**Bromoxynil**
Analysis of Risks
to
Endangered and Threatened Salmon and Steelhead

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## Summary

Bromoxynil is a selective contact foliage herbicide used to control a variety of grasses and broadleaf weeds. It is available for use on food and feed crops. Non-food uses include fallow/idle ground, outdoor industrial , non-agricultural, uncultivated areas, ornamental plants, industrial/commercial lawns (non-residential), ornamentals, golf course turf, and sod farms.

Registered formulations include the Technical Grade for manufacturing use formulation as an emulsifiable concentrate, soluble concentrate or a gel formulation, in water soluble packages. There are no residential use's for this product.

Typical application rates range from 0.25 lb a.i./acre to 0.5 lb a.i./acre. The Agency has previously determined that the overall acute risk to freshwater and estuarine fish is low. Chronic risk was judged to be minimal. Acute risk to aquatic invertebrates was determined to be medium(Rergistration Eligibility Decision, 1998, pg. vii)

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

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

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

**Contents**



**Attachments:**



## 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 are 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.

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 $2.39 \times 10^{-9}$, 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 (Hasler, AD. and Wisbey, WJ, 1951; Adron, SW, Mackie, AM, 1978)

**2. Description of Bromoxynil:**

**A. Chemical History:** Bromoxynil was initially registered in 1965 for use as a herbicide in wheat and barley. In 1972 tolerances were established for field and fodder crops, meat and meat byproducts of cattle, hogs, horses, and sheep. Throughout the 1980's additional tolerances were established for a variety of vegetable, field, and fodder crops.

**B: Chemical Description:**

- ❏ Common Name: bromoxynil phenol<br>bromoxynil octanoate
- ❏ Chemical Name: [3,5-dibromo-4-hydroxybenzonitrile]

- Chemical Family: benzonitrile
- Case Number: 2070
- CAS Registry Number: phenol (1689-84-5)<br>octanoate (1689-99-2)
- OPP Chemical Code: phenol (035301)<br>octanoate (035302)
- Empirical Formula: phenol ($C_7H_3Br_2NO_2$)<br>octanoate ($C_{15}H_{17}Br_2NO_2$)
- Trade and Other Names: Buctril®, Moxy 2E®, Broclean®, Bromac®, Bromax®, Bronate®, Bronate Advanced®,Bronate Pro®, Brox-M®,Buctril®
- Basic Manufacturer: Rhone-Poulenc

Bromoxynil is a white, colorless solid with a melting point of 194-196°C. The octanoate is an amber waxy solid with a characteristic odor. The melting point is 45-46°C. Vapor pressure is 0.11 mm Hg at 25°C. The octanoate rapidly hydrolyzes to bromoxynil at pH>9. In pure form it is soluble in acetone to 170g/L, methanol to 90 g/L. The octanoate is soluble in acetone and ethanol to 100g/L, benzene, xylene to 700 g/L, chloroform, dichloromethane to 800 g/l, and cyclohexanone to 550 g/l.

In a study by Zottini *et al* (1994) bromoxynil was found to have mitochondrial effect in *Pisum sativum* (peas). The effects included the membrane potential, [delta]pH, matrix $Ca^2$+ movements,and dicarboxylate transport. No effects were seen on ATPase activity, internal NADH, or succinic dehydrogenases. The authors concluded that inhibition of the dicarboxylate carrier was the prime method of action by bromoxynil.

**C. Chemical Use:** The following is based on the currently registered uses of bromoxynil:

- Type of Agent: Herbicide
- Class: Restricted Use
- Summary of Sites:
    - Food Crops: Grain Crops (triticale), Root Crops (garlic, onion)
    - Food + Feed Crops: Beverage Crops (mint), Crops grown for Oil

(flax), Flavoring and Spice Crops (peppermint and spearmint), Grain Crops (barley, field corn, rye, oats, sorghum, triticale, wheat). Groups that cross established crop groupings (cotton), and Specialized Field Crops ( popcorn, sweet corn),

- Residential: None

- Feed Crops: Forage Grasses, Millet, Sorghum, Sudangrass, Forage Legumes and other Non-Grass Forage Crops (alfalfa), Grasses Grown for Seed.

- Commercicial Non-food Crops: Uncultivated Agricultural Lands, Grasses grown for seed, Industrial (outdoor) areas, Ornamental Herbaceous Plants, Ornamental Lawns and Turf, Golf Course Turf, Sod Farms.

- Target Pests: Annual Sowthistle, Black Nightshade,Blue Mustard,Broadleaf Weeds, Buffalobur, Canada Thistle, Coast Fiddleneck, Common Cocklebur, Common Groundsel, Common Lambsquaters, Common Ragweed, Common Tarweed, Corn Chamomolie, Corn Gromwell, Corn Cockle, Eastern Black Nightshade, Frederick Field Pennycross, Giant Ragweed, Green Smartweed, Hairy Nightshade, Hemp Sesbania, Green Smartweed, Henbit, Iveyleaf, Morninglory, Fimsonweed, Knawel, Kochia, Ladysthimb, London Rocket, Mayweed, Pennsylvania Smartweed, Pepperweed, Prostrate Knockweed, Prostate Spurge, Redroot Pigweed, Russian Thistle, Sheperdspurse, Silverleaf, Nightshade, Spiny Pigweed, Spurweed, Sunflower, Tall Morninglory, Tall Waterhemp, Tartary Buckwheat, Tumble Mustard, Velvetleaf, Venice Mallow, Wild Buckwheat, Wild Mustard, Wild Radish, Yellow Woodsorrel.

❏ Formulation Types Registered: Technical Grade/Manufacturing-Use Product (MUP), technical solid 87.3 to 98.0% a.i.

❏ End-use Product; Emulsifiable concentrate, 15.74 to 33.4% a.i. Liquid 15.74 to 33.4% a.i. Bromoxynil is typically applied with a wide range of fertilizers and insecticides, including, but not limited to, Captan, Atrazine and 2,4-D.

❏ Method and Rate of Application:

- Equipment: Aircraft, ground spray, irrigation, hand wand, moving wheel irrigation, solid set irrigation, spray set sprinkler.

- Method:. Band treatment, broadcast chemigation, directed spray, ground spray, low volume (concentrate) spray.

- Timing: Cutting, Dormant, Established Plantings, Postemergence, Prebloom, Preemergence, Preplant, Seedling stage, or when needed.

The Agency estimates that 2.5 to 3.0 million pounds of bromoxynil are applied on an annual basis, however it was noted that actual use is highly variable from year to year. 91% of the use is on three crops: field corn (57%), wheat (26%), and barley (8%). The remaining 9% is distributed among other grain crops, alfalfa, garlic, mint, onions, flax, and non-agricultual use sites.

**Table 3: National Use Estimate for Bromoxynil** (USGS Data)

| Crop | Lbs a.i. Applied (Max) |
|---|---|
| Barley | 262,377 |
| Corn | 1,528,361 |
| Oats, Rye | 44,287 |
| Sorghum | 79,103 |
| Wheat | 1,273,103 |
| Alfalfa Hay | 81,205 |
| Rice | 41,295 |
| Mint | 23,241 |
| Onions | 14,026 |
| Garlic | 13,893 |

**D. Incidents**: A total of 107 incidents are contained in the Agency database. The significant majority involve damage to crops. No aquatic incidents were reported.

**E. Estimated and actual concentrations of bromoxynil in water**:

Environmental fate studies indicate that bromoxynil (phenol and octanoate) should not persist in surface waters, although USGS NAWQA data indicate that bromoxynil was detected in 1.1% of all samples collected. Modeled EEC’s are based on cotton which the Agency has determined to be the most conservative estimate for surface water entry. A Tier II analysis, based on the PRZM-EXAMS model (Pesticide Root Zone Model Version 2.3 and Exposure Analysis Modeling System 2.94) was conducted to calculate Estimated Environmental Concentrations (EEC's) based on cotton application parameters. Based on these studies the maximum peak EEC was determined to be 12.3 ppb and the maximum estimated, long term mean was 0.24 ppb. In a study by Waite *et al* in 2003 bromoxynil concentrations in pond water were found at a maximum of 4.2 ng $m^3$.

Actual monitoring data (USGS, NAQAW) data from 1993-1995 of 1, 925 surface water samples found 20 detections at ≥0.03 ppb, yielding a median value of 0.105 ppb and a mean of 0.53 ppb. The maximum recorded was a single sample at 6.1 ppb. The sites sampled were primarily agricultural drainage.

Bromoxynil octanoate degraded with a half life of <12 hours under experimental conditions in an aerobic, aqueous environment. This finding was confirmed in a study by Muir *et al* in 1991, based on dissipation in Delta Marsh (Canada). It was undetectable at 48 hours. The degradates formed appear to vary with the species of microbe metabolizing bromoxynil. (W.C.Ford, 200 http://umbbd.ach.umn.edu/box/bos_map.html). They found that when metabolized by *Flavobacterium sp.* the sequential products were 2,6-Dibromohydoroquinone, [(2E,4E)-1,5-Dibrom-3hydroxy-muconic semialdehyde], 2-Bromomaleylacetate, and Maleylacetate. When metabolized by *Klebsiella pneumoniae* or *Rhodococcus rhodochrous* the sequential degradates were 3,5-Dibromo-4-hydroxybenzamide, 2,6-Dibromophenol, and Malleylacetate. The differences appear linked to specific enzymes including nitrile hydrase, bromoxynil nitrolase, decarboxylase's, chlorphenol 4-monooxygenase (*Klebsiella* and *Rhodococcus*) pentachloro-phenol monooxygenase, 2,6-DiCH dioxygenase, and maleylacetate reductase (*Flavobacterium*).

**F. Ecological Effects Toxicity Assessment**:

**i. Freshwater Fish:** The minimum data required to establish the toxicity of bromoxynil to freshwater fish is from two species. The preferred species are rainbow trout and bluegill sunfish. Results of these tests are shown in Table 4.

**Table 4: Freshwater Fish, Acute Toxicity**

| **Species** | **% a.i.** | **96-hour $LC_{50}$** | **Toxicity Class** |
|---|---|---|---|
| *Oncorhynchus mykiss* (rainbow trout) | 36.6 octanoate | 50 ppb | Very Highly Toxic |
| *Oncorhynchus mykiss* (rainbow trout) | 87.3 octanoate | 100 ppb | Highly Toxic |
| *Oncorhynchus mykiss* (rainbow trout) | 21.5 phenol | 3870 ppb | Moderately Toxic |
| *Oncorhynchus mykiss* (rainbow trout) | 95.0 phenol | 2100 ppb | Moderately Toxic |

| | | | |
|---|---|---|---|
| *Lepomis macrochirus* (bluegill sunfish) | 94.8 heptanoate | 29 ppb | Very Highly Toxic |
| *Lepomis macrochirus* (bluegill sunfish) | 87.3 octanoate | 53 ppb | Very Highly Toxic |
| *Lepomis macrochirus* (bluegill sunfish) | 95.0 phenol | 4000 ppb | Moderately Toxic |
| *Lepomis macrochirus* (bluegill sunfish) | 21.5 phenol | 4943 ppb | Moderately Toxic |
| *Ictalurus nebulosus* (catfish) | 36.6 octanoate | 23 ppb | Very Highly Toxic |

Bromoxynil is classified as very highly toxic or moderately toxic to freshwater fish.

**ii. Freshwater Fish, Chronic**: A freshwater fish early life-cycle test was performed. Results available are listed in Table 5.

**Table 5: Freshwater Fish Life Cycle Testing**

| Species | % a.i. | LOEL (ppb) | NOEL (ppb) | EFFECT |
|---|---|---|---|---|
| *Pimephales promelas* (Fathead Minnow) | 97.2 octanoate | 39 | 18 | Decreased larval growth, survival, and embryo hatching success |
| *Pimephales promelas* (Fathead Minnow | 63.0 octanoate | 18 | 9 | Decreased larval survival |

Growth of freshwater fish is affected at 9.0 ppb.

**iii. Freshwater Invertebrates, Acute:** The preferred species for testing bromoxynil toxicity in freshwater invertebrates is the waterflea. Results of acute toxicity tests are shown in Table 6:

**Table 6: Acute Toxicity of bromoxynil in Freshwater Invertebrates**

| Species | % a.i. | 48-hour $LC_{50}$/$EC_{50}$) | Toxicity Class |
|---|---|---|---|
| *Daphnia pulex* (Waterflea) | 36.6 octanoate | 11 ppb | Very Highly Toxic |
| *Daphnia magna* (Waterflea) | 87.3 octanoate | 96 ppb | Very Highly Toxic |
| *Daphnia magna* (Waterflea) | 94.8 heptanoate | 31 ppb | Very Highly Toxic |
| *Daphnia magna* (Waterflea) | 95.0 phenol | 19,220 ppb | Slightly Toxic |
| *Daphnia magna* (Waterflea) | 21.5 phenol | 15,910 ppb | Slightly Toxic |

Bromoxynil octanoate and heptanoate is categorized as very highly toxic to freshwater invertebrates on an acute basis. The phenol formulation appears to be the lowest risk compound, and is categorized as slightly toxic.

**iv. Table 7: Freshwater Aquatic Invertebrate Life Cycle Testing**

| Species | % a.i. | NOEL (ppb) | LOEL (ppb) | MATC (ppb) | Effect |
|---|---|---|---|---|---|
| *Daphnia magna* | 97..2 octanoate | 2.5 | 5.9 | 3.8 | reproduction and growth |
| *Dapnia magna* | 60 octanoate | 2.6 | 5.3 | 3.7 | survival |

The results of these tests indicate that aquatic invertebrate reproductive impairment may occur at bromoxynil levels greater than 2.5 ppb.

**v. Estuarine/Marine Fish Acute Toxicity**

**Table 8: Estuarine/Marine Fish Acute Toxicity**

| **Species** | **% a.i.** | **96 hour LC50** | **Toxicity Category** |
|---|---|---|---|
| *Cyprinodon variegatus* (sheepshead minnow) | 97.2 | 170 ppb | Highly Toxic |

This studie indicates that bromoxynil is highly toxic to estuarine/marine fish,

**vi. Estuarine and Marine Invertebrate Organisms, Acute Toxicity:**

**Table 9: Acute Toxicity of Bromoxynil to Marine/Estuarine Invertebrates**

| **Species** | **% a.i.** | **$LC_{50}/EC_{50}$** | **Toxicity Class** |
|---|---|---|---|
| *Mysidopsis bahia* | 92.4 octanoate | 65 ppb | Very Highly Toxic |
| *Crassostrea virginica* | 92.4 octanoate | 155 ppb | Highly Toxic |

These studies indicate that bromoxynil is very highly toxic or highly toxic to estuarine/marine invertebrates.

**vii. Estuarine/marine Invertebrate Life-Cycle Testing**

Testing of bromoxynil in estuarine/marine invertebrate life cycles was not available

## G. EEC and Risk Quotients for Subject Species:

**Table 10: EEC's (RED** Bromoxynil,1998)

| Crop | Method | Rate (lbs a.i./A) /#application | Peak EEC (ppb) | 4-Day EEC (ppb) | 21-Day EEC (ppb) | 56-Day EEC (ppb) |
|---|---|---|---|---|---|---|
| Corn, Small grain | Broadcast, ground and aerial | 0.5 (1) | 4.5 | 2.2 | 0.4 | 0.15 |
| Corn | Broadcast, ground and and Aerial | 0.28 (1) | 2.6 | 1.2 | 0.3 | 0.15 |
| Small Grains | Broadcast, ground and aerial | 0.31 (1) | 3.0 | 1.3 | 0.3 | 0.15 |
| Cotton | Broadcast, ground | 0.5 (3) | 9.4 | 4.5 | 0.9 | 0.3 |
| Cotton | Broadcast, ground | 0.4 (2) | 8.0 | 3.8 | 0.7 | 0.3 |
| Cotton | Aerial | 0.5 (3) | 10.0 | 5.0 | 1.0 | 0.4 |
| Cotton | Aerial | 0.4 (2) | 8.4 | 4.1 | 0.9 | 0.3 |

Risk Quotients (RQ's) were calculated for freshwater fish, based on toxicity data and EEC determinations. The results of these calculations are shown in Table 11

**Table 11: Acute Risk Quotients for Freshwater Fish**. (RED for Bromoxynil, 1998)

| Crop | Method | Rate lbs a.i./A (number of applications) | Peak EEC (ppb) | Acute RQ, Bluegill | Acute RQ Catfish |
|---|---|---|---|---|---|
| Corn, small grain | Broadcast, ground and aerial | 0.5(1) | 4.5 | 0.08 | 0.20 |
| Corn | Broadcast, ground and aerial | 0.28 (1) | 2.6 | 0.05 | 0.11 |
| Small grain | Broadcast ground and aerial | 0.31 (1) | 3.0 | 0.02 | 0.13 |
| Cotton | Broadcast, ground | 0.5 (3) | 9.4 | 0.18 | 0.4 |
| Cotton | Broadcast, ground | 0.4 (2) | 8.0 | 0.15 | 0.3 |
| Cotton | Aerial | 0.5 (3) | 10.0 | 0.19 | 0.4 |
| Cotton | Aerial | 0.4 (2) | 8.4 | 0.16 | 0.4 |

Endangered species RQ's exceeded the LOC for all crop applications except small grains. Marine/estuarine RQs were similarly determined and are shown in Table 12.

