103301 2/19/82 R. Balcomb 2/19/82

ECOLOGICAL EFFECTS PROFILE

A. M... ...g Use - Technical Acephate

AQUATIC ORGANISMS

Short-term fish bioassays with technical material indicate tht acephate is practically non-toxic. Hutchinson (1970, 00014705) reports that the 96-hour LC_{50} for rainbow trout, bluegill sunfish and channel catfish are greater than 1000 ppm. Johnson and Finley (1980, No ID) have published the same result for rainbow trout, fathead minnow, channel catfish, and bluegill. Tests with aquatic invertebrates demonstrate that technical acephate is likewise relatively non-toxic: the 48 hour LC_{50} value for scud is greater than 100 ppm (Schoettger and Mauck 1976, 05012201) and the 96 hour LC_{50} for chironomus (Johnson and Finley, 1980) is >1000 ppm. Bioassays with brown shrimp (Slight, 00014711; 48 hour LC_{50}=22.9 ppm) and Atlantic oyster embryos (Slight 1970, 00014713; 48 hour TL_{50}=5.41 ppm) similarly suggest low toxicity to marine organisms.

BIRDS

Laboratory testing indicates that technical acephate is moderately toxic to birds. Mastalski and Jenkins (1970, 00014701) report the single-dose acute oral LD_{50} for the ring-necked pheasant as 140 mg/kg. The acute oral LD_{50} for mallards has been variously reported as 234 mg/kg (Mastalski and Jenkins, 00014700) and 350 mg/kg (Hudson, 00015962). Eight-day dietary feeding studies suggest a lower avian sensitivity to technical acephate with reported LC_{50} values of 1280 ppm for bobwhite (Fletcher 1976, 00015956) and >5000 ppm for mallards (Fletcher 1976, 00015957).

Avian reproduction studies with technical acephate indicate dietary 'no-effect' levels >5 ppm but <20 ppm for mallards (Beavers et al., 00029691) and >20 ppm but <80 ppm for bobwhite (Beavers et al., 00029692) in a 16 week exposure. In mallards egg production was similar between control and treatment groups, however, the number of surviving ducklings (monitored to age 14 days) were reduced 20% at the 20 and 80 ppm treatment levels; no effects were noted at the 5 ppm level. In bobwhite, egg production and chick survival was not affected at the 5 and 20 ppm treatment levels but was reduced significantly at the 80 ppm level. Concurrent studies of brain AChE activity under the conditions of the above reproduction tests [Beavers et al., 00029689 (mallard); Beavers et al., 00029690 (bobwhite)] indicate reduced activity in all treatment groups with impairment increasing with dosage.

B. Formulated Product Testing

AQUATIC ORGANISMS

The formulated product Orthene 75 SC/S has been tested on a variety of

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fish species with results indicating that, like technical acephate, the product is practically non-toxic to fish. Reported 96-hour fish LC_{50} values range 760 ppm for rainbow trout (Johnson and Finley 1980, No ID) to greater than 4000 ppm for Mosquito fish (Thompson and Huntoon 1971, 00014709).

Aquatic invertebrates have been tested with Orthene 75 SC/S. This formulation was moderately toxic to daphnia magna with a 48-hour LC_{50} of 1.3 ppm (U.S.E.P.A.-Thompkins, No ID). Testing with other species has shown this formulation is somewhat less toxic with reported values of 12 ppm for the stonefly (skwala 96-hour LC_{50} - Johnson and Finley 1980, No ID). A 21-day daphnia magna reproduction study was conducted with Orthene 75 SC/S (U.S.E.P.A. -Thompkins, No ID). Adult survival was not affected by the pesticide (highest concentration = 1.5 ppm), however, the number of offspring per female was reduced at concentrations of 375 ppb and higher.

Three field studies monitoring the impact of formulated acephate (assumed to be Orthene Forest Spray - 75% a.i.) on aquatic oraganisms were reviewed. Bocsor and O'Connor (00014637) studied the effects of Orthene applied at 0.5 lbs a.i./a to two forest ponds and a stream in Pennsylvania. Sixty-five fish (bluegills, perch and bullheads) caged in a pond showed no effects up to 8 days post-application. Benthic invertebrates were sampled at eleven pond and stream stations. One station showed a significant ($P<0.1$) decrease in chironomids following treatment. Other stations, however, showed no adverse effects. The researchers concluded that the "aquatic ecosystem under study was not significantly affected." Robeni (00014547) studied the effects of Orthene spruce budworm applications (0.5 lbs/a) on stream organisms in Maine. Aquatic insects increased their drift following treatment but the standing crop of invertebrates was not affected. The spraying resulted in significant reductions in brain AChE activity in suckers but not in trout or salmod. Salmonid growth and condition was considered unaffected and newly hatched smelt grew normally.

TERRESTRIAL ORGANISMS

Laboratory acute testing on birds (Zinkl et al., No ID) with Orthene 75S indicates that this formulation is similar in toxicity to technical acephate (dark-eyed junco: LD_{50}=106 mg/kg, LC_{50}=1495 ppm).

