Appendix K. Review of ECOTOX database for Dimethoate and Omethoate

K.1. Identification of dimethoate toxicity data relevant to CRLF assessment that are more sensitive than those reported in the 2006 RED

The most sensitive toxicity data identified in the RED, that are representative of direct and indirect effects to the aquatic and terrestrial phases of the California red legged frog (CRLF) are identified in Tables K.1 and K.2. The RED did not contain registrant-submitted toxicity data for aquatic or terrestrial plants. More sensitive values for the different endpoints, as identified in ECOTOX are identified below. Several of the ECOTOX references have already been reviewed by EFED (USEPA 2006).

The following steps were followed in searching ECOTOX for dimethoate exposures:

1) Only endpoints identified in ECOTOX Tables 1 and 2 were considered.
2) Endpoints were identified that were more sensitive than those presented in Tables K.1 and K.2, below.
    a) For acute exposures to fish, only 96-h LC_{50} values were considered.
    b) For acute exposures to invertebrates, 48-96-h EC_{50} values were considered.
    c) For aquatic plants, EC_{50} values were considered.
3) Endpoints from tests where organisms were exposed to formulated product ("Conc Type" = F) were not considered, with the exception of exposures to amphibians.
4) Only data points where considered where the "conc type" field was identified as "A" (meaning that the study author defined the effects concentration in terms of the active ingredient)

Table K.1. Summary of most sensitive toxicity for assessing direct and indirect effects of dimethoate to CRLF in aquatic habitats.

Assessment Endpoint	Species (common name)	End-point	Mean concentration (mg/L)	Ref. (MRID)
Measures of Direct Effects				
Acute toxicity to CRLF	*Oncorhyncus mykiss* (Rainbow Trout)	LC_{50}	6.2	40094602
Chronic toxicity to CRLF	*Oncorhyncus mykiss* (Rainbow Trout)	NOAEC[1]	0.43	43106303
Measures of Indirect Effects				
Toxicity to unicellular plants composing aquatic habitat and representing prey for tadpole CRLF	*Anabaena variabilis* (blue-green algae)	EC_{50}	0.084	Das and Adhikary 1996
Toxicity to multicellular plants composing aquatic habitat	No data are available at this time			
Acute toxicity to invertebrates (prey)	*Pteronarcys californica* (Stonefly)	EC_{50}	0.043	00003503
Chronic toxicity to invertebrates (prey)		NOAEC[2]	0.0005	
Acute toxicity to fish and frogs representing prey	*Oncorhyncus mykiss* (Rainbow Trout)	LC_{50}	6.2	40094602
Acute toxicity to fish and other species of frogs (prey)	*Oncorhyncus mykiss* (Rainbow Trout)	NOAEC[1]	0.43	43106303

[1]LOAEC = 0.84 mg/L. Affected endpoint: reduced growth.

[2] Estimated using acute to chronic ratio with *Daphnia magna* data.

Table K.2. Summary of most sensitive toxicity for assessing direct and indirect effects of dimethoate to CRLF in terrestrial habitats. Study classifications based on EFED's ecotoxicity database.

Assessment Endpoint	Species (common name)	End-point	Mean concentration	Ref. (MRID)
Measures of Direct Effects				
Acute toxicity to CRLF	*Agelaius phoeniceus* (red-winged blackbird)	LD_{50}	5.4 mg/kg	00020560
Sub-acute toxicity to CRLF	*Phasianus colchicus* (ring-necked pheasant)	LC_{50}	332 mg/kg-diet	00022923
Chronic toxicity to CRLF	*Colinus virginianus* (Northern bobwhite quail)	NOAEC[1]	4.0 ppm	44049001
Measures of Indirect Effects				
Acute toxicity to invertebrates (prey)	*Apis mellifera* (Honey bee)	LD_{50}	0.05 µg a.i./ bee	00026489
Acute toxicity to mammals (prey)	*Rattus norvegicus* (laboratory rat)	LD_{50}	358 mg/kg	00164220
Chronic toxicity to mammals (prey)	*Rattus norvegicus* (laboratory rat)	NOAEC[2]	0.1 mg/kg-bw	45529702
Acute toxicity to frogs representing prey	*Agelaius phoeniceus* (red-winged blackbird)	LD_{50}	5.4 mg/kg	00020560
Sub-acute toxicity to frogs representing prey	*Phasianus colchicus* (ring-necked pheasant)	LC_{50}	332 mg/kg-diet	00022923
Chronic toxicity to other species of frogs (prey)	*Colinus virginianus* (Northern bobwhite quail)	NOAEC[1]	4.0 ppm	44049001
Toxicity to monocot plants composing wetland and terrestrial habitat	No data are available at this time			
Toxicity to dicot plants composing wetland and terrestrial habitat				

[1] LOAEC = 10.1 ppm. Affected endpoints included: reduced egg production, viable embryos, 3-week old embryos, normal hatchlings, 14-day old survivor weight, adult male and female body weight, egg shell thickness.

