



ARTICLES

THE POISONING OF LAKE DAVIS: WEIGHING THE RISKS

BY
Nathan R. Goedde*

I. INTRODUCTION

The poisoning of Lake Davis¹ to eradicate an illegally introduced species of pike captured the public's attention and grabbed headlines throughout California. Northern pike, discovered in the lake in 1994 but probably planted there several years earlier, are large predatory fish that do not naturally occur west of the Rocky Mountains.² They are voracious eaters, feeding primarily upon fish but also devouring waterfowl, frogs, and crayfish.³ Pike introductions in other western lakes destroyed sports fisheries.⁴ Because of this concern, fishery biologists predicted that if the pike in Lake Davis were not eliminated they would travel downstream to the Sacramento-San Joaquin Delta, and would prey upon salmon, steelhead, Delta smelt, and other threatened fish species.⁵ To prevent this, on October 15, 1997, the California Department of Fish and Game (DFG) applied a poison that killed all of the fish in Lake Davis.⁶

Residents of Plumas County vehemently opposed DFG's controversial plan, fearing the poison would contaminate their drinking water and scare away tour-

* Nathan R. Goedde is a 2L at King Hall and a Masters' student in the Ecology Graduate Group at the University of California at Davis. He has an undergraduate degree in Environmental and Resource Science from UCD. Mr. Goedde wishes to extend special thanks to Holly Doermus and Peter Moyle for their encouragement.

¹ Lake Davis in Plumas County is actually a human-made reservoir constructed by the California Department of Water Resources in the 1960s. See CAL. DEP'T OF FISH AND GAME, THE THREAT FROM NORTHERN PIKE IN LAKE DAVIS TO CALIFORNIA'S FISHERIES: HOW ROTENONE IS USED TO MANAGE OUR FISHERY RESOURCES (1996).

² Cariad Hayes, *Delta Eludes Duck-Eating Fish*, 6 ESTUARY 3 (1997).

³ *Id.*

⁴ CAL. DEP'T OF FISH AND GAME, *supra* note 1.

⁵ Letter from Dennis McEwan, President, California-Nevada Chapter of the American Fisheries Society to Brian Finlayson, Pesticides Investigations Unit, California Department of Fish and Game (Nov 5, 1996).

⁶ CAL. DEP'T OF FISH AND GAME, *supra* note 1.

ists. Many residents believed adding one more exotic species to the less-than-pristine Delta would have little impact and wanted DFG to stay out of Plumas County.⁷ Others opposed to the poisoning urged DFG to consider alternatives not involving the introduction of chemical agents to their drinking water.

This article examines the arguments for and against DFG's pike eradication project to assess whether the Department's decision to poison Lake Davis was justified. Before addressing this question, a discussion of the exotic species problem provides the necessary background to make an informed assessment of DFG's decision.

II. EXOTIC SPECIES AND THE "FRANKENSTEIN EFFECT"

Introduced or exotic species are those species not naturally occurring in a given locality, but are present due to human actions.⁸ In contrast, natives are species naturally occurring in a given locale.⁹ Thus, northern pike are exotic when they occur west of the Rockies, but are native in the Midwest where they originated.

Since ancient times, humans have intentionally introduced exotic species for food production and aesthetic reasons.¹⁰ For example, agriculturists grow exotic crops to help sustain the human population in many areas of the world. Most introductions, however, are not so beneficial to humankind, nor are they so easily contained. Whereas modern agricultural crops are often so different from their wild counterparts that they cannot easily survive without the application of water and fertilizers, many introduced plants and animals flourish without human assistance, therefore invading and permanently establishing themselves in natural ecosystems.¹¹

⁷ But see Letter from Daniel P. Cavanagh, Vice President and Manager of the Poitola Office of Plumas Bank, to State Senator Tim Leslie (April 21, 1997) (explaining that residents are not opposed to receiving subsidy from DFG in form of planted hatchery trout to attract tourists because with recent reductions in timber harvesting, tourism has become increasingly important element of local economy).

⁸ THE CONCISE OXFORD DICTIONARY OF ECOLOGY (Michael Allaby ed., 1994).

⁹ *Id.*

¹⁰ See, e.g., Peter B. Moyle, *Fish Introductions Into North America: Patterns and Ecological Impact in Ecology of Biological Invasions of North America and Hawaii*, 58 *ECOLOGICAL STUDIES* (1986) (describing Roman introduction of carp to Italy and how carp introductions later tracked spread of Christianity as fish escaped from monastery ponds).

¹¹ *Id.*

A. Biological Impacts

Exotic organisms may invade ecosystems to such an extent that native species become extinct. For example, grazing and exotic species reduced California bunchgrass prairie from a cover of nearly one fourth of the state to an almost nonexistent thicket of native grasses.¹² Today, people who travel through California's Central Valley are able to see few, if any, native wildflowers or bunchgrasses.¹³ Exotic species also produce dramatic effects outside of California. They contributed to the decline of a large number of the species listed as threatened or endangered under the federal Endangered Species Act.¹⁴

Exotic species can have significant impacts on the environment even without causing extinction. They blur the regional distinctiveness of the natural world, reducing our ability to explore and discover distinct parts of Earth's natural diversity. They also present problems for scientists studying biogeography and evolution because early human-assisted introductions can mask important evolutionary events. As a result of these and other effects, scientists regard introduced species as one of the most serious elements of human-induced global change.¹⁵

1. The "Frankenstein Effect"

In 1986, Moyle *et al.* coined the term "Frankenstein Effect" to describe the unintended results of intentionally introducing exotic fish species.¹⁶ They noted that while faunal tinkering is a major activity of fisheries managers throughout the world, fish introductions are particularly extensive in North America.¹⁷

¹² THE NATURE CONSERVANCY, JEPSON PRAIRIE PRESERVE HANDBOOK (1992).

¹³ *Id.* (stating that even in Jepson Prairie Preserve in Solano County's most pristine vestige of California bunchgrass prairie, exotic weeds such as wild oats, bromes, barleys, fescues and fillaees dominate landscape).

