Appendix B – Ecological Effects Data

This appendix contains toxicity data from three sources: Ecotoxicology guideline studies in Agency files, data located by ECOTOX in open literature, and data as presented in the methyl parathion RED. Reviews for open literature data included in the table, or reviewed and not found valid for quantitative or qualitative use, are also included.

Table 1 Ecological Guideline Studies[M] for Methyl Parathion

Guideline #	Requirement Description	Test Product	Data Valid for Risk Assessment?	MRID	Study Classification
71-1	Avian Acute Oral	No guideline studies located in files or listed in OPPIN			
71-2	Avian Subacute Dietary	Technical Penncap-M TEP	Yes Yes No[F]	102329[A,L] 102329[A,] 44173913	Supplemental Supplemental Core[F]
71-4	Avian Reproduction	Technical	Yes Yes	41179301 41179302	Supplemental Supplemental
Non	Avian Acute Dermal	EC Formulation Penncap-M	Not used[R] Not used[R]	71200 83103	Supplemental Supplemental
72-1	FW Fish Acute	Technical Penncap-M TEP	Yes Yes No[F]	128791 128791 40932101	Core Core Core[F]
72-2	FW Aquatic Invertebrate Acute	Technical Penncap-M	Yes Yes	128790 128790	Core Core
72-3 (a)	SW Fish Acute	TEP	No[F]	40932103	Core[F]
72-4	SW Aquatic Invertebrate	TEP	No[F]	40932104	Core
72-4	FW Fish Early Life Stage	Technical Penncap-M	Yes Yes	128791 128791	Supplemental Supplemental
72-4	SW Fish Early Life Stage	Technical	No	41083101	Invalid
72-4(b)	FW Aquatic Invertebrate Reproduction	Technical Penncap-M Technical	Yes Yes Yes	41506801 128790 43035401	Supplemental Core Supplemental
123-1(a)	Seedling Emergence	No guideline studies located in files or listed in OPPIN			
123-1 (b)	Vegetative Vigor	No guideline studies located in files or listed in OPPIN			
141-1	Honey Acute Contact	No guideline studies located in files or listed in OPPIN			
	Honey Bee Acute Oral	Technical Penncap-M	Not used[R] Not used[R]	44038201 44038201	Core Core
141-2	Honey Bee Foliage Contact	Penncap-M	Not used[R]	44173914	Core

[M] Not including mammalian studies, which are reviewed by HED
[A] Not reported in OPPIN
TEP Typical End-use Product
[F] Toxicity data from end-use products can be used to evaluate toxicity of a product as compared to the technical but are not used to calculate RQs, even if study is classified as Core for formulation, designated in this table as Core [F]
[R] Currently, there is no standard method for using this type of data in the risk assessment.

Table 2 Summary of Guideline Acute Toxicity Studies for Aquatic Organisms Located in Preparation of this Assessment

Species	LC_{50} (mg/L)	Slope	95% C.I. (mg/L)	MRID	Toxicity Category	Study Classification	Notes
Freshwater Fish (72-1)							
Rainbow trout[R] *(Onchorhynchus mykiss)*	2.2	ND	1.5-2.7	40932101 Suprenant 1988	Moderately toxic	Core	Typical end-use product (43.2 % ai)
Rainbow trout *(Onchorhynchus mykiss)*	5.2	6.3 (3.1-9.5)	4.2-6.6	00128791 Bailey 1983	Moderately toxic	Core	Penncap-M[1]
	7.2	ND	3.5-11.2			Core	Technical[1]
Freshwater Invertebrates (72-2)							
Water flea *(Daphnia magna)*	0.00330	5.4 (3.3-7.6)	0.00274-0.00391	00128790 Bailey 1983	Very highly toxic	Core	Penncap-M[1]
	0.00717	5.0 (3.1-6.8)	0.00597-0.00876			Core	Technical[1]
Marine/Estuarine Fish (72-3)							
Sheepshead minnow[R] *(Cyprinodon variegates)*	3.4	3.8 (2.6-5.1)	2.8-4.1	40932103 Surprenant 1988	Moderately toxic	Core	Typical end-use product (43.2 % ai)
Marine/Estuarine Invertebrates							
Mysid shrimp[R] (*Mysidopsis bahia*)	0.00035	NR	0.00031-0.00039	40932104 Surprenant 1988	Very highly toxic	Core	Typical end-use product (43.2 % ai)

[R] As reported and used in the EFED RED chapter
[1] Statistics recalculated to filtered and mean-measured values (Penncap-M) and mean-measured values (technical)
ND Available data not appropriate for probit analysis

Table 3 Summary of Guideline Chronic Toxicity Data for Aquatic Organisms Located in Preparation of this Assessment

Species	LOAEC (mg/L)	NOAEC (mg/L)	MRID	Study Classification	Notes
Freshwater Invertebrates (72-4(b))					
Water flea[R] *(Daphnia magna)*	0.000562	0.000178	41506801 Heimbach 1987	Supplemental	Survival, growth, and offspring/parent daphnia 96% ai
Water flea[R] *(Daphnia magna)*	0.00251	0.00016	00128790 Bailey 1983	Core	Penncap-M Young produced/day Avg number of young produced 75.1% ai
Water flea[ND] *(Daphnia magna)*	0.00085	0.00043	43035401	Supplemental	Most sensitive endpoints were survival, weight, and time to first brood
Freshwater Fish (72-1)					
Rainbow trout[R] *(Onchorhynchus mykiss)*	0.10	>0.10	00128791 Bailey 1983	Supplemental	Penncap-M Length and weight endpoints affected, fry survival affected at 0.40 mg/L
	0.08	>0.08			Technical Length and weight endpoints affected, fry survival affected at 1.91 mg/L

[R] As reported and used in the EFED RED chapter
[ND] New registrant-submitted guideline study, not used in RED

Table 4 Summary of Guideline Acute Data for Birds Located in Preparation of this Assessment

Species	LC_{50}/LD_{50} (mg/kg)	Slope	95% C.I.	MRID	Toxicity Category	Study Classification	Notes
Avian Subacute Dietary(71-2)							
Bobwhite quail (*Colinus virginianus*)	33.3	6.8 (3.5-10.2)	25.1-40.9	102329 Pennwalt 1972	Very highly toxic	Supplemental	Penncap-M
	28.2	8.7 (4.0-13.3)	22.0-35.3				Technical
Avian Acute Dermal Exposure[1]							
Bobwhite quail[R] (*Colinus virginianus*)	2.9	NR	2.3-3.7	71200 Beavers 1980	No scale for this type of test	Supplemental (Non-guideline)	45.42% ai EC formulation Under wings
Bobwhite quail[R] (*Colinus virginianus*)	9.1	NR	NA	83103 Beavers 1980		Supplemental (Non-guideline)	22.0% ai Penncap-M Under wings

[R] As reported and used in the EFED RED chapter

[1] Not guideline, but submitted by registrant. Dermal studies performed by dosing birds with methyl parathion under the wings.

NA Not applicable, non-definitive endpoint

Table 5 Summary of Guideline Acute Toxicity Data for Terrestrial Animals Other than Birds Located in Preparation of this Assessment

Species	LD_{50}	Slope	95% C.I.	MRID	Toxicity Category	Study Classification	Notes
Mammal Acute Oral (81-1)							
Rat[R]	3.6 (M) mg/kg	NR	1.63-7.92	Accesssion 243414	Very highly toxic	Core Minimum (HED study)	Methyl parathion 80% Male value was EFED endpoint in RED
	23.0 (F) mg/kg	NR	13.7-38.6		Highly toxic		
Rat	6-16 (M) mg/kg	NR	NR	Document 000168	Highly toxic to very highly toxic	(HED study)	Technical Lowest female endpoint was HED endpoint in RED
	4.5-24 (F) mg/kg						
Terrestrial Invertebrates (141-X)							
Honey bee[R] (*Apis mellifera*)	0.214 μg/bee	NR	NR	44038201	Highly toxic (Acute oral)	Core	Penncap-M
	0.111 μg/bee	NR	NR				Technical

Table 6 Summary of Guideline Chronic Toxicity Data for Terrestrial Animals as Located in Preparation of this Assessment

Species	LOAEC mg/kg	NOAEC mg/kg	MRID	Endpoints Affected	Study Classification	Notes
Avian Reproduction						
Bobwhite quail[R] (*Colinus virginianus*)	15.5	6.3	41179302 (Beavers 1988)	Number of eggs laid, eggs set/hen, adult female bodyweight	Core	Technical
Mallard duck[R] (*Anas platyrhynchos*)	>14.7	>14.7	41179301 (Beavers 1988)	No effects at highest concentration tested	Supplemental	Technical
Mammal Chronic						
Rat	>25	25	00119087	No significant differences in any endpoints noted. Maternal weights were reduced somewhat during lactation, but recovered afterwards	Core Minimum (HED study)	Technical

[R] As reported and used in the EFED RED chapter
NR – Not reported, raw data not available to recalculate.

Table 7 ECOTOX Data Valid for Quantitative or Qualitative Use: Freshwater Invertebrates and Aquatic Plants

Species	LC_{50} (µg/L)	Slope	95% C.I. (µg/L)	ECOTOX #	Toxicity Category	Endpoint Use Category	Notes
Freshwater Invertebrates							
Water flea *(Daphnia magna)*	2.3 (24-hr)	NP	2.2-2.5	E91481 Duquesne	Very highly toxic	QUAN	PARAOXON Study examined effects of 24-hr pulse exposure followed by 48-hr recovery.
Amphipod *(Hylalla azteca)*	2.1 (mp alone)	NP	1.0-2.9	E64955 Anderson & Lydy 2002	Very highly toxic	$QUAN^{NL}$	MIXTURE Study examined effects of mixtures of atrazine and methyl parathion. Authors concluded exposure to atrazine potentiated effects of methyl parathion
	1.2 (w/80µg/L atrazine	NP	NP		Very highly toxic	QUAL	
	0.7 (w/200µg/L atrazine	NP	NP		Very highly toxic	QUAL	
Aquatic Plants							
Green alga *(Scenedesmus subspicatus)*	15,000 (72-hr)	NP	NP	E4008 Schafer *et. al.,* 1993	No scale for this type of organism	QUAN	Data are based on OECD guideline 72-hr static test.
Aquatic mosquito fern *(Azolla pinnata)*	18,400	NP	18,010-18,810	E17302 Rosakutty & Kumaraguru 1994	No scale for this type of organism	QUAL	MIXTURE Test conducted on end-use product (Metacid-50), which also contains some DDT. Methyl parathion is dominant active (50% by weight) Provides additional line of evidence for aquatic plants.

