Comments submitted by e-mail to: commentletters@waterboards.ca.gov.
PLEASE CONFIRM RECEIPT. Document is 5 pages and includes 3 attachments as exhibits. Hard copy to follow by mail to:

Jeanine Townsend, Clerk to the Board
State Water Resources Control Board
1001 I Street, 24th Floor
Sacramento, CA 95814

December 14, 2008

To:

State Water Resources Control Board

Subject:

Comment Letter – Antidegradation Policy (Resolution 68-16)

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For several years we have been reviewing state and federal policies and analyzing data regarding the deliberate poisoning of lakes and streams in Wilderness Areas and National Parks by state fish and game agencies and by the U.S. Fish and Wildlife Service for various fish management objectives. We are submitting these comments as private citizens in the public interest.

We strongly recommend that the State Water Board expand the list of Outstanding National Resource Waters (ONRWs) in California to include waters in designated Wilderness Areas and National Parks within California's boundaries. These are among the most undisturbed lands and waters remaining in the country. They serve as repositories for species and biotic communities that have been lost elsewhere and are critical to science as comparison reference habitats for information and restoration in other areas.

The Antidegradation Policy of the Clean Water Act states that "where high quality waters constitute an outstanding National resource, such as waters of National and State parks and wildlife refuges and waters of exceptional recreational or ecological significance, that water quality shall be maintained and protected"(Code of Federal Regulations, Title 40, Sec. 131.12).

Apparently, the California State Water Resources Control Board has been operating as if the state has only one ONRW, Lake Tahoe.[1]

The Water Quality Standards Handbook (4.7) outlines specific requirements for ONRWs ((40 CFR 131.12(a)(3)). "ONRWs are provided the highest level of protection under the antidegradation policy." "The regulation requires water quality to be maintained and protected in ONRWs." "ONRWs are often regarded as the highest quality waters of the United States. The regulation "permits States to allow some limited activities that result in temporary and short-term changes in the water quality of ONRW. Such activities must not permanently degrade water quality or result in water quality lower than that necessary to protect the existing uses in the ONRW. It is difficult to give an exact

[1] This designation applied to Lake Tahoe is somewhat ironic because the biotic community and physical conditions of Lake Tahoe are highly disturbed. The California Department of Fish and Game and the public have introduced many non-native fish and invertebrates in the lake and the native Lahontan cutthroat trout are gone. The ONRW designation is apparently based on the unique size and recreational and economic value of the lake.

definition of 'temporary' and 'short-term' because of the variety of activities that might be considered. However, in rather broad terms, EPA's view of temporary is weeks and months, not years."

The antidegradation policy further states for all water bodies, even those without ONRW status, that "species that are in the water body and which are consistent with the designated use (i.e., not aberrational) must be protected, even if not prevalent in number or importance. Nor can activity be allowed which would render the species unfit for maintaining the use. Water quality should be such that it results in no mortality and no significant growth or reproductive impairment of resident species" (Water Quality Standards Handbook, Appendix I-3, 4.9.2.2). And these protections hold for all existing aquatic life whether or not a water body supports fish.

Poisoning of lakes and streams with rotenone formulations and antimycin is occurring or being proposed for many Wilderness Areas and National Parks in the western U.S. and, specifically, in California. The objectives of these projects, to get rid of non-native fish that have been introduced by Fish and Game Departments, are commendable. The methods, however, are not. These poisons are causing long-term and probably permanent losses of invertebrate and amphibian species. We have discussed these in detail in two documents submitted to the EPA and attached here as exhibits A and B (Erman and Erman, Rotenone Risk Assessments, April 10, 2006; Erman and Erman, Antimycin A Risk Assessments, March 19, 2007).

Dr. David Herbst, an aquatic invertebrate specialist, also submitted to the California State Clearinghouse, June 28, 2002, a letter outlining long-term impacts of rotenone formulations as piscicides.

Recently, on October 16, 2008, the EPA finally made a "May Affect" and "Likely to Adversely Affect" determination for rotenone on the California red-legged frog (CRLF) when the poison is used in aquatic habitats. The EPA has also determined that there is the potential for modification of CRLF designated critical habitat from the use of rotenone as a piscicide. "Indirect effects to the CRLF may also occur through the loss of both vertebrate and invertebrate aquatic forage items." (EPA website)

Rotenone formulations would be expected to have the same impacts on many other amphibians in California.

Prentiss Inc., Foreign Domestic Chemicals, and Tifia International LLC, manufacturers of rotenone in the U.S., have petitioned the EPA to remove rotenone from the list of pesticides for terrestrial use, but not (yet) for aquatic use (EPA website). We suspect, but do not know for sure, that this petition is because of the growing evidence of the connection between rotenone and Parkinson's disease (Science Citation Index, Web of Science).

There has been some recent disturbing history with the SWRCB and its attitude to protection of existing uses in what should be considered ONRWs. The Lahontan Regional Water Quality Control Board (Lahontan Board) decided, September 8, 2004, not to issue an NPDES permit to the California Department of Fish and Game for a rotenone poisoning of streams and a lake in the Carson-Iceberg Wilderness Area. None of the agencies involved had produced an EIR or an EIS under either CEQA or NEPA. However, on July 6, 2005, the SWRCB overturned the decision of the Lahontan Board and issued a highly flawed NPDES permit on the project. The issue was taken to court on the grounds that NEPA had not been followed, and the Federal Court issued a temporary restraining order and then a preliminary injunction on the project (U.S. District Court, Eastern District of California, No. Civ.S-05-1633 FCD KJM) (Attached as Exhibit C).

Other activities occurring in ONRWs, such as the stocking of non-native fish or sediment from cattle grazing and construction also would seem to come under the responsibility of the SWRCB insofar as these activities affect and cause long-term deterioration of existing instream water uses. The stocking of non-native fish by the California Department of Fish and Game is a form of biological pollution that has been ignored for far too long in the state. Only recently has legal action brought about an order for preparation of a joint EIR/EIS on this activity.

We urge the SWRCB to take a more active and responsible attitude toward protecting what should be considered the Outstanding National Resource Waters of California. We sincerely hope the Board will more respectfully follow the spirit, intent, and goals of the antidegradation policy in protecting and maintaining the long-term, existing instream water uses in California.

Comments submitted by e-mail to: opp-docket@epa.gov. PLEASE CONFIRM RECEIPT. Document is 22 pages including 8 figures. Hard copy to follow by mail to:

Public Information and Records Integrity Branch (PIRIB) (7502C),
Office of Pesticide Programs (OPP),
Environmental Protection Agency,
1200 Pennsylvania Ave., NW, Washington, DC 20460-0001.
Docket ID No. OPP-EPA-HQ-2005-0494.

April 10, 2006.

To:
Environmental Protection Agency
Rotenone Risk Assessments
Attention Docket ID No. OPP-EPA-HQ-2005-0494

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We are aquatic ecologists who have reviewed over the past several years many of the rotenone poisoning projects conducted or proposed by the California Department of Fish and Game (CDFG) on streams and lakes on public land in California and by other state fish and game agencies, by the US Fish and Wildlife Service (FWS), and as permitted by the USDA Forest Service (US Forest Service) throughout the West. We are submitting these comments as private citizens in the public interest. We are commenting specifically on the effects of rotenone when used as a "piscicide" in the nation's streams, rivers, and lakes.

Rotenone versus synergized rotenone formulations:

The Environmental Protection Agency should recognize and distinguish among the many formulations of "rotenone." Pure rotenone is rarely used in fish poisoning operations. For example, the formulation of choice by CDFG in California over the past many years has been Nusyn-Noxfish, which contains other toxic cube resins, such as deguelin, and piperonyl butoxide in percentages equal to rotenone. Deguelin, tephrosin and other rotenoids have been shown in published reports to have the same properties as rotenone as an insecticide. Piperonyl butoxide is highly acutely toxic to aquatic macroinvertebrates (EPA, National Pesticide Telecommunications Network). These formulations also contain many other inert ingredients that are not desirable for release into natural waters.

Collateral damage to non-target species and aquatic communities from the application of rotenone formulations:

Rotenone formulations can not be referred to merely as "piscicides" (as this EPA announcement has) thereby implying that they kill only fish. In fact, rotenone formulations act as a poison on many non-target organisms and have major long-term impacts on aquatic invertebrates and on amphibians. Rotenone inhibits the ability of fish and other aquatic animals that obtain oxygen from water, to use oxygen.

The CDFG and the US Forest Service have recently been requesting rotenone projects of three years duration, with up to two applications per year, because they have had so little success in eliminating unwanted fish with one-year applications (e.g., US Forest Service Decision Notice 2004). And often these poisoning regimens have been repeated on approximately 10-year cycles in the same stream basins or lakes. The great majority of aquatic invertebrates have one-year life cycles. A three-year project eliminates many invertebrates from the stream and riparian area for as long as four years and longer. Many terrestrial animals are dependent on the food source of emerging stream insects, amphibians, and fish and are put at risk from these projects because a major part of their food supply is eliminated for several years. This cascading effect in food webs is a major ecological disturbance.

The impacts of rotenone on aquatic invertebrates are well known, have been studied for many years and continue to be studied (e.g. Almquist 1959, Binns 1967, Meadows 1973, Helfrich 1978, Engstrom-Heg et al. 1978, Chandler 1982, Dudgeon 1990, Mangum and Madrigal 1999, Cerreto et al. 2003). The impacts are variable depending on the sensitivity of each species to rotenone. Some species may be eliminated or greatly reduced while more resistant species are increased after rotenone poisoning. Cosmopolitan or "weedy" colonizer species, relatively insensitive to rotenone, tend to replace more sensitive species and the overall species diversity decreases.

Most of the aquatic invertebrate studies have been short-term. Most have only identified larval aquatic insect forms and, therefore, have not determined the number of species affected or eliminated by rotenone. If a higher taxon than a single species is affected, one can assume that a higher number of species is being affected. For example, when a study reports that a genus, family, or order has disappeared or shown major stream drift, one must assume the taxon represents more than one, and perhaps many, species.

In a short-term study on a Pennsylvania stream, Helfrich (1978) found that all 4 major orders of macroinvertebrates in the study stream exhibited substantial decreases in numerical abundance 11 days after rotenone treatment. Populations of Plecoptera and Diptera were "nearly exterminated." Trichoptera and Ephemeroptera were reduced to 50% of the pretreatment levels.

A 5-year study on a river in Utah (Mangum and Madrigal 1999) found that "up to 100% of Ephemeroptera, Plecoptera, and Trichoptera [mayflies, stoneflies and caddisflies] were missing after the second rotenone application. Forty-six percent of the taxa recovered within one year, but 21% of the taxa were still missing after five years. At least 19 species were still missing five years after the rotenone treatments. (We say "at least" because some taxa were identified only to genus and may have included more than one species). It should be noted that the rotenone formulation that was used in the Mangum and Madrigal study was Noxfish, which does not contain the synergist piperonyl butoxide found in

Nusyn-Noxfish. We would expect even more toxic effects to macroinvertebrates from Nusyn-Noxfish.

The California Lahontan Regional Water Quality Control Board required that the CDFG conduct monitoring on aquatic macroinvertebrates before and after the application of Nusyn-Noxfish to several streams in the Lahontan region. We have obtained CDFG reports and data from two of those studies, one on Silver King Creek, 1990 through 1996 (Trumbo et al. 2000 a); and the other on Silver Creek, 1994 through 1998 (Trumbo et al. 2000 b), both in the Carson–Iceberg Wilderness Area, Humboldt-Toiyabe National Forest, CA. We also obtained most of the original data reports that were prepared by the USDA Forest Service, National Aquatic Ecosystem Monitoring Center Laboratory, Provo, Utah for these two CDFG reports.

F.A. Mangum of the National Aquatic Ecosystem Monitoring Center Laboratory, prepared the reports from data collected before and after the 1991-1993 poisoning of Silver King Creek above Llewellyn Falls. We found the following quotes in the data report submitted to the California Department of Fish and Game in 1997 from the USDA Forest Service, National Aquatic Ecosystem Monitoring Center Laboratory, Provo, Utah. (Mangum, F.A. 9 Jan. 1997. Aquatic Ecosystem Inventory - Macroinvertebrate Analysis Silver King Creek, 1996. USDA Forest Service, National Aquatic Ecosystem Monitoring Center Laboratory, Provo, Utah):

<u>Station 1, Control Section, Four Mile Creek</u>

"Many of the species missing in Silver King Creek following rotenone treatments were still found in Four Mile Creek." (p. 8)

<u>Station 2, Silver King Creek</u>

"16 taxa (33%) found in the pre-rotenone community were still missing;" (p. 14)

<u>Station 3, Silver King Creek</u>

"There were still 11 taxa or 28% of the pre-rotenone community still missing at this station;" (p. 15)

<u>Station 6, Silver King Creek</u>

"...there were still 17 taxa or 38% of the pre-rotenone community missing;" (p. 15)

<u>Station 7, Silver King Creek</u>

"...but 13 taxa (30%) were still missing from the pre-rotenone community at this station; see Table 4. Most of the missing taxa have been observed to be sensitive to rotenone." (p. 16)

Station 8, Silver King Creek

"There were still 14 taxa (30%) missing at this station compared to pre-rotenone samples;" (p. 17).

Our analysis of the same data indicates an even higher number of macroinvertebrate taxa missing three years after the last poisoning on Silver King Creek. The average percent missing taxa from the five treatment stations was 41.9%; the highest percent taxa missing from a single station was 46.7%.

Some of our analyses of these data are summarized in Figures 1 through 8. We found that macroinvertebrate diversity in Silver King Creek was significantly reduced two and three years (considered long-term in the Lahontan Basin Plan) following poisoning with Nusyn-Noxfish (Fig. 1) and that peltoperlid stoneflies were greatly reduced in the long-term (Figs. 2 and 3). Percentage of taxa that were still the same at the poisoned stations after they were poisoned compared to before was significantly lower than at the control station (Fig. 4). In Silver Creek (a different stream from Silver King Creek) the mean number of taxa were significantly reduced two years after the last poisoning (Figs. 5 and 6), stonefly abundance was greatly reduced (Fig. 7), and peltoperlid stoneflies had nearly disappeared two years after the last rotenone poisoning (Fig 8). The peltoperlid stoneflies had been the most abundant stonefly group prior to poisoning.