¹⁴ John L. Dentler, *Noah's Farce: The Regulation and Control of Exotic Fish and Wildlife*, 17 U. PUGET SOUND L. REV. 191, 197-203 (1993); D.R. Lassuy *Introduced Species as a Factor in Extinction and Endangerment of Native Fish Species* in H.L. Schramm and R.G. Piper, *Uses and Effects of Cultured Fishes in Aquatic Ecosystems*, 15 AMERICAN FISHERIES SOCIETY SYMPOSIUM 391-96 (1995).

¹⁵ P.M. Vitousek *et al.*, *Introduced Species: A Significant Component of Human-Caused Global Change* 21(1) NEW ZEALAND J. ECOLOGY 1-16 (1997).

¹⁶ P.B. Moyle *et al.*, *The Frankenstein Effect: Impact of Introduced Fishes on Native Fishes in North America*, in FISH CULTURE IN FISHERIES MANAGEMENT (R.H. Stroud ed., 1986).

¹⁷ *Id.*

Native fish populations declined and in some cases were extirpated as a result of direct interaction with introduced fishes.¹⁸ Moyle compared these attempts to improve nature to the ambitious but ill-fated experiment of Mary Shelley's Dr. Frankenstein, and discouraged the continued introduction of exotic fishes.¹⁹

2. *The Nile Perch Disaster and Other Examples*

Introduced fish have dramatic unintended effects, both on native fishes and local human communities. The introduction of the Nile perch into Lake Victoria in Africa is an example of one such disaster.²⁰ Prior to perch introduction, the lake contained between two and five hundred colorful endemic cichlid species that were valuable as aquarium fishes and served as a staple food of the local people. The Nile perch, a popular game fish capable of growing to more than six feet and four hundred pounds, was introduced to support a commercial fishery. Subsequently, hundreds of native species became extinct or severely depleted.²¹

The overwhelming success of the Nile perch had profound consequences for the local people. For centuries they harvested the native cichlids and sundried the fish for later consumption. The high oil content of perch flesh, however, made wood fires, rather than sunlight, necessary for drying. As a result, deforestation of islands and the lakeshore is occurring, increasing erosion and eutrophication of the lake.²² Where a diverse biological wonder once existed, Lake Victoria is rapidly becoming a homogenous, polluted monument to humankind's misguided tinkering with nature.

The Nile perch fiasco is just one of many disastrous introductions. In another example, this time unintentional, the construction of the St. Lawrence Seaway and other canals allowed sea lamprey to invade the previously isolated Laurentian Great Lakes.²³ The lamprey, a snake-like fish that uses a sucking disc and bony tongue to attach to other fish and feed on their bodily fluids, does not usually kill its natural prey. The Great Lakes fishes, however, were not adapted to cope with this foreign predator, and many were unable to survive the lamprey's

¹⁸ *Id.* at 415-16.

¹⁹ *Id.*

²⁰ PETER B. MOYLE, *FISH: AN ENTHUSIASTS GUIDE* 217-20 (1993).

²¹ *Id.*

²² *Id.*

²³ P.B. MOYLE AND J.J. CECH, JR., *FISH: AN INTRODUCTION TO ICHTHYOLOGY* 198 (1988).

unique method of feeding. Soon after the lamprey invaded each lake, populations of the larger species of fish plummeted. Chemical poisons and other control measures were used to reduce the lamprey populations, but while these efforts allowed some recovery of native fishes, the lamprey and their effects will never be completely removed from the Great Lakes.²⁴

B. Economic Impacts

Exotic species can produce economic as well as ecological costs. The European zebra mussel, a native of western Russia, was discovered in the Great Lakes in 1988.²⁵ The mussel, which is believed to have traveled to the United States in the ballast water of ships, is very prolific and readily colonizes objects such as plants, boats, and pipes. The mussel has clogged intake pipes with diameters of up to twenty-four inches and has shut down several power and water treatment plants. Control of zebra mussels in the Great Lakes region cost more than \$120 million between 1989 and 1994.²⁶

In 1996, members of a United Nations-sponsored workshop on biological invasions concluded that introduced species create problems almost as significant as human-induced habitat changes.²⁷ A recent government study of the economic impacts of exotic organisms found that between 1906 and 1991, seventy-nine exotic species caused losses of \$79 billion, and that fifteen species may cause future losses of \$134 billion.²⁸ DFG's recent awareness of these problems may have served as a motivating factor behind the Department's zealous efforts to eradicate northern pike from Lake Davis. Yet, the Department's position is somewhat ironic given its long history of introducing fish species where they do not naturally occur.²⁹

²⁴ *Id.*

²⁵ Jodi L. Cassell, *Public Education to Thwart Aquatic Nuisances* 51 CAL. AGRIC. 19-21 (1997).

²⁶ *Id.*

²⁷ Peter B. Moyle, *The Importance of an Historical Perspective: Fish Introductions*, 22 FISHERIES 14 (1997).

²⁸ OFFICE OF TECHNOLOGY ASSESSMENT, U.S. CONGRESS, OTA-F-565, HARMFUL NON-INDIGENOUS SPECIES IN THE UNITED STATES 5 (1993).

²⁹ Of the 58 taxa of established exotic fishes in California, DFG is responsible for deliberately introducing 27 of them. The California Fish and Game Commission historically placed little value on California's native fishes. For example, in 1916 the Commission reportedly stated that it wanted to see the native bull trout exterminated. W.A. Dill and A.J. Cordone, *History and Status of Introduced Fishes in California, 1871-1996: Conclusions*, 22 FISHERIES 15 (1997).