A number of avian population studies have been conducted in treated forests and rangeland. Two studies were undertaken in Canada at use rates equivalent to U.S. forest registrations (0.5 lbs AI/A). Reported results indicate that treatments had no significant impact on exposed bird communities (Buckner and McLeod 1975, 05017571, Buckner et al 1976, 05019256). One Canadian study (Buckner and McLeod 1977, 05021173) monitoring a combined treatment of acephate (0.05 lbs AI/A) and Bacillus thuringiensis (19.0 BIU) AI/A reported reduced warbler activity one day

bird pop study

following treatment but normal activity was evident on subsequent surveys. Bart (05014922) monitored acephate forest treatments in New York (0.5 lbs AI/A) finding significant reductions in red-eyed vireos and numerical (though not statistically significant) reductions in rose-breasted grosbeaks and scarlet tanagers. Richmond et al (1979, No ID) report that forest applications at 1.0 lbs AI/A and 2.0 lbs AI/A in Oregon resulted in significant brain cholinesterase depression in exposed birds but population censusing indicated no major changes in the total numbers of breeding pairs, overall abundance or species diversity. Three birds apparently suffering from acephate poisoning were noted. A decrease in the number of warbling vireos and yellow-rumped warblers occurred following treatment but declines were not conclusively attributed to acephate. A follow-up survey on treated plots one year later (no pesticide treatment) showed no large fluctuations in bird abundance and birds collected for enzyme analysis showed no AChE depression.

Petersen (1981, No ID) monitored the reproductive success of birds inhabiting rangeland treated at 0.1 lb/a. With the exception of fledging survival, the parameters examined showed no statistical differences between treatment and control plots. Fledging success on treated plots was equally below control levels before and after spraying thus not indicating a treatment effect. Preliminary reports from two recent rangeland studies (McEwen et al, 1980 - No ID; McEwen and DeWeese 1981, No ID) suggested applications at 0.1 lbs AI/A resulted in widespread but sublethal AChE depression.

Steph and Stone (00014640) monitored small mammal populations in a mixed deciduous/coniferous forest in New York that was treated with acephate at 0.5 lbs AI/A. They report that indices of population density based on trapping success and mark and recapture showed no significant increase in mortality or emigration occurred in sprayed areas. Statistically significant differences were detected in several reproductive parameters but the researchers suggest that observed differences may be attributed to natural variations in the timing of the reproductive cycles of control and treatment populations.

HAZARO ASSESSMENT

AQUATIC ORGANISMS

The principal registered field crop uses of acephate are for insect pest control in cotton, lettuce, and tobacco [H. Jamerson, Acephate Qualitative Use Assessment,EPA (BFSD),1981]. Contamination of water may occur from such uses via runoff, drift or inadvertent direct spraying of aquatic habitat. Laboratory testing indicates that typical fish 96-hour LC_{50} values for acephate formulations are greater than 1000 ppm. Aquatic invertebrates, though showing a lower LC_{50} range [Daphnia magna 48-hour LC_{50}=1.3 ppm (U.S.E.P.A.-Thompkins, No IO; skwala (stonefly) 96-hour LC_{50}=12 ppm (Johnson and Finley 1980, No IO)] are also not highly sensitive. Under the conditions of a maximum hazard scenario where acephate is sprayed (1.0 lbs AI/A) directly (misapplication) into a pond six inches deep aquatic concentrations would not be expected to exceed 0.73 ppm immediately after treatment. This concentration is sufficiently below the levels demonstrated to be acutely toxic that we may conclude that normal use is unlikely to significantly impact aquatic ecosystems adjacent to treated areas. As acephate degrades fairly rapidly and has very low bioaccumution potential (Acephate Task 3: Environmental Fate Profile, EPA Contract No. 68-01-5830, 1982) chronic hazards are not indicated.

Forest uses of acephate will result in spray over of forest streams and small ponds. At the registered forest rate (0.5 lbs a.i./acre) we may predict direct spraying of streams will result in maximum water concentrations of 0.367 ppm in 6 inches of water. Rabeni (00014547) reports measured concentrations peaked at 0.135 ppm in treated (0.5 lb/a) forest streams one hour post-spray declining rapidly thereafter (Table 1). Such concentrations would not be expected to result in ecologically significant reductions in non-target aquatic organisms. Field monitoring studies (Rabeni, 00014547; Bocsor and O'Connor, 00014637) support this presumption, demonstrating that acephate forest uses did not result in fish mortality and had minor, short-term effects on aquatic invertebrates.

TABLE 1. - Orthene concentrations in streams (ppb) (After Rabeni 1978, 00014547).