**Table 12: Risk Quotient Determinations for Marine/Estuarine Fish** (RED for Bromoxynil 1998)

| Crop | Method | Rate (lbs a.i./A) | Peak EEC (ppb) | Acute RQ, |
|---|---|---|---|---|
| Corn, small grain | Broadcast, ground and aerial | 0.5(1) | 4.5 | 0.07 |
| Corn | Broadcast, ground and aerial | 0.28 (1) | 2.6 | 0.04 |
| Small grain | Broadcast ground and aerial | 0.31 (1) | 3.0 | 0.04 |
| Cotton | Broadcast, ground | 0.5 (3) | 9.4 | 0.15 |
| Cotton | Broadcast, ground | 0.4 (2) | 8.0 | 0.12 |
| Cotton | Aerial | 0.5 )3) | 10.0 | 0.15 |
| Cotton | Aerial | 0.4 (2) | 8.4 | 0.13 |

With the exception of low (typical) application on corn and small grains, the LOC was exceeded for endangered species. Risk Quotients were also determined for aquatic (freshwater) invertebrates. Results of these calculations are shown in Table 13.

**Table 13: Risk Quotients for Bromoxynil in Freshwater Invertebrates** (RED for Bromoxynil,1998)

| Crop | Method | Rate lbs a.i./A (number of applications) | Peak EEC (ppb) | Acute RQ, |
|---|---|---|---|---|
| Corn, small grain | Broadcast, ground and aerial | 0.5(1) | 4.5 | 0.4 |
| Corn | Broadcast, ground and aerial | 0.28 (1) | 2.6 | 0.3 |
| Small grain | Broadcast ground and aerial | 0.31 (1) | 3.0 | 0.3 |
| Cotton | Broadcast, ground | 0.5 (3) | 9.4 | 0.9 |
| Cotton | Broadcast, ground | 0.4 (2) | 8.0 | 0.7 |
| Cotton | Aerial | 0.5 )3) | 10.0 | 0.9 |
| Cotton | Aerial | 0.4 (2) | 8.4 | 0.7 |

The endangered species LOC was exceeded for all applications modeled.

**Table 14: Estuarine/Marine Invertebrate risk Quotients** (RED for Bromoxynil, 1998)

| Crop | Method | Rate (lbs a.i./A) | Peak EEC (ppb) | Acute RQ, |
|---|---|---|---|---|
| Corn, small grain | Broadcast, ground and aerial | 0.5(1) | 4.5 | 0.07 |
| Corn | Broadcast, ground and aerial | 0.28 (1) | 2.6 | 0.04 |
| Small grain | Broadcast ground and aerial | 0.31 (1) | 3.0 | 0.04 |
| Cotton | Broadcast, ground | 0.5 (3) | 9.4 | 0.15 |
| Cotton | Broadcast, ground | 0.4 (2) | 8.0 | 0.12 |
| Cotton | Aerial | 0.5 )3) | 10.0 | 0.15 |
| Cotton | Aerial | 0.4 (2) | 8.4 | 0.13 |

The endangered species LOC was exceeded for all applications except corn and small grains at the low (typical) application rate.

**H. Discussion and Characterization of Risk Assessment.**

Bromoxynil is a restricted use herbicide. It appears highly toxic to both fish and invertebrates. It is, however, very short lived in the environment (half life<12 hours). This observation suggests that this chemical will have adverse effects only if used during critical periods of salmon and steelhead life cycles, such as the breeding and rearing periods. Use of bromoxynil during periods when salmon and steelhead are not in the areas exposed should pose no threat to the species of concern.

Bromoxynil would likely be used in the spring planting season. Cotton is an exception, where multiple applications (as many as 3) are practiced. Because cotton is not grown in the Pacific Northwest, and only in limited quantity in California, the danger from cotton treatment appears minimal. As suggested above, the timing of application is the most significant consideration, and worthy of further examination.

In the summary review of data the Agency determined that “the overall risk to freshwater fish from exposure to bromoxynil octoate is expected to be low”. In addition the Agency determined that “chronic risk to freshwater fish and estuarine fish from exposure to bromoxynil octanoate is expected to be minimal”. Some risk to aquatic invertebrates was expected, however only medium.

**I. Existing Protections**: The current protections include guidelines for spray drift control. Permanent water bodies are not to be exposed directly, as there are no aquatic uses registered.

**3. Description of Pacific salmon and steelhead Evolutionarily Significant Units relative to bromoxynil use sites**.

The following review of bromoxynil use in California and the Pacific Northwest is derived from several sources. California data is taken directly from the Department of Pesticide Regulation published census and tabulation of actual chemical used. The tables for Idaho, Oregon, and Washington are constructed with the 1997 USDA Census of Agriculture as the basis for crops present in each state. Specific usage estimates are derived from the USDA Census and the EPA estimated use table, contained in the RED. Where data are not available, it is presumed that application will be to the entire crop at the maximum rate. It is anticipated that this amount is an overestimate of actual use, however it represents the best available data at the time of review. In all counties if the reported or calculated level of pesticide use is less than 1 pound, they are listed as no use.

All available crops are included in reported data for Oregon, Washington, and Idaho. Within California, only the specific crops and pesticide usage are considered. For tabulation, both the octanoate and heptanoate are combined. Within Washinton, Oregon, and Idaho the use rates vary from 0.375 to 0.5 lbs a.i./A (Jed Colquhon, PNW Pesticide Regulation) East of the Cascade mountains. The range west of the Cascades is 0.38 to 0.05 (the label maximum). The principal crop is wheat. Specifications in the Northwest stipulate application before November or after February at an early stage of weed development. In general, this chemical is, with a few exceptions, a poor to fair agent for most weeds of concern.

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). Hydro logic units in this ESU are Cuyama (upstream barrier - Vaquero Dam), Santa Maria, San Antonio, Santa Ynez (upstream barrier - Bradbury Dam), Santa Barbara Coastal, Ventura (upstream barriers - Casitas Dam, Robles Dam, Matilja Dam, Vern Freeman Diversion Dam), Santa Clara (upstream barrier - Santa Felicia Dam), Calleguas, and Santa Monica Bay (upstream barrier - Rindge Dam). Counties comprising this ESU show a very high percentage of declining and extinct populations.

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

Within San Diego County, the San Mateo Creek runs through Camp Pendleton Marine Base and into the Cleveland National Forest. While there are agricultural uses of pesticides in other parts of California within the range of this ESU, it would appear that there are no such uses in the vicinity of San Mateo Creek. Within Los Angeles County, this steelhead occurs in Malibu

Creek and possibly, but unlikely, Topanga Creek. Neither of these creeks drain agricultural areas. There is a potential for steelhead in waters that drain agricultural areas in Ventura, Santa Barbara, and San Luis Obispo counties, but the small quantities of bromoxynil used make effects highly unlikely. Usage of bromoxynil in counties where this ESU occurs are presented in Table 15.

**Table 15. Counties supporting the Southern California steelhead ESU**

| County | Site | Acres Treated | lbs a.i. Applied |
|---|---|---|---|
| Los Angeles | Alfalfa | 128 | 92 |
| Los Angeles | Oat | 7,486 | 865 |
| Los Angeles | Onion | 160 | 29 |
| San Diego | Oat | 96 | 29 |
| San Luis Obispo | Barley | 96 | 18 |
| San Luis Obispo | Hay | 1,129 | 299 |
| San Luis Obispo | Landscape | NR | 2 |
| San Luis Obispo | Oat | 796 | 171 |
| San Luis Obispo | Onion | 43 | 24 |
| San Luis Obispo | Turf/Sod | 60 | 22 |
| San Luis Obispo | Outdr Plants | 1 | 1 |
| Santa Barbara | Hay | 224 | 69 |
| Santa Barbara | Outdr Transpl | 602 | 166 |
| Santa Barbara | Oat | 637 | 134 |
| Santa Barbara | Onion | 11 | 4 |
| Santa Barbara | Sudan Grass | 50 | 9 |
| Santa Barbara | Turf/Sod | 95 | 20 |
| Santa Barbara | Wheat | 26 | 9 |
| Santa Clara | Forage Hay | 110 | 57 |
| Santa Clara | Barley | 110 | 20 |
| Santa Clara | Garlic | 152 | 51 |

| | | | |
|---|---|---|---|
| Santa Clara | Lanscape | NR | 9 |
| Santa Clara | Oat | 568 | 300 |
| Santa Clara | Onion | 368 | 36 |
| Santa Clara | Wheat | 720 | 98 |
| Santa Clara | Rye | 12 | 3 |
| Santa Clara | Uncultivated Ag | 9 | 7 |
| Ventura | Oat | 130 | 42 |
| Ventura | Onion | 758 | 135 |
| Ventura | Turf/Sod | 47 | 17 |

2. South Central California Steelhead ESU

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

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

**Table 16: Counties supporting the South Central California steelhead ESU**

| County | Site | Acres Treated | lbs. a.i. Applied |
|---|---|---|---|
| Monterey | Alfalfa | 243 | 12 |
| Monterey | Barley | 419 | 80 |
| Monterey | Corn | 58 | 16 |

| | | | |
|---|---|---|---|
| Monterey | Landscape | NR | 577 |
| Monterey | Oat | 1,087 | 359 |
| Monterey | Onion | 2,493 | 473 |
| Monterey | Rights of Way | NR | 237 |
| Monterey | Rye | 96 | 35 |
| Monterey | Ryegrass | 89 | 31 |
| Monterey | Sudangrass | 74 | 26 |
| Monterey | Uncultivated Ag | 45 | 16 |
| Monterey | Uncultivated Non-Ag | 6 | 2 |
| Monterey | Wheat | 138 | 39 |
| San Benito | Wheat (butyrate) | 44 | 11 |
| San Benito | Barley | 120 | 22 |
| San Benito | Hay | 414 | 97 |
| San Benito | Oat | 1,320 | 387 |
| San Benito | Onion | 1,410 | 131 |
| San Benito | Wheat | 697 | 88 |
| San Mateo | Landscape | NR | 4 |
| San Luis Obispo | Barley | 96 | 18 |
| San Luis Obispo | Hay | 1,129 | 299 |
| San Luis Obispo | Landscape | NR | 2 |
| San Luis Obispo | Oat | 796 | 171 |
| San Luis Obispo | Onion | 43 | 24 |
| San Luis Obispo | Turf/Sod | 60 | 22 |
| San Luis Obispo | Outdr Plants | 1 | 1 |
| Santa Clara | Forage Hay | 110 | 57 |
| Santa Clara | Barley | 110 | 20 |
| Santa Clara | Garlic | 152 | 51 |

| | | | |
|---|---|---|---|
| Santa Clara | Lanscape | NR | 9 |
| Santa Clara | Oat | 568 | 300 |
| Santa Clara | Onion | 368 | 36 |
| Santa Clara | Wheat | 720 | 98 |
| Santa Clara | Rye | 12 | 3 |
| Santa Clara | Uncultivated Ag | 9 | 7 |
| Santa Cruz | Hay | 18 | 6 |

3. Central California Coast Steelhead ESU

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

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

Counties of occurrence for this ESU are Santa Cruz, San Mateo, San Francisco, Marin, Sonoma, Mendocino, Napa, Alameda, Contra Costa, Solano, and Santa Clara counties. Usage of bromoxynil in the counties where the Central California coast steelhead ESU is presented in Table 17.

**Table 17: Counties supporting the Central California Coast steelhead ESU**

| County | Site | Acres Treated | lbs. a.i. Applied |
|---|---|---|---|
| Alameda | Landscape | NR | 7 |
| Alameda | Oat | 238 | 24 |
| Alameda | Wheat | 60 | 22 |
| Contra Costa | Alfalfa | 200 | 36 |
| Contra Costa | Hay | 34 | 12 |
| Contra Costa | Landscape | NR | 13 |
| Contra Costa | Oat | 147 | 34 |
| Contra Costa | Pasture | 11 | 7 |
| Contra Costa | Wheat | 36 | 6 |
| Marin | | | None |
| Mendocino | | | None |
| Napa | Landscape | NR | 17 |
| Napa | Oat | 70 | 39 |
| Napa | Public Health | NR | 7 |
| San Francisco | | | None |
| San Mateo | Landscape | NR | 3 |
| Santa Clara | Hay | 55 | 26 |
| Santa Clara | Barley | 95 | 10 |
| Santa Clara | Garlic | 76 | 25 |
| Santa Clara | Laandscape | NR | 3 |
| Santa Clara | Oat | 284 | 147 |
| Santa Clara | Onion | 184 | 18 |
| Santa Clara | Wheat | 360 | 87 |
| Santa Cruz | Hay | 18 | 6 |
| Solano | Alfalfa | 1,094 | 279 |
| Solano | Barley | 110 | 22 |

| | | | |
|---|---|---|---|
| Solano | Outdr Plants | 206 | 49 |
| Solano | Oat | 165 | 10 |
| Solano | Ryegrass | 226 | 74 |
| Solano | Sorghum | 802 | 226 |
| Solano | Uncultivated Ag | 100 | 27 |
| Solano | Wheat | 325 | 125 |
| Sonoma | Hay | 100 | 36 |
| Sonoma | Oat | 396 | 140 |
| Sonoma | Pastureland | 120 | 44 |

4. California Central Valley Steelhead ESU

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

This ESU includes populations ranging from Shasta, Trinity, and Whiskeytown areas, along with other Sacramento River tributaries in the North, down the Central Valley along the San Joaquin River to and including the Merced River in the South, and then into San Pablo and San Francisco Bays. Counties at least partly within this area are Alameda, Amador, Butte, Calaveras, Colusa, Contra Costa, Glenn, Marin, Merced, Nevada, Placer, Sacramento, San Francisco, San Joaquin, San Mateo, Solano, Sonoma, Stanislaus, Sutter, Tehama, Tuloumne, Yolo, and Yuba. A large proportion of this area is heavily agricultural. Usage of bromoxynil in counties where the California Central Valley steelhead ESU occurs is presented in Table 18.

