Chlorpyrifos
Analysis of Risks
to
Endangered and Threatened Salmon and Steelhead

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Summary

Chlorpyrifos is an organophosphorous insecticide, acaricide, and nematicide widely used in agriculture and formerly in residential areas. Primary agricultural uses are on corn and fruit trees. Most residential uses and some other non-agricultural uses were cancelled following a June, 2000 Memorandum of Agreement. Chlorpyrifos is very highly toxic to fish, and EPA's screening-level risk assessment noted concerns for direct, lethal effects on fish. The high toxicity to organisms that serve as food for threatened and endangered Pacific salmon and steelhead are also of significant concern in areas where there is considerable chlorpyrifos use. An endangered species risk assessment is developed for federally listed Pacific salmon and steelhead. This assessment applies the findings of the Office of Pesticide Program's Environmental Risk Assessment developed for non-target fish and wildlife as part of the reregistration process to determine the potential risks to the 26 listed threatened and endangered Evolutionarily Significant Units (ESUs) of Pacific salmon and steelhead, plus one proposed ESU (Central Valley Fall/Late Fall-Run Chinook Salmon). An assessment based on ESU habitat and chlorpyrifos use (or potential use) within each county concluded that the use of chlorpyrifos may affect 19 of these ESUs, is not likely to adversely affect 6 ESUs, and will have no effect on two ESUs.

Introduction

This analysis was prepared by the U.S. Environmental Protection Agency (EPA) Office of Pesticides (OPP) to evaluate the risks of chlorpyrifos to threatened and endangered Pacific salmon and steelhead. The format of this analysis is the same as for previous analyses. The background section explaining the risk assessment process is the same as was presented in a previous assessment for diazinon. As before, we have used the general aquatic risk assessment from the "Reregistration Eligibility Science Chapter For Chlorpyrifos Fate and Environmental Risk Assessment Chapter" of June 8, 2000, developed by the Environmental Fate and Effects Division of OPP (EFED ERA) and the September 28, 2001 Interim Reregistration Eligibility Decision (IRED) as the starting basis.

Dow AgroSciences, the original and still a primary registrant of chlorpyrifos, provided OPP with significant information which OPP considered in preparing this analysis. This included extractions from the EFED ERA and IRED, discussions of particular areas such as endocrine disruption and olfaction, a re-analysis of counties and specific areas within the various salmon and steelhead ESUs, and compilation of usage in California and potential acreage in Oregon, Washington, and Idaho. We have used their compiled factual information (e.g., crop acreage, citations of toxicity from the RED science chapter) often without specific attribution, and we have augmented this factual information with other relevant information obtained by OPP directly from the sources. Where we have considered their discussions, analyses, and risk conclusions, we have specifically attributed these to them, and have not necessarily agreed with their points. Any conclusions in OPP's analysis are OPP's conclusions, whether consistent or inconsistent with those reached by Dow AgroSciences. Their entire analysis will be transmitted as ancillary information.

Problem Formulation - The purpose of this analysis is to determine whether the registration of chlorpyrifos as an insecticide for use on various crops may affect threatened and endangered (T&E or listed) Pacific anadromous salmon and steelhead and their designated critical habitat.

Scope - This analysis is specific to listed western salmon and steelhead and the watersheds in which they occur. It is acknowledged that chlorpyrifos 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.

Contents

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 the 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. 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.

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, 1991). 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 fish and aquatic invertebrates

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	>0.5	May be indirect effects on T&E fish through food supply reduction
Aquatic plant acute EC50	>0.5	May be indirect effects on aquatic vegetative cover for T&E fish

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 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.

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. It would appear that the Scholz et al (2000) work contradicts the 6x hypothesis. 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 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 sublethal effects until there are additional data.

2. Description of chlorpyrifos

a. Registered uses

Chlorpyrifos is an organophosphate insecticide, acaricide and miticide used to control a variety of insects, first registered in 1965 for control of foliage and soil-borne insect pests on a variety of food and feed crops. Chlorpyrifos is one of the most widely used organophosphate insecticides in the U.S. and, until 2000 when nearly all residential uses were cancelled, was one of the major insecticides used in residential settings. Currently registered uses include food and feed crops, golf courses, nursery and greenhouse use, non-structural wood treatments such as utility poles and fence posts, and as an adult mosquitocide. Structural treatments for termites are also currently registered, but are being phased out. All use of products for structural termite control will be prohibited after December 31, 2005, unless acceptable data demonstrate that risks from these exposures are not of concern. Remaining indoor non-residential uses include shipholds, railroad boxcars, industrial and manufacturing plants, typically for ant and roach control.

At present, there are 312 chlorpyrifos registrations, including 83 "Special Local Needs" (state) registrations. Forty of the Special Local Needs registrations are for California, Idaho, Oregon, and Washington. There are six registrants that produce "manufacturing use products" to be formulated into "end use products" and a large number of registrants that then make the end use products. Registrants producing chlorpyrifos have end use products that tend to emphasize agricultural uses. Many of the end use product registrations by smaller registrants are for golf courses, residential containerized ant baits, industrial plants, and termiticide uses.

Only a few products contain other active ingredients. The vast majority and all agricultural use products contain only chlorpyrifos. Most commonly, chlorpyrifos is formulated with pyrethroids for indoor uses in plants, warehouses, and ships, etc. One mosquito adulticide product also contains permethrin. Several of the granular golf course and road median turf products appear to be primarily fertilizers but also contain chlorpyrifos and herbicides such as trifluralin and benfluralin. One product has dichlorvos and may be used on ornamentals in road medians, golf courses, and industrial plant surfaces. One product for indoor greenhouse use contains cyfluthrin. A wood preservative for "finished" wood has an anti-mildew agent. Cattle ear tags impregnated with chlorpyrifos may also be impregnated with diazinon, cypermethrin, or permethrin.

(1) Agricultural uses

Chlorpyrifos currently has a number of uses on a wide variety of crops, although there is a potential for some of these to be cancelled as part of the reregistration process. Those crops currently under consideration for continued use and which are grown in areas with Pacific salmon and steelhead include alfalfa, almonds, apples, asparagus, broccoli, cabbage, carrots (grown for seed only), cauliflower, cherries, citrus, corn, cotton, cranberries, figs, filberts, grapes, grass seed, mint, nectarines, onions, pears, peaches, pecans, plums & prunes, radishes, snap beans (seed treatment), sorghum, strawberries, sugarbeets, sunflowers, sweet potatoes, turnips, other vegetables, walnuts, wheat, pulp wood, and Christmas trees (nurseries and plantations).

(2) Non-agricultural uses

Chlorpyrifos was formerly registered for many indoor and outdoor uses in and around residential areas. Nearly all of these were cancelled in a June 2000 Memorandum of Agreement. The only remaining residential use by homeowners is the use of containerized baits for control of roaches and ants; indoor uses will also be continued in ship holds, railroad boxcars, industrial plants, manufacturing plants, or food processing plants. The containerized bait and indoor uses will not result in entry of chlorpyrifos into surface waters.

Outdoor non-agricultural use of chlorpyrifos is also continued (or at least is not cited for cancellation in the Memorandum of Agreement) for adult mosquito control, including in residential areas, fire ant control, golf courses, pulpwood (cottonwood/poplar) production, nursery and greenhouse uses, animal premises, cattle ear tags, sod farms, industrial plant sites, road median strips, and non-structural wood treatments such as utility poles and fence posts.

b. Chlorpyrifos usage

According to OPP's Quantitative Use Assessment (QUA) and based on available pesticide survey usage information for the years of 1987 through 1998, an annual estimate of chlorpyrifos' total domestic usage is approximately 20,960,000 pounds active ingredient (a.i.) for 8,027,000 acres treated. Most of the acreage is treated with 2.3 pounds a.i. or less per application and 3.9 pounds a.i. or less per year. Maximum rates can be much greater, although they are not likely to be used unless there is high pest pressure. Chlorpyrifos is an insecticide with its largest agricultural market in terms of total pounds a.i. allocated to corn (26%). No other crop is treated with more than 3% of the total pounds of chlorpyrifos applied. The largest non-agricultural markets in terms of total pounds of a.i. applied are termite control (24%) and turf (12%). As a result of the June 7, 2000 Memorandum of Agreement, which eliminated residential uses and intends to phase out the termite uses (assuming additional data to support the use are not provided), approximately 10 million pounds of chlorpyrifos (approximately 50% of the total) have been or will be phased out of the market place. Crops with a high percentage of their total U.S. planted acres treated include brussels sprouts (73%), cranberries (46%), apples (44%), broccoli (41%), and cauliflower (31%).

3. General aquatic risk assessment for endangered and threatened salmon and steelhead

a. Aquatic toxicity of chlorpyrifos

There is a large amount of aquatic toxicity data on chlorpyrifos. The quality of these data is highly variable. OPP has rigorous validation requirements for data used in assessments, and these data (Tables 3 and 4, and Table 6 through Table 9) are used in preference to other data. Compilations of chlorpyrifos toxicity data are also available in EPA's AQUIRE database, and in the review by Barron and Woodburn (1995). The following summary is based largely on the EFED ERA for chlorpyrifos.

At present, aquatic risk assessments are limited to exposure to dissolved concentrations in water. Quantitative methods are unavailable to assess risks for aquatic dietary exposures (i.e., consumption of aquatic organisms by predator fish). In general, uptake of chemicals from the water through the gills is rapid and is considered the primary route by which pesticides enter the body of either fish or aquatic invertebrates. Extensive acute toxicity data are available on technical grade chlorpyrifos for both freshwater and estuarine aquatic organisms. Some acute studies show effects of varying environmental parameters such as different temperatures, pHs, water hardness, and salinity on toxicity. Acute toxicity data are also available for formulated products and the major degradate.

(1) Acute toxicity to freshwater fish

Table 3 presents the acute toxicity data for fish that have been reviewed in OPP's files. Acceptable and supplemental acute 96-hour toxicity tests indicate that technical chlorpyrifos is very highly toxic to both coldwater and warmwater fish species. Acute LC50 values are available for 9 freshwater fish species for technical chlorpyrifos and range from 1.8 ppb for bluegill sunfish to 595 ppb for mosquitofish. A number of studies with technical chlorpyrifos were tested to determine the effect on toxicity of various environmental parameters, such as temperature, pH, water hardness, fish size, and static versus flow-through exposures. These were part of a larger effort with a number of chemicals to determine appropriate testing methodology in the development of standardized testing protocols. In general, acute toxicity of chlorpyrifos was found to increase as test temperature and pH levels increase. Results were not definitive for water hardness, fish size, and static and flow-through tests. Three fish species collected from clean waters appear to be more sensitive to chlorpyrifos than fish collected from a polluted area. Acclimation to cholinesterase inhibition is a known phenomenon seen in the review of avian reproduction tests with bobwhite that have been reviewed by OPP and is therefore not unexpected in fish.

We looked also at literature data. Barron and Woodburn (1995) summarized fish acute toxicity data extensively, and we also looked at the AQUIRE data base. We did not look at all of the original reports, and we have not ascertained the validity of all of these data. We do believe, however, that the data in Table 3, which come from tests conducted under Good Laboratory Practices (GLPs) and which have been stringently validated, are the best available data for risk assessment purposes. In summary of the data in Table 3 for freshwater fish, Table 5 for estuarine fish, and the additional AQUIRE data, tests have been done for over 40 species of domestic and foreign, saltwater and freshwater fish; the AQUIRE data are comparable to the values listed in Table 3. For formulated products, the range of LC50 values was 0.8 ppb to 2200 ppb, with most values being in the range of 4.5-50 ppb. For tests with the active ingredient, the range of LC50 values is 1.3 ppb to >2000 ppb, with the majority of test results being between 3 ppb and 45 ppb.

Existing toxicity data on the formulated products are not particularly useful because the tested products are not currently registered except for the ME20 formulation. The ME20 formulation is a "micro-encapsulated" form intended to be released slowly over time, which is the most likely explanation for the relative lack of toxicity indicated in Table 3 for bluegill and rainbow trout. There are no fish test data available on the 4E formulation, an emulsifiable concentrate which is very widely used in agriculture; several registrants market a 4E formulation.

Table 3. Aquatic organisms: acute toxicity of chlorpyrifos to freshwater fish (from EFED ERA).

Species	Scientific name	% a.i.	96-hour LC50 (ppb)	Toxicity Category	Guide-eline [a]
Bluegill sunfish	*Lepomis macrochirus*	Tech.	3.3	very highly toxic	Y
Bluegill sunfish	*Lepomis macrochirus*	97.0%	1.8; 2.4	very highly toxic	Y
Bluegill sunfish	*Lepomis macrochirus*	95.9%	5.8	very highly toxic	Y

Species	Scientific name	% a.i.	96-hour LC50 (ppb)	Toxicity Category	Guide-eline[a]
Bluegill sunfish	*Lepomis macrochirus*	61.5% Durban 6	0.8	very highly toxic	Y
Bluegill sunfish	*Lepomis macrochirus*	25% Durban 25W	9.5	very highly toxic	Y
Bluegill sunfish	*Lepomis macrochirus*	25% Durban 25W	17.3	very highly toxic	Y
Bluegill sunfish	*Lepomis macrochirus*	26.5% Durban ME20	768	moderately toxic	S
Bluegill sunfish (18ºC)	*Lepomis macrochirus*	97.0%	2.4 (pH 7.1, 44 mg/L hardness) 1.8 (pH 7.4, 272 mg/L hardness)	very highly toxic	S
Bluegill sunfish (pH 7.4, 272 mg/L)	*Lepomis macrochirus*	97.0%	4.2 (13ºC) 1.8 (18ºC) 2.5 (24ºC) 1.7 (29ºC)	very highly toxic	S
Channel catfish	*Ictalurus punctatus*	Tech.	13.4	very highly toxic	Y
Channel catfish	*Ictalurus punctatus*	97.0%	280	highly toxic	Y
Cutthroat trout	*Salmo clarki*	97.0%	13.4; 18.4; 26.0	very highly toxic	Y
Cutthroat trout (10ºC, 44 mg/L)	*Salmo clarki*	97.0%	18.4 (pH 7.5) 5.4 (pH 9.0)	very highly toxic	S
Cutthroat trout (10ºC, pH 7.4-7.5)	*Salmo clarki*	97.0%	18.4 (44 mg/L hardness) 26.0 (162 mg/L hardness)	very highly toxic	S
Fathead minnow	*Pimephales promelas*	99.9%	203	highly toxic	Y
Fathead minnow	*Pimephales promelas*	10% Durban 10CR	122.2	highly toxic	Y
Fathead minnow	*Pimephales promelas*	Tech.	140	highly toxic	S
Fathead minnow	*Pimephales promelas*	Tech	150; 170	highly toxic	S
Fathead minnow	*Pimephales promelas*	10% Durban 10CR	122.2 (77-167.4)	highly toxic	S
Fathead minnow	*Pimephales promelas*	10% Durban 10CR	120	highly toxic	S
Golden shiner	*Notemigonus crysoleucas*	99%	35; 45; 125 (36 h)	very highly toxic	S
Green sunfish	*Lepomis cyanellus*	99%	22.5; 37.5; 125 (36 h)	very highly toxic	S
Lake trout	*Salvelinus namaycush*	97.0%	98	very highly toxic	Y
Lake trout	*Salvelinus namaycush*	97.0%	244	highly toxic	Y
Lake trout	*Salvelinus namaycush*	97.0%	73 (static) 244 (flow)	very highly toxic	S
Lake trout	*Salvelinus namaycush*	97.0%	227 (0.30 g fish) 73 (2.9 g fish)	very highly toxic	S
Lake trout (12ºC, 44 mg/L)	*Salvelinus namaycush*	97.0%	140 (pH 6.0) 98 (pH 7.5) 205 (pH 9.0)	very highly toxic	S
Mosquitofish	*Gambusia affinis*	99%	215; 320; 595 (36 h)	highly toxic	S
Rainbow trout	*Oncorhynchus mykiss*	Tech.	3	very highly toxic	Y
Rainbow trout	*Oncorhynchus mykiss*	99.9%	8.0	very highly toxic	Y
Rainbow trout	*Oncorhynchus mykiss*	97.0%	7.1	very highly toxic	Y
Rainbow trout	*Oncorhynchus mykiss*	95.9%	25	very highly toxic	Y
Rainbow trout	*Oncorhynchus mykiss*	61.5% Durban 6	< 8.3	very highly toxic	Y
Rainbow trout	*Oncorhynchus mykiss*	26.5% Durban ME20	2,200	moderately toxic	S

Species	Scientific name	% a.i.	96-hour LC50 (ppb)	Toxicity Category	Guide-eline[a]
Rainbow trout (pH 7.1, 44 mg/L)	*Oncorhynchus mykiss*	97.0%	51 (2ºC) 15 (7ºC) 7.1 (13ºC) <1 (18ºC)	very highly toxic	S

[a] Y = fulfills guideline requirements; S = supplemental

(2) Acute toxicity to freshwater invertebrates

Results from acute studies with freshwater invertebrates (Table 4) indicate that technical grade chlorpyrifos is very highly toxic to several freshwater invertebrates including adult life stages. Acute LC50 values are available on 4 freshwater invertebrate species for technical chlorpyrifos and range from 0.1 ppb for *Daphnia magna* to 50 ppb for the stonefly larvae *Pteronarcys californica*. Adults are usually less sensitive to pesticides than young life stages. *Ceriodaphnia dubia* is used as test species in biomonitoring studies to assess toxicity, because it is very sensitive to chemicals. According to the EFED ERA, some reports which could not be located, suggest that the acute chlorpyrifos toxicity values for *Ceriodaphnia dubia* are about 0.005 to 0.08 ppb which would make it the most sensitive freshwater species. We located information indicating an EC50 of 0.06 ppb for this species (Bailey et al., 1996) but could not find data confirming the numbers indicated in the EFED chapter. Bailey et al., (1996) also found that the addition of piperonyl butoxide ameliorated the toxicity of chlorpyrifos.

Invertebrates serve as a food source for juvenile salmon and steelhead. Comparative toxicology of various invertebrate species is important because a reduction in a single species may not be relevant unless it is an abundant and key food source., whereas reductions in many species or key species may be very relevant. Again, we looked at certain literature such as Barron and Woodburn (1995) and the AQUIRE data base. Because of the extensive amount of data available, we have summarized the reported test endpoints by taxa in Table 5. In summary, the aquatic arthropods that are important food sources have generally comparable sensitivity. Amphipods and daphnids are the most sensitive taxa. Insects are slightly less sensitive for tests with the lowest endpoints, although the data indicate that within many insect orders considerable variability exists. Molluscs are quite a bit less sensitive. As with fish, we believe that the data developed under GLPs and validated by OPP, as presented in Table 4, represent the best available data for making a risk assessment.

Table 4. Aquatic organisms: acute toxicity of chlorpyrifos to freshwater invertebrates (from EFED ERA).

Species	Scientific name	% a.i.	96-hour LC50 (ppb)	Toxicity Category	Guide-line[a]
Scud	*Gammarus lacustris*	97.0%	0.11	very highly toxic	S
Stonefly	*Classenia sabulosa*	97.0%	8.2	very highly toxic	S
Stonefly	*Pteronarcys californica*	97.0%	10	very highly toxic	S
Water flea	*Daphnia magna*	97.7%	1.7 (48 h)	very highly toxic	Y
Water flea	*Daphnia magna*	95.9%	0.10 (48 h)	very highly toxic	Y

Water flea	*Daphnia magna*	25.6% Dursban ME20	115 (48 h)	highly toxic	S

[a] Y = fulfills guideline requirements; S = supplemental

Table 5. Invertebrate acute toxicity, from AQUIRE data base

Taxon	number of data points	range of results (median values, i.e., LC50 or EC50) all values in ppb	formulation or active ingredient
		Insects	
mayflies	4	0.3-29	F
mayflies	1	0.25	A
midges	28	0.6-130	F
midges	6	0.3-600	A
mosquitoes	64	0.16-23.6 (one outlier at 4100)	F
mosquitoes	26	0.2-8.93	A
resistant mosquitoes	7	620,000-11,700,000	A
other dipterans	1	27	F
stoneflies	2	0.57-10	A
stoneflies	1	0.38	F
caddisflies	2	0.77-30	F
odonata	1	11.4	F
hemipterans	4	1.22-35.2	F
hemipterans	2	1.94-15	A
coleopterans	3	0.8-100	F
coleopterans	8	6-52	A
		Other arthropods	
daphnids	13	0.11- 6.4	F
daphnids	27	0.053-4.9 (one outlier at 344)	A
amphipods	11	0.07-0.39	F
amphipods	3	0.1-0.32	A
isopods	1	2.7	F
copepod	1	0.94	F
brine shrimp	19	30->18,000	F

brine shrimp	3	1700-2000	A
other shrimp	12	0.039-4.8	F
other shrimp	7	0.37-2.4	A
crayfish	3	37672	F
crabs	4	200-600	F
crabs	1	5.2	A
Other invertebrates			
snails	3	>94 - 3000	F
oyster	1	270	F
mussels (SW)	2	4900-22,500	F
oligochaetes	1	>36	F
flatworms	1	2000-4300	F
nematodes	3	0.9-1.6	F
rotifers	1	reproduction 360	F
rotifers	5	10670-12000	F
rotifers	3	1400-1900	A

(3) Chronic toxicity to freshwater fish and invertebrates
The chronic toxicity data cited in the EFED ERA for chlorpyrifos are summarized in Table 6. For fathead minnows, effects on growth of both the parental generation and offspring were noted at the lowest tested concentration, 0.12 ppb. Survival of both generations was affected at 1.09 ppb in a full life-cycle study. Reduced fathead minnow growth and survival, and increased occurrence of spinal deformity, were observed in early life stages at concentrations from 2.1 to 4.8 ppb. *Daphnia magna* were more sensitive than fathead minnows, with effects on survival and reproduction reported at 0.08 ppb. Consistent with OPP practice, we have used the lowest no-observed-effect-concentration (NOEC) from tests on the active ingredient in the assessment of chronic risk. The fish NOEC is 0.57 ppb for the fathead minnow and the aquatic invertebrate NOEC is 0.04 ppb for *Daphnia magna*.

The EFED ERA attempts to ascertain the chronic toxicity level to bluegill, the most sensitive fish species in the acute test, by making comparisons with effect levels in the acute and chronic tests for fathead minnow. I have used a more recent, validated "acute-chronic estimator" (Mayer et al., 2002) to estimate the chronic toxicity to bluegill. This method, based upon time-to-effects at various concentrations, applies to chronic effects related to growth and survival, but cannot be used to estimate reliably the effect levels on the physiological reproductive system. Initially, the technique estimates a mortality endpoint for a chronic exposure, but this is modified by an adjustment made to account for the differences between mortality and growth (Mayer et al., 1986). Because the fathead minnow chronic endpoints relate to survival and growth, our use here is considered a valid use of the method. The least square regression resulted in a chronic survival NOEC of 0.32 ppb, which was then adjusted by 0.4x to yield a chronic NOEC for the endpoint of growth of 0.08 ppb. Although the baseline data are not robust for estimating a reproduction endpoint from the chronic survival NOEC, a 0.1x adjustment is considered conservative. Therefore, we estimate the bluegill reproduction NOEC to be 0.032 ppb. All estimates here were developed by Dr. Foster Mayer of EPA's Office of Research and Development Gulf Ecology Division (Mayer, personal communication, 3/18/2002).

Although the acute-chronic estimation is considered scientifically valid, the approach has not yet been accepted by EFED because the preference is to use actual test data, which is generally available for pesticides. Therefore, this analysis uses the fathead minnow NOEC of 0.57 ppb for the risk assessment.

Table 6. Aquatic organisms: chronic toxicity of chlorpyrifos to freshwater fish and invertebrates (from EFED ERA).

Species	Scientific name	Duration	% a.i.	Endpoints affected	NOEC (ppb)	LOEC (ppb)
Fathead minnow	*Pimephales promelas*	32 d	98.7%	body wt.	1.6	3.2
Fathead minnow	*Pimephales promelas*	30 d	10% Dursban 10CR	spinal deformity	1.29	2.1
Fathead minnow	*Pimephales promelas*	32 d	10% Dursban 10CR	survival, body wt.	2.2	4.8
Fathead minnow	*Pimephales promelas*	full life-cycle	99.7%	F_0, F_1 survival	0.57	1.09
Fathead minnow	*Pimephales promelas*	full life-cycle	10% Dursban 10CR	F_0 wt., F_1 biomass	<0.12	0.12
Water flea	*Daphnia magna*	21 d	97.1%	F_0 survival, # offspring	0.04	0.08

(4) Acute toxicity to estuarine and marine fish

Acute results indicate that technical grade chlorpyrifos is moderately to very highly toxic to estuarine and marine fish species (Table 7). Acute LC50 values are available for 11 estuarine fish species and range from 0.96 to > 1,000 ppb. Results from flow-through tests with measured test concentrations yielded more toxic values than static, nominal tests. In general, younger life stages are more sensitive than older stages. Several estuarine fish species are more sensitive to chlorpyrifos than bluegill, the most sensitive freshwater species.

Table 7. Aquatic organisms: acute toxicity of chlorpyrifos to estuarine and marine fish (from EFED ERA).

Species	Scientific name	% a.i.	96-hour LC50 (ppb)	Toxicity Category	Guide-line[a]
Tidewater silversides (1 d old)	*Menidia peninsulae*	92%	0.96 (flow) 4.2 (static)	very highly toxic	S
Tidewater silversides (7 d old)	*Menidia peninsulae*	92%	0.52 (flow) 2.0 (static)	very highly toxic	Y
Tidewater silversides (14 d old)	*Menidia peninsulae*	92%	0.42 (flow) 1.8 (static)	very highly toxic	Y
Tidewater silversides (28 d old)	*Menidia peninsulae*	92%	0.89 (flow) 3.9 (static)	very highly toxic	Y
Tidewater silversides (60 d old)	*Menidia peninsulae*	92%	1.3 (flow)	very highly toxic	Y
Atlantic silversides (1 d old)	*Menidia menidia*	92%	0.51 (flow) 4.5 (static)	very highly toxic	S
Atlantic silverside (7 d old)	*Menidia menidia*	92%	1.0 (flow) 2.8 (static)	very highly toxic	Y
Atlantic silverside (14 d old)	*Menidia menidia*	92%	1.1 (flow) 2.4 (static)	very highly toxic	Y
Atlantic silverside (28 d old)	*Menidia menidia*	92%	3.0 (flow) 4.1 (static)	very highly toxic	Y
Atlantic silverside (53 d old)	*Menidia menidia*	92%	1.7 (static)	very highly toxic	Y
Atlantic silverside (adult)	*Menidia menidia*	92%	1.7 (flow)	very highly toxic	S
California grunion (1 d old)	*Leuresthes tenuis*	92%	1.0 (flow) 5.5 (static)	very highly toxic	S
California grunion (7 d old)	*Leuresthes tenuis*	92%	2.7 (flow) 2.7 (static)	very highly toxic	Y
California grunion (14 d old)	*Leuresthes tenuis*	92%	1.0 (flow) 1.8 (static)	very highly toxic	Y
California grunion (28 d old)	*Leuresthes tenuis*	92%	1.3 (flow) 2.6 (static)	very highly toxic	Y
Inland silverside	*Menidia beryllina*	92%	4.2 (flow)	very highly toxic	Y
Gulf killifish	*Fundulus grandis*	92%	1.8 (flow)	very highly toxic	Y
Longnose killifish	*Fundulus similis*	92%	3.2 (flow)	very highly toxic	Y
Longnose killifish	*Fundulus similis*	92%	4.1 (flow)	very highly toxic	S
Striped mullet	*Mugil cephalus*	92%	5.4 (flow)	very highly toxic	Y
Spot	*Leiostomus xanthurus*	92%	7.0 (flow) (48 h)	very highly toxic	S
Sheepshead minnow	*Cyprinodon variegatus*	92%	270 (flow)	highly toxic	Y
Gulf toadfish	*Opsanus beta*	92%	68 (flow) 520 (static)	very highly toxic	Y
Striped bass	*Morone saxatilis*	99%	0.58	very highly toxic	S

[a] Y = fulfills guideline requirements; S = supplemental

(5) Acute toxicity to estuarine and marine invertebrates

Acute toxicity tests with estuarine and marine invertebrates (Table 8) indicate that technical grade chlorpyrifos is classified as very highly toxic to shrimp and to oysters during shell deposition, and moderately toxic to larval oysters. Acute LC50 values are available for 6 estuarine invertebrate species and range from 0.035 for mysid shrimp to 2,000 ppb for oyster embryo-larvae.

