INITIAL TRENDS IN CHEMICAL CONTAMINATION, TOXICITY AND LAND USE IN CALIFORNIA WATERSHEDS:

Stream Pollution Trends (SPoT) Monitoring Program Second Report Field Years 2009-2010

Overview

The State Water Resources Control Board's Surface Water Ambient Monitoring Program (SWAMP) has released the second report on results from a continuing statewide program that measures trends in pollution levels and toxicity in major California watersheds. The program is called the Stream Pollution Trends monitoring program (SPoT), and it is one of three statewide projects funded by SWAMP. The report, Initial Trends in Chemical Contamination, Toxicity and Land Use in California Watersheds, summarizes results from the 2009–2010 annual SPoT surveys and represents an assessment of large watersheds across California to determine how stream pollutant concentrations are affected by land use, with an emphasis on urban and agricultural development. These data were compared to the 2008 SPoT sampling year, allowing a preliminary assessment of emerging trends. SPoT is improving our understanding of the long-term trends of watershed contamination and associated toxicity. This program investigates the impacts of land development on water quality, helps prioritize water bodies in need of water quality management, and evaluates the effectiveness of management programs designed to improve stream health. SPoT forms the foundation for other regional programs and provides a statewide perspective so that local and regional water quality monitoring efforts can evaluate how conditions in their streams compare to those in other California watersheds.

About the Survey

To most efficiently detect pollutant trends in California streams, the SPoT program measures contaminant concentrations and toxicity in sediments that accumulate in the lower reaches of large watersheds. In 2008, samples were collected from 92 of the nearly 200 major hydrologic units in California. Sediment samples are collected once per year when streams return to base flow conditions after the high flows that carry pollutants washed from watershed surfaces during storms. Sediments are monitored because the majority of contaminants entering streams accumulate in sediments, and this environmental compartment integrates pollution signals over time. Each sample is analyzed for industrial compounds, pesticides, and metals, and is tested for toxicity to a resident aquatic crustacean, the amphipod *Hyalella azteca*. Results are compared across watersheds throughout the state, and pollutant concentrations are compared to land use and other human activities.

Pajaro River in central California. Photo courtesy of California Coastal Records Project. Used by permission. Copyright ©2002-2010 Kenneth & Gabrielle Adelman, California Coastal Records Project, www.californiacoastline.org

Findings

Statewide Conditions Statewide toxicity trends were evaluated from 2008 – 2011. The incidence of toxicity remained relatively stable over those four years with significant toxicity being observed in approximately 22% of sediment samples. Approximately 7% of the samples were identified as highly toxic. Highly toxic samples were collected from agricultural watersheds in the Central Valley's Tulare Basin, the central coast, in urban areas of Southern California, and in the Tijuana River. Of the general classes of organic chemicals measured, pyrethroid pesticides demonstrated an increasing trend in detections and concentrations in sediments. Both the average and range of total pyrethroid concentrations increased in 2010 (Figure 1).

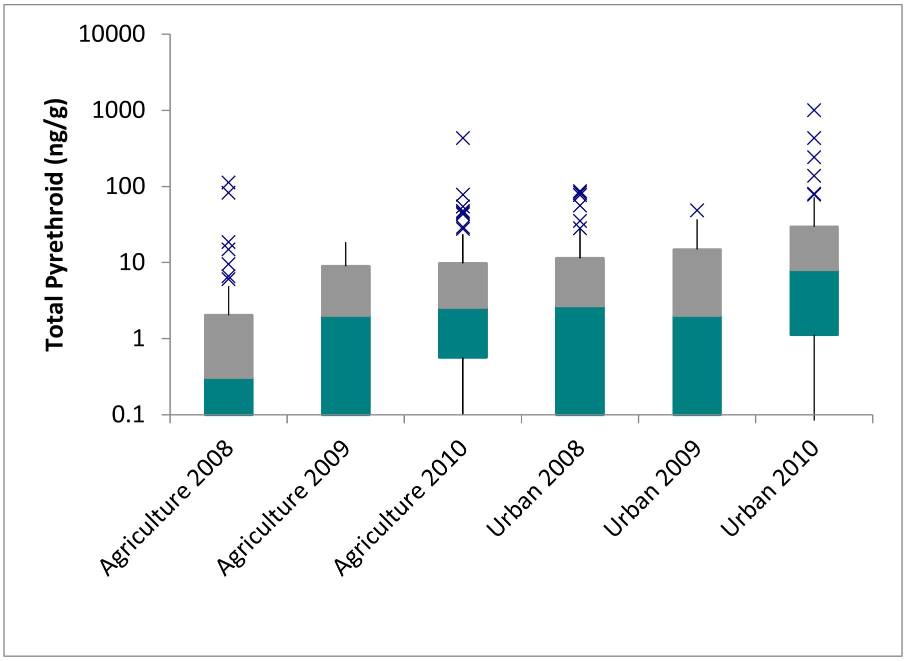

Figure 1. Total pyrethroid pesticide concentrations measured in sediments in relation to watershed land use in SPoT watersheds. *Concentrations of pyrethroids increased between 2008 and 2010.*

Bifenthrin was the most commonly detected pyrethroid in the 2008 and 2010 SPoT samples. One possible explanation is that of all the pyrethroids, bifenthrin is the most stable in aquatic environments. Bifenthrin use is also increasing. The chlorinated compounds DDT and PCBs saw a general decline over the three years, whereas detections and concentrations of PAHs, PBDEs and selected metals remained relatively constant. Detections and concentrations of organophosphate pesticides in sediment also decreased between 2008 and 2010.