**Table 18: Counties supporting the California Central Valley steelhead ESU**.

| County | Site | Acres Treated | lbs. a.i. Applied |
|---|---|---|---|
| Alameda | Landscape | NR | 7 |
| Alameda | Oat | 238 | 24 |
| Alameda | Wheat | 60 | 22 |
| Amador | Alfalfa | 130 | 35 |
| Amador | Oat | 390 | 141 |

| | | | |
|---|---|---|---|
| Amador | Wheat | 120 | 43 |
| Butte | Oat | 210 | 43 |
| Butte | Wheat | 663 | 214 |
| Calveras | | | None |
| Contra Costa | Alfalfa | 200 | 36 |
| Contra Costa | Hay | 34 | 12 |
| Contra Costa | Landscape | NR | 13 |
| Contra Costa | Oat | 147 | 34 |
| Contra Costa | Pasture | 11 | 7 |
| Contra Costa | Wheat | 36 | 6 |
| Glenn | Alfalfa | 2,050 | 477 |
| Glenn | Barley | 100 | 27 |
| Glenn | Corn | 606 | 121 |
| Glenn | Cotton | 274 | 86 |
| Glenn | Oat | 312 | 117 |
| Glenn | Rights of Way | NR | 29 |
| Glenn | Wheat | 441 | 142 |
| Marin | | | None |
| Merced | Alfalfa | 7,969 | 1,642 |
| Merced | Barley | 50 | 14 |
| Merced | Corn | 1,234 | 340 |
| Merced | Cotton | 592 | 92 |
| Merced | Hay | 674 | 167 |
| Merced | Oat | 15,898 | 4,448 |
| Merced | Pastureland | 51 | 150 |
| Merced | Rights of Way | NR | 63 |
| Merced | Wheat | 7,303 | 3,154 |

| | | | |
|---|---|---|---|
| Nevada | | | None |
| Placer | Oat | 50 | 15 |
| San Joaquin | Alfalfa | 4,679 | 892 |
| San Joaquin | Barley | 230 | 83 |
| San Joaquin | Corn | 1,762 | 227 |
| San Joaquin | Hay | 1,654 | 415 |
| San Joaquin | Outdr Plants | 1,740 | 473 |
| San Joaquin | Oat | 10,512 | 2,075 |
| San Joaquin | Onion | 79 | 22 |
| San Joaquin | Rights of Way | NR | 21 |
| San Joaquin | Rye | 188 | 63 |
| San Joaquin | Ryegrass | 52 | 15 |
| San Joaquin | Wheat | 4,503 | 1,304 |
| San Joaquin | Turf/Sod | 94 | 32 |
| San Francisco | | | None |
| San Mateo | Landscape | NR | 4 |
| Shasta | Garlic | 130 | 5 |
| Shasta | Oat | 26 | 10 |
| Shasta | Onion | 8 | 4 |
| Shasta | Turf/Sod | 38 | 14 |
| Solano | Alfalfa | 1,094 | 279 |
| Solano | Barley | 110 | 22 |
| Solano | Outdr Plants | 206 | 49 |
| Solano | Oat | 165 | 10 |
| Solano | Ryegrass | 226 | 74 |
| Solano | Sorghum | 802 | 226 |
| Solano | Uncultivated Ag | 100 | 27 |

| | | | |
|---|---|---|---|
| Solano | Wheat | 325 | 125 |
| Sonoma | Hay | 100 | 36 |
| Sonoma | Oat | 396 | 140 |
| Sonoma | Pastureland | 120 | 44 |
| Stanislaus | Alfalfa | 4,315 | 1,040 |
| Stanislaus | Barley | 682 | 178 |
| Stanislaus | Corn | 544 | 257 |
| Stanislaus | Oat | 17,508 | 4,908 |
| Stanislaus | Rights of Way | NR | 25 |
| Stanislaus | Wheat | 2,405 | 683 |
| Sutter | Alfalfa | 155 | 28 |
| Sutter | Oat | 158 | 37 |
| Sutter | Sorghum | 250 | 45 |
| Sutter | Wheat | 1,221 | 369 |
| Tehama | Hay | 200 | 36 |
| Tehama | Oat | 998 | 274 |
| Tehama | Rights of Way | NR | 29 |
| Tehama | Rye | 80 | 22 |
| Tehama | Wheat | 496 | 102 |
| Tuolumne | Landscape | NR | 6 |
| Yolo | Alfalfa | 3,952 | 815 |
| Yolo | Barley | 166 | 63 |
| Yolo | Corn | 3,416 | 808 |
| Yolo | Cotton | 512 | 124 |
| Yolo | Hay | 40 | 14 |
| Yolo | Grass, Seed | 140 | 25 |
| Yolo | Landscape | NR | 21 |

| | | | |
|---|---|---|---|
| Yolo | Outdr Plants | 107 | 17 |
| Yolo | Oat | 1,993 | 573 |
| Yolo | Pastureland | 3,912 | 1,125 |
| Yolo | Research | 50 | 19 |
| Yolo | Rights of Way | NR | 20 |
| Yolo | Ryegrass | NR | 47 |
| Yolo | Sorghum | 525 | 181 |
| Yolo | Sudangrass | 329 | 70 |
| Yolo | Uncultivated Ag | 30 | 11 |
| Yolo | Uncultivated Non-Ag | 10 | 4 |
| Yolo | Wheat | 5,058 | 1,444 |

5. Northern California Steelhead ESU

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

This Northern California coastal steelhead ESU occupies river basins from Redwood Creek in Humboldt County, CA to the Gualala River, inclusive, in Mendocino County, CA. River entry ranges from August through June and spawning from December through April, with peak spawning in January in the larger basins and in late February and March in the smaller coastal basins. The Northern California ESU has both winter and summer steelhead, including what is presently considered to be the southernmost population of summer steelhead, in the Middle Fork Eel River. Counties included appear to be Humboldt, Mendocino, Trinity, and Lake. Table 19 shows the use of bromoxynil in the counties where the Northern California steelhead ESU occurs.

**Table 19: Counties supporting the Northern California steelhead ESU**

| County | Site | Acres Treated | lbs. a.i. Applied |
|---|---|---|---|
| Humbolt | | | None |
| Lake | Oat | 340 | 433 |
| Mendocino | | | None |

| | | | |
|---|---|---|---|
| Trinity | | | None |

6. Upper Columbia River steelhead ESU

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

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

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

Tables 20 and 21 show the cropping information and maximum potential bromoxynil use for Washington counties where the Upper Columbia River steelhead ESU is located and for the Oregon and Washington counties where this ESU migrates.

**Table 20. Spawning and rearing areas supporting the Upper Columbia River steelhead ESU**

| State | County | Site | Acres Treated | lbs a.i. Applied |
|---|---|---|---|---|
| WA | Benton | Wheat | 130,981 | 65,491 |
| WA | Benton | Barley | 435 | 218 |
| WA | Benton | Alfalfa | 13,241 | 6,621 |
| WA | Benton | Hay | 733 | 367 |
| WA | Benton | Corn | 16,086 | 8,053 |
| WA | Benton | Outdr Plants | 216 | 108 |
| WA | Benton | Onions | 3,398 | 1,699 |

| | | | | |
|---|---|---|---|---|
| WA | Chelan | Wheat | 1,864 | 578 |
| WA | Chelan | Hay | 1,953 | 605 |
| WA | Chelan | Alfalfa | 1.790 | 555 |
| WA | Columbia | Corn | 51 | 26 |
| WA | Columbia | Wheat | 77,511 | 38,756 |
| WA | Columbia | Barley | 17,547 | 8,774 |
| WA | Columbia | Oat | 1,891 | 946 |
| WA | Columbia | Alfalfa | 19,769 | 9,885 |
| WA | Columbia | Hay | 985 | 493 |
| WA | Franklin | Corn | 23,171 | 11,586 |
| WA | Franklin | Wheat | 109,627 | 54,814 |
| WA | Franklin | Alfalfa | 70,943 | 35,472 |
| WA | Franklin | Hay | 1,013 | 507 |
| WA | Grant | Corn | 62.493 | 31,247 |
| WA | Grant | Wheat | 203,498 | 101,749 |
| WA | Grant | Barley | 6,548 | 3,274 |
| WA | Grant | Alfalfa | 120,251 | 60,126 |
| WA | Grant | Barley | 8,548 | 4,274 |
| WA | Grant | Popcorn | 2,022 | 1,011 |
| WA | Grant | Outdr Plants | 6,453 | 3,227 |
| WA | Grant | Hay | 126,450 | 63,225 |
| WA | Okanogan | Corn | 855 | 428 |
| WA | Okanogan | Alfalfa | 21,880 | 10,940 |
| WA | Okanogin | Outdr Plants | 91 | 46 |
| WA | Okanogan | Barley | 614 | 307 |
| WA | Okanogan | Hay | 34,283 | 17,142 |
| WA | Okanogan | Wheat | 8,410 | 4,205 |

| | | | | |
|---|---|---|---|---|
| WA | Okanogan | Oat | 1,407 | 704 |
| WA | Yakima | Corn | 12,680 | 6,340 |
| WA | Yakima | Wheat | 50,430 | 25,215 |
| WA | Yakima | Outdr Plants | 786 | 393 |
| WA | Yakima | Barley | 502 | 251 |
| WA | Yakima | Alfalfa | 43,866 | 21,933 |
| WA | Yakima | Hay | 2,397 | 1,199 |

**Table 21: Oregon and Washington counties that are migration corridors for the Upper Columbia River steelhead ESU.**

| State | County | Site | Acres Treated | lbs a.i. Applied |
|---|---|---|---|---|
| OR | Columbia | Corn | 48 | 24 |
| OR | Columbia | Oat | 13 | 7 |
| OR | Columbia | Alfalfa | 10,789 | 5,395 |
| OR | Columbia | Hay | 8,373 | 4,187 |
| OR | Columbia | Outdr Plants | 9 | 5 |
| OR | Gilliam | Wheat | 95,584 | 47,792 |
| OR | Gilliam | Barley | 13,175 | 6,588 |
| OR | Gilliam | Oat | 4,557 | 2,279 |
| OR | Gilliam | Alfalfa | 3,826 | 1,913 |
| OR | Gilliam | Hay | 1,146 | 573 |
| OR | Hood River | Alfalfa | 1,595 | 798 |
| OR | Hood River | Hay | 856 | 428 |
| OR | Hood River | Corn | 175 | 88 |
| OR | Morrow | Corn | 9,276 | 4,638 |
| OR | Morrow | Wheat | 167,070 | 83,535 |
| OR | Morrow | Alfalfa | 25,211 | 12,606 |

| | | | | |
|---|---|---|---|---|
| OR | Morrow | Hay | 1,886 | 943 |
| OR | Multnomah | Wheat | 1,688 | 844 |
| OR | Multnomah | Alfalfa | 3,082 | 1,541 |
| OR | Multnomah | Hay | 1,269 | 635 |
| OR | Multnnomah | Corn | 1,405 | 703 |
| OR | Sherman | Wheat | 99,837 | 49,919 |
| OR | Sherman | Oat | 165 | 83 |
| OR | Sherman | Alfalfa | 339 | 170 |
| OR | Sherman | Outdr Plants | 95 | 48 |
| OR | Umatilla | Corn | 6,901 | 3,451 |
| OR | Umatilla | Wheat | 263,624 | 131,812 |
| OR | Umatilla | Rye | 1,860 | 930 |
| OR | Umatilla | Alfalfa | 33,080 | 16,548 |
| OR | Umatilla | Hay | 6,123 | 3.062 |
| OR | Umatilla | Outdr Plants | 371 | 186 |
| OR | Wasco | Wheat | 63,389 | 31,695 |
| OR | Wasco | Alfalfa | 10,684 | 5,342 |
| OR | Wasco | Hay | 1,446 | 723 |
| OR | Wasco | Outdr Plants | 144 | 72 |
| WA | Clark | Oat | 1,174 | 587 |
| WA | Clark | Alfalfa | 19,769 | 9,885 |
| WA | Clark | Hay | 9,430 | 4,715 |
| WA | Clark | Barley | 830 | 415 |
| WA | Clark | Corn | 87 | 44 |
| WA | Cowlitz | Wheat | 293 | 147 |
| WA | Cowlitz | Hay | 136 | 68 |
| WA | Cowlitz | Corn | 460 | 230 |

| | | | | |
|---|---|---|---|---|
| WA | Cowlitz | Outdr Plants | 230 | 115 |
| WA | Cowlitz | Alfalfa | 4,261 | 2,131 |
| WA | Klickitat | Oat | 194 | 97 |
| WA | Klickitat | Alfalfa | 35,540 | 17,770 |
| WA | Klickitat | Hay | 1,124 | 562 |
| WA | Klickitat | Barley | 7,464 | 3,732 |
| WA | Pacific | Hay | 3,861 | 1,931 |
| WA | Pacific | Alfalfa | 5,619 | 2,810 |
| WA | Wahkiakum | | | None |
| WA | Walla Walla | Wheat | 232,419 | 116,210 |
| WA | Walla Walla | Barley | 22,584 | 11,292 |
| WA | Wallla Walla | Alfalfa | 10,411 | 5,206 |
| WA | Walla Walla | Hay | 224 | 112 |
| WA | Walla Walla | Corn | 8,062 | 4,031 |
| WA | Walla Walla | Outdr Plants | 2,706 | 1,353 |

7. Snake River Basin steelhead ESU

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

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

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

Tables 22 and 23 show the cropping information for the Pacific Northwest counties where the Snake River Basin steelhead ESU is located and for the Oregon and Washington counties where this ESU migrates.

**Table 22: Rearing/spawning areas supporting the Snake River Basin steelhead ESU** .

| State | County | Site | Acres Treated | lbs a.i. Applied |
|---|---|---|---|---|
| ID | Adams | Barley | 312 | 156 |
| ID | Adams | Oat | 443 | 222 |
| ID | Adams | Alfalfa | 14,756 | 7,378 |
| ID | Adams | Hay | 2,606 | 1,303 |
| ID | Adams | Outdr Plants | 8 | 4 |
| ID | Adams | Wheat | 104 | 52 |
| ID | Blain | Wheat | 2,837 | 880 |
| ID | Blain | Barley | 17,270 | 5,354 |
| ID | Blain | Oat | 315 | 98 |
| ID | Blain | Alfalfa | 21,615 | 6,701 |
| ID | Boise | Barley | 300 | 93 |
| ID | Boise | Alfalfa | 2,751 | 853 |
| ID | Clearwater | Barley | 6,058 | 3,029 |

| | | | | |
|---|---|---|---|---|
| ID | Clearwater | Oat | 3,029 | 1,515 |
| ID | Clearwater | Alfalfa | 9,177 | 4,589 |
| ID | Clearwater | Hay | 4,858 | 2,429 |
| ID | Custer | Wheat | 645 | 323 |
| ID | Custer | Barley | 2,386 | 1,193 |
| ID | Custer | Oat | 150 | 75 |
| ID | Custer | Alfalfa | 32,122 | 16,061 |
| ID | Custer | Hay | 1,607 | 804 |
| ID | Idaho | Wheat | 62,283 | 31,142 |
| ID | Idaho | Barley | 28,872 | 14,436 |
| ID | Idaho | Alfalfa | 41,025 | 20,513 |
| ID | Idaho | Hay | 14,087 | 7,044 |
| ID | Latah | Oat | 649 | 325 |
| ID | Latah | Alfalfa | 17,540 | 8,770 |
| ID | Latah | Hay | 7,996 | 3,983 |
| ID | Latah | Outdr Plants | 3 | 2 |
| ID | Lemhi | Barley | 487 | 244 |
| ID | Lemhi | Oat | 441 | 221 |
| ID | Lemhi | Alfalfa | 46,392 | 23,196 |
| ID | Lemhi | Hay | 7,067 | 3,534 |
| ID | Nez Perce | Wheat | 89,990 | 44,995 |
| ID | Nez Perce | Oat | 115 | 58 |
| ID | Nez Perce | Alfalfa | 10,236 | 5,118 |
| ID | Nez Perce | Hay | 2,720 | 1,360 |
| ID | Nez Perce | Corn | 15 | 8 |
| ID | Valley | Wheat | 652 | 326 |
| ID | Valley | Oat | 1,701 | 851 |

| | | | | |
|---|---|---|---|---|
| ID | Valley | Alfalfa | 4,511 | 2,256 |
| ID | Valley | Hay | 2,154 | 1077 |
| OR | Baker | Wheat | 6,294 | 1,951 |
| OR | Baker | Barley | 1,953 | 605 |
| OR | Baker | Oat | 269 | 83 |
| OR | Baker | Alfalfa | 73,694 | 22,845 |
| ID | Valley | Outdr Plants | 2 | 1 |
| OR | Union | Wheat | 36,394 | 18,197 |
| OR | Union | Oat | 1,220 | 610 |
| OR | Union | Alfalfa | 42,236 | 21,118 |
| OR | Union | Hay | 5,738 | 2,869 |
| OR | Union | Outdr Plants | 371 | 186 |
| OR | Wallowa | Wheat | 14,502 | 7,251 |
| OR | Wallowa | Oat | 560 | 280 |
| OR | Wallowa | Alfalfa | 31,646 | 15,823 |
| OR | Wallowa | Hay | 6,358 | 3,179 |
| WA | Asotin | Wheat | 21,110 | 10,555 |
| WA | Asotin | Barley | 10,205 | 5,103 |
| WA | Asotin | Alfalfa | 4,515 | 2,258 |
| WA | Asotin | Hay | 2,613 | 1,307 |
| WA | Columbia | Corn | 51 | 26 |
| WA | Columbia | Wheat | 77,511 | 38,756 |
| WA | Columbia | Barley | 17,547 | 8,774 |
| WA | Columbia | Oat | 1,891 | 946 |
| WA | Columbia | Alfalfa | 19,769 | 9,885 |
| WA | Columbia | Hay | 985 | 493 |
| WA | Franklin | Corn | 23,171 | 11,586 |

| | | | | |
|---|---|---|---|---|
| WA | Franklin | Wheat | 109,627 | 54,814 |
| WA | Franklin | Alfalfa | 70,943 | 35,472 |
| WA | Franklin | Hay | 1,013 | 507 |
| WA | Garfield | Wheat | 71,689 | 35,845 |
| WA | Garfield | Barley | 38,082 | 19,041 |
| WA | Garfield | Alfalfa | 2,310 | 1,155 |
| WA | Garfield | Hay | 1,460 | 730 |
| WA | Walla Walla | Wheat | 232,419 | 116,210 |
| WA | Walla Walla | Barley | 22,584 | 11,292 |
| WA | Wallla Walla | Alfalfa | 10,411 | 5,206 |
| WA | Walla Walla | Hay | 224 | 112 |
| WA | Walla Walla | Corn | 8,062 | 4,031 |
| WA | Walla Walla | Outdr Plants | 2,706 | 1,353 |