III. THE LAKE DAVIS CONTROVERSY:
A SUMMARY OF RECENT DEVELOPMENTS

In 1988, DFG discovered the illegal planting of northern pike in Frenchman Reservoir in Plumas County. Three years after discovering the pike, the Department sought to control the fish by applying 18,000 gallons of a chemical formulation containing rotenone, an organic pesticide, to the reservoir, killing all of the resident pike.³⁰

DFG launched such drastic action to prevent the natural or human-assisted spread of the pike to other California waterways, particularly the Sacramento-San Joaquin Delta. The Delta supports several threatened species as well as a multimillion-dollar commercial salmon fishery. DFG also wanted to maintain the trout fishery in Frenchman Reservoir, which would face severe depletion if the predatory pike were allowed to remain.³¹

Unfortunately, the Department failed to act quickly enough. Unbeknownst to DFG, someone already transplanted enough northern pike to establish another illegal population in Lake Davis.³² Lake Davis is more than four times as large as Frenchman Reservoir, holding up to 84,370 acre-feet of water. Lake Davis and Frenchman Reservoir were formed when the Department of Water Resources dammed tributaries to the Feather River in the 1960s. Both reservoirs provide recreation, flood control, and irrigation water for agriculture, but Lake Davis also supplements the City of Portola's drinking water supply.³³

DFG discovered pike in Lake Davis in August 1994,³⁴ just one month after the agency released a Final Programmatic Environmental Impact Report (PEIR) entitled "Rotenone Use For Fisheries Management." Although DFG considered several options in the PEIR, including dewatering, blasting, and angling regulations, the Department established application of a proven effective commercial rotenone formulation as the preferred method to eliminate undesirable aquatic organisms.³⁵

³⁰ Pete Weisser, *Rainbows Return to Frenchman*, 53 *OUTDOOR CAL.* 1 (1992).

³¹ CAL. DEP'T OF FISH AND GAME, *THE LAKE DAVIS NORTHERN PIKE ERADICATION PROJECT FINAL ENVIRONMENTAL IMPACT REPORT* (Jan. 1997) [hereinafter "EIR"].

³² In all other respects, the Frenchman Reservoir pike removal project was a complete success. No northern pike have been found in the reservoir since 1991, and DFG has re-established an excellent trout fishery for anglers. Weisser, *supra* note 10.

³³ EIR, *supra* note 31.

³⁴ *Id.*

California laws and public policy require that the Department ensure the continued existence of California's fishes.³⁶ In addition, California Fish and Game Code § 5501 specifically authorizes DFG to "take any fish which, in its opinion is unduly preying upon any bird, mammal or fish."³⁷ This authority has been construed to include taking fish by using pesticides, and to authorize DFG to determine when a particular predatory species of fish should be eliminated.³⁸ These responsibilities form the basis for DFG's actions in Plumas County.

As originally described in the project environmental impact report (EIR), Lake Davis was to be drawn down to between fifty and seventy-five percent capacity before DFG applied two-thirds gallons of Nusyn-Noxfish[®] for each acre-foot of water remaining in the reservoir. When completely mixed, the resultant concentration of Nusyn-Noxfish[®] would be two milligrams per liter of water. During the application and until detoxification was complete, the reservoir would be closed to public access and DFG would supply the City of Portola with an alternate water supply. DFG estimated that natural dissipation of the rotenone and other chemicals would take approximately fourteen days depending on the temperature of the water. Following this dissipation, the Department would restock the reservoir with hundreds of thousands of rainbow trout up to five inches in length and between five and ten thousand pounds of "trophy-size" trout. Lake Davis would not be used as a drinking water source until there were no detectable levels of rotenone or any other formulation ingredients. DFG would test wells in the surrounding area for contaminants before and after treatment.³⁹

Plumas County residents reacted immediately and powerfully to DFG's plan. Most of the 2,500 people living in Portola vehemently opposed DFG's plan to poison part of their drinking water supply. Project opponents protested at the state capitol and voiced their opinions in several public hearings. They even persuaded State Senator Tim Leslie to introduce legislation stalling the project until the Department of Health Services determined that Portola's drinking water would not be permanently affected.⁴⁰ The law also required development of

³⁵ *Id.*

³⁶ See CAL. FISH AND GAME CODE § 1700 (West 1998); CAL. FISH AND GAME CODE §§ 2050-2098 (West 1998).

³⁷ CAL. FISH AND GAME CODE § 5501 (West 1998).

³⁸ *Churchill v. Parnell*, 170 Cal App. 3d 1094, 1098 (1985).

³⁹ EIR, *supra* note 31.

⁴⁰ CAL. S.B. 1312 took effect immediately upon being signed by Governor Wilson on September 22, 1997.

a monitoring program to ensure that no detectable level of the chemicals remained in the water.⁴¹

Some citizens sued to stop the project. During the summer of 1997, they convinced a superior court judge to issue a temporary restraining order, preventing DFG from partially draining the lake as it had planned.⁴² The project opponents were ultimately unable to prevent the poisoning, however, and on October 15, 1997, DFG applied 16,000 gallons of Nusyn-Noxfish[®] (containing a total of approximately ten gallons of trichloroethylene (TCE)) and 64,000 pounds of powdered rotenone to the lake. In the days following the poisoning, DFG removed twenty tons of dead fish from the Lake. The Department estimates that an additional forty tons sank to the bottom.⁴³

At the time of its poisoning, Lake Davis held approximately 50,000 acre-feet of water, 20,000 acre-feet more than it would have contained if not for the temporary restraining order. Ironically, the project opponents' suit resulted in 25,600 pounds of additional powdered rotenone and 6,400 gallons more Nusyn-Noxfish,[®] (containing approximately five gallons more TCE) being added to the lake relative to the amount that would have been used had DFG been allowed to drain the reservoir as planned.⁴⁴

On the night before the poisoning, over a thousand protesters gathered in Portola and held a candlelight vigil, waving banners with messages such as "We Like Pike," "Save Our Lake," and "Poison Kills."⁴⁵ Two protesters received national media coverage by chaining themselves to floating buoys in the lake. Police removed them without use of force, but paramedics rushed one to a hospital to be treated for hypothermia.⁴⁶

DFG and the State of California received nationwide attention from the extensive media coverage of the Plumas County protest. Some people questioned the wisdom of DFG's decision to apply poison to part of a city's drinking water

⁴¹ CAL. S.B. 1312, 1997-98 Regular Session (1997).

⁴² The temporary restraining order required DFG to provide an alternative water supply before it could begin drawing down the reservoir. The order was lifted when DFG constructed a 500,000-gallon water tank. Telephone Interview with Patrick J. Foy Public Information Officer/Biologist, California Department of Fish and Game (Nov 14, 1997).

