

Importance of Rotenone as a Management Tool for Fisheries

By the American Fisheries Society Fish Management Chemicals Subcommittee
Task Force on Fishery Chemicals

The piscicide rotenone, commonly used by fishery managers throughout North America to remove undesirable fish from lakes and streams, is increasingly under attack today by citizens concerned about environmental and human health impacts. In order to continue its use in the future, these concerns must be addressed head-on by fish and wildlife agencies.

What is the current status of rotenone use in fish management? Nearly 95,000 kg of rotenone were used as a piscicide in North America during the ten-year period from 1988–1997. Rotenone use in fish management is not new; humans have used it in several forms for centuries to harvest fish for consumption and to manipulate fish communities. In the article by McClay, in this issue (*Fisheries* 25(5):15–21), the frequency of rotenone use for maintenance of recreational fisheries, eradication of exotic species, and restoration of threatened and endangered species in North America is as widespread today as ever before, although the quantity used has declined. This decline apparently reflects concerns associated with increasing environmental regulations and public relations issues, rather than an actual decline in the need for rotenone, or any known hazard.

What is rotenone? Rotenone is a naturally occurring substance found in many plants of the family Leguminosae that interferes with cellular respiration. It affects all gill-breathing animals; birds and mammals are not affected because they neutralize rotenone by enzymatic action in their guts. Rotenone selectively affects fish because the exposure to rotenone through the gills, directly into the blood, circumvents

the enzymatic neutralization in the gut. Rotenone is formulated as a powder (ground-up plant material) or as a liquid. Because rotenone is fairly insoluble in water, petroleum-based solvents aid in the dispersion of the toxicant in lakes and streams.

Rotenone enables fish and wildlife agencies to eradicate entire populations and communities of fishes with minimum impact to nontarget wildlife. Although other approaches such as electrofishing and gill netting are useful in controlling fish populations, they do not eradicate fish. In California alone, several species of threatened or endangered fish including the Lahontan cutthroat trout (*Onchorynchus clarki henshawi*), Paiute cutthroat trout (*O. c. seleniris*), Little Kern golden trout (*O. aquabonita whitei*), Volcano Creek golden trout (*O. a. aquabonita*), and the Owen's pupfish (*Cyprinodon radiosus*) owe their continued existence to the selective use of rotenone by state and federal wildlife agencies. Similar rotenone programs in Utah, Colorado, Montana, and Idaho are preserving other fish species for future generations to enjoy and appreciate. In addition to the restoration of threatened and endangered species of fish, rotenone has been used successfully to eradicate highly predatory exotic species such as white bass (*Morone chrysops*) and northern pike (*Esox lucius*) from California reservoirs. If allowed to spread down river, both of these predators likely would have further reduced the already stressed populations of chinook salmon (*O. tshawytscha*), steelhead trout (*O. mykiss*), and native nongame fish from rivers in northern and central California.

What are the public health hazards? We are not aware of any public

health impacts from the use of rotenone in fisheries management. Rotenone does not cause birth defects, reproductive dysfunction, gene mutations, or cancer. The U.S. Environmental Protection Agency (EPA) concluded in 1981, and again in 1989 that, "The use of rotenone for fish control does not present a risk of unreasonable adverse effects to humans and the environment." The liquid formulations contain materials that are the same as those found in fuel oil and are present in waters everywhere because of frequent use of outboard motors. No public health effects from rotenone use as a piscicide have been reported. Consistent with the known safety of rotenone for fish control, the EPA determined that a reentry interval was not needed for persons who swim in waters treated with rotenone, based on an assessment of the toxicology data and exposure levels.

What is the registration status of rotenone? Rotenone is in the process of being reregistered by the EPA and the Canadian Pest Management Regulatory Agency. The reregistration will be completed in the United States by 2002 and in Canada by 2006. Because reregistration requirements are expensive and the annual use is limited (in comparison to agricultural chemicals), rotenone registrants had low interest in reregistering rotenone; thus, the reregistration of rotenone depends on assistance from public entities who want rotenone registration to be maintained for piscicidal use. The U.S. Fish and Wildlife Service (FWS) joined the International Association of Fish and Wildlife Agencies to fund research at the Upper Midwest Environmental Sciences Center at La Crosse, Wisconsin. After the research was completed, several rotenone registrants (e.g., AgrEvo Environmental Health, Inc.) formed a Rotenone Task Force

This article represents the opinion of the authors as members of the AFS Fish Management Chemicals Subcommittee Task Force on Fishery Chemicals.

that currently is completing the reregistration of rotenone as a piscicide.

Why is rotenone use controversial? Fish and wildlife agencies responding to a recent survey (see McClay's article) identified public acceptance and understanding of management decisions that lead to rotenone treatments as major issues. The controversy appears to be rooted in three main areas: (1) persons who oppose changes to a perceived natural situation or oppose the use and development of fish monocultures, (2) persons who are alarmed by the perception of widespread application of chemicals that might be dangerous to people and the environment, and (3) persons who oppose killing of fish by any means. Although rotenone is a useful and beneficial fishery management tool, its use has resulted in considerable adverse public reaction and negative publicity in the states of California, Colorado, Michigan, Minnesota, and New York. Two recent examples are the treatments of Knife Lake, Minnesota, in 1990 and Davis Lake, California, in 1997. Public relations issues included fish mortalities downstream of the application site and persistence of treatment chemicals in water and air. It is the manner in which rotenone was used, not the chemical, that contributed to these incidents. These issues could have been better dealt with if the fish and wildlife agency involved had gained more public input and support prior to the treatment, done a better job of educating the public and implementing the treatment, and provided better technical, administrative, and political support during all phases of the treatment.

As more demands are placed on North American waters, and the public becomes more environmentally aware, we must respond with guidelines to use rotenone more prudently and with less impact and controversy. Although we recognize that the general public does not fully understand rotenone treatments, only 48% of fish and wildlife agencies indicated that they performed environmental impact analyses or assessments on proposed projects. This is unfortunate, because environmental analyses are disclosure

documents that contain project objectives and discussions of environmental tradeoffs. In order to ensure the use of rotenone in the future, we must do a better job of using rotenone wisely and communicating project objectives to the public. The public should understand that it is often human-induced perturbations that prompt rotenone treatments, and that the minor short-term losses of aquatic life will be offset by more significant, long-term benefits. Benefits may include improved angling quality, threatened or endangered species recovery, continued existence of all native species, and maintenance of a sufficient resource to support reasonable recreational fisheries. However in addition to just using rotenone, we also need to be its stewards and defenders to ensure its continued availability.

Where do we go from here? Several years ago, the American Fisheries Society (AFS) applied for a grant from the FWS Federal Aid Administrative Funds of the Sport Fish Restoration Program to develop and implement a Rotenone Stewardship Program. This was done because AFS recognized that there was a need to balance reasonable environmental safeguards with the more prudent use of rotenone. To date, the program staff has written a Rotenone Use Manual for the safe and effective use of rotenone that emphasizes planning and public involvement. Plans are underway for a public information program to inform the public on the benefits and risks of rotenone and an electronic information system for fisheries biologists that will provide up-to-date information on use restrictions, experts in rotenone use, important issues and solutions, and the registration status of rotenone. Rotenone continues to be a very valuable tool in fisheries without which, many management options will be lost. Fish and wildlife agencies need to take the lead in insuring its future availability. A commitment now to the safe and effective use of rotenone that emphasizes planning and public involvement is critical. Our fisheries depend on it. 