Diuron
Analysis of Risks
to
Endangered and Threatened Salmon and Steelhead

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Summary

Diuron is an herbicide widely used on a variety of crop and non-crop sites. It is has modest toxicity to fish and aquatic invertebrates and high toxicity to plants. Exposure can be very high from the non-crop uses with high application rates. Exposure from agricultural uses can be moderately high in certain situations.

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). The use of diuron on certain crops (peaches, walnuts, filberts) may affect 10 ESUs at application rates above 3.2 lb ai/A, may affect 7 ESUs at application rates above 2.2 lb ai/A, and will have no effect on 10 ESUs at any labeled agricultural rate. The use of diuron for non-crop sites, especially rights-of-way, may affect 25 ESUs, may affect but is not likely to adversely affect one ESU, and will have no effect on one ESU.

Introduction

This analysis was prepared by the U.S. Environmental Protection Agency (EPA) Office of Pesticides (OPP) to evaluate the risks of diuron 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, except that we have updated our criteria for indirect effects on aquatic plant cover to bring this in line with the acute risk concerns used by the Environmental Fate and Effects Division of OPP (EFED).

As before, we have used the general aquatic risk assessment from EFED's "Environmental Risk Assessment for the Reregistration of Diuron" (EFED ERA) of August 27, 2001, developed by the Environmental Fate and Effects Division for use in the forthcoming Reregistration Eligibility

Decision, as the starting basis (Attachment 1). This document is on line at: http://cascade.epa.gov/RightSite/dk_public_collection_item_detail.htm?ObjectType=dk_docket_item&cid=OPP-2002-0249-0005&ShowList=xreferences&Action=view

Problem Formulation - The purpose of this analysis is to determine whether the registration of diuron as an herbicide for use on various crop and non-crop sites may affect threatened and endangered (T&E or listed) Pacific anadromous salmon and steelhead or adversely modify 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 diuron 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, 2001). This makes any quantitative analysis very difficult to address aquatic exposure from home use. It also indicates that a no-use or no-spray buffer approach for protection, which we consider quite viable for agricultural areas, may not be particularly useful for urban areas.

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

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

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

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

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

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

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

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

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

Test data	Risk quotient	Presumption
Acute LC50	>0.5	Potentially high acute risk
Acute LC50	>0.1	Risk that may be mitigated through restricted use classification
Acute LC50	>0.05	Endangered species may be affected acutely, including sublethal effects
Chronic NOEC	>1	Chronic risk; endangered species may be affected chronically, including reproduction and effects on progeny
Acute invertebrate LC50[a]	>0.5	May be indirect effects on T&E fish through food supply reduction
Aquatic plant acute EC50[a]	>1[b]	May be indirect effects on aquatic vegetative cover for T&E fish

a. Indirect effects criteria for T&E species are not in Urban and Cook (1986); they were developed subsequently.
b. This criterion has been changed from previous requests. The basis is to bring the endangered species criterion for

indirect effects on aquatic plant populations in line with EFED's concern levels for these populations..

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

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

Sublethal Effects - With respect to sublethal effects, Tucker and Leitzke (1979) did an extensive review of existing ecotoxicological data on pesticides. Among their findings was that sublethal effects as reported in the literature did not occur at concentrations below one-fourth to one-sixth of the lethal concentrations, when taking into account the same percentages or numbers affected, test system, duration, species, and other factors. This was termed the "6x hypothesis". Their review included cholinesterase inhibition, but was largely oriented towards externally observable parameters such as growth, food consumption, behavioral signs of intoxication, avoidance and repellency, and similar parameters. Even reproductive parameters fit into the hypothesis when the duration of the test was considered. This hypothesis supported the use of lethality tests for use in assessing 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. 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 diuron

a. Registered uses

Diuron is a broad-spectrum residual herbicide registered for pre- and early post-emergent control of both broadleave and annual grassy weeds. It is used on a variety of fruit and nut crops, grains, cotton, corn, sorghum, mint, asparagus, sugarcane, seed crops, alfalfa, coffee, hay, cut flowers, and for fallow and idle cropland use. It may be used in irrigation and drainage systems when water is not present. It also has widespread use in non-agricultural applications, especially industrial and rights-of-way uses, where total vegetation control is desired; often it is combined with other herbicides for total vegetation control. Such broad-spectrum weed control includes along fence lines, rights-of-way (pipelines, powerlines, railway lines, roads), footpaths, in timber yards and storage areas, around commercial, industrial and farm buildings, electrical substations, and petroleum storage tanks. It has some use as an algacide in ornamental ponds, fountains, and aquaria, but not natural water bodies. It may be used as a mildewicide in paints used on buildings and structures. A former use as an antifouling paint is no longer registered in the U. S., but may be registered in other countries.

There are currently 71 products registered for use nationally, and 31 Special Local Needs registrations for specific states. The latter include one for California, 13 for Oregon, 7 for Washington; there are none for Idaho. Most products are formulated as granules, or as wettable powder, emulsifiable concentration, water dispersible granules for spray applications. There are speciality formulations for use as a mildewicide in paints and for aquatic use to control algae in ornamental ponds, fountains, and aquaria. A former use to control algae in natural water bodies is no longer permitted in the U. S. Representative labels are included as attachment 2.

Many of these products contain additional active ingredients. Most are herbicides, but chlorothalonil, a fungicide, is used in the paint preservative formulations. Herbicides formulated with diuron include paraquat, thiadiazuron, bromacil, imazapyr, monosodium methanearsonate, tebuthiuron, sodium chlorate, sodium metaborate, sulfometuron-methyl, and copper sulfate.

Diuron acts by inhibiting the Hill reaction in photosynthesis which limits the production of high energy compounds such as ATP used for various metabolic processes. Diuron is primarily absorbed through plant roots. It is transported upward through the xylem, and exerts its action at the seedling stage when the newly emerged plant starts to photosynthesize. It is effective primarily on annual broadleaved weeds, annual grasses, or newly emerged perennial plants. Established perennial plants are less susceptible, which is the basis for its use in fruit and nut crops.

Diuron is typically applied as a pre-emergent herbicide to the soil, and needs to be watered in to be effective. It may persist in the soil throughout much of the season, thus providing continuing control of weeds. It can also be effective as a post-emergent herbicide, especially if applied during high humidity and warm temperatures, and with a surfactant added to enhance penetration into the weeds. In formulations with other herbicides, typically the “other” herbicide provides knockdown of established weeds, while the diuron inhibits additional weeds from becoming established.

b. Application rates and Methods

Table 3 below summarizes the various usages, application rates, and application methods for diuron. In addition to the maximum labeled rates, Table 3 includes the typical application rates used by 80 % of growers, according to the registrant’s survey. The higher application rates (6.4 - 12 lbs. ai/A) are for non-agricultural sites and some crops such as grapes and citrus. The typical application rates are usually 50-80 % lower than labeled rates. Currently, some labels allow for non-crop uses as high as 48 lb ai/A; however, the registrants have agreed to reduce the maximum rate to 12 lb ai/A, and will change their labels following issuance of the Reregistration Eligibility Decision which is scheduled to be completed before October 1, 2003. Table 3 presents the agreed-upon rates and the risk assessment uses these rates and the methods.

Table 3. List of maximum labeled application rates and methods for diuron.

End-uses	Appl. Methods [a]	Max. Label Rates (lbs ai)	Typical Rates(lbs ai)	Seasonal Max. Rate
Non-Agricultural				

railroad	A/G	12	6	12
roadside, utilities, irrigation, drainage ditch	G	12	6	12
Agricultural				
grape	G	9 .6 (3.2 for western U. S.)	2.0	9.6 (3.2 west)
citrus	G	6 .4 (3.2 for western U. S.)	3.2	9.6 (3.2 west)
olives	G	1.6	-	1.6
alfalfa	A/G	3. 2	2.4	3.2
peaches, walnuts, filberts	G	4.0	3.2	4.0
apples, pears	G	3.2	3.2	4.0
caneberries, blueberries	G	2.4	-	2.4
mint	G	2.4	-	2.4
asparagus	A/G	3.2	-	4.8
artichokes	G	3.2	-	3.2
grains	A/G	1.6	-	1.6
corn	G	0.8	-	0.8
birdsfoot trefoil & red clover (western OR)	G	1.6	-	1.6
iris, narcissus bulb crops (Western WA)	G	3.2	-	3.2
hybrid poplar	G	2.4	-	2.4
field peas	G	1.6	-	1.6
grass seeds	A/G	3.2[b] (1.8 for fescue)	1.5	3.2
cotton	A/G	2.0	0.8	2.2

a. A=aerial; G=ground

b. Grass seed rates vary by the type of grass; 3.2 lb/A is for alta fescue, tall fescue, Astoria bentgrass, highland bentgrass, Kentucky bluegrass, and orchardgrass; 1.6 lb/A for ryegrass and fine fescue.

c. diuron usage

According to OPP's Quantitative Use Assessment (QUA) for diuron (Attachment 3) and based on available pesticide survey usage information for the years of 1990 through 1999, an annual estimate of diuron's total domestic usage is approximately 8,000,000 pounds active ingredient; slightly over half is used in non-agricultural areas. About 25% of diuron is used on railroads; other non-agricultural sites of high usage (5-9% of total diuron) are pipelines and industrial facilities, roads, and sanitation/utilities. Among agricultural uses, the highest amounts of diuron are used on oranges (15%), cotton (10%), seed crops (9%), grapefruit (3%), and alfalfa (3%).

Average application rates are highest for pipelines/industrial facilities at 6.5 lb ai/A, railroads at 4.7 lb ai/A, and sanitation/utilities at 3.6 lb ai/A. Crop uses are all under 3 lb ai/A for average application rates. Maximum rates for western crops are 3.2 lb ai/A, except for peaches and walnuts where the maximum rate is 4.0 lb ai/A.

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 4 presents diuron usage from 1993-2001 in California. Table 5 presents all of the diuron uses in California for 2001. For the major crop uses (>1000 lb ai/yr), a comparison of the acreage treated and the pounds used indicates that average application rates for California are consistently below 2 lb ai/A. Average application rates for non-crop uses are higher, but because of insufficient information on acreage reported, they cannot be quantified for most of these uses.

Table 4. Reported use of diuron in California, 1993-2001, in pounds of active ingredient

1993	1994	1995	1996	1997	1998	1999	2000	2001
1,074,854	1,234,507	1,054,409	1,265,426	1,228,114	1,504,268	1,188,640	1,343,727	1,104,771

Table 5. Reported use of diuron, by crop or site, for 2001 in California.

crop or site	pounds active ingredient used	acres treated
rights-of-way	523,868	nr
oranges	173,960	96,727
alfalfa	167,479	119,434
landscape maintenance	55,052	nr
grapes	50,548	67,825
walnut	28,504	21,819
lemon	18,857	10,956
cotton	18,848	436,014
asparagus	16,583	8,675
olive	13,164	9,568
grapefruit	5,824	3,729
uncultivated non-agriculture	5,532	1,443
public health	3,469	nr

crop or site	pounds active ingredient used	
structural pest control	3,173	nr
tangerine	2,317	1,387
uncultivated agriculture	2,056	644
regulatory pest control	1,864	nr
nursery outdoor transplants	1,855	1,280
tangelo	1,853	1,019
industrial site	1,814	328
pears	1363	1,105
citrus	1,229	857
ditch bank	986	175
mint	878	688
animal premises	676	143
beans	583	10
apples	525	905
pecan	428	216
nursery greenhouse flowers	222	126
nursery outdoor container plants	218	287
peaches	203	422
avocado	138	55
nursery-outdoor flowers	111	114
corn (forage-fodder)	104	45
oats	101	49
research commodity	69	4
prunes	66	28
water area	46	32
boysenberry	22	11
nursery greenhouse container plants	20	3

crop or site	pounds active ingredient used	acres treated
wheat	20	115
Christmas trees	18	14
food processing plant	16	4
almonds	15	10
nursery greenhouse transplants	15	16
pistachio	12	22
artichoke	12	11
kumquat	12	5
soil fumigation/preplant	10	1
turf/sod	8	7
pastureland	5	6
dairy equipment	4	2
small fruits & berries	4	2
corn (human consumption)	3	62
plums	3	7
nectarines	2	5
apricots	2	6
state total	1,104,771	

There are limited data available on the amount of diuron used in the Pacific Northwest. The National Agricultural Statistics Service provides some information on diuron usage in the Pacific Northwest. For nursery uses, estimates are provided only for Oregon; diuron is used on about 3% of the Oregon nursery operations, with 19% of the fruit and nut tree and 15% of the cut flower operations using it (USDA 2002b). Fruit and vegetable usage of diuron is presented in Table 6; asparagus is the only vegetable crop with very high usage, although many crops are not covered by USDA (2001) in the Pacific Northwest. Based upon the QUA, we would also expect significant agricultural usage on grass seed, alfalfa, and winter wheat. Usage on non-crop sites, especially rights-of-way could be very high.

Table 6. Estimated usage of diuron on fruit and vegetable crops in Oregon and Washington.

Site and state[a]	% area applied	# appl	rate/year (#ai/A)	total lb ai applied
apples, OR [b]	7	1	1.1	700
apples, WA [b]	1	1	1.56	2700
asparagus, WA [c]	48	1.5	2.09	70,700
blackberries, OR	40	1	1.53	3800
blueberries, OR	27	1.1	1.49	1100
cherries (sweet), OR				none reported
cherries (sweet), WA				none reported
grapes, WA				none reported
pears, OR	17	1.5	1.63	4600
pears, WA	8	1	1.35	2600
raspberries, OR	19	1.1	1.12	800
raspberries, WA	26	1	0.8	2000

[a] Only sites where diuron is registered are included
[b] All fruits are from USDA, 2002a
[c] Asparagus data are from USDA, 2001

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

a. Aquatic toxicity of diuron

There is a fairly large amount of aquatic toxicity data on diuron. The quality of these data is variable. OPP has rigorous validation requirements for data used in assessments, and these data referenced as EFED, Mayer and Ellersieck (1986) and Johnson and Finley (1980) in Tables 7-13 are used in preference to other data. Compilations of diuron toxicity data are also available in EPA's AQUIRE database. We obtained original papers where readily available; those which could not be obtained in a timely fashion are indicated as "AQUIRE" plus the cited reference.

(1) Acute toxicity to freshwater fish

The EFED ERA lists only one data point for each species represented in EFED's one-liner data base, the point representing the lowest LC50 value. Mayer and Ellersieck (1986) present data from a substantial number of acute fish tests; we have included all of these even if they are not included in the EFED ERA. Many of the AQUIRE data are included. However, many of the older fish and aquatic invertebrate tests were reviewed in 1980 and considered invalid; these are omitted, although those considered as "supplemental" are included..

Table 7 shows that the 96-hour acute toxicity of technical diuron to coldwater fish ranges from 0.71 ppm for cutthroat trout to 7.7 ppm for rainbow trout. For typical warmwater fish, the 96-hour LC50 values are from 2.8 ppm for bluegill to 14.2 ppm for fathead minnow. There are several tests with formulated products. The formulated product testing all shows less toxicity than for comparable species tested with the technical diuron. There are 1973 data on an 80% formulated product showing striped bass to be very sensitive (Hughes, 1973), but there are no data on this species for the technical material.

Table 7. Acute toxicity of diuron to freshwater fish.

Species	Scientific name	% a.i.	96-hour LC50 (ppm)	Toxicity Category	Reference
Technical material					
Coho salmon	Oncorhynchus kisutch	95	<2.4[a]	>moderately toxic	Mayer & Ellersieck, 1986
Cutthroat trout	*Salmo clarki*	95	0.71- 2.2 (11 tests)	moderately - highly toxic	Mayer & Ellersieck, 1986
Lake trout	*Salvelinus namaycush*	95	1.1-2.7 (12 tests)	moderately toxic	Mayer & Ellersieck, 1986
Rainbow trout	*Oncorhynchus mykiss*	95	1.95 (red)	moderately toxic	EFED
Rainbow trout	*Oncorhynchus mykiss*	95	3.5-7.7 (6 tests)	moderately toxic	Mayer & Ellersieck, 1986
Bluegill sunfish	*Lepomis macrochirus*	95	2.8-10.4 (11 tests)	moderately toxic	Mayer & Ellersieck, 1986
Bluegill sunfish	*Lepomis macrochirus*	tech	8.9 @ 12.7^{0}C	moderately toxic	Macek et. al (1969)
Bluegill sunfish	*Lepomis macrochirus*	tech	7.6 @ 18.3^{0}C	moderately toxic	Macek et. al (1969)
Bluegill sunfish	*Lepomis macrochirus*	tech	5.9 @ 23.8^{0}C	moderately toxic	Macek et. al (1969)
Bluegill sunfish	*Lepomis macrochirus*	95	3.2	moderately toxic	EFED
Fathead minnow	*Pimephales promelas*	98.6	7.7 ppm (168 hr)	moderately toxic	Call et al. (1987)
Fathead minnow	*Pimephales promelas*	98.6	14.2 ppm	slightly toxic	EFED (Call et al., 1987)
Fathead minnow	*Pimephales promelas* (1.5 month old)	99.8	27.1 ppm (10d)[b]	slightly toxic	Nebeker & Schuytema, 1998
Fathead minnow	*Pimephales promelas* 2 .5 day old eggs	99.8	11.7 ppm (7d)[b]	slightly toxic	Nebeker & Schuytema, 1998
Formulated product[c]					
Bluegill sunfish	*Lepomis macrochirus*	80	>300	practically non-toxic	EFED
Bluegill sunfish	*Lepomis macrochirus*	28FC	84	slightly toxic	EFED
Rainbow trout	*Oncorhynchus mykiss*	80WP	16	slightly toxic	Mayer & Ellersieck, 1986
Rainbow trout	*Oncorhynchus mykiss*	80	19.6	slightly toxic	EFED
Rainbow trout	*Oncorhynchus mykiss*	28FC	23.8	slightly toxic	EFED
Striped bass larvae	*Morone saxatilis*	80	0.5	highly toxic	Hughes, 1973
Striped bass fingerlings	*Morone saxatilis*	80	6	moderately toxic	Hughes, 1973
Unidentified or inadequately identified material					
Coho salmon	*Oncorhynchus kisutch*	unk[d]	16 ppm (48 hr)	slightly toxic	Bond et al., 1960
Bluegill sunfish	*Lepomis macrochirus*	F?	4	moderately toxic	AQUIRE (Cope, 1965)
Bluegill sunfish	*Lepomis macrochirus*	A?	7.4 (48-hr)	moderately toxic	AQUIRE (Cope, 1966)
Rainbow trout	*Oncorhynchus mykiss*	A?	4.3 (48hr)	moderately toxic	AQUIRE (Cope, 1966)

Species	Scientific name	% a.i.	96-hour LC50 (ppm)	Toxicity Category	Reference
Mosquitofish	*Gambusia affinis*	A?	>10	slightly toxic	AQUIRE (Ahmed & Washino, 1976)
Carp	*Carassius sp.*	F?	63 ppm	slightly toxic	AQUIRE (Knapek & Lakota, 1974)
Grass carp	*Ctenpharyngodon idella*	F?	31 ppm	slightly toxic	AQUIRE (Tooby et al., 1980)
Carp	*Cyprinus carpio*	F?	2.9ppm	moderately toxic	AQUIRE (Knapek & Lakota, 1974)
Harlequin fish	*Rasbora heteromorpha*	F?	190 ppm (48 hr)	practically non-toxic	AQUIRE (Tooby et al., 1975)
Tench	*Tinca tinca*	F?	15.5 ppm	slightly toxic	AQUIRE (Knapek & Lakota, 1974)

a. The 24-hour LC50 for coho salmon was reported as 11 ppm.

b Test was called a "chronic" test by authors, but was really a long acute (subacute) test

c. FC= flowable concentrate; WP=wettable powder

d. Material was referred to as either diuron or as "Karmex." Karmex has been used as a name for a former 28% emulsifiable concentrate formulation of diuron; it may have been used also for an 80% formulation, but this is not in our historical records.