Table 8. Aquatic organisms: acute toxicity of chlorpyrifos to estuarine and marine invertebrates (from EFED ERA).

Species	Scientific name	% a.i.	96-hour LC50 (ppb)	Toxicity Category	Guided-eline[a]
Mysid shrimp	*Americamysis bahia*	92%	0.035 (flow) 0.056 (static)	very highly toxic	Y
Mysid shrimp	*Americamysis bahia*	95%	0.045	very highly toxic	Y
Mysid shrimp	*Americamysis bahia*	92%	0.04	very highly toxic	S
Brown shrimp	*Penaeus aztecus*	92%	0.20 (48 h)	very highly toxic	S
Grass shrimp	*Palaemonetes pugio*	92%	1.5 (48 h)	very highly toxic	S
Pink shrimp	*Penaeus duorarum*	92%	2.4 (48 h)	very highly toxic	S
Eastern oyster (embryo-larvae)	*Crassostrea virginica*	92%	2000	moderately toxic	Y
Eastern oyster (shell deposition)	*Crassostrea virginica*	92%	34 (13ºC) 270 (28ºC)	very highly toxic	Y
Eastern oyster	*Crassostrea virginica*	95%	84	very highly toxic	S
Blue crab	*Callinectes sapidus*	92%	5.2 (48 h)	very highly toxic	S

[a] Y = fulfills guideline requirements; S = supplemental

(6) Chronic toxicity to estuarine and marine fish and invertebrates

Results of chronic toxicity tests with estuarine and marine fish are presented in Table 9. The toxicity results of the three fish early life studies on the three *Menidia* spp. are very similar. The NOECs for the three tests range from 0.28 to 0.75 ppb. The adverse effects were statistically ($P < 0.05$) significant reductions in survival and/or body weight. In the tidewater silversides Early Life Stage test, a reduction in fish survival of 42 percent at 0.38 ppb was not statistically ($P < 0.05$) significant. Results from the mysid shrimp life cycle study indicate chronic toxicity to chlorpyrifos at 0.0046 ppb (the lowest test level).

Table 9. Aquatic organisms: chronic toxicity of chlorpyrifos to estuarine and marine fish and invertebrates (from EFED ERA; all studies supplemental).

Species	Scientific name	Duration	% a.i.	Endpoints affected	NOEC (ppb)	LOEC (ppb)
Tidewater silversides	*Menidia peninsulae*	28 d	Tech.	survival	0.38	0.78
Atlantic silversides	*Menidia menidia*	28 d	Tech.	survival, body weight	0.28	0.48
Inland silversides	*Menidia beryllina*	28 d	Tech.	survival, body weight	0.75	1.8
Mysid shrimp	*Americamysis bahia*	full life-cycle	99.7%	number of young	<0.0046	0.0046

(7) Toxicity to aquatic plants and algae

There are very few data on aquatic plants or algae (Table 10). There are no data available on *Lemna gibba* or other aquatic vascular plants, the preferred taxon for assessing risks to aquatic macrophytes. Toxicity studies on three estuarine algal species yielded LC50 values ranging from 140 to 300 ppb. Direct applications of chlorpyrifos up to 240 ppb reduced the growth of several algal species which took from 9 to 17 days to recover. At direct application rates up to 1 lb ai/A in ponds 10 to 13 inches deep, an algal bloom of a blue-green algae *(Anabaena)* was observed. The authors assumed that dramatic reductions in herbivorous invertebrates caused the algal bloom.

Table 10. Aquatic organisms: acute toxicity of chlorpyrifos to algae (from EFED ERA).

Species	Scientific name	% a.i.	7-d EC50 (ppb)	Guideline[a]
Golden-brown alga	*Isochrysis galbana*	92%	140	S
Diatom	*Thalassiosira pseudonana*	92%	150 (120-180)	S
Diatom	*Skeletonema costatum*	92%	300 (270-340)	Y

[a] Y = fulfills guideline requirements; S= supplemental

(8) Microcosm and field enclosure studies

Outdoor pond microcosm and littoral enclosure studies with chlorpyrifos applied directly to water show effects on sensitive aquatic invertebrate populations after a single application as low as 0.3 ppb (Giddings, 1993). The results for treatments of 0.5 ppb and higher suggest adverse effects on young fish growth and possibly recruitment (Giddings 1993; Siefert et al. 1989). The EFED ERA cited a study by Shannon et al. (1989) as evidence for effects on invertebrates at 0.19 ppb, but this study was conducted in a highly artificial test system (laboratory flasks); the results cannot be considered indicative of responses of natural invertebrate populations or communities. Other microcosm and mesocosm studies with chlorpyrifos were reviewed by Giesy et al. (1999).

(9) Toxicity of degradates

The major degradate of chlorpyrifos, 3,5,6-trichloro-2-pyridinol (TCP), is moderately to slightly toxic to freshwater fish and invertebrate species (Table 11). The degradate is considerably less toxic to fish and invertebrates than is chlorpyrifos and is not considered contributory to risk.

Table 11. Aquatic organisms: acute toxicity of the chlorpyrifos degradate TCP to fish and aquatic invertebrates (from EFED ERA).

Species	Scientific name	% a.i.	96-hour LC50 (ppm)	Toxicity Category	Guideline[a]
Rainbow trout	*Oncorhynchus mykiss*	99.7%	1.5	moderately toxic	Y
Coho salmon	*Oncorhynchus kisutch*	99.7%	1.8	moderately toxic	S
Chum salmon	*Oncorhynchus keta*	99.7	1.8		
Chinook salmon	*Oncorhynchus tshawytscha*	99.7%	2.1	moderately toxic	S
Sockeye salmon	*Oncorhynchus nerka*	99.7%	2.5	moderately toxic	S
Pink salmon	*Oncorhynchus gorbuscha*	99.7%	2.7	moderately toxic	S
Bluegill sunfish	*Lepomis macrochirus*	99.9%	12.5	slightly toxic	Y
Rainbow trout	*Oncorhynchus mykiss*	99.9%	12.6	slightly toxic	Y
Atlantic silversides	*Menidia menidia*	99.9%	58.4	slightly toxic	Y
Waterflea	*Daphnia magna*	99.9%	10.4	slightly toxic	Y
Eastern oyster	*Crassostrea virginica*	99.9%	9.3	moderately toxic	Y
Grass shrimp	*Palaeomonetes pugio*	99.9%	83	slightly toxic	Y

[a] Y = fulfills guideline requirements; S = supplemental

(10) Toxicity of inerts

Attachment 2 lists the composition of Lorsban[1] 4E, 15G, and 75 WG formulations and acute toxicity information for each component, where available from tests or QSAR estimates. Additional information than is presented here is considered Confidential Business Information (CBI). CBI may not be made public by EPA, but can be made available to NMFS following CBI clearance.

The following information was provided by Dow AgroSciences (Giddings et al., 2003)

> "Four of the components of Lorsban 4E are more toxic to algae than is chlorpyrifos, but considering the low percent composition (0.006 to 1.5% w/w) this toxicity level is not considered relevant at expected environmental concentrations. Two of these components are also toxic to daphnids and three are toxic to fish, but less toxic than chlorpyrifos is. Although QSAR was not possible for the antifoaming agent mixture, it is not expected to be toxic because the molecular weight of its principal component is >> 1000. It also is present at a low percent composition (0.05% w/w).
>
> "No toxicity data are available for the Lorsban 15G carrier. However, this clay is a natural constituent of many mineral soils. The stabilizer in Lorsban 15G is much less toxic than the active ingredient.
>
> "Lorsban 75WG has three components without data and for which QSAR is not possible. However, based on chemical class these ingredients are not expected to be toxic. The second emulsifier and antimicrobial ingredient are much less toxic to fish than is chlorpyrifos."

Confidential statements of formulation have been reviewed for other products. Inert ingredients have been identified and available toxicity data have been obtained. The chlorpyrifos active ingredient is very highly toxic to fish and aquatic invertebrates. Some inert ingredients exhibit aquatic toxicity, but not to the extent of chlorpyrifos itself.

(11) Review of literature on sublethal and endocrine effects

Giddings et al., (2003) prepared discussions on each of these subjects. There are no reports of which we or they are aware on chlorpyrifos and the olfactory system. Laboratory studies have investigated other cholinesterase-inhibiting insecticides and atrazine and found effects on predator avoidance and reproductive priming, but we seriously question extrapolation to untested compounds. We believe that the discussion by Giddings et al., (2003) in their Attachment 3 has merit with respect to population impacts of pesticides on salmon. However, we disagree that population impacts are the primary issue with respect to pesticides and species listed under the Endangered Species Act. Consultations are unquestionably necessary to address olfactory impairment when it has been demonstrated, and it may be necessary to take action to promote the

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recovery of listed salmon and steelhead should the best available science so indicate. However, absent specific data, we do not believe that this applies to chlorpyrifos.

Giddings et al. (2003) also prepared a discussion of endocrine effects of pesticides in which they state:

> "Endocrine effects have been attributed to many existing pesticides found in surface water systems. However, in our review of the literature (Attachment 4) there is no evidence suggesting endocrine disruption occurs in salmonids or other aquatic organisms following exposure to acetylcholinesterase-inhibiting compounds such as OP insecticides."

OPP does not currently consider this to be an issue, at least certainly not with respect to chlorpyrifos. The ESA requires the use of best available science. It is our understanding that there is no science involved in speculating that one or another agent conceivably could be the cause of some effect. We note that EPA is in the process of developing a program to address potential endocrine disruption effects, although it probably should be more accurately termed reproductive and thyroid hormone effects because any stress will activate endocrine activities that can be considered a "disruption" of the resting state. Regardless of terminology, this program is intended to screen chemicals (not just pesticides) that may have adverse effects. Once the program is underway, data will be developed across an array of chemicals which will facilitate the understanding of mechanisms and the nature of compounds that activate those mechanisms. Whether through this program or other research, any scientifically valid information that relates to reproductive or other hormonal effects of pesticides will be taken seriously and the results incorporated into assessments for T&E species. We believe that this position has already been demonstrated in the olfactory area by our stance on diazinon expressed in previous analyses.

b. Environmental fate and transport

The environmental fate and transport of chlorpyrifos are presented in the EFED ERA. Pages 8-13 discuss more general aspects of dissipation and mobility in aquatic environments, while pages 19-25 present a surface water fate and exposure assessment, including the EECs used for risk assessment for various use sites. Pages 25-30 have information on monitoring of chlorpyrifos in the water, including both chemical analytical and bio-monitoring. The following is an abbreviated summary of these data.

The major route of dissipation appears to be aerobic and anaerobic metabolism. Hydrolysis, photodegradation, and volatilization play only a limited role in the dissipation process. Chlorpyrifos appears to degrade slowly in soil under both aerobic and anaerobic conditions; field data indicate a field half life of less than 60 days. It is largely immobile, with little or no leaching. The TCP degradate is mobile in soils, and also persistent when not exposed to light. Chlorpyrifos has the potential to bioaccumulate in fish and other aquatic organisms and enter the aquatic food web if exposure is continuous or frequent, but it rapidly depurates from fish when aquatic exposures cease.

Chlorpyrifos is moderately to highly persistent in the environment and binds to soil. Chlorpyrifos can contaminate surface water at application via spray drift and can be transported offsite to water. Based on the partioning coefficients, most chlorpyrifos runoff will occur via adsorption to eroding soil rather than by dissolution in runoff water. However, when runoff volume greatly exceeds sediment yield, dissolution in runoff water may also contribute significantly to runoff. Quantities of chlorpyrifos transported are generally less than 1% of the amount applied, but the quantities transported of the TCP degradate may be greater. Substantial fractions of applied chlorpyrifos could be available for runoff for several weeks to months post-application.

Chlorpyrifos is relatively stable to hydrolysis at acid and neutral pHs, but has a half life of 16 days at pH 9. The hydrolytic stability in combination with the aqueous photolysis half-life of 30 days, low volatilization, and degradation under aerobic conditions indicate that chlorpyrifos will be somewhat persistent in the water columns of some aqueous systems that have relatively long hydrological residence times. However, volatilization and/or adsorption to sediment may substantially reduce the persistence of dissolved chlorpyrifos in shallow waters and in waters receiving influxes of uncontaminated sediment, respectively. Racke (1993). attributed short dissipation half-lives in the water column (sometimes < 1 day) to volatilization and/or adsorption to sediment. The relatively low to moderate susceptibility of chlorpyrifos to degradation under anaerobic conditions indicates that it will also be somewhat persistent in anaerobic bottom sediment.

The intermediate to high soil/water partitioning of chlorpyrifos indicates that its concentration in sediment will be much greater than its concentration in water. The whole body BCFs were 2727X in rainbow trout exposed to 0.30 ppb in a 28-day flow-through study and 1900X in eastern oysters, indicating moderate potential for bioaccumulation. Although the observed rapid depuration rates should somewhat modify its bioaccumulation potential, chlorpyrifos has been detected at several ppb in the tissues of many fish collected from many different surface waters.

As part of the National Study of Chemical Residues in Fish (US EPA 1992), 23% of the fish from 362 sites nationwide had chlorpyrifos residues above the detection limit of approximately 0.05 µg/kg. The maximum value was 344 µg/kg in carp tissue collected from the Alamo River in Imperial County, CA. Concentrations between 60 and 70 µg/kg were detected in fish collected from GA, TX, WI, and CA. The 90th percentile value was slightly greater than 10 µg/kg. Since chlorpyrifos was found to rapidly depurate in the fish BCF test, the presence of chlorpyrifos residues in fish would suggest existing or recent exposures.

The major degradate of chlorpyrifos, TCP, appears to be more persistent than chlorpyrifos. The much lower soil/water partitioning indicate that substantial amounts of TCP may be available for runoff for longer periods than chlorpyrifos, would be mostly as dissolved material in runoff water, and that TCP is probably more persistent in water/sediment systems than chlorpyrifos. Concentrations are likely to be comparable in sediment and water. The low soil/water partitioning of TCP suggests that its bioaccumulation potential is probably low. The considerably lower aquatic toxicity of TCP than chlorpyrifos indicates that the persistence of TCP should not contribute to risk.

c. Incidents

A number of fish kills have been reported for chlorpyrifos. Most incidents are related to termite treatments around buildings, often when significant rainfall occurred before treatment could be completed. The termite uses are scheduled to be phased out in 2005 unless additional data are provided to demonstrate the efficacy of a 0.5% treatment for termites (US EPA, 2000). However, fish kills were also observed adjacent to chlorpyrifos-treated areas during terrestrial field studies on citrus in California and a golf course in Florida. Reported fish kills, along with fish and aquatic invertebrate mortality observed in field studies, are presented in detail on pages 77-82, and 89-92 of the EFED ERA. We note that many of the studies and situations involving aquatic species relate to aquatic uses of chlorpyrifos as a mosquito larvicide or rice pesticide, which are no longer registered uses. However, there are a few incidents that appear to be agriculturally related. Information is limited on most of these, and unlike the termite treatments, they can only be attributed to chlorpyrifos as possible or probable, and not highly probable.

The EFED ERA (p 92) also cites a study by NOAA (1992) that concluded that chlorpyrifos was responsible for only a few fish kills even though it was one of the inventoried pesticides found most often in coastal aquatic biota. Chlorpyrifos was rated as one of the most hazardous pesticides in NOAA's inventory using its hazard rating system.

d. Estimated and actual concentrations of chlorpyrifos in water

(1) EECs from models

In the EFED ERA, estimated environmental concentrations of chlorpyrifos in aquatic systems were modeled using GENEEC and PRZM-EXAMS to reflect use on corn, citrus, peanuts, cotton and tobacco. Use patterns for these sites reflect the range of application rates, frequency of application, maximum seasonal limits and application methods for chlorpyrifos. Estimated concentrations derived from the models were used to assess acute and chronic risks to freshwater and estuarine organisms in ponds and estuarine areas, respectively. Acute risks were assessed using peak EECs. Chronic risk quotients were calculated using an exposure period ranging from 96 hours to 21 days in the EFED ERA.

A number of scenarios were modeled in the ERA (pages 20-25). Selected results are presented in Table 12. As we have stated in previous requests, the results are rather unrealistic for use with Pacific salmon and steelhead; so additional, more pertinent, results are presented in Tables 13 and 14. The primary difficulty with the estimates in the EFED ERA is that all were modeled for areas that will have far more runoff than will occur in the Pacific states, even including the more mesic parts of western Oregon and Washington because the precipitation there, while substantial, does not typically occur in large runoff events. In addition, the model is based upon the upper 10th percentile of runoff events. This would not be unrealistic if the precipitation scenarios were based upon the Western areas being addressed in this analysis. But the upper 10th percentile values further exaggerate the high rainfall events that occur occasionally (e.g., associated with hurricanes, tornadoes, etc) in the areas used for the models.

Regardless of whether the crop scenarios are eastern or western or the analyses are from GENEEC or PRZM-EXAMS models, all of the EECs are based upon the farm pond model and would not necessarily relate to flowing water situations, except for acute exposures in first order streams.

Table 12. Estimated environmental concentrations (PRZM-EXAMS) and risk quotients (freshwater fish) for chlorpyrifos and selected crops, as presented in the EFED ERA.

Crop	Application	Peak EEC (ppb)	Acute Risk Quotient	4- and 21-day chronic EEC (ppb)	Chronic Risk Quotient
Corn, IA	ground spray, 3 lb a.i./A, incorp. 2", 1 appl.	2.75	1.5	1.28 - 2.18	2.2 - 3.8
Corn, GA	aerial, foliar, 1 lb a.i./A, 11 appl.	33.8	19	23.7 - 28.1	42 - 49
Corn, IA	granular, 1.1 lb a.i./A, incorp 4", 1 appl.	0.98	0.54	0.44 - 0.77	0.77 – 1.4
Corn, MS	granular, 1.1 lb a.i./A, incorp 4", 1 appl.	2.71	1.5	1.3 - 2.2	2.3 – 3.9
Citrus, FL	airblast, 3.5 lb a.i./A, 2 appl.	37.3	21	18.7 - 30.9	33 - 54
Peanuts, GA	ground spray, 2 lb a.i./A, 2 appl.	9.38	5.2	4.29 - 7.36	7.5 - 13
Cotton, MS	aerial, foliar, 1 lb a.i./A, 6 appl.	27.2	15	17.3 - 22.9	30 - 40
Tobacco, NC	ground spray, 5 lb a.i./A, 1 appl.	30.6	17	12.0 - 24.0	21 - 42

Because the Table 12 results are based upon a risk assessment at the national level and are thought to overestimate the EECs, additional PRZM-EXAMS models were run on selected western sites. These results are in Table 13 for fish and Table 14 for aquatic invertebrates. The selection of sites is constrained by the availability of existing scenarios; there are no scenarios, for example, that address crops in the more arid areas of the Pacific Northwest. In general, the results indicate that EECs in western states will be rather lower than were found in the original EECs in the EFED risk assessment. The only close comparison between the two sets of data is for cotton, where only the site was changed; the application rate, number, and other parameters are the same. A more than 4-fold difference occurs with the peak residues, although this diminishes to slightly more than 2-fold difference in 60-day chronic residues.

Table 13. Estimated environmental concentrations (PRZM-EXAMS) and risk quotients (freshwater fish) for chlorpyrifos and selected western crops, based upon an acute LC50 of 1.8 ppb for bluegill and a chronic NOEC of 0.57 ppb for fathead minnow.

Crop	Application	Peak EEC (ppb)	Acute Risk Quotient	60-d Chronic EEC (ppb)	Chronic Risk Quotient
Sugarbeets, CA	ground spray, 1 lb a.i./A, incorp. 1-2", 1 appl.	0.94	0.52	0.27	0.47
Alfalfa, CA	aerial, foliar, 1 lb a.i./A, 4 appl.	4.5	2.5	2.4	4.2
Alfalfa, CA	ground, soil, 1 lb a.i./A, 1 appl.	0.61	0.34	0.17	0.3
Almonds, CA	airblast, 2 lb a.i./A, 3 appl.	9.8	5.4	4.7	8.2
Cotton, CA	aerial, foliar, 1 lb a.i./A, 6 appl.	6.6	3.7	4.5	7.9
Apples, OR	airblast dormant spray, 3 lb a.i./A, 1 appl.	9.2	5.1	2.8	4.9
Christmas trees, OR	aerial, foliar, 1 lb a.i./A, 1 appl	3.1	1.7	0.84	1.5
Christmas trees, OR	aerial, foliar, 1 lb a.i./A, 2 appl	4.5	2.5	1.7	3

Table 14. Estimated environmental concentrations (PRZM-EXAMS) and risk quotients (aquatic invertebrates) for chlorpyrifos and selected western crops, based upon an acute LC50 of 0.1 ppb and a chronic NOEC of 0.04 ppb, both for *Daphnia magna*.

Crop	Application	Peak EEC (ppb)	Acute Risk Quotient	21-d Chronic EEC (ppb)	Chronic Risk Quotient
Sugarbeets, CA	ground spray, 1 lb a.i./A, incorp. 1-2", 1 appl.	0.94	9.4	0.44	11
Alfalfa, CA	aerial, foliar, 1 lb a.i./A, 4 appl.	4.5	45	2.7	68
Alfalfa, CA	ground, soil, 1 lb a.i./A, 1 appl.	0.61	6.1	0.27	6.8
Almonds, CA	airblast, 2 lb a.i./A, 3 appl.	9.8	98	6.3	158
Cotton, CA	aerial, foliar, 1 lb a.i./A, 6 appl.	6.6	66	4.9	123
Apples, OR	airblast dormant spray, 3 lb a.i./A, 1 appl.	9.2	92	4.5	113

Christmas trees, OR	aerial, foliar, 1 lb a.i./A, 1 appl	3.1	31	1.4	35
Christmas trees, OR	aerial, foliar, 1 lb a.i./A, 2 appl	4.5	45	2.6	65

(2) Other uses

A number of chlorpyrifos uses are not amenable to EEC modeling. Many should not cause any harm.

1. Mosquito control: Several chlorpyrifos products are registered for control of adult mosquitoes. One of these products also contains permethrin, a pyrethroid insecticide. The chlorpyrifos may be applied as a fog or mist of fine droplet size. Applications are limited to mosquito abatement districts, other government agencies, or their contractors. Applications may be made with ground or aerial equipment. Based upon the directions, the application rate may be as high as 0.025 lb ai/A of chlorpyrifos. Although the intent is to keep the fine droplets in the air so that they will come into contact with the flying adult mosquitoes, EFED estimates that as much as 10% of the material may reach the ground, or 0.0025 lb ai/A. Label warnings state, “For terrestrial uses, do not apply directly to water, or to areas where surface water is present....” The mosquito adulticide use pattern is considered terrestrial, but could occur in the vicinity of water. If inadvertently applied over water, the 0.0025 lb ai/A would result in aquatic residues of 18.5 ppb in 6 inches of water or 1.5 ppb in 6 feet of water. In the formulation with permethrin, the permethrin component would have residues of 0.5 ppb in 6 inches and 0.04 ppb in 6 feet of water. The chlorpyrifos-permethrin formulation has an additional limitation that it cannot be used within 100 feet of water, which is mostly likely because permethrin products typically have setback zones from water.

It does not seem very likely that the mosquito adulticide use of chlorpyrifos (including the product containing permethrin) will reach salmon bearing waters in sufficient quantity to be a concern. Mosquitoes do not occur in flowing water, although they may occur in stagnant or backwater areas of streams and rivers. In lakes, they tend to be at the edges. In flowing water situations, the spray, which would be in fine droplets, would likely be transported quickly away and not be a concern. The lake habitats of the two sockeye ESUs are on Federal lands, and presumably they would not be sprayed.

If the hundred foot buffer existed for all mosquito adulticide products, then I could conclude there would be no effect on salmon and steelhead, taking into consideration their typically flowing water habitats or primary existence on Federal lands for the sockeye in lakes. Absent such a buffer, there is too much uncertainty. Even though fish kills from any mosquito adulticides are exceedingly unusual, we cannot provide sufficient assurance about sublethal effects to reach a “no effect” determination. I can, however, conclude that mosquito adulticide use of chlorpyrifos is not likely to adversely affect and salmon or steelhead ESU.

2. Cattle ear tags. Cattle will not go in the water up over their ears. There is a very remote chance that a cattle ear tag would fall off in the water. There is evidence that ear tags come off occasionally in feed lots due to contact with other cattle. The chances that enough cattle ear tags come off in water where salmon or steelhead may occur and to cause a problem to listed fish is so remote as to be discountable. I conclude no effect from this use.

3. Nursery use on ornamentals. We cannot estimate potential aquatic exposure from nursery uses. We can determine past usage in California, and potentially treated acreage in the Pacific Northwest. We will use our best judgement to make calls on an ESU by ESU basis.

4. Golf courses: EFED reviewed a Florida golf course study with both granular and liquid (sprayed) chlorpyrifos. The purpose was to evaluate hazards to terrestrial, not aquatic, animals. For each formulation, two applications were made at 4 pounds ai/A, 21 days apart. Chlorpyrifos levels of 1.69 and 2.55 ppb were found in water after the second granular application. No measureable residues were found after the first application nor after either application with the liquid formulation. These two samples were the only ones of 16 water samples taken showing detectable residues, with the detection level being 1 ppb. Dead fish were found in "water hazards" and a small pond associated with this field study, but there are no data on residues in the fish. It is quite likely, but not certain, that chlorpyrifos was responsible. Rainfall in the form of localized afternoon thundershowers is frequent in the study area; annual rainfall in Tampa is approximately 124.5 cm, sixty percent of which occurs between June and September.(See page 200-202 of EFED ERA for study details.)

Following the June 2000 Memorandum of Agreement, golf course use is now limited to 1 lb ai/A, which may be repeated as needed. The label states to "thoroughly water immediately after treatment to wash the insecticide into the turf." The four-fold reduction in application rate should result in a corresponding reduction in aquatic exposure. In addition, western salmon and steelhead areas seldom get heavy showers during the season of likely use. Turf also inhibits runoff, which is why buffer strips that are vegetated are used to reduce erosion or transport of applied pesticides or fertilizers.

Use of chlorpyrifos on golf courses is unlikely to result in widespread exposure of listed salmon and steelhead. However, even a four-fold reduction in the aquatic residues found in the Florida study would result in 0.64 and 0.42 ppb in the water. The Florida study could not detect residues below 1 ppb, but the concerns for direct effects to fish are considered to occur at 0.09 ppb, and for indirect effects at 0.05 ppb. The reduced likelihood of storm events in western areas, relative to Florida, should diminish concerns, especially for indirect effects, but it is difficult to consider an elimination of all direct risk for golf course areas immediately next to salmon bearing streams.

The IRED specifies that no-spray zones ("buffer" or "setback") will be required for all crop uses. These no-spray zones will apply to rivers, natural ponds, lakes, streams, reservoirs, marshes, estuaries and commercial fish ponds. For ground applications the buffer is 25 feet. It does not appear in the IRED, or at least is not obvious, that the buffers apply to non-crop uses or to granular formulations. If there were a 25 foot vegetated buffer from salmon bearing waters, then there should be no effect on listed salmon and steelhead.