[2]LOAEC = 400 mg/kg/day. Affected endpoints included: brain/blood acetylcholinesterase inhibition, decreased weight.

1.1. Freshwater fish

ECOTOX contained two 96-h LC_{50} values for exposures of freshwater fish to dimethoate that were more sensitive than reported in the RED. Those values are summarized in Table K.3. No chronic values identified in ECOTOX for freshwater fish exposed to dimethoate were more sensitive than those reported in the RED.

Table K.3. Acute toxicity data identified in ECOTOX for freshwater fish exposed to dimethoate. These values are more sensitive than reported in the RED (see Table K.1).

Organism	Endpoint	Value (mg/L)	ECOTOX Ref#
Smooth breasted snakefish (*Channa orientalis*)	96-h LC_{50}	4.275-4.55	5860
Bluegill (*Lepomis macrochirus*)	96-h LC_{50}	6	6797

The value corresponding to the smooth breasted snakefish was derived from an exposure involving dimethoate contained in a formulated product. Therefore, this value was not considered further for the purposes of deriving an endpoint for this assessment. Because both acute and chronic toxicity data were available for the rainbow trout and because the acute toxicity endpoint for rainbow trout (LC_{50} = 6.2mg/L) was similar to that of the bluegill (LC_{50} = 6 mg/L), the acute toxicity endpoint for the rainbow trout was used for this assessment.

1.2. Aquatic-phase amphibians

No acute or chronic values were identified in ECOTOX for aquatic-phase amphibians exposed to dimethoate where the "conc type" was identified as "A." There were three studies (ECOTOX references 6661, 6362 and 11521) identified in **Table 2** involving exposures of freshwater frogs of the genus *Rana* (*Rana tigrina* and *Rana hexadactyla*) to formulated products containing dimethoate. Since exposures involved formulated products, these data were not used for quantifying the effects of dimethoate to the CRLF.

1.2. Freshwater Invertebrates

ECOTOX contained two 96-h LC_{50} values for freshwater invertebrates that were more sensitive than reported in the RED. Those values are summarized in **Table K.4**. These values were derived from exposures involving dimethoate contained in a formulated product. Therefore, these values were not considered further for the purposes of deriving an endpoint for this assessment. No chronic toxicity values, identified in ECOTOX for freshwater invertebrates exposed to dimethoate, were more sensitive than those reported in the RED science chapter.

Table K.4. Acute toxicity data identified in ECOTOX for freshwater invertebrates exposed to dimethoate. These values are more sensitive than reported in the RED (see Table K.1).

Organism	Endpoint	Value (mg/L)	ECOTOX Ref#
Mayfly (*Baetis rhodani*)	96-h LC_{50}	0.007	13409
Caddisfly (*Hydropsyche siltalai*)	96-h LC_{50}	0.023	13409

1.3. Aquatic plants

ECOTOX contained four EC_{50} values for exposures of freshwater unicellular (nonvascular) plants to dimethoate. Those values are summarized in Table K.5. No additional toxicity values were identified in ECOTOX for freshwater vascular plants exposed to dimethoate.

Table K.5. Acute toxicity data identified in ECOTOX for freshwater unicellular plants exposed to dimethoate.

Organism	Endpoint	Value (mg/L)	ECOTOX Ref#
Cyptomonad (*Cryptomonas pyrenodifera*)	6-d EC_{50}	16	16010
Green algae (*Pseudokirchneriella subcapitata*)	4-d EC_{50}	36, 37, 38	69584

1.4. Birds

No acute or chronic toxicity values identified in ECOTOX for birds exposed to dimethoate were more sensitive than those reported in the RED science chapter.

1.5. Terrestrial invertebrates

No acute or chronic toxicity values identified in ECOTOX for terrestrial invertebrates exposed to dimethoate were more sensitive than those reported in the RED science.

1.6. Terrestrial mammals

No acute toxicity values identified in ECOTOX for terrestrial mammals exposed to dimethoate were more sensitive than those reported in the RED science chapter. One study (ECOTOX reference 79194) reports chronic toxicity endpoint for mammals exposed to dimethoate which is lower (16-d LOAEL = 28 ppm) than that reported in the RED science chapter.

1.7. Terrestrial plants

No EC_{25} values were identified in ECOTOX for terrestrial plants exposed to dimethoate; however, two studies were reported in ECOTOX that are useful for qualitatively describing the phytotoxicity of dimethoate. In a study conducted in Europe, six species of "weeds" were exposed to dimethoate at a rate of 0.02 lb a.i./A. After 28 days, mean dry weight was significantly affected in two species (*Agrostemma githago* and *Urtica urens*), both of which were dicots (ECOTOX Reference 87590). In another study involving exposures of wheat to 0.5 lb a.i./A, chlorosis and necrosis were observed, with mass and overall yield (bushels/acre) unaffected (ECOTOX Reference 75355).