(2) Acute toxicity to freshwater invertebrates

There is a moderate range of invertebrate sensitivity, with most EC50/LC50 values exceeding 1 ppm. Results from acute studies with freshwater invertebrates (Table 8) indicate that technical grade diuron is highly toxic to amphipods and moderately toxic to many other freshwater invertebrates. 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.

Table 8. Acute toxicity of diuron to freshwater invertebrates (from EFED ERA and AQUIRE).

Species	Scientific name	% a.i.	96-hour LC50 (ppm)	Toxicity Category	Reference
Scud	*Gammarus fasciatus*	tech	0.7	highly toxic	Sanders, 1970
Scud	*Gammarus lacustris*	tech	0.16	highly toxic	Sanders, 1969
Scud	*Gammarus fasciatus*	95	0.16	highly toxic	Mayer & Ellersieck, 1986
Stonefly	*Pteronarcys californica*	95	1.2	moderately toxic	Mayer & Ellersieck, 1986
Water flea	*Daphnia magna*	80	8.4 (48 hr)	moderately toxic	EFED
Water flea	*Daphnia magna*	tech	47 (26 hr)	slightly toxic	Crosby & Tucker, 1966
Aquatic sowbug	*Asellus brevicauda*	95	15.5	slightly toxic	Mayer & Ellersieck, 1986
Water flea	*Daphnia pulex*	95	1.4 (48 hr)	moderately toxic	Mayer & Ellersieck, 1986
Water flea	*Simocephalus serrulatus*	95	2.0 (48 hr)	moderately toxic	Mayer & Ellersieck, 1986
Water flea	*Daphnia pulex*	F?	3 hr >40	slightly toxic	AQUIRE (Nishiuchi & Hashimoto, 1967)
Water flea	*Moina macrocarpa*	F?	3 hr >40	slightly toxic	AQUIRE (Nishiuchi & Hashimoto, 1967)
Water flea	*Daphnia magna*	F?	0.4	highly toxic	AQUIRE (Knapek & Lakota, 1974)

Mosquito	*Aedes aegypti*	F?	1.2	moderately toxic	AQUIRE (Knapek & Lakota, 1974)

(3) Chronic toxicity to freshwater fish and invertebrates

The chronic toxicity data cited in the EFED ERA for diuron are summarized in Table 9. Fathead minnows, with a NOEC of 26.4 ppb, are considerably more sensitive than the tested aquatic invertebrates. Effects on aquatic invertebrates in chronic tests have not been demonstrated below 3.4 ppm, but the preferred test species, *Daphnia magna*, was not tested at concentrations above 0.2 ppm. The most sensitive invertebrate species in acute tests, *Gammarus lacustris* and *G. fasciatus* were not tested in chronic studies.

Table 9. Chronic toxicity of diuron to freshwater fish and invertebrates (from EFED ERA).

Species	Scientific name	Duration	% a.i.	Endpoints affected	NOEC (ppb)	LOEC (ppb)	Reference
Fathead minnow	*Pimephales promelas*	60 d	98.6	# surviving young	26.4	61.8	EFED
Fathead minnow	*Pimephales promelas*	60 d	98.6	fry development & survival	33.4	78.0	Call et al. 1987
Water flea	*Daphnia magna*	28 d	98.2	no effect at highest concentration	200	>200	EFED
Water flea	*Daphnia pulex*	7d	99.8	mortality, # young	4000	7700	Nebeker & Schuytema, 1998
Amphipod	*Hyalella azteca*	10d	99.8	survival, reduced weight	7900	15,700	Nebeker & Schuytema, 1998
Midge	*Chironomus tentans*	10d	99.8	growth	3400	7900	Nebeker & Schuytema, 1998

(4) Acute toxicity to estuarine and marine fish

Acute results indicate that technical grade diuron is moderately toxic to estuarine and marine fish (Table 10). Acute LC50 values are very similar for the two species tested.

Table 10. Acute toxicity of diuron to estuarine and marine fish (from EFED ERA).

Species	Scientific name	% a.i.	96-hour LC50 (ppm)	Toxicity Category	Reference
Striped mullet	*Mugil cephalus*	95%	6.3	moderately toxic	EFED
Sheepshead minnow	*Cyprinodon variegatus*	99%	6.7	moderately toxic	EFED

(5) Acute toxicity to estuarine and marine invertebrates

Acute toxicity tests with estuarine and marine invertebrates (Table 11) indicate that technical grade diuron is moderately toxic to shrimp, oysters, and clams. The lowest LC50 value is 1.1 ppm for mysid shrimp.

Table 11. Acute toxicity of diuron to estuarine and marine invertebrates.

Species	Scientific name	% a.i.	96-hour LC50 (ppm)	Toxicity category	Reference
Mysid shrimp	*Americamysis bahia*	99%	1.1	moderately toxic	EFED

Mysid shrimp	*Americamysis bahia*	99%	1.2	moderately toxic	EFED
Brown shrimp	*Penaeus aztecus*	92%	>1 (48 hr)	moderately toxic	
Eastern oyster (embryo-larvae)	*Crassostrea virginica*	95%	1.8	moderately toxic	EFED
Eastern oyster (shell deposition)	*Crassostrea virginica*	96.8%	4.8	moderately toxic	EFED
clam	*Mercenaria mercenaria* (larvae)	F?[a]	12 day LC50>5ppm	≤ moderately toxic	Davis & Hidu, 1969
clam	*Mercenaria mercenaria* (eggs)	F?[a]	48 hr EC50 (level) =2.53ppm	moderately toxic	Davis & Hidu, 1969

a. Test material not adequately identified, but authors repeatedly used trade names, suggesting formulated product. But if formulated product, we do not know which.

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

Chronic toxicity data for estuarine/marine organisms is presented in Table 12. While the NOEC for the mysid shrimp appears to be less than for the sheepshead minnow, it is notable that the usually very sensitive mysid has a LOEC above that of the sheepshead. As with freshwater organisms, the fish seem to be more sensitive to diuron.

Table 12. Chronic toxicity of diuron to estuarine fish and invertebrates (from EFED ERA).

Species	Scientific name	Duration	% a.i.	Endpoints affected	NOEC (ppm)	LOEC (ppm)
Sheepshead minnow	*Cyprinodon variegatus*	38 d	96.8%	Survival, reduced growth	<0.44	0.44
Mysid shrimp	*Americamysis bahia*	28 d	96.8%	Growth, reproduction	0.27	0.56

(7) Toxicity to aquatic plants and algae

There are surprisingly few data on diuron for aquatic vascular plants or algae (Table 13), considering that diuron has been used as an aquatic herbicide. No duckweed test has been submitted to support registration. The 25 ppb value developed by Teisseire, et al. (1999) is the preferred value because the test material was appropriately identified.

Table 13. Acute toxicity of diuron to algae and vascular plants.

Species	Scientific name	% a.i.	7-d EC50 (ppb)	Reference
Green algae	*Neochloris sp.*	95%	28 (72 hr)	EFED
Green algae	*Platymonas sp.*	95%	17 (72 hr)	EFED
Red algae	*Porphyridium cruentem*	95%	24 (72 hr)	EFED
Red algae (macrophytic)	*Porphyra yezoensis*	NR	9-14 (10 hr)	Yoshida, et al., 1986
Green algae	*Selanastrum capricornutum*	96.8%	2.4 (96 hr)	EFED
Green algae	*Scenedesmus subspicatus*	NR	36 (72 hr)	Schafer et al 1994
duckweed	*Lemna major* (= *Spirodela polyrhiza*)	NR (prob tech)[a]	41	Liu & Cedeño-Maldonado, 1974
duckweed	*Lemna perpusilla*	NR (prob tech)[a]	15	Liu & Cedeño-Maldonado, 1974
duckweed	*Lemna minor*	98%	25	Teisseire, et al., 1999

a. We cannot be confident that the technical material was used, but the authors used the full chemical name (1-(3,4-dichlorophenyl)-3,3-dimethylurea) rather than the generic name of diuron, which suggests that the technical material, or possibly even a purer form, was used.

Tesseire et al., (1999) looked at the separate and combined toxicity of diuron and copper, and diuron and folpet to the duckweed, *Lemna minor*. They found that diuron plus copper resulted in inhibition that was less than additive, suggesting an antagonistic effect. However, the differences between the predicted effects and the actual effects were small. When tested with folpet, a fungicide, the effects of diuron on the duckweed were essentially unaffected by the various concentrations of folpet.

(8) Toxicity of multiple active ingredient products

There are no known fish toxicity data on diuron products that contain other herbicidal active ingredients. As noted above, Tesseire et al., (1999) found that diuron and copper sulfate had slightly antagonistic interaction in tests with duckweed; this may or may not relate to fish toxicity. Table 14 presents the acute toxicity values in EFED's database that demonstrate the greatest toxicity of the technical material to fish. Copper sulfate is, by far, the most toxic of these compounds. The only registered use of compounds containing diuron and copper sulfate is to control algae in ornamental ponds, aquaria, and fountains (including those with fish present); use in natural waters is prohibited, and therefore there will be no exposure to wild salmon and steelhead. For most of the other herbicides used in combination with diuron, fish toxicity was not demonstrated at the highest doses tested. The sodium metaborate and bromacil did have demonstrable toxicity, but far less than that of diuron. Although we cannot be certain of interactions of the herbicidal components that would enhance fish toxicity, we can see no basis to expect any enhancement since diuron does not exhibit the enzymatic actions or the endocrine activity that is most likely to contribute to synergism. We conclude that the risks of these combination products, except the copper combinations, will be based primarily upon the diuron component

We did not include the diuron products in combination with fungicides because these are all paint additives where there will be no exposure to fish. The use of such paints is not for boats or structures that would be in water.

Table 14. Fish toxicity of other herbicides in diuron products.

Pesticide	Most sensitive species	Lowest LC50 value for technical material% a.i.	Reference	Note
bromacil	rainbow trout	36 ppm	EFED	
thidiazuron	rainbow trout	>19 ppm (NOEL)	EFED	no LC50 generated for any fish (all >)
paraquat	channel catfish	>100	EFED	formulated products toxic at 13 ppm and up
sulfometuron-methyl	bluegill, rainbow trout	>12.5 ppm	EFED	LC50> highest dose tested (up to 150 ppm) for any fish

tebuthiuron	bluegill	106 ppm	EFED	
sodium chlorate	bluegill, rainbow trout	>1000 ppm	EFED	
sodium metaborate	bluegill	>100 ppm	EFED	formulated product; no technical test data available from EFED
	coho salmon	12.2 ppm 11.8 days	AQUIRE	apparently tested in marine environment - Thompson et al., (1976)
monosodium methanearsonate	bluegill	>47.5 ppm	EFED	formulated product testing as low as 12 ppm
copper sulfate	rainbow trout	0.032 ppm	EFED	highly dependent upon hardness; more sensitive in soft water
imazapyr	bluegill, rainbow trout, channel catfish	>100 ppm	EFED	

(9) Toxicity of degradates

Mayer and Ellersieck (1986) report on test data for diuron using aged test solutions (Table 15). The use of aged test solutions is intended to determine toxicity after a period of time in which loss of the parent pesticide may occur. There is no differentiation between chemical degradation, physical removal (e.g., volatilization), or even biological inactivation, but such tests can indicate whether toxicity increases, decreases, or is stable over time. The data for diuron indicate that toxicity decreases modestly over time, indicating that no quick-forming degradates are of toxicological importance to fish relative to the parent diuron.

Table 15. Acute 96-hour LC50 values (ppm) for aged test solutions of diuron (from Mayer and Ellersieck, 1986).

Species	Scientific name	% a.i.	96-hour LC50 values (ppm) after aging				
			0 days	7 days	14 days	21 days	28 days
Cutthroat trout	*Oncorhynchus clarki*	95	1.5	11.5	13.8	12.8	12.3
Rainbow trout	*Oncorhynchus mykiss*	95	3.5	4.2	13.4	7.4	9.4
Lake trout	*Salvelinus namaycush*	95	ND[a]	3.2	3.6	11.5	ND[a]

[a] ND - No data, apparently no test was run.

The only major degradate identified in environmental fate studies was N'-(3,4-dichlorophenyl)-N-methylurea (DCPMU). Minor degradates included demethylated DCPMU (DCPU), dichloroaniline (DCA), and 3,3',4,4'-tetrachlorobenzene (TCAB). The DCPMU is not considered to be of toxicological concern, at least for human health. The DCA is of some toxicological concern, but because diuron degrades so slowly, the DCA is formed only in amounts less than 1% and is therefore not considered a risk concern, relative to the parent diuron. We note that DCA is a degradate from other active ingredients, and OPP apparently will be requiring fish toxicity data. If such data, when generated, change our risk concerns, we will inform the Service.

(10) Toxicity of inerts

The formulated product testing presented in Table 7 do not indicate that inert products are toxic, at least relative to the diuron. All formulated product test results indicate lower toxicity, for the same species, than any test with the active ingredient alone.

(11) Review of literature on sublethal and endocrine effects

There is some evidence (Saglio & Trijasse, 1998) that diuron can have effects on fish swimming behavior at concentrations well below lethality levels. In tests with various swimming behaviors, diuron (99% ai) at 5 ppb affected grouping in goldfish (*Carrasius auratus*), and conspecific skin extracts caused attraction. These effects were statistically significant at 5 ppb, but were not statistically significant at 0.5 ppb or at a higher concentration of 50 ppb. Burst swimming was observed to increase, which was statistically significant at 50 ppb, but not lower concentrations. Burst swimming is a typical fish escape response elicited by predators, tapping on aquaria glass, exposure to certain amino acids, and probably a variety of other stimuli.

We have found no evidence that suggests diuron has endocrine effects beyond those that would be manifested in typical reproductive toxicity tests. Should any such information become available, be considered valid, and indicate a risk to fish, we will re-evaluate our conclusions for the effects of diuron on Pacific salmon and steelhead.

b. Environmental fate and transport

The environmental fate and transport of diuron are presented in the EFED ERA on pages 8-11. The individual fate and transport studies are summarized in Appendix 1, pages 27-29. EECs and model inputs are on pages 29-52

In summary, diuron is persistent in terrestrial environments. It is resistant to laboratory hydrolysis at pH's 5, 7, and 9. The calculated half-lives in aqueous and soil photolysis studies were 43 and 173 days, respectively. The half-lives in aerobic and anaerobic soil metabolism studies were 372 and 1000 days, respectively. However, in anaerobic and aerobic aquatic metabolism studies, degradation appeared to be accelerated with half-lives of 33 and 5 days in aerobic and anaerobic systems, respectively. The EFED reviewer indicated that microbial degradation is the primary mechanism of loss in aquatic environments, and a separate EFED analysis of diuron as an aquatic herbicide indicated it would not persist in aquatic environments.

In terrestrial field dissipation studies in FL, MS, and CA with sand, silt loam, and silty clay loam soils, respectively, the half-lives were 73, 139, and 133 days, respectively. The major degradate, DCPMU, was more persistent.

Diuron has the potential to leach to ground and to contaminate surface waters. An adsorption/desorption/leaching study showed that diuron has low-medium K_{oc} (468-1666); additional information needs to be submitted for this study to be acceptable. In addition, diuron has low water solubility (42 ppm).