Several products contain the herbicides benfluralin and/or trifluralin, as well as fertilizers. Based upon trifluralin RED indicating that endangered fish criteria are barely exceeded at 2 lb ai/A, and that the maximum rate for the herbicides in these combination products is 1 lb ai/A, along with benfluralin exhibiting only about 10% of the toxicity of trifluralin (81 ppb vs 8.4 ppb), the addition of the herbicides to these turf products should not be significant, relative to the chlorpyrifos.

4. Road median strips and industrial plant outdoor turf uses: The use of chlorpyirfos on these sites should be minimal and dispersed. I conclude that there will be no effect on listed fish.

5. Termiticide use. There is substantial use of chlorpyrifos to control termites. Over 250,000 pounds of chlorpyrifos were used on structural treatments in California in 2001, the second highest use in the state after cotton. Fish kills have occurred. Theoretically, termiticide treatments should be covered sufficiently to preclude runoff. There is limited information available, but it appears that most fish kills have occurred as a result of a storm event occurring before all of the treated area is adequately covered.

According to the June, 2000 Memorandum of Agreement, there will be no sale, distribution, or use of chlorpyrifos for pre-construction termiticide use after December 1, 2005, unless the registrant submits acceptable data and OPP deems these additional data adequate to support the continued registration. This **may** end the termiticide use of chlorpyrifos in 2½ years, but it also may be that additional acceptable data will be provided.

(3) Measured residues in the environment

The EFED ERA presents monitoring data for aquatic residues on pages 25-28. Although other, mostly smaller scale, studies are discussed in the chapter, it is the high quality NAWQA data that appear to be the most relevant. On a national basis across the original 20 study units, 2689 samples were taken. The highest chlorpyrifos residues were 0.4 ug/L from agricultural areas, 0.19 ug/L from urban streams, and 0.13 ug/L from mixed land-use streams; detection percentages were 14.6%, 26.5%, and 14.4%, respevctively. The 95th percentile highest residues were 7-20% of the maximum residues.

The above figures are for a national basis. In Table 15 below are the maximum detections and percentage of samples with detections for NAWQA study areas in the range of listed Pacific salmon and steelhead. While the NAWQA sampling data are considered high quality, they are not targeted to sites and times where chlorpyrifos is used. Even regular sampling according to a predetermined schedule may not detect peak residues unless the samples happen to be taken shortly afterwards and adjacent to sites treated with chlorpyrifos.

Table 15. Chlorpyrifos residues: percentage of samples with detections and maximum amounts found, as interpreted from graphical presentations.

Study unit	% detects	maximum residue (ug/L)[a]	Reference
San Joaquin-Tulare Basin	52%	~0.4	Dubrovsky et al., 1998
Sacramento Basin agricultural	29%	0.016	Domagalski et al., 2000
Sacramento Basin urban	37%	~0.05	Domagalski et al., 2000
Sacramento Basin mixed	20%	~0.003	Domagalski et al., 2000
Upper Willamette River Basin	21%	~0.3	Wentz et al., 1998
Central Columbia Plateau	9%	0.1	Williamson et al., 1998
Puget Sound Basin urban	7%	~0.08	Ebbert et al., 2000
Puget Sound Basin agricultural	0	not detected	Ebbert et al., 2000
Puget Sound Basin mixed	0	not detected	Ebbert et al., 2000

a. Approximate values as determined visually from points on logarithmic bar graphs

California's DPR compiled monitoring data on chlorpyrifos and diazinon from 22 studies done between 1991 and 2002 (Spurlock (2002). A total of 3901 samples were taken for chlorpyrifos at 82 sites. These data include some of the USGS NAWQA data in the San Joaquin-Tulare Basin and the Sacramento River Basin. Sampling was targeted to potentially high use areas and to times when residues would be most likely detected, although attempts were not necessarily made at peak times and places for specific pesticides. Therefore, the results cannot be considered as representative of other areas. The sampling is considered to represent agricultural areas with minimal input from urban uses. The results indicated that, although chlorpyrifos is used in part as a winter dormant spray, there was only one winter detection, unlike diazinon. Chlorpyrifos detections (all records) were greater than 70% in tributaries from April through October. Detections in the rivers peaked at 10% in April and 13% in May; all other months had detection rates less than 10%. The report indicated that chlorpyrifos was not detected in any river (Sacramento, Feather, and Bear) in the Sacramento River basin.

Spurlock (2002) indicated that the largest number of chlorpyrifos applications in the San Joaquin Valley occurred to cotton in August and September, with other substantial applications made to alfalfa in March and to nut crops in May through August. In the Sacramento River Basin, peak applications are to nut crops in June through August, with a smaller peak for alfalfa in March and a fairly steady rate of applications throughout the year for structural pest control of termites. Usage in the Sacramento Valley is considerably lower than in the San Joaquin Valley.

For rivers, the 19 highest concentrations exceeded 0.1 ug/L, with the highest being 0.35 ug/l. However, 15 of those concentrations were in the Imperial Valley, far from listed salmon and steelhead habitat. One sample in the San Joaquin River at Laird Park (near Modesto) had 0.34 ug/L of chlorpyrifos, and two samples in the Merced River near Newman had 0.26 and 0.12 ug/L of chlorpyrifos. One sample at 0.12 ug/L was taken from the Salinas River in watershed of the Central California Coast Steelhead ESU.

The six highest concentrations in tributaries were all above 1 ug/L. These six and all but two of the 50 highest concentrations were found in Orestimba Creek, which was acknowledged to be sampled disproportionately (1312 samples of 1824 samples taken in tributaries), primarily in a targeted study by Dow AgroSciences in 1996 and 1997 (Poletika et al., 2002). Because daily samples were taken in the Dow study, it seems likely that they found the peak residues that could have occurred. The highest concentrations were 2.28, 1.46, 1.46, 1.26, 1.17, and 1.04 ug/L. Four of these values occurred over a 4-day period from March 26-29, one on April 23, and one on August 21. Spurlock (2002) did not report rainfall that would result in a runoff event, but it seems likely that a storm event occurred in late March.

In their attached assessment of chlorpyrifos risks to listed salmon and steelhead, Dow AgroSciences (Giddings, et al., 2003) summarizes the monitoring data as follows:

> "In the IRED ecological risk assessment, concentrations of chlorpyrifos reported in NAWQA and California monitoring data were used to assess risks for some typical flowing waters. Much of this information was reviewed by Giesy et al. (1999). These authors concluded that overall, the existing data monitoring data do not suggest ecologically significant risks, except in a few locations. They further concluded that in most stream and river systems chlorpyrifos exposure is episodic and would not elicit chronic effects in nontarget aquatic organisms. Therefore, the rare risks were attributed to acute effects on sensitive freshwater invertebrates. A more recent intensive monitoring study conducted in an agriculturally dominated tributary of the San Joaquin River demonstrated a similar exposure pattern and low probability of ecologically significant risks (Poletika et al. 2002)."

We do not necessarily disagree with this assessment for risks to aquatic populations in general, but we note that the standard for evaluating risks to listed species is considerably more stringent than "low probability" and "ecologically significant risks."

e. Recent changes in chlorpyrifos registrations

A number of changes in chlorpyrifos registrations have or will occur. The primary change that has already occurred is the deletion of all homeowner uses except for "containerized" ant and roach baits which should result in no environmental exposure. Other residential uses (not applied by homeowners) are also being cancelled except for adult mosquito control and treatment of individual fire ant mounds. Termiticide uses will be phased out, ending in 2005; however, the uses may be allowed to continue if registrants submit sufficient data demonstrating that the 0.5% formulations are efficacious.

Additional changes that have already occurred (relevant to listed Pacific salmon and steelhead) are deletion of use on apples after bloom and deletion of use on tomatoes, and the designation of all emulsifiable concentrate formulations as "restricted use" pesticides. Use on golf courses has been reduced from 4 lb ai/A to 1 lb ai/A, and other non-residential, non-agricultural uses are limited to road medians and industrial plant sites.

There are a number of additional changes in agricultural uses that will occur that will mitigate the environmental risk. These are presented in the IRED on pages 91-94 and summarized below in Table 16. For all agricultural uses, there will be required no-spray zones around water bodies of 25 feet for ground boom sprays and chemigation, 50 feet for orchard airblast applications, and for 150 feet for aerial applications by either fixed-wing aircraft or helicopters. For certain crops there are reductions in application rates, reductions in the maximum number of applications per year, and specified intervals between applications as follows:

Table 16. Changes in application rates and numbers for chlorpyrifos as specified in IRED

crop	formulations affected	application rate (old to new)	number of applications per year (old to new)	maximum amount per acre per year
alfalfa	liquid	NA	8 to 4	NA
citrus	liquids	6 lb ai/A to 2 lb ai/A[a]	NA	NA
citrus (orchard floor)	granular	NA	10 to 3	10 lb ai to 3 lb ai
corn	liquid	NA	unspecified to 3	7.5 lb ai to 3 lb ai
corn	granular	NA	unspecified to 2	7.5 lb ai to 2 lb ai
cotton	liquid	NA	6 to 3	6 lb ai to 3 lb ai
sorghum	liquid	NA	unspecified to 3	NA
sugar beets	liquid	NA	4 to 3	4 lb ai to 3 lb ai
sugar beets	granular	NA	unspecified to 3	13.5 lb ai to 3 lb ai
tree nuts	liquid	NA	NA	8 lb ai to 4 lb ai
walnut and almond orchard floors	liquid	NA	unspecified to 2	8 lb ai to 4 lb ai

a. The 6 lb ai/A rate is retained for five counties in California and only for the control of red scale. These counties (Fresno, Kings, Kern, Madera, and Tulare) are not within the range or critical habitat of listed salmon or steelhead.

In their assessment, provided as ancillary material, Dow AgroSciences has delineated changes in several of their product labels that are intended for use beginning in 2004 (pages 23-25 in Giddings et al., 2003). They have also calculated the reduction in risk that they believe would occur as a result of these changes (Table 11, page 25, in Giddings et al., 2003). Although OPP expects other registrants to make changes required in the IRED, we cannot provide any assurance that other changes indicated by Dow AgroSciences (e.g, withdrawal of granular formulations for alfalfa) will be matched by other registrants of chlorpyrifos products.

f. Existing protections

Nationally, there are no specific protective measures for endangered and threatened species beyond the generic statements on the current chlorpyrifos labels. Chlorpyrifos emulsifiable concentrate products are classified as restricted use and can only be applied by certified applicators. As stated on all pesticide labels, it is a violation of Federal law to use this product in a manner inconsistent with its labeling. There are a variety of measures on chlorpyrifos labels for the protection of agricultural workers and other humans, which are not discussed here, but which may be seen on the attached labels. The Environmental Hazards section for a typical chlorpyrifos agricultural use label states:

"This pesticide is toxic to birds and wildlife, and extremely toxic to fish and aquatic organisms. Do not apply directly to water, to areas where surface water is present, or to intertidal areas below the mean high water mark. Drift and runoff from treated areas may be hazardous to aquatic organisms in adjacent aquatic sites. Cover or incorporate spills. Do not contaminate water when disposing of equipment washwaters or rinsate. This product is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees are visiting the treatment area. Protective information may be obtained from your cooperative agricultural extension service."

Labels for chlorpyrifos spray formulations do or will have the specific no-spray zones required in the IRED to reduce spray drift exposure to aquatic habitats. As noted above, these are 25 feet for ground and chemigation, 50 feet for orchard airblast, and 150 feet for aerial applications.

Some section 24(c), Special Local Needs, labels contain additional protective labeling for endangered species. An example is the Special Local Needs label for chlorpyrifos use on strawberries in Washington, which states:

> "This pesticide is extremely toxic to fish and aquatic organisms. Lorsban-4E should not be used under this SLN label where impact on listed threatened or endangered species is likely. You may contact the Washington Department of Fish & Wildlife, National Marine Fisheries Service or US Fish and Wildlife Service for information on listed threatened or endangered species (e.g., Bull trout, Chinook salmon). Consult the Federal label for additional restrictions and precautions to protect aquatic organisms."

It is unlcear whether both of the Services and the Washington Department of Fish and Game have concurred on this statement which may result in their being contacted by pesticide applicators. OPP approves of pesticide users learning more about listed species, but applicators may think that additional directions or limitations may be available from such contacts when such information should be available on labels or in label-referenced county bulletins when they are developed.

OPP's endangered species program has developed a series of county bulletins which provide information to pesticide users on steps that would be appropriate for protecting endangered or threatened species. Chlorpyrifos is included in these county bulletins in California. Bulletin development is an ongoing process, and there are no bulletins yet developed that would address fish in the Pacific Northwest. OPP is preparing such bulletins.

In California, the Department of Pesticide Regulation (DPR)in the California Environmental Protection Agency creates county bulletins consistent with those developed by OPP. However, California also has a system of County Agricultural Commissioners responsible for pesticide regulation, and all agricultural and commercial applicators must get a permit for the use of any restricted use pesticide and must report all pesticide use, restricted or not. The California bulletins for protecting endangered species have been in use for about 5 years. Although they are currently "voluntary " in nature, the Agricultural Commissioners strongly promote their use by pesticide applicators. Chlorpyrifos is currently included in these bulletins for protection of both terrestrial and aquatic animals. Agricultural and other commercial applicators are well sensitized to the need for protecting endangered and threatened species. DPR believes that the vast majority of agricultural applicators in California are following the limitations in these bulletins (Richard Marovich, Endangered Species Project, DPR, telephone communication, July 19, 2002).

OPP currently has proposed (67 *Federal Register* 231, 71549-71561, December 2, 2002) a final implementation program that includes labeling products to require pesticide applicators to follow provisions in county bulletins. The comment period has closed; comments are being evaluated; and a final *Federal Register* Notice is anticipated, most likely by the end of 2003, perhaps considerably earlier. After this notice becomes final, pesticide registrants will be required to put on their products label statements mandating that applicators follow the label and county bulletins. These will be enforceable under FIFRA.

g. Discussion and general risk conclusions for chlorpyrifos

(1) Fish
The lowest fish LC50 used in the EFED ERA is 1.8 ppb for bluegill sunfish. OPP's level of concern for endangered species is 0.05 times the LC50. Thus, OPP would consider endangered fish to be at risk when chlorpyrifos concentrations exceed 0.09 ppb.

NMFS may note in the ancillary materials being provided that Giddings et al. (2003) do not agree with this approach, and would prefer to use the geometric mean for rainbow trout studies that meet guideline requirements. Specificially, they state:

> "However, the 96-h LC50 for three salmonid species ranged from 3 ppb to 244 ppb in toxicity studies that, in OPP's judgment, met guideline standards (Table 3). The most sensitive salmonid tested was rainbow trout, the same species (*Oncorhynchus mykiss*) as steelhead. The geometric mean of the four acceptable 96-h LC50 values for rainbow trout was 8.1 ppb. Applying OPP's 0.05 multiplier to the rainbow trout mean LC50 gives a concentration of 0.4 ppb that, if not exceeded, would not be expected to put salmonids at risk."

OPP does not agree with this approach. It is OPP's responsibility to consult when there can be any adverse effect (technically, any effect at all), including sublethal, on even a single individual of a listed species. Our criteria are admittedly conservative, but they are required by the Endangered Species Act and also based on a long history of using a very sensitive criterion to trigger the consultation process. This criterion may be based on median lethal test results, but the additional uncertainty factors (e.g., the 0.05 "multiplier") are intended to account for effects at the LC01 level, interlaboratory variation, intraspecies sensitivities, sublethal effects, sensitive situations, etc. On this basis, we believe it appropriate to use the most sensitive species and the lowest LC50 value on the technical material for that species. There may be some merit for NMFS to consider in the Giddings et al. (2003) approach in evaluating the risks to **populations** of salmonids, but OPP's standard is for analysis of any effect on a listed species, not just effects on populations.

The chronic no-observed-effect-concentration for fish is considered to be 0.57 ppb. Using the no-effect criterion already gets below the level (statistically) for individual effects. The additional factors of uncertainty here are considered to be addressed by the extremely low likelihood of continuous exposure over a chronic period of time at the NOEC. For chlorpyrifos, using the acute criterion of 0.09 ppb is more conservative, and we are using that value to address all direct effects.

(2) Invertebrates

In the EFED ERA, OPP used a *Daphnia magna* LC50 of 0.1 ppb as the most sensitive species in validated tests. OPP's criteria consider that an EEC greater than 0.5 times the LC50 could have an effect on populations of aquatic invertebrates that may serve as a food source for listed fish. On this basis, concerns for indirect effects on the food supply for fish (including threatened and endangered salmonids) would occur at concentrations greater than 0.05 ppb. In the ancillary materials being provided, Giddings, et al., (2003) argue that "even if the most sensitive invertebrate species were affected, other less sensitive species would still remain as a food source at higher chlorpyrifos concentrations." This appears to be based upon microcosm studies by Giddings (1993) and by Siefert et al. (1989). OPP agrees with the principle that there may be many less sensitive species that can serve as food supply for fish, but takes issue with the statement as it applies to chlorpyrifos. First, we note that a wide variety of aquatic arthropods are very sensitive to chlorpyrifos (Tables 4 and 5); very few are in categories where chlorpyrifos can be said to be less than "very highly toxic". Second, the microcosm studies are too limited for extrapolation to the diversity of environments where young salmon and steelhead require an adequate food supply. Third, there is an indication that at least some populations of listed salmon and steelhead are food limited; studies involving artificial supplementation of food showed that populations with additional food (hatchery salmon carcasses) had higher densities, increased body weight, and better condition than populations without supplemental food (Bilby et al., 1998). Therefore, we consider that the 0.05 ppb level is an appropriate criterion for protection of the aquatic invertebrate food supply for listed salmon and steelhead.

The chronic NOEC is 0.04 ppb and the LOEC is 0.08 ppb. The 0.05 ppb value for acute risks is below this LOEC, but slightly above the NOEC. However, use of the chronic NOEC is intended for the protection of aquatic invertebrates as a listed species rather than as a food source for listed fish. OPP has not yet developed a standard criterion for addressing chronic effects to a food source of listed fish, but any such criterion would be less stringent than for listed aquatic invertebrates. Therefore, we will use the acute criterion of 0.05 ppb, which is nearly the same.

(3) Water Quality Criteria

The Office of Water's Water Quality Criteria for chlorpyrifos are 0.083 ppb (1-h average) and 0.041 ppb (4-d average) for freshwater, and 0.011 ppb (1-h average) and 0.0056 ppb (4-d average) for saltwater (EPA 1986). The U. S. Fish and Wildlife Service agreed with these criteria in their synoptic review of chlorpyrifos (Odenkirchen & Eisler, 1988).

(4) Conclusions

Making "typical" risk conclusions regarding the aquatic risk of chlorpyrifos to threatened and endangered Pacific salmon and steelhead is confounded by a number of factors. On a lethal basis, chlorpyrifos is very highly toxic to fish and can have sublethal effects. Invertebrate food supply may be affected if these fish feed on aquatic arthropods, most of which are very sensitive. But invertebrates in other phyla are quite a bit less sensitive. Even among aquatic arthropods, where at least one toxicity test shows LC50 values less than 1 ppb, there are often other test data for similar species showing LC50 values 10 or sometimes 100 times higher (i.e., less toxic) than the most sensitive tests exhibit. Sensitivity differences were also found in a pond study (Siefert et al., 1988, as cited in EFED ERA, p75-76) where 19 of 55 invertebrate taxa exposed to chlorpyrifos concentrations were significantly reduced in numbers, at concentrations as low as 0.51 ppb. These data indicate that 36 taxa were not reduced in statsitically significant numbers. In a microcosm study, Giddings (1993) found that macroinvertebrate communities were not markedly affected at levels below 0.3 ppb. The applicability of either pond or microcosm studies to salmon and steelhead situations in lotic waters is questionable.

While the high toxicity of chlorpyrifos is fairly clear, the potential exposure is not, and the actual risk is based upon a combination of toxicity and exposure. PRZM-EXAMS models are based upon pond scenarios which may initially be comparable to first order streams. Dissipation should occur much more rapidly in streams, but at least some, and perhaps a moderate amount, of the chlorpyrifos loss from the water column will be due to adsorption to sediments, where it could be available to benthic invertebrates. In addition, it should be noted again that the PRZM-EXAMS models maximize all of the inputs by considering maximum application rates, maximum number of applications, minimum intervals, and conservative environmental fate and transport parameters. The models also assume that 100% of the modeled area is treated with the pesticide. On this basis, every use site for which a PRZM-EXAMS model has been used with chlorpyrifos exceeds the risk criteria for both direct effects to fish and indirect effects to aquatic invertebrates.

Maximizing the modeling parameters can be appropriate for some, probably few, situations with high pest pressure and somewhat atypical application conditions, and where there is a concern for direct effects, such as to fish. When the concern is for indirect effects, such as the availability of adequate food supply, then use of more typical conditions is warranted, especially in considering the percentage of an area that is treated and the size, location, and type of the receiving water that is exposed through runoff and/or drift. This all provides great uncertainties about aquatic concentrations that may actually be occurring. Despite this difficulty, the toxicity data do allow us to determine the concentrations of concern. Based upon our best professional judgement, OPP believes that aquatic concentrations of chlorpyrifos below 0.09 ppb will be protective of listed salmon and steelhead for direct effects and that aquatic concentrations below 0.05 ppb will be protective of the aquatic invertebrate food supply for these fish. Aquatic concentrations somewhat above these levels might not be a concern, but there is too much uncertainty to recommend higher levels. Except for the potential exposure of benthic invertebrates, there appears to be little opportunity for chronic exposure of chlorpyrifos to stream-dwelling species.

Targeted monitoring data may provide the most appropriate data on concentrations of chlorpyrifos in aquatic systems, at least with respect to the areas monitored. Dow AgroSciences took daily samples of water from three sites on Orestimba Creek in the San Joaquin River Basin (Spurlock, 2002); such a sampling regimen should capture peak values. Spurlock reported 1150 samples taken during the time of this study, and several dozens had chlorpyrifos levels above 0.15 ppb; the 6 highest samples had over 1 ppb of chlorpyrifos. It should be noted that Orestimba Creek is in an area that is strongly agricultural on both sides, and dominated by crops on which chlorpyrifos can be used; it is likely that this is the worst possible case for a creek scenario. Unfortunately, the sampling regimen did not apparently include the San Joaquin River into which Orestimba Creek flows. Other monitoring data from other years presented by Spurlock (2002) indicate only one sample in the San Joaquin River that exceeded the 0.09 ppb level of concern for direct effects on listed fish; 9 samples were at or above the 0.05 ppb level of concern for indirect effects. Additional samples in the Merced River also exceeded the concern levels for direct effects (2 samples) and indirect effects (5 additional samples) of chlorpyrifos.

These monitoring data show that chlorpyrifos concentrations in aquatic systems may exceed criteria for both direct and indirect effects. While most of the exceedances occurred in Orestimba Creek, which is not good salmon and steelhead habitat, if it provides any at all, there were a few exceedances in the San Joaquin and Merced Rivers. Spurlock (2002) did indicate that the use of chlorpyrifos has steadily decreased in recent years. In 2000, reported applications of chlorpyrifos in the Sacramento and San Joaquin river basins were 42 percent of that in 1997. The highest river concentrations of chlorpyrifos were reported during the early 1990s; however, recent river sampling for both has been limited. There have been no river detections of chlorpyrifos since March 1995.

Spurlock (2002) also reported that chlorpyrifos residues were not typically found in urban streams, but Arcade Creek near Sacramento was an exception. It is also possible that urban uses elsewhere may not have been followed by aquatic residue monitoring. In any case, the deletion of essentially all homeowner uses, and most other residential uses, should significantly reduce risks in waters that drain urban areas. There is a potential for continued termiticide use until the phase-out is completed at the end of 2005, although there is some possibility that acceptable data to support the continued termiticide use of chlorpyrifos will be submitted. The termiticide use could be a concern when incompletely treated areas are not adequately covered before storm events. However, it is thought that the largest contribution, by far, to urban aquatic environments was from the use by homeowners, primarily on turf, that is no longer a registered use.

The conclusions reached below, then, are based upon the 0.09 ppb concern level for direct effects to salmon and steelhead and the 0.05 ppb concern level for their aquatic arthropod food supply. For direct effects, it is considered that any use reflected by the PRZM-EXAMS models in Tables 13 and 14 adjacent to where listed salmon or steelhead occur would be a concern for direct effects unless the acreage treated were minuscule (e.g., an acre or two), or in larger bodies of water including the migratory corridors. A no-spray buffer, even a small one, would mitigate some situations. Therefore, for direct effects, the key aspect of "may affect" determinations is the location of use next to salmon bearing waters where there would not be sufficient dilution.

For indirect effects, the "may affect" determinations will be made on the basis of population effects on the aquatic arthropod food supply for listed salmon and steelhead. In such cases, "adjacency" is not as critical a factor because harm to one or a few individuals of the food source should not be a factor, but loss of populations would be. Therefore, the extent of usage in an area is more relevant and the typical, rather than maximum rates of application can also be a consideration.

For all ESUs, there are and always will be uncertainties. Our information used in making the determinations is existing data generated in the past. We can make projections for the future but we can provide little assurance that something will not change to render our projections into the future moot. Our intent is to use the best available scientific and commercial data and then to apply our best professional judgement.

4. Listed salmon and steelhead ESUs and comparison with chlorpyrifos use areas

The sources of data available on chlorpyrifos use are considerably different for California than for other states. California has full pesticide use reporting by all applicators except homeowners. Oregon has initiated a process for full use reporting, but it is not in place yet, and may not be in place very soon for budgetary reasons. Washington and Idaho do not have such a mechanism to our knowledge.

The latest information for California pesticide use is for the year 2001 [URL: http://www.cdpr.ca.gov/docs/pur/purmain.htm]. The reported information to the County Agricultural Commissioners includes pounds used, acres treated for agricultural and certain other uses, and the specific location treated. The pounds and acres are reported to the state, but the specific location information is retained at the county level and is not readily available. Table 17 presents chlorpyrifos usage over the past nine years in California. Table 18 presents all of the chlorpyrifos uses in California for 2001 where there were more than 100 pounds for a site. The tables further below for each ESU include all of the uses reported to California's Department of Pesticide Regulation (DPR). However, uses in any county that are less than 100 pounds are not reported by use; they are included as "other".

The use of chlorpyrifos for termites is scheduled to be phased out by 2005. However, the phase-out agreement does provide a possibility that the termite uses could be continued if certain efficacy data are submitted. Therefore, we have included California's usage data for termite control, even though it will go down, and seems likely to end. We do not have comparable data for the Pacific Northwest; Giesy et al. (1999) present data showing that Washington state had only 0.08% of all termiticide treatments in the country and had an incident rate of 0.0138% for aquatic contamination. While they could not deny some fish kills and other adverse incidents from termiticides on a national basis, they did suggest that the rates of these occurring are low enough to not be a general concern. In most cases, misuse, i.e., not following label directions, seems to have been involved.

The landscape maintenance usage category for California includes both use by commercial applicators around home and business landscaping and the golf course use. Use of chlorpyrifos in residential areas, whether by homeowners or commercial applicators has already completed the phaseout period. However, use on golf courses is allowed to continue, although at 1/4 the pre-2000 application rate. We included the landscape maintenance usage information in the tables below, but we are unable to distinguish residential and business area landscaping usage which will not continue from the golf course usage which will.

Table 17. Reported use of chlorpyrifos in California, 1993-2001, in pounds of active ingredient.

