Naled
Analysis of Risks
to
Endangered and Threatened Pacific Salmon and Steelhead

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Summary

Naled is a fast-acting, nonsystemic organophosphate (OP) insecticide registered nationally for control of a variety of insects on non-agricultural areas and many field, fruit and vegetable crops. Naled is one of the principal OP insecticides used for adult mosquito control in the United States. An Interim Eligibility Document (IRED) that includes an ecological risk assessment for fish, invertebrates and aquatic plants was issued in January 2002. Naled is moderately toxic to very highly toxic to freshwater fish, moderately toxic to estuarine fish, and highly toxic to freshwater invertebrates and estuarine invertebrates. The Estimated Environmental Concentrations (EECs) were modeled for crops in California and the Pacific Northwest on which it is commonly used. This assessment concluded that naled may affect 10 of the Evolutionarily Significant Units (ESUs). In 10 others, naled may affect the ESU, but is not likely to adversely affect the species of concern. In 6 of the ESUs, there will be no effects from naled use.

Introduction

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

Scope: Although this analysis is specific to listed Pacific anadromous salmon and steelhead and the watersheds in which they occur, it is acknowledged that naled 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.

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1. Background

Under section 7 of the Endangered Species Act, the Office of Pesticide Programs (OPP) of the U. S. Environmental Protection Agency (EPA) is required to consult on actions that 'may affect' Federally listed endangered or threatened species or that may adversely modify designated critical habitat. Situations where a pesticide may affect a fish, such as any of the salmonid species listed by the National Marine Fisheries Service (NMFS), include either direct or indirect effects on 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. Exceptions are known to occur for only an occasional pesticide, as based on the several dozen fish species that have been frequently tested. Sappington et al. (2001), Beyers et al. (1994) and Dwyer et al. (1999), among others, have shown that endangered and threatened fish tested to date are similarly sensitive, on an acute basis, to a variety of pesticides and other chemicals as their non-endangered counterparts.

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

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

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

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

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

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

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

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

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

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

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

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

It is, however, quite necessary to address the potential that home and garden pesticides may have to affect T&E species, even in the absence of reliable data. Therefore, I have developed a hypothetical scenario, by adapting an existing scenario, to address pesticide use on home lawns where it is most likely that residential pesticides will be used outdoors. It is exceedingly important to note that there is no quantitative, scientifically valid support for this modified scenario; rather it is based on my best professional judgement. I do note that the original scenario, based on golf course use, does have a sound technical basis, and the home lawn scenario is effectively the same as the golf course scenario. Three approaches will be used. First, the treatment of fairways, greens, and tees will represent situations where a high proportion of homeowners may use a pesticide. Second, I will use a 10% treatment to represent situations where only some homeowners may use a pesticide. Even if OPP cannot reliably determine the percentage of homeowners using a pesticide in a given area, this will provide two estimates. Third, where the risks from lawn use could exceed our criteria by only a modest amount, I can back-calculate the percentage of land that would need to be treated to exceed our criteria. If a smaller percentage is treated, this would then be below our criteria of concern. The percentage here would be not just of lawns, but of all of the treatable area under consideration; but in urban and highly populated suburban areas, it would be similar to a percentage of lawns. Should reliable data or other information become available, the approach will be altered appropriately.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

2. Description and use of naled

a. Description of chemical

Naled is an organophosphate pesticide, first registered in 1959 for use as an insecticide-acaricide. It is used primarily to control adult mosquitos, but it is also used to control leaf-eating insects on a variety of fruits, nuts, vegetables and field crops such as cucurbit vegetables, citrus, brassica and leafy vegetables, cotton, alfalfa, safflower, sugar beets, soybeans, peaches, grapes, strawberries, and dried and succulent beans and peas. Other uses include control of pest insects such as blackflies, horn flies, and stable flies in woodlands, swamps, corrals, holding pens, feedlots, pastureland and rangeland for public pest control programs and for areas containing dairy and beef cattle, hogs, horses and sheep. Other non-food uses include treatments in and around food processing plants, loading docks, cull piles, refuse areas, in greenhouses and on outdoor-grown ornamentals. Its use in pet flea collars has been voluntarily canceled by the registrants and, according to the Registration Division, naled will not be allowed to be re-registered for pet collar use again.

- ❑ Common Name: naled
- ❑ Chemical Name: 1,2-dibromo-2,2-dichloromethyl dimethyl phosphate
- ❑ Chemical Family: Organophosphate
- ❑ Case Number: 0092
- ❑ CAS Registry Number: 300-76-5
- ❑ OPP Chemical Code: 034401
- ❑ Empirical Formula: $C_4H_7O_4PBr_2Cl_2$
- ❑ Molecular Weight: 381

- Vapor Pressure: 2 x 10-4 mm Hg @ 20° C
- Melting Point: 27° C
- Trade and Other Names: Dibrom®
- Technical Registrants: AMVAC Chemical Corporation

Naled is practically insoluble in water and has limited solubility in aliphatic hydrocarbons. It is highly soluble in oxygenated solvents such as ketones and alcohols.

Naled is formulated as an emulsifiable concentrate (36% to 85 % a.i.), liquid ready-to-use (1% to 78% a.i.) and soluble concentrate liquid (20% to 87.4% a.i.). Its common product name is "Dibrom", and the main registrant is AMVAC Chemical Corporation. It is applied by air and ground equipment, and in greenhouses, via hot plate/hot pan equipment. It cannot be applied through any type of irrigation system for any use, nor through backpack spray equipment on agricultural crops. Naled is applied at the first sign of insects for which it is labeled to control, with a minimum of seven days between applications. Repeat applications may be made up to the maximum seasonal amount indicated. Naled is classified as a general use pesticide.

b. Summary of labeled uses

Table 3 lists the registered crops and nonagricultural use sites, the maximum application rates for each site and the maximum amount of naled that can be applied to each use site as stated on the label. The application rates on the labels are expressed as pints of product per acre for the agricultural uses or fluid ounces or pints per gallon(s)of water for the nonagricultural sites such as ornamentals and around and in building structures. As the risk assessment methods are based on exposure expressed as pounds active ingredient per acre (lb a.i./A), the rates on the labels were converted to this unit of application. Regardless of the product or formulation, the application rates convert to the same rates when expressed as lb a.i./A.

Table 3. Registered crops and maximum application rates and methods of application for naled

Crop or Site	Maximum rate per application (lb ai/A)[1]	Maximum amount per season[2]
Alfalfa	1.41	3 appl.
Almonds	2.81 (ground only) (Dormant or delayed-dormant only)	1 appl.
Beans, lima beans and peas (dry and succulent)	1.41 (ground) 0.94 (aerial in CA only)	4.22 lb

Broccoli, Brussel sprouts, cabbage, cauliflower, collards, kale	1.88	9.4 lb
Cantaloupes, muskmelons	0.94	1.88 lb
Hops	0.94	5 appl.
Melons grown for seed	0.94	1.88 lb
Celery	1.41	7 lb
Chard	1.41 (ground only)	7 lb
Cotton	0.94	4.69 lb
Eggplant, peppers	1.88	5.62 lb
Grapes	0.63 (ground only) 0.94 (Airblast in CA only)	5.62 lb 5.62 lb
Melons, pumpkins, winter squash	1.88	Not stated
Oranges, lemons, grapefruit, tangerines	1.88	5.62 lb
Peaches	2.81 (ground only) (Dormant or delayed-dormant only)	1 appl.
Rice	0.63	3 appl.
Safflower (CA and AZ only)	2.11	4.69 lb
Spinach	1.41 (ground only) (except AZ and CA)	7 lb
Strawberries	0.94	4.69 lb
Sugar beets	0.94	4.69 lb
Summer squash	1.88	5.62 lb
Tomatoes	0.94	Not stated
Walnuts	1.88	3.75 lb
Forest and shade trees, ornamental shrubs and flowering plants	(1 pt in 100 gal water) (ground only) equiv to 0.94 lb. Rate not given in terms of acreage treated.	Repeat as necessary
Greenhouse-vapor treatment of ornamentals	1 fl oz per 10,000 cu ft of closed greenhouse	Number of appl. and intervals between appl. depends on pest
In, around food processing plants, loading docks, cull piles, refuse areas, cider mills	5 pt to 100 gal of water (ground only) equiv to 4.69 lb. Rate not given in terms of acreage treated	Apply every 5 to 7 days as necessary

Residential areas and swamps for gnat and fly control	0.25	Make appl. during peak of infestation and repeat as necessary.
Agricultural areas, woodlands – Wide area public pest control programs sponsored by govt. entities for gnat and fly control[3]	0.25	Make appl. during peak of infestation and repeat as necessary.
Residential areas, swamps and livestock pasture incl. dairy cattle for mosquito control[3]	0.1	Make appl. during peak of infestation and repeat as necessary. Interval of 10 days between appl. if lactating dairy animals present.
Agricultural areas, woodlands – Wide area public pest control programs sponsored by govt. entities for mosquito control[3]	0.1	Make appl. during peak of infestation and repeat as necessary.
Corrals, holding pens, feedlots and rangeland containing dairy and beef cattle, hogs, horses and sheep for gnat, fly and mosquito control[3]	0.25	Not stated
Rangeland -range cattle	0.4 (aerial)	Not stated

[1]The rates for most use sites are given as range, depending on pest species and/or level of infestation. We report the maximum single rate for each site. If not specified the use site can be treated by both ground and aerial methods of application.
[2]For some sites the maximum is described in terms of the maximum number of applications on that use site for the season or year. For others it is given as the maximum amount of the product that can be applied in that same period.
[3]Consult your Sate Fish and Game Agency before applying this product. It is not necessary to avoid farm buildings.

c. Proposed label changes required by the IRED

The 2002 IRED required three label changes to mitigate risks to nontarget species:

- ♦ Reduce application rates for control of black fly from 0.25 to 0.1 lb a.i./A and reduce rates on peaches and almonds from 2.81 to 1.875 lb a.i./A.
- ♦ Require buffer zones around permanent bodies of water to reduce runoff.
- ♦ Establish spray setbacks to reduce spray drift for agricultural uses.

