Integrating monitoring to better understand patterns and trends in contamination and toxicity in California watersheds

Stream Pollution Trends Program (SPoT)

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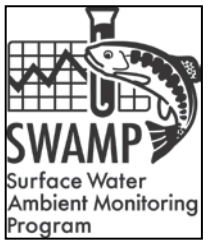


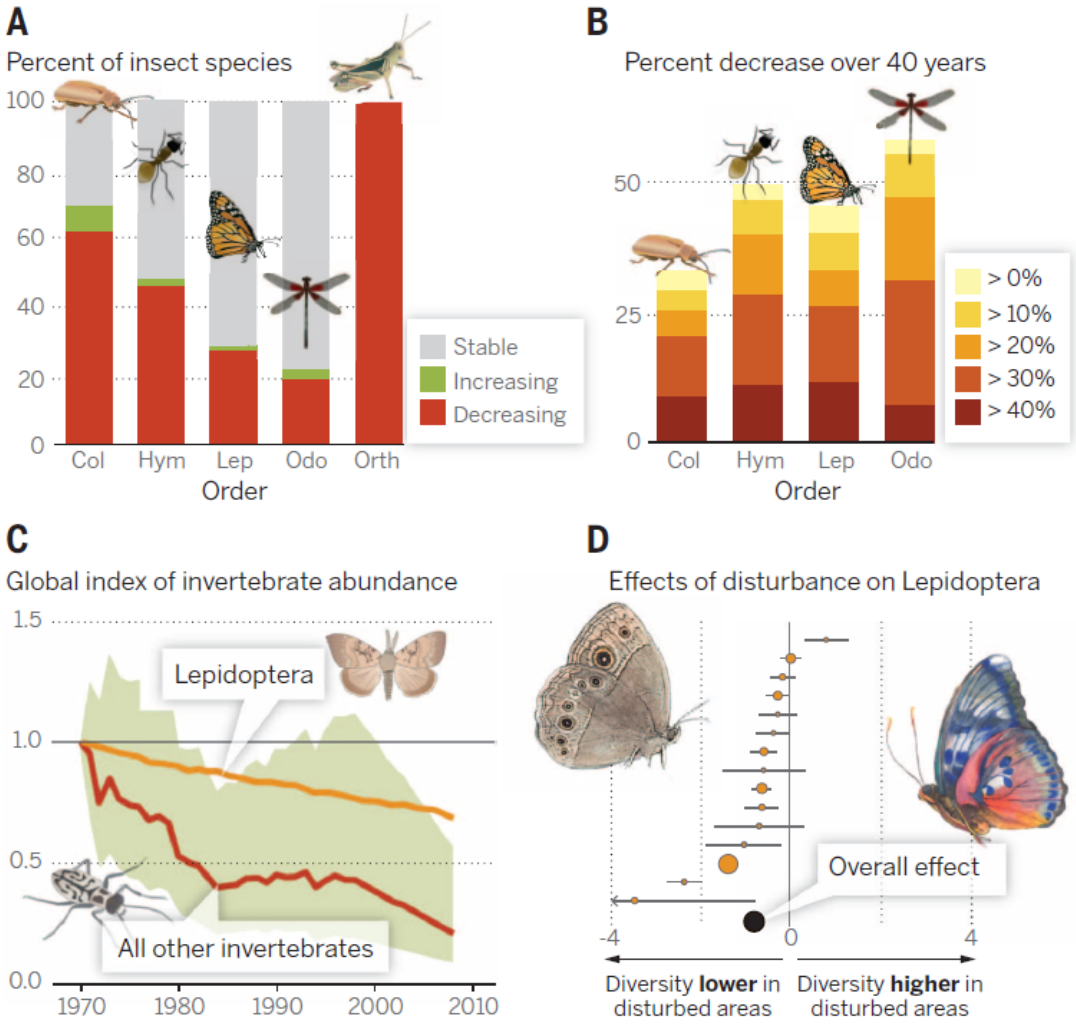
California Department of
Pesticide Regulation

Importance of Surface Water Toxicity Monitoring in California

- Surface water toxicity is pervasive in California.
- Between 2001 and 2010, 50% of sites had at least one toxic water or sediment sample.
- Evidence suggests toxicity to invertebrates is primarily caused by pesticides – chemistry + TIEs.
- A growing number of 303(d) listed water bodies have been listed due to toxicity caused by pesticides – listings often lag behind current use.
- Water and sediment toxicity are linked to macroinvertebrate community impacts.