NP Not presented by authors, raw data not available to calculate
$QUAN^{NL}$ Of suitable quality for quantative use, but no lowest endpoint located

Table 8 All Freshwater Fish Data Located (96-hr)

Organism	LC_{50} (ug/L)	95% CI	Ref
Cutthroat trout	1850	1390-2470	Mayer & Ellersieck
Barbus dorsalus (Two spot African barb)	2100	NA	E6722, Rao
Onchoryhnchus mykiss (Rainbow trout)	2200	1500-2700	MRID 40932101, Core
Cyprinus carpio (Common carp)	2360	NA	E91468, Thiruvalluvan
Lepomis macrochirus (Bluegill)	2434	NA	E6897, Auwater
Rainbow trout	2750	2000-3780	Mayer & Ellersieck
Onchoryhnchus mykiss (Rainbow trout)	2800	NA	E15572, Palawski
Yellow perch	3060	2530-3700	Mayer & Ellersieck
Lake trout	3360	2910-3890	Mayer & Ellersieck
Rainbow trout	3700	3130-4380	Mayer & Ellersieck
Lake trout	3780	2810-5090	Mayer & Ellersieck
Anguilla anguilla (common eel)	4120	NA	E11055, Ferrando
Bluegill	4380	3480-5510	Mayer & Ellersieck
Morone saxatilis (Striped bass)	4500	NA	E2012, Hughes
Brown trout	4700	3900-5750	Mayer & Ellersieck
Cutthroat trout	4880	4150-5730	Mayer & Ellersieck
Largemouth bass	5220	4320-6310	Mayer & Ellersieck
Channel catfish	5240	4270-6440	Mayer & Ellersieck
Coho salmon	5300	4900-5600	Mayer & Ellersieck
Carassius carassius (Crucian carp)	5500	NA	E3241, Dela Cruz
Labeo rohita (Rohu)	6340	NA	E11261, Bengeri
Catla catla (Catla)	6500	NA	E19255, Alam
Black bullhead	6640	4970-8880	Mayer & Ellersieck
Green sunfish	6860	5590-8420	Mayer & Ellersieck
Green sunfish	6900	6030-7890	Mayer & Ellersieck
Bluegill	6900	6400-7440	Mayer & Ellersieck
Heteropneutus fossilis (Indian catfish)	7000	NA	E5262, Srivastava
Carp	7130	6440-7870	Mayer & Ellersieck
Fathead minnow	7200	5700-9100	Mayer & Ellersieck
Pimephales promelas (Fathead minnow)	7500	NA	E2155, Henderson
Lepidocephalichthyes guntea	8000	NA	E289, Alam
Fathead minnow	8900	7780-10200	Mayer & Ellersieck
Goldfish	9000	8100-9900	Mayer & Ellersieck
Tilapia nilotica (Nile tilapia)	9500	NA	E3241, Dela Cruz
Fathead minnow	9960	8630-11500	Mayer & Ellersieck
Oryzias latipes (Medaka)	11200	NA	E89099, Wolfe
Gambusia affinis (Western mosquitofish)	12806	NA	E62030, Boone

NA Not available

Note: Fish data were abundant and relatively consistent. Specific studies were not reviewed. Most sensitive value used as assessment endpoint.

Table 9 ECOTOX Data Valid for Quantitative or Qualitative Use: Amphibians (Aquatic-Phase)

Species		LC_{50} (µg/L)	Slope	95% C.I. (µg/L)	ECOTOX #	Toxicity Category	Endpoint Use Category	Notes
Amphibians (Aquatic-Phase)								
Indian bullfrog tadpoles *(Rana tigrina)*		4,396 (96 hr)	14.8 (0.9-28.6)	2,460-5,510	E9226 Alam & Shafi 1991	Moderately toxic	QUAL	Test conducted on end-use product (Metacid-50), which also contains DDT. Endpoint corrected to percent technical. Provides order of magnitude estimate of toxicity for underrepresented taxa.
Indian bullfrog adult *(Rana tigrina*	Male 8.4g	4,000 (96 hr)	NP	3,850-4,150	E52442 Mudgall & Patil 1987	Moderately toxic	QUAL	Test conducted on "commercial grade methyl parathion 50%" Endpoint corrected to percent technical. Provides order of magnitude estimate of toxicity for underrepresented taxa.
	Female 20.1g	5,750 (96 hr)		5,600-6,100		Moderately toxic	QUAL	
Indian bullfrog tadpoles *(Rana tigrina)*		4,360 (96 hr)	NP	3,300-5,960	E66399 Kennedy & Sampath 2001	Moderately toxic	QUAL	Technical methyl parathion used as test substance, but given errors in reporting and lack of raw data to confirm LC_{50} estimates, not considered suitable for quantitative use in assessment. Provides order of magnitude estimate of toxicity for underrepresented taxa.
Indian bullfrog tadpoles *(Rana tigrina)*		4,860 (96 hr)	NP	NP	E65895 Sampath, *et al.,* 2002	Moderately toxic	QUAL	Given lack of raw data to confirm LC_{50} estimates, endpoints not considered suitable for quantitative use in assessment. Provides order of magnitude estimate of toxicity for underrepresented taxa.

NP Not presented by authors, raw data not available to calculate

Table 10 ECOTOX Data Valid for Quantitative or Qualitative Use: Birds (Oral Dose)

Species	LC_{50}/LD_{50} (mg/kg)	Slope	95% C.I.	ECOTOX#	Toxicity Category	Endpoint Use Category	Notes
Avian Oral Dose							
American kestrel *(Falco sparvarius)*	est. 3.1	13.8 (-1.1-28.6)	2.7-infinity	E38447	Very highly toxic	QUAL	Estimated LD_{50} was slightly above concentrations tested. Sufficient partial kill data existed that probit estimate of LD_{50} could be obtained, but significant uncertainty surrounds estimate. Average weight of an American kestrel is approximately 120 g.[1]
Bobwhite quail (*Colinus virginianus*)	9.8	26.8 (12.6-41.0)	9.5-10.2	E39539	Highly toxic	QUAN	Pen-reared (groups statistically inseparable)
	10.2	37.0 (15.4-58.6)	9.8-10.5				Wild-caught (groups statistically inseparable)

[1] Bernstein,MH, Curtis, MB, and DM Hudson (1979). Independence of brain and body temperature in flying American kestrels. *American Journal of Physiology-Regulatory, Integrative, and Comparative Physiology*. 237:R58-R62. *F. sparverius* mean mass 119 g.
Smallwood, JA (1987). Sexual Segregation by habitat in American kestrels wintering in Southeastern Florida: Vegetative structure and response to differential prey availability. The Condor 89:842-849. *F. sparverius* mean mass males 115g, females 124g.
Yamamoto JT and GM Santolo (2000). Body condition effects in American kestreals fed selenomethionione. Journal of Wildlife Diseases 36(4):646-652. *F. sparverius* mass 111.5-118.7g.
www.hawkmountain.org/meida/kestrel.pdf *F. sparverius* mass 97-150g.
www.biokids.umich.edu/critters/Falco_sparverius *F. sparverius* mass males 103-120g, females 126-166g..

Table 11 ECOTOX Data Valid for Quantitative or Qualitative Use: Honeybee Acute Contact

Species	LD_{50} µg/bee	Slope	95% C.I.	ECOTOX#	Toxicity Category	Endpoint use category	Notes
Honeybee Acute Contact							
Honeybee (Apis mellifera)	0.28	NP	0.23-0.35	E91623	Highly toxic	QUAN	Most sensitive colony Authors tested 14 colonies.
	0.54	NP	0.41-0.70			$QUAN^{NL}$	Least sensitive colony Authors tested 14 colonies.
Thai honeybee *(Apis cerana indica)*	0.08	NP	0.06-0.10		Highly toxic	QUAN	Authors tested 6 colonies, but all had the same LD_{50}. This was the most sensitive endpoint located, but adequate data on the mass of these bees could not be located for this assessment. Mass data required to convert toxicity value into units suitable for comparison to exposure estimates. *Apis cerana indica* are smaller than *Apis mellifera.*

NP Not presented by authors, raw data not available to calculate
$QUAN^{NL}$ Of suitable quality for quantative use, but no lowest endpoint located

Table 12 Terrestrial Plant Data as Reported in ECOTOX[1]

Species	NOAEL (lb ai/A)	ECOTOX Reference
Monocots		
Bread wheat *(Triticum aestivum)*	0.202	E89091, Noetzal *et al.,*1994b
Rice *(Oryza sativa)*	0.25	E91471, Papenburg *et al.,* 1997
Rice *(Oryza sativa)*	0.446	E91429, Mohanty *et al.,* 1994
Rice *(Oryza sativa)*	0.446	E91647, Kushwaha 1995
Bread wheat *(Triticum aestivum)*	0.5	E91472, Noetzal *et al.,*1996
Barley *(Hordeum vulgare)*	0.5	E88845, Noetzal *et al.,* 1988
Bread wheat *(Triticum aestivum)*	0.5	E89090, Noetzal *et al.,*1994
Bread wheat *(Triticum aestivum)*	0.5	E91914, Johnson & Kammerzell 1991
Rice *(Oryza sativa)*	0.535	E91390, Wills & Street 1988
Rice *(Oryza sativa)*	0.669	E92124, Garg 1986
Rice *(Oryza sativa)*	0.892	E91584, Pangtey 1990
Grass (Poaceae)	0.981	E91626, Stewart & Ferguson 1989
Dicots		
Bell pepper *(Capsicum annuum)*	0.445	E91430, Murthy *et al.,* 1993
Sesame *(Sesamum orientale)*	17.84	E91627, Ghorpade & Thakur 1995

Studies not reviewed and validated for specific uses. Data is used as it appears in ECOTOX.

Table 13 Summary of Acute Toxicity Studies for Fish as Reported and Used in RED

Species	LC_{50} (mg/L)	Slope	95% C.I. (mg/L)	MRID	Toxicity Category	Study Classification	Notes
Freshwater							
Rainbow trout[R] *(Onchorhynchus mykiss)*	2.2	NR	1.5-2.7	40932101 Suprenant 1988	Moderately toxic	Core (Guideline)	Typical end-use product (43.2 % ai)
Bluegill[R] *(Lepomis macrochirus)*	1.0	NR	0.6-1.6	40098001 Mayer 1986	Highly toxic	Core (Compliation)[1]	Appears to be an end-use product (77% ai)
Channel catfish[R] *(Ictalurus punctatus)*	5.2	NR	4.3-6.4	40094602 Johnson 1980	Moderately toxic	Core (Compilation)[1]	90% ai
Cutthroat trout[R] *(Onchorynchus clarkii)*	1.9	NR	1.4-2.5	40094602 Johnson 1980	Moderately toxic	Core (Compilation)[1]	90% ai
Marine/Estuarine							
Spot[R] (*Leiostmous xanthurus*)	0.059	NR	0.045-0.074	40228401 Mayer 1986	Very highly toxic	Supplemental (Compilation)[1]	99% ai
Striped bass[R] (*Morone saxatilis*	0.79	NR	0.17-1.4	05000819 Korn 1974	Highly toxic	Core (Open literature)[2]	80% ai
Sheepshead minnow[R] *(Cyprinodon variegates)*	3.4	NR	2.8-4.1	40932103 Surprenant 1988	Moderately toxic	Core (Guideline)	Typical end-use product (43.2 % ai)

[R] As reported and used in the EFED RED chapter

NR – Not reported, raw data not available to recalculate.

[1] Mayer and Ellersieck 1986 and Johnson and Finlay 1980 are compilations of data regarding pesticide effects on aquatic organisms. Many, although not all, of the data reported are based on tests conducted in government laboratories. In some, although not all cases, raw data is available and results can be evaluated.

[2] Does not meet current OPP/ECOTOX screening standards.

