Methomyl
Analysis of Risks
to
Endangered and Threatened Salmon and Steelhead

March 31, 2003

William Erickson, Ph.D. and Larry Turner, Ph.D.
Environmental Field Branch
Office of Pesticide Programs

Summary

Methomyl is a carbamate insecticide (ovicide/larvacide/adulticide) registered nationally for control of insects on a wide range of field, fruit, and vegetable crops, sod farms, and as a commercial fly bait. Methomyl is moderately to highly toxic to fish and is mostly highly to very highly toxic to aquatic invertebrates. A Reregistration Eligibility Decision (RED) that includes an ecological risk assessment for freshwater and estuarine fish and aquatic invertebrates was issued in December of 1998. The highest risk is to aquatic invertebrates, but the level of concern for endangered fish is exceeded for most use sites. Reduction in populations of aquatic invertebrates might adversely affect the food supply of listed Pacific salmon and steelhead. Chronic risks to fish and aquatic invertebrates also is presumed for those situations where chronic exposure might occur, such as in standing waters into which runoff may occur. Some mitigation measures were required by the RED, including the requirement for a set-back distance from surface waters for all agricultural applications. This buffer (25 feet for ground applications, 150 to 450 feet for aerial applications) is now reflected on product labels. However, we are unable to quantify reductions in aquatic estimated environmental concentrations that may result from applicators adhering to a no-spray buffer.

We conclude that methomyl may affect 24 Evolutionarily Significant Units (ESUs) but will have no effect on two ESUs. These determinations are based on the extent of crop acreage potentially treated in counties within an ESU, possible adverse direct effects of methomyl on fish, and potential adverse effects on the aquatic invertebrate food supply of listed steelhead and salmon. Major uncertainties in this analysis include lack of statewide and county-level usage information for ESUs in Oregon, Washington, and Idaho and the impact of buffers in limiting runoff and drift of methomyl into surface waters adjacent to treatment sites.

Introduction

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

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

Contents

1. Background

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

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

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

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

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

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

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

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

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

Inert Ingredients - OPP does take into account the potential effects of what used to be termed "inert" ingredients, but which are beginning to be referred to as "other ingredients". OPP has classified these ingredients into several categories. A few of these, such as nonylphenol, can no longer be used without including them on the label with a specific statement indicating the potential toxicity. Based upon our internal databases, we 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. We 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. We 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. We do note, however, that we do not have aquatic data on most formulated products, although we often have testing on one or perhaps two formulations of an active ingredient.

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

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

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

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

One area of significant weakness in modeling EECs relates to residential uses, especially by homeowners, but also to an extent by commercial applicators. There are no usage data in OPP that relate to pesticide use by homeowners on a geographic scale that would be appropriate for an assessment of risks to listed species. For example, we may know the maximum application rate for a lawn pesticide, but we do not know the size of the lawns, the proportion of the area in lawns, or the percentage of lawns that may be treated in a given geographic area. There is limited information on soil types, slopes, watering practices, and other aspects that relate to transport and fate of pesticides. We do know that some homeowners will attempt to control pests with chemicals and that others will not control pests at all or will use non-chemical methods. We would expect that in some areas, few homeowners will use pesticides, but in other areas, a high percentage could. As a result, OPP has insufficient information to develop a scenario or address the extent of pesticide use in a residential area. It is also important to note that pesticides used in urban areas can be expected to transport considerable distances if they should run off on to concrete or asphalt, such as with streets (e.g., TDK Environmental, 1991). This makes any quantitative analysis very difficult to address aquatic exposure from home use. It also indicates that a no-use or no-spray buffer approach for protection, which we consider quite viable for agricultural areas, may not be particularly useful for urban areas.

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

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

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

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

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

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

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

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

Table 2. Risk-quotient criteria for fish and aquatic invertebrates

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

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

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

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

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

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

2. Description and use of methomyl

Methomyl is a carbamate insecticide (ovicide/larvacide/adulticide) registered nationally for control of insects on a wide range of field, fruit, and vegetable crops and on sod-farm turf. It is also registered as a commercial fly bait. There are no homeowner uses. Methomyl is primarily a contact insecticide that gives rapid knockdown and also provides short-term effects from the ingestion of treated foliage. Currently, 10 products are registered under Section 3 of FIFRA. End-use formulations include soluble concentrate, wettable powder, granular, pelleted/tableted, and water soluble packaged. Products registered as fly baits also contain (Z)-9-tricosene (0.04 to 0.26% ai) as an active ingredient; labels note that these products contain a sex attractant and feeding synergist. Eighteen additional methomyl products are registered to individual states under Special Local Needs (SLN) provisions in Section 24(c) of FIFRA. California has seven SLNs for use to control insects on ornamentals, beans, soybeans, radishes, sweet potatoes, Chinese broccoli, broccoli raab, and pumpkins. Oregon, Washington, and Idaho do not have any SLNs for methomyl. Methomyl also was previously registered as a molluscide to control snails and slugs and as a fungicide for control of blights, rots, mildews and other fungal diseases. Those uses, as well as uses on ornamentals and in greenhouses, have been canceled.

Methomyl also is a degradate of thiodicarb, a registered insecticide. Potential adverse affects due to exposure of listed salmonids from methomyl's occurrence as a thiodicarb degradate is not addressed here but are discussed in the thiodicarb analysis, which is being developed concurrently.

Methomyl products for agricultural use are registered as restricted use products that can be applied only by certified applicators or someone under their supervision. Methomyl can be applied by air or ground for most agricultural uses (apples and blueberries by ground application only). Fly baits are labeled for commercial use only. Application rates for the various use sites were obtained from product labels and are summarized in Table 3. Additional use directions, restrictions, and precautions are specified on the product labels (attached).

Table 3. Methomyl use sites and application information (source: product labels)

Use site	Max. single appl. rate (lb ai/acre)	Max. no. appl. per crop/year[a]	Max. lb ai per crop/year
Cabbage, Lettuce (head)	0.9	15[b]	7.2
Cauliflower, Celery, Chinese cabbage	0.9	10[b]	7.2
Sweet corn	0.45	28[c]	6.3
Tomatoes	0.45	16	6.3
Broccoli, Carrots	0.9	10[b]	6.3
Cucumber, Melons, Squash (summer)	0.9	12	5.4
Brussel sprouts	0.9	10[b]	5.4
Onions (green), Collards	0.9	8	5.4

Use site	Max. single appl. rate (lb ai/acre)	Max. no. appl. per crop/year[a]	Max. lb ai per crop/year
Peaches	0.9	6	5.4
Beans, Eggplant, Peppers, Potatoes, Strawberries, Sugarbeets, Anise	0.9	10	4.5
Asparagus, Endive, Escarole	0.9	8	4.5
Apples[d], Grapes	0.9	5[e]	4.5
Alfalfa	0.9	10	3.6
Beets (table), Leafy green vegetables, Spinach, Onions (dry)	0.9	8[e]	3.6
Blueberries[d]	0.9	4	3.6
Turf (sod farms only)	0.9	4	3.6
Peas, Garlic	0.9	6[f]	2.7
Oranges, Lemons, Grapefruit, Tangelo, Tangerine	0.9	4	2.7
Nectarine	0.9	3	2.7
Field corn, Pop corn	0.45	10	2.25
Cotton	0.675	8[f]	1.8
Barley, Oats, Rye, Wheat, Mint	0.45	4	1.8
Pears, Pomegranates, Chicory	0.9	2	1.8
Soybeans	0.45	3	1.35
Bermudagrass pasture	0.9	4	0.9
Avocado, Lentils, Sorghum	0.9	2	0.9
Fly control (commercial establishments)	applied in bait stations, as scatter baits, or as a brush-on paste		

[a] the minimum interval between treatments is 5 to 7 days, except as noted
[b] the minimum interval between treatments is 2 days for broccoli, brussels sprouts, cabbage, cauliflower, and lettuce
[c] the minimum interval between treatments is 1 day for sweet corn
[d] application to apples and blueberries is by ground only
[e] the minimum interval between treatments is 7 days for apples and bulb onions
[f] the minimum interval between treatments is 3 days for peas and cotton

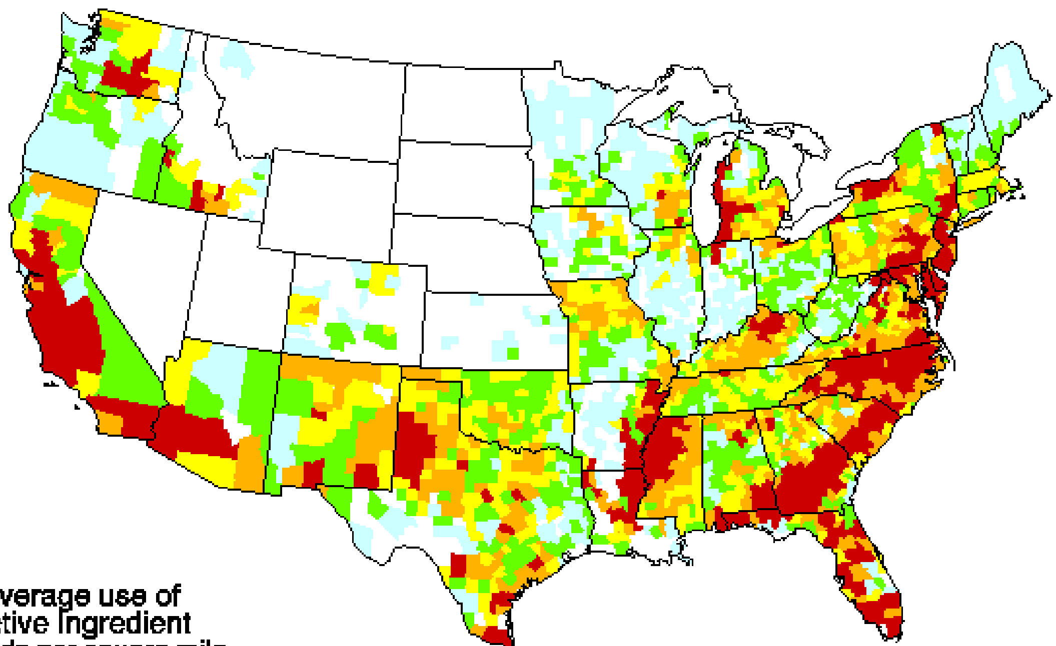
We have no recent national data on the amount of methomyl applied annually. According to the 1998 RED, an estimated 2.5 to 3.5 million pounds of methomyl active ingredient were applied annually in the U.S. between 1987 and 1995. Methomyl is used on many crops, but those with most use (total lb ai) nationwide during that period were lettuce, sweet corn, cotton, tomatoes, and cabbage. Some data from the 1990s also are available from the U.S. Geological Survey

(USGS). The USGS estimated county pesticide use for the conterminous United States by combining (1) state-level information on pesticide use rates available from the National Center for Food and Agricultural Policy from pesticide use information collected by state and federal agencies over a 4-year period (1992–1995), and (2) county-level information on harvested crop acreage from the 1992 Census of Agriculture. The average annual pesticide use, the total amount of pesticide applied (in pounds), and the corresponding area treated (in acres) were compiled for 208 pesticide compounds that are applied to crops in the conterminous United States. Pesticide use was ranked by compound and crop on the basis of the amount of each compound applied to 86 selected crops. Their data indicate that the crops of highest methomyl usage during the mid-1990s were cotton (~410,000 lb ai), sweet corn (~315,000 lb ai), and lettuce (~248,000 lb ai). USGS also mapped methomyl use on selected crops (Figure 1). This map is included here as a quick and easy visual depiction of where methomyl may have been used on agricultural crops. However, it should not be used for any quantitative analysis, because it is based on 1992 crop acreage data and was developed from 1990-1995 statewide estimates of use that were then applied to that county acreage without consideration of local practices and usage.