The IRED allows the registrants to sell products with the old label statements for 26 months form the date of issuance of the IRED (January 2002) and persons other than the registrants may sell the naled products for 50 months from the date of issuance. Therefore the registrants have until the end of March this year to comply. The protective measures currently on the labels are discussed in section 3.f.

d. Estimated usage of naled

The IRED provided national usage data for 1987 to 1997 indicating that approximately one million pounds of naled are used annually, with 70 percent for mosquito/black fly control, 28 percent for agricultural uses, and 2 percent for pet collars. The use information was updated in July 2003, after the issuance of the IRED, by OPP's Biological and Economics Analysis Division (BEAD). The updated information covers national usage from 1992 through 2001. The total U.S. poundage is unchanged and the major use is still for mosquito control (71 percent of the total use).The use on cotton is also high as 12 percent of all naled use occurs on this crop. The crop with the highest percent of crop treated with naled is safflower at 9 percent. No other crop has more than 7 percent of its acreage treated with naled. Application rates per acre on these sites are generally less than 3 pounds a.i./A.

As the usage scenario is complicated for naled, we are including the analysis here as it provides important details on the use of naled in California and the Pacific Northwest (PNW) states of Oregon and Washington. Several crops for which naled is labeled are not included here as the data analysis indicated that there is no usage observed on these sites or there are insufficient data to provide an estimate. The sites on which naled is not used are spinach, peanuts, rice and soybeans. The sites for which there are insufficient data are chard, cucumbers, pumpkins, squash and hops. Eggplants are not listed because this crop is only treated with naled in New Jersey and Florida.

Table 4. EPA's quantitative usage analysis for naled

Site	**Acres grown (000)**	**Acres treated (000)**		**% of crop treated**		**lb ai applied (000)**		**Ave appl rate**			**States of most usage**
		Wtd Avg	Est Max	Wtd Avg	Est Max	Wtd Avg	Est Max	lb ai/A/ yr	# ap/y r	lb ai/A /ap	% of total ob ai used on this site
Tangerines	24	0	1	1%	4%	0	1	1	1.0.	1	CA 100%
Grapefruit	194	0	0	0%	0%	0	0	0.5	3.0	0.2	AZ CA FL TX 100%
Lemons	63	0	0	0%	0%	0	0	1.1	1.0	1.1	CA 100%
Oranges	770	8	18	1%	2%	2	4	0.3	1.3	0.2	CA AZ 100%
Peaches	212	1	2	1%	1%	3	6	3.1	1.0	3.1	CA 94%
Strawberries	50	3	8	7%	16%	6	15	1.8	2.2	0.8	CA 85%
Grapes	795	20	43	1%	2%	3	6	0.2	1.2	0.1	CA 100%
Almonds	429	2	8	1%	2%	5	21	2.3	1.2	1.9	CA 100%
Walnuts	205	3	8	3%	4%	8	23	0.8	1.1	0.7	CA 100%
Celery	34	2	6	7%	18%	1	7	0.4	1.8	0.2	CA MI 100%

Kale	4	0	0	4%	8%	0	1	3.1	1.9	1.6	CA OH SC 90%
Lettuce	268	1	2	0%	1%	4	17	5.2	2.9	1.8	CA 100%
Broccoli	107	7	11	6%	10%	10	18	1.5	1.0	1.5	CA 100%
Brussels Sprouts	4	1	3	5%	10%	1	6	1.0	3.4	0.3	CA 100%
Cabbage	84	5	9	6%	11%	4	9	0.7	1.0	0.7	FL CA 87%
Cauliflower	57	2	15	4%	10%	5	30	1.4	1.1	1.3	CA 100%
Collards	15	1	1	1%	2%	0	0	0.0	1.0	0.0	CA NC SC 91%
Melons	368	0	2	0%	0%	1	5	2.9	1.5	2.0	CA 100%
Peppers	48	0	0	3%	6%	3	6	1.9	1.2	1.6	CA MI 90%
Tomatoes	500	0	1	0%	0%	0	1	1.0	1.3	0.8	CA FL 83%
Beans/Peas-Green	723	0	4	0%	1%	0	1	1.4	1.4	1.0	FL CA 100%
Beans/Peas-Dry	2,181	1	2	0%	0%	1	4	1.1	1.4	0.8	CA 86%
Alfalfa	23,949	23	41	0%	0%	32	67	1.4	1.6	0.9	ID OR 90%
Safflower	243	22	33	9%	14%	17	25	0.8	1.2	0.7	CA 100%
Cotton	12,689	90	176	1%	1%	120	250	1.3	1.2	1.1	CA LA 100%
Sugar Beets	1,434	4	8	0%	1%	4	8	0.9	1.0	0.9	CA 88%
Livestock	-	-	-	-	-	23	46	-	-	-	-
Total of above:		**196**	**402**			**253**	**578**				
Mosquito Abatement Districts (MADS)	-	-	-	-	-	700	1200	-	-	0	
Grand Total						**953**	**1252**				

COLUMN HEADINGS
Wtd Avg = Weighted average--the most recent years and more reliable data are weighted more heavily.
Est Max = Estimated maximum, which is estimated from available data.
Average application rates are calculated from the weighted averages.

NOTES ON TABLE DATA
Usage data covers 1992- 2001 for agriculture, and up to 1997 for nonag.
Calculations of the above numbers may not appear to agree because they are displayed as rounded:

to the nearest 1000 for acres treated or lb. a.i. (Therefore 0 = < 500)
to the nearest whole percentage point for % of crop treated. (Therefore 0% = < 0.5%)
A dash (-) indicates that information on this site is NOT available within EPA or is insufficient to provide an estimate.

BEAD's analysis indicates that most of the agricultural use of naled occurs in California. The only use occurring in the PNW states is the use on alfalfa with a weighted average of 32,000 pounds to 23,000 acres of the crop. California, Washington, and Oregon each have Special Local Needs [section 24(c)] labels for the treatment of alfalfa grown for seed with naled. This use is not on the national Dibrom labels.

Additional data from the 1990s also are available from the U.S. Geological Survey (USGS). The USGS estimated county pesticide use for the conterminous United States by combining (1) state-level information on pesticide use rates available from the National Center for Food and Agricultural Policy from pesticide use information collected by state and federal agencies over a 4-year period (1992–1995), and (2) county-level information on harvested crop acreage from the 1992 Census of Agriculture. The average annual pesticide use, the total amount of pesticide applied (in pounds), and the corresponding area treated (in acres) were compiled for 208 pesticide compounds that are applied to crops in the conterminous United States. Pesticide use was ranked by compound and crop on the basis of the amount of each compound applied to 86 selected crops. Their data indicate that the agricultural crops of highest naled usage during the mid-1990s were cotton (~153,000 lb ai), safflower (~ 25,000 lb ai), citrus (~ 23,000 lb ai), grapes (~ 20,000 lb ai) and alfalfa hay (~ 16,000 lb ai). These five uses comprised 80% of the total national use of naled in the mid-1990s. Other uses that range from 11,000 lb ai to 5,000 lb ai were, in descending amount, broccoli, sugar beets for sugar, field and grass seed, brussel sprouts and cabbage. USGS also mapped naled use on selected crops. This map is a quick and easy visual depiction of where naled may have been used on agricultural crops. However, it should not be used for any quantitative analysis, because it is based on 1992 crop acreage data and was developed from 1990-1995 statewide estimates of uses that were then applied to that county acreage without consideration of local practices and usage. Refer to the map from http://ca.water.usgs.gov/pnsp/use92/naled.html.

USGS recently updated their website and now has national crop use maps based on the 1997 Census of Agriculture and state-level information from the National Center for Food and Agricultural Policy from pesticide use information collected by state and federal agencies for 1995 to 1998. These data indicate that there have been substantial changes in the national use of naled from the early 1990s to the later 1990s. The agricultural crops of highest naled usage are cotton (~ 441,000 lb ai), broccoli (~ 32,000 lb ai), safflower (~ 21,000 lb ai), cauliflower (~ 17,000 lb ai) and sugar beets (~ 17,000 lb ai). These five uses comprised 88% of the total national use of naled in the late 1990s. Other uses that range from 12,000 lb ai to 7,000 lb ai were, in descending amount, cabbage, citrus, strawberries and walnuts. The USGS map for the 1997 Census of Agriculture data, is available at http://ca.water.usgs.gov/cgi-bin/pnsp/pesticide_use_maps_1997.pl?map=W6044.

A quick comparison of the two maps, indicates that the average use of naled depicted as pounds per square mile of county per year decreased from a maximum level of >= 0.244 lb per sq. mi. in 1992 to a maximum amount of >= 0.031 lb per sq. mi. in 1997. The use in Washington appears to have been somewhat greater in 1992 compared to 1997, whereas Oregon's level of use did not change significantly.

Information for the use of naled on selected crops in Washington and Oregon is available from the USDA/NASS Washington Agricultural Statistics Service in their "Agricultural Chemical Usage" reports (http://jan.mannlib.cornell.edu/reports/nassr/other/pcu-bb/) but the data are not reported at the county level. The data for 2000 to 2002 indicate that naled use is very small compared to use of other insecticides registered for the same fruit, vegetable, nursery crops, and dairy cattle. Oregon is a USDA/NASS program state for strawberries, nurseries, and floriculture. Washington is a program state for grapes and dairy cattle and their facilities. Therefore, naled use in terms of amount applied per crop is recorded. The data indicated that naled is not used on Oregon strawberries or Washington grapes. The nursery and "all floriculture" uses in Oregon are so limited that its use is not reported. However, 4% of the cut flower market is treated with naled in Oregon.

NASS reported that a total of 3100 pounds of naled were applied to dairy cattle in all 21 program states in 2001. There were insufficient reports to publish data for Washington.

We are not aware of any comprehensive sources of annual pesticide-use information for Oregon and Washington. Oregon is attempting to implement full pesticide-use reporting but has not yet done so. However, Washington State Department of Agriculture (WSDA, unpublished report, 2004, attachment f) provided us with information regarding the present use of naled in that state. Although it is registered for a number of crops grown in the state, it is likely only used on a few. Very limited acreages of celery (<100 acres), collards, kale, eggplant, melons (<200 acres), bell and chili peppers (<500 acres) are grown in the state. Although there are about 20,000 acres of hops, WSDA reported that naled is typically not used, as the growers prefer to use other insecticides. Sugar beets was a substantial crop in 2001, with over 28,000 acres in production. However, the processing plant closed, and this crop is being phased out of production. Only 4,000 acres were grown in 2002. Alfalfa was identified as a major use, with 6,000 acres treated with 4,500 lbs a.i.