	North Brook (treated)	South Brook (treated)	Squaw Brook (control)
Pre-spray	0	0	0
Post-spray 1 hour	135.3	113.2	-
Post-spray 1 day	12.7	65.0	-
Post-spray 2 days	40.8	9.B	-

TERRESTRIAL ORGANISMS

Comparison of avian LD_{50} (Mallard LD_{50}=234 mg/kg, Mastalski and Jenkins 00D14700) and mammalian LD_{50} (rat LD_{50}=900 mg/kg; Stehn and Stone 00014640) values with commonly used acute oral toxicity rating schemes (Matsumara, 1975) indicate that acephate is moderately toxic to birds and slightly toxic to mammals. Avian 8-day dietary toxicity values (mallard LC_{50}>5000 ppm, Fletcher 1976, 00D15957; bobwhite LC_{50}=1280 ppm, Fletcher 1976, 00015956) when compared to a dietary toxicity rating scheme (Hill et al, 1975) suggest that acephate is slightly toxic to bobwhite and practically non-toxic to mallards.

Kenaga (1973) estimated pesticide residues on avian food items (Table 2) based on a review of typical crop residue values and calculated the amount of toxicant that different sized birds might be exposed to in their diets. These data relative to the cited laboratory LC_{50}/LD_{50} values indicate that acephate applied at maximum labeled rates (1.0 lbs AI/A) will not occur in avian foods at levels lethal to most birds. These dietary estimates are also generally applicable to mammals and do not suggest a potential for acute poisoning.

TABLE 2. - Estimation of the mg of toxicant/kg of body weight/day intake by birds of varying sizes resulting from eating different foods from an area treated uniformly with an application of 1 pound of toxicant per acre. (From Kenaga, 1973).

Illustrative Examples of ppm[1] In or On Different types of Food Eaten by Birds	Mg/kg/Day Ingested by Different Sized Birds 20 gm 18%[2]	100 gm 9.2%	1,000 gm 3.6%
240 (sparse foliage)	43	22	9
58 (dense foliage, insects)	10	5.3	2.1
10 (seeds, fruit, large insects)	1.8	0.9	0.4

[1]Ppm pesticide residue immediately after application based on maximum values cited.

[2]Percent of body weight ingested in dry food per day.

Dietary exposure is perhaps the principal route of pesticide uptake but outdoor applications of liquid formulations inevitably result in some dermal exposure to wildlife. Ravsina et al.(00014703) showed that treating all unfeathered portions of the legs and feet of English sparrows (15 times in a 21-day period) with aqueous dilutions of Orthene 75S (concentrations ranged from 0.1-5% Orthene 75S) did not cause toxic symptoms or mortality. These data do not raise expectations for dermal intoxication but as the feathers were not treated they do not address the related hazard of exposure via preening.

Hazards to wildlife cannot be estimated with certainly from laboratory tests (Heinz et al.,1979) therefore field studies when available should be the primary focus of risk assessment. Several bird population studies have been conducted in forests treated with acephate (Table 3). Buckner and McLeod (05017571, 05019256, 05021173) conducted three

TABLE 3. - Avian Field Studies with Acephate

Habitat	Citation	Use Rate	Result
Coniferous Forest (Canada)	Buckner and McLeod (05017571)	0.5 lbs AI/A 1.25 lbs AI/A	No observable effect
Coniferous Forest (Canada)	Buckner and McLeod (05019256)	0.5 lbs AI/A 0.25 lbs AI/A	No observable effect
Coniferous Forest (Canada)	Buckner and McLeod (05021173)	0.5 lbs AI/A (with Bacillus thuringiensis)	Temporary reduction warbler activity
Hardwood Forest (New York)	Bart (05014922)	0.5 lbs AI/A	Significant reduction in red-eyed vireos (P<0.05). Possible reduction in two other species.
Coniferous Forest (Oregon)	Richmond et al (No IO)	1-2 lbs AI/A	- No major change breeding pairs, relative bird abundance or species diversity. - High incidence of sublethal AChE depression (<50%) - Three birds observed exhibiting toxic symptoms
Coniferous Forest (Idaho)	Zinkl et al (No IO)	0.5 lbs AI/A	High incidence of sublethal AChE depression (<50%)

Table 4

Brain cholinesterase depression in birds collected from forests sprayed with acephate[1]

LOCATION	RATE (lbs AI/A)								
Idaho	0.5	Day	0	1	3	6	25-26		
		# depressed / # collected	12/23	14/26	13/14	18/27	3/19		
Oregon	1.0	Day	0	1	2	4	7	15-33	89
		# depressed / # collected	1/14	7/13	11/13	8/13	6/9	12/20	1/16
Oregon	2.0	Day	0	1	2	6			
		# depressed / # collected	1/7	7/7	6/6	6/6			

[1] Zinkl, J.G., R.B. Roberts, C.J. Henney and D.S. Lenhart. 1980. Inhibition of brain cholinesterase of forest birds and squirrels exposed to aerially applied acephate (Orthene®). Bull. Environ. Contam. Toxicol. 24, 676.

forest birds/squirrel

Ibid, 1979, Brain cholinesterase activities of passerine birds in forests sprayed with cholinesterase inhibiting insecticides, Nat. Acad. Sci., ISBN 0-309-02871-X.