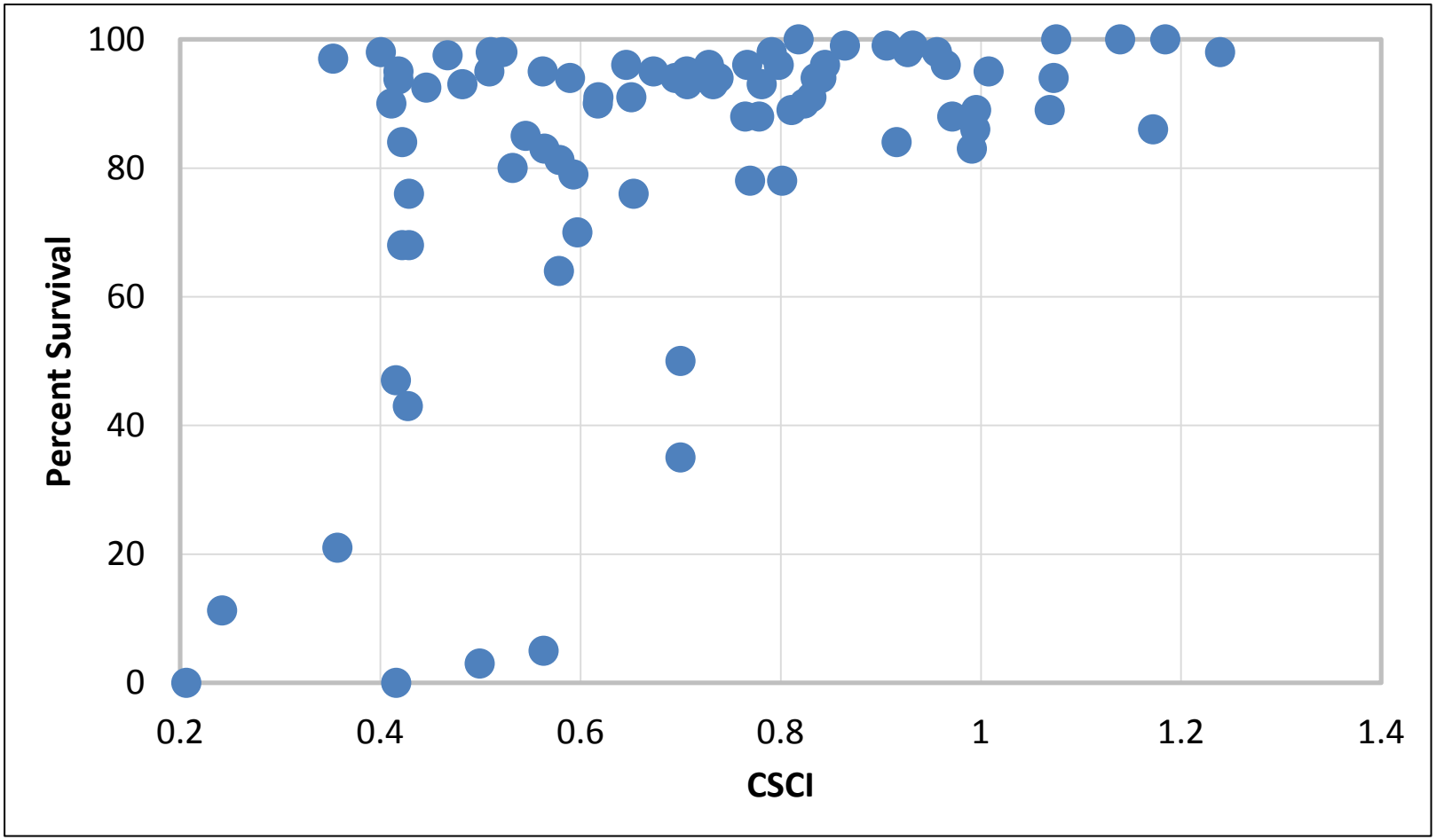
Worldwide Insect Declines:

from Dirzo et al. 2014 *Science*



Laboratory Toxicity Correlates with Instream BMI Impacts

- Linking laboratory toxicity results and field contamination with impacts to benthic macroinvertebrates will support causal assessments. Ultimately formulate hypotheses to test.

