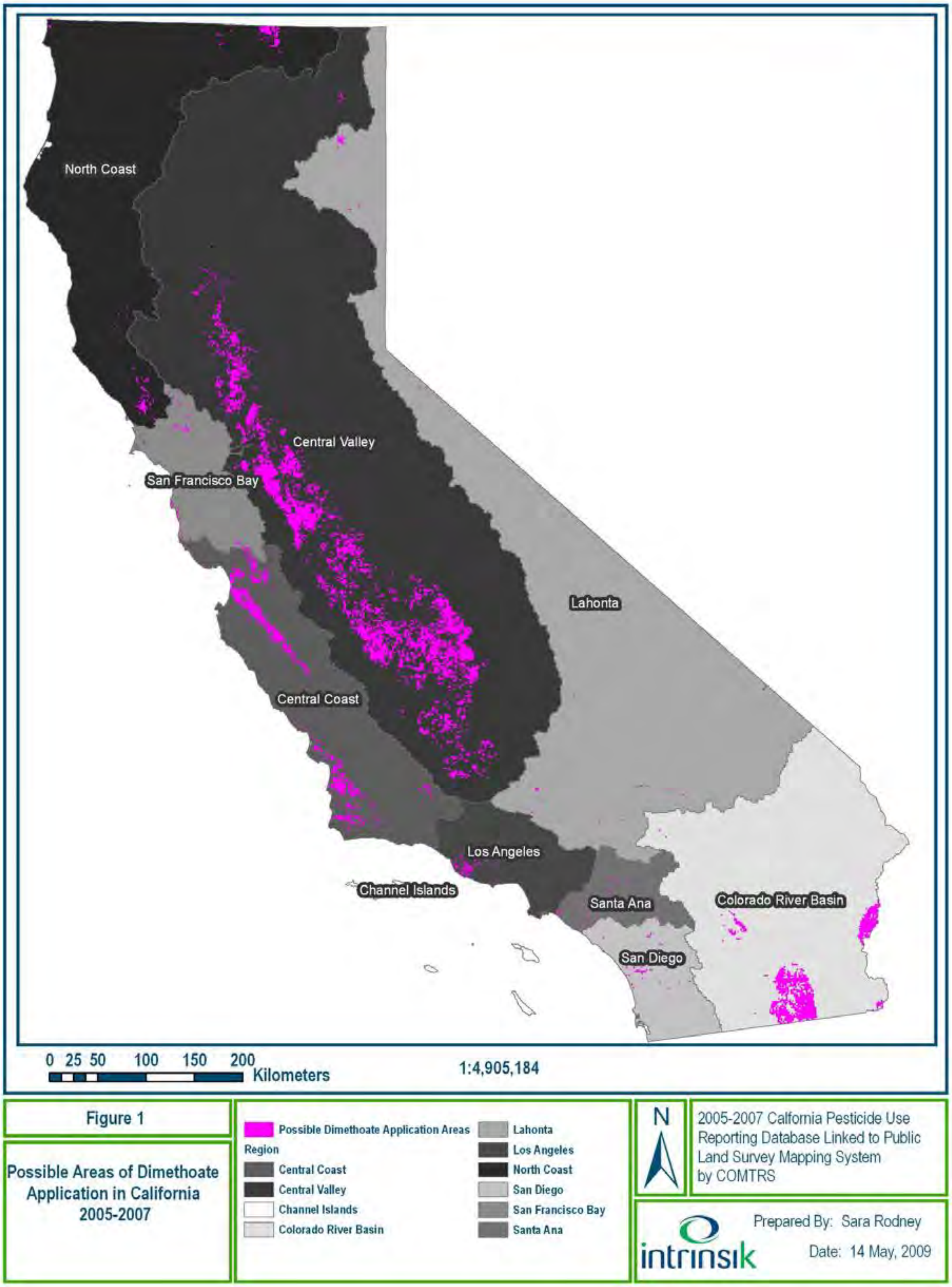
Geographical information systems (GIS) can integrate these data elements and establish the initial area of concern. The remainder of this appendix provides a detailed description of the approach used to establish a refined initial area of concern for CRLF potentially exposed to dimethoate in California.