Table 14 Summary of Acute Toxicity Studies for Aquatic Invertebrates and Aquatic Plants as Reported and Used in RED

Species	EC_{50} (mg/L)	Slope	95% C.I. (mg/L)	MRID	Toxicity Category	Study Classification	Notes
Freshwater Invertebrates							
Water flea[R] *(Daphnia magna)*	0.00014	NR	0.00009-0.00020	40094602 Johnson 1980	Very highly toxic	Core (Compilation)[1]	90% ai
Crayfish[R] (*Orconectes nais*)	0.015	NR	NR	40094602 Johnson 1980	Very highly toxic	Supplemental (Compilation)[1]	90% ai
Marine/Estuarine Invertebrates							
Eastern oyster[R] (*Crassostrea virginica)*	12	NR	10-16	40228401 Mayer 1986	Slightly toxic	Core (Compilation)[1]	99% ai
Mysid shrimp[R] (*Mysidopsis bahia*)	0.00035	NR	0.00031-0.00039	40932104 Surprenant 1988	Very highly toxic	Core (Guideline)	Typical end-use product (43.2 % ai)
Mysid shrimp[R] (*Mysidopsis bahia*)	0.00078	NR	0.00058-0.00110	40228401 Mayer 1986	Very highly toxic	Core (Compilation)[1]	99% ai
Marine/estuarine plants[2]							
Marine diatom[R] *(Skeletonema costatum)*	5.3	NR	4.3-5.7	66341 Lowe 1981	Not applicable	Supplemental (Gulf Breeze Lab)	Technical

[R] As reported and used in the EFED RED chapter

[1] Mayer and Ellersieck 1986 and Johnson and Finlay 1980 are compilations of data regarding pesticide effects on aquatic organisms. Many, although not all, of the data reported are based on tests conducted in government laboratories. In some, although not all cases, raw data is available and results can be evaluated.

[2] No freshwater aquatic plant data listed

NR – Not reported, raw data not available to recalculate.

Table 15 Summary of Chronic Toxicity Data for Aquatic Organisms as Reported and Used in RED

Species	LOAEC (mg/L)	NOAEC (mg/L)	MRID	Study Classification	Notes
Freshwater Invertebrates					
Water flea[R] *(Daphnia magna)*	0.000562	0.000178	41506801 Heimbach 1987	Supplemental (Guideline study)	Survival, growth, and offspring/parent daphnia 96% ai
Water flea[R] *(Daphnia magna)*	0.00025	0.00002	44371716 Fernandez-Casalderrey	Supplemental (Open literature)[1]	Neonates produced, survival, and growth (length); 80% ai
Water flea[R] *(Daphnia magna)*	0.00251	0.00016	00128790 Bailey 1983	Core (Guideline study)	Young produced/day Avg. number of young produced 75.1% ai
Freshwater Fish					
Fathead minnow[R] *(Pimephales promelas)*	0.38	0.31	233438 Jarvinen 1988	Core (Open literature)[2]	Weight endpoint affected.
Rainbow trout[R] *(Onchorhynchus mykiss)*	<0.08	ND	00128791 Bailey 1983	Supplemental (Guideline)	Length and weight endpoints affected Penncap-M
Marine/Estuarine Invertebrates					
Mysid shrimp[R] (*Mysidopsis bahia*)	0.00037	0.00011	66341 Lowe 1981	Core (Gulf Breeze Lab)	Most sensitive endpoints survival and number of offspring/female

[R] As reported and used in the EFED RED chapter

[1] Reviewed as ECOTOX 14996 for CRLF assessment, re-classified Invalid, see review later in this Appendix.

[2] Does not meet current OPP/ECOTOX screening standards.

Table 16 Summary of Acute Data for Terrestrial Animals as Reported and Used in RED

Species	LC_{50}/LD_{50}	95% C.I.	MRID	Toxicity Category	Study Classification	Notes
Avian Acute Oral						
American kestrel[R] *(Falco sparverius)*	3.1	2.3-4.1	44371701 Rattner 1983	Very highly toxic	Supplemental (Open literature)[2]	98.2% ai
Mallard duck[R] (*Anas platyrhynchos*)	6.6	4.4-9.9	001600000 Hudson 1979	Very highly toxic	Core (Open literature)[3]	80% ai
Bobwhite quail[R] (*Colinus virginianus*)	7.6	5.7-10.0	001600000 Hudson 1979[3]	Very highly toxic	Core (Open literature)[3]	80% ai
Avian Subacute Dietary						
Bobwhite quail (*Colinus virginianus*)	28.2	22.0-35.3	102329 Pennwalt 1972	Very highly toxic	Supplemental (Guideline)	Technical Not in OPPIN
Mallard duck[R] (*Anas platyrhynchos*)	336	269-413	00022923 Hill 1975	Highly toxic	Core (Patuxent/DOI study)[4]	80% ai
Ring-necked pheasant[R] *(Phasianus colchicus)*	91	77-107	00022923 Hill 1975	Highly toxic	Core (Patuxent/DOI study)[4]	80% ai
Avian Acute Dermal Exposure[1]						
Bobwhite quail[R] (*Colinus virginianus*)	2.9	2.3-3.7	71200 Beavers 1980	Very highly toxic	Supplemental (Registrant non-guideline)	45.42% ai EC formulation Under wings
Bobwhite quail[R] (*Colinus virginianus*)	9.1	NA	83103 Beavers 1980	Very highly toxic	Supplemental (Registrant non-guideline)	22.0% ai Penncap-M Under wings
Mallard duck[R] (*Anas platyrhynchos*)	53.6	39.3-72.9	001600000 Hudson 1979	Moderately toxic	Supplemental (Open literature)[3]	80% ai (technical?) Feet exposed

[R] As reported and used in the EFED RED chapter
[1] Dermal studies performed by dosing birds with methyl parathion on feet or under the wings.
[2] Reviewed as ECOTOX 38447 for CRLF assessment, classified as valid for qualitative use.
[3] Cited as Hudson 1984 in RED data tables, as Hudson 1979 in reference list. Does not meet current OPP/ECOTOX acceptability criteria.
[4] Acceptable for OPP and ECOTOX, listed as ECOTOX 35243, not most sensitive endpoint.
NA Not applicable, non-definitive endpoint

Table 17 Summary of Acute Toxicity Data for Terrestrial Animals Other than Birds as Reported and Used in RED

Species	LD_{50}	Slope	95% C.I.	MRID	Toxicity Category	Study Classification	Notes
Mammal Acute Oral							
Rat[R]	3.6 (M) mg/kg	NR	1.63-7.92	243414	Very highly toxic	Minimum (HED study)	Methyl parathion 80% Not the same as HED endpoint
	23.0 (F) mg/kg	NR	13.7-38.6		Highly toxic		
Terrestrial Invertebrates							
Honey bee[R] (*Apis mellifera*)	0.111 μg/bee	NR	NR	44038201	Highly toxic (Acute oral)	Core (Guideline)	Technical or EC (not specified)
	0.214μg/bee	NR	NR				Penncap-M

Table 18 Summary of Chronic Toxicity Data for Terrestrial Animals as Reported and Used in RED

Species	LOAEC mg/kg	NOAEC mg/kg	MRID	Endpoints Affected	Study Classification	Notes
Avian Reproduction						
Bobwhite quail[R] (*Colinus virginianus*)	15.5	6.3	41179302	Number of eggs laid, eggs set/hen, adult female bodyweight	Core (Guideline)	Technical
Mallard duck[R] (*Anas platyrhynchos*)	>14.7	>14.7	41179301	No effects at highest concentration tested	Supplemental (Guideline)	Technical
Mammal Chronic						
Rat[R]	NR	5	00119087	Decreased pup survival	Core Minimum (HED study)	Technical
	NR	5		Reduced maternal body weight during lactation		

[R] As reported and used in the EFED RED chapter
NR – Not reported, raw data not available to recalculate.

Open Literature Review Summaries:

Studies Rated for Quantitative (QUAN) or Qualitative (QUAL) Use

Note: The following reviews include some studies which were not rated as valid for quantitative or qualitative use as assessment endpoints but valid for qualitative use as a line of evidence for sublethal effects. Data from these studies are not reported in the toxicity tables, but may be mentioned in the text of the main document.

Open Literature Review Summary

Chemical Name: Methyl Parathion

PC Code: 053501

ECOTOX Record Number and Citation:

E91481

Duquesne, S. (2006). Effects of an Organophosphate on *Daphnia magna* at Suborganismal and Organismal levels: Implications for Population Dynamics. Ecotoxicology and Environmental Safety 65:145-150.

Purpose of Review (DP Barcode or Litigation):

Litigation California Red-legged Frog (Methyl parathion)

Date of Review: 1/15/08

Summary of Study Findings:

Author exposed *D. magna* neonates to a 24-hour pulse of technical grade methyl paraoxon, then moved exposed animals to clean medium and analyzed survival, growth, reproduction, and biochemical endpoints for the exposed animals. Author states five test concentrations were used, ranging from 0.3-2.2 μg/L (note: Figure 1 and Table 1 appear to indicate a test concentration of 3.0 μg/L was tested as well). Concentrations were analytically verified. Author did not provide measured concentrations, but states "real concentrations were in the range of expected concentrations, (*e.g.* 81% for 3 μg/L)." Authors note that experimental conditions for the reproductive test were based on the OECD 1979 guideline for reproductive tests with *D. magna*. Author also measured cholinesterase inhibition. Use of a control was reported for the reproduction test. Author states mean number of offspring per control individual met OECD requirement. Survival and reproduction tests used approximately 20 neonates, and the cholinesterase inhibition assays used approximately 60 neonates. Water chemistry parameters were measured for the survival test and were within acceptable parameters. EC_{50} was calculated using SPSS probit analysis. Survival and reproduction were evaluated with one-way ANOVA ($p<0.01$).

Author calculated survival EC_{50} for a 24-hr exposure and 48-hr recovery (used in assessment as a 24-hr value) is 2.3 μg/L (95% CI 2.2-2.5). (Table 1). EC_{50} decreased with length of observation 2.1 μg/L (7 days) and 2.0 μg/L (14 days).

Author noted cholinesterase inhibition at concentrations as low as 0.7 μg/L during day 1 (exposure to methyl paraoxon). Exposure to concentrations > 1.0 μg/L had lasting effects on size and significant effects on reproduction at 14 days. Effects on population growth rate were statistically significant at 1.5 μg/L.

Author noted that survival effects were generally seen within 7 days following exposure and reproductive effects were noted up to 14 days following exposure, but then seemed to recover.

Based on data contained in this paper, for methyl paraoxon:
24-hr EC50 = 2.2 μg/L (2.1-2.5 μg/L)
NOAEC = 1.0 μg/L
LOAEC = 1.5 μg/L

Description of Use in Document (QUAL, QUAN, INV):

QUAN- 24-hr EC50, NOAEC, LOAEC

Rationale for Use:

Best available data located for effects of methyl paraoxon on aquatic invertebrates.

Limitations of Study:

Duration of exposure shorter than typically used in either survival or reproductive guideline tests.

Primary Reviewer:

Paige D. Doelling, Ph.D., Fisheries Biologist, ERB1

Secondary Reviewer

Edward Odenkirchen, Ph.D, Senior Scientist, ERB1

Open Literature Review Summary

Chemical Name: Methyl Parathion

PC Code: 053501

ECOTOX Record Number and Citation:

E64955

Anderson TD and Lydy MJ. (2002) Increased Toxicity to Invertebrates Associated with a Mixture of Atrazine and Organophosphate Insecticides. Environmental Toxicology and Chemistry. 21 (7): 1507-1514.