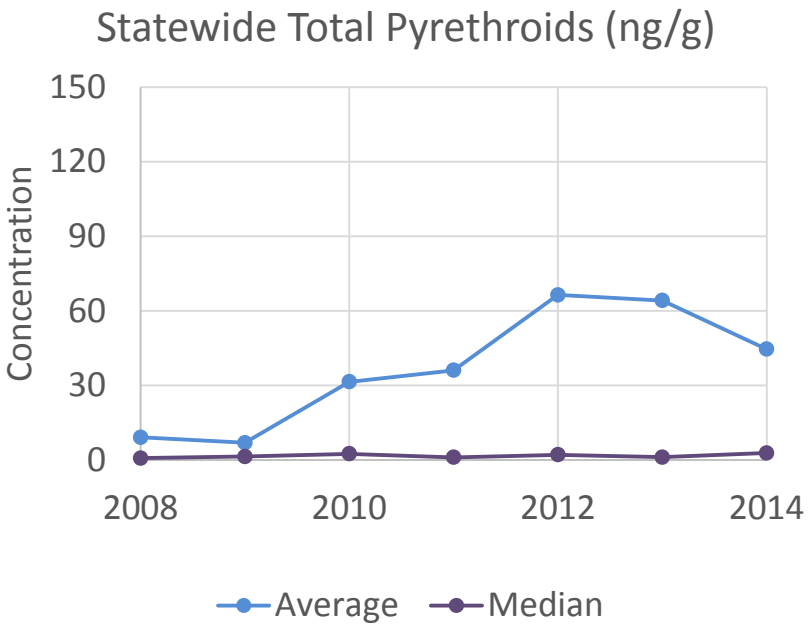


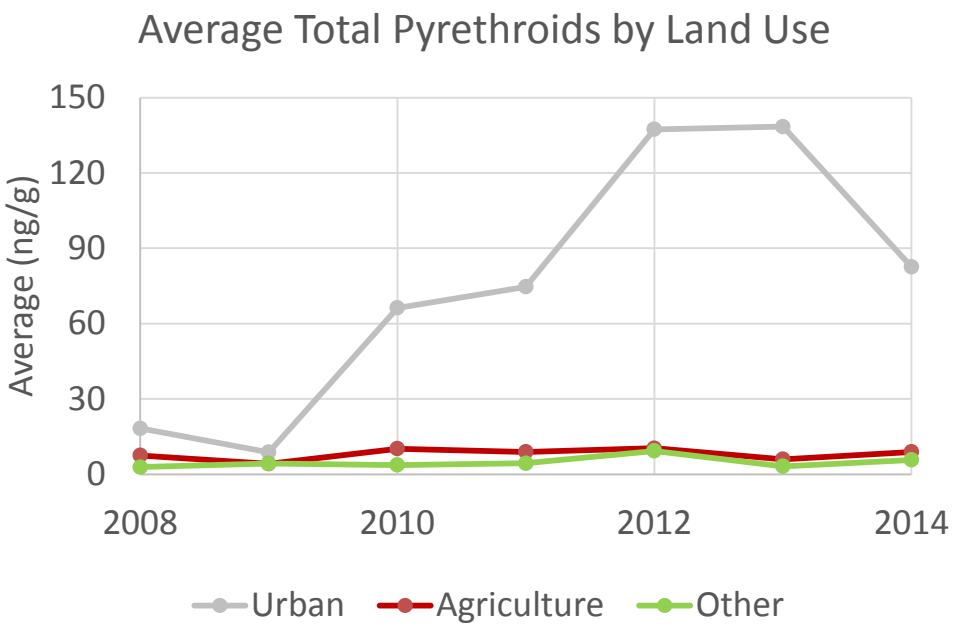
Current SPoT Design = Trend Analysis since 2008

Sites	50 Annually 50 Bi-Annually
Toxicity	*Hyalella azteca* (All Sites), *Chironomus dilutus* (Urban Sites)
Cold Toxicity	*Hyalella azteca* (subset)
Pyrethroids, OPs, OCs, PCBs, PAHs, PBDEs and Metals	All Sites
Fipronil (as of 2013)	Urban Sites
Microcystin (as of 2013)	All Sites

Are conditions getting better or worse?