investigations and report no bird population reductions of other adverse effects on forest birds in Canada. Bart (05014922) noted a significant ($P<0.05$) post-treatment (0.5 lbs AI/A) decline in red-eyed vireos and two other canopy insectivores showed numerical but not statistically significant reductions. Richmond et al. (1979, No ID, also reported by Zinkl et al., 1979) studied experimental (unregistered) tussock moth applications in Oregon [treatment rates (1.0-2.0 lbs AI/A) were substantially higher than currently registered forest rates (0.5 lbs AI/A)]. Some abnormal behavior and a high incidence (Table 4) of sublethal AChE depression (<50% inhibition) were observed but no major changes in the number of breeding pairs, relative abundance or species diversity were reported. Possible reductions in warbling vireos and yellow-rumped warblers were detected. Bird censusing the following year indicated no long-term effects. Zinkl et al (1980, No ID) studied brain AChE activity in forest birds in Idaho exposed to acephate applied at the registered rate (0.5 lbs AI/A). The incidence of AChE depression was lower (Table 4) than that reported for the 1.0 and 2.0 lb rates (Richmond et al.,1979) and 94% of the observed depressions were at levels considered sublethal (<50% reduction).

These studies indicate that acephate applied directly to forest habitat may result in widespread AChE (brain) depression in birds and possibly reductions in some insectivorous species. That acephate is more toxic than laboratory tests would indicate is attributable in part, perhaps, to its degradation to more potent AChE inhibitors (Zinkl et al, 1981, No ID). Nonetheless treatments did not result in major changes in overall bird abundance, species diversity or population reductions that will carry over to subsequent breeding periods. The reasonableness of this conclusion is enhanced by consideration of the use history of more acutely toxic (Hill et al, 1975) forest insecticides such as sumithion and phosphamidon in Canada. Large areas of forest have been treated in Canada annually since the late 1960's with field studies indicating sizable reductions in some bird species (Pearce et al, 1979). Despite these losses annual breeding bird surveys have not indicated downward trends in treated areas prompting Canada Wildlife Service researchers to conclude "that the natural resilence of songbird populations has in the long run compensated for the sometimes

TABLE 5. - Spruce Budworm Control in Maine 1976-80: Frequency of Repeat Applications (D. Kucera, USDA - personal communication)

Number of Pesticide Treatments Per Site	Acreage ($x10^6$)	Percent of Total
1	2.95	42
2	1.70	34
3	.93	18
4	.303	5
5	.013	>1

locally substantial, shortterm setbacks that have been attributed to forest spraying" (Pearce et al, In Press). From the standpoint of recovery of losses it is pertinent that forest insect outbreaks are episodic and dynamic such that the same sites are not treated year after year (Table 4) as may occur in agriculture (pers. comm. Dr. Daniel Kucera, USDA, Forest Service, Forest Pest Management) thus allowing untreated recovery periods.

The effect of acephate (0.5 lbs AI/A) on small forest mammals was investigated by Stehn and Stone (00014640) in New York. Stomach residue analysis indicated that ingestion at the highest rate detected (0.017 mg/kg/day) was unlikely to result in acute poisoning. Population density based on trapping success and the number of recaptured marked individuals showed that no increase in mortality or emigration occurred in sprayed areas. Differences in reproduction were detected between sprayed and control areas, however, the investigators stated that variation in the timing of the reproductive cycle between populations existed and this may account for the observed effect.

Acephate is registered (24c) for grasshopper control on rangeland with rates, typically, at 0.1 lbs AI/A. Rangeland, like forest, is important habitat and treatment of large areas with pesticides may result in widespread residues on wildlife food as well as dermal and inhalation exposure to local animals. McEwen et al (Progress Report 1980, unpublished, No ID) studied wildlife exposed to acephate rangeland applications (0.1 lbs AI/A) in Arizona. Results were somewhat variable; plot bird censusing indicated a mean population increase on control plots of 7.8% and a 15.7% decline in treated areas while line transect counts showed a 20% population reduction in untreated areas and 25% loss in plots sprayed. No statistical tests were applied to these preliminary data. Live-trapping indicated no reduction in the number of small mammals. Brain AChE activity was monitored with birds showing small to moderate reductions in treated areas but mammals retaining normal enzyme activity. AChE inhibition in the songbirds collected indicated that birds were exposed to sublethal (20% depressions) rather than life-threatening reductions in brain activity (i.e. >50%; See Ludke, 1975). No fresh carcasses or other evidence of mortality were found. McEwen and DeWeese (Research Summary-1981, unpublished, No ID) in a subsequent monitoring of acephate rangeland treatments in Wyoming again report widespread but sublethal post-spray reductions in bird brain AChE. In contrast to their previous study in Arizona small mammals also showed slightly reducted AChE activity (12-14%). No direct mortality was observed. Peterson (1981, No ID) studied the nesting success of rangeland birds exposed to acephate (0.1 lbs AI/A) and reports that reproduction on sprayed plots was comparable to control areas.

These field studies indicate that acephate rangeland treatments will result in measureable wildlife poisoning, particularly of birds, however, effects are not likely to be lethal or significantly impair behavior.