In 2003, CDFG provided the Lahontan Regional Water Quality Control Board (LRWQCB) staff misleading information when they claimed that "No evidence of long-term impacts were found in either study" (Interagency Study Proposal, LRWQCB files, June 15, 2003, Evaluation of Rotenone use in Silver King Basin on Aquatic Macroinvertebrates, 2003-2007). Our analysis of the data available in the reports showed otherwise.

Our analyses of these data will continue as agencies release the data to us. However, it has been extremely difficult to get all the data and the US Forest Service and CDFG failed to release a complete set of data from these two streams even to the Lahontan RWQCB after the Board formally requested it.

We know that an average of 41.9% of the broad taxa of macroinvertebrates were still missing from the Silver King Creek drainage as long as three years following the last rotenone treatment. We do not know how many species these taxa represent. To our knowledge, neither the US Forest Service, CDFG, nor the USFWS have ever made an inventory of macroinvertebrate species prior to a stream or lake poisoning project in California. There is no way to know whether or not other rare and/or endemic macroinvertebrate species are in a project area prior to poisoning or whether or not any of the macroinvertebrate species ranked as endangered, restricted range, or rare in the California Natural Diversity Database are present. We think this lack of knowledge of aquatic species present prior to rotenone poisoning extends throughout the US.

Many of the stream poisoning projects now being carried out or proposed in the western US are in the most pristine and unspoiled streams and rivers of the country in designated Wilderness Areas and national parks. Many are in isolated headwater areas that have a high probability of containing other rare and endemic aquatic species, for the same reason that they have rare subspecies of fish. Our research has revealed rare and/or endemic species of invertebrates in many springs and headwater reaches in the Sierra (e.g., Erman and Erman 1990, 1995). We also have found that aquatic invertebrate species persist in undisturbed streams over many years. Other researchers also have found persistence of invertebrate taxa in undisturbed streams over many years (e.g., Robinson et al. 2000). These are the sites that should be most protected.

Studies of insect dispersal in Europe have found that biological recovery of aquatic insect communities following insecticide poison events or severe organic pollution may take decades (Sode and Wiberg-Larsen 1993).

The mountain yellow-legged frog and the Yosemite toad are both candidates for listing as endangered species and both are or were found in stream basins in the Sierra Nevada that are proposed for fish eradication or where fish eradication has been attempted for many decades. There is no time during the year that tadpoles of the mountain yellow-legged frog would not be in a stream in higher elevations because the mountain yellow-legged frog spends up to four years as a tadpole. Adult frogs are highly aquatic compared to other amphibian species (Dr. Kathleen Matthews, USDA Pacific Southwest Experiment Station 2003, High Sierra Ecosystems, Science Perspectives, USDA Pacific Southwest Experiment Station).

<u>Inability of fish and game departments to properly manage rotenone applications in the field:</u>

Use of rotenone as a fish poison requires that rotenone must be neutralized chemically in order to control its toxic effect downstream from treatment areas. This chemical neutralization is commonly attempted with potassium permanganate. Failure by the CDFG to achieve complete neutralization and to cause fish kills from the potassium permanganate itself is documented in California Regional Water Quality Control Board (RWQCB) files.

We have read reports from the Lahontan RWQCB files and from CDFG files. During rotenone poisoning of Silver King Creek, Mono County, 1992, approximately 1000 fish were killed downstream of the project area from the application of potassium permanganate (Lahontan RWQCB files). The following year, 1993, during a repeat poisoning of the same area, detoxification of the rotenone was chemically incomplete (Flint et al. 1998). The record shows that CDFG has difficulty managing the performance of potassium permanganate and detoxifying the rotenone.

In the Lahontan Region alone, 6 of 11 rotenone projects since 1988 have violated water quality standards. Rotenone, rotenolone, or naphthalene have been detected downstream or have persisted longer than limits established in Basin Plans (Lahontan RWQCB files).

During application of rotenone in Silver Creek, Mono County, in 1994, independent testing by the Regional Water Quality Control Board found carcinogenic compounds in water. In contrast, testing by CDFG at the same sites found no detectable carcinogenic compounds (Lahontan RWQCB files).

Rotenone was detected in sediment during a CDFG project in Silver Creek, Sept. 20, 1995. CDFG was well over their target application rate of rotenone, with data apparently missing at a critical period (Lahontan RWQCB files).

Rotenone and its breakdown products have persisted in water for long periods after CDFG poisoning projects (Lahontan RWQCB files).

Higher amounts of rotenone have been used than are recommended because of accidents (e.g., Flint et al. 1998). In Silver King Creek non-native fish in live cars (used to monitor effectiveness of the poison) escaped into the stream section being poisoned, not once but twice (Flint et al. 1998). As a result, "the creek was heavily doused with rotenone from backpack sprayers so that total concentrations peaked at 40 $\mu g/l$ at detox, about twice (sic) expected." Not all the escaped fish were found (Flint et al. 1998). Thus, even as CDFG was attempting to get rid of fish, they were accidentally introducing them.

Rotenone can not solve the problem of unwanted fish species

Until the responsible agencies recognize and acknowledge the underlying reasons for many of the unwanted species in the nation's waters and riparian zones, they will be unable to solve the problems with pesticides.

Non-native fish species have been and continue to be stocked by state fish and game agencies and by the US Fish and Wildlife Service. These species were/are stocked without environmental review and constitute a form of biological pollution. Perhaps the greatest threat of these stocking programs is the lesson they teach the public: it is a good idea to move fish around. For this reason and because of the continued official agency fish stocking, few fish eradication projects are successful in removing unwanted fish species over the long term (see for example, the decades-long records of poisoning streams and springs in the Golden Trout Wilderness and the Carson–Iceberg Wilderness, CA).

Rotenone formulations usually can not kill all the unwanted fish. An attempted fish eradication project in a reservoir, Lake Davis, CA, in the mid 1990s failed to eradicate the northern pike, poisoned a water supply for the town of Portola, and cost the state $15 million, some paid in reparations to the local community (Braxton-Little, Sacramento Bee, March 1, 2005). Components of the rotenone formulation, including piperonyl butoxide, persisted in the reservoir long after the poisoning was conducted. Portola has not used water from the reservoir since that time. The pike have been thriving in the intervening years, probably partly due to elimination of predators and competitors. The reservoir had been stocked with many non-native fish, but the northern pike was an illegal stocking, that is, a species not stocked by the CDFG. It is not easy for members of the public to understand why they can not stock the fish they want, if fish and game agencies can do it.

Freshwater habitats in the US are undergoing degradation and biological impoverishment from many sources (Erman 1996). It makes little sense to add poisons to streams and lakes in misguided attempts to save threatened and endangered fish without comprehensive understanding of why these fish species are endangered and with no concern for endangering other non-target species. It was never the intent of the Endangered Species Act to conduct recovery projects to increase single species that would put other species at risk of extinction.

Inadequate EPA review of connection between rotenone and Parkinson's Disease

The EPA rotenone risk assessment document has provided inadequate review and analysis of the connection between rotenone and Parkinson's Disease. In the various sections where the topic comes up, the EPA has repeated the statement "although several studies have linked sub-chronic rotenone exposure to Parkinson's disease-like symptoms in laboratory rats, the exposure methods used to obtain these results are not typically encountered through the current registered uses of rotenone." A critical analysis of the literature on this subject is restricted in the EPA document to the original study by Betarbet et al. (2000) and a paper on zebrafish by Bretaud et al. (2004). The Betarbet et al. study methods are critiqued and the findings judged of "uncertain relevancy" (p. 55 and elsewhere) as if this initial paper which first showed the connection between rotenone and Parkinson's disease is the sum total of current knowledge and technique. Such a review and analysis is insufficient for an EPA document of this importance.

The Web of Science presently lists 210 scientific papers connecting rotenone and Parkinson's disease. Many of these are extremely relevant to the EPA assessment, for example, Vanacore et al., 2002, have conducted a meta-analysis of all case control studies to the date of their work and are following the fate of a cohort of licensed pesticide users. More recently, Brown, T.P. et al., 2006, reviewed the extensive and growing literature on this subject and found "…a relatively consistent relationship between pesticide exposure and PD" and "…data suggest that paraquat and rotenone may have neurotoxic actions that potentially play a role in the development of PD…"

Inadequate EPA review of components of rotenone formulations

The EPA rotenone risk assessment document is incomplete in its treatment of ingredients associated with formulated end-products of rotenone. It has concluded that cube root resins do not contribute substantially to the toxicity of rotenone because technical grade rotenone is twice (at least) as toxic as the formulated end-product of rotenone. This conclusion is apparently based on the data reported in Table 3.17 for three formulations, Prentox Grass Carp Management Bait, Chem Sect Chem Fish Regular, and Chem Sect Cube Root Powder Toxicant.

However, the range of fomulations presented does not cover the range of actual formulations, associated products or potential toxicity. For example, work by Cabizza et al., 2004, found residues on olives of deguelin, tephrosin, and beta-rotenolone were very similar to rotenone and some data indicated similar acute toxicity values for deguelin and rotenone. The EPA and producers of rotenone products (e.g., Chem Sect Chem fish Regular, Table 3.17, and Nusyn-Noxfish and CFT Legumine) combine all such active compounds as "cube root resins" although their relative amounts and toxicities in end-product formulations are not equivalent. The limited data presented in Table 3.17 of the document support caution in making conclusions about toxicity of other cube resins. For example, Chem Sect Chem Fish Regular, 5% rotenone and 5% other cube resins, was 8 times more toxic to male rats than the other two products that contained no other cube resins. There are no data to reveal whether the other cube resins in Chem Sect Chem Fish Regular were rotenolone, tephrosin, deguelin or a mixture, or which was predominant.

Detailed work on extract from the source plant (*Lonchocarpus*) has found as many as 25 other minor rotenoids in cube resin (Fang andCasida 1999). Thus, other "cube root resins" is too broad a term for useful toxicity characterization and a more complete discussion and review is required than is in the EPA document.

Recommendations

We recommend 1) that the use of rotenone as an aquatic poison be halted in most cases in the US, 2) that its use should always require an NPDES permit [See earlier comments we submitted to the EPA, Attention Docket ID No. OW–2003–0063, April 1, 2005], and 3) that where it is permitted, application should be monitored and overseen by an independent, unbiased agency. The agencies promoting the use of rotenone in stream and lake poisoning can not be relied upon to also monitor and accurately report the effects of its use. We think that independent aquatic scientists, including macroinvertebrate and amphibian specialists, must be involved in the analysis of the impacts of rotenone on aquatic communities and species of non-target organisms.

Summary

To summarize, aquatic poisons rarely solve the problems for which they are used because the same fish and game agencies that promote them continue to stock non-native fish. Members of the public learn from the example of the agencies and also move fish around. And fish poisoning often does not kill all the target fish.

The record is clear that the state and federal agencies using rotenone in California streams and lakes are incapable of applying the products without major problems.

We think the impacts of rotenone use in the streams and lakes of the US over the past 60 or 70 years has significantly reduced the diversity and changed the communities of aquatic macroinvertebrates and has probably eliminated some, perhaps many, non-target species. It has likely also had a major effect on some amphibians and has had a secondary food web effect on terrestrial animals that depend on fish, amphibians, and emerging aquatic insects for food. The effects of "piscicides" in general on non-target species have been understudied, poorly analyzed, and denied or ignored by some of the state and federal agencies involved in stream and lake poisoning.

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Explanation of figures:

Figure 1. Silver King Creek Macroinvertebrate Diversity Long-term Response to Nusyn-Noxfish (a rotenone poison).

Plot of the Margalev diversity index. Data is from Trumbo et al. (2000a) It compares the mean diversity index (± 1 standard error) for the control site (Station 1 in Trumbo et al. 2000a) and the sites eventually poisoned (Stations 2, 3, 6, 7, 8). The bars labeled "Before" are mean values for the two years before poisoning (1990 and 1991 before poison). The bars labeled "Long-term" are mean values for the two years, 1995 and 1996, following the last poisoning in 1993.

Figure 2. Silver King Peltoperlid Stoneflies.

Mean number of individuals (± 1 standard error) of the stonefly family Peltoperlidae, a taxon difficult to mistakenly identify. Data are from Trumbo et al. (2000a). Data in the Trumbo et al. (2000a) report are in tables of Plecoptera by taxon. Values for all taxa in the family Peltoperlidae (i.e., *Yoroperla brevis, Yoroperla* and Peltoperlidae) were summed for each date and station. "Before" on the x-axis means before poison and includes the samples from 1990 and 1991 (before poisoning). "During" includes the samples from 1991 after poisoning, 1992 before and after, 1993 before and after, and 1994 (one year after final poisoning). "Long-term" includes samples from 1995 and 1996, two and three years following the final poisoning.

Figure 3. Percentage of Peltoperlidae in Silver King Creek (of all Stoneflies).

This plot is of the same data and source as Fig. 2 except the number of individuals of Peltoperlidae from the poisoned stations (Stations 2, 3, 6, 7, 8) are divided by the total number of individuals of all taxa and expressed as a percentage (± 1 standard error). The periods and samples are the same as in Fig. 2.

Figure 4. Percentage of taxa the same as those found before poisoning began, Silver King Creek.

The mean of 5 poison stations includes ± 1 SE. Data were not available for 1992 at the Control station. 1992 and 1993 include samples from before (b) and after (p) poison applied. Long-term results are considered those of 1995 and 1996 according to Lahonton Basin Plan. (Data from Mangum 1991, 1993-1996)

Figure 5. Silver Creek Number of Taxa.

Mean number of taxa (±1 standard error) from a study on Silver Creek (a different stream from Silver King Creek) reported in Trumbo et al. (2000 b. There was no control station in this study. The years are given under the periods used to calculate Before, During and Long-term. All four stations are used to calculate the mean for each bar.

Figure 6. Silver Creek Number of Taxa showing time of poison (Nusyn-Noxfish) application.

This is a plot of the mean number of taxa from Silver Creek based on the same data (Trumbo et al. 2000 b) shown in Fig. 4. The sample periods are given on the x-axis and vertical arrows indicate time of poisoning.

Figure 7. Silver Creek Stonefly abundance

Plot of mean (± 1 standard error) number of individuals (for all taxa in the Stonefly order) for Silver Creek based on data in Trumbo et al. (2000 b). Data are grouped as in Fig. 5. All four stations are used for each bar.