At the state and county level, more data are available for naled use in California than in Oregon or Washington. California requires full pesticide-use reporting by most applicators (excluding homeowners), and the California Department of Pesticide Regulation (DPR) provides the information at the county level (www.cdpr.ca.gov/docs/pur/purmain.htm).

DPR reports use trends of cholinesterase-inhibiting pesticides. Their information shows that use of naled peaked in 1995 and 1997, and has been relatively decreasing since then. The last reported data indicated that about 200,000 pounds were used in 2002. Likewise the cumulative acres treated with naled peaked in 1995 and 1997 and have been relatively declining since then. DPR's list of the top 100 pesticides used in agriculture in California in October 2003 placed naled at number 73 based on the use of only 201,504 pounds active ingredient, applied to 154,963 acres statewide. Table 5 presents the annual use and cumulative acres for naled use in

California from 1993 to 2002.

Table 5. Reported use of naled (lb a.i. per Acre) in California from 1993 to 2002

1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
180,666	457,839	703,092	351,531	616,606	260,413	298,939	255,761	261,881	196,698
166,768	472,431	701,269	338,537	605,922	250,843	279,719	244,508	233,860	154,963

Table 6 presents the uses and amounts active ingredient applied in 2002.

Table 6. Uses of naled in California in 2002 (Source: California DPR Pesticide Use Report).

2002		
Commodity	**lb a.i.**	**Amount treated[1]**
Alfalfa	8357 14	6773 acres 30 sq. ft.
Almond	686	332 acres
Animal premises	14413 953 585	27,044 units 2,976,060 sq. ft. 375 acres
Bean, dried	4175	4659 acres
Bean, succulent	1183	1299 acres
Bean, unspecified	243	241 acres
Broccoli	9223	6227 acres
Brussel sprouts	87	65 acres
Cabbage	546	448 acres
Cattle	48	700 cu.ft.
Cauliflower	3753	3039 acres
Celery	4	5 acres
Chicken	7	2 acres
Citrus	23	56 acres
Collard	594	326 acres
Commodity fumigation	40	no units given
Corn, human consumption	34	30 acres
Cotton	87,089	89,337 acres
Cucumber	2	2 acres

Dairy Equipment	1025 48	203 units 180 cu. ft.
Grape	1034	1188 acres
Grape, wine	462	534 acres
Kale	521	281 acres
Landscape maintenance	5376	no units given
Lemon	3	3 acres
Lettuce, head	1	40 acres
Lettuce, leaf	14	10 acres
N-Greenhouse flower[2]	777	337acres
N-Greenhouse plants in container	20 2	3 acres 121,000 sq. ft.
N-Greenhouse transplants	2	3 acres
N-Outdoor flower	51	51 acres
N-Outdoor plants in containers	39	51 acres
N-Outdoor transplants	2	13 acres
Orange	2563	2037 acres
Pastureland	2	25 acres
Peach	37	15 acres
Peas	460	751 acres
Pepper, fruiting	619	581 acres
Poultry	79	245 units
Public health	15,409	no units given
Regulatory pest control[3]	535	no units given
Research commodity	51 10	no units given 12 acres
Rights of way	9	no units given
Safflower	5714	4276 acres
Soil fumigation/preplant	30	25 acres
Squash	36	47 acres
Squash, summer	56	29 acres
Strawberry	13,662 27	14,031 acres 27 sq. ft.

Structural pest control	1869	no units given
Sugarbeet	10,291	10,739 acres
Swiss chard	39	40 acres
Tangelo	40	20 acres
Tomato	26	17 acres
Uncultivated non-ag	105	415 acres
Walnut	8313	6035 acres
Chemical total	**201,504**	

[1] Amount treated = cumulative acres, square feet, cubic feet or units treated over time.
[2] N =ornamentals grown and treated in nurseries
[3] Public health refers to control of mosquitoes

One use of naled for which it is difficult to get detailed information is its use to control mosquitoes, which constitutes over 70% of the nationwide use of this insecticide. Anecdotal evidence indicated that naled use as a mosquito adulticide control agent is predominately in the eastern, midwestern and southern states where the climates during the summer months are typically more tropical and wetter than in California and the PNW. Applications are limited to mosquito abatement programs, commercial pest control operators and state operations with ground or air equipment. The mosquito adulticide use pattern is considered to be terrestrial, but applications can be made over water to get drift of the chemical over vegetative areas where the adults are found. Personal communication with the major registrant, AMVAC, verified this information. They have a very small market of their three major mosquito formulations in the PNW. Most of their market occurs in other regions of the country (indicated above) where in addition to the climate in those regions, there is a greater preponderance of non-flowing bodies of water which is prime breeding habitat for mosquitoes. Based on the confidential marketing information they gave me, and looking at the application rates on the labels, we estimate that the naled products treat from 5,000 acres to 60,000 acres in Washington, Oregon and Idaho combined.

We believe that this estimate is not unrealistic based upon personal communication with a mosquito control applicator in Grant County, Washington. He relayed that their mosquito control operations occur at least 50 miles from salmonid habitat. Naled formulations are not used to a great extent in that county and even less in other mosquito districts in that state. When it is used, it is applied by trucks in neighborhoods and parks from sundown to sunup as naled breaks down quickly in sunlight.

Based on the information from the registrant and a local user, it is our professional judgment that naled is not an important agent in controlling adult mosquitoes in the PNW. It does not seem likely that naled will reach salmon-bearing waters in sufficient quantity to be of concern from this use. As verified by the registrant, mosquitoes do not occur in flowing waters, although they may occur in stagnant areas of streams and rivers. In lakes the mosquitoes tend to be along the edges. If any spray of naled should enter flowing waters, its rapid breakdown and the quick transport in the water flow would reduce any potential residues to levels that are not significant. The lake habitats of the two sockeye ESUs are on federal lands, and we presume they would not be sprayed with this chemical. Based on this information we conclude that the mosquito adulticide use of naled is not likely to adversely affect any salmon or steelhead ESU through direct or indirect effects.

Some of the uses such as the greenhouse are indoors and not considered to be a route of exposure to nontarget organisms. Other uses such as around the exterior of buildings, refuse piles, etc. are spot treatment and not likely to produce substantial drift or runoff to impact salmon and steelhead. None of these uses were considered routes of exposure to nontarget organisms in either the EFED risk assessment or the naled IRED.

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

a. Aquatic toxicity

The acute toxicity data indicate that technical grade naled is moderately toxic to very highly toxic to freshwater fish, moderately toxic to estuarine fish, and very highly toxic to freshwater invertebrates and highly toxic to very highly to estuarine invertebrates.

Tests of freshwater and estuarine fish and invertebrates with formulated products indicated that the products are moderately toxic to highly toxic to freshwater fish, very highly toxic to freshwater and estuarine invertebrates and moderately toxic to estuarine fish.

Adverse effects on growth of freshwater and estuarine organisms occurred at exposure concentrations of 15 ppb for freshwater fish, 0.1 ppb for freshwater invertebrates and 0.2 ppb for estuarine invertebrates.

The data from the IRED and the EFED database are presented in Tables 4 through 8 and from the AQUIRE Database in Table 9.

Table 4. Acute toxicity of naled to freshwater fish (source: EFED Pesticide Ecotoxicity Database, EFED's Naled Ecological Risk Assessment and IRED)

Species	Scientific Name	% ai	96-h LC 50 (ppb)	Toxicity Category
Technical				
Rainbow trout	*Oncorhynchus mykiss*	90	195	Highly toxic
Rainbow trout	*Oncorhynchus mykiss*	90	345	Highly toxic
Rainbow trout	*Oncorhynchus mykiss*	Tech.	160	Highly toxic
Rainbow trout	*Oncorhynchus mykiss*	Tech.	210	Highly toxic
Bluegill sunfish	*Lepomis macrochirus*	90	2200	Moderately toxic
Bluegill sunfish	*Lepomis macrochirus*	Tech.	600	Highly toxic

Cutthroat trout	*Oncorhynchus clarki*	90	127	Highly toxic
Lake trout	*Salvelinus namycush*	90	87	Very highly toxic
Fathead minnow	*Pimephales promelas*	90	3300	Moderately toxic
Channel catfish	*Ictalurus punctatus*	90	710	Highly toxic
Largemouth bass	*Micropterus salmoides*	90	1900	Moderately toxic
Formulated Products				
Rainbow trout	*Oncorhynchus mykiss*	15	900	Highly toxic
Bluegill sunfish	*Lepomis macrochirus*	15	4000	Moderately toxic

Table 5. Acute toxicity of naled to freshwater invertebrates (source: EFED Pesticide Ecotoxicity Database, EFED's Naled Ecological Risk Assessment and IRED)

Species	**Scientific Name**	**% ai**	**48-h LC 50 (ppb)**	**Toxicity Category**
Technical				
Waterflea	*Daphnia pulex*	90	0.4	Very highly toxic
Waterflea	*Daphnia magna*	91.6	0.3	Very highly toxic
Sowbug	*Asellus brevicaudus*	90	41 (96-h)	Very highly toxic
Scud	*Gammarus fasciatus*	90	18 (96-h)	Very highly toxic
Waterflea	*Simocephalus serrulatus*	90	1.1	Very highly toxic
Stonefly	*Pteronarcys californica*	90	8.0 (96-h)	Very highly toxic
Scud	*Gammarus lacustris*	97	0.14	Very highly toxic
Grass shrimp	*Palaemonetes kadiakensis*	90	92	Very highly toxic
Formulated Products				
Waterflea	*Daphnia magna*	85	0.5	Very highly toxic
Waterflea	*Daphnia magna*	58	1.5	Very highly toxic
Waterflea	*Daphnia magna*	36	2.0	Very highly toxic
Waterflea	*Daphnia magna*	15	2.9	Very highly toxic

Table 6. Acute toxicity of naled to estuarine fish and invertebrates (source: EFED Pesticide Ecotoxicity Database, EFED's Naled Ecological Risk Assessment and IRED)

Species	Scientific Name	% ai	96-h LC 50 (ppb)	Toxicity Category
Technical				
Sheepshead minnow	*Cyprinodon variegatus*	90	1200	Moderately toxic
Grass shrimp	*Palaemonetes vulgaris*	90	9.3	Very highly toxic
Eastern oyster	*Crassostrea virginica*	90	190	Highly toxic
Formulated Products				
Sheepshead minnow	*Cyprinodon variegatus*	59.5	1200	Moderately toxic
Eastern oyster	*Crassostrea virginica*	59.6	91	Very highly toxic
Mysid	*Mysidopsis bahia*	59.6	8.8	Very highly toxic

Table 7. Chronic toxicity of naled to fish and invertebrates (source: EFED Pesticide Ecotoxicity Database, EFED's Naled Ecological Risk Assessment and IRED)

Species	Scientific Name	% ai	Duration	Endpoints affected	NOEC (ppb)	LOEC (ppb)
Fathead minnow	*Pimephales promelas*	94.4	35 days	length and weight	6.9	15
Waterflea	*Daphnia magna*	97.3	21 days	length	0.045	0.098
Mysid	*Mysidopsis bahia*	89.2	31 days	length	<0.2	0.2

OPP does not categorize toxicity to plants. However, the data indicate that naled is less toxic to aquatic vascular plants than to algae.

