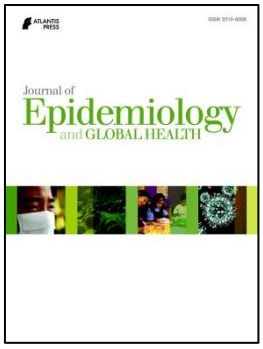

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The fog of war: Why the environmental crusade for anadromous fish species in California could disarm the State's local vector control districts in their war against mosquitoes

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Abstract In California, local mosquito and vector control districts have successfully controlled mosquito and vector-borne diseases by improving drainage patterns and applying pesticides. The Bay-Delta Conservation Plan, which is a proposed habitat conservation plan for the Sacramento-San Joaquin Bay-Delta estuary, proposes to add over 70,000 acres of habitat in the Delta to improve conditions for threatened and endangered aquatic and terrestrial species. This habitat could also be a suitable mosquito breeding habitat, which will be located in close proximity to urban and suburban communities. Wetland management practices and continued pesticide applications in the Delta could mitigate the effects of a new mosquito breeding habitat. Recent legal developments, however, require districts to obtain and comply with Clean Water Act permits, which restrict the application of pesticides in or near waters of the United States. Moreover, the U.S. Environmental Protection Agency has taken the first step in a rulemaking process that could further limit or prohibit the use of certain vector control pesticides in the Delta. In the near term and until less harmful methods for mosquito control are available, local vector control districts' application of mosquito control pesticides should be exempt from Clean Water Act permit requirements.

1. Introduction

California local governments' anti-mosquito campaign began in earnest between 1918 and 1919 in response to endemic malaria in rural and agrarian communities. By 1919 and based on results of blood smear testing, more than half of the population of some communities in California's Anderson Valley tested positive for malaria [1]. Growing public health concerns caused the State to fund the first mosquito abatement district–the Anderson

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Mosquito Abatement District [1]. Following the first mosquito season after the formation of the Anderson Mosquito Abatement District, blood sampling of residents revealed only 16% of the population tested positive for malaria, and only approximately 5% of the samples indicated malaria plasmodium in its active phase [1, p. 106]. Anderson Mosquito Abatement District succeeded by combining agricultural drainage improvements with diligent chemical application in mosquito breeding and rearing habitats [1, pp. 10, 104–106]. While malaria no longer is endemic in California, local vector control districts continue to rely on drainage and water body improvements and pesticide applications, in addition to a statewide education campaign, to prevent or contain outbreaks of the West Nile virus, St. Louis Encephalitis virus, and other mosquito-borne illnesses and diseases. One environmental policy proposal and a recent federal court decision, however, jeopardize vector control districts' continued successes at maintaining public health and preventing mosquito-borne disease outbreaks in California. In order to avoid Anderson Valley's history repeating itself in communities throughout California, local vector control districts need near-term legal and regulatory assurances that will protect their abilities to apply pesticides to mosquito breeding and rearing habitats wherever they may be found.

2. Background discussion

California's Sacramento-San Joaquin Delta is located south of Sacramento, west of Stockton and east of the San Francisco Bay. The Delta is the confluence of the Sacramento, San Joaquin, American, Calaveras and Mokelumne Rivers, which combine and flow west to meet the incoming saltwater of San Francisco Bay. The Delta is one of the largest estuaries in the United States, an important stop on the North American flyway, which is traveled by migratory birds, and home to several aquatic and terrestrial species that are classified as threatened or endangered under the Federal and California Endangered Species Acts. These species include Delta Smelt, which lives within the Delta for all of its life cycle, and anadromous Salmonidae fish, which migrate through the Delta. West of Sacramento, between the Delta to the south and a northerly curve of the Sacramento River to the North, is the Yolo Bypass, which was constructed for flood control purposes. When the Sacramento River is experiencing high-flow conditions, floodwaters are diverted into the bypass, which allows the floodwaters to reach the Delta quicker and with fewer risks to the population in the greater Sacramento area. When the bypass is not flooded, it is managed for agricultural and habitat purposes.

Several threatened and endangered fish species within the Delta have experienced some years of high mortality rates. The Delta has been described as being in a state of ecological collapse, which, scientists explain, has been caused by several factors, including a reduction in the amount of suitable habitat for threatened and endangered fish species, predators, and stressors like chemicals and agricultural runoff. The Bay Delta Conservation Plan (''BDCP''), a State, Federal and local stakeholder effort to improve the habitat in the Delta for threatened and endangered fish species, proposes improving the Delta ecosystem by managing water flows into the Yolo Bypass and creating up to 60,000 acres of new tidal habitat and over 10,000 acres of inundated floodplain habitat to promote anadromous Salmonidae fish migration and juvenile rearing, and to support several threatened and endangered terrestrial species [2]. This new habitat may very well benefit threatened and endangered species, but those tens of thousands of acres of wetland, tidal and inundated floodplain habitats will also welcome mosquito breeding and rearing in a vast area that lies within close proximity to nearby urban and suburban communities.

