Acephate
Analysis of Risks
to
Endangered and Threatened Salmon and Steelhead

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Summary

Acephate is a widely used, non-restricted, organophosphate insecticide, first registered in the United States in 1973. It is applied to food crops, common to the west and northwest, including beans (green and lima), Brussel sprouts, cauliflower, celery, cranberries, lettuce, peppermint and peppers. Other non-food, agricultural uses include seed treatments for cotton and peanuts. Acephate also has residential use in and around buildings, homes, apartments, and pantries and is used for the control of roaches, wasps, fire ants, crickets, and other pests. Other residential uses include application to home lawns, trees, shrubs, and ornamentals.

Public Health applications occur in and around industrial, institutional, and commercial buildings, including restaurants, food handling establishments, ware houses, stores, hotels, manufacturing plants, and ships for the control of roaches and fire ants.

Acephate is also used on sod, golf course turf, field borders, fence rows, roadsides,ditch banks, borrow pits, wasteland, and greenhouse and horticultural nursury floral and foliage plants.

The main target pests include armyworms, aphids, beetles, bollworms.borers, budworms, cankerworms, crickets, cutworms, fire ants, fleas, grasshoppers, leafhoppers, loopers, mealyworms, mites, moths, roaches, spiders, thrips, wasps, weevils, and whiteflies.

Registered formulations include wetable powder, soluble powder, soluble extruded pellets, granules, water soluble bags, and liquid. A wide range of application methods are approved for acephate, ranging from hose-end sprayers and belly grinders, to high pressure sprays and aerial application by aircraft, for agricultural use. Application rates vary considerably between food and non-food uses and for specific crops, structural uses, and pests.

[1] **Comment: Data and the analysis based upon these data reflect information available at the time this report was completed. Additional data, which may have submitted or changes in status after the submission date are not included in the authors evaluations, presentations, or comments.**

Scope - Although this analysis is specific to listed western salmon and steelhead and the watersheds in which they occur, it is acknowledged that acephate is registered for uses that may occur outside this geographic scope and that additional analyses may be required to address other T&E species in the Pacific states as well as across the United States. I understand that any subsequent analyses, requests for consultation, and resulting Biological Opinions may necessitate that Biological Opinions relative to this request be revisited, and could be modified. Much of the quantitative information presented and used was derived from the Registration Eligibility Decision (RED) and the Ecological Risk Assessment (ERA, Attachment 2) developed by the Ecological Fate and Effects Division (EFED) for the RED (Attachment 1).

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Attachments:

1. Reregistration Eligibility Decision for acephate, Case 102
2. EFED RED Chapter, acephate
3. EPA Quantitative Usage Analysis, acephate
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1. Background

Under section 7 of the Endangered Species Act, the Office of Pesticide Programs (OPP) of the U. S. Environmental Protection Agency (EPA) is required to consult on actions that ‘may affect’ Federally listed endangered or threatened species or that may adversely modify designated critical habitat. Situations where a pesticide may affect a fish, such as any of the salmonid species listed by the National Marine Fisheries Service (NMFS), include either direct or indirect effects on fish. Direct effects result from exposure to a pesticide at levels that may cause harm.

Acute Toxicity - Relevant acute data are derived from standardized toxicity tests with lethality as the primary endpoint. These tests are conducted with what is generally accepted as the most sensitive life stage of fish, i.e., very young fish from 0.5-5 grams in weight, and with species that are usually among the most sensitive. These tests for pesticide registration include analysis of observable sublethal effects as well. The intent of acute tests is to statistically derive a median effect level; typically the effect is lethality in fish (LC50) or immobility in aquatic invertebrates (EC50). Typically, a standard fish acute test will include concentrations that cause no mortality, and often no observable sublethal effects, as well as concentrations that would cause 100% mortality. By looking at the effects at various test concentrations, a dose-response curve can be derived, and one can statistically predict the effects likely to occur at various pesticide concentrations; a well done test can even be extrapolated, with caution, to concentrations below those tested (or above the test concentrations if the highest concentration did not produce 100% mortality).

OPP typically uses qualitative descriptors to describe different levels of acute toxicity, the most likely kind of effect of modern pesticides (Table 1). These are widely used for comparative purposes, but must be associated with exposure before any conclusions can be drawn with respect to risk. Pesticides that are considered highly toxic or very highly toxic are required to have a label statement indicating that level of toxicity. The FIFRA regulations [40CFR158.490(a)] do not require calculating a specific LC50 or EC50 for pesticides that are practically non-toxic; the LC50 or EC50 would simply be expressed as >100 ppm. When no lethal or sublethal effects are observed at 100 ppm, OPP considers the pesticide will have "no effect" on the species.

Table 1. Qualitative descriptors for categories of fish and aquatic invertebrate toxicity (from Zucker, 1985)

LC50 or EC50	Category description
< 0.1 ppm	Very highly toxic
0.1- 1 ppm	Highly toxic
>1 < 10 ppm	Moderately toxic
> 10 < 100 ppm	Slightly toxic
> 100 ppm	Practically non-toxic

Comparative toxicology has demonstrated that various species of scaled fish generally have equivalent sensitivity, within an order of magnitude, to other species of scaled fish tested under the same conditions. Exceptions are known to occur for only an occasional pesticide, as based on the several dozen fish species that have been frequently tested. Sappington et al. (2001), Beyers et al. (1994) and Dwyer et al. (1999), among others, have shown that endangered and threatened fish tested to date are similarly sensitive, on an acute basis, to a variety of pesticides and other chemicals as their non-endangered counterparts.

Chronic Toxicity - OPP evaluates the potential chronic effects of a pesticide on the basis of several types of tests. These tests are often required for registration, but not always. If a pesticide has essentially no acute toxicity at relevant concentrations, or if it degrades very rapidly in water, or if the nature of the use is such that the pesticide will not reach water, then chronic fish tests may not be required [40CFR158.490]. Chronic fish tests primarily evaluate the potential for reproductive effects and effects on the offspring. Other observed sublethal effects are also required to be reported. An abbreviated chronic test, the fish early-life stage test, is usually the first chronic test conducted and will indicate the likelihood of reproductive or chronic effects at relevant concentrations. If such effects are found, then a full fish life-cycle test will be conducted. If the nature of the chemical is such that reproductive effects are expected, the abbreviated test may be skipped in favor of the full life-cycle test. These chronic tests are designed to determine a "no observable effect level" (NOEL) and a "lowest observable effect level" (LOEL). A chronic risk requires not only chronic toxicity, but also chronic exposure, which can result from a chemical being persistent and resident in an environment (e.g., a pond) for a chronic period of time or from repeated applications that transport into any environment such that exposure would be considered "chronic".

As with comparative toxicology efforts relative to sensitivity for acute effects, EPA, in conjunction with the U. S. Geological Survey, has a current effort to assess the comparative toxicology for chronic effects also. Preliminary information indicates, as with the acute data, that endangered and threatened fish are again of similar sensitivity to similar non-endangered species.

Metabolites and Degradates - Information must be reported to OPP regarding any pesticide metabolites or degradates that may pose a toxicological risk or that may persist in the environment [40CFR159.179]. Toxicity and/or persistence test data on such compounds may be required if, during the risk assessment, the nature of the metabolite or degradate and the amount that may occur in the environment raises a concern. If actual data or structure-activity analyses are not available, the requirement for testing is based upon best professional judgement.

Inert Ingredients - OPP does take into account the potential effects of what used to be termed "inert" ingredients, but which are beginning to be referred to as "other ingredients". OPP has classified these ingredients into several categories. A few of these, such as nonylphenol, can no longer be used without including them on the label with a specific statement indicating the potential toxicity. Based upon our internal databases, I can find no product in which nonylphenol is now an ingredient. Many others, including such ingredients as clay, soybean oil, many polymers, and chlorophyll, have been evaluated through structure-activity analysis or data and determined to be of minimal or no toxicity. There exist also two additional lists, one for inerts with potential toxicity which are considered a testing priority, and one for inerts unlikely to be toxic, but which cannot yet be said to have negligible toxicity. Any new inert ingredients are required to undergo testing unless it can be demonstrated that testing is unnecessary.

The inerts efforts in OPP are oriented only towards toxicity at the present time, rather than risk. It should be noted, however, that very many of the inerts are in exceedingly small amounts in pesticide products. While some surfactants, solvents, and other ingredients may be present in fairly large amounts in various products, many are present only to a minor extent. These include such things as coloring agents, fragrances, and even the printers ink on water soluble bags of pesticides. Some of these could have moderate toxicity, yet still be of no consequence because of the negligible amounts present in a product. If a product contains inert ingredients in sufficient quantity to be of concern, relative to the toxicity of the active ingredient, OPP attempts to evaluate the potential effects of these inerts through data or structure-activity analysis, where necessary.

For a number of major pesticide products, testing has been conducted on the formulated end-use products that are used by the applicator. The results of fish toxicity tests with formulated products can be compared with the results of tests on the same species with the active ingredient only. A comparison of the results should indicate comparable sensitivity, relative to the percentage of active ingredient in the technical versus formulated product, if there is no extra activity due to the combination of inert ingredients. I note that the "comparable" sensitivity must take into account the natural variation in toxicity tests, which is up to 2-fold for the same species in the same laboratory under the same conditions, and which can be somewhat higher between different laboratories, especially when different stocks of test fish are used.

The comparison of formulated product and technical ingredient test results may not provide specific information on the individual inert ingredients, but rather is like a "black box" which sums up the effects of all ingredients. I consider this approach to be more appropriate than testing each individual inert and active ingredient because it incorporates any additivity, antagonism, and synergism effects that may occur and which might not be correctly evaluated from tests on the individual ingredients. I do note, however, that we do not have aquatic data on most formulated products, although we often have testing on one or perhaps two formulations of an active ingredient.

Risk - An analysis of toxicity, whether acute or chronic, lethal or sublethal, must be combined with an analysis of how much will be in the water, to determine risks to fish. Risk is a combination of exposure and toxicity. Even a very highly toxic chemical will not pose a risk if there is no exposure, or very minimal exposure relative to the toxicity. OPP uses a variety of chemical fate and transport data to develop "estimated environmental concentrations" (EECs) from a suite of established models. The development of aquatic EECs is a tiered process.

The first tier screening model for EECs is with the GENEEC program, developed within OPP, which uses a generic site (in Yazoo, MS) to stand for any site in the U. S. The site choice was intended to yield a maximum exposure, or "worst-case," scenario applicable nationwide, particularly with respect to runoff. The model is based on a 10 hectare watershed that surrounds a one hectare pond, two meters deep. It is assumed that all of the 10 hectare area is treated with the pesticide and that any runoff would drain into the pond. The model also incorporates spray drift, the amount of which is dependent primarily upon the droplet size of the spray. OPP assumes that if this model indicates no concerns when compared with the appropriate toxicity data, then further analysis is not necessary as there would be no effect on the species.

It should be noted that prior to the development of the GENEEC model in 1995, a much more crude approach was used to determining EECs. Older reviews and Reregistration Eligibility Decisions (REDs) may use this approach, but it was excessively conservative and does not provide a sound basis for modern risk assessments. For the purposes of endangered species consultations, we will attempt to revise this old approach with the GENEEC model, where the old screening level raised risk concerns.

When there is a concern with the comparison of toxicity with the EECs identified in GENEEC model, a more sophisticated PRZM-EXAMS model is run to refine the EECs if a suitable scenario has been developed and validated. The PRZM-EXAMS model was developed with widespread collaboration and review by chemical fate and transport experts, soil scientists, and agronomists throughout academia, government, and industry, where it is in common use. As with the GENEEC model, the basic model remains as a 10 hectare field surrounding and draining into a 1 hectare pond. Crop scenarios have been developed by OPP for specific sites, and the model uses site-specific data on soils, climate (especially precipitation), and the crop or site. Typically, site-scenarios are developed to provide for a worst-case analysis for a particular crop in a particular geographic region. The development of site scenarios is very time consuming; scenarios have not yet been developed for a number of crops and locations. OPP attempts to match the crop(s) under consideration with the most appropriate scenario. For some of the older OPP analyses, a very limited number of scenarios were available. As more scenarios become available and are geographically appropriate to selected T&E species, older models used in previous analyses may be updated.

One area of significant weakness in modeling EECs relates to residential uses, especially by homeowners, but also to an extent by commercial applicators. There are no usage data in OPP that relate to pesticide use by homeowners on a geographic scale that would be appropriate for an assessment of risks to listed species. For example, we may know the maximum application rate for a lawn pesticide, but we do not know the size of the lawns, the proportion of the area in lawns, or the percentage of lawns that may be treated in a given geographic area. There is limited information on soil types, slopes, watering practices, and other aspects that relate to transport and fate of pesticides. We do know that some homeowners will attempt to control pests with chemicals and that others will not control pests at all or will use non-chemical methods. We would expect that in some areas, few homeowners will use pesticides, but in other areas, a high percentage could. As a result, OPP has insufficient information to develop a scenario or address the extent of pesticide use in a residential area.

It is, however, quite necessary to address the potential that home and garden pesticides may have to affect T&E species, even in the absence of reliable data. Therefore, I have developed a hypothetical scenario, by adapting an existing scenario, to address pesticide use on home lawns where it is most likely that residential pesticides will be used outdoors. It is exceedingly important to note that there is no quantitative, scientifically valid support for this modified scenario; rather it is based on my best professional judgement. I do note that the original scenario, based on golf course use, does have a sound technical basis, and the home lawn scenario is effectively the same as the golf course scenario. Three approaches will be used.

First, the treatment of fairways, greens, and tees will represent situations where a high proportion of homeowners may use a pesticide. Second, I will use a 10% treatment to represent situations where only some homeowners may use a pesticide. Even if OPP cannot reliably determine the percentage of homeowners using a pesticide in a given area, this will provide two estimates. Third, where the risks from lawn use could exceed our criteria by only a modest amount, I can back-calculate the percentage of land that would need to be treated to exceed our criteria. If a smaller percentage is treated, this would then be below our criteria of concern. The percentage here would be not just of lawns, but of all of the treatable area under consideration; but in urban and highly populated suburban areas, it would be similar to a percentage of lawns. Should reliable data or other information become available, the approach will be altered appropriately.

It is also important to note that pesticides used in urban areas can be expected to transport considerable distances if they should run off on to concrete or asphalt, such as with streets (e.g., TDK Environmental, 2001). This makes any quantitative analysis very difficult to address aquatic exposure from home use. It also indicates that a no-use or no-spray buffer approach for protection, which we consider quite viable for agricultural areas, may not be particularly useful for urban areas.

Finally, the applicability of the overall EEC scenario, i.e., the 10 hectare watershed draining into a one hectare farm pond, may not be appropriate for a number of T&E species living in rivers or lakes. This scenario is intended to provide a “worst-case” assessment of EECs, but very many T&E fish do not live in ponds, and very many T&E fish do not have all of the habitat surrounding their environment treated with a pesticide. OPP does believe that the EECs from the farm pond model do represent first order streams, such as those in headwaters areas (Effland, et al. 1999). In many agricultural areas, those first order streams may be upstream from pesticide use, but in other areas, or for some non-agricultural uses such as forestry, the first order streams may receive pesticide runoff and drift. However, larger streams and lakes will very likely have lower, often considerably lower, concentrations of pesticides due to more dilution by the receiving waters. In addition, where persistence is a factor, streams will tend to carry pesticides away from where they enter into the streams, and the models do not allow for this. The variables in size of streams, rivers, and lakes, along with flow rates in the lotic waters and seasonal variation, are large enough to preclude the development of applicable models to represent the diversity of T&E species’ habitats. We can simply qualitatively note that the farm pond model is expected to overestimate EECs in larger bodies of water.

Indirect Effects - We also attempt to protect listed species from indirect effects of pesticides. We note that there is often not a clear distinction between indirect effects on a listed species and adverse modification of critical habitat (discussed below). By considering indirect effects first, we can provide appropriate protection to listed species even where critical habitat has not been designated. In the case of fish, the indirect concerns are routinely assessed for food and cover.

The primary indirect effect of concern would be for the food source for listed fish. These are best represented by potential effects on aquatic invertebrates, although aquatic plants or plankton may be relevant food sources for some fish species. However, it is not necessary to protect individual organisms that serve as food for listed fish. Thus, our goal is to ensure that pesticides will not impair populations of these aquatic arthropods. In some cases, listed fish may feed on other fish. Because our criteria for protecting the listed fish species is based upon the most sensitive species of fish tested, then by protecting the listed fish species, we are also protecting the species used as prey.

In general, but with some exceptions, pesticides applied in terrestrial environments will not affect the plant material in the water that provides aquatic cover for listed fish. Application rates for herbicides are intended to be efficacious, but are not intended to be excessive. Because only a portion of the effective application rate of an herbicide applied to land will reach water through runoff or drift, the amount is very likely to be below effect levels for aquatic plants. Some of the applied herbicides will degrade through photolysis, hydrolysis, or other processes. In addition, terrestrial herbicide applications are efficacious in part, due to the fact that the product will tend to stay in contact with the foliage or the roots and/or germinating plant parts, when soil applied. With aquatic exposures resulting from terrestrial applications, the pesticide is not placed in immediate contact with the aquatic plant, but rather reaches the plant indirectly after entering the water and being diluted. Aquatic exposure is likely to be transient in flowing waters. However, because of the exceptions where terrestrially applied herbicides could have effects on aquatic plants, OPP does evaluate the sensitivity of aquatic macrophytes to these herbicides to determine if populations of aquatic macrophytes that would serve as cover for T&E fish would be affected.

For most pesticides applied to terrestrial environment, the effects in water, even lentic water, will be relatively transient. Therefore, it is only with very persistent pesticides that any effects would be expected to last into the year following their application. As a result, and excepting those very persistent pesticides, we would not expect that pesticidal modification of the food and cover aspects of critical habitat would be adverse beyond the year of application. Therefore, if a listed salmon or steelhead is not present during the year of application, there would be no concern. If the listed fish is present during the year of application, the effects on food and cover are considered as indirect effects on the fish, rather than as adverse modification of critical habitat.

Designated Critical Habitat - OPP is also required to consult if a pesticide may adversely modify designated critical habitat. In addition to the indirect effects on the fish, we consider that the use of pesticides on land could have such an effect on the critical habitat of aquatic species in a few circumstances. For example, use of herbicides in riparian areas could affect riparian vegetation, especially woody riparian vegetation, which possibly could be an indirect effect on a listed fish. However, there are very few pesticides that are registered for use on riparian vegetation, and the specific uses that may be of concern have to be analyzed on a pesticide by pesticide basis. In considering the general effects that could occur and that could be a problem for listed salmonids, the primary concern would be for the destruction of vegetation near the stream, particularly vegetation that provides cover or temperature control, or that contributes woody debris to the aquatic environment. Destruction of low growing herbaceous material would be a concern if that destruction resulted in excessive sediment loads getting into the stream, but such increased sediment loads are insignificant from cultivated fields relative to those resulting from the initial cultivation itself. Increased sediment loads from destruction of vegetation could be a concern in uncultivated areas. Any increased pesticide load as a result of destruction of terrestrial herbaceous vegetation would be considered a direct effect and would be addressed through the modeling of estimated environmental concentrations. Such modeling can and does take into account the presence and nature of riparian vegetation on pesticide transport to a body of water.

Risk Assessment Processes - All of our risk assessment procedures, toxicity test methods, and EEC models have been peer-reviewed by OPP's Science Advisory Panel. The data from toxicity tests and environmental fate and transport studies undergo a stringent review and validation process in accordance with "Standard Evaluation Procedures" published for each type of test. In addition, all test data on toxicity or environmental fate and transport are conducted in accordance with Good Laboratory Practice (GLP) regulations (40 CFR Part 160) at least since the GLPs were promulgated in 1989.

The risk assessment process is described in "Hazard Evaluation Division - Standard Evaluation Procedure - Ecological Risk Assessment" by Urban and Cook (1986) (termed Ecological Risk Assessment SEP below), which has been separately provided to National Marine Fisheries Service staff. Although certain aspects and procedures have been updated throughout the years, the basic process and criteria still apply. In a very brief summary: the toxicity information for various taxonomic groups of species is quantitatively compared with the potential exposure information from the different uses and application rates and methods. A risk quotient of toxicity divided by exposure is developed and compared with criteria of concern. The criteria of concern presented by Urban and Cook (1986) are presented in Table 2.

Table 2. Risk quotient criteria for direct and indirect effects on T&E fish

Test data	Risk quotient	Presumption
Acute LC50	>0.5	Potentially high acute risk
Acute LC50	>0.1	Risk that may be mitigated through restricted use classification
Acute LC50	>0.05	Endangered species may be affected acutely, including sublethal effects
Chronic NOEC	>1	Chronic risk; endangered species may be affected chronically, including reproduction and effects on progeny
Acute invertebrate LC50[a]	>0.5	May be indirect effects on T&E fish through food supply reduction

Aquatic plant acute EC50[a]	>1[b]	May be indirect effects on aquatic vegetative cover for T&E fish

a. Indirect effects criteria for T&E species are not in Urban and Cook (1986); they were developed subsequently.
b. This criterion has been changed from our earlier requests. The basis is to bring the endangered species criterion for indirect effects on aquatic plant populations in line with EFED's concern levels for these populations.

The Ecological Risk Assessment SEP (pages 2-6) discusses the quantitative estimates of how the acute toxicity data, in combination with the slope of the dose-response curve, can be used to predict the percentage mortality that would occur at the various risk quotients. The discussion indicates that using a "safety factor" of 10, as applies for restricted use classification, one individual in 30,000,000 exposed to the concentration would be likely to die. Using a "safety factor" of 20, as applies to aquatic T&E species, would exponentially increase the margin of safety. It has been calculated by one pesticide registrant (without sufficient information for OPP to validate that number), that the probability of mortality occurring when the LC50 is 1/20th of the EEC is 2.39×10^{-9}, or less than one individual in ten billion. It should be noted that the discussion (originally part of the 1975 regulations for FIFRA) is based upon slopes of primarily organochlorine pesticides, stated to be 4.5 probits per log cycle at that time. As organochlorine pesticides were phased out, OPP undertook an analysis of more current pesticides based on data reported by Johnson and Finley (1980), and determined that the "typical" slope for aquatic toxicity tests for the "more current" pesticides was 9.95. Because the slopes are based upon logarithmically transformed data, the probability of mortality for a pesticide with a 9.95 slope is again exponentially less than for the originally analyzed slope of 4.5.