Figure 8. Silver Creek Peltoperlid Stonefly Abundance.

Mean number of individuals (± 1 standard error) of the family Peltoperlidae. The data are from the report by Trumbo et al. (2000 b). Times and stations are as in Fig. 6.

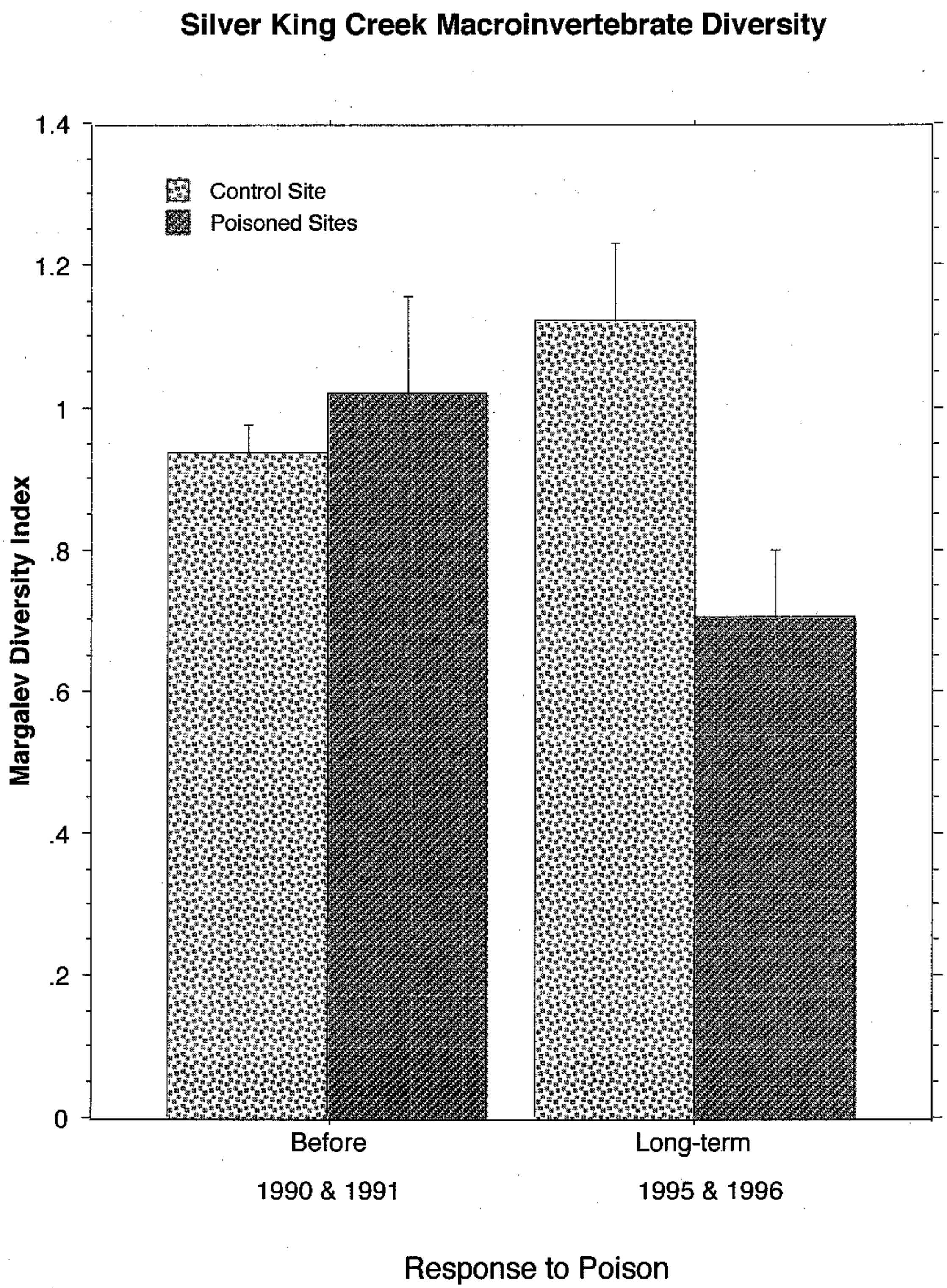

Figure 1. Silver King Creek macroinvertebrate diversity long-term response to Nusyn-Noxfish (a rotenone poison).

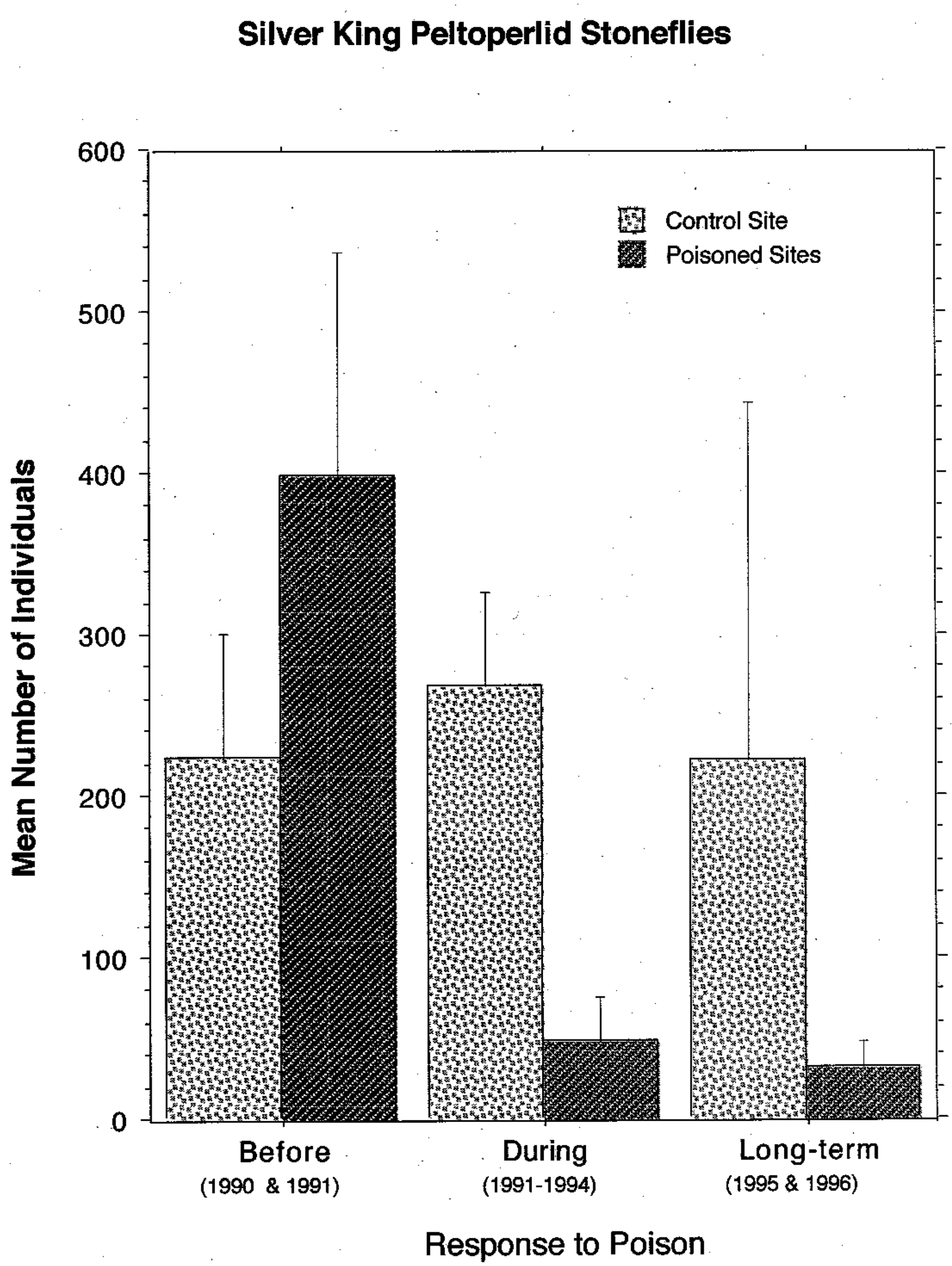

Figure 2. Silver King peltoperlid stoneflies.

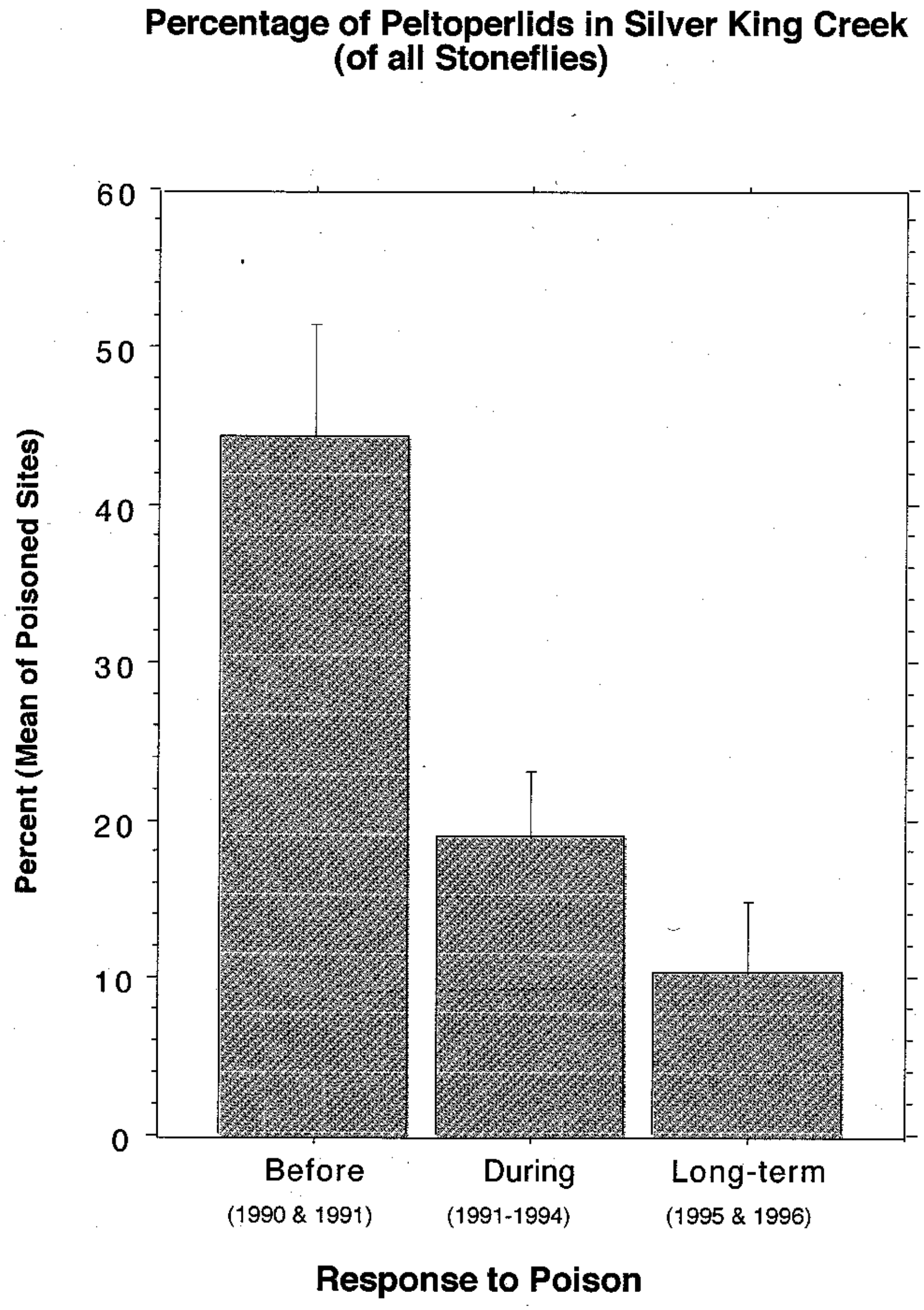

Figure 3. Percentage of peltoperlids in Silver King Creek (of all stoneflies).

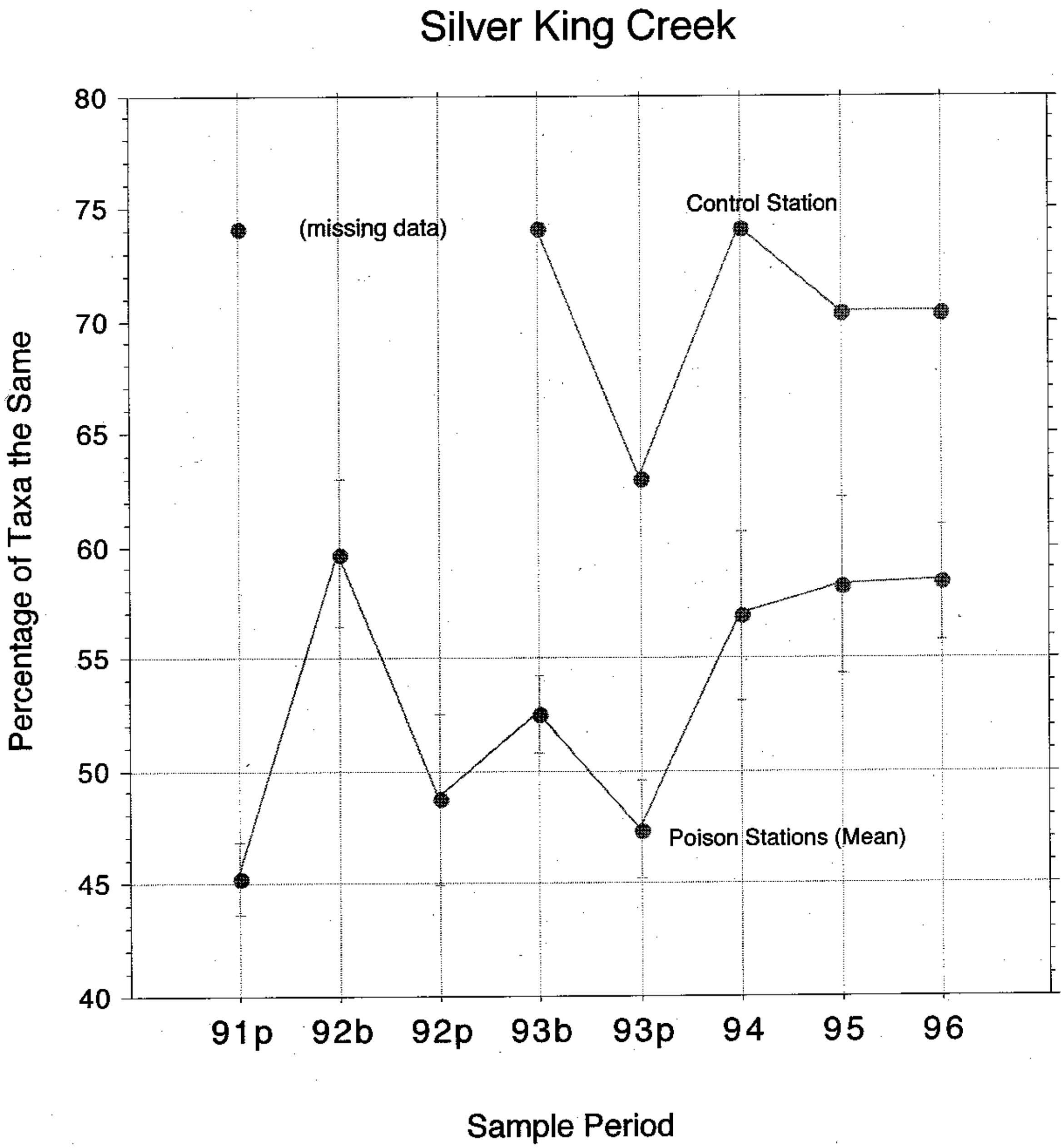

Figure 4. Percentage of taxa the same as those found before poisoning began.