Table 8. Acute toxicity of naled to aquatic plants (source: EFED Pesticide Ecotoxicity Database, EFED's Naled Ecological Risk Assessment and IRED)

Species	Scientific Name	% ai	NOEC (ppb)	EC50 (ppb)
Duckweed	*Lemna gibba*	94.4	<1800	> 1800 (14-D)
Freshwater diatom	*Navicula pelliculosa*	94.4	2	12 (5-D)
Green algae	*Selenastrum capricornutum*	94.4	N.R.*	20 (5-D)
Blue-green algae	*Anabaena flos-aquae*	94.4	60	640 (5-D)
Marine diatom	*Skeletonema costatum*	94.4	2	15 (5-D)

* N.R. = The value was not reported.

There are some aquatic toxicity data for naled from EPA's AQUIRE database (http://www.epa.gov/ecotox/). We did not look at the original papers but report the toxicity values for the toxicity test periods that are analogous to the those required by OPP testing requirements as a means of comparison. The AQUIRE reference numbers for each reported value are provided. In addition to the studies listed below there were additional studies that were taken from the EFED Pesticide Toxicity Database that are listed in tables 4 through 8 above, and, therefore, are not included in Table 9. Also many of the fish toxicity values listed in AQUIRE were based on 24-hour exposure periods, instead of the standard 96-hour period used by the Agency. These values were not included in Table 9.

Table 9. Summary of acute toxicity data from the EPA AQUIRE database.

Species	Scientific Name	Test Chemical*	96-h LC 50 (ppb)	Reference
Freshwater Fish				
Bluegill	*Lepomis macrochirus*	Form.	180	2871
Rainbow trout	*Oncorhynchus mykiss*	Form.	220, 340	2085
Rainbow trout	*Oncorhynchus mykiss*	Form.	132, 175, 250	6797
Estuarine Fish				
Striped bass	*Morone saxatilis*	Form.	500	602, 6615
Freshwater Invertebrates				
Aquatic sowbug	*Asellus brevicaudus*	Active	230	887
Waterflea	*Daphnia pulex*	Form.	0.35 (48-h)	888
Scud	*Gammarus fasciatus*	Active	14	887
Scud	*Gammarus lacustris*	Form.	110	885
Crayfish	*Orconectes nais*	Active	1800	887
Grass shrimp	*Palaemonetes kadiakensis*	Active	90	887
Stonefly	*Pteronarcys californicus*	Form.	8.0	889
Waterflea	*Simocephalus serrulatus*	Form.	1.1 (48-h)	888
Estuarine Invertebrates				
Blue crab	*Callinectes sapidus*	Form.	300 (48-h)	2188
American oyster	*Crassostrea virginica*	Form.	640	2188
Korean shrimp	*Palaemon macrodactylus*	Form.	4.3, 15.4	6615

* Form. = Test was conducted with formulated products. The product composition and percent active ingredient were not given.
Active = Test was conducted with the active ingredient, but the percent naled was not given.

The AQUIRE database of toxicity values and those reported in EFED's chapter for the naled IRED show some variation in the range of chemical concentrations set for the LD_{50}. The levels of acute toxicity values from AQUIRE are 132 to 340 ppb for freshwater fish and 0.35 to 1800 ppb for freshwater invertebrates compared to 87 to 4000 ppb and 0.3 to 92 ppb for fish and invertebrates, respectively, from OPP data. Most of the data in AQUIRE are reported from studies conducted with formulated products, however, the types of formulations and percents active ingredient were not reported. Therefore, it is difficult to compare these data with those reported by OPP. The AQUIRE database is not always reliable regarding the test being with the formulation or the active ingredient; unless the test indicates an active ingredient, it is put into AQUIRE as formulation testing. However, we have seen values reported for the technical material in Mayer & Ellersieck (1986) (listed as reference 6797) to be reported in AQUIRE as a formulation test whereas the reference indicates that the tests were conducted with the technical material. We report the information on formulation versus active ingredient, but we need to note that it is not completely reliable.

Dichlorvos (DDVP) is the primary degradate of naled, and is also an organophosphate pesticide that is registered to control household, public health and stored product insects. Because of its use as an active ingredient in pesticide formulations, there are a large number of toxicity studies for this chemical. Tables 10 through 14 list the pertinent data for DDVP from the EFED database. These data indicate that technical DDVP is moderately to highly toxic to freshwater fish, practically nontoxic to very highly toxic to freshwater invertebrates, slightly to moderately toxic to estuarine fish, slightly to very highly toxic to estuarine invertebrates. The Agency stated in the Naled IRED that any risks associated from dichlorvos resulting from the use of naled will be dealt with later in the IRED for dichlorvos.

Table 10. Acute toxicity of dichlorvos to freshwater fish (source: EFED Pesticide Ecotoxicity Database)

Species	Scientific Name	% ai	96-h LC 50 (ppb)	Toxicity Category
Cutthroat trout	*Oncorhynchus clarki*	90	213	Highly toxic
Cutthroat trout	*Oncorhynchus clarki*	100	170	Highly toxic
Lake trout	*Salvelinus namycush*	90	183	Highly toxic
Lake trout	*Salvelinus namycush*	100	187	Highly toxic
Fathead minnow	*Pimephales promelas*	100	11.6 ppm	Slightly toxic
Mosquitofish	*Gambusia affinis*	100	5.27 ppm	Moderately toxic
Bluegill sunfish	*Lepomis macrochirus*	100	869	Highly toxic
Rainbow trout	*Oncorhynchus mykiss*	100	100	Highly toxic
Rainbow trout	*Oncorhynchus mykiss*	98.1	100	Highly toxic
Bluegill sunfish	*Lepomis macrochirus*	4	>180 ppm	Practically nontoxic
Bluegill sunfish	*Lepomis macrochirus*	46	800	Highly toxic

Bluegill sunfish	*Lepomis macrochirus*	42.4	4300	Moderately toxic
Rainbow trout	*Oncorhynchus mykiss*	42.4	750	Highly toxic

Table 11. Acute toxicity of dichlorvos to freshwater invertebrates (source: EFED Pesticide Ecotoxicity Database)

Species	**Scientific Name**	**% ai**	**48-h LC 50 (ppb)**	**Toxicity Category**
Waterflea	*Simocephalus serrulatus*	100	0.26 .	Very highly toxic
Scud	*Gammarus lacustris*	100	0.50 (96-h)	Very highly toxic
Stonefly	*Pteronarcys californica*	100	0.10 (96-h)	Very highly toxic
Waterflea	*Daphnia pulex*	100	0.066 .	Very highly toxic
Mud snail	*Massa obsoleta*	90	>25.7 (96-h)	Very highly toxic
Scud	*Gammarus fasciatus*	Tech.	400 ppm (96-h)	Practically nontoxic
Waterflea	*Daphnia magna*	46	1000 .	Highly toxic

Table 12. Acute toxicity of dichlorvos to estuarine fish and invertebrates (source: EFED Pesticide Ecotoxicity Database)

Species	**Scientific Name**	**% ai**	**96-h LC 50 (ppb)**	**Toxicity Category**
Fish				
Sheepshead minnow	*Cyprinodon variegatus*	98	7350	Moderately toxic
Muumichog	*Fundulus heteroclitus*	90	3200	Moderately toxic
Striped killifish	*Fundulus majalis*	90	2300	Moderately toxic
Northern pipefish	*Sygnathus fuscus*	90	2200	Moderately toxic
Sheepshead minnow	*Cyprinodon variegatus*	42.4	14.4 ppm	Slightly toxic
Invertebrates				
Sand shrimp	*Crangon septemspinosa*	N.R.	4	Very highly toxic
Shore shrimp	*Palaemonetes vulgaris*	N.R.	15	Very highly toxic
Hermit crab	*Pagurus longicarpus*	N.R.	45	Very highly toxic
Eastern oyster	*Crassostrea virginica*	98	89.1 ppm	Slightly toxic
Eastern oyster	*Crassostrea virginica*	98	>1000	Moderately toxic
Mysid	*Mysidopsis bahia*	98	19	Very highly toxic

Eastern oyster	*Crassostrea virginica*	42.4	2180	Moderately toxic
Mysid	*Mysidopsis bahia*	42.4	44	Very highly toxic

* N.R. = The value was not reported.

