Coumaphos
Analysis of Risks
to
Endangered and Threatened Salmon and Steelhead

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Summary

Coumaphos is an insecticide registered nationally for control of face flies, horn flies, fly larvae, cattle grubs, ticks (including ear tick), lice, mites, screwworms, sheep ked, fleeceworms, varroa mites and small hive beetles on livestock and in beehives. A Reregistration Eligibility Decision (RED) that includes an ecological risk assessment for fish and invertebrates was issued in August 1996. Coumaphos is moderately to highly toxic to both warmwater and coldwater fishes, highly toxic to marine estuarine fish and mollusks, and very highly toxic to freshwater and marine invertebrates. The Estimated Environmental Concentrations (EECs) were modeled with a Tier 1 model, GENEEC, for current labeled application rates. Acute and chronic risk quotients were calculated from these EECs and the available toxicity values indicate no direct risk to endangered fish. The values indicate there is a direct effect to invertebrates, however, due to the low poundage used in the Pacific Northwest and California and its seasonal localized treatment applications there will be no risk to invertebrates. We conclude that coumaphos will not present a direct effect on Pacific salmon and steelhead and no indirect effects based on loss of their aquatic invertebrate food supply.

Introduction

This analysis was prepared by the U.S. Environmental Protection Agency (EPA) Office of Pesticides Programs (OPP) to evaluate the risks of coumaphos to threatened and endangered Pacific salmon and steelhead. The format of this analysis is the same as for previous analyses. The background section explaining the risk assessment process is the same as was presented in a previous assessment for diazinon, except that we have updated our criteria for indirect effects on aquatic plant cover to bring this in line with the acute risk concerns used by the Environmental Fate and Effects Division of OPP (EFED). Several other minor wording changes have also been made that have no bearing on the technical analysis.

The general aquatic risk assessment presented in the "Reregistration Eligibility Decision (RED) coumaphos" issued in August, 1996 and general use information in the "Reregistration Eligibility Decision Addendum and FQPA Tolerance Reassessment Progress Report (TRED) coumaphos" issued in September 2000 were the starting basis for this assessment
(Attachment A and B, respectively). These documents (US EPA, 1996, 2000) are on line at: http://cfpub.epa.gov/oppref/rereg/status.cfm?show=rereg#C. In addition, Bayer Corp. the

primary registrant, has developed an ancillary analysis of potential effects on salmon and steelhead and provided this for our consideration in developing our effects determination (Bayer Corp., Hall and Gagliano 2004). We have used and cited information from this analysis. We will be providing it for the Service's use when Service personnel have been cleared for Confidential Business Information (CBI), but it contains proprietary data on usage developed by another party and can not be made available to persons not cleared for CBI. While we use certain factual data, and refer to it, all conclusions in this current analysis are those of OPP.

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

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

Attachments:

A. Reregistration Eligibility Decision (RED) Coumaphos
B. Reregistration Eligibility Decision Addendum and FQPA Tolerance Reassessment Progress Report (TRED) Coumaphos
C. Quantitative Usage Analysis (QUA) for Coumaphos

D. Washington State Coumaphos Use Summary
E. Screening Level Aquatic Exposure Assessment for the Use of Coumaphos in the Pacific Northwest and California to Treat Cattle via Spray and Vat Dips

1. Background

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

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

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

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

LC50 or EC50	Category description

< 0.1 ppm	Very highly toxic
0.1- 1 ppm	Highly toxic
>1 < 10 ppm	Moderately toxic
> 10 < 100 ppm	Slightly toxic
> 100 ppm	Practically non-toxic

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

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

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

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

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

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

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

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

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

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

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

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

Finally, the applicability of the overall EEC scenario, i.e., the 10 hectare watershed draining into a one hectare farm pond, may not be appropriate for a number of T&E species living in rivers or lakes. This scenario is intended to provide a "worst-case" assessment of

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

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

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

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

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

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

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

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

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

Test data	Risk quotient	Presumption
Acute LC_{50}	>0.5	Potentially high acute risk
Acute LC_{50}	>0.1	Risk that may be mitigated through restricted use classification
Acute LC_{50}	>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 LC_{50}[a]	>0.5	May be indirect effects on T&E fish through food supply reduction
Aquatic plant acute EC_{50}[a]	>1[b]	May be indirect effects on aquatic vegetative cover for T&E fish