Purpose of Review (DP Barcode or Litigation):

Litigation California Red-legged Frog (Methyl parathion)

Date of Review: 1/18/08

Summary of Study Findings:

Authors investigated the effects of exposure to binary mixtures of atrazine and organophosphorus insecticides on the amphipod *Hyalla azteca* and the housefly *Musca domestica*. *H. azteca* was exposed in water. M. domestica was exposed via topical application. Authors conclude that topical exposure to atrazine did not significantly increase OP toxicity to *M. domestica*. This review focuses on results for methyl parathion on *H. azteca*. Authors note in their introduction "The combined interaction has been suggested to be the result of cytochrome-dependent monoxygenase induction, resulting in increased biotransformation of the parent compound to the more potent *o*-analog."

Technical grade methyl parathion and atrazine were used. Authors analytically verified concentrations of the pesticides, and state the drop in concentrations in the 96-hr testing period was never greater than 15%. Results are reported in terms of nominal concentrations. Authors began experiment with a 96-hr acute toxicity assay, using 5 concentrations, 3 replicates of each concentration, and 10 amphipods in each treatment. Chemicals were solubilized in analytical-grade acetone. Solvent controls were maintained. Authors do not report mortality in solvent controls. Water chemistry parameters were monitored, although authors do not report values. Probit analysis was used to determine LC_{50}, LC_{15}, LC_5, and LC_1. LC_{50} reported for *H. azteca* was 2.1 μg/L (95% CI 1.0-2.9), which is in good agreement with data for similar organisms. Raw data were not available to confirm statistical analysis.

Authors then tested the various effect levels determined for methyl parathion with varying levels of atrazine (0 – 200 μg/L). In previous tests using atrazine alone, no effects on *H. azteca* were observed by the authors at concentrations of up 10,000 μg/L. They found that a concentration of 80 μg/L significantly increased toxicity of methyl parathion to *H. azteca,* and authors estimated the LC_{50} for methyl parathion in the binary

mixture to be 1.2 μg/L (95%CI not given). This is approximately one-half the concentration for methyl parathion alone, but within the 95% CI (1.0-2.9 μg/L) listed by the authors. At 200 μg/L atrazine, estimated LC_{50} for the binary mixture was 0.7 μg/L. Authors tested effects of a binary mixture of methyl parathion at the LC_1 concentration (0.3 μg/L) and 200 μg/L atrazine. A 49% decrease in cholinesterase activity as compared to solvent controls was noted for this treatment group, as opposed to a 12% reduction when tested at the methyl parathion LC_1 concentration alone. Authors also tested for a sequential exposure effect by exposing amphipods to 80 μg/L atrazine for 48, 96, and144 hours prior to exposure to methyl parathion. No effects were noted for the shorter treatment periods, but exposure for 144 hrs made methyl parathion 1.2 times more toxic.

Description of Use in Document (QUAL, QUAN, INV):

QUAL-mixture data

QUAN- LC_{50} (although not the most sensitive located, so not used in assessment.)

Rationale for Use:

Data derived in this study show environmentally occurring mixtures with atrazine may cause methyl parathion to be more toxic than the evaluation of the chemical singly would suggest. Currently, there are no active registrations containing both atrazine and methyl parathion in an end-use product.

Limitations of Study:

Raw data and QA/QC data not presented in publication, could not be confirmed.

Primary Reviewer:

Paige D. Doelling, Ph.D., Fisheries Biologist, ERB1

Secondary Reviewer

Sujatha Sankula, Ph.D, Biologist, ERB1

Open Literature Review Summary

Chemical Name: Methyl Parathion

PC Code: 053501

ECOTOX Record Number and Citation:

E4008

Schafer H, Hettler H, Fritsche U, Pitzen G, Roderer G, and A. Wenzel. (1994) Biotests Using Unicellular Algae and Ciliates for Predicting Long-term Effects of Toxicants. *Ecotoxicology and Environmental Safety* 27:64-81.

E4335

Schafer H, Wenzel A, Fritsche U, Roderer G, and W Traunspurger. (1993) Long-term effects of Selected Xenobiotica on Freshwater Green Algae: Development of a Flow-through System. *Science of the Total Environment* supplement 735-740.

Purpose of Review (DP Barcode or Litigation):

Litigation California Red-legged Frog (Methyl parathion)

Date of Review: 1/18/08

Summary of Study Findings:

Data reported in both papers is essentially the same, and was likely based on the same set of laboratory experiments.

Shafer *et al*., (1993) (E4335) was focused on explaining the workings of the flow-through system. Authors tested a number of pesticides, including methyl parathion, atrazine, copper sulphate, cadmium chloride, pentachlorophenol, 3,4-dichloroaniline, lindane, and 1,2 dichloropropane. The green alga *Chlamydomonas reinhardi* was tested in the flow-through system, and in a static test. Details of the static test are not given in this publication, but are included in the second publication, Schafer *et. al,* (1994) (E4008). In all cases except for pentachlorophenol, toxicity was 3-38 times higher in the flow-through system. Authors note that chemical analyses (conducted on days 4, 7, and 10) "demonstrated a good consistency of test substance concentrations" but do not provide data regarding mean-measured concentrations or percent recovery of nominal. No specific explanation is provided as to why the values are so different than the static tests.

In the second paper Schafer *et. al,* (1994) (E4008), details for the static test are provided. Authors tested two algae (*Chlamydonmonas reinhardi* and *Scenedesmus subspicatus*) and a ciliate (*Tetrahymena pyriformis*). *C. reinhardii* was tested in both the static and flow-through systems.

Procedures for the static test were based on OECD guideline 201 (1984). Technical grade organic chemicals were dissolved in acetone; acetone concentrations never exceeded 0.1g/L in the static test solutions. Authors note that concentrations were

analytically verified, although they do not report concentrations or discuss QA/QC procedures associated with the analytical verifications. It is unclear whether reported results are based on nominal or measured concentrations. Raw data was not provided, and reviewer was unable to verify statistical analysis. EC_{50} and EC_{10} values were "calculated according to OECD Guideline 201." Reported NOAEC is actually the EC_{10}. Number of test concentrations used was not reported, but tests were run in triplicate, and algal cells in each flask were counted three times.

Investigators report the following results for the static tests:

Organism	**EC_{50} µg/L**	**NOAEC µg/L**
C. reinhardi (72-hr)	>100,000	>100,000
S. subspicatus (72-hr)	15,000	8,000
T. pyriformis (48-hr)	4,650	2,050

Description of Use in Document (QUAL, QUAN, INV):

QUAN-Data from static tests

INV-Data from flow-through tests

Rationale for Use:

Best available data for effects of methyl parathion on aquatic plants. Consistent with other data located for aquatic plants.

Limitations of Study:

Raw data not reported, statistics could not be verified. Unknown whether effects reporting is based on nominal or measured concentration. Specific mechanism(s) causing differential toxicity between the two types of tests is uncertain, and it cannot be determined from the publication if the more sensitive endpoint in the flow-through system is related to the chemical or if it is an artifact of the test system itself.

Primary Reviewer:

Paige D. Doelling, Ph.D., Fisheries Biologist, ERB1

Secondary Reviewer

Sujatha Sankula, Ph.D, Biologist, ERB1

Open Literature Review Summary

Chemical Name: Methyl Parathion

PC Code: 053501

ECOTOX Record Number and Citation:

E17302

Rosakutty, PJ and Kumaraguru, AK. (1994) Effect of Metacid-50 on the Biofertilizer *Azolla pinnnata* R. Br. *Pollution Research* 13 (1):45-52

Purpose of Review (DP Barcode or Litigation):

Litigation California Red-legged Frog (Methyl parathion)

Date of Review: 1/16/08

Summary of Study Findings:

The authors studied the effects of the end use product Metacid-50 on the aquatic mosquito fern *Azolla pinnata*, which grows with rice crops, and is considered to be a biofertilizer. Authors note that *Anabaena* (a blue-green alga) is an endosymbiont for the fern. Five concentrations and a control were used. Control mortality was not reported. Authors report endpoints in terms of methyl parathion, and appear to have corrected for percent technical in the end-use product, but concentrations were not analytically verified. The 96-hr EC_{50} they report (18,400 μg/L, 95% CI 18,010-18,810 μg/L) is based on "number of fronds which showed signs of senescence, wilting, bleaching, shrinking, and death". EC_{50} was estimated using Finney (1947) probit analysis. Authors do not provide raw data for this evaluation and reviewer was unable to confirm statistics. Authors also measure chlorophyll a and chlorophyll b, and found that both decreased with increasing concentration of Metacid. Plant biomass, presented (Table 2) in terms of fresh weight and dry weight (15^{th} day and 20^{th} day) do not appear to differ greatly from the controls. Authors note that at low concentrations (~150 μg/L) a biomass increase was noted. Authors conclude, based on their data, that a Metacid concentration of up to 150 μg/L should pose no risk to the fern.

Description of Use in Document (QUAL, QUAN, INV):

QUAL- EC_{50} 18,400 μg/L, 95% CI 18,010-18,810 μg/L

Rationale for Use:

Provides additional line of evidence for aquatic plants, for which no guideline studies were located.

Limitations of Study:

Raw data not provided, statistics cannot be confirmed. Outcome may have been affected by other compounds in end-use product. Concentrations not analytically verified, uncertain as to whether they are reported in terms of technical or end-use product.

Primary Reviewer:

Paige D. Doelling, Ph.D., Fisheries Biologist, ERB1

Secondary Reviewer

Sujatha Sankula, Ph.D, Biologist, ERB1

Open Literature Review Summary

Chemical Name: Methyl Parathion

PC Code: 053501

ECOTOX Record Number and Citation:

E9226

Alam and Shafi (1991). Toxicity of Two Agricultural Chemicals Metacid 50 and Ekalux EC25 to Tadpoles of Rana tigrina

Purpose of Review (DP Barcode or Litigation):

Litigation California Red-legged Frog (Methyl parathion)

Date of Review: 1/10/09

Summary of Study Findings:

Authors evaluated toxicity of end-product Metacid 50 (50% methyl parathion, also contains unknown % of DDT[2]) on wild-caught tadpoles of *Rana tigrina*, the Indian bullfrog. Specimens were captured from "local ponds". Previous pesticide exposure was unknown, but authors note that unhealthy organisms were excluded from the test.

Solutions were tested in glass aquaria. Authors do not report whether test solution was renewed, and concentrations do not appear to have been confirmed analytically. No water quality data was reported. Controls were used in this experiment and in experiment on a second pesticide, Ekalux EC25 (quinalafos). Reported mortality was zero for both sets of controls. According to information provided by authors, 100 tadpoles were tested at 10 concentrations, in addition to the control. Authors visually determined LC_{50} and report the 96-hr LC_{50} as 9.5 mg/L (9500 μg/L). It is unclear whether the reported concentration is for the end-use product or technical. Reviewer has assumed reported concentrations are for end-use product. Recalculated statistics, corrected for percent technical are attached to this review. Reviewer has also assumed all toxic effects are associated with the methyl parathion.

[2] Metacid-50 appears to be used primarily and perhaps only in India, as several papers by Indian researchers evaluating the product were located. It does not appear to have been registered in the U.S. and a search of OPPIN, the Crop Protection Handbook, the Union Carbide website (for which Metacid-50 is a registered trademark) and a general Google search did not locate a label. A separate publication (Monhanty-Hejmadi a& Dutta 1981 Environ. Pollut 24(2):145-161) lists the composition of Metacid as DDT+Methyl parathion with "50% w/w methyl parathion, 10% emulsifier, balance solvents" and no mention of the actual percentage of DDT.