The above discussion focuses on mortality from acute toxicity. OPP is concerned about other direct effects as well. For chronic and reproductive effects, our criteria ensures that the EEC is below the no-observed-effect-level, where the "effects" include any observable sublethal effects. Because our EEC values are based upon "worst-case" chemical fate and transport data and a small farm pond scenario, it is rare that a non-target organism would be exposed to such concentrations over a period of time, especially for fish that live in lakes or in streams (best professional judgement). Thus, there is no additional safety factor used for the no-observed-effect-concentration, in contrast to the acute data where a safety factor is warranted because the endpoints are a median probability rather than no effect.

Sublethal Effects - With respect to sublethal effects, Tucker and Leitzke (1979) did an extensive review of existing ecotoxicological data on pesticides. Among their findings was that sublethal effects as reported in the literature did not occur at concentrations below one-fourth to one-sixth of the lethal concentrations, when taking into account the same percentages or numbers affected, test system, duration, species, and other factors. This was termed the "6x hypothesis". Their review included cholinesterase inhibition, but was largely oriented towards externally observable parameters such as growth, food consumption, behavioral signs of intoxication, avoidance and repellency, and similar parameters. Even reproductive parameters fit into the hypothesis when the duration of the test was considered. This hypothesis supported the use of lethality tests for use in assessing acute ecotoxicological risk, and the lethality tests are well enough established and understood to provide strong statistical confidence, which can not always be achieved with sublethal effects. By providing an appropriate safety factor, the concentrations found in lethality tests can therefore generally be used to protect from sublethal effects. As discussed earlier, the entire focus of the early-life-stage and life-cycle chronic tests is on sublethal effects.

In recent years, Moore and Waring (1996) challenged Atlantic salmon with diazinon and observed effects on olfaction as relates to reproductive physiology and behavior. Their work indicated that diazinon could have sublethal effects of concern for salmon reproduction. However, the nature of their test system, direct exposure of olfactory rosettes, could not be quantitatively related to exposures in the natural environment. Subsequently, Scholz et al. (2000) conducted a non-reproductive behavioral study using whole Chinook salmon in a model stream system that mimicked a natural exposure that is far more relevant to ecological risk assessment than the system used by Moore and Waring (1996). The Scholz et al. (2000) data indicate potential effects of diazinon on Chinook salmon behavior at very low levels, with statistically significant effects at nominal diazinon exposures of 1 ppb, with apparent, but non-significant effects at 0.1 ppb.

It would appear that the Scholz et al (2000) work contradicts the 6x hypothesis for acute effects. The research design, especially the nature and duration of exposure, of the test system used by Scholz et al (2000), along with a lack of dose-response, precludes comparisons with lethal levels in accordance with the 6x hypothesis as used by Tucker and Leitzke (1979). Nevertheless, it is known that olfaction is an exquisitely sensitive sense. And this sense may be particularly well developed in salmon, as would be consistent with its use by salmon in homing (Hasler and Scholz, 1983). So the contradiction of the 6x hypothesis is not surprising. As a result of these findings, the 6x hypothesis needs to be re-evaluated with respect to olfaction. At the same time, because of the sensitivity of olfaction and because the 6x hypothesis has generally stood the test of time otherwise, it would be premature to abandon the hypothesis for other acute sublethal effects until there are additional data.

2. Description of Acephate

A. Chemical Description: Acephate was first registered in the United States in 1973 as an insecticide for ornamentals. The first agricultural uses were registered in 1974 and included numerous interim measures to reduce or mitigate dietary, occupational, and domestic exposures. In preparation for the currently referenced RED (1997) forestry and rangeland/pasture uses were deleted and the RED finalized in 1999. Acephate is used to control many arthropod pests associated with several vegetable crops and ornamental foliage. Acephate is an unrestricted pesticide that has wide application in both homeowner and commercial structures and associated grounds. The most common non-agricultural use appears to be the control of fire ants.

B. Acephate Classification:

❑ Common Name: Acephate

❑ Chemiical Name: O, S-Dimethyl acetylphosphoranidothioate

- Chemical Family: Organophosphate
- Case Number: 0042
- CAS RegistryNumber: 30560-19-1
- OPP Chemical Code: 103301
- Empirical Formula: $C_4H_{10}N0_3PS$
- Molecular Weight: 183.16 g/mol
- Vapor Pressure: 1.7 x 10-6 mm Hg at 24° C
- Trade and Other Names: Orthene®
- Technical Registrants: Valent U.S.A. Corporation
Micro-Flow Company LLC
United Phosphorus Ltd.
Drexel Chemical Corporation

Acephate technical is a colorless to white solid with a melting point of 81-91° C. Acephate is highly soluble in water (79g/100ml), acetone (151 g/100ml), and ethanol (>100g/100 ml). It is also soluable, to lessor degrees, in methanol (57.5g/100ml), ethyl acetate (35g/100ml), benzene (16g/100ml), and hexane (<0.1g/100ml). Acephate degrades into another registered organophosphate chemical, methamidophos, which is the subject of a separate review.

C: Acephate Use Profile: The following represents a general summary of the current registered uses of acephate. Detailed application rates and application methods are presented in Appendiix A of the current RED and elsewhere in this review when required for generation of application totals in the areas of interest.

Food: Acephate may be used on beans (green and lima), Brussels sprouts, cauliflower, celery, cotton, cotton seed, head lettuce, macadamia nuts, peanuts, peppermint, peppers (bell and non-bell), soybeans (Mississippi and Texas only), and spearmint.

Non-food Agriculture: Acephate may be used as a seed treatment on cotton and peanuts (for planting only), and non-bearing crops such as tobacco and citrus.

Residential: Acephate is used in and around residential buildings, homes, apartments, and in pantries for the control of roaches, wasps, fire ants, and crickets, among other pests. It is also used on home lawns, shrubs, trees, and ornamentals.

Public Health: Acephate is used in and around residential, industrial, institutional and commercial buildings, including resturants, food handling facilities,warehouses, stores, hotels, manufacturing plants, and ships for the control of roaches and fire ants.

Non-food Uses: Acephate is applied to sod, golf course turf, field borders, fence rows, roadsides, ditch banks, borrow pits, wasteland, greenhouses, and horticultural nursery floral and foliage plants.

Target Pests: Armyworms, aphids, beetles, bollworms, borers, budworms, cankerworms, crickets, cut worms, fire ants, fleas, grasshoppers, leafhoppers, loopers, mealybugs, mites, moths, roaches, spiders, weevils, whiteflies, etc.

Registered Formulation Types: wetable powder, soluble powder, soluble extruded pellets, granules, water soluble bags, and liquid

Method and Rate of Application:

Equipment: Granular acephate can be applied by belly grinder, hand, tractor-drawn spreader, push type spreader, or shaker can. Liquid acephate (prepared from soluble powders or extruded pellets) can be applied by aircraft, airblast sprayer, backpack sprayer, chemigation, hydraulic sprayers, groundboom sprayer, handgun, high presure sprayer, hopper box (for seed treatment), low presure handwand, seed slurrey treatments, sprinkler can, transplanting in water (tobacco), or by aerosol generator (greenhouse).

Residential applications can be made by aerosol can, backpack sprayer, hose-end sprayer, or low pressure handwand. Residential granular applications can be made by shaker can or by hand. Residential soluble powder application can be by sprinkler can or compressed air sprayers.

Method and Rate: Acephate may be used for seed, in-furrow, foliar spray, and soil mound (drench and dry methods for use againest fire ants) treatments, float bed, plant bed, and transplant (tobacco) treatments. Indoors, it is used as spot, crack and crevice treatments, and bait treatments. Rates vary according to the method used and the pest. The highest registered rate for a single application is 5 lbs a.i./A on commercial/residential turf. The highest seasonal rate is 6 lbs a.i./A/year (1 lb a.i./A at 6 applications) for cotton.

Classification: Acephate products are unrestricted use pesticides.

Acephate is a member of the organophosphate group of insecticides, and acts through the common pathway of cholinesterase inhibition. For areas in the Pacific Northwest, where such crops as wheat, barley, and oats constitute the major land use sites, acephate has no registered useage. The current registered food uses are beans (snap, dry, and lima), Brussels sprouts, cauliflower, celery, cranberries, head lettuce, pepper, and peppermint/spearmint. Within California, a state identified as a major user of acephate, cotton is also a registered site.

Non-food use includes ornamental plants, trees, shrubs, turf (including golf course), greenhouse, and outdoor horticultuaral applications. In addition, numerous residential and commercial pest control applications are approved.

A review of Agency files indicates that currently, 140 products are actively registered for use. Examination of available labels demonstrate that most contain acephate at concentrations ranging from <10% to >90 a.i. as the sole active ingredient. Agricultural products are represented by all registered formulations, including seed treatment products. Of those products containing more than one ingredient (both agricultural and homeowner use), the most common additions appear to be phosphoramidothioate, resmethrin, triforine, and fenbutatin-oxide.A summary of currently registered agricultural application rates is shown in Table 3, below.

Table 3: Lable Application Rates in the Areas of Interest (lbs a.i./Acre)

Site	Max. Single Rate (lbs a.i./A)	Max. Applications/Season	Max. lbs a.i. Applied/Season
Beans (dry, lima, snap) (Sol Powder/Pellets)	1.0 lbs a.i./A	Not Specified	2.0 lbs a.i./A
Brussels Sprouts (Sol Powder/Pellets)	1.0 lbs a.i./A	Not Specified	2.0 lbs a.i./A
Cauliflower (Sol Powder/Pellets)	1.0 lbs a.i./A	Not Specified	2.0 lbs a.i./A
Celery (Sol Powder/Pellets)	1.0 llb a.i./A	Not Specified	2.0 lbs a.i./A
Cotton (hopper box)	0.2 lb a.i./A	1	0.2 lb a.i./A
Cotton (at-planting, Granular, Sol Powder/Pellets)	1.0 lb a.i./A	1	1.0 lb a.i./A
Cotton (post-emergence, foliar, aerial; Sol Powder/Pellets)	1.0 lb a.i./A (CA and AZ only)	Not Specified	4.0 lbs a.i./A
Cotton (post-emergence, foliar, ground;Sol Powder/Pellets)	1.0 lb a.i./A	Not Specified	4.0 lbs a.i./A
Cranberries (post-emergence, foliar; Sol Powder/Pellets, chemigation/aerial)	1.0 lb a.i./A	1	1.0 lb a.i./A

Cranberries (post-emergence, foliar, sprinkler/aerial; Sol powder/Pellets)	1.0 lb a.i./A	1	1.0 lb a.i./A
Lettuce (post-emergence, foliar, ground/aerial; Sol Powder/Pellets(	1.0 lb a.i./A	Not Specified	2.0 lbs a.i./A
Lupines (post-emergence, fikiar, ground/aerial; Sol Powder/Pellets)	1.0 lb a.i./A (WA only)	Not Specified	2.0 lbs a.i./A
Peppermint (foliar, ground/aerial; Sol Powder/Pellets)	1.0 lb a.i./A	2	2.0 lbs a.i./A
Peppers-Bell (post-emergence, foliar, ground/aerial; Sol Powder/Pellets)	1.0 lb a.i./A	Not Specified	2.0 lbs a.i./A
Peppers-Unspecified (at planting/post-emergence with soil incorporation, ground; Granular)	1.0 lb a.i./A	Not Specified	2 lbs a.i./A

By Agency estimates, approximately 4 to 5 million pounds of acephate are used annually. Major crops include cotton (up tp 1.4 million acres treated, mainly in AZ, TX, and MS), tobacco (up to 700,000 acres), vegetables (up to 400,000 acres, mostly in CA, AZ, FL, IL, WI, TX, MI, GA, NJ), turf (100,000 acres in the south), and mint (77,000 acres in ID and OR). Within CA, the Californniia Department of Pesticide Regulation reported that total acephate use increased from 240,109 lbs a.i. in 2001 to 258, 955 in 2002, while the total treated acres declined to 232,90 A from 266,197 A, suggesting an increase in the percent of planted acres treated. This is consistent with the Agency view that overall use of acephate on vegetable crops is increasing.

Geanessi and Silver (2000) traced acephate usage between 1992 and 1997. They found that overall use declined significantly lbs with the greatest changes seen in tobacco (down 698,000 lbs a.i), cotton (down 70,000 lbs a.i.), and lettuce (down 60,000 lbs a.i.).During this same period the use of acepahe on celery increased by 39,000 lbs a.i. The changes in lettuce and celery use are of greatest significance in the areas currently under review.

3. Aquatic Risk Assessment for Endangered and Threatened Salmon and Steelhead:

A: Aquatic Toxicity:

i. Freshwater Fish, Acute:

Acute toxicity of acepahate to freshwater fish (Table 4) was conducted in accordance with agency guidelines. In addition, toxicity data on the major degradate, methamidophos, was submitted and included in data associated with the RED for acephate.

Table 4: Acute Toxicity of Parent Acephate to Freshwater Fish

Name	Taxonomic Name	% a.i. Tested	96 Hour LC_{50} ppm a.i.	Toxicity Category
Rainbow Trout	*Oncorhynchus mykiss*	94	110 (static)	Practically Non-Toxic
Rainbow Trout	*Oncorhynchus mykiss*	75	730 (static)	Practically Non-Toxic
Rainbow Trout	*Oncorhynchus mykiss*	tech	>1000 (static)	Practically Non-Toxic
Rainbow Trout	*Oncorhynchus mykiss*	94	1100 (static)	Practically Non-Toxic
Rainbow Trout	*Oncorhynchus mykiss*	75	2740 (static)	Practically Non-Toxic
Bluegill Sunfish	*Lepromis macrochirus*	94	>50 (static)	Slightly Toxic
Bluegill Sunfish	*Lepromis macrochirus*	75	2000 (static)	Practically Non-Toxic
Bluegill Sunfish	*Lepromis macrochirus*	75	>200 (static)	Practically Non-Toxic
Bluegill Sunfish	*Lepromis macrochirus*	94	>1000 (static)	Practically Non-Toxic
Bluegill Sunfish	*Lepromis macrochirus*	75	>1000 (static)	Practically Non-Toxic
Atlantic Salmon	NR	97	>50 (static)	Practically Non-Toxic
Brook Trout	*Salvelinus fontinalis*	75	>100 (static)	Practically Non-Toxic
Brook Trout	*Salvelinus fontinalis*	94	>100 (static)	Practically Non-Toxic
Largemouth Bass	*Micopterus salmoides*	75	3000 (static)	Practically Non-Toxic
Cutthroat Trout	*Salmo clarki*	94	>50 (static)	Slightly Toxic
Cutthroat Trout	*Salmo clarki*	94	>100 (static)	Practically Non-Toxic
Cutthroat Trout	*Salmo clarki*	75	>100 (static)	Practically Non-Toxic
Goldfish	*Carassius auratus*	75	>4000 (static)	Practically Non-Toxic
Yellow Perch	*Perca falvescens*	94	>50 (static)	Slightly Toxic
Yellow Perch	*Perca falvescens*	75	>100 (static)	Practically Non-Toxic
Channel Catfish	*Ictiobus cyrinallus*	94	>1000 (static)	Practically Non-Toxic

Channel Catfish	*Ictiobus cyrinallus*	75	560-1000 (static)	Practically Non-Toxic
Channel Catfish	*Ictiobus cyrinallus*	75	1500 (static)	Practically Non-Toxic
Fathead Minnow	*Pimephales promelas*	94	>1000 (static)	Practically Non-Toxic
Fathead Minnow	*Pimephales promelas*	75	>1000 (static)	Practically Non-Toxic
Mosquito Fish	*Gambusia affinis*	75	6000 (static)	Practically Non-Toxic

The LC_{50} in this series of tests falls in the range of 50 to >100 ppm, indicating that acephate is slightly to practically non-toxic in all species tested, including Rainbow Trout and Bluegill Sunfish, the Agency recommended test subjects. As mentioned above, methamidophos is a primary degradate of the parent acephate. Acute freshwater fish toxicity data was submitted on this chemical and the results are shown in Table 5.

Table 5: Acute Toxicity of Methamidophos to Freshwater Fish

Name	**Taxonomic Name**	**% a.i. Tested**	**96 Hour LC_{50} ppm a.i.**	**Toxicity Category**
Rainbow Trout	*Oncorhynchus mykiss*	74	25 (static)	Slightly Toxic
Rainbow Trout	*Oncorhynchus mykiss*	71	40[1] (static)	Slightly Toxic
Rainbow Trout	*Oncorhynchus mykiss*	40	37 (static)	Slightly Toxic
Rainbow Trout	*Oncorhynchus mykiss*	75	51 (static)	Slightly Toxic
Rainbow Trout	*Oncorhynchus mykiss*	75.3	1.28[1] (static)	Slightly Toxic
Bluegill Sunfish	*Lepromis macrochirus*	74	34 (static)	Slightly Toxic
Bluegill Sunfish	*Lepromis macrochirus*	40[2]	31 (static)	Slightly Toxic
Bluegill Sunfish	*Lepromis macrochirus*	75.4	45 (static)	Slightly Toxic
Bluegill Sunfish	*Lepromis macrochirus*	75	46 (static)	Slightly Toxic
Carp	Cyprinpus carpio	90	681 (static)	Slightly Toxic

[1] Author notes that the LC50 value is based on finding test and thatthis product is expected to kill rainbow trout at 9 ppm on total formulation.
[2] Formulation was with propylene glycol. The author concuded that this contributed to the toxicity of the formulation

The LC_{50} falls beween 10 and 100 ppm, leading to the classification of methamidophos as slightly toxic.

ii. Freshwater Fish, Chronic:

At the time of this review, fish early life-stage data had not been required for acephate, although the potential need for such data was noted. Because the aquatic invertebrate *Daphnia magna* was considered more sensitive than fish, use of invertebrates as a substitute for direct fish data was accepted.

iii. Freshwater Invertebrates, Acute:

Both parent acephate and its degradate, methamidophos, were evaluated for their acute efects on a number of invertebrate species. The preferred species is *Daphnia magna.* Results of this testing are presented in Tables 6 and 7.

Table 6: Acute Toxicity of Acephate to Freshwater Invertebrates

Name	Taxonomic Name	% a.i. Tested	48 Hour LC_{50} ppm a.i.	Toxicity Category
Waterflea	*Daphnia magna*	75	1.3	Moderately Toxic
Waterflea	*Daphnia magna*	98	67.17	Slightly Toxic
Scud	*Gammarus pserdolimneaus*	94	>50 (96 hrs)	Slightly Toxic
Stonefly	*Pteronarella badia*	94	6.4 (96 hrs)	Moderately Toxic
Stonefly	*Pteronarella badia*	94	9.5	Moderately Toxic
Stonefly	*Pteronarella badia*	94	11.7 (96 hrs)	Slightly Toxic
Stonefly	*Pteronarella badia*	75	12 (96 hrs)	Slightly Toxic
Stonefly	*Pteronarella badia*	75	12	Slightly Toxic
Stonefly	*Pteronarella badia*	95	12	Slightly Toxic
Midge	*Chironomus plumosus*	94	>1000	Practically Non-Toxic
Midge	*Chironomus plumosus*	94	>50	Slightly Toxic
Midge	*Chironomus plumosus*	75	>1000	Practically Non-Toxic
Mayfly larvae	*Hexagenia sp*	98	N/A	(1)
Stonefly larvae	*Pteronarella badia*	98	N/A	(1)
Damselfly larvae	*Calopteryx sp*	98	N/A	(1)
Mosquito	*Culex sp*	98	N/A	(1)
Water-boatman	*Corixidae sp*	98	8.2	Moderately Toxic
Backswimmer	*Notonecta sp*	98	10.4	Slightly Toxic
Crayfish	*Procamborus clarki*	75	>750 (120 hrs)	Practically Non-Toxic

[1] Hussain MA, Mohamad RB, Oloffs P.C. (1985). *Studies on the Toxicity, Metabolism, and Anticholinesterase Properties of Acephate and Methamidiphos.* J.Environ. Sci. Health, B20(1), p. 129-147. These listed invertebrates were tested and the backswimmer was found to have ChE inhibition for 4 hours before recovery begins. The authors express the opinion that aquatic insects and, possibly fish, exposed to the chemicals may not recover by spontaneou reactivation of AchE, producing increased physiological stress.

There appears to be a somewhat wider range of sensitivity with aquatic invertebrates than freshwater fish to the effects of acephate. The LC_{50} range of 1.0 to >100 categorizes acephate as moderately toxic to aquatic invertebrates, on an acute basis.

Table 7: The Acute Toxicity of the Degradate Methamidophos on Aquatic Invertebrates

Name	Taxonomic Name	% a.i. Tested	48 Hour LC_{50} ppm a.i.	Toxicity Category
Waterflea	*Daphnia magna*	74	0.026	Very Highly Toxic
Waterflea	*Daphnia magna*	72	0.050	Very Highly Toxic
Waterflea	*Daphnia magna*	technical	0.027	Very Highly Toxic
Freshwater Prawn	*Macrobrochium rosenbergii*	600g./L	0.000042	Very Highly Toxic

Of the species and chemicals tested, the freshwater invertebrates appear most sensitive to methamidiphos. With and acute LC_{50} <0.01 ppm, it is classified as very highly toxic.

iii. Freshwater Invertebrates, Chronic Toxicity:

Chronic toxixity testing for freshwater invertebrates was conducted using the waterflea, *Daphnia magna*. Results of this testing are shown in Table 8>

Table 8: The Chronic Toxicity of Acephate to Freshwater Invertebrates

Name	Taxonomic Name	% a.i. Tested	21-Day NOAEC/LOAEC (ppm	MATC (ppm)	Endpoints Affected
Waterflea	*Dapnia magna*	unknown	0.050/0.375	0.237	Reduced number of young at 375 ppm and higher.

Acephate affects Waterflea reproduction with an MATC of 0.237 ppm.

B. Toxicity to Marine and Estuarine Organisms;

iv. Aquatic Toxicity to Estuarine and Marine Fish

Testing for estuarine and marine toxicity of acephate and its degradate, methamidophos, was conducted due to the potential direct application of the agent to water (mainly in the now discontinued forestry uses) and because of the numerous counties within the areas of interest that are in costal locations. The results of these test are listed in ables 9 and 10.