Figure 1. USGS Map for Methomyl (http://ca.water.usgs.gov/pnsp/use92/index.html)

METHOMYL

ESTIMATED ANNUAL AGRICULTURAL USE



Crops	Total Pounds Applied	Percent National Use
cotton	409, 821	16. 73
sweet corn	315, 003	12. 86
lettuce	247, 866	10. 12
apples	153, 951	6. 28
alfalfa hay	122, 379	5. 00
corn	116, 553	4. 76
peanuts	99, 489	4. 06
tomatoes	94, 352	3. 85
sorghum	88, 785	3. 62
grapes	75, 880	3. 10

At the state and county level, more data are available for methomyl use in California than in Oregon, Washington, and Idaho. California requires full pesticide-use reporting by most applicators (excluding homeowners), and the California Department of Pesticide Regulation (DPR) provides the information at the county level (www.cdpr.ca.gov/docs/pur/purmain.htm). The amount of active ingredient applied and the number of acres treated from 1997 through 2001 is presented in Table 4. Usage by crop in 2000 and 2001 is provided in Table 5. We also have included usage by crop for 1997 to indicate where the decline in usage has occurred in the past five years. Usage has declined markedly in some crops, notably cotton, broccoli, head lettuce, alfalfa, and tomatoes. According to the DPR's 2001 Summary of Pesticide Use Report Data, reduction in the use of methomyl occurred as growers began rotating in some of the newer reduced-risk pesticides. County-level usage information is not provided here but is tabulated in section "4" where we address the potential for exposure of individual steelhead and salmon ESUs. We do not know if nationwide usage of methomyl has declined as it has in California.

Table 4. Reported pounds of methomyl (active ingredient) used and acreage treated in California from 1997 to 2001 (source: California DPR Pesticide Use Report)

Usage	1997	1998	1999	2000	2001
Lb ai applied	833,758	666,442	551,181	550,591	378,302
Acres treated	1,376,868	1,118,188	880,910	893,424	627,220

Table 5. Major crop uses of methomyl in California in 1997, 2000, and 2001 (source: California DPR Pesticide Use Report)

Use site	1997		2000		2001	
	lb ai applied	acres treated	lb ai applied	acres treated	lb ai applied	acres treated
Alfalfa	152,612	290,637	91,891	183,762	79,681	155,411
Lettuce, head	129,913	192,885	91,805	123,647	57,105	83,453
Lettuce, leaf	36,668	59,663	29,845	46,131	22,554	35,426
Tomatoes	87,673	130,335	79,692	128,476	32,479	50,616
Grapes	38,486	58,689	37,346	51,082	32,224	38,903
Corn[a]	33,471	76,005	28,497	66,437	24,615	56,867
Sugarbeets	49,362	93,969	27,330	48,836	17,537	33,162

Use site	1997		2000		2001	
	lb ai applied	acres treated	lb ai applied	acres treated	lb ai applied	acres treated
Strawberries	12,595	14,441	13,227	16,364	11,997	14,918
Cantaloupe	10,788	19,512	13,052	21,165	10,627	17,056
Celery	25,652	32,881	15,636	20,027	9182	12,419
Melons	4315	9305	5976	11,986	7255	11,566
Beans, dry	10,852	22,379	10,209	19,402	6775	11,668
Onion, dry	9697	13,267	11,571	15,411	5121	7971
Peppers[b]	10,999	18,320	9557	14,648	5600	8937
Cotton	79,899	130,821	7313	12,340	3346	5627
Broccoli	27,036	36,623	5415	8750	3188	5806
Others[c]	123,437	190,403	84,390	120,371	54,137	85,385

[a] corn grown for human consumption
[b] fruiting peppers only
[c] includes asparagus, beets, corn (forage/fodder), cucumbers, nectarines, oranges, peaches, potatoes, pomegranates, spinach, sudangrass, watermelon, green onions, pumpkins, and a variety of other uses

We are not aware of any comprehensive sources of annual pesticide-use information for Oregon, Washington, or Idaho. Oregon is attempting to implement full pesticide-use reporting but has not yet done so. Information for selected crops in Washington is available from the USDA/NASS Washington Agricultural Statistics Service (www.nass.usda.gov/wa), but the data are not reported at the county level. State-wide pesticide use was reported for green peas, asparagus, onions, carrots, lima beans, sweet corn, potatoes, apples, grapes, pears, sweet cherries, and strawberries. Methomyl was not reported to have been used on any of these crops in 2000 or 2001, although about 300 lb ai was used on 1% of the green pea acreage in 1998. We can find no additional data on usage or sales of methomyl, nor has any information been provided to us by the registrant.

a. Aquatic toxicity of methomyl

The acute toxicity data for freshwater fish indicate that technical-grade methomyl is moderately to highly toxic to a variety of fish tested (Table 6) and is highly to mostly very highly toxic to aquatic invertebrates (Table 7). Additional testing indicates that the formulations tested (24% and 29% ai) also were moderately to highly toxic to fish and highly to very highly toxic to invertebrates. These formulated product data are within the expected range of variation and indicate no significant effects from ingredients other than the active ingredient methomyl. A degradate (thiolacetohydroxamic acid, 5-methyl ester) also was tested and found to be practically nontoxic to the bluegill.

Table 6. Acute toxicity of methomyl to freshwater fish (source: EFED Pesticide Ecotoxicity Database)

Species	Scientific name	% ai	96-h LC50 (ppb)	Toxicity category
Rainbow trout	*Oncorhynchus mykiss*	98.7	1600	moderately toxic
		95	860	highly toxic
		90	2400	moderately toxic
		29	1200	moderately toxic
		24	1400	moderately toxic
		24	3200	moderately toxic
Bluegill sunfish	*Lepomis macrochirus*	98.7	1880	moderately toxic
		95	480	highly toxic
		29	670	highly toxic
		24	370	highly toxic
		24	7700	moderately toxic
		degradate[a]	462,000	practically nontoxic
Channel catfish	*Ictalurus punctatus*	95	530	highly toxic
		24	300	highly toxic
		29	320	highly toxic
Largemouth bass	*Micropterus salmoides*	95	1250	moderately toxic
		24	760	highly toxic
Brook trout	*Salvelinus fontinalis*	99	1500	moderately toxic
		24	1200	moderately toxic
Atlantic salmon	*Salmo salar*	99	560	highly toxic
		29	1200	moderately toxic
		24	1400	moderately toxic
Brook trout	*Salvelinus fontinalis*	95	1500	moderately toxic

Species	Scientific name	% ai	96-h LC50 (ppb)	Toxicity category
		24	2200	moderately toxic
Fathead minnow	*Pimephales promelas*	95	2800	moderately toxic
		29	1500	moderately toxic
		24	1800	moderately toxic
Cutthroat trout	*Oncorhynchus clarki*	95	6800	moderately toxic

[a] thiolacetohydroxamic acid, 5-methyl ester

Table 7. Acute toxicity of methomyl to freshwater invertebrates (source: EFED Pesticide Ecotoxicity Database)

Species	Scientific name	% ai	48-h EC50 or LC50 (ppb)	Toxicity category
Water flea	*Daphnia magna*	99	31.7	very highly toxic
		95	8.8	very highly toxic
		95	28.7	very highly toxic
		24	7.6 (96 h)	very highly toxic
Scud	*Gammarus pseudolimnaeus*	99	920 (96 h)	highly toxic
		24	720 (96 h)	highly toxic
Stone fly nymph	*Skwala* sp.	95	34 (96 h)	very highly toxic
		24	29 (96 h)	very highly toxic
Stone fly nymph	*Pteronarcella badia*	95	69 (96 h)	very highly toxic
		24	60 (96 h)	very highly toxic
Stone fly nymph	*Isogenus* sp.	95	343 (96 h)	highly toxic
		24	29 (96 h)	very highly toxic

Species	Scientific name	% ai	48-h EC50 or LC50 (ppb)	Toxicity category
Midge	*Chironomus plumosus*	95	88 (96 h)	very highly toxic
		24	32 (96 h)	very highly toxic

Adverse chronic effects on reproduction or growth of freshwater fish and invertebrates occurred at exposure concentrations of 117 ppb for fish and 0.8 ppb for the water flea (Table 8). Test organisms in these studies were continuously exposed to the test material for periods of 3 weeks or more.

Table 8. Chronic toxicity of methomyl to freshwater fish and invertebrates (source: EFED Pesticide Ecotoxicity Database)

Species	Scientific name	% ai	test duration (days)	Endpoints affected	NOEC / LOEC (ppb)
Fathead minnow	*Pimephales promelas*	technical	28	larval survival	57 / 117
		98.4	193	growth	76 / 142
Water flea	*Daphnia magna*	technical	21	no. young per female	0.4 / 0.8
		99	28	reproduction	1.6 / 3.1

The available acute toxicity categorize technical-grade methomyl as moderately toxic to estuarine fish and as mostly moderately to very highly toxic to estuarine invertebrates (Table 9). However, a shell deposition study with the Eastern oyster indicated no toxicity to that species. Except for the oyster, toxicity values for estuarine organisms are comparable to those for freshwater organisms. We do not know why an active ingredient previously registered to control terrestrial snails and slugs can be practically nontoxic to oysters, but it might relate to the route of exposure (aquatic versus direct exposure). Two tests using a formulation indicated comparable or less toxicity than that of the technical material.

Table 9. Aquatic organisms: acute toxicity of methomyl to estuarine fish and invertebrates (source: EFED Pesticide Ecotoxicity Database)

Species	Scientific name	% ai	96-h LC50 or EC50 (ppb)	Toxicity category
Sheepshead minnow	*Cyprinodon variegatus*	98.4	1160	moderately toxic

Species	Scientific name	% ai	96-h LC50 or EC50 (ppb)	Toxicity category
Grass shrimp	*Palaemonetes vulgaris*	90	49	very highly toxic
		30	130	highly toxic
Mysid	*Mysidopsis bahia*	98.4	230	highly toxic
Pink shrimp	*Penaeus duorarum*	90	19	very highly toxic
Mud crab	*Neopanope texana*	90	410	highly toxic
Fiddler crab	*Uce pugilator*	30	2380	moderately toxic
Eastern oyster (shell deposition)	*Crassostrea virginica*	98.4	>140,000	practically nontoxic

Adverse chronic effects on reproduction or growth of estuarine fish and invertebrates occurred at exposure concentrations of 490 ppb for fish and 29 ppb for the mysid shrimp (Table 10). Test organisms in these studies were continuously exposed to the test material for periods of 4 to 5 weeks.

Table 10. Chronic toxicity of methomyl to estuarine fish and invertebrates (source: EFED Pesticide Ecotoxicity Database)

Species	Scientific name	% ai	test duration (days)	endpoints affected	NOEC / LOEC (ppb)
Sheepshead minnow	*Cyprinodon variegatus*	98.6	36	reproduction and/or growth	260 / 490
Mysid shrimp	*Mysidopsis bahia*	98.6	28	reproduction and/or growth	29 / 59

As discussed in the methomyl RED, an outdoor microcosm study was conducted in 1992 to evaluate the effects of methomyl on populations of zooplankton, phytoplankton, macroinvertebrates, and bluegill sunfish. Methomyl was applied to seven treatment groups over a period of 22 days. Two application rates were used at three different application intervals. The dosing regime was based on extreme estimates of potential loading in natural aquatic ecosystems. No methomyl-related treatment effects were observed for bluegill or phytoplankton populations. Decreases in abundance of Cladocera zooplankton populations occurred, but populations of Copepoda and Rotifera increased in abundance possibly because of decreased competition with Cladocera. Macroinvertebrate (Ephemeroptera) abundance decreased in the two highest treatment groups. Decreases in abundance of Chironomidae also occurred but were very short-lived and not dose related, and they could not be attributed to methomyl exposure. The study was conducted in a closed system and might not be readily applicable to an open system. The results of this study did not change the risk conclusions in the environmental risk assessment in the RED.

b. Environmental fate and transport

Methomyl appears to be moderately persistent and highly mobile. The dominant routes of dissipation appear to be metabolism (biologically-mediated degradation), leaching, and photolysis in clear waters. Site-specific factors affecting the persistence of methomyl include aerobicity, organic matter and soil moisture content, exposure to sunlight, pH, climate (especially rainfall) and crop management factors that influence leaching and runoff. The basic chemical and fate properties of methomyl are summarized below. Additional details can be found in the attached RED.