**Table 23. Washington and Oregon counties through which the Snake River Basin steelhead ESU migrates**

| State | County | Site | Acres Treated | lbs a.i. Applied |
|---|---|---|---|---|
| OR | Clatsop | Alfalfa | 4,385 | 2,193 |
| OR | Clatsop | Hay | 1,056 | 528 |
| OR | Clatsop | Corn | 1,072 | 536 |
| OR | Clatsop | Outdr Plants | 9 | 5 |
| OR | Columbia | Corn | 48 | 24 |
| OR | Columbia | Oat | 13 | 7 |
| OR | Columbia | Alfalfa | 10,789 | 5,395 |
| OR | Columbia | Hay | 8,373 | 4,187 |
| OR | Columbia | Outdr Plants | 9 | 5 |
| OR | Gilliam | Wheat | 95,584 | 47,792 |

| | | | | |
|---|---|---|---|---|
| OR | Gilliam | Barley | 13,175 | 6,588 |
| OR | Gilliam | Oat | 4,557 | 2,279 |
| OR | Gilliam | Alfalfa | 3,826 | 1,913 |
| OR | Gilliam | Hay | 1,146 | 573 |
| OR | Hood River | Alfalfa | 1,595 | 798 |
| OR | Hood River | Hay | 856 | 428 |
| OR | Hood River | Corn | 175 | 88 |
| OR | Multnomah | Wheat | 1,688 | 844 |
| OR | Multnomah | Alfalfa | 3,082 | 1,541 |
| OR | Multnomah | Hay | 1,269 | 635 |
| OR | Multnnomah | Corn | 1,405 | 703 |
| OR | Sherman | Wheat | 99,837 | 49,919 |
| OR | Sherman | Oat | 165 | 83 |
| OR | Sherman | Alfalfa | 339 | 170 |
| OR | Sherman | Outdr Plants | 95 | 48 |
| OR | Umatilla | Corn | 6,901 | 3,451 |
| OR | Umatilla | Wheat | 263,624 | 131,812 |
| OR | Umatilla | Rye | 1,860 | 930 |
| OR | Umatilla | Alfalfa | 33,080 | 16,548 |
| OR | Umatilla | Hay | 6,123 | 3.062 |
| OR | Umatilla | Outdr Plants | 371 | 186 |
| OR | Wasco | Wheat | 63,389 | 31,695 |
| OR | Wasco | Alfalfa | 10,684 | 5,342 |
| OR | Wasco | Hay | 1,446 | 723 |
| OR | Wasco | Outdr Plants | 144 | 72 |
| WA | Benton | Wheat | 130,981 | 65,491 |
| WA | Benton | Barley | 435 | 218 |

| | | | | |
|---|---|---|---|---|
| WA | Benton | Alfalfa | 13,241 | 6,621 |
| WA | Benton | Hay | 733 | 367 |
| WA | Benton | Corn | 16,086 | 8,053 |
| WA | Benton | Onions | 3,398 | 1,699 |
| WA | Clark | Oat | 1,174 | 587 |
| WA | Clark | Alfalfa | 19,769 | 9,885 |
| WA | Clark | Hay | 9,430 | 4,715 |
| WA | Clark | Barley | 830 | 415 |
| WA | Clark | Corn | 87 | 44 |
| WA | Cowlitz | Wheat | 293 | 147 |
| WA | Cowlitz | Hay | 136 | 68 |
| WA | Cowlitz | Corn | 460 | 230 |
| WA | Cowlitz | Outdr Plants | 230 | 115 |
| WA | Cowlitz | Alfalfa | 4,261 | 2,131 |
| WA | Klickitat | Oat | 194 | 97 |
| WA | Klickitat | Alfalfa | 35,540 | 17,770 |
| WA | Klickitat | Hay | 1,124 | 562 |
| WA | Klickitat | Barley | 7,464 | 3,732 |
| WA | Wahkiakum | | | None |
| WA | Pacific | Hay | 3,861 | 1,931 |
| WA | Pacific | Alfalfa | 5,619 | 2,810 |
| WA | Walla Walla | Wheat | 232,419 | 116,210 |
| WA | Walla Walla | Barley | 22,584 | 11,292 |
| WA | Wallla Walla | Alfalfa | 10,411 | 5,206 |
| WA | Walla Walla | Hay | 224 | 112 |
| WA | Walla Walla | Corn | 8,062 | 4,031 |
| WA | Walla Walla | Outdr Plants | 2,706 | 1,353 |

8   Upper Willamette River steelhead ESU

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

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

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

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

Tables 24 and 25 show the cropping information for Oregon counties where the Upper Willamette River steelhead ESU is located and for the Oregon and Washington counties where this ESU migrates.

**Table 24: Spawning and rearing habitat of the Upper Willamette River steelhead ESU**.

| State | County | Site | Acres Treated | lbs a.i. Applied |
|---|---|---|---|---|
| OR | Benton | Rye | 18,475 | 9,238 |
| OR | Benton | Corn | 5,735 | 2,868 |
| OR | Benton | Wheat | 4,338 | 2,169 |
| OR | Benton | Oat | 1,584 | 792 |
| OR | Benton | Alfalfa | 8,157 | 4,079 |
| OR | Benton | Hay | 5,637 | 2,819 |

| | | | | |
|---|---|---|---|---|
| OR | Lincoln | Alfalfa | 2,954 | 916 |
| OR | Benton | Outdr Plants | 681 | 341 |
| OR | Linn | Corn | 177 | 89 |
| OR | Linn | Wheat | 5,306 | 2,653 |
| OR | Linn | Oat | 1,428 | 714 |
| OR | Linn | Rye | 23,528 | 11,764 |
| OR | Linn | Alfalfa | 39,364 | 19,682 |
| OR | Linn | Hay | 31,183 | 15,592 |
| OR | Linn | Corn | 5,771 | 2,886 |
| OR | Linn | Outdr Plants | 542 | 271 |
| OR | Polk | Rye | 24,250 | 1,125 |
| OR | Polk | Corn | 1,835 | 918 |
| OR | Polk | Wheat | 9,471 | 4,736 |
| OR | Polk | Barley | 379 | 190 |
| OR | Polk | Oat | 2,273 | 1,137 |
| OR | Polk | Alfalfa | 20,440 | 10,220 |
| OR | Polk | Hay | 12,321 | 6,161 |
| OR | Polk | Outdr Plants | 1,328 | 664 |
| OR | Clackamas | Rye | 4,520 | 2,260 |
| OR | Clackamas | Wheat | 1,783 | 892 |
| OR | Clackamas | Barley | 259 | 130 |
| OR | Calckamus | Alfalfa | 20,756 | 10,378 |
| OR | Clackamus | Hay | 13,493 | 6,747 |
| OR | Clackamus | Outdr Plants | 9,708 | 4,854 |
| OR | Clackamas | Corn | 1,072 | 536 |
| OR | Morrow | Corn | 9,276 | 4,638 |
| OR | Morrow | Wheat | 167,070 | 83,535 |

| | | | | |
|---|---|---|---|---|
| OR | Morrow | Alfalfa | 25,211 | 12,606 |
| OR | Morrow | Hay | 1,886 | 943 |
| OR | Marion | Rye | 1150 | 575 |
| OR | Marion | Corn | 14,533 | 7,267 |
| OR | Marion | Wheat | 10,341 | 5,171 |
| OR | Marion | Barley | 134 | 67 |
| OR | Marion | Oat | 2.582 | 1,291 |
| OR | Marion | Alfalfa | 16,985 | 8,493 |
| OR | Marion | Hay | 9,704 | 4,852 |
| OR | Marion | Outdr Plants | 12,900 | 6,450 |
| OR | Tilamook | Alfalfa | 7,896 | 2,448 |
| OR | Yamhill | Rye | 10,959 | 5,480 |
| OR | Yamhill | Wheat | 13,989 | 6,995 |
| OR | Yamhill | Barley | 380 | 190 |
| OR | Yamhill | Oat | 2,525 | 1,263 |
| OR | Yamhill | Alfalfa | 19,091 | 9,546 |
| OR | Yamhill | Hay | 8,783 | 4,392 |
| OR | Yamhill | Outdr Plants | 3,613 | 1,807 |
| OR | Yamhill | Corn | 4,149 | 2,075 |
| OR | Washington | Wheat | 17,020 | 8,510 |
| OR | Washington | Barley | 153 | 77 |
| OR | Washington | Oat | 5,258 | 2,629 |
| OR | Washington | Alfalfa | 1,680 | 840 |
| OR | Washington | Hay | 7,244 | 3,622 |
| OR | Washington | Rye | 2,977 | 1,489 |
| OR | Washington | Corn | 4,962 | 2,481 |
| OR | Washington | Outdr Plants | 4,155 | 2,078 |

**Table 24. Oregon and Washington counties that are part of the migration corridors of the Upper Willamette River steelhead ESU.**

| State | County | Site | Acres Treated | lbs a.i. Applied |
|---|---|---|---|---|
| OR | Multnomah | Wheat | 1,688 | 844 |
| OR | Multnomah | Alfalfa | 3,082 | 1,541 |
| OR | Multnomah | Hay | 1,269 | 635 |
| OR | Multnnomah | Corn | 1,405 | 703 |
| OR | Clatsop | Alfalfa | 4,385 | 2,193 |
| OR | Clatsop | Hay | 1,056 | 528 |
| OR | Clatsop | Corn | 1,072 | 536 |
| OR | Clatsop | Outdr Plants | 9 | 5 |
| OR | Columbia | Corn | 48 | 24 |
| OR | Columbia | Oat | 13 | 7 |
| OR | Columbia | Alfalfa | 10,789 | 5,395 |
| OR | Columbia | Hay | 8,373 | 4,187 |
| OR | Columbia | Outdr Plants | 9 | 5 |
| WA | Clark | Oat | 1,174 | 587 |
| WA | Clark | Alfalfa | 19,769 | 9,885 |
| WA | Clark | Hay | 9,430 | 4,715 |
| WA | Clark | Barley | 830 | 415 |
| WA | Clark | Corn | 87 | 44 |
| WA | Columbia | Corn | 51 | 26 |
| WA | Columbia | Wheat | 77,511 | 38,756 |
| WA | Columbia | Barley | 17,547 | 8,774 |
| WA | Columbia | Oat | 1,891 | 946 |
| WA | Columbia | Alfalfa | 19,769 | 9,885 |
| WA | Columbia | Hay | 985 | 493 |

| | | | | |
|---|---|---|---|---|
| WA | Cowlitz | Wheat | 293 | 147 |
| WA | Cowlitz | Hay | 136 | 68 |
| WA | Cowlitz | Corn | 460 | 230 |
| WA | Cowlitz | Outdr Plants | 230 | 115 |
| WA | Cowlitz | Alfalfa | 4,261 | 2,131 |
| WA | Wahkiakum | | | None |
| WA | Pacific | Hay | 1,798 | 899 |
| WA | Pacific | Alfalfa | 5,619 | 2010 |

9. Lower Columbia River steelhead ESU

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

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

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

Tables 25 and 26 show the cropping information for Oregon and Washington counties where the Lower Columbia River steelhead ESU is located and for the Oregon and Washington counties where this ESU migrates.

| | | | | |
|---|---|---|---|---|
| OR | Clackamas | Rye | 4,520 | 2,260 |

| | | | | |
|---|---|---|---|---|
| OR | Clackamas | Wheat | 1,783 | 892 |
| OR | Clackamas | Barley | 259 | 130 |
| OR | Calckamus | Alfalfa | 20,756 | 10,378 |
| OR | Clackamus | Hay | 13,493 | 6,747 |
| OR | Clackamus | Outdr Plants | 9,708 | 4,854 |
| OR | Clackamas | Corn | 1,072 | 536 |

**Table 25. Spawning/rearing areas for the Lower Columbia steelhead ESU**

| State | County | Site | Acres Treated | lbs a.i. Applied |
|---|---|---|---|---|
| OR | Hood River | Alfalfa | 1,595 | 798 |
| OR | Hood River | Hay | 856 | 428 |
| OR | Hood River | Corn | 175 | 88 |
| OR | Marion | Rye | 1150 | 575 |
| OR | Marion | Corn | 14,533 | 7,267 |
| OR | Marion | Wheat | 10,341 | 5,171 |
| OR | Marion | Barley | 134 | 67 |
| OR | Marion | Oat | 2.582 | 1,291 |
| OR | Marion | Alfalfa | 16,985 | 8,493 |
| OR | Marion | Hay | 9,704 | 4,852 |
| OR | Marion | Outdr Plants | 12,900 | 6,450 |
| OR | Multnomah | Wheat | 1,688 | 844 |
| OR | Multnomah | Alfalfa | 3,082 | 1,541 |
| OR | Multnomah | Hay | 1,269 | 635 |
| OR | Multnnomah | Corn | 1,405 | 703 |
| OR | Washington | Wheat | 17,020 | 8,510 |
| OR | Washington | Barley | 153 | 77 |

| | | | | |
|---|---|---|---|---|
| OR | Washington | Oat | 5,258 | 2,629 |
| OR | Washington | Alfalfa | 1,680 | 840 |
| OR | Washington | Hay | 7,244 | 3,622 |
| OR | Washington | Rye | 2,977 | 1,489 |
| OR | Washington | Corn | 4,962 | 2,481 |
| OR | Washington | Outdr Plants | 4,155 | 2,078 |
| WA | Clark | Oat | 1,174 | 587 |
| WA | Clark | Alfalfa | 19,769 | 9,885 |
| WA | Clark | Hay | 9,430 | 4,715 |
| WA | Clark | Barley | 830 | 415 |
| WA | Clark | Corn | 87 | 44 |
| WA | Skamania | Alfalfa | 489 | 245 |

**Table 26: Migratory corridors for the Lower Columbia River Steelhead ESU.**

| State | County | Site | Acres Treated | lbs a.i. Applied |
|---|---|---|---|---|
| OR | Clatsop | Alfalfa | 4,385 | 2,193 |
| OR | Clatsop | Hay | 1,056 | 528 |
| OR | Clatsop | Corn | 1,072 | 536 |
| OR | Clatsop | Outdr Plants | 9 | 5 |
| WA | Lewis | Corn | 662 | 331 |
| WA | Lewis | Wheat | 1,104 | 552 |
| WA | Lewis | Alfalfa | 24,463 | 12,232 |
| WA | Lewis | Hay | 12,517 | 6,259 |
| WA | Lewis | Outdr Plants | 485 | 243 |
| WA | Pacific | Hay | 1,798 | 899 |
| WA | Pacific | Alfalfa | 5,619 | 2010 |

| | | | | |
|---|---|---|---|---|
| WA | Wahkiakum | | | None |

10. Middle Columbia River Steelhead ESU

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

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

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

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

Tables 27 and 28 show the cropping information for Oregon and Washington counties where the Middle Columbia River steelhead ESU is located and for the Oregon and Washington counties where this ESU migrates.