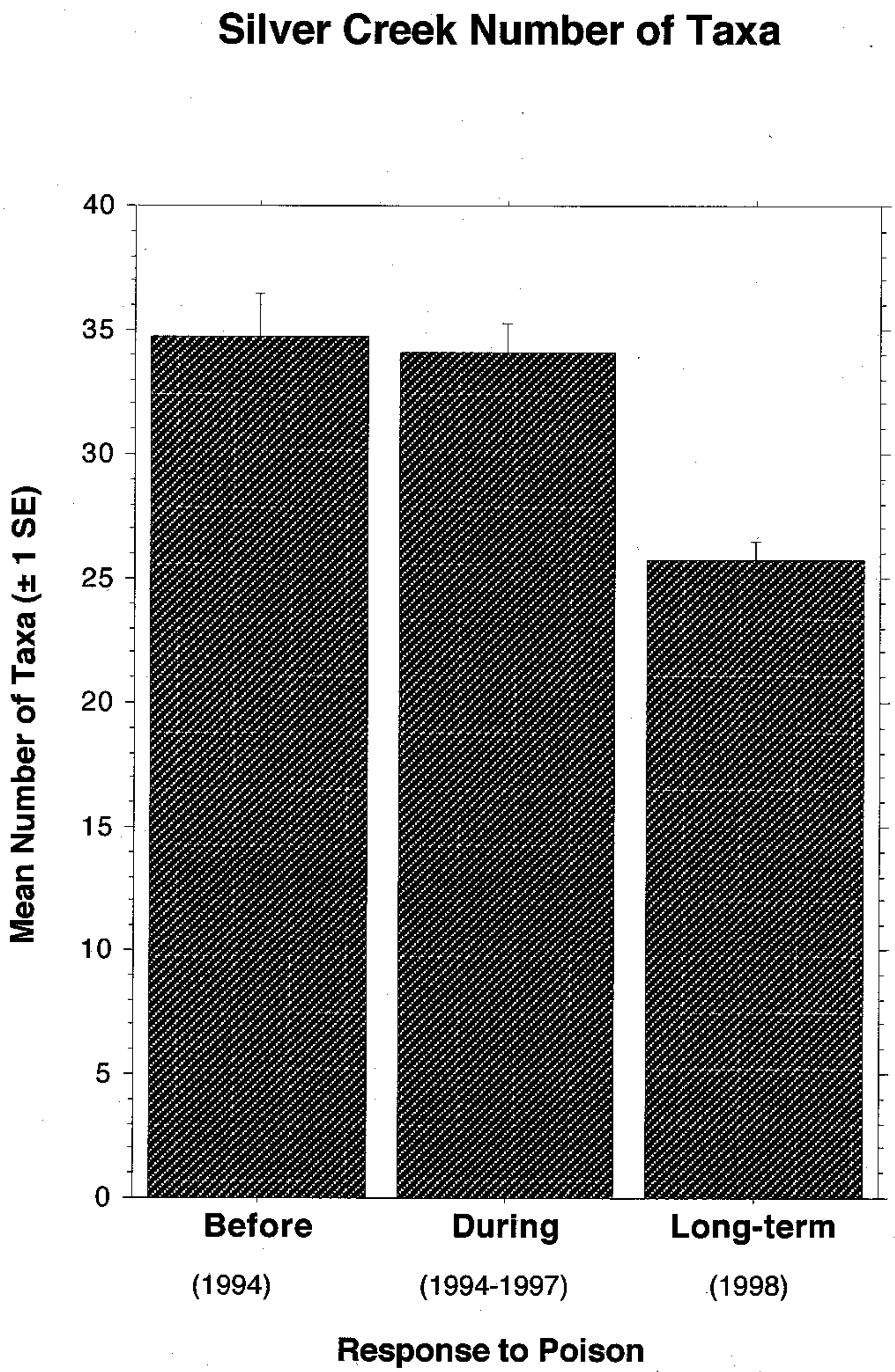

Figure 5. Silver Creek number of taxa.

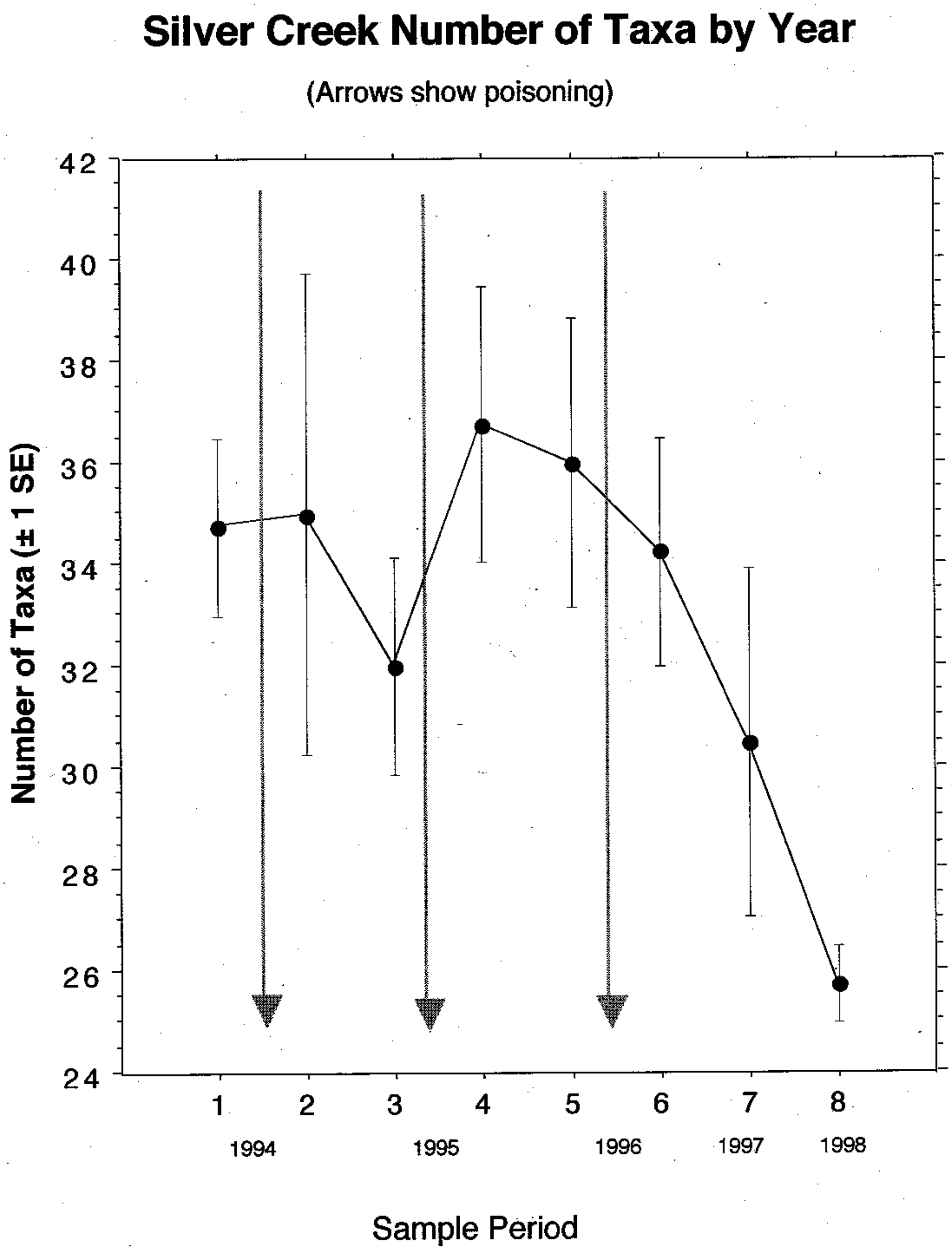

Figure 6. Silver Creek number of taxa showing time of poison (Nusyn-Noxfish) application.

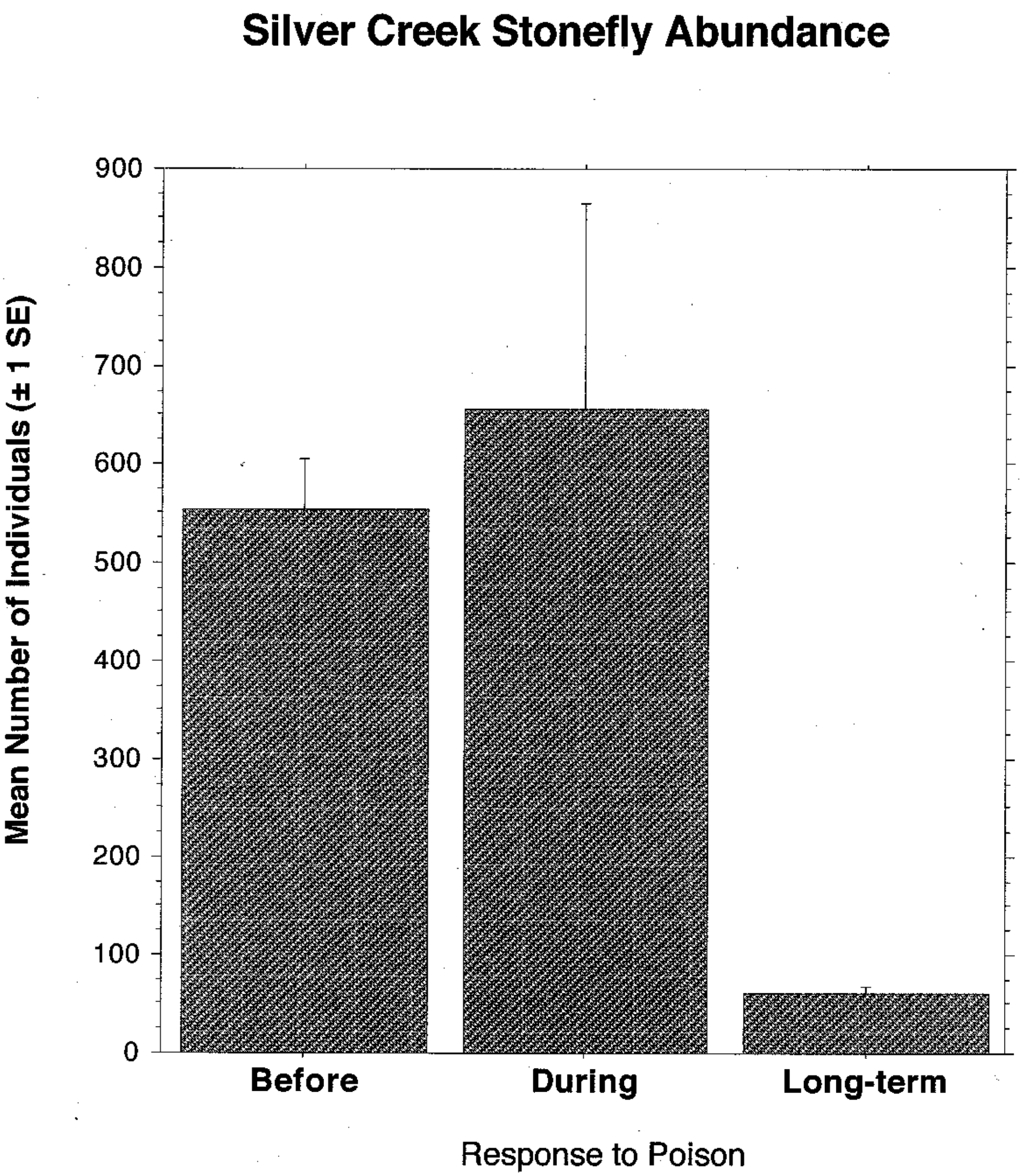

Figure 7. Silver Creek stonefly abundance.