⁴³ *Id.*

⁴⁴ *Id.*

⁴⁵ *Six O'clock News* (KXTV, Oct. 14, 1997); *Ten O'clock News* (KQVR, Oct. 14, 1997).

⁴⁶ Telephone Interview with Patrick J. Foy Public Information Officer/Biologist, California Department of Fish and Game (Nov 14, 1997).

supply. The following section provides a more detailed analysis of the arguments for and against DFG's use of Nusyn-Noxfish® in Lake Davis.

IV. BALANCING THE RISKS AND BENEFITS

Given the well-documented ecological and economic impacts of exotic species, it may seem surprising that DFG's plan engendered such fierce opposition. However, the residents of Plumas County feared the project would threaten their health and disrupt their economy, things they hold more dear than the fate of downstream fish populations. A fair appraisal of DFG's decision to apply rotenone to Lake Davis requires weighing of the health and economic impacts of the project against the harm it prevented.

A. What is Nusyn-Noxfish® and How Does it Work?

Nusyn-Noxfish® is a chemical mixture designed to eradicate fish from lakes, ponds, reservoirs, and streams. Rotenone, other associated resins, and piperonyl butoxide are the active ingredients.⁴⁷ Rotenone is one of several similar rotenoid compounds naturally occurring in two plant genera, *Derris* and *Louhocarpus*, and was used for hundreds of years to stun and kill fish.⁴⁸ Depending upon the dose received, rotenone can have a powerful inhibitory effect on the cellular respiratory processes of fish, birds, and mammals. Fish are particularly sensitive to rotenone because their gills are directly exposed to the water, allowing the chemical immediate entrance to the blood stream. Birds and mammals are not nearly as sensitive to oral exposures to rotenone because the chemical is partially broken down by enzymes in their digestive systems before reaching the blood.⁴⁹ For this reason, rotenone is characterized as a selective pesticide to fish and other gill-breathing organisms when used at the low concentrations indicated on the product label.⁵⁰

⁴⁷ CAL. DEP'T OF FISH AND GAME, ROTENONE USE FOR FISHERIES MANAGEMENT, FINAL PROGRAMMATIC ENVIRONMENTAL IMPACT REPORT (July 1994).

⁴⁸ J. Leonard, *Notes on the Use of Derris as a Fish Poison*, 68 TRANSACTIONS OF THE AMERICAN FISHERIES SOCIETY 269-79 (1939).

⁴⁹ EIR, *supra* note 31, at 27-28.

⁵⁰ Cal. Dep't of Fish and Game, *The Threat from Northern Pike in Lake Davis and How Rotenone is Used to Help Manage Our Fishery Resources* (visited Sept. 5, 1997) <<http://www.dfg.ca.gov/coned/index.html>>.

Piperonyl butoxide is a synergist that enhances the effectiveness of rotenone. The toxicity of a 2.5 percent rotenone solution with the synergist is equivalent to that of an unsynergized 5 percent rotenone solution.⁵¹ The remainder of the active ingredients, the associated rotenoid compounds, vary in their pesticidal effectiveness and solubility, but rotenone itself is almost completely insoluble in water.⁵²

Since rotenone and water do not readily mix, the makers of Nusyn-Noxfish[®] dissolve it in other petroleum-based ingredients which act as emulsifiers to facilitate dispersion in water. These solvents are characterized as inert on the product label⁵³ because they do not contribute to the lethality of the formulation.⁵⁴ Such "inert" ingredients include naphthalene, methylnaphthalene, xylene, and TCE.⁵⁵ The effects of these chemicals are probably the most controversial aspects of the Lake Davis project because the National Institute for Occupational Safety classifies TCE as a carcinogen.⁵⁶

B. The Potential Impacts on Human Health and the Economy

The Plumas County Board of Supervisors is not primarily concerned with DFG's duty to conserve California fishes. Instead, the Supervisors' immediate worry is fulfilling their responsibilities to provide for the health and welfare of their constituents. It is therefore understandable why they may object to a project allowing toxic, and in the case of TCE, carcinogenic chemicals to be added to Portola's water supply.

1. Human Health Impacts

The chief concern of the project's opponents was the addition of TCE to Portola's drinking water supply.⁵⁷ According to DFG and the California Environmental Protection Agency (CalEPA), the active and inactive ingredients of Nusyn-

⁵¹ EIR, *supra* note 31, at 16.

⁵² *Id.* at 14.

⁵³ *Id.* at 244.

⁵⁴ *Id.* at 16.

⁵⁵ *Id.*

⁵⁶ National Safety Council, Environment Writer, *Trichloroethylene Chemical Backgrounder* (visited Nov. 10, 1997) <<http://www.nsc.org/ehc/ew/chems/trichbr.htm>>.

⁵⁷ See Letter from Christopher Stanton, M.D., a family physician in Potola, to Jaqueline Schafer, Director, Department of Fish and Game (Nov 2, 1996); see also Save Lake Davis Committee, *Poisoning Lake Davis: A*

Noxfish® would rapidly dissipate from the water.⁵⁸ When asked if adding the components of the rotenone formulation to a primary drinking water source is safe, CalEPA indicated that the controversial “inert” components of Nusyn-Noxfish® are present in fuel oil and are already chronically present in lake water because of the widespread use of outboard motors. CalEPA concluded there is “no significant risk from the addition of Nusyn-Noxfish® to Lake Davis,” particularly since the water would not be used for human consumption until traces of all Nusyn-Noxfish® ingredients become undetectable.”⁵⁹ Most Portola residents were not satisfied with CalEPA and DFG assurances, however; they believe TCE represents a threat to their health and consider any such risk, no matter how small, to be “significant.”