Data Elements

The California pesticide use reporting database (CA PUR) provides data on pesticide use in California. The use data includes the location (land parcel) to which particular pesticide products have been applied. This information can be related to the California Public Land Survey System (PLSS) to the section level (1 mile by 1 mile grid) by county, meridian, township, range, and section of the Public Lands Survey mapping system (COMTRS). The use information includes identity of the pesticide applied, crop or other use type, amount of pesticide used, product name, etc. The PUR data used in the determination of the initial area of concern for dimethoate included data available from 2005 to 2007 (Appendix A, Figure 1). The three-year use period should account for changes in pesticide use that arise due to crop rotations, variable annual pest outbreaks, and other factors that fluctuate from year to year. The total land area to which dimethoate has been applied during 2005-2007 in California (in one or more of the three years), based on the CA PUR data is 3.9 million acres (approximately 4% of the total area of California; Appendix A, Figure 1). Table 1 below presents how this total area is split among the regions of California.

Table 1. Areas of possible dimethoate application in 2005, 2006 or 2007 by region.

Region	***Area (acres)***	***Percentage***
Central Valley	2,617,416	67.5
Colorado River Basin	535,058	13.8
Central Coast	478,101	12.3
North Coast	99,523	2.6
Los Angeles	36,950	1.0
Lahonta	32,352	0.8
San Francisco Bay	29,378	0.8
San Diego	29,163	0.8
Santa Ana	19,625	0.5



California red-legged frogs are present in many California counties. Areas that support CRLF, but are outside the critical habitat designation, are still subject to conservation actions and regulations under Sections 7(a)(1) and 7(a)(2) of the ESA. Observations of CRLFs (n = 1007) are recorded in the California Natural Diversity Database (CNDDB), with observations listed as far back as 1919 (Appendix A, Figure 2) (CNDDB, 2009). Some of the occurrence records spatially overlap. In total, areas of observed occurrence in California sum to approximately 526,100 acres (or roughly 0.5% of the total area of California). These areas are concentrated in the San Francisco Bay and Central Coast regions (Appendix A, Figure 2).

Critical habitat is defined in Section 3 of the Endangered Species Act to include:

- Specific areas in the geographical area occupied by a species at the time it is listed in accordance with the Act, on which are found those physical or biological features (i) essential to the conservation of the species, and (ii) that may require special management considerations or protection; and

- Specific areas outside the geographical area occupied by a species at the time it is listed, upon a determination that such areas are essential for conservation of the species (DOI, 2006).

Primary constituent elements (PCEs) are used to define what constitutes critical habitat for a listed species. PCEs are those physical and biological features that the Fish and Wildlife Service (FWS) deems essential to the conservation of the species. The PCEs for the CRLF include aquatic breeding habitat, non-breeding aquatic habitat, upland habitat, and dispersal habitat. The FWS has recently designated 36 critical habitat units comprising 450,289 acres for the California red-legged frog (Appendix A, Figure 3). These areas contain sufficient aquatic habitat for breeding and non-breeding activities and sufficient upland habitat for shelter, foraging, predator avoidance and dispersal. CRLF critical habitat in California sums to 450,289 acres (or approximately 0.4% of the total area of California). Similar to the areas of occurrence, the critical habitat areas are concentrated in the San Francisco Bay and Central Coast regions (Appendix A, Figure 3). The critical habitats are found in 20 California counties including Alameda, Butte, Contra Costa, El Dorado, Kern, Los Angeles, Marin, Merced, Monterey, Napa, Nevada, San Benito, San Luis Obispo, San Mateo, Santa Barbara, Santa Clara, Santa Cruz, Solano, Ventura, and Yaba counties (DOI, 2006).