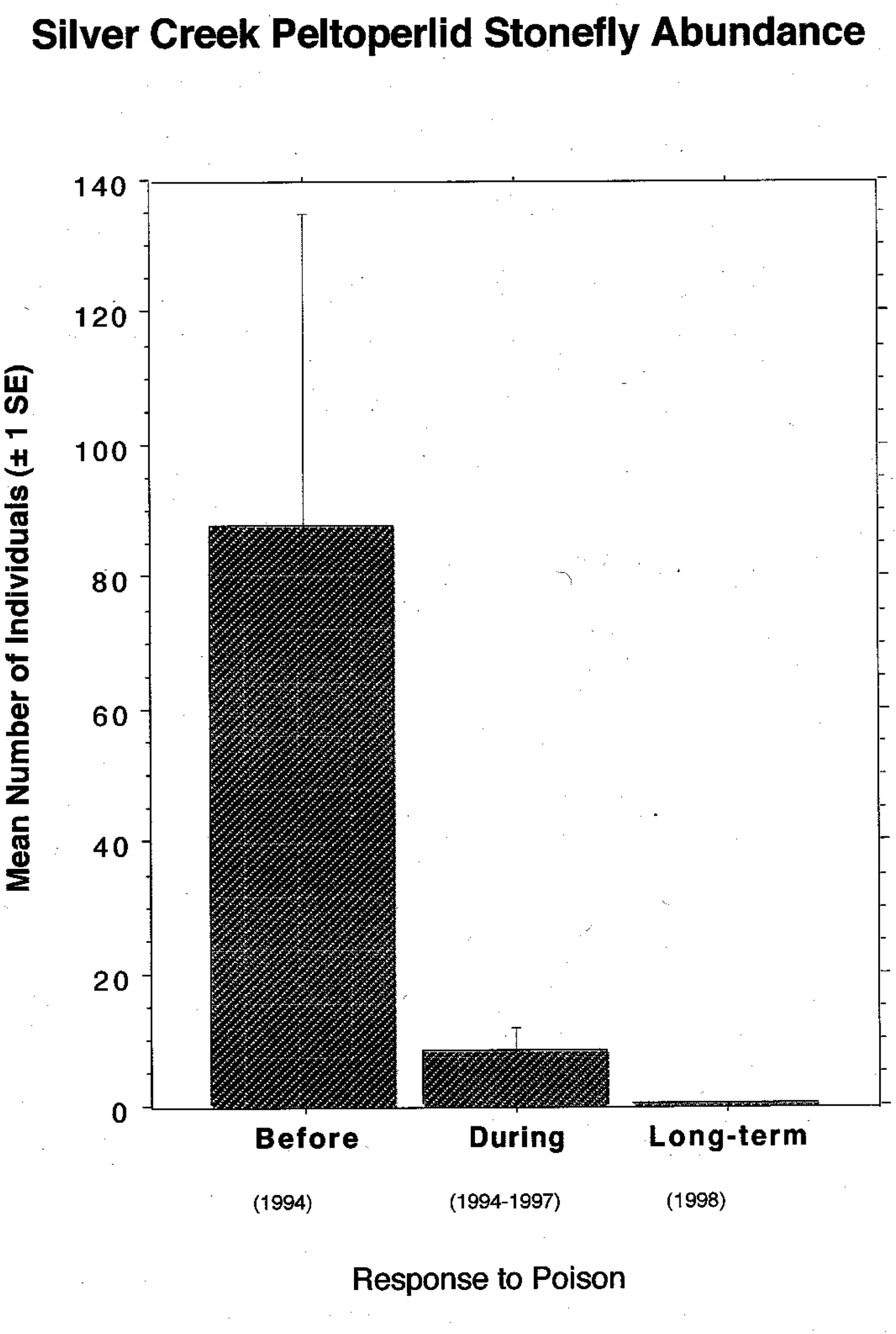

Figure 8. Silver Creek peltoperlid stonefly abundance.

Office of Pesticide Programs (OPP),
Regulatory Public Docket (7502P)
Environmental Protection Agency,
1200 Pennsylvania Ave., NW., Washington, DC 20460-0001.
Docket ID No. EPA–HQ–OPP–2006–1002.
Sent to *Federal eRulemaking Portal:* http://www.regulations.gov
Document includes 19 pages + 3 figures (22 pages)

March 19, 2007

To:
Environmental Protection Agency
Antimycin A Risk Assessments
Attention Docket ID No. OPP–EPA–HQ–2006–1002

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We are aquatic ecologists who have reviewed over the past several years many of the freshwater poisoning projects conducted or proposed by state fish and game agencies, by the US Fish and Wildlife Service (FWS), and as permitted by the USDA Forest Service throughout the western U.S. We have read the EPA risk assessment for the reregistration of Antimycin A (Young and Seeger undated). We have reviewed much of the literature on effects of antimycin on non-target species (aquatic invertebrates and amphibians). We are submitting these comments as private citizens in the public interest. We are commenting specifically on the environmental effects of antimycin (trade name Fintrol) when used as a "piscicide" in the nation's streams, rivers, and lakes.

We submitted comments and data to the EPA in April 2005 and April 2006 on the need to retain NPDES permits under the Clean Water Act for the use of pesticides in the Nation's waters and on the problems that rotenone poisons cause for non-target species when used to kill fish in streams and lakes. It is with some sense of futility that we submit these comments on antimycin. We have little hope that the EPA will take appropriate action to protect the freshwater environment and non-target species from the application of poisons by fish and game agencies to the nation's most sensitive and pristine waters. The recent action by the EPA to eliminate NPDES permits for aquatic pesticides is a major step backward in protecting the environment, aquatic species, and water quality in the US.

We assume that independent scientists and other members of the public will be allowed the same opportunity for comment after the EPA deadline that employees of fish and game agencies and other government agencies were allowed following the comment deadline for rotenone use last year.

<u>Myths about antimycin</u>

Two myths arise repeatedly in discussions of antimycin. One is that antimycin is an antibiotic (e.g., Dawson and Kolar 2003). The second is that it has no lasting impact on non-target species.

We know of no record that antimycin has ever been registered with the FDA as an antibiotic for either human or veterinary use. It has been known since at least 1973 that it does not kill most bacteria, and is therefore not an antibiotic in the common sense (Lennon and Vezina 1973). However, it may have been the unfortunate title of that 1973 paper, "Antimycin A, a piscicidal antibiotic," that led fisheries managers to believe that it was an antibiotic. At any rate, the myth has continued and is often repeated, perhaps in the belief that calling a substance an "antibiotic" sounds better somehow than acknowledging that it is a poison that kills many forms of life. It seems odd that the Lennon and Vezina paper was not reviewed in a 2002 assessment of antimycin A use in fisheries (Finlayson et al. 2002), nor was it included in the EPA risk assessment.

In addition to its use by fish managers to poison freshwater life, antimycin, along with rotenone, has become a common agent used in biochemistry to block mitochondrial electron transport and inhibit the respiratory chain at known locations. Both chemicals are routinely used to kill cells (apoptosis) in experimental biochemical research (e.g., Campas, et al. 2006; Ding, et al. 2006).

The second myth, that antimycin has little or no lasting impact on other non-target aquatic animals, is less investigated and has not been proven. Antimycin, like the various formulations of rotenone, can not be referred to merely as a"piscicide," thereby implying that it kills only fish. In fact, antimycin acts as a poison on many non-target organisms. It readily kills aquatic invertebrates and amphibians, as the EPA risk assessment has acknowledged.

<u>The problem</u>

It was never the intention of the Endangered Species Act to attempt to save one species while putting other species at risk of extinction. Therefore, whether or not all species of aquatic invertebrates and amphibians are present and survive the use of aquatic poisons must be examined in detail. So, also, should the EPA examine the long-term or permanent success rate of aquatic poisons to "restore" the target fish species. It seems within the purview of the EPA to examine the policies of state fish and game agencies and the U.S. Fish and Wildlife Service that have led to the release of so many non-native fish species into U.S. waters. This form of biological pollution continues without environmental review. It leads to the professed need by these same agencies to poison streams and lakes in our most pristine waters, that is, National Parks, Wilderness Areas, and Outstanding National Resource Water (ONRW).

Many of the "restoration" projects being proposed and conducted at present are in water most likely to have endemic and rare species of amphibians and invertebrates as well as rare species of fish. State fish and game agencies, the USDA Forest Service, and the Fish and Wildlife Service have been taking a single-species approach to these poisoning projects, poisoning everything in an aquatic system and then replacing the fish species they want. The projects are often large and have little chance of succeeding in eliminating the unwanted fish species over the long term. "Complete elimination of undesirable fish is the exception rather than the rule in larger lakes and streams" (Lennon 1970).

<u>Inadequacy of studies and evidence of impacts to non-target species</u>

In the studies we have examined, the questions being asked and the analyses being done are inadequate to determine the impact of antimycin on freshwater communities and non-target species. The fundamental questions arising from the application of antimycin and rotenone to aquatic systems should be, 1) are species of non-target animals disappearing from the single or repeated use of poisons over many years? 2) Is the community of species changing in terms of relative proportions and numbers of individuals? And 3) what are the aquatic and terrestrial food web effects of these changes or losses in the short- and long-term?

Instead, however, the few studies that have been conducted on antimycin effects on aquatic invertebrates have asked, "Are invertebrates present again in the stream or lake following poisoning within a relatively short period of time (usually one year or less)?" The answer to that question will always be "yes" because some species of invertebrates are adapted to almost any environmental condition and will inhabit even the most disturbed sites.

Few studies on the effects of antimycin on non-target species have been published in peer-reviewed journals. Most are unpublished agency reports based on monitoring before and after the application of antimycin. Most of these reports do not contain the raw data. None have been done at a species level. Antimycin has been used to poison aquatic habitats in the US for 40 years.

To our knowledge, no inventories of species have been done anywhere in the western US prior to a stream or lake poisoning operation. And we suspect the same is true for the eastern US. The monitoring studies done in co-ordination with poisoning operations are conducted at broader taxonomic levels than species, that is, at genus, family, order, and class levels. Total taxa and EPT (Ephemeroptera, Plecoptera, Trichoptera) measurements are not precise enough to answer the most fundamental questions about the outcomes of poisoning. Some species will be highly sensitive to antimycin and will disappear; others will be less so. Some species will rapidly inhabit a recently vacated ecological niche and will expand in numbers. Not all species of mayflies, stoneflies and caddisflies, the EPT, (incidentally, these are orders of insects, not families as stated in the EPA risk assessment) are sensitive to all impacts. Some are highly tolerant to some conditions (see, for example, a discussion in Erman 1996). Nor do we necessarily know that these groups of insects are the aquatic invertebrates most sensitive to antimycin. They may be, but data do not exist to make that assessment. Diptera, for example, are far more diverse (more species) in freshwater habitats than the EPT and some may be as sensitive to antimycin or more so than are some species of mayflies, stoneflies, or caddisflies.

In the study of a small trout stream poisoned with antimycin to remove non-game fish in Wisconsin, Jacobi and Degan (1977) found that the cranefly genus *Antocha*, a Diptera, decreased after antimycin exposure and continued a downward trend two years after the application of antimycin (Fig. 1). *Antocha* showed a similar response to rotenone poisoning in the Great Basin National Park (NP) where it was still missing three years after the poisoning (Darby et al. 2004). It was probably not the same species as that in Wisconsin, but illustrates the extreme sensitivity of some Diptera to aquatic poisons.

In the Great Basin NP study a species of mayfly was as sensitive to rotenone as was *Antocha* and also was still missing after three years.

Many species of invertebrates were significantly depressed immediately following the antimycin poisoning in the Wisconsin study (Jacobi and Degan

1977). The crustacean *Gammarus pseudolimnaeus* recovered rapidly and increased in biomass over its pre-antimycin levels (Fig. 1).

The same study reported dramatic changes in the amount of plant cover on the stream bottom and the total biomass of benthic macroinvertebrates. Both measures increased substantially up to two years after antimycin poisoning compared to the control stream (Fig. 2). In other words, in the stream poisoned with antimycin the community structure and food pathways became much altered up to 2 years after poisoning compared to a control stream. We were unable to evaluate other changes because data for only the most common 18 taxa out of 38 were presented in the report (Jacobi and Degan 1977). The study was conducted for only two years. Therefore, it is unknown whether or not the aquatic invertebrate and plant community ever recovered from this poisoning.

The EPA must recognize that following a large disturbance, a common response in streams at some point is an increase in abundance or biomass of some species. This response has been known since the earliest days of pollution monitoring, and should not be confused with a "recovery" of the stream ecosystem. The EPA risk assessment in reviewing a macroinvertebrate monitoring study in Great Basin National Park states, "However, by 9 months post-treatment, invertebrate populations had returned to pre-treatment conditions and in some cases exceeded pre-treatment abundance by over 300%…." This particular study was conducted for only one year after poisoning. There is no way to know whether or not the stream community and species recovered. The 300% increase in abundance of something can not be considered a recovery, but is rather indication of a disturbance.

Cosmopolitan, less sensitive, or "weedy" colonizer species tend to increase in numbers following a disturbance: poison released into a stream or lake is a disturbance.

There also seems to be some misunderstanding in the EPA risk assessment and in some of the studies we have reviewed about the meaning of the word "taxa." It refers to any level of taxonomic resolution. It is not synonymous with "species." If a taxon higher than the species level disappears, we know that at least one species is gone, but the taxon may have represented several or many species. In most cases, the broader the taxon, the more species it represents. For example, a family represents far more species than a genus (with a few exceptions).

Most aquatic insects can be identified to species only by their adult forms, and mature forms are necessary for species identification for most other aquatic invertebrates (such as snails, clams, aquatic worms, crustaceans, etc.). A study reported by the National Park Service in Moore et al. (2005) states in the Executive Summary that "after one year all aquatic macroinvertebrate species were at or above pre-treatment levels." However, the rapid bioassessment methods of aquatic forms that were used in the study could not have determined species.

Monitoring of larval forms at genus levels and higher can often indicate impacts from a disturbance. It can not, however, tell us what species or how many may be lost from poisoning. Monitoring is not mitigation for poisoning. There is no mitigation for the loss of a species. And monitoring is not the same thing as a species inventory.

A healthy stream system may have 200 or more species of aquatic macroinvertebrates in it.

Stream poisoning is a special risk to species in springs, seeps and headwater streams. Many of the projects we have reviewed have poisoned these habitats. Such habitats are highly likely to contain rare, endemic, or relict species. Many have narrow distributions and narrow environmental tolerances. Many are not found lower in the stream system (Erman and Erman 1990, 1995; Erman 1998). They can not be replaced by downstream drift of larvae from upstream or by adults flying upstream to deposit eggs. And, of course, species that do not fly or have limited flight capability have even less chance of repopulating poisoned streams or lakes.

The terms "short-term" and "long-term" when referring to impacts on aquatic invertebrates are not defined by the EPA or in the studies we have reviewed. We have found no data collected on antimycin effects on non-target species for longer than two years following poisoning. We suggest that any impact still obvious one year after a poisoning event should be considered a long-term impact, but that monitoring should continue as long as changes are apparent. That period may be five or ten years or more.