Molecular weight:	162.2
Water solubility (25°C):	58,000 ppm
Vapor pressure:	1×10^{-5} mM Hg
Henry's Law constant:	1.8×10^{-10} atm-m^3/mol
Hydrolysis ($t_{1/2}$):	pH 5: stable
	pH 7: stable
	pH 9: 30 days
Aqueous photolysis ($t_{1/2}$):	1 day
Soil Photolysis ($t_{1/2}$):	36 days
Aerobic soil metabolism ($t_{1/2}$):	11 to 45 days
Anaerobic aquatic metabolism ($t_{1/2}$):	<7 to 14 days
K_{oc}:	24

Methomyl photolyzes quickly in water but slowly in soils. It is moderately stable to aerobic soil metabolism but degrades more rapidly under anaerobic conditions. While methomyl becomes more susceptible to hydrolysis as the pH increases above neutral, this is not expected to be a major route of dissipation under most circumstances. Laboratory studies show that methomyl does not readily adsorb to soil and has the potential to be very mobile. Dissipation from the soil surface occurs by a combination of chemical breakdown and movement. Field studies show that the varying dissipation rates for methomyl were related primarily to differences in soil moisture content, which may affect the microbial activity, and rainfall/irrigation, which could influence leaching.

Several degradates have been identified. The major degradate in most metabolism studies was CO_2. Another degradate, S-methyl-N-hydroxythioacetamidate, which is highly mobile, appears to be primarily a product of alkaline hydrolysis. In an aquatic metabolism study, methomyl degraded with estimated half-lives of 4-5 days. After 7 days, acetonitrile comprised a maximum of 17% and acetamide up to 14% of the amount of methomyl applied. After 102 days, volatilized acetonitrile totaled up to 27% of the applied and $^{14}CO_2$ up to 46% of the applied material. We found no evidence in the RED or elsewhere that any of these degradates have been flagged for toxicological concern.

The low octanol/water partition coefficient (K_{ow} ranges from 1.29 to 1.33) suggests that methomyl will not accumulate in fish.

c. Incidents

OPP maintains two databases of reported incidents. The Ecological Incident Information System (EIIS) contains information on environmental incidents which are provided voluntarily to OPP by state and federal agencies and others. There have been periodic solicitations for such information to the states and the U. S. Fish and Wildlife Service. The second database is a compilation of incident information known to pesticide registrants and any data conducted by them that shows results differing from those contained in studies provided to support registration. These data and studies (together termed incidents) are required to be submitted to OPP under regulations implementing FIFRA section 6(a)(2).

We are aware of several incidents for methomyl, although only three involved aquatic organisms. In one incident in Georgia in 1992, about 125 fish, mostly bluegills, carp, and bowfin, were found dead in a pond and ditch located about 50 to 75 yards from a sweet corn field. The dead fish were found the day after the field was aerially treated with methomyl and another insecticide (Lorsban). The State of Georgia analyzed water samples from the pond and ditch and reported methomyl levels of 136 ppb in the pond and 44 ppb and 8 ppb at two sampling sites in the ditch. Little information is available on the other two incidents, both in California. One of those in 2001 reportedly involved several thousand dead catfish and shad. The other, in 1978, involved about 540 catfish and largemouth bass.

d. Estimated and measured concentrations of methomyl in surface waters

Estimated environmental concentrations (EECs)

In the environmental risk assessment in the RED, aquatic EECs were modeled for aerial application to several crop sites using PRZM/EXAMS scenarios. The crops include lettuce (2 application rates), sweet corn, peaches, and cotton. The EECs are presented in Table 11. However, as a mitigation measure required in the RED, the maximum application rate for peaches has been reduced from 1.8 lb ai/acre per application to 0.9 lb ai/acre per application; therefore, EECs for peaches should be 50% lower than tabulated. Also, the EECs for lettuce modeled for 9 lb ai/acre per year (0.9 lb ai/acre x 10 applications) may be overly conservative, because current labels allow no more than 8 applications at the 0.9 lb ai/acre rate. The usage data in Table 5 actually indicate that the average application to lettuce in California is less than 1 lb ai per acre per year.

Table 11. Estimated Environmental Concentrations (EECs) for Aquatic Exposure Modeled With PRZM/EXAMS for Aerial Application on Selected Crops

Use site	Appl. rate (lb ai/acre)	No. appl./appl. interval (days)	Peak EEC (ppb)	21-day-avg. EEC (ppb)	56-day-avg. EEC (ppb)
Lettuce	0.9	10[a] (2)	88	84	81
	0.225	15 (2)	30	28	26
Sweet corn	0.45	16 (1)	60	59	54
Peaches	1.8[b]	3 (5)	99	95	85
Cotton	0.6	3 (3)	55	52	47

[a] only 7.2 lb ai/acre is allowed on lettuce per crop season; therefore, no more than 8 applications may currently be made at the maximum single application rate of 0.9 lb ai/acre
[b] the current maximum application rate is 0.9 lb ai/acre for peaches

Measured Concentrations in Surface Water

Methomyl aquatic residue monitoring studies have been conducted in several states. The studies were associated with sweet corn in Illinois and Georgia, apples in Michigan, lettuce and tomatoes in Florida, and cantaloupe in California. The dissipation half-life from the soil surface ranged from 4 to 26 days in these studies. In at least one study, the dissipation rate increased greatly after rainfall events, suggesting that leaching may be a major route of dissipation. Foliar dissipation half-lives ranged from a few hours (on corn) to 4 days (on apples). Peak concentrations in adjacent water bodies at each site varied from approximately 2 to 175 ppb. Such variations would be expected because of differences in site characteristics, weather conditions, and cropping practices. At least under the conditions of the monitoring studies, spray drift appeared to be the primary source of methomyl residues reaching the surface waters. Runoff may be more of a contributing factor under site, soil, and weather characteristics that favor runoff. It should also be noted that these studies were conducted prior to the requirement for a buffer to reduce drift into surface waters.

CA cantaloupe: Two fields in Fresno were treated with 6 aerial applications of 0.90 lb ai/acre. One field was irrigated 5 times and the other 4 times. The half-life of methomyl in the soil was between 12 and 21 days in the period after the last application. The mean methomyl concentration measured in the surface waters receiving irrigation runoff was 0.86 to 4.6 ppb. Maximum concentrations leaving the two sites were 71 and 96 ppb. The total amount leaving the field as runoff was less than 0.2% of the amount applied.

Illinois sweet corn: Two sites were treated with 16 daily aerial applications of 0.45 lb ai/acre for a total of 7.2 lb ai/acre. Results indicated that 75-78% of the methomyl applied dissipated from foliage within 7.5 hours after application, and it dissipated in the soil with a half-life of 6.5 days. Maximum concentrations in canal water at two sites within or adjacent to treated fields were 5.0 to 26.5 ppb. Two additional sampling stations were located 180 m and 900 m from each treated site. Median concentrations at the downstream sites were below the limit of detection (LOD = 0.2 ppb). At site 1, where the canal flowed directly through the field, downstream concentrations showed four peaks above 10 ppb during the application period. These concentrations dropped to about 1 ppb within 3 days after the peak and then declined below the LOD. At the second site, where the canal ran adjacent to the treatment area, peak concentrations did not exceed 3 ppb and most were less than the LOD. These data suggest that methomyl concentrations in flowing waters may be somewhat less than PRZM/EXAMS estimates (60 ppb peak) for the farm-pond scenario.

Georgia Sweet Corn: The Georgia site planted to sweet corn included flumes, diversion walls, and ditches constructed to direct field runoff directly into a pond. The site was experimentally treated with 29 aerial applications of 0.3 to 0.5 lb ai/acre at 1-day intervals, for a total of 11.25 lbs. ai/acre. The average half-life of methomyl in soil was 9 days. Pond concentrations peaked 19 days into the application period and were at or near the LOD 16 days after the final application. Samples were collected from two stream stations as well as the pond. Methomyl concentrations in water samples collected from an adjacent stream ranged from 1.1 to 175 ppb. Median methomyl concentrations during the application period were 5.5, 3.4 and 0.95 ppb, respectively for the upstream, pond, and downstream stations. The 96-hour and 21-day average concentrations in the pond were 6.7 and 4.2 ppb, respectively. We note that these pond concentrations exceed those modeled for PRZM/EXAMS for loading from 6.3 lb ai per acre per year, which is the current maximum rate.

Michigan Apple Orchard: At the two sites in Michigan, apple orchards surrounded a pond on three sides at one site and all sides at the other. Each orchard received 5 applications of 1.35 lb ai/acre (total of 6.75 lb ai/acre) at 5-day intervals with an air blast sprayer. Median methomyl concentrations in soil ranged from 932 to 12,500 ppb. The half-life of methomyl in soil was 26 days during a dry period, decreasing to 8 days after rainfall events. Half-life of methomyl residues on apple foliage was 4 days. Only 19 to 50% of the total methomyl applied actually reached spray drift cards on-site. The most noticeable increase in methomyl concentration in pond water was associated with the application day which had the highest wind speeds. Deposition cards placed on the surface of the pond showed that the pond received between 0.2 to 0.44% of the application rate. Methomyl concentrations in water leaving the field ranged from 300 to 1320 ppb during the application period and <20 ppb 2 to 3 weeks later. Median methomyl concentrations in the pond water ranged from 0.16 to 13.3 ppb during the application period, dropping below the quantification limit (0.2 ppb) within 9 to 30 days after the final application. The registrant concluded that spray drift was the primary source of methomyl in the pond.

Florida Lettuce: Two fields in the Lake Apopka area of Florida were treated with 10 aerial applications of 0.9 lb ai/acre at 2-day intervals (total of 9.0 lb ai/acre). Methomyl dissipated rapidly from the surface layer ($t_{1/2}$=4-5 days) and slower from deeper soil layers ($t_{1/2}$=8-10 days). Median methomyl concentrations were 16 and 47 ppb in lateral canals and 3 and 6 ppb in main canals. The peak 96-hour and 21-day average concentrations reaching Lake Apopka were 0.8 and 0.3 ppb, respectively. The highest measured concentration entering the lake was 1.7 ppb immediately after the canals were pumped down in expectation of a rain storm; this fell below the limit of quantification within 6 days. Concentrations in the lake were generally two orders of magnitude less than those of the canals.

Florida Tomato: A study was conducted on tomatoes grown using plastic cover to reduce weed competition to determine the amount of methomyl run-off likely to occur under this cultivation practice. A total of five foliar applications were made over two months (0.81 lb ai/acre for applications 1 and 5, and 0.45 lb ai/acre for applications 2,3, and 4). The calculated half-life of methomyl on the plastic mulches was approximately 6 hours. The short half-life suggests that the potential for accumulation on plastic ground cover or runoff is low.

Few other monitoring data are available. The South Florida Water Management District (SFWMD) collected samples every two to three months from 27 surface water sites from November 1988 through November 1993 and analyzed them for multiple pesticides. Methomyl was detected (detection limits ranging from 1.9 to 20 ppb) in one sample at a concentration of 1.9 ppb. In 1994, Washington state collected surface water samples in April, June, and October from 8 sites (24 total samples) and analyzed them for multiple pesticides including methomyl. Methomyl was not detected in any of the samples above an approximate quantification limit of 0.04 ppb. However, methomyl was detected at a concentration of 0.088 ppb in a 1993 sample collected from a site (Salmon Creek) that was not sampled in 1994. Neither study indicated whether the samples were taken in major methomyl use areas, and detections are not related to actual methomyl usage.

According to the environmental risk assessment, a search of STORET for methomyl in surface water revealed 9 detections in 3849 samples collected from 37 states. Detections were reported in California (5 detects ranging from 0.13 to 0.67 ppb), Texas (3 detects from 0.12 to 1 ppb), Pennsylvania (0.19 ppb), and Washington (0.9 ppb). Most of the detection limits were below 1 ppb.

e. Changes in registration status

The methomyl RED issued in December of 1998 required several mitigation measures to reduce risks to freshwater invertebrates and mammals. These include the following:

- the seasonal application rate for broccoli, cabbage, cauliflower, celery Chinese cabbage, sweet corn, head lettuce, and tomatoes was reduced from a maximum of 7.2 to 9 lb ai/acre, depending on the crop, to 6.3 to 7.2 lb ai/acre

- the maximum single application rate for peaches and sod was reduced from 1.8 lb ai/acre to 0.9 lb ai/acre

- label statements were required to minimize the potential for ground water and surface water contamination (see "g. Existing protection measures")

- label statements were required to state the toxicity of methomyl to bees and other nontarget organisms (see "g. Existing protection measures")

- measures were required to reduce the potential for spray drift during aerial or ground applications; these restrictions include buffer zones (see "g. Existing protection measures")

- a statement supporting the use of an Integrated Pest Management plan was added to product labels (see "g. Existing protection measures")

- maintaining restricted use classification for all products except the 1% fly baits; products labeled for restricted use can be purchased and applied only by certified (i.e., trained) applicators or persons under their supervision

- molluscide uses (snails, slugs) also have been canceled since the RED was issued

f. General risk conclusions

According to the environmental risk assessment in the RED, RQs exceed the acute LOC for freshwater and/or estuarine fish for all modeled use sites (Table 12). Acute RQs for aquatic invertebrates were much higher and exceeded the LOC for aquatic-invertebrate population effects by 3- to 22-fold. These acute RQs indicate both possible direct effects on listed steelhead and salmon as well as potential adverse effects on their aquatic-invertebrate food supply. Chronic LOCs are only slightly exceeded for endangered fish, but chronic exposure may be considerably less in steelhead and salmon streams than in the modeled farm pond. However, the high exceedance of the chronic LOC for aquatic inverebrates indicates that their populations might be at risk in stagnant waters where chronic exposure is most likely. This could exacerbate reductions in the food supply of the listed salmonids.