Table 9: Acute Toxicity , Estuarine and Marine Fish

Name	Taxonomic Name	% a.i. Tested	96 Hour LC_{50} ppm a.i.	Toxicity Category
Sheepshead Minnow	*Cyprinodon variegatus*	94	910 (flow through)	Practically Non-Toxic
Sheepshead Minnow	*Cyprinodon variegatus*	94	>3200 (28 days) (flow through)	Practically Non-Toxic
Mumichog	*Fundulus heteroclitus*	75	2872 (m) static) 3299 (f) (static	Practically Non-Toxic
Pin Fish	*Lagodon rhomboides*	94	85 (flow through)	Slightly Toxic
Spot	*Leinstomus xanthurns*	94	>100 (static)	Practically Non-Toxic

The LC_{50} falls between 10 and >100 ppm, classifying acephate as slightly toxic to practiucally non-toxix in esuarine/marine fish.

Table 10: Methamidophos Acute Toxicity to Estuarine and Marine Fish

Name	Taxonomic Name	% a.i. Tested	96 Hour LC_{50} ppm a.i.	Toxicity Category
Sheepshead Minnow	*Cyprinodon variegatus*	70.1	5.6	Moderately Toxic

The LC_{50} of 1 - 10 ppm indicates the methamidophos is moderately toxic to estuarine and marine fish.

C. Environmental Fate and Transport:

i. Environmental Fate Assessment:

Aerobic soil metabolism is the main degradation process. Under expected conditions of use, it is rapidly metabolized (half life < 2 days) to the intermediate methamidophos, another insecticidal compound. Methamidophos is rapidly metabolized by soil microorganisms (half life < 10 days) to carbon dioxide and microbial biomass. A complete list of acephate metabolites is provided in Table 11.

Table 11: Acephate Metabolites

Chemical	CAS Number	PC Code	Names and Synonyms
Metamidophos	10265-92-6	101201	**O,S-dimethyl phosphoramidothioate; O,S-dimethyl thiohoshoric acid amide; RE-9006**
O-Dimethyl methamidophos	170808-29-6	-	S-Methyl phosporamidothioate
DMPT	4576-53-4	-	O,S-dimethyl phosphorothioate; RE18421

SMPT	-	-	S-methyl N-acetylphosphoroamidithioate; RE 17245
RE-18420	-	-	O-methyl N-acetylphosphoramidate
Methyl disulfide	-	-	Methyl Disulfide

Under laboratory conditions. Acephate is stable to hydrolysis, except at high pH's (half life at pH 9 of 18 days). Acephate is not persistent in clay soils under anaerobic clay sediment associated with creek models (half life of 6.6 days). It is not subject to photodegradation. Under anerobic conditions the main degradates were carbon dioxide and methane (>60%), with other products present at < 10%. Acceptable data on aerobic degradation conditions was not available, however supplemental information indicates that degradation of acephate under aquatic, aerobic conditions with sediment present is rapid.

In the laboratory, acephate is very soluble in water (80.1 - 83.5 g/100ml) and very mobile (K_{OC} = 4.7). Methamidohos appears more mobile than parent acephate. Field studies, conducted in Missisippi (tobacco, silt loam soil), California (bell peppers on silt loam soil), Florida (cauliflower on sandy soil), and Iowa (soybeans on loam soil) produced half lives of 2 days or less, with no residual detection of parent acephate or any known degradates.

In the laboratory, studies on bioaccumulation of acephate in freshwater fish (Bluegill Sunfish) indicated it was insignificant, with a maximum accumulation factor of 10x with exposure to acephate at 0.007 and 0.7 ppm.

ii. Environmental Fate and Transport:

1. Abiotic Hydrolysis**:** Acephate is stable to hydolysis at pH 5 and 7. Minor degradates (< 10%) were DMPT (Hydrolysis of the P-N bond); RE-17245 (hydrolysis of the O-methyl-P bond); and methamidophos (formed by hydrolysis of the N-C bond). At more elevated pH (9) DMPT was the major degradate (>30%), while other degratdats formed appeared closely linked to the location of ^{14}C in the material acephate applied.

2. Photodgradation in Water: Acephate appeared photolytically stable at pH 7, irradiated by natural sunlight for 35 days. In the presence of a photosensitizer (1% acetone) acephate degraded with a half life of 39.6 days at pH 7. The major degradates detected were DMPT (3.6%), RE-17245 (4.6%), and methamidophos (1.6%).

3. Anaerobic Aquatic Metabolism: [S-methyl-^{14}C] acephate degraded with a first order half life of 6.6 days in anerobic, flooded, clay soil. Initial pH was 7.0, increasing to pH 7.9 by the conclusion of the study. (day 20). The major degradates were ^{14}C volatiles (64.5%), including $^{14}CO_2$ (32.9%), and $^{14}CH_4$ (46.8%). The typical major degradate, methamidophos, was present in the aqueous phase at a level of 0.5% of the applied radioactivity. Within the sediments, methamidophos, DMPT and SMPT were detetected, but never exceeded 1% of the applied radioactivity.

4. Aerobic Aqueous Metabolism: Acceptable data regarding aerobic aqueous metabolism were not available to the Agency at the time of evaluation.

5. Mobility: Supplemental data for acephate, methamidophos, and DMPT generally did not yield adsorption rates adequate to calculate Freundlich adsorption coefficients. In clay-loam soil, the reported adsorption values for parent acephate are presented in Table 12.

Table 12: Adsorption Data for Acephate, Metamidophos, and DMPT in Clayloam Soil

					Acephate			Methhamidophos			DMPT		
Soil	**pH**	**CEC**	**% Clay**	**% Organic**	**K**	**l/n**	**r^2**	**K**	**l/n**	**r^2**	**K**	**l/n**	**r^2**
Clayloam	5.8	20.2	32	3.3	0.090	1.06	0.96	0.029	0.64	0.93	0.030	0.69	0.92

Based on this data it appears that acephate and the major degradates will be very mobile in soils.

6. Volatility: Because of the vapor pressure of acephate (1.7×10^{-6} mm Hg/Torr; 5.1×10^{-13} atm mole/m^3) it is not expected that it will volitalize from soil or water.

iii. Bioaccumulation:

Acephate did not accumulate significantly in the edible portions or viscera of bluegill sunfish (*Lepomis macrochirus*) continuously exposed to 0.007 of 0.7 ppm for 35 days. The average bioconcentration factor was 10X, and decreased during the 14 day depuration period.

iv. Spray Drift:

Acephate spray drift, following application by aircraft or blast spray in orchards, was estimated following the guidelines of the Spray Drift Task Force (SDTF). The amount of drift from ground spray was estimated at 1% of the applied volume, at a maximum of 100 feet downwind.

v. Incidents and Field Studies:

Numerous reports of adverse incidents have been incorportaed into the history of acephate, however, the majority were unclear or acephate was applied in association with other agents and not clearly identified as the causative agent. Only a single incident is reported in which acephate, with some certainty, caused an adverse effect on aquatic organisms. This incident is described below:

1000468-001 (06/06/92): Allegheny, Penn. A fishkill occurred in a backyard pond as a result of acephate use on a lawn. The application rate, fish species, and number of dead fish was not made available.

Some field studies are available regarding the effects of acephate on aquatic organisms. Analysis of the reports provided the following, specific incidents:

A: Moosehead Lake ME. A 75% acephate solution was applied at 0.5 lb a.i./A to forested land. Brook Trout and landlocked salmon showed no decrease in ChE activity, but suckers (bottom feeders) demonstrated a 28% decrease in ChE activity. Invertebrate mortality was noted, resulting in altered diet selection for the Brook Trout, but no other effects were noted.. Young salmonid growth was not affected and smolt developed normally. The standing crop of macroinvertebrates retuned to normal over a period of about 8 days.

B. Two ponds and a stream in PA were exposed to acephate at a rate of 0.5 lb a.i./A within a forested environment. 65 caged fish (bluegill sunfish, perch, and bullheads) were held within the treated areas. After 8 days exposure, no effects were noted. Macroinvertebrate samples similarly demonstrated no adverse effects.

C. A study of Orthene, in comparison to Summithion, Carbaryl, Dylox, Matacil, and Dimilin with respect to effects on brook trout, Atlantic salmon, scud and stoneflies concluded that Orthene (acephate) did not pose any significant toxicity hazard to fish or aquatic invertebrates "when compared to the other chemicals".

D. Direct application of acephate to a stream for 5 hours at a rate of 1000 ppb resulted in no mortality to fish or benthic invertebrates (Green *et al*, 1981).

E. In a study of trout exposed to 400 mg/l acephate for 24 hours, ChE activity was depressed 38.2%. upon removal to fresh water. For an additional 24 hours, brain ChE activity was depressed 42.5%. These changes were not noted at a level of 100 mg/l acephate. Mortality was not noted, and ChE depression as high as 70% was not determined to be consistently fatal. The authors conclude (Zinid, *et al*, 1987) that reduced ChE activisty might impair food aquisition and other activity related factors in fish behavior.

F. Moultan *et al* (1996) studied *Elliptio complanata* (freshwater mussel) and *Corbicula fluminea* (asiatic clam) ChE depression at levels of 1.3 mg/L acephate, which appeared to increase in direct proportion to temperature. Acephate reduced shell closure rate at levels of 5 mg/l and the authors conclude that this correlated with a reported die-off of mussels in North Carolina, also associated with seasonal reductions in water level and elevation in temperature.

G. In 1990, approximately 1000 fresh water mussels (including *Elliptio steinstanana*, a federally listed endangered species) were observed in north-central North Carolina. The die off occurred during a seasonal period of low water flow and elevated temperature in a stream reach dominated by forestry and agricultural activities. Pathological examination demonstrated no physical abnormalities and chemical analysis failed to disclose the presence of any organo-phosphate residues. ChE activity, however, was reduced in the adductor muscle by 65-73% and a diagnosis of anticholinesterase poinsoning was presumed.

vi. **Estimated and Actual Concentrations of Acephate in Water**

Estimated environmental concentrations (EEC's) were calculated using GENEEC and PRIZM-EXAMS modeling methods for the two crops with highest use rates and the largest number of repetitions. For acephate these crops were cotton (in Mississippi) and tobacco (in North Carolina). The first tier screening model for EECs is with the GENEEC program, developed within OPP, which uses a generic site (in Yazoo, MS) to stand for any site in the U. S. The site choice was intended to yield a maximum exposure, or "worst-case," scenario applicable nationwide. The model is based on a 10 hectare watershed that surrounds a one hectare pond, two meters deep.

The second tier of modeling, used when there are concerns identified with the results of the screening model, is a PRZM-EXAMS model, which is used widely throughout academia, government, and industry. Crop scenarios have been developed by OPP for specific sites, and the model uses site-specific data on soils, climate (especially precipitation), and the crop or site. Typically, site-scenarios are developed to provide for a worst-case analysis for a particular crop in a particular geographic region. The development of site scenarios is very time consuming; scenarios have not yet been developed for a number of crops and locations. For acephate, models were prepared for cotton (MS), tobacco (NC), and cranberries (WA).

Both the GENEEC and the PRZM-EXAMS models are based on the 1 hectare farm pond surrounded by 10 hectares of crop, all of which is treated with the pesticide. However, except for the sockeye salmon, all of the listed salmon and steelhead occur in streams, some of which are of moderate size even where spawning occurs. OPP has determined that this model does approximate what might be found in first order streams, and those salmon that spawn in first order streams could be exposed to concentrations as modeled. Larger streams would have lower concentrations because modeled inputs are maximized relative to the crops at the edge of the stream. OPP cannot quantitate the amount of likely reduction in EECs that would result in larger streams except to note that it would be qualitatively less, perhaps much less.

Inut parameters utilized in the modeled EEC formulation for acephate are provided in tables 13 and 14, below.

Table 13: PRIZM 3.1 Input Parameters for Acephate

Input Parameter	Value	Source
Foliar Volitilization	0 d^{-1}	-
Foliar Decay Rate	0 d^{-1}	-
Foliar Washoff Extraction Coefficient	0.5 cm^{-1}	-
Plant Uptake	0	-
Soil Water Partition Coefficient (KD)	0.09 L kg^{-1}	MRID40504811
Dissolved Phase Decat Rate Upper Horizon	0.301 d^{-1}	MRID00014991
Adsoorbed Phase Decay Rate Upper Horizon	0.301 d^{-1}	MRID00014991
Dissolved Phase Decay Rate Lower Horizon	0.301 d^{-1}	MROD00014991
Adsorbed Phase Decay Rate Lower Horizon	0.301 d^{-1}	MRID00014991
Vapor Phase Decay Rate	0 d^{-1}	-

Table 14: EXAMS 2.97.5 Input Parameters for Acephate

Input Parameter	Value	Source
Aerobic Aqueous Metabolism Constant	6028 x $10^{-3}h^{-1}$	MRID00014991
Sediment Metabolism Constant	0	-
Neutral Hydrolysis Rate Constant	stable	MRID41081604
Partition Coefficient for all Modeled Crops	0.09 $mL \cdot g^{-1}$	MRID40504811

Molecular Mass	183.16 g·mol $^{-1}$	EFGWB One-Liner
Solubility	801000 mg·L^{-1} (25° C)	MRID40390601
Quantum Yield	1	-
Vapor Pressure	1.7 x 10^{-6} torr	MRID40645901
Henry's Law Constant	5.1 x 10^{-13} Atm M^{3} Mole^{-1}	EFGWB One Liner
Q10 for Sediment	2	-
Q10 for the Water Column	2	-

It should also be noted that the pond scenario is not representative of the duration of exposure that would occur even in first order streams. Again, this can only be stated qualitatively because quantitative differences would be very site-specific based upon both size and flow rate of the stream. In addition, acephate is rather stable at acid and neutral pH values but degrades more rapidly under alkaline conditions (pH 9).

Although pH data are temporally and spatially variable for both biological and geological reasons, most of the salmon and steelhead ESUs tend to be in water that is slightly acid to strongly alkaline. In the Upper Columbia drainage, pH values at many different sites monitored by the Washington Department of Ecology (http://www.ecy.wa.gov/programs/eap/fw_riv/rv_main.html) are mostly 6.8 to 8.5, with 2 of 36 sites having the range extend below 6 (5.9-9.7 and 5.8-8,6) and with 11 sites having a high end pH above 9. This pattern holds for other areas in Washington east of the Cascades. Even with all of the forests in western Washington, pH values along the streams draining into the Pacific Ocean or Puget Sound are more often on the alkaline side than on the acid side, although they do tend to be less alkaline than in the eastern part of the state.

USGS monitoring (URL: http://waterdata.usgs.gov/nwis/qw) indicates that pH values in the Salmon, Clearwater, and Snake River areas of Idaho (HUCs 170602 & 170603) range from 5.6 to 9.2. Mean lower end pHs are 6.4 and mean higher end pHs are 8.7 at the various sites. In eastern Oregon (HUCs 170601, 170701, & 170702), mean lower end pHs were 6.9 (range 6.1-7.6) and mean upper end pHs were 8.7 (range 7.7-9.2). As with Washington, western and coastal Oregon pH values still tend to be above 7, but not as pronounced as east of the Cascades. In California, USGS measured pH values in salmon and steelhead ESUs again tend to be slightly acid to strongly alkaline, although several extremely acid or extremely alkaline values were reported. Of the sampled sites in these ESUs (n=86), about one-third had low end values above 7 (n=26) and about one-third had high end values above 9 (n=24); some of these are the same sites.

Based on these pH data, it appears that acephate will be rather less persistent than projected in the Environmental Risk Assessment. There are insufficient data to quantify this, and the data are confounded by natural pH variability. However, even a relatively brief exposure to strongly alkaline pH water (e.g., pH=9), could result in significant hydrolysis.

The results of these studies (TIER II PRZM-EXAMS) as determined for the two selected crops, treated with acephate, are presented in Table 15, below.

Table 15: Tier II, Upper Tenth Percentile EEC's for Acephate

Crop	Peak	4-Day	21-Day	60-Day	90-Day	Over-all Mean	90% CB Mean
Cotton	82	61	33	15	10	1.8	2.0
Tobacco	29	23	13	6.2	4.1	0.8	0.9

Direct, quantitative information, on the actual levels of acephate in surface water is rather limited, and often quite old. The USGS Water Quality Assessment Program is not currently analyzing for acephate (or methamidophos), and they do not have accepted analytical methods in place. State natural resources and agricultural agencies, universities, and the open literature from 1980 to 1997 provide a few examples of direct assessment of acephate in the environment. Three samples were collected from streams in Santa Clara county, California. The actual value of acephate was known to be less than 10µg/L, however the actual detection limit is unclear. Eight samples from a stream in Piscataquis county Main were collected and the maximum level of acephate found to be 135µg/L, which decreased rapidly with time. In 1986 a sample from a spring in Santa Cruz county California was reported to have a value of less than 10µg/L, but the actual concentration is unclear. Records of 844 samples were taken from 1984-1987 in California and the value of acephate was less than 10µg/L, but again the actual value present was not included and detection limits were unclear. From 1992 to 1993, the USGS obtained 27 samples from Sarasota and Hillsborough counties Florida, and acephate was not detected.

A report on chemicals in water from 1992-1997 included 602 samples from Washington and Florida that were analyzed for the presence of acephate and there were no detections. Detection limits, however, were rather variable. They ranged from 0.3 to 25 ppb and is is unclear if the samples were collected from areas where acephate was known to be used.

A report from Washington state described 52 samples collected from areas associated with drainage from cranberry bogs included 13 samples in which acephate was detected. The level of detection (LOD) was 0.03 ppb and the maximum observed level was 0.32 ppb.

vii. **Risk to Aquatic Organisms**

The Risk Quotients (RQ's) for freshwater and estuarine organisms were generated from EEC's and toxicity data. The acute RQ's from acephate for freshwater fish (including rainbow trout), aquatic invertebrates (including *Daphnia magna*), and estuarine invertebrates (including pink shrimp) are listed in Table 16, below.

Table 16: Acute Risk Quotients for Acephate

Site - Rate in lbs a.i./A (No of Appl.)	Type of Appl.	Acute RQ Freshwater Fish	Aqute RQ Aquatic Invertebrates	Aqute RQ Estuarine Fish	Acute RQ Oyster	Aqute RQ Estuarine Invertebrate
Cranberry 1(1)	ground aerial	<0.05 <0.05	<0.05 <0.05	<0.05 <0.05	<0.05 0.05	<0.05 <0.05
Tobacco 1.33(3)	aerial	<0.05	<0.05	<0.05	<0.05	<0.05
Cotton 1(6)	aerial	<0.05	**0.06**	<0.05	<0.05	<0.05

Only for cotton, with aerial application (the worst case scenario), was the Level of Concern (LOC) for endangered species exceeded. There were no exceedences for acute risk or restricted use.

The RQ's for invertebrate chronic risk from acephate are presented in Table 17, below

Table 17: Chronic Risk Quotients for Acephate to Invertebrate Organisms.

Site - Rate in lbs a.i./A (No. of Appl.)	Type of Appl.	Chronic RQ, Freshwater Invertebrates	Chronic RQ Estuarine Invertebrates
Cranberries 1(1)	ground aerial	0.07 0.07	0.02 0.02
Tobacco 1.33(3)	aerial	0.09	0.10
Cotton 1(6)	aerial	0.23	0.06

There are no exceedences for chronic risk from acephate to freshwater or estuarine invertebrates. No data is available to assess chronic risk to fish from acephate.

In addition to determining EEC's and RQ's for parent acephate, GENEEC modeling was conducted for the metabolite methamidophos in aquatic and estuarine organisms. From the data provided, the relative rate of methamidophos application was estimated from the application rate of parent acephate. Previously discussed chemical characteristics do suggest that methamidophos will be the major degradate under the expected conditions of use. EEC's for methamidophos (as a degradate of acephate) are presented in Table 18.

Table 18: Estimated Environmental Concentrations for Aquatic Exposure to Methamidophos (as a degradate)

Site	Appl. Method	Acephate Appl. Rate)lbs a.i./A)	Effective Methamidophos Appl. Rate	N. Appls/Interval	Initial EEC (Peak), ppm
Cranberries	ground aerial	1 1	0.25 0.25	2/3 2/3	0.008 0.008
Tobacco	ground aerial	1.33 1.33	0.3325 0.3325	3/3 3/3	0.026 0.027
Cotton	ground aerial	1 1	0.25 0.25	6/3 6/3	0.021 0.023

Acute RQ,s for aquatic organisms exposed to methamidophos as a degradate of acephate were generated for rainbow trout (freshwater fish), *Daphnia magna* (freshwater invertebrate), sheepshead minnow (estuarine fish), and mysid shrimp (estuarine invertebrate). The results of these determinations are presented in Table 19.

Table 19: Acute RQ's for Methamidophos as a Degradate of Acephate Application

Site/Appl Rate lbs a.i. (No. of Appl)	Type of Appl.	Fish, Freshwater	Aquatic Invertebrate	Fish, Estuarine	Estuarine Invertebrate
Cranberries 1(1)	ground aerial	<0.05 <0.05	0.31 0.31	<0.05 <0.05	<0.05 <0.05
Tobacco 1 (3)	ground aerial	<0.05 <0.05	1.00 1.04	<0.05 <0.05	<0.05 <0.05

Cotton 1 (6)	ground aerial	<0.05 <0.05	0.81 0.83	<0.05 <0.05	<0.05 <0.05

As acephate degrades into methamidophos, the LOC's for endangered species and restricted use are exceeded for aquatic invertebrates. No other exceedences were observed. Chronic risk could not be assessed because acceptable data were not available.

viii. **Discussion and General Risk Conclusions for Acephate**

Acephate is known to have numerous exceedences in a variety of organisms, including mammals, birds, amphibians, and reptiles. The focus of this review, however, is on estuarine and freshwater fish and invertebrates. The only observed acute exceedence for acephate in fish and invertebrates was noted in freswater invertebrates in the cotton site scenario. In a similar manner, the endangered species and restricted use LOC's for aquatic invertebrates were exceeded with methamidophos, the primary degrade of acephate under typical use conditions. Chronic risk LOC's, where available, were not exceeded in any of the crop site scenarios.

ix. **Existing Protections**.

A large number of existing protections and mitigation stipulations exist for dietary, occupational, and residential exposure. The ecological risk management steps include a minimal spray interval of three days for all application rates up to 0.5 lbs a.i/A, and seven days for rates greater than 0.5 lbs a.i./A. Special labeling restrictions are present to protect honeybees, which are suseptable to acephate toxicity. Additional labeling lanquage has been added to reduce the potential for spray drift.

4. Derscription and Discussion of Pacific Salmon and Steelhead Evolutionarily Significant units Relative to the use of Acephate.