The Save Lake Davis Committee (SLDC) says they do not oppose pike eradication per se, but rather objects to the contamination of their water supply and ground water.⁶⁰ They remember how “another government agency assured us Agent Orange was safe for people...they [DFG] appear to be trying to deceive the public to divert attention from the real issue—public health.”⁶¹ SLDC and other county officials point to studies identifying TCE as a “notorious groundwater contaminant” linked to human cancers and birth defects.⁶² SLDC fears Plumas County residents may be exposed to the same risks described in Jonathan Harr’s nonfiction book, *A Civil Action*, describing how TCE-contaminated water caused leukemia in residents of Woburn, Massachusetts. SLDC compares the assurances made by Woburn’s city engineer, that the level of TCE in groundwater was acceptable for human consumption, to similar claims by DFG and CalEPA in the Lake Davis case. SLDC threatened that Lake Davis area residents, like the successful plaintiffs described in Harr’s bestseller, could sue the State, costing taxpayers huge sums to pay for DFG’s reckless endangerment of lives, health and property.⁶³

Threshold Groundwater Contamination Issue—Why Should You Care? (August 11, 1997); Letter from Gina M. Solomon, M.D., Senior Scientist, Natural Resources Defense Council, to Douglas Wheeler Secretary, The Resources Agency (Aug. 25, 1997).

⁵⁸ Letter from James W Wells, Director, California Environmental Protection Agency to Rod Olsen, Office of Senator Tim Leslie (Oct. 30, 1996).

⁵⁹ *Id.*

⁶⁰ Save Lake Davis Committee, *POISONING LAKE DAVIS: A THRESHOLD GROUNDWATER CONTAMINATION ISSUE—WHY SHOULD YOU CARE?* (Aug. 11, 1997).

⁶¹ *Id.*

⁶² *Id.*

⁶³ *Id.*

The National Institute for Occupational Safety and Health and California's Proposition 65 list TCE as a carcinogen. SLDC asserts that TCE is a common groundwater contaminant in the eastern United States because TCE does not degrade over time; it is highly resistant to biological degradation. They further note that the contamination in Woburn is expected to last for thousands of years, and refuse to believe DFG's claim that TCE will dissipate rapidly through evaporation.⁶⁴

In response to DFG's provision of an alternative drinking water supply, SLDC contends that TCE from contaminated water is ingested primarily through inhalation of vapor and absorption through the skin while showering, so merely providing bottled drinking water will not remove the risk of cancer and birth defects. Because TCE is heavier than water, SLDC worries that TCE could sink to the bottom of the lake, where it will accumulate in the sediment and potentially contaminate the surrounding groundwater and wells.⁶⁵

DFG does not deny that TCE is toxic and has been linked to cancer, although human cancer risks are unclear according to the International Agency for Research on Cancer and the U.S. Department of Health and Human Services' Agency for Toxic Substances and Disease Registry.⁶⁶ Rather than arguing the chemical's carcinogenicity, DFG emphasizes the volatility of TCE and the minute quantities applied to Lake Davis. According to the Department, fewer than ten gallons of TCE were present in the 16,000 gallons of Nusyn-Noxfish[®] applied to the lake, and most of that amount volatilized into the air before even reaching the water. According to DFG, which has been monitoring the dissipation of Nusyn-Noxfish[®] constituents since it was applied, the maximum concentration detected in the lake following treatment was 0.3 parts per billion.⁶⁷ The U.S. Environmental Protection Agency (EPA) set the drinking water standard for TCE in water systems at five parts per billion.⁶⁸ Therefore, the maximum concentration of TCE—which was reached in only one of ten sample locations⁶⁹—was still less than one sixteenth of the maximum level which the EPA considers safe for human consumption.

⁶⁴ *Id.*

⁶⁵ *Id.*

⁶⁶ Agency for Toxic Substances and Disease Registry, ToxFAQs, *Trichloroethylene (TCE)* (visited Nov. 10, 1997) <<http://www.watsdr.cdc.gov:8080/tfacts19.html>>.

⁶⁷ Foy, *supra* note 46.

⁶⁸ Agency for Toxic Substances and Disease Registry, *supra* note 66.

⁶⁹ Foy, *supra* note 46.

If DFG merely provided Portola residents with bottled water as SLDC feared, then it would have been theoretically possible for residents to inhale TCE vapor while showering. However, DFG built a water tank and provided the city of Portola with an alternative source of tap water free of TCE. Thus, the residents of Portola were not exposed to TCE through showering or other household water uses.

Some of the disagreement over whether TCE would naturally dissipate involved the behavior of the chemical in ground versus surface waters. TCE breaks down extremely slowly—if at all—in groundwater, but is known to degrade within a few weeks in air or surface water.⁷⁰ SLDC expressed concern over the possibility of ground water contamination; arguably, because TCE is heavier than water, when applied to the lake it could have sunk to the bottom and moved through the soil to the groundwater.⁷¹ DFG maintains that this is an unlikely scenario because TCE is a volatile organic compound which quickly evaporates in the air. The Department acknowledges that if a fifty-five gallon drum of TCE were dumped into the lake, a portion could be expected to reach the bottom. When DFG treated the lake, however, they sprayed Nusyn-Noxfish[®] over the water surface, allowing all but extremely low levels of the chemical to evaporate almost immediately.⁷²

Although some uncertainty remains concerning the health threat posed by TCE, the risks seem negligible given the small quantities applied and the low concentration measured in Lake Davis. This does not mean that it was entirely unreasonable to oppose the project on the grounds of safety. It is natural for citizens to resent actions of their government that expose them to any additional risk of harm, no matter how remote. While many of us are quite willing to voluntarily assume risks, whether from our diets, smoking, skydiving, sunbathing or countless other common activities, we find risks that are involuntarily assumed to be inherently repugnant. Safety concerns are not the only basis for opposition to DFG's actions, however. There is no doubt that the project adversely affected the economy of Plumas County.

⁷⁰ Agency for Toxic Substances and Disease Registry, *supra* note 66.

⁷¹ Save Lake Davis Committee, *supra* note 60.

⁷² Foy, *supra* note 46.

2. Economic Impacts

The economic impacts of poisoning Lake Davis are more certain than the potential health impacts. Federally mandated reductions in timber harvesting caused significant harm to the region's economy in the past ten years. However, the Eastern Plumas County Chamber of Commerce reported increases in the region's employment rate in each of the past four years, primarily due to increasing tourism. Lake Davis is the largest lake in eastern Plumas County, and attracts people who enjoy fishing, hunting, and camping. According to the Plumas Corporation, which annually spends \$350,000 from the County general fund to promote tourism, tourism provides a quarter of all the jobs in Plumas County. In 1994, tourism brought \$136 million to Plumas County, generating over \$10 million in taxes.⁷³ The poisoning of Lake Davis jeopardizes the County's reputation and its status as a tourist destination.