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

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

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

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

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

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

2. Description of Coumaphos:

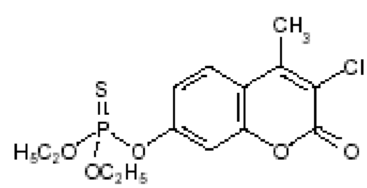
A. Chemical History

Coumaphos was first registered in 1958 for use as an insecticide. Coumaphos is currently registered for the control of insects, mites, and ticks on beef cattle, dairy cattle, horses, swine and swine bedding. Bayer Corporation no longer supports the use of coumaphos on sheep and goats and has requested voluntary cancellation of these uses. Since 1999, the Agency has exempted several State agencies from the provisions of FIFRA due to emergency conditions that required the use of coumaphos in bee hives to control varroa mites and small hive beetles.

B: Chemical Description:

<u>Coumaphos</u>:

- Common Name: Coumaphos
- Chemical Name: O,O-diethyl O-(3-chloro-4-methyl-2-oxo-2H-1-benzopyran-7-yl) phosphorothioate



- Chemical Family: Organophosphate
- Case Number: 0018
- CAS Registry Number: 56-72-4
- OPP Chemical Code: 036501
- Molecular Weight: 362.8

- Empirical Formula: $C_{14}H_{16}ClO_5PS$

- Trade and Other Names: Asuntol, Bay 21/199, Baymix, Co-Ral, Coumarin, ENT-17957, Meldane, Muscatox, Negashunt and Resitox

- Basic Manufacturer: Bayer Corp.

Technical coumaphos is a tan solid with a purity of 96% and a melting point of 90-95°C. At 20°C, coumaphos is soluble in acetone (23.82 g/100 ml) and diethyl phthalate (21.50 g/100 ml); much less soluble in denatured alcohol and xylene (0.9 g/100 ml in each); only slightly soluble in octanol (0.13 g/100 ml), hexane (0.07 g/100 ml), and mineral spirits (0.09g/100 ml); and insoluble in water (0.002 g/100 ml). Coumaphos is stable under normal conditions, but hydrolyzes slowly under alkaline conditions.

C. Chemical Use:

The following is based on the currently registered uses of Coumaphos:

- Type of Agent: Insecticide/acaricide

- Classification: Two liquid products, the 11.6% emulsifiable concentrate and the 42% flowable are classified as Restricted Use Pesticides (RUPs); all other products have general classification.

- Summary of Sites:

  - Food: Coumaphos is used as a direct animal treatment on beef and dairy cattle, horses, goats, sheep and swine. Predominant use is on beef cattle. Bayer Corporation no longer supports the use of coumaphos on sheep and goats and has requested voluntary cancellation of these uses.

  - Terrestrial Food/Feed Crops: None

  - Terrestrial Non-Food and Feed Crop: Swine bedding, beehives.

  - Public Health: None

  - Target Pests: Face fly, horn fly, fly larvae, cattle grubs, ticks (including ear tick), lice, mites, screwworms, sheep ked, fleeceworms, varroa mites and small hive beetles.

- Formulation Types Registered:

  Technical Grade/Manufacturing-Use Product (MUP): Technical Grade Active Ingredient (96% pure), manufacturing product (25% ai dust).

  End-use Product: 1% ai dust, 11.6% ai and 6.15% ai emulsifiable concentrates, 42% ai flowable concentrate, 10% ai strips, and 20% ai ear tags.

- Methods of Application:

  - Equipment: Dip vats, low and high-pressure hand wands, back rubber/oiler, mechanical dusters, dust bags, shaker cans, ear tags, and strips.

  - Method and Rate: Applied directly to livestock. Depending on animals treated and formulation type, the maximum label application rates range from 0.005 to 0.025 lbs ai/gallon for spray or dip, 0.076 lbs ai/gallon of oil for back rubbers, 0.000625 to 0.013 lbs ai/animal for dust, 0.042 lbs ai/1,000 sq. ft. of swine bedding, 0.0030865 lbs ai for strips (source: http://www.cdpr.ca.gov/docs/sec18/pdf/04-02.html), and 0.0125 lb ai for 2 ear tags (the label reads 0.03125 lb/tag so I assumed that was the total weight of one tag and I took 20% of that doubled to get the poundage of coumaphos for 2 tags).

  - Timing: Used primarily during early spring to late summer or during the fly season. Multiple applications to livestock and livestock areas are allowed.