Table 12. Acute and Chronic Risk Quotients for Freshwater and Estuarine Fish and Aqautic Invertebrates, Based on Toxicity for the Most Sensitive Species (Tables 6 to 10) and EECs Modeled from PRZM/EXAMS (Table 11)

Use site	appl. rate (lb a i/ acre) x no. appl.	freshwater fish[a]	freshwater invertebrates[b]	estuarine fish[c]	estuarine invertebrates[d]
Acute RQ[e]					
Lettuce	0.9 x 10	0.18	10.0	0.08	4.6
	0.225 x 15	0.06	3.4	0.03	1.6
Sweet corn	0.45 x 16	0.12	6.8	0.05	3.2
Peaches	1.8 x 3	0.20	11.2	0.09	5.2
Chronic RQ[f]					
Lettuce	0.9 x 10	1.5	140	no data	
	0.225 x 15	0.5	46		
Sweet corn	0.45 x 16	1.0	98		
Peaches	1.8 x 3	1.7	158		

[a] catfish LC50 = 500 ppb and fathead minnow NOEC = 57 ppb
[b] water flea EC50 = 8.8 ppb and NOEC = 0.6 ppb
[c] sheepshead minnow LC50 = 1160 ppb
[d] pink shrimp LC50 = 49 ppb
[e] peak EEC/LC50 or EC50
[f] 60-day-average EEC for fish and 21-day-average EEC for invertebrates

Based on the available data, we believe that listed salmonids may be at direct risk from exposure to methomyl. They also may be at indirect risk from possible depletion of their aquatic-invertebrate food supply. However, we note that a set-back distance is now required for all agricultural applications of methomyl. PRZM/EXAMS does not account for a buffer when estimating aquatic concentrations, and we cannot quantify the extent to which EECs might decrease as the result of not spraying immediately adjacent to surface waters. The available monitoring data were obtained prior to a requirement for a buffer. Qualitatively, we expect exposure and risk to be reduced to some extent from the requirement that ground applicators not spray within 25 feet of surface water and aerial applicators not spray within 150 feet (450 feet for ULV sprays). However, lacking any quantification of reduced aquatic concentrations, we do not know whether such a no-spray buffer is sufficiently protective of endangered fish and their food supply.

g. Existing protective measures

Nationally, there are no specific protective measures for endangered and threatened species beyond the generic statements on the current methomyl labels. As stated on all product labels, it is a violation of Federal law to use a product in a manner inconsistent with its labeling. FIFRA section 3 labels for agricultural uses of methomyl warn that "This pesticide is toxic to fish, aquatic invertebrates, and mammals." and requires that applicators adhere to the following:

> "Do not apply directly to water or to areas where surface water is present or to intertidal areas below the mean-high water mark. Drift and runoff may be hazardous to aquatic organisms in neighboring areas. Do not contaminate water when disposing of equipment washwater or rinsate."

The "ENVIRONMENTAL HAZARDS" statement on the product label also warn that methomyl is highly toxic to bees and should not be allowed to drift to blooming crops or weeds while bees are visiting the treatment area. It also warns that this chemical may leach and contaminate groundwater where soils are permeable and the water table is shallow. Surface water can be contaminated through spray drift. Under some conditions, methomyl may have a high potential for runoff into surface water for several days to weeks after application. Such conditions might include poorly drained soils, frequently flooded areas, areas with ditches draining into surface waters, and others.

SPRAY DRIFT MANAGEMENT and AERIAL DRIFT REDUCTION ADVISORY INFORMATION sections also are included on the product label (see attached labels) to provide advice to applicators to help reduce spray drift from treatment sites.

The RED also required a buffer to reduce movement of methomyl into water. The USE DIRECTIONS for agricultural product labels specify the following:

> "Do not apply by ground equipment within 25 feet, or by air within 100 feet of lakes, reservoirs, rivers, estuaries, commercial fish ponds and natural, permanent streams, marshes or natural, permanent ponds. Increase the buffer zone to 450 feet from the above aquatic areas when ultra low volume application is made."

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

In California, the Department of Pesticide Regulation (DPR) in the California Environmental Protection Agency creates county bulletins consistent with those developed by OPP. However, California also has a system of County Agricultural Commissioners responsible for pesticide regulation. All commercial applicators must get a permit for the use of any restricted use pesticide and must report all pesticide use. The California bulletins for protecting endangered species have been in use for about 5 years. The Agricultural Commissioners strongly promote their use by pesticide applicators and, before issuing a permit for use of a restricted use product, may require that applicators follow the recommendations in the bulletins. DPR believes that the vast majority of agricultural applicators in California are following the limitations in the bulletins (Richard Marovich, Endangered Species Project, DPR, telephone communication, July 19, 2002).

The California bulletins include salmon and steelhead locations, and methomyl is listed as an aquatic hazard. To protect endangered aquatic organisms, the use limitations specified below are recommended:

> "Do not use in currently occupied habitat (see Species Descriptions for possible exceptions)."
>
> "For sprayable or dust formulations: when the air is calm or moving away from habitat, commence applications on the side nearest the habitat and proceed away from the habitat. When air currents are moving toward habitat, do not make applications within 200 yards by air or 40 yards by ground upwind from occupied habitat. The county agricultural commissioner may reduce or waive buffer zones following a site inspection, if there is an adequate hedgerow, windbreak, riparian corridor or other physical barrier that substantially reduces the probability of drift."
>
> "Provide a 20 foot minimum strip of vegetation (on which pesticides should not be applied) along rivers, creeks, streams, wetlands, vernal pools and stock ponds or on the downhill side of fields where run-off could occur. Prepare land around fields to contain run-off by proper leveling, etc. Contain as much water "on-site" as possible. The planting of legumes, or other cover crops for several rows adjacent to off-target water sites is recommended. Mix pesticides in areas not prone to run-off such as concrete mixing/loading pads, disked soil in flat terrain or graveled mix pads, or use a suitable method to contain spills and/or rinsate. Properly empty and triple-rinse pesticide containers at time of use."
>
> "Conduct irrigations efficiently to prevent excessive loss of irrigation waters through run-off. Schedule irrigations and pesticide applications to maximize the interval of time between the pesticide application and the first subsequent irrigation. Allow at least 24 hours between application of pesticides listed in this bulletin and any irrigation that results in surface run-off into natural waters. Time applications to allow sprays to dry prior to rain or sprinkler irrigations. Do not make aerial applications while irrigation water is on the field unless surface run-off is contained for 72 hours following the application."

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

In the following discussion of individual ESUs and methomyl use, we present available information on the listed Pacific salmon and steelhead ESUs and discuss the potential for the use of methomyl and possible exposure and risk of each ESU. Our information on the various ESUs is taken almost entirely from various Federal Register Notices relating to listing, critical habitat, or status reviews. As previously noted, usage data in California was obtained from the California Department of Pesticide Regulation's Summary of Pesticide Use Report Data for 2001. In Oregon, Washington, and Idaho, methomyl can potentially be used on most agricultural crops, but usage data are not available statewide or at the county level. For those states, we provide 1997 Agricultural Census data on the amount of cultivated acreage in each county within an ESU. Because methomyl can be used on a wide variety of crops (see Table 3), we assume it may be used in those counties with extensive acreage in cropland.

A. Steelhead

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

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

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

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

1. Southern California Steelhead ESU

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

Within San Diego County, the San Mateo Creek runs through Camp Pendleton Marine Base and into the Cleveland National Forest. While there are agricultural uses of pesticides in other parts of California within the range of this ESU, it would appear that there are no such uses in the vicinity of San Mateo Creek. Within Los Angeles County, this steelhead occurs in Malibu Creek and possibly Topanga Creek. Neither of these creeks drain agricultural areas. There is also a potential for steelhead waters to drain agricultural areas in Ventura, Santa Barbara, and San Luis Obispo counties.

Usage of methomyl in 2001 in counties where this ESU occurs is presented in Table 13.

Table 13. Use of methomyl in 2001 in counties within the Southern California steelhead ESU.

County	use site	methomyl usage (lb ai)	acres treated
San Diego	*all sites*	*903*	
	tomato	585	902
	sweet corn	140	311
	potato	125	175
Los Angeles	*all sites*	*686*	
	onion	432	480
	potato	193	215

County	use site	methomyl usage (lb ai)	acres treated
Ventura	*all sites*	*4749*	
	strawberry	1986	2277
	celery	786	977
	tomato	466	451
	pepper	459	683
San Luis Obispo	*all sites*	*1282*	
	nectarine	314	349
	grapes	265	305
	celery	181	318
Santa Barbara	*all sites*	*2574*	
	celery	655	816
	strawberry	531	746
	potato	344	382
	head lettuce	306	596

We conclude that use of methomyl may affect the Southern California steelhead ESU. We make this determination based on the amount of methomyl applied in these counties in 2001, the potential for acute risk to endangered fish, and the potential for indirect effects due to depletion of this ESU's aquatic-invertebrate food supply.

2. South Central California Steelhead ESU

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

This ESU includes the hydrologic units of Pajaro (upstream barriers - Chesbro Reservoir, North Fork Pachero Reservoir), Estrella, Salinas (upstream barriers - Nacimiento Reservoir, Salinas Dam, San Antonio Reservoir), Central Coastal (upstream barriers - Lopez Dam, Whale Rock Reservoir), Alisal-Elkhorn Sloughs, and Carmel. Counties of occurrence include Santa Cruz, 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 14 shows methomyl usage in 2001 in those counties where this ESU occurs.

Table 14. Use of methomyl in 2001 in counties with the South Central California steelhead ESU.

County	use site	methomyl usage (lb ai)	acres treated
Santa Cruz	*all sites*	*2392*	
	strawberry	1509	1822
	head lettuce	631	912
	leaf lettuce	141	220
San Benito	*all sites*	*4116*	
	asparagus	1001	1255
	leaf lettuce	956	1470
	head lettuce	726	1057
	celery	789	1004
Monterey	*all sites*	*46,820*	
	leaf lettuce	12,525	19,426
	head lettuce	9640	14,925
	strawberry	7487	9456
	celery	6119	8455
	grapes	5678	7833
San Luis Obispo	*all sites*	*1282*	
	nectarine	314	349
	grapes	265	305
	celery	181	318

We conclude that use of methomyl may affect the South Central California steelhead ESU. We make this determination based on the very large amount of methomyl applied in these counties, especially Monterey Co., in 2001. Methomyl poses an acute risk to endangered fish and has a potential for indirect effects due to depletion of this ESU's aquatic-invertebrate food supply.

3. Central California Coast Steelhead ESU

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

Creek, Santa Cruz County, (inclusive), and the drainages of San Francisco and San Pablo Bays eastward to the Napa River (inclusive), Napa County. The Sacramento-San Joaquin River Basin of the Central Valley of California is excluded. Steelhead in most tributary streams in San Francisco and San Pablo Bays appear to have been extirpated, whereas most coastal streams sampled in the central California coast region do contain steelhead.

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

Usage of methomyl in 2001 in counties in the Central California coast steelhead ESU is presented in Table 15.

Table 15. Use of methomyl in 2001 in counties with the Central California Coast steelhead ESU.