Two studies that were termed aquatic field dissipation studies looked at the application of diuron to the top and slope of a ditchbank. The study in Solano County, California had an agricultural field on one side and a railroad on the other side. The other study was comparable and was done in Arkansas, and is not further discussed here. The highest label rate of 12 lb ai/A was applied to the top berm and the slope leading down to the water at the bottom of the ditch. The study looked at concentrations of diuron in various parts of the environment over 178 days. Samples were taken every two days for the first 10 days, and then periodically until the end of the study. Rainfall was 8.72 inches over the period of the study, which was 68% of the mean rainfall over a ten year period. Sampling was also taken at 7 times, beginning with 0-hour, on days following rain events. The maximum amount in the sediment at the bottom of the ditch was 0.76 ppm immediately after application, declined to 0.13 ppm after four days, and was not detected after 6 days, except for one 0.066 ppm sample taken 256 days after application. The sediment half life was calculated by OPP to be 18.6 hours. No degradation products were found in the sediment. Diuron was found in the water only on day 2 and day 4 at a concentration of 0.013 ppm; no degradates were found in the water. No diuron was found in the water following any of the rain events.

c. Incidents

A few fish kills have been reported for diuron, but most are from intentional misuse. Of 20 reported incidents where fish were killed, 16 resulted from direct application to ponds, which is not allowed as a legal use in the U. S.. Two incidents were from use on unidentified agricultural crops where diuron subsequently ran off into adjacent waters. In one instance 12 bass and catfish were killed in Oklahoma, and in the other, 3000 unidentified fish were killed in Maryland. It is considered “probable” that diuron caused these kills, but it is unknown if the diuron was applied according to the label. Another incident resulted from spraying fence rows, with subsequent runoff into a pond, killing all of the algae within two days and 30-40 fish two days later. Diuron was applied by a pressure spray in combination with imazapyr and metsulfuron-methyl. It is likely that the spray application was the causative event, but it seems very likely that the cause of the fish deaths was low dissolved oxygen which was found to be markedly reduced; fish were observed “groping for air.” The fourth incident was associated with application of a bromacil-diuron product to an electrical substation. It appears to be unlikely to have resulted from diuron because copper sulfate had been applied several days previously, and measured amounts of diuron and bromacil in the pond were very low, whereas copper concentrations were above median lethal levels for several fish species.

d. Estimated and actual concentrations of diuron in water

(1) EECs from models

Diuron aquatic EECs were estimated using EFED's Tier I surface water model GENEEC II, which is based on climate and soils relative to the southeastern U.S., and which therefore are not likely to be representative of the western U. S. The values are conservative high-end EECs intended to stand as a high exposure scenario for the entire U. S. The EEC values of various western crops and rates at various durations using aerial or ground application rates are summarized in Table 16. Please note that these are not the same as appear in the EFED ERA; rather they are adjusted (linearly) for application rates on the labels that apply to the western U. S.; the EECs have also been rounded off.

Table 16. Diuron EECs for various crops using GENEEC (ppb) (from EFED ERA)

End-uses	rate	Aerial			Ground		
Agricultural							
		Peak	21 d. avg	60 d. avg	Peak	21 d. avg	60 d.. avg
grape	3.2	-	-	-	110	89	62
citrus	3.2	-	-	-	110	89	62
alfalfa	3.2	116	94	66	110	89	62
peaches, walnuts	4	-	-	-	137	111	78
apples, pears, pecans	3.2				110	89	62
cotton	2	73	59	41	69	56	39
Non-Agricultural							
		Peak	21 d. avg	60 d. avg	Peak	21 d. avg	60 d.. avg
Railroad	12	437	353	248	412	333	234
Roadside, utilities, irrigation, drainage ditch	12	-	-	-	412	333	234

Based upon the GENEEC EEC results, all uses exceed the criteria for T&E fish. The EFED ERA then presents the Tier II surface water model PRZM/EXAMS results to obtain more realistic EECs with grape (CA), citrus (FL) and apple (NY) scenarios. These scenarios were chosen to reflect a wide range of application rates and weather conditions on a national basis. PRZM-EXAMS and GENEEC2 EECs are listed in Table 17, but again these EECs are adjusted to reflect rates in the western crops, even if the scenario is not from the west. GENEEC's EECs are generally greater than those of PRZM/EXAMS and the results also depend on regional vulnerability. For the use of diuron on grapes in California, GENEEC's EECs were 5.2-8.4 times higher than those from PRZM/EXAMS. For Florida citrus and New York apples, GENEEC 2 EEC's were 0.95-1.6 and 1.6-2.6 times those for PRZM-EXAMS, respectively.

Table 17. GENEEC vs PRZM/EXAMS EECs for diuron on various crops (from EFED ERA).

Crop Scenario	Application Rate (lb ai/acre)	Method of Appl.	No. of Appl.	EEC (ppb)					
				GENEEC			PRZM/EXAMS		
				peak	21 d.	60 d.	peak	21 d.	60 d.
CA-Grape	3.2	Ground	1	110	89	62	13	13	12
FL-Citrus	3.2	Ground	1	110	89	62	69	67	65
NY-Apple	3.2	Ground	1	110	89	62	42	42	41

All of the EECs in Table 17, except for grapes with the refined PRZM/EXAMS model, exceed the criteria of concern for T&E fish. Based upon the significant differences between the PRZM-EXAMS results for California grapes and grapes modeled on a high runoff, vulnerable soils basis, we requested some additional PRZMS-EXAMS models for other western crops. There are a limited number of crop scenarios from which to choose. From those, we selected crops with the highest application rates and those represent the drier areas in California and the more humid areas in Oregon. The results and comparison of peak values with GENEEC are presented in Table 18. The results indicate, not unexpectedly, that the southeastern U. S.-based GENEEC models considerably overestimate the diuron EECs relative to those based upon the upper tier PRZM/EXAMS models using western climate and soils. We would further expect that EECs would be lower in Oregon and Washington east of the Cascades relative to the models based in the Willamette Valley. We must also reiterate here that even the refined PRZM/EXAMS EECs are based upon the farm pond as the receiving water, which may be realistic for first order streams, but which is very conservative relative to larger streams and rivers.

Table 18. GENEEC vs PRZM/EXAMS Peak EECs for diuron on various western crops.

Crop Scenario	Application Rate (lb ai/acre)	Method of Appl.	No. of Appl.	EEC (ppb)	
				GENEEC	PRZM/EXAMS
				peak	peak
OR grass seed	3.2	Ground	1	not done	16
OR-walnuts	4.0	Ground	1	137 [a]	43 [a]
OR- apples	3.2	Ground	1	110 [a]	18
CA-apples	3.2	Ground	1	110 [a]	10
CA-alfalfa	3.2	Aerial	1	116 [a]	22
CA- citrus	3.2	Ground	1	110 [a]	3
CA - walnuts [b]	4.0	Ground	1	137 [a]	21

a. Exceeds criteria for direct effects on fish based upon a cutthroat trout LC50 of 710 ppb and a concern level of 35.5 ppb (0.05 x LC50); also exceeds criteria for indirect effects on aquatic vegetation that may serve as cover for T&E fish, based on a *Lemna minor* EC50 of 25 ppb.
b. Scenario actually based on almonds as a surrogate for California walnuts

(2) Non-crop uses

Irrigation ditch use

Application of diuron in irrigation ditches is supposed to be done when there is no water in the ditch. Label directions call for applications in the non-crop season when the ditch is not in use. Application should preferably be made when the ditch is moist, and it is important that the diuron be "fixed" in the soil by moisture. If less than 4 inches or rainfall occurs, the ditch should be filled partially with water, allowed to stand 72 hours, and then drained.

The discussion of environmental fate and transport (section 3 c, above) does include a ditch bank study. This study only marginally resembles the application directions because the diuron was applied to the top of the berm and the sides of the ditch above the water. The ditch did have water in it, but the material was not applied there. Rather than having 4 inches of precipitation or filling the ditch to "fix" the diuron into the soil, there was a total of 8.7 inches of rain over the 178 day study period. It is perhaps relevant that little diuron was found in the ditch water after the first several days, and even the residues found were rather low. But the resemblance between the study and the application methods on the label suggests that the lack of residues in the water is not necessarily to be expected from labeled applications. It is, however, relevant that the half-life of the diuron in the sediment was 18.6 hours. In other words, we may not know how much diuron will get in the water or sediment, but that which does get into the sediment will not remain there very long.

Rights-of-way

OPP classifies three specific kinds of rights-of-way: highway, railroad, and utility (including pipeline). It is important to note that there is no quantitative scenario that can be applied to rights-of-way to enhance an aquatic risk assessment. In the EFED ERA, an EEC for the rights-of-way use was based on GENEEC, with the typical farm pond model of a 10 Ha watershed draining into a 1 Ha pond. Even though this is obviously an inappropriate spatial model for a rights-of-way use, it does provide a comparative estimate that can be used to assess risks. It may be too conservative or not conservative enough depending upon the nature of the right-of-way.

Two basic scenarios for aquatic risk assessment can be identified for rights-of-way. The first is where a rights-of-way crosses a water body, typically a stream or river. In such cases, there is very often a slope associated with the approach to the bridge crossing the stream. The length and slope of the approach determine the amount of a rights-of-way herbicide that could move down the approach and run into the water, and of course, the fate and transport characteristics of the particular herbicide are important.

To provide some perspective on the treated area for a stream-crossing right-of-way, one can assume, for example, an eight foot wide strip treated on both sides of a road would mean that one treated acre would be a strip approximately 0.5 miles long. In other words, if a road starts a downward slope 0.5 mile from a bridge, then there is a potential for the amount of herbicide on one treated acre to be available for runoff into the water. Obviously, if the treated strip is wider or narrower the amount of herbicide that is available for runoff is proportionately greater or smaller, respectively. If the right-of-way slopes down on both sides of the crossing, then the treated area is double. OPP considers that the typical pond scenario for estimated environmental concentrations does represent first order streams. But the pond scenario has a 10-acre treated area for the one acre pond (or 10 hectares for a 1-hectare pond). To mimic the pond scenario, and assuming that a right-of-way goes down hill on both sides of the crossing, it would require that the downhill slope be 2.5 miles long on each side of the crossing, or 5 miles long if the slope is on only one side of the crossing. Rights-of-way can vary hugely, but this scenario does seem plausible, in general, for a pesticide that is applied continuously along the right-of-way. Directed or spot treatments would result in considerably less pesticide applied.

A second type of right-of-way exposure would occur when a right-of-way follows a stream, such as through a narrow valley, rather than crossing the stream. This approach would apply to roads and railroads, but would be unlikely for utilities or pipelines except for very brief stretches. This initially appears to provide a much higher potential for stream exposure. But using the same kind of calculations as above would result in mimicking the farm pond model by treating a long stretch along the stream, 5 miles for the 8-foot wide treatment. The potential would be higher for runoff from applications to the stream side of the right-of-way, but would be lower from the away side of the right-of-way. But there would also be 5 miles of stream into which the runoff could flow, whereas on the crossing scenario above, almost all of the runoff would flow into a very small portion of the stream at the crossing.

The intent of the above discussion is to provide some perspective on rights-of-way uses. It must be reiterated that there is no model for such areas. Railroads, and many roads, are often well-bermed when they follow a stream. Whether a road is banked or crowned, and how a shoulder is constructed can make a significant difference in the manner that runoff occurs and the quantity that will run off. Slopes can be steep or shallow, long or short. And, of course, the climate and soils are very important, as well as the nature of the particular pesticide being used. Diuron, for example, needs to be activated by moisture. Therefore, it is likely to be applied to such sites when rain is expected. Light to moderate rain can result in the diuron being activated in place; heavy rain can cause runoff.

<u>Other uses</u>

The other non-crop uses of diuron are not really amenable to EEC modeling. Many of these uses would involve spot treatment, which would reduce the loading to aquatic environments relative to treatment of a broad area. For example, if as much as 1/4 of a non-crop area was spot treated, this would reduce the area-wide application to less than the highest western agricultural rate of 3.2 lb ai/A. Broad area treatment would occur in petroleum tank farms, which are well bermed to prevent loss of any petroleum products that spill and which would eliminate runoff of diuron, and rights-of-way.

Other diuron use sites include lumberyards, storage areas, industrial plants sites, and around farm buildings. But the labels really indicate “non-cropland” with the specific sites as mentioned as “such as” sites. In other words, diuron could be used to control weeds on any non-cropland site. The variety of sites is huge, even considering only those that are specifically mentioned on the label. The area covered by “around farm buildings” would not likely be too extensive, but industrial sites could be of almost any size. Thus, we cannot estimate the potential exposure to aquatic environments from such uses.

(3) Measured residues in the environment

NAWQA data

Monitoring data on diuron are available from the NAQWA program and one rights-of-way study in California. Table 19 presents a summary of the NAWQA monitoring data in study sites within the range of Pacific salmon and steelhead. The maximum figures for Pacific salmon and steelhead areas are 14 ppb from an agricultural site of the Willamette Valley study area, and 11 ppb from an urban site in the Sacramento River study area.

We note that the NAWQA sampling data, while considered high quality, are not targeted to sites and times where diuron 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 diuron. It seems likely, but may not be correct, that the highest NAWQA residues are sufficiently higher than typical residues that they may actually represent peaks.

Table 19. Diuron residues: detection frequency and maximum amounts found.

Study unit	# samples	% detects	use	max residue (ug/L)	# >1 ug/L	Reference
San Joaquin-Tulare Basin	181	54	agricultural	1.9	4	Dubrovsky et al., 1998
			mixed	4.8	11	
Sacramento Basin	80	68	agricultural	< 1	0	Domagalski et al., 2000
		86	urban	11	6	
		54	mixed	< 1	0	

Upper Willamette River Basin	190	53	agricultural	14	46	Wentz et al., 1998
			urban	3.4	2	
Central Columbia Plateau	231	20	mixed	< 1	0	Williamson et al., 1998
			agricultural	< 1	0	
Puget Sound Basin	27	4	urban	2.4	1	Ebbert et al., 2000
			agricultural	< 1	0	
			mixed	< 1	0	

<u>Targeted studies</u>

Powell, et al. (1996) looked at the residues in runoff water and in soil following application to a 2.4M wide strip of highway right-of-way at a rate of 3.49 kg/Ha, followed by 13 mm of "artificial rain" in one hour. Diuron concentrations in the runoff water ranged from 144 to 1770 ppb. Of three sites, no runoff occurred on one, at the second, 5-12% of the applied water and 0.2-3.2% of the applied diuron ran off, and at the third site, 17-46% of the water and 2.5-5.4% of the diuron ran off. At a fourth site sampled during several winter storms, diuron concentrations ranged from 46 to 2849 ppb. The largest amount removed in any sampled period was 8.4% of the diuron in one 28-hr period.

No measurements were taken in any receiving water during the study. To put these runoff amounts in perspective with respect to receiving water, the amount removed can be modeled as an input into OPP's standard 1 Ha farm pond model, 2 M deep, containing 20,000,000 liters of water. The maximum amount running off was 3.2%, 5.4%, and 8.4% at two sites with artificial rain and one site with natural rain, respectively, all based upon the application rate of 3.49 Kg/Ha. Assuming a 1 Ha treatment area, the runoff amount would be 0.11, 0.19, and 0.29 Kg, respectively, or to continue using OPP's farm pond model, these would be 1.1, 1.9, and 2.9 Kg for 10 Ha. These would yield 55 ppb, 95 ppb, and 145 ppb, respectively. It is recognized that a 10 Ha treatment of rights of way may not run off into a single body of water (10 Ha at 2.4 M treated on either side of a road would extend for a 2.1 Km distance), and also recognized that 1 Ha pond would not represent receiving water where salmon and steelhead occur. Nevertheless, this approach allows for comparisons with more common scenarios. See section xxx for additional discussion on rights-of-way.

e. Water Quality Criteria

EPA's Office of Water has not established Water Quality Criteria for diuron. The Canadian criteria for drinking water is 150 ppb (HWC, 1993) and Nowell and Resek (1994) report that the National Academy of Sciences and Engineering established a chronic criterion of 1.6 ppb for freshwater aquatic life. The basis for either of these criteria is not entirely clear, but it is our understanding that the National Academy of Sciences and Engineering approach to setting aquatic life criteria was to simply take the most sensitive aquatic animal test data and divide it by 100. The *Gammarus* data were generated before these criteria were set, and are 100 times the 1.6 ppb criterion..

f. Recent changes in diuron registrations

A few changes are expected to occur in diuron registrations. The RED is scheduled to be completed by the end of September, 2003. Some agreements on label changes have been reached, and those changes are considered in this analysis. It is likely that additional changes will occur, but these cannot be determined at the present time.

The label changes that have occurred and are relevant to ecological risks include deletion of aerial applications for all uses except rights-of-way, alfalfa, and cotton. Use on muck soils is eliminated, although this is probably not relevant to salmon and steelhead areas. Application rates are reduced nationally for various crops, but these reduced rates were already maximum rates with respect to western states. For non-crop uses, rates are being reduced from as much as 48 lb ai/A to a maximum of 12 lb ai/A.

g. Existing protections

Nationally, there are no specific protective measures for endangered and threatened species beyond the generic statements on the current diuron labels. These simply state: Do not apply directly to water, to areas where surface water is present, or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment washwaters. Cover or incorporate spills." There may be minor variations of this statement on different labels.

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. Diuron is currently included in these bulletins for the protection of plants, but not for the protection of T&E fish or other animals. It could be included for other species, as appropriate. 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. 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. Any measures necessary to protect T&E salmon and steelhead from diuron would most likely be promulgated through this system.

h. Discussion and general risk conclusions for diuron

The LOCs for acute effects on endangered fish are exceeded for non-agricultural uses at 12 lb ai/A. The LOCs for acute effects on endangered fish are also exceeded for agricultural uses where only Tier 1 GENEEC models, or where Tier 2 PRZM/EXAMS models use eastern scenarios. Chronic LOCs for endangered fish are exceeded for all uses, based upon the same models. LOCs for indirect effects on food supply for T&E fish are exceeded for the non-agricultural uses of diuron, and many of the modeled agricultural uses. Refined, Tier 2 PRZM/EXAMS models for western crop scenarios indicate much lower EECs than for eastern crops. With such models, LOCs are exceeded for agricultural uses of diuron only for peaches, walnuts, and filberts at their highest rates.