No one is disputing that the poisoning of Lake Davis will at least temporarily tarnish Plumas County's image. The severity of these effects, however, remain unclear. According to the manager of the Portola Office of Plumas Bank, the county "may never recover from this latest pearl of government wisdom." He noted, "there is no public relations firm in the world who could put a positive spin on the word 'poison.'"⁷⁴ SLDC argues that the project will increase unemployment and force many people onto welfare,⁷⁵ impacts similar to those caused by the poisoning of Frenchman Reservoir. They complain that the Frenchman project "severely damaged businesses." One small business owner reportedly lost about two-thirds of his normal customers and \$1-2 million over the years following that poisoning.⁷⁶ Warning that the project would create "economic havoc" in Plumas County, an officer of Placer Savings Bank stated that "14 real estate/escrows have been canceled, some requiring forfeiture of deposits, upon buyers learning of the threat to the water supply and resultant potential for health risks."⁷⁷ SLDC complains that DFG has not proposed any reimbursement for lost business, jobs, or property values caused by the Lake Davis project.⁷⁸

⁷³ Save Lake Davis Committee, *supra* note 60.

⁷⁴ Letter from Daniel P. Cavanagh, Vice President and Manager of the Portola Office of Plumas Bank, to State Senator Tim Leslie (Apr. 21, 1997).

⁷⁵ Save Lake Davis Committee, *supra* note 60.

⁷⁶ Statement of Mr. Dick Wiggins, Wiggins' Trading Post, Chilcoot, California.

⁷⁷ Letter from Robert C. Haydon, President and Chief Executive Officer of Placer Savings Bank, to Governor Pete Wilson (Apr. 21, 1997).

⁷⁸ Save Lake Davis Committee, *supra* note 60.

DFG does not dispute that the County's economy has been adversely affected by the pike eradication project. One representative of the Department believes the threat to the county's long term image is the most legitimate of the project opponents' concerns. DFG's solution is to re-stock the lake with rainbow trout as soon as the Nusyn-Noxfish[®] constituents dissipate. The Department hopes that within five years the lake will offer some of the best trout fishing opportunities in the state.⁷⁹ DFG promised that next spring it will issue news releases and include an article in *Outdoor California* advertising the fishing opportunities at Lake Davis and encouraging anglers to visit the reservoir.⁸⁰

DFG's efforts are unlikely to mitigate all of the negative economic consequences of the project, and residents of eastern Plumas County will be forced to bear a disproportionate share of the burden of protecting California's aquatic systems from pike invasion. Perhaps the state legislature should consider reimbursing the county and affected property owners in Plumas County. Such a measure would result in a more equitable distribution of the costs of the illegal pike introduction.

C. Potential Impacts If Pike Are Not Eliminated

The Save Lake Davis Committee and DFG disagree on another fundamental issue. According to DFG, Lake Davis contained the only population of northern pike in California.⁸¹ In contrast, SLDC argues that pike already invaded the waters that DFG hopes to protect. SLDC claims that local fishermen found pike in Frenchman Reservoir, Lake Almanor, Lake Oroville, and other waterways.⁸² A DFG-affiliated newsletter documenting a pike sighting in the Delta bolsters their argument. The newsletter, published in winter of 1997 by the Interagency Ecological Program for the Sacramento-San Joaquin Estuary,⁸³ reports that

⁷⁹ Foy, *supra* note 46.

⁸⁰ EIR, *supra* note 31, at 47.

⁸¹ *Id.* at 13.

⁸² Save Lake Davis Committee, *supra* note 60.

⁸³ The Interagency Ecological Program consists of ten member agencies. The state agencies include the Department of Water Resources, the Department of Fish and Game, and the State Water Resources Control Board. The federal agencies are the Fish and Wildlife Service, the Bureau of Reclamation, the Geological Survey, the Army Corps of Engineers, the National Marine Fisheries Service, and the U.S. Environmental Protection Agency. The only non-government organization in the program is the San Francisco Estuarine Institute. According to the program's website, these ten agencies work together to develop a better understanding of the Sacramento-San Joaquin Estuary's ecology and the effects of the State Water Project and

“a northern pike was observed at the SWP fish facility on December 12. The fish was not saved, but the operator was familiar with northern pike. The fish was 207mm fork length and had the following characteristics: light splotches along the sides; long nose and sharp teeth; dorsal fin closer to caudal fin than to head with opposing anal fin; forked tail.”⁸⁴

DFG acknowledges what it calls “an unqualified report of a northern pike...in the Sacramento-San Joaquin Delta.”⁸⁵ The Department says that although this is “alarming,” there is “no sure way of determining if it was a northern pike.”⁸⁶ This seems to be a rather empty assertion since the sighting was reported in a DFG-affiliated newsletter and included an accurate technical description of the pike. If the employee is not truly qualified to make the identification, DFG should have provided the public with enough information to independently conclude that the identification was suspect. The Department certainly has access to information regarding the employee’s training, and its failure to report this information casts suspicion on DFG’s argument. Although there may be “no sure way of determining if it was a northern pike,” the Department could easily test the employee’s ability to identify preserved specimens of the fish. This would provide both the agency and the public with a better indication of the veracity of the sighting.

DFG’s next response to those who claim that pike have been found in waters besides Lake Davis is perhaps more convincing. DFG argues that, assuming such sightings were accurate, the presence of a single pike does not prove that the species has established a reproducing population in a given location. When one considers the infrequency of reported pike sightings relative to the prevalence of fish sampling in California, it seems unlikely that viable populations of pike are established in other waterways. Although government, academic, and private biologists extensively sample the Delta and other waters, none reported finding even a solitary pike.⁸⁷

Federal Central Valley Project operations on the physical, chemical, and biological conditions of the San Francisco Bay-Delta estuary. Interagency Ecological Program for the Sacramento-San Joaquin Estuary, 1996 *Organizational Structure of the Interagency Ecological Program* (visited Nov. 14, 1997) <<http://www.iep.water.ca.gov/neworgan.html>>.