It is important in terms of long-term exposure and potential ecological effects on wildlife that the great majority of managed rangeland sites are not treated annually, rather lapses of 3-5 years between economically serious pest infestations are common (personal communications: Mr. Ronald Johnson, APHIS, USDA and Dr. Robert Pfadt, University of Wyoming). It is concluded therefore that the modest anticipated impact on rangeland vertebrates is within acceptable limits.

No wildlife field studies are available for field crop or ornamental uses[1] of acephate. The rangeland and forest studies, however, have monitored comparable application rates and as these studies have demonstrated that the effects of acephate are within acceptable limits in high jeopardy uses[2] the risks associated with agricultural and ornamental uses are unlikely to be greater.

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[1]Most of these uses involve liquid or soluble powder formulations of acephate and therefore the routes of exposure will be comparable to those of the 75% AI soluble powder formulation used on rangeland and forest. A notable exception is the 1.5% acephate granular formulation. Birds are likely to consume this product directly from the soil surface or, inadvertently, when it is attached to soil invertebrates such as earthworms. Avian hazards are not indicated for this product, however, as the moderate acute oral toxicity of acephate would require that birds consume hundreds to thousands of granules (depending on body size and sensitivity) to reach LD_{50} dose values.

[2]Pesticide exposure to wildlife from agricultural and ornamental uses is mitigated relative to forest or rangeland uses by the resultant patchy distribution of residues. In farming and suburban areas birds may feed in treated areas but also take a substantial portion of their food from adjacent untreated areas. In addition nesting in crops treated with acephate (cotton, tobacco, lettuce) would be uncommon. In contrast forest and rangeland insect control programs result in pesticide treatments to large contiguous blocks of prime habitat such that exposed wildlife have little opportunity to nest or forage in uncontaminated areas.

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Zinkl, J.G., R.B. Roberts, C.J. Henney and D.S. Lenhart. 1979. Brain cholinesterase activities of passerine birds in forests sprayed with cholinesterase inhibiting insecticides. Nat. Acad. Sci., ISBN 0-309-02871-X.

MANUFACTURING USE ACEPHATE

Generic Data Requirements: Ecological Effects (See Chapter VIII)

Guidelines Citation	Name Of Test	Are Data Required?	Composition	Does EPA Have Data To Partially Or Totally Satisfy This Requirement?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c) 2(B)?
163.71-1	Avian Single-Dose Oral LD_{50}	Yes	Tech	Yes	00014700 00014701	No
163.71-2	Avian Dietary LC_{50}	Yes	Tech	Yes	00015956 00015957	No
163.71-3	Wild Mammal Toxicity	No				
163.71-4	Avian Reproduction	No				
163.71-5	Simulated and Actual Field Testing for Mammals & Birds	No				
163.72-1	Fish Acute LC_{50}	Yes	Tech	Yes	05018314 000147D5	No
133.72-2	Acute Toxicity to Freshwater Aquatic Invertebrates	Yes	Tech	Yes	05018314 00014861 Johnson & Finley 1980 (No ID)	No

Generic Data Requirements: Ecological Effects (See Chapter VIII)

Guidelines Citation	Name Of Test	Are Data Required?	Composition	Does EPA Have Data To Partially Or Totally Satisfy This Requirement?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c) 2(B)?
163.72-3	Acute Toxicity to Estuarine & Marine Organisms	No				
163.72-4	Fish Early Life-Stage aquatic invertebrate Life cycle.	No				
163.72-5	Fish Life-Cycle	No				
163.72-6	Aquatic Organism Accumulation	No				
163.72-7	Simulated or Actual Field Testing for Aquatic Organisms	No				

These data requirements are current as of May, 1981. Refer to the guidance package for updated requirements.

END USE ACEPHATE

Product Specific Data Requirements: Ecological Effects (See Chapter VIII)

Guidelines Citation	Name Of Test	Are Data Required?	Composition	Does EPA Have Data To Partially Or Totally Satisfy This Requirement?	Bibliographic Citation	Must Additional Data be Submitte Under FIFRA 3(c) 2(B)?
163.71-1	Avian Single-Dose Oral LD_{50}	No				
163.71-2	Avian Dietary LC_{50}	No				
163.71-3	Wild Mammal Toxicity	No				
163.71-4	Avian Reproduction	Yes	TECH	Yes	00029691 00029692	No
163.71-5	Simulated and Actual Field Testing for Mammals & Birds	Yes	75 SC/S	Yes	05014922 00014639 05019256 05021173 05017571 00014860 Petersen et al. 1981 McEwen et al. 1980 McEwen & DeWeese 1981 Richmond et al. 1979 Zinkl et al. 1980	No
163.72-1	Fish Acute LC_{50}	No				
163.72-2	Acute Toxicity to Freshwater Aquatic Invertebrates	Yes	75 SC/S	Yes	Johnson & Finley 1980 U.S.E.P.A. 1978	No

END USE (CONTINUED)

Product Specific Data Requirements: Ecological Effects (See Chapter VIII)

Guidelines Citation	Name Of Test	Are Data Required?	Composition	Does EPA Have Data To Partially Or Totally Satisfy This Requirement?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c) 2(B)?
163.72-3	Acute Toxicity to Estuarine & Marine Organisms	No				
163.72-4	Fish Early Life-Stage aquatic invertebrate Life cycle.	No				
163.72-5	Fish Life-Cycle	No				
163.72-6	Aquatic Organism Accumulation	No				
163.72-7	Simulated or Actual Field Testing for Aquatic Organisms	No				

Refer to the guidance package for updated requirements.