The new and restored Delta and Yolo Bypass wetland, tidal and floodplain habitats could be designed and managed to control mosquito breeding and rearing. The Central Valley Joint Venture's Mosquito Working Group, which includes representatives of state and federal wildlife agencies, wildlife-oriented non-governmental organizations, the Mosquito and Vector Control Association of California, and U.C. Davis, among others, developed a Technical Guide to Best Management Practices for Mosquito Control in Wetlands (the ''BMPs'') [3]. The BMPs include wetland management techniques to effectively control mosquitoes and mosquito breeding within the Delta ecosystem and the restored and newly-created habitats under the BDCP. Local Delta restoration efforts like the BDCP, however, have not embraced BMPs as essential criteria on which restored and newly created wetlands should be designed and managed. Indeed, BDCP's and other wetland managers' abilities to implement the BMPs could be constrained by the cost of implementation and the funding for personnel that would be needed to effectively implement the BMPs.

The BMPs, even if fully implemented, would need to be supplemented with pesticide applications in order to effectively control mosquitoes and mitigate the consequences of expanded mosquito breeding and rearing habitats within the Delta and Yolo

Bypass. Local vector control districts could continue to apply pesticides to aquatic and terrestrial habitats that could kill mosquitoes in the larval or adult stages of development. Such mosquito abatement efforts, however, are constrained by a recent decision of the federal United States Court of Appeals for the Sixth Circuit in *National Cotton Council v. United States Environmental Protection Agency*, 553 F.3d 927 (6th Cir. 2009).

Before the Sixth Circuit issued its decision in *National Cotton Council*, vector control districts could apply EPA-approved pesticides to land and waterways as long as they followed the EPA-approved instructions on the pesticides' labels.[1] The *National Cotton Council* decision now will require vector control districts to obtain a permit under the federal Clean Water Act[2] before the districts can spray EPA-approved mosquito pesticides to federal waters, uplands that drain into those waters and wetlands adjacent to those waters-areas like the Delta, the Yolo Bypass, and the 70,000 acres of new habitat that have been proposed under the BDCP. Such a permit under the Clean Water Act will require local vector control districts to: constrain the timing, type and concentrations of all pesticide applications; monitor pesticide levels in habitats within which the pesticides are applied; and report on chemical levels, pesticide applications and any applications and consequences of application that are inconsistent with the permit's terms. The permits will constrain vector control districts' abilities to tactfully and flexibly apply pesticides to control mosquitoes; and the permit, not public health needs, will drive the timing and extent of pesticide applications. Moreover, the costs of complying with monitoring and reporting requirements for Clean Water Act permits will substantially burden already budget-strained vector control districts. For example, the North Carolina Mosquito and Vector Control Association estimates that, for fiscal year 2011, such monitoring and reporting costs for all of the state's 75 mosquito abatement districts will be between US$ 4 million and US$ 5 million, or roughly between $55,000 and $66,000 per district [4].

In addition to existing restrictions on local vector control districts, the EPA recently published a notice in the Federal Register that it is seeking to obtain public input regarding Delta water quality that may be affecting threatened and endangered species in the Delta [5]. Among other things, the EPA is interested in the effect of pyrethroids:, which are synthetic chemical compounds that are used for vector control in urban and suburban areas [5, p. 42]. Vector control districts primarily use pyrethrins, which are organic chemicals that are contained in the seed casings of the chrysanthemum, for mosquito control. EPA's Federal Register notice, however, is written broadly to request public comments on pesticides of concern, and the EPA therefore may receive comments on and could consider regulating pyrethrins. While the notice does not have any current regulatory impact on local vector control districts, it is the first step in a regulatory process that could result in limitations on pesticides that local vector control districts use in order to control mosquitoes and maintain public health.

The creation of tens of thousands of acres of new mosquito breeding and rearing habitats within striking distance of Sacramento, Stockton and San Francisco Bay-area communities, coupled with the current and potential future legal limitations on local vector control districts, threatens those districts' abilities to continue to succeed in their almost century-long vector control efforts. Consequently, California could enter an era of greater outbreaks of West Nile virus and other mosquito-borne illnesses. These additional constraints on vector control could adversely impact public health and make it more difficult to institute prudent policy decisions to empower local vector control districts to continue their efforts to control mosquitoes and protect public health.

3. Moving forward: promises for the future and assurances for today

Long-term mosquito control may rely on pesticide applications, the implementation of alternative mosquito control techniques, and the application of less ecologically harmful compounds. Building on evidence that certain naturally produced odorants can directly influence CO_2-mediated avoidance behavior of *Drosophila* (fruit flies) [6], investigators are currently studying whether similar natural compounds could effectively inhibit the odorant receptors in the West Nile virus-transmitting *Culex* mosquitoes, which would disrupt

[1] The EPA approves pesticides and pesticide labeling pursuant to its authority under the Federal Insecticide, Fungicide & Rodenticide Act (''FIFRA''), Title 7 of the Unites States Code, sections 136—136y.