Table 13. Chronic toxicity of dichlorvos to fish and invertebrates (source: EFED Pesticide Ecotoxicity Database)

Species	Scientific Name	% ai	Duration	Endpoints affected	NOEC (ppb)	LOEC (ppb)
Rainbow trout	*Oncorhynchus mykiss*	98	61 days	survival	5.2	10.1
Waterflea	*Daphnia magna*	98	21 days	growth and # of young produced	0.0058	0.0122
Sheepshead minnow	*Cyprinodon variegatus*	98	34 days	survival and length	960	1840
Mysid	*Mysidopsis bahia*	98	28 days	length and weight	1.48	3.25

Table 14. Acute toxicity of dichlorvos to aquatic plants (source: EFED Pesticide Ecotoxicity Database)

Species	Scientific Name	% ai	48-h NOEC (ppm)	EC50 (ppb)
Algae	*Isochrysis galbana*	98	N.R.	14
Marine diatom	*Skeletonema costatum*	98	N.R.	28
Marine diatom	*Thalassioria pseudonana*	98	N.R.	17
Green algae	*Dunaliella tertiolecta*	98	N.R.	>100

* N.R. = The value was not reported.

b. Environmental fate and transport

The information in this section is condensed from the 2002 IRED, page 12 and the EFED risk assessment of November 1997, pages 11 to 19.

Naled and its degradates, dichlorvos and dichloroacetic acid (DCAA), are transformed by abiotic hydrolysis, indirect photolysis in water and biodegradation. In sterilized buffered solutions maintained at 25°C, the estimated half-lives of hydrolysis were 96 hours at pH 5, 15.4 hours at pH 7 and 1.6 hours at pH 9. The photodegradation of naled was measured in the presence and absence of natural sunlight on soil and in air. The half-lives of degradation were 0.54 and 0.58 hours under light and dark conditions on soil, and 58 and 99 hours under light and dark conditions in the air.

While naled and dichlorvos are potentially mobile in soil, their degradation is rapid, and thus, residues of naled, dichlorvos and DCAA should be available for runoff into surface waters for only one or two days post-application. They are unlikely to leach into ground water. Under terrestrial, aquatic and forestry field conditions naled dissipated rapidly with half-lives of less than two days. Hydrolysis, biodegradation and possibly reactions with soil surfaces are responsible for the transformations of naled and dichlorvos. Volatilization from soils and/or water is a major mode of transport for naled and its bioactive degradate, dichlorvos (MeisterPro Farm Chemicals Handbook, 2000, pg.C273). The major routes of contamination of surface waters by naled are spray drift and direct application for mosquito abatement.

In an aquatic dissipation study conducted in Florida and Mississippi, naled was applied at 0.4 lb a.i./A in five aerial applications over a two-week period to ponds. The chemical dissipated from pond water with a half-life of less than one day. The maximum concentration isolated at the Florida site was 18 ppm, and 6 ppm was isolated at the Mississippi site. The concentrations decreased with the depth of the water column. One day post-treatment, naled was less than 2 ppb at the Florida site and less than 1 ppb at the Mississippi site. The maximum concentration of the degradate dichlorvos measured at each site was 13 ppb in Florida and 14 ppb in Mississippi. Following the last application, dichlorvos was not detected (less than 1 ppb) after seven days. Neither chemical was detected in the sediments.

Naled and its degradates have a low potential to bioaccumulate. Static bioaccumulation studies indicated that naled applied at 31 to 127 ppb to tanks containing killifish did not accumulate in whole body tissues over a 7-day exposure period. At the end of the first hour of exposure dichlorvos was found at a concentration of 40 ppb, but it was not detected at later sampling times. The dissipation half-life of naled in the tanks was less than one day.

c. Incidents

OPP maintains two databases of reported incidents. The Ecological Incident Information System (EIIS) contains information on environmental incidents which are provided voluntarily to OPP by state and federal agencies and others. There have been periodic solicitations for such information to the states and the U. S. Fish and Wildlife Service. The second database is a compilation of incident information known to pesticide registrants and any data conducted by them that shows results differing from those contained in studies provided to support registration. These data and studies (together termed incidents) are required to be submitted to OPP under regulations implementing FIFRA section 6(a)(2). There are no incidents on aquatic organisms related to naled in the database.

d. Estimated and measured concentrations of naled in surface waters

<u>Measured concentrations in water</u>

At the time the IRED was written there were no ground or surface water monitoring data.

Our search of the USGS NAWQA and the California DPR Surface Water Database for this consultation also found no records, although DPR indicated that they frequently analyzed water samples for naled. The lack of residues is not surprising given the rapid degradation of naled in the environment.

Estimated environmental concentrations (EECs)

The EEC calculations, based on PRZM/EXAMS scenarios, presented in the naled IRED were not adequate for this consultation as they were based on an older version of the PRZM/EXAMS model and older scenarios. Therefore EFED provided us with new EEC calculations specific for this consultation. The 2002 use data from California DPR was used as the basis of selecting the scenarios to be modeled. The rationale was to choose crops with the greater amount of acreage treated, tempered by the modeling scenarios currently available. The California scenarios that were selected are alfalfa, cotton, sugar beets (which is also applicable to strawberries), broccoli (which is applicable to all vegetable crops) and walnuts. There are currently no scenarios for Washington, so Oregon was selected as the PNW state for modeling. The uses were selected based on information from the USDA agricultural census and the BEAD analysis. The sites chosen for Oregon are rangeland, alfalfa and green beans.

The input parameters for the PRZM/EXAM models are listed in table 15.

Table 15: PRZM/EXAMS input parameters for naled use on various crops in CA and OR.

Input variable (Units)	Input value & calculations	Source/Quality of data
Application method	Aerial except for greenbeans	EPA Reg. No. 5481-479
Interval between appl. (d)	7	EPA Reg. No. 5481-479
Aerobic soil met. $t_{1/2}$(day)	1	EFED-DWA (10-22-1997)
Hydrolysis $t_{1/2}$(day)	0.64 (CA) 0.07 (OR)	For CA and OR, pH used were 6 and 9, respectively (USGS , 1991)
Aerobic aquatic met. $t_{1/2}$(day)	1.5	EFED-DWA (10-22-1997)
Solubility @ 25 ^{0}C (mg/L)	10	Naled Red Document (9-19-1996); multiplied by 10 (Input parameters guideline)
Vapor pressure (torr)	2E-4	Naled Red Document (9-19-1996)
K_{oc} (mL/g)	180	EFED-DWA (10-22-1997)
Henry's Law Const. (atm.m^3/mole)	1.0E-4	Calculated
Aquatic photolysis $t_{1/2}$(day)	stable	MRID# 41310702 & 42445103
MWT (g/mole)	381	Naled Red Document (9-19-1996)

Table 16 presents the application rates and the number of applications used in each crop scenario. The models are based on the application methods on the current naled (Dibrom) labels for each use.

Table 16. Estimated Environmental Concentrations (EECs) for Aquatic Exposure Modeled With PRZM/EXAMS

State	Registered Crop	Appl. Rate lbai/A (No. App.)	Estimated Environmental Concentration (ppb)		
			Peak	21 day avg.	60 day avg.
CA	Alfalfa	1.4 (3)	4.00	0.440	0.153
	Cotton	0.94 (5)	2.62	0.271	0.160
	Sugarbeets	0.94 (5)	2.62	0.300	0.173
	Broccoli	1.88 (10)	5.25	0.600	0.609
	Walnuts	1.88 (2)	5.25	0.378	0.132
OR	Rangeland	0.4	1.14	0.03	0.01
	Alfalfa	1.41 (3)	4.00	0.286	0.100
	Beans	1.41	0.80	0.020	0.007

We note that these EECs are likely to be higher on some of the crops than we would actually expect in California and the PNW because the application information used in the modeling is based on nationwide maximum application rates for each crop. However, the usage information from California (Table 6) indicates that the amounts used in 2002 on the modeled crops were 1.23 pounds a.i./a on alfalfa, 1.48 pounds a.i./a on broccoli, 1.38 pounds a.i./a on walnuts, all of which are lower than the maximum label rates. The modeled rates for the other California scenarios are equivalent to the labeled rates for those crops. We do not have application rate information for Oregon, but the information from WSDA indicates that only 0.75 pounds a.i./a is used on alfalfa, and California DPR data in Table 6 indicates that the rates on rangeland/pastureland in that state is only 0.08 pounds a.i./a, and that on beans is 0.91 pounds a.i./a. Also the BEAD and NASS reports, summarized in section 2(d) indicated that the use is not significant in terms of pounds applied nationally each year. Furthermore, the PRZM-EXAMS models are based on runoff into a one-acre farm pond, which is very different than the flowing river habitats of endangered and threatened salmon and steelhead. If a validated model for flowing rivers were available, the EEC values would be significantly lower than those reported here, but currently the difference cannot be quantified.

e. General risk conclusions

Our risk conclusions are based on risk quotients (RQs) derived from the available toxicity data (Tables 4 to 8) and EECs from the PRZM-EXAMS model for currently labeled rates and number(s) of applications for each crop as indicated in Table 16 above. The RQs are presented in Table 17.

Table 17. Acute and Chronic Risk Quotients for Freshwater and Estuarine Fish and Aquatic Invertebrates, Based on Toxicity for the Most Sensitive Species (Tables 4 to 8) and EECs Modeled from PRZM/EXAMS (Table 9)

Use Site	Acute Risk Quotients[h]					Chronic Risk Quotients[i]	
	freshwater fish		freshwater invertebrate[c]	estuarine fish[d]	estuarine invertebrate[e]	freshwater fish[f]	freshwater invertebrate[g]
CA Alfalfa	0.021[a]	0.046[b]	13.33	0.003	0.43	0.02	9.78
CA Cotton	0.013	0.030	8.73	0.002	0.28	0.02	6.02
CA Sugarbeets	0.013	0.030	8.73	0.002	0.28	0.03	6.67
CA Broccoli	0.027	0.060	17.5	0.004	0.56	0.09	13.33
CA Walnuts	0.027	0.060	17.5	0.004	0.56	0.02	8.4
OR Rangeland	0.002	.005	0.75	0.0003	0.04	8.9	8.0
OR Alfalfa	0.021	0.046	13.33	0.003	0.43	0.01	6.36
OR Beans	0.004	0.009	2.67	0.001	0.09	0.001	0.44

[a] Rainbow trout LC50 = 195 ppb.
[b] Lake trout acute LC50 = 87 ppb.
[c] Daphnia magna LC50 = 0.30 ppb.
[d] Sheepshead minnow LC50 = 1200 ppb.
[e] Mysid LC50 = 9.3 ppb.
[f]Fathead minnow chronic NOEC = 6.9 ppb.
[g] Daphnia chronic NOEC = 0.045 ppb.
[h] Peak EEC/LC50; the acute LOC is >0.05 for endangered fish and >0.5 for aquatic invertebrate populations.
[h]21-day-avg EEC/NOEC for invertebrates and the60-day-avg EEC/NOEC for rainbow trout; the chronic LOC is 1.0 for fish and invertebrates.