Spatial Analysis

The data sets described above were imported into ArcView 9.1 and spatially overlain. To determine the initial area of concern, the PLSS layer and CA PUR data for dimethoate (2005-2007) were related by COMTRS. The resulting data layer was then overlain with the CNDDB CRLF observation data (1919-2008) and the critical habitat polygons provided by FWS (2006). The initial area of concern was defined by the intersection of the occurrence and critical habitat areas with the areas of possible dimethoate application (Appendix A, Figure 4). The initial area of concern includes 6 of the 36 critical habitat areas. The rest of the initial area of concern is derived from the intersection of areas of observed occurrence and dimethoate application in 2005, 2006 or 2007. The total initial area of concern is 24,695 acres (or approximately 0.02% of the total area of California). Most of the area is concentrated in the Central Coast region (20,069 acres), followed by the San Francisco Bay (2,489 acres), Central Valley (1,583 acres) and North Coast (555 acres) regions (Appendix A, Figure 4). All of the initial area of concern

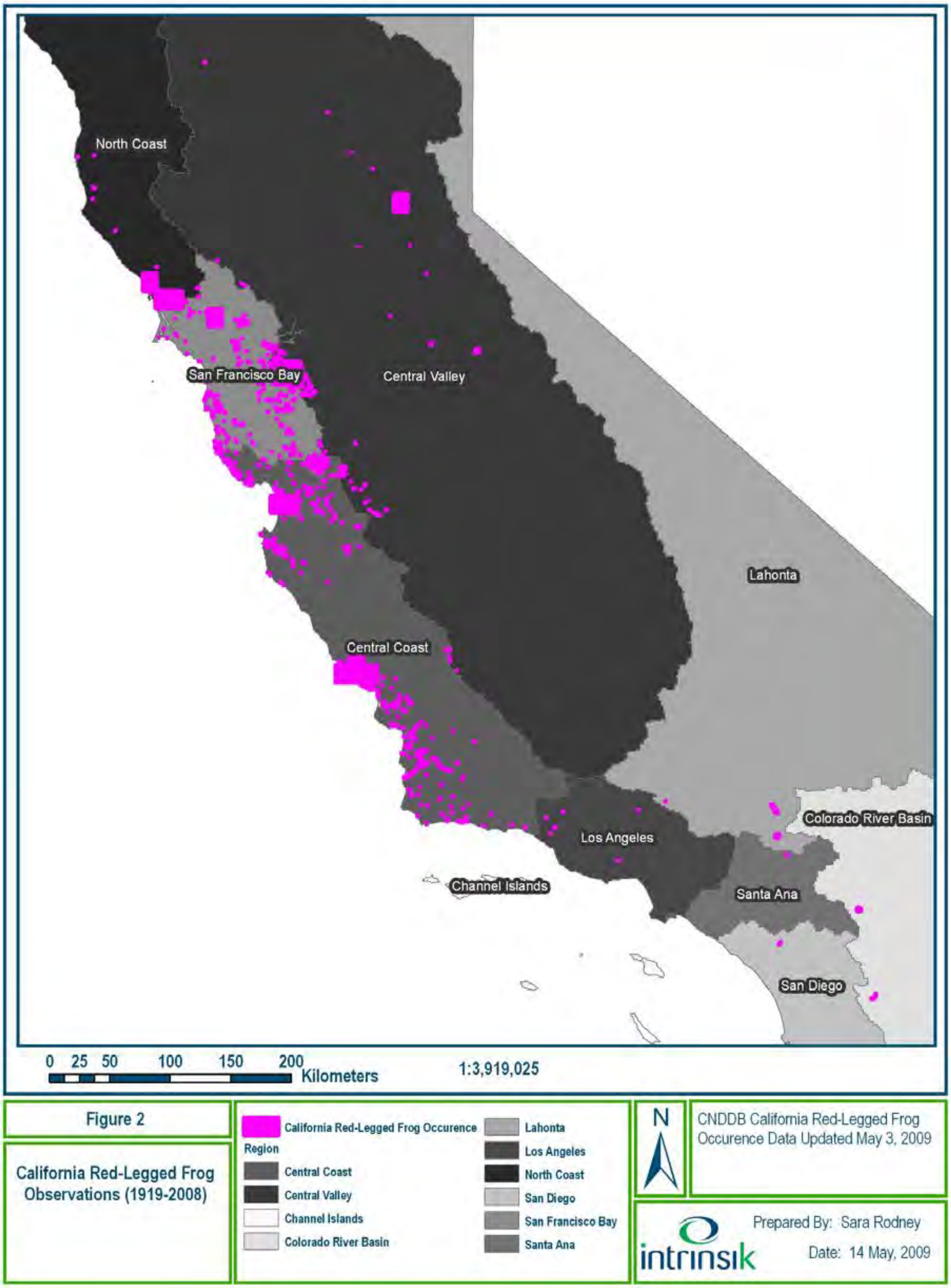
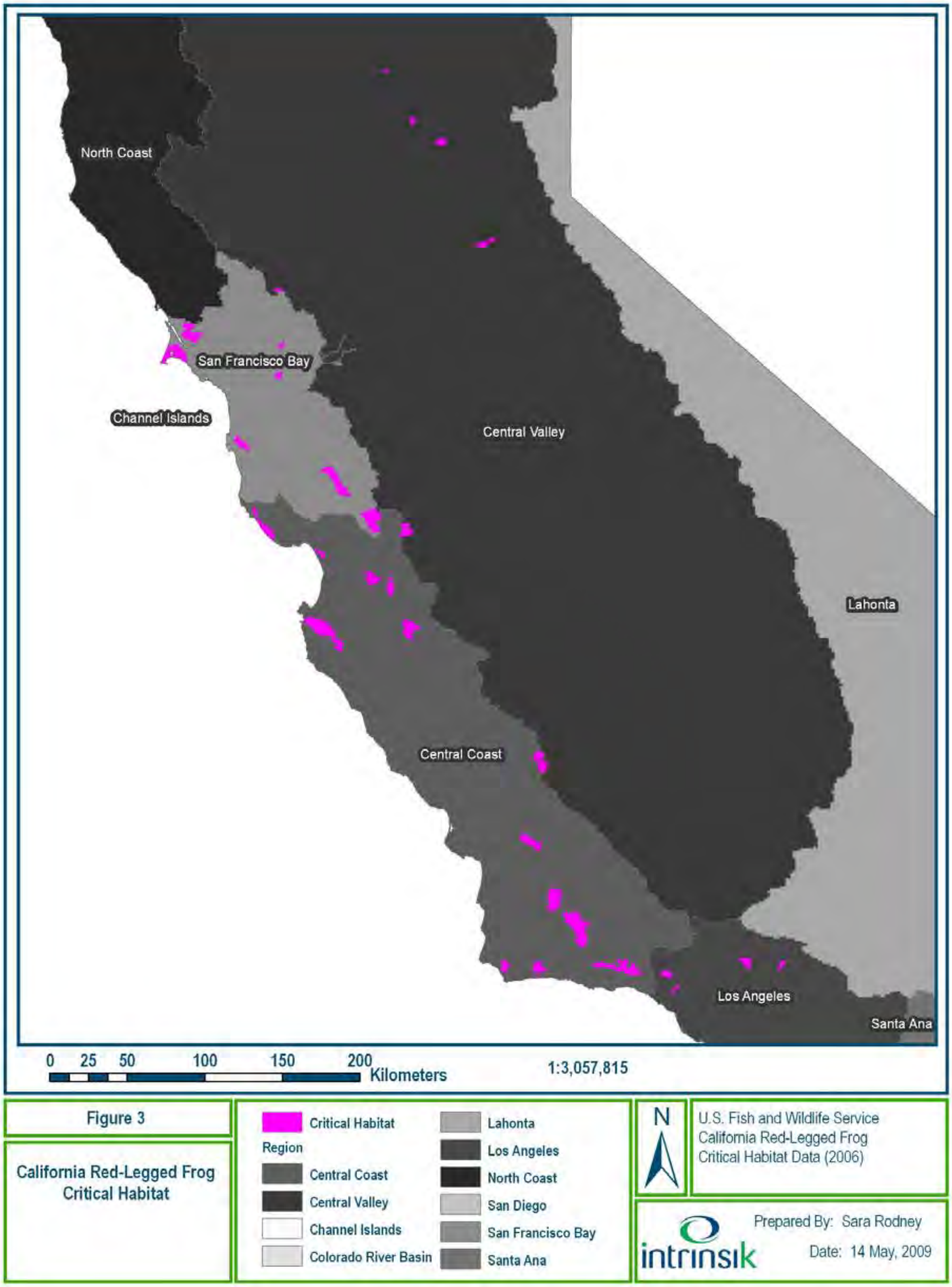


Figure 2

California Red-Legged Frog Observations (1919-2008)



occurs within 85 km of the Pacific coast. This is consistent with the concentration of areas of observed occurrence and critical habitat in the Central Coast and San Francisco Bay regions.