[2] The federal Clean Water Act, Title 33 of the United States Code, sections 1251—1387, prohibits the discharge of a pollutant from a point source into waters of the United States, unless the discharger first obtains a National Pollutant Discharge Elimination System (NPDES) permit from the EPA. In its decision in *National Cotton Council*, the Sixth Circuit concluded that the spraying of FIFRA-approved pesticides over waters of the United States without first obtaining a NPDES permit violates the Clean Water Act.

those mosquitoes' host-seeking behaviors [7]. Researchers at the Dayalbagh Education Institute in Agra, India, have concluded that the fungus *Chrysosporium tropicum* could be an effective method for controlling mosquitoes in their adult life stage [8]. Other researchers at the Defence Research Laboratory, in Tezpur, Assam, India, Annamalai University, Annamalainagar and A.V.C. College, Mannampandal in Tamil Nadu, India, are studying whether natural plant extracts could be used to control mosquitoes in the larval life stage [9,10]. This sample is representative of and not an exhaustive list of global efforts to find natural and ecologically safe compounds that could effectively control mosquitoes. Such natural compounds would be less harmful to the environment and less likely to constitute a pollutant that would be subject to permitting under the Clean Water Act.

Development of new technologies and improved mosquito-fighting strategies that are safer for the environment will require funding for research and development and a long-term commitment to pursuing such technologies and strategies. In the near term and until effective, less harmful and cost-efficient, alternative technologies and strategies are developed, however, local vector control districts that are on the front lines of the mosquito wars need legal and regulatory assurances that will allow them to flexibly and strategically apply pesticides to mosquito habitats in order to prevent outbreaks of West Nile virus and other vector-borne illnesses in California. Before the Sixth Circuit's decision in the *National Cotton Council* case, the EPA had been effectively regulating the availability, use and application of vector control pesticides under the Federal Insecticide, Fungicide & Rodenticide Act (FIFRA). Under FIFRA, the EPA regulates the distribution, sale and use of pesticides, including vector control pesticides, by reviewing pesticides and pesticide labeling instructions to determine if pesticides, if applied according to their labeling instructions, will cause unreasonable adverse effects on the environment. Further, in California, the State Department of Pesticide Regulation, the State Department of Public Health and county agricultural commissioners all participate in the regulation, approval and application of pesticides for vector control purposes. The Sixth Circuit's decision in *National Cotton Council* will require local vector control districts to comply with an unnecessary additional layer of legal and regulatory protocols, and such protocols could restrict those districts' abilities to preserve public health and control mosquitoes.

In order to empower local mosquito control districts to flexibly and effectively apply pesticides for vector control and other public health purposes, local vector control districts should be exempt from a Clean Water Act permit requirement. Without such an exemption, local vector control districts will be constrained to the terms of their Clean Water Act permits, which will limit those districts' abilities to control mosquitoes flexibly and effectively. The proposed creation and restoration of over 70,000 acres of tidal, wetland and inundated floodplain habitats in the Delta and Yolo Bypass–areas that are subject to the Clean Water Act–will intensify the mosquito-control challenges of local mosquito control districts with jurisdictions that overlie the Delta and Yolo Bypass. Those districts support constructing wetlands and implementing wetland management practices that benefit threatened and endangered species, so long as those efforts don't adversely affect mosquito control. Policymakers and lawmakers, in turn, should provide those districts with legal and regulatory assurances that enable them to flexibly and effectively apply FIFRA-approved pesticides to all mosquito habitats, including habitats that are subject to the Clean Water Act, in order to control mosquitoes and protect public health.

4. Conclusion

Until an effective, less harmful and cost-efficient mosquito control technology or technique is developed, continued effective mosquito control (and hence improved public health) in California will rely on local vector control districts' pesticide applications and statewide education efforts. Policy makers and lawmakers have a choice: provide near-term legal and regulatory assurances that empower local vector control districts to diligently continue their fight against the bite; or maintain the status quo, which will severely limit vector control districts' abilities to flexibly and effectively eradicate mosquitoes and maintain public health in California. On 2011, the U.S. House of Representatives passed House Resolution 872, which, if approved by the senate and signed by the President, would create such a Clean Water Act permitting exemption [11]; even if H.R. 872 does not become law, Congress should be encouraged to propose other bills like H.R. 872 that would provide the assurances that local vector control districts need in order to effectively protect public health in California.

Conflict of interest

Richard P. Shanahan is an attorney and partner of, and Stephen M. Siptroth is former associate attorney at, Bartkiewicz, Kronick ; Shanahan, P.C., which is a law firm Sacramento California that rep-

resents several local mosquito and vector control districts and the Mosquito and Vector Control Association of California. There are no other known conflicts of interest or other interests that may have affected the views of the authors.

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