⁸⁴ Scott Barrow, *Fish Salvage Facilities*, 10 INTERAGENCY ECOLOGICAL PROGRAM FOR THE SACRAMENTO-SAN JOAQUIN ESTUARY NEWSL. 1, 6 (Winter 1997).

⁸⁵ Cal. Dept of Fish and Game, *The Threat from Northern Pike in Lake Davis and How Rotenone is Used to Help Manage Our Fishery Resources* (visited Sept. 5, 1997) <<http://www.wdfg.ca.gov/coned/index.html>>.

⁸⁶ *Id.*

⁸⁷ *Id.*

The history of an introduced smelt, the wakasagi, is instructive. The fish was introduced into Sierra reservoirs in the 1950s and a few individuals made it to the Delta by the 1970s.⁸⁸ However, no successful colonization of the Delta occurred until the late 1980s following their establishment in Folsom Lake.⁸⁹ Wakasagi are now common in the system and are hybridizing with the already threatened Delta smelt.⁹⁰ This demonstrates how some individuals may be found in regions beyond the species' range of successful reproduction. Ecologists refer to such individuals as "extralimitals" or "strays." These individuals are too thinly scattered to find conspecifics of the opposite sex, so reproduction usually does not occur. Based on the extensive sampling that regularly occurs in the Delta without detecting any northern pike, it seems likely that even if a few stray individuals are present they will live out their lives without finding spawning partners and reproducing.⁹¹

It is possible that pike already moved, or were illegally introduced to other waters of California, but there is currently no evidence of successful pike reproduction outside of Lake Davis. Thus it seems reasonable for DFG, which is responsible for protecting California's commercial salmon fishery and other threatened native species, to conclude that Lake Davis contained the only successfully reproducing population of northern pike in California.

1. Biological Costs

Accurate evaluation of the risks posed by the northern pike in Lake Davis requires an assessment of the likelihood of their spreading beyond the lake, as well as an estimation of the magnitude of their impact should they successfully invade other waters.

a. The Possibility of Containment

If DFG allowed northern pike to remain in Lake Davis, there are two distinct means whereby the fish could establish themselves outside the reservoir. First, anglers could illegally introduce pike to other regions if they interpret the

⁸⁸ Electronic Interview with Peter B. Moyle, Professor, Department of Wildlife, Fish and Conservation Biology, University of California, Davis (Nov. 7, 1997).

⁸⁹ *Id.*

⁹⁰ *Id.*

⁹¹ *Id.*

Department's failure to act as approval of additional introductions.⁹² Second, the pike could travel downstream, either when water spills over Lake Davis' dam or through the dam outlet, to the Feather River and Lake Oroville. Once they reached Lake Oroville, colonization of the Delta would be certain because the lake provides suitable spawning habitat and is too large to poison effectively.⁹³ From Oroville, it would be an easy journey to the lower Feather and Sacramento Rivers, from which the pike could soon colonize the Delta.⁹⁴

The illegal introductions of northern pike into Frenchman Reservoir and Lake Davis indicate that some people are willing to transplant pike from one lake to another. Researchers found that illegal introductions account for twenty-one percent of the thirty-three populations of northern pike and walleye in major northwest waters.⁹⁵ If the northern pike were allowed to remain in Lake Davis, they would provide a ready supply for further illegal introductions in the region.

DFG's inaction at Lake Davis would provide an incentive for further plantings by demonstrating the effectiveness of private introductions. This is not mere speculation; it has already happened with the exotic inland silverside. Following its introduction into Clear Lake and subsequent DFG inaction, anglers actively moved the fish to many reservoirs throughout the state.⁹⁶ Inland silversides are now one of the most common fish in the Delta.⁹⁷ Given enough time, it seems likely that northern pike would be similarly treated and eventually wind up in the Delta.

According to Dr. Peter Moyle, one of the premier authorities on the environmental effects of introduced species and California native fishes, the trek between Lake Davis and the Sacramento river would be arduous for invading pike because they would encounter numerous cataracts and waterfalls.⁹⁸ It would take time for the fish to successfully cross these barriers, but according to Moyle, that is why it was worth DFG's taking the risk that it has not already happened.⁹⁹

⁹² Letter from Peter B. Moyle, Professor, Department of Wildlife, Fish and Conservation Biology, University of California, Davis, to Jaqueline E. Schafer, Director, Department of Fish and Game (May 14, 1997).

⁹³ Moyle, electronic interview, *supra* note 88.

⁹⁴ *Id.*

⁹⁵ Thomas E. McMahon & David H. Bennett, *Walleye and Northern Pike: Boost or Bane to Northwest Fisheries?*, 21 *FISHERIES* 6-13.

⁹⁶ Moyle, letter to Jaqueline E. Schafer, *supra* note 92.

⁹⁷ Barrow, *supra* note 84.

⁹⁸ Moyle, electronic interview, *supra* note 88.

⁹⁹ *Id.*

Several organizations joined Moyle in urging DFG to eradicate the pike before they could escape Lake Davis.¹⁰⁰

b. The Magnitude of the Potential Impacts

It is impossible to predict all of the ecological effects of an invasion of the Delta by northern pike. However, fisheries biologists agree that if the pike became established the biological costs would be enormous.¹⁰¹ According to DFG, a Michigan study revealed that northern pike consumed 1.5 million ducks in one year.¹⁰² This study, along with DFG's discovery of a 31-inch northern pike in Lake Davis with a 17.5-inch trout in its stomach,¹⁰³ helped to convince the Department that northern pike are voracious predators and would adversely affect California's fisheries. According to Moyle, all of his research¹⁰⁴ suggests that "species most likely to have severe negative impacts on aquatic ecosystems are top predators like the pike."¹⁰⁵

Moyle predicts that if northern pike became established in the Sacramento River they would occupy shallow water habitats along the river edge, which are

¹⁰⁰ See *id.*; see also Letter from Dennis McEwan, President, California-Nevada Chapter of the American Fisheries Society, to Brian Finlayson, Pesticides Investigations Unit, California Department of Fish and Game (Nov. 5, 1996); Letter from W.F. Grader, Jr., Executive Director, Pacific Coast Federation of Fishermen's Associations, to Jacqueline E. Schafer, Director, California Dept. of Fish & Game (Nov. 5, 1996); Letter from Roger Thomas, President, Golden Gate Fishermen's Association, to Jacqueline E. Schafer, Director, California Dept. of Fish & Game (Nov. 29, 1996); Letter from Robert C. Fletcher, Chairman, Pacific Fishery Management Council, to Jacqueline E. Schafer, Director, California Dept. of Fish & Game (Oct. 28, 1996); Letter from Jim Edmondson, Executive Director, California Trout, to Patrick O'Brien, Dept. of Fish and Game (Mar. 1, 1995).