The NOEC value for the aquatic macrophyte, *Lemna gibba,* is < 1.8 ppm. Comparing this value to the highest peak EEC value (5.25 ppb) in Table x provides an RQ of 0.003.

OPP uses an RQ > 0.05 (LOC > 0.05) to indicate there is a potential direct acute risk to endangered aquatic species. The acute risk LOCs are exceeded for freshwater fish from the uses on broccoli and walnuts in California when the lake trout toxicity value, and not the rainbow trout value, is used to calculate the RQ values. The acute freshwater fish RQs are normally based on the most sensitive species tested with the pesticide in question; in this case, the lake trout which has an LC50 value of 87 ppb. However, the rainbow trout is a better model for the listed salmonids and more accurately represents the risks of naled to these listed species. When the rainbow trout toxicity value of 195 ppb is used to calculate risk, the results indicate that there are no acute risk LOC exceedences for freshwater fish. Additionally, there are no chronic risks to fish as the RQs are less than the LOC of 1.0. Therefore we conclude that there are no direct effects on endangered and threatened salmon and steelhead from the use of naled on agricultural crops and rangeland uses.

The LOC for determining indirect effects to endangered salmonids through loss of their food supply or loss of cover is RQ > 0.5 for acute effects on freshwater and estuarine invertebrates and aquatic plant growth, respectively. The acute risk LOC is exceeded for freshwater invertebrates from all modeled uses, whereas those for estuarine invertebrates are only exceeded for the broccoli and walnut uses in California. The chronic LOC (RQ > 1) is exceeded for freshwater invertebrates for all uses except green beans in Oregon. The aquatic plant growth LOC is not exceeded for any use of naled. Therefore, we conclude that all agricultural uses may present an indirect effect from loss of the food supply through acute and chronic exposures of their invertebrate food supply, but there will not be indirect effects regarding loss of plant cover in the habitat. We note that chronic risk to invertebrates is not likely in flowing waters where naled should be rapidly dissipated, but this risk could adversely impact aquatic invertebrates inhabiting lentic waters.

Naled hydrolyzes extremely quickly ($T_{1/2}$ =1.6 hours) at pH 9 and fairly quickly ($T_{1/2}$ = 15.4 hours) at pH 7. Waters in the arid parts of salmon and steelhead range are generally alkaline, particularly during the spring and summer growing season, as reported by the U.S. Geological Survey (http://waterdata.usgs.gos.nwis/qw) and the Washington Department of Ecology (http://www.ecy.wa.gov/programs/eap/fw_riv/rv_main.html). Even in the western wetter areas that drain coastal mountains and forests, pH values are more often on the alkaline side than on the acid side, although they are less alkaline than in the arid areas. Thus the bioavailability of naled should be reduced. The EFED fate assessment concluded that naled is only potentially available to run off into surface water from the site of application for only a few days post-application. Once in the water, regardless of the pH of the receiving waters, it will degrade rapidly and have minimal impact on chronic surface water concentrations, about 1 to 2 ppb. Therefore, it is not likely that the concentrations necessary to cause chronic effects in invertebrate populations will be realized.

According to the EFED fate assessment, the maximum amount of dichlorvos formed from naled is approximately 20% of the amount of naled originally applied. Because of its high rate of volatility, naled tends to diffuse into the atmosphere rather than degrade. The EFED assessments, including the naled IRED, concluded that the contribution of dichlorvos from the degradation of naled is not significant. The summaries of the aquatic field dissipation studies done in Florida and Mississippi demonstrate this. Therefore, we do not consider the presence of dichlorvos in the waters of salmon and steelhead from the breakdown of naled to be biologically significant.

Another mitigating factor in the exposure and risks of salmon and steelhead relates to the label statements requiring a buffer zone of 25 feet for ground applications, 100 feet for airblast and mist blower applications and 150 feet for aerial applications from bodies of water such as rivers and streams and a vegetative filter strip of 10 feet to reduce the amount of naled entering waterways from spray drift during applications or from surface runoff following rainfalls that occur one to two days after application.

The 1989 Biological Opinion from the U.S. Fish and Wildlife Service (FWS) requires a use limitation (buffer zone) of 40 yards (120 feet) from the edge of water for ground applications. The label statement approaches the buffer zone size provided by the FWS in the Opinion. The incidental take number for naled was set at zero. At the time the Opinion was written by the FWS the use of naled was significantly more widespread than current use, and the labels at that time did not have the protective measures developed during the IRED process since the mid-1990s. Even without the relatively recent protective measures and with a greater volume of use of the chemical in the PNW and California at the time the Opinion was written, the FWS considered the 40 yard limitation sufficient protection for endangered and threatened aquatic species. Although it cannot be quantified, the use of a 100 foot buffer zone may be equivalent in protection to the FWS buffer zone of 40 yards.

To conclude, the use of a farm pond to model exposure to species that inhabit fast-slowing streams is less than ideal. The use of the rainbow trout toxicity data and use of naled at rates less than the modeled maximum label rates, to characterize risk to endangered and threatened salmonids, are potential sources of error.

Nationally, there are no specific protective measures for endangered and threatened species beyond the generic statements on the current naled labels. As stated on product labels, it is a violation of federal law to use a product in a manner inconsistent with its labeling. FIFRA section 3 labels for agricultural, ornamental and some mosquito and fly control uses warn that

> "This pesticide is toxic to fish, aquatic invertebrates and wildlife. For terrestrial uses, do not apply directly to water or to areas where surface water is present or to intertidal areas below the mean high water mark. Do not apply within 24 hours following rainfall or irrigation, or in areas where intense or sustained rainfall is forecasted to occur within 24 hours following application. Runoff from treated areas may be hazardous to aquatic organisms in neighboring areas. Do not contaminated water when disposing of equipment washwaters or rinsate. This product is highly toxic to bees exposed to direct treatment on blooming crops or weeds. Do not apply this product or allow to drift to blooming crops or weeds while bees are actively visiting the area."

The labels for the agricultural products also contain statements that cultivation cannot occur with 10 feet of an aquatic area such as lakes, reservoirs, rivers, permanent streams, marshes, natural ponds, estuaries and commercial fish farm ponds. Ground applications to field and vegetable crops have a 25-foot buffer zone around aquatic areas, and aerial applications have a 150-foot buffer zone. Air-blast and mist blower applications to tree and vine crops have a 100-foot buffer zone for treatments of almonds and peaches and a 50-foot buffer zone for grapes, citrus and walnuts.

There are several labels registered solely for mosquito and fly control and the label statements vary according to the formulator. AMVAC, the major registrant, has the most extensive label statements for their mosquito control products.

“This pesticide is toxic to fish, aquatic invertebrates and wildlife. Do not apply directly to water except when used over water as labeled for adult mosquito, blackfly, or housefly control. For terrestrial uses, do not apply directly to water or to intertidal areas where surface water is present or to intertidal areas below the mean high water mark. Runoff from treated areas may be hazardous to aquatic organisms in neighboring areas. Do not contaminated water when disposing of equipment washwaters or rinsate. This product is highly toxic to bees exposed to direct treatment on blooming crops or weeds. Do not apply this product or allow to drift to blooming crops or weeds while bees are actively visiting the area.”

Other registrants of mosquito and fly control products of naled have simpler statements.

“This product is toxic to fish, birds and other wildlife. Keep out of lakes, streams and ponds. Direct application to water is prohibited. Do not apply when weather conditions favor drift from areas treated. Do not contaminate any body of water by cleaning of equipment of disposal of wastes. This product is highly toxic to bees exposed to direct treatment or residues on crops. Protective information may be obtained from your Cooperative Agricultural Extension Service.”

Some of the mosquito labels also state that the products can only be applied by trained personnel in commercial pest control and public health abatement programs and others state that the user has to consult with their Fish and Game Agency before using the product before treating for mosquito and fly control in areas such as woodlands, swamps, pastures that are “wide area pest control programs sponsored by governmental entities”.

The IRED indicated that the label statements for mosquito/black fly control products must be amended to include statements that the primary State agency responsible for regulating pesticides must be consulted before the making the first application in a season to determine if permits are required or if regulatory mandates exits. The product cannot be applied over water except to target areas where mosquitoes may rest.

OPP’s endangered species program has developed a series of county bulletins which provide information to pesticide users on steps that would be appropriate for protecting endangered or threatened species. Bulletin development is on ongoing process, and there are no bulletins yet developed that would address fish in the Pacific Northwest. OPP is preparing such bulletins. OPP’s county bulletins have limitations on the use of naled in the habitats of endangered aquatic species which state that it cannot be applied within 100 yards from the edge of the water for ground applications, nor within 1/4 mile for aerial applications. ULV applications cannot be applied within one mile from the edge of water. These limitations, taken from Biological Opinions written by the FWS, are only in the bulletins and not currently on product labels.

In consideration of the time passed since the last Biological Opinion, and the refinement of OPP models and methods, it is quite likely that these recommendations need revision. A significant reduction in the recommended buffer size may, indeed be justified based on more recent data, including those reported in this review. In California, DPR creates county bulletins consistent with those developed by OPP. Naled has several use limitations including a prohibition on its use in currently occupied habitat; requirement for a 20-foot minimum vegetative filter strip along aquatic areas; timing and limits on irrigation and buffer zones of 200 yards for aerial applications and 40 yards for ground applications. These guidelines may more accurately reflect actual protective needs. The intent is to have the use limitations listed in the county bulletins on product labels when the Endangered Species Protection Program becomes final.

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

Data referred to in the following review and conclusions are contained in attachments **d** (California) and **e** (Pacific Northwest), and referred to by table numbers.

(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. Naled would not be used in this kind of forest, 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 naled in counties where this ESU occurs are presented in Table 18.

Approximately 4,500 pounds a.i. are applied within the Southern California Steelhead ESU for agricultural purposes. Current guidelines prohibit residential use in this densely populated area, however the high toxicity of naled to both endangered fish and their prey indicates that naled use may affect this ESU, but is not likely to adversely affect the species.