Author reported concentration (ppm)	Reviewer-corrected concentration (ppm, equivalent to mg/L)*	96-hour mortality percentage
4.0	2.0	0
5.0	2.5	2
6.0	3.0	3
7.0	3.5	7
8.0	4.0	18
8.5	4.25	35
9.5	4.75	52
10.5 (10.0?**)	5	72
10.25	5.125	100
10.5	5.25	100
Control	0	0

* Based on assumption that all toxicity is associated with methyl parathion component of end-use product. Adjusted author reported concentration by 0.5 (for 50% w/w in product).

** listed as 10.5 in published table. Reviewer has interpreted this as a mis-print, and based on the surrounding series, assumed it to be 10.0, and corrected accordingly.

Description of Use in Document (QUAL, QUAN, INV):

QUAL

Rationale for Use:

Given uncertainties in reporting, and reviewer adjusted values, this data is not suitable for quantitative use in assessment. However, it does provide an order of magnitude estimate, and indicates that sensitivity of tadpoles to methyl parathion is in a range similar to that of fish.

Limitations of Study:

Concentrations of test product not analytically verified. Uncertain whether results were reported based on end-use product, or corrected for technical MP. Errors in reporting of concentrations in table.

Primary Reviewer:

Paige D. Doelling, Ph.D., Fisheries Biologist, ERB1

Secondary Reviewer

Sujatha Sankula, Ph.D, Biologist, ERB1

ENTER YOUR NAME.
? Paige
ENTER THE TRADE NAME OF THE CHEMICAL.
? methyl parathion
ENTER THE TEST TYPE. (I.E. QUAIL. ACUTE ORAL LD50)
? tadpole LC50

ENTER THE NUMBER OF CONTROL ANIMALS USED.
IF UNKNOWN, ENTER 0.
? 100
ENTER THE NUMBER OF CONTROL ANIMALS THAT DIED.
? 0
ENTER THE NUMBER OF TREATMENT LEVELS,
EXCLUDING CONTROLS.
? 10
ON THE NEXT 10 LINES, ENTER (IN DESCENDING ORDER) THE
CONCENTRATIONS
TO WHICH EACH GROUP WAS EXPOSED. ENTER ONE CONCENTRATION PER
LINE. (concentrations are in mg/L)
? 5.25
? 5.125
? 5
? 4.75
? 4.25
? 4.0
? 3.5
? 3.0
? 2.5
? 2.0
IS THE NUMBER OF ANIMALS THE SAME AT ALL TREATMENT LEVELS?
ENTER Y OR N.
? Y
NUMBER OF ANIMALS PER TREATMENT LEVEL
? 100

ON THE NEXT 10 LINES, ENTER THE NUMBER OF ANIMALS AT EACH TREATMENT
LEVEL THAT WERE DEAD AT THE CONCLUSION OF THE TEST. USE SAME ORDER
? 100
? 100
? 72
? 52
? 35
? 18
? 7
? 3
? 2
? 0

RESULTS CALCULATED USING THE PROBIT METHOD

ITERATIONS	G	H	GOODNESS OF FIT PROBABILITY
8	.8762491	41.58232	0

A PROBABILITY OF 0 MEANS THAT IT IS LESS THAN 0.001

SINCE THE PROBABILITY IS LESS THAN 0.05, RESULTS CALCULATED USING THE PROBIT METHOD PROBABLY SHOULD NOT BE USED.

SLOPE = 14.76927
95 PERCENT CONFIDENCE LIMITS = .944026 AND 28.59451

LC50 = 4.396262
95 PERCENT CONFIDENCE LIMITS = 2.459977 AND 5.509561

LC10 = 3.606569
95 PERCENT CONFIDENCE LIMITS = .1325203 AND 4.169164

Open Literature Review Summary

Chemical Name: Methyl Parathion

PC Code: 053501

ECOTOX Record Number and Citation:

52442

Mudgall CF and HS Patil (1987). Toxic Effects of Dimethoate and Methyl Parthion on Glycogen Reserves of Male and Female *Rana cynanophlyctis*. Journal of Environmental Biology 8:237-244.

Purpose of Review (DP Barcode or Litigation):

Litigation California Red-legged Frog (Methyl parathion)

Date of Review: 1/10/08

Summary of Study Findings:

The focus of the paper was on changes in glycogen content in muscle, liver, and kidney of adult frogs. Prior to conducting the evaluation of glycogen, authors performed an experiment to establish the LC_{50} for test organisms. Although frogs in this test were adults, the exposure route was aquatic contact, thus this study is considered an aquatic-phase evaluation.

Authors used wild caught frogs in a static renewal test. Solutions were renewed every 24 hours, but concentrations were not confirmed analytically. Tap water was used as the medium. Ten frogs were used per experimental concentration, but authors do not discuss how many experimental concentrations were used. Male and female frogs were tested separately. Female frogs (~20g) were substantially larger than the male frogs (~8 g). Authors used "commercial grade methyl parathion 50%". It is unclear whether values reported are for the solution, or if they have been corrected for percent technical. Reviewer has assumed values were for solution, and a table of corrected values is presented below. Authors note LC_{50} and 95% CI values were determined following the methods of Litchfield and Wilcoxon (1949). Raw data was not included in the paper, so statistics could not be confirmed.

Test Organism (frogs)	Author reported		Reviewer corrected	
	LC_{50} (mg/L)	95% CI(mg/L)	LC_{50}(mg/L)	95%CI(mg/L)
Male (8.4 g± 0.8)	8.0	7.7-8.3	4.0	3.85-4.15
Female (20.1 g± 1.4)	11.5	11.2-12.2	5.75	5.6-6.1

Effects on glycogen in muscle, liver, and kidney tissue were tested at concentrations of 5 mg/L toxicant, and 10 mg/L toxicant. Males and females were tested separately. The only statistically significant change was in the muscle glycogen of female frogs (~20 g) at a concentration of 10 mg/L (NOAEC- 5.0 mg/L, LOAEC 10 mg/L, increased glycogen (corrected value 2.5 mg/L methyl parathion and 5.0 mg/L methyl parathion)). Authors noted frogs were "excitable and hyperactive", and that they made attempts to avoid the test medium.

Description of Use in Document (QUAL, QUAN, INV):

LC_{50} -QUAL

NOAEC, LOAEC-QUAL

Rationale for Use:

LC_{50}-Provides order of magnitude estimate for underrepresented taxon.

NOAEC, LOAEC-Provides line of evidence for mode of action and sublethal effects on underrepresented taxon.

Limitations of Study:

Methyl parathion concentrations not analytically verified. No report of control mortality. Raw data and adequate documentation of LC_{50} test not provided in publication.

Primary Reviewer:

Paige D. Doelling, Ph.D., Fisheries Biologist, ERB1

Secondary Reviewer

Sujatha Sankula, Ph.D, Biologist ERB1

Open Literature Review Summary

Chemical Name: Methyl Parathion

PC Code: 053501

ECOTOX Record Number and Citation:

E66399

Kennedy, IJJ and Sampath, K (2001) Short-term and long-term survival studies in *Rana tigrina* tadpoles with reference to methyl parathion toxicity. Journal of Environmental Biology 22(4):267-271.

Purpose of Review (DP Barcode or Litigation):

Litigation California Red-legged Frog (Methyl parathion)

Date of Review: 1/10/08

Summary of Study Findings:

Authors report a 96-hr LC_{50} of 4.36 ppm (mg/L) in the abstract, and 1.36 ppm in the introductory text and tables. They also report a 96% fiducial limit with lower bounds of 3.30 ppm and 5.96 ppm. The ECOTOX report generated for this assessment reports a 96 hour LC_{50} of 1.300-1.360. Graphs in publication show 4.36 ppm as the value. Reviewer has interpreted 4.36 ppm as the correct 96-hr LC_{50}, with a 95% CI of (3.30-5.96 ppm).

Acute toxicity tests were static renewal. Pesticide concentrations were not analytically confirmed. Controls were used, but control mortality was not described. No water quality parameters were given. Ten (10) animals were used per test concentration, but test concentrations were not specified. Statistical analysis could not be confirmed.

Authors also report mortality data for a long-term study, extending until the tadpoles reach the 4^{th} Gosner stage (disappearance of tail). Within the study, there is no correlation of the stage to a specific number of days.

Description of Use in Document (QUAL, QUAN, INV):

QUAL-acute LC_{50}, also "extended exposure (4^{th} Gosner stage)" LC_{50}

Rationale for Use:

Provides an order of magnitude estimate for underrepresented taxon.

Limitations of Study:

Given errors in reporting and lack of raw data to confirm author generated estimates of LC_{50}, this study is not suitable for quantitative use as an acute LC_{50}.

Related Publications

E65895

Sampath, K, Kennedy IJJ, and R James (2002) Pesticide Impact on Excretory Physiology of the Common Frog , *Rana tigrina* (Daud) Tadpoles. *Bulletin of Environmental Contaminaation and Toxicology* 68:652-659.

Primary Reviewer:

Paige D. Doelling, Ph.D., Fisheries Biologist, ERB1

Secondary Reviewer

Sujatha Sankula, Ph.D, Biologist, ERB1

Confirmation of Statistics for Extended Exposure Test.

ENTER YOUR NAME.
? paige
ENTER THE TRADE NAME OF THE CHEMICAL.
? methyl parathion
ENTER THE TEST TYPE. (I.E. QUAIL. ACUTE ORAL LD50)
? frog gosner stage IV

ENTER THE NUMBER OF CONTROL ANIMALS USED.
IF UNKNOWN, ENTER 0.
?10
ENTER THE NUMBER OF CONTROL ANIMALS THAT DIED.
? 0
ENTER THE NUMBER OF TREATMENT LEVELS,
EXCLUDING CONTROLS.
? 5
ON THE NEXT 5 LINES, ENTER (IN DESCENDING ORDER) THE
CONCENTRATIONS
TO WHICH EACH GROUP WAS EXPOSED. ENTER ONE CONCENTRATION PER
LINE.
? 2.0
? 1.6
? 1.2
? 0.8
? 0.4

ON THE NEXT 5 LINES, ENTER THE NUMBER OF ANIMALS AT EACH TREATMENT
LEVEL THAT WERE DEAD AT THE CONCLUSION OF THE TEST. USE SAME ORDER.
? 7
? 6
? 5
? 3
? 1
AN APPROXIMATE LC50 FOR THIS SET OF DATA IS 1.2

RESULTS CALCULATED USING THE MOVING AVERAGE METHOD

SPAN	G	LC50	95 PERCENT CONFIDENCE LIMITS	
4	.8044036	1.241053	.5283783	3.019805

RESULTS CALCULATED USING THE PROBIT METHOD

ITERATIONS	G	H	GOODNESS OF FIT PROBABILITY
2	.4325941	1	.9992466

SLOPE = 2.588482
95 PERCENT CONFIDENCE LIMITS = .8859887 AND 4.290976

LC50 = 1.250564
95 PERCENT CONFIDENCE LIMITS = .8520381 AND 2.111892

LC10 = .4040832
95 PERCENT CONFIDENCE LIMITS = 5.086587E-02 AND .6596409
****

Open Literature Review Summary

Chemical Name: Methyl Parathion

PC Code: 053501

ECOTOX Record Number and Citation:

E65895

Sampath, K, Kennedy IJJ, and R James (2002) Pesticide Impact on Excretory Physiology of the Common Frog, *Rana tigrina* (Daud) Tadpoles. *Bulletin of Environmental Contamination and Toxicology* 68:652-659.