(1) Fish

The lowest fish LC50 used in the EFED ERA is 710 ppb for cutthroat trout. On this basis, OPP's level of acute concern (0.05 times the LC50) for diuron and endangered fish would be 35.5 ppb. Concentrations above this level are considered to pose an acute risk to T&E salmon and steelhead.

The chronic no-observed-effect-concentration for fish is considered to be 26.4 ppb. OPP's level of concern for chronic effects is the chronic NOEL, 26.4 ppb for diuron. Chronic exposure is not expected in flowing waters because diuron is only applied once per year at maximum rates, or twice at one-half the maximum rate.

The EFED ERA indicated that concerns for endangered and threatened fish existed for all uses except for grapes in California; the details are on pages 18-19 of the EFED ERA. However, all of the uses modeled except the grapes were based on either the screening level GENEEC model which uses a high runoff, vulnerable soils scenario based on a southeastern U. S. site, or an upper tier PRZM/EXAMS scenario based in New York for apples and Florida for citrus. When PRZM/EXAMS models were run for western crops (Table 18), LOCs for T&E fish were exceeded only in the Oregon walnut scenario.

The non-crop uses all have the potential to exceed the LOCs for T&E fish. Although we believe that the GENEEC model does overestimate for western states, the EECs at 12 lb ai/A are well above LOCs and seem unlikely to go below them based solely on western climate and soils. In particular, the rights-of-way use for railroads where application can be made by aircraft seem problematic even if we cannot define a single scenario for such uses. Other rights-of-way uses, even though they would have ground application only, also would seem to exceed criteria. The lack of appropriate definition of rights-of-way uses precludes a quantitative analysis; however in my best professional judgement, I believe that the wide area use of diuron for non-crop sites may affect T&E salmon and steelhead where diuron is used near their habitat.

Because the agricultural use sites with much lower applications do not exceed criteria, excepting walnuts in the Pacific Northwest, the use of lower rates for non-crop sites or spot treatments of small areas would probably not be a problem. Yet the potential for rights-of-way exposures of streams, especially smaller streams, exists and could be higher than for the agricultural sites, depending especially on the spatial arrangement of the rights-of-way to salmon-bearing streams. OPP has insufficient data to negate these concerns.

Other than lower rates for non-crop uses, another alternative to reduce exposure aquatic environments is through the use of spot treatments. Such treatments would typically only involve a small portion of a given area, depending upon the density of the treated pest plant. Control of invasive or noxious weeds might often be possible through spot treatments. Based upon the crop EEC models, it appears that treating less than 20% of an area with spot applications would reduce loading to aquatic environments to below levels of concern. This would require an even 20% treated; treating the 20% of an area that is next to an aquatic environment and not treating the 80% away from that environment would not be effective in reducing loading. Again, this is a judgement call and is not amenable to quantitation.

(2) Invertebrates

In the EFED ERA, OPP used a *Gammarus* LC50 of 160 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 80 ppb. Because this concentration is considerably higher than the concern level for direct effects to the fish, it is considered that the food supply for T&E fish will be well protected by the criterion for these direct effects. The same is also true for chronic effects on invertebrates as food supply, since the chronic effect NOEL is lower for fish than for aquatic invertebrates.

(3) Cover

There is some question as to which data are most appropriate for an evaluation of cover for T&E salmon and steelhead. There are no EFED validated data on aquatic vascular plants, which are preferred to algae in addressing cover issues. The Liu & Maldonado (1974) data are probably from technical diuron, but it is uncertain. Therefore, the Tesseire et al.(1999) data seem most relevant, and these data indicate an EC50 for *Lemna minor* of 25 ppb. Based upon this, OPP would have concerns for cover for T&E fish at concentrations in excess of 25 ppb.

No information could be located in several literature searches that addressed the effects of diuron on freshwater rooted vegetation. However, Haynes, et al., (2000) tested diuron in outdoor aquaria with three species of seagrasses, (*Zostera capricorni, Haplophila ovalis, Cymodocea serrulata).* Photosynthesis was affected in all three species within two hours at 10 and 100 ppb of diuron. *H. ovalis* was also affected after 24 hours at 1 ppb, as was *Z capricorni* after 5 days exposure. Recovery after the exposure period was initially rapid, then fluctuated; all three species still exhibited some effects on photosynthesis after 10 days (5 days after exposure) at 100 ppb. We cannot determine if the results of these studies would be applicable to freshwater rooted vegetation.

In further experiments, McGinnis-Ng and Ralph (2003) found that eelgrass (*Zostera capricorni*) exposed to 10 and 100 ppb exhibited reduced photosynthesis during the first two hours of a 10 hour exposure. At 10 ppb, effects on photosynthesis continued in the laboratory as had been observed by Haynes, et al. (2000), but in the field recovery began to occur even during the remainder of the ten hour exposure period. At 100 ppb, effects continued throughout the exposure period, but recovery in the field was observed after 24 hours (14 hours after end of exposure). In the laboratory, some recovery occurred, but only after exposure ended, and full recovery was not observed by the end of the 96 hour study. While these data suggest that the effects in the field are more resilient than in the laboratory, we are unaware of other data to support this finding.

It would appear that these data may increase concerns for indirect effects initially, but reduce them over a period of time. Based upon the *Lemna* data, concerns for indirect effects on plant cover would occur at EECs of 25 ppb. This is not significantly lower than the concern for direct effects at 35.5 ppb in the water. In addition, based upon the results of EEC modeling, there would be no difference in the sites where EECs are 35.5 ppb and where they are 25 ppb; i.e., those that are above 25 ppb are also above 35.5 ppb, and those below 35.5 ppb are also below 25 ppb..

(4) Conclusions

Agricultural uses

Based upon the toxicity data for diuron and the Tier II PRZM/EXAMS EECs generated for the western U. S. uses of diuron, it appears that EECs are below the criteria of concern for most agricultural uses of diuron. The agricultural uses that may affect listed Pacific salmon and steelhead are filberts, walnuts and peaches, based upon a western Oregon scenario. For all other agricultural uses, there will be no effect on these species.

Although the western Oregon walnut, peach, and filbert scenario exceeds criteria at 4 lb ai/A, the 43 ppb EEC exceeds the criteria only modestly. For direct effects, the LOC is 35.5 ppb, and for indirect effects on aquatic plant cover, the LOC is 25 ppb. Based upon the direct effects criterion, application rates below 3.3 lb ai/A would not exceed LOCs. Based upon the indirect effects on cover, application rates below 2.3 lb ai/A would not exceed the LOC. In areas of high usage, where considerable acreage can be treated, there would be concerns for both the direct and indirect effects; in areas with only modest acreage, the concerns would be for direct effects, such as when diuron is applied near a small stream. Considering that the EECs are base on upper tenth percentile climate conditions and 95% confidence limits on many of the environmental fate parameters, I can conclude that there would be no direct or indirect effect from these uses at application rates at or below 2.2 lb ai/A.

It may appear that, if rates above 2.2 lb ai/A would be a concern for walnuts, filberts, and peaches, then it should also be a concern for other crops such as apples. However, the timing of applications is such that the walnuts, filberts, and peaches may include more winter precipitation (walnut and filbert applications may be made in late fall after harvest and peach applications must be made 8 months before harvesting) that would lead to a higher runoff potential; applications to apples are made in the spring.

The PRZM/EXAMS model for walnuts in California (using almonds as a surrogate for the walnuts) resulted in an EEC of 21 ppb, below the concern level for both direct and indirect effects, even at the 4 lb ai/A application rate. I conclude that there would be no effect on ESUs in the San Joaquin Valley that approximate the 11 inches of precipitation of this model. There is some question on how far this model can be extrapolated, since the results are not linear based upon precipitation; soils are also relevant. (Precipitation data are from Western Regional Climate Center, and for California are at: http://www.wrcc.dri.edu/htmlfiles/ca/ca.ppt.ext.html) It seems likely that it would apply to most of the walnut-growing areas, but I cannot be certain. San Luis Obispo County has considerable walnut acreage and has about 22 inches of precipitation per year. The Sacramento Valley has considerable walnut acreage and has precipitation ranging from about 18 inches per year in Sacramento to 26 inches per year in Chico. Because of uncertainty, I cannot eliminate concerns at the 4 lb ai/A application rate. However, in my best professional judgement, there will be no effect on salmon and steelhead ESUs in these two areas at application rates at or below 3.2 lb ai/A. There are areas of California, especially higher elevations and the northern coast where the precipitation is higher, but there are minimal or no walnuts grown in these areas. Peach acreage treated with diuron is negligible with only 24 acres treated in the entire Central Valley, and filberts are not a California crop.

Based upon the data, the models, and my best judgement, I conclude that there will be no effect on any salmon or steelhead ESU as a result of diuron use on any agricultural crop in California at applications rates of 3.2 lb ai/A, and that in the San Joaquin Valley, there will be no effect even at maximum label rates for walnuts at 4 lb ai/A.

This leaves eastern Washington and Oregon. Only Yakima County has more than several hundred acres of walnuts, filberts and peaches. The east side of the Cascades is relatively arid, once out of the mountains. Towns along the east side of the Cascades in Washington typically have about 10 inches of precipitation per year (Western Regional Climate Center at http://www.wrcc.dri.edu/htmlfiles/wa/wa.ppt.ext.html) I conclude that there is no effect of diuron on any salmon or steelhead ESU in eastern Oregon or Washington from any agricultural crop even at the highest agricultural rate of 4.0 lb ai/A.

Non-agricultural uses

The non-agricultural uses of diuron not only can be done at higher application rates than for agricultural uses, but there is also more potential for the diuron to get into salmon-bearing streams, at least in certain situations. We cannot quantify the exposure well and on the basis of these high rates and the uncertainties at lower rates, I conclude that the rights-of-way and irrigation ditch uses may affect listed Pacific salmon and steelhead, with the exception of spot applications for occasional plants, not to exceed a uniform 10% of an area.

I recognize that the state of Washington is working with the Service regarding the use of diuron on road rights-of-way (personal communication, Ray Willard, Washington State Department of Transportation, June, 2003), and may be working with transportation departments in other states. These departments may be able to develop very finely-tuned procedures on treating rights-of-way that would avoid effects on listed fish; I am only able to base my considerations on the labels for these products. It is important to recognize that detailed descriptions of projects and procedures can remove significant amounts of uncertainty. Any conclusions reached in this rather broad label-based analysis should not preclude other more directed and specific methods for using diuron (or other pesticides) in ways that will not affect listed salmon and steelhead.

Other non-agricultural uses such as industrial sites may affect listed salmon and steelhead except I conclude that the following will not affect these species:
1. Petroleum tank farms or other sites that are well bermed to prevent runoff where such berms are checked for integrity prior to applications.
2. Spot treatments where less than 20% of an area is treated for industrial sites, lumberyards, storage areas, etc.

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

Please note that OPP will be transmitting a separate analysis of ESUs and their critical habitat to NMFS. We have noted this in previous consultation requests, but it is taking somewhat longer than anticipated. 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. 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. Diuron 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 diuron in counties where this ESU occurs are presented in Table 20.

Table 20. Use of diuron in counties with the Southern California steelhead ESU.

County	Crop or other use site	Usage (pounds)	Acres treated
San Diego	**landscape maintenance**	1,252	nr
	lemon	776	370
	greenhouse container plants	14	2
	orange	171	184
	rights-of-way	9,545	nr
	structural pest control	<1	nr
	tangerine	29	20
	county total	11,787	
Los Angeles	alfalfa	1,606	1640
	food processing plant	16	4
	industrial site	86	20
	landscape maintenance	4,187	nr
	rights-of-way	85,933	nr
	county total	91,828	

County	Crop or other use site	Usage (pounds)	Acres treated
Ventura	avocado	32	20
	landscape maintenance	129	nr
	lemon	8,573	4,443
	greenhouse flowers	1	<1
	orange	2,055	1,629
	rights-of-way	8,961	nr
	structural pest control	408	nr
	tangerine	4	1
	county total	20,163	
San Luis Obispo	alfalfa	833	1,058
	asparagus	11	7
	grape	357	245
	grapefruit	64	20
	landscape maintenance	469	nr
	lemon	450	325
	orange	67	80
	rights-of-way	1,778	nr
	uncultivated ag	1	5
	uncultivated non-ag	4	48
	walnut	4,072	30
	county total		
Santa Barbara	alfalfa	200	272
	asparagus	34	14
	avocado	96	30
	bean	583	10
	citrus	2	1
	landscape maintenance	115	nr
	lemon	1,639	854
	nursery greenhouse flowers	1	1
	greenhouse container plants	<1	nr
	rights-of-way	9,022	nr
	tangerine	22	15
	county total	11,715	

There is considerable diuron usage on rights-of-way and other non-crop sites within this ESU. I cannot ascertain where diuron would be used on rights-of-way within this ESU, relative to where the steelhead occurs. On the basis of the high application rate, the potential direct and indirect effects of diuron at high rates, and uncertainty of exposure, I conclude that the non-crop use of diuron may affect the Southern California steelhead ESU.

The only crop use of concern (see discussion in section 3h(4) above) grown in this area is walnuts in San Luis Obispo County. The highest rate exceeds LOCs. I conclude that there will be no effect on the Southern California steelhead ESU from use on walnuts where the application rate is 3.2 lb ai/A or below, but that use above 3.2 lb ai/A may affect this ESU.

(2) South Central California Steelhead ESU

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

This ESU includes the hydrologic units of Pajaro (upstream barriers - Chesbro Reservoir, North Fork Pachero Reservoir), Estrella, Salinas (upstream barriers - Nacimiento Reservoir, Salinas Dam, San Antonio Reservoir), Central Coastal (upstream barriers - Lopez Dam, Whale Rock Reservoir), 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 diuron in counties where this ESU occurs are presented in Table 21.

Table 21. Use of diuron in counties with the South Central California steelhead ESU.

County	Crop or other use site	Usage (pounds)	Acres treated
Santa Cruz	**landscape maintenance**	50	nr
	rights-of-way	867	nr
	county total	917	
San Benito	alfalfa	202	185
	asparagus	1,079	371
	grape	137	125
	industrial site	2	1
	landscape maintenance	28	nr
	rights-of-way	1,125	nr
	uncultivated ag	3	2
	uncultivated non-ag	35	30
	county total	2,611	

County	Crop or other use site	Usage (pounds)	Acres treated
Monterey	alfalfa	14	6
	artichoke	7	8
	asparagus	1,933	900
	grape	3,522	2,798
	landscape maintenance	457	nr
	lemon	108	70
	nursery greenhouse flowers	6	3
	nursery greenhouse transplants	3	1
	rights-of-way	2,696	nr
	uncultivated non-ag	1,176	176
	county total	9,923	
San Luis Obispo	alfalfa	833	1,058
	asparagus	11	7
	grape	357	245
	grapefruit	64	20
	landscape maintenance	469	nr
	lemon	450	325
	orange	67	80
	rights-of-way	1,778	nr
	uncultivated ag	1	5
	uncultivated non-ag	4	48
	walnut	4,072	30
	county total		

There is low to moderate diuron usage on rights-of-way and other non-crop sites within this ESU. I cannot ascertain where diuron would be used on rights-of-way within this ESU, relative to where the steelhead occurs. On the basis of the high application rate, the potential direct and indirect effects of diuron at high rates, and uncertainty of exposure, I conclude that the non-crop use of diuron may affect the South Central California steelhead ESU.

The only crop use of concern (see discussion in section 3h(4) above) grown in this area is walnuts in San Luis Obispo County. The highest rate exceeds LOCs. I conclude that there will be no effect on the South Central California steelhead ESU from use on walnuts where the application rate is 3.2 lb ai/A or below, but that use above 3.2 lb ai/A may affect this ESU.

(3) Central California Coast Steelhead ESU

The Central California coast steelhead ESU was proposed for listing as endangered on August 9, 1996 (61FR41541-41561) and the listing was made final, as threatened, a year later (62FR43937-43954, August 18, 1997). Critical Habitat was proposed February 5, 1999 (64FR5740-5754) and designated on February 16, 2000 (65FR7764-7787). This coastal steelhead ESU occupies California river basins from the Russian River, Sonoma County, to Aptos Creek, Santa Cruz County, (inclusive), and the 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 22).

Table 22. Use of diuron in counties with the Central California Coast steelhead ESU.

County	Crop or other use site	Usage (pounds)	Acres treated
Santa Cruz	**landscape maintenance**	50	nr
	rights-of-way	867	nr
	county total	917	
San Mateo	**landscape maintenance**	777	nr
	rights-of-way	1,633	nr
	uncultivated non-ag	96	12
	county total	2,507	
San Francisco	**landscape maintenance**	88	nr
	rights-of-way	247	nr
	county total	334	
Marin	**industrial site**	107	22
	landscape maintenance	164	nr
	rights-of-way	590	nr
	county total	862	

County	Crop or other use site	Usage (pounds)	Acres treated
Sonoma	alfalfa	30	10
	grape	674	632
	landscape maintenance	852	nr
	outdoor container plants	67	23
	nursery outdoor transplants	4	2
	rights-of-way	5,356	nr
	structural; pest control	1,158	nr
	uncultivated non-ag	142	22
	county total	8,284	
Mendocino	alfalfa	10	4
	grape	755	669
	landscape maintenance	469	nr
	nursery greenhouse flowers	<1	9,200
	pear	48	40
	rights-of-way	19	nr
	uncultivated non-ag	4	2
	county total	1,304	
Napa	grape	29	63
	landscape maintenance	361	nr
	public health	2,384	nr
	rights-of-way	557	nr
	county total	3,331	
Alameda	alfalfa	713	496
	grape	9	18
	landscape maintenance	1973	nr
	rights of way	13,831	nr
	structural pest control	131	nr
	uncultivated ag	3.2	nr
	uncultivated non-ag	460	101
	county total	17,122	
Contra Costa	alfalfa	487	310
	asparagus	434	271
	grapes	183	107
	landscape maintenance	4,104	nr
	rights of way	6,721	nr
	small fruits/berries	4	2
	structural pest control	6	nr
	uncultivated ag	20	4
	uncultivated non-ag	320	97
	walnut	8	4
	county total	12,287	

County	Crop or other use site	Usage (pounds)	Acres treated
Solano	alfalfa	8,197	5,187
	grape	120	30
	landscape maintenance	1,662	nr
	pear	35	48
	rights-of-way	13,049	nr
	structural; pest control	10	nr
	uncultivated non-ag	275	50
	walnut	932	283
	county total	24,281	
Santa Clara	alfalfa	24	15
	landscape maintenance	3,773	nr
	greenhouse container plants	7	1
	nursery outdoor transplants	291	60
	oat	61	41
	research commodity	42	4
	rights-of-way	9,700	nr
	county total	13,898	

There is considerable diuron usage on rights-of-way and other non-crop sites within this ESU. I cannot ascertain where diuron would be used on rights-of-way within this ESU, relative to where the steelhead occurs. On the basis of the high application rate, the potential direct and indirect effects of diuron at high rates, and uncertainty of exposure, I conclude that the non-crop use of diuron may affect the Central California Coast steelhead ESU.