**Table 27: Spawning/Rearing areas for the Middle Columbia Steelhead ESU**

| State | County | Site | Acres Treated | lbs a.i. Applied |
|---|---|---|---|---|
| OR | Crook | Wheat | 2,367 | 1,184 |
| OR | Crook | Alfalfa | 1,637 | 819 |
| OR | Crook | Hay | 10,292 | 5,146 |
| OR | Crook | Outdr Plants | 261 | 131 |
| OR | Gilliam | Wheat | 95,584 | 47,792 |
| OR | Gilliam | Barley | 13,175 | 6,588 |
| OR | Gilliam | Oat | 4,557 | 2,279 |
| OR | Gilliam | Alfalfa | 3,826 | 1,913 |
| OR | Gilliam | Hay | 1,146 | 573 |
| OR | Harney | Alfalfa | 133,916 | 41,514 |
| OR | Jefferson | Wheat | 12,470 | 6,235 |
| OR | Jefferson | Barley | 543 | 272 |
| OR | Jefferson | Alfalfa | 19,394 | 9,677 |
| OR | Jefferson | Hay | 3,465 | 1,733 |
| OR | Jefferson | Oats | 509 | 255 |
| OR | Jefferson | Outdr Plants | 3,897 | 1,949 |
| OR | Morrow | Wheat | 167,070 | 83,535 |
| OR | Morrow | Barley | 2,688 | 1,344 |
| OR | Morrow | Alfalfa | 25,211 | 12,606 |
| OR | Morrow | Hay | 1,886 | 943 |
| OR | Morrow | Corn | 3,720 | 1,860 |
| OR | Sherman | Wheat | 99,837 | 49,919 |
| OR | Sherman | Oat | 165 | 83 |
| OR | Sherman | Alfalfa | 339 | 170 |

| | | | | |
|---|---|---|---|---|
| OR | Sherman | Outdr Plants | 95 | 48 |
| OR | Umatilla | Corn | 6,901 | 3,451 |
| OR | Umatilla | Wheat | 263,624 | 131,812 |
| OR | Umatilla | Rye | 1,860 | 930 |
| OR | Umatilla | Alfalfa | 33,080 | 16,548 |
| OR | Umatilla | Hay | 6,123 | 3.062 |
| OR | Umatilla | Outdr Plants | 371 | 186 |
| OR | Union | Wheat | 36,394 | 18,197 |
| OR | Union | Oat | 1,220 | 610 |
| OR | Union | Alfalfa | 42,236 | 21,118 |
| OR | Union | Hay | 5,738 | 2,869 |
| OR | Union | Outdr Plants | 371 | 186 |
| OR | Wasco | Wheat | 63,389 | 31,695 |
| OR | Wasco | Alfalfa | 10,684 | 5,342 |
| OR | Wasco | Hay | 1,446 | 723 |
| OR | Wasco | Outdr Plants | 144 | 72 |
| OR | Wheeler | Barley | 61 | 31 |
| OR | Wheeler | Alfalfa | 12,110 | 6,055 |
| OR | Wheeler | Hay | 2,546 | 1,273 |
| WA | Benton | Wheat | 130,981 | 65,491 |
| WA | Benton | Barley | 435 | 218 |
| WA | Benton | Alfalfa | 13,241 | 6,621 |
| WA | Benton | Hay | 733 | 367 |
| WA | Benton | Corn | 16,086 | 8,053 |
| WA | Benton | Onions | 3,398 | 1,699 |
| WA | Chelan | Wheat | 1,864 | 932 |
| WA | Chelan | Hay | 554 | 277 |

| | | | | |
|---|---|---|---|---|
| WA | Chelan | Alfalfa | 1,953 | 977 |
| WA | Douglas | Barley | 2,751 | 1,376 |
| WA | Douglas | Alfalfa | 3,516 | 1,758 |
| WA | Douglas | Hay | 993 | 497 |
| WA | Douglas | Wheat | 200,291 | 100,146 |
| WA | Grant | Corn | 62.493 | 31,247 |
| WA | Grant | Wheat | 203,498 | 101,749 |
| WA | Grant | Barley | 6,548 | 3,274 |
| WA | Grant | Alfalfa | 120,251 | 60,126 |
| WA | Grant | Hay | 126,450 | 63,225 |
| WA | Kittitas | Corn | 10 | 1 |
| WA | Okanogan | Corn | 855 | 428 |
| WA | Okanogan | Alfalfa | 21,880 | 10,940 |
| WA | Okanogan | Hay | 34,283 | 17,142 |
| WA | Okanogan | Wheat | 8,410 | 4,205 |
| WA | Okanogan | Oat | 1,407 | 704 |
| WA | Skamania | | | None |
| WA | Franklin | Wheat | 122 | 6 |
| WA | Franklin | Corn | 113 | 14 |
| WA | Walla Walla | Wheat | 232,419 | 116,210 |
| WA | Walla Walla | Barley | 22,584 | 11,292 |
| WA | Wallla Walla | Alfalfa | 10,411 | 5,206 |
| WA | Walla Walla | Hay | 224 | 112 |
| WA | Walla Walla | Corn | 8,062 | 4,031 |
| WA | Walla Walla | Outdr Plants | 2,706 | 1,353 |
| WA | Yakima | Corn | 12,680 | 6,340 |
| WA | Yakima | Wheat | 50,430 | 25,215 |

| | | | | |
|---|---|---|---|---|
| WA | Yakima | Outdr Plants | 786 | 393 |
| WA | Yakima | Barley | 502 | 251 |
| WA | Yakima | Alfalfa | 43,866 | 21,933 |
| WA | Yakima | Hay | 2,397 | 1,199 |

**Table 28. Washington and Oregon counties through which the Middle Columbia River steelhead ESU migrates**

| State | County | Site | Acres Treated | lbs a.i. Applied |
|---|---|---|---|---|
| OR | Clatsop | Alfalfa | 4,385 | 2,193 |
| OR | Clatsop | Hay | 1,056 | 528 |
| OR | Clatsop | Corn | 1,072 | 536 |
| OR | Clatsop | Outdr Plants | 9 | 5 |
| OR | Columbia | Corn | 48 | 24 |
| OR | Columbia | Oat | 13 | 7 |
| OR | Columbia | Alfalfa | 10,789 | 5,395 |
| OR | Columbia | Hay | 8,373 | 4,187 |
| OR | Columbia | Outdr Plants | 9 | 5 |
| OR | Hood River | Alfalfa | 1,595 | 798 |
| OR | Hood River | Hay | 856 | 428 |
| OR | Hood River | Corn | 175 | 88 |
| OR | Multnomah | Wheat | 1,688 | 844 |
| OR | Multnomah | Alfalfa | 3,082 | 1,541 |
| OR | Multnomah | Hay | 1,269 | 635 |
| OR | Multnnomah | Corn | 1,405 | 703 |
| OR | Wallowa | Wheat | 14,502 | 7,251 |
| OR | Wallowa | Oat | 560 | 280 |
| OR | Wallowa | Alfalfa | 31,646 | 15,823 |

| | | | | |
|---|---|---|---|---|
| OR | Wallowa | Hay | 6,358 | 3,179 |
| WA | Clark | Oat | 1,174 | 587 |
| WA | Clark | Alfalfa | 19,769 | 9,885 |
| WA | Clark | Hay | 9,430 | 4,715 |
| WA | Clark | Barley | 830 | 415 |
| WA | Clark | Corn | 87 | 44 |
| WA | Cowlitz | Wheat | 293 | 147 |
| WA | Cowlitz | Hay | 136 | 68 |
| WA | Cowlitz | Corn | 460 | 230 |
| WA | Cowlitz | Outdr Plants | 230 | 115 |
| WA | Cowlitz | Alfalfa | 4,261 | 2,131 |
| WA | Pacific | Hay | 1,798 | 899 |
| WA | Pacific | Alfalfa | 5,619 | 2010 |
| WA | Wakiakum | | | None |

**B. Chinook salmon**

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

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

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

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

1. Sacramento River Winter-run Chinook Salmon ESU

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

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

Table 29 shows the Bromoxynil usage in California counties supporting the Sacramento River winter-run chinook salmon ESU. Use of Bromoxynil in counties with the Sacramento River winter-run Chinook salmon ESU. Spawning areas are primarily in Shasta and Tehama counties above the Red Bluff diversion dam.

**Table 29: California counties supporting the Sacramento River, winter-run chinook ESU.**

| County | Site | Acres Treated | lbs a.i. Applied |
|---|---|---|---|
| Alameda | Landscape | NR | 7 |
| Alameda | Oat | 238 | 24 |

| | | | |
|---|---|---|---|
| Alameda | Wheat | 60 | 22 |
| Amador | Alfalfa | 130 | 35 |
| Amador | Oat | 390 | 141 |
| Amador | Wheat | 120 | 43 |
| Butte | Oat | 210 | 43 |
| Butte | Wheat | 663 | 214 |
| Contra Costa | Alfalfa | 200 | 36 |
| Contra Costa | Hay | 34 | 12 |
| Contra Costa | Landscape | NR | 13 |
| Contra Costa | Oat | 147 | 34 |
| Contra Costa | Pasture | 11 | 7 |
| Contra Costa | Wheat | 36 | 6 |
| Colusa | Alfalfa | 1,564 | 964 |
| Colusa | Corn | 706 | 124 |
| Colusa | Cotton | 4,049 | 1,479 |
| Colusa | Oat | 66 | 24 |
| Colusa | Ryegrass | 12 | 4 |
| Colusa | Sorghum | 290 | 10 |
| Colusa | Sudangrass | 130 | 35 |
| Colusa | Wheat | 1,351 | 400 |
| Glenn | Alfalfa | 2,050 | 477 |
| Glenn | Barley | 100 | 27 |
| Glenn | Corn | 606 | 121 |
| Glenn | Cotton | 274 | 86 |
| Glenn | Oat | 312 | 117 |
| Glenn | Rights of Way | NR | 29 |
| Glenn | Wheat | 441 | 142 |

| | | | |
|---|---|---|---|
| Marin | | | None |
| Napa | Landscape | NR | 17 |
| Napa | Oat | 125 | 34 |
| Napa | Public Health | NR | 7 |
| Nevada | | | None |
| Placer | Oat | 50 | 15 |
| Sacramento | Alfalfa | 104 | 33 |
| Sacramento | Corn | 1,468 | 330 |
| Sacramento | Landscape | NR | 8 |
| Sacramento | Oat | 366 | 67 |
| Sacramento | Wheat | 430 | 153 |
| San Francisco | | | None |
| San Mateo | Landscape | NR | 4 |
| Shasta | Garlic | 130 | 5 |
| Shasta | Oat | 26 | 10 |
| Shasta | Onion | 8 | 4 |
| Shasta | Turf/Sod | 38 | 14 |
| Solano | Alfalfa | 1,094 | 279 |
| Solano | Barley | 110 | 22 |
| Solano | Outdr Plants | 206 | 49 |
| Solano | Oat | 165 | 10 |
| Solano | Ryegrass | 226 | 74 |
| Solano | Sorghum | 802 | 226 |
| Solano | Uncultivated Ag | 100 | 27 |
| Solano | Wheat | 325 | 125 |
| Sonoma | Hay | 100 | 36 |
| Sonoma | Oat | 396 | 140 |

| | | | |
|---|---|---|---|
| Sonoma | Pastureland | 120 | 44 |
| Sutter | Alfalfa | 155 | 28 |
| Sutter | Oat | 158 | 37 |
| Sutter | Sorghum | 250 | 45 |
| Sutter | Wheat | 1,221 | 369 |
| San Mateo | Landscape | NR | 3 |
| Tehama | Hay | 200 | 36 |
| Tehama | Oat | 998 | 274 |
| Tehama | Rights of Way | NR | 29 |
| Tehama | Rye | 80 | 22 |
| Tehama | Wheat | 496 | 102 |
| Yolo | Alfalfa | 3,952 | 815 |
| Yolo | Barley | 166 | 63 |
| Yolo | Corn | 3,416 | 808 |
| Yolo | Cotton | 512 | 124 |
| Yolo | Hay | 40 | 14 |
| Yolo | Grass, Seed | 140 | 25 |
| Yolo | Landscape | NR | 21 |
| Yolo | Outdr Plants | 107 | 17 |
| Yolo | Oat | 1,993 | 573 |
| Yolo | Pastureland | 3,912 | 1,125 |
| Yolo | Research | 50 | 19 |
| Yolo | Rights of Way | NR | 20 |
| Yolo | Ryegrass | NR | 47 |
| Yolo | Sorghum | 525 | 181 |
| Yolo | Sudangrass | 329 | 70 |
| Yolo | Uncultivated Ag | 30 | 11 |

| | | | |
|---|---|---|---|
| Yolo | Uncultivated Non-Ag | 10 | 4 |
| Yolo | Wheat | 5,058 | 1,444 |

2. Snake River Fall-run Chinook Salmon ESU

The Snake River fall-run chinook salmon ESU was proposed as threatened in 1991 (56FR29547-29552, June 27, 1991) and listed about a year later (57FR14653-14663, April 22, 1992). Critical habitat was designated on December 28, 1993 (58FR68543-68554) to include all tributaries of the Snake and Salmon Rivers accessible to Snake River fall-run chinook salmon, except reaches above impassable natural falls and Dworshak and Hells Canyon Dams. The Clearwater River and Palouse River watersheds are included for the fall-run ESU, but not for the spring/summer run. This chinook ESU was proposed for reclassification on December 28, 1994 (59FR66784-57403) as endangered because of critically low levels, based on very sparse runs. However, because of increased runs in the subsequent year, this proposed reclassification was withdrawn (63FR1807-1811, January 12, 1998).

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

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

Table 30 shows the cropping information for Pacific Northwest counties where the Snake River fall-run chinook salmon ESU is located. Migration corridors are the same as those in Table 22.

**Table 30 : Spawning/rearing areas supporting the Snake River Fall-run chinook salmon ESU**

| State | County | Site | Acres Treated | lbs a.i. Applied |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| ID | Adams | Alfalfa | 14,756 | 7,378 |
| ID | Adams | Hay | 2,606 | 1,303 |
| ID | Adams | Outdr Plants | 8 | 4 |
| ID | Adams | Wheat | 104 | 52 |
| ID | Clearwater | Barley | 6,058 | 3,029 |
| ID | Clearwater | Oat | 3,029 | 1,515 |
| ID | Clearwater | Alfalfa | 9,177 | 4,589 |
| ID | Clearwater | Hay | 4,858 | 2,429 |
| ID | Idaho | Wheat | 62,283 | 31,142 |
| ID | Idaho | Barley | 28,872 | 14,436 |
| ID | Idaho | Alfalfa | 41,025 | 20,513 |
| ID | Idaho | Hay | 14,087 | 7,044 |
| ID | Latah | Oat | 649 | 325 |
| ID | Latah | Alfalfa | 17,540 | 8,770 |
| ID | Latah | Hay | 7,996 | 3,983 |
| ID | Latah | Outdr Plants | 3 | 2 |
| ID | Lewis | Barley | 21,851 | 10,926 |
| ID | Lewis | Oat | 1,388 | 694 |
| ID | Lewis | Alfalfa | 6,335 | 3,168 |
| ID | Lewis | Hay | 1,328 | 664 |
| ID | Lewis | Wheat | 64,387 | 32,194 |
| ID | Nez Perce | Wheat | 89,990 | 44,995 |
| ID | Nez Perce | Oat | 115 | 58 |
| ID | Nez Perce | Alfalfa | 10,236 | 5,118 |
| ID | Nez Perce | Hay | 2,720 | 1,360 |
| ID | Nez Perce | Corn | 15 | 8 |
| ID | Shoshone | | | None |

| | | | | |
|---|---|---|---|---|
| OR | Union | Wheat | 36,394 | 18,197 |
| OR | Union | Oat | 1,220 | 610 |
| OR | Union | Alfalfa | 42,236 | 21,118 |
| OR | Union | Hay | 5,738 | 2,869 |
| OR | Union | Outdr Plants | 371 | 186 |
| OR | Wallowa | Wheat | 14,502 | 7,251 |
| OR | Wallowa | Oat | 560 | 280 |
| OR | Wallowa | Alfalfa | 31,646 | 15,823 |
| OR | Wallowa | Hay | 6,358 | 3,179 |
| WA | Adams | Corn | 134 | 17 |
| WA | Asotin | | | None |
| WA | Franklin | Corn | 23,171 | 11,586 |
| WA | Franklin | Wheat | 109,627 | 54,814 |
| WA | Franklin | Alfalfa | 70,943 | 35,472 |
| WA | Franklin | Hay | 1,013 | 507 |
| WA | Garfield | Barley | 36,082 | 18,041 |
| WA | Garfield | Alfalfa | 2,310 | 1,155 |
| WA | Garfield | Hay | 482 | 241 |
| WA | Garfield | Wheat | 71,689 | 35,845 |
| WA | Walla Walla | Wheat | 232,419 | 116,210 |
| WA | Walla Walla | Barley | 22,584 | 11,292 |
| WA | Wallla Walla | Alfalfa | 10,411 | 5,206 |
| WA | Walla Walla | Hay | 224 | 112 |
| WA | Walla Walla | Corn | 8,062 | 4,031 |
| WA | Walla Walla | Outdr Plants | 2,706 | 1,353 |

3. Snake River Spring/Summer-run Chinook Salmon

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

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

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

Table 31 shows the counties where the Snake River spring/summer-run chinook salmon ESU occurs. The cropping information for the migratory corridors is the same as for the Snake River fall-run chinook salmon and is in the Table 22.