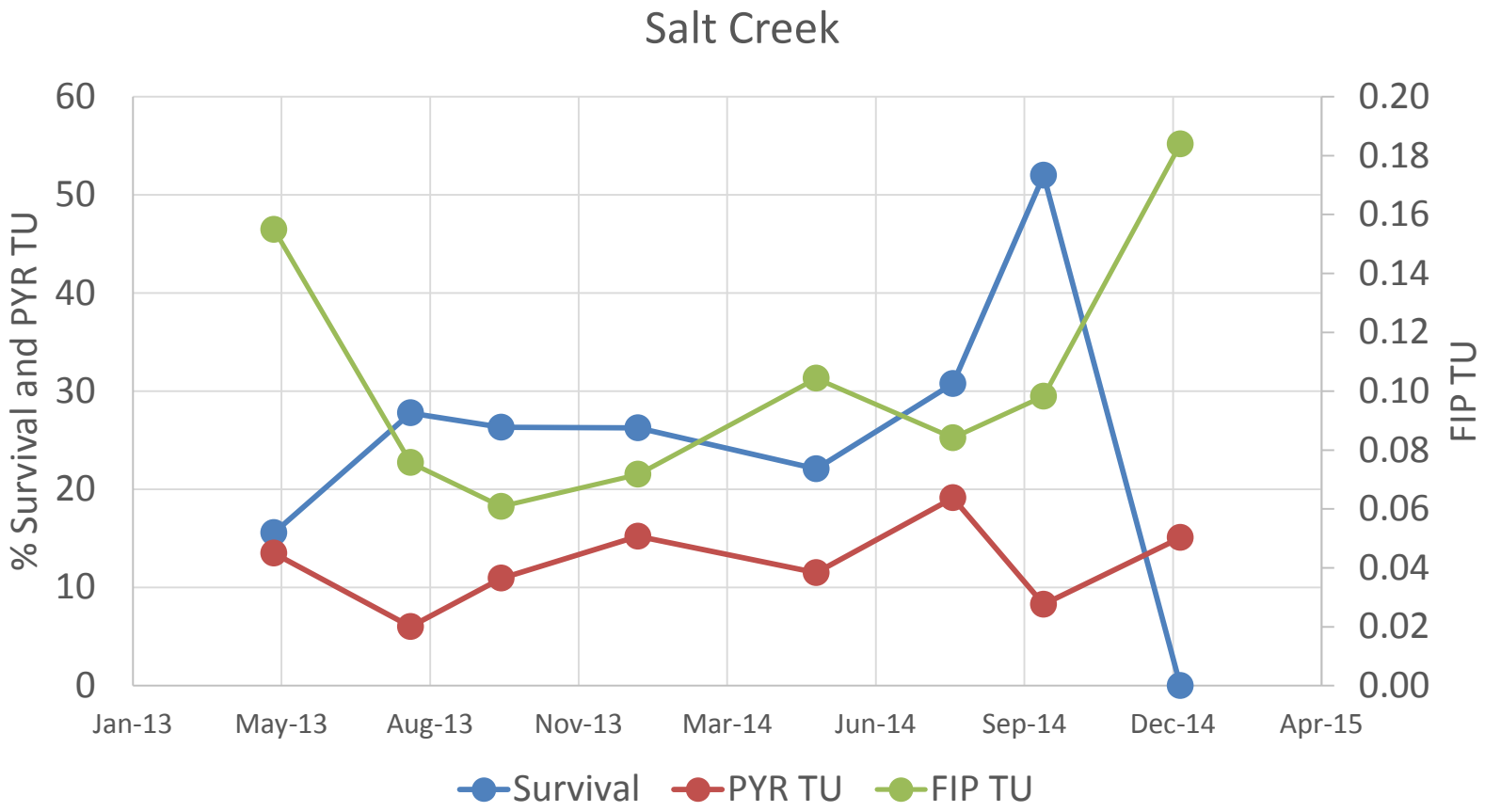
What is the magnitude and extent of any problems?





54%	52%	86%	80%	83%	77%	88%

Salt Creek (901INTSC5) – Integrated monitoring with DPR



- Pyrethroids – Consistent concentrations. Single and double-digit TUs.
- Fipronil – Consistent concentrations at about one-tenth TU – based on H. azteca LC50.