(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. Naled use within this ESU is shown in Table 19.

In the South-Central California Steelhead ESU there is considerable use of naled in Monterey county (21,912 lbs a.i.). This usage and the high toxicity of naled to cold water fish and their food supply, causes concern that the use of naled may affect the T&E fish species through both direct and indirect means, however the RQ index suggests it is not likely to adversely affect the species of concern.

(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 20).

There is modest use of naled within the Central California Coastal Steelhead ESU. Because of the high toxicity of naled, it may affect this ESU, but modest use indicates it will probably not adversely affect the T&E species through direct or indirect effects.

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. County data is shown in Table 21.

There is considerable use of naled in some of the counties within the Central Valley California Steelhead ESU (San Joaquin, Merced) and a potential for unreported, non-agricultural applications. These factors, combined with the high toxicity of naled indicate that use of this pesticide may affect the T&E species directly or indirectly through loss of prey, however the data models developed by EFED indicate that adverse effects are unlikely. Naled may affect, but is unlikely to adversely affect, the species of 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 would be no naled usage. Table 22 shows the reported use of naled in these counties.

No use of naled is reported in this ESU and it will therefore have no effect on the T&E species of concern.

(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.

Table 23 shows county data for naled use in this ESU. 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.

The Upper Columbia Steelhead ESU is located in an area of intense agricultural activity. Naled is used in large quantities and may affect the T&E species of concern.

(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 naled 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 naled. 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.

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 24 shows 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.

There is a rather large amount of acreage that could potentially be treated with naled within this ESU. Given the factors discussed in the toxicity section above, the likelihood for effects from these uses seems significant. Therefore, I conclude that the use of naled may affect the Snake River Basin Steelhead ESU due to reduction in the food sources within its breeding areas.

(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 naled would not likely 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 25 shows 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.

There is a rather large amount of acreage that could potentially be treated with naled within this ESU. Given the factors discussed in the toxicity section above, the likelihood for effects from these uses seems high. I conclude naled use may affect the T&E species in this ESU.

(9) Lower Columbia River Steelhead ESU

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

This ESU includes all tributaries from the lower Willamette River (below Willamette Falls) to Hood River in Oregon, and from the Cowlitz River up to the Wind River in Washington. These tributaries would provide the spawning and presumably the growth areas for the young steelhead. It is not clear if the young and growing steelhead in the tributaries would use the nearby mainstem of the Columbia prior to downstream migration. If not, the spawning and rearing habitat would occur in 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 26 identifies cropping information for this ESU. Table 26 identifies the crop data for this ESU.

There is a moderate amount of acreage that could potentially be treated with naled within this ESU. However, the bulk of Clackamas County acreage is most likely not in the watershed of this ESU, and there are many counties in which there is no reported usage of naled For these reasons, along with the factors discussed previously, the likelihood for effects from these uses seems very moderate. I conclude that the use of naled may affect, but is not likely to adversely affect, the Lower Columbia River Steelhead ESU.

(10) Middle Columbia River Steelhead ESU

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

This steelhead ESU occupies “the Columbia River Basin and tributaries from above the

Wind River in Washington and the Hood River in Oregon (exclusive), upstream to, and including, the Yakima River, in Washington." The Critical Habitat designation indicates the downstream boundary of the ESU to be Mosier Creek in Wasco County, Oregon; this is consistent with Hood River being "excluded " in the listing notice. No downstream boundary is listed for the Washington side of the Columbia River, but if Wind River is part of the Lower Columbia steelhead ESU, it appears that Collins Creek, Skamania County, Washington would be the last stream down river in the Middle Columbia River ESU. Dog Creek may also be part of the ESU, but White Salmon River certainly is, since the Condit Dam is mentioned as an upstream barrier.

The only other upstream barrier, in addition to Condit Dam on the White Salmon River, is the Pelton Dam on the Deschutes River. As an upstream barrier, this dam would preclude steelhead from reaching the Metolius and Crooked Rivers as well the upper Deschutes River and its tributaries.

In the John Day River watershed, we have excluded Harney County, Oregon because there is only a tiny amount of the John Day River and several tributary creeks (e.g., Utley, Bear Cougar creeks) which get into high elevation areas (approximately 1700M and higher) of northern Harney County where there are no crops grown. Union and Wallowa Counties, Oregon were excluded because the small reaches of the Umatilla and Walla Walla Rivers in these counties occur in high elevation areas where crops are not grown.

The Oregon counties then that appear to have spawning and rearing habitat are Gilliam, Morrow, Umatilla, Sherman, Wasco, Crook, Grant, Wheeler, and Jefferson counties. Washington counties providing spawning and rearing habitat would be Benton, 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. Specific crop data for this ESU are listed in Table 27.

There is a rather large amount of acreage that could potentially be treated with naled within this ESU. Given the factors discussed previously, the likelihood for effects from these uses seems moderate, but cannot be precluded. Therefore, I conclude that the use of naled may affect the Middle Columbia River Steelhead ESU.

(b) Chinook salmon

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

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

Coastwide, chinook salmon typically remain at sea for 2 to 4 years, with the exception of a small proportion of yearling males (called jack salmon) which mature in freshwater or return after 2 or 3 months in salt water. Ocean-type chinook salmon tend to migrate along the coast, while stream-type chinook salmon are found far from the coast in the central North Pacific. They return to their natal streams with a high degree of fidelity. Seasonal “runs” (i.e., spring, summer, fall, or winter), which may be related to local temperature and water flow regimes, have been identified on the basis of when adult chinook salmon enter freshwater to begin their spawning migration. Egg deposition must occur at a time to ensure that fry emerge during the following spring when the river or estuary productivity is sufficient for juvenile survival and growth.

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

1) Sacramento River Winter-run Chinook Salmon ESU

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

Critical Habitat has been designated to include the Sacramento River from Keswick Dam, Shasta County (river mile 302) to Chipps Island (river mile 0) at the west end of the Sacramento-San Joaquin delta, and then westward through most of the fresh or estuarine waters, north of the Oakland Bay Bridge, to the ocean. Estuarine sloughs in San Pablo and San Francisco bays (including San Mateo and Santa Clara counties) are excluded (58FR33212-33219, June 16, 1993).Table 28 contains data for this ESU.

There is modest use of naled within this the Sacramento River, Winter-Run Chinook Salmon ESU. Use of naled in this ESU will have no effect the T&E species of concern.

(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 naled would not be used; the private land areas of Valley County where naled 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 29 identifies crop data for this ESU.

The Snake River Fall-Run Chinook Salmon ESU is located in an area of significant agricultural use and naled can be used in large quantities. The toxicity of this chemical, used significantly in this ESU, suggests that it may affect the T&E species of concern

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3. Snake River Spring/Summer-run Chinook Salmon

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

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

Table 30 shows crop data for this area. Spawning and rearing counties mentioned in the Critical Habitat Notice include Union, Umatilla, Wallowa, and Baker counties in Oregon; Adams, Blaine, Custer, Idaho, Lemhi, Lewis, Nez Perce, and Valley counties in Idaho; and Asotin, Columbia, Franklin, Garfield, Walla Walla, and Whitman counties in Washington. However, Umatilla and Baker counties in Oregon and Blaine County in Idaho are excluded because accessible river reaches are all well above areas where naled can be used. Counties with migratory corridors are all of those down stream from the confluence of the Snake and Columbia Rivers.

The Snake River Fall-Run Chinook Salmon ESU is located in an area of significant agricultural use and naled can be used in large quantities. The toxicity of this chemical, used significantly in this ESU, suggests that it may affect the T&E species of concern

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4. Central Valley Spring-run Chinook Salmon ESU

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

Hydrologic units and upstream barriers within this ESU are the Sacramento-Lower Cow-Lower Clear, Lower Cottonwood, Sacramento-Lower Thomas (upstream barrier - Black Butte Dam), Sacramento-Stone Corral, Lower Butte (upstream barrier - Chesterville Dam), Lower Feather (upstream barrier - Orville Dam), Lower Yuba, Lower Bear (upstream barrier - Camp Far West Dam), Lower Sacramento, Sacramento-Upper Clear (upstream barriers - Keswick Dam, Whiskey town dam), Upper Elder-Upper Thomas, Upper Cow-Battle, Mill-Big Chico, Upper Butte, Upper Yuba (upstream barrier - Englebright Dam), Suisin Bay, San Pablo Bay, and San Francisco Bay. These areas are said to be in the counties of Shasta, Tehama, Butte, Glenn, Colusa, Sutter, Yolo, Yuba, Placer, Sacramento, Solano, Nevada, Contra Costa, Napa, Alameda, Marin, Sonoma, San Mateo, and San Francisco. I note, however, with San Mateo County being well south of the Oakland Bay Bridge, it is difficult to see why this county was included (Table 31).

Within the California Central Valley Spring-Run Chinook Salmon ESU, there is modest use of naled in a large geographic area with an extensive watershed. Naled use will not affect the T&E species of concern in 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 Naled could be used are Humboldt, Trinity, Mendocino, Lake, Sonoma, and Marin. A small portion of Glenn County is also included in the Critical Habitat, but naled would not be used in the forested upper elevation area. Crop data for this area is shown in Table 32.

There is no reported use of naled in the California Coastal Chinook Salmon ESU, and it will therefore have no effect on the species of concern.

6. Puget Sound Chinook Salmon ESU

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

The Hydrologic units and upstream barriers are the Strait of Georgia, San Juan Islands, Nooksack, Upper Skagit, Sauk, Lower Skagit, Stillaguamish, Skykomish, Snoqualmie (upstream barrier - Tolt Dam), Snohomish, Lake Washington (upstream barrier - Landsburg Diversion), Duwamish, Puyallup, Nisqually (upstream barrier - Alder Dam), Deschutes, Skokomish, Hood Canal, Puget Sound, Dungeness-Elwha (upstream barrier - Elwha Dam). Affected counties in Washington, apparently all of which could have spawning and rearing habitat, are Skagit, Whatcom, San Juan, Island, Snohomish, King, Pierce, Thurston, Lewis, Grays Harbor, Mason, Clallam, Jefferson, and Kitsap (Table 33).