**Table 31: Spawning/rearing area supporting the Snake River spring/summer chinook ESU**

| State | County | Site | Acres Treated | lbs a.i. Applied |
|---|---|---|---|---|
| ID | Adams | Alfalfa | 14,756 | 7,378 |
| ID | Adams | Hay | 2,606 | 1,303 |
| ID | Adams | Outdr Plants | 8 | 4 |
| ID | Adams | Wheat | 104 | 52 |
| ID | Blain | Wheat | 2,837 | 880 |
| ID | Blain | Barley | 17,270 | 5,354 |

| | | | | |
|---|---|---|---|---|
| ID | Blain | Oat | 315 | 98 |
| ID | Blain | Alfalfa | 21,615 | 6,701 |
| ID | Benewah | | | None |
| ID | Clearwater | Barley | 6,058 | 3,029 |
| ID | Clearwater | Oat | 3,029 | 1,515 |
| ID | Clearwater | Alfalfa | 9,177 | 4,589 |
| ID | Clearwater | Hay | 4,858 | 2,429 |
| ID | Idaho | Wheat | 62,283 | 31,142 |
| ID | Idaho | Barley | 28,872 | 14,436 |
| ID | Idaho | Alfalfa | 41,025 | 20,513 |
| ID | Idaho | Hay | 14,087 | 7,044 |
| ID | Lewis | Barley | 21,851 | 10,926 |
| ID | Lewis | Oat | 1,388 | 694 |
| ID | Lewis | Alfalfa | 6,335 | 3,168 |
| ID | Lewis | Hay | 1,328 | 664 |
| ID | Lewis | Wheat | 64,387 | 32,194 |
| ID | Nez Perce | Wheat | 89,990 | 44,995 |
| ID | Nez Perce | Oat | 115 | 58 |
| ID | Nez Perce | Alfalfa | 10,236 | 5,118 |
| ID | Nez Perce | Hay | 2,720 | 1,360 |
| ID | Nez Perce | Corn | 15 | 8 |
| ID | Nez Perce | | | None |
| ID | Shoshone | Alfalfa | 5 | 3 |
| ID | Valley | Wheat | 652 | 326 |
| ID | Valley | Oat | 1,701 | 851 |
| ID | Valley | Alfalfa | 4,511 | 2,256 |
| ID | Valley | Hay | 2,154 | 1077 |

| ID | Valley | Outdr Plants | 2 | 1 |
|---|---|---|---|---|
| OR | Baker | Wheat | 6,294 | 1,951 |
| OR | Baker | Barley | 1,953 | 605 |
| OR | Baker | Oat | 269 | 83 |
| OR | Baker | Alfalfa | 73,694 | 22,845 |
| OR | Union | Wheat | 36,394 | 18,197 |
| OR | Union | Oat | 1,220 | 610 |
| OR | Union | Alfalfa | 42,236 | 21,118 |
| OR | Union | Hay | 5,738 | 2,869 |
| OR | Union | Outdr Plants | 371 | 186 |
| OR | Wallowa | Wheat | 14,502 | 7,251 |
| OR | Wallowa | Oat | 560 | 280 |
| OR | Wallowa | Alfalfa | 31,646 | 15,823 |
| OR | Wallowa | Hay | 6,358 | 3,179 |
| WA | Asotin | | | None |
| WA | Franklin | Corn | 23,171 | 11,586 |
| WA | Franklin | Wheat | 109,627 | 54,814 |
| WA | Franklin | Alfalfa | 70,943 | 35,472 |
| WA | Franklin | Hay | 1,013 | 507 |
| WA | Garfield | Barley | 36,082 | 18,041 |
| WA | Garfield | Alfalfa | 2,310 | 1,155 |
| WA | Garfield | Hay | 482 | 241 |
| WA | Garfield | Wheat | 71,689 | 35,845 |
| WA | Walla Walla | Wheat | 232,419 | 116,210 |
| WA | Walla Walla | Barley | 22,584 | 11,292 |
| WA | Wallla Walla | Alfalfa | 10,411 | 5,206 |
| WA | Walla Walla | Hay | 224 | 112 |

| | | | | |
|---|---|---|---|---|
| WA | Walla Walla | Corn | 8,062 | 4,031 |
| WA | Walla Walla | Outdr Plants | 2,706 | 1,353 |

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.

**Table 32: California counties supporting the Central Valley spring-run chinook salmon ESU.**

| County | Site | Acres Treated | Lbs a.i. Applied |
|---|---|---|---|
| Alameda | Landscape | NR | 7 |
| Alameda | Oat | 238 | 24 |
| Alameda | Wheat | 60 | 22 |
| Amador | Alfalfa | 130 | 35 |
| Amador | Oat | 390 | 141 |
| Amador | Wheat | 120 | 43 |
| Butte | Oat | 210 | 43 |
| Butte | Wheat | 663 | 214 |
| Contra Costa | Alfalfa | 200 | 36 |
| Contra Costa | Hay | 34 | 12 |

| | | | |
|---|---|---|---|
| Contra Costa | Landscape | NR | 13 |
| Contra Costa | Oat | 147 | 34 |
| Contra Costa | Pasture | 11 | 7 |
| Contra Costa | Wheat | 36 | 6 |
| Colusa | Alfalfa | 1,564 | 964 |
| Colusa | Corn | 706 | 124 |
| Colusa | Cotton | 4,049 | 1,479 |
| Colusa | Oat | 66 | 24 |
| Colusa | Ryegrass | 12 | 4 |
| Colusa | Sorghum | 290 | 10 |
| Colusa | Sudangrass | 130 | 35 |
| Colusa | Wheat | 1,351 | 400 |
| Glenn | Alfalfa | 2,050 | 477 |
| Glenn | Barley | 100 | 27 |
| Glenn | Corn | 606 | 121 |
| Glenn | Cotton | 274 | 86 |
| Glenn | Oat | 312 | 117 |
| Glenn | Rights of Way | NR | 29 |
| Glenn | Wheat | 441 | 142 |
| Marin | | | None |
| Napa | Landscape | NR | 17 |
| Napa | Oat | 125 | 34 |
| Napa | Public Health | NR | 7 |
| Nevada | | | None |
| Placer | Oat | 50 | 15 |
| San Francisco | | | None |
| San Mateo | Landscape | NR | 4 |

| | | | |
|---|---|---|---|
| Shasta | Garlic | 130 | 5 |
| Shasta | Oat | 26 | 10 |
| Shasta | Onion | 8 | 4 |
| Shasta | Turf/Sod | 38 | 14 |
| Solano | Alfalfa | 1,094 | 279 |
| Solano | Barley | 110 | 22 |
| Solano | Outdr Plants | 206 | 49 |
| Solano | Oat | 165 | 10 |
| Solano | Ryegrass | 226 | 74 |
| Solano | Sorghum | 802 | 226 |
| Solano | Uncultivated Ag | 100 | 27 |
| Solano | Wheat | 325 | 125 |
| Sonoma | Hay | 100 | 36 |
| Sonoma | Oat | 396 | 140 |
| Sonoma | Pastureland | 120 | 44 |
| Sutter | Alfalfa | 155 | 28 |
| Sutter | Oat | 158 | 37 |
| Sutter | Sorghum | 250 | 45 |
| Sutter | Wheat | 1,221 | 369 |
| San Mateo | Landscape | NR | 3 |
| Tehama | Hay | 200 | 36 |
| Tehama | Oat | 998 | 274 |
| Tehama | Rights of Way | NR | 29 |
| Tehama | Rye | 80 | 22 |
| Tehama | Wheat | 496 | 102 |
| Yolo | Alfalfa | 3,952 | 815 |
| Yolo | Barley | 166 | 63 |

| | | | |
|---|---|---|---|
| Yolo | Corn | 3,416 | 808 |
| Yolo | Cotton | 512 | 124 |
| Yolo | Hay | 40 | 14 |
| Yolo | Grass, Seed | 140 | 25 |
| Yolo | Landscape | NR | 21 |
| Yolo | Outdr Plants | 107 | 17 |
| Yolo | Oat | 1,993 | 573 |
| Yolo | Pastureland | 3,912 | 1,125 |
| Yolo | Research | 50 | 19 |
| Yolo | Rights of Way | NR | 20 |
| Yolo | Ryegrass | NR | 47 |
| Yolo | Sorghum | 525 | 181 |
| Yolo | Sudangrass | 329 | 70 |
| Yolo | Uncultivated Ag | 30 | 11 |
| Yolo | Uncultivated Non-Ag | 10 | 4 |
| Yolo | Wheat | 5,058 | 1,444 |
| Yuba | | | None |

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 bromoxynil could be used are Humboldt, Trinity, Mendocino, Lake, Sonoma, and Marin.

**Table 33: California counties supporting the California coastal chinook salmon ESU.**

| County | Site | Acres Treated | Lbs a.i. Applied |
|---|---|---|---|
| Glenn | Alfalfa | 2,050 | 477 |
| Glenn | Barley | 100 | 27 |
| Glenn | Corn | 606 | 121 |
| Glenn | Cotton | 274 | 86 |
| Glenn | Oat | 312 | 117 |
| Glenn | Rights of Way | NR | 29 |
| Glenn | Wheat | 441 | 142 |
| Humbolt | | | None |
| Lake | Oat | 340 | 433 |
| Marin | | | None |
| Mendocino | | | None |
| Sonoma | Hay | 100 | 36 |
| Sonoma | Oat | 396 | 140 |
| Sonoma | Pastureland | 120 | 44 |
| Trinity | | | None |

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 34: Washington counties where the Puget Sound chinook salmon ESU is located**.

| State | County | Site | Acres Treated | lbs a.i. Applied |
|---|---|---|---|---|
| WA | Clallum | Alfalfa | 5,457 | 2,279 |
| WA | Clallum | Hay | 1,735 | 868 |
| WA | Clallum | Corn | 44 | 22 |
| WA | Clallum | Outdr Plants | 157 | 79 |
| WA | Grays Harbor | Oats | 50 | 25 |
| WA | Grays Harbor | Alfalfa | 12,335 | 6,168 |
| WA | Grays Harbor | Hay | 3,540 | 1,770 |
| WA | Grays Harbor | Outdr Plants | 82 | 41 |
| WA | Grays Harbor | Corn | 1,295 | 648 |
| WA | Jefferson | Alfalfa | 2,741 | 1,371 |
| WA | Jefferson | Hay | 853 | 427 |
| WA | Jefferson | Outdr Plants | 40 | 20 |
| WA | King | Corn | 67 | 8 |
| WA | King | Alfalfa | 7,253 | 3,627 |
| WA | King | Hay | 1,724 | 862 |
| WA | King | Corn | 155 | 78 |
| WA | King | Outdr Plants | 436 | 218 |
| WA | Kitsap | Alfalfa | 1,375 | 688 |
| WA | Kitsap | Hay | 469 | 235 |
| WA | Kitsap | Corn | 4 | 2 |
| WA | Kitsap | Outdr Plants | 436 | 218 |
| WA | Lewis | Corn | 662 | 331 |
| WA | Lewis | Wheat | 1,104 | 552 |
| WA | Lewis | Alfalfa | 24,463 | 12,232 |
| WA | Lewis | Hay | 12,517 | 6,259 |

| | | | | |
|---|---|---|---|---|
| WA | Lewis | Outdr Plants | 485 | 243 |
| WA | Mason | Alfalfa | 2,113 | 1,057 |
| WA | Mason | Hay | 1,194 | 597 |
| WA | Mason | Outdr Plants | 186 | 93 |
| WA | Pierce | Corn | 367 | 184 |
| WA | Pierce | Alfalfa | 6,966 | 3,843 |
| WA | Pierce | Hay | 3,878 | 1,939 |
| WA | Pierce | Outdr Plants | 1,444 | 722 |
| WA | San Juan | Alfalfa | 3,971 | 1,986 |
| WA | San Juan | Hay | 3,017 | 1,509 |
| WA | San Juan | Outdr Plants | 24 | 12 |
| WA | Skagit | Corn | 656 | 328 |
| WA | Skagit | Wheat | 3,477 | 1,739 |
| WA | Skagit | Barley | 821 | 411 |
| WA | Skagit | Oat | 62 | 31 |
| WA | Skagit | Alfalfa | 19,446 | 9,723 |
| WA | Skagit | Hay | 5,665 | 2,833 |
| WA | Skagit | Outdr Plants | 4,154 | 2,077 |
| WA | Snohomish | Corn | 259 | 130 |
| WA | Snohomish | Wheat | 428 | 214 |
| WA | Snohomish | Barley | 199 | 100 |
| WA | Snohomish | Alfalfa | 15,913 | 7,957 |
| WA | Snohomish | Hay | 4,127 | 2,064 |
| WA | Snohomish | Outdr Plants | 4,154 | 2,077 |
| WA | Thurston | Alfalfa | 12,190 | 6,095 |
| WA | Thurston | Hay | 4,994 | 2,497 |
| WA | Thurston | Corn | 55 | 28 |

| | | | | |
|---|---|---|---|---|
| WA | Thurston | Outdr Plants | 1,025 | 513 |
| WA | Whatcom | Corn | 236 | 118 |
| WA | Whatcom | Wheat | 626 | 313 |
| WA | Whatcom | Alfalfa | 40,910 | 20,455 |
| WA | Whatcom | Hay | 10,906 | 5,453 |
| WA | Whatcom | Outdr Plants | 320 | 160 |

7. Lower Columbia River Chinook Salmon ESU

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

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

**Table 35: Oregon and Washington counties where the Lower Columbia River chinook salmon ESU occurs.**

| State | County | Site | Acres Treated | lbs a.i. Applied |
|---|---|---|---|---|
| OR | Clackamas | Rye | 4,520 | 2,260 |
| OR | Clackamas | Wheat | 1,783 | 892 |
| OR | Clackamas | Barley | 259 | 130 |
| OR | Calckamus | Alfalfa | 20,756 | 10,378 |
| OR | Clackamus | Hay | 13,493 | 6,747 |
| OR | Clackamus | Outdr Plants | 9,708 | 4,854 |

| | | | | |
|---|---|---|---|---|
| OR | Clackamas | Corn | 1,072 | 536 |
| OR | Clatsop | Alfalfa | 4,385 | 2,193 |
| OR | Clatsop | Hay | 1,056 | 528 |
| OR | Clatsop | Corn | 1,072 | 536 |
| OR | Clatsop | Outdr Plants | 9 | 5 |
| OR | Hood River | Alfalfa | 1,595 | 798 |
| OR | Hood River | Hay | 856 | 428 |
| OR | Hood River | Corn | 175 | 88 |
| OR | Marion | Rye | 1150 | 36 |
| OR | Marion | Corn | 193 | 24 |
| OR | Multnomah | Wheat | 1,688 | 844 |
| OR | Multnomah | Alfalfa | 3,082 | 1,541 |
| OR | Multnomah | Hay | 1,269 | 635 |
| OR | Multnnomah | Corn | 1,405 | 703 |
| OR | Wasco | Wheat | 63,389 | 31,695 |
| OR | Wasco | Alfalfa | 10,684 | 5,342 |
| OR | Wasco | Hay | 1,446 | 723 |
| OR | Washington | Rye | 37 | 1 |
| OR | Washington | Corn | 287 | 36 |
| WA | Clark | Oat | 1,174 | 587 |
| WA | Clark | Alfalfa | 19,769 | 9,885 |
| WA | Clark | Hay | 9,430 | 4,715 |
| WA | Clark | Barley | 830 | 415 |
| WA | Clark | Corn | 87 | 44 |
| WA | Cowlitz | Wheat | 293 | 147 |
| WA | Cowlitz | Hay | 136 | 68 |
| WA | Cowlitz | Corn | 460 | 230 |

| | | | | |
|---|---|---|---|---|
| WA | Cowlitz | Outdr Plants | 230 | 115 |
| WA | Cowlitz | Alfalfa | 4,261 | 2,131 |
| WA | Klickitat | | | None |
| WA | Lewis | Corn | 662 | 331 |
| WA | Lewis | Wheat | 1,104 | 552 |
| WA | Lewis | Alfalfa | 24,463 | 12,232 |
| WA | Lewis | Hay | 12,517 | 6,259 |
| WA | Lewis | Outdr Plants | 485 | 243 |
| WA | Pacific | Hay | 1,798 | 899 |
| WA | Pacific | Alfalfa | 5,619 | 2010 |
| WA | Pierce | Corn | 367 | 184 |
| WA | Pierce | Alfalfa | 6,966 | 3,843 |
| WA | Pierce | Hay | 3,878 | 1,939 |
| WA | Pierce | Outdr Plants | 1,444 | 722 |
| WA | Skamania | Hay | 178 | 89 |
| WA | Wakiakum | Alfalfa | 12,190 | 6,095 |
| WA | Wakiakum | Hay | 2,783 | 1,392 |

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 bromoxynil would not be used. Salmon habitat for this ESU is exceedingly limited in Douglas County also, but we cannot rule out future Bromoxynil use in Douglas County.

Tables 36 and 37 show the cropping information for Oregon counties where the Upper Willamette River chinook salmon ESU occurs and for the Oregon and Washington counties where this ESU migrates.