K.2. Identification of omethoate toxicity data relevant to CRLF assessment

Although omethoate is expected to be short-lived, toxicity data for this degradate of dimethoate were reviewed. One study by Anderson and Zhu (2004) (ECOTOX reference # 74947) was referenced in ECOTOX for exposures of aquatic benthic invertebrates to omethoate (Anderson and Zhu 2004). In this study, midges (*Chironomus tentans*) were exposed to omethoate for 2 days. Although the concentration type of this study was "F," a review of this study indicated that the test substance was actually 99% omethoate.

One study (ECOTOX reference # 79198) was referenced in ECOTOX for exposures of terrestrial invertebrates to omethoate. In this study, honeybees (*Apis mellifera*) were exposed to omethoate. The concentration type of this study was "F."

No additional studies were referenced in ECOTOX for exposures of aquatic and terrestrial organisms to omethoate.

K.3. Cited ECOTOX References

Abdel-Hamid MI; (1996) Development and Application of a Simple Procedure for Toxicity Testing Using Immobilized Algae. Water Sci Technol 33(6): 129-138. ECOTOX REF# 69584.

Anderson, T.D. and K.Y. Zhu. 2004. Synergistic and antagonistic effects of atrazine on the toxicity of organophosphorodithioate and organophosphorothioate insecticides to *Chironomus tentans* (Diptera: Chironomidae). Pestic Biochem Physiol 80(1): 54-64. ECOTOX REF# 74947.

Baekken T;Aanes KJ; (1991) Pesticides in Norwegian Agriculture. Their Effects on Benthic Fauna in Lotic Environments. Preliminary Results. Int Assoc Theor Appl Limnol Proc (Int Ver Theor Angew Limnol Verh . ECOTOX REF# 13409.

Chapin, J.W and J.S. Thomas. 1999. Efficacy and phytotoxicity of insecticides tank-mixed with express herbicide and topdress nitrogen for barley yellow dwarf suppression on wheat. Arthropod Management Tests, 24: 320-321. ECOTOX Reference # 75355.

Dutta SK;Mohanty-Hejmadi P; (1978) Life History & Pesticide Susceptible Embryonic Stages of the Indian Bull Frog Rana tigrina Daudin. Indian J Exp Biol 16(6)(): 727-729. ECOTOX REF# 6661.

Fiedler, L. 1988. Assessment of chronic toxicity of selected insecticides to honeybees. J. Apic Res 26(2): 115-122. ECOTOX REF# 79198.

Hanley, M.E and M.D. Whiting. 2005. Insecticides and arable weeds: effects on germination and seedling growth. Ecotoxicology, 14: 483-490. ECOTOX reference # 87590.

Kallqvist T;Romstad R; (1994) Effects of Agricultural Pesticides on Planktonic Algae and Cyanobacteria - Examples of Interspecies Sensitivity Variations. Norw J Agric Sci Suppl 13(): 117-131. ECOTOX REF# 16010.

Khangarot BS;Sehgal A;Bhasin MK; (1985) 'Man and Biosphere' - Studies on the Sikkim Himalayas. Part 6: Toxicity of Selected Pesticides to Frog Tadpole Rana hexadactyla (Lesson). Acta Hydrochim Hydrobiol. ECOTOX REF# 11521.

Mahadevaswami MP;Kaliwal BB; (2002) "Effect of Dimethoate Administration Schedules on Compensatory Ovarian Hypertrophy, Follicular Dynamics, and Estrous Cycle in Hemicastrated Mice". J Basic Clin Physiol Pharmacol 13(3): 225-248. ECOTOX REF# 79194.

Mayer FL Jr.;Ellersieck MR; (1986) Manual of Acute Toxicity: Interpretation and Data Base for 410 Chemicals and 66 Species of Freshwater Animals. "Resour Publ No 160, U S Dep Interior, Fish Wildl Serv, Washington, DC(): 505 p. (USGS Data File)-". ECOTOX REF# 6797.

Mohanty-Hejmadi P;Dutta SK; (1981) Effects of Some Pesticides on the Development of the Indian Bull Frog Rana tigerina. Environ Pollut Ser A24(2): 145-161. ECOTOX REF# 6362.

Verma SR;Bhatnagar MC;Dalela RC; (1978) "Biocides in Relation to Water Pollution. Part 2: Bioassay Studies of Few Biocides to a Fresh Water Fish, Channa gachua". Acta Hydrochim Hydrobiol 6(2): 137-144. ECOTOX REF# 5860.