# SPATIAL AND TEMPORAL TRENDS IN TOXICITY AND CHEMICAL CONTAMINATION RELATIVE TO LAND USE IN CALIFORNIA WATERSHEDS:

## Stream Pollution Trends (SPoT) Monitoring Program Fourth Report – Seven-Year Trends 2008-2014

### Overview

- The State Water Resources Control Board's Surface Water Ambient Monitoring Program (SWAMP) has released the fourth report on results from the Stream Pollution Trends monitoring program (SPoT).

- The report, Spatial and Temporal Trends in Toxicity and Chemical Contamination Relative to Land Use in California Watersheds, summarizes results from seven years of annual SPoT surveys which assess large watersheds across California to determine how stream pollutant concentrations are affected by land use, with an emphasis on urban and agricultural development.

- 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 data provide a statewide perspective on the impact of pollution on stream health and allows local and regional water quality managers to evaluate how conditions in their streams compare to those in other California watersheds.

### About the Survey

- The SPoT program measures contaminant concentrations and toxicity in sediments that accumulate in the lower reaches of large watersheds.

- 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, legacy and current-use pesticides, and metals, and is tested for toxicity to a resident aquatic crustacean, the amphipod *Hyalella azteca*.

- The focus of the current report is on trends in toxicity and chemical measurements as they relate to land use, and summarizes results as they relate to the project's assessment questions.

## Level I Questions:

- Are our aquatic ecosystems healthy?
- What stressors and processes affect our water quality?

## Level II Questions:

- Are beneficial uses impacted?
- Are conditions getting better or worse?
- What are the magnitude and extent of any problems?
- What's causing the problem?
- Are solutions working?

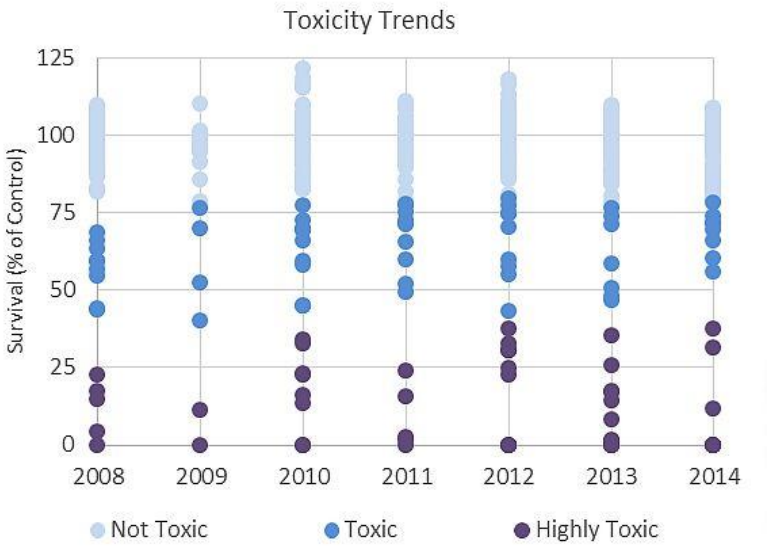
## Toxicity Results

*Are beneficial uses impacted?*

Yes. Significant toxicity is consistently observed indicating beneficial uses are not fully protected.

*Is Toxicity getting better or worse?*

Yes and No. The percentage of toxic samples has remained consistent, but there is an increasing number of sites with “high toxicity.”



## Contaminant Results

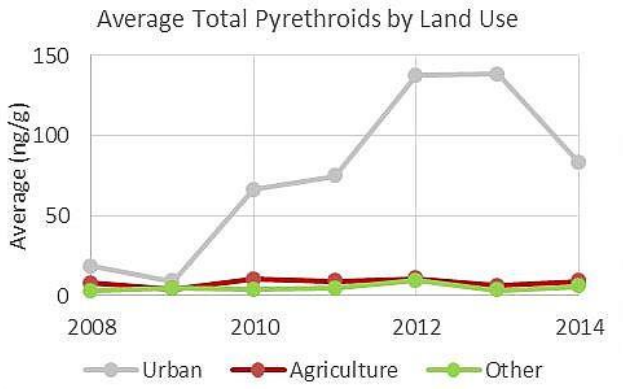
*Is contamination increasing or decreasing?*