The following is an estimate of acephate application, by counties and crops, to the T&E Salmon and Steelhead in the listed ESU's from California, Oregon, Washington, and Idaho. Usage data for California is derived from the CDPR 2001 Annual Pesticide Use Report. Estimates for Oregon, Washington, and Idaho are derived from the 1997 USDA Crop Census. Determinatioins of treated crops is based on data from Table I, Estimated Usage of Pesticide, included in the RED for acephate (Attachment 3). The application rate, used to calculate total pesticide applied, is from Appendix A, Use patterns Eligible for Reregistration, also from the RED for acephate. Because multiple applications are permitted for acephate, the total seasonal rate was utilized as the basis.

A. Steelhead

Steelhead, *Oncorhyncus mykiss*, exhibit one of the most complex suite of life history traits of any salmonid species. Steelhead may exhibit anadromy or freshwater residency. Resident forms are usually referred to as ''rainbow'' or ''redband'' trout, while anadromous life forms are termed ''steelhead.'' The relationship between these two life forms is poorly understood, however, the scientific name was recently changed to represent that both forms are a single species.

Steelhead typically migrate to marine waters after spending 2 years in fresh water. They then reside in marine waters for typically 2 or 3 years prior to returning to their natal stream to spawn as 4- or 5-year-olds. Unlike Pacific salmon, they are capable of spawning more than once before they die. However, it is rare for steelhead to spawn more than twice before dying; most that do so are females. Steelhead adults typically spawn between December and June. Depending on water temperature, steelhead eggs may incubate in redds for 1.5 to 4 months before hatching as alevins. Following yolk sac absorption, alevins emerge as fry and begin actively feeding. Juveniles rear in fresh water from 1 to 4 years, then migrate to the ocean as ‘‘smolts.’’

Biologically, steelhead can be divided into two reproductive ecotypes. “Stream maturing,” or “summer steelhead” enter fresh water in a sexually immature condition and require several months to mature and spawn. “Ocean maturing,” or “winter steelhead” enter fresh water with well-developed gonads and spawn shortly after river entry. There are also two major genetic groups, applying to both anadromous and non-anadromous forms: a coastal group and an inland group, separated approximately by the Cascade crest in Oregon and Washington. California is thought to have only coastal steelhead while Idaho has only inland steelhead.

Historically, steelhead were distributed throughout the North Pacific Ocean from the Kamchatka Peninsula in Asia to the northern Baja Peninsula, but they are now known only as far south as the Santa Margarita River in San Diego County. Many populations have been extirpated.

1. Southern California Steelhead ESU

The Southern California steelhead ESU was proposed for listing as endangered on August 9, 1996 (61FR41541-41561) and the listing was made final a year later (62FR43937-43954, August 18, 1997). Critical Habitat was proposed February 5, 1999 (64FR5740-5754) and designated on February 16, 2000 (65FR7764-7787). This ESU ranges from the Santa Maria River in San Luis Obispo County south to San Mateo Creek in San Diego County. Steelhead from this ESU may also occur in Santa Barbara, Ventura and Los Angeles counties, but this ESU apparently is no longer considered to be extant in Orange County (65FR79328-79336, December 19, 2000). Hydrologic units in this ESU are Cuyama (upstream barrier - Vaquero Dam), Santa Maria, San Antonio, Santa Ynez (upstream barrier - Bradbury Dam), Santa Barbara Coastal, Ventura (upstream barriers - Casitas Dam, Robles Dam, Matilja Dam, Vern Freeman Diversion Dam), Santa Clara (upstream barrier - Santa Felicia Dam), Calleguas, and Santa Monica Bay (upstream barrier - Rindge Dam). Counties comprising this ESU show a very high percentage of declining and extinct populations.

River entry ranges from early November through June, with peaks in January and February. Spawning primarily begins in January and continues through early June, with peak spawning in February and March.

Within San Diego County, the San Mateo Creek runs through Camp Pendleton Marine Base and into the Cleveland National Forest. While there are agricultural uses of pesticides in other parts of California within the range of this ESU, it would appear that there are no such uses in the vicinity of San Mateo Creek. Within Los Angeles County, this steelhead occurs in Malibu Creek and possibly, but unlikely, Topanga Creek. Neither of these creeks drain agricultural areas, however acephate products for residential use may constitute some stream impact. In addition, there is no use of acephate reported by DPR for either Los Angeles or San Diego counties for the year 2000. There is a potential for steelhead waters to drain agricultural areas in Ventura, Santa Barbara, and San Luis Obispo counties. Usage of Acephate in counties where this ESU occurs are presented in Table 20.

Table 20. Counties supporting the Southern California steelhead ESU

County	Site	Acres Treated	lbs a.i. Applied
Los Angeles	Landscape Maint.	NR	508
Los Angeles	Outdoor Flowers	NR	0.4
San Diego	Outdoor Flowers	2083	560
San Diego	Outdoor Transplant	190	35
San Diego	Peppers	180	101
San Diego	Struct. Pest Cont	NR	980
San Luis Obispo	Bean, Succulent	233	232
San Luis Obispo	Brussel Sprout	0.5	0.4
San Luis Obispo	Cauliflower	61	60
San Luis Obispo	Celery	1427	1226
San Luis Obispo	Lettuce	1616	1384
San Luis Obispo	Landscape Maint	NR	66
San Luis Obispo	Outdoor Flower	144	76
San Luis Obispo	Outdoor Plants	10	5
San Luis Obispo	Outdoor Transplant	169	142
San Luis Obispo	Peppers	554	537
San Luis Obispo	Structural Pest Cont	NR	554
San Luis Obispo	Bean, Umspec.	3	3
Santa Barbara	Bean, Succulant	6	6
Santa Barbara	Cauliflower	116	95
Santa Barbara	Celery	1941	1779
Santa Barbara	Landscape Maint	NR	40
Santa Barbara	Lettuce, Head	6579	5204
Santa Barbara	Lettuce, Leaf	13	10

Santa Barbara	Outdoor Flower	2502	1349
Santa Barbara	Outdoor Plants	133	67
Santa Barbara	Rangeland	10	3
Santa Barbara	Spinich	5	8
Santa Barbara	Structural Pest Cont	NR	14
Santa Barbara	Uncultivated, non-AG	69	21
Santa Barbara	Outdoor Transplant	NR	274
Santa Barbara	Peppers.	133	82
Ventura	Bean, Succulent	679	369
Ventura	Bean, Unspec	4182	3253
Ventura	Cauliflower	2	2
Ventura	Celery	6175	5852
Ventura	Landscape Maint	NR	12
Ventura	Lettuce. Head	84	82
Ventura	Lettuce, Leaf	2	2
Ventura	Structural Pest Cont	NR	116
Ventura	Rights of Way	NR	15
Ventura	Pepper	604	451
Ventura	Outdoor Transp	211	127
Ventura	Outdoor Plant	3004	504
Ventura	Mint	257	154
Ventura	Outdoor Flower	1855	761

Agricultural use of acephate in the Southern California Steelhead ESU is moderate, and commonly associated with coastal sites. The relatively low toxicity of acephate to the species of interest, high flow rates in coastal rivers and streams, and high solubility of the pesticide suggest that agricultural acephate will pose no threat to salmon and steelhead. Because acephate has many residential uses, the very large population centers within this site pose a less well understood and predictable potential effect. At this time, however, specific data is not available on residential use and a determination of adverse effects can not, therefore, be made by this author. Another source of unknown potential acephate contamination is use on golf courses. A survey of the Southern California Golf Association reported 103 golf courses in Los Angeles

County alone. While California most likely contains the majority of courses within the area of review, it is likely that some courses are located throughout the area of concern and the specific practices of grounds keepers relative to acephate use were not available to the Agency. A survey by the Arizona Extension Service evaluated pesticide use on golf courses and identified the major 7 products used. Total applications ranging from 2.8 lbs a.i. (imidacloprid) to 563.4 lbs a.i. (carbaryl) per course were seen. Acephate use was not identified. If similar usage patterns prevail in California and the Pacific Northwest, it would appear that golf course use would not be a significant contributor of environmental acephate and a threat to salmon and steelhead. This observation, however, as with residential use, can only be inferred from incidental data. Even given these uncertainties, the low toxicity of acephate leads to the conclusion that there will be no effect on this ESU.

2. South Central California Steelhead ESU

The South Central California steelhead ESU was proposed for listing as endangered on August 9, 1996 (61FR41541-41561) and the listing was made final, as threatened, a year later (62FR43937-43954, August 18, 1997). Critical Habitat was proposed February 5, 1999 (64FR5740-5754) and designated on February 16, 2000 (65FR7764-7787). This coastal steelhead ESU occupies rivers from the Pajaro River, Santa Cruz County, to (but not including) the Santa Maria River, San Luis Obispo County. Most rivers in this ESU drain the Santa Lucia Mountain Range, the southernmost unit of the California Coast Ranges (62FR43937-43954, August 18, 1997). River entry ranges from late November through March, with spawning occurring from January through April.

This ESU includes the Hydrologic units of Pajaro (upstream barriers - Chesbro Reservoir, North Fork Pachero Reservoir), Estrella, Salinas (upstream barriers - Nacimiento Reservoir, Salinas Dam, San Antonio Reservoir), Central Coastal (upstream barriers - Lopez Dam, Whale Rock Reservoir), Alisa-Elkhorn Sloughs, and Carmel. Counties of occurrence include Santa Cruz, San Benito, Monterey, and San Luis Obispo. There are agricultural areas in these counties, and these areas would be drained by waters where steelhead critical habitat occurs.

Table 21: Counties supporting the South Central California steelhead ESU

County	Site	Acres Treated	lbs. a.i. Applied
Monterey	Bean, Dried	2956	2061
Monterey	Bean, Succulant	241	184
Monterey	Brussel Sprout	4	3
Monterey	Cabbage	10	8
Monterey	Cauliflower	1255	1198
Monterey	Celery	11000	9295
Monterey	Grape, wine	31	28
Monterey	Landscape Maint	NR	846
Monterey	Letuce, Head	57	41

Monterey	Lettuce, Leaf	88	77
Monterey	Outdoor Flower	1040	442
Monterey	Outdoor Plants	7	3
Monterey	Outdoor Transp	77	12
Monterey	Pasture Land	240	29
Monterey	Pepper	1232	915
Monterey	Pepper, Spice	135	98
Monterey	Research	NR	13
Monterey	Rights of Way	NR	0.2
Monterey	Spinich	15	18
Monterey	Structural Pest Cont	NR	86
Monterey	Uncultivated, non-Ag	244	19
San Benito	Cauliflower	35	24
San Benito	Celery	768	605
San Benito	Landscape Maint	NR	7
San Benito	Lettuce, Head	3429	2868
San Benito	Lettuce, Leaf	60	48
San Benito	Outdoor Flower	24	9
San Benito	Outdoor Plants	1552	56
San Benito	Outdoor Transpl	NR	7
San Benito	Peppers	2111	1804
San Benito	Research	NR	12
San Benito	Structural Pest Cont	NR	27
San Mateo	Landscape Maint	NR	109
San Mateo	Outdoor Flower	69	21
San Mateo	Outdoor Plants	NR	81
San Mateo	Structural Pest Cont	NR	280
San Luis Obispo	Bean, Succulent	233	232
San Luis Obispo	Brussel Sprout	0.5	0.4
San Luis Obispo	Cauliflower	61	60
San Luis Obispo	Celery	1427	1226

San Luis Obispo	Lettuce	1616	1384
San Luis Obispo	Landscape Maint	NR	66
San Luis Obispo	Outdoor Flower	144	76
San Luis Obispo	Outdoor Plants	10	5
San Luis Obispo	Outdoor Transplant	169	142
San Luis Obispo	Peppers	554	537
San Luis Obispo	Structural Pest Cont	NR	554
San Luis Obispo	Bean, Umspec.	3	3
Santa Clara	Broccoli	10	8
Santa Clara	Celery	236	226
Santa Clara	Chinese Greens	63	5
Santa Clara	Landscape Maint	NR	690
Santa Clara	Lettuce, Head	17	16
Santa Clara	Lettuce, Leaf	300	215
Santa Clara	Outdoor Plants	59	20
Santa Clara	Outdoor Transp	59	49
Santa Clara	Pepper	2089	1496
Santa Clara	Pepper, Spice	20	8
Santa Clara	Research	39	25
Santa Clara	Rights of Way	NR	13
Santa Clara	Structural Pest Cont	NR	253
Santa Clara	Squash	1	1
Santa Cruz	Bean, Unspec	1	1
Santa Cruz	Cauliflower	134	91
Santa Cruz	Celery	191	156
Santa Cruz	Landscape Maint	NR	103
Santa Cruz	Outdoor Flower	338	95
Santa Cruz	Outdoor Plants	48	19
Santa Cruz	Outdoor Transpl	84	41
Santa Cruz	Structural Pest Cont	NR	58

There appears to be only moderate use of acephate within the South Central California Steelhead ESU. This is a very large geographic area and the overall usage and level of toxicity of acephate lead to a determination that there will be no effect on this ESU.

3. Central California Coast Steelhead ESU

The Central California coast steelhead ESU was proposed for listing as endangered on August 9, 1996 (61FR41541-41561) and the listing was made final, as threatened, a year later (62FR43937-43954, August 18, 1997). Critical Habitat was proposed February 5, 1999 (64FR5740-5754) and designated on February 16, 2000 (65FR7764-7787). This coastal steelhead ESU occupies California river basins from the Russian River, Sonoma County, to Aptos Creek, Santa Cruz County, (inclusive), and the drainage of San Francisco and San Pablo Bays eastward to the Napa River (inclusive), Napa County. The Sacramento-San Joaquin River Basin of the Central Valley of California is excluded. Steelhead in most tributary streams in San Francisco and San Pablo Bays appear to have been extirpated, whereas most coastal streams sampled in the central California coast region do contain steelhead.

Only winter steelhead are found in this ESU and those to the south. River entry ranges from October in the larger basins, late November in the smaller coastal basins, and continues through June. Steelhead spawning begins in November in the larger basins, December in the smaller coastal basins, and can continue through April with peak spawning generally in February and March. Hydrologic units in this ESU include Russian (upstream barriers - Coyote Dam, Warm Springs Dam), Bodega Bay, Suisun Bay, San Pablo Bay (upstream barriers - Phoenix Dam, San Pablo Dam), Coyote (upstream barriers - Almaden, Anderson, Calero, Guadelupe, Stevens Creek, and Vasona Reservoirs, Searsville Lake), San Francisco Bay (upstream barriers - Calveras Reservoir, Chabot Dam, Crystal Springs Reservoir, Del Valle Reservoir, San Antonio Reservoir), San Francisco Coastal South (upstream barrier - Pilarcitos Dam), and San Lorenzo-Soquel (upstream barrier - Newell Dam).

Counties of occurrence for this ESU are Santa Cruz, San Mateo, San Francisco, Marin, Sonoma, Mendocino, Napa, Alameda, Contra Costa, Solano, and Santa Clara counties. Usage of acephate in the counties where the Central California coast steelhead ESU is presented in Table 22.

Table 22: Counties supporting the Central California Coas steelhead ESU

County	Site	Acres Treated	lbs. a.i. Applied
Alameda	Landscape Maint	NR	196
Alameda	Outdr Plants	15	3
Alameda	Structural Pest Cont	NR	171
Contra Costa	Landscape Maint	NR	67
Contra Costa	Outdr Flowers	0.4	.05
Contra Costa	Outdr Plants	100	43
Contra Costa	Outdr Transplants	64	24
Contra Costa	Rights of Way	NR	.06

Contra Costa	Structural Pest Cont	NR	83
Marin	Landscape Maint	NR	11
Marin	Outdr Plants	NR	0.2
Marin	Structural Pest Cont	NR	58
Mendocino	Landscape Maint	NR	0.07
Mendocino	Outdr Flowers	0.8	0.75
Mendocino	Outdr Plants	NR	2
Mendocino	Structural Pest Cont	NR	5
Napa	Grape, Wine	2	1
Napa	Landscape Maint	NR	9
Napa	Outdr Plants	NR	0.08
Napa	Rights of Way	NR	0.4
Napa	Structural Pest Cont	NR	31
San Francisco	Landscape Maint	NR	5
San Francisco	Structural Pest Cont	NR	364
San Mateo	Landscape Maint	NR	109
San Mateo	Outdr Flower	69	21
San Mateo	Outdr Plants	NR	90
San Mateo	Structural Pest Cont	NR	280
Santa Clara	Broccoli	10	8
Santa Clara	Celery	236	226
Santa Clara	Chinese Greens	63	5
Santa Clara	Landscape Maint	NR	690
Santa Clara	Lettuce, Head	17	16
Santa Clara	Lettuce, Leaf	300	215
Santa Clara	Outdoor Plants	59	20
Santa Clara	Outdoor Transp	59	49
Santa Clara	Pepper	2089	1496
Santa Clara	Pepper, Spice	20	8
Santa Clara	Research	39	25
Santa Clara	Rights of Way	NR	13

Santa Clara	Structural Pest Cont	NR	253
Santa Clara	Squash	1	1
Santa Cruz	Bean, Unspec	1	1
Santa Cruz	Cauliflower	134	91
Santa Cruz	Celery	191	156
Santa Cruz	Landscape Maint	NR	103
Santa Cruz	Outdoor Flower	338	95
Santa Cruz	Outdoor Plants	48	19
Santa Cruz	Outdoor Transpl	84	41
Santa Cruz	Structural Pest Cont	NR	58
Solano	Bean, Dried	1134	676
Solano	Landscape Maint	NR	8
Solano	Outdr Plants	411	426
Solano	Pepper, Spice	24	9
Solano	Structural Pest Cont	NR	41
Sonoma	Landscape Maint	NR	6
Sonoma	Outdr Flower	40	36
Sonoma	Outdr Plants	71	71
Sonoma	Outdr Transplants	NR	3
Sonoma	Structural Pest Cont	NR	46

Agricultural use of acephate within the Central california Coast Steelhead ESU appears to be minimal. There are, however, several major population centers present and acephate may be used extensively in residential, homeowner settings. Because quantitative values for these uses were not avaiable, the residential use of this pesticide is an uncertainty. The data avalable, however, support the assumption that acephate will have no effect on this ESU, even given the uncertainties.

4. California Central Valley Steelhead ESU

The California Central Valley steelhead ESU was proposed for listing as endangered on August 9, 1996 (61FR41541-41561) and the listing was made final in 1998 (63FR 13347-13371, March 18, 1998). Critical Habitat was proposed February 5, 1999 (64FR5740-5754) and designated on February 16, 2000 (65FR7764-7787).

This ESU includes populations ranging from Shasta, Trinity, and Whiskeytown areas, along with other Sacramento River tributaries in the North, down the Central Valley along the San Joaquin River to and including the Merced River in the South, and then into San Pablo and San Francisco Bays. Counties at least partly within this area are Alameda, Amador, Butte, Calaveras, Colusa, Contra Costa, Glenn, Marin, Merced, Nevada, Placer, Sacramento, San Francisco, San Joaquin, San Mateo, Solano, Sonoma, Stanislaus, Sutter, Tehama, Tuloumne, Yolo, and Yuba. A large proportion of this area is heavily agricultural. Usage of acephate in counties where the California Central Valley steelhead ESU occurs is presented in Table 23.

Table 23: Counties supporting the California Central Valley steelhead ESU.

County	Site	Acres Treated	lbs. a.i. Applied
Alameda	Landscape Maint	NR	196
Alameda	Outdr Plants	15	3
Alameda	Structural Pest Cont	NR	171
Amador	Landscape Maint	NR	0.3
Butte	Bean, Unspec	470	331
Butte	Landscape Maint	NR	34
Butte	Outdr Plants	NR	0.3
Butte	Structural Pest Cont	NR	15
Calaveras	Structural Pest Cont	NR	0.2
Contra Costa	Landscape Maint	NR	67
Contra Costa	Outdr Flower	0.4	0.05
Contra Costa	Outdr Plants	100	0.2
Contra Costa	Outdr Transplants	64	24
Contra Costa	Rights of Way	NR	0.06
Contra Costa	Structural Pest Cont	NR	83
Glenn	Bean, Dried	366	323
Glenn	Bean, Succulent	128	76
Glenn	Structural Pest Cont	NR	1
Marin	Landscape Maint	NR	11
Marin	Outdr Plants	NR	0.2
Marin	Structural Pest Cont	NR	58
Merced	Bean, Dried	1062	824
Merced	Bean, Succulant	2795	2251
Merced	Christmas Trees	8	1.5
Merced	Cotton	4383	3088
Merced	Outdr Plants	14	1

Merced	Peppers	225	125
Merced	Squash	71	20
Merced	Structural Pest Cont	NR	7
Nevada	Landscape Maint	NR	5
Nevada	Structural Pest Cont	NR	1
Placer	Landscape Maint	NR	100
Placer	Outdr Plants	47	27
Placer	Structural Pest Cont	NR	24
Sacramento	Bean, Unsp	127	109
Sacramento	Landscape Maint	NR	317
Sacramento	Outdr Plants	793	206
Sacramento	Structural Pest Cont	NR	67
San Joaquin	Beans, Dried	372	247
San Joaquin	Bean, Succulent	219	188
San Joaquin	Bean, Unspec	41	31
San Joaquin	Landscape Maint	NR	15
San Joaquin	Outdr Plants	1154	1019
San Joaquin	Pepper	250	165
San Joaquin	Structural Pest Cont	NR	12
San Francisco	Landscape Maint	NR	5
San Francisco	Structural Pest Cont	NR	364
San Mateo	Landscape Maint	NR	109
San Mateo	Outdr Flower	69	21
San Mateo	Outdr Plants	NR	90
San Mateo	Structural Pest Cont	NR	280
Shasta	Landscape Maint	NR	57
Shasta	Mint	140	136
Shasta	Outdr Transplants	NR	46
Shasta	Structural Pest Cont	NR	53
Solano	Bean, Dried	1134	676
Solano	Landscape Maint	NR	8

Solano	Outdr Plants	411	426
Solano	Pepper, Spice	24	9
Solano	Structural Pest Cont	NR	41
Sonoma	Landscape Maint	NR	6
Sonoma	Outdr Flower	40	36
Sonoma	Outdr Plants	71	71
Sonoma	Outdr Transplants	NR	3
Sonoma	Structural Pest Cont	NR	46
Stanislaus	Bean, Dried	9428	7543
Stanislaus	Bean, Succulent	3458	2795
Stanislaus	Landscape Maint	NR	22
Stanislaus	Outdr Plants	22	32
Stanislaus	Outdr Transplants	1876	1401
Stanislaus	Rights of Way	NR	2
Stanislaus	Structural Pest Cont	NR	29
Sutter	Bean, Dried	2339	2229
Sutter	Bean, Succulent	1514	1114
Sutter	Landscape Maint	NR	0.2
Sutter	Outdr Plants	7	17
Sutter	Outdr Transplants	386	246
Sutter	Structural Pest Cont	NR	7
Tehama	Bean, Dried	67	60
Tehama	Bean, Succulent	108	81
Tehama	Structural Pest Cont	NR	7
Tuolumne	Outdr Plants	0.25	0.03
Tuolumne	Structural Pest Cont	NR	0.4
Yolo	Bean, Dried	205	154
Yolo	Cotton	333	255
Yolo	Landscape Maint	NR	3
Yolo	Pepper	77	58
Yolo	Research	NR	21

Yolo	Strucural Pest Cont	NR	13
Yuba	Structural Pest Cont	NR	5

The California Central Valley Steelhead ESU constitutes a very large geographic area. Although there is extensive agricultural activity in portions of the ESU, acephate does not appear to be a major chemical used. This combined with low toxicity leads me to believe that acephate will have no effect on the species of interest within this ESU.