County	use site	methomyl usage (lb ai)	acres treated
Santa Cruz	*all sites*	*2392*	
	strawberry	1509	1822
	head lettuce	631	912
	leaf lettuce	141	220
San Mateo	all sites	24	
San Francisco		0	
Marin		0	
Sonoma	all sites	26	
Mendocino	all sites	11	
Napa		0	
Alameda	all sites	1	

County	use site	methomyl usage (lb ai)	acres treated
Contra Costa	*all sites*	*6743*	
	sweet corn	5994	13,314
Solano	*all sites*	*3379*	
	sweet corn	1539	3670
	sorghum	482	1152
Santa Clara	*all sites*	*1115*	
	celery	365	434
	peppers	205	222
	sweet corn	188	413

We conclude that use of methomyl may affect the Central California Coast steelhead ESU. We make this determination based on the amount of methomyl applied in these counties in 2001, the potential for acute risk to endangered fish, and the potential for indirect effects due to depletion of this ESU's aquatic-invertebrate food supply.

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 methomyl in this ESU in 2001 is provided in Table 16.

Table 16. Use of methomyl in 2001 in counties with the California Central Valley steelhead ESU.

County	use site	methomyl usage (lb ai)	acres treated
Alameda	all sites	1	
Amador		0	
Butte	*all sites*	*596*	
	beans	397	770
	cucumbers	134	215
Calaveras		0	
Colusa	*all sites*	*7339*	
	tomatoes	2764	5421
	cucumbers	1376	1968
	beans	1113	2017
Contra Costa	*all sites*	*6743*	
	sweet corn	5994	13,314
Glenn	*all sites*	*1965*	
	alfalfa	937	2393
	cotton	212	472
Marin		0	
Merced	*all sites*	*29,635*	
	alfalfa	12,367	32,749
	tomatoes	8163	13,131
	sugarbeet	1750	3058
	sweet potato	1623	2127
Nevada		0	
Placer	all sites	6	
Sacramento	*all sites*	*2460*	
	sudangrass	1555	3467
	sweet corn	205	456
San Joaquin	*all sites*	*2184*	
	tomatoes	1168	3530
	sweet corn	462	920

County	use site	methomyl usage (lb ai)	acres treated
San Mateo	all sites	24	
San Francisco		0	
Shasta	all sites	7	
Solano	*all sites* sweet corn sorghum	*3379* 1539 482	 3670 1152
Sonoma	all sites	26	
Stanislaus	*all sites* tomatoes beans sudangrass	*7794* 3346 1948 362	 6025 3926 800
Sutter	*all sites* melons tomatoes	*3040* 1459 429	 2137 1090
Tehama	all sites	63	
Tuloumne		0	
Yolo	*all sites* melons alfalfa sweet corn cucumbers tomatoes	*5802* 2248 664 655 427 384	 4842 1931 1408 558 818
Yuba		0	

We conclude that use of methomyl may affect the California Central Valley steelhead ESU. We make this determination based on the large amount of methomyl applied in these counties in 2001. We make this determination based on the very large amount of methomyl applied in these counties, especially Monterey Co., in 2001. Methomyl poses an acute risk to endangered fish and has a potential for indirect effects due to depletion of this ESU's aquatic-invertebrate food supply.

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.

Methomyl use in this ESU in 2001 is presented in Table 17.

Table 17. Use of methomyl in 2001 in counties with the Northern California steelhead ESU

County	use site	methomyl usage (lb ai)	acres treated
Humboldt		0	
Mendocino	all sites	11	
Trinity		0	
Lake		0	

We conclude that methomyl will have no effect on the Northern California steelhead ESU, because little or no usage of methomyl occurred in 2001 in the counties comprising this ESU. Use of methomyl in California has been declining in recent years, and it seems unlikely that use would increase significantly within this ESU in future years.

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.

Crop acreage in the Washington and Oregon counties within this ESU is provided in Tables 18 and 19. Methomyl potentially is used on a wide variety of crops, but we have no information on which crops are treated in these counties.

Table 18. Cropland acreage in Washington counties where there is spawning and growth of the Upper Columbia River steelhead ESU.

State	county	cultivated cropland acreage[a]
WA	Benton	268,372
WA	Franklin	291,696
WA	Kittitas	57,456
WA	Yakima	264,490
WA	Chelan	31,423
WA	Douglas	217,703
WA	Okanogan	72,732
WA	Grant	529,087

[a]Cultivated cropland: includes all harvested cropland and all failed cropland.

Table 19. Cropland acreage in Oregon and Washington counties that are migration corridors for the Upper Columbia River steelhead ESU.

State	county	cultivated cropland acreage[a]
WA	Walla Walla	337,660
WA	Klickitat	93,193
WA	Skamania	1205+

WA	Clark	27,860
WA	Cowlitz	8227+
WA	Wahkiakum	3515+
WA	Pacific	5451
OR	Gilliam	100,729+
OR	Umatilla	384,163
OR	Sherman	127,018+
OR	Morrow	220,149 +
OR	Wasco	97,230
OR	Hood River	17,346+
OR	Multnomah	14,692
OR	Columbia	15,054+
OR	Clatsop	4772

[a] Cultivated cropland: includes all harvested cropland and all failed cropland. Failed cropland acreage is not reported for some counties due to privacy concerns when only a few farms report such acreage. We have denoted this "acreage" with a "+" in the cultivated cropland column in the relevant tables. Such acreage typically is small and statewide accounts for only 0.7% of harvested cropland acreage in Washington, 3.7% in Oregon, and 3.2% in Idaho.

We conclude that methomyl may affect the Upper Columbia River steelhead ESU. Our determination is made based on the possible use of methomyl on a variety of crops in counties within this ESU, direct risk of methomyl to endangered fish, and the potential for depletion of this ESU's aquatic-invertebrate food supply. However, there is much uncertainty in this determination, especially because usage information for methomyl is lacking for these counties.

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. We have excluded Baker County, Oregon, which has a tiny fragment of the Imnaha River watershed. 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 methomyl use in agricultural areas. We have similarly excluded the Upper Grande Ronde watershed tributaries (e.g., Looking Glass and Cabin Creeks) that are barely into higher elevation forested areas of Umatilla County. 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. We have excluded these areas because they are not relevant to use of methomyl. 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 we were 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 19 and 20 show the crop acreage for the Pacific Northwest counties encompassing spawning and rearing habitat of the Snake River Basin steelhead ESU and for the Oregon and Washington counties where this ESU migrates. Methomyl potentially is used on a wide variety of crops, but we have no information on which crops are treated in these counties.

Table 19. Cropland acreage in Pacific Northwest counties which provide spawning and rearing habitat for the Snake River Basin steelhead ESU.

State	county	cultivated cropland acreage[a]
ID	Adams	16,779
ID	Idaho	147,557
ID	Nez Perce	168,365
ID	Custer	34,754
ID	Lemhi	41,837+

ID	Valley	6990+
ID	Lewis	119,860
ID	Clearwater	24,266
ID	Latah	200,691
WA	Adams	392,556
WA	Asotin	32,892
WA	Garfield	108,553
WA	Columbia	97,743
WA	Whitman	804,893
WA	Franklin	291,696
WA	Walla Walla	337,660
OR	Wallowa	54,138
OR	Union	90.349

[a]Cultivated cropland: includes all harvested cropland and all failed cropland. Failed cropland acreage is not reported for some counties due to privacy concerns when only a few farms report such acreage. We have denoted this "acreage" with a "+" in the cultivated cropland column in the relevant tables. Such acreage typically is small and statewide accounts for only 0.7% of harvested cropland acreage in Washington, 3.7% in Oregon, and 3.2% in Idaho.

Table 20. Cropland acreage in Washington and Oregon counties through which the Snake River Basin steelhead ESU migrates.

State	county	cultivated cropland acreage[a]
WA	Benton	268,372
WA	Klickitat	93,193
WA	Skamania	1205+
WA	Clark	27,860
WA	Cowlitz	8227+
WA	Wahkiakum	3515+
WA	Pacific	5451
OR	Umatilla	384,163

OR	Morrow	220,149 +
OR	Gilliam	100,729+
OR	Sherman	127,018+
OR	Wasco	97,230
OR	Hood River	17,346+
OR	Multnomah	14,692
OR	Columbia	15,054+
OR	Clatsop	4772

[a] Cultivated cropland: includes all harvested cropland and all failed cropland. Failed cropland acreage is not reported for some counties due to privacy concerns when only a few farms report such acreage. We have denoted this "acreage" with a "+" in the cultivated cropland column in the relevant tables. Such acreage typically is small and statewide accounts for only 0.7% of harvested cropland acreage in Washington, 3.7% in Oregon, and 3.2% in Idaho.

We conclude that methomyl may affect the Snake River Basin steelhead ESU. This determination is made based on the possible use of methomyl on a variety of crops in counties within this ESU, direct risk of methomyl to endangered fish, and the potential for depletion of this ESU's aquatic-invertebrate food supply. However, there is much uncertainty in this determination, especially because usage information for methomyl is lacking for these counties.

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 methomyl 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 21 and 22 show the cropland acreage for this ESU in Oregon and Washington counties. Methomyl potentially is used on a wide variety of crops, but we have no information on which crops are treated in these counties.

Table 21. Cropland acreage in the spawning and rearing habitat of the Upper Willamette River steelhead ESU.

State	county	cultivated cropland acreage[a]
OR	Benton	69,214
OR	Linn	248,392
OR	Polk	89,599
OR	Clackamas	59,923
OR	Marion	202,353
OR	Yamhill	95,440
OR	Washington	85,190

[a] Cultivated cropland: includes all harvested cropland and all failed cropland

Table 22. Cropland acreage in Oregon and Washington counties that are part of the migration corridors of the Upper Willamette River steelhead ESU.

State	county	cultivated acreage[a]
WA	Clark	27,860
WA	Cowlitz	8227+
WA	Wahkiakum	3515+
WA	Pacific	5451
OR	Multnomah	14,692

OR	Columbia	15,054+
OR	Clatsop	4772

[a] Cultivated cropland: includes all harvested cropland and all failed cropland. Failed cropland acreage is not reported for some counties due to privacy concerns when only a few farms report such acreage. We have denoted this "acreage" with a "+" in the cultivated cropland column in the relevant tables. Such acreage typically is small and statewide accounts for only 0.7% of harvested cropland acreage in Washington, 3.7% in Oregon, and 3.2% in Idaho.

We conclude that methomyl may affect the Upper Willamette River steelhead ESU. This determination is made based on the possible use of methomyl on a variety of crops in counties within this ESU, direct risk of methomyl to endangered fish, and the potential for depletion of this ESU's aquatic-invertebrate food supply. However, there is much uncertainty in this determination, especially because usage information for methomyl is lacking for these counties.

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 23 and 24 show the crop acreage 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. Methomyl potentially is used on a wide variety of crops, but we have no information on which crops are treated in these counties.

Table 23. Cropland acreage in counties that provide spawning and rearing habitat for the Lower Columbia River Steelhead ESU.

State	county	cultivated cropland acreage[a]
OR	Hood River	17,346+
OR	Clackamas	59,923
OR	Multnomah	14,692
WA	Clark	27,860
WA	Cowlitz	29,569
WA	Skamania	8227+

[a]Cultivated cropland: includes all harvested cropland and all failed cropland. Failed cropland acreage is not reported for some counties due to privacy concerns when only a few farms report such acreage. We have denoted this "acreage" with a "+" in the cultivated cropland column in the relevant tables. Such acreage typically is small and statewide accounts for only 0.7% of harvested cropland acreage in Washington, 3.7% in Oregon, and 3.2% in Idaho.

Table 24. Cropland acreage in counties that are migratory corridors for the Lower Columbia River Steelhead ESU.

State	county	cultivated acreage[a]
OR	Columbia	15,054+
OR	Clatsop	4772
WA	Pacific	5451
WA	Wahkiakum	3515+

[a]Cultivated cropland: includes all harvested cropland and all failed cropland. Failed cropland acreage is not reported for some counties due to privacy concerns when only a few farms report such acreage. We have denoted this "acreage" with a "+" in the cultivated cropland column in the relevant tables. Such acreage typically is small and statewide accounts for only 0.7% of harvested cropland acreage in Washington, 3.7% in Oregon, and 3.2% in Idaho.

We conclude that methomyl may affect the Lower Columbia River Steelhead ESU. This determination is made based on the possible use of methomyl on a variety of crops in counties within this ESU, direct risk of methomyl to endangered fish, and the potential for depletion of this ESU's aquatic-invertebrate food supply. However, there is much uncertainty in this determination, especially because usage information for methomyl is lacking for these counties.