D. Estimated uses of coumaphos

This section summarizes the best estimates available for the pesticide uses of coumaphos, based on pesticide usage information for 1990-1999 available to the Agency. A full listing of all uses of coumaphos, with the corresponding use and usage data for each site (cattle or other livestock), has been completed and is included in the "Quantitative Usage Analysis (QUA) for Coumaphos," dated August 15, 2000 (attachment C). The data, reported on an aggregate and site basis, reflect annual fluctuations in use patterns as well as the variability in using data from various information sources. Approximately 71,000 lbs a.i. of coumaphos is used annually in the United States, according to Agency estimates.

Coumaphos' largest market in terms of total pounds of active ingredient use is allocated to beef and dairy cattle (83%). Of this 83%, beef cattle account for 95% of the coumaphos cattle usage with dairy accounting for the remaining 5% of cattle usage. The remaining total usage is allocated to other livestock including: sheep, swine, horses and bees (16%). Use has generally declined over the last 10 years although there was an increase in use of the insecticide due to the use of the CheckMite+® beestrip miticide for the control of the varroa mite in bee hives (Bayer Corp., Hall and Gagliano 2004).

Table 3. Coumaphos Estimated Usage for Representative Sites (source: QUA Coumaphos 2000)

Site	Livestock (Millions)	Animals Treated (Millions)		Lbs. Active Ingredient Applied		Livestock Treated (% US Inventory)		Average Application Rate (Likely Averages)	States of Most Usage
		Wtd Avg	Est Avg	Wtd Avg	Est Avg	Wtd Avg	Est Avg	lb ai/ hd/yr	
Cattle[1]	99	5.1	19.7	59,000	156,000	5.1%	20%	0.012	TX, AZ, CO
Other Livestock[2]	76	1.0	2.6	12,000	26,000	1.3%	3%	0.012	

COLUMN HEADINGS
Wtd Avg = Weighted average--the most recent years and more reliable data are weighted more heavily.
Est Max = Estimated maximum, which is estimated from available data.
Average application rates are calculated from the weighted averages.
NOTES ON TABLE DATA
Usage data primarily covers 1990 - 1999. Calculations of the above numbers may not appear to agree because they are displayed as rounded
[1]The sum of the likely maximums is improbable since it is unlikely that ALL uses would be at their likely maximum at the same time. The total value is not additive as it is calculated based on available data.
[2] Other livestock include: swine–58 million; sheep–11 million; goats–3 million; and horses–2 million.
Sources: U.S. Census of Agriculture; State Usage Surveys from TX, KS, NY, WY, and NV; State use recommendations; USDA, NASS, 2000 and EPA data. Refer to the "Quantitative Usage Analysis for Coumaphos," dated August 15, 2000, prepared by OPP Biological and Economic Analysis Division.

At the state and county level, more data are available for coumaphos 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). We are not aware of any comprehensive sources of annual pesticide-use information for Washington, Idaho, or Oregon.

The Washington State Department of Agriculture (WSDA) has provided information on the acreage of major coumaphos treated sites and additional details on amounts used for certain of these sites (WSDA, 2004). These are in table 4 ; additional information is in the full report, which is included as Attachment D.

Table 4. Major uses of coumaphos in Washington (WSDA 2004)

Livestock	WASS[1] 2002 Est. No.	Rate per Head (gm)	Rate per Head per Year	Est. Lbs. Applied
Cattle, beef	253,000	Not enough data to quantify[3]		

Cattle, dairy	247,000	0.20	1.80	100
Honeybee colony[2]	44,000	-	-	156

[1]Washington Agricultural Statistics Service
[2]These have had no peer review input; source:2003 Section 18 Usage Report - 55,420 strips were used in Washington State.
[3]Data from "*U.S.D.A. Agricultural Chemical Usage - 1997 Livestock and General Farm Summary*" indicates 6,200 pounds of coumaphos used in the West for insect control on all livestock. The "West" includes AZ, CA, CO, ID, MT, NV, NM, OR, UT, WA, and WY. All livestock includes beef cattle, dairy cattle, hogs, sheep, and equine.

Information for selected livestock in Washington and Idaho is available from the USDA/NASS Washington Agricultural Statistics Service in their "Agricultural Chemical Usage" reports (http://jan.mannlib.cornell.edu/reports/nassr/other/pcu-bb/#livestock) but the data are not reported at the county level. The data for 2001 indicate that coumaphos use on dairy cattle was very small. The report indicated that total applied coumaphos in Washington was 100 pounds. Coumaphos was included under the list of insecticides used on dairy cattle in Idaho, but the amounts were so limited (less than 50 pounds a.i., the smallest amount they recorded) that no usage data was provided. Coumaphos was not listed in the tables for beef cattle, swine, horse, and swine bedding in the report.