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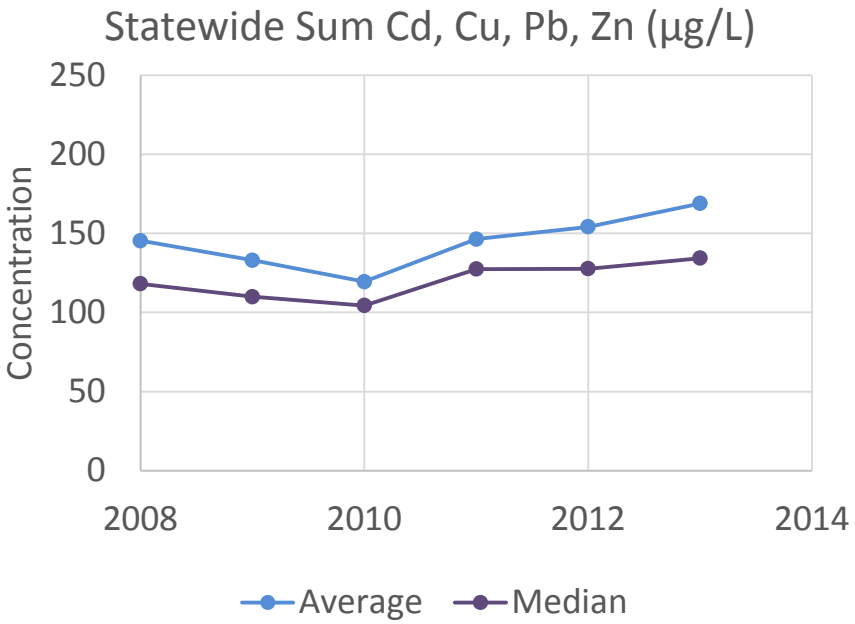