Year	1993	1994	1995	1996	1997	1998	1999	2000	2001
Use	2,246,121	2,887,838	3385416	2,687,809	3,152,564	2,355,626	2,257,936	2,093,382	1,673,183

Table 18. Reported use of chlorpyrifos, by crop, for 2001 in California. Only crops with 100 or more pounds of chlorpyrifos included in this table, but all reported chlorpyrifos use is included in county use profiles.

crop or site	lb a.i. used	acres treated
cotton	271892	291412
structural pest control	251069	--
alfalfa	231550	453129
almond	162846	94748
orange	148604	70290

crop or site	lb a.i. used	acres treated
walnut	141558	79623
lemon	66648	20000
grape	63375	36527
broccoli	58984	48543
sugarbeet	48350	77494
peach	29058	14986
nectarine	23104	12967
plum	20434	10735
corn, field	20089	20471
cauliflower	17453	18657
apple	12468	7934
nursery - outdoor	9563	–
corn, sweet	9546	29356
landscape maintenance	9,087	–
pear	8,612	5220
asparagus	7,242	7229
brussel sprout	6609	7350
cabbage	6,075	5870
sweet potato	5,539	2781
strawberry	5194	5724
fig	4871	2455
prune	4,042	2483
grapefruit	3,727	2544
tangerine	3,106	1544
chinese cabbage	2,683	2507
rights-of-way	2424	--
citrus	1,716	593
onion, dry	1645	1684
tangelo	1365	618
bok choy	1,087	960
bean, dried (commodity)[a]	996	--
cherry	991	635
kale	816	907
grass, seed	705	231
radish	704	523
wheat	691	1298
animal premises	632	–
mint	585	442
sorghum/milo	514	717
sunflower	427	543
turf/sod	411	406
avocado	365	400
chinese greens	301	156

crop or site	lb a.i. used	acres treated
rappini	253	131
herb, spice	163	108
cucumber (commodity)[a]	149	--
regulatory pest control	111	--
public health[b]	106	--
total	1673183	--

a. Commodity treatments are post harvest, not in the field.

b. Public health treatments can be mosquito or fire ant treatments; 95 of these pounds were in San Diego County.

Information in the tables below for Oregon, Washington, and Idaho are for the acreage of the crops on which chlorpyrifos can be used. These acreage data were taken from the 1997 USDA agricultural census. The amount of chlorpyrifos used on each crop in each county is not known. Data on the percentage of crop area treated with chlorpyrifos are available for some crops for Washington (Doane Market Research; WSDA 2002), and national percentages for many crops are reported in OPP's Quantitative Usage Analysis. The crops with the greatest potential chlorpyrifos use in Washington, Oregon, and Idaho, based on percentage of crop acres treated in Washington, are the following:

sugarbeets (72% of crop acres in WA treated, 1998)
apples (91% of crop acres in WA treated, 1997)
pears (44% of crop acres in WA treated, 1998)
cherries (51% of stone fruit acres in WA treated, 1998)
dry onions (30% of crop acres in WA treated, 2000).

Crops with high acreage (> 25,000 acres total) in WA, OR, ID counties containing salmonid ESUs, but for which little chlorpyrifos use is likely, are the following:

wheat (4,000,000 acres; 1% of crop acres treated nationwide)
alfalfa (745,818 acres; 3% of crop acres treated nationwide; 1% in WA, 1998)
corn (83,018 acres; 7% of crop acres treated nationwide; 6% in WA, 2000)
grapes (48,566 acres; <1% of crop acres treated nationwide; 7% in WA, 2000)
filberts (32,588 acres; 6% of crop acres treated nationwide)
snap beans (25,619 acres; chlorpyrifos used for seed treatment only).
grass seed (500,000 acres; chlorpyrifos used on 10,000 acres)[2]

Mint also has high acreage in these counties (73,865 acres). The percentage of acres treated with chlorpyrifos is unknown and presumed to be high.

[2] Personal communication, Mark Melbye, Linn County Extension Service, March 31, 2003

About 18% of Christmas trees in Oregon are treated with chlorpyrifos.[3]

Based on this information from the QUA, chlorpyrifos use in Idaho counties with salmonid ESUs is estimated to be low. This is consistent with USGS data (Attachment 1). The counties and crops in Washington and Oregon with the greatest potential for chlorpyrifos use are the following (acres in parentheses):

Adams, WA: mint (7,328), apples (3,457), sugarbeets (1,570)
Benton, WA: apples (18,425), pears (472), cherries (3,219), sugarbeets (4,284), dry onions (3,398)
Chelan, WA: apples (17,096), pears (8,298), cherries (3,704)
Douglas, WA: apples (14,383), pears (1,104), cherries (1,842)
Franklin, WA: apples (9,000)
Grant, WA: apples (33,615), pears (998), cherries (3,470), sugarbeets (10,792), dry onions (6,214), mint (15,610)
Okanogan, WA: apples (24,164), pears (3,280), cherries (1,003),
Walla Walla, WA: apples (5,222), cherries (280), dry onions (2,172)
Whitman, WA: mint (12,577)
Yakima, WA: apples (75,264), pears (10,190), cherries (6,129)
Crook, OR: sugarbeets (1,510), mint (5,501)
Hood River, OR: apples (2,592), pears (11,788), cherries (1,081)
Jackson, OR: pears (9,387)
Lane, OR: mint (5,350)
Union, OR: sugarbeets (1,035), mint (9,226)
Wasco, OR: cherries (7,352)

In addition, there is a fairly high potential for use on wheat, grass seed, and alfalfa. None of these crops is treated with chlorpyrifos to a great extent, but based upon the very high acreage grown, they still must be considered significant. In the whole state of Washington, for example, the 1997 agricultural census reports 2.4 million acres of wheat grown and 460,000 acres of alfalfa. Although only 1% of winter wheat and 3% of alfalfa are treated on a national basis, that rate would lead to 24,000 acres of wheat and almost 15,000 acres of alfalfa being treated with chlorpyrifos.

In the tables below for each ESU, data are not included for chlorpyrifos uses that have been cancelled.

Dow AgroSciences provided input on the ESUs and the acreages of crops where chlorpyrifos could be used. They started with information presented in the diazinon analysis previously developed. That information on the distribution of the ESUs was taken almost entirely from

[3] National Agricultural Statistics Service, Agricultural Chemical Usage, 2000 Nursery and Floriculture Summary at http://usda.mannlib.cornell.edu/reports/nassr/other/pcu-bb/#nursery

Federal Register Notices relating to listing, critical habitat, or status reviews. Dow AgroSciences stated the following:

> "Initially, descriptions of ESU occurrence were taken directly from OPP's analysis of diazinon risks to endangered and threatened salmon and steelhead, which relied upon existing ESU maps available from NMFS. Due to altered descriptions of the ESU critical habitat published in the Federal Register in recent years, many of these maps are out of date. Some error was therefore likely in determining the counties containing agricultural land and falling within ESU boundaries. To correct this deficiency Dow AgroSciences redrew the ESU boundaries, taking into account the most current published descriptions. Attachment 5 gives the details of the process by which ESUs were delineated using the new critical habitat descriptions. Also provided is an analysis of county contribution to potential chlorpyrifos loading in critical habitat based on factors such as elevation analysis and location of various categories of federal land where chlorpyrifos use does not occur."
>
> "Any counties that were added or removed from OPP's analysis as a result of redrawing the ESU boundaries are reflected in the analysis and risk conclusions for specific ESUs discussed in the following sections."

Giddings et al., (2003) present more details in the ancillary materials transmitted, and use a redline-strikeout approach to make changes easily identifiable.

It is OPP's intent to be as accurate as possible in the delineation of these ESUs. We note that Dow AgroSciences have made several adjustments with which we agree, e.g., where we omitted a county through oversight. We also note a couple of "corrections" with which we do not agree, and a couple that we tentatively disagree with, subject to feedback from NMFS. Specifically, the latter have to do with counties that have water within the HUC code, but where the counties do not abut the migratory rivers. Most specifically, these relate to Clackamas and Washington counties in Oregon and the migratry corridors for Upper Columbia and Snake River ESUs, for example. We projected that migrating salmon and steelhead, whether upstream or downstream, would stay in the rivers rather than go up side channels and tributaries. If this is correct, then Clackamas and Washington counties would not be directly associated with the Columbia River migratory corridor. If this is incorrect, we can make the appropriate adjustments. We do not believe that the assessment of potential chlorpyrifos effects would change regardless of this factor.

Please note that OPP will be transmitting a separate analysis of ESUs and their critical habitat to NMFS. This analysis will include what we perceive to be the most appropriate boundaries for designated critical habitat. We will be requesting comments from NMFS on the counties to be included. Depending upon NMFS comments, we will make any corrections and then will compare the results with those consultation packages previously transmitted. As stated above for chlorpyrifos, we do not believe that any corrections will materially change the risk assessments. However, adjustments may result in changes on where protective measures need to be taken after consultation is completed. We are not asking for comments on ESUs as part of this particular package.

(a) Steelhead

Steelhead, *Oncorhynchus mykiss*, exhibit one of the most complex suites 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 (spawning beds) 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 nonanadromous 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). The San Mateo Creek watershed also includes a small portion of the southwest corner of Riverside County, but the area is in the Cleveland National Forest. Chlorpyrifos is not used in forests, so Riverside County was excluded from the analysis. 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 Topanga Creek. Neither of these creeks drain agricultural areas.

Reportable usage of chlorpyrifos in counties where this ESU occurs are presented in Table 19.

Table 19. Use of chlorpyrifos in counties with the Southern California steelhead ESU.

County	Crop	Usage (pounds)	Acres treated
San Diego	avocado	365	400
	grapefruit	278	284
	landscape maintenance	536	
	lemon	612	551
	orange	634	888
	strawberry	283	285
	nursery	844	
	structural (termites)	4582	
	other	172	
Los Angeles	alfalfa	626	1,490
	landscape maintenance	870	
	nursery	269	
	structural (termites)	85950	
	other	34	
Ventura	broccoli	1948	2433
	cabbage	1070	1108
	corn	711	720
	cucumber	149	
	landscape maintenance	176	
	lemon	49430	14,716
	orange	1817	1,581
	strawberry	3434	3,859
	nursery	342	
	structural (termites)	858	

County	Crop	Usage (pounds)	Acres treated
	other	266	
San Luis Obispo	alfalfa	110	150
	apple	180	90
	bok choy	542	479
	broccoli	3,764	2,818
	cabbage	145	137
	cauliflower	980	1,228
	chinese cabbage	1853	1,640
	grape	2199	1,107
	landscape maintenance	124	
	lemon	1386	826
	orange	373	164
	nursery	122	
	structural (termites)	1048	
	other	112	
Santa Barbara	apple	343	201
	broccoli	14707	12,521
	cabbage	1096	1,121
	cauliflower	4783	5,589
	chinese cabbage	310	321
	corn	163	179
	grape	1550	1,773
	lime	119	222
	strawberry	314	322
	walnut	479	467
	nursery	2150	
	structural (termites)	478	
	other	337	

Agricultural chlorpyrifos use within the Southern California steelhead ESU is moderate; termiticide use has been high. The greatest agricultural use is on lemons in Ventura County and broccoli and cauliflower in Santa Barbara County. The use of chlorpyrifos in these counties may affect this the southern California Steelhead ESU. Applicators following DPR's bulletins will have a buffer area which should reduce the impacts. But the high uses may still be a concern if they occur close to salmon bearing streams.

(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), Alisal-Elkhorn Sloughs, and Carmel. Counties of occurrence include Santa Cruz, Santa Clara, San Benito, Monterey, and San Luis Obispo.

There is considerable agricultural use in most counties within this ESU. There is a potential for steelhead waters to drain agricultural areas. Reportable usage of chlorpyrifos in counties where this ESU occurs are presented in Table 20.

Table 20. Use of chlorpyrifos in counties with the South-Central California steelhead ESU.

County	Crop	Usage (pounds)	Acres treated
Santa Cruz	apple	1255	818
	broccoli	168	130
	brussel sprout	3224	3,516
	cauliflower	201	198
	other	502	
Santa Clara	apple	24	16
	alfalfa	167	241
	broccoli	223	234
	Chinese cabbage	105	105
	landscape maintenance	1687	
	sweet corn	329	358
	grapes	626	314
	structural (termites)	1250	
	other	331	
San Benito	alfalfa	209	210
	apple	286	217
	broccoli	577	581
	cabbage	1078	1,028
	cauliflower	144	161
	grape	277	139
	walnut	1239	910
	other	316	

County	Crop	Usage (pounds)	Acres treated
Monterey	bok choy	149	119
	broccoli	33002	24,682
	brussel sprout	1541	1,550
	cabbage	2255	1,955
	cauliflower	11175	11,292
	chinese cabbage	205	149
	corn	114	46
	grape	2568	1,442
	kale	734	819
	lemon	428	229
	radish	599	259
	rappini	253	131
	walnut	239	120
	structural (termites)	751	
	other	506	
San Luis Obispo	alfalfa	110	150
	apple	180	90
	bok choy	542	479
	broccoli	3764	2,818
	cabbage	145	137
	cauliflower	980	1,228
	chinese cabbage	1853	1,640
	grape	2199	1,107
	landscape maintenance	124	
	lemon	1386	826
	orange	373	164
	nursery	122	
	structural (termites)	1048	
	other	112	

Chlorpyrifos use within the South Central California steelhead ESU is moderate. The greatest uses are on broccoli and cauliflower in Monterey county. Again, these acreages are high enough that even with DPR's bulletins, an impact is possible and we therefore conclude that chlorpyrifos may affect the South Central California steelhead 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 drainages 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 (Table 21).

Table 21. Use of chlorpyrifos in counties with the Central California Coast steelhead ESU.

County	Crop	Usage (pounds)	Acres treated
Santa Cruz	apple	1255	818
	broccoli	168	130
	brussel sprout	3224	3,516
	cauliflower	201	198
	other	502	
San Mateo	brussel sprout	1816	2,257
	structural (termites)	542	
	other	90	
San Francisco	other	40	
Marin	structural (termites)	288	
	other	52	
Sonoma	apple	1380	1,408
	landscape maintenance	615	
	structural (termites)	1252	
	other	83	
Mendocino	apple	225	112
	pear	2195	1,867
	structural (termites)	349	
	other	23	
Napa	structural (termites)	187	
	other	21	

County	Crop	Usage (pounds)	Acres treated
Alameda	structural (termites)	877	
	other	3	
Contra Costa	asparagus	133	133
	landscape maintenance	349	
	structural (termites)	12663	
	other	100	
Solano	alfalfa	1710	2,974
	almond	506	287
	grass, seed	705	231
	sorghum/milo	238	355
	sunflower	172	133
	walnut	2768	1,514
	structural (termites)	2816	
	other	148	
Santa Clara	apple	24	16
	alfalfa	167	241
	broccoli	223	234
	Chinese cabbage	105	105
	landscape maintenance	1687	
	sweet corn	329	358
	grapes	626	314
	structural (termites)	1250	
	other	331	

Use of chlorpyrifos in this region is fairly low except for the potential termiticide use. Because of the low usage, the relatively few acres treated, the likelihood that the termiticide use will not continue, and because of the provisions of DPR's county bulletins, the use of chlorpyrifos may affect, but is not likely to adversely affect the South Central California Steelhead ESU.

(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, Napa, Nevada, Placer, Sacramento, San Benito, San Francisco, San Joaquin, San Mateo, San Francisco, Santa Clara, Shasta, Solano, Sonoma, Stanislaus, Sutter, Tehama, Tuloumne, Yolo, and Yuba. A large proportion of this area is heavily agricultural, but there are also large amounts of urban and suburban areas. Usage of chlorpyrifos in counties where the California Central Valley steelhead ESU occurs is presented in Table 22. Most agricultural use of chlorpyrifos would likely be as a spray in orchards during the dormant season.

Table 22. Use of chlorpyrifos in counties with the California Central Valley steelhead ESU.

County	Crop	Usage (pounds)	Acres treated
Alameda	structural (termites)	877	
	other	3	
Amador	walnut	263	132
	other	51	
Butte	alfalfa	342	645
	almond	3886	2,529
	orange	113	97
	peach	211	142
	prune	269	205
	walnut	18536	10,019
	structural (termites)	203	
	other	105	
Calaveras	walnut	260	155
	other	12	
Colusa	alfalfa	613	1,189
	almond	974	696
	cotton	2880	3,373
	walnut	1543	834
	other	120	
Contra Costa	asparagus	133	133
	landscape maintenance	349	
	structural (termites)	12663	
	other	100	
Glenn	alfalfa	1548	2,796
	almond	3754	2,327
	cotton	951	1,029
	orange	233	110
	sunflower	146	279
	walnut	6488	3,771
	other	96	
Marin	structural (termites)	288	
	other	52	

County	Crop	Usage (pounds)	Acres treated
Merced	alfalfa	8022	14503
	almond	21396	15,623
	asparagus	223	224
	chinese cabbage	138	132
	corn	2964	3,020
	cotton	8916	9,167
	fig	2684	1,350
	orange	1044	541
	sweet potato	4868	2,457
	walnut	4365	2,481
	structural (termites)	5846	
	other	402	
Napa	structural (termites)	187	
	other	21	
Nevada	structural (termites)	748	
	other	26	
Placer	structural (termites)	17713	
	landscape maintenance	109	
	other	32	
Sacramento	alfalfa	1632	2,325
	apple	326	162
	corn	180	181
	landscape maintenance	1420	
	pear	696	348
	walnut	181	119
	nursery	104	
	structural (termites)	24720	
	other	46	
San Benito	alfalfa	209	210
	apple	286	217
	broccoli	577	581
	cabbage	1078	1,028
	cauliflower	144	161
	grape	277	139
	walnut	1239	910
	other	316	
San Joaquin	alfalfa	5650	11,422
	almond	5890	3,265
	apple	661	538
	asparagus	2263	2,311
	corn	3179	2,348
	pear	146	73
	walnut	18506	10,482

County	Crop	Usage (pounds)	Acres treated
	nursery	139	
	structural (termites)	13690	
	other	309	
San Mateo	brussel sprout	1816	2,257
	structural (termites)	542	
	other	90	
San Francisco	other	40	
Santa Clara	apple	24	16
	alfalfa	167	241
	broccoli	223	234
	Chinese cabbage	105	105
	landscape maintenance	1687	
	sweet corn	329	358
	grapes	626	314
	structural (termites)	1250	
	other	331	
Shasta	mint	249	189
	turf/sod	324	320
	walnut	352	175
	other	122	
Solano	alfalfa	1710	2,974
	almond	506	287
	grass, seed	705	231
	sorghum/milo	238	355
	sunflower	172	133
	walnut	2768	1,514
	other	148	
Sonoma	apple	1380	1,408
	landscape maintenance	615	
	structural (termites)	1252	
	other	83	
Stanislaus	alfalfa	5199	10,136
	almond	36984	20,605
	animal premises	452	
	apple	1528	872
	citrus	741	100
	corn	3595	3,102
	sweet potato	671	325
	walnut	23188	12,878
	structural (termites)	9504	
	other	238	

County	Crop	Usage (pounds)	Acres treated
Sutter	alfalfa	547	1143
	bean, dried	981	
	cabbage	104	133
	peach	610	376
	walnut	16541	8,806
	structural (termites)	254	
	other	330	
Tehama	alfalfa	553	863
	almond	2704	1,422
	prune	107	160
	walnut	7847	4,514
	other	23	
Tuolumne	other	172	
Yolo	alfalfa	7657	14996
	almond	267	157
	cotton	699	751
	pear	143	96
	sorghum/milo	260	330
	walnut	5005	2869
	nursery	759	
	structural (termites)	972	
	other	148	
Yuba	peach	160	80
	pear	268	162
	prune	540	285
	walnut	6022	3,075
	structural (termites)	676	

There is substantial use of chlorpyrifos on orchards, as well as cotton and alfalfa, within the California Central Valley steelhead ESU. The use of chlorpyrifos may affect this ESU. DPR's bulletins will mitigate most of the risk, but cannot completely eliminate the "may affect" determination for the California Central Valley Steelhead 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, Glenn, Lake, and Sonoma. Glenn and Lake counties are excluded from this particular analysis because the hydrologic units in these counties are entirely within the Mendocino National Forest, where there will be no chlorpyrifos usage. Table 23 shows the reported use of chlorpyrifos in these counties.

Table 23. Use of chlorpyrifos in counties with the Northern California steelhead ESU.

County	Crop	Usage (pounds)	Acres treated
Humboldt	other	20	
Mendocino	apple	225	112
	pear	2195	1,867
	structural (termites)	349	
	other	23	
Sonoma	apple	1380	1,408
	landscape maintenance	615	
	structural (termites)	1252	
	other	83	
Trinity	other	2	

Chlorpyrifos use within the Northern California steelhead ESU is limited. I conclude that with the provisions of the DPR bulletins, chlorpyrifos use may affect, but is not likely to adversely affect the Northern California Steelhead 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.

Note: Adams County, WA was not one of the counties named in the critical habitat FR Notice, but appears to be included in a hydrologic unit named in that notice. We have included it here, but seek NMFS guidance for future efforts.

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

Note: As discussed at the beginning of the ESU discussions, we have excluded Clackamas and Washington counties in Oregon from the migratory corridors.

Table 24 shows the cropping information where chlorpyrifos can be used in Washington counties where the Upper Columbia River steelhead ESU is located. Table 25 shows the information for the Oregon and Washington counties where this ESU migrates. In these tables, if there is no acreage given for a specific crop, this means that there are too few growers in the area for USDA to make the data available.

Table 24. Crops on which chlorpyrifos can be used in counties containing spawning and rearing habitat for the Upper Columbia River steelhead ESU.

State	County	Crops and acreage planted	Acres	Total acreage
WA	Adams	corn (5,388), wheat (303,813), sugarbeets (1,570), grass seed (7,487), alfalfa (22,350), asparagus (422), snap beans (102), dry onions (1,453), apples (3,457), cherries, grapes, pears, mint (7,328)	353,370	1231999
WA	Benton	corn, wheat (130,981), sugarbeets (4,284), grass seed, alfalfa (13,241), asparagus (1,638), dry onions (3,398), apples (18,425), apricots (174), cherries (3,219), grapes (15,929), nectarines (106), peaches (149), pears (472), plums & prunes (180), walnuts (41), mint, nursery crops (161)	192398	1089993
WA	Chelan	wheat (1,864), alfalfa (1,210), apples (17,096), apricots (81), cherries (3,704), nectarines (22), peaches (21), pears (8,298), plums & prunes (3), walnuts, Christmas trees (42)[a], nursery crops (12)	32353	1869848
WA	Douglas	wheat (200,291), alfalfa (1,763), apples (14,383), apricots (315), cherries (1,842), nectarines (91), peaches (167), pears (1,104), nursery crops (7)	219963	1165158

State	County	Crops and acreage planted	Acres	Total acreage
WA	Franklin	corn (11,337), wheat (109,627), sunflower (698), sugarbeets, grass seed, alfalfa (70,943), asparagus (8,610), snap beans (236), carrots (3,574), dry onions (4,074), apples (9,000), apricots (68), cherries (2,165), grapes (2,813), nectarines (129), peaches (262), pears (156), plums & prunes (43), walnuts, strawberries (17), mint (1,586)	225,338	794999
WA	Grant	corn (29,953), wheat (203,498), sugarbeets (10,792), grass seed (6,801), alfalfa (115,509), asparagus (940), snap beans (671), carrots (2,207), dry onions (6,214), apples (33,615), apricots (266), cherries (3,470), grapes (3,132), nectarines (163), peaches (261), pears (998), plums & prunes (5), filberts, walnuts (5), strawberries (2), mint (15,610), nursery crops (1562)	435674	1712881
WA	Kittitas	wheat (5,224), alfalfa (8,571), apples (1,859), cherries, peaches (1), pears (331), plums & prunes (1), filberts (1), mint (409), Christmas trees (23)[a]	16420	1469862
WA	Okanogan	wheat (8,410), alfalfa (21,880), broccoli (1), carrots (1), apples (24,164), apricots (13), cherries (1,003), nectarines (38), peaches (67), pears (3,280), plums & prunes (1), filberts (10), walnuts (29), strawberries, Christmas trees (22)[a], nursery crops (25)	58944	3371698
WA	Yakima	corn (12,680), wheat (50,430), grass seed (1,070), alfalfa (33,833), asparagus (7,034), snap beans (106), cabbage (144), dry onions, turnips (40), apples (75,264), apricots (285), cherries (6,129), grapes (15,529), nectarines (605), peaches (1,438), pears (10,190), plums & prunes (478), filberts (6), walnuts (11), nursery crops (408)	215680	2749514

Table 25. Crops on which chlorpyrifos can be used in counties in the migration corridor of the Upper Columbia River steelhead ESU.

State	County	Crops and acreage planted	Acres	Total acreage
OR	Clatsop	alfalfa, apples, cranberries (32), Christmas trees (72)[a] , nursery crops (3)	107	529482

State	County	Crops and acreage planted	Acres	Total acreage
OR	Columbia	corn (48), wheat, alfalfa (421), apples (39), cherries (7), grapes (6), peaches, pears (12), plums & prunes (2), filberts, walnuts (11), other nuts, strawberries (6), Christmas trees (1,239)[a]	1791	420332
OR	Gilliam	wheat (95,584), alfalfa (2,450)	98034	770,664
OR	Hood River	wheat, alfalfa (443), broccoli, apples (2,592), cherries (1,081), grapes (63), peaches (13), pears (11,788), Christmas trees (178)[a]	16158	334,328
OR	Morrow	corn (9,276), wheat (167,070), sugarbeets, grass seed (1,113), alfalfa (22,180), dry onions (1,284), apples	200923	1301021
OR	Multnomah	wheat (1,688), grass seed, alfalfa (389), broccoli (29), cabbage (459), carrots, cauliflower (55), turnips, apples (51), cherries (8), grapes (28), peaches (36), pears (25), plums & prunes (3), walnuts (2), other nuts, strawberries (171), Christmas trees (273)[a], nursery crops (2609)	5826	278,570
OR	Sherman	wheat (99,837), alfalfa (230)	100067	526,911
OR	Umatilla	corn (6,901), wheat (263,624), grass seed (10,064), alfalfa (24,013), asparagus (1,093), snap beans (587), dry onions (3,914), apples (3,927), apricots (14), cherries (349), grapes (163), nectarines, peaches (7), pears (4), plums & prunes (365), strawberries (9), mint	315034	2,057,809
WA	Clark	grass seed, alfalfa (836), snap beans (2), cabbage, apples (33), cherries, grapes (32), peaches (46), pears (75), plums & prunes (10), filberts (87), walnuts (51), strawberries (162), mint, Christmas trees (679)[a], nursery crops (122)	2135	401,850
WA	Cowlitz	wheat (293), alfalfa (105), snap beans (1), carrots, apples (14), cherries (2), grapes, pears (3), filberts (1), walnuts (5), strawberries, Christmas trees (128)[a], nursery crops (54)	606	728,781
WA	Klickitat	wheat (40,401), grass seed, alfalfa (28,434), cabbage, apples (516), apricots (18), cherries (457), grapes (419), peaches (199), pears (923), plums & prunes (1), walnuts	71368	1,198,385
WA	Pacific	alfalfa (110), apples, cherries, grapes, cranberries (1312), Christmas trees (93)[a]	1515	623,722

State	County	Crops and acreage planted	Acres	Total acreage
WA	Skamania	alfalfa (164), apples (75), grapes, pears (477), other nuts (4)	720	1,337,179
WA	Wahkiakum	alfalfa	0	169,125
WA	Walla Walla	corn (6,539), wheat (232,419), grass seed (8,233), alfalfa (11,787), asparagus (1,414), snap beans (250), cabbage (6), carrots, dry onions (2,172), radishes, apples (5,222), cherries (280), grapes, plums & prunes (22)	268344	813,108

There is a considerable amount of acreage, especially orchard crops, where chlorpyrifos may be used within the reproductive and rearing area of this ESU. In these counties there are 164,000 acres of apples, 24,000 acres of pears, and 18,000 acres of cherries, as well as 24,000 acres of mint, sugarbeets, and dry onions, all of which have large percentages of the crop treated with chlorpyrifos. While only 1% of the crop may be treated nationally, there are over 1,000,000 acres of wheat, and there are over 250,000 acres of alfalfa, of which 3% may be treated, in the reproduction and rearing parts of this ESU. There is much less acreage likely to be treated with chlorpyrifos in the migration corridor, and the Columbia River provides substantial dilution. I conclude that the use of chlorpyrifos may affect this ESU in its spawning and rearing areas.