Personal communication from the major registrant (Bayer Corp., Hall and Gagliano 2004) indicated that none of the coumaphos uses are registered in California except for Checkmite+®
(honeybee colony use), which is authorized for use under FIFRA Section 18 Emergency Exemption. All of the coumaphos uses, except Co-Ral Flowable, are registered in Oregon, Washington and Idaho. They indicated that the Pacific Northwest has a small portion of the total number of cattle in the U.S. (OR - 1.5%, WA - 1.1%, ID - 2.1%, CA - 5.2%). In the Pacific Northwest, direct application to land is not allowed.

The latest information for California pesticide use is for the year 2001 [URL: http://www.cdpr.ca.gov/docs/pur/purmain.htm]. The reported information to the County Agricultural Commissioners includes pounds used, acres treated for agricultural and certain other uses, and the specific location treated. The pounds and acres are reported to the state, but the specific location information is retained at the county level and is not readily available. Table 5 presents coumaphos usage from 1993-2001 in California and Table 6 presents acreage treated with coumaphos from 1993-2001 in California. The 2002 Annual Report for California indicates that only 61.7 lbs ai were applied throughout the state. Table 7 presents amount of active ingredient applied by site in California in 2002.

Table 5. Reported use of Coumaphos in California, 1993-2002 (lb ai) (source: California DPR Pesticide Use Report)

1993	1994	1995	1996	1997	1998	1999	2000	2001	2002

0	0	0	0	0	0	15	152	97	62

Table 6. Reported acreage treated with Coumaphos in California (lb ai) (source: California DPR Pesticide Use Report)

1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
0	0	0	0	0	0	0	1,339	809	733

Table 7. Use of Coumaphos by site in California in 2002 (source: California DPR Pesticide Use Report)

Site	Pounds of Active Ingredient Applied	Number of Applications	Units Treated[1]
Almond	5.73	1	2,000
Beehive	52.95 + 1.20[2] + 0.12[2]	74	52,231
Fumigation, Other	1.29		
Rights of Way	0.45		
Total	61.7	82	

[1]Units may vary.
[2]First number relates to the number of units treated; additional coumaphos uses for the second and third numbers did not report the number of units treated.

Bayer Corp. submitted information on the amounts of coumaphos sold in the four states of the Pacific Northwest including California by use site for 2002 (Bayer Corp., Hall and Gagliano 2004). However, these data are proprietary and are protected by FIFRA definitions of Confidential Business Information (CBI) under Section 10 (d)(1)(A), (B) and (C). However, in general terms, relatively little coumaphos is used as compared to other insecticides registered for the same sites.

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

A. Aquatic toxicity

The acute toxicity data indicate that technical grade coumaphos is moderately to highly toxic to both warmwater and coldwater fishes, highly toxic to marine estuarine fish and mollusks, and very highly toxic to freshwater and marine invertebrates. Data from the RED and the EFED database are presented in Tables 8 through 11, and the data from AQUIRE is presented in Table 12.

Table 8. Acute toxicity of coumaphos to freshwater fish (source: EFED Pesticide Ecotoxicity Database and RED)

Species	Scientific Name	% ai	96-h LC 50 (ppb)	Toxicity Category
Bluegill sunfish	*Lepomis macrochirus*	99.6	5000*	Moderately toxic
		95.0	340	Highly toxic
Rainbow trout	*Oncorhynchus mykiss*	99.6	5900	Moderately toxic
		95.0	890	Highly toxic
Lake trout	*Salvelinus namaycush*	95.0	593	Highly toxic
Cutthroat trout	*Oncorhynchus clarki*	95.0	862	Highly toxic
Largemouth bass	*Micropterus salmoides*	95.0	1100	Moderately toxic
Walleye	*Stizostedion vitreum v.*	95.0	780	Highly toxic
Channel catfish	*Ictalurus punctatus*	95.0	840	Highly toxic

*source: RED; EFED Pesticide Ecotoxicity Database indicates 96-h LC 50 as 5300 ppb.