5. Northern California Steelhead ESU

The Northern California steelhead ESU was proposed for listing as threatened on February 11, 2000 (65FR6960-6975) and the listing was made final on June 7, 2000 (65FR36074-36094). Critical Habitat has not yet been officially established.

This Northern California coastal steelhead ESU occupies river basins from Redwood Creek in Humboldt County, CA to the Gualala River, inclusive, in Mendocino County, CA. River entry ranges from August through June and spawning from December through April, with peak spawning in January in the larger basins and in late February and March in the smaller coastal basins. The Northern California ESU has both winter and summer steelhead, including what is presently considered to be the southernmost population of summer steelhead, in the Middle Fork Eel River. Counties included appear to be Humboldt, Mendocino, Trinity, and Lake. Table 24 shows the use of acephate in the counties where the Northern California steelhead ESU occurs.

Table 24.: Counties supporting the Northern California steelhead ESU

County	Site	Acres Treated	lbs. a.i. Applied
Humbolt	Landscape Maint	NR	.03
Humbolt	Outdr Flower	8	3
Humbolt	Structural Pest Cont	NR	74
Lake	Landscape Maint	NR	1
Lake	Structural Pest Cont	NR	3
Mendocino	Landscape Maint	NR	0.07
Mendocino	Outdr Flowers	0.8	0.75
Mendocino	Outdr Plants	NR	2
Mendocino	Structural Pest Cont	NR	5
Trinity	Structural Pest Cont	NR	0.01

The northern California Steelhead ESU is an area of low population, minimal development, and very limited agricultural chemical usage. There will be no effects from acephate in this ESU.

6. Upper Columbia River steelhead ESU

The Upper Columbia River steelhead ESU was proposed for listing as endangered on August 9, 1996 (61FR41541-41561) and the listing was made final a year later (62FR43937-43954, August 18, 1997). Critical Habitat was proposed February 5, 1999 (64FR5740-5754) and designated on February 16, 2000 (65FR7764-7787).

The Upper Columbia River steelhead ESU ranges from several northern rivers close to the Canadian border in central Washington (Okanogan and Chelan counties) to the mouth of the Columbia River. The primary area for spawning and growth through the smolt stage of this ESU is from the Yakima River in south Central Washington upstream. Hydrologic units within the spawning and rearing habitat of the Upper Columbia River steelhead ESU and their upstream barriers are Chief Joseph (upstream barrier - Chief Joseph Dam), Okanogan, Similkameen, Methow, Upper Columbia-Entiat, Wenatchee, Moses-Coulee, and Upper Columbia-Priest Rapids. Within the spawning and rearing areas, counties are Chelan, Douglas, Okanogan, Grant, Benton, Franklin, Kittitas, and Yakima, all in Washington.

Areas downstream from the Yakima River are used for migration. Additional counties through which the ESU migrates are Walla Walla, Klickitat, Skamania, Clark, Columbia, Cowlitz, Wahkiakum, and Pacific, Washington; and Gilliam, Morrow, Sherman, Umatilla, Wasco, Hood River, Multnomah, Columbia, and Clatsop, Oregon.

Tables 25 and 26 show the cropping information and maximum potential acephate use for Washington counties where the Upper Columbia River steelhead ESU is located and for the Oregon and Washington counties where this ESU migrates.

Table 25. Spawning and rearing areas supporting the Upper Columbia River steelhead ESU

State	County	Site	Acres Treated	lbs a.i. Applied
WA	Benton	Peppers	1	2
WA	Benton	Nursery, Outdrs	50	38
WA	Franklin	Beans, Dried	124	248
WA	Franklin	Beans, Lima	534	1068
WA	Franklin	Beans, Snap		
WA	Franklin	Nursery, Outdrs	456	342
WA	Franklin	Mint	666	1332
WA	Grant	Beans, Dried	868	1736
WA	Grant	Beans, Lima	2094	4188
WA	Grant	Beans, Snap	262	524
WA	Grant	Pepper, Hot	1	2
WA	Grant	Mint	6556	13112

WA	Grant	Nursery, Outdrs	1484	1113
WA	Okanogan	Peppers, Hot	1	2
WA	Okanogan	Nursery, Outdrs	21	16
WA	Yakima	Beans, Dried	107	214
WA	Yakima	Beans, Snap	41	82
WA	Yakima	Pepper, Hot	20	40
WA	Yakima	Pepper, Sweet	211	422
WA	Yakima	Mint	5282	10564
WA	Yakima	Nursery, Outdrs	94	71

Table 26: Oregon and Washington counties that are migration corridors for the Upper Columbia River steelhead ESU.

State	County	Site	Acres Treated	lbs a.i. Applied
OR	Clatsop	Cranberries	16	16
OR	Clatsop	Nursery, Outdrs	2	2
OR	Columbia			None
OR	Gilliam			None
OR	Hood River			None
OR	Morrow			None
OR	Multnomah	Peppers, Hot	1	2
OR	Multnomah	Peppers, Sweet	7	14
OR	Multnomah	Nursery, Outdrs	253	190
OR	Multnomah	Beans, Snap	1	2
OR	Multnomah	Caulflower	1	1
OR	Sherman	Peppers, Hot	1	2
OR	Umatilla	Nursery, Outdrs	55	41
OR	Umatilla	Mint	1305	2610
OR	Umatilla	Beans, Snap	1	2
OR	Umatilla	Lettuce	5	10
OR	Wasco	Nursery, Outdrs	22	17
WA	Clark	Snap Beans	2	4

WA	Clark	Nursery, Outdrs	105	79
WA	Cowlitz	Nursery, Outdrs	53	40
WA	Cowlitz	Snap Beans	1	2
WA	Klikitat			None
WA	Pacific	Cranberries	669	669
WA	Skamannia			None
WA	Wahkiakum			None
WA	Walla Walla	Lettuce	382	764
WA	Walla Walla	Nursery, Outdrs	332	249

The Upper Columbia River Steelhead ESU courses through major agricultural zones, however acephate does not appear to be a major chemical used. This is most likely due to the limited sites for which acephate is registered relative to the major crop acreage in the area. This factor, coupled with the low population density and toxicity of acephate, leads me to conclude that acephate have no effect on the species of principal interest for this review.

7. Snake River Basin steelhead ESU

The Snake River Basin steelhead ESU was proposed for listing as endangered on August 9, 1996 (61FR41541-41561) and the listing was made final a year later (62FR43937-43954, August 18, 1997). Critical Habitat was proposed February 5, 1999 (64FR5740-5754) and designated on February 16, 2000 (65FR7764-7787).

Spawning and early growth areas of this ESU consist of all areas upstream from the confluence of the Snake River and the Columbia River as far as fish passage is possible. Hells Canyon Dam on the Snake River and Dworshak Dam on the Clearwater River, along with Napias Creek Falls near Salmon, Idaho, are named as impassable barriers. These areas include the counties of Wallowa, Baker, Union, and Umatilla (northeastern part) in Oregon; Asotin, Garfield, Columbia, Whitman, Franklin, and Walla Walla in Washington; and Adams, Idaho, Nez Perce, Blaine, Custer, Lemhi, Boise, Valley, Lewis, Clearwater, and Latah in Idaho. Baker County, Oregon, which has a tiny fragment of the Imnaha River watershed was excluded. While a small part of Rock Creek that extends into Baker County, this occurs at 7200 feet in the mountains (partly in a wilderness area) and is of no significance with respect to acephate use in agricultural areas. Similarly excluded are the Upper Grande Ronde watershed tributaries (e.g., Looking Glass and Cabin Creeks) that are barely into higher elevation forested areas of Umatilla County. However, crop areas of Umatilla County are considered in the migratory routes. In Idaho, Blaine and Boise counties technically have waters that are part of the steelhead ESU, but again, these are tiny areas which occur in the Sawtooth National Recreation Area and/or National Forest lands. They have been excluded because they are not relevant to use of acephate. The agricultural areas of Valley County, Idaho, appear to be primarily associated with the Payette River watershed, but there is enough of the Salmon River watershed in this county that it was not able to exclude it.

Critical Habitat also includes the migratory corridors of the Columbia River from the confluence of the Snake River to the Pacific Ocean. Additional counties in the migratory corridors are Umatilla, Gilliam, Morrow, Sherman, Wasco, Hood River, Multnomah, Columbia, and Clatsop in Oregon; and Benton, Klickitat, Skamania, Clark, Cowlitz, Wahkiakum, and Pacific in Washington.

Tables 27 and 28 show the cropping information for the Pacific Northwest counties where the Snake River Basin steelhead ESU is located and for the Oregon and Washington counties where this ESU migrates.

Table 27: Rearing/spawning areas supporting the Snake River Basin steelhead ESU .

State	County	Site	Acres Treated	lbs a.i. Applied
ID	Adams			None
ID	Clearwater	Beans, dried	11	22
ID	Custer			None
ID	Idaho	Beans, dried	76	152
ID	Latah	Beans, dried	57	114
ID	Lemhi			None
ID	Nez Perce	Beans, dried	228	456
ID	Valley			None
OR	Union	Peppers, Hot	1	2
OR	Wallowa	Peppers, Sweet	4	8
WA	Adams	Peppers, Sweet	1	2
WA	Adams	Nursery, Outdrs	50	38
WA	Adams	Beans, Dried	124	248
WA	Adams	Beans, Lima	534	1068
WA	Asotin			None
WA	Columbia			None
WA	Franklin	Mint	168	336
WA	Franklin	Beans, Dried	107	214
WA	Franklin	Beans, Snap	41	82
WA	Franklin	Pepper, Hot	20	40
WA	Franklin	Pepper, Sweet	211	422
WA	Garfield			None
WA	Walla Walla	Lettuce	382	764
WA	Walla Walla	Nursery, Outdrs	332	249

WA	Whitman	Nursery, Outdrs	19	14

Table 28: Washington and Oregon counties through which the Snake River Basin steelhead ESU migrates

State	County	Site	Acres Treated	lbs a.i. Applied
OR	Clatsop	Cauliflower	12	12
OR	Clatsop	Lettuce	40	80
OR	Columbia	Nursery, Outdrs	22	17
OR	Gilliam			None
OR	Hood River			None
OR	Morrow			None
OR	Multnomah	Peppers, Hot	1	2
OR	Multnomah	Peppers, Sweet	7	14
OR	Multnomah	Beans, Snap	1	2
OR	Multnomah	Cauliflower	1	1
OR	Sherman	Peppers, Hot	1	2
OR	Umatilla	Nursery, Outdrs	55	41
OR	Umatilla	Mint	1305	2610
OR	Umatilla	Beans, Snap	1	2
OR	Umatilla	Lettuce	5	2
OR	Wasco	Nursery, Outdrs	22	17
WA	Benton	Beans, Snap	111	222
WA	Benton	Nursery, Outdrs	456	342
WA	Clark	Snap Beans	2	4
WA	Clark	Nursery, Outdrs	105	79
WA	Cowlitz	Nursery, Outdrs	53	40
WA	Cowlitz	Snap Beans	1	2
WA	Klickitat			None
WA	Wahkiakum			None
WA	Pacific	Cranberries	669	669
WA	Skamania			None

WA	Walla Walla	Lettuce	382	249
WA	Walla Walla	Nursery, Outdrs	332	249

Acephate is not a major agricultural chemical within the Snake River Basin Steelhead ESU, and I anticipate no effects to this ESU.

8 Upper Willamette River steelhead ESU

The Upper Willamette River steelhead ESU was proposed for listing as threatened on March 10, 1998 (63FR11798-11809) and the listing was made final a year later (64FR14517-14528, March 25, 1999). Critical Habitat was proposed February 5, 1999 (64FR5740-5754) and designated on February 16, 2000 (65FR7764-7787). Only naturally spawned, winter steelhead trout are included as part of this ESU; where distinguishable, summer-run steelhead trout are not included.

Spawning and rearing areas are river reaches accessible to listed steelhead in the Willamette River and its tributaries above Willamette Falls up through the Calapooia River. This includes most of Benton, Linn, Polk, Clackamas, Marion, Yamhill, and Washington counties, and small parts of Lincoln and Tillamook counties. However, the latter two counties are small portions in forested areas where acephate would not be used, and these counties are excluded from my analysis. While the Willamette River extends upstream into Lane County, the final Critical Habitat Notice does not include the Willamette River (mainstem, Coastal and Middle forks) in Lane County or the MacKenzie River and other tributaries in this county that were in the proposed Critical Habitat.

Hydrologic units where spawning and rearing occur are Upper Willamette, North Santiam (upstream barrier - Big Cliff Dam), South Santiam (upstream barrier - Green Peter Dam), Middle Willamette, Yamhill, Molalla-Pudding, and Tualatin.

The areas below Willamette Falls and downstream in the Columbia River are considered migrations corridors, and include Multnomah, Columbia and Clatsop counties, Oregon, and Clark, Cowlitz, Wahkiakum, and Pacific counties, Washington.

Tables 29 and 30 show the cropping information for Oregon counties where the Upper Willamette River steelhead ESU is located and for the Oregon and Washington counties where this ESU migrates.

Table 29: Spawning and rearing habitat of the Upper Willamette River steelhead ESU.

State	County	Site	Acres Treated	lbs a.i. Applied
OR	Benton	Snap Beans	1201	2402
OR	Benton	Cauliflower	4	4
OR	Benton	Mint	1229	2458
OR	Benton	Nursury, Outdrs	2232	1674
OR	Linn	Mint	1628	3256
OR	Linn	Snap Beans	717	1434

OR	Linn	Sweet Pepper	6	12
OR	Linn	Nursery, Outdrs	831	623
OR	Polk	Snap Beans	845	1698
OR	Polk	Cauliflower	1	1
OR	Polk	Lettuce	2	14
OR	Polk	Hot Peppers	1	2
OR	Clackamus	Beans, Dry	75	150
OR	Clackamus	Beans, Lima	669	1338
OR	Clackamus	Snap Beans	59	118
OR	Clackamus	Nursery, Outdrs	85	64
OR	Marion	Letuce	2	4
OR	Marion	Sweet Pepper	1	2
OR	Marion	Nursery, Outdrs	956	717
OR	Marion	Snap Beans	385	778
OR	Yamhill	Lettuce	1	2
OR	Yamhill	Nursery, Outdrs	6	5
OR	Yamhill	Snap Beans	1	2
OR	Washington	Hot Peppers	1	2
OR	Washington	Sweet Peppers	4	8
OR	Washington	Nursery, Outdrs	22	17

Table 30. Oregon and Washington counties that are part of the migration corridors of the Upper Willamette River steelhead ESU.

State	County	Site	Acres Treated	lbs a.i. Applied
OR	Multnomah	Peppers, Hot	1	2
OR	Multnomah	Peppers, Sweet	7	14
OR	Multnomah	Nursery, Outdrs	253	190
OR	Multnomah	Beans, Snap	1	2
OR	Multnomah	Caulflower	1	1
OR	Clatsop	Cranberries	16	16
OR	Clatsop	Nursery, Outdrs	2	2
OR	Columbia	Nursery, Outdrs	22	17

WA	Clark	Snap Beans	2	4
WA	Clark	Nursery, Outdrs	105	79
WA	Cowlitz	Nursery, Outdrs	53	40
WA	Cowlitz	Snap Beans	1	2
WA	Wahkiakum			None
WA	Pacific	Cranberries	669	669

The upper Willamette River Steelhead ESU is not an area of extensive acephate use, with the largest sites being the mint and bean crops. There is also a rather low population density, suggesting that agriculture would be the major source of acephate. These factors and the toxicity of acephate combine to lead me to conclude there will be no effects from acephate to this ESU.

9. Lower Columbia River steelhead ESU

The Lower Columbia River steelhead ESU was proposed for listing as endangered on August 9, 1996 (61FR41541-41561) and the listing was made final a year later (62FR43937-43954, August 18, 1997). Critical Habitat was proposed February 5, 1999 (64FR5740-5754) and designated on February 16, 2000 (65FR7764-7787).

This ESU includes all tributaries from the lower Willamette River (below Willamette Falls) to Hood River in Oregon, and from the Cowlitz River up to the Wind River in Washington. These tributaries would provide the spawning and presumably the growth areas for the young steelhead. It is not clear if the young and growing steelhead in the tributaries would use the nearby mainstem of the Columbia prior to downstream migration. If not, the spawning and rearing habitat would occur in the counties of Hood River, Clackamas, and Multnomah counties in Oregon, and Skamania, Clark, and Cowlitz counties in Washington. Tributaries of the extreme lower Columbia River, e.g., Grays River in Pacific and Wahkiakum counties, Washington and John Day River in Clatsop county, Oregon, are not discussed in the Critical Habitat FRNs; because they are not "between" the specified tributaries, they do not appear part of the spawning and rearing habitat for this steelhead ESU. The mainstem of the Columbia River from the mouth to Hood River constitutes the migration corridor. This would additionally include Columbia and Clatsop counties, Oregon, and Pacific and Wahkiakum counties, Washington.

Hydrologic units for this ESU are Middle Columbia-Hood, Lower Columbia-Sandy (upstream barrier - Bull Run Dam 2), Lewis (upstream barrier - Merlin Dam), Lower Columbia-Clatskanie, Lower Cowlitz, Lower Columbia, Clackamas, and Lower Willamette.

Tables 30 and 31 show the cropping information for Oregon and Washington counties where the Lower Columbia River steelhead ESU is located and for the Oregon and Washington counties where this ESU migrates.

Table 31. Spawning/rearing areas for the Lower Columbia steelhead ESU

State	County	Site	Acres Treated	lbs a.i. Applied

OR	Clackamus	Peppers, Sweet	59	118
OR	Clackamus	Beans, Dried	3	2
OR	Clackamus	Beans, Snap	229	458
OR	Clackamus	Nursery, Outdrs	2233	1675
OR	Clackamus	Cauliflower	12	12
OR	Clackamus	Lettuce	83	166
OR	Hood River	Cranberries	16	16
OR	Hood River	Nursery, Outdrs	2	2
OR	Multnomah	Peppers, Hot	1	2
OR	Multnomah	Peppers Sweet	7	14
OR	Multnomah	Nursery, Outdrs	253	190
OR	Multnomah	Beans, Snap	1	2
OR	Multnomah	Cauliflower	1	1
WA	Clark	Snap Beans	2	4
WA	Clark	Nursery, Outdrs	105	79
WA	Cowlitz	Nursery, Outdrs	53	40
WA	Cowlitz	Snap Beans	1	2
WA	Skamania			None

Table 32: Migratory corridors for the Lower Columbia River Steelhead ESU.

State	County	Site	Acres Treated	lbs a.i. Applied
OR	Clatsop	Cauliflower	12	12
OR	Clatsop	Lettuce	40	80
WA	Pacific			None
WA	Wahkiakum			None

The lower Columbia River Steelhead ESU is located in association with one of the worlds great rivers and typcally demonstrates very large water masses and high flow rates. Acephate use is minimal within the ESU, and acephate applied at the higher reaches of the watershed would likely have degraded or been diluted below toxic levels. I anticipate no effects from acephate use on the species of interest within this ESU.

10. Middle Columbia River Steelhead ESU

The Middle Columbia River steelhead ESU was proposed for listing as threatened on March 10, 1998 (63FR11798-11809) and the listing was made final a year later (64FR14517-14528, March 25, 1999). Critical Habitat was proposed February 5, 1999 (64FR5740-5754) and designated on February 16, 2000 (65FR7764-7787).

This steelhead ESU occupies "the Columbia River Basin and tributaries from above the Wind River in Washington and the Hood River in Oregon (exclusive), upstream to, and including, the Yakima River, in Washington." The Critical Habitat designation indicates the downstream boundary of the ESU to be Mosier Creek in Wasco County, Oregon; this is consistent with Hood River being "excluded" in the listing notice. No downstream boundary is listed for the Washington side of the Columbia River, but if Wind River is part of the Lower Columbia steelhead ESU, it appears that Collins Creek, Skamania County, Washington would be the last stream down river in the Middle Columbia River ESU. Dog Creek may also be part of the ESU, but White Salmon River certainly is, since the Condit Dam is mentioned as an upstream barrier. There is limited data on the status of the Dog and Collins creeks. The only other upstream barrier, in addition to Condit Dam on the White Salmon River is the Pelton Dam on the Deschutes River. As an upstream barrier, this dam would preclude steelhead from reaching the Metolius and Crooked Rivers as well the upper Deschutes River and its tributaries.

In the John Day River watershed, I have excluded Harney County, Oregon because there is only a tiny amount of the John Day River and several tributary creeks (e.g., Utley, Bear Cougar creeks) which get into high elevation areas (approximately 1700M and higher) of northern Harney County where there are no crops grown. Similarly, the Umatilla River and Walla Walla River get barely into Union County OR, and the Walla Walla River even gets into a tiny piece of Wallowa County, Oregon. But again, these are high elevation areas where crops are not grown, and are excluded counties for this analysis.

The Oregon counties then that appear to have spawning and rearing habitat are Gilliam, Morrow, Umatilla, Sherman, Wasco, Crook, Grant, Wheeler, and Jefferson counties. Hood River, Multnomah, Columbia, and Clatsop counties in Oregon provide migratory habitat. Washington counties providing spawning and rearing habitat would be Benton, Columbia, Franklin, Kittitas, Klickitat, Skamania, Walla Walla, and Yakima, although only a small portion of Franklin County between the Snake River and the Yakima River is included in this ESU. Skamania, Clark, Cowlitz, Wahkiakum, and Pacific Counties in Washington provide migratory corridors.