¹⁰¹ See, e.g., Letter from Dennis McEwan, President, California-Nevada Chapter of the American Fisheries Society, to Brian Finlayson, Pesticides Investigations Unit, California Department of Fish and Game (Nov. 5, 1996); Electronic Interview with Peter B. Moyle, Professor, Department of Wildlife, Fish and Conservation Biology, University of California, Davis (Nov. 7, 1997); Denny Lassuy *Comments on the Proposal to Eradicate Northern Pike From Davis Lake* (Aug. 8, 1996) (predicting severe impacts of pike invasion).

¹⁰² Hayes, *supra* note 2.

¹⁰³ Foy, *supra* note 46.

¹⁰⁴ See, e.g., Electronic Interview with Peter B. Moyle, Professor, Department of Wildlife, Fish and Conservation Biology, University of California, Davis (Nov. 7, 1997); Moyle, *supra* note 16; Peter B. Moyle and R.M. Yoshiyama, *Protection of Aquatic Biodiversity in California: a Five-Tiered Approach*, 19 FISHERIES 6-18; Peter B. Moyle and T. Light, *Fish Invasions in California: Do Abiotic Factors Determine Success?*, 77 ECOLOGY 1666; Peter B. Moyle and T. Light, *Biological Invasions of Fresh Water: Empirical Rules and Assembly Theory*, 78 BIOLOGICAL CONSERVATION 149-61.

¹⁰⁵ Moyle, electronic interview, *supra* note 88.

essential for the survival of juvenile salmon, splittail, and other threatened native fishes.¹⁰⁶ Moyle anticipates that a pike invasion would negate all of the potential positive effects of the multimillion-dollar CALFED proposals to create more shallow water habitat in the estuary.¹⁰⁷ DFG forecasts that “already depressed stocks of salmon, native and wild trout, striped bass, and other anadromous, resident, and native stocks would be jeopardized by predation and increased competition.”¹⁰⁸

Ultimately, allowing pike to invade the Delta would lead to further listings of threatened and endangered species and extinctions. At the request of DFG, the American Fisheries Society established an independent panel to review the Department’s assessment of the risks posed by the northern pike population in Lake Davis. The Society responded in September 1996, warning that DFG should pursue “immediate eradication of the pike” to protect the already imperiled Central Valley fisheries. According to one panelist, “every day that goes by increases the probability that pike will escape the lake” and if anything, DFG “has understated the potential problems that northern pike are likely to create if they invade the aquatic ecosystems of the Central Valley.”¹⁰⁹

2. Economic Costs

Further listings of threatened and endangered species would be costly to society, because they would inhibit land use and water development. Existing economic uses would also be affected, but it is difficult to estimate the magnitude of these effects. If the pike invade the Delta and cause the extinction of California’s salmon, the multimillion commercial salmon fishery would be lost. Also, the extinction of a species represents an irreversible loss of genetic resources, which may have economic, scientific, educational, historical, aesthetic, and recreational repercussions.

¹⁰⁶ Moyle, letter to Jaqueline E. Schafer, *supra* note 92.

¹⁰⁷ *Id.*

¹⁰⁸ EIR, *supra* note 31.

¹⁰⁹ Moyle, electronic interview, *supra* note 88.

D. Availability of Alternatives

Although DFG considered several methods of pike eradication in the project EIR, the Department chose application of Nusyn-Noxfish[®] because it is the only method with a proven record. According to one DFG representative, the only alternative that comes close to reaching the effectiveness of rotenone is the use of explosives during winter when the lake is covered with ice.¹¹⁰ Blasting was rejected, however, out of concern that the explosions would harm the lake's earthen dam.

Some opponents of the project argued that allowing anglers to fish them out could eliminate the pike. Others recommended that DFG use nets and electroshockers to physically remove the fish. None of these strategies are likely to remove all of the pike, however, and even if effective they would take several years to complete. By that time, some individuals would have already spread downstream.¹¹¹

One alternative that DFG failed to include in the project EIR was ultimately implemented in a final compromise with the Plumas County project opponents. Rather than treating the lake entirely with Nusyn-Noxfish[®], DFG used half Nusyn-Noxfish[®] and half powdered rotenone. This reduced the amount of TCE and other inert ingredients released into the lake by fifty percent.¹¹²

V. CONCLUSION: SHOULD DFG HAVE APPLIED ROTENONE TO LAKE DAVIS?

Since there was a high probability of northern pike invading other California waterways, and the magnitude of the potential harm was so great, the Department's decision to poison Lake Davis was justifiable. If the pike became established in Lake Oroville, they would become permanent members of the state's fauna, forever altering California's aquatic ecosystems and likely contributing to extinctions of native fish. Such irreplaceable losses outweigh the relatively short-lived economic impacts of the project in Plumas County.

The position of Plumas County residents is understandable, however, because they are being forced to sacrifice the health of their local economy and their sense of security in order to preserve California's fishes. Although they may

¹¹⁰Foy, *supra* note 46.

¹¹¹*Id.*

¹¹²*Id.*

recognize that the net benefits of the project outweigh the costs, this doesn't make their burden any easier to bear.

It is regrettable that Plumas County residents must suffer as a result of the criminal introduction of northern pike in Lake Davis. However, the state legislature could alleviate these effects by compensating the County and local businesses for lost tax revenues and tourist dollars. The Department of Fish and Game acted reasonably in choosing the most effective and timely means of eliminating the threat posed by northern pike.