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. We are unsure of the status of these 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, we have excluded Harney County, Oregon because there is only a tiny amount of the John Day River and several tributary creeks (e.g., Utley, Bear Cougar creeks) which get into high elevation areas (approximately 1700M and higher) of northern Harney County where there are no crops grown. 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 we have excluded these 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 25 and 26 show the crop acreage 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. Methomyl potentially is used on a wide variety of crops, but we have no information on which crops are treated in these counties.

Table 25. Cropland acreage in counties that provide spawning and rearing habitat for the Middle Columbia River Steelhead ESU

State	county	cultivated cropland acreage[a]
OR	Gilliam	100,729+
OR	Morrow	220,149 +
OR	Umatilla	384,163
OR	Sherman	127,018+
OR	Wasco	97,230
OR	Crook	35,824
OR	Grant	46,399
OR	Wheeler	15,523
OR	Jefferson	44,873
WA	Benton	268,372
WA	Columbia	97,743
WA	Franklin	291,696
WA	Kittitas	57,456
WA	Klickitat	93,193
WA	Skamania	1205+
WA	Walla Walla	337,660
WA	Yakima	264,490

[a]Cultivated cropland: includes all harvested cropland and all failed cropland. Failed cropland acreage is not reported for some counties due to privacy concerns when only a few farms report such acreage. We have denoted this "acreage" with a "+" in the cultivated cropland column in the relevant tables. Such acreage typically is small and statewide accounts for only 0.7% of harvested cropland acreage in Washington, 3.7% in Oregon, and 3.2% in Idaho.

Table 26. Cropland acreage in Washington and Oregon counties through which the Middle Columbia River steelhead ESU migrates

State	county	cultivated acreage[a]
WA	Skamania	1205+

WA	Clark	27,860
WA	Cowlitz	8227+
WA	Pacific	5451
WA	Wahkiakum	3515+
OR	Hood River	17,346+
OR	Multnomah	14,692
OR	Columbia	15,054+
OR	Clatsop	4772

[a]Cultivated cropland: includes all harvested cropland and all failed cropland. Failed cropland acreage is not reported for some counties due to privacy concerns when only a few farms report such acreage. We have denoted this "acreage" with a "+" in the cultivated cropland column in the relevant tables. Such acreage typically is small and statewide accounts for only 0.7% of harvested cropland acreage in Washington, 3.7% in Oregon, and 3.2% in Idaho.

We conclude that methomyl may affect the Middle Columbia River Steelhead ESU. This determination is made based on the possible use of methomyl on a variety of crops in counties within this ESU, direct risk of methomyl to endangered fish, and the potential for depletion of this ESU's aquatic-invertebrate food supply. However, there is much uncertainty in this determination, especially because usage information for methomyl is lacking for these counties.

B. Chinook salmon

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

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

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

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

1. Sacramento River Winter-run Chinook Salmon ESU

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

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

Use of methomyl in this ESU in 2001 is presented in Table 27.

Table 27. Use of methomyl in 2001 in counties with the Sacramento River winter-run chinook salmon ESU. Spawning areas are primarily in Shasta and Tehama counties above the Red Bluff diversion dam

County	use site	methomyl usage (lb ai)	acres treated
Alameda	all sites	1	

County	use site	methomyl usage (lb ai)	acres treated
Butte	*all sites*	*596*	
	beans	397	770
	cucumbers	134	215
Colusa	*all sites*	*7339*	
	tomatoes	2764	5421
	cucumbers	1376	1968
	beans	1113	2017
Contra Costa	*all sites*	*6743*	
	sweet corn	5994	13,314
Glenn	*all sites*	*1965*	
	alfalfa	937	2393
	cotton	212	472
Marin		0	
Sacramento	*all sites*	*2460*	
	sudangrass	1555	3467
	sweet corn	205	456
San Mateo	all sites	24	
San Francisco		0	
Shasta	all sites	7	
Solano	*all sites*	*3379*	
	sweet corn	1539	3670
	sorghum	482	1152
Sonoma	all sites	26	
Sutter	*all sites*	*3040*	
	melons	1459	2137
	tomatoes	429	1090
Tehama	all sites	63	

County	use site	methomyl usage (lb ai)	acres treated
Yolo	*all sites*	*5802*	
	melons	2248	4842
	alfalfa	664	1931
	sweet corn	655	1408
	cucumbers	427	558
	tomatoes	384	818

We conclude that use of methomyl may affect the Sacramento River winter-run chinook salmon ESU. We make this determination based on the amount of methomyl applied in these counties in 2001. Methomyl poses an acute risk to endangered fish and has a potential for indirect effects due to depletion of this ESU's aquatic-invertebrate food supply.

2. Snake River Fall-run Chinook Salmon ESU

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

In 1998, NMFS proposed to revise the Snake River fall-run chinook to include those stocks using the Deschutes River (63FR11482-11520, March 9, 1998). The John Day, Umatilla, and Walla Walla Rivers would be included; however, fall-run chinook in these rivers are believed to have been extirpated. It appears that this proposal has yet to be finalized. We have not included these counties here; however, we 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. I note that 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, we have excluded them from consideration because methomyl would not be used in these areas. We have, however, kept Umatilla County as part of the migratory corridor.

Tables 29 and 30 show the cropland acreage for Pacific Northwest counties where the Snake River fall-run chinook salmon ESU is located and for the Oregon and Washington counties where this ESU migrates. Methomyl potentially is used on a wide variety of crops, but we have no information on which crops are treated in these counties.

Table 29. Cropland acreage in Pacific Northwest counties which provide spawning and rearing habitat for the Snake River fall-run chinook ESU.

State	county	cultivated cropland acreage[a]
ID	Adams	16,779
ID	Idaho	147,557
ID	Nez Perce	168,365
ID	Valley	6990+
ID	Lewis	119,860
ID	Benewah	59,294
ID	Shoshone	459+
ID	Clearwater	24,266
ID	Latah	200,691
WA	Adams	392,556
WA	Lincoln	471,220
WA	Spokane	297,722
WA	Asotin	32,892

State	county	cultivated cropland acreage[a]
WA	Garfield	108,553
WA	Columbia	97,743
WA	Whitman	804,893
WA	Franklin	291,696
WA	Walla Walla	337,660
OR	Wallowa	54,138
OR	Union	90.349

[a]Cultivated cropland: includes all harvested cropland and all failed cropland. Failed cropland acreage is not reported for some counties due to privacy concerns when only a few farms report such acreage. We have denoted this "acreage" with a "+" in the cultivated cropland column in the relevant tables. Such acreage typically is small and statewide accounts for only 0.7% of harvested cropland acreage in Washington, 3.7% in Oregon, and 3.2% in Idaho.

Table 30. Cropland acreage in Washington and Oregon counties through which the Snake River fall-run chinook and the Snake River fall-run chinook ESUs migrate

State	county	cultivated cropland acreage[a]
WA	Benton	268,372
WA	Klickitat	93,193
WA	Skamania	1205+
WA	Clark	27,860
WA	Cowlitz	8227+
WA	Wahkiakum	3515+
WA	Pacific	5451
OR	Umatilla	384,163
OR	Morrow	220,149 +
OR	Gilliam	100,729+
OR	Sherman	127,018+
OR	Wasco	97,230
OR	Hood River	17,346+

State	county	cultivated cropland acreage[a]
OR	Multnomah	14,692
OR	Columbia	15,054+
OR	Clatsop	4772

[a]Cultivated cropland: includes all harvested cropland and all failed cropland. Failed cropland acreage is not reported for some counties due to privacy concerns when only a few farms report such acreage. We have denoted this "acreage" with a "+" in the cultivated cropland column in the relevant tables. Such acreage typically is small and statewide accounts for only 0.7% of harvested cropland acreage in Washington, 3.7% in Oregon, and 3.2% in Idaho.

We conclude that methomyl may affect the Snake River fall-run chinook ESU. This determination is made based on the possible use of methomyl on a variety of crops in counties within this ESU, direct risk of methomyl to endangered fish, and the potential for depletion of this ESU's aquatic-invertebrate food supply. However, there is much uncertainty in this determination, especially because usage information for methomyl is lacking for these counties.

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, we have excluded Umatilla and Baker counties in Oregon and Blaine County in Idaho because accessible river reaches are all well above areas where methomyl 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 crop acreage for Oregon and Washington counties where the Snake River spring/summer-run chinook salmon ESU occurs. The crop acreage for the migratory corridors is the same as for the Snake River fall-run chinook salmon (Table 30). Methomyl potentially is used on a wide variety of crops, but we have no information on which crops are treated in these counties.

Table 31. Cropland acreage in counties which provide spawning and rearing habitat for the Snake River spring/summer run chinook ESU

State	county	cultivated cropland acreage[a]
ID	Adams	16,779
ID	Idaho	147,557
ID	Nez Perce	168,365
ID	Custer	34,754
ID	Lemhi	41,837+
ID	Valley	6990+
ID	Lewis	119,860
ID	Latah	200,691
WA	Asotin	32,892
WA	Garfield	108,553
WA	Columbia	97,743
WA	Whitman	804,893
WA	Franklin	291,696

State	county	cultivated cropland acreage[a]
OR	Wallowa	54,138
OR	Union	90.349

[a]Cultivated cropland: includes all harvested cropland and all failed cropland. Failed cropland acreage is not reported for some counties due to privacy concerns when only a few farms report such acreage. We have denoted this "acreage" with a "+" in the cultivated cropland column in the relevant tables. Such acreage typically is small and statewide accounts for only 0.7% of harvested cropland acreage in Washington, 3.7% in Oregon, and 3.2% in Idaho.

We conclude that methomyl may affect the Snake River spring/summer run chinook ESU. This determination is made based on the possible use of methomyl on a variety of crops in counties within this ESU, direct risk of methomyl to endangered fish, and the potential for depletion of this ESU's aquatic-invertebrate food supply. However, there is much uncertainty in this determination, especially because usage information for methomyl is lacking for these counties.

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 Thomes (upstream barrier - Black Butte Dam), Sacramento-Stone Corral, Lower Butte (upstream barrier - Centerville Dam), Lower Feather (upstream barrier - Oroville Dam), Lower Yuba, Lower Bear (upstream barrier - Camp Far West Dam), Lower Sacramento, Sacramento-Upper Clear (upstream barriers - Keswick Dam, Whiskeytown dam), Upper Elder-Upper Thomes, Upper Cow-Battle, Mill-Big Chico, Upper Butte, Upper Yuba (upstream barrier - Englebright Dam), Suisin Bay, San Pablo Bay, and San Francisco Bay. These areas are 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. However, with San Mateo County being well south of the Oakland Bay Bridge, it is difficult to see why this county was included.

Table 32 contains usage information from 2001 for the California counties supporting the Central Valley spring-run chinook salmon ESU.

Table 32. Use of methomyl in 2001 in counties with the Central Valley spring run chinook salmon ESU

County	use site	methomyl usage (lb ai)	acres treated
Alameda	all sites	1	
Butte	*all sites*	*596*	
	beans	397	770
	cucumbers	134	215
Colusa	*all sites*	*7339*	
	tomatoes	2764	5421
	cucumbers	1376	1968
	beans	1113	2017
Contra Costa	*all sites*	*6743*	
	sweet corn	5994	13,314
Glenn	*all sites*	*1965*	
	alfalfa	937	2393
	cotton	212	472
Marin		0	
Napa		0	
Nevada		0	
Placer	all sites	6	
Sacramento	*all sites*	*2460*	
	sudangrass	1555	3467
	sweet corn	205	456
San Mateo	all sites	24	
San Francisco		0	
Shasta	all sites	7	
Solano	*all sites*	*3379*	
	sweet corn	1539	3670
	sorghum	482	1152
Sonoma	all sites	26	

County	use site	methomyl usage (lb ai)	acres treated
Sutter	*all sites*	*3040*	
	melons	1459	2137
	tomatoes	429	1090
Tehama	all sites	63	
Yolo	*all sites*	*5802*	
	melons	2248	4842
	alfalfa	664	1931
	sweet corn	655	1408
	cucumbers	427	558
	tomatoes	384	818
Yuba		0	

We conclude that use of methomyl may affect the Central Valley spring run chinook salmon ESU. We make this determination based on the amount of methomyl applied in these counties in 2001. Methomyl poses an acute risk to endangered fish and has a potential for indirect effects due to depletion of this ESU's aquatic-invertebrate food supply.