ECOLOGICAL EFFECTS

TOPICAL DISCUSSION

Effects on Birds

Twenty-five studies were received and evaluated under this topic (Table 1). Twenty-four are acceptable for use in hazard essessments for birds.

TABLE 1 - Studies Evaluated

Author	I.D.
Beavers et al.	00029689
Beavers et al.	00029690
Beavers et al.	00029692
Bart et al.	00014639
Bart	05014922
Booth	05018200
Buckner and McLeod	05017571
Buckner and McLeod	00014860
Buckner and McLeod	05021173
Buckner et al.	05019256
Fink et al.	00029691
Fletcher	?
Fletcher	00015231
Fletcher	00015956
Fletcher	00015957
Hudson	00015962
Mastalski and Jenkins	00014700
Mastalski and Jenkins	00014701
McEwen et al.	No ID
McEwen and DeWeese	No ID
Petersen et al.	No ID
Ravsina	00014703
Richmond et al.	No ID
Zinkl et al.(1980)	No ID
Zinkl et al.(1981)	No ID

The minimum testing required for establishing the acute toxicity of acephate to birds is the single-dose oral LD_{50} test on either an upland game species (preferably bobwhite or ring-necked pheasant) or waterfowl (preferably mallard) (Sec. 163.71-1). The acceptable data are listed in Table 2.

TABLE 2. Single-dose oral LD_{50}

Species	Test Material	LD_{50}	Author	Date	ID	Fulfills Guideline Requirements
Mallard	Technical	350 mg/kg	Mastalski & Jenkins	1970	00014700	Yes

Mallard	Technical	234 mg/kg	Hudson	1972	00015962	No
Ring-necked	Technical	140 mg/kg	Mastalski & Jenkins	1970	00014701	Yes

The available avian acute oral toxicity studies satisfy guideline requirements and demonstrate that acephate is moderately toxic to mallards and ring-necked pheasants.

A minimum of two eight-day dietary toxicity studies (preferably bobwhite and mallard) are required to establish the short-term subacute effects of acephate (Sec. 163.71-2). The acceptable data are presented in Table 3. These studies satisfy guideline requirements and demonstrate that technical acephate is slightly toxic (bobwhite) to practically non-toxic (mallard) by dietary exposure.

TABLE 3. Eight-day dietary LC_{50} Studies

Species	Test Material	LC_{50}	Author	Date	I.D.	Fulfills Guidelines Requirements
Mallard	Technical	>5000 ppm	Fletcher	1976	00015957	Yes
Bobwhite	Technical	1280 ppm	Fletcher	1976	00015956	Yes

Avian reproduction studies indicate 'no-effect' levels (NOEL) >5 ppm but <20 ppm for mallards (Beavers et al., 00029691) and >20 ppm but <80 ppm for bobwhite (Beavers et al., 00029692) under a 16 week dietary exposure (Table 4).

TABLE 4. Avian Reproduction Studies

Species	Test Material	NOEL	Author	Date	I.D.	Filfills Guideline Requirements
Mallard	Technical	>5 ppm <20 ppm	Beavers, et al. WLI	1979	00029691	Yes ✓
Bobwhite	Technical	>20 ppm <80 ppm	Beavers, et al. WLI	1979	00029692	Yes ✓

Brain AChE activity studies [Beavers et al., 00029689 (mallard); Beavers et al., 00029690 (bobwhite)] concurrent with the above reproduction tests indicate reduced activity in all treatment groups with impairment increasing with dosage. At the 80 ppm treatment level ACHE inhibition in both species typically exceeded 50% during the 18 week exposure period. Brain acetylcholinesterase depression of this magnitude may be life-threatening (Ludke et al., 1975) and suggests a basis for the observed reduction in reproductive output. ACHE activity returned to normal within 4 weeks in bobwhite and 8 weeks in mallards when the birds were returned to an untreated diet. These studies are consdiered scientifically sound, however, no guideline requirements exist for such tests.

Field studies are required to determine the impact of acephate forest and rangeland uses on birds (Sec. 163.71-5). The acceptable data are listed in Table 5.