(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, Walla Walla, Adams, Lincoln, and Spokane in Washington; and Adams, Idaho, Nez Perce, Blaine, Custer, Lemhi, Boise, Valley, Lewis, Clearwater, and Latah in Idaho. We have excluded Baker County, Oregon, which has a tiny fragment of the Imnaha River. While a small part of Rock Creek 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 chlorpyrifos use in agricultural areas. We have similarly excluded the Upper Grande Ronde watershed tributaries (e.g., Looking Glass and Cabin Creeks) that are barely into higher elevation forested areas of Umatilla County. 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. These areas are not relevant to use of chlorpyrifos. 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 it was included.

Note: We are uncertain about the inclusion of Adams, Lincoln and Spokane counties in Washington in this ESU. They are not named in the Critical Habitat FR Notice, but they appear to include waters in the listed hydrologic unit. We have included them below, but will be seeking NMFS guidance in a separate request.

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 Walla Walla, Benton, Klickitat, Skamania, Clark, Cowlitz, Wahkiakum, and Pacific in Washington.

Table 26 and Table 27 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. In these tables, if there is no acreage given for a specific crop, this means that there are too few growers in the area for USDA to make the data available.

Table 26. Crops on which chlorpyrifos can be used in counties containing spawning and rearing habitat for the Snake River Basin steelhead ESU.

State	County	Crops and acreage planted	Acres	Total acreage
ID	Adams	corn (104), wheat (200), alfalfa (9,223), apples	9527	873,399
ID	Clearwater	wheat (9,106), grass seed (839), alfalfa (2,640)	12585	1,575,396
ID	Custer	wheat (645), alfalfa (24,467)	25112	3152382
ID	Idaho	wheat (62,283), grass seed, alfalfa (20,266), apples (6), cherries (2), grapes (1), peaches, pears (2), plums & prunes (2), filberts, Christmas trees (20)[a]	82582	5430522
ID	Latah	wheat (90,706), grass seed (3,161), alfalfa (7,202), apples (3), cherries (19), pears, Christmas trees (78)[a]	101169	689,089
ID	Lemhi	alfalfa (28,143), apples (6), apricots, cherries (9), peaches (3), pears (2)	28163	2,921,172
ID	Lewis	wheat (64,367), grass seed, alfalfa (3,885)	68252	306,601
ID	Valley	wheat (652), alfalfa (1,599), carrots	2251	2,354,043
OR	Union	wheat (36,394), sugarbeets (1,035), grass seed (7,236), alfalfa (25,818), carrots, apples (39), apricots, cherries (596), peaches (12), pears, plums & prunes, mint (9,226), Christmas trees (55)[a]	80411	1,303,476
OR	Wallowa	wheat (14,502), grass seed (189), alfalfa (18,253), apples (8), peaches, nursery crops (6)	32958	2,013,071

State	County	Crops and acreage planted	Acres	Total acreage
WA	Adams	corn (5,388), wheat (303,813), sugarbeets (1,570), grass seed (7,487), alfalfa (22,350), asparagus (422), snap beans (102), dry onions (1,453), apples (3,457), cherries, grapes, pears, mint (7,328)	353370	1,231,999
WA	Asotin	wheat (21,110), grass seed (1,136), alfalfa (1,648), apples (24), apricots (5), cherries (17), peaches (18), pears (6)	23964	406,983
WA	Benton	corn, wheat (130,981), sugarbeets (4,284), grass seed, alfalfa (13,241), asparagus (1,638), dry onions (3,398), apples (18,425), apricots (174), cherries (3,219), grapes (15,929), nectarines (106), peaches (149), pears (472), plums & prunes (180), walnuts (41), mint, nursery crops (161)	192398	1,089,993
WA	Columbia	corn (51), wheat (77,511), grass seed (253), alfalfa (1,780), apples	79595	556,034
WA	Franklin	corn (11,337), wheat (109,627), sunflower (698), sugarbeets, grass seed, alfalfa (70,943), asparagus (8,610), snap beans (236), carrots (3,574), dry onions (4,074), apples (9,000), apricots (68), cherries (2,165), grapes (2,813), nectarines (129), peaches (262), pears (156), plums & prunes (43), walnuts, strawberries (17), mint (1,586)	225338	794,999
WA	Garfield	wheat (71,689), grass seed (2,830), alfalfa (802)	75321	454,744
WA	Lincoln	corn (564), wheat (355,317), sugarbeets, grass seed (1,676), alfalfa (15,972), carrots, apples, cherries (1)	373350	1,479,196
WA	Spokane	corn, wheat (115,324), grass seed (22,657), alfalfa (35,493), snap beans, carrots (34), dry onions, apples (227), apricots (11), cherries (50), grapes (3), pears (24), plums & prunes (1), strawberries (30), Christmas trees (127)[a], nursery crops (128)	174109	1,128,835
WA	Walla Walla	corn (6,539), wheat (232,419), grass seed (8,233), alfalfa (11,787), asparagus (1,414), snap beans (250), cabbage (6), carrots, dry onions (2,172), radishes, apples (5,222), cherries (280), grapes, plums & prunes (22)	268344	813108

State	County	Crops and acreage planted	Acres	Total acreage
WA	Whitman	corn (101), wheat (478,098), grass seed (4,251), alfalfa (6,644), apples (19), cherries, pears (2), mint (12,577), Christmas trees (4)[a]	501696	1382006

Table 27. Crops on which chlorpyrifos can be used in counties in the migration corridor of the Snake River Basin steelhead ESU.

State	County	Crops and acreage planted	Acres	Total acreage
OR	Clatsop	alfalfa, apples, cranberries (32), Christmas trees (72)[a] , nursery crops (3)	107	529,482
OR	Columbia	corn (48), wheat, alfalfa (421), apples (39), cherries (7), grapes (6), peaches, pears (12), plums & prunes (2), filberts, walnuts (11), other nuts, strawberries (6), Christmas trees (1,239)[a]	1791	420332
OR	Gilliam	wheat (95,584), alfalfa (2,450)	98034	770664
OR	Hood River	wheat, alfalfa (443), broccoli, apples (2,592), cherries (1,081), grapes (63), peaches (13), pears (11,788), Christmas trees (178)[a]	16158	334328
OR	Morrow	corn (9,276), wheat (167,070), sugarbeets, grass seed (1,113), alfalfa (22,180), dry onions (1,284), apples	200923	1301021
OR	Multnomah	wheat (1,688), grass seed, alfalfa (389), broccoli (29), cabbage (459), carrots, cauliflower (55), turnips, apples (51), cherries (8), grapes (28), peaches (36), pears (25), plums & prunes (3), walnuts (2), other nuts, strawberries (171), Christmas trees (273)[a], nursery crops (2609)	5826	278570
OR	Sherman	wheat (99,837), alfalfa (230)	100067	526911
OR	Umatilla	corn (6,901), wheat (263,624), grass seed (10,064), alfalfa (24,013), asparagus (1,093), snap beans (587), dry onions (3,914), apples (3,927), apricots (14), cherries (349), grapes (163), nectarines, peaches (7), pears (4), plums & prunes (365), strawberries (9), mint	315034	2057809
OR	Wasco	wheat (63,369), grass seed (169), alfalfa (7,239), apples (463), apricots (32), cherries (7,352), grapes (110), peaches (30), pears (385), plums & prunes, strawberries	79149	1523958

State	County	Crops and acreage planted	Acres	Total acreage
WA	Benton	corn, wheat (130,981), sugarbeets (4,284), grass seed, alfalfa (13,241), asparagus (1,638), dry onions (3,398), apples (18,425), apricots (174), cherries (3,219), grapes (15,929), nectarines (106), peaches (149), pears (472), plums & prunes (180), walnuts (41), mint, nursery crops (161)	192398	1089993
WA	Cowlitz	wheat (293), alfalfa (105), snap beans (1), carrots, apples (14), cherries (2), grapes, pears (3), filberts (1), walnuts (5), strawberries, Christmas trees (128)[a], nursery crops (54)	606	728781
WA	Klickitat	wheat (40,401), grass seed, alfalfa (28,434), cabbage, apples (516), apricots (18), cherries (457), grapes (419), peaches (199), pears (923), plums & prunes (1), walnuts	71368	1198385
WA	Pacific	alfalfa (110), apples, cherries, grapes, cranberries (1312), Christmas trees (93)[a]	1515	623722
WA	Skamania	alfalfa (164), apples (75), grapes, pears (477), other nuts (4)	720	1337179
WA	Wahkiakum	alfalfa	0	169125

There is a considerable amount of acreage, especially orchard crops, where chlorpyrifos may be used within the reproductive area of this ESU. In these counties there are 36,000 acres of apples, 5,000 acres of cherries, and 46,000 acres of mint, sugarbeets, dry onions, and pears in the reproductive and spawning areas. Very large acreage of wheat and alfalfa occurs. Counties in the migration corridor contain nearly 150,000 acres of orchard and 15,000 acres of sugarbeets and dry onions. The use of chlorpyrifos may affect the Snake River Basin Steelhead 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 mountainous forested areas where chlorpyrifos would not be used, and these counties are excluded from the analysis.

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 migration corridors, and include Multnomah, Columbia, and Clatsop counties, Oregon, and Clark, Cowlitz, Wahkiakum, and Pacific counties, Washington.

Table 28 and Table 29 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. In these tables, if there is no acreage given for a specific crop, this means that there are too few growers in the area for USDA to make the data available.

Table 28. Crops on which chlorpyrifos can be used in counties containing spawning and rearing habitat for the Upper Willamette steelhead ESU.

State	County	Crops and acreage planted	Acres	Total acreage
OR	Benton	wheat (4,338), grass seed, alfalfa (570), snap beans (3,080), broccoli, Christmas trees (5822)[a], dry onions (3), apples (62), cherries (18), grapes (242), peaches (8), pears (7), plums & prunes (5), filberts (493), walnuts (23), strawberries (17), mint (2,925), nursery crops (149)	15779	432,961
OR	Clackamas	corn (14), wheat (1,783), grass seed (9,829), alfalfa (1,072), snap beans (334), broccoli (184), cabbage (72), Christmas trees (17,715)[a], cauliflower (319), dry onions, radishes (144), turnips, apples (167), cherries (53), grapes (207), peaches (78), pears (37), plums & prunes (37), filberts (3,994), walnuts (51), strawberries (608), nursery crops (10,503)	47201	1,195,712
OR	Linn	corn (4), wheat (5,306), grass seed (198,471), alfalfa (2,507), snap beans (2,688), broccoli (267), cabbage, carrots, cauliflower (164), dry onions (1), apples (133), cherries (157), grapes (93), nectarines (3), peaches (73), plums & prunes (14), filberts (1,820), walnuts (55), strawberries (52), mint (4,105), Christmas trees (1,083)[a], nursery crops (155)	217151	1,466,507

State	County	Crops and acreage planted	Acres	Total acreage
OR	Marion	corn (16), wheat (10,341), grass seed (98,930), alfalfa (1,315), snap beans (12,101), broccoli (2,548), cabbage (157), carrots (76), cauliflower (1,505), dry onions (2,036), apples (555), cherries (1,568), grapes (761), nectarines, peaches (179), pears (150), plums & prunes (145), filberts (7,061), walnuts (15), strawberries (1,858), mint (3,695), Christmas trees (8,590)[a], nursery crops (7090)	160692	758,394
OR	Polk	wheat (9,741), grass seed (52,375), alfalfa (774), snap beans (598), broccoli, cabbage, carrots, apples (157), apricots, cherries (1,888), grapes (1,123), peaches (51), pears (63), plums & prunes (595), filberts (2,394), walnuts (33), other nuts, strawberries (22), mint (2,448), Christmas trees (4,508)[a]	76770	474,296
OR	Washington	wheat (17,020), grass seed (18,465), alfalfa (1,680), snap beans (988), broccoli (400), cabbage, carrots (1), cauliflower, dry onions (196), apples (279), cherries (211), grapes (989), peaches (168), pears (69), plums & prunes (358), filberts (5,595), walnuts (679), other nuts, strawberries (1,257), Christmas trees (2,695)[a], nursery crops (4130)	55160	463,231
OR	Yamhill	corn, wheat (13,989), grass seed (32,904), alfalfa (2,294), snap beans (1,838), broccoli (308), dry onions, apples (310), cherries (1,693), grapes (2,887), nectarines, peaches (104), pears (54), plums & prunes (369), filberts (7,110), walnuts (608), other nuts (41), strawberries (265), Christmas trees (1,811)[a], nursery crops (3444)	70029	457,986

a. The Agricultural census only provides acreage for cut Christmas trees; to account for uncut trees that may be treated, we have multiplied the cut tree acreage by 7 up to the maximum acreage for "other nursery crops" (which includes uncut Christmas trees) in the census.

Table 29. Crops on which chlorpyrifos can be used in counties in the migration corridor of the Upper Willamette steelhead ESU.

State	County	Crops and acreage planted	Acres	Total acreage
OR	Clatsop	alfalfa, apples, cranberries (32), Christmas trees (72)[a], nursery crops (3)	107	529,482

State	County	Crops and acreage planted	Acres	Total acreage
OR	Columbia	corn (48), wheat, alfalfa (421), apples (39), cherries (7), grapes (6), peaches, pears (12), plums & prunes (2), filberts, walnuts (11), other nuts, strawberries (6), Christmas trees (1,239)[a]	1791	420,332
OR	Multnomah	wheat (1,688), grass seed, alfalfa (389), broccoli (29), cabbage (459), carrots, cauliflower (55), turnips, apples (51), cherries (8), grapes (28), peaches (36), pears (25), plums & prunes (3), walnuts (2), other nuts, strawberries (171), Christmas trees (273)[a], nursery crops (2609)	5826	278,570
WA	Clark	grass seed, alfalfa (836), snap beans (2), cabbage, apples (33), cherries, grapes (32), peaches (46), pears (75), plums & prunes (10), filberts (87), walnuts (51), strawberries (162), mint, Christmas trees (679)[a], nursery crops (122)	2135	401,850
WA	Cowlitz	wheat (293), alfalfa (105), snap beans (1), carrots, apples (14), cherries (2), grapes, pears (3), filberts (1), walnuts (5), strawberries, Christmas trees (128)[a], nursery crops (54)	606	728,781
WA	Pacific	alfalfa (110), apples, cherries, grapes, cranberries (1312), Christmas trees (93)[a]	1515	623,722
WA	Wahkiakum	alfalfa	0	169,125

a. The Agricultural census only provides acreage for cut Christmas trees; to account for uncut trees that may be treated, we have multiplied the cut tree acreage by 7 up to the maximum acreage for "other nursery crops" (which includes uncut Christmas trees) in the census.

There is a moderate amount of acreage, over 20,000 acres of fruit and nut orchards, 15,000 acres of mint and dry onion, where chlorpyrifos may be used, along with at least 20,000 acres of Christmas trees, nursery crops, and grass seeds known to be treated with chlorpyrifos in the reproductive and growth areas of this ESU. There is almost no acreage of crops with high chlorpyrifos use in the migration corridor. The use of chlorpyrifos may affect the Upper Willamette River steelhead 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 Hood River, Clackamas, and Multnomah counties in Oregon, and Skamania, Clark, Cowlitz, and Lewis 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.

Table 30 and Table 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. In these tables, if there is no acreage given for a specific crop, this means that there are too few growers in the area for USDA to make the data available.

Table 30. Crops on which chlorpyrifos can be used in counties containing spawning and rearing habitat for the Lower Columbia River steelhead ESU.

State	County	Crops and acreage planted	Acres	Total acreage
OR	Clackamas	corn (14), wheat (1,783), grass seed (9,829), alfalfa (1,072), snap beans (334), broccoli (184), cabbage (72), cauliflower (319), Christmas trees (17,715)[a], dry onions, radishes (144), turnips, apples (167), cherries (53), grapes (207), peaches (78), pears (37), plums & prunes (37), filberts (3,994), walnuts (51), strawberries (608), nursery crops (10,503)	47201	1,195,712
OR	Hood River	wheat, alfalfa (443), broccoli, apples (2,592), cherries (1,081), grapes (63), peaches (13), pears (11,788), Christmas trees (178)[a]	16158	334,328

State	County	Crops and acreage planted	Acres	Total acreage
OR	Multnomah	wheat (1,688), grass seed, alfalfa (389), broccoli (29), cabbage (459), carrots, cauliflower (55), turnips, apples (51), cherries (8), grapes (28), peaches (36), pears (25), plums & prunes (3), walnuts (2), other nuts, strawberries (171), Christmas trees (273)[a], nursery crops (2,609)	5826	278,570
WA	Clark	grass seed, alfalfa (836), snap beans (2), cabbage, apples (33), cherries, grapes (32), peaches (46), pears (75), plums & prunes (10), filberts (87), walnuts (51), strawberries (162), mint, Christmas trees (679)[a], nursery crops (122)	2135	401,850
WA	Cowlitz	wheat (293), alfalfa (105), snap beans (1), carrots, apples (14), cherries (2), grapes, pears (3), filberts (1), walnuts (5), strawberries, Christmas trees (128)[a], nursery crops (54)	606	728,781
WA	Lewis	wheat (1,104), alfalfa (937), snap beans, apples (77), cherries (10), grapes (4), pears (8), plums & prunes (3), filberts (25), walnuts (4), other nuts (14), strawberries, Christmas trees (7,323)[a]	9509	1,540,991
WA	Skamania	alfalfa (164), apples (75), grapes, pears (477), other nuts (4)	720	1,337,179

a. The Agricultural census only provides acreage for cut Christmas trees; to account for uncut trees that may be treated, we have multiplied the cut tree acreage by 7 up to the maximum acreage for "other nursery crops" (which includes uncut Christmas trees) in the census.

Table 31. Crops on which chlorpyrifos can be used in counties in the migration corridor of the Lower Columbia River steelhead ESU.

State	County	Crops and acreage planted	Acres	Total acreage
OR	Clatsop	alfalfa, apples, cranberries (32), Christmas trees (72)[a], nursery crops (3)	107	529,482
OR	Columbia	corn (48), wheat, alfalfa (421), apples (39), cherries (7), grapes (6), peaches, pears (12), plums & prunes (2), filberts, walnuts (11), other nuts, strawberries (6), Christmas trees (1,239)[a]	1791	420,332
WA	Pacific	alfalfa (110), apples, cherries, grapes, cranberries (1312), Christmas trees (93)[a]	1515	623,722
WA	Wahkiakum	alfalfa	0	169,125

a. The Agricultural census only provides acreage for cut Christmas trees; to account for uncut trees that may be treated, we have multiplied the cut tree acreage by 7 up to the maximum acreage for "other nursery crops" (which includes uncut Christmas trees) in the census.

There is only modest acreage where chlorpyrifos can be used in counties containing reproductive and growth areas of this ESU, except Hood River County, which contains about 15,000 acres of orchards and Clackamas County where chlorpyrifos is known to be used on Christmas trees and nursery crops. The counties included in the migratory corridor for this ESU contain almost no crops on which chlorpyrifos is likely to be used. The use of chlorpyrifos may affect the Lower Columbia River steelhead 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.

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, we 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. Union and Wallowa Counties, Oregon were excluded because the small reaches of the Umatilla and Walla Walla Rivers in these counties occur in high elevation areas where crops are not grown.

The Oregon counties then that appear to have spawning and rearing habitat are Gilliam, Morrow, Umatilla, Sherman, Wasco, Crook, Grant, Wheeler, and Jefferson counties. Washington counties providing spawning and rearing habitat would be Benton, Columbia, Franklin, Kittitas, Klickitat, Skamania, Walla Walla, and Yakima. Only small portions of Franklin and Skamania Counties intersect with the spawning and rearing habitat of this ESU.

Migratory corridors include Hood River, Multnomah, Columbia, and Clatsop counties in Oregon, and Skamania, Clark, Cowlitz, Wahkiakum, and Pacific Counties in Washington.

Table 32 and Table 33 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. In these tables, if there is no acreage given for a specific crop, this means that there are too few growers in the area for USDA to make the data available.

Table 32. Crops on which chlorpyrifos can be used in counties containing spawning and rearing habitat for the Middle Columbia River steelhead ESU.

State	County	Crops and acreage planted	Acres	Total acreage
OR	Crook	wheat (2,362), sugarbeets (1,510), grass seed (186), alfalfa (14,023), mint (5,501)	23582	1,906,892
OR	Gilliam	wheat (95,584), alfalfa (2,450)	98034	770,664
OR	Grant	wheat (579), alfalfa (11,296), apples, apricots (19), pears	11894	2,898,444
OR	Jefferson	wheat (12,470), sugarbeets (2,396), grass seed (9,627), alfalfa (10,944), apples (4), mint (3,105)	38546	1,139,744
OR	Morrow	corn (9,276), wheat (167,070), sugarbeets, grass seed (1,113), alfalfa (22,180), dry onions (1,284), apples	200923	1,301,021
OR	Sherman	wheat (99,837), alfalfa (230)	100067	526,911
OR	Umatilla	corn (6,901), wheat (263,624), grass seed (10,064), alfalfa (24,013), asparagus (1,093), snap beans (587), dry onions (3,914), apples (3,927), apricots (14), cherries (349), grapes (163), nectarines, peaches (7), pears (4), plums & prunes (365), strawberries (9), mint	315034	2,057,809
OR	Wasco	wheat (63,369), grass seed (169), alfalfa (7,239), apples (463), apricots (32), cherries (7,352), grapes (110), peaches (30), pears (385), plums & prunes, strawberries	79149	1,523,958
OR	Wheeler	wheat, alfalfa (5,494), apples (23)	5517	1,097,601
WA	Benton	corn, wheat (130,981), sugarbeets (4,284), grass seed, alfalfa (13,241), asparagus (1,638), dry onions (3,398), apples (18,425), apricots (174), cherries (3,219), grapes (15,929), nectarines (106), peaches (149), pears (472), plums & prunes (180), walnuts (41), mint, nursery crops (161)	192398	1,089,993

State	County	Crops and acreage planted	Acres	Total acreage
WA	Chelan	wheat (1,864), alfalfa (1,210), apples (17,096), apricots (81), cherries (3,704), nectarines (22), peaches (21), pears (8,298), plums & prunes (3), walnuts, Christmas trees (42)[a], nursery crops (12)	32353	1,869,848
WA	Columbia	corn (51), wheat (77,511), grass seed (253), alfalfa (1,780), apples	79595	556,034
WA	Franklin	corn (11,337), wheat (109,627), sunflower (698), sugarbeets, grass seed, alfalfa (70,943), asparagus (8,610), snap beans (236), carrots (3,574), dry onions (4,074), apples (9,000), apricots (68), cherries (2,165), grapes (2,813), nectarines (129), peaches (262), pears (156), plums & prunes (43), walnuts, strawberries (17), mint (1,586)	225338	794,999
WA	King	corn (30), alfalfa (358), snap beans, broccoli (8), cabbage (88), carrots (10), cauliflower, dry onions (4), radishes, turnips (2), apples (64), apricots (1), cherries (8), grapes (2), peaches (1), pears (19), plums & prunes (4), filberts (3), walnuts (3), strawberries (42), Christmas trees (346)[a], nursery crops (328)	1321	1,360,705
WA	Kittitas	wheat (5,224), alfalfa (8,571), apples (1,859), cherries, peaches (1), pears (331), plums & prunes (1), filberts (1), mint (409), Christmas trees (23)[a]	16420	1,469,862
WA	Klickitat	wheat (40,401), grass seed, alfalfa (28,434), cabbage, apples (516), apricots (18), cherries (457), grapes (419), peaches (199), pears (923), plums & prunes (1), walnuts	71368	1,198,385
WA	Lewis	wheat (1,104), alfalfa (937), snap beans, apples (77), cherries (10), grapes (4), pears (8), plums & prunes (3), filberts (25), walnuts (4), other nuts (14), strawberries, Christmas trees (7,323)[a]	9509	1,540,991
WA	Pierce	alfalfa (70), snap beans (200), cabbage (242), carrots, radishes, apples (61), cherries (5), grapes, pears (4), plums & prunes, filberts, strawberries (125), Christmas trees (765)[a], nursery crops (160)	1632	1,072,350
WA	Skamania	alfalfa (164), apples (75), grapes, pears (477), other nuts (4)	720	1,337,179

State	County	Crops and acreage planted	Acres	Total acreage
WA	Walla Walla	corn (6,539), wheat (232,419), grass seed (8,233), alfalfa (11,787), asparagus (1,414), snap beans (250), cabbage (6), carrots, dry onions (2,172), radishes, apples (5,222), cherries (280), grapes, plums & prunes (22)	268344	813,108
WA	Yakima	corn (12,680), wheat (50,430), grass seed (1,070), alfalfa (33,833), asparagus (7,034), snap beans (106), cabbage (144), dry onions, turnips (40), apples (75,264), apricots (285), cherries (6,129), grapes (15,529), nectarines (605), peaches (1,438), pears (10,190), plums & prunes (478), filberts (6), walnuts (11), nursery crops (408)	215680	2,749,514

a. The Agricultural census only provides acreage for cut Christmas trees; to account for uncut trees that may be treated, we have multiplied the cut tree acreage by 7 up to the maximum acreage for "other nursery crops" (which includes uncut Christmas trees) in the census.

Table 33. Crops on which chlorpyrifos can be used in counties in the migration corridor of the Middle Columbia River steelhead ESU.

State	County	Crops and acreage planted	Acres	Total acreage
OR	Clatsop	alfalfa, apples, cranberries (32), Christmas trees (72)[a], nursery crops (3)	107	529,482
OR	Columbia	corn (48), wheat, alfalfa (421), apples (39), cherries (7), grapes (6), peaches, pears (12), plums & prunes (2), filberts, walnuts (11), other nuts, strawberries (6), Christmas trees (1,239)[a]	1791	420,332
OR	Hood River	wheat, alfalfa (443), broccoli, apples (2,592), cherries (1,081), grapes (63), peaches (13), pears (11,788), Christmas trees (178)[a]	16158	334,328
OR	Multnomah	wheat (1,688), grass seed, alfalfa (389), broccoli (29), cabbage (459), carrots, cauliflower (55), turnips, apples (51), cherries (8), grapes (28), peaches (36), pears (25), plums & prunes (3), walnuts (2), other nuts, strawberries (171), Christmas trees (273)[a], nursery crops (2609)	5826	278,570
WA	Clark	grass seed, alfalfa (836), snap beans (2), cabbage, apples (33), cherries, grapes (32), peaches (46), pears (75), plums & prunes (10), filberts (87), walnuts (51), strawberries (162), mint, Christmas trees (679)[a], nursery crops (122)	2135	401,850

State	County	Crops and acreage planted	Acres	Total acreage
WA	Cowlitz	wheat (293), alfalfa (105), snap beans (1), carrots, apples (14), cherries (2), grapes, pears (3), filberts (1), walnuts (5), strawberries, Christmas trees (128)[a], nursery crops (54)	606	728,781
WA	Pacific	alfalfa (110), apples, cherries, grapes, cranberries (1312), Christmas trees (93)[a]	1515	623722
WA	Skamania	alfalfa (164), apples (75), grapes, pears (477), other nuts (4)	720	1,337,179
WA	Wahkiakum	alfalfa	0	169,125

a. The Agricultural census only provides acreage for cut Christmas trees; to account for uncut trees that may be treated, we have multiplied the cut tree acreage by 7 up to the maximum acreage for "other nursery crops" (which includes uncut Christmas trees) in the census.

There is a large acreage of crops in the counties containing this ESU on which chlorpyrifos is likely to be used. The counties containing habitat for the Middle Columbia River steelhead contain 132,000 acres of apples, 21,000 acres of pears, and 24,000 acres of cherries, as well as 34,000 acres of mint, sugarbeets, and dry onions. In addition, there is well over a million acres of alfalfa and wheat which are treated in much lower acreages. There are an additional 12,907 acres of these crops in Franklin County, but they should be relatively insignificant because the only part of Franklin County in this ESU is the towns of Richland and Pasco. The counties containing the migration corridor have much lower acreage of crops on which chlorpyrifos is likely to be used, except for 12,000 acres of pears in Hood River County. The use of chlorpyrifos may affect the Middle Columbia River steelhead 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.