To derive an appropriate refined Action Area, further spatial analysis would involve accounting for the movement of dimethoate from the areas of initial concern via spray drift, erosion, flow of water and movement of contaminated prey items. For the reasons outlined in the Comments section above, the analyses conducted by EPA to define off-field movement of dimethoate were seriously flawed and cannot be used to define the Action Area using our refined initial area of concern as a starting point.

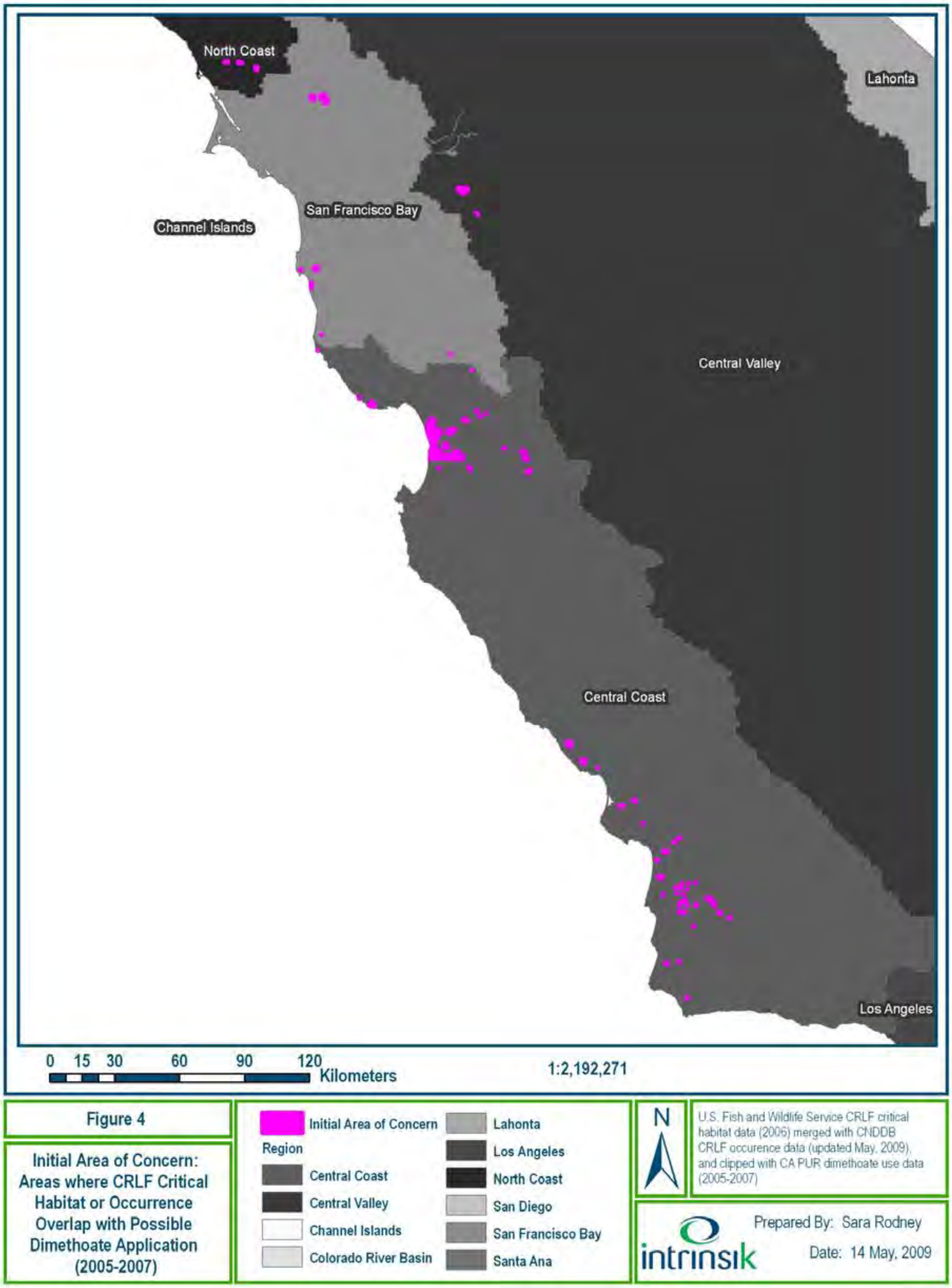


Figure 4

Initial Area of Concern: Areas where CRLF Critical Habitat or Occurrence Overlap with Possible Dimethoate Application (2005-2007)

APPENDIX B

RISK CATEGORIES FOR INDIRECT EFFECTS TO CRLF

APPENDIX B: RISK CATEGORIES FOR INDIRECT EFFECTS TO CRLF

The risk categories for indirect effects are based on several considerations including:

- Losses of small numbers of individuals from a few sensitive populations in a local system are likely to be reversible and should not lead to adverse effects on ecosystem function (Moore, 1998; Giddings et al., 2005). When only sensitive individuals or local populations have been affected by a stressor, other more tolerant species with similar function often increase such that overall ecosystem function is unaffected (Schindler, 1990; Moore, 1998). It is because of ecosystem resiliency and functional redundancy that regulatory programs such as the development of national water quality criteria in the United States and the Netherlands have as their goal protection of 95% or more of aquatic species (Stephan et al., 1985; EPA 1995; Janssen et al., 2004). Although chains of events or risk cascades can occur (i.e., toxic effects on a sensitive species causes ripples throughout the ecosystem), the results of mesocosm and field studies indicate that the opposite is far more common – a community or ecosystem is less sensitive than its most sensitive species (e.g., Moore, 1998). This statement is one of the foundations of hierarchy theory as proposed by Allen and Starr (1982). The theory proposes that effects at lower levels of ecological organization (e.g., population or species level) are not necessarily translated to higher levels of ecological organization (e.g., community level). This theory has been demonstrated