A study in California, South Fork of the Kern River, on drift of invertebrates following antimycin application showed major drift as a result of the poisoning (Stefferud 1977). Drift occurred as dead or dying invertebrates lost their hold on the bottom substrate and drifted in the water column. "The data gathered in this study indicate that use of antimycin as a piscicide has a definite effect upon the aquatic invertebrate community in cold mountain streams" (Stefferud 1977). "Dead or dying tadpoles were also collected in the drift nets" (Stefferud 1977). Funding for the planned continuation of that study was apparently withdrawn, and no further data were collected after the first year of results.

The EPA risk assessment seems to have relied uncritically on interpretations of data and studies provided to them from proponents of antimycin and rotenone for fish management. In our review of the Moore et al., 2005, report on the Sam's Creek study from the National Park Service, we found that there were few data presented to fully evaluate statements and conclusions. Different methods of sampling, different methods of taxonomic identification, and different levels of expertise were used to obtain data for number or identity of taxa. We were unable to differentiate what data were obtained under the various methods. We also found many errors in the data and missing sampling periods.

The few data that are presented reveal major problems in the report. There are three figures (Figures 8, 9, 10 in Moore et al. 2005) from the Sams Creek macroinvertebrate study and some additional numbers given in the text. There were 5 control and 4 treatment sites in the study. The so-called Treatment Site 9, however, was outside the boundaries of the antimycin exposure zone (i.e., downstream from the project boundary at stream barrier 646 m). The authors claim the station was affected in 2001 by the potassium permanganate detoxification process but (perhaps?) not antimycin. In either case, it did not receive the same treatment as the three other treatment stations.

There are no data on concentrations of antimycin A or $KMnO_4$ reported from samples in Sams Creek to judge the exposure of macroinvertebrates from site 9. The change in total taxa number (Fig. 8) and EPT taxa number (Fig. 9) for site 9 suggests something happened.

A portion of Sams Creek and Starkey Creek (the farthest upstream locations) was poisoned with antimycin in October 2000. Two macroinvertebrate Treatment Sites (site 2 and site 4) lie within the treatment area of this poisoning event. Three different releases of antimycin occurred because the NPS personnel considered the dose insufficient to kill all fish (see p. 15-17 in Moore et al. 2005). Nevertheless, the report summarized "The observations of October 25, 26, and 27, 2000, provided evidence that the antimycin was eliminating rainbow trout but that it was only effective over a much shorter vertical distance..." (Moore et al. 2005, p. 17). We are unable to determine from the report whether or not the data reported in Fig. 10 for the period Sept./Oct. '00 was before or after the antimycin release. Thus, the interpretation of subsequent samples at site 2 and 4 taken the following year in September 2001, and considered "before" conditions is unclear. It is possible that antimycin released in the upstream reaches in October 2000 affected sensitive taxa of macroinvertebrates. Taxa loss or replacement of sensitive species may have already occurred at these sites. Thus, after another antimycin exposure in 2001 further changes in taxa in October 2001 and September 2002 would be confounded.

If stations 2 and 4 were poisoned in 2000, they are not "before" treatment stations for the purposes of Figures 8 and 9. For some reason the "before treatment" data referred to in the report and collected in 1996-97 were not used in these figures.

We are told nothing about the use of potassium permanganate in 2000 and do not know if it affected station 9 at that time as well.

Data presented (Figures 8, 9, 10) are internally inconsistent from one figure to another, and do not correspond to text references to the "same" data.
For example, Fig. 10 summarized the total number of taxa collected at all sites for all dates. These values can be compared for the dates of September 2001 and October 2001 shown in Figure 8. Of the nine values representing the number of total taxa before poisoning (September 2001), seven are different between Fig. 8 and Fig. 10, and for the 9 values representing October 2001, four appear

different. In other words, 61% of the supposed same data for two sampling periods differed between Figs. 8 and. 10.

In addition, the authors' text reference to data (p. 23) concerning (treated) site 9 stated total taxa declined from 61 in September 2001 to 40 taxa in October 2001. These values do not correspond to data in either Figure 8 or 10 (58 to 46 and 61 to 47, respectively).

Nevertheless, the National Park Service carried out its own analysis of variance on the number of total taxa (and EPT taxa) before (Sept. 2001) compared to 1 year after (Sept./Oct. '02) antimycin exposure using all 9 stations for treatment and control. They found no significant differences (although no ANOVA table was presented.) We are unable to fully replicate the analysis they performed without the full original (correct) data. However, we used the difference in number of total taxa shown in their Figure 10 between Sept. '01 and Oct. 01 and Sept./Oct. '02 (Fig. 3).

Our results suggest that there were differences before and after antimycin and treatment and control. In the ANOVA of just the 1-year difference in total taxa, the result is a significant difference at p=0.0901. We reject a null hypothesis at less than p= 0.05 because of the very weak power of the test with so few degrees of freedom and other uncertainties about the data.

Additional uncertainties about the study appear in the report. In the section on methods for the macroinvertebrate study, the report states "In the laboratory, aquatic insects were identified to the lowest taxonomic level possible" (Moore, et al. 2005, p. 9), and also "teams of experienced collectors used a multi-habitat approach to conduct aquatic macroinvertebrate sampling for each sample collected." But, later, explaining variation in samples from control stations, the report states: "Variation between samples occurred because: 1) the same collectors were not available for each sample, 2) each collector did not have the same field identification expertise for a particular taxon, or 3) were uncertain of how many potential taxa might be represented by what appeared to be a single taxon in the field" (p. 21). These contradictions leave us questioning, were identifications made in the laboratory or in the field? Were collectors experienced or were they not? They also represent another large inconsistency in the methods and, therefore, in the data.

Without seeing the original data we can not answer the many questions raised by the Moore et al. report. If the EPA is going to rely so heavily on these studies to make their determination of risk assessment, we strongly recommend they obtain and analyze the original data and send it out for independent peer review by scientists who have no connection to, or interest in, promoting the use of aquatic poisons.

In our analysis of studies on rotenone effects in California, we found that the California Department of Fish and Game final reports to the Regional Water Quality Board misrepresented invertebrate impacts that were obvious in the raw data (see Erman and Erman comments on rotenone submitted to the EPA, April 2006)

Problems with Antimycin Application

Agency personnel have difficulty correctly applying the target dose of antimycin to streams. Recent examples are revealing. During the project in Sams Creek in the Great Smoky Mountain NP (Moore et al. 2005), personnel were unable to regulate antimycin dosage for two days in the initial stream poisoning in October 2000. "Unfortunately, the bottle containing the correct amount of antimycin for Sams Creek was inadvertently switched with the bottle for Starkey Creek" (Moore et al. 2005, p. 16). Personnel repeatedly tried different applications, new batches of antimycin, and increasing concentrations because sentinel trout failed to die as fast as expected. These procedures were eventually halted by the third day when "...additional concerns related to *Neophylax kolodskii* (a caddisfly thought to exist only in the treatment area) were raised as was the issue of not completing the project within allotted time frames..." (Moore et al. 2005, p. 16).

It is worth noting that actual measurement of antimycin in the stream sections was not conducted (is it possible with existing technology?), and there is no further information in the report concerning the fate of the endemic caddisfly species. We also wonder whether the detoxification station, cued by dye in the water and not the presence of antimycin, might also have operated for a period of time with unknown effects on downstream invertebrate populations.

This episode at Sams Creek is reminiscent of a project in Wisconsin in 1972 in which errors in calculating dosage and equipment failure resulted in four times the concentrations administered over the "target" values (Jacobi and Degan 1977).

When antimycin poisoning of Sams Creek was resumed in September 2001, the project lasted over 11 days during which time potassium permanganate was used on nine days at the single detoxification station for a total of 64 hours (Moore et al. 2005, Table 2, p. 21). The authors state that in treatment site 9, below the detoxification location, "Apparently the cumulative effect of nine days of treatment with this strong oxidizer eliminated the Ephemeroptera (mayfly) taxon and all but one individual in the common stonefly family Peltoperlidae from this sample site" (Moore et al. 2005, p. 23).

The target concentration of antimycin relies on estimates of stream flow, among other factors. Measurement of stream discharge by velocity-cross section techniques is known to have uncertainty. Under ideal conditions errors in discharge can be as small as 2% (standard error of the estimate) or as large as about 20% when conditions are poor. (Sauer and Meyer 1992).

Poison drip stations are allocated along a stream course according to "best guesses" of past experience elsewhere for how far a lethal concentration will travel (e.g., Moore et al. 2005). It is common practice not only to drip rotenone or antimycin into the stream but also to deliver additional unknown quantities to springs, seeps, side channels, pools, and back eddies (Darby et al. 2004, Moore et al. 2005). For example, in the project in the Great Basin National Park, Darby et al. 2004 stated "...rotenone dry powder was mixed with sand and gelatin with handfuls deposited in rivulets that fed the main channel from seeps and springs" (p. 5). And elsewhere "Concentrations of antimycin averaged 8 $\mu g/L$. Concentration within various headwater reaches often exceeded 25 $\mu g/L$ to compensate for spring and seep inflows between drip stations. Back eddies of the stream and adjacent springs and seeps were treated with 250 ml of Fintrol using a backpack sprayer" (Darby et al. 2004, p. 5).

In a more recent project in Arizona, antimycin was applied by the usual drip stations and also by antimycin laden sand into pools and by backpack sprayers to isolated water bodies, backwaters, and vegetated stream margins "...with renovation crews instructed to approximate an application of 50 $\mu g/L$" (Dinger and Marks, in press). These procedures hardly constitute rigorous control of application rates and given the fact that few projects report actual (rather than "target") concentrations over time; true exposure values are speculative. If, as suggested in the EPA risk assessment, some limitations will be recommended for frequency of application, we suspect that agencies will merely substitute higher dose rates to insure lethal conditions. In other words, more projects would operate at the manufacturers legal limit on the label for antimycin. Already, as seen in the Fossil Creek project, state agency personnel in Arizona opted for levels of 50 to 100 $\mu g/L$ antimycin A because of concerns that water quality would reduce efficacy and the desire to have total fish kill on the first try (Dinger and Marks, in press).

The Dinger and Marks study (in press) reported that antimycin killed invertebrates, many taxa were still missing after 5 months, and there was a shift to "more tolerant taxa." No changes in taxa occurred at the control station during those five months. But the study was marred by a permanent change in flow after the first five months. Nevertheless, the authors continued collecting samples for two years after the antimycin poisoning. Some taxa had not recovered after two years. The authors do not report taxa numbers or type at the control station after two years. Whether or not the taxa missing after two years were from antimycin or the change in flow is unknown.

The Dinger and Marks study is the highest "target" rate of antimycin application reported in invertebrate studies we have reviewed, but there were insufficient instream measurements of actual concentrations to determine what levels were reached in the past. In our review of rotenone projects, for example, we found that in Silver King Creek, CA, the target level of rotenone (which is measured) was 25 $\mu g/L$. Concentrations measured on several occasions at a single downstream monitoring station, however, showed rotenone plus the first decay product (rotenolone, also poisonous) reached 40 $\mu g/L$ (Flint et al. 1998).

Those measurements did not include the equal amounts of other cube resins, also poisons, in the Nusyn-Noxfish.

The routine procedure of adding "handfuls" of poison-laced sand, of using backpack sprayers "to approximate an application rate," and of other uncontrolled methods of dispersing poison render meaningless approximations of actual instream concentrations. In addition, we urge caution in making the judgement that a single high concentration of antimycin is more toxic than repeated releases of a lower concentration. The issue for animal survival is exposure to a poison, that is, time and concentration.

We have noticed in recent environmental assessments that agencies do not want to reveal or decide on the poison or formulation they will use. In a recent Finding of No significant Impact on an extremely large poisoning project in New Mexico, in the Rio Costilla watershed (over 150 miles of stream, 25 lakes, and a reservoir) the poisons and formulations to be used are not specified in the public document. The same tactic is being used in the Lake Davis watershed in California by the California Department of Fish and Game. (Antimycin is not proposed for use in the California study, however, because at present it is not allowed in California.) That watershed and reservoir was poisoned about 10 years ago and is now slated to be poisoned again because of a total failure to eliminate the targeted fish species. We must assume that agencies may use more than one poison, as often as they want, in amounts as high as they want, and without monitoring or oversight by any independent agency.

The Fintrol label (FIFRA approved) does not restrict concentration at present. It recommends up to roughly 25 $\mu g/L$ if cold temperatures and high pH exist in the receiving water. It says the only way to determine lethal dose is to perform a bioassay. It does not contain an explicit legal limit.

The EPA draft risk assessment states on p. 18, "Although maximum treatment rates are not stated on the label, this risk assessment is based on an upper-bound treatment rate of 25 $\mu g/L$ applied once per year." The EPA Table 3 (p. 18) also reiterates that the maximum rate per application is "roughly" 25 ppb ($\mu g/L$). But in an Addendum to the EPA risk assessment much higher levels of antimycin and more applications per year are listed.

Further, the paper by Dinger and Marks states, "However, the label allows for treatment outside this limit when 2 conditions are met: 1) bioassays indicate the need for higher levels, and 2) permission from the state game and fish agency are [sic] required. For Fossil Creek both conditions were met (the treatment was performed by AZGFD), ensuring legality" (note: AZGFD means Arizona Game and Fish Dept).

Therefore, at present, the EPA has removed the requirement of NPDES permits and the FIFRA label says that if more than "roughly 25 $\mu g/L$" is applied, the agency doing the poisoning can determine whether or not to use more poison than recommended. There is no independent monitoring and no oversight by other agencies.

A statement appeared in a 2006 Decision Notice for a poisoning project on Crawford Creek, Montana: "Antimycin (another EPA registered piscicide) will not be used in this project because of recent information related to quality control of product and reduced effectiveness." If the product has poor quality control and is ineffective, why is it being used in natural waters at all; and why are these problems not part of the EPA risk assessment discussion?

<u>Interactions with other pesticides present in water</u>.