The only crop use of concern (see discussion in section 3h (4) above) grown in this area is walnuts, although the treated acreage was under 1000 acres in 2001. The highest rate exceeds LOCs. I conclude that there will be no effect on the Central California Coast steelhead ESU from use on walnuts where the application rate is 3.2 lb ai/A or below, but that use above 3.2 lb ai/A may affect this 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 diuron in counties where the California Central Valley steelhead ESU occurs is presented in Table 23.

Table 23. Use of diuron in counties with the California Central Valley steelhead ESU.

County	Crop or other use site	Usage (pounds)	Acres treated
Alameda	alfalfa	713	496
	grape	9	18
	landscape maintenance	1973	nr
	rights of way	13,831	nr
	structural pest control	131	nr
	uncultivated ag	3.2	nr
	uncultivated non-ag	460	101
	county total	17,122	
Amador	alfalfa	201	104
	grape	574	526
	landscape maintenance	153	nr
	rights of way	3,695	nr
	structural pest control	66	nr
	walnut	59	65
	county total	4,749	
Butte	alfalfa	39	20
	citrus	12	22
	cotton	1	20
	landscape maintenance	994	nr
	olive	156	326
	orange	60	92
	regulatory pest control	276	nr
	rights of way	3,581	nr
	structural pest control	1	nr
	uncultivated ag	192	48
	uncultivated non-ag	577	167
	walnut	3545	2,053
	county total	9435	

County	Crop or other use site	Usage (pounds)	Acres treated
Calaveras	grape	1	3
	landscape maintenance	836	nr
	regulatory pest control	30	nr
	rights of way	1,007	nr
	structural pest control	16	nr
	uncultivated non-ag	62	19
	walnut	29	22
	county total	1,981	
Colusa	alfalfa	2,309	1,543
	cotton	239	9,209
	landscape maintenance	47	nr
	rights of way	6354	nr
	structural pest control	6	nr
	walnut	72	45
	county total	9,027	
Contra Costa	alfalfa	487	310
	asparagus	434	271
	grapes	183	107
	landscape maintenance	4,104	nr
	rights of way	6,721	nr
	small fruits/berries	4	2
	structural pest control	6	nr
	uncultivated ag	20	4
	uncultivated non-ag	320	97
	walnut	8	4
	county total	12,287	
Glenn	alfalfa	526	398
	cotton	41	1,419
	olive	1,049	929
	orange	45	54
	pecan	16	10
	rights of way	5,543	nr
	walnut	632	855
	county total	7,852	
Marin	**industrial site**	107	22
	landscape maintenance	164	nr
	rights-of-way	590	nr
	county total	862	

County	Crop or other use site	Usage (pounds)	Acres treated
Merced	alfalfa	34,253	25,418
	almond	15	10
	animal premises	166	5
	corn (forage-fodder)	73	15
	cotton	867	33,754
	grape	644	520
	industrial site	66	12
	landscape maintenance	84	nr
	oat	40	8
	orange	39	20
	peach	24	36
	rights of way	18,950	nr
	uncultivated ag	6	30
	walnut	849	nr
	county total	56,075	
Nevada	**landscape maintenance**	207	nr
	rights-of-way	1,055	nr
	structural pest control	6	nr
	county total	1,268	
Placer	**landscape maintenance**	647	nr
	rights of way	2,077	nr
	county total	2,724	
Sacramento	alfalfa	1,301	791
	apple	10	11
	artichoke	5	3
	asparagus	219	112
	grape	1,587	4,281
	landscape maintenance	832	nr
	pear	259	343
	rights of way	15,799	nr
	structural pest control	40	nr
	county total	20,052	

County	Crop or other use site	Usage (pounds)	Acres treated
San Joaquin	alfalfa	23,079	15,729
	animal premises	212	123
	apple	214	369
	asparagus	7,570	4,608
	cotton	2	46
	ditch bank	26	25
	grape	6,143	10,066
	landscape maintenance	312	nr
	pear	32	75
	rights of way	16,403	nr
	structural pest control	29	nr
	uncultivated ag	1,622	526
	uncultivated non-ag	1,128	359
	walnut	3,211	3,807
	county total	59,984	
San Francisco	**landscape maintenance**	88	nr
	rights-of-way	247	nr
	county total	334	
San Mateo	**landscape maintenance**	777	nr
	rights-of-way	1,633	nr
	uncultivated non-ag	96	12
	county total	2,507	
Shasta	**landscape maintenance**	379	nr
	mint	349	246
	public health	188	nr
	rights-of-way	1,061	nr
	structural pest control	11	nr
	walnut	131	55
	county total	2,120	
Solano	alfalfa	8,197	5,187
	grape	120	30
	landscape maintenance	1,662	nr
	pear	35	48
	rights-of-way	13,049	nr
	structural; pest control	10	nr
	uncultivated non-ag	275	50
	walnut	932	283
	county total	24,281	

County	Crop or other use site	Usage (pounds)	Acres treated
Sonoma	alfalfa	30	10
	grape	674	632
	landscape maintenance	852	nr
	outdoor container plants	67	23
	nursery outdoor transplants	4	2
	rights-of-way	5,356	nr
	structural pest control	1,158	nr
	uncultivated non-ag	142	22
	county total	8,284	
Stanislaus	alfalfa	5,400	4,091
	apple	117	43
	boysenberry	22	11
	citrus	233	284
	grape	1,878	1,977
	landscape maintenance	541	nr
	greenhouse transplants	12	15
	outdoor container plants	12	30
	public health	455	nr
	rights-of-way	25,605	nr
	structural pest control	42	nr
	walnut	2,962	3,117
	county total	37,278	
Sutter	alfalfa	29	10
	cotton	4	168
	landscape maintenance	67	nr
	pistachios	12	22
	prune	66	28
	rights-of-way	5,067	nr
	structural pest control	14	nr
	uncultivated ag	144	12
	walnut	1,091	710
	county total	6,494	
Tehama	**landscape maintenance**	103	nr
	olive	484	412
	rights-of-way	1,801	nr
	structural pest control	223	nr
	walnut	2,231	1018
	county total	4,841	

County	Crop or other use site	Usage (pounds)	Acres treated
Tuolumne	**landscape maintenance**	1,439	nr
	rights-of-way	1,225	nr
	structural pest control	47	nr
	uncultivated non-ag	3	30
	county total	2,715	
Yolo	alfalfa	12,219	9,277
	asparagus	68	36
	cotton	98	3,845
	grape	217	318
	landscape maintenance	211	nr
	outdoor container plants	18	12
	nursery outdoor transplants	16	5
	orange	1	7
	research commodity	26	nr
	rights-of-way	5,219	nr
	walnut	611	450
	county total	18,705	
Yuba	alfalfa	224	130
	landscape maintenance	26	nr
	rights-of-way	2,178	nr
	structural pest control	2	nr
	walnut	1,015	821
	county total	3,445	

There is considerable diuron usage on rights-of-way and other non-crop sites within this ESU. I cannot ascertain where diuron would be used on rights-of-way within this ESU, relative to where the steelhead occurs. On the basis of the high application rate, the potential direct and indirect effects of diuron at high rates, and uncertainty of exposure, I conclude that the non-crop use of diuron may affect the California Central Valley steelhead ESU.

The only crop uses of concern (see discussion in section 3h(4) above) grown in this area are walnuts and peaches; diuron was used on substantial walnut acreage, but only on 24 acres of peaches. The highest rate exceeds LOCs. I conclude that there will be no effect on the California Central Valley steelhead ESU from use on walnuts or peaches where the application rate is 3.2 lb ai/A or below, but that use above 3.2 lb ai/A may affect this ESU. By itself, 24 acres of peaches would be of no concern for indirect effects, and it should be below the LOCs for direct effects, but in combination with a high rate use on walnuts, we cannot rule out some concern.

(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 diuron usage. Table 24 shows the reported use of diuron in these counties.

Table 24. Use of diuron in counties with the Northern California steelhead ESU.

County	Crop or other use site	Usage (pounds)	Acres treated
Humboldt	**landscape maintenance**	108	nr
	nursery greenhouse flowers	20	45
	nursery outdoor flowers	78	80
	rights-of-way	25	nr
	county total	231	
Mendocino	alfalfa	10	4
	grape	755	669
	landscape maintenance	469	nr
	nursery greenhouse flowers	<1	9,200
	pear	48	40
	rights-of-way	19	nr
	uncultivated non-ag	4	2
	county total	1,304	
Trinity	**rights-of-way**	2	nr
Lake	grape	20	13
	landscape maintenance	1,138	nr
	pear	988	599
	rights-of-way	1,357	nr
	structural pest control	51	nr
	county total	3,554	

There is fairly low diuron usage on rights-of-way and other non-crop sites within this ESU. I cannot ascertain where diuron would be used on rights-of-way within this ESU, relative to where the steelhead occurs. On the basis of the high application rate, the potential direct and indirect effects of diuron at high rates, and uncertainty of exposure, I conclude that the non-crop use of diuron may affect the Northern California steelhead ESU.

The only crop use of concern (see discussion in section 3h(4) above) grown in this area is walnuts. Diuron was not used on walnuts in 2001 within this ESU, but there is substantial acreage of walnuts in Lake County, and it could be used. The highest rate exceeds LOCs. I conclude that there will be no effect on the Northern California steelhead ESU from use on walnuts where the application rate is 3.2 lb ai/A or below, but that use above 3.2 lb ai/A may affect this ESU.

(6) Upper Columbia River Steelhead ESU

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

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

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.

Table 25 shows the cropping information where diuron can be used in Washington counties where the Upper Columbia River steelhead ESU is located. Table 26 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 25. Crops on which diuron can be used at a high rate 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	none	0	1,231,999
WA	Benton	peaches (149) walnuts (41),	190	1,089,993
WA	Chelan	peaches (21) walnuts	21	1,869,848
WA	Douglas	peaches (167)	167	1,165,158
WA	Franklin	peaches (262) walnuts	262	794,999
WA	Grant	peaches (261) walnuts (5) filberts	266	1,712,881
WA	Kittitas	filberts (1) peaches (1)	2	1,469,862
WA	Okanogan	peaches (67) walnuts (29) filberts (10)	106	3,371,698
WA	Yakima	peaches (1,438) walnuts (11) filberts (6)	1,455	2,749,514

Table 26. Crops on which diuron can be used at a high rate in counties in the migration corridor of the Upper Columbia River steelhead ESU.

State	County	Crops and acreage planted	Acres	Total acreage
OR	Clatsop	none	0	529,482
OR	Columbia	walnuts (11) filberts peaches	11	420,332
OR	Gilliam	none	0	770,664
OR	Hood River	peaches (13)	13	334,328
OR	Morrow	none	0	1,301,021
OR	Multnomah	peaches (36) walnuts (2)	38	278,570
OR	Sherman	none	0	526,911
OR	Umatilla	peaches (7)	7	2,057,809
WA	Clark	filberts (87) walnuts (51) peaches (46)	184	401,850
WA	Cowlitz	walnuts (5) filberts (1)	6	728,781

State	County	Crops and acreage planted	Acres	Total acreage
WA	Klickitat	peaches (199) walnuts	199	1,198,385
WA	Pacific	none	0	623,722
WA	Skamania	none	0	1,337,179
WA	Wahkiakum	none	0	169,125
WA	Walla Walla	none	0	813,108

We have no information on diuron usage on rights-of-way and other non-crop sites within this ESU. I cannot ascertain if or where diuron would be used on rights-of-way within this ESU, relative to where the steelhead occurs. On the basis of the high application rate, the potential direct and indirect effects of diuron at high rates, and uncertainty of exposure, I conclude that the non-crop use of diuron may affect the Upper Columbia River steelhead ESU.

As discussed in section 3h(4) above, all crop uses in eastern Washington are below LOCs. The acreage in the migratory corridors is low and dilution is substantial. I conclude that there will be no effect on the Upper Columbia River steelhead ESU from agricultural use of diuron.

(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 diuron use in agricultural and registered non-crop 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 diuron. 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 27 and Table 28 show the cropping information for the Pacific Northwest counties where the Snake River Basin steelhead ESU is located and for the Oregon and Washington counties where this ESU migrates. 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 27. Crops on which diuron can be used at a high rate 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	none	0	873,399
ID	Clearwater	none	0	1,575,396
ID	Custer	none	0	3,152,382
ID	Idaho	filberts peaches	nr	5,430,522
ID	Latah	none	0	689,089
ID	Lemhi	peaches (3)	3	2,921,172
ID	Lewis	none	0	306,601
ID	Valley	none	0	2,354,043
OR	Union	peaches (12)	12	1,303,476
OR	Wallowa	peaches	nr	2,013,071
WA	Adams	none	0	1,231,999
WA	Asotin	peaches (18)	18	406,983
WA	Benton	peaches (149) walnuts (41)	190	1,089,993
WA	Columbia	none	0	556,034
WA	Franklin	peaches (262) walnuts	262	794,999
WA	Garfield	none	0	454,744
WA	Lincoln	none	0	1,479,196

State	County	Crops and acreage planted	Acres	Total acreage
WA	Spokane	peaches (42)	42	1,128,835
WA	Walla Walla	none	0	813,108
WA	Whitman	none	0	1,382,006

Table 28. Crops on which diuron can be used at a high rate in counties in the migration corridor of the Snake River Basin steelhead ESU.

State	County	Crops and acreage planted	Acres	Total acreage
OR	Clatsop	none	0	529,482
OR	Columbia	walnuts (11) filberts peaches	11	420,332
OR	Gilliam	none	0	770,664
OR	Hood River	peaches (13)	13	334,328
OR	Morrow	none	0	1,301,021
OR	Multnomah	peaches (36) walnuts (2)	38	278,570
OR	Sherman	none	0	526,911
OR	Umatilla	peaches (7)	7	2,057,809
OR	Wasco	peaches (30)	30	1,523,958
WA	Benton	peaches (149) walnuts (41)	190	1,089,993
WA	Cowlitz	walnuts (5) filberts (1)	6	728,781
WA	Klickitat	peaches (199) walnuts	199	1,198,385
WA	Pacific	none	0	623,722
WA	Skamania	none	0	1,337,179
WA	Wahkiakum	none	0	169,125

We have no information on diuron usage on rights-of-way and other non-crop sites within this ESU. I cannot ascertain if or where diuron would be used on rights-of-way within this ESU, relative to where the steelhead occurs. On the basis of the high application rate, the potential direct and indirect effects of diuron at high rates, and uncertainty of exposure, I conclude that the non-crop use of diuron may affect the Snake River Basin steelhead ESU.

As discussed in section 3h(4) above, all crop uses in eastern Washington and Idaho are below LOCs. The acreage in the migratory corridors is low and dilution is substantial. I conclude that there will be no effect on the Snake River Basin steelhead ESU from agricultural use of diuron.

(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 diuron 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 29 and Table 30 show the cropping information for Oregon counties where the Upper Willamette River steelhead ESU is located and for the Oregon and Washington counties where this ESU migrates. 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 29. Crops on which diuron can be used at a high rate in counties containing spawning and rearing habitat for the Upper Willamette steelhead ESU.

State	County	Crops and acreage planted	Acres	Total acreage
OR	Benton	filberts (493) walnuts (23) peaches (8)	524	432,961
OR	Clackamas	filberts (3,994) peaches (78) walnuts (51)	4,123	1,195,712
OR	Linn	filberts (1,820) peaches (73) walnuts (55)	1,948	1,466,507
OR	Marion	filberts (7,061) peaches (179) walnuts (155)	7,395	758,394

State	County	Crops and acreage planted	Acres	Total acreage
OR	Polk	filberts (2,394) peaches (51) walnuts (33)	2,478	474296
OR	Washington	filberts (5,595) walnuts (679) peaches (168)	6,442	463,231
OR	Yamhill	filberts (7,110) walnuts (608) peaches (104)	7,822	457,986

Table 30. Crops on which diuron can be used at a high rate in counties in the migration corridor of the Upper Willamette steelhead ESU.

State	County	Crops and acreage planted	Acres	Total acreage
OR	Clatsop	none	0	529,482
OR	Columbia	walnuts (11) filberts peaches	11	420,332
OR	Multnomah	peaches (36) walnuts (2)	38	278,570
WA	Clark	filberts (87) walnuts (51) peaches (46)	184	401,850
WA	Cowlitz	walnuts (5) filberts (1)	6	728,781
WA	Pacific	none	0	623,722
WA	Wahkiakum	none	0	169,125

We have no information on diuron usage on rights-of-way and other non-crop sites within this ESU. I cannot ascertain if or where diuron would be used on rights-of-way within this ESU, relative to where the steelhead occurs. On the basis of the high application rate, the potential direct and indirect effects of diuron at high rates, and uncertainty of exposure, I conclude that the non-crop use of diuron may affect the Upper Willamette steelhead ESU.