Purpose of Review (DP Barcode or Litigation):

Litigation California Red-legged Frog (Methyl parathion)

Date of Review: 1/10/09

Summary of Study Findings:

Focus of study was on acute (24-hr) sublethal effects of methyl parathion on the excretory processes of *Rana tigrina* tadpoles. Incidental to this, authors conducted and reported a 96-hr LC_{50}. LC_{50} tests were static renewal, replaced daily, but concentrations were not analytically determined. Eight concentrations were tested, with 10 tadpoles per concentration. Controls were maintained, but control mortality was not reported. LC_{50} values were calculated using Finney (1971) probit analysis. Authors report 96-hr LC_{50} as 4.86 ppm. Authors do not describe whether technical methyl parathion or an end-use product was used in testing.

Sublethal tests evaluated excretory function of tadpoles from Gosner stages I through IV, exposed to 3 different sublethal concentrations of methyl parathion (described by authors as 10%, 20%, and 30% of their LC_{50}). Authors do not describe whether technical methyl parathion or an end-use product was used in testing. Concentrations do not appear to have been analytically verified. Controls were used, but control mortality was not reported. Water quality parameters were measured and appear to have been within a reasonable range. Ammonia and urea production were measured colorimetrically, and concentrations were converted to an energy value (J/g/day). "Two-way ANOVA was applied to determine the significance of interaction between pesticide concentrations and developmental stages of tadpoles on the excretion of NH_3-N and urea-N. Students 't' test was used to determine the significance of mean values between control and experimental groups."

Authors noted an increase of total nitrogen production in all stages of tadpoles exposed to all concentrations of methyl parathion. Extent of increase was correlated with dose.

Description of Use in Document (QUAL, QUAN, INV):

QUAL-LC_{50}

QUAL-Sublethal data regarding physiological stress effects at concentrations as low as 0.486 mg/L

Rationale for Use:

LC_{50}-Provides order of magnitude estimate for underrepresented taxa.

Sub-lethal data-Provides line of evidence for mode of action and sublethal effects on underrepresented taxon.

Limitations of Study:

Methyl parathion concentrations not analytically verified. No report of control mortality. Raw data and adequate documentation of LC_{50} test not provided in publication.

Related Publications

E66399

Kennedy, IJJ and Sampath, K (2001) Short-term and long-term survival studies in *Rana tigrina* tadpoles with reference to methyl parathion toxicity. *Journal of Environmental Biology* 22(4):267-271.

Primary Reviewer:

Paige D. Doelling, Ph.D., Fisheries Biologist, ERB1

Secondary Reviewer

Sujatha Sankula, Ph.D, Biologist, ERB1

Open Literature Review Summary

Chemical Name: Methyl Parathion

PC Code: 053501

ECOTOX Record Number and Citation:

E12043

Yasmeen and Nayeemunnisa. (1985) Effects of Methyl Parathion on the Rate of Oxygen consumption of Tadpoles of Frog, *Rana cyanophlictis*. Current Science 54 (13):649-650.

Purpose of Review (DP Barcode or Litigation):

Litigation California Red-legged Frog

Date of Review: 1/10/08

Summary of Study Findings:

Authors report a 24-hr LC_{50} estimated as range-finding test for an investigation of sublethal effects (reduction of oxygen consumption). No raw data for the LC_{50} test is given, and detail of the test are not provided. Three-week old wild-caught tadpoles were tested in a solution of tap water and methyl parathion prepared from the emusifiable concentrate (EC 50%). Concentrations do not appear to have been analytically verified. Authors do not note if LC_{50} estimate of 8 ppm presented is in terms of the emusifiable concentrate or if it has been corrected for the technical (which would be approximately 4 ppm, consistent with toxicity data for other tadpoles.)

The main focus of the paper is on modifications to oxygen consumption, and authors do note that tadpoles "…show and increase in the rate of oxygen uptake on 24 hour exposure to methyl parathion..." They conclude "this indicates that the stress caused due to methyl parathion exposure requires greater energy, and hence an increase in the metabolic rate…" Reviewer agrees with this conclusion although given uncertainty regarding actual concentrations of methyl parathion, recommends it only for qualitative use in descriptions of sublethal effects.

Description of Use in Document (QUAL, QUAN, INV):

INV- LC_{50} endpoint

QUAL-Description of increased oxygen consumption when not linked with a specific concentration.

Rationale for Use:

Provides line of evidence for mode of action and sublethal effects on underrepresented taxon.

Limitations of Study:

Uncertainty regarding actual concentration of methyl parathion. No report of control mortality. Concentrations not analytically verified. No reporting of QA/QC procedures.

Primary Reviewer:

Paige D. Doelling, Ph.D., Fisheries Biologist, ERB1

Secondary Reviewer

Sujatha Sankula, Ph.D, Biologist, ERB1

Open Literature Review Summary

Chemical Name: Methyl Parathion

PC Code: 053501

ECOTOX Record Number and Citation:

E38447

Rattner BA and JC Franson (1984). Methyl parathion and fenvalerate toxicity in American kestrels: acute physiological response and effects of cold. Canadian Journal of Physiology and Pharmacology 62:787-792.

Purpose of Review (DP Barcode or Litigation):

Litigation California Red-legged Frog (Methyl parathion)

Date of Review: 1/9/2008

Summary of Study Findings:

This study was focused on physiological responses, and authors report an estimated LD_{50} incidental to their main work. Authors do not note source of birds. Data used by reviewer to estimate LD_{50} includes data from three experiments reported in the same paper. It is unclear if author used data from all three experiments or just one experiment. Estimated LD_{50} reported by author and confirmed by reviewer is 3.1 mg/kg, which is slightly above the highest dose tested (3.0 mg/kg). The upper bound for the 95% confidence interval could not be determined. Authors evaluated the kestrel's ability to thermoregulate following methyl parathion intoxication and the correlation of this effect with brain and plasma cholinesterase inhibition. Birds dosed with 2.0-3.0 mg/kg evidenced a drop in body temperature and plasma cholinesterase within 2 hrs of dosing. For birds that survived, both body temperature and cholinesterase levels showed recovery within the 10 hr post-dosing monitoring period. Body temperature declines appeared to be correlated with approximately a 50% reduction in brain and plasma cholinesterase activity. Plasma cholinesterase activity was inhibited in the lower dose treatment groups (0.375 and 1.0 mg/kg) as well, but the percent inhibition was not statistically significantly different from the controls. Authors also tested the effect of exposure to lowered temperatures (5°C versus 22 °C) in birds treated with 2.25 mg/kg methyl parathion. The magnitude of the drop in body temperature to birds exposed to cold temperatures was similar to birds maintained at 22°C, but the consequences were more severe, with a 60% (3 out of 5) mortality rate in the cold-exposed birds. There was no mortality in the dosed birds maintained at 22°C.

Description of Use in Document (QUAL, QUAN, INV):

QUAL-Mortality data used to recalculate an LD_{50}, but it was nondefinitive

QUAL-Data and information regarding biochemical endpoints and sublethal effects used as line of evidence.

Rationale for Use:

Most sensitive endpoint located for birds. Although a 50% kill was not achieved, endpoint is 3X lower than endpoint located for bobwhite quail. (9.8 mg/kg, Buerger et al. 1984). Reviewer's opinion is that this data is consistent with metabolic activiation of methyl parathion, and higher metabolic rate for smaller birds.

Limitations of Study:

Study did not establish a definitive LD_{50}, and was based on a small sample set (approx 5 birds per treatment level). Significant uncertainty surrounds the estimated value-this uncertainty should be acknowledged any place value is used, and value should be presented as a greater than (>) value.

Primary Reviewer:

Paige D. Doelling, Ph.D., Fisheries Biologist, ERB1

Secondary Reviewer

Sujatha Sankula, Ph.D, Biologist, ERB1

ENTER YOUR NAME.
? Paige
ENTER THE TRADE NAME OF THE CHEMICAL.
? Methyl parathion
ENTER THE TEST TYPE. (I.E. QUAIL. ACUTE ORAL LD50)
? american kestrel acute oral LD50

ENTER THE NUMBER OF CONTROL ANIMALS USED.
IF UNKNOWN, ENTER 0.
? 16
ENTER THE NUMBER OF CONTROL ANIMALS THAT DIED.
? 0
ENTER THE NUMBER OF TREATMENT LEVELS,
EXCLUDING CONTROLS.
? 6
ON THE NEXT 6 LINES, ENTER (IN DESCENDING ORDER) THE CONCENTRATIONS
TO WHICH EACH GROUP WAS EXPOSED. ENTER ONE CONCENTRATION PER LINE.
? 3
? 2.5
? 2.25
? 2
? 1
? 0.375
IS THE NUMBER OF ANIMALS THE SAME AT ALL TREATMENT LEVELS?
ENTER Y OR N.
? N
ON THE NEXT 6 LINES, ENTER THE NUMBER OF
ANIMALS EXPOSED AT EACH TREATMENT LEVEL. USE SAME ORDER.
? 5
? 6
? 5
? 5
? 5
? 5
ON THE NEXT 6 LINES, ENTER THE NUMBER OF ANIMALS AT EACH TREATMENT
LEVEL THAT WERE DEAD AT THE CONCLUSION OF THE TEST. USE SAME ORDER.
? 2
? 1
? 0
? 0
? 0
? 0

NOTE TO REVIEWER: THIS DATA SET DOES NOT MEET
THE CRITERIA ESTABLISHED BY THE COMMITTEE ON
METHODS FOR TOXICITY TESTS WITH AQUATIC ORGANISMS
BECAUSE NO PERCENT DEAD IS GREATER THAN 65 PERCENT.

NEITHER THE BINOMIAL TEST NOR THE MOVING AVERAGE METHOD
CAN GIVE ANY RESULTS FOR THIS DATA. EITHER THE HIGHEST
CONCENTRATION
KILLED LESS THAN 50 PERCENT OR THE LOWEST KILLED MORE THAN 50.
IF THE PROBIT SLOPE IS NEGATIVE, ENTER DATA AGAIN USING NUMBER
ALIVE INSTEAD OF NUMBER DEAD.

AN APPROXIMATE LC50 FOR THIS SET OF DATA IS 0

THE MOVING AVERAGE METHOD CANNOT BE USED WITH THIS DATA SET
BECAUSE NO SPAN WHICH PRODUCES MOVING AVERAGE ANGLES THAT
BRACKET
45 DEGREES ALSO USES TWO PERCENT DEAD BETWEEN 0 AND 100
PERCENT.