The EPA risk assessment has evaluated antimycin as if there are no other complicating chemicals in the environment that may increase toxicity. Antimycin works by interfering with the electron transport system in cell mitochondria (Dawson and Kolar 2003). With many toxins, such as rotenone and antimycin, the effect on the transport system is mediated by an organism's natural defenses. But when certain compounds are also present in the environment, toxicity is increased because the natural defense system (cytochrome P450) is reduced (Li et al. 2007). This result is well established for the role of piperonyl butoxide (PBO) as a synergist in formulations of rotenone and other insecticides. However, it is also known that other pesticides themselves may function much like PBO (in blocking cytochrome P450) and, hence, increase substantially the toxicity of insecticides. The EPA is aware of these relationships, and in their rotenone risk assessment cited the work by Bills et al., 1981, for example, that showed PCBs multiplied the toxicity of rotenone to fish. There is other work that has established similar relationships among a range of pesticides and herbicides (e.g., Bielza, et al. 2007). There is also strong evidence that residues of common herbicides and insecticides (and PBO) may remain in aquatic sediments (Woudneh and Oros 2006) or in the water, even in remote national parks (LeNoir et al. 1999, Angermann et al. 2002).

It is likely that low level residues of pesticides are present now in many aquatic habitats, and these levels may increase without the further review or analysis previously required by NPDES permits. At present, we are unaware of any fish poisoning project that has analyzed water or sediments for low level pesticide residue prior to applying rotenone formulations or antimycin.

Has the EPA considered the role of potential synergists on the toxicity of antimycin in its risk analysis, and are these risks to non-target aquatic invertebrates and amphibians accounted for under the proposed reregistration?

Summary and conclusions

Antimycin clearly affects non-target species and probably eliminates some and, possibly many, invertebrates and amphibians. Some species may be permanently exterminated. No studies to date have proven that antimycin is harmless. Several studies have shown impacts to non-target animals and communities at broad taxonomic levels.

The EPA was wrong to eliminate National Pollution Discharge Elimination System (NPDES) permits for the use of stream and lake poisons. NPDES permits, issued under the Clean Water Act, allowed projects to be evaluated by an independent agency (in California, Regional Water Quality Boards and the State Water Board) on a site-specific basis, at the local level, and to include monitoring requirements. In California, the NPDES review assures that projects are in compliance with the Basin Plans for each regional water district. The NPDES permit review also determines whether or not a project is likely to cause harm to non-target species and whether or not the project protects beneficial uses of water.

Stream and lake poisoning projects, being conducted and proposed by agencies at present, are large covering many stream miles and many lakes. They are often in the most pristine areas of the country—Wilderness Areas, National Parks, and Outstanding National Resource Waters. These areas deserve the greatest protection and are most likely to have endemic and/ or rare non-target species.

Stream and lake poisoning projects to eliminate unwanted fish species have a poor record of long-term success. Agencies poison waters for two or three years, unwanted fish return within about 10 years, and the agencies begin poisoning again. Agencies have a long record of errors and mishaps with their poisoning operations.

We recommend that antimycin reregistration be denied for all but small, artificial ponds and self-contained fish farm ponds that have no outlets.

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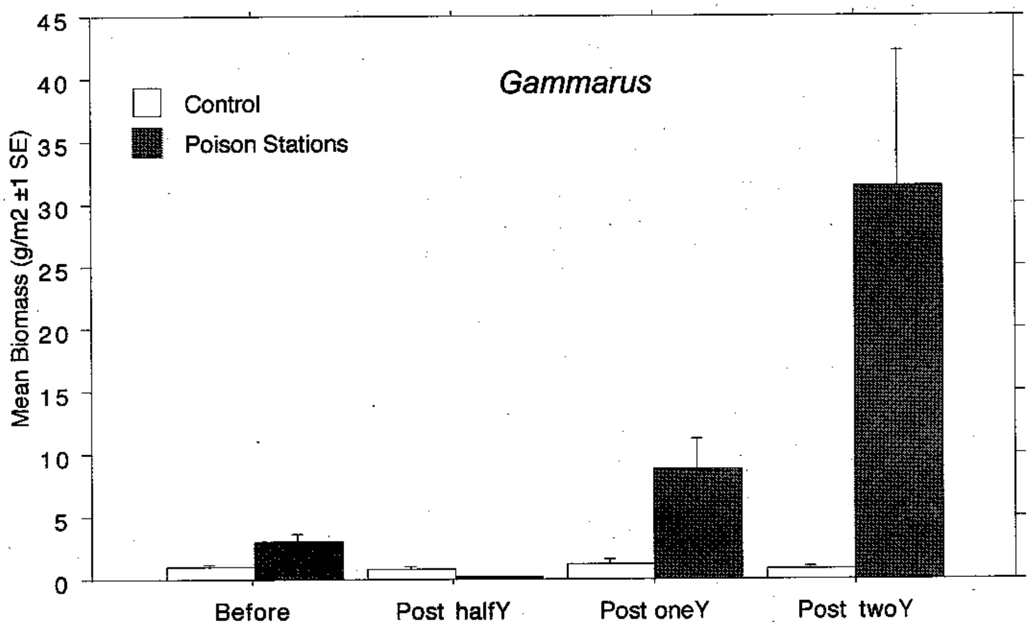

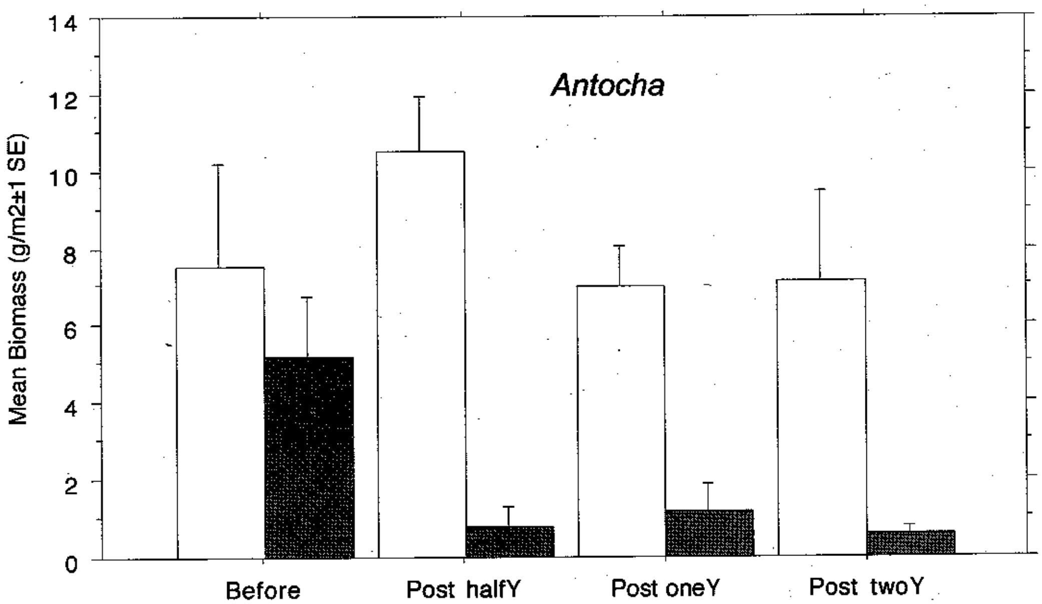

Fig.1. Change in biomass of the crustacean *Gammarus* and crane fly larvae *Antocha* before and 0.5, 1, and 2 years after treatment with antimycin (Data from Jacobi and Degan 1977).

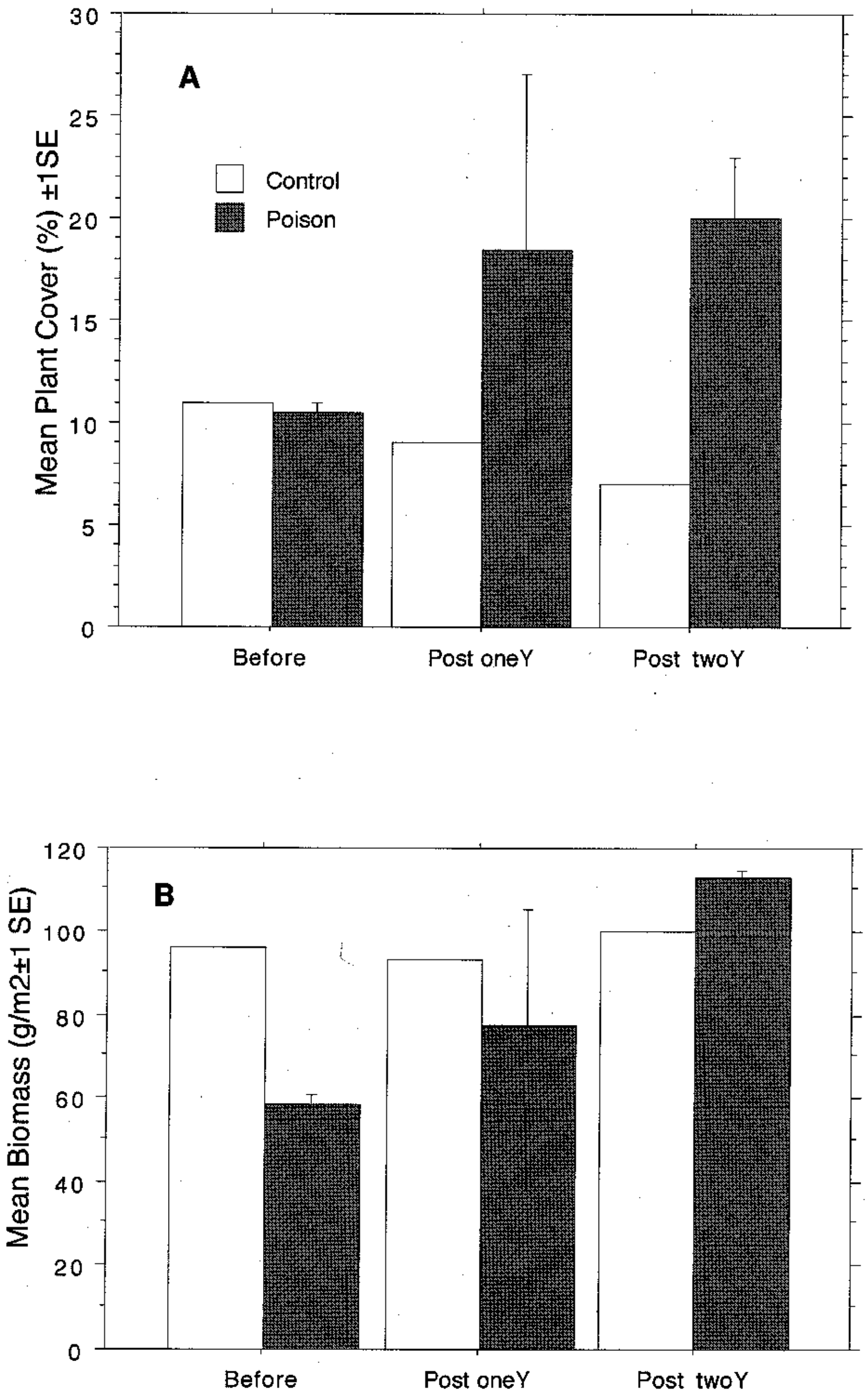

Fig.2. Percentage of stream bottom covered by aquatic plants (A) and total benthic macoinvertebrate biomass (B) in treated and control streams before, 1 year and 2 years after antimycin po.
(Data from Table 6, Jacobi and Degan 1977)

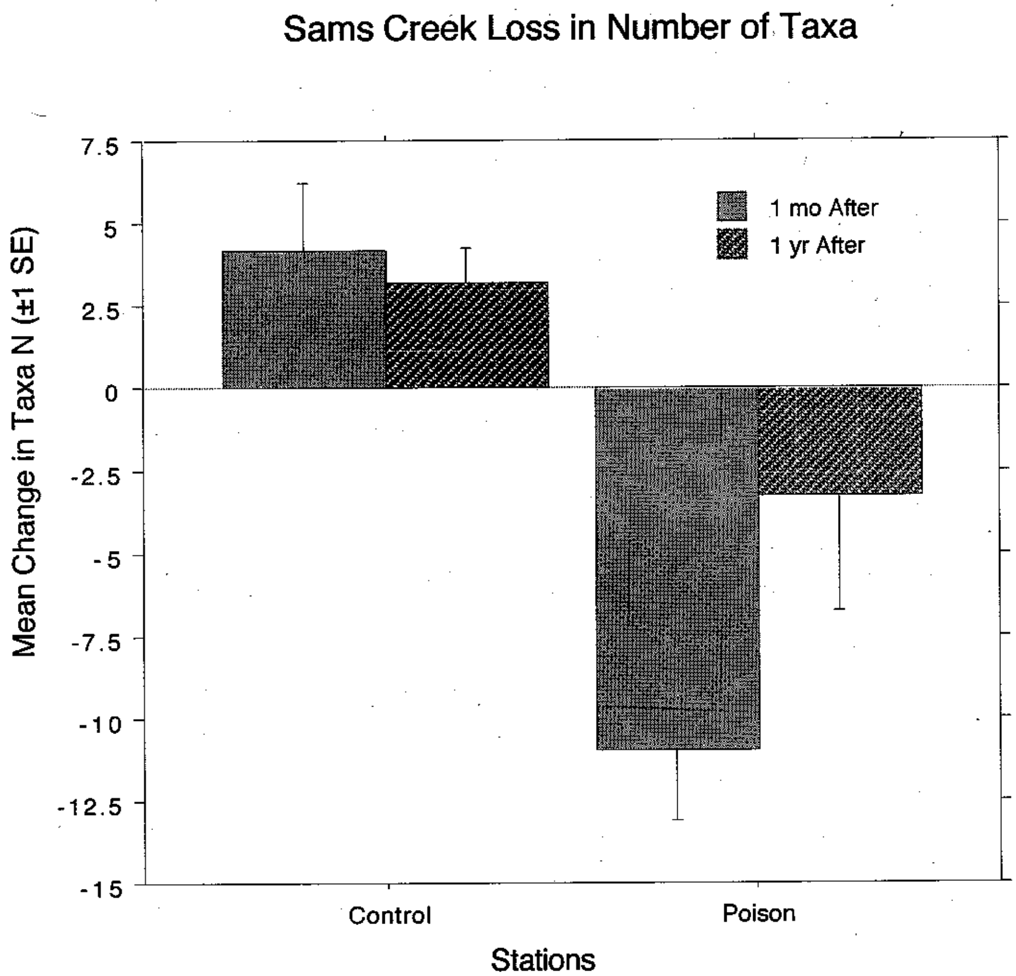

Fig. 3. Change in total number of taxa at control and antimycin treatment stations in Sams Creek. Bars represent the number of total taxa collected before antimycin treatment in September 2001 minus the total number of taxa collected in October 2001 (1 mo after) and September 2002 (1 yr after) in control and treatment sites. (Data from Fig. 10, Moore et al. 2005). The treatment sites averaged 11 taxa lost in the month after poisoning and 3.2 taxa 1 year after antimycin while the control sites gained 4.2 and 3.2 taxa for the same periods.