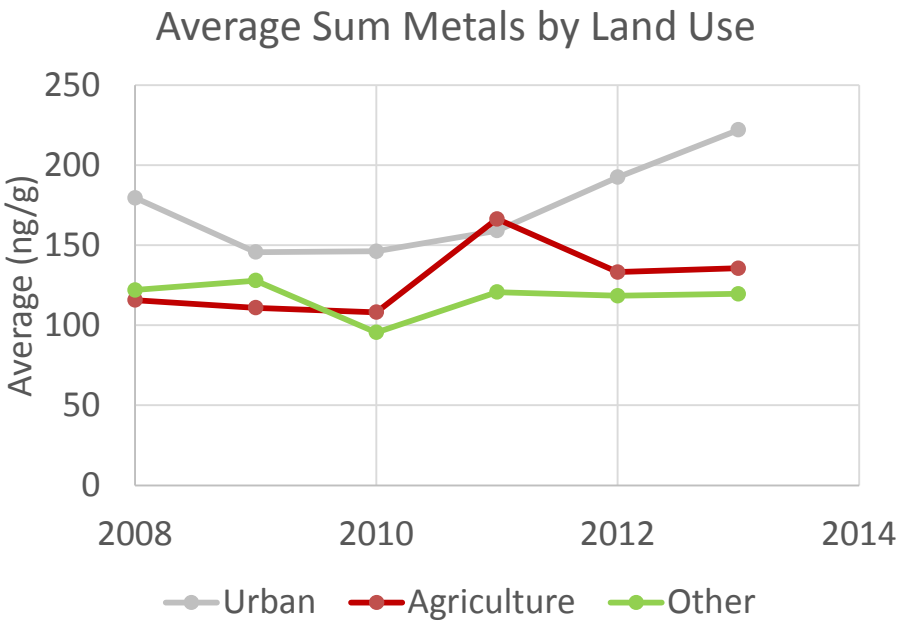
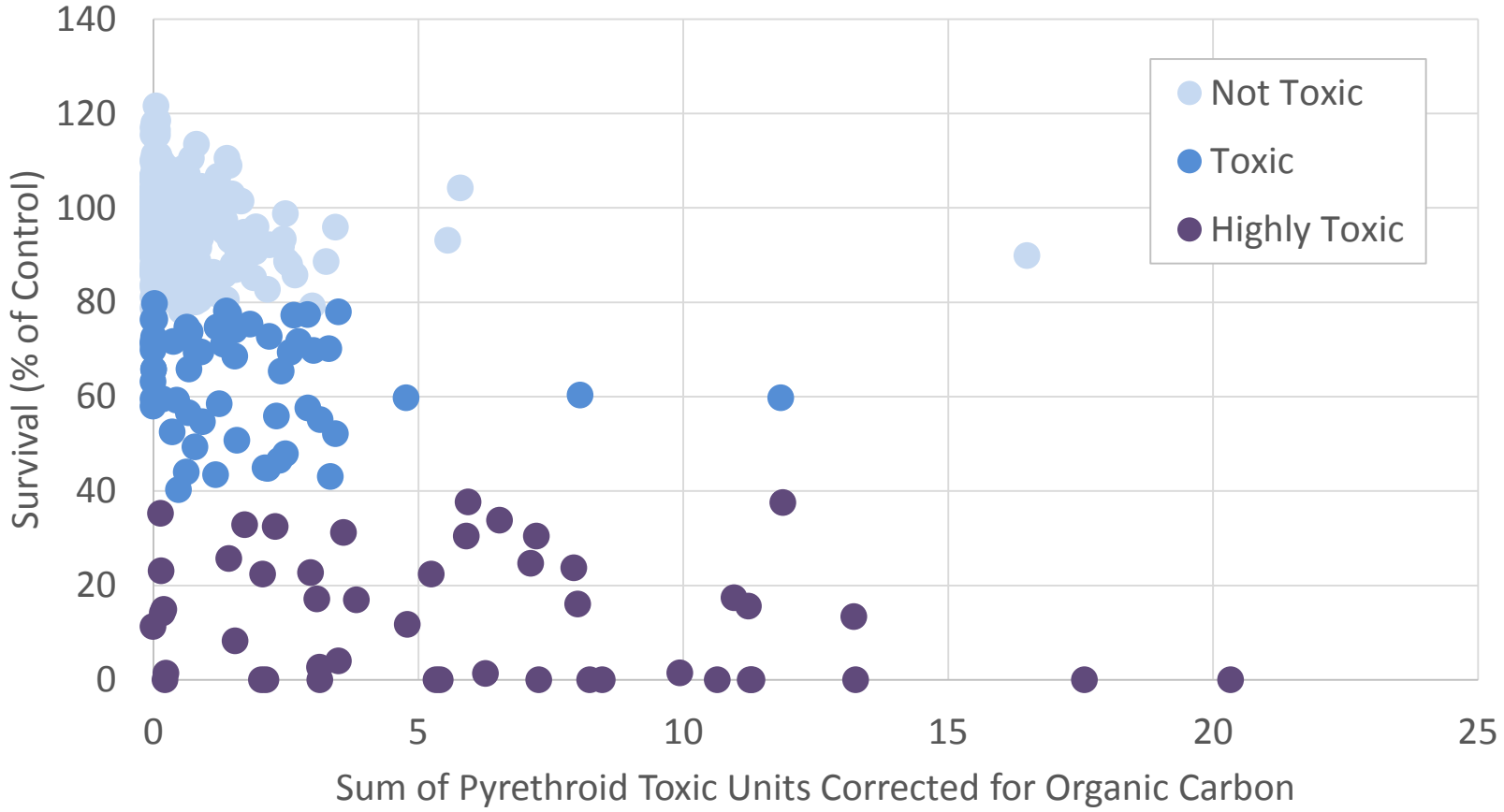