RESULTS CALCULATED USING THE PROBIT METHOD

ITERATIONS	G	H	GOODNESS OF FIT PROBABILITY
9	1.164418	1	.9787274

SLOPE = 13.77048
95 PERCENT CONFIDENCE LIMITS =-1.088996 AND 28.62995

LC50 = 3.081765
95 PERCENT CONFIDENCE LIMITS = 2.70308 AND +INFINITY

LC10 = 2.492145
95 PERCENT CONFIDENCE LIMITS = 0 AND 2.927213
****

Open Literature Review Summary

Chemical Name: Methyl Parathion

PC Code: 053501

ECOTOX Record Number and Citation:

E39539

Buerger, TT, Mortensen, SR, Kendall, RJ, and MJ Hooper. (1994) Metabolism and Acute Toxicity of Methyl Parathion in Pen-reared and Wild Northern Bobwhites. Environmental Toxicology and Chemistry 13:7 pp 1139-1143.

Purpose of Review (DP Barcode or Litigation):

Litigation California Red-legged Frog (Methyl Parathion)

Date of Review: 1/9/2008

Summary of Study Findings:

Methods: Pen reared bobwhite were from the colony at the Institute for Wildlife Technology, Western Washington University were 8 months old at the time tested. All birds were from the same hatch. Wild bobwhites, captured at Tall Timbers Research Station, Tallahassee, FL were subadults (greater than four months but less than one year). All birds were dosed with technical methyl parathion (99.5% purity) in corn oil carrier, via oral intubation. Control birds received only the corn oil carrier, administered in the same fashion. All treatment groups except one (10.4 mg/kg, wild) were comprised of an equal amount of males and females. The 10.4 mg/kg wild group was six males and four females. There was no control mortality. Birds were observed for 14 days following dosing. Birds which died were necropsied, and brains were frozen for later determination of cholinesterase activity (ChE). At termination of the observation, survivors were sacrificed, and brains were frozen for later determination of cholinesterase activity (ChE). Author's statistical analyses included determination of LD_{50} values, 95 % CI, and slope using probit analysis, and comparison of brain ChE activities with one-way ANOVA (α=0.05). Tukey-Kramer procedure was used for comparison of means. Using data provided in publication (nonsurvivors and survivors), reviewer recalculated probit analysis using the TOXANAL program. Statistical confirmation of inputs and results are included in this review.

Authors dosed 64 pen-reared birds and 40 wild-caught birds (equal sexes) with methyl parathion at concentrations ranging from 9.1-11.1 mg/kg. Dose range was based on a previous range finding test. Controls were maintained for both sets of birds, and control mortality was zero. Author determined and reviewer confirmed LD_{50} values for the pen-reared birds and wild-caught birds were 9.8 mg/kg (95% CI 9.5-10.2), and 10.22 mg/kg (95% CI 9.8-10.5), respectively. The groups were statistically inseparatble. Acute symptoms noted during the tests included lethargy, ataxia, diarrhea, and muscle tremors. Authors also measured brain cholinesterase activity of both the birds that died, and those that survived (sacrificed at the end of a 14-day observation period). Brain cholinesterase activity in the birds that died (both groups) was approximately 25% that of the controls.

Birds that survived exhibited decreased brain cholinesterase activity (approximately 70% that of controls) at the end of the observation period, indicating that while there is recovery, a period of impairment for birds receiving non-lethal doses may last days to weeks. Authors do not discuss whether there is any gender difference in response to the pesticide. Authors conclude there is no statistically significant difference in response between the pen-reared bobwhites and the wild-caught bobwhites for any of the parameters they measured.

Description of Use in Document (QUAL, QUAN, INV): QUAN

Valid for quantitative use, but not the lowest endpoint located. Used qualitatively in discussion of acute endpoint, and as weight of evidence for potential impact of sub-lethal effects.

Rationale for Use:

Provides good quality LD_{50} data for a commonly tested species. Also provides comparison of biochemical endpoint affected, and how that might relate to mortality. Analysis of survivors provides some insight into time period impairment may continue in exposed birds.

Limitations of Study:

Raw data not available to reviewer.

Primary Reviewer:

Paige D. Doelling, Ph.D., Fisheries Biologist, ERB1

Secondary Reviewer

Sujatha Sankula, Ph.D, Biologist, ERB1

Confirmation of Statistics for E39539 (Buerger et. al, 1994)

ENTER YOUR NAME.
? Paige
ENTER THE TRADE NAME OF THE CHEMICAL.
? Methyl parathion
ENTER THE TEST TYPE. (I.E. QUAIL. ACUTE ORAL LD50)
? Bobwhite Aucte oral ld50 (pen-reared)

ENTER THE NUMBER OF CONTROL ANIMALS USED.
IF UNKNOWN, ENTER 0.
? 16
ENTER THE NUMBER OF CONTROL ANIMALS THAT DIED
? 0
ENTER THE NUMBER OF TREATMENT LEVELS,
EXCLUDING CONTROLS.
? 4
ON THE NEXT 4 LINES, ENTER (IN DESCENDING ORDER) THE
CONCENTRATIONS
TO WHICH EACH GROUP WAS EXPOSED. ENTER ONE CONCENTRATION PER
LINE.
? 10.6
? 10.1
? 9.6
? 9.1
IS THE NUMBER OF ANIMALS THE SAME AT ALL TREATMENT LEVELS?
ENTER Y OR N.
? Y
ON THE NEXT 4 LINES, ENTER THE NUMBER OF
ANIMALS EXPOSED AT EACH TREATMENT LEVEL. USE SAME ORDER.
? 16
? 16
? 16
? 16
ON THE NEXT 4 LINES, ENTER THE NUMBER OF ANIMALS AT EACH
TREATMENT
LEVEL THAT WERE DEAD AT THE CONCLUSION OF THE TEST. USE SAME
ORDER.
? 14
? 9
? 5
? 4
AN APPROXIMATE LC50 FOR THIS SET OF DATA IS 9.974478

RESULTS CALCULATED USING THE MOVING AVERAGE METHOD

SPAN	G	LC50	95 PERCENT CONFIDENCE LIMITS	
3	.2793068	9.875234	9.542216	10.2427

RESULTS CALCULATED USING THE PROBIT METHOD

ITERATIONS	G	H	GOODNESS OF FIT PROBABILITY
3	.2798216	1	.4561664

SLOPE = 26.81267
95 PERCENT CONFIDENCE LIMITS = 12.62926 AND 40.99608

LC50 = 9.828374
95 PERCENT CONFIDENCE LIMITS = 9.500778 AND 10.16041

LC10 = 8.812841
95 PERCENT CONFIDENCE LIMITS = 7.737325 AND 9.215969

ENTER YOUR NAME.
? Paige
ENTER THE TRADE NAME OF THE CHEMICAL.
? methyl parathion
ENTER THE TEST TYPE. (I.E. QUAIL. ACUTE ORAL LD50)
? bobwhite acute oral LD0 (wild-caught)

ENTER THE NUMBER OF CONTROL ANIMALS USED.
IF UNKNOWN, ENTER 0.
? 10
ENTER THE NUMBER OF CONTROL ANIMALS THAT DIED.
? 0
ENTER THE NUMBER OF TREATMENT LEVELS,
EXCLUDING CONTROLS.
? 4
ON THE NEXT 4 LINES, ENTER (IN DESCENDING ORDER) THE CONCENTRATIONS
TO WHICH EACH GROUP WAS EXPOSED. ENTER ONE CONCENTRATION PER LINE.
? 11.1
? 10.4
? 10.3
? 9.5
IS THE NUMBER OF ANIMALS THE SAME AT ALL TREATMENT LEVELS?
ENTER Y OR N.
? Y

ENTER THE NUMBER OF ANIMALS USED AT ONE TREATMENT LEVEL.
? 10
ON THE NEXT 4 LINES, ENTER THE NUMBER OF ANIMALS AT EACH TREATMENT
LEVEL THAT WERE DEAD AT THE CONCLUSION OF THE TEST. USE SAME ORDER.
? 10
? 5
? 5
? 2
AN APPROXIMATE LC50 FOR THIS SET OF DATA IS 10.34988

RESULTS CALCULATED USING THE MOVING AVERAGE METHOD

SPAN	G	LC50	95 PERCENT CONFIDENCE LIMITS	
3	.3190794	10.32704	9.920666	10.69063

RESULTS CALCULATED USING THE PROBIT METHOD

ITERATIONS	G	H	GOODNESS OF FIT PROBABILITY
13	.340129	1	.3261677

SLOPE = 37.01064
95 PERCENT CONFIDENCE LIMITS = 15.42582 AND 58.59546

LC50 = 10.1956
95 PERCENT CONFIDENCE LIMITS = 9.800359 AND 10.50907

LC10 = 9.421032
95 PERCENT CONFIDENCE LIMITS = 8.270683 AND 9.800798
****

Open Literature Review Summary

Chemical Name: Methyl Parathion

PC Code: 053501

ECOTOX Record Number and Citation:

E91623

Kumar, A. and Kumar, J. (1994). Variability in Tolerance to Some Insecticides in *Apis mellifera* L. and *Apis cerana Indica* F. Colonies. *Entomon* 19: 67-72.

Purpose of Review (DP Barcode or Litigation):

Litigation California Red-legged Frog (Methyl parathion)

Date of Review: 11/29/07

Summary of Study Findings:

Authors were examining variations in resistance to pesticides among colonies of bees, both the honeybee *(Apis mellifera)* and the Thai honeybee *(Apis cerana indica). Apis mellifera* is larger than *Apis cerana,* and is the organism typically used in guideline acute contact and acute dose tests.

Bees used were outgoing foragers (>21 days old). Technical grade methyl parathion was applied dermally to the thoracic tergum. 4-5 treatment concentrations were used, with 3 replicates and 10-15 bees per replicate. Authors evaluated mortality at 24 hours. Bees unable to move or with uncoordinated movements were considered dead. "Data for per cent mortality were corrected by Abbott's (1925) formula and subjected to a probit analysis (Finney 1971)." Concentrations were not analytically verified. The specific source of test organisms was not reported. Controls were used, but control mortality was not reported.

Fourteen colonies of *Apis mellifera* were tested. LD_{50} for the most sensitive colony was 0.28 μg/bee (95% CI 0.23-0.35 μg/bee). LD_{50} for the least sensitive colony was 0.54 μg/bee (95% CI 0.41-0.70 μg/bee). There was approximately a 2X difference in LD_{50}s from the most sensitive to the most tolerant. Authors do not mention a statistical analysis to evaluate differences in the colonies, but do conclude that there is no evidence of tolerance development for methyl parathion.

Six colonies of *Apis cerana indica* were tested. LD_{50} for all colonies was 0.08 μg/bee, but 95% CI for the colonies varied slightly, with the widest being 0.06-0.10 μg/bee.

Description of Use in Document (QUAL, QUAN, INV):

LD_{50}-QUAN

Rationale for Use:

Study well-documented, contains suitable controls and number of replicates. Data analyzed using standard toxicological techniques. Lowest endpoints located for bee.

Limitations of Study:

No specific limitations noted. Weight/size comparison between bee species would have been helpful, but was not included.

Primary Reviewer:

Paige D. Doelling, Ph.D., Fisheries Biologist, ERB1

Secondary Reviewer

Sujatha Sankula, Ph.D, Biologist, ERB1

Open Literature Review Summary

Chemical Name: Methyl Parathion

PC Code: 053501

ECOTOX Record Number and Citation:

E70351

Atkins EL and D. Kellum. (1986) Comprative Morphogenic and Toxicity Studies on Effect of Pesticides on Honeybee Brood. Journal of Apricultural Research 25(4):242-255.