Tables 31 and 32 show the cropping information for Oregon and Washington counties where the Middle Columbia River steelhead ESU is located and for the Oregon and Washington counties where this ESU migrates.

Table 33. Spawning/Rearing areas for the Middle Columbia Steelhead ESU

State	County	Site	Acres Treated	lbs a.i. Applied
OR	Crook	Mint	2310	4620
OR	Crook	Nursrery, Outdrs	60	45
OR	Gilliam			None
OR	Jefferson	Nursery, Outdrs	152	114
OR	Jefferson	Mint	1229	2458

OR	Morrow			None
OR	Sherman	Peppers, Hot	1	2
OR	Umatilla	Nursery, Outdrs	55	41
OR	Umatilla	Mint	1305	2610
OR	Umatilla	Beans, Snap	1	2
OR	Umatilla	Lettuce	5	10
OR	Wasco	Nursery, Outdrs	22	17
OR	Wheeler			None
WA	Benton	Beans, Snap	111	222
WA	Benton	Nursery	456	342
WA	Columbia			None
WA	Franklin	Mint	168	336
WA	Franklin	Beans, Dried	107	214
WA	Franklin	Beans, Snap	41	82
WA	Franklin	Peppers, Hot	20	40
WA	Franklin	Peppers, Sweet	211	422
WA	Grant	Mint	5282	10564
WA	Grant	Nursery, Outdrs	1484	1113
WA	Grant	Beans, Dried	868	1736
WA	Kittitat			None
WA	Skamania			None
WA	Walla Walla	Lettuce	382	764
WA	Walla Walla	Nursery, Oudrs	332	249
WA	Yakima	Lettuce	2	4
WA	Yakima	Peppers, Sweet	1	2
WA	Yakima	Nursery, Outdrs	181	136
WA	Yakima	Herbs	3	3

Table 34. Washington and Oregon counties through which the Middle Columbia River steelhead ESU migrates

State	County	Site	Acres Treated	lbs a.i. Applied

OR	Clatsop	Cauliflower	12	12
OR	Clatsop	Lettuce	40	80
OR	Columbia			None
OR	Hood River	Cranberries	16	16
OR	Hood River	Nursery, Outdrs	2	2
OR	Multnomah	Pepperes, Hot	2	4
OR	Multnomah	Peppers, Sweet	7	14
OR	Multnomah	Nursery, Outdrs	253	190
OR	Multnomah	Beans, Snap	1	2
OR	Multnomah	Cauliflower	1	1
WA	Clark	Snap Beans	2	4
WA	Clark	Nursery, Outdrs	105	79
WA	Cowlitz	Nursery, Outdrs	53	40
WA	Cowlitz	Snap Beans	1	2
WA	Pacific	Cranberries	669	669
WA	Wakiakum			None

The middle Columbia River Steelhead ESU is not an area of significant acephate use, and I anticipate no effects on this ESU.

B. Chinook salmon

Chinook salmon *(Oncorhynchus tshawytscha)* is the largest salmon species; adults weighing over 120 pounds have been caught in North American waters. Like other Pacific salmon, chinook salmon are anadromous and die after spawning.

Juvenile stream- and ocean-type chinook salmon have adapted to different ecological niches. Ocean-type chinook salmon, commonly found in coastal streams, tend to utilize estuaries and coastal areas more extensively for juvenile rearing. They typically migrate to sea within the first three months of emergence and spend their ocean life in coastal waters. Summer and fall runs predominate for ocean-type chinook. Stream-type chinook are found most commonly in headwater streams and are much more dependent on freshwater stream ecosystems because of their extended residence in these areas. They often have extensive offshore migrations before returning to their natal streams in the spring or summer months. Stream-type smolts are much larger than their younger ocean-type counterparts and are therefore able to move offshore relatively quickly.

Coast-wide, chinook salmon typically remain at sea for 2 to 4 years, with the exception of a small proportion of yearling males (called jack salmon) which mature in freshwater or return after 2 or 3 months in salt water. Ocean-type chinook salmon tend to migrate along the coast, while stream-type chinook salmon are found far from the coast in the central North Pacific.

They return to their natal streams with a high degree of fidelity. Seasonal ‘‘runs’’ (i.e., spring, summer, fall, or winter), which may be related to local temperature and water flow regimes, have been identified on the basis of when adult chinook salmon enter freshwater to begin their spawning migration. Egg deposition must occur at a time to ensure that fry emerge during the following spring when the river or estuarine productivity is sufficient for juvenile survival and growth.

Adult female chinook will prepare a spawning bed, called a redds, in a stream area with suitable gravel composition, water depth and velocity. After laying eggs in a redds, adult chinook will guard the redds from 4 to 25 days before dying. Chinook salmon eggs will hatch, depending upon water temperatures, between 90 to 150 days after deposition. Juvenile chinook may spend from 3 months to 2 years in freshwater after emergence and before migrating to estuarine areas as smolts, and then into the ocean to feed and mature. Historically, chinook salmon ranged as far south as the Ventura River, California, and their northern extent reaches the Russian Far East.

1. Sacramento River Winter-run Chinook Salmon ESU

The Sacramento River Winter-run chinook was emergency listed as threatened with critical habitat designated in 1989 (54FR32085-32088, August 4, 1989). This emergency listing provided interim protection and was followed by (1) a proposed rule to list the winter-run on March 20, 1990, (2) a second emergency rule on April 20, 1990, and (3) a formal listing on November 20, 1990 (59FR440-441, January 4, 1994). A somewhat expanded critical habitat was proposed in 1992 (57FR36626-36632, August 14, 1992) and made final in 1993 (58FR33212-33219, June 16, 1993). In 1994, the winter-run was reclassified as endangered because of significant declines and continued threats (59FR440-441, January 4, 1994).

Critical Habitat has been designated to include the Sacramento River from Keswick Dam, Shasta County (river mile 302) to Chipps Island (river mile 0) at the west end of the Sacramento-San Joaquin delta, and then westward through most of the fresh or estuarine waters, north of the Oakland Bay Bridge, to the ocean. Estuarine sloughs in San Pablo and San Francisco bays are excluded (58FR33212-33219, June 16, 1993).

Table 35 shows the Acephate usage in California counties supporting the Sacramento River winter-run chinook salmon ESU. Use of Acephate in counties with the Sacramento River winter-run Chinook salmon ESU. Spawning areas are primarily in Shasta and Tehama counties above the Red Bluff diversion dam.

Table 35: California counties supporting the Sacramento River, winter-run chinook ESU.

County	Site	Acres Treated	lbs a.i. Applied
Alameda	Landscape Maint	NR	196
Alameda	Outdr Plants	15	3
Alameda	Structural Pest Cont	NR	171
Butte	Bean, Unspec	470	331
Butte	Landscape Maint	NR	34
Butte	Outdr Plants	NR	0.3

Butte	Structural Pest Cont	NR	15
Contra Costa	Landscape Maint	NR	67
Contra Costa	Outdr Flowers	0.4	.05
Contra Costa	Outdr Plants	100	43
Contra Costa	Outdr Transplants	64	24
Contra Costa	Rights of Way	NR	.06
Contra Costa	Structural Pest Cont	NR	83
Glenn	Bean, Dried	366	323
Glenn	Bean, Succulent	128	76
Glenn	Structural Pest Cont	NR	1
Marin	Landscape Maint	NR	11
Marin	Outdr Plants	NR	0.2
Marin	Structural Pest Cont	NR	58
Sacramento	Bean, Unsp	127	109
Sacramento	Landscape Maint	NR	317
Sacramento	Outdr Plants	793	206
Sacramento	Structural Pest Cont	NR	67
San Francisco	Landscape Maint	NR	5
San Francisco	Structural Pest Cont	NR	364
San Mateo	Landscape Maint	NR	109
San Mateo	Outdr Flower	69	21
San Mateo	Outdr Plants	NR	90
San Mateo	Structural Pest Cont	NR	280
Shasta	Landscape Maint	NR	57
Shasta	Mint	140	136
Shasta	Outdr Transplants	NR	46
Shasta	Structural Pest Cont	NR	53
Solano	Bean, Dried	1134	676
Solano	Landscape Maint	NR	8
Solano	Outdr Plants	411	426
Solano	Pepper, Spice	24	9

Solano	Structural Pest Cont	NR	41
Sonoma	Landscape Maint	NR	6
Sonoma	Outdr Flower	40	36
Sonoma	Outdr Plants	71	71
Sonoma	Outdr Transplants	NR	3
Sonoma	Structural Pest Cont	NR	46
Sutter	Beans, Dried	2339	2229
Sutter	Bean, Succulent	1514	1114
Sutter	Landscape Maint	NR	0.2
Sutter	Outdr Plants	7	17
Sutter	Outdr Transplants	386	246
Sutter	Structural Pest Cont	NR	7
Tehama	Bean, Dried	67	50
Tehama	Bean, Unspec	108	81
Tehama	Structural Pest Cont	NR	7
Yolo	Bean, Dried	205	154
Yolo	Cotton	333	255
Yolo	Landscape Maint	NR	3
Yolo	Pepper	77	58
Yolo	Research	NR	21
Yolo	Structural Pest Cont	NR	13

The Sacramento River, winter-run, Chinook Salmon ESU is associated with numerous agriculture sites and significant modifications to the normal water flow patterns. Acephate does not, however, appear to be extensively used within the area, and I anticipate no effects from its limited use.

2. Snake River Fall-run Chinook Salmon ESU

The Snake River fall-run chinook salmon ESU was proposed as threatened in 1991 (56FR29547-29552, June 27, 1991) and listed about a year later (57FR14653-14663, April 22, 1992). Critical habitat was designated on December 28, 1993 (58FR68543-68554) to include all tributaries of the Snake and Salmon Rivers accessible to Snake River fall-run chinook salmon, except reaches above impassable natural falls and Dworshak and Hells Canyon Dams. The Clearwater River and Palouse River watersheds are included for the fall-run ESU, but not for the spring/summer run. This chinook ESU was proposed for reclassification on December 28, 1994 (59FR66784-57403) as endangered because of critically low levels, based on very sparse runs.

However, because of increased runs in the subsequent year, this proposed reclassification was withdrawn (63FR1807-1811, January 12, 1998).

In 1998, NMFS proposed to revise the Snake River fall-run chinook to include those stocks using the Deschutes River (63FR11482-11520, March 9, 1998). The John Day, Umatilla, and Walla Walla Rivers would be included; however, fall-run chinook in these rivers are believed to have been extirpated. It appears that this proposal has yet to be finalized. I have not included these counties here; however, I would note that the Middle Columbia River steelhead ESU encompasses these basins, and crop information is presented in that section of this analysis.

Hydrologic units with spawning and rearing habitat for this fall-run chinook are the Clearwater, Hells Canyon, Imnaha, Lower Grande Ronde, Lower North Fork Clearwater, Lower Salmon, Lower Snake-Asotin, Lower Snake-Tucannon, and Palouse. These units are in Baker, Umatilla, Wallowa, and Union counties in Oregon; Adams, Asotin, Columbia, Franklin, Garfield, Lincoln, Spokane, Walla Walla, and Whitman counties in Washington; and Adams, Benewah, Clearwater, Idaho, Latah, Lewis, Nez Perce, Shoshone, and Valley counties in Idaho. Custer and Lemhi counties in Idaho are not listed as part of the fall-run ESU, although they are included for the spring/summer-run ESU. Because only high elevation forested areas of Baker and Umatilla counties in Oregon are in the spawning and rearing areas for this fall-run chinook, they were excluded them from consideration because acephate would not be used in these areas.

Tables 34 and 35 show the cropping information for Pacific Northwest counties where the Snake River fall-run chinook salmon ESU is located and for the Oregon and Washington counties where this ESU migrates.

Table 36 : Spawning/rearing areas supporting the Snake River Fall-run chinook salmon ESU

State	County	Site	Acres Treated	lbs a.i. Applied
ID	Adams			None
ID	Benewah			None
ID	Clearwater	Beans, dried	11	22
ID	Idaho	Beans, Dried	76	152
ID	Latah	Beans, Dried	57	114
ID	Lewis			None
ID	Nez Perce	Beans, Dried	228	456
ID	Shoshone			None
OR	Union	Peppers, Hot	1	2
OR	Wallowa	Peppers, Sweet	4	8
WA	Adams	Peppers, Sweet	1	2
WA	Adams	Nurery, Outdrs	50	38
WA	Adams	Beans, Dried	124	248

WA	Adams	Beans, Lima	534	1068
WA	Asotin			None
WA	Franklin	Beans, Snap	41	82
WA	Franklin	Mint	168	336
WA	Franklin	Beans, Dried	107	214
WA	Franklin	Peppers, Hot	20	40
WA	Franklin	Peppers, Sweet	211	422
WA	Garfield			None
WA	Walla Walla	Lettuce	382	764
WA	Walla Walla	Nursery, Outdrs	332	249
WA	Whitman	Nursery, Outdrs	19	14

There is minimal use of acephate within the Snake River fall-run, Chinook Salmon ESU, and I anticipate no effects to this ESU.

3. Snake River Spring/Summer-run Chinook Salmon

The Snake River Spring/Summer-run chinook salmon ESU was proposed as threatened in 1991 (56FR29542-29547, June 27, 1991) and listed about a year later (57FR14653-14663, April 22, 1992). Critical habitat was designated on December 28, 1993 (58FR68543-68554) to include all tributaries of the Snake and Salmon Rivers (except the Clearwater River) accessible to Snake River spring/summer chinook salmon. Like the fall-run chinook, the spring/summer-run chinook ESU was proposed for reclassification on December 28, 1994 (59FR66784-57403) as endangered because of critically low levels, based on very sparse runs. However, because of increased runs in subsequent year, this proposed reclassification was withdrawn (63FR1807-1811, January 12, 1998).

Hydrologic units in the potential spawning and rearing areas include Hells Canyon, Imnaha, Lemhi, Little Salmon, Lower Grande Ronde, Lower Middle Fork Salmon, Lower Salmon, Lower Snake-Asotin, Lower Snake-Tucannon, Middle Salmon-Chamberlain, Middle Salmon - Panther, Pahsimerol, South Fork Salmon, Upper Middle Fork Salmon, Upper Grande Ronde, Upper Salmon, and Wallowa. Areas above Hells Canyon Dam are excluded, along with unnamed “impassable natural falls”. Napias Creek Falls, near Salmon, Idaho, was later named an upstream barrier (64FR57399-57403, October 25, 1999). The Grande Ronde, Imnaha, Salmon, and Tucannon subbasins, and Asotin, Granite, and Sheep Creeks were specifically named in the Critical Habitat Notice.

Spawning and rearing counties mentioned in the Critical Habitat Notice include Union, Umatilla, Wallowa, and Baker counties in Oregon; Adams, Blaine, Custer, Idaho, Lemhi, Lewis, Nez Perce, and Valley counties in Idaho; and Asotin, Columbia, Franklin, Garfield, Walla Walla, and Whitman counties in Washington. However, Umatilla and Baker counties in Oregon and Blaine County in Idaho are excluded because accessible river reaches are all well above areas where acephate can be used. Counties with migratory corridors are all of those down stream from the confluence of the Snake and Columbia Rivers.

Table 38 shows the counties where the Snake River spring/summer-run chinook salmon ESU occurs. The cropping information for the migratory corridors is the same as for the Snake River fall-run chinook salmon and is in the table above.

Table 38: Spawning/rearing area supporting the Snake River spring/summer chinook ESU

State	County	Site	Acres Treated	lbs a.i. Applied
ID	Adams			None
ID	Idaho	Beans, Dried	76	152
ID	Latah	Beans, Dried	57	114
ID	Lewis			None
ID	Nez Perce	Beans, Dried	228	456
ID	Shoshone			None
ID	Valley			None
OR	Union	Peppers, Hot	1	2
OR	Wallowa	Peppers, Sweet	4	8
WA	Asotin			None
WA	Franklin	Beans, Snap	41	82
WA	Franklin	Mint	168	336
WA	Franklin	Beans, Dried	107	214
WA	Franklin	Peppers, Hot	20	40
WA	Franklin	Peppers, Sweet	211	422
WA	Garfield			None
WA	Walla Walla	Lettuce	382	764
WA	Walla Walla	Nursery, Outdrs	332	249
WA	Whitman	Nursery, Outdrs	19	14

There is minimal use of acephate within the Snake River spring/summer Chinook Salmon ESU, and I anticipate no effects in this ESU.

4. Central Valley Spring-run Chinook Salmon ESU

The Central valley Spring-run chinook salmon ESU was proposed as threatened in 1998 (63FR11482-11520, March 9, 1998) and listed on September 16, 1999 (64FR50393-50415). Critical habitat was designated February 16, 2000 (65FR7764-7787) to encompass all river reaches accessible to listed chinook salmon in the Sacramento River and its tributaries in California, along with the down stream river reaches into San Francisco Bay, north of the Oakland Bay Bridge, and to the Golden Gate Bridge

Hydrologic units and upstream barriers within this ESU are the Sacramento-Lower Cow-Lower Clear, Lower Cottonwood, Sacramento-Lower Thomas (upstream barrier - Black Butte Dam), Sacramento-Stone Corral, Lower Butte (upstream barrier - Chesterville Dam), Lower Feather (upstream barrier - Orville Dam), Lower Yuba, Lower Bear (upstream barrier - Camp Far West Dam), Lower Sacramento, Sacramento-Upper Clear (upstream barriers - Keswick Dam, Whiskey town dam), Upper Elder-Upper Thomas, Upper Cow-Battle, Mill-Big Chico, Upper Butte, Upper Yuba (upstream barrier - Englebright Dam), Suisin Bay, San Pablo Bay, and San Francisco Bay. These areas are said to be in the counties of Shasta, Tehama, Butte, Glenn, Colusa, Sutter, Yolo, Yuba, Placer, Sacramento, Solano, Nevada, Contra Costa, Napa, Alameda, Marin, Sonoma, San Mateo, and San Francisco. I note, however, with San Mateo County being well south of the Oakland Bay Bridge, it is difficult to see why this county was included.

Table 39: California counties supporting the Central Valley spring-run chinook salmon ESU.

County	Site	Acres Treated	Lbs a.i. Applied
Alameda	Landscape	NR	196
Alameda	Outdr Plants	15	3
Alameda	Structural Pest Cont	NR	171
Butte	Bean, Unspec	470	331
Butte	Landscape	NR	34
Butte	Outdr Plants	NR	0.3
Butte	Structural Pest Cont	NR	15
Calaveras	Structural Pest Cont	NR	0.2
Colusa	Beans, Dried	1726	1673
Colusa	Cotton	317	200
Colusa	Structural Pest Cont	NR	0.7
Contra Costa	Landscape	NR	67
Contra Costa	Outdr Flowers	0.4	.05
Contra Costa	Outdr Plants	100	43
Contra Costa	Outdr Transplants	64	24
Contra Costa	Rights of Way	NR	.06
Contra Costa	Structural Pest Cont	NR	83
Glenn	Bean, Dried	366	323
Glenn	Bean, Succulent	128	76
Glenn	Structural Pest Cont	NR	1
Merced	Beans, Dried	1062	823
Merced	Beans, Green	2795	2251

Merced	Cotton	4382	3088
Merced	Nursery, Outdrs	14	1
Merced	Pepper	225	124
Merced	Structural Pest Cont	NR	7
Marin	Landscape Maint	NR	11
Marin	Outdr Plants	NR	0.2
Marin	Structural Pest Cont	NR	58
Placer	Landscape	NR	100
Placer	Nursery, Outdrs	47	27
Placer	Strucural Pest Cont	NR	24
Sacramento	Bean, Unsp	127	109
Sacramento	Landscape Maint	NR	317
Sacramento	Outdr Plants	793	206
Sacramento	Structural Pest Cont	NR	67
San Francisco	Landscape Maint	NR	5
San Francisco	Structural Pest Cont	NR	364
San Mateo	Landscape Maint	NR	109
San Mateo	Outdr Flower	69	21
San Mateo	Outdr Plants	NR	90
San Mateo	Structural Pest Cont	NR	280
Shasta	Landscape Maint	NR	57
Shasta	Mint	140	136
Shasta	Outdr Transplants	NR	46
Shasta	Structural Pest Cont	NR	53
Solano	Bean, Dried	1134	676
Solano	Landscape Maint	NR	8
Solano	Outdr Plants	411	426
Solano	Pepper, Spice	24	9
Solano	Structural Pest Cont	NR	41
Sonoma	Landscape Maint	NR	6
Sonoma	Outdr Flower	40	36

Sonoma	Outdr Plants	71	71
Sonoma	Outdr Transplants	NR	3
Sonoma	Structural Pest Cont	NR	46
Sutter	Beans, Dried	2339	2229
Sutter	Bean, Succulent	1514	1114
Sutter	Landscape Maint	NR	0.2
Sutter	Outdr Plants	7	17
Sutter	Outdr Transplants	386	246
Sutter	Structural Pest Cont	NR	7
Tehama	Bean, Dried	67	50
Tehama	Bean, Unspec	108	81
Tehama	Structural Pest Cont	NR	7
Yolo	Bean, Dried	205	154
Yolo	Cotton	333	255
Yolo	Landscape Maint	NR	3
Yolo	Pepper	77	58
Yolo	Research	NR	21
Yolo	Strucural Pest Cont	NR	13
Yuba	Structural Pest Cont	NR	5

The Central Valley spring-run Chinook ESU incorporates a very large land mass with extensive water flow modification, often under some form of physical control for agriculture and drinking water. In addition, numerous population centers are present, mainly on the coast, and the residential use of acephate is not well known or easy to quantify. There is, however, relatively low usage of acephate for agriculture, leading me to conclude that despite extensive manipulation and commercial development, no effects to this ESU from acephate use.

5. California Coastal Chinook Salmon ESU

The California coastal chinook salmon ESU was proposed as threatened in 1998 (63FR11482-11520, March 9, 1998) and listed on September 16, 1999 (64FR50393-50415). Critical habitat was designated February 16, 2000 (65FR7764-7787) to encompass all river reaches and estuarine areas accessible to listed chinook salmon from Redwood Creek (Humboldt County, California) to the Russian River (Sonoma County, California), inclusive.