**Table 36: Spawning/Rearing areas for the Upper Willamette River chinook ESU**

| State | County | Site | Acres Treated | lbs a.i. Applied |
|---|---|---|---|---|
| OR | Benton | Rye | 18,475 | 9,238 |
| OR | Benton | Corn | 5,735 | 2,868 |
| OR | Benton | Wheat | 4,338 | 2,169 |
| OR | Benton | Oat | 1,584 | 792 |
| OR | Benton | Alfalfa | 8,157 | 4,079 |
| OR | Benton | Hay | 5,637 | 2,819 |
| OR | Benton | Outdr Plants | 681 | 341 |
| OR | Clackamas | Rye | 4,520 | 2,260 |
| OR | Clackamas | Wheat | 1,783 | 892 |
| OR | Clackamas | Barley | 259 | 130 |
| OR | Calckamus | Alfalfa | 20,756 | 10,378 |
| OR | Clackamus | Hay | 13,493 | 6,747 |
| OR | Clackamus | Outdr Plants | 9,708 | 4,854 |
| OR | Clackamas | Corn | 1,072 | 536 |
| OR | Douglas | Rye | 32 | 1 |
| OR | Lane | Rye | 471 | 15 |
| OR | Lane | Wheat | 2,651 | 1,326 |
| OR | Lane | Barley | 147 | 74 |

| | | | | |
|---|---|---|---|---|
| OR | Lane | Alfalfa | 28,728 | 14,364 |
| OR | Lane | Hay | 18,643 | 9,322 |
| OR | Lane | Outdr Plants | 1,098 | 549 |
| OR | Lane | Corn | 2,593 | 1,297 |
| OR | Lincoln | Alfalfa | 2,954 | 916 |
| OR | Marion | Rye | 1150 | 36 |
| OR | Marion | Corn | 193 | 24 |
| OR | Polk | Rye | 24,250 | 1,125 |
| OR | Polk | Corn | 1,835 | 918 |
| OR | Polk | Wheat | 9,471 | 4,736 |
| OR | Polk | Barley | 379 | 190 |
| OR | Polk | Oat | 2,273 | 1,137 |
| OR | Polk | Alfalfa | 20,440 | 10,220 |
| OR | Polk | Hay | 12,321 | 6,161 |
| OR | Polk | Outdr Plants | 1,328 | 664 |
| OR | Polk | Rye | 525 | 16 |
| OR | Tilamook | Alfalfa | 7,896 | 2,448 |
| OR | Wasco | | | None |
| OR | Yamhill | Rye | 10,959 | 5,480 |
| OR | Yamhill | Wheat | 13,989 | 6,995 |
| OR | Yamhill | Barley | 380 | 190 |
| OR | Yamhill | Oat | 2,525 | 1,263 |
| OR | Yamhill | Alfalfa | 19,091 | 9,546 |
| OR | Yamhill | Hay | 8,783 | 4,392 |
| OR | Yamhill | Outdr Plants | 3,613 | 1,807 |
| OR | Yamhill | Corn | 4,149 | 2,075 |
| OR | Washington | Alfalfa | 14,539 | 7,270 |

| | | | | |
|---|---|---|---|---|
| OR | Washington | Corn | 287 | 36 |
| OR | Washington | Wheat | 17,020 | 8,510 |
| OR | Washington | Barley | 153 | 77 |
| OR | Washington | Oat | 5,278 | 2,629 |
| OR | Washington | Hay | 7,244 | 3,622 |
| OR | Washington | Corn | 4,962 | 2,481 |
| OR | Washington | Outdr Plants | 4,155 | 2,078 |

**Table 37: Migration corridors of the Upper Willamette River chinook salmon ESU**.

| State | County | Site | Acres Treated | lbs a.i. Applied |
|---|---|---|---|---|
| OR | Clatsop | Alfalfa | 4,385 | 2,193 |
| OR | Clatsop | Hay | 1,056 | 528 |
| OR | Clatsop | Corn | 1,072 | 536 |
| OR | Clatsop | Outdr Plants | 9 | 5 |
| OR | Columbia | Corn | 48 | 24 |
| OR | Columbia | Oat | 13 | 7 |
| OR | Columbia | Alfalfa | 10,789 | 5,395 |
| OR | Columbia | Hay | 8,373 | 4,187 |
| OR | Columbia | Outdr Plants | 9 | 5 |
| OR | Multnomah | Wheat | 1,688 | 844 |
| OR | Multnomah | Alfalfa | 3,082 | 1,541 |
| OR | Multnomah | Hay | 1,269 | 635 |
| OR | Multnnomah | Corn | 1,405 | 703 |
| WA | Clark | Oat | 1,174 | 587 |
| WA | Clark | Alfalfa | 19,769 | 9,885 |
| WA | Clark | Hay | 9,430 | 4,715 |
| WA | Clark | Barley | 830 | 415 |

| | | | | |
|---|---|---|---|---|
| WA | Clark | Corn | 87 | 44 |
| WA | Cowlitz | Wheat | 293 | 147 |
| WA | Cowlitz | Hay | 136 | 68 |
| WA | Cowlitz | Corn | 460 | 230 |
| WA | Cowlitz | Outdr Plants | 230 | 115 |
| WA | Cowlitz | Alfalfa | 4,261 | 2,131 |
| WA | Pacific | Hay | 1,798 | 899 |
| WA | Pacific | Alfalfa | 5,619 | 2,010 |

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 38), with the lower river reaches being migratory corridors (Table 39).

Most bromoxynil 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 potato, the only crop for bromoxynil. However, a modest amount is used on potato below that confluence in counties on either side of the Columbia River, but all upstream of the John Day Dam.

Tables 38 and 39 show the cropping information for Washington counties that support the Upper Columbia River chinook salmon ESU and for the Oregon and Washington counties where this ESU migrates.

**Table 38. Counties Supporting the Upper Columbia Chinook ESU Spawning/Rearing Area**

| State | County | Site | Acres Treated | lbs a.i. Applied |
|---|---|---|---|---|
| WA | Benton | Wheat | 130,981 | 65,491 |

| | | | | |
|---|---|---|---|---|
| WA | Benton | Barley | 435 | 218 |
| WA | Benton | Alfalfa | 13,241 | 6,621 |
| WA | Benton | Hay | 733 | 367 |
| WA | Benton | Corn | 16,086 | 8,053 |
| WA | Benton | Onions | 3,398 | 1,699 |
| WA | Chelan | Wheat | 1,864 | 932 |
| WA | Chelan | Alfalfa | 1,953 | 977 |
| WA | Chelan | Hay | 449 | 225 |
| WA | Chelan | Outdr Plants | 26 | 13 |
| WA | Douglas | Wheat | 200,291 | 100,146 |
| WA | Douglas | Oat | 671 | 336 |
| WA | Douglas | Barley | 2,751 | 1,376 |
| WA | Douglas | Alfalfa | 1,783 | 892 |
| WA | Douglas | Outdr Plants | 7 | 4 |
| WA | Grant | Corn | 62.493 | 31,247 |
| WA | Grant | Wheat | 203,498 | 101,749 |
| WA | Grant | Barley | 6,548 | 3,274 |
| WA | Grant | Alfalfa | 120,251 | 60,126 |
| WA | Grant | Hay | 126,450 | 63,225 |
| WA | Kittitas | Corn | | |
| WA | Kittitas | Wheat | 5,224 | 2,612 |
| WA | Kittitas | Barley | 135 | 68 |
| WA | Kittitas | Alfalfa | 45,685 | 22,843 |
| WA | Kittitas | Hay | 33,528 | 16,764 |
| WA | Kittitas | Oat | 898 | 449 |
| WA | Kittitas | Corn | 4,432 | 2,216 |
| WA | Kittitas | Outdr Plants | 182 | 91 |

| | | | | |
|---|---|---|---|---|
| WA | Okanogan | Corn | 855 | 428 |
| WA | Okanogan | Alfalfa | 21,880 | 10,940 |
| WA | Okanogan | Hay | 34,283 | 17,142 |
| WA | Okanogan | Wheat | 8,410 | 4,205 |
| WA | Okanogan | Oat | 1,407 | 704 |
| WA | Skamania | | | None |

**Table 39: Migration corridors for the Upper Columbia River Chinook salmon ESU**.

| State | County | Site | Acres Treated | lbs a.i. Applied |
|---|---|---|---|---|
| OR | Clatsop | Alfalfa | 4,385 | 2,193 |
| OR | Clatsop | Hay | 1,056 | 528 |
| OR | Clatsop | Corn | 1,072 | 536 |
| OR | Clatsop | Outdr Plants | 9 | 5 |
| OR | Columbia | Corn | 48 | 24 |
| OR | Columbia | Oat | 13 | 7 |
| OR | Columbia | Alfalfa | 10,789 | 5,395 |
| OR | Columbia | Hay | 8,373 | 4,187 |
| OR | Columbia | Outdr Plants | 9 | 5 |
| OR | Gilliam | Wheat | 95,584 | 47,792 |
| OR | Gilliam | Barley | 13,175 | 6,588 |
| OR | Gilliam | Oat | 4,557 | 2,279 |
| OR | Gilliam | Alfalfa | 3,826 | 1,913 |
| OR | Gilliam | Hay | 1,146 | 573 |
| OR | Hood River | Alfalfa | 1,595 | 798 |
| OR | Hood River | Hay | 856 | 428 |
| OR | Hood River | Corn | 175 | 88 |
| OR | Morrow | Wheat | 167,070 | 83,535 |

| | | | | |
|---|---|---|---|---|
| OR | Morrow | Barley | 2,688 | 1,344 |
| OR | Morrow | Alfalfa | 25,211 | 12,606 |
| OR | Morrow | Hay | 1,886 | 943 |
| OR | Morrow | Corn | 3,720 | 1,860 |
| OR | Multnomah | Wheat | 1,688 | 844 |
| OR | Multnomah | Alfalfa | 3,082 | 1,541 |
| OR | Multnomah | Hay | 1,269 | 635 |
| OR | Multnnomah | Corn | 1,405 | 703 |
| OR | Sherman | Wheat | 99,837 | 49,919 |
| OR | Sherman | Oat | 165 | 83 |
| OR | Sherman | Alfalfa | 339 | 170 |
| OR | Sherman | Outdr Plants | 95 | 48 |
| OR | Umatilla | Corn | 6,901 | 3,451 |
| OR | Umatilla | Wheat | 263,624 | 131,812 |
| OR | Umatilla | Rye | 1,860 | 930 |
| OR | Umatilla | Alfalfa | 33,080 | 16,548 |
| OR | Umatilla | Hay | 6,123 | 3.062 |
| OR | Umatilla | Outdr Plants | 371 | 186 |
| OR | Wasco | Wheat | 63,389 | 31,695 |
| OR | Wasco | Alfalfa | 10,684 | 5,342 |
| OR | Wasco | Hay | 1,446 | 723 |
| OR | Wasco | Outdr Plants | 144 | 72 |
| WA | Cowlitz | Wheat | 293 | 147 |
| WA | Cowlitz | Hay | 136 | 68 |
| WA | Cowlitz | Corn | 460 | 230 |
| WA | Cowlitz | Outdr Plants | 230 | 115 |
| WA | Cowlitz | Alfalfa | 4,261 | 2,131 |

| | | | | |
|---|---|---|---|---|
| WA | Franklin | Corn | 23,171 | 11,586 |
| WA | Franklin | Wheat | 109,627 | 54,814 |
| WA | Franklin | Alfalfa | 70,943 | 35,472 |
| WA | Franklin | Hay | 1,013 | 507 |
| WA | Skamania | | | None |
| WA | Pacific | Hay | 1,798 | 899 |
| WA | Pacific | Alfalfa | 5,619 | 2010 |
| WA | Walla Walla | Wheat | 232,419 | 116,210 |
| WA | Walla Walla | Barley | 22,584 | 11,292 |
| WA | Wallla Walla | Alfalfa | 10,411 | 5,206 |
| WA | Walla Walla | Hay | 224 | 112 |
| WA | Walla Walla | Corn | 8,062 | 4,031 |
| WA | Walla Walla | Outdr Plants | 2,706 | 1,353 |
| WA | Yakima | Corn | 12,680 | 6,340 |
| WA | Yakima | Wheat | 50,430 | 25,215 |
| WA | Yakima | Outdr Plants | 786 | 393 |
| WA | Yakima | Barley | 502 | 251 |
| WA | Yakima | Alfalfa | 43,866 | 21,933 |
| WA | Yakima | Hay | 2,397 | 1,199 |

**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.

**Table 40: California counties supporting the Central California coast Coho salmon ESU**.

| County | Site | Acres Treated | Lbs a.i. Applied |
|---|---|---|---|
| Marin | | | None |
| Mendocino | | | None |
| Napa | Landscape | NR | 17 |
| San Mateo | Landscape | NR | 6 |
| Santa Cruz | Hay | 18 | 6 |
| Sonoma | Hay | 100 | 36 |

| | | | |
|---|---|---|---|
| Sonoma | Oat | 396 | 140 |
| Sonoma | Pastureland | 120 | 44 |

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 bromoxynil can be used. Klamath county is excluded because it lies beyond an impassable barrier.

Tables 41 shows the usage of bromoxynil in the California counties supporting the Southern Oregon/Northern California coastal coho salmon ESU. Table 42 shows the cropping information for Oregon counties where the Southern Oregon/Northern California coastal coho salmon ESU occurs..

**Table 41:California Counties where the Southern Oregon/Northern California Coastal Coho Salmon ESU Occurs**

| County | Site | Acres Treated | Lbs a.i. Applied |
|---|---|---|---|
| Del Norte | | | None |

| | | | |
|---|---|---|---|
| Humbolt | | | None |
| Lake | Oat | 340 | 432 |
| Mendocino | | | None |
| Trinity | | | None |

**Table 42: Oregon counties where there is habitat for the Southern Oregon/Northern California coastal coho salmon ESU.**

| State | County | Site | Acres Treated | lbs a.i. Applied |
|---|---|---|---|---|
| OR | Curry | Alfalfa | 1,637 | 819 |
| OR | Curry | Outdr Plants | 156 | 78 |
| OR | Douglas | Alfalfa | 35,989 | 17,995 |
| OR | Douglas | Wheat | 123 | 62 |
| OR | Douglas | Hay | 27,300 | 13,650 |
| OR | Douglas | Corn | 175 | 88 |
| OR | Douglas | Outdr Plants | 146 | 73 |
| OR | Jackson | Wheat | 1,294 | 647 |
| OR | Jackson | Barley | 548 | 274 |
| OR | Jackson | Oat | 9 | 5 |
| OR | Jackson | Alfalfa | 21,078 | 10,539 |
| OR | Jackson | Hay | 12,480 | 6,240 |
| OR | Jackson | Corn | 283 | 142 |
| OR | Jackson | Outdr Plants | 96 | 48 |
| OR | Josephine | Wheat | 18 | 9 |
| OR | Josephine | Oat | 78 | 39 |
| OR | Josephine | Alfalfa | 7,237 | 3,619 |
| OR | Josephine | Hay | 4,356 | 2,178 |
| OR | Josephine | Corn | 37 | 19 |
| OR | Josephine | Outdr Plants | 240 | 120 |

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. .