UNITED STATES DISTRICT COURT

EASTERN DISTRICT OF CALIFORNIA

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CALIFORNIANS FOR ALTERNATIVES TO TOXICS, a non-profit corporation; WILDERNESS WATCH, a non-profit corporation, LAUREL AMES, an individual and ANN MCCAMPBELL, an individual,

Plaintiffs,

v.

JACK TROYER, in his official capacity; USDA FOREST SERVICE; GARY SCHIFF, in his official capacity,

Defendants.

NO. CIV. S-05-1633 FCD KJM

MEMORANDUM AND ORDER

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This matter is before the court on plaintiffs' motion for a preliminary injunction enjoining defendants "from allowing to be conducted or conducting any component of the Silver King Creek Paiute Cutthroat Trout ["PCT"] Recovery Project [the "Project"],[1]

[1] The goal of the Project is to rid the waters, some 11 miles of creek and a nearby lake, of non-native rainbow trout, which have interbred with PCT and compete with it for food. Once the rainbow trout are eliminated, part of the area would be restocked with genetically pure PCT.

including specifically any application of rotenone formulations and potassium permanganate to Silver King Creek, its tributaries and backwaters, and Tamarack Lake, in the Carson-Iceberg Wilderness in California." ([Proposed] Order Granting Pls.' P.I. Mot., filed Aug. 26, 2005.)[2] The court heard oral argument on the motion on August 30, 2005 and announced from the bench its decision to grant the motion. By this order, the court memorializes its reasons for the decision, previously stated on the record at the hearing.[3]

To obtain a preliminary injunction, a party must show either: "(1) a combination of probable success on the merits and the possibility of irreparable injury, or (2) that serious questions are raised and the balance of hardships tips sharply in [its favor]." Stuhlbarg Int'l Sales Co. v. John D. Brush & Co., Inc., 240 F.3d 832, 839-40 (9th Cir. 2001). "These two formulations represent two points on a sliding scale in which the required degree of irreparable harm increases as the probability of success decreases." Roe v. Anderson, 134 F.3d 1400, 1402 (9th Cir. 1998). Under either formulation of the test, a plaintiff must still demonstrate a significant threat of irreparable injury. Oakland Tribune, Inc. v. Chronicle Publishing Co., 762 F.2d 1374, 1376 (9th Cir. 1985).

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[2] The court previously granted plaintiffs, on August 23, a temporary restraining order on the same terms. The matter was set for a preliminary injunction hearing on an expedited schedule in light of time constraints and logistical issues regarding implementation of the Project.

[3] The underlying facts of this case are exhaustively discussed by the parties in their briefs, and they accordingly are not discussed herein.

Here, plaintiffs made a strong showing of irreparable harm if the Project is not enjoined and that the balance of interests tips decisively in their favor. As such, to prevail on the motion, plaintiffs were only required to raise "serious questions" as to the merits of their NEPA claims (namely, that the United States Department of Agriculture Forest Service (the "Service") violated NEPA in failing to prepare an Environmental Impact Statement ("EIS") and/or that the service's Environmental Assessment ("EA") was inadequate), which the court found they did. The court will address in turn below the bases for each of these findings.

1. Irreparable Harm

There is no dispute that poisoning the waters with rotenone, a highly toxic chemical lethal to acquatic organisms that obtain oxygen from water, will kill macroinvertebrates and certain species may never return to the impacted area. (Erman Decl., ¶s 3, 29.) While the parties dispute the relative ability of macroinvertebrates to repopulate,[4] the lethal consequences are certain.

Additionally, plaintiffs present evidence that the poisoning may harm certain "rare and endemic" macroinvertebrates present in the area. According to plaintiffs' macroinvertebrate expert,

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[4] According to plaintiffs' experts data from past projects in other reaches of Silver King Creek show that even years after the poisoning, entire taxa were still missing from the stream (on average, between 30 to 40% of all macroinvertebrate taxa were still missing three years after the project). (Erman Decl., ¶s 13-15, 24-28, 31.) To the contrary, defendants' experts maintain the macroinvertebrate populations will recover quickly and to an "excellent" level as they have in past, similar projects. (Moyle Decl., ¶s 10-16; Behke Decl., ¶s 11-15.)

Nancy Erman, it is "highly probable" that such species exist in the area. While defendants' experts dispute this conclusion, there has not been any studies to confirm either parties' position. Nevertheless, equity favors plaintiffs because once the poisoning takes place, the eradication of such species, if present, is, again, swift and certain.

Finally, it is undisputed that the subject area is an unimpaired reference in that it has never been previously poisoned. Were the court to allow the poisoning to proceed immediately, that reference would be permanently eliminated. In that regard, as in others, the execution of the Project means the stark finality to life in an eleven mile stream in the treasured Sierra Nevada Mountains.

For these reasons, plaintiffs have demonstrated a strong likelihood of irreparable harm if the court does not enjoin the Project.

2. Balancing of Interests

In plaintiffs' favor is evidence that macro-invertebrates, and possibly rare and endemic macroinvertebrates, will be killed by the poisoning and may never repopulate; additionally, the poisoning will eliminate the unimpaired reference. In defendants' favor, the PCT is a listed "threatened species" under the Endangered Species Act. According to the Service, in the absence of immediate implementation of the Project, the long term survival of the PCT will be in some doubt. (Somer Decl., ¶ 6, 12.)

However, the PCT Recovery Plan itself explicitly finds that the PCT has only a "moderate degree of threat."[5] (Ex. FF at iii.) Likewise, defendants did not produce any convincing evidence that absent implementation of the Project this year or even in the next few years, the PCT would be at risk of extinction. Rather, there is undisputed evidence that the pure strain of PCT has existed in the Silver King Creek above Llewellyn Falls for at least 11 years without any negative impacts, thus providing additional protection for the survival of the species.[6] Also, significantly, defendants did not argue in their joint petition to the California State Water Board that there was any urgency to act in 2005.[7]

Defendants' reliance on the possibility of some catastrophic event, such as a forest fire or flood, which could destroy the existing PCT in its present habitats is unconvincing. Such

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[5] Defendants are incorrect that the Recovery Plan stated that the PCT is "highly vulnerable" to extinction. Rather, the Plan stated that the PCT *would be* "highly vulnerable" *if* the pure, self-sustaining runs of PCT did not already exist in at least six other creek watersheds (*which it does)*.

[6] From the EA, it also appears that PCT currently exists in the Corral Valley Creek and Coyote Valley Creek within the Silver King Creek Basin, and plaintiffs assert in waters outside the Basin.

[7] Indeed, it is worth noting that defendants have made in a series of choices which have delayed implementation of the Project. First, they choose in 2002 to not conduct a full NEPA analysis; that decision resulted in litigation against the Service; ultimately, the Service settled the suit, promising to perform the requisite analysis. However, two years passed until completion of the EA at issue here. Upon seeking the necessary permits from state agencies, defendants again further delayed the matter; rather than provide information in response to the Lahonton Regional Board's inquiries, defendants cancelled implementation of the Project for 2004. Instead, they waited until the summer of 2005 to seek a permit from the State Water Board.

possibilities always exist and are too speculative to serve as a sufficient basis to permit a project of this nature to go forward. Moreover, it is not certain this Project would insure against the consequences of such a catastrophe. Lastly, defendants raise the specter of future state and federal budgetary constraints which may affect the Project. Such speculation has no place in balancing the environmental injuries in this case.

In sum, considering all the relevant interests, the court finds that the balance of interests tips sharply in favor of plaintiffs.

3. **Merits of NEPA Claims**

Because plaintiffs made a strong showing of irreparable harm and that the balance of interests tips decisively in plaintiffs' favor, plaintiffs must only demonstrate "serious questions" as to the merits of their NEPA claims. Plaintiffs have done so on at least two grounds.[8]

NEPA mandates that federal agencies prepare a detailed EIS for all "major Federal actions significantly affecting the quality of the human environment." 42 U.S.C. § 4332(2)(c). An EIS must be prepared if "substantial questions are raised as to whether a project . . . will have a significant impact on the

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[8] To prevail on the motion, plaintiffs need only show a likelihood of success on the merits/serious questions as to *one* of their claims for relief. Accordingly, the court does not consider herein all of plaintiffs' claims nor all of the grounds for plaintiffs' claims (for example, plaintiffs base their NEPA claim for failure to prepare an EIS on five criteria for finding "significance" sufficient to trigger the obligation to prepare an EIS but the court only discusses two such criteria in this order). The court considers these two criteria because they raise some overlapping issues.

environment." Blue Mountains Biodiversity Project v. Blackwood, 161 F.3d 1208, 1212 (9^{th} Cir. 1998). NEPA regulations provide various factors for evaluating significance. 40 C.F.R. § 1508.27. Pertinent to this order are the following factors, either one of which can lead to a finding of "significance" (see Public Citizen v. Dept. of Transportation, 316 F.3d 1002, 1023 (9^{th} Cir. 2003)):

(1) The degree to which the effects on the quality of the human environment are likely to be highly controversial. 40 C.F.R. § 1508.27(b)(4).

(2) The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks. Id. at § 1508.27(b)(5).

Plaintiffs need not show that the "significant effects *will in fact occur*," because raising "substantial questions whether a project may have a significant effect [on the environment] is sufficient." Idaho Sporting Congress v. Thomas, 137 F.3d 1146, 1150 (9^{th} Cir. 1998).

As to the first factor, a "controversy" means that there is a substantial (scientific) dispute about the size, nature, or effect of the major federal action, rather than merely opposition to it. Anderson v. Evans, 371 F.3d 475, 489 (9^{th} Cir. 2004). Here, plaintiffs have raised substantial questions as to whether such a controversy existed sufficient to trigger an EIS.

For example, plaintiffs have raised a serious question as to whether plaintiffs' experts' comments and objections on the EA, especially those of Nancy Erman and Dr. David Herbst, were adequately addressed by the Service, particularly in light of Ms.

Erman's and Dr. Herbst's notable and well recognized expertise in the precise area of Sierra Nevada mountain invertebrate ecology. In light of that notable expertise, their opinions and concerns deserved close and extensive attention; the Service should have carefully and publicly weighed their opinions against other *comparable* expert opinions. While the Service's *conclusions* are clear in the EA and FONSI, how and why the Service reached those conclusions is not at all clear. That process of assessing and balancing the environmental impacts deserves far more transparent and careful analysis. Thus, at this juncture, the court finds that substantial questions remain. See e.g., Sierra Club v. United States Forest Service, 843 F.2d 1190, 1193 (9th Cir. 1988) (holding that the Sierra Club's "affidavits and testimony of conservationists, biologists, and other experts who were highly critical of the EAs and disputed the Forest Service's conclusion that there would be no significant effects from logging because the sequoias could be protected and their regeneration enhanced," was "*precisely the type of 'controversial' action for which an EIS must be prepared.")* (Emphasis added.)

Secondly, plaintiffs have raised a serious question as to whether the possible effects on the human environment are so "highly uncertain or involve unique or unknown risks" that an EIS should have been prepared.

> The very purpose of NEPA's requirement that an EIS be prepared for all actions that may significantly affect the environment is to obviate the need for [s]peculation by insuring that available data is gathered and analyzed prior to implementation of the proposed action.

Foundation for North American Wild Sheep v. United States Dept.

Of Agriculture, 681 F.2d 1172, 1179 (9th Cir. 1982). Here, plaintiffs raise substantial questions regarding the presence of potential rare and endemic macroinvertebrates in the subject area. There have been no studies and thus there is a complete lack of data regarding this issue. The parties dispute whether such studies are mandated by industry standards, but nevertheless the issue has been a central concern since the Project's inception. Plaintiffs have continued to raise these same questions at every stage, as well as the failure of the Service to adequately address these issues. At this point, it appears to the court that the solid scientific data regarding Ms. Erman's declaration that there is a high probability that rare and endemic species live in the Project area, is "precisely the [type] of information . . . that is required *before* a decision that *may* have a significant adverse impact on the environment is made." National Parks & Conservation Ass'n v. Babbitt, 241 F.3d 722, 733 (9th Cir. 2001) (emphasis in original and added). As the Ninth Circuit said in Babbitt, "[p]reparation of an EIS is mandated where uncertainty may be resolved by further collection of data, . . . or where the collection of data may prevent speculation on potential . . . effects." Id. at 732 (internal quotations and citation omitted.) Plaintiffs have raised a substantial question on this exact issue.[9]

Therefore, for the foregoing reasons, the court GRANTS plaintiffs' motion for a preliminary injunction:

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[9] The court notes that on this issue, the Forest Service had two years to gather this information, between the earlier 2002 EA and the 2004 EA, yet for reasons unclear to the court, it choose not to do so.

IT IS HEREBY ORDERED that Defendants United States Forest Service, and each of them, and their respective agents, partners, employees, contractors, assignees, successors, representatives, permittees and all persons acting under authority from, in concert with, or for them in any capacity, including in a volunteer capacity, are enjoined from allowing to be conducted or conducting any component of the Silver King Creek Paiute Cutthroat Trout Recovery Project, including specifically any application of rotenone formulations and potassium permanganate to Silver King Creek, its tributaries and backwaters, and Tamarack Lake, in the Carson-Iceberg Wilderness in California.

In the court's discretion and in light of the nature of the case, the court relieves plaintiffs of the obligation to file a bond. Fed. R. Civ. P. 65(c); See People ex rel. Van de Kamp v. Tahoe Regional Plan, 766 F.2d 1319 (9th Cir. 1985) (bond not required because of the "chilling effect" on public interest litigants seeking to protect the environment).

IT IS SO ORDERED.

DATED:August 31, 2005

/s/ Frank C. Damrell Jr.
FRANK C. DAMRELL JR.
United States District Judge