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 methomyl could be used are Humboldt, Trinity, Mendocino, Lake, Sonoma, and Marin. A small portion of Glenn County is also included in the Critical Habitat, but methomyl would not likely be used in the forested upper elevation areas.

Table 33 contains 2001 usage information for the California counties supporting the California coastal chinook salmon ESU.

Table 33. Use of methomyl in 2001 in counties within the California coastal chinook salmon ESU

County	use site	methomyl usage (lb ai)	acres treated
Humboldt		0	
Mendocino	all sites	11	
Sonoma	all sites	26	
Marin		0	
Trinity		0	
Lake		0	

We conclude a no effect for the California coastal chinook salmon ESU. Little or no methomyl was used in 2001 in the counties comprising this ESU. Use of methomyl in California has been declining in recent years, and it seems unlikely that use would increase significantly within this ESU in future years.

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 shows the crop acreage for Washington counties where the Puget Sound chinook salmon ESU is located. Methomyl potentially is used on a wide variety of crops, but we have no information on which crops are treated in these counties.

Table 34. Cropland acreage in counties within the Critical Habitat of the Puget Sound chinook salmon ESU.

State	county	cultivated cropland acreage[a]
WA	Skagit	57,978
WA	Whatcom	65,679
WA	San Juan	4057
WA	Island	9764
WA	Snohomish	28,836
WA	King	9827
WA	Pierce	13,430
WA	Thurston	12,130+
WA	Lewis	29,569
WA	Grays Harbor	15,682
WA	Mason	1703+
WA	Clallam	6119
WA	Jefferson	2151+
WA	Kitsap	1300+

[a]Cultivated cropland: includes all harvested cropland and all failed cropland. Failed cropland acreage is not reported for some counties due to privacy concerns when only a few farms report such acreage. We have denoted this "acreage" with a “+” in the cultivated cropland column in the relevant tables. Such acreage typically is small and statewide accounts for only 0.7% of harvested cropland acreage in Washington, 3.7% in Oregon, and 3.2% in Idaho.

We conclude that methomyl may affect the Puget Sound chinook salmon ESU. This determination is made based on the possible use of methomyl on a variety of crops in counties within this ESU, direct risk of methomyl to endangered fish, and the potential for depletion of this ESU’s aquatic-invertebrate food supply. However, there is much uncertainty in this determination, especially because usage information for methomyl is lacking for these counties.

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, Wasco, 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. We have excluded Pierce County, Washington because the very small part of the Cowlitz River watershed in this county is at a high elevation where methomyl would not likely be used.

Table 35 shows the crop acreage for Oregon and Washington counties where the Lower Columbia River chinook salmon ESU occurs. Methomyl potentially is used on a wide variety of crops, but we have no information on which crops are treated in these counties.

Table 35. Cropland acreage in counties that are in the Critical Habitat of the Lower Columbia River chinook salmon ESU.

State	county	cultivated cropland acreage[a]
OR	Wasco	97,230
OR	Hood River	17,346+
OR	Marion	202,353
OR	Clackamas	59,923
OR	Multnomah	14,692
OR	Washington	85,190
OR	Columbia	15,054+
OR	Clatsop	4772
WA	Pacific	5451
WA	Wahkiakum	3515+
WA	Clark	27,860
WA	Cowlitz	8227+
WA	Lewis	29,569
WA	Klickitat	93,193

WA	Skamania	1205+

[a]Cultivated cropland: includes all harvested cropland and all failed cropland. Failed cropland acreage is not reported for some counties due to privacy concerns when only a few farms report such acreage. We have denoted this "acreage" with a "+" in the cultivated cropland column in the relevant tables. Such acreage typically is small and statewide accounts for only 0.7% of harvested cropland acreage in Washington, 3.7% in Oregon, and 3.2% in Idaho.

We conclude that methomyl may affect the Lower Columbia River chinook salmon ESU. This determination is made based on the possible use of methomyl on a variety of crops in counties within this ESU, direct risk of methomyl to endangered fish, and the potential for depletion of this ESU's aquatic-invertebrate food supply. However, there is much uncertainty in this determination, especially because usage information for methomyl is lacking for these counties.

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

Tables 36 and 37 show the crop acreage for Oregon counties where the Upper Willamette River chinook salmon ESU occurs and for the Oregon and Washington counties where this ESU migrates. Methomyl potentially is used on a wide variety of crops, but we have no information on which crops are treated in these counties.

Table 36. Cropland acreage in the spawning and rearing habitat of the Upper Willamette River chinook salmon ESU.

State	county	cultivated cropland acreage[a]

OR	Douglas	37,498
OR	Lane	73,841
OR	Benton	69,214
OR	Linn	248,392
OR	Polk	89,599
OR	Clackamas	59,923
OR	Marion	202,353
OR	Yamhill	95,440
OR	Washington	85,190

[a]Cultivated cropland: includes all harvested cropland and all failed cropland.

Table 37. Cropland acreage in the migration corridors of the Upper Willamette River chinook salmon ESU.

State	county	cultivated cropland acreage[a]
WA	Clark	27,860
WA	Cowlitz	8227+
WA	Wahkiakum	3515+
WA	Pacific	5451
OR	Multnomah	14,692
OR	Columbia	15,054+
OR	Clatsop	4772

[a]Cultivated cropland: includes all harvested cropland and all failed cropland. Failed cropland acreage is not reported for some counties due to privacy concerns when only a few farms report such acreage. We have denoted this "acreage" with a "+" in the cultivated cropland column in the relevant tables. Such acreage typically is small and statewide accounts for only 0.7% of harvested cropland acreage in Washington, 3.7% in Oregon, and 3.2% in Idaho.

We conclude that methomyl may affect the Upper Willamette River chinook salmon ESU. This determination is made based on the possible use of methomyl on a variety of crops in counties within this ESU, direct risk of methomyl to endangered fish, and the potential for depletion of this ESU's aquatic-invertebrate food supply. However, there is much uncertainty in this determination, especially because usage information for methomyl is lacking for these counties. Risk is also likely to be mitigated by the requirement for a buffer for aerial and ground applications and because agricultural products can be used only by certified (i.e., trained) applicators, but we cannot quantify whether aquatic concentrations would be reduced sufficiently to preclude adverse effects. We need to confer with NMFS as to whether these measures provide adequate protection for this ESU.

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 31), with the lower river reaches being migratory corridors (Table 32).

Tables 38 and 39 present cropland acreage for those Washington counties that support the Upper Columbia River chinook salmon ESU and for Oregon and Washington counties where this ESU migrates. Methomyl potentially is used on a wide variety of crops, but we have no information on which crops are treated in these counties.

Table 38. Cropland acreage in Washington counties where there is spawning and rearing habitat for the Upper Columbia River chinook salmon ESU

State	county	cultivated cropland acreage[a]
WA	Benton	268,372
WA	Kittitas	57,456
WA	Chelan	31,423
WA	Douglas	217,703
WA	Okanogan	72,732
WA	Grant	529,087

[a]Cultivated cropland: includes all harvested cropland and all failed cropland.

Table 39. Cropland acreage in counties that are migration corridors for the Upper Columbia River chinook salmon ESU

State	county	cultivated cropland acreage[a]
WA	Franklin	291,696
WA	Yakima	264,490
WA	Walla Walla	337,660
WA	Klickitat	93,193
WA	Skamania	1205+
WA	Clark	27,860
WA	Cowlitz	8227+
WA	Wahkiakum	3515+
WA	Pacific	5451
OR	Gilliam	100,729+
OR	Umatilla	384,163
OR	Sherman	127,018+
OR	Morrow	220,149 +
OR	Wasco	97,230
OR	Hood River	17,346+
OR	Multnomah	14,692
OR	Columbia	15,054+
OR	Clatsop	4772

[a]Cultivated cropland: includes all harvested cropland and all failed cropland. Failed cropland acreage is not reported for some counties due to privacy concerns when only a few farms report such acreage. We have denoted this "acreage" with a "+" in the cultivated cropland column in the relevant tables. Such acreage typically is small and statewide accounts for only 0.7% of harvested cropland acreage in Washington, 3.7% in Oregon, and 3.2% in Idaho.

We conclude that methomyl may affect the Upper Columbia River chinook salmon ESU. This determination is made based on the possible use of methomyl on a variety of crops in counties within this ESU, direct risk of methomyl to endangered fish, and the potential for depletion of this ESU's aquatic-invertebrate food supply. However, there is much uncertainty in this determination, especially because usage information for methomyl is lacking for these counties.

C. Coho Salmon

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

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

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

1. Central California Coast Coho Salmon ESU

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

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

Table 40 contains methomyl usage information for 2001 for the California counties supporting the Central California coast coho salmon ESU.

Table 40. Use of methomyl in 2001 in counties with the Central California Coast coho ESU

County	use site	methomyl usage (lb ai)	acres treated
Santa Cruz	*all sites*	*2392*	
	strawberry	1509	1822
	head lettuce	631	912
	leaf lettuce	141	220
San Mateo	all sites	24	
Marin		0	
Sonoma	all sites	26	
Mendocino	all sites	11	
Napa		0	

We conclude that use of methomyl may affect the Central California Coast coho ESU. We make this determination based the reported use of methomyl on strawberries and lettuce in Santa Cruz Co. in 2001. Methomyl poses an acute risk to endangered fish and has a potential for indirect effects due to depletion of this ESU's aquatic-invertebrate food supply.

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, Klamath, and Douglas, in Oregon. However, we have excluded Glenn County, California from this analysis because the salmon habitat in this county is not near the agricultural areas.

Methomyl use in 2001 in California counties occupied by this ESU is presented in Table 41. Cropland acreage for Oregon counties within this ESU is provided in Table 42. Methomyl potentially is used on a variety of crops in Oregon, but we have no information on which crops are treated in these counties.

Table 41. Methomyl usage in California counties within the Southern Oregon/Northern California coastal coho salmon ESU

County	use site	methomyl usage (lb ai)	acres treated
Humboldt		0	
Mendocino	all sites	11	
Del Norte		0	
Siskiyou		0	
Trinity		0	
Lake		0	

Table 42. Cropland acreage in Oregon counties where there is habitat for the Southern Oregon/Northern California coastal coho salmon ESU

State	county	cultivated cropland acreage[a]
OR	Curry	1807
OR	Jackson	33,529
OR	Josephine	9015
OR	Douglas	37,498

[a]Cultivated cropland: includes all harvested cropland and all failed cropland. Failed cropland acreage is not reported for some counties due to privacy concerns when only a few farms report such acreage. We have denoted this

"acreage" with a "+" in the cultivated cropland column in the relevant tables. Such acreage typically is small and statewide accounts for only 0.7% of harvested cropland acreage in Washington, 3.7% in Oregon, and 3.2% in Idaho.

We conclude that methomyl may affect the Southern Oregon/Northern California coastal coho salmon ESU. This determination is made based solely on the possible use of methomyl on a variety of crops in the Oregon counties within this ESU, direct risk of methomyl to endangered fish, and the potential for depletion of this ESU's aquatic-invertebrate food supply. However, there is much uncertainty in this determination, because we have no usage information for any of the Oregon counties. Risk is also likely to be mitigated by the requirement for a buffer for aerial and ground applications and because agricultural products can be used only by certified (i.e., trained) applicators, but we cannot quantify whether aquatic concentrations would be reduced sufficiently to preclude adverse effects. We need to confer with NMFS as to whether these measures provide adequate protection for this ESU.

3. Oregon Coast coho salmon ESU

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

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

Table 43 shows the cropland acreage for Oregon counties where the Oregon coast coho salmon ESU occurs. Methomyl potentially is used on a wide variety of crops, but we have no information on which crops are treated in these counties.

Table 43. Cropland acreage in counties where there is habitat for the Oregon coast coho salmon ESU

State	county	cultivated cropland acreage[a]
OR	Curry	1807
OR	Coos	14,115+
OR	Douglas	37,498
OR	Lane	73,841
OR	Lincoln	3626+
OR	Benton	69,214
OR	Polk	89,599
OR	Tillamook	6448
OR	Clatsop	4772

[a]Cultivated cropland: includes all harvested cropland and all failed cropland. Failed cropland acreage is not reported for some counties due to privacy concerns when only a few farms report such acreage. We have denoted this "acreage" with a "+" in the cultivated cropland column in the relevant tables. Such acreage typically is small and statewide accounts for only 0.7% of harvested cropland acreage in Washington, 3.7% in Oregon, and 3.2% in Idaho.