The Hydrologic units and upstream barriers are Mad-Redwood, Upper Eel (upstream barrier - Scott Dam), Middle Fort Eel, Lower Eel, South Fork Eel, Mattole, Big-Navarro-Garcia, Gualala-Salmon, Russian (upstream barriers - Coyote Dam; Warm Springs Dam), and Bodega Bay. Counties with agricultural areas where Acephate could be used are Humboldt, Trinity, Mendocino, Lake, Sonoma, and Marin. A small portion of Glenn County is also included in the Critical Habitat, but acephate would not be used in the forested upper elevation areas.

Table 40: California counties supporting the California coastal chinook salmon ESU.

County	Site	Acres Treated	Lbs a.i. Applied
Humbolt	Nursery, Outdrs	8	1
Humbolt	Structural pest Cont	NR	74
Lake	Landscape	NR	1
Lake	Structural Pest Cont	NR	3
Marin	Landscape Maint	NR	11
Marin	Outdr Plants	NR	0.2
Marin	Structural Pest Cont	NR	58
Mendocino	Landscape	NR	01
Mendocino	Nursery, Outdrs	6000	3
Mendocino	Structural Pest Cont	NR	5
Sonoma	Landscape Maint	NR	6
Sonoma	Outdr Flower	40	36
Sonoma	Outdr Plants	71	71
Sonoma	Outdr Transplants	NR	3
Sonoma	Structural Pest Cont	NR	46
Trinity			None

The California Coastal Chinook Salmon ESU is located in an area of sparce population, low agricultural development, and very limited application of acephate. I do not believe the current use patterns indicate a potential for adverse events from acephate. There is no effect from acephate in this ESU.

6. Puget Sound Chinook Salmon ESU

The Puget Sound chinook salmon ESU was proposed as threatened in 1998 (63FR11482-11520, March 9, 1998) and listed a year later (64FR14308-14328, March 24, 1999). Critical habitat was designated February 16, 2000 (65FR7764-7787) to encompass all marine, estuarine, and river reaches accessible to listed chinook salmon in Puget Sound and its tributaries, extending out to the Pacific Ocean.

The Hydrologic units and upstream barriers are the Strait of Georgia, San Juan Islands, Nooksack, Upper Skagit, Sauk, Lower Skagit, Stillaguamish, Skykomish, Snoqualmie (upstream barrier - Tolt Dam), Snohomish, Lake Washington (upstream barrier - Landsburg Diversion), Duwamish, Puyallup, Nisqually (upstream barrier - Alder Dam), Deschutes, Skokomish, Hood Canal, Puget Sound, Dungeness-Elwha (upstream barrier - Elwha Dam). Affected counties in Washington, apparently all of which could have spawning and rearing habitat, are Skagit, Whatcom, San Juan, Island, Snohomish, King, Pierce, Thurston, Lewis, Grays Harbor, Mason, Clallam, Jefferson, and Kitsap.

Table 41: Washington counties where the Puget Sound chinook salmon ESU is located.

State	County	Site	Acres Treated	lbs a.i. Applied
WA	Clallum	Nursery, Outdrs	36	27
WA	Grays Harbor	Cranberries	122	122
WA	Island	Nursery, Outdrs	40	30
WA	Island	Beans, Snap	262	524
WA	Jefferson	Beans, Snap	1	2
WA	King	Mint	6556	13112
WA	King	Nursery, Outdrs	1484	1113
WA	Kitsap	Beans, Snap	98	196
WA	Kitsap	Beans, Dry	407	814
WA	Lewis	Nursery, Outdrs	306	230
WA	Mason	Nursery, Outdrs	112	84
WA	Pierce	Beans, Snap	2	4
WA	Pierce	Nursery, Outdrs	955	716
WA	Pierce	Lettuce	1	2
WA	San Juan	Herbs	1	1
WA	San Juan	Lettuce	1	2
WA	Skagit	Nursery, Outdrs	6	5
WA	Snohomish	Nursery, Outdrs	213	160
WA	Thurston	Celery	44	88
WA	Whatcom	Herbs	1	1
WA	Whatcom	Nursery, Outdrs	236	177

The Puget Sound Chinook Salmon ESU is located in a body of water that is largely closed except for the northern portion, which opens to the Straits of Juan de Fuca and the Georgia Straits of Canada. The unusual character of Puget Sound results in exceptional tidal activity (greater than ±20 feet in the Spring) and considerable water movement. This is reflected in the flow patterns of the tributaries serving as salmon habitat. The high rates of water flow, tidal disturbances, and similar factors will greatly enhance the high solubilty of acephate and can be expected to quickly reduce its concentration below toxic levels. I anticipate no effects from acephate use on the species of interest in ths review.

7. Lower Columbia River Chinook Salmon ESU

The Lower Columbia River chinook salmon ESU was proposed as threatened in 1998 (63FR11482-11520, March 9, 1998) and listed a year later (64FR14308-14328, March 24, 1999). Critical habitat was designated February 16, 2000 (65FR7764-7787) to encompass all river reaches accessible to listed chinook salmon in Columbia River tributaries between the Grays and White Salmon Rivers in Washington and the Willamette and Hood Rivers in Oregon, inclusive, along with the lower Columbia River reaches to the Pacific Ocean.

The Hydrologic units and upstream barriers are the Middle Columbia-Hood (upstream barriers - Condit Dam, The Dalles Dam), Lower Columbia-Sandy (upstream barrier - Bull Run Dam 2), Lewis (upstream barrier - Merlin Dam), Lower Columbia-Clatskanie, Upper Cowlitz, Lower Cowlitz, Lower Columbia, Clackamas, and the Lower Willamette. Spawning and rearing habitat would be in the counties of Hood River, Waco, Columbia, Clackamas, Marion, Multnomah, and Washington in Oregon, and Klickitat, Skamania, Clark, Cowlitz, Lewis, Wahkiakum, Pacific, Yakima, and Pierce in Washington. Clatsop County appears to be the only county in the critical habitat that does not contain spawning and rearing habitat, although there is only a small part of Marion County that is included as critical habitat. Pierce County, Washington was excluded because the very small part of the Cowlitz River watershed in this county is at a high elevation where acephate would not be used.

Table 42: Oregon and Washington counties where the Lower Columbia River chinook salmon ESU occurs.

State	County	Site	Acres Treated	lbs a.i. Applied
OR	Clackamus	Beans, Dried	3	2
OR	Clackamus	Beans, Snap	229	458
OR	Clackamus	Peppers, Sweet	59	118
OR	Clackamus	Nursery, Outdrs	2233	1675
OR	Clackamus	Lettuce	83	166
OR	Clackamus	Cauliflower	12	12
OR	Clatsop	Cauliflower	12	12
OR	Clatsop	Lettuce	40	80
OR	Columbia	Nursery, Outdr	22	17
OR	Hood River	Cranberries	16	16
OR	Hood River	Nursery, Outdrs	2	2
OR	Marion	Nursery, Outdrs	956	717
OR	Marion	Sweet Pepper	1	2
OR	Marion	Snap Beans	385	778
OR	Marion	Letuce	2	4
OR	Multnomah	Peppers, Hot	1	2
OR	Multnomah	Peppers Sweet	7	14

OR	Multnomah	Nursery, Outdrs	253	190
OR	Multnomah	Beans, Snap	1	2
OR	Multnomah	Cauliflower	1	1
OR	Wasco	Nursery, Outdrs	22	17
OR	Washington	Lettuce	1	2
OR	Washington	Hot Peppers	1	2
OR	Washington	Sweet Peppers	4	8
OR	Washington	Nursery, Outdrs	36	27
WA	Clark	Snap Beans	2	4
WA	Clark	Nursery, Outdrs	105	79
WA	Cowlitz	Nursery, Outdrs	53	40
WA	Klickitat	Sweet Peppers	1	2
WA	Lewis	Nursery, Outdrs	306	230
WA	Cowlitz	Snap Beans	1	2
WA	Pacific	Cranberries	669	669
WA	Skamania			None
WA	Wakiakum			None

There is minimal acephate use in the lower Columbia River Chinook Salmon ESU. This combined with the large and rapid water flow of the region, leads me to conclude there will be no effects from acephate use.

8. Upper Willamette River Chinook Salmon ESU

The Upper Willamette River Chinook Salmon ESU was proposed as threatened in 1998 (63FR11482-11520, March 9, 1998) and listed a year later (64FR14308-14328, March 24, 1999). Critical habitat was designated February 16, 2000 (65FR7764-7787) to encompass all river reaches accessible to listed chinook salmon in the Clackamas River and the Willamette River and its tributaries above Willamette Falls, in addition to all down stream river reaches of the Willamette and Columbia Rivers to the Pacific Ocean.

The Hydrologic units included are the Lower Columbia-Sandy, Lower Columbia-Clatskanie, Lower Columbia, Middle Fork Willamette, Coast Fork Willamette (upstream barriers - Cottage Grove Dam, Dorena Dam), Upper Willamette (upstream barrier - Fern Ridge Dam), McKenzie (upstream barrier - Blue River Dam), North Santiam (upstream barrier - Big Cliff Dam), South Santiam (upstream barrier - Green Peter Dam), Middle Willamette, Yamhill, Molalla-Pudding, Tualatin, Clackamas, and Lower Willamette. Spawning and rearing habitat is in the Oregon counties of Clackamas, Douglas, Lane, Benton, Lincoln, Linn, Polk, Marion, Yamhill, Washington, and Tillamook. However, Lincoln and Tillamook counties include salmon habitat only in the forested parts of the coast range where Acephate would not be used.

Salmon habitat for this ESU is exceedingly limited in Douglas County also, but we cannot rule out future Acephate use in Douglas County.

Tables 43 and 44 show the cropping information for Oregon counties where the Upper Willamette River chinook salmon ESU occurs and for the Oregon and Washington counties where this ESU migrates.

Table 43: Spawning/Rearing areas for the Upper Willamette River chinook ESU

State	County	Site	Acres Treated	lbs a.i. Applied
OR	Benton	Snap Beans	1201	2402
OR	Benton	Cauliflower	4	4
OR	Benton	Nursury, Outdrs	2232	1674
OR	Clackamus	Nursery, Outdrs	2233	1675
OR	Benton	Mint	1229	2458
OR	Clackamus	Lettuce	83	166
OR	Clackamus	Cauliflower	12	12
OR	Clackamus	Beans, Snap	229	458
OR	Clackamus	Beans, Dried	3	2
OR	Clackamus	Peppers, Sweet	59	118
OR	Douglas	Cauliflower	12	12
OR	Douglas	Lettuce	40	80
OR	Douglas	Sweet Pepper	2	4
OR	Douglas	Hursery, Outdrs	406	305
OR	Lane	Beans, Snap	4719	9438
OR	Lane	Cauliflower	316	316
OR	Lane	Celery	22	44
OR	Lane	Hot Peppers	1	2
OR	Lane	Sweet peppers	15	30
OR	Linn	Sweet Pepper	6	12
OR	Linn	Nursery, Outdrs	831	623
OR	Linn	Snap Beans	717	1434
OR	Linn	Mint	1628	3256
OR	Marion	Letuce	2	4
OR	Marion	Nursery, Outdrs	956	717

OR	Marion	Snap Beans	385	778
OR	Marion	Sweet Pepper	1	2
OR	Marion	Letuce	2	4
OR	Marion	Snap Beans	385	778
OR	Marion	Sweet Pepper	1	2
OR	Polk	Cauliflower	1	1
OR	Polk	Snap Beans	845	1698
OR	Polk	Hot Peppers	1	2
OR	Polk	Lettuce	2	14
OR	Wasco	Nursery, Outdrs	22	17
OR	Washington	Lettuce	1	2
OR	Washington	Hot Peppers	1	2
OR	Washington	Sweet Peppers	4	8
OR	Washington	Nursery, Outdrs	22	17
OR	Yamhill	Lettuce	1	2
OR	Yamhill	Snap Beans	1	2
OR	Yamhill	Snap Beans	1	2

Table 44: Migration corridors of the Upper Willamette River chinook salmon ESU.

State	County	Site	Acres Treated	lbs a.i. Applied
OR	Clatsop	Cauliflower	12	12
OR	Clatsop	Lettuce	40	80
OR	Columbia	Nursery, Outdr	22	17
OR	Multnomah	Peppers, Hot	1	2
OR	Multnomah	Peppers Sweet	7	14
OR	Multnomah	Nursery, Outdrs	253	190
OR	Multnomah	Beans, Snap	1	2
OR	Multnomah	Cauliflower	1	1
WA	Clark	Beans, Snap	2	2
WA	Clark	Nursery, Outdrs	105	79
WA	Cowlitz	Snap Beans	1	2
WA	Pacific	Cranberries	669	669

The Upper Willamette River Chinook Salmon ESU is located in an areas of rather high agricultural development. Acephate is not, however, registered for use on the major crops of the area (wheat, barley, oats, etc) and is therefore limted to a few specialized sites. Mint, grown for oil, and beans are the major sites of acephate use in this ESU. Because of this limited application, and the low toxicity of acephate to the species of interest, I anticipate no effects from its use.

9. Upper Columbia River Spring-run Chinook Salmon ESU

The Upper Columbia River Spring-run Chinook Salmon ESU was proposed as endangered in 1998 (63FR11482-11520, March 9, 1998) and listed a year later (64FR14308-14328, March 24, 1999). Critical habitat was designated February 16, 2000 (65FR7764-7787) to encompass all river reaches accessible to listed chinook salmon in Columbia River tributaries upstream of the Rock Island Dam and downstream of Chief Joseph Dam in Washington, excluding the Okanogan River, as well as all down stream migratory corridors to the Pacific Ocean. Hydrologic units and their upstream barriers are Chief Joseph (Chief Joseph Dam), Similkameen, Methow, Upper Columbia-Entiat, Wenatchee, Upper Columbia-Priest Rapids, Middle Columbia-Lake Wallula, Middle Columbia-Hood, Lower Columbia-Sandy, Lower Columbia-Clatskanie, Lower Columbia, and Lower Willamette. Counties in which spawning and rearing occur are Chelan, Douglas, Okanogan, Grant, Kittitas, and Benton (Table 45), with the lower river reaches being migratory corridors (Table 46).

Most acephate usage occurs upstream from the confluence of the Snake River with the Columbia River, but not as far north as Chelan, and Okanogan counties, where there is limited acreage of the major crops for acephate. However, a modest amount is used on the same crops below that confluence in counties on either side of the Columbia River, but all upstream of the John Day Dam.

Tables 45 and 46 show the cropping information for Washington counties that support the Upper Columbia River chinook salmon ESU and for the Oregon and Washington counties where this ESU migrates.

Table 45. Counties Supporting the Upper Columbia Chinook ESU Spawning/Rearing Area

State	County	Site	Acres Treated	lbs a.i. Applied
WA	Benton	Nursery	456	342
WA	Benton	Beans, Snap	111	222
WA	Chelan	Nursery, Outdrs	17	14
WA	Douglas	Nursery, Outdrs	2	1
WA	Grant	Nursery, Outdrs	1484	1113
WA	Grant	Beans, Dried	868	1736
WA	Grant	Mint	5282	10564
WA	Kittitas	Beans, Snap	40	80
WA	Kittitas	Mint	3077	6154

WA	Kittitat			None
WA	Okanogan	Lettuce	1	2
WA	Okanogan	Nursery, Outdrs	213	160
WA	Skamania			None

Table 46: .Migration corridors for the Upper Columbia River Chinook salmon ESU.

State	County	Site	Acres Treated	lbs a.i. Applied
OR	Clatsop	Cauliflower	12	12
OR	Clatsop	Lettuce	40	80
OR	Columbia	Nursery, Outdr	22	17
OR	Gilliam			None
OR	Hood River	Cranberries	16	16
OR	Hood River	Nursery, Outdrs	2	2
OR	Morrow	Beans, Dry	11	22
OR	Multnomah	Peppers, Hot	1	2
OR	Multnomah	Sweet Pepper	7	14
OR	Multnomah	Nursery, Outdrs	253	190
OR	Multnomah	Beans, Snap	1	2
OR	Multnomah	Cauliflower	1	1
OR	Sherman	Sweet Pepper	7	14
OR	Umatilla	Mint	1305	2610
OR	Umatilla	Beans, Snap	1	2
OR	Umatilla	Lettuce	5	10
OR	Wasco	Nursery, Outdrs	22	17
WA	Clark	Beans, Snap	2	2
WA	Clark	Nursery, Outdrs	105	79
WA	Cowlitz	Snap Beans	1	2
WA	Franklin	Beans, Snap	41	82
WA	Franklin	Mint	168	336
WA	Franklin	Beans, Dried	107	214
WA	Franklin	Peppers, Hot	20	40
WA	Franklin	Peppers, Sweet	211	422

WA	Klckitat			None
WA	Skamania			None
WA	Pacific	Cranberries	669	669
WA	Walla Walla	Lettuce	382	764
WA	Walla Walla	Nursery, Oudrs	332	249
WA	Yakima	Lettuce	2	4
WA	Yakima	Peppers, Sweet	1	2
WA	Yakima	Nursery, Outdrs	181	136
WA	Yakima	Herbs	3	3

The Upper Columbia Chinook ESU is located in areas of rather high agricultural development. Acephate is not, however, registered for use on the major crops of the areas (wheat, barley, oats, etc.) and is therefore limted to a few specialized sites. Mint, grown for oil, is the major site of acephate use in this ESU. Because of this limited application, and the low toxicity of acephate to the species of interest, I anticipate no effects from its use.

C. Coho Salmon

Coho salmon, *Oncorhynchus kisutch*, were historically distributed throughout the North Pacific Ocean from central California to Point Hope, AK, through the Aleutian Islands into Asia. Historically, this species probably inhabited most coastal streams in Washington, Oregon, and central and northern California. Some populations may once have migrated hundreds of miles inland to spawn in tributaries of the upper Columbia River in Washington and the Snake River in Idaho.

Coho salmon generally exhibit a relatively simple, 3 year life cycle. Adults typically begin their freshwater spawning migration in the late summer and fall, spawn by mid-winter, then die. Southern populations are somewhat later and spend much less time in the river prior to spawning than do northern coho. Homing fidelity in coho salmon is generally strong; however their small tributary habitats experience relatively frequent, temporary blockages, and there are a number of examples in which coho salmon have rapidly re-colonized vacant habitat that had only recently become accessible to anadromous fish.

After spawning in late fall and early winter, eggs incubate in redds for 1.5 to 4 months, depending upon the temperature, before hatching as alevins. Following yolk sac absorption, alevins emerge and begin actively feeding as fry. Juveniles rear in fresh water for up to 15 months, then migrate to the ocean as ‘‘smolts’’ in the spring. Coho salmon typically spend two growing seasons in the ocean before returning to their natal stream. They are most frequently recovered from ocean waters in the vicinity of their spawning streams, with a minority being recovered at adjacent coastal areas, decreasing in number with distance from the natal streams. However, those coho released from Puget Sound, Hood Canal, and the Strait of Juan de Fuca are caught at high levels in Puget Sound, an area not entered by coho salmon from other areas.

<u>1. Central California Coast Coho Salmon ESU</u>

The Central California Coast Coho Salmon ESU includes all coho naturally reproduced in streams between Punta Gorda, Humboldt County, CA and San Lorenzo River, Santa Cruz County, CA, inclusive. This ESU was proposed in 1995 (60FR38011-38030, July 25, 1995) and listed as threatened, with critical habitat designated, on May 5, 1999 (64FR24049-24062). Critical habitat consists of accessible reaches along the coast, including Arroyo Corte Madera Del Presidio and Corte Madera Creek, tributaries to San Francisco Bay.

Hydrologic units within the boundaries of this ESU are: San Lorenzo-Soquel (upstream barrier - Newell Dam), San Francisco Coastal South, San Pablo Bay (upstream barrier - Phoenix Dam- Phoenix Lake), Tomales-Drake Bays (upstream barriers - Peters Dam-Kent Lake; Seeger Dam-Nicasio Reservoir), Bodega Bay, Russian (upstream barriers - Warm springs dam-Lake Sonoma; Coyote Dam-Lake Mendocino), Gualala-Salmon, and Big-Navarro-Garcia. California counties included are Santa Cruz, San Mateo, Marin, Napa, Sonoma, and Mendocino.

Table 47: California counties supporting the Central California coast Coho salmon ESU.

County	Site	Acres Treated	Lbs a.i. Applied
Marin	Landscape Maint	NR	11
Marin	Outdr Plants	NR	0.2
Marin	Structural Pest Cont	NR	58
Mendocino	Landscape	NR	01
Mendicino	Structural Pest Cont	NR	6
Mendocino	Nursery, Outdrs	6000	3
Napa	Grape, Wine	2	1
Napa	Landscape Maint	NR	9
Napa	Outdr Plants	NR	0.08
Napa	Rights of Way	NR	0.4
Napa	Structural Pest Cont	NR	31
San Mateo	Landscape Maint	NR	109
San Mateo	Outdoor Flower	69	21
San Mateo	Outdoor Plants	NR	81
San Mateo	Structural Pest Cont	NR	280
Santa Cruz	Bean, Unspec	1	1
Santa Cruz	Cauliflower	134	91
Santa Cruz	Celery	191	156
Santa Cruz	Landscape Maint	NR	103
Santa Cruz	Outdoor Flower	338	95
Santa Cruz	Outdoor Plants	48	19

Santa Cruz	Outdoor Transpl	84	41
Santa Cruz	Structural Pest Cont	NR	58
Sonoma	Landscape Maint	NR	6
Sonoma	Outdr Flower	40	36
Sonoma	Outdr Plants	71	71
Sonoma	Outdr Transplants	NR	3
Sonoma	Structural Pest Cont	NR	46

There are very minimal applications of acephate to commercial properties within the Central California Central Coast Coho Salmon ESU, with the largest single site being structural pest control in San Mateo county. This low use rate, coupled with the low toxicity of acephate to the species of interest in this review, supports a decision there will be no effect from acephate use.

2. Southern Oregon/Northern California Coast Coho Salmon ESU

The Southern Oregon/Northern California coastal coho salmon ESU was proposed as threatened in 1995 (60FR38011-38030, July 25, 1995) and listed on May 6, 1997 (62FR24588-24609). Critical habitat was proposed later that year (62FR62741-62751, November 25, 1997) and finally designated on May 5, 1999 (64FR24049-24062) to encompass accessible reaches of all rivers (including estuarine areas and tributaries) between the Mattole River in California and the Elk River in Oregon, inclusive.