Relationship between Water Quality Indicators and Land Use

The higher the percentage of urban land cover, the greater the in-stream contamination and sediment toxicity (amphipod mortality). There was a significant correlation between sediment toxicity and urban land cover in 2008 and with urban and agricultural land cover in 2010. Sediment toxicity was correlated with a number of organic chemical classes in 2008 and 2010. The strongest correlations were between toxicity and pyrethroid pesticides (Figure 2). Pesticide toxicity thresholds were exceeded in 13% of the samples collected in 2008, 9% in 2009, and 20% in 2010. Most of the elevated concentrations were for the pyrethroid pesticide bifenthrin, and nearly half of the samples with an exceeded threshold for pesticides were considered highly toxic. Because pyrethroids are more toxic at colder temperatures, the relationship between pyrethroids and sediment toxicity was further investigated by assessing sediment toxicity at the standard test temperature, 23 °C, and at 15 °C. The colder temperature represents the average ambient temperature in California watersheds. Sixty-seven percent of the samples tested at 15 °C were highly toxic, whereas only 7% of the samples tested at 23 °C were highly toxic.

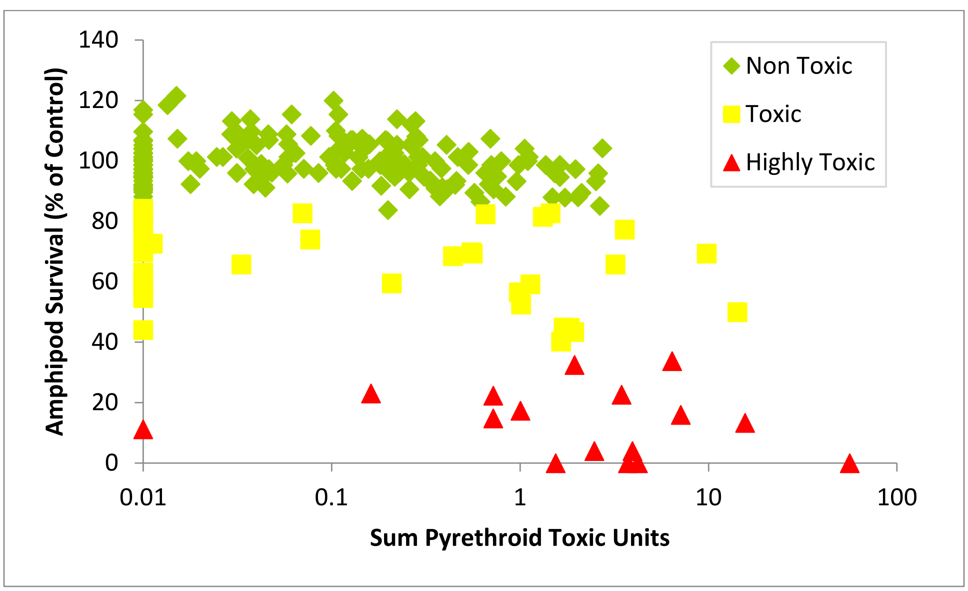

Figure 2. Relationship between total pyrethroid pesticide concentrations (as Toxic Units) and amphipod survival in SPoT sediment samples tested between 2008-2010. *Amphipod survival decreases as pyrethroids increase in sediments.*

Next Steps

SPoT will begin its sixth year of watershed monitoring in April 2013. Given the evidence that pesticides are associated with ambient toxicity in California waters, certain emerging pesticides will be prioritized as SPoT monitoring proceeds. Because of increasing use and the potential for surface water toxicity due to fipronil, this pesticide has been included for statewide monitoring starting in 2013. Legacy pesticides, PCBs and organophosphates will be monitored less often.

Urban stream near the southern California coast.

Beginning in 2013, SPoT will be collaborating with the California Department of Pesticide Regulation to evaluate the effectiveness of new label restrictions for the use of pyrethroid pesticides in urban applications. Four “intensive” monitoring sites will be jointly sampled by SPoT and CDPR to determine whether new regulations result in reduced pyrethroid concentrations in the associated watersheds.

Algal toxins have recently been found in polluted waterbodies throughout California and certain cyanotoxins have been associated with liver toxicity in marine mammals. In a new collaboration with California State University Monterey Bay, SPoT will measure microcystin-LR in stream sediment interstitial water beginning in 2013.

Sampling the Navarro River in Mendocino County.

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