Table 9. Acute toxicity of coumaphos to freshwater invertebrates (source: EFED Pesticide Ecotoxicity Database and Red)

Species	Scientific Name	% ai	48-h LC 50 (ppb)	Toxicity Category
Scud	*Gammarus lacustris*	95.0	0.074 (96-h)	Very highly toxic
		98.9	0.224	Very highly toxic
		97.0	0.14	Very highly toxic
		95.0	0.15 (96-h)	Very highly toxic
Waterflea	*Daphnia magna*	98.9	0.192	Very highly toxic

Table 10. Acute toxicity of coumaphos to estuarine and marine fish and invertebrates (source: RED)

Species	Scientific Name	% ai	48-h Toxicity (ppb)	Toxicity Category
Fish				

Sheepshead minnow	*Cyprinodon variegatus*	95	LC_{50} = 280	Highly toxic
Mollusk				
Eastern oyster	*Crassostrea virginica*	95	EC_{50} = 880	Highly toxic
		95	EC_{50} = 290 (96-h)	Highly toxic
Crustacean				
Pink Shrimp	*Panaeus duorarum*	95	LC_{50} = 2.0	Very Highly toxic

Adverse chronic effects on survival or growth of freshwater fish and invertebrates occurred at exposure concentrations of 24.6 ppb of technical coumaphos for fish and 0.0758 ppb for invertebrates.

Table 11. Chronic toxicity of coumaphos to fish and invertebrates (source: EFED Pesticide Ecotoxicity Database and RED)

Species	Scientific Name	% ai	Duration	Endpoints	NOEC (ppb)	LOEC (ppb)
Rainbow trout	*Oncorhynchus mykiss*	99.1	62 days	Fry length and weight	11.7	24.6
Waterflea	*Daphnia magna*	99.1	21 days	Survival	0.0337	0.0758

According to the RED, exposure to nontarget plants is minimal. Data requirements for non-target plant testing are not applicable for the coumaphos use patterns, and no studies were required or submitted.

There are some aquatic toxicity data for coumaphos from EPA's AQUIRE database (http://www.epa.gov/ecotox/). We did not look at the original papers but report the toxicity values for the toxicity test periods that are analogous to the those required by OPP testing requirements as a means of comparison. The AQUIRE reference numbers for each reported value are provided. The data corroborate the toxicity values reported in EFED's database and the coumaphos RED. The range of acute toxicity values for the active ingredient from AQUIRE are 150 to 62000 ppb for freshwater fish and 0.15 to 427 ppb for freshwater invertebrates compared to 340 to 5900 ppb and 0.074 to 0.224 ppb for fish and invertebrates, respectively, from OPP data. Most of the data in AQUIRE are reported from studies conducted with formulated products, however, the types of formulations and percents active ingredient were not reported. Therefore, it is difficult to directly compare these data with those reported by OPP.

Table 12. Summary of acute toxicity data from EPA AQUIRE database

Species	Scientific Name	Test Chemical*	96-h Toxicity (ppb)	Reference
Freshwater Fish				
Goldfish	*Carassius auratus*	Form.	LC50 = 18000	2893
Bluegill Sunfish	*Lepomis macrochirus*	Form.	LC50 = 180	936
		Form.	LC50 = 180	2893
		Form.	LC50 = 150	2893
Striped bass	*Marone saxatilis*	Form.	LC50 = 62000	966
Coho salmon	*Oncorhynchus kisutch*	Form.	LC50 = 15000	522
Rainbow trout	*Oncorhynchus mykiss*	Form.	LC50 = 1500	522
Fathead minnow	*Pimephales promelas*	From.	LC50 = 18000	936
Guppy	*Poecilia reticulata*	Form.	LC50 = 560	2893
Estuarine Fish				
Threespine stickleback	*Gasterosteus aculeatus*	Form.	LC50 = 1862	522
		Form.	LC50 = 1470	522
Freshwater Invertebrates				
Scud	*Gammarus fasciatus*	Active	LC50 = 0.15	887
Mayfly	*Hexagenia* sp.	Active	LC50 = 427 (24-h)	2158
Caddisfly	*Hydropsyche* sp.	Active	LC50 = 5.2 (24-h)	2158
Estuarine Invertebrates				
Eastern oyster	*Crassostrea virginica*	Form.	EC50 = 950	646
		Form.	EC50 = 510	646

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

The AQUIRE database is not always reliable regarding the test being with the formulation or the active ingredient; unless the test indicates an active ingredient, it is inputted into AQUIRE as formulation testing. However, we have seen values reported for the technical material in Mayer & Ellersieck (1986) to be reported in AQUIRE as a formulation test We report the information on formulation versus active ingredient, but we need to note that it is not completely reliable.