As discussed in section 3h(4) above, the high rates for peaches, walnuts, and filberts exceed LOCs. There will be no effect from other crop uses. There is substantial acreage of filberts, and additional acreage of walnuts and peaches, in the area where this steelhead occurs. I conclude that the use of diuron on peaches, walnuts, and filberts at application rates above 2.2 lb ai/A may affect the Upper Willamette steelhead ESU; there will be no effect at 2.2. lb ai/A and below.

(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 31 and Table 32 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 31. Crops on which diuron can be used at a high rate 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	filberts (3,994) peaches (78) walnuts (51)	4,123	1,195,712
OR	Hood River	peaches (13)	13	334,328
OR	Multnomah	peaches (36) walnuts (2)	38	278,570
WA	Clark	filberts (87) walnuts (51) peaches (46)	184	401,850
WA	Cowlitz	walnuts (5) filberts (1)	6	728,781

State	County	Crops and acreage planted	Acres	Total acreage
WA	Lewis	filberts (25) walnuts (4)	29	1,540,991
WA	Skamania	none	0	1,337,179

Table 32. Crops on which diuron can be used at a high rate in counties in the migration corridor of the Lower Columbia River steelhead ESU.

State	County	Crops and acreage planted	Acres	Total acreage
OR	Clatsop	none	0	529,482
OR	Columbia	walnuts (11) filberts peaches	11	420,332
WA	Pacific	none	0	623,722
WA	Wahkiakum	none	0	169,125

We have no information on diuron usage on rights-of-way and other non-crop sites within this ESU. I cannot ascertain if or where diuron would be used on rights-of-way within this ESU, relative to where the steelhead occurs. On the basis of the high application rate, the potential direct and indirect effects of diuron at high rates, and uncertainty of exposure, I conclude that the non-crop use of diuron may affect the Lower Columbia River steelhead ESU.

As discussed in section 3h(4) above, the high rates for peaches, walnuts, and filberts exceed LOCs. There will be no effect from other crop uses. There is moderate acreage of filberts in Clackamas County, and additional acreage of these three crops in other parts of this ESU. I conclude that the use of diuron on peaches, walnuts, and filberts at application rates above 2.2 lb ai/A may affect the Lower Columbia River steelhead ESU; there will be no effect at 2.2. lb ai/A and below.

(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, 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 33 and Table 34 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 33. Crops on which diuron can be used at a high rate 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	none	0	1,906,892
OR	Gilliam	none	0	770,664
OR	Grant	none	0	2,898,444
OR	Jefferson	none	0	1,139,744
OR	Morrow	none	0	1,301,021
OR	Sherman	none	0	526,911
OR	Umatilla	peaches (7)	7	2,057,809
OR	Wasco	peaches (30)	30	1,523,958
OR	Wheeler	none	0	1,097,601

State	County	Crops and acreage planted	Acres	Total acreage
WA	Benton	peaches (149) walnuts (41)	190	1,089,993
WA	Franklin	peaches (262) walnuts	262	794,999
WA	Kittitas	filberts (1) peaches (1)	2	1,469,862
WA	Klickitat	peaches (199) walnuts	199	1,198,385
WA	Skamania	none	0	1,337,179
WA	Walla Walla	none	0	813,108
WA	Yakima	peaches (1,438) walnuts (11) filberts (6)	1,455	2,749,514

Table 34. Crops on which diuron can be used at a high rate in counties in the migration corridor of the Middle Columbia River steelhead ESU.

State	County	Crops and acreage planted	Acres	Total acreage
OR	Clatsop	none	0	529,482
OR	Columbia	walnuts (11) filberts peaches	11	420,332
OR	Hood River	peaches (13)	13	334,328
OR	Multnomah	peaches (36) walnuts (2)	38	278,570
WA	Clark	filberts (87) walnuts (51) peaches (46)	184	401,850
WA	Cowlitz	walnuts (5) filberts (1)	6	728,781
WA	Pacific	none	0	623,722
WA	Skamania	none	0	1,337,179
WA	Wahkiakum	none	0	169,125

We have no information on diuron usage on rights-of-way and other non-crop sites within this ESU. I cannot ascertain if or where diuron would be used on rights-of-way within this ESU, relative to where the steelhead occurs. On the basis of the high application rate, the potential direct and indirect effects of diuron at high rates, and uncertainty of exposure, I conclude that the non-crop use of diuron may affect the Middle Columbia River steelhead ESU.

As discussed in section 3h(4) above, all crop uses in eastern Washington and Oregon are below LOCs. The acreage in the migratory corridors is low and dilution is substantial. I conclude that there will be no effect on the Middle Columbia River steelhead ESU from agricultural use of diuron.

(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 35 shows the diuron usage in California counties supporting the Sacramento River winter-run chinook salmon ESU.

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

County	Crop or other use site	Usage (pounds)	Acres treated
Alameda	alfalfa	713	496
	grape	9	18
	landscape maintenance	1973	nr
	rights of way	13,831	nr
	structural pest control	131	nr
	uncultivated ag	3.2	nr
	uncultivated non-ag	460	101
	county total	17,122	
Amador	alfalfa	201	104
	grape	574	526
	landscape maintenance	153	nr
	rights of way	3,695	nr
	structural pest control	66	nr
	walnut	59	65
	county total	4,749	

County	Crop or other use site	Usage (pounds)	Acres treated
Butte	alfalfa	39	20
	citrus	12	22
	cotton	1	20
	landscape maintenance	994	nr
	olive	156	326
	orange	60	92
	regulatory pest control	276	nr
	rights of way	3,581	nr
	structural pest control	1	nr
	uncultivated ag	192	48
	uncultivated non-ag	577	167
	walnut	3545	2,053
	county total	9435	
Colusa	alfalfa	2,309	1,543
	cotton	239	9,209
	landscape maintenance	47	nr
	rights of way	6354	nr
	structural pest control	6	nr
	walnut	72	45
	county total	9,027	
Contra Costa	alfalfa	487	310
	asparagus	434	271
	grapes	183	107
	landscape maintenance	4,104	nr
	rights of way	6,721	nr
	small fruits/berries	4	2
	structural pest control	6	nr
	uncultivated ag	20	4
	uncultivated non-ag	320	97
	walnut	8	4
	county total	12,287	
Glenn	alfalfa	526	398
	cotton	41	1,419
	olive	1,049	929
	orange	45	54
	pecan	16	10
	rights of way	5,543	nr
	walnut	632	855
	county total	7,852	

County	Crop or other use site	Usage (pounds)	Acres treated
Marin	**industrial site**	107	22
	landscape maintenance	164	nr
	rights-of-way	590	nr
	county total	862	
Sacramento	alfalfa	1,301	791
	apple	10	11
	artichoke	5	3
	asparagus	219	112
	grape	1,587	4,281
	landscape maintenance	832	nr
	pear	259	343
	rights of way	15,799	nr
	structural pest control	40	nr
	county total	20,052	
San Joaquin	alfalfa	23,079	15,729
	animal premises	212	123
	apple	214	369
	asparagus	7,570	4,608
	cotton	2	46
	ditch bank	26	25
	grape	6,143	10,066
	landscape maintenance	312	nr
	pear	32	75
	rights of way	16,403	nr
	structural pest control	29	nr
	uncultivated ag	1,622	526
	uncultivated non-ag	1,128	359
	walnut	3,211	3,807
	county total	59,984	
San Francisco	**landscape maintenance**	88	nr
	rights-of-way	247	nr
	county total	334	
San Mateo	**landscape maintenance**	777	nr
	rights-of-way	1,633	nr
	uncultivated non-ag	96	12
	county total	2,507	

County	Crop or other use site	Usage (pounds)	Acres treated
Shasta	**landscape maintenance**	379	nr
	mint	349	246
	public health	188	nr
	rights-of-way	1,061	nr
	structural pest control	11	nr
	walnut	131	55
	county total	2,120	
Solano	alfalfa	8,197	5,187
	grape	120	30
	landscape maintenance	1,662	nr
	pear	35	48
	rights-of-way	13,049	nr
	structural; pest control	10	nr
	uncultivated non-ag	275	50
	walnut	932	283
	county total	24,281	
Sonoma	alfalfa	30	10
	grape	674	632
	landscape maintenance	852	nr
	outdoor container plants	67	23
	nursery outdoor transplants	4	2
	rights-of-way	5,356	nr
	structural; pest control	1,158	nr
	uncultivated non-ag	142	22
	county total	8,284	
Tehama	**landscape maintenance**	103	nr
	olive	484	412
	rights-of-way	1,801	nr
	structural pest control	223	nr
	walnut	2,231	1018
	county total	4,841	

County	Crop or other use site	Usage (pounds)	Acres treated
Yolo	alfalfa	12,219	9,277
	asparagus	68	36
	cotton	98	3,845
	grape	217	318
	landscape maintenance	211	nr
	outdoor container plants	18	12
	nursery outdoor transplants	16	5
	orange	1	7
	research commodity	26	nr
	rights-of-way	5,219	nr
	walnut	611	450
	county total	18,705	

There is considerable diuron usage on rights-of-way and other non-crop sites within this ESU. I cannot ascertain where diuron would be used on rights-of-way within this ESU, relative to where this salmon occurs. On the basis of the high application rate, the potential direct and indirect effects of diuron at high rates, and uncertainty of exposure, I conclude that the non-crop use of diuron may affect the Sacramento River winter-run chinook salmon ESU.

The only crop use of concern (see discussion in section 3h(4) above) grown in this area is walnuts, and diuron has been used on substantial walnut acreage in several counties. The highest rate exceeds LOCs. I conclude that there will be no effect on the Sacramento River winter-run chinook salmon ESU from use on walnuts where the application rate is 3.2 lb ai/A or below, but that use above 3.2 lb ai/A may affect this ESU.

(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 diuron would not be used; the private land areas of Valley County where diuron 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 36 and Table 37 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 36. Crops on which diuron can be used at a high rate 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	none	0	873,399
ID	Clearwater	none	0	1,575,396
ID	Idaho	filberts peaches	nr	5,430,522
ID	Latah	none	0	689,089
ID	Lewis	none	0	306,601
ID	Nez Perce	peaches (22)	22	543,434
OR	Gilliam	none	0	770,664
OR	Jefferson	none	0	1,139,744
OR	Morrow	none	0	1,301,021
OR	Sherman	none	0	526,911
OR	Union	peaches (12)	12	1,303,476
OR	Wallowa	peaches	nr	2,013,071
OR	Wasco	peaches (30)	30	1,523,958
WA	Asotin	peaches (18)	18	406,983
WA	Columbia	none	0	556,034
WA	Franklin	peaches (262) walnuts	262	794,999
WA	Garfield	none	0	454,744
WA	Walla Walla	none	0	813,108
WA	Whitman	none	0	1,382,006

Table 37. Crops on which diuron can be used at a high rate 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	none	0	529,482
OR	Columbia	walnuts (11) filberts peaches	11	420,332
OR	Hood River	peaches (13)	13	334,328

State	County	Crops and acreage planted	Acres	Total acreage
OR	Multnomah	peaches (36) walnuts (2)	38	278,570
OR	Umatilla	peaches (7)	7	2,057,809
WA	Benton	peaches (149) walnuts (41)	190	1,089,993
WA	Clark	filberts (87) walnuts (51) peaches (46)	184	401,850
WA	Cowlitz	walnuts (5) filberts (1)	6	728,781
WA	Klickitat	peaches (199) walnuts	199	1,198,385
WA	Pacific	none	0	623,722
WA	Skamania	none	0	1,337,179
WA	Wahkiakum	none	0	169,125

We have no information on diuron usage on rights-of-way and other non-crop sites within this ESU. I cannot ascertain if or where diuron would be used on rights-of-way within this ESU, relative to where this salmon occurs. On the basis of the high application rate, the potential direct and indirect effects of diuron at high rates, and uncertainty of exposure, I conclude that the non-crop use of diuron may affect the Snake River fall-run chinook salmon ESU.

As discussed in section 3h(4) above, all crop uses in eastern Oregon and Washington and in Idaho are below LOCs. The acreage in the migratory corridors is low and dilution is substantial. I conclude that there will be no effect on the Snake River fall-run chinook salmon ESU from agricultural use of diuron.

(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, Pashimerol, 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 diuron can be used. We have excluded Valley County, Idaho because that portion in the Salmon River watershed is all in forested areas where diuron would not be used; the private land areas of Valley County where diuron 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 38 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 39. 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 38. Crops on which diuron can be used at a high rate 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	none	0	873,399
ID	Blaine	none	0	1,692,735
ID	Custer	none	0	3,152,382
ID	Idaho	filberts peaches	nr	5,430,522
ID	Lemhi	peaches (3)	3	2,921,172
ID	Lewis	none	0	306,601
ID	Nez Perce	peaches (22)	22	543,434
OR	Union	peaches (12)	12	1,303,476
OR	Wallowa	peaches	nr	2,013,071
WA	Adams	none	0	1,231,999

State	County	Crops and acreage planted	Acres	Total acreage
WA	Asotin	peaches (18)	18	406,983
WA	Columbia	none	0	556,034
WA	Franklin	peaches (262) walnuts	262	794,999
WA	Garfield	none	0	454,744
WA	Walla Walla	none	0	813,108
WA	Whitman	none	0	1,382,006

Table 39. Crops on which diuron can be used at a high rate 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	none	0	529,482
OR	Columbia	walnuts (11) filberts peaches	11	420,332
OR	Gilliam	none	0	770,664
OR	Hood River	peaches (13)	13	334,328
OR	Morrow	none	0	1,301,021
OR	Multnomah	peaches (36) walnuts (2)	38	278,570
OR	Sherman	none	0	526,911
OR	Umatilla	peaches (7)	7	2,057,809
OR	Wasco	peaches (30)	30	1,523,958
WA	Benton	peaches (149) walnuts (41)	190	1,089,993
WA	Clark	filberts (87) walnuts (51) peaches (46)	184	401,850
WA	Cowlitz	walnuts (5) filberts (1)	6	728,781
WA	Klickitat	peaches (199) walnuts	199	1,198,385
WA	Pacific	none	0	623,722
WA	Skamania	none	0	1,337,179
WA	Wahkiakum	none	0	169,125

We have no information on diuron usage on rights-of-way and other non-crop sites within this ESU. I cannot ascertain if or where diuron would be used on rights-of-way within this ESU, relative to where this salmon occurs. On the basis of the high application rate, the potential direct and indirect effects of diuron at high rates, and uncertainty of exposure, I conclude that the non-crop use of diuron may affect the Snake River spring-summer-run chinook salmon ESU.

As discussed in section 3h(4) above, all crop uses in eastern Washington and Idaho are below LOCs. The acreage in the migratory corridors is low and dilution is substantial. I conclude that there will be no effect on the Snake River spring-summer-run chinook salmon ESU from agricultural use of diuron.

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

Table 40. Use of diuron in counties with the Central Valley spring run chinook salmon ESU.

County	Crop or other use site	Usage (pounds)	Acres treated
Alameda	alfalfa	713	496
	grape	9	18
	landscape maintenance	1973	nr
	rights of way	13,831	nr
	structural pest control	131	nr
	uncultivated ag	3.2	nr
	uncultivated non-ag	460	101
	county total	17,122	

County	Crop or other use site	Usage (pounds)	Acres treated
Butte	alfalfa	39	20
	citrus	12	22
	cotton	1	20
	landscape maintenance	994	nr
	olive	156	326
	orange	60	92
	regulatory pest control **rights**	276	nr
	of way	3,581	nr
	structural pest control	1	nr
	uncultivated ag	192	48
	uncultivated non-ag	577	167
	walnut	3545	2,053
	county total	9435	
Colusa	alfalfa	2,309	1,543
	cotton	239	9,209
	landscape maintenance	47	nr
	rights of way	6354	nr
	structural pest control	6	nr
	walnut	72	45
	county total	9,027	
Contra Costa	alfalfa	487	310
	asparagus	434	271
	grapes	183	107
	landscape maintenance	4,104	nr
	rights of way	6,721	nr
	small fruits/berries	4	2
	structural pest control	6	nr
	uncultivated ag	20	4
	uncultivated non-ag	320	97
	walnut	8	4
	county total	12,287	
Glenn	alfalfa	526	398
	cotton	41	1,419
	olive	1,049	929
	orange	45	54
	pecan	16	10
	rights of way	5,543	nr
	walnut	632	855
	county total	7,852	

County	Crop or other use site	Usage (pounds)	Acres treated
Marin	**industrial site**	107	22
	landscape maintenance	164	nr
	rights-of-way	590	nr
	county total	862	
Napa	grape	29	63
	landscape maintenance	361	nr
	public health	2,384	nr
	rights-of-way	557	nr
	county total	3,331	
Nevada	**landscape maintenance**	207	nr
	rights-of-way	1,055	nr
	structural pest control	6	nr
	county total	1,268	
Placer	**landscape maintenance**	647	nr
	rights of way	2,077	nr
	county total	2,724	
Sacramento	alfalfa	1,301	791
	apple	10	11
	artichoke	5	3
	asparagus	219	112
	grape	1,587	4,281
	landscape maintenance	832	nr
	pear	259	343
	rights of way	15,799	nr
	structural pest control	40	nr
	county total	20,052	
San Francisco	**landscape maintenance**	88	nr
	rights-of-way	247	nr
	county total	334	
San Mateo	**landscape maintenance**	777	nr
	rights-of-way	1,633	nr
	uncultivated non-ag	96	12
	county total	2,507	
Shasta	**landscape maintenance**	379	nr
	mint	349	246
	public health	188	nr
	rights-of-way	1,061	nr
	structural pest control	11	nr
	walnut	131	55
	county total	2,120	

County	Crop or other use site	Usage (pounds)	Acres treated
Solano	alfalfa	8,197	5,187
	grape	120	30
	landscape maintenance	1,662	nr
	pear	35	48
	rights-of-way	13,049	nr
	structural; pest control	10	nr
	uncultivated non-ag	275	50
	walnut	932	283
	county total	24,281	
Sonoma	alfalfa	30	10
	grape	674	632
	landscape maintenance	852	nr
	outdoor container plants	67	23
	nursery outdoor transplants	4	2
	rights-of-way	5,356	nr
	structural; pest control	1,158	nr
	uncultivated non-ag	142	22
	county total	8,284	
Sutter	alfalfa	29	10
	cotton	4	168
	landscape maintenance	67	nr
	pistachios	12	22
	prune	66	28
	rights-of-way	5,067	nr
	structural pest control	14	nr
	uncultivated ag	144	12
	walnut	1,091	710
	county total	6,494	
Tehama	**landscape maintenance**	103	nr
	olive	484	412
	rights-of-way	1,801	nr
	structural pest control	223	nr
	walnut	2,231	1018
	county total	4,841	

County	Crop or other use site	Usage (pounds)	Acres treated
Yolo	alfalfa	12,219	9,277
	asparagus	68	36
	cotton	98	3,845
	grape	217	318
	landscape maintenance	211	nr
	outdoor container plants	18	12
	nursery outdoor transplants	16	5
	orange	1	7
	research commodity	26	nr
	rights-of-way	5,219	nr
	walnut	611	450
	county total	18,705	
Yuba	alfalfa	224	130
	landscape maintenance	26	nr
	rights-of-way	2,178	nr
	structural pest control	2	nr
	walnut	1,015	821
	county total	3,445	

There is considerable diuron usage on rights-of-way and other non-crop sites within this ESU. I cannot ascertain where diuron would be used on rights-of-way within this ESU, relative to where this salmon occurs. On the basis of the high application rate, the potential direct and indirect effects of diuron at high rates, and uncertainty of exposure, I conclude that the non-crop use of diuron may affect the Central Valley spring-run chinook salmon ESU.