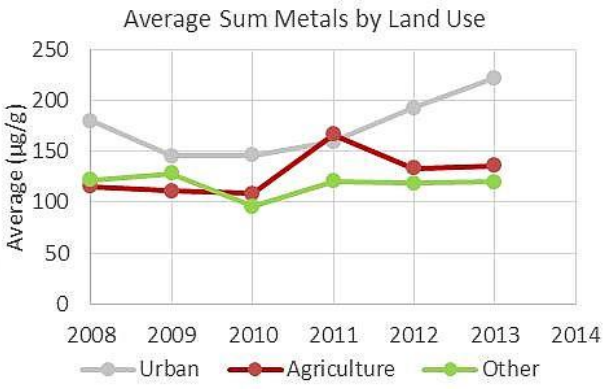
**Yes...** Average concentrations of pyrethroid pesticides, metals and PBDEs are significantly increasing, driven by increased concentrations and detections in urban watersheds. Fipronil is a pesticide of emerging concern whose use is increasing, as are the number of detections and average concentrations.

**…and No.** The organochlorine compounds (DDTs and PCBs) are significantly decreasing.

*What are the magnitude and extent of problems?*

Significant contaminant increases were observed in urban watersheds. Between 2010 and 2013, average concentrations of pyrethroids have doubled.



## Relationships Between Toxicity and Chemical Concentrations

*What are the magnitude and extent of any problems?*

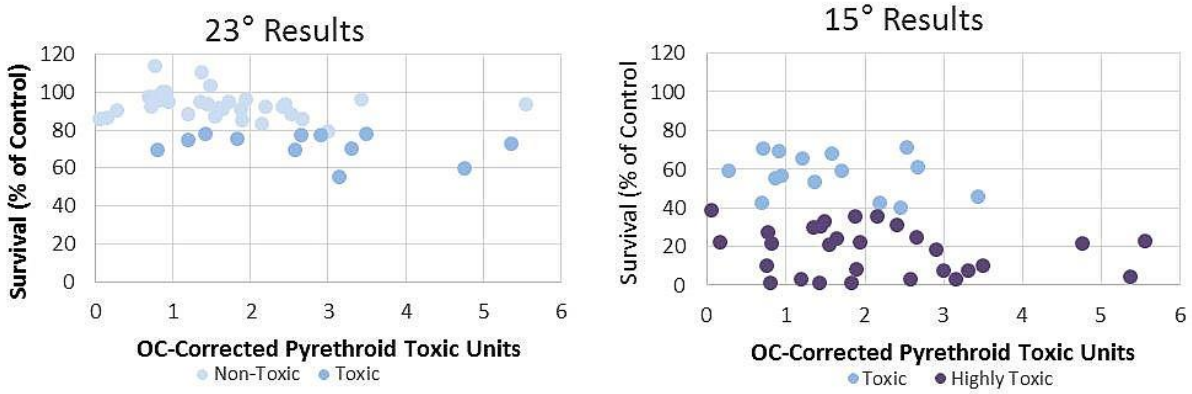
Chemical contamination and toxicity are most severe in urban watersheds.

*What's causing the problem?*

Urban watersheds have the highest contaminant concentrations, and toxicity has the strongest correlations with urban insecticides.

Toxicity thresholds for pesticides were exceeded in 19% of the samples. Most of the exceeded thresholds were for pyrethroid pesticides.

Pyrethroid toxicity increases with lower temperature. Significantly more samples were toxic, and the magnitude of toxicity was much greater when samples were tested at the more environmentally relevant test temperature of 15° C.




## Management Actions and Anticipated Future Trends

*Are solutions working?*

SPoT data are being used to monitor two statewide management actions, and a number of more local actions. More stringent rules for the urban application of pyrethroid pesticides were put in place in 2012, but have not yet resulted in reduced load to SPoT's urban watersheds. A significant reduction of copper in automobile brake pads was legislated in 2010, and is expected to result in a corresponding reduction of copper in SPoT sediments by the 2020s.

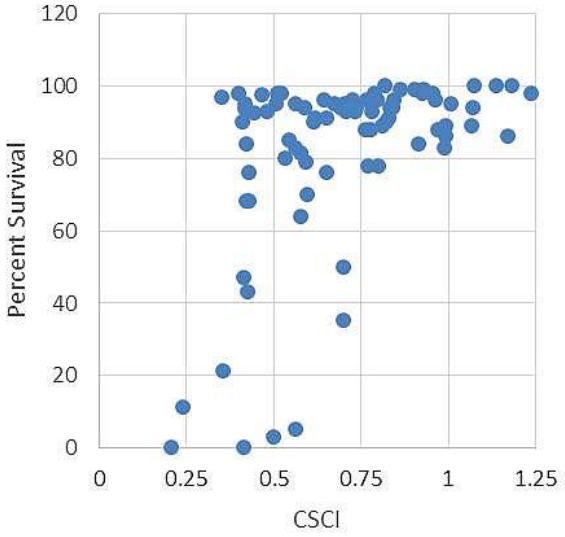
## SPoT Indicators in Relation to Stream Ecology