Coastwide, 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 estuary productivity is sufficient for juvenile survival and growth.

Adult female chinook will prepare a spawning bed, called a redd, in a stream area with suitable gravel composition, water depth and velocity. After laying eggs in a redd, adult chinook will guard the redd 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 (including San Mateo and Santa Clara counties) are excluded (58FR33212-33219, June 16, 1993).

Table 34 shows the chlorpyrifos usage in California counties supporting the Sacramento River winter-run chinook salmon ESU.

Table 34. Use of chlorpyrifos in counties with the Sacramento River winter-run chinook salmon ESU.

County	Crop	Usage (pounds)	Acres treated
Alameda	structural (termites)	877	
	other	3	

County	Crop	Usage (pounds)	Acres treated
Butte	alfalfa	342	645
	almond	3886	2,529
	orange	113	97
	peach	211	142
	prune	269	205
	structural (termites)	203	
	walnut	18536	10,019
	other	105	
Colusa	alfalfa	613	1189
	almond	974	696
	cotton	2880	3,373
	walnut	1543	834
	other	120	
Contra Costa	asparagus	133	133
	landscape maintenance	349	
	structural (termites)	12663	
	other	100	
Glenn	alfalfa	1548	2,796
	almond	3754	2,327
	cotton	951	1,029
	orange	233	110
	sunflower	146	279
	walnut	6488	3,771
	other	96	
Marin	structural (termites)	288	
	other	52	

County	Crop	Usage (pounds)	Acres treated
Sacramento	alfalfa	1632	2,325
	apple	326	162
	corn	180	181
	landscape maintenance	1420	
	nursery	104	
	pear	696	348
	structural (termites)	24720	
	walnut	181	119
	other	46	
San Francisco	other	40	
Shasta	mint	249	189
	turf/sod	324	320
	walnut	352	175
	other	122	
Solano	alfalfa	1710	2,974
	almond	506	287
	grass, seed	705	231
	sorghum/milo	238	355
	structural (termites)	2816	
	sunflower	172	133
	walnut	2768	1,514
	other	148	
Sonoma	apple	1380	1,408
	landscape maintenance	615	
	structural (termites)	1252	
	other	83	
Sutter	alfalfa	547	1143
	bean, dried	981	
	cabbage	104	133
	peach	610	376
	walnut	16541	8,806
	structural (termites)	254	
	other	330	

County	Crop	Usage (pounds)	Acres treated
Tehama	alfalfa	553	863
	almond	2704	1422
	prune	107	160
	walnut	7847	4514
	other	23	
Yolo	alfalfa	7657	14,996
	almond	267	157
	cotton	699	751
	nursery	759	
	pear	143	96
	sorghum/milo	260	330
	structural (termites)	972	
	walnut	5005	2869
	other	148	
Yuba	peach	160	80
	pear	268	162
	prune	540	285
	structural (termites)	676	
	walnut	6022	3075

There is fairly high use of chlorpyrifos on orchards in several counties for this ESU, as well as alfalfa in Yolo County and others. Considerable termiticide uses have occurred in the past, and may continue at least for two more years. Even with DPR's bulletins, which should mitigate the risk substantially, chlorpyrifos may affect the Sacramento River winter run chinook salmon.

(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 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.

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. The proposed revision of the ESU adds the Lower Deschutes, Trout, Lower John Day, Upper John Day, North Fork - John Day, Middle Fork - John Day, Willow, Umatilla, and Walla Walla hydrologic units. It appears that no additions have been proposed for Washington tributaries to the Columbia River. These units are in Wasco, Jefferson, Crook, Sherman, Gilliam, Wheeler, Morrow, Baker, Umatilla, Grant, Harney, 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.

Wasco, Jefferson, Sherman, Gilliam, Wheeler, Morrow, Crook, Harney, and Grant Counties were included to encompass the more recent definition including the Deschutes and John Day Rivers. However, because the FR Notice indicated that this ESU was extirpated in the John Day, Umatilla, and Walla Walla rivers, we have excluded Wheeler, Grant, and Harney counties from the analysis, and also Umatilla County except as part of the migratory corridor. We have retained Wasco, Sherman, and Jefferson counties along the lower Deschutes River and Gilliam and Morrow counties along Willow Creek as potential spawning and rearing habitat. We also excluded Crook County because it is above Pelton Dam.

As explained previously, we have excluded the high elevation sliver of Imnaha Creek in Baker County. In addition, we have re-examined other watershed considerations that we made in previous consultation analyses. Because Palouse Falls is an upstream barrier to passage, we are now excluding Adams, Lincoln, and Spokane counties in Washington from this ESU analysis. As best as we can tell, it appears that Benewah County, ID was also included in the counties in the Critical Habitat FR Notice as part of the Palouse River watershed, and we have therefore excluded it also. Finally, it appears that waters in Shoshone County, ID are all above Dworshak Dam, which is an upstream barrier. As a result of this re-examination, we now consider that spawning and rearing habitat for the Snake River fall chinook includes Nez Perce, Latah, Lewis, Clearwater, Adams, Idaho, and Valley counties in Idaho; Wallowa, Union, and the newly added Wasco, Sherman, Jefferson, Gilliam and Morrow counties in Oregon; and Asotin, Columbia, Franklin, Garfield, Walla Walla, and Whitman counties in Washington. For this particular analysis, we have excluded Valley County, Idaho because that portion in the Salmon River watershed is all in forested areas where chlorpyrifos would not be used; the private land areas of Valley County where chlorpyrifos could be used are in the Payette River watershed. As always, we solicit NMFS comments on these counties to included or excluded.

The migratory corridor of Snake River fall-run chinook includes the additional counties of Umatilla, Hood River, Multnomah, Columbia, and Clatsop in Oregon, and Benton, Klickitat, Skamania, Clark, Cowlitz, Wahkiakum, and Pacific in Washington.

Table 35 and Table 36 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. In these tables, if there is no acreage given for a specific crop, this means that there are too few growers in the area for USDA to make the data available.

Table 35. Crops on which chlorpyrifos can be used in counties containing spawning and rearing habitat for the Snake River fall-run chinook salmon ESU.

State	County	Crops and acreage planted	Acres	Total acreage
ID	Adams	corn (104), wheat (200), alfalfa (9,223), apples	9,527	873399
ID	Clearwater	wheat (9,106), grass seed (839), alfalfa (2,640)	12585	1575396
ID	Idaho	wheat (62,283), grass seed, alfalfa (20,266), apples (6), cherries (2), grapes (1), peaches, pears (2), plums & prunes (2), filberts, Christmas trees (20)[a]	82582	5430522
ID	Latah	wheat (90,706), grass seed (3,161), alfalfa (7,202), apples (3), cherries (19), pears, Christmas trees (78)[a]	101169	689089
ID	Lewis	wheat (64,367), grass seed, alfalfa (3,885)	68252	306601
ID	Nez Perce	corn, wheat (89,990), grass seed (5,739), alfalfa (6,262), apples (9), apricots (1), cherries (4), peaches (22)	102,027	543434
OR	Gilliam	wheat (95,584), alfalfa (2,450)	98,034	770664
OR	Jefferson	wheat (12,470), sugarbeets (2,396), grass seed (9,627), alfalfa (10,944), apples (4), mint (3,105)	38546	1139744
OR	Morrow	corn (9,276), wheat (167,070), sugarbeets, grass seed (1,113), alfalfa (22,180), dry onions (1,284), apples	200923	1301021
OR	Sherman	wheat (99,837), alfalfa (230)	100067	526911
OR	Union	wheat (36,394), sugarbeets (1,035), grass seed (7,236), alfalfa (25,818), carrots, apples (39), apricots, cherries (596), peaches (12), pears, plums & prunes, mint (9,226), Christmas trees (55)[a]	80411	1,303,476

State	County	Crops and acreage planted	Acres	Total acreage
OR	Wallowa	wheat (14,502), grass seed (189), alfalfa (18,253), apples (8), peaches, nursery crops (6)	32958	2,013,071
OR	Wasco	wheat (63,369), grass seed (169), alfalfa (7,239), apples (463), apricots (32), cherries (7,352), grapes (110), peaches (30), pears (385), plums & prunes, strawberries	79149	1,523,958
WA	Asotin	wheat (21,110), grass seed (1,136), alfalfa (1,648), apples (24), apricots (5), cherries (17), peaches (18), pears (6)	23964	406,983
WA	Columbia	corn (51), wheat (77,511), grass seed (253), alfalfa (1,780), apples	79595	556,034
WA	Franklin	corn (11,337), wheat (109,627), sunflower (698), sugarbeets, grass seed, alfalfa (70,943), asparagus (8,610), snap beans (236), carrots (3,574), dry onions (4,074), apples (9,000), apricots (68), cherries (2,165), grapes (2,813), nectarines (129), peaches (262), pears (156), plums & prunes (43), walnuts, strawberries (17), mint (1,586)	225338	794,999
WA	Garfield	wheat (71,689), grass seed (2,830), alfalfa (802)	75321	454,744
WA	Walla Walla	corn (6,539), wheat (232,419), grass seed (8,233), alfalfa (11,787), asparagus (1,414), snap beans (250), cabbage (6), carrots, dry onions (2,172), radishes, apples (5,222), cherries (280), grapes, plums & prunes (22)	268344	813,108
WA	Whitman	corn (101), wheat (478,098), grass seed (4,251), alfalfa (6,644), apples (19), cherries, pears (2), mint (12,577), Christmas trees (4)[a]	501696	1382006

a. The Agricultural census only provides acreage for cut Christmas trees; to account for uncut trees that may be treated, we have multiplied the cut tree acreage by 7 up to the maximum acreage for "other nursery crops" (which includes uncut Christmas trees) in the census.

Table 36. Crops on which chlorpyrifos can be used in counties in the migration corridor of the Snake River fall-run chinook salmon and the Snake River spring-summer-run chinook salmon ESUs.

State	County	Crops and acreage planted	Acres	Total acreage
OR	Clatsop	alfalfa, apples, cranberries (32), Christmas trees (72)[a], nursery crops (10503)	107	529482

State	County	Crops and acreage planted	Acres	Total acreage
OR	Columbia	corn (48), wheat, alfalfa (421), apples (39), cherries (7), grapes (6), peaches, pears (12), plums & prunes (2), filberts, walnuts (11), other nuts, strawberries (6), Christmas trees (1,239)[a]	1791	420332
OR	Hood River	wheat, alfalfa (443), broccoli, apples (2,592), cherries (1,081), grapes (63), peaches (13), pears (11,788), Christmas trees (178)[a]	16158	334328
OR	Multnomah	wheat (1,688), grass seed, alfalfa (389), broccoli (29), cabbage (459), carrots, cauliflower (55), turnips, apples (51), cherries (8), grapes (28), peaches (36), pears (25), plums & prunes (3), walnuts (2), other nuts, strawberries (171), Christmas trees (273)[a], nursery crops (2609)	5826	278570
OR	Umatilla	corn (6,901), wheat (263,624), grass seed (10,064), alfalfa (24,013), asparagus (1,093), snap beans (587), dry onions (3,914), apples (3,927), apricots (14), cherries (349), grapes (163), nectarines, peaches (7), pears (4), plums & prunes (365), strawberries (9), mint	315034	2,057,809
WA	Benton	corn, wheat (130,981), sugarbeets (4,284), grass seed, alfalfa (13,241), asparagus (1,638), dry onions (3,398), apples (18,425), apricots (174), cherries (3,219), grapes (15,929), nectarines (106), peaches (149), pears (472), plums & prunes (180), walnuts (41), mint, nursery crops (161)	192398	1,089,993
WA	Clark	grass seed, alfalfa (836), snap beans (2), cabbage, apples (33), cherries, grapes (32), peaches (46), pears (75), plums & prunes (10), filberts (87), walnuts (51), strawberries (162), mint, Christmas trees (679)[a], nursery crops (122)	2135	401,850
WA	Cowlitz	wheat (293), alfalfa (105), snap beans (1), carrots, apples (14), cherries (2), grapes, pears (3), filberts (1), walnuts (5), strawberries, Christmas trees (128)[a], nursery crops (54)	606	728781
WA	Klickitat	wheat (40,401), grass seed, alfalfa (28,434), cabbage, apples (516), apricots (18), cherries (457), grapes (419), peaches (199), pears (923), plums & prunes (1), walnuts	71368	1198385

State	County	Crops and acreage planted	Acres	Total acreage
WA	Pacific	alfalfa (110), apples, cherries, grapes, cranberries (1312), Christmas trees (93)[a]	1515	623722
WA	Skamania	alfalfa (164), apples (75), grapes, pears (477), other nuts (4)	720	1,337,179
WA	Wahkiakum	alfalfa	0	169125

a. The Agricultural census only provides acreage for cut Christmas trees; to account for uncut trees that may be treated, we have multiplied the cut tree acreage by 7 up to the maximum acreage for "other nursery crops" (which includes uncut Christmas trees) in the census.

As with other upper Columbia and Snake River salmonids, there is a large acreage of crops in the counties containing this ESU on which chlorpyrifos is likely to be used and a very large acreage of wheat and alfalfa where chlorpyrifos is likely to be used quite a bit less. The counties containing spawning and rearing habitat for the Snake River Fall-Run chinook contain 112,000 acres of apples, 20,000 acres of cherries, 17,000 acres of mint, 7,000 acres of sugarbeet, and 15,000 acres of dry onions. The counties containing the migration corridor also have 118,000 acres of orchards. The use of chlorpyrifos may affect the Snake River Fall-Run chinook 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, and Wallowa, and Baker counties in Oregon; Adams, Blaine, Custer, Idaho, Lemhi, Lewis, and Nez Perce, and Valley counties in Idaho; and Asotin, Columbia, Franklin, Garfield, Walla Walla, and Whitman counties in Washington. We have excluded Umatilla and Baker County in Oregon and Blaine County in Idaho because accessible river reaches are all well above areas where chlorpyrifos can be used. We have excluded Valley County, Idaho because that portion in the Salmon River watershed is all in forested areas where chlorpyrifos would not be used; the private land areas of Valley County where chlorpyrifos could be used are in the Payette River watershed. Other counties within migratory corridors are all of those down stream from the confluence of the Snake and Columbia Rivers: Umatilla, Morrow, Gilliam, Sherman, Wasco, Hood River, Multnomah, Columbia, and Clatsop Counties in Oregon, and Klickitat, Skamania, Clark, Cowlitz, Wahkiakum, and Pacific Counties in Washington.

Table 37 shows the crop-acreage information for Oregon and Washington counties where the Snake River spring/summer-run chinook salmon ESU occurs. The cropping information for the migratory corridors is shown in Table 38. If there is no acreage given for a specific crop, this means that there are too few growers in the area for USDA to make the data available.

Table 37. Crops on which chlorpyrifos can be used in counties containing spawning and rearing habitat for the Snake River spring-summer-run chinook salmon ESU.

State	County	Crops and acreage planted	Acres	Total acreage
ID	Adams	corn (104), wheat (200), alfalfa (9,223), apples	9527	873399
ID	Blaine	wheat (2,837), alfalfa (17,425), nursery crops (28)	20290	1692735
ID	Custer	wheat (645), alfalfa (24,467)	25,112	3152382
ID	Idaho	wheat (62,283), grass seed, alfalfa (20,266), apples (6), cherries (2), grapes (1), peaches, pears (2), plums & prunes (2), filberts, Christmas trees (20)[a]	82582	5430522
ID	Lemhi	alfalfa (28,143), apples (6), apricots, cherries (9), peaches (3), pears (2)	28163	2921172
ID	Lewis	wheat (64,367), grass seed, alfalfa (3,885)	68252	306601
ID	Nez Perce	corn, wheat (89,990), grass seed (5,739), alfalfa (6,262), apples (9), apricots (1), cherries (4), peaches (22)	102027	543,434
OR	Union	wheat (36,394), sugarbeets (1,035), grass seed (7,236), alfalfa (25,818), carrots, apples (39), apricots, cherries (596), peaches (12), pears, plums & prunes, mint (9,226), Christmas trees (55)[a]	80411	1,303,476
OR	Wallowa	wheat (14,502), grass seed (189), alfalfa (18,253), apples (8), peaches, nursery crops (6)	32952	2,013,071

State	County	Crops and acreage planted	Acres	Total acreage
WA	Adams	corn (5,388), wheat (303,813), sugarbeets (1,570), grass seed (7,487), alfalfa (22,350), asparagus (422), snap beans (102), dry onions (1,453), apples (3,457), cherries, grapes, pears, mint (7,328)	353370	1,231,999
WA	Asotin	wheat (21,110), grass seed (1,136), alfalfa (1,648), apples (24), apricots (5), cherries (17), peaches (18), pears (6)	23964	406,983
WA	Columbia	corn (51), wheat (77,511), grass seed (253), alfalfa (1,780), apples	79595	556,034
WA	Franklin	corn (11,337), wheat (109,627), sunflower (698), sugarbeets, grass seed, alfalfa (70,943), asparagus (8,610), snap beans (236), carrots (3,574), dry onions (4,074), apples (9,000), apricots (68), cherries (2,165), grapes (2,813), nectarines (129), peaches (262), pears (156), plums & prunes (43), walnuts, strawberries (17), mint (1,586)	225338	794,999
WA	Garfield	wheat (71,689), grass seed (2,830), alfalfa (802)	75321	454,744
WA	Walla Walla	corn (6,539), wheat (232,419), grass seed (8,233), alfalfa (11,787), asparagus (1,414), snap beans (250), cabbage (6), carrots, dry onions (2,172), radishes, apples (5,222), cherries (280), grapes, plums & prunes (22)	268344	813,108
WA	Whitman	corn (101), wheat (478,098), grass seed (4,251), alfalfa (6,644), apples (19), cherries, pears (2), mint (12,577), Christmas trees (4)[a]	501696	1,382,006

a. The Agricultural census only provides acreage for cut Christmas trees; to account for uncut trees that may be treated, we have multiplied the cut tree acreage by 7 up to the maximum acreage for "other nursery crops" (which includes uncut Christmas trees) in the census.

Table 38. Crops on which chlorpyrifos can be used in counties in the migration corridor of the Snake River spring-summer-run chinook salmon ESU.

State	County	Crops and acreage planted	Acres	Total acreage
OR	Clatsop	alfalfa, apples, cranberries (32), Christmas trees (72)[a], nursery crops (3)	107	529,482
OR	Columbia	corn (48), wheat, alfalfa (421), apples (39), cherries (7), grapes (6), peaches, pears (12), plums & prunes (2), filberts, walnuts (11), other nuts, strawberries (6), Christmas trees (1,239)[a]	1791	420,332
OR	Gilliam	wheat (95,584), alfalfa (2,450)	98034	770,664

State	County	Crops and acreage planted	Acres	Total acreage
OR	Hood River	wheat, alfalfa (443), broccoli, apples (2,592), cherries (1,081), grapes (63), peaches (13), pears (11,788), Christmas trees (178)[a]	16158	334328
OR	Morrow	corn (9,276), wheat (167,070), sugarbeets, grass seed (1,113), alfalfa (22,180), dry onions (1,284), apples	200,923	1301021
OR	Multnomah	wheat (1,688), grass seed, alfalfa (389), broccoli (29), cabbage (459), carrots, cauliflower (55), turnips, apples (51), cherries (8), grapes (28), peaches (36), pears (25), plums & prunes (3), walnuts (2), other nuts, strawberries (171), Christmas trees (273)[a], nursery crops (2609)	5826	278570
OR	Sherman	wheat (99,837), alfalfa (230)	100067	526911
OR	Umatilla	corn (6,901), wheat (263,624), grass seed (10,064), alfalfa (24,013), asparagus (1,093), snap beans (587), dry onions (3,914), apples (3,927), apricots (14), cherries (349), grapes (163), nectarines, peaches (7), pears (4), plums & prunes (365), strawberries (9), mint	315,034	2057809
OR	Wasco	wheat (63,369), grass seed (169), alfalfa (7,239), apples (463), apricots (32), cherries (7,352), grapes (110), peaches (30), pears (385), plums & prunes, strawberries	79,149	1523958
WA	Benton	corn, wheat (130,981), sugarbeets (4,284), grass seed, alfalfa (13,241), asparagus (1,638), dry onions (3,398), apples (18,425), apricots (174), cherries (3,219), grapes (15,929), nectarines (106), peaches (149), pears (472), plums & prunes (180), walnuts (41), mint, nursery crops (161)	192398	1089993
WA	Clark	grass seed, alfalfa (836), snap beans (2), cabbage, apples (33), cherries, grapes (32), peaches (46), pears (75), plums & prunes (10), filberts (87), walnuts (51), strawberries (162), mint, Christmas trees (679)[a], nursery crops (122)	2135	401850
WA	Cowlitz	wheat (293), alfalfa (105), snap beans (1), carrots, apples (14), cherries (2), grapes, pears (3), filberts (1), walnuts (5), strawberries, Christmas trees (128)[a], nursery crops (54)	606	728781

State	County	Crops and acreage planted	Acres	Total acreage
WA	Klickitat	wheat (40,401), grass seed, alfalfa (28,434), cabbage, apples (516), apricots (18), cherries (457), grapes (419), peaches (199), pears (923), plums & prunes (1), walnuts	71,368	1198385
WA	Pacific	alfalfa (110), apples, cherries, grapes, cranberries (1312), Christmas trees (93)[a]	1515	623722
WA	Skamania	alfalfa (164), apples (75), grapes, pears (477), other nuts (4)	720	1,337,179
WA	Wahkiakum	alfalfa	0	169,125

a. The Agricultural census only provides acreage for cut Christmas trees; to account for uncut trees that may be treated, we have multiplied the cut tree acreage by 7 up to the maximum acreage for "other nursery crops" (which includes uncut Christmas trees) in the census.

There is a large acreage of crops in the counties containing this ESU on which chlorpyrifos is likely to be used. The counties containing habitat for the Snake River Spring-Summer-Run chinook contain well over 50,000 acres of crops frequently treated and over a million acres of crops which are less treated with chlorpyrifos. The counties containing the migration corridor also have 150,000 acres of orchards and 15,000 acres of sugarbeets and dry onions. The use of chlorpyrifos in this county may affect the Snake River Spring-Summer-Run chinook 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 downstream 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 Thomes (upstream barrier - Black Butte Dam), Sacramento-Stone Corral, Lower Butte (upstream barrier - Centerville Dam), Lower Feather (upstream barrier - Oroville Dam), Lower Yuba, Lower Bear (upstream barrier – Camp Far West Dam), Lower Sacramento, Sacramento-Upper Clear (upstream barriers – Keswick Dam, Whiskeytown dam), Upper Elder-Upper Thomes, 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 in the counties of Shasta, Tehama, Butte, Glenn, Colusa, Sutter, Yolo, Yuba, Placer, Sacramento, Solano, Nevada, Contra Costa, Napa, Alameda, Marin, Sonoma, San Mateo, San Francisco, and Santa Clara. However, Santa Clara and San Mateo counties are south of the Oakland Bay Bridge and are not included in the analysis.

Table 39 contains usage information for the California counties supporting the Central Valley spring-run chinook salmon ESU.

Table 39. Use of chlorpyrifos in counties with the Central Valley spring-run chinook salmon ESU.

County	Crop	Usage (pounds)	Acres treated
Alameda	structural (termites)	877	
	other	3	
Butte	alfalfa	342	645
	almond	3886	2529
	orange	113	97
	peach	211	142
	prune	269	205
	structural (termites)	203	
	walnut	18536	10,019
	other	105	
Colusa	alfalfa	613	1,189
	almond	974	696
	cotton	2880	3,373
	walnut	1543	834
	other	120	
Contra Costa	asparagus	133	133
	landscape maintenance	349	
	structural (termites)	12663	
	other	100	
Glenn	alfalfa	1548	2,796
	almond	3754	2,327
	cotton	951	1,029
	orange	233	110
	sunflower	146	279
	walnut	6488	3,771
	other	96	
Marin	structural (termites)	288	
	other	52	
Napa	structural (termites)	187	
	other	21	

County	Crop	Usage (pounds)	Acres treated
Nevada	structural (termites)	748	
	other	26	
Placer	structural (termites)	17713	
	landscape maintenance	109	
	other	32	
Sacramento	alfalfa	1632	2,325
	apple	326	162
	corn	180	181
	landscape maintenance	1420	
	nursery	104	
	pear	696	348
	structural (termites)	24720	
	walnut	181	119
	other	46	
San Francisco	other	40	
Shasta	mint	249	189
	turf/sod	324	320
	walnut	352	175
	other	122	
Solano	alfalfa	1710	2,974
	almond	506	287
	grass, seed	705	231
	sorghum/milo	238	355
	structural (termites)	2816	
	sunflower	172	133
	walnut	2768	1,514
	other	148	
Sonoma	apple	1380	1,408
	landscape maintenance	615	
	structural (termites)	1252	
	other	83	

County	Crop	Usage (pounds)	Acres treated
Sutter	alfalfa	547	1,143
	bean, dried	981	
	cabbage	104	133
	peach	610	376
	walnut	16541	8,806
	structural (termites)	254	
	other	330	
Tehama	alfalfa	553	863
	almond	2704	1,422
	prune	107	160
	walnut	7847	4,514
	other	23	
Yolo	alfalfa	7657	14,996
	almond	267	157
	cotton	699	751
	nursery	759	
	pear	143	96
	sorghum/milo	260	330
	structural (termites)	972	
	walnut	5005	2,869
	other	148	
Yuba	peach	160	80
	pear	268	162
	prune	540	285
	structural (termites)	676	
	walnut	6022	3075

There is considerable use of chlorpyrifos on orchards in the area supporting this ESU, especially in the upper Sacramento Valley (Glenn, Butte, Sutter, Yuba, and Yolo Counties). There is also a moderate amount of termiticide use for at least two more years. Even with DPR's bulletins, which should mitigate the risk substantially, chlorpyrifos may affect the Central Valley Spring Run Chinook Salmon ESU

(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 pesticides could be used are Humboldt, Trinity, Mendocino, Sonoma, and Marin. A small portion of Glenn County is also included in the Critical Habitat, but chlorpyrifos would not be used in the forested upper elevation areas. A small portion of Lake County contains habitat for this ESU, but is entirely within the Mendocino National Forest.

Table 40 contains usage information for the California counties supporting the California coastal chinook salmon ESU.

Table 40. Use of chlorpyrifos in counties with the California coastal chinook salmon ESU.

County	Crop	Usage (pounds)	Acres treated
Humboldt	other	20	
Marin	structural (termites)	288	
	other	52	
Mendocino	apple	225	112
	pear	2195	1867
	structural (termites)	349	
	other	23	
Sonoma	apple	1380	1408
	landscape maintenance	615	
	structural (termites)	1252	
	other	83	
Trinity	other	2	

Chlorpyrifos use is low to moderate in the counties where this ESU is found. With the mitigation provided by DPR's county bulletins, I conclude that chlorpyrifos may affect, but is not likely to adversely affect the California Coastal Chinook Salmon 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. Grays Harbor County was excluded because the very small amount of habitat is within the Olympic National Forest.

Table 41 shows the acreage information for Washington counties where the Puget Sound chinook salmon ESU is located. In this table, if there is no acreage given for a specific crop, this means that there are too few growers in the area for USDA to make the data available.

Table 41. Crops on which chlorpyrifos can be used in counties containing spawning and rearing habitat for the Puget Sound chinook salmon ESU.