The only crop uses of concern (see discussion in section 3h(4) above) grown in this area are walnuts and peaches; diuron was used on substantial walnut acreage, but only on 24 acres of peaches. The highest rate exceeds LOCs. I conclude that there will be no effect on the Central Valley spring-run chinook salmon ESU from use on walnuts where the application rate is 3.2 lb ai/A or below, but that use above 3.2 lb ai/A may affect this 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 diuron 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 41 contains usage information for the California counties supporting the California coastal chinook salmon ESU.

Table 41. Use of diuron in counties with the California coastal chinook salmon ESU.

County	Crop or other use site	Usage (pounds)	Acres treated
Humboldt	**landscape maintenance**	108	nr
	nursery greenhouse flowers	20	45
	nursery outdoor flowers	78	80
	rights-of-way	25	nr
	county total	231	
Mendocino	alfalfa	10	4
	grape	755	669
	landscape maintenance	469	nr
	nursery greenhouse flowers	<1	9,200
	pear	48	40
	rights-of-way	19	nr
	uncultivated non-ag	4	2
	county total	1,304	
Sonoma	alfalfa	30	10
	grape	674	632
	landscape maintenance	852	nr
	outdoor container plants	67	23
	nursery outdoor transplants	4	2
	rights-of-way	5,356	nr
	structural; pest control	1,158	nr
	uncultivated non-ag	142	22
	county total	8,284	
Marin	**industrial site**	107	22
	landscape maintenance	164	nr
	rights-of-way	590	nr
	county total	862	
Trinity	**rights-of-way**	2	nr

County	Crop or other use site	Usage (pounds)	Acres treated
Lake	grape	20	13
	landscape maintenance	1,138	nr
	pear	988	599
	rights-of-way	1,357	nr
	structural pest control	51	nr
	county total	3,554	

There is moderate diuron usage on rights-of-way and other non-crop sites within this ESU. I cannot ascertain where diuron would be used on rights-of-way within this ESU, relative to where this salmon occurs. On the basis of the high application rate, the potential direct and indirect effects of diuron at high rates, and uncertainty of exposure, I conclude that the non-crop use of diuron may affect the California coastal chinook salmon ESU.

The only crop use of concern (see discussion in section 3h(4) above) grown in this area is walnuts. Diuron was not used on walnuts in 2001 within this ESU, but there is substantial acreage of walnuts in Lake County, and it could be used. The highest rate exceeds LOCs. I conclude that there will be no effect on the California coastal chinook salmon ESU from use on walnuts where the application rate is 3.2 lb ai/A or below, but that use above 3.2 lb ai/A may affect this ESU.

(6) Puget Sound Chinook Salmon ESU

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

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

Table 42 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 42. Crops on which diuron can be used at a high rate 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	none	0	1,116,900
WA	Island	none	0	133,499
WA	Jefferson	none	0	1,157,642
WA	King	walnuts (3) filberts (3)	6	1,360,705
WA	Kitsap	none	0	253,436
WA	Lewis	filberts (25) walnuts (4)	29	1,540,991
WA	Mason	none	0	615,108
WA	Pierce	filberts	nr	1,072,350
WA	San Juan	filberts (2) peaches (1)	3	11,963
WA	Skagit	filberts (12)	12	1,110,583
WA	Snohomish	filberts (11)	11	1,337,728
WA	Thurston	filberts (2)	2	465,322
WA	Whatcom	filberts (206) walnuts (1)	207	1,356,006

We have no information on diuron usage on rights-of-way and other non-crop sites within this ESU. I cannot ascertain if or where diuron would be used on rights-of-way within this ESU, relative to where this salmon occurs. On the basis of the high application rate, the potential direct and indirect effects of diuron at high rates, and uncertainty of exposure, I conclude that the non-crop use of diuron may affect the Puget Sound chinook salmon ESU.

As discussed in section 3h(4) above, the high rates for peaches, walnuts, and filberts exceed LOCs. There will be no effect from other crop uses. There is negligible acreage of these crops, except for low acreage of filberts in Whatcom County within this ESU. I conclude that the use of diuron on filberts, and possibly peaches and walnuts, at application rates above 2.2 lb ai/A may affect the Puget Sound chinook salmon ESU; there will be no effect at 2.2. lb ai/A and below.

(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 diuron 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 43 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 43. Crops on which diuron can be used at a high rate 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	filberts (3,994) peaches (78) walnuts (51)	4,123	1,195,712
OR	Clatsop	none	0	529,482
OR	Columbia	walnuts (11) filberts peaches	11	420,332
OR	Hood River	peaches (13)	13	334,328
OR	Multnomah	peaches (36) walnuts (2)	38	278,570
WA	Clark	filberts (87) walnuts (51) peaches (46)	184	401,850
WA	Cowlitz	walnuts (5) filberts (1)	6	728,781
WA	Klickitat	peaches (199) walnuts	199	1,198,385
WA	Lewis	filberts (25) walnuts (4)	29	1,540,991

State	County	Crops and acreage planted	Acres	Total acreage
WA	Pacific	none	0	623,722
WA	Skamania	none	0	1,337,179
WA	Wahkiakum	none	0	169,125

We have no information on diuron usage on rights-of-way and other non-crop sites within this ESU. I cannot ascertain if or where diuron would be used on rights-of-way within this ESU, relative to where this salmon occurs. On the basis of the high application rate, the potential direct and indirect effects of diuron at high rates, and uncertainty of exposure, I conclude that the non-crop use of diuron may affect the Lower Columbia River chinook salmon ESU.

As discussed in section 3h(4) above, the high rates for peaches, walnuts, and filberts exceed LOCs. There will be no effect from other crop uses. There is moderate acreage of filberts in Clackamas County, and additional acreage of these three crops in other parts of this ESU. I conclude that the use of diuron on peaches, walnuts, and filberts at application rates above 2.2 lb ai/A may affect the Lower Columbia River chinook salmon ESU; there will be no effect at 2.2. lb ai/A and below.

(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 diuron 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 44 and Table 45 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 44. Crops on which diuron can be used at a high rate in counties containing spawning and rearing habitat for the Upper Willamette chinook ESU.

State	County	Crops and acreage planted	Acres	Total acreage
OR	Benton	filberts (493) walnuts (23) peaches (8)	524	432,961
OR	Clackamas	filberts (3,994) peaches (78) walnuts (51)	4,123	1,195,712
OR	Lane	filberts (3,677) walnuts (105) peaches (54)	3,836	2,914,656
OR	Linn	filberts (1,820) peaches (73) walnuts (55)	1,948	1,466,507
OR	Marion	filberts (7,061) peaches (179) walnuts (155)	7,395	758,394
OR	Polk	filberts (2,394) peaches (51) walnuts (33)	2,478	474296
OR	Washington	filberts (5,595) walnuts (679) peaches (168)	6,442	463,231
OR	Yamhill	filberts (7,110) walnuts (608) peaches (104)	7,822	457,986

Table 45. Crops on which diuron can be used at a high rate in counties in the migration corridor of the Upper Willamette chinook ESU.

State	County	Crops and acreage planted	Acres	Total acreage
OR	Clackamas	filberts (3,994) peaches (78) walnuts (51)	4,123	1,195,712
OR	Clatsop	none	0	529,482
OR	Columbia	walnuts (11) filberts peaches	11	420,332

State	County	Crops and acreage planted	Acres	Total acreage
OR	Multnomah	peaches (36) walnuts (2)	38	278,570
WA	Clark	filberts (87) walnuts (51) peaches (46)	184	401,850
WA	Cowlitz	walnuts (5) filberts (1)	6	728,781
WA	Lewis	filberts (25) walnuts (4)	29	1,540,991
WA	Pacific	none	0	623,722
WA	Wahkiakum	none	0	169,125

We have no information on diuron usage on rights-of-way and other non-crop sites within this ESU. I cannot ascertain if or where diuron would be used on rights-of-way within this ESU, relative to where this salmon occurs. On the basis of the high application rate, the potential direct and indirect effects of diuron at high rates, and uncertainty of exposure, I conclude that the non-crop use of diuron may affect the Upper Willamette chinook salmon ESU.

As discussed in section 3h(4) above, the high rates for peaches, walnuts, and filberts exceed LOCs. There will be no effect from other crop uses. There is substantial acreage of filberts, and additional acreage of walnuts and peaches, in the area where this steelhead occurs. I conclude that the use of diuron on peaches, walnuts, and filberts at application rates above 2.2 lb ai/A may affect the Upper Willamette chinook salmon ESU; there will be no effect at 2.2. lb ai/A and below.

(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 46). 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 47).

[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 46 and Table 47 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 46. Crops on which diuron can be used at a high rate 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	peaches (21) walnuts	21	1,869,848
WA	Douglas	peaches (167)	167	1,165,158
WA	Okanogan	peaches (67) walnuts (29) filberts (10)	106	3,371,698

Table 47. Crops on which diuron can be used at a high rate 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	none	0	529,482
OR	Columbia	walnuts (11) filberts peaches	11	420,332
OR	Gilliam	none	0	770,664
OR	Hood River	peaches (13)	13	334,328
OR	Morrow	none	0	1,301,021
OR	Multnomah	peaches (36) walnuts (2)	38	278,570
OR	Sherman	none	0	526,911
OR	Umatilla	peaches (7)	7	2,057,809
OR	Wasco	peaches (30)	30	1,523,958
WA	Benton	peaches (149) walnuts (41)	190	1,089,993
WA	Clark	filberts (87) walnuts (51) peaches (46)	184	401,850
WA	Cowlitz	walnuts (5) filberts (1)	6	728,781

State	County	Crops and acreage planted	Acres	Total acreage
WA	Franklin	peaches (262) walnuts	262	794,999
WA	Grant	peaches (261) walnuts (5) filberts	266	1,712,881
WA	Kittitas	filberts (1) peaches (1)	2	1,469,862
WA	Klickitat	peaches (199) walnuts	199	1,198,385
WA	Pacific	none	0	623,722
WA	Skamania	none	0	1,337,179
WA	Wahkiakum	none	0	169,125
WA	Walla Walla	none	0	813,108
WA	Yakima	peaches (1,438) walnuts (11) filberts (6)	1,455	2,749,514

We have no information on diuron usage on rights-of-way and other non-crop sites within this ESU. I cannot ascertain if or where diuron would be used on rights-of-way within this ESU, relative to where this salmon occurs. On the basis of the high application rate, the potential direct and indirect effects of diuron at high rates, and uncertainty of exposure, I conclude that the non-crop use of diuron may affect the Upper Columbia River spring-run chinook salmon ESU.

As discussed in section 3h(4) above, all crop uses in eastern Washington are below LOCs. The acreage in the migratory corridors is low and dilution is substantial. I conclude that there will be no effect on the Upper Columbia River spring-run chinook salmon ESU from agricultural use of diuron.

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

Table 48. Use of diuron in counties with the Central Valley Fall/Late Fall-run chinook salmon ESU.

County	Crop or other use site	Usage (pounds)	Acres treated
Alameda	alfalfa	713	496
	grape	9	18
	landscape maintenance	1973	nr
	rights of way	13,831	nr
	structural pest control	131	nr
	uncultivated ag	3.2	nr
	uncultivated non-ag	460	101
	county total	17,122	
Amador	alfalfa	201	104
	grape	574	526
	landscape maintenance	153	nr
	rights of way	3,695	nr
	structural pest control	66	nr
	walnut	59	65
	county total	4,749	

County	Crop or other use site	Usage (pounds)	Acres treated
Butte	alfalfa	39	20
	citrus	12	22
	cotton	1	20
	landscape maintenance	994	nr
	olive	156	326
	orange	60	92
	regulatory pest control	276	nr
	rights of way	3,581	nr
	structural pest control	1	nr
	uncultivated ag	192	48
	uncultivated non-ag	577	167
	walnut	3545	2,053
	county total	9435	
Calaveras	grape	1	3
	landscape maintenance	836	nr
	regulatory pest control	30	nr
	rights of way	1,007	nr
	structural pest control	16	nr
	uncultivated non-ag	62	19
	walnut	29	22
	county total	1,981	
Colusa	alfalfa	2,309	1,543
	cotton	239	9,209
	landscape maintenance	47	nr
	rights of way	6354	nr
	structural pest control	6	nr
	walnut	72	45
	county total	9,027	
Contra Costa	alfalfa	487	310
	asparagus	434	271
	grapes	183	107
	landscape maintenance	4,104	nr
	rights of way	6,721	nr
	small fruits/berries	4	2
	structural pest control	6	nr
	uncultivated ag	20	4
	uncultivated non-ag	320	97
	walnut	8	4
	county total	12,287	

County	Crop or other use site	Usage (pounds)	Acres treated
El Dorado	**industrial site**	2	5
	landscape maintenance	532	nr
	rights-of-way	851	nr
	county total	1,386	
Glenn	alfalfa	526	398
	cotton	41	1,419
	olive	1,049	929
	orange	45	54
	pecan	16	10
	rights of way	5,543	nr
	walnut	632	855
	county total	7,852	
Marin	**industrial site**	107	22
	landscape maintenance	164	nr
	rights-of-way	590	nr
	county total	862	
Merced	alfalfa	34,253	25,418
	almond	15	10
	animal premises	166	5
	corn (forage-fodder)	73	15
	cotton	867	33,754
	grape	644	520
	industrial site	66	12
	landscape maintenance	84	nr
	oat	40	8
	orange	39	20
	peach	24	36
	rights of way	18,950	nr
	uncultivated ag	6	30
	walnut	849	nr
	county total	56,075	
Napa	grape	29	63
	landscape maintenance	361	nr
	public health	2,384	nr
	rights-of-way	557	nr
	county total	3,331	
Placer	**landscape maintenance**	647	nr
	rights of way	2,077	nr
	county total	2,724	

County	Crop or other use site	Usage (pounds)	Acres treated
Sacramento	alfalfa	1,301	791
	apple	10	11
	artichoke	5	3
	asparagus	219	112
	grape	1,587	4,281
	landscape maintenance	832	nr
	pear	259	343
	rights of way	15,799	nr
	structural pest control	40	nr
	county total	20,052	
San Francisco	**landscape maintenance**	88	nr
	rights-of-way	247	nr
	county total	334	
San Joaquin	alfalfa	23,079	15,729
	animal premises	212	123
	apple	214	369
	asparagus	7,570	4,608
	cotton	2	46
	ditch bank	26	25
	grape	6,143	10,066
	landscape maintenance	312	nr
	pear	32	75
	rights of way	16,403	nr
	structural pest control	29	nr
	uncultivated ag	1,622	526
	uncultivated non-ag	1,128	359
	walnut	3,211	3,807
	county total	59,984	
Shasta	**landscape maintenance**	379	nr
	mint	349	246
	public health	188	nr
	rights-of-way	1,061	nr
	structural pest control	11	nr
	walnut	131	55
	county total	2,120	

County	Crop or other use site	Usage (pounds)	Acres treated
Solano	alfalfa	8,197	5,187
	grape	120	30
	landscape maintenance	1,662	nr
	pear	35	48
	rights-of-way	13,049	nr
	structural; pest control	10	nr
	uncultivated non-ag	275	50
	walnut	932	283
	county total	24,281	
Sonoma	alfalfa	30	10
	grape	674	632
	landscape maintenance	852	nr
	outdoor container plants	67	23
	nursery outdoor transplants	4	2
	rights-of-way	5,356	nr
	structural; pest control	1,158	nr
	uncultivated non-ag	142	22
	county total	8,284	
Stanislaus	alfalfa	5,400	4,091
	apple	117	43
	boysenberry	22	11
	citrus	233	284
	grape	1,878	1,977
	landscape maintenance	541	nr
	greenhouse transplants	12	15
	outdoor container plants	12	30
	public health	455	nr
	rights-of-way	25,605	nr
	structural pest control	42	nr
	walnut	2,962	3,117
	county total	37,278	
Sutter	alfalfa	29	10
	cotton	4	168
	landscape maintenance	67	nr
	pistachios	12	22
	prune	66	28
	rights-of-way	5,067	nr
	structural pest control	14	nr
	uncultivated ag	144	12
	walnut	1,091	710
	county total	6,494	

County	Crop or other use site	Usage (pounds)	Acres treated
Tehama	**landscape maintenance**	103	nr
	olive	484	412
	rights-of-way	1,801	nr
	structural pest control	223	nr
	walnut	2,231	1018
	county total	4,841	
Trinity	**rights-of-way**	2	nr
Yolo	alfalfa	12,219	9,277
	asparagus	68	36
	cotton	98	3,845
	grape	217	318
	landscape maintenance	211	nr
	outdoor container plants	18	12
	nursery outdoor transplants	16	5
	orange	1	7
	research commodity	26	nr
	rights-of-way	5,219	nr
	walnut	611	450
	county total	18,705	
Yuba	alfalfa	224	130
	landscape maintenance	26	nr
	rights-of-way	2,178	nr
	structural pest control	2	nr
	walnut	1,015	821
	county total	3,445	

There is considerable diuron usage on rights-of-way and other non-crop sites within this ESU. I cannot ascertain where diuron would be used on rights-of-way within this ESU, relative to where this salmon occurs. On the basis of the high application rate, the potential direct and indirect effects of diuron at high rates, and uncertainty of exposure, I conclude that the non-crop use of diuron may affect the Central Valley fall/late fall-run chinook salmon ESU.