**Table 43: Oregon counties where the Oregon coast coho salmon ESU occurs**.

| State | County | Site | Acres Treated | lbs a.i. Applied |
|---|---|---|---|---|
| OR | Benton | Rye | 18,475 | 9,238 |
| OR | Benton | Corn | 5,735 | 2,868 |
| OR | Benton | Wheat | 4,338 | 2,169 |
| OR | Benton | Oat | 1,584 | 792 |
| OR | Benton | Alfalfa | 8,157 | 4,079 |
| OR | Benton | Hay | 5,637 | 2,819 |
| OR | Benton | Outdr Plants | 681 | 341 |
| OR | Clatsop | Alfalfa | 4,385 | 2,193 |
| OR | Clatsop | Hay | 1,056 | 528 |
| OR | Clatsop | Corn | 1,072 | 536 |
| OR | Clatsop | Outdr Plants | 9 | 5 |
| OR | Columbia | Corn | 48 | 24 |
| OR | Columbia | Oat | 13 | 7 |

| | | | | |
|---|---|---|---|---|
| OR | Columbia | Alfalfa | 10,789 | 5,395 |
| OR | Columbia | Hay | 8,373 | 4,187 |
| OR | Columbia | Outdr Plants | 9 | 5 |
| OR | Coos | Corn | 18 | 2 |
| OR | Curry | Alfalfa | 1,637 | 819 |
| OR | Curry | Outdr Plants | 156 | 78 |
| OR | Douglas | Alfalfa | 35,989 | 17995 |
| OR | Douglas | Wheat | 123 | 62 |
| OR | Douglas | Hay | 27,300 | 13,650 |
| OR | Douglas | Corn | 175 | 88 |
| OR | Douglas | Outdr Plants | 146 | 73 |
| OR | Lane | Rye | 471 | 15 |
| OR | Lane | Corn | 45 | 6 |
| OR | Lincoln | | | None |
| OR | Josephine | Wheat | 18 | 9 |
| OR | Josephine | Oat | 78 | 39 |
| OR | Josephine | Alfalfa | 7,237 | 3,619 |
| OR | Josephine | Hay | 4,356 | 2,178 |
| OR | Josephine | Corn | 37 | 19 |
| OR | Josephine | Outdr Plants | 240 | 120 |
| OR | Polk | Rye | 24,250 | 1,125 |
| OR | Polk | Corn | 1,835 | 918 |
| OR | Polk | Wheat | 9,471 | 4,736 |
| OR | Polk | Barley | 379 | 190 |
| OR | Polk | Oat | 2,273 | 1,137 |
| OR | Polk | Alfalfa | 20,440 | 10,220 |
| OR | Polk | Hay | 12,321 | 6,161 |

| | | | | |
|---|---|---|---|---|
| OR | Polk | Outdr Plants | 1,328 | 664 |
| OR | Tillamook | Alfalfa | 7,896 | 2,448 |
| OR | Yamhill | Rye | 10,959 | 5,480 |
| OR | Yamhill | Wheat | 13,989 | 6,995 |
| OR | Yamhill | Barley | 380 | 190 |
| OR | Yamhill | Oat | 2,525 | 1,263 |
| OR | Yamhill | Alfalfa | 19,091 | 9,546 |
| OR | Yamhill | Hay | 8,783 | 4,392 |
| OR | Yamhill | Outdr Plants | 3,613 | 1,807 |
| OR | Yamhill | Corn | 4,149 | 2,075 |
| OR | Washington | Alfalfa | 14,539 | 7,270 |
| OR | Washington | Corn | 287 | 36 |
| OR | Washington | Wheat | 17,020 | 8,510 |
| OR | Washington | Barley | 153 | 77 |
| OR | Washington | Oat | 5,278 | 2,629 |
| OR | Washington | Hay | 7,244 | 3,622 |
| OR | Washington | Corn | 4,962 | 2,481 |
| OR | Washington | Outdr Plants | 4,155 | 2,078 |

**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 to 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 out migrate to seawater almost immediately after emerging from the gravel that covers their redds. This means that survival and growth in juvenile chum salmon depend less on freshwater conditions than on favorable estuarine and marine conditions.

1.  Hood Canal Summer-run chum salmon ESU

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

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

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

**Tables 44:  Washington counties where the Hood Canal summer-run chum salmon ESU Occurs.**

| State | County | Site | Acres Treated | lbs a.i. Applied |
|---|---|---|---|---|
| WA | Island | Barley | 487 | 244 |

| | | | | |
|---|---|---|---|---|
| WA | Island | Alfalfa | 7,608 | 3,804 |
| WA | Island | Hay | 1,557 | 779 |
| WA | Island | Corn | 15 | 8 |
| WA | Jefferson | Hay | 853 | 427 |
| WA | Jefferson | Alfalfa | 2,741 | 1,371 |
| WA | Kitsap | Alfalfa | 1,375 | 688 |
| WA | Kitsap | Hay | 469 | 235 |
| WA | Kitsap | Corn | 4 | 2 |
| WA | Kitsap | Outdr Plants | 436 | 218 |

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 45: Oregon and Washington counties where the Columbia River chum salmon ESU occurs**.

| State | County | Site | Acres Treated | lbs a.i. Applied |
|---|---|---|---|---|
| OR | Clatsop | Alfalfa | 4,385 | 2,193 |
| OR | Clatsop | Hay | 1,056 | 528 |
| OR | Clatsop | Corn | 1,072 | 536 |
| OR | Clatsop | Outdr Plants | 9 | 5 |

| | | | | |
|---|---|---|---|---|
| OR | Columbia | Corn | 48 | 24 |
| OR | Columbia | Oat | 13 | 7 |
| OR | Columbia | Alfalfa | 10,789 | 5,395 |
| OR | Columbia | Hay | 8,373 | 4,187 |
| OR | Columbia | Outdr Plants | 9 | 5 |
| OR | Multnomah | Wheat | 1,688 | 844 |
| OR | Multnomah | Alfalfa | 3,082 | 1,541 |
| OR | Multnomah | Hay | 1,269 | 635 |
| OR | Multnnomah | Corn | 1,405 | 703 |
| OR | Washington | Rye | 37 | 4 |
| OR | Washington | Corn | 287 | 36 |
| WA | Clark | Oat | 1,174 | 587 |
| WA | Clark | Alfalfa | 19,769 | 9,885 |
| WA | Clark | Hay | 9,430 | 4,715 |
| WA | Clark | Barley | 830 | 415 |
| WA | Clark | Corn | 87 | 44 |
| WA | Cowlitz | Wheat | 293 | 147 |
| WA | Cowlitz | Hay | 136 | 68 |
| WA | Cowlitz | Corn | 460 | 230 |
| WA | Cowlitz | Outdr Plants | 230 | 115 |
| WA | Cowlitz | Alfalfa | 4,261 | 2,131 |
| WA | Lewis | Corn | 67 | 8 |
| WA | Pacific | Hay | 1,798 | 899 |
| WA | Pacific | Alfalfa | 5,619 | 2,010 |
| WA | Skamania | Hay | 178 | 89 |
| WA | Wakiakum | Alfalfa | 12,190 | 6,095 |
| WA | Wakiakum | Hay | 2,783 | 1,392 |

## 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 kocanee, are non-anadromous and have been observed on the spawning grounds together with their anadromous counterparts. Some sockeye, particularly the more northern populations, spawn in mainstem rivers.

Growth is influenced by competition, food supply, water temperature, thermal stratification, and other factors, with lake residence time usually increasing the farther north a nursery lake is located. In Washington and British Columbia, lake residence is normally 1 or 2 years. Incubation, fry emergence, spawning, and adult lake entry often involve intricate patterns of adult and juvenile migration and orientation not seen in other *Oncorhynchus* species.

Upon emergence from the substrate, lake-type sockeye salmon juveniles move either downstream or upstream to rearing lakes, where the juveniles rear for 1 to 3 years prior to migrating to sea. Smolt migration typically occurs beginning in late April and extending through early July.

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

### 1. Ozette Lake Sockeye Salmon ESU

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

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

**Table 46: Clallum County where there is habitat for the Ozette Lake sockeye salmon ESU.**

| State | County | Site | Acres Treated | lbs a.i. Applied |
|---|---|---|---|---|
| WA | Clallum | Barley | 453 | 227 |
| WA | Clallum | Alfalfa | 5,457 | 2,729 |
| WA | Clallum | Hay | 1,735 | 868 |
| WA | Clallum | Oudr Plants | 157 | 79 |
| WA | Clallum | Corn | 44 | 22 |

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. Bromoxynil 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 bromoxynil in the lower and larger river reaches during its juvenile or adult migration.

Table 47 shows the acreage of potential sites in Idaho counties where this species reproduces. The critical spawning zones demonstrate, at the maximum allowable application levels.

Table 48 shows the acreage of crops where bromoxynil can be used in Oregon and Washington counties along the migratory corridor for this ESU.

**Table 47. Idaho counties where there is spawning and rearing habitat for the Snake River sockeye salmon ESU.**

| State | County | Site | Acres Treated | lbs a.i. Applied |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| ID | Blaine | Wheat | 2,837 | 1,419 |
| ID | Blaine | Barley | 17,270 | 8,635 |
| ID | Blaine | Oat | 315 | 158 |
| ID | Blaine | Alfalfa | 21,615 | 10,808 |
| ID | Blaine | Hay | 725 | 363 |
| ID | Blaine | Outdr Plants | 28 | 14 |
| ID | Custer | Wheat | 645 | 323 |
| ID | Custer | Barley | 2,386 | 1,193 |
| ID | Custer | Oat | 150 | 75 |
| ID | Custer | Alfalfa | 32,122 | 16,061 |
| ID | Custer | Hay | 1,607 | 804 |

**Table 48. Oregon and Washington counties that are in the migratory corridors for the Snake River sockeye salmon ESU.**

| State | County | Site | Acres Treated | lbs a.i. Applied |
|---|---|---|---|---|
| OR | Clatsop | Alfalfa | 4,385 | 2,193 |
| OR | Clatsop | Hay | 1,056 | 528 |
| OR | Clatsop | Corn | 1,072 | 536 |
| OR | Clatsop | Outdr Plants | 9 | 5 |
| OR | Columbia | Corn | 48 | 24 |
| OR | Columbia | Oat | 13 | 7 |
| OR | Columbia | Alfalfa | 10,789 | 5,395 |
| OR | Columbia | Hay | 8,373 | 4,187 |
| OR | Columbia | Outdr Plants | 9 | 5 |
| OR | Gilliam | Wheat | 95,584 | 47,792 |
| OR | Gilliam | Barley | 13,175 | 6,588 |
| OR | Gilliam | Oat | 4,557 | 2,279 |

| | | | | |
|---|---|---|---|---|
| OR | Gilliam | Alfalfa | 3,826 | 1,913 |
| OR | Gilliam | Hay | 1,146 | 573 |
| OR | Hood River | Alfalfa | 1,595 | 798 |
| OR | Hood River | Hay | 856 | 428 |
| OR | Hood River | Corn | 175 | 88 |
| OR | Morrow | Wheat | 167,070 | 83,535 |
| OR | Morrow | Barley | 2,688 | 1,344 |
| OR | Morrow | Alfalfa | 25,211 | 12,606 |
| OR | Morrow | Hay | 1,886 | 943 |
| OR | Morrow | Corn | 3,720 | 1,860 |
| OR | Multnomah | Wheat | 1,688 | 844 |
| OR | Multnomah | Alfalfa | 3,082 | 1,541 |
| OR | Multnomah | Hay | 1,269 | 635 |
| OR | Multnnomah | Corn | 1,405 | 703 |
| OR | Sherman | Wheat | 99,837 | 49,919 |
| OR | Sherman | Oat | 165 | 83 |
| OR | Sherman | Alfalfa | 339 | 170 |
| OR | Sherman | Outdr Plants | 95 | 48 |
| OR | Umatilla | Corn | 6,901 | 3,451 |
| OR | Umatilla | Wheat | 263,624 | 131,812 |
| OR | Umatilla | Rye | 1,860 | 930 |
| OR | Umatilla | Alfalfa | 33,080 | 16,548 |
| OR | Umatilla | Hay | 6,123 | 3.062 |
| OR | Umatilla | Outdr Plants | 371 | 186 |
| OR | Wallowa | | | None |
| OR | Wasco | Wheat | 63,389 | 31,695 |
| OR | Wasco | Alfalfa | 10,684 | 5,342 |

| | | | | |
|---|---|---|---|---|
| OR | Wasco | Hay | 1,446 | 723 |
| OR | Wasco | Outdr Plants | 144 | 72 |
| WA | Asotin | | | None |
| WA | Benton | Wheat | 130,981 | 65,491 |
| WA | Benton | Barley | 435 | 218 |
| WA | Benton | Alfalfa | 13,241 | 6,621 |
| WA | Benton | Hay | 733 | 367 |
| WA | Benton | Corn | 16,086 | 8,053 |
| WA | Benton | Onions | 3,398 | 1,699 |
| WA | Franklin | Corn | 23,171 | 11,586 |
| WA | Franklin | Wheat | 109,627 | 54,814 |
| WA | Franklin | Alfalfa | 70,943 | 35,472 |
| WA | Franklin | Hay | 1,013 | 507 |
| WA | Garfield | | | None |
| WA | Walla Walla | Wheat | 232,419 | 116,210 |
| WA | Walla Walla | Barley | 22,584 | 11,292 |
| WA | Wallla Walla | Alfalfa | 10,411 | 5,206 |
| WA | Walla Walla | Hay | 224 | 112 |
| WA | Walla Walla | Corn | 8,062 | 4,031 |
| WA | Walla Walla | Outdr Plants | 2,706 | 1,353 |
| WA | Pacific | Hay | 1,798 | 899 |
| WA | Pacific | Alfalfa | 5,619 | 2010 |
| WA | Skamania | Hay | 178 | 89 |
| WA | Whitman | | | None |

**4. Specific Conclusions for California and Pacific Northwest Steelhead and Salmon ESUs**

Bromoxynil is a chemical that has relatively high toxicity to aquatic organisms. Particularly in the Pacific Northwest it is available for use on many major crops, including wheat, barley, and corn. Actual practice, as indicated in the RED for bromoxynil, is probably far lower than the estimates presented in this review. The potential, however, under current labels and guidelines, is significant. Use at the maximum rates and on major portions of these large crops could, in many ESU's, have an effect on the species of concern.

In large measure the effects of bromoxynil are time dependant. It is short lived in the aqueous environment (<12 hours). However, due to high acute toxicity, if used and allowed to reach sensitive areas, it could affect the regions and species of concern. Intragraval development, the presumed most sensitive time in salmonid development, occurs from August or September through January for most species of concern. Sockeye salmon and Chum salmon extend this period to April or May (Johnson, DH, 2001; Williams *et al* 1975). There are, however,no specific controls on when growers might choose to apply this product, although it is most likely a pre-plant or early post-emergemce treatment mainly used the spring. Fall application for sites such as winter wheat are possible. The potential application times, spring and fall, clearly overlap many of the sensitive periods in salmon and steelhead presence. In the Pacific Northwest specific data are not available on exact total usage but the maximum rate of 0.5 lbs a.i./A is an acceptable practice and was used to make determinations of risk. Bromopxynil is used both east and west of the Cascades, however its poor performance on many problem weeds suggests it is not a major herbicide in the PNW. Guidelines for winter wheat west of the Cascade Mountains are 0.375 - 0.5 lbs a.i./A, with total application not to exceed 0.5 lbs a.i/A (J. Colquhoun). For spring wheat and oats the rate is 0.38 - 0.5 lbs a.i./A (J. Ynish , D. Marishita). Bromoxynil is considered a good product east of the Cascades,where similar rates are used. When formulated with decabra it is considered an excellent agent. The product is not recommended in western Washington. In alfalfa the rate is 0.25 - 0.35 lbs a.i./A or 0.5 lbs a.i./A if applied through irrigation (B. Parker). It is used only for control of broadleaf weeds.

In large measure the concerns regarding use of this product in the identified ESU's relate to potential high quantities and the relatively high acute toxicity of the chemical. It is also noted that the designation of specific salmon runs is actually only a reference to adult migrations. Salmon and steelhead, at various stages of development, are in the waters covered by the ESU designation throughout the year. The determinations listed below reflect concern for early development times, particularly pre-emergent fry (Johnson, DH 2001).

**Table 49: Summary of Findings for California and Pacific Northwest Salmon and Steelhead ESUs**

| Species | ESU | Finding |
|---|---|---|
| Steelhead | Southern California | May Affect, but Not Likely to Adversely Affect |
| Steelhead | South-Central California Coast | May Affect, but Not Likely to Adversely Affect |

| | | |
|---|---|---|
| Steelhead | Central California Coast | May Affect, but Not Likely to Adversely Affect |
| Steelhead | Central Valley California | May Affect, but Not Likely to Adversely Affect |
| Steelhead | Northern California | No Effect |
| Steelhead | Upper Columbia River | May Affect |
| Steelhead | Snake River Basin | May Affect |
| Steelhead | Upper Willamette River | May Affect |
| Steelhead | Lower Columbia River | May Affect |
| Steelhead | Middle Columbia River | May Affect |
| Chinook Salmon | Sacramento River winter run | May Affect, but Not Likely to Adversely Affect |
| Chinook Salmon | Snake River fall run | May Affect |
| Chinook Salmon | Snake River spring/summer run | May Affect |
| Chinook Salmon | Central Valley spring run | May Affect, but Not Likely to Adversely Affect |
| Chinook Salmon | California Coastal | No Effect |
| Chinook Salmon | Puget Sound | May Affect, but Not Likely to Adversely Affect |
| Chinook Salmon | Lower Columbia | May Affect, but Not Likely to Adversely Affect |
| Chinook Salmon | Upper Willamette | May Affect |
| Chinook Salmon | Upper Columbia | May Affect |
| Coho Salmon | Central California Coast | No Effect |
| Coho Salmon | Southern Oregon/Northern California | May Affect, but Not Likely to Adversely Affect |
| Coho Salmon | Oregon Coast | May Affect, but Not likely to Adversely Affect |
| Chum Salmon | Hood Canal summer run | May Affect, but Not Likely to Adversely Affect |

| | | |
|---|---|---|
| Chum Salmon | Columbia River | May Affect |
| Sockeye Salmon | Ozette Lake | No Effect |
| Sockeye Salmon | Snake River | May Affect |

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# Attachment 1
# Reregistration Eligibility Decision for Bromoxynil

# Attachment 2
# Sample Label
# Bromoxynil

# Attachment 3
# USGS Usage Map for Bromoxynil