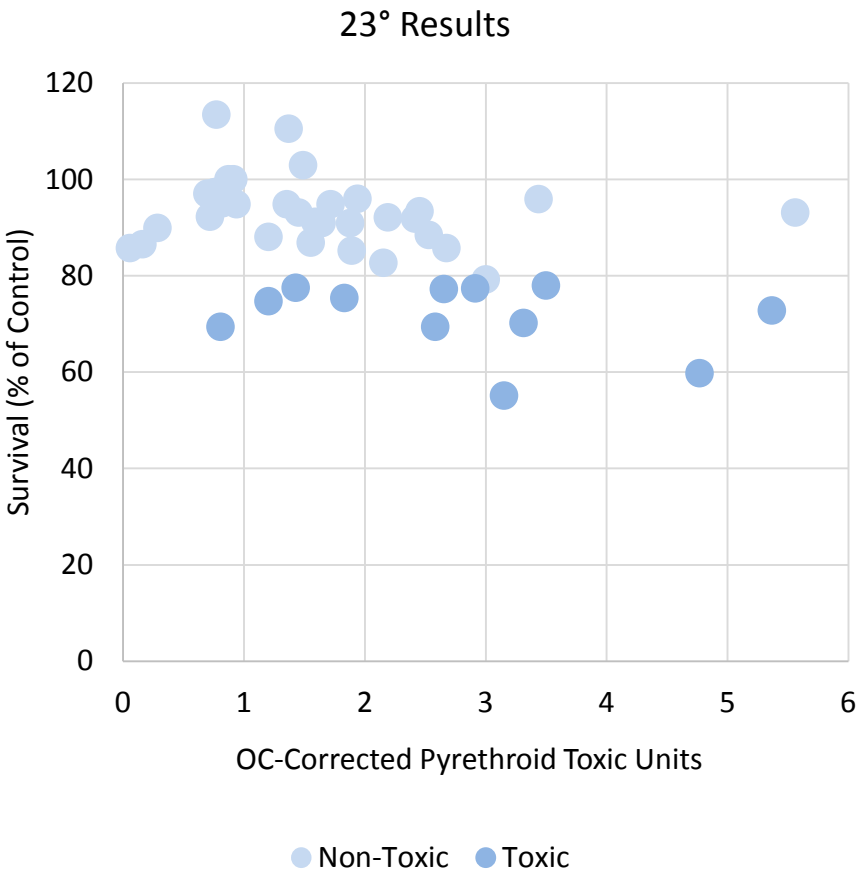


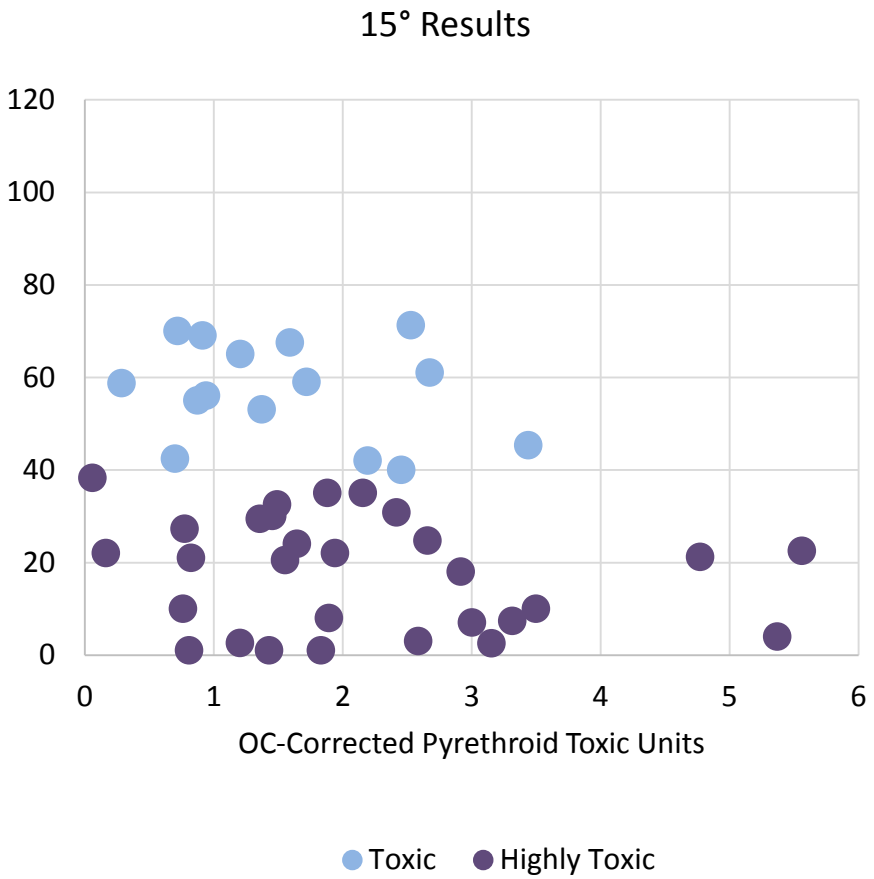
What is causing the problem?



- Toxic unit calculated by dividing the measured concentration by the median lethal concentration (LC50) for *Hyalella azteca*.
- Pesticide LC50s were exceeded in 19% of the samples.

Confirmation pyrethroids are part of the problem





- Comparison of two temperature toxicity results plotted against organic carbon-corrected toxic units.