We conclude that methomyl may affect the Oregon coast coho salmon ESU. This determination is made based on the possible use of methomyl on a variety of crops in counties within this ESU, direct risk of methomyl to endangered fish, and the potential for depletion of this ESU's aquatic-invertebrate food supply. However, there is much uncertainty in this determination, especially because usage information for methomyl is lacking for these counties.

D. Chum Salmon

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

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

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

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

1. Hood Canal Summer-run chum salmon ESU

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

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

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

Table 44 shows the cropland acreage for Washington counties where the Hood Canal summer-run chum salmon ESU occurs. Methomyl potentially is used on a wide variety of crops, but we have no information on which crops are treated in these counties.

Table 44. Cropland acreage in counties where there is habitat for the Hood Canal Summer-run chum salmon ESU

State	county	cultivated cropland acreage[a]
WA	Mason	1703+
WA	Clallam	6119
WA	Jefferson	2151+
WA	Kitsap	1300+
WA	Island	9764

[a]Cultivated cropland: includes all harvested cropland and all failed cropland. Failed cropland acreage is not reported for some counties due to privacy concerns when only a few farms report such acreage. We have denoted this "acreage" with a "+" in the cultivated cropland column in the relevant tables. Such acreage typically is small and statewide accounts for only 0.7% of harvested cropland acreage in Washington, 3.7% in Oregon, and 3.2% in Idaho.

We conclude that methomyl may affect the Hood Canal Summer-run chum salmon ESU. This determination is made based on the possible use of methomyl on a variety of crops in counties within this ESU, direct risk of methomyl to endangered fish, and the potential for depletion of this ESU's aquatic-invertebrate food supply. However, there is much uncertainty in this determination, especially because usage information for methomyl is lacking for these counties.

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 shows the crop acreage information for Oregon and Washington counties where the Columbia River chum salmon ESU occurs. Methomyl potentially is used on a wide variety of crops, but we have no information on which crops are treated in these counties.

Table 45. Cropland acreage in counties where there is habitat for the Columbia River chum salmon ESU.

State	county	cultivated acreage[a]
WA	Skamania	1205+
WA	Clark	27,860

State	county	cultivated acreage[a]
WA	Lewis	29,569
WA	Cowlitz	8227+
WA	Pacific	5451
WA	Wahkiakum	3515+
OR	Multnomah	14,692
OR	Columbia	15,054+
OR	Washington	85,190
OR	Clatsop	4772

[a]Cultivated cropland: includes all harvested cropland and all failed cropland. Failed cropland acreage is not reported for some counties due to privacy concerns when only a few farms report such acreage. We have denoted this "acreage" with a "+" in the cultivated cropland column in the relevant tables. Such acreage typically is small and statewide accounts for only 0.7% of harvested cropland acreage in Washington, 3.7% in Oregon, and 3.2% in Idaho.

We conclude that methomyl may affect the Columbia River chum salmon ESU. This determination is made based on the possible use of methomyl on a variety of crops in counties within this ESU, direct risk of methomyl to endangered fish, and the potential for depletion of this ESU's aquatic-invertebrate food supply. However, there is much uncertainty in this determination, especially because usage information for methomyl is lacking for these counties.

E. Sockeye Salmon

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

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

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

1. Ozette Lake Sockeye Salmon ESU

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

While Lake Ozette, itself, is part of Olympic National Park, its tributaries extend outside park boundaries, much of which is private land. There is limited agriculture in the whole of Clallam County (Table 46). However, we have no usage data to indicate how much methomyl is used in this county.

Table 46. Cropland acreage in Clallum County where there is habitat for the Ozette Lake sockeye salmon ESU

State	county	cultivated cropland acreage[a]
WA	Clallam	6119

[a]Cultivated cropland: includes all harvested cropland and all failed cropland.

We conclude that methomyl may affect the Ozette Lake sockeye salmon ESU. This determination is made based on the possible use of methomyl on a variety of crops in Clallum Co., direct risk of methomyl to endangered fish, and the potential for depletion of this ESU's aquatic-invertebrate food supply. However, there is much uncertainty in this determination, especially because usage information for methomyl is lacking for Clallum Co.

2. Snake River Sockeye Salmon ESU

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

Spawning and rearing habitats are considered to be all of the above-named lakes and creeks, even though at the time of the critical habitat Notice, spawning only still occurred in Redfish Lake. These habitats are in Custer and Blaine counties in Idaho. However, the habitat area for the salmon is high elevation areas in a National Wilderness area and National Forest. Methomyl cannot be used in this area. It is possible that this salmon ESU could be exposed to methomyl in the lower and larger river reaches during its juvenile or adult migration.

Cropland acreage in counties encompassing spawning and rearing habitat and migratory corridors for the Snake River sockeye salmon ESU is provided in Tables 47 and 48. Methomyl potentially is used on a wide variety of crops, but we have no information on which crops are treated in these counties.

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

State	county	cultivated cropland acreage[a]
ID	Custer	34,754
ID	Blaine	47,565

[a]Cultivated cropland: includes all harvested cropland and all failed cropland.

Table 48. Cropland acreage in counties within the migratory corridors for the Snake River sockeye salmon ESU

State	county	cultivated acreage[a]
ID	Idaho	147,557
ID	Lemhi	41,837+
ID	Lewis	119,860
ID	Nez Perce	168,365
WA	Asotin	6990+
WA	Garfield	32,892
WA	Whitman	108,553
WA	Columbia	804,893

State	county	cultivated acreage[a]
WA	Walla Walla	97,743
WA	Franklin	337,660
WA	Benton	291,696
WA	Klickitat	268,372
WA	Skamania	93,193
WA	Clark	1205+
WA	Cowlitz	27,860
WA	Wahkiakum	8227+
WA	Pacific	3515+
OR	Wallowa	5451
OR	Umatilla	54,138
OR	Morrow	384,163
OR	Gilliam	220,149 +
OR	Sherman	100,729+
OR	Wasco	127,018+
OR	Hood River	97,230
OR	Multnomah	17,346+
OR	Columbia	14,692
OR	Clatsop	15,054+

[a]Cultivated cropland: includes all harvested cropland and all failed cropland. Failed cropland acreage is not reported for some counties due to privacy concerns when only a few farms report such acreage. We have denoted this "acreage" with a “+” in the cultivated cropland column in the relevant tables. Such acreage typically is small and statewide accounts for only 0.7% of harvested cropland acreage in Washington, 3.7% in Oregon, and 3.2% in Idaho.

We conclude that methomyl may affect the Snake River sockeye salmon ESU. This determination is made based on the possible use of methomyl on a variety of crops in counties within this ESU, direct risk of methomyl to endangered fish, and the potential for depletion of this ESU’s aquatic-invertebrate food supply. However, there is much uncertainty in this determination, especially because usage information for methomyl is lacking for these counties.

5. Summary conclusions for listed Pacific salmon and steelhead

Based on the available information and best professional judgement, our conclusions on potential adverse effects on listed Pacific salmon and steelhead are provided in Table 49. We conclude that methomyl will have no effect on two ESUs but may affect 24 ESUs.

For those ESUs in California, we base our determinations on reported usage of methomyl in individual counties in 2001, the potential direct risk to endangered steelhead and salmon, and the potential for indirect effects from loss of aquatic-invertebrate food resources. We note that only trained applicators can apply methomyl to agricultural crops and that a no-spray buffer of 25 feet for ground application and 100 feet for aerial application (450 feet for ULV application) is required on product labels. However, we do not know if this buffer is sufficiently protective. The California bulletins recommend a 200-yard buffer for aerial application and a 40-yard buffer for ground application as well as a 20-foot minimum vegetative strip between the treatment site and surface waters. Although the use limitations in the bulletins are voluntary, methomyl is a restricted use pesticide and, therefore, California applicators must obtain a permit from their County Ag. Commissioner's Office. The Ag. Commissioner's Office supports the bulletin use limitations and may require in the permit that the applicator must adhere to the use limitations.

For the ESUs in Oregon, Washington, and Idaho, we do not have methomyl usage information at the state- or county-level. Therefore, in counties with extensive cropland acreage, we assume that methomyl may be used on a variety of crops. Only Certified (i.e., trained) Applicators can apply methomyl to agricultural crops, and they must adhere to the requirement for a no-spray buffer of 25 feet by ground application and 100 feet by aerial application (450 feet for ULV application). However, we do not know if this buffer is sufficiently protective of the listed steelhead and salmon and their food supply. We will need to confer with NMFS as to whether these measures provide adequate protection for these ESUs or if other measures are needed in addition to a buffer. It would be of value to discuss any proposed mitigation strategy with the affected state pesticide regulatory agencies to ensure consideration of local conditions and use practices.

Table 49. Summary conclusions on specific ESUs of listed Pacific salmon and steelhead for methomyl

Species	ESU	Finding
Steelhead	Southern California	may affect
Steelhead	South-Central California Coast	may affect
Steelhead	Central California Coast	may affect
Steelhead	Central Valley, California	may 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
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
Chinook Salmon	California Coastal	no effect
Chinook Salmon	Puget Sound	may affect
Chinook Salmon	Lower Columbia	may affect
Chinook Salmon	Upper Willamette	may affect
Chinook Salmon	Upper Columbia	may affect
Coho salmon	Central California	may affect
Coho salmon	Southern Oregon/Northern California Coasts	may affect
Coho salmon	Oregon Coast	may affect
Chum salmon	Hood Canal summer-run	may affect

Species	ESU	Finding
Chum salmon	Columbia River	may affect
Sockeye salmon	Ozette Lake	may affect
Sockeye salmon	Snake River	may affect

References

Beyers, D.W., T.J. Keefe, and C.A. Carlson. 1994. Toxicity of carbaryl and malathion to two federally endangered fishes, as estimated by regression and ANOVA. Environ. Toxicol. Chem. 13:101-107.

Dwyer, F.J., D.K. Hardesty, C.E. Henke, C.G. Ingersoll, G.W. Whites, D.R. Mount, and C.M. Bridges. 1999. Assessing contaminant sensitivity of endangered and threatened species: Toxicant classes. U.S. Environmental Protection Agency Report No. EPA/600/R-99/098, Washington, DC. 15 p.

Effland, W.R., N.C. Thurman, and I. Kennedy. Proposed Methods For Determining Watershed-Derived Percent Cropped Areas and Considerations for Applying Crop Area Adjustments To Surface Water Screening Models; USEPA Office of Pesticide Programs; Presentation To FIFRA Science Advisory Panel, May 27, 1999.

Hasler, A.D. and A.T. Scholz. 1983. Olfactory Imprinting and Homing in Salmon. New York: Springer-Verlag. 134 p.

Johnson, W.W., and M.T. Finley. 1980. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. USFWS Publication No. 137.

Moore, A. and C. P. Waring. 1996. Sublethal effects of the pesticide diazinon on the olfactory function in mature male Atlantic salmon parr. J. Fish Biol. 48:758-775.

Sappington, L.C., F.L. Mayer, F.J. Dwyer, D.R. Buckler, J.R. Jones, and M.R. Ellersieck. 2001. Contaminant sensitivity of threatened and endangered fishes compared to standard surrogate species. Environ. Toxicol. Chem. 20:2869-2876.

Scholz, N.T., N.K. Truelove, B.L. French, B.A. Berejikian, T.P. Quinn, E. Casillas, and T.K. Collier. 2000. Diazinon disrupts antipredator and homing behaviors in chinook salmon (*Oncorhynchus tshawytscha*). Can. J. Fish. Aquat. Sci., 57:1911-1918.

TDK Environmental. 2001. Diazinon & Chlorpyrifos Products: Screening for Water Quality. Contract Report prepared for California Department of Pesticide Regulation. San Mateo, California.

Tucker, R.K. and J.S. Leitzke. 1979. Comparative toxicology of insecticides for vertebrate wildlife and fish. Pharmacol. Ther., 6:167-220.

Urban, D.J. and N.J. Cook. 1986. Hazard Evaluation Division - Standard Evaluation Procedure - Ecological Risk Assessment, U. S. EPA Publication 540/9-86-001.

Zucker E. 1985. Hazard Evaluation Division - Standard Evaluation Procedure - Acute Toxicity Test for Freshwater Fish. U. S. EPA Publication 540/9-85-006.