

Pyrethroid Pesticides in the Sacramento-San Joaquin Delta: Sources and impacts on Delta waters

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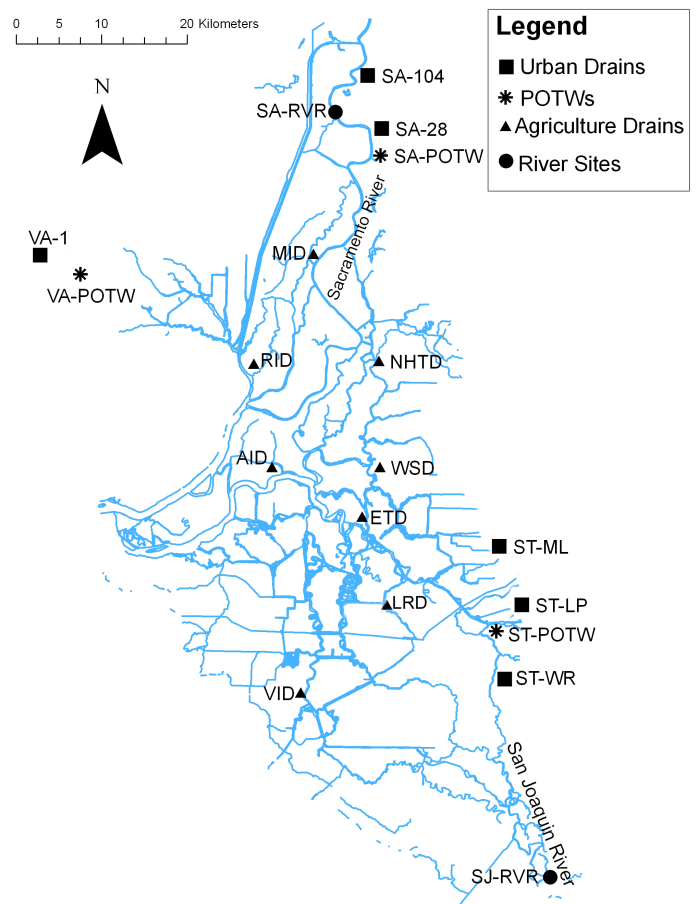
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OBJECTIVE: To better understand sources of pyrethroid insecticides to the Delta, and to examine their effects on the water bodies in to which they are released.

STUDY APPROACH

- Pyrethroid insecticides are widely used in agricultural and urban settings. California agriculture uses 355,000 lb/yr, and non-agricultural uses comprise another 567,000 lb/yr. Retail sales are not included but would be added to the non-agricultural use.
- To better understand sources of pyrethroids to the Delta, we sampled 8 agricultural pump stations, 6 urban runoff pump stations or storm drains, 3 municipal wastewater treatment plants, and the Sacramento and San Joaquin Rivers as they enter the Delta.
- Potential sources were sampled on 3-5 occasions in the dry season of 2008, and 3 occasions in the wet seasons of 2008 or 2009.
- Transects were sampled along Ulatis Creek, Alamo Creek, American River, San Joaquin River, and Sacramento River as they passed through urban areas, after 2-4 rain events.
- Samples were analyzed for pyrethroids and water toxicity testing was done with a native crustacean, *Hyalella azteca*. For several of the pyrethroids, a concentration of only 2 parts pyrethroid in a trillion parts water (2 ng/L) is sufficient to cause paralysis in *Hyalella*.



RESULTS: URBAN RUNOFF

- Virtually all urban runoff contained pyrethroids, typically at about 4 times the concentration that would paralyze *Hyalella*.
- Not surprisingly given these pyrethroid concentrations, nearly all urban runoff samples caused toxicity when *Hyalella* was exposed to the water.
- A Toxicity Identification Evaluation (TIE) was done on 7 runoff samples to help determine the cause of toxicity. Results were consistent with pyrethroids as the cause of toxicity in every case.
- Bifenthrin and cyfluthrin are the pyrethroids of greatest toxicological concern in urban runoff. Both are used by professional pest control firms and are also available in retail stores.
- Urban runoff quality was comparable in all communities studied (Sacramento, Stockton, Vacaville), suggesting the conclusions can be extrapolated to urban runoff in general.

RESULTS: MUNICIPAL WASTEWATER

- Pyrethroids were present in about 2/3 of the final effluent samples from wastewater treatment plants.
- They were found most often, and in highest concentration, at the Sacramento treatment plant, followed by Vacaville, and then Stockton.
- The typical wastewater treatment plant effluent contains pyrethroids at about 0.5-1.5 times the concentrations that cause *Hyalella* paralysis.
- Toxicity was seen in every sample from the Sacramento facility and never seen at Stockton. TIE results were not always definitive, but in general, indicate pyrethroids were a significant cause of toxicity.
- The Sacramento plant was the largest single discharger of pyrethroids among all Delta discharges studied, usually releasing at least 10 g/day. A storm water pumping station releases about 3 g/d.

RESULTS: AGRICULTURE

- Agricultural discharges occasionally contained detectable pyrethroids (about 30% of samples).
- Toxicity to *Hyalella* was seen in about 10% of the agricultural samples, and in every case, could be linked to the pyrethroid lambda-cyhalothrin or the organophosphate insecticide, chlorpyrifos.
- Input of pyrethroids from the agricultural pump stations is difficult to quantify, but is probably well under that of an urban pump station in most cases.

RESULTS: RECEIVING WATERS

- Ulatis Creek and Alamo Creek were sampled following two storms. Before entering Vacaville, there were no detectable pyrethroids in either creek and only one sample (of 6) had slight toxicity. As the creeks left the city, they contained 4-10 times the concentration of pyrethroids that cause paralysis in *Hyalella*, and all samples caused high toxicity.
- The American River was sampled from Folsom Lake to the Sacramento River confluence after several storms. Toxicity to *Hyalella* was found repeatedly, extending over 20 miles of the river on one occasion and intermittently over 30 miles on another. The pyrethroid bifenthrin appeared responsible.
- Toxicity in the American River was compounded by the low flows maintained in the river by low releases from Folsom Dam during February and March (800 cfs). Thus, there was less water in the river to dilute the bifenthrin-containing runoff. There was no toxicity following a May rain when flows were over 4000 cfs.
- In the San Joaquin River, one sample on the downstream edge of Stockton was toxic to *Hyalella*, probably due to bifenthrin. We have no data to determine how far down the river the effect extended.
- Pyrethroids (most often bifenthrin) were found in the Sacramento River as it passed through the city of Sacramento. Concentrations peaked near the threshold of causing toxicity. No toxicity was seen, probably because the times of elevated bifenthrin concentrations occurred concurrently with high suspended sediments that reduced its availability to organisms.
- Release of pyrethroid insecticides from urban centers is sufficient to adversely affect water quality over considerable lengths of small to moderate size water bodies (up to the American River in size). In the larger water bodies (Sacramento and San Joaquin Rivers), localized impacts are possible after a typical storm event.