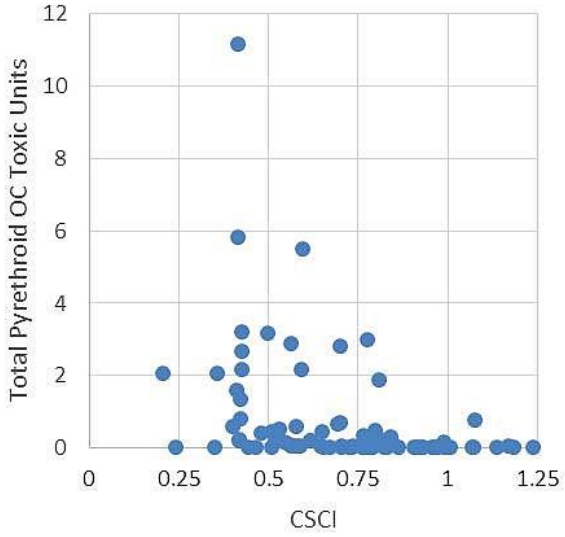
*Are our aquatic ecosystems healthy?*

Not all of our watersheds are healthy. When data from SPoT are combined with data from other programs, it is clear that anthropogenic stressors are affecting ecosystem health. Amphipod survival in laboratory toxicity tests is significantly correlated with healthy benthic macroinvertebrate communities. Declines in amphipod survival and low California Stream Condition Indices (CSCI) are correlated with elevated pyrethroid concentrations.

*What stressors and processes affect our water quality?*

Data from SPoT and other projects indicate that elevated concentrations of current-use pesticides such as pyrethroids are a significant environmental stressor affecting laboratory toxicity and correlating with low CSCI scores.



## New for the Reporting Cycle

- Current-use pesticides continue to be associated with ambient toxicity in California waters, and SPoT is prioritizing newer classes of emerging pesticides as monitoring proceeds.
- In 2015 SPoT added another indicator organism (Chironomus dilutus) to assess the effects of fipronil and its degradates at urban stations.
- A recent collaboration integrated Regional SWAMP monitoring for water column toxicity with the Department of Pesticide Regulation's (DPR) agricultural surface water monitoring. Significant toxicity was observed at sites that were minimally toxic to U.S. EPA 3-species tests (Anderson et al., in preparation). Chemical analysis by DPR detected a number of current-use and emerging pesticides, and toxicity testing results indicated these chemicals have the potential to impact the receiving systems. In addition to monitoring organophosphate and pyrethroids in water, this monitoring is specifically targeting water concentrations of the neonicotinoid insecticide imidacloprid. Because neonicotinoids are not expected to partition to sediments due to their high solubility, SPoT and DPR will collaborate on toxicity testing of water samples collected and analyzed by DPR from urban and agricultural watersheds throughout the state. Water column toxicity testing with C. dilutus and H. azteca coupled with DPR analysis of current-use pesticides in water is intended to provide up-to-date information on risk of emerging contaminants to California watersheds. These data can then be used to more proactively manage neonicotinoids and other pesticides before they impact receiving waters.
- Algal toxins have recently been found in polluted waterbodies throughout California and certain cyanotoxins have been associated with liver toxicity in marine mammals. SPoT has been collaborating with California State University Monterey Bay since 2013 to measure microcystin-LR in stream sediments. Preliminary data show up to 29% of samples had microcystin detections. Monitoring microcystins bound to stream sediments may be an indicator of harmful algal blooms upstream or in-stream toxin production. Future research includes analysis of spatial and temporal patterns in toxicity and evaluating whether in situ or upstream processes are responsible for sediment-bound microcystins.

## Next Steps

- SPoT will continue to focus on toxicity and contaminant trends and how they relate to land use, and there will be an added focus on current-use pesticides and chemicals of emerging concern.
- The collaboration between SPoT and DPR will assess toxic effects of more soluble emerging pesticides such as imidacloprid. This effort will be linked to the State Water Board's Strategy to Optimize Resource Management of Storm Water (STORMS), which is emphasizing reduction of storm water toxicity associated with pesticides.
- SPoT will also focus on the statewide trends and the effects of algal toxins.

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