State	County	Crops and acreage planted	Acres	Total acreage
WA	Clallam	alfalfa (1,790), carrots, apples (29), cherries (11), grapes (4), pears (1), plums & prunes (1), strawberries (13), nursery crops (27)	1876	1116900
WA	Island	alfalfa (2,100), apples (18), grapes (14), pears (1), strawberries, Christmas trees (79)[a], nursery crops (14)	2226	133499
WA	Jefferson	alfalfa, snap beans, apples (5), Christmas trees (13)[a], nursery crops (17)	35	1157642
WA	King	corn (30), alfalfa (358), snap beans, broccoli (8), cabbage (88), carrots (10), cauliflower, dry onions (4), radishes, turnips (2), apples (64), apricots (1), cherries (8), grapes (2), peaches (1), pears (19), plums & prunes (4), filberts (3), walnuts (3), strawberries (42), Christmas trees (346)[a], nursery crops (328)	1321	1360705

State	County	Crops and acreage planted	Acres	Total acreage
WA	Kitsap	alfalfa, snap beans (1), carrots (1), apples (21), cherries (6), grapes (8), pears (4), plums & prunes (4), strawberries (7), Christmas trees (674)[a], nursery crops (88)	814	253436
WA	Lewis	wheat (1,104), alfalfa (937), snap beans, apples (77), cherries (10), grapes (4), pears (8), plums & prunes (3), filberts (25), walnuts (4), other nuts (14), strawberries, Christmas trees (7,323)[a]	9509	1540991
WA	Mason	alfalfa (125), snap beans (2), carrots, apples (5), cherries (1), grapes, pears (1), Christmas trees (2,391)[a], nursery crops (33)	2558	615108
WA	Pierce	alfalfa (70), snap beans (200), cabbage (242), carrots, radishes, apples (61), cherries (5), grapes, pears (4), plums & prunes, filberts, strawberries (125), Christmas trees (765)[a], nursery crops (160)	1632	1072350
WA	San Juan	alfalfa (170), snap beans, carrots (1), apples (64), cherries (1), grapes (13), peaches (1), pears (5), plums & prunes (2), filberts (2), strawberries (2)	261	11963
WA	Skagit	wheat (3,477), grass seed, alfalfa (782), snap beans (4), broccoli, carrots (555), apples (357), cherries, grapes, pears (5), plums & prunes, filberts (12), strawberries (281), Christmas trees (98)[a], nursery crops (359)	5930	1110583
WA	Snohomish	wheat (428), grass seed, alfalfa (235), snap beans (10), broccoli (4), cabbage, carrots (2), cauliflower, apples (47), cherries (3), grapes (1), peaches (42), pears (27), plums & prunes (2), filberts (11), strawberries (81), Christmas trees (557)[a], nursery crops (414)	1864	1337728
WA	Thurston	alfalfa (543), snap beans (2), broccoli, cabbage (1), carrots, cauliflower (1), dry onions (1), radishes (1), apples (23), cherries (4), grapes, pears (5), filberts (2), strawberries (74), Christmas trees (715)[a], nursery crops (618)	1990	465322

State	County	Crops and acreage planted	Acres	Total acreage
WA	Whatcom	corn, wheat (626), alfalfa (708), snap beans (1), broccoli (1), cabbage, apples (174), cherries (4), grapes (10), pears (15), plums & prunes, filberts (206), walnuts (1), strawberries (297), Christmas trees (275)[a], nursery crops (396)	2714	1356006

a. The Agricultural census only provides acreage for cut Christmas trees; to account for uncut trees that may be treated, we have multiplied the cut tree acreage by 7 up to the maximum acreage for "other nursery crops" (which includes uncut Christmas trees) in the census.

There is not a substantial acreage where chlorpyrifos can be used within this ESU and the cancellation of homeowner uses should markedly reduce use from recent historical times. However, there are several thousand acres of Christmas trees and a variety of smaller acreage crops that have high percentage treatment in this ESU. Most of the Lewis County Christmas trees are likely to be in the Columbia River watershed, rather than draining into Puget Sound. Without mitigations such as is provided by DPR's bulletins, even this modest acreage is sufficient that chlorpyrifos may affect the Puget Sound Chinook Salmon ESU

(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 River 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, Wasco, Columbia, Clackamas, Marion, Multnomah, and Washington in Oregon, and Klickitat, Skamania, Clark, Cowlitz, Lewis, Wahkiakum, and Pacific in Washington. Only small forested parts of Wasco County and Marion County intersect the hydrologic units, and these were excluded from the analysis because chlorpyrifos would not be used there. The migration corridors include portions of Clatsop and Columbia Counties in Oregon and Pacific County in Washington.

Note: We have made several changes in the counties included in this ESU. We will be providing details and a rationale in a separate submission to NMFS.

Table 42 shows the cropping information for Oregon and Washington counties where the Lower Columbia River chinook salmon ESU occurs. In this table, if there is no acreage given for a specific crop, this means that there are too few growers in the area for USDA to make the data available.

Table 42. Crops on which chlorpyrifos can be used in counties containing spawning and rearing habitat or migration corridor for the Lower Columbia River chinook salmon ESU.

State	County	Crops and acreage planted	Acres	Total acreage
OR	Clackamas	corn (14), wheat (1,783), grass seed (9,829), alfalfa (1,072), snap beans (334), broccoli (184), cabbage (72), cauliflower (319), Christmas trees (17,715)[a], dry onions, radishes (144), turnips, apples (167), cherries (53), grapes (207), peaches (78), pears (37), plums & prunes (37), filberts (3,994), walnuts (51), strawberries (608), nursery crops (10503)	47201	1195712
OR	Clatsop	alfalfa, apples, cranberries (32), Christmas trees (72)[a], nursery crops (3)	107	529482
OR	Columbia	corn (48), wheat, alfalfa (421), apples (39), cherries (7), grapes (6), peaches, pears (12), plums & prunes (2), filberts, walnuts (11), other nuts, strawberries (6), Christmas trees (1,239)[a]	1791	420332
OR	Hood River	wheat, alfalfa (443), broccoli, apples (2,592), cherries (1,081), grapes (63), peaches (13), pears (11,788), Christmas trees (178)[a]	16158	334328
OR	Multnomah	wheat (1,688), grass seed, alfalfa (389), broccoli (29), cabbage (459), carrots, cauliflower (55), turnips, apples (51), cherries (8), grapes (28), peaches (36), pears (25), plums & prunes (3), walnuts (2), other nuts, strawberries (171), Christmas trees (273)[a], nursery crops (2609)	5826	278570
WA	Clark	grass seed, alfalfa (836), snap beans (2), cabbage, apples (33), cherries, grapes (32), peaches (46), pears (75), plums & prunes (10), filberts (87), walnuts (51), strawberries (162), mint, Christmas trees (679)[a], nursery crops (122)	2135	401850
WA	Cowlitz	wheat (293), alfalfa (105), snap beans (1), carrots, apples (14), cherries (2), grapes, pears (3), filberts (1), walnuts (5), strawberries, Christmas trees (128)[a], nursery crops (54)	606	728781

State	County	Crops and acreage planted	Acres	Total acreage
WA	Klickitat	wheat (40,401), grass seed, alfalfa (28,434), cabbage, apples (516), apricots (18), cherries (457), grapes (419), peaches (199), pears (923), plums & prunes (1), walnuts	71368	1198385
WA	Lewis	wheat (1,104), alfalfa (937), snap beans, apples (77), cherries (10), grapes (4), pears (8), plums & prunes (3), filberts (25), walnuts (4), other nuts (14), strawberries, Christmas trees (7,323)[a]	9509	1,540,991
WA	Pacific	alfalfa (110), apples, cherries, grapes, cranberries (1312), Christmas trees (93)[a]	1515	623,722
WA	Skamania	alfalfa (164), apples (75), grapes, pears (477), other nuts (4)	720	1,337,179
WA	Wahkiakum	alfalfa	0	169125

a. The Agricultural census only provides acreage for cut Christmas trees; to account for uncut trees that may be treated, we have multiplied the cut tree acreage by 7 up to the maximum acreage for "other nursery crops" (which includes uncut Christmas trees) in the census.

The counties containing this ESU have a relatively large acreage of crops on which chlorpyrifos is likely to be used. These counties contain 79,000 acres of apples, 24,000 acres of pears, 8,000 acres of cherries, and over 25,000 acres of Christmas trees and nursery crops. The orchards are largely in Yakima and Hood River counties, while the Christmas trees and nursery crops are in lower portions of the watershed. The use of chlorpyrifos in these counties may affect the Lower Columbia River chinook ESU.

(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, Douglas, Lincoln and Tillamook counties include salmon habitat only in the forested areas where chlorpyrifos would not be used; and were therefore excluded from the analysis. Migration corridors include Clackamas, Multnomah, Columbia, and Clatsop Counties in Oregon, and Clark, Cowlitz, Wahkiakum, Lewis, and Pacific Counties in Washington.

Table 43 and Table 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. In these tables, if there is no acreage given for a specific crop, this means that there are too few growers in the area for USDA to make the data available.

Table 43. Crops on which chlorpyrifos can be used in counties containing spawning and rearing habitat for the Upper Willamette chinook ESU.

State	County	Crops and acreage planted	Acres	Total acreage
OR	Benton	wheat (4,338), grass seed, alfalfa (570), snap beans (3,080), broccoli, Christmas trees (5822)[a], dry onions (3), apples (62), cherries (18), grapes (242), peaches (8), pears (7), plums & prunes (5), filberts (493), walnuts (23), strawberries (17), mint (2,925), nursery crops (149)	15779	432961
OR	Clackamas	corn (14), wheat (1,783), grass seed (9,829), alfalfa (1,072), snap beans (334), broccoli (184), cabbage (72), cauliflower (319), Christmas trees (17,715)[a], dry onions, radishes (144), turnips, apples (167), cherries (53), grapes (207), peaches (78), pears (37), plums & prunes (37), filberts (3,994), walnuts (51), strawberries (608), nursery crops (10503)	47201	1195712
OR	Lane	wheat (2,651), grass seed (32,433), alfalfa (876), snap beans (1,796), broccoli (5), cabbage (11), carrots (270), cauliflower (4), dry onions (3), apples (174), cherries (249), grapes (631), nectarines (2), peaches (54), pears (51), plums & prunes (34), filberts (3,677), walnuts (105), strawberries (74), mint (5,350), Christmas trees (2,431)[a] , nursery crops (325)	51206	2914656

State	County	Crops and acreage planted	Acres	Total acreage
OR	Linn	corn (4), wheat (5,306), grass seed (198,471), alfalfa (2,507), snap beans (2,688), broccoli (267), cabbage, carrots, cauliflower (164), dry onions (1), apples (133), cherries (157), grapes (93), nectarines (3), peaches (73), plums & prunes (14), filberts (1,820), walnuts (55), strawberries (52), mint (4,105), Christmas trees (1,083)[a], nursery crops (155).	217151	1466507
OR	Marion	corn (16), wheat (10,341), grass seed (98,930), alfalfa (1,315), snap beans (12,101), broccoli (2,548), cabbage (157), carrots (76), cauliflower (1,505), dry onions (2,036), apples (555), cherries (1,568), grapes (761), nectarines, peaches (179), pears (150), plums & prunes (145), filberts (7,061), walnuts (15), strawberries (1,858), mint (3,695), Christmas trees (8590)[a] , nursery crops (7090)	160692	758394
OR	Polk	wheat (9,741), grass seed (52,375), alfalfa (774), snap beans (598), broccoli, cabbage, carrots, apples (157), apricots, cherries (1,888), grapes (1,123), peaches (51), pears (63), plums & prunes (595), filberts (2,394), walnuts (33), other nuts, strawberries (22), mint (2,448), Christmas trees (4,508)[a]	76770	474296
OR	Washington	wheat (17,020), grass seed (18,465), alfalfa (1,680), snap beans (988), broccoli (400), cabbage, carrots (1), cauliflower, dry onions (196), apples (279), cherries (211), grapes (989), peaches (168), pears (69), plums & prunes (358), filberts (5,595), walnuts (679), other nuts, strawberries (1,257), Christmas trees (2,695)[a], nursery crops (4130)	55160	463231
OR	Yamhill	corn, wheat (13,989), grass seed (32,904), alfalfa (2,294), snap beans (1,838), broccoli (308), dry onions, apples (310), cherries (1,693), grapes (2,887), nectarines, peaches (104), pears (54), plums & prunes (369), filberts (7,110), walnuts (608), other nuts (41), strawberries (265), Christmas trees (1,811)[a], nursery crops (3444)	70029	457986

a. The Agricultural census only provides acreage for cut Christmas trees; to account for uncut trees that may be treated, we have multiplied the cut tree acreage by 7 up to the maximum acreage for "other nursery crops" (which includes uncut Christmnas trees) in the census.

Table 44. Crops on which chlorpyrifos can be used in counties in the migration corridor of the Upper Willamette chinook ESU.

State	County	Crops and acreage planted	Acres	Total acreage
OR	Clackamas	corn (14), wheat (1,783), grass seed (9,829), alfalfa (1,072), snap beans (334), broccoli (184), cabbage (72), cauliflower (319), Christmas trees (17,715)[a], dry onions, radishes (144), turnips, apples (167), cherries (53), grapes (207), peaches (78), pears (37), plums & prunes (37), filberts (3,994), walnuts (51), strawberries (608), nursery crops (10503)	47201	1195712
OR	Clatsop	alfalfa, apples, cranberries (32), Christmas trees (72)[a] , nursery crops (3)	107	529482
OR	Columbia	corn (48), wheat, alfalfa (421), apples (39), cherries (7), grapes (6), peaches, pears (12), plums & prunes (2), filberts, walnuts (11), other nuts, strawberries (6), Christmas trees (1,239)[a]	1791	420332
OR	Multnomah	wheat (1,688), grass seed, alfalfa (389), broccoli (29), cabbage (459), carrots, cauliflower (55), turnips, apples (51), cherries (8), grapes (28), peaches (36), pears (25), plums & prunes (3), walnuts (2), other nuts, strawberries (171), Christmas trees (273)[a], nursery crops (2609)	5826	278570
WA	Clark	grass seed, alfalfa (836), snap beans (2), cabbage, apples (33), cherries, grapes (32), peaches (46), pears (75), plums & prunes (10), filberts (87), walnuts (51), strawberries (162), mint, Christmas trees (679)[a], nursery crops (122)	2135	401850
WA	Cowlitz	wheat (293), alfalfa (105), snap beans (1), carrots, apples (14), cherries (2), grapes, pears (3), filberts (1), walnuts (5), strawberries, Christmas trees (128)[a], nursery crops (54)	606	728781

State	County	Crops and acreage planted	Acres	Total acreage
WA	Lewis	wheat (1,104), alfalfa (937), snap beans, apples (77), cherries (10), grapes (4), pears (8), plums & prunes (3), filberts (25), walnuts (4), other nuts (14), strawberries, Christmas trees (7,323)[a]	9509	1540991
WA	Pacific	alfalfa (110), apples, cherries, grapes, cranberries (1312), Christmas trees (93)[a]	1515	623,722
WA	Wahkiakum	alfalfa	0	169125

a. The Agricultural census only provides acreage for cut Christmas trees; to account for uncut trees that may be treated, we have multiplied the cut tree acreage by 7 up to the maximum acreage for "other nursery crops" (which includes uncut Christmas trees) in the census.

There is a moderate amount of acreage, 8,000 acres of orchard and 21,000 acres of mint and dry onion, where chlorpyrifos can be used, along with considerable grass seed, Christmas trees, and nursery crops where chlorpyrifos is known to be used on at least 20,000 acres within the reproductive and growth areas of this ESU. There is almost no acreage of crops with high chlorpyrifos use in the migration corridor. The use of chlorpyrifos may affect the Upper Willamette River chinook ESU in its spawning and rearing areas. Effects are not likely in the migratory corridors because the bulk of the Christmas trees in Lewis County are rather far upstream and likely to dissipate before reaching the Columbia River.

(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, and Okanogan (Table 45). The lower river reaches are migratory corridors and include Clatsop, Columbia, Gilliam, Hood River, Morrow, Multnomah, Sherman, Umatilla, and Wasco Counties in Oregon, and Benton, Grant, Clark, Cowlitz, Franklin, Kittitas, Klickitat, Skamania, Wahkiakum, Walla Walla, Yakima, and Pacific Counties in Washington (Table 46).

[Note: In previous consultations, we incorrectly included Grant, Kittitas and Benton counties in Washington as part of the spawning and growth habitat. However, these counties are below Rock Island Dam and have been moved to the migratory corridor table.]

Table 45 and Table 46 show the cropping information for Washington counties that support the Upper Columbia River spring-run chinook salmon ESU and for the Oregon and Washington counties where this ESU migrates. In these tables, if there is no acreage given for a specific crop, this means that there are too few growers in the area for USDA to make the data available.

Table 45. Crops on which chlorpyrifos can be used in counties containing spawning and rearing habitat for the Upper Columbia River spring-run chinook salmon ESU.

State	County	Crops and acreage planted	Acres	Total acreage
WA	Chelan	wheat (1,864), alfalfa (1,210), apples (17,096), apricots (81), cherries (3,704), nectarines (22), peaches (21), pears (8,298), plums & prunes (3), walnuts, Christmas trees (42)[a], nursery crops (12)	32353	1869848
WA	Douglas	wheat (200,291), alfalfa (1,763), apples (14,383), apricots (315), cherries (1,842), nectarines (91), peaches (167), pears (1,104), nursery crops (7)	219963	1165158
WA	Okanogan	wheat (8,410), alfalfa (21,880), broccoli (1), carrots (1), apples (24,164), apricots (13), cherries (1,003), nectarines (38), peaches (67), pears (3,280), plums & prunes (1), filberts (10), walnuts (29), strawberries, Christmas trees (22)[a], nursery crops (25)	58944	3371698

a. The Agricultural census only provides acreage for cut Christmas trees; to account for uncut trees that may be treated, we have multiplied the cut tree acreage by 7 up to the maximum acreage for "other nursery crops" (which includes uncut Christmas trees) in the census.

Table 46. Crops on which chlorpyrifos can be used in counties in the migration corridor of the Upper Columbia River spring-run chinook salmon ESU.

State	County	Crops and acreage planted	Acres	Total acreage
OR	Clatsop	alfalfa, apples, cranberries (32), Christmas trees (72)[a]	104	529,482
OR	Columbia	corn (48), wheat, alfalfa (421), apples (39), cherries (7), grapes (6), peaches, pears (12), plums & prunes (2), filberts, walnuts (11), other nuts, strawberries (6), Christmas trees (1,239)[a]	1791	420332
OR	Gilliam	wheat (95,584), alfalfa (2,450)	98034	770664
OR	Hood River	wheat, alfalfa (443), broccoli, apples (2,592), cherries (1,081), grapes (63), peaches (13), pears (11,788), Christmas trees (178)[a]	16158	334328
OR	Morrow	corn (9,276), wheat (167,070), sugarbeets, grass seed (1,113), alfalfa (22,180), dry onions (1,284), apples	200923	1301021

State	County	Crops and acreage planted	Acres	Total acreage
OR	Multnomah	wheat (1,688), grass seed, alfalfa (389), broccoli (29), cabbage (459), carrots, cauliflower (55), turnips, apples (51), cherries (8), grapes (28), peaches (36), pears (25), plums & prunes (3), walnuts (2), other nuts, strawberries (171), Christmas trees (273)[a], nursery crops (2609)	5826	278570
OR	Sherman	wheat (99,837), alfalfa (230)	100067	526911
OR	Umatilla	corn (6,901), wheat (263,624), grass seed (10,064), alfalfa (24,013), asparagus (1,093), snap beans (587), dry onions (3,914), apples (3,927), apricots (14), cherries (349), grapes (163), nectarines, peaches (7), pears (4), plums & prunes (365), strawberries (9), mint	315,034	2057809
OR	Wasco	wheat (63,369), grass seed (169), alfalfa (7,239), apples (463), apricots (32), cherries (7,352), grapes (110), peaches (30), pears (385), plums & prunes, strawberries	79,149	1523958
WA	Benton	corn, wheat (130,981), sugarbeets (4,284), grass seed, alfalfa (13,241), asparagus (1,638), dry onions (3,398), apples (18,425), apricots (174), cherries (3,219), grapes (15,929), nectarines (106), peaches (149), pears (472), plums & prunes (180), walnuts (41), mint, nursery crops (161)	192398	1089993
WA	Clark	grass seed, alfalfa (836), snap beans (2), cabbage, apples (33), cherries, grapes (32), peaches (46), pears (75), plums & prunes (10), filberts (87), walnuts (51), strawberries (162), mint, Christmas trees (679)[a], nursery crops (122)	2135	401850
WA	Cowlitz	wheat (293), alfalfa (105), snap beans (1), carrots, apples (14), cherries (2), grapes, pears (3), filberts (1), walnuts (5), strawberries, Christmas trees (128)[a], nursery crops (54)	606	728781

State	County	Crops and acreage planted	Acres	Total acreage
WA	Franklin	corn (11,337), wheat (109,627), sunflower (698), sugarbeets, grass seed, alfalfa (70,943), asparagus (8,610), snap beans (236), carrots (3,574), dry onions (4,074), apples (9,000), apricots (68), cherries (2,165), grapes (2,813), nectarines (129), peaches (262), pears (156), plums & prunes (43), walnuts, strawberries (17), mint (1,586)	225,338	794999
WA	Grant	corn (29,953), wheat (203,498), sugarbeets (10,792), grass seed (6,801), alfalfa (115,509), asparagus (940), snap beans (671), carrots (2,207), dry onions (6,214), apples (33,615), apricots (266), cherries (3,470), grapes (3,132), nectarines (163), peaches (261), pears (998), plums & prunes (5), filberts, walnuts (5), strawberries (2), mint (15,610), nursery crops (1,562)	435674	1712881
WA	Kittitas	wheat (5,224), alfalfa (8,571), apples (1,859), cherries, peaches (1), pears (331), plums & prunes (1), filberts (1), mint (409), Christmas trees (23)[a]	16420	1469862
WA	Klickitat	wheat (40,401), grass seed, alfalfa (28,434), cabbage, apples (516), apricots (18), cherries (457), grapes (419), peaches (199), pears (923), plums & prunes (1), walnuts	71368	1198385
WA	Pacific	alfalfa (110), apples, cherries, grapes, cranberries (1312), Christmas trees (93)[a]	1515	623722
WA	Skamania	alfalfa (164), apples (75), grapes, pears (477), other nuts (4)	720	1337179
WA	Wahkiakum	alfalfa	0	169125
WA	Walla Walla	corn (6,539), wheat (232,419), grass seed (8,233), alfalfa (11,787), asparagus (1,414), snap beans (250), cabbage (6), carrots, dry onions (2,172), radishes, apples (5,222), cherries (280), grapes, plums & prunes (22)	268,344	813108
WA	Yakima	corn (12,680), wheat (50,430), grass seed (1,070), alfalfa (33,833), asparagus (7,034), snap beans (106), cabbage (144), dry onions, turnips (40), apples (75,264), apricots (285), cherries (6,129), grapes (15,529), nectarines (605), peaches (1,438), pears (10,190), plums & prunes (478), filberts (6), walnuts (11), nursery crops (408)	215680	2749514

a. The Agricultural census only provides acreage for cut Christmas trees; to account for uncut trees that may be treated, we have multiplied the cut tree acreage by 7 up to the maximum acreage for "other nursery crops" (which includes uncut Christmas trees) in the census.

There is a considerable amount of acreage, especially orchard crops, where chlorpyrifos may be used within the spawning and rearing area of this ESU. In these counties there are 58,000 acres of apples, 13,000 acres of pears, and 7,000 acres of cherries. There is also more than 200,000 acres of lesser treated crops: wheat and alfalfa. An even greater acreage is likely to be treated with chlorpyrifos in the migration corridor, especially in Yakima County. The use of chlorpyrifos may affect the Upper Columbia River Spring-Run Chinook ESU in its spawning and rearing areas, and quite possibly in the Columbia River migratory corridor above the Snake River.

(10) Central Valley Fall/Late Fall-run Chinook Salmon ESU (proposed for listing)
The Central Valley Fall/Late Fall-run chinook salmon ESU was proposed for listing in 1998 (63FR11482-11520, March 9, 1998). The National Marine Fisheries Service concluded at that time that "chinook salmon in this ESU are not presently in danger of extinction but are likely to become endangered in the foreseeable future." In a later reassessment (64FR50394-50415, September 16, 1999), NMFS stated that the populations had increased in abundance, and this ESU is not likely to become endangered in the foreseeable future. Critical habitat is still under development.

Hydrologic units and upstream barriers within this ESU are the San Pablo Bay (upstream barrier – San Pablo Reservoir), San Francisco Bay, Coyote (upstream barrier – Calaveras Reservoir), Suisun Bay, San Joaquin Delta, Middle San Joaquin-Lower Merced-Lower Stanislaus (upstream barrier – Crocker Diversion La Grange), Lower Calaveras-Mormon Slough (upstream barrier – New Hogan), Lower Consumnes-Lower Mokelumne (upstream barrier – Camanche Dam), Upper Consumnes, Lower Sacramento, Lower American (upstream barrier – Nimbus Dam), Upper Coon-Upper Auburn, Lower Bear (upstream barrier – Camp Far West Dam), Lower Feather (upstream barrier – Oroville Dam), Lower Yuba (upstream barrier – Englebright Dam), Lower Butte, Sacramento-Stone Corral, Upper Butte, Sacramento-Lower Thomes (upstream barrier – Black Butte Dam), Mill-Big Chico, Upper Elder-Upper Thomes, Cottonwood Headwaters, Lower Cottonwood, Sacrament-Lower Cow-Lower Clear (upstream barrier – Keswick Dam Shasta), Upper Cow-Battle (upstream barrier – Whiskeytown Dam), and Sacramento-Upper Clear.

These areas are in the counties of Shasta, Trinity, Tehama, Glenn, Butte, Colusa, Sutter, Yuba, Yolo, Placer, El Dorado, Amador, Sacramento, Solano, Napa, Marin, Sonoma, San Francisco, San Mateo, Santa Clara, Alameda, Contra Costa, San Joaquin, Calaveras, Stanislaus, and Merced. As with the other Central Valley ESUs, we have omitted San Mateo and Santa Clara counties from the usage analysis because they are south of the Oakland Bay Bridge. There is no Critical Habitat FR Notice on this, but there is nothing we have seen that suggests this would be different from the other Central Valley ESUs.

Table 47 contains usage information for the California counties supporting the Central Valley Fall/Late Fall-run chinook salmon ESU.

Table 47. Use of chlorpyrifos in counties with the Central Valley Fall/Late Fall-run chinook salmon ESU.