TABLE 5. Avian Field Studies - Orthene Forest Spray

Author	Date	I.D.	Rate	Location	Comment
Bart	1979	05014922	0.5 lbs AI/A	New York (forest)	
Bart at al.	1975	00014639	0.5 lbs AI/A	New York (forest)	Unpublished version of 05014922 (above).
Buckner et al.	1976	05019256	0.2 lbs AI/A 0.5 lbs AI/A	Canada (forest)	
Buckner & McLeod	1977	05021173	0.05 lbs AI/A	Newfoundland (forest)	Applied with *Bacillus thuringiensis*
Buckner & McLeod	1975	05017571	0.5 lbs AI/A 1.25 lbs AI/A	Canada (forest)	
Buckner & McLeod	1975	00014860	--	--	Study is identical to 05017571 above.
Petersen et al.	1981	unassigned	0.1 lbs AI/A	Wyoming (rangeland)	
McEwen et al.	1980	unassigned	0.1 lbs AI/A	Arizona (rangeland)	
McEwen & DeWeese	1981	unassigned	0.1 lbs AI/A	Wyoming (rangeland)	
Richmond et al.	1979	unassigned	1.0 lbs AI/A 2.0 lbs AI/A	Oregon (forest)	
Zinkl et al.	1980	unassigned	0.50 lbs AI/A	Idaho (forest)	

The effects of pesticides on bird communities can be variable and complex thus it is seldom possible to identify any one field monitoring study as defining the hazard and fulfilling the guideline requirement for such testing. The available field studies for acephate are of this sort; no one study provides sufficient information to determine risks but, taken as a whole and reviewed against what is known historically of the effects of forest spray programs on bird populations, they fulfill guideline requirments and provide sufficient information for a hazard assessment. These studies indicate that acephate forest spray treatments may result in local population reductions in some bird species as well a high incidence of brain AChE inhibition (sublethal) but that effects are not excessive, long-lasting, or likely to diminish wildlife resources.

Effects on Freshwater Fish

Fifteen studies were evaluated under this topic (Table 1). Thirteen are acceptable for use in hazard assessments.

TABLE 1. - Freshwater Fish Studies Evaluated

Author	ID
Bocsor and O'Connor	00014637
Dvangsawasdi and Klaverkamp	05020323
Hutchinson	00014705
Hydorn	05020212
Klaverkamp et al	05017149
Johnson and Finley	No ID
Rabeni	00014547
Rabeni and Stanley	05012201
Schoettger and Mauck	05018314
Schoettger and Mauck	00014861
Thompson	00014706
Thompson	00014707
Thompson	00014708
Thompson and Huntoon	00014709
Thompson and Huntoon	00014710

The minimum data required for establishing the toxicity of technical acephate to freshwater fish are the results of two 96-hour bioassays (Sec. 163.72-1): [one coldwater species (preferably rainbow trout) and one warmwater species (preferably bluegill sunfish)]. These data (Table 2) demonstrate that technical acephate is practically non-toxic to freshwater fish and satisfy guideline requirements.

TABLE 2. - Freshwater fish acute toxicity studies with technical acephate.

Species	96-hour LC50 (ppm)	Author	Date	ID	Fulfills Guideline Requirements
Brook Trout	>1000	Schoettger & Mauck	1978	05018314	Yes X
Rainbow Trout	>1000	Hutchinson	1970	00014705	Yes
Bluegill Sunfish	>1000	Hutchinson	1970	00014705	Yes
Channel Catfish	>1000	Hutchinson	1970	00014705	Yes
Rainbow Trout	1,100	Johnson & Finley	1980	No ID (40094602)	Yes

TABLE 2 (Cont'd.)

Species	96-hour LC50 (ppm)	Author	Date	ID	Fulfills Guideline Requirements
Cutthroat Trout	>100	Johnson & Finley	1980	--	Yes
Brook Trout	>100	Johnson & Finley	1980	--	Yes
Fathead Minnow	>1000	Johnson & Finley	1980	--	Yes
Channel Catfish	>1000	Johnson & Finley	1980	--	Yes
Bluegill	>1000	Johnson & Finley	1980	--	Yes
Yellow Perch	>50	Johnson & Finley	1980	--	Yes

Aquatic toxicity studies on formulated products not are required as testing with technical material has shown acephate to be very non-toxic to fish. However several studies (Table 3) were received and evaluated. These data demonstrate that Orthene 75 SC/S is practically non-toxic to freshwater fish.

Table 3
FORMULATED PRODUCT (Orthene 75 SC/S)

Species	LC50 (ppm)	Author	Date	ID	Fulfills Guideline Requirements
Bluegill Sunfish	2000	Thompson	1971	00014706	---
Black Bass	3000	Thompson	1971	00014707	---
Channel Catfish	1500	Thompson	1971	00014708	---
Mosquito Fish	>4000	Thompson & Huntoon	1971	00014709	---
Goldfish	>4000	Thompson & Huntoon	1971	00014710	---
Cutthroat Trout	>100	Johnson & Finley	1980	--	---
Rainbow Trout	730	Johnson & Finley	1980	--	---
Fathead Minnow	>1000	Johnson & Finley	1980	--	---
Bluegill	>1000	Johnson & Finley	1980	--	---
Yellow Perch	>100	Johnson & Finley	1980	--	---
Channel Catfish	560-1000	Johnson & Finley	1980	--	---

Based on the demonstrated low toxicity of acephate to freshwater fish no simulated or actual field studies are required (Sec. 163.72-6). Though no requirement exists three field studies were received and reviewed.