Purpose of Review (DP Barcode or Litigation):

Litigation California Red-legged Frog (Methyl parathion)

Date of Review: 12/4/07

Summary of Study Findings:

Focus of paper was Bee Larval Morphogenic Tests (BLMGT), which "allowed the effects of pesticides on individual larvae to be determined in the hive." In the test, the queen was allowed to lay larvae in the comb, and the food source for the colony was contaminated with the pesticide. Bees were evaluated for survival following adult emergence. Authors note "the analyzed data were then compared with laboratory data obtained for adult bees." Adult LD_{50} data is presented in Table 4 and Table 5. Authors do not cite a specific source for this data, although it may have come from other testing at their laboratory. No specific test procedures are described for the adult LD_{50}.

For the larval test, authors tested methyl parathion 2 EC (emusifiable concentrate). They do not discuss whether data presented were corrected for percent technical. Authors dosed food in the bottom of the hive cells with the pesticide dissolved in acetone. Acetone-treated controls were maintained. Reported adult mortality associated with acetone was $\leq$5% (Table 2). For the larval data, authors used Abbott's formula (1925) to correct for control mortality and probit analysis to determine LD_X and slope. Authors present a brood LD_{50} in terms of μg/larvae, but are not specific as to how they derived this number. Raw data are not available to confirm any statistics or calculations. Results of this test are interpreted by reviewer as an oral dose.

For methyl parathion, combined data for all ages of larvae resulted in:
r=0.985
slope=2.175
intercept 5.079
LD10=0.237 µg/larvae
LD50=0.920 µg/larvae
LD90=3.566 µg/larvae

Description of Use in Document (QUAL, QUAN, INV):

QUAL-LDx data for larvae

INV-Adult LD50

Rationale for Use:

Provides line of evidence for underrepresented taxa likely to be affected by use of this pesticide.

Limitations of Study:

Raw data were not available to confirm calculations and statistics. It is uncertain whether data was corrected for percent technical. Test procedure, data, and analysis for adult LD_{50} value were not provided in this publication.

Primary Reviewer:

Paige D. Doelling, Ph.D., Fisheries Biologist, ERB1

Secondary Reviewer

Sujatha Sankula, Ph.D, Biologist, ERB1

Open Literature Review Summary

Chemical Name: Methyl Parathion

PC Code: 053501

ECOTOX Record Number and Citation:

79198

Fiedler, L. (1987) Assessment of Chronic Toxicity of Selected Insecticides to Honeybees. Journal of Apicultural Research 26(2):115-122.

Purpose of Review (DP Barcode or Litigation):

Litigation California Red-legged Frog (Methyl parathion)

Date of Review: 1/10/08

Summary of Study Findings:

Note: Authors report LD_{50} for methyl parathion and methyl paraoxon, but these values are provided for comparision and are not derived from this study, although they have been coded into the ECOTOX database.

Author conducted a test evaluating a 14-day exposure to sugar syrup contaminated with methyl parathion and methyl paraoxon. Technical grade pesticides were used, solubilized in acetone. Authors used an acetone control. Four treatment groups were used, with concentrations of pesticide ranging from 0.25 to 2.00 ppm. Concentrations were analytically measured, and recoveries were 89.4%-97.7% of nominal. Food consumption was reduced in groups exposed to contaminated food. Control mortality for the methyl parathion group was 13.1%, and control mortality for methyl-paraoxon group was 13.1%. Authors calculate a corrected mortality figure for the experimental groups.

After a 14-day exposure to methyl parathion, there was 97.7% mortality in the 0.25 ppm treatment group. Over the same exposure period, there was 100% mortality in the 0.25 ppm methyl paraoxon group. For methyl parathion, 100% mortality occurred on day 4 for groups exposed to ≥0.5 ppm. 100% mortality occurred at day 14 for the 0.25 ppm treatment group. For methyl paraoxon, 100% mortality occurred at day 5 for all treatment groups. For methyl parathion (based on data in Figure 1), a 96-hr LD_{50} would be approximately the 0.25 ppm dose. With methyl paraoxon, a 96-hr LC_{50} cannot be estimated, because percent kills are too high. At 24-hrs, the LD_{50} can be bounded by the percent kill at 0.25 ppm (~10%) and 0.5 ppm (~60%).

Author calculates a CAIC (cumulative insecticide consumption per bee), and time to 50% mortality for each of the treatment levels (see table below)

Insecticide		0.25 ppm	0.5 ppm	1.00 ppm	2.00 ppm	Acute oral LD_{50}*
Methyl parathion	CAIC (mg/bee)	55.7	60.4	81.5	+	0.266[a] µg/bee
	Time to 50% mortality (days)	4.0	1.8	1.0	(0.6)	
Methyl paraoxon	CAIC (mg/bee)	31.0	+	+	+	0.029 [b] µg/bee
	Time to 50% mortality (days)	1.9	(0.8)	(0.5)	(0.5)	

*From other sources, not this study, thus not acceptable (from this publication) for quantitative use.

+greater than 50% mortality at 24 hours

[a] Cited as Beran 1970 (foreign language (German))

[b] Cited as Fieldler unpublished

Description of Use in Document (QUAL, QUAN, INV):

QUAL-Ingestion of food items contaminated with 0.25 ppm methyl parathion is likely to cause 50% mortality if consumed daily for four days.

QUAL- Ingestion of food items contaminated with 0.25 ppm methyl paraoxon is likely to cause 50% mortality if consumed daily for 1.9 days.

INV- LD_{50} presented in Table 40 (methyl parathion 0.266 µg/bee, 30 ng/bee; methyl paraoxon 29 ng/bee, 30 ng/bee)

Rationale for Use:

Provides useful toxicity information for underrepresented taxa likely to be affected by use of this pesticide.

Limitations of Study:

Well documented study. Secondary source reporting of LD_{50} data.

Primary Reviewer:

Paige D. Doelling, Ph.D., Fisheries Biologist, ERB1

Secondary Reviewer

Sujatha Sankula, Ph.D, Biologist, ERB1

Open Literature Review Summaries:
Studies Rated Invalid

Open Literature Review Summary

Chemical Name: Methyl Parathion

PC Code: 053501

ECOTOX Record Number and Citation:

E14996

Fernandez-Casalderrey, A., Ferrando, M. D., and Andreu-Moliner, E. (1995). Chronic Toxicity of Methylparathion to Daphnia magna: Effects on Survival, Reproduction, and Growth. *Bull.Environ.Contam.Toxicol.* 54: 43-49.

Purpose of Review (DP Barcode or Litigation):

Litigation California Red-legged Frog

Date of Review: 10/30/07

Summary of Study Findings:

Two tests are described in paper, an acute (24-hr) range finding test, and 21-day chronic test.
Test organisms: *Daphnia magna* neonates (6-24 hr old juveniles)
Test material: 80% purity methyl parathion (authors do not discuss if values provided in the paper are corrected for purity). Chemical concentrations were not confirmed analytically.

Acute (24 hr) test: (described as range-finding test, this value was not the focus of paper) Authors note the acute test was based on standard procedures contained in EEC 1984. 84/449/EEC, in Official Journal of the European Communities, L251, 27, pp. 155-159. Six test concentration, plus solvent (acetone) control were used. Control survival was reported as 100%. 10 neonates were tested per replicate, and the experiment was repeated 3 times. Acute calculations based on methods in Litchfield and Wilcoxon (1949). Authors calculated 24-hr LC_{50}, with a 95% CI.

Results: 24hr LC_{50} 0.31 ng/L, with a standard deviation. of 0.07 ng/L, 95% CI of 0.13-0.63, and coefficient of variation 22.5%

Authors also note a 24-hr EC_{50} for the rotifer *Brachionus calyciflorus* of 29.2 mg/L.

Chronic: 21-day test, using concentrations based on range-finding test, as cited and decribed above.

Five tests concentrations (0.07, 0.15, 0.20, 0.25, 0.27 ng/L) were used, plus a negative control and solvent control. Solvent used in experiment was acetone, no greater than 1μg/L. Control survival was noted as 100%.

Test Conditions: Dechlorinated tap water, 15 juveniles used (reviewer interpreted this as a number per treatment), daphnids fed daily, and transferred to clean beaker with pesticide solution daily, test animals observed daily, progeny removed and discarded.

Endpoints measured: Longevity, time to first reproduction, total number of neonates per female, number of brood, brood size. Also measured the growth of parent from apex of helmet to base of tail spine.

Calculations: ANOVA, comparing negative control, acetone control, and test concentrations, at a significance of α=0.05. Mean values compared by Duncan's multiple range test.

Results:

NOAEC: 0.20 ng/L LOAEC 0.25 ng/L

Endpoints: Longevity; reproduction (total production of young per female, mean brood size, mean number of broods), length.

Description of Use in Document (QUAL, QUAN, INV):

INV

Rationale for Use:

Study not used in ecological risk assessment.

Limitations of Study:

Based on information provided in the paper, authors appear to have taken care to follow standard procedures in both conducting the test and analyzing the resulting data. Concentrations of test material were not confirmed analytically, at least based on information contained within the article. This fact, in combination with the fact that results reported by authors are 3-5 orders of magnitude lower than results reported by other authors in tests of the same organism with the same pesticide, lead reviewer to conclude that some extrinsic factor may have affected the outcome of the test. Factors not accounted for in author's reporting include: 1) lack of analytical verification of test concentrations (in this case a dilution or mathematical discrepancy would not have been noted); 2) other potential contaminants in the test water that might affect response of the test organism (no analysis of test water appeared to have been conducted); 3) provenance and viability of the test organisms.

Notes and Reviewer Comments

Authors published a number of papers on related topics, from 1991-1995, and similar problems may occur in all publications. In comparison to other literature and guideline studies located, endpoints determined by this group of authors are 3-5 orders of magnitude lower than those determined in other studies. Source of this variability is uncertain, but could be related to: 1) other chemical species in the water, 2) water chemistry, 3) measurement or mathematical error, or 4) overall health and sensitivity of the test organism *(i.e.*, a highly sensitive strain of *Daphnia magna*). Without additional

raw data to verify conclusions presented in the paper, reviewer recommends data from this paper not be included in an ecological risk assessment, and that data from related papers be reviewed carefully prior to use.

Study reviewed:

E14996

Fernandez-Casalderrey, A., Ferrando, M. D., and Andreu-Moliner, E. (1995). Chronic Toxicity of Methylparathion to Daphnia magna: Effects on Survival, Reproduction, and Growth. *Bull.Environ.Contam.Toxicol.* 54: 43-49.

Related studies:

E6857
Fernandez-Casalderrey, A., Ferrando, M. D., and Andreu-Moliner, E. (1993). Chronic Toxicity of Methylparathion to the *Rotifer Brachionus calyciflorus* fed on *Nannochloris oculata* and *Chlorella pyrenoidosa*. *Hydrobiologia* 255/256: 41-49.

E4340
Fernandez-Casalderrey, A., Ferrando, M. D., and Andreu-Moliner, E. (1993). Effect of the Insecticide Methylparathion on Filtration and Ingestion Rates of *Brachionus calyciflorus* and *Daphnia magna*. *Sci.Total Environ.* 867-876 (Suppl. Part 2).

E5096
Fernandez-Casalderry, A., Ferrando, M. D., and Andreu-Moliner, E. (1992). Acute Toxicity of Several Pesticides to Rotifer *(Brachionus calyciflorus).* *Bull.Environ.Contam.Toxicol.* 48: 14-17 (OECDG Data File).

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