County	Crop	Usage (pounds)	Acres treated
Alameda	structural (termites)	877	
	other	3	
Amador	walnut	263	132
	other	51	
Butte	alfalfa	342	645
	almond	3886	2,529
	orange	113	97
	peach	211	142
	prune	269	205
	structural (termites)	203	
	walnut	18536	10,019
	other	105	
Calaveras	walnut	260	155
	other	12	
Colusa	alfalfa	613	1,189
	almond	974	696
	cotton	2880	3,373
	walnut	1543	834
	other	120	
Contra Costa	asparagus	133	133
	landscape maintenance	349	
	structural (termites)	12663	
	other	100	
El Dorado	structural (termites)	2062	
	other	38	

County	Crop	Usage (pounds)	Acres treated
Glenn	alfalfa	1548	2,796
	almond	3754	2327
	cotton	951	1,029
	orange	233	110
	sunflower	146	279
	walnut	6488	3,771
	other	96	
Marin	structural (termites)	288	
	other	52	
Merced	alfalfa	8022	14503
	almond	21396	15,623
	asparagus	223	224
	chinese cabbage	138	132
	corn	2964	3,020
	cotton	8916	9,167
	fig	2684	1,350
	orange	1044	541
	structural (termites)	5846	
	sweet potato	4868	2457
	walnut	4365	2481
	other	402	
Napa	structural (termites)	187	
	other	21	
Placer	structural (termites)	17713	
	landscape maintenance	109	
	other	32	

County	Crop	Usage (pounds)	Acres treated
Sacramento	alfalfa	1632	2,325
	apple	326	162
	corn	180	181
	landscape maintenance	1420	
	nursery	104	
	pear	696	348
	structural (termites)	24720	
	walnut	181	119
	other	46	
San Francisco	other	40	
San Joaquin	alfalfa	5650	11,422
	almond	5890	3,265
	apple	661	538
	asparagus	2263	2,311
	corn	3179	2,348
	nursery	139	
	pear	146	73
	structural (termites)	13690	
	walnut	18506	10,482
	other	309	
Shasta	mint	249	189
	turf/sod	324	320
	walnut	352	175
	other	122	
Solano	alfalfa	1710	2,974
	almond	506	287
	grass, seed	705	231
	sorghum/milo	238	355
	structural (termites)	2816	
	sunflower	172	133
	walnut	2768	1,514
	other	148	

County	Crop	Usage (pounds)	Acres treated
Sonoma	apple	1380	1,408
	landscape maintenance	615	
	structural (termites)	1252	
	other	83	
Stanislaus	alfalfa	5199	10,136
	almond	36984	20,605
	animal premises	452	
	apple	1528	872
	citrus	741	100
	corn	3595	3,102
	structural (termites)	9504	
	sweet potato	671	325
	walnut	23188	12878
	other	238	
Sutter	alfalfa	547	1143
	bean, dried	981	
	cabbage	104	133
	peach	610	376
	walnut	16541	8,806
	structural (termites)	254	
	other	330	
Tehama	alfalfa	553	863
	almond	2704	1422
	prune	107	160
	walnut	7,847	4514
	other	23	
Trinity	other	2	

County	Crop	Usage (pounds)	Acres treated
Yolo	alfalfa	7657	14996
	almond	267	157
	cotton	699	751
	nursery	759	
	pear	143	96
	sorghum/milo	260	330
	structural (termites)	972	
	walnut	5005	2869
	other	148	
Yuba	peach	160	80
	pear	268	162
	prune	540	285
	structural (termites)	676	
	walnut	6022	3075

There is considerable use of chlorpyrifos on orchards on a broad scale in the area supporting the proposed Central Valley Fall/Late Fall Run Chinook Salmon ESU. OPP is conferring with NMFS and concludes that the high use may affect this ESU even with the considerable mitigations provided by DPR's bulletins.

(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 recolonized 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.

(1) Central California Coast Coho Salmon ESU

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. San Francisco County lies within the north-south boundaries of this ESU, but was not named in the Crtitical Habitat FR Notice, presumably because there are no coho salmon streams in the county; it is excluded.

Table 48 contains usage information for the California counties supporting the Central California coast coho salmon ESU.

Table 48. Use of chlorpyrifos in counties with the Central California Coast coho ESU.

County	Crop	Usage (pounds)	Acres treated
Santa Cruz	apple	1255	818
	broccoli	168	130
	brussel sprout	3224	3516
	cauliflower	201	198
	other	502	
San Mateo	brussel sprout	1816	2257

	structural (termites)	542	
	other	90	
Marin	structural (termites)	288	
	other	52	
Sonoma	apple	1380	1408
	landscape maintenance	615	
	structural (termites)	1252	
	other	83	
Mendocino	apple	225	112
	pear	2195	1867
	structural (termites)	349	
	other	23	
Napa	structural (termites)	187	
	other	21	

Chlorpyrifos use is low to moderate in the counties where this ESU is found. With the substantial mitigation provided by DPR's county bulletins, I conclude that chlorpyrifos may affect, but is not likely to adversely affect the Central California Coast coho salmon ESU.

(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, and Siskiyou in California and Curry, Jackson, Josephine, Klamath, and Douglas in Oregon. The habitat in Glenn and Lake Counties, CA is within the Mendocino National Forest, and that in Douglas County, OR is entirely within the Rogue River and Umpqua National Forests, where chlorpyrifos would not be used; therefore, Glenn, Lake, and Douglas Counties were excluded from this analysis.

Note: We previously included Klamath County, OR in this ESU, but have now omitted it because it appears to be entirely above various named upstream barriers. Again we will submit more details in a separate transmittal to NMFS.

The reportable chlorpyrifos usage in the California counties supporting the Southern Oregon/Northern California coastal coho salmon ESU is shown in Table 49. Table 50 shows the acreage where chlorpyrifos may be used on orchard crops in the Oregon counties where the Southern Oregon/Northern California coastal coho salmon ESU occurs. In Table 50, if there is no acreage given for a specific crop, this means that there are too few growers in the area for USDA to make the data available.

Table 49. Use of chlorpyrifos in California counties with the Southern Oregon/Northern California coastal coho salmon ESU.

County	Crop	Usage (pounds)	Acres treated
Del Norte	other	49	
Humboldt	other	20	
Mendocino	apple	225	112
	pear	2,195	1867
	structural (termites)	349	
	other	23	
Siskiyou	alfalfa	335	671
	other	88	
Trinity	other	2	

Table 50. Crops on which chlorpyrifos can be used in Oregon counties containing habitat for the Southern Oregon/Northern California Coastal coho salmon ESU.

State	County	Crops and acreage planted	Acres	Total acreage
OR	Curry	broccoli, apples (27), cherries (4), grapes, pears (3), plums & prunes (6), strawberries (1), cranberries (581), Christmas trees (16)[a]	638	1041557
OR	Jackson	wheat (1,294), grass seed (315), alfalfa (3,954), snap beans, broccoli (1), cabbage, carrots (1), dry onions (40), apples (360), apricots (10), cherries (27), grapes (400), nectarines (14), peaches (198), pears (9,387), plums & prunes (15), filberts, walnuts (27), strawberries (18), Christmas trees (113)[a], nursery crops (39)	16213	1782633
OR	Josephine	wheat (18), alfalfa (1,1,43), snap beans (1), broccoli (2), cabbage (1), carrots (4), cauliflower (1), dry onions (1), apples (181), cherries (9), grapes (355), peaches (29), pears, plums & prunes (1), walnuts (18), strawberries (3), Christmas trees (238)[a] , nursery crops (21)	2026	1,049,308

a. The Agricultural census only provides acreage for cut Christmas trees; to account for uncut trees that may be treated, we have multiplied the cut tree acreage by 7 up to the maximum acreage for "other nursery crops" (which includes uncut Christmas trees) in the census.

Chlorpyrifos use is fairly low in the California counties where this ESU is found, but there is pear use of concern, since pears are a very highly treated crop. In Oregon, there is only a small amount of acreage, 9,000 acres of pears and less than 1,000 acres of apples, where chlorpyrifos is likely to be used in the reproductive and growth areas of this ESU. With the DPR bulletins, there will probably be no effect, but it appears that our conclusion should be for the whole ESU. On the basis of orchard use in Oregon, I conclude that the use of chlorpyrifos may affect the Southern Oregon/northern California Coho Salmon ESU.

(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, and Clatsop. However, the portions of Yamhill, Washington, and Columbia counties that are within the ESU are primarily mountainous forested areas where chlorpyrifos cannot be used, and were excluded from this analysis. Benton and Polk counties are primarily part of the Willamette River watershed, but the small parts that may drain into the Pacific Ocean do include agricultural areas, and therefore they are included in the analysis.

Table 51 show the acreage where chlorpyrifos can be used for Oregon counties where the Oregon coast coho salmon ESU occurs. In this table, if there is no acreage given for a specific crop, this means that there are too few growers in the area for USDA to make the data available.

Table 51. Crops on which chlorpyrifos can be used in counties containing habitat for the Oregon Coast coho salmon ESU.

State	County	Crops and acreage planted	Acres	Total acreage
OR	Benton	wheat (4,338), grass seed, alfalfa (570), snap beans (3,080), broccoli, Christmas trees (5822)[a], dry onions (3), apples (62), cherries (18), grapes (242), peaches (8), pears (7), plums & prunes (5), filberts (493), walnuts (23), strawberries (17), mint (2,925), nursery crops (149)	15, 779	432,961
OR	Clatsop	alfalfa, apples, cranberries (32), Christmas trees (72)[a]	104	529,482
OR	Coos	wheat, alfalfa, apples (28), apricots, cherries (11), grapes (12), nectarines (1), peaches (1), pears (4), plums & prunes (3), filberts (1), walnuts (1) cranberries (1,499), nursery crops (21)	1582	1,024,346
OR	Curry	broccoli, apples (27), cherries (4), grapes, pears (3), plums & prunes (6), strawberries (1), cranberries (581), Christmas trees (16)[a]	638	1,041,557
OR	Douglas	wheat (123), grass seed (2,361), alfalfa (1,984), snap beans (19), broccoli (3), cabbage (4), carrots, cauliflower, apples (148), apricots (1), cherries (64), grapes (581), nectarines, peaches (53), pears (105), plums & prunes (305), filberts (55), walnuts (171), strawberries (24), Christmas trees (1,279)[a], nursery crops (121)	7401	3,223,576

State	County	Crops and acreage planted	Acres	Total acreage
OR	Lane	wheat (2,651), grass seed (32,433), alfalfa (876), snap beans (1,796), broccoli (5), cabbage (11), carrots (270), cauliflower (4), dry onions (3), apples (174), cherries (249), grapes (631), nectarines (2), peaches (54), pears (51), plums & prunes (34), filberts (3,677), walnuts (105), strawberries (74), mint (5,350), Christmas trees (2,431)[a], nursery crops (325)	51206	2,914,656
OR	Lincoln	alfalfa, snap beans (1), broccoli (1), apples (22), grapes (1), pears (1), plums & prunes, Christmas trees (76)[a]	102	626,976
OR	Polk	wheat (9,741), grass seed (52,375), alfalfa (774), snap beans (598), broccoli, cabbage, carrots, apples (157), apricots, cherries (1,888), grapes (1,123), peaches (51), pears (63), plums & prunes (595), filberts (2,394), walnuts (33), other nuts, strawberries (22), mint (2,448), Christmas trees (4,508)[a]	76770	474,296
OR	Tillamook	nursery crops (11)	11	705,417

a. The Agricultural census only provides acreage for cut Christmas trees; to account for uncut trees that may be treated, we have multiplied the cut tree acreage by 7 up to the maximum acreage for "other nursery crops" (which includes uncut Christmas trees) in the census.

There is a moderate amount of acreage in counties containing this ESU. However, the vast majority is actually in the Willamette River watershed rather than the watershed of coastal streams. In analyses of previous pesticides, we have made a no effect determination for a similar set of uses and this ESU. However, chlorpyrifos exhibits considerable toxicity, along with potential indirect effects. While it is not a significant risk, there is sufficient uncertainty and no existing protective measures that I conclude that chlorpyrifos may affect the Oregon Coast Coho Salmon ESU.

(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, Island, and Grays Harbor. Grays Harbor County was excluded because the very small amount of habitat is within the Olympic National Forest.

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.'

Table 52 shows the acreage of crops in these counties on which chlorpyrifos can be used. In this table, if there is no acreage given for a specific crop, this means that there are too few growers in the area for USDA to make the data available.

Table 52. Crops on which chlorpyrifos can be used in counties containing habitat for the Hood Canal summer-run chum salmon ESU.

State	County	Crops and acreage planted	Acres	Total acreage
WA	Clallam	alfalfa (1,790), carrots, apples (29), cherries (11), grapes (4), pears (1), plums & prunes (1), strawberries (13), nursery crops (27)	1876	1,116,900
WA	Island	alfalfa (2,100), apples (18), grapes (14), pears (1), strawberries, Christmas trees (79)[a], nursery crops (14)	2226	133,499
WA	Jefferson	alfalfa, snap beans, apples (5), Christmas trees (13)[a], nursery crops (17)	35	1,157,642
WA	Kitsap	alfalfa, snap beans (1), carrots (1), apples (21), cherries (6), grapes (8), pears (4), plums & prunes (4), strawberries (7), Christmas trees (674)[a], nursery crops (88)	814	253,436
WA	Mason	alfalfa (125), snap beans (2), carrots, apples (5), cherries (1), grapes, pears (1), Christmas trees (2,391)[a], nursery crops (33)	2558	615,108

a. The Agricultural census only provides acreage for cut Christmas trees; to account for uncut trees that may be treated, we have multiplied the cut tree acreage by 7 up to the maximum acreage for "other nursery crops" (which includes uncut Christmas trees) in the census.

There is almost no acreage in counties containing this ESU on which chlorpyrifos is likely to be used. Even most of the lesser treated crops (alfalfa) have low acreage. However, there are over 2000 acres of Christmas trees in Mason County, and 18% of Christmas trees in the Willamette Valley of Oregon are treated with chlorpyrifos. Without any mitigations, such as would occur with DPR's bulletins, I must conclude that the use of chlorpyrifos may affect the Hood Canal Summer-run Chum Salmon 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. Because the ESU extends on the Oregon side only up to

Milton Creek, and because we cannot see that Milton Creek reaches into Washington County, we have excluded Washington County from this ESU. Washington County was named in the Critical Habitat FR Notice. It appears that the Washington County connection with the hydrologic unit is with the Willamette River which is upstream from Milton Creek. We solicit NMFS comment.

Table 53 shows the cropping information for Oregon and Washington counties where the Columbia River chum salmon ESU occurs. In this table, if there is no acreage given for a specific crop, this means that there are too few growers in the area for USDA to make the data available.

Table 53. Crops on which chlorpyrifos can be used in counties containing habitat for the Columbia River chum salmon ESU.

State	County	Crops and acreage planted	Acres	Total acreage
OR	Clatsop	alfalfa, apples, cranberries (32), Christmas trees (72)[a]	104	529,482
OR	Columbia	corn (48), wheat, alfalfa (421), apples (39), cherries (7), grapes (6), peaches, pears (12), plums & prunes (2), filberts, walnuts (11), other nuts, strawberries (6), Christmas trees (1,239)[a]	1791	420,332
OR	Multnomah	wheat (1,688), grass seed, alfalfa (389), broccoli (29), cabbage (459), carrots, cauliflower (55), turnips, apples (51), cherries (8), grapes (28), peaches (36), pears (25), plums & prunes (3), walnuts (2), other nuts, strawberries (171), Christmas trees (273)[a], nursery crops (2609)	5826	278,570
WA	Clark	grass seed, alfalfa (836), snap beans (2), cabbage, apples (33), cherries, grapes (32), peaches (46), pears (75), plums & prunes (10), filberts (87), walnuts (51), strawberries (162), mint, Christmas trees (679)[a], nursery crops (122)	2135	401,850
WA	Cowlitz	wheat (293), alfalfa (105), snap beans (1), carrots, apples (14), cherries (2), grapes, pears (3), filberts (1), walnuts (5), strawberries, Christmas trees (128)[a], nursery crops (54)	606	728,781
WA	Lewis	wheat (1,104), alfalfa (937), snap beans, apples (77), cherries (10), grapes (4), pears (8), plums & prunes (3), filberts (25), walnuts (4), other nuts (14), strawberries, Christmas trees (7,323)[a]	9509	1,540,991

State	County	Crops and acreage planted	Acres	Total acreage
WA	Pacific	alfalfa (110), apples, cherries, grapes, cranberries (1312), Christmas trees (93)[a]	1515	623,722
WA	Skamania	alfalfa (164), apples (75), grapes, pears (477), other nuts (4)	720	1,337,179
WA	Wahkiakum	alfalfa	0	169125

a. The Agricultural census only provides acreage for cut Christmas trees; to account for uncut trees that may be treated, we have multiplied the cut tree acreage by 7 up to the maximum acreage for "other nursery crops" (which includes uncut Christmas trees) in the census.

There is very little crop acreage (about 2,000 acres of orchards scattered among nine counties) in counties containing this ESU. Even the Christmas trees are largely upstream enough considering the very limited spawning and rearing habitat for this ESU that dissipation and dilution would be sufficient for me to conclude that chlorpyrifos will have no effect on the Lower Columbia River Chum Salmon 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. Table 54 shows the acreage within this county for crops in which chlorpyrifos can be used.

Table 54. Crops on which chlorpyrifos can be used in counties containing habitat for the Ozette Lake sockeye salmon ESU.

State	County	Crops and acreage planted	Acres	Total acreage
WA	Clallam	alfalfa (1,790), carrots, apples (29), cherries (11), grapes (4), pears (1), plums & prunes (1), strawberries (13), nursery crops (27)	1876	1116900

Alfalfa neither is grown to any extent in the tributaries to Ozette Lake nor is it treated with chlorpyrifos. There is effectively no acreage of any crop along the Ozette tributaries.[4] I conclude that Chlorpyrifos will have no effect on the Ozette Lake sockeye salmon 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 high elevation areas in a National Wilderness area and National Forest. Chlorpyrifos cannot be used on such a site, and therefore there will be no exposure in the spawning and rearing habitat. Considering that the migratory corridors are larger rivers any exposure during migration should be well below levels of concern.

[4] Personal communication, Curtis Beus, County Extension Agent, Clallam County, WA. April 1, 2003

Table 55 shows the acreage of crops in counties containing habitat for this ESU. Table 56 shows the acreage in counties containing the migratory corridors for this ESU. If there is no acreage given for a specific crop, this means that there are too few growers in the area for USDA to make the data available.

Table 55. Crops on which chlorpyrifos can be used in counties containing habitat for the Snake River sockeye ESU.

State	County	Crops and acreage planted	Acres	Total acreage
ID	Blaine	wheat (2,837), alfalfa (17,425), nursery crops (28)	20290	1692735
ID	Custer	wheat (645), alfalfa (24,467)	25,112	3152382

Table 56. Crops on which chlorpyrifos can be used in counties in the migration corridor of the Snake River sockeye ESU.

State	County	Crops and acreage planted	Acres	Total acreage
ID	Idaho	wheat (62,283), grass seed, alfalfa (20,266), apples (6), cherries (2), grapes (1), peaches, pears (2), plums & prunes (2), filberts, Christmas trees (20)[a]	82582	5430522
ID	Lemhi	alfalfa (28,143), apples (6), apricots, cherries (9), peaches (3), pears (2)	28163	2921172
ID	Lewis	wheat (64,367), grass seed, alfalfa (3,885)	68252	306601
ID	Nez Perce	corn, wheat (89,990), grass seed (5,739), alfalfa (6,262), apples (9), apricots (1), cherries (4), peaches (22)	102,027	543434
OR	Clatsop	alfalfa, apples, cranberries (32), Christmas trees (72)[a]	104	529482
OR	Columbia	corn (48), wheat, alfalfa (421), apples (39), cherries (7), grapes (6), peaches, pears (12), plums & prunes (2), filberts, walnuts (11), other nuts, strawberries (6), Christmas trees (1,239)[a]	1791	420332
OR	Gilliam	wheat (95,584), alfalfa (2,450)	98034	770,664
OR	Hood River	wheat, alfalfa (443), broccoli, apples (2,592), cherries (1,081), grapes (63), peaches (13), pears (11,788), Christmas trees (178)[a]	16158	334,328
OR	Morrow	corn (9,276), wheat (167,070), sugarbeets, grass seed (1,113), alfalfa (22,180), dry onions (1,284), apples	200923	1301021
OR	Multnomah	wheat (1,688), grass seed, alfalfa (389), broccoli (29), cabbage (459), carrots, cauliflower (55), turnips, apples (51), cherries (8), grapes (28), peaches (36), pears (25), plums & prunes (3), walnuts (2), other nuts, strawberries (171), Christmas trees (273)[a], nursery crops (2609)	5826	278,570
OR	Sherman	wheat (99,837), alfalfa (230)	100067	526911
OR	Umatilla	corn (6,901), wheat (263,624), grass seed (10,064), alfalfa (24,013), asparagus (1,093), snap beans (587), dry onions (3,914), apples (3,927), apricots (14), cherries (349), grapes (163), nectarines, peaches (7), pears (4), plums & prunes (365), strawberries (9), mint	315034	2057809
OR	Wasco	wheat (63,369), grass seed (169), alfalfa (7,239), apples (463), apricots (32), cherries	79149	1523958
WA	Asotin	wheat (21,110), grass seed (1,136), alfalfa	23964	406,983

State	County	Crops and acreage planted	Acres	Total acreage
WA	Benton	corn, wheat (130,981), sugarbeets (4,284), grass seed, alfalfa (13,241), asparagus (1,638), dry onions (3,398), apples (18,425), apricots (174), cherries (3,219), grapes (15,929), nectarines (106), peaches (149), pears (472), plums & prunes (180), walnuts (41), mint, nursery crops (161)	192398	1,089,993
WA	Clark	grass seed, alfalfa (836), snap beans (2), cabbage, apples (33), cherries, grapes (32), peaches (46), pears (75), plums & prunes (10), filberts (87), walnuts (51), strawberries (162), mint, Christmas trees (679)[a], nursery crops (122)	2135	401,850
WA	Columbia	corn (51), wheat (77,511), grass seed (253), alfalfa (1,780), apples	79595	556,034
WA	Cowlitz	wheat (293), alfalfa (105), snap beans (1), carrots, apples (14), cherries (2), grapes, pears (3), filberts (1), walnuts (5), strawberries, Christmas trees (128)[a], nursery crops (54)	606	728,781
WA	Franklin	corn (11,337), wheat (109,627), sunflower (698), sugarbeets, grass seed, alfalfa (70,943), asparagus (8,610), snap beans (236), carrots (3,574), dry onions (4,074), apples (9,000), apricots (68), cherries (2,165), grapes (2,813), nectarines (129), peaches (262), pears (156), plums & prunes (43), walnuts, strawberries (17), mint (1,586)	225338	794,999
WA	Garfield	wheat (71,689), grass seed (2,830), alfalfa (802)	75321	454,744
WA	Klickitat	wheat (40,401), grass seed, alfalfa (28,434), cabbage, apples (516), apricots (18), cherries (457), grapes (419), peaches (199), pears (923), plums & prunes (1), walnuts	71368	1,198,385
WA	Pacific	alfalfa (110), apples, cherries, grapes, cranberries (1,312), Christmas trees (93)[a]	1515	623,722
WA	Skamania	alfalfa (164), apples (75), grapes, pears (477), other nuts (4)	720	1,337,179
WA	Wahkiakum	alfalfa	0	169,125

State	County	Crops and acreage planted	Acres	Total acreage
WA	Walla Walla	corn (6,539), wheat (232,419), grass seed (8,233), alfalfa (11,787), asparagus (1,414), snap beans (250), cabbage (6), carrots, dry onions (2,172), radishes, apples (5,222), cherries (280), grapes, plums & prunes (22)	268344	813,108
WA	Whitman	corn (101), wheat (478,098), grass seed (4,251), alfalfa (6,644), apples (19), cherries, pears (2), mint (12,577), Christmas trees (4)[a]	501696	1,382,006

a. The Agricultural census only provides acreage for cut Christmas trees; to account for uncut trees that may be treated, we have multiplied the cut tree acreage by 7 up to the maximum acreage for "other nursery crops" (which includes uncut Christmas trees) in the census.

There are no crops in the spawning and rearing habitat for this precarious sockeye ESU. Alfalfa is a lightly treated crop that occurs in Blaine and Custer Counties, but it would be grown downstream. There is a small potential for chlorpyrifos use along the migratory corridors in Idaho, and use could be fairly extensive in Washington and perhaps Oregon. But by the time the young sockeye, the most sensitive life stage in all likelihood (if it is like other salmonids that have been tested), reaches this area, there will be significant dilution to preclude likely effects even if there are treated fields next to the Snake River. I would expect no effect, but because of uncertainty along the migratory corridors, I am only able to conclude that chlorpyrifos may affect, but is not likely to affect the Snake River Sockeye Salmon ESU.

5. Specific conclusions for Pacific salmon and steelhead

1. No use of chlorpyrifos is expected in the critical habitat of the Ozette Lake Sockeye Salmon ESU. There is very limited use quite upstream from the Lower Columbia Chum Salmon ESU, and dissipation and dilution should be more than sufficient to avoid any harm. There will be no effect of chlorpyrifos on these two ESUs.

2. There is limited use of chlorpyrifos in the upper middle and northern coastal areas of California, and protection is afforded by DPR's county bulletins. Chlorpyrifos may affect, but is not likely to adversely affect the California Coastal Chinook Salmon ESU, the Central California Coho Salmon ESU, the Northern California Coastal Steelhead ESU, and the Central California Coastal Steelhead ESU.

3. There are no existing protections for the Snake River Sockeye Salmon ESU, but there will be no exposure in its spawning and rearing areas in the vicinity of Redfish, Stanley, and other lakes. There is a remote possibility that some exposure could occur during the migration of this species, but it should be discountable. Chlorpyrifos may affect, but is not likely to adversely affect this ESU.

4. There is moderate to high use of chlorpyrifos in the Central Valley and southern coastal areas of California. Although it is expected that DPR's county bulletins will mitigate most of the risk,

there is still a reasonable potential that some exposure and harm could occur or that the food sources could be impaired. Chlorpyrifos may affect the Central Valley Spring run chinook ESU, the proposed Central Valley fall/late fall run Chinook ESU, the Sacramento River winter run ESU, the Central Valley California Steelhead, the Southern California Steelhead, and the South-Central California Steelhead.

5. There is very high potential chlorpyrifos use and no current protection measures in place for the Upper Columbia Chinook salmon ESU, the Snake River spring/summer run Chinook Salmon ESU, the Snake River fall run Chinook salmon ESU, the Snake River Basin Steelhead ESU, the Upper Columbia River Steelhead ESU, and the Middle Columbia River Steelhead ESU. Chlorpyrifos may affect these ESUs.

6. There is potential for moderate to high use of chlorpyrifos in areas occupied by the Upper Willamette River Chinook Salmon ESU, the Lower Columbia River Chinook Salmon ESU, the Upper Willamette River Steelhead ESU, and the lower Columbia River Steelhead ESU. There are no existing protective measures. Chlorpyrifos may affect these ESUs.

7. The Southern Oregon/Northern California Coastal Coho Salmon ESU would probably not be affected in California Counties as a result of protective measures in DPR's county bulletins. But there is higher potential use and no protective measures for the Oregon population. Chlorpyrifos may affect this ESU.

8. There is low to moderate potential use of chlorpyrifos in the area of the Puget Sound Chinook Salmon ESU. There are no protective measures. Effects, if any, would be low but not discountable because of uncertainty on locations of chlorpyrifos use and salmon runs. Chlorpyrifos may affect this ESU.

9. There is rather low potential use of chlorpyrifos in areas occupied by the Oregon Coast Coho Salmon ESU and the Hood Canal Chum Salmon Summer Run ESU, but the potential for effects cannot be discounted given that there are no current protective measures. Chlorpyrifos may affect these ESUs.

Table 57. Summary conclusions on specific ESUs of salmon and steelhead for chlorpyrifos.

Species	ESU	finding
Chinook Salmon	Upper Columbia	may affect
Chinook Salmon	Snake River spring/summer-run	may affect
Chinook Salmon	Snake River fall-run	may affect
Chinook Salmon	Upper Willamette	may affect
Chinook Salmon	Lower Columbia	may affect

Chinook Salmon	Puget Sound	may affect
Chinook Salmon	California Coastal	may affect, but not likely to adversely affect
Chinook Salmon	Central Valley spring-run	may affect
Chinook Salmon	Sacramento River winter-run	may affect
Chinook Salmon	Central Valley fall/late fall run (proposed for listing)	may affect
Coho salmon	Oregon Coast	may affect
Coho salmon	Southern Oregon/Northern California Coast	may affect
Coho salmon	Central California	may affect, but not likely to adversely affect
Chum salmon	Hood Canal summer-run	may affect, but not likely to adversely affect
Chum salmon	Columbia River	no effect
Sockeye salmon	Ozette Lake	no effect
Sockeye salmon	Snake River	may affect, but not likely to adversely affect
Steelhead	Snake River Basin	may affect
Steelhead	Upper Columbia River	may affect
Steelhead	Middle Columbia River	may affect
Steelhead	Lower Columbia River	may affect
Steelhead	Upper Willamette River	may affect
Steelhead	Northern California	may affect, but not likely to adversely affect
Steelhead	Central California Coast	may affect, but not likely to adversely affect
Steelhead	South-Central California	may affect
Steelhead	Southern California	may affect
Steelhead	Central Valley, California	may affect

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