Three field studies monitoring the impact of formulated acephate (assumed to be Orthene Forest Spray - 75% active ingredient) on fish were reviewed. Bocsor and O'Connor (00014637) studied the effects of Orthene applied at 0.5 lbs AI/A to two forest ponds and a stream in Pennsylvania. Sixty-five fish (bluegills, perch and bullheads) caged in a pond showed no effects of the pesticide treatment up to 8 days post-application. Rabeni (00014547) investigated Orthene applications (assumed to be 0.5 lbs AI/A) on stream organisms in Maine. The spraying resulted in a signficant reduction in brain AChE activity in suckers but not in trout or salmon. Brook trout were found to change their diet for a few days after spraying apparently in response to the sudden availability of arboral arthopods that were killed by Orthene and fell into the streams (also see Hydorn, Rabeni and Jennings, 05020212). Salmonid growth and condition was considered unaffected and newly hatched smelt grew normally. Rabeni concluded that Orthene had relatively minor, short-term effects on the streams studied.

Bibliography of Uncatalogued
Acephate Studies

Johnson, W.W. and M.T. Finley. 1980. Handbook of acute toxicity of chemicals to fish and aquatic invertebrates. United States Department of the Interior Fish and Wildlife Service/Resource Publication 137 Washington, D.C.

McEwen, L.C. and L.R. DeWeese. Unpublished. Summary of 1981 Field studies of acephate effects on rangeland wildlife. U.S. Fish and Wildlife Service, Patuxent Wildlife Research Center.

McEwen, L.C., L.R. DeWeese, T. Lamont, and E. Kolbe. Unpublished. Field studies of wildlife hazards related to new range grasshopper control chemicals and other materials. Progress Report: October 1, 1979 - September 30, 1980. U.S. Department of Interior, Fish and Wildlife Service, Patuxent Wildlife Research Center.

Petersen, B., D. Palmer and R. Ryder. (1981) Unpublished. The effects of acephate on rangeland wildlife. Colorado State University, Fishery and Wildlife Biology Department, Fort Collins, Colorado.

Richmond, Merle L., Charles J. Henny, Randy L. Floyd, R. William Mannan, Deborah M. Finch, and Lawrence R. DeWeese. 1979. Effects of Sevin-4-Oil, Dimilin, and Orthene on forest birds in Northeastern Oregon. Res. Paper PSW-148, 19 p., illus. Pacific Southwest Forest and Range Exp. Stn., Forest Service, U.S. Dep. Agric. Berkeley, Calif.

Thompkins, James. (1978) Unpublished. Acephate: 21-Day Life Cycle Test (Daphnia magna). U.S.E.P.A., Benefits and Field Studies Division, Agricultural Research Center, Beltsville, Md.

Thompkins, James. (1978) Unpublished. Acephate: 48-hour acute toxicity test (Daphnia magna). U.S.E.P.A., Benefits and Field Studies Division, Agricultural Research Center, Beltsville, Md.

Zinkl, J.G., R.B. Roberts, C.J. Henney and D.S. Lenhart. 1980. Inhibition of brain cholinesterase of forest birds and squirrels exposed to aerially applied acephate (Orthene®). Bull. Environ. Contam. Toxicol. 24, 676.

Zinkl, J.G., R.B. Roberts, P.J. Shea and J. Lasmanis. 1981. Toxicity of Acephate and Methamidophos to Dark-eyed Juncos. Bull. Environm. Contam. Toxicol. 10, 185-192.

Effects on Wild Mammals

Three studies were received and reviewed under this topic. All were found acceptable for use in a hazard assessment. Steph and Stone (00014640) monitored small mammal populations in a mixed deciduous/coniferous forest in New York that was treated with acephate at 0.5 lbs AI/A. They report that indices of population density based on trapping success and mark and recapture showed no signficant increase in mortality or emigration occurred in sprayed areas. Significant differences were detected in several reproductive parameters but the researchers suggest that differences in the timing of the reproductive cycles between control and treatment populations may be responsible for the observed variation. McEwen et al (1980, No ID) investigated rangeland mammals exposed at 0.1 lbs AI/A in Arizona. Live-trapping indicated no reduction in populations of small mammals and brain CHE analysis showed no post-treatment inhibition in deer mice and wood rats. McEwen and DeWeese (1981, No ID) studied similar treatments in Wyoming and found slight CHE depression (15%) in small mammals there. No indication of mortality was found in either rangeland study.

The Agency currently has no minimum data requirements for wild mammals. There are no wild mammal studies required for currently registered acephate uses.

Effects on Reptiles and Amphibians

One study was received and evaluated under this topic. Lyons et al. (05019255) report that the 24-hour LC_{50} of technical acephate for *Rana clamitans* tadpoles is greater than 5000 ppm. This study is acceptable for use in a hazard assessment and demonstrates that acephate is relatively non-toxic to this amphibian species.

The Agency has not established minimum toxicity testing requirements for reptiles and amphibians. There are no acute or chronic toxicity studies required for currently registered acephate uses.