A significant amount of naled is applied within the Puget Sound Chinook Salmon ESU. Despite the rapid turnover of water in this area and the short half-life (<2 days) of naled, I must conclude that the use of naled may affect the T&E species of concern.

7. Lower Columbia River Chinook Salmon ESU

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

Crop data for this ESU are shown in Table 34. The Hydrologic units and upstream barriers are the Middle Columbia-Hood (upstream barriers - Condit Dam, The Dalles Dam), Lower Columbia-Sandy (upstream barrier - Bull Run Dam 2), Lewis (upstream barrier - Merlin Dam), Lower Columbia-Clatskanie, Upper Cowlitz, Lower Cowlitz, Lower Columbia, Clackamas, and the Lower Willamette. Spawning and rearing habitat would be in the counties of Hood River, Waco, Columbia, Clackamas, Marion, Multnomah, and Washington in Oregon, and Klickitat, Skamania, Clark, Cowlitz, Lewis, Wahkiakum, Pacific, Yakima, and Pierce in Washington. Clatsop County appears to be the only county in the critical habitat that does not contain spawning and rearing habitat, although there is only a small part of Marion County that is included as critical habitat. Pierce County, Washington was excluded because the very small part of the Cowlitz River watershed in this county is at a high elevation where naled would not be used.

A significant amount of naled is applied within the Lower Columbia River Chinook Salmon ESU. Despite the rapid turnover of water in this area and the short half-life (<2 days) of naled, I must conclude that the use of naled may affect the T&E species of concern.

8. Upper Willamette River Chinook Salmon ESU

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

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

Table 35 shows the cropping information for Oregon counties where the Upper Willamette Rive chinook salmon ESU occurs and for the Oregon and Washington counties where this ESU migrates..

A significant amount of naled is applied within the Upper Willamette River Chinook Salmon ESU. Despite the rapid turnover of water in this area and the short half-life (<2 days) of naled, I must conclude that the use of naled may affect the T&E species of concern.

9. Upper Columbia River Spring-run Chinook Salmon ESU

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

Columbia-Hood, Lower Columbia-Sandy, Lower Columbia-Clatskanie, Lower Columbia, and Lower Willamette. Counties in which spawning and rearing occur are Chelan, Douglas, Okanogan, Grant, Kittitas, and Benton (Table 36), with the lower river reaches being migratory corridors (Table 46).

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

A significant amount of naled is applied within the Upper Columbia River Chinook Salmon ESU. Despite the rapid turnover of water in this area and the short half-life (<2 days) of naled, I must conclude that the use of naled may affect the T&E species of 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 re-colonized vacant habitat that had only recently become accessible to anadromous fish.

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

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. Agriculture data for this ESU are shown in Table 37.

Minimal usage of naled is reported for the Central California Coast Coho Salmon ESU, and it will not affect the species of concern.

2. Southern Oregon/Northern California Coast Coho Salmon ESU

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

The Southern Oregon/Northern California Coast coho salmon ESU occurs between Punta Gorda, Humboldt County, California and Cape Blanco, Curry County, Oregon. Major basins with this salmon ESU are the Rogue, Klamath, Trinity, and Eel river basins, while the Elk River, Oregon, and the Smith and Mad Rivers, and Redwood Creek, California are smaller basins within the range. Hydrologic units and the upstream barriers are Mattole, South Fork Eel, Lower Eel, Middle Fork Eel, Upper Eel (upstream barrier - Scott Dam-Lake Pillsbury), Mad-Redwood, Smith, South Fork Trinity, Trinity (upstream barrier - Lewiston Dam-Lewiston Reservoir), Salmon, Lower Klamath, Scott, Shasta (upstream barrier - Dwinnell Dam-Dwinnell Reservoir), Upper Klamath (upstream barrier - Irongate Dam-Irongate Reservoir), Chetco, Illinois (upstream barrier - Selmac Dam-Lake Selmac), Lower Rogue, Applegate (upstream barrier - Applegate Dam-Applegate Reservoir), Middle Rogue (upstream barrier - Emigrant Lake Dam-Emigrant Lake), Upper Rogue (upstream barriers - Agate Lake Dam-Agate Lake; Fish Lake Dam-Fish Lake; Willow Lake Dam-Willow Lake; Lost Creek Dam-Lost Creek Reservoir), and Sixes. Related counties are Humboldt, Mendocino, Trinity, Glenn, Lake, Del Norte, Siskiyou in California and Curry, Jackson, Josephine, and Douglas, in Oregon. However, I have excluded Glenn County, California from this analysis because the salmon habitat in this county is not near the agricultural areas where naled can be used. Klamath county is excluded because it lies beyond an impassable barrier. Crop data are in Table 38.

There is moderate use of naled in the Southern Oregon/Northern California Coho Salmon ESU. In consideration of the toxicity of this chemical to both fish and macroinvertebrates, it is evident that the use of naled may affect the species of concern, however the short half-life of naled implies it is not likely to adversely affect the 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, Clatsop. However, the portions of Yamhill, Washington, and Columbia counties that are within the ESU do not include agricultural areas where naled can be used, and they were eliminated in this analysis (Table 39).

Significant amounts of naled are used within the Oregon Coast Coho Salmon ESU. The short half-life and expected rapid turnover of water in the region suggest, however, the while naled may affect the species of concern, it not be likely to adversely affect the 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, and Island.

Streams specifically mentioned, in addition to Hood Canal, in the proposed critical habitat Notice include Union River, Tahuya River, Big Quilcene River, Big Beef Creek, Anderson Creek, Dewatto River, Snow Creek, Salmon Creek, Jimmycomelately Creek, Duckabush ‘stream’, Hamma Hamma ‘stream’, and Dosewallips ‘stream’. Crop data are listed in Table 40 for the Hood Canal ESU.

Hood Canal is an isolated body of water, with the only open channel to the sea being at the northern-most extreme to the Straits of Juan de Fuca. It is not a significant agricultural area and has a low population density. Less than 15,000 lbs a.i. are calculated as potentially used in this ESU. The toxicity data, however, indicates that naled use may have effects on the ESU, but is not likely to adversely affect it.

2. Columbia River Chum Salmon ESU

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

Critical habitat for the Columbia River chum salmon ESU encompasses all accessible reaches and adjacent riparian zones of the Columbia River (including estuarine areas and tributaries) downstream from Bonneville Dam, excluding Oregon tributaries upstream of Milton Creek at river km 144 near the town of St. Helens. These areas are the Hydrologic units of Lower Columbia - Sandy (upstream barrier - Bonneville Dam, Lewis (upstream barrier - Merlin Dam), Lower Columbia - Clatskanie, Lower Cowlitz, Lower Columbia, Lower Willamette in the counties of Clark, Skamania, Cowlitz, Wahkiakum, Pacific, Lewis, Washington and Multnomah, Clatsop, Columbia, and Washington, Oregon. It appears that there are three extant populations in Grays River, Hardy Creek, and Hamilton Creek (Table 41).

The Columbia River Chum Salmon ESU is a site of modest naled use. While this use may affect the ESU, it is not likely to adversely affects the species..

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. Agriculture us is shown in Table 42.

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

1. Ozette Lake Sockeye Salmon ESU

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

While Lake Ozette, itself, is part of Olympic National Park, its tributaries extend outside park boundaries, much of which is private land. There is limited agriculture in the whole of Clallam County, and most of this is well away from the Ozette watershed. Table 42 shows the use of naled in this ESU.

The Ozette Lake Sockeye Salmon ESU is located solely in Caballus County, WA. Mush of this county is occupied by the Olympic Mountains National Park and other controlled access lands. A total of 4,312 lbs a.i. use is reported for the entire ESU, a rather large geographic are. This use will have no effects of the species of concern.

2. Snake River Sockeye Salmon ESU

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

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

Table 43 shows the limited acreage of crops in counties where this ESU reproduces. All of this crop production is away from and at a much lower elevation than the spawning and rearing habitat. The critical spawning zones demonstrate, at the maximum allowable application levels, the potential for 2,050 lbs of naled, distributed over 23,600 A of cultivated land and a much larger area including non-agricultural properties.

A moderate amount of naled is applied within the Snake River Sockeye Salmon ESU, which suggests it may affect but is unlikely to adversely affect the T&E species of concern. The critical spawning and rearing area (Redfish Lake) is, however, at high altitude and in protected areas.

Table 44: Summary of Conclusions for Naled

Species	ESU	Finding
Chinook Salmon	Upper Columbia	May affect
Chinook Salmon	Snake River spring/summer run	May Affect
Chinook Salmon	Snake River fall run	May Affect
Chinook Salmon	Upper Willamette	May Affect
Chinook Salmon	Lower Columbia	May Affect
Chinook Salmon	Puget Sound	May Affect

Chinook Salmon	California Coastal	No Effect
Chinook Salmon	Central Valley spring run	No Effect
Chinook Salmon	Sacramento River winter run	No Effect
Coho Salmon	Oregon Coast	May affect, but unlikely to adversely affect
Coho Salmon	Southern Oregon/Northern California	May affect, but unlikely to adversely affect
Coho Salmon	Central California	No Effect
Chum Salmon	Hood Canal summer run	May affect, but unlikely to adversely affect
Chum Salmon	Columbia River	May affect, but unlikely to adversely affect
Sockeye Salmon	Ozette Lake	No Effect
Sockeye Salmon	Snake River	May affect, but unlikely to adversely affect
Steelhead	Snake River Basin	May Affect
Steelhead	Upper Columbia River	May Affect
Steelhead	Middle Columbia River	May Affect
Steelhead	Lower Columbia River	May affect, but unlikely to adversely affect
Steelhead	Upper Willamette River	May Affect
Steelhead	Northern California	No Effect
Steelhead	Central California Coast	May affect, but unlikely to adversely affect
Steelhead	South-Central California Coast	May affect, but unlikely to adversely affect
Steelhead	Southern California	May affect, but unlikely to adversely affect
Steelhead	Central Valley California	May affect, but unlikely to adversely affect

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Attachment a
Interim Reregistration Eligibility Decision for Naled

Attachment b
EFED Chapter C for Naled

Attachment c

Attachment d
Use of Naled in California, by County

Attachment e
Use of Naled in the Pacific Northwest, by County

Attachment f
Washington State Department of Agriculture
Estimate of Naled Use