in a number of mesocosm and field studies for both pesticides (Giddings et al., 1996; Versteeg et al., 1999) and for other environmental stressors (Kimmerer and Allen, 1982; Schindler, 1990; Moore, 1998). For example, the loss of amphipods and isopods from mesocosms exposed to cypermethrin had no apparent impact on the overall ecosystem because other groups of organisms (e.g., rotifers, copepods, chironomids) expanded to fill the role of the missing species (Farmer et al., 1985).

- Several studies have shown that aquatic invertebrate species, particularly those with short generation times and high reproductive rates (e.g., cladocerans, copepods, ostracods), recover quickly from brief episodes of increased mortality due to pesticides (van den Brink et al., 1996; Sherratt et al., 1999; Barnthouse, 2004). These studies indicate that many aquatic invertebrate populations would recover quickly from a short-term dimethoate exposure even in scenarios classified as low or intermediate risk. Liess and Schulz (1999), however, showed that recovery can take a very long time (months to years) for aquatic invertebrates when local populations are extirpated. Thus, risk scenarios in the high risk category would be of concern for aquatic invertebrate populations.

- Although there are exceptions (direct effects to threatened and endangered species), an effect level of 10% is unlikely to be ecologically significant to a local population. Such an effect generally cannot be reliably confirmed by field studies (Moore, 1998; Suter et al., 2000). Thus, when concentrations of a pesticide are less than the 5^{th} percentile on the low effects SSD, it is likely that at least 95% of aquatic species are being protected.

- Controlled exposure-response experiments with microcosms and mesocosms have demonstrated that at some level of exposure, temporary changes occur in the abundance of a few, sensitive species. At a higher level of exposure, more severe and longer-lasting impacts occur that may have pronounced effects on community structure and function. The transition from minor (i.e., ecologically tolerable) to major impacts usually occurs at concentrations greater than the 10^{th} percentile of single species low toxic effect values (Giddings et al., 1996, 1997; Solomon et al., 1996; Versteeg et al., 1999).