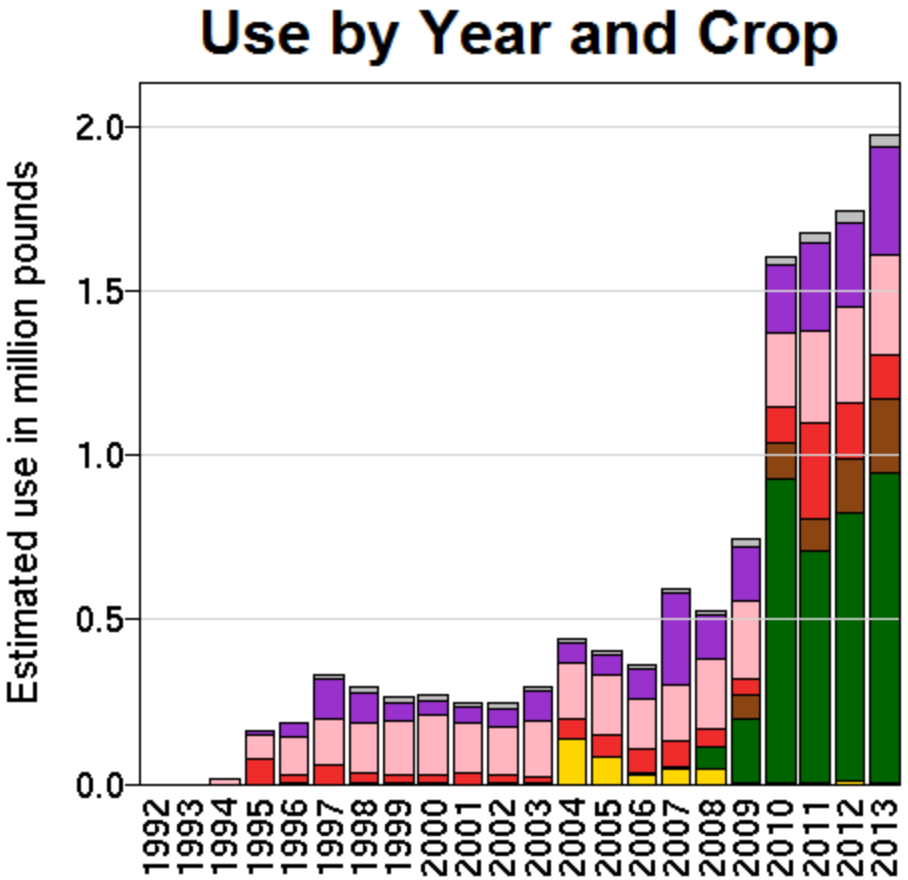
Are conditions getting better or worse?

What is the magnitude and extent of any problems?

2013-2014 Tier II Fipronil Results	Year	Fipronil	Fipronil Sulfide	Fipronil Sulfone	Fipronil Desulfinyl
% Detection	2013	18	40	60	33
	2014	30	47	77	43
Avg. Concentration	2013	0.536	0.434	2.81	1.29
	2014	1.267	0.641	3.55	3.07
Max Concentration	2013	13.1	6.42	51.0	35.1
	2014	27.4	8.83	58.5	70.7

CECs – Neonicotinoids – e.g., Imidacloprid

- Toxic to insects, especially chironomids
- Detections are increasing (e.g., Region 3 and 7 collaborative monitoring with DPR)
- Highly soluble – water column toxicity testing
- Proposed collaboration with DPR at 10 SPoT sites
- Future 303(d) listings?



USGS NAWQA data

Contaminants of Emerging Concern

1. The Pesticide Treadmill (or Pesticycle) has led us through a number of chemical classes:
    1. Organochlorines (DDT) > Organophosphates (chlorpyrifos) > Pyrethroids (bifenthrin) > Phenylpyrazoles (fipronil) **> Neonicotinoids (imidacloprid)**
2. Lists of CECs from SFEI and SCCWRP include pyrethroids and fipronil, but detections of imidacloprid are on the rise.
3. Continued collaboration with DPR's Surface Water Monitoring will enable SPoT to stay ahead of the Pesticycle and detect emerging pesticides before significant impacts occur.
    1. Additional funding will enable the SPoT Program to implement a water monitoring component that will screen DPR stations for toxicity to *Hyalella azteca* and *Chironomus dilutus*.
    2. DPR connection will also aid the State Board Stormwater Strategy to Establish Statewide Framework for Urban Pesticide Reduction.

Collaborations with Department of Pesticide Regulation