The Southern Oregon/Northern California Coast coho salmon ESU occurs between Punta Gorda, Humboldt County, California and Cape Blanco, Curry County, Oregon. Major basins with this salmon ESU are the Rogue, Klamath, Trinity, and Eel river basins, while the Elk River, Oregon, and the Smith and Mad Rivers, and Redwood Creek, California are smaller basins within the range. Hydrologic units and the upstream barriers are Mattole, South Fork Eel, Lower Eel, Middle Fork Eel, Upper Eel (upstream barrier - Scott Dam-Lake Pillsbury), Mad-Redwood, Smith, South Fork Trinity, Trinity (upstream barrier - Lewiston Dam-Lewiston Reservoir), Salmon, Lower Klamath, Scott, Shasta (upstream barrier - Dwinnell Dam-Dwinnell Reservoir), Upper Klamath (upstream barrier - Irongate Dam-Irongate Reservoir), Chetco, Illinois (upstream barrier - Selmac Dam-Lake Selmac), Lower Rogue, Applegate (upstream barrier - Applegate Dam-Applegate Reservoir), Middle Rogue (upstream barrier - Emigrant Lake Dam-Emigrant Lake), Upper Rogue (upstream barriers - Agate Lake Dam-Agate Lake; Fish Lake Dam-Fish Lake; Willow Lake Dam-Willow Lake; Lost Creek Dam-Lost Creek Reservoir), and Sixes. Related counties are Humboldt, Mendocino, Trinity, Glenn, Lake, Del Norte, Siskiyou in California and Curry, Jackson, Josephine, and Douglas, in Oregon. However, I have excluded Glenn County, California from this analysis because the salmon habitat in this county is not near the agricultural areas where acephate can be used. Klamath county is excluded because it lies beyond an impassable barrier.

Tables 48 shows the usage of acephate in the California counties supporting the Southern Oregon/Northern California coastal coho salmon ESU. Table 47 shows the cropping information for Oregon counties where the Southern Oregon/Northern California coastal coho salmon ESU occurs..

Table 48.:California Counties where the Southern Oregon/Northern California Coastal Coho Salmon ESU Occuirs

County	Site	Acres Treated	Lbs a.i. Applied
Del Norte	Nursery, Outdrs	38	1
Del Norte	Structural Pest Cont	NR	2
Humbolt	Landscape Maint	NR	.03
Humbolt	Outdr Flower	8	3
Humbolt	Structural Pest Cont	NR	74
Lake	Landscape Maint	NR	1
Lake	Structural Pest Cont	NR	3
Mendocino	Landscape Maint	NR	0.07
Mendocino	Outdr Flowers	0.8	0.75
Mendocino	Outdr Plants	NR	2
Mendocino	Structural Pest Cont	NR	5
Siskyou	Mint	81	77
Siskyou	Structural Pest Cont	NR	2
Trinity	Structural Pest Cont	NR	0.01

Table 49. Oregon counties where there is habitat for the Southern Oregon/Northern California coastal coho salmon ESU.

State	County	Site	Acres Treated	lbs a.i. Applied
OR	Curry			None
OR	Douglas	Cauliflower	12	12
OR	Douglas	Lettuce	40	80
OR	Douglas	Sweet Pepper	2	4
OR	Douglas	Hursery, Outdrs	406	305
OR	Jackson	Beans, Snap	1201	2402
OR	Jackson	Nursery, Outdr	33	25
OR	Jackson	Lettuce	6	12
OR	Jackson	Hot Peppers	1	2
OR	Jackson	Sweet Peppers	2	2

OR	Josephine	Mint	2249	4498
OR	Josephine	Beans, Snap	1048	2096
OR	Josephine	Hot Peppers	1	2
OR	Josephine	Nursery, Outdrs	125	94

Within the southern Oregon, northern California Coastal Coho Salmon ESU, there appears to be only limited agricultural use of acephate, primarily in Josephine and Jackson counties. This limited application and the toxicity of acephate leads me to believe that there will be no effects from acephate use.

3. Oregon Coast coho salmon ESU

The Oregon coast coho salmon ESU was first proposed for listing as threatened in 1995 (60FR38011-38030, July 25, 1995), and listed several years later 63FR42587-42591, August 10, 1998). Critical habitat was proposed in 1999 (64FR24998-25007, May 10, 1999) and designated on February 16, 2000 (65FR7764-7787).

This ESU includes coastal populations of coho salmon from Cape Blanco, Curry County, Oregon to the Columbia River. Spawning is spread over many basins, large and small, with higher numbers further south where the coastal lake systems (e.g., the Tenmile, Tahkenitch, and Siltcoos basins) and the Coos and Coquille Rivers have been particularly productive. Critical Habitat includes all accessible reaches in the coastal Hydrologic reaches Necanicum, Nehalem, Wilson-Trask-Nestucca (upstream barrier - McGuire Dam), Siletz-Yaquina, Alsea, Siuslaw, Siltcoos, North Umpqua (upstream barriers - Cooper Creek Dam, Soda Springs Dam), South Umpqua (upstream barrier - Ben Irving Dam, Galesville Dam, Win Walker Reservoir), Umpqua, Coos (upstream barrier - Lower Pony Creek Dam), Coquille, Sixes. Related Oregon counties are Douglas, Lane, Coos, Curry, Benton, Lincoln, Polk, Tillamook, Yamhill, Washington, Columbia, Clatsop. However, the portions of Yamhill, Washington, and Columbia counties that are within the ESU do not include agricultural areas where acephate can be used, and they were eliminated in this analysis.

Table 50: Oregon counties where the Oregon coast coho salmon ESU occurs.

State	County	Site	Acres Treated	lbs a.i. Applied
OR	Benton	Snap Beans	1201	2402
OR	Benton	Mint	1229	2458
OR	Benton	Cauliflower	4	4
OR	Benton	Nursury, Outdrs	2232	1674
OR	Clatsop	Cauliflower	12	12
OR	Clatsop	Lettuce	40	80
OR	Coos	Nursery, Outdrs	33	25
OR	Curry			None
OR	Douglas	Cauliflower	12	12

OR	Douglas	Lettuce	40	80
OR	Douglas	Sweet Peppers	2	4
OR	Douglas	Nursery, Outdrs	406	305
OR	Lane	Beans, Snap	4719	9438
OR	Lane	Cauliflower	316	316
OR	Lane	Celery	22	44
OR	Lane	Hot Peppers	1	2
OR	Lane	Sweet peppers	15	30
OR	Lincoln	Nursery, Outdrs	2967	2225
OR	Polk	Cauliflower	1	1
OR	Polk	Snap Beans	845	1698
OR	Polk	Hot Peppers	1	2
OR	Polk	Lettuce	2	14
OR	Tillamook			None

The coastal location and relatively high water flow rates in the Oregon Coast Coho Salmon ESU appear to enhance the high solubility and rapid degradation attributed to acephate. The limited use of acephate and its low toxicity leads to the decision that acephate will have no effects within this ESU on the species of interest.

D. Chum Salmon

Chum salmon, *Oncorhynchus keta*, have the widest natural geographic and spawning distribution of any Pacific salmonid, primarily because its range extends farther along the shores of the Arctic Ocean. Chum salmon have been documented to spawn from Asia around the rim of the North Pacific Ocean to Monterey Bay in central California. Presently, major spawning populations are found only as far south as Tillamook Bay on the northern Oregon coast.

Most chum salmon mature between 3 and 5 years of age, usually 4 years, with younger fish being more predominant in southern parts of their range. Chum salmon usually spawn in coastal areas, typically within 100 km of the ocean where they do not have surmount river blockages and falls. However, in the Skagit River, Washington, they migrate at least 170 km.

During the spawning migration, adult chum salmon enter natal river systems from June to March, depending on characteristics of the population or geographic location. . In Washington, a variety of seasonal runs are recognized, including summer, fall, and winter populations. Fall-run fish predominate, but summer runs are found in Hood Canal, the Strait of Juan de Fuca, and in southern Puget Sound, and two rivers in southern Puget Sound have winter-run fish.

Redds are usually dug in the mainstem or in side channels of rivers. Juveniles outmigrate to seawater almost immediately after emerging from the gravel that covers their redds. This means that survival and growth in juvenile chum salmon depend less on freshwater conditions than on favorable estuarine and marine conditions.

1. Hood Canal Summer-run chum salmon ESU

The Hood Canal summer-run chum salmon ESU was proposed for listing as threatened, and critical habitat was proposed, in 1998 (63FR11774-11795, March 10, 1998). The final listing was published a year later (63FR14508-14517, March 25, 1999), and critical habitat was designated in 2000 (65FR7764-7787).

Critical habitat for the Hood Canal ESU includes Hood Canal, Admiralty Inlet, and the straits of Juan de Fuca, along with all river reaches accessible to listed chum salmon draining into Hood Canal as well as Olympic Peninsula rivers between Hood Canal and Dungeness Bay, Washington. The Hydrologic units are Skokomish (upstream boundary - Cushman Dam), Hood Canal, Puget Sound, Dungeness-Elwha, in the counties of Mason, Clallam, Jefferson, Kitsap, and Island.

Streams specifically mentioned, in addition to Hood Canal, in the proposed critical habitat Notice include Union River, Tahuya River, Big Quilcene River, Big Beef Creek, Anderson Creek, Dewatto River, Snow Creek, Salmon Creek, Jimmycomelately Creek, Duckabush ‘stream’, Hamma Hamma ‘stream’, and Dosewallips ‘stream’.

Tables 51: Washington counties where the Hood Canal summer-run chum salmon ESU Occurs.

State	County	Site	Acres Treated	lbs a.i. Applied
WA	Clallum	Nursery, Outdrs	36	27
WA	Island	Nursery, Outdrs	40	30
WA	Island	Beans, Snap	262	524
WA	Jefferson	Beans, Snap	1	2
WA	Kitsap	Beans, Snap	98	196
WA	Kitsap	Beans, Dry	407	814

The Hood Canal is a rather well protected body of water in a largely undeveloped portion of Washington State. It is closed to the south and opens to the Straits of Juan de Fuca in the north. To the west, the back ranges of the Olympic Mountains form a protective crest, while to the east the canal is separated by land from Puget Sound and the developed portions of the Puget Sound Basin. As is seen in Table 51, agrcultural use of acephate is minimal. The low population density and largely rural nature of the area encompassing the Hood Canal Summer Run Chum Salmon ESU leads me to believe there will be no effects to this ESU.

2. Columbia River Chum Salmon ESU

The Columbia River chum salmon ESU was proposed for listing as threatened, and critical habitat was proposed, in 1998 (63FR11774-11795, March 10, 1998). The final listing was published a year later (63FR14508-14517, March 25, 1999), and critical habitat was designated in 2000 (65FR7764-7787).

Critical habitat for the Columbia River chum salmon ESU encompasses all accessible reaches and adjacent riparian zones of the Columbia River (including estuarine areas and tributaries) downstream from Bonneville Dam, excluding Oregon tributaries upstream of Milton Creek at river km 144 near the town of St. Helens. These areas are the Hydrologic units of Lower Columbia - Sandy (upstream barrier - Bonneville Dam, Lewis (upstream barrier - Merlin Dam), Lower Columbia - Clatskanie, Lower Cowlitz, Lower Columbia, Lower Willamette in the counties of Clark, Skamania, Cowlitz, Wahkiakum, Pacific, Lewis, Washington and Multnomah, Clatsop, Columbia, and Washington, Oregon. It appears that there are three extant populations in Grays River, Hardy Creek, and Hamilton Creek.

Table 52: Oregon and Washington counties where the Columbia River chum salmon ESU occurs.

State	County	Site	Acres Treated	lbs a.i. Applied
OR	Clatsop	Cauliflower	12	12
OR	Clatsop	Lettuce	40	80
OR	Columbia	Nursery, Outdrs	22	17
OR	Multnomah	Peppers, Hot	1	2
OR	Multnomah	Peppers Sweet	7	14
OR	Multnomah	Nursery, Outdrs	253	190
OR	Multnomah	Beans, Snap	1	2
OR	Multnomah	Cauliflower	1	1
OR	Washington	Lettuce	1	2
OR	Washington	Hot Peppers	1	2
OR	Washington	Sweet Peppers	4	8
OR	Washington	Nursery, Outdrs	22	17
WA	Clark	Beans, Snap	2	2
WA	Clark	Nursery, Outdrs	105	79
WA	Cowlitz	Snap Beans	1	2
WA	Lewis	Nursery, Outdrs	306	230
WA	Pacific	Cranberries	669	669
WA	Skamania			None
WA	Wahkiakum			None

The Columbia River Chum Salmon ESU is located largely in association with one of the worlds great rivers. Large water flow rates, great size, and direct access to the Pacific Ocean will greatly enhance the high solubility and short half-life of acephate. I would anticipate no effects from it’s use in this ESU.

E. Sockeye Salmon

Sockeye salmon, *Oncorhynchus nerka*, are the third most abundant species of Pacific salmon, after pink and chum salmon. Sockeye salmon exhibit a wide variety of life history patterns that reflect varying dependency on the fresh water environment. The vast majority of sockeye salmon typically spawn in inlet or outlet tributaries of lakes or along the shoreline of lakes, where their distribution and abundance is closely related to the location of rivers that provide access to the lakes. Some sockeye, known as kokanee, are non-anadromous and have been observed on the spawning grounds together with their anadromous counterparts. Some sockeye, particularly the more northern populations, spawn in mainstem rivers.

Growth is influenced by competition, food supply, water temperature, thermal stratification, and other factors, with lake residence time usually increasing the farther north a nursery lake is located. In Washington and British Columbia, lake residence is normally 1 or 2 years. Incubation, fry emergence, spawning, and adult lake entry often involve intricate patterns of adult and juvenile migration and orientation not seen in other *Oncorhynchus* species. Upon emergence from the substrate, lake-type sockeye salmon juveniles move either downstream or upstream to rearing lakes, where the juveniles rear for 1 to 3 years prior to migrating to sea. Smolt migration typically occurs beginning in late April and extending through early July.

Once in the ocean, sockeye salmon feed on copepods, euphausiids, amphipods, crustacean larvae, fish larvae, squid, and pteropods. They will spend from 1 to 4 years in the ocean before returning to freshwater to spawn. Adult sockeye salmon home precisely to their natal stream or lake. River-and sea-type sockeye salmon have higher straying rates within river systems than lake-type sockeye salmon.

1. Ozette Lake Sockeye Salmon ESU

The Ozette Lake sockeye salmon ESU was proposed for listing, along with proposed critical habitat in 1998 (63FR11750-11771, March 10, 1998). It was listed as threatened on March 25, 1999 (64FR14528-14536), and critical habitat was designated on February 16, 2000 (65FR7764-7787). This ESU spawns in Lake Ozette, Clallam County, Washington, as well as in its outlet stream and the tributaries to the lake. It has the smallest distribution of any listed Pacific salmon.

While Lake Ozette, itself, is part of Olympic National Park, its tributaries extend outside park boundaries, much of which is private land. There is limited agriculture in the whole of Clallam County, and most of this is well away from the Ozette watershed.

Table 53: Clallum County where there is habitat for the Ozette Lake sockeye salmon ESU.

State	County	Site	Acres Treated	lbs a.i. Applied
WA	Clallum	Mint	666	1332

The Ozette Lake Sockeye Salmon ESU is located in a remote area of the most northwest county in Washington. There is minimal agriculture and most is located close to the large towns (i.e. Port Angeles). Ozette Lake is protected and located in a largely undeveloped area where tourism is a major industry. I anticipate no effects from acephate in this ESU.

2. Snake River Sockeye Salmon ESU

The Snake River sockeye salmon was the first salmon ESU in the Pacific Northwest to be listed. It was proposed and listed in 1991 (56FR14055-14066, April 5, 1991 & 56FR58619-58624, November 20, 1991). Critical habitat was proposed in 1992 (57FR57051-57056, December 2, 1992) and designated a year later (58FR68543-68554, December 28, 1993) to include river reaches of the mainstem Columbia River, Snake River, and Salmon River from its confluence with the outlet of Stanley Lake down stream, along with Alturas Lake Creek, Valley Creek, and Stanley, Redfish, Yellow Belly, Pettit, and Alturas lakes (including their inlet and outlet creeks).

Spawning and rearing habitats are considered to be all of the above-named lakes and creeks, even though at the time of the Critical Habitat Notice, spawning only still occurred in Redfish Lake. These habitats are in Custer and Blaine counties in Idaho. However, the habitat area for the salmon is at high elevation, above the agriculture zone, and in protected areas of a National Wilderness area and National Forest. Acephate cannot be used on such a site, and therefore there will be no exposure in the spawning and rearing habitat. There is a probability that this salmon ESU could be exposed to acephate in the lower and larger river reaches during its juvenile or adult migration.

Table 54 shows the limited acreage of crops in Idaho counties where this ESU reproduces. All of this crop production is away from and at a much lower elevation than the spawning and rearing habitat. The critical spawning zones demonstrate, at the maximum allowable application levels, the potential for 2,050 lbs of acephate, distributed over 23,600 A of cultivated land and a much larger area including non-agricultural properties

Table 55 shows the acreage of crops where Acephate can be used in Oregon and Washington counties along the migratory corridor for this ESU.

Table 54. Idaho counties where there is spawning and rearing habitat for the Snake River sockeye salmon ESU.

State	County	Site	Acres Treated	lbs a.i. Applied
ID	Blaine			None
ID	Custer			None

Table 55. Oregon and Washington counties that are in the migratory corridors for the Snake River sockeye salmon ESU.

State	County	Site	Acres Treated	lbs a.i. Applied
ID	Idaho	Beans, Dry	76	152
ID	Lemhi			None
ID	Nez Perce	Beans, Dry	228	456
OR	Clatsop	Cauliflower	12	12
OR	Clatsop	Lettuce	40	80
OR	Columbia	Nursery, Outdrs	22	17

OR	Gilliam			None
OR	Hood River	Cranberries	16	16
OR	Hood River	Nursery, Outdrs	2	2
OR	Morrow	Beans, Dry	11	22
OR	Multnomah	Peppers, Hot	1	2
OR	Multnomah	Peppers Sweet	7	14
OR	Multnomah	Nursery, Outdrs	253	190
OR	Multnomah	Beans, Snap	1	2
OR	Multnomah	Cauliflower	1	1
OR	Sherman	Sweet Pepper	7	14
OR	Umatilla	Mint	1305	2610
OR	Umatilla	Beans, Snap	1	2
OR	Umatilla	Lettuce	5	10
OR	Wallowa	Beans, Snap	1	2
OR	Wasco	Lettuce	5	10
WA	Asotin			None
WA	Benton	Nursery	456	342
WA	Benton	Beans, Snap	111	222
WA	Clark	Beans, Snap	1	2
WA	Columbia			None
WA	Franklin	Beans, Snap	41	82
WA	Franklin	Mint	168	336
WA	Franklin	Beans, Dried	107	214
WA	Franklin	Peppers, Hot	20	40
WA	Franklin	Peppers, Sweet	211	422
WA	Garfield			None
WA	Klickitat	Sweet Peppers	1	2
WA	Walla Walla	Lettuce	382	764
WA	Walla Walla	Nursery, Outdrs	332	249
WA	Pacific	Cranberries	669	669
WA	Skamania			None

WA	Whitman	Beans, Dry	64	128

Although the migratory passages of the Snake River Sockeye Salmon ESU include many areas of significant agricultural use, the T&E species are more likely to be in larger, downstream rivers and tributaries, where the dilution effects on acephate are likely to be maximized. The important spawning and rearing areas are at a higher elevation than the agricultural sites, and therefore will not be be exposed to the pesticide. It should also be noted that the principal spawning area (Redfish Lake) is located on controlled parklands and not within an area of commercial agriculture. Because the spawning and rearing area is well protected and the migratory corridors are in large, fast moving rivers, I conclude acephate will have no effect on this ESU.

5. Specific Conclusions for Pacific Salmon and Steelhead

The evaluation of acephate by EFED indicated that there were no exceedences of the LOC's for the T&E fish species examined for this report. In only a single instance was the LOC for endangered species exceeded for aquatic invertebrates (cotton). This latter observation suggest some potential for indirect effects on the fish species through a partial loss of the food supply. The young salmon and steelhead do not, however, actively feed until movement from the redds is initiated, instead using stored yolk sac material. After active movement begins, it is likely that the dilution and degradation pattern of acephate will rapidly eliminate any potential threat to the macroinvertebrate food source. It was also previously noted that invertebrate populations rather rapidly return (~8 days) in experimental field studies.

In addition to being relatively low in toxicity, acephate degrades quickly and is highly soluble, suggesting that any contamination of the water used by endangered salmon and steelhead will quickly dissipate. Acephate use within the ESU's is also limited by the rather select list of registered uses and the exculsion of major crops within the area, such as wheat and barley, Particularly in the Pacific Northwest, these major crops occupy very large proportions of the land used for agriculture.

Based on these observations, the table below (Table 56) summarizes my conclusions for acephate in California and Northwest Steehead and Salmon ESU's:

Table 56: Summary of Conclsions for Acephate

Species	ESU	Finding
Chinook Salmon	Upper Columbia	No Effect
Chinook Salmon	Snake River spring/summer run	No Effect
Chinook Salmon	Snake River fall run	No Effect
Chinook Salmon	Upper Willamette	No Effect
Chinook Salmon	Lower Columbia	No Effect
Chinook Salmon	Puget Sound	No Effect
Chinook Salmon	California Coastal	No Effect
Chinook Salmon	Central Valley spring run	No Effect

Chinook Salmon	Sacramento River winter run	No Effect
Coho Salmon	Oregon Coast	No Effect
Coho Salmon	Southern Oregon/Northern California	No Effect
Coho Salmon	Central California	No Effect
Chum Salmon	Hood Canal summer run	No Effect
Chum Salmon	Columbia River	No Effect
Sockeye Salmon	Ozette Lake	No Effect
Sockeye Salmon	Snake River	No Effect
Steelhead	Snake River Basin	No Effect
Steelhead	Upper Columbia River	No Effect
Steelhead	Middle Columbia River	No Effect
Steelhead	Lower Columbia River	No Effect
Steelhead	Upper Willamette River	No Effect
Steelhead	Northern California	No Effect
Steelhead	Central California Coast	No Effect
Steelhead	South-Central California Coast	No Effect
Steelhead	Souther California	No Effect
Steelhead	Central Valley California	No Effect

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Attachment 1
Reregistration Eligibility Decision for Acephate

Case No. 0042

Attachment 2
Environmental Fate and Effects Division
Chapter for Acephate RED

Case 0042

Attachment 3
EPA Quantitative Usage Analysis
Acephate

Attachment 4

Example Labels
Acephate