- Based on an analysis of EPA regulatory practice, Suter et al. (2000) concluded that decreases in an ecological assessment endpoint of less than 20% are generally acceptable. For example, the approximate detection limit of field measurement techniques used in regulating contaminants based on bioassessment of aquatic ecosystems is 20%. The community metrics for an exposed benthic invertebrate community must be reduced by more than 20% compared to pristine reference sites to be considered even slightly impaired in the EPA rapid bioassessment procedure (Plafkin et al., 1989).

- The curve corresponding to a risk product of 2% passes through the points corresponding to a very low probability (i.e., 10%) of 20% or greater effect, and a low probability (i.e., 20%) of 10% or greater effect. Thus, based on the above consideration, if the highest or *maximum risk product* is less than 2% for an exposure scenario, then it is a low risk scenario for indirect effects.

- The curve corresponding to a risk product of 10% passes through the points corresponding to a very high probability (100%) of 10% or greater effect, and a median probability (*i.e.*, 50%) of 20% or greater effect. Scenarios with a maximum risk product of 10% or more would be considered to be high risk scenarios because there is a high to very high probability of detectable and possibly major impacts on local prey and plant species that could lead to effects on species that depend on these organisms for food and habitat. Scenarios with a maximum risk product equal to or greater than 2% but less than 10% are judged to be intermediate risk scenarios.

- Where there is a very low likelihood of a scenario affecting prey and plant species, risk is categorized as *de minimis*. A 5% probability of exceeding 5% mortality lies on the curve defined by the *risk product* equal to 0.25% (e.g., 5% probability of 5% or greater effect = 0.25%). This value is thus used as the upper limit for the *de minimis* risk category.

APPENDIX C

HOME RANGE OF PREY OF TERRESTRIAL ADULT CRLF

APPENDIX C: HOME RANGE OF PREY OF TERRESTRIAL ADULT CRLF

California red-legged frogs (CRLFs) consume a variety of insect and invertebrate species (Hayes and Tennant, 1985). They have also been reported to consume larger prey such as fish (e.g., *Gasterosteius aculeatus*), amphibians (e.g., Pacific tree frog -- *Hyla regilla*), and mammals (e.g., California mouse -- *Peromyscus californicus*) (Hayes and Tennant, 1985). Of these prey, species from the genus *Peromyscus* (e.g., California mouse, deer mouse) and *Hyla* may inhabit areas where dimethoate is applied. Although unlikely, there is a potential for CRLFs to consume *Peromyscus* or *Hyla* that were exposed at the site of dimethoate application and then traveled to CRLF habitat. Home range information for *H. regilla* indicates a home range is approximately 33 m for resident frogs, with movements of up to 400 m for migrating frogs (Morey, 2005). The home range of *P. californicus* varies greatly from 150 to 3,788 m^2, with average ranges of 1,161 to 1,500 m^2 (Ribble and Salvioni, 1990; USC, 2006). Home ranges for deer mice (*P. maniculatus*) also vary greatly, ranging from 242 to 3,000 m^2 (Bunker, 2001). Mean home ranges reported in the U.S. EPA *Wildlife Exposure Factors Handbook* for deer mice vary from 140 to 1,280 m^2 (EPA, 1993). Using a conservative approach to select from the available data, the maximum home range of 3,788 m^2 for *P. californicus* was used to estimate the distance from a treated field that a mouse could potentially travel. The maximum home range was converted to a radius using the following equations:

$$Area\,of\;a\,circle = \pi R^2$$
$$3{,}788\,m^2 = \pi R^2$$
$$R = \sqrt{\frac{3{,}788\,m^2}{\pi}}$$
$$R = 34.7 \approx 35\,m$$

where *R* = radius (m). Thus, the likely maximum distance that a California mouse would travel from the center of it's home range is 35 m. It would thus be an unusual event for CRLFs, which forage in or near aquatic habitats, to encounter California mice or other small mammals that occur on fields treated with dimethoate.