B. Environmental fate and transport

Based upon a review of studies submitted, coumaphos is persistent in the environment, with the exception that aqueous photolysis is rapid (half-life 33 hours). The half-life is much greater than 30 days for hydrolysis; much greater than a year for aerobic soil metabolism; and approximately 118 to 185 days for field dissipation. Coumaphos also appears

to be immobile, with K_d values ranging from 61 to 298 for parent and from 91 to 161 for the degradate chlorferon. Coumaphos accounted for 0.4% of leachate from a sandy loam column and
less than 2% of leachate from columns of sand, silt loam, and silty clay loam. Ground water contamination could result where ground water is close to the surface.

Coumaphos does not accumulate significantly in aquatic food chains. In a supplemental study, total coumaphos accumulated in bluegill sunfish with a maximum bioconcentration factor of 541 in whole fish during 30 days of exposure at 10 µg/l, in a flow-through aquatic system. In both edible and nonedible tissues, 33% of the extractable radioactivity was coumaphos, while 63-68% remained at the origin. In general, accumulated coumaphos residues were depurated rapidly, with 98% elimination after 1 day in untreated water.

The major degradates identified under aerobic conditions were chlorferon, which reached a maximum of 6.2% of the organosoluble radioactivity recovered at six months, and 6-hydroxyl-3-methylbenzofuran, the oxygen analog, which comprised a maximum of 0.2% of recovered radioactivity at six months. In column leaching studies, chlorferon and 6-hydroxyl-3-methylbenzofuran comprised 3.1% and 0.2%, respectively, in the top six inches of the sandy loam soil column. Similar results were obtained in the three other soil columns (using sand, silt loam, and siltyclay loam). There are no available data on toxicity of these degredates to aquatic organisms.

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).

The Agency has received documented field kills for terrestrial animals (bees and one bird). We are aware of no incident reports of coumaphos for aquatic animals or plants.

D. Estimated and Actual Concentration of Coumaphos in Water

<u>Estimated environmental concentrations (EECs)</u>

Even though Bayer Corp. stated that there is limited usage of coumaphos on cattle in the Pacific Northwest and California (Bayre Corp., Hall and Gagliano 2004) we requested an exposure assessment from Environmental Fate and Effects Division (EFED).

The results of this assessment indicate that application of bioremediated spent vat-dip solutions to agricultural lands is unlikely to exceed a peak concentration of 1.6 ppb and an ecologically relevant average concentration of 1.0 ppb. Estimated environmental concentrations from spray applications to cattle is not likely to exceed 0.15 ppb from the loss of coumaphos from the washoff of a single cow 30 minutes after treatment or up to 113 cows may wade into surface water 30 minutes after being treated without exceeding the endangered species level of concern of 0.05 based on results from a bluegill sunfish toxicity study. Values for the loss of coumaphos into surface water are presented in Table 13. For complete analysis refer to attachment E.

In the environmental risk assessment in the 1996 RED, EFED made an assessment for the use of coumaphos spray applied to cattle. When treated cattle enter water after being sprayed, some fraction of coumaphos on their skins, dissolves in the water. The assessment in the RED has been revised. The key adjustment made to the previous assessment is the amount of coumaphos applied to cattle on a square foot basis. Previously, the registrant washoff studies were based on a 25% active ingredient wettable powder formulation. The current assessment is based on a 42% flowable formulation. A linear adjustment was made to the amount of coumaphos per square foot to account for this, but no adjustment was made to the percent washoff. The fraction of cow surface area available for coumaphos washoff into the water body was adjusted from 25% in the earlier assessment to 50% in the current assessment. The previous assessment used an estimate based on the cow standing in the water body up to the hair break line. This represents approximately 25% of the cow. No consideration was made for wave action exceeding this line or the possibility that cows may be in the water during a light rain event. These routes of exposure were added in, increasing the fraction of surface area exposed to washoff to 50 percent. All other factors were the same.

Table 13. Screening Level Exposures from the Loss of Coumaphos Applied to Cattle Wading into Surface Water Following Spray Application.

Loading Contribution	Estimated Environmental Concentration (µg/L)	Maximum Cows in Water to Avoid Exceeding the Endangered Species Level of Concern (0.05) for Fish		
	Single Cow	Based on Bluegill Sunfish (LC_{50} = 0.34 mg/L)	Based on Rainbow Trout (LC_{50} = 5.9 mg/L)	Based on Walleye (LC_{50} = 0.78 mg/L)

Coumaphos dislodging from cattle[1]	0.15	113	1966	260

[1]100% dislodging is assumed to occur from that portion of the cow that is submerged in the water (i.e., 25%) and another 25% is assumed to dislodge from wave action contacting non-submerged portions of the body and dislodging occurring during a light rain event.