The only crop uses of concern (see discussion in section 3h(4) above) grown in this area are walnuts and peaches; diuron was used on substantial walnut acreage, but only on 24 acres of peaches. The highest rate exceeds LOCs. I conclude that there will be no effect on the Central Valley fall/late fall-run chinook salmon ESU from use on walnuts or peaches where the application rate is 3.2 lb ai/A or below, but that use above 3.2 lb ai/A may affect this ESU. By itself, 24 acres of peaches would be of no concern for indirect effects, and it should be below the LOCs for direct effects, but in combination with a high rate use on walnuts, we cannot rule out some concern.

(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 Critical Habitat FR Notice, presumably because there are no coho salmon streams in the county; it is excluded.

Table 49 contains usage information for the California counties supporting the Central California coast coho salmon ESU.

Table 49. Use of diuron in counties with the Central California Coast coho ESU.

County	Crop or other use site	Usage (pounds)	Acres treated
Santa Cruz	**landscape maintenance**	50	nr
	rights-of-way	867	nr
	county total	917	
San Mateo	**landscape maintenance**	777	nr
	rights-of-way	1,633	nr
	uncultivated non-ag	96	12
	county total	2,507	
Marin	**industrial site**	107	22
	landscape maintenance	164	nr
	rights-of-way	590	nr
	county total	862	
Sonoma	alfalfa	30	10
	grape	674	632
	landscape maintenance	852	nr
	outdoor container plants	67	23
	nursery outdoor transplants	4	2
	rights-of-way	5,356	nr
	structural; pest control	1,158	nr
	uncultivated non-ag	142	22
	county total	8,284	
Mendocino	alfalfa	10	4
	grape	755	669
	landscape maintenance	469	nr
	nursery greenhouse flowers	<1	9,200
	pear	48	40
	rights-of-way	19	nr
	uncultivated non-ag	4	2
	county total	1,304	
Napa	grape	29	63
	landscape maintenance	361	nr
	public health	2,384	nr
	rights-of-way	557	nr
	county total	3,331	

There is fairly low diuron usage on rights-of-way and other non-crop sites within this ESU. I cannot ascertain where diuron would be used on rights-of-way within this ESU, relative to where this salmon occurs. On the basis of the high application rate, the potential direct and indirect effects of diuron at high rates, and uncertainty of exposure, I conclude that the non-crop use of diuron may affect the Central California coast coho salmon ESU.

The only crop use of concern (see discussion in section 3h(4) above) grown in this area is walnuts. Diuron was not used on walnuts in 2001 within this ESU and there is limited acreage of walnuts within this ESU. I conclude that there will be no effect on 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 diuron 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 diuron usage in the California counties supporting the Southern Oregon/Northern California coastal coho salmon ESU is shown in Table 50. Table 51 shows the acreage where diuron may be used on crops in the Oregon counties where the Southern Oregon/Northern California coastal coho salmon ESU occurs. In Table 51, 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 50. Use of diuron in California counties with the Southern Oregon/Northern California coastal coho salmon ESU.

County	Crop or other use site	Usage (pounds)	Acres treated
Humboldt	**landscape maintenance**	108	nr
	nursery greenhouse flowers	20	45
	nursery outdoor flowers	78	80
	rights-of-way	25	nr
	county total	231	
Mendocino	alfalfa	10	4
	grape	755	669
	landscape maintenance	469	nr
	nursery greenhouse flowers	<1	9,200
	pear	48	40
	rights-of-way	19	nr
	uncultivated non-ag	4	2
	county total	1,304	
Del Norte	nursery outdoor flowers	33	34
	nursery outdoor transplants	1,544	1214
	county total	1,577	
Siskiyou	alfalfa	1,027	1,024
	mint	61	33
	rights-of-way	149	nr
	county total	1,237	
Trinity	**rights-of-way**	2	nr
Lake	grape	20	13
	landscape maintenance	1,138	nr
	pear	988	599
	rights-of-way	1,357	nr
	structural pest control	51	nr
	county total	3,554	

Table 51. Crops on which diuron can be used at a high rate 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	none	0	1,041,557
OR	Jackson	peaches (198) walnuts (27) filberts	225	1,782,633
OR	Josephine	peaches (29) walnuts (18)	47	1,049,308

There is moderate diuron usage in California on rights-of-way and other non-crop sites within this ESU; we have no information on the usage of diuron on these sites in Oregon. I cannot ascertain where diuron would be used on rights-of-way within this ESU, relative to where this salmon occurs. On the basis of the high application rate, the potential direct and indirect effects of diuron at high rates, and uncertainty of exposure, I conclude that the non-crop use of diuron may affect the southern Oregon/northern California coastal coho salmon ESU.

The only crop uses of concern (see discussion in section 3h(4) above) grown in this area are walnuts, peaches, and possibly filberts. Diuron was not used on walnuts in 2001 within the California portion of this ESU, but there is substantial acreage of walnuts in Lake County, and it could be used. There is a small amount of these crops in southern Oregon. The highest rate exceeds LOCs. I conclude that there will be no effect on the southern Oregon/northern California coastal coho salmon ESU from use on walnuts where the application rate is 3.2 lb ai/A or below, but that use above 3.2 lb ai/A may affect this 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 diuron 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 52 show the acreage where diuron 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 52. Crops on which diuron can be used at a high rate in counties containing habitat for the Oregon Coast coho salmon ESU.

State	County	Crops and acreage planted	Acres	Total acreage
OR	Benton	filberts (493) walnuts (23) peaches (8)	524	432,961
OR	Clatsop	none	0	529,482
OR	Coos	filberts (1) peaches (1) walnuts (1)	3	1,024,346
OR	Curry	none	0	1,041,557
OR	Douglas	walnuts (171) filberts (55) peaches (53)	279	3,223,576
OR	Lane	filberts (3,677) walnuts (105) peaches (54)	3,836	2,914,656
OR	Lincoln	none	0	626,976
OR	Polk	filberts (2,394) peaches (51) walnuts (33)	2,478	474296
OR	Tillamook	none	0	705,417

We have no information on diuron usage on rights-of-way and other non-crop sites within this ESU. I cannot ascertain if or where diuron would be used on rights-of-way within this ESU, relative to where this salmon occurs. On the basis of the high application rate, the potential direct and indirect effects of diuron at high rates, and uncertainty of exposure, I conclude that the non-crop use of diuron may affect the Oregon Coast coho salmon ESU.

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. Nevertheless, a high rate use of diuron could be a concern, as discussed in section 3h(4) above. I conclude that there will be no effect on the Oregon Coast coho salmon ESU at application rates on walnuts, peaches, and filberts at or below 2.2 lb ai/A, and no effect from diuron use on other agricultural crops. Applications to walnuts, peaches, or filberts above 2.2 lb ai/A 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 53 shows the acreage of crops in these counties on which diuron 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 53. Crops on which diuron can be used at a high rate in counties containing habitat for the Hood Canal summer-run chum salmon ESU.

State	County	Crops and acreage planted	Acres	Total acreage
WA	Clallam	none	0	1,116,900
WA	Island	none	0	133,499
WA	Jefferson	none	0	1,157,642
WA	Kitsap	none	0	253,436
WA	Mason	none	0	615,108

We have no information on diuron usage on rights-of-way and other non-crop sites within this ESU. I cannot ascertain if or where diuron would be used on rights-of-way within this ESU, relative to where this salmon occurs. On the basis of the high application rate, the potential direct and indirect effects of diuron at high rates, and uncertainty of exposure, I conclude that the non-crop use of diuron may affect the Hood Canal summer-run chum salmon ESU.

There will be no effect of diuron use on agricultural crops because the high rate crops of concern are not grown within counties where the Hood Canal summer-run chum salmon ESU occurs.

(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 54 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 54. Crops on which diuron can be used at a high rate in counties containing habitat for the Columbia River chum salmon ESU.

State	County	Crops and acreage planted	Acres	Total acreage
OR	Clatsop	none	0	529,482
OR	Columbia	walnuts (11) filberts peaches	11	420,332
OR	Multnomah	peaches (36) walnuts (2)	38	278,570
WA	Clark	filberts (87) walnuts (51) peaches (46)	184	401,850
WA	Cowlitz	walnuts (5) filberts (1)	6	728,781
WA	Lewis	filberts (25) walnuts (4)	29	1,540,991
WA	Pacific	none	0	623,722
WA	Skamania	none	0	1,337,179
WA	Wahkiakum	none	0	169,125

We have no information on diuron usage on rights-of-way and other non-crop sites within this ESU. I cannot ascertain if or where diuron would be used on rights-of-way within this ESU, relative to where this salmon occurs. On the basis of the high application rate, the potential direct and indirect effects of diuron at high rates, and uncertainty of exposure, I conclude that the non-crop use of diuron may affect the Columbia River chum salmon ESU.

As discussed in section 3h(4) above, the high rates for peaches, walnuts, and filberts exceed LOCs. There will be no effect from other crop uses. There is moderate acreage of filberts in Clackamas County, and additional acreage of these three crops in other parts of this ESU. I conclude that the use of diuron on peaches, walnuts, and filberts at application rates above 2.2 lb ai/A may affect the Columbia River chum salmon ESU; there will be no effect at 2.2. lb ai/A and below.

(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 55 shows that there is no acreage within this county for crops where diuron can be used.

Table 55. Crops on which diuron can be used at a high rate in counties containing habitat for the Ozette Lake sockeye salmon ESU.

State	County	Crops and acreage planted	Acres	Total acreage
WA	Clallam	none	0	1,116,900

We have no information on diuron usage on rights-of-way and other non-crop sites within this ESU. I cannot ascertain if or where diuron would be used on rights-of-way within this ESU, relative to where this sockeye occurs. Even rights-of-way areas are rather limited by its remote location. However, on the basis of the high application rate, the potential direct and indirect effects of diuron at high rates, and uncertainty of exposure, I conclude that the non-crop use of diuron may affect the Ozette Lake sockeye salmon ESU, but that it is not likely to affect this ESU.

With no acreage of the high rate crops, I conclude that there will be no effect of diuron on crops for 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. Diuron 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.

Table 56 shows the acreage of crops in counties containing habitat for this ESU. Table 57 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 56. Crops on which diuron can be used at a high rate in counties containing habitat for the Snake River sockeye ESU.

State	County	Crops and acreage planted	Acres	Total acreage
ID	Blaine	none	0	1,692,735
ID	Custer	none	0	3,152,382

Table 57. Crops on which diuron can be used at a high rate in counties in the migration corridor of the Snake River sockeye ESU.

State	County	Crops and acreage planted	Acres	Total acreage
ID	Idaho	filberts peaches	nr	5,430,522
ID	Lemhi	peaches (3)	3	2,921,172
ID	Lewis	none	0	306,601
ID	Nez Perce	peaches (22)	22	543,434
OR	Clatsop	none	0	529,482
OR	Columbia	walnuts (11) filberts peaches	11	420,332
OR	Gilliam	none	0	770,664
OR	Hood River	peaches (13)	13	334,328
OR	Morrow	none	0	1,301,021
OR	Multnomah	peaches (36) walnuts (2)	38	278,570
OR	Sherman	none	0	526,911
OR	Umatilla	peaches (7)	7	2,057,809
OR	Wasco	peaches (30)	30	1,523,958
WA	Asotin	peaches (18)	18	406,983
WA	Benton	peaches (149) walnuts (41)	190	1,089,993
WA	Clark	filberts (87) walnuts (51) peaches (46)	184	401,850
WA	Columbia	none	0	556,034
WA	Cowlitz	walnuts (5) filberts (1)	6	728,781
WA	Franklin	peaches (262) walnuts	262	794,999
WA	Garfield	none	0	454,744
WA	Klickitat	peaches (199) walnuts	199	1,198,385
WA	Pacific	none	0	623,722
WA	Skamania	none	0	1,337,179
WA	Wahkiakum	none	0	169,125
WA	Walla Walla	none	0	813,108

State	County	Crops and acreage planted	Acres	Total acreage
WA	Whitman	none	0	1,382,006

There are no crops in the spawning and rearing habitat for this precarious sockeye ESU. There may be rights-of-way, but usage by the other Federal agencies should only be done consistent with no effect determinations because of specific details and procedures, or in accordance with biological opinions. In the migratory corridors, there should be sufficient dilution of diuron, even from rights-of-way use. I conclude that there will be no effect of crop or non-crop use of diuron on the Snake River sockeye salmon ESU.

5. Specific conclusions for Pacific salmon and steelhead

1. There is known to be a large amount of diuron use on rights-of-way and other non-crop sites in California. I believe the same to be true for Oregon and Washington, and possibly Idaho. We have negligible information on how and where diuron is used on such sites, except that we know a high rate is allowed on the label. On the basis of the high application rate, the potential direct and indirect effects of diuron at high rates, and uncertainty of exposure, the non-crop use of diuron may affect all listed salmon and steelhead ESUs except the Snake River sockeye salmon. But it is not likely to adversely affect the Ozette Lake sockeye salmon.

2. Based upon the modest toxicity of diuron and the potential environmental exposure, only the high application rate crops which include use during the winter or late winter seasons exceed our Levels of Concern. These crops are peaches, walnuts, and filberts. Diuron use on other crops will have no effect on listed salmon and steelhead.

3. The high rate crops have different potential environmental exposure based upon the amount of runoff that occurs. In low runoff areas, there is insufficient diuron loading to aquatic environments to be of concern. Therefore, diuron will have no effect on the Upper Columbia River steelhead ESU, Snake River Basin steelhead ESU, Middle Columbia River steelhead ESU, Snake River fall-run chinook salmon ESU, Snake River spring-summer-run chinook salmon ESU, Upper Columbia River spring-run chinook salmon ESU, California coastal coho salmon ESU, Hood Canal spring/summer-run chum salmon ESU, and the Snake River sockeye salmon ESU.

4. In areas with somewhat greater precipitation, there may be concerns at the highest rates. Diuron use on these three crops will have no effect at application rates at or below 3.2 lb ai/A, but at above this rate may affect the Southern California steelhead ESU, South Central California steelhead ESU, Central California coastal steelhead ESU, California Central Valley steelhead ESU, Northern California steelhead ESU, Sacramento River winter-run chinook salmon ESU, California Central Valley spring-run chinook salmon ESU, California coastal chinook salmon ESU, and the proposed California Central Valley fall/late fall chinook salmon ESU.

5. In areas with even higher precipitation, there may be concerns at even lower rates. Diuron use on these three crops will have no effect at application rates at or below 2.2 lb ai/A, but at above this rate may affect the Upper Willamette steelhead ESU, Lower Columbia River steelhead ESU, Puget Sound chinook salmon ESU, Lower Columbia River chinook salmon ESU, Upper Willamette River chinook salmon ESU, Oregon coastal coho salmon ESU, and the Columbia River chum salmon ESU.

Recommendations

1. California has a system in place to have any necessary pesticide use limitations conveyed to pesticide users through the county bulletins that they have developed for EPA. These bulletins are readily available on-line and through the County Agricultural Commissioners, who have been sensitized to the need for protecting T&E species. Any specific limitations to protect T&E salmon and steelhead can be included in these bulletins. It may be appropriate to have a dialogue among EPA, NMFS, and DPR to consider this and possibly other aspects of use limitations.

2. In Oregon and Idaho, I am aware of no specific state programs to address pesticides and salmon and steelhead. I recommend that OPP develop county bulletins for use in these states and that buffers and/or other means of protection be developed in conjunction with these states. It has been OPP policy to work with states, even those without specific programs, to develop implementation methods that have a high potential to be effective within each state.

3. In Washington, I recommend that OPP and NMFS work with the WSDA Task Force to implement appropriate protection. I believe that this protection should be consistent with the reduction in exposure that would result in potential diuron loading to aquatic habitats to be reduced to below levels of concern. Buffers is one possible protective method, but the most appropriate protection may take a form entirely different from buffers.

Table 58. Summary conclusions on specific ESUs of salmon and steelhead for diuron.

Species	ESU	crop finding [a]	non-crop finding
Chinook Salmon	Upper Columbia spring-run	no effect	may affect
Chinook Salmon	Snake River spring/summer-run	no effect	may affect
Chinook Salmon	Snake River fall-run	no effect	may affect
Chinook Salmon	Upper Willamette	may affect [b]	may affect

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

Steelhead	Northern California	may affect [c]	may affect
Steelhead	Central California Coast	may affect [c]	may affect
Steelhead	South-Central California	may affect [c]	may affect
Steelhead	Southern California	may affect [c]	may affect
Steelhead	Central Valley, California	may affect [c]	may affect

a. Applies to walnuts, filberts, and peaches only. All other crops result in no effect.
b. May affect above 2.2 lb ai/A. No effect at this and lower rates
c. May affect above 3.2 lb ai/A. No effect at this and lower rates

6. References

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