In addition, coumaphos may enter surface water via application of bioremediated spent dip vat solutions to soils where it would be available for leaching to ground water or for direct runoff following a runoff producing rainfall event. Two assumptions can be made with regard to the handling of spent solution. Once in the bioremediation ponds, the level of solution within the pond is maintained by evaporation and removal and proper disposal of solids. Alternatively, the liquid is discharged to water under an NPDES permit or applied to land. Under an NPDES permit, OPP assumes that precautions have been taken to adequately protect aquatic life. Application of bioremediated coumaphos to agricultural land was assessed by OPP as a potential exposure pathway.

Using information from the June 2000 Revised Tier I Drinking Water Assessment for Coumaphos (D266513), aquatic exposures were estimated using GENEEC Version 2.0 (August 1, 2001). Results are summarized in Table 14. Tier I modeling was conducted to estimate the environmental concentration from runoff and spray drift of coumaphos applied to the standard 10 ha field moving into in a small, static water body. The standard GENEEC exposure scenario was used to best represent the disposal of spent vat solution in the endangered species action area.

Table 14. 1 in 10 year Surface Water Estimated Environmental Concentrations of Coumaphos from Application of Spent Vat-Dip Bioremediated Solution.

Drift Scenarios	Loading Contribution	Estimated Environmental Concentration (µg/L)			
		Peak	4 day average	21 day average	60 day average
No Drift	runoff only	1.51	1.48	1.31	1.02
Ground Spray	runoff +1%drift	1.58	1.54	1.37	1.06

<u>NAWQA data</u>

Surface water monitoring data are not included in the NAWQA (http://infotrek.er.usgs.gov/servlet/page?_pageid=543&_dad=portal30&_schema=PORTAL30) monitoring programs.

E. General risk conclusions

Our risk conclusions are based on risk quotients (RQs) derived from the available toxicity data (Tables 8 to 12) and EECs from the GENEEC model for currently labeled rates. The RQs are presented in Table 15.

Table 15. Risk Quotients (RQ) for Freshwater and Estuarine Fish and Invertebrates based on toxicity for the most sensitive species from technical grade testing of the active ingredient (Tables 8 to 12) and EECs modeled by GENEEC (Tables 13 and 14).

Use Scenarios	Peak EEC	Acute FW Fish RQ[1]	Acute FW Invert RQ[2]	Acute Est. Fish RQ[3]	Acute Est. Invert RQ[4]	21-day EEC	Chronic FW Invert EEC[5]	60-day EEC	Chronic FW Fish RQ[6]
Spray									
Coumaphos dislodging from cattle	0.15	<0.001	2.03	<0.001	0.075	NR[7]	-	NR[7]	-
Dip-Vat Bioremediated Solution									
No Drift	1.51	0.004	20.40	0.005	0.76	1.31	38.87	1.02	0.09
Ground Spray	1.58	0.005	21.35	0.006	0.79	1.37	40.65	1.06	0.09

[1]Bluegill sunfish LC_{50} = 340 ppb
[2]Scud LC_{50} = 0.074 ppb
[3]Sheepshead minnow LC_{50} = 280 ppb
[4]Pink shrimp LC_{50} = 2.0 ppb
[5]Waterflea NOEC = 0.0337 ppb
[6]Rainbow trout NOEC = 11.7 ppb
[7]EECs for 21- and 60-days were not calculated or reported

Based solely on the most sensitive species and maximum EECs, the criteria of concern for coumaphos are not exceeded for direct acute (RQ > 0.05) or chronic effects (RQ > 1.0) for freshwater and estuarine fish from all uses. This indicates that coumaphos will have no direct effect on the Pacific salmon and steelhead despite the moderate to high acute toxicity to freshwater and estuarine fish. With respect to indirect effects that coumaphos may have on freshwater and estuarine invertebrate food sources for T&E salmon and steelhead, the criteria of concern (RQ > 0.5) for acute effects are exceeded for spray and dip vat remediation applications. These uses also exceed the criteria of concern (RQ > 1.0) for indirect, chronic effects.

Only certain coumaphos products are registered in the Pacific Northwest and California, limiting exposure to aquatic organisms. Registered products in Washington, Idaho, and Oregon include dust, emulsifiable insecticide, spray, ear tags, and bee strips (WSDA pers. comm., ODA pers. comm., and www.kellysolutions.com/id). Co-Ral flowable is not registered in any of those states (WSDA pers. comm., ODA pers. comm., and www.kellysolutions.com/id) and is considered a restricted use pesticide that can only be sold to and used by USDA (APHIS) in dip vats on the Texas-Mexico border for cattle coming into the United States from Mexico in the tick quarantine zone in Texas (Bayer Corp., Hall and Gagliano 2004). Since Co-Ral flowable product is the only product used in the cattle treatment via dip vats, no exposure will occur from ground application of bioremediated solution in the PNW and California. None of the coumaphos uses are registered in California except for Checkmite+® (honeybee colony use), which is authorized for use under FIFRA Section 18 Emergency Exemption (DPR, URL: http://www.cdpr.ca.gov/docs/pur/purmain.htm). Relatively little coumaphos is used in the PNW and California as compared to other insecticides registered for the same sites**.**

According to Bayer Corp. (Hall and Gagliano 2004) direct application to land is not allowed in the Pacific Northwest. In addition, Bayer (Hall and Gagliano 2004) has not produced or sold Co-Ral 1% Dust in over 15 years, though there are other companies that sell 1% coumaphos dust products. Co-Ral Emulsifiable Livestock Insecticide is a restricted use product that can only be sold to certified pesticide applicators, which limits the use of this product.

Bayer indicates that the environmental exposure from other Co-Ral products (Fly & Tick Spray, Cattle Ear Tag) and the Co-Ral Emulsifiable Livestock Insecticide is very low for several reasons. These products are used for seasonal fly control on cattle. Washington, Oregon and Idaho are not large cattle producing states, so use of these products is minimal. Based on 2002-03 USDA Census Data for cattle (beef, dairy and calves) the total population is 96.7 million head, of which the Pacific Northwest has a very small percentage (OR – 1.5%, WA – 1.1%, ID – 2.1%, CA – 5.2%). Total applied coumaphos in 2002 in Washington was 100 pounds (WSDA, 2004). The amounts of coumaphos used in Idaho in 2001 were so limited (less than 50 pounds a.i., the smallest amount they recorded) that no usage data was provided (USDA/NASS).

In addition, according to Bayer, the main fly pest in the Pacific Northwest is the Face Fly. Coumaphos is not the preferred treatment by cattlemen for this pest. The duration of the fly season in the Pacific Northwest is short (4 months maximum) limiting the time in which coumaphos products would be applied. The amount of coumaphos products currently used is very limited because of its niche market and due to the prevalent use of endecticides, such as ivermectin, which preclude the need for external fly control on livestock. Also, nutrient management strategies for cattle or dairy farms currently exist in much of the Pacific Northwest, which result in limiting the proximity of cattle to streams and rivers. The short half-life of coumaphos in water (33 hours, photolytic) indicates that chronic exposure will not be a problem (RED 1996).

Exposure from the cattle ear tag and the CheckMite+® bee strip is limited. They release very small amounts of coumaphos over the course of 3 to 6 months from a slow-release plastic matrix. As stated in the RED, cattle will generally enter into the water up to the hair break line, which is clearly visible on the sides of the cattle. Therefore, cows generally do not wade in water with their heads submerged and exposure from ear tags is minimal. The use of bee strips is limited to beehives and therefore, not a likely route of exposure to aquatic species. Any residues are limited to honey and bees wax, neither of which is released into the environment (Bayer Corp., Hall and Gagliano 2004).

As discussed in detail above, the low poundage of coumphos used in the PNW and California and its seasonal localized treatment applications (cattle and bee hives), indicate that, in my professional judgement, I do not expect the registered uses in the PNW and California to have an effect on aquatic species. I conclude that coumaphos will have no effect on Pacific salmon and steelhead either directly or indirectly through loss of their food supply.

F. Existing protective measures

Nationally, there are no specific protective measures for endangered and threatened species beyond the generic statements on the current coumaphos labels. As stated on product labels, it is a violation of Federal law to use a product in a manner inconsistent with its labeling. Labels for coumaphos have the Environmental Hazard Statement:

> This pesticide is toxic to mammals, birds, fish, and aquatic invertebrates. Coumaphos washed off wading treated livestock may be hazardous to aquatic organisms. Do not contaminate water when disposing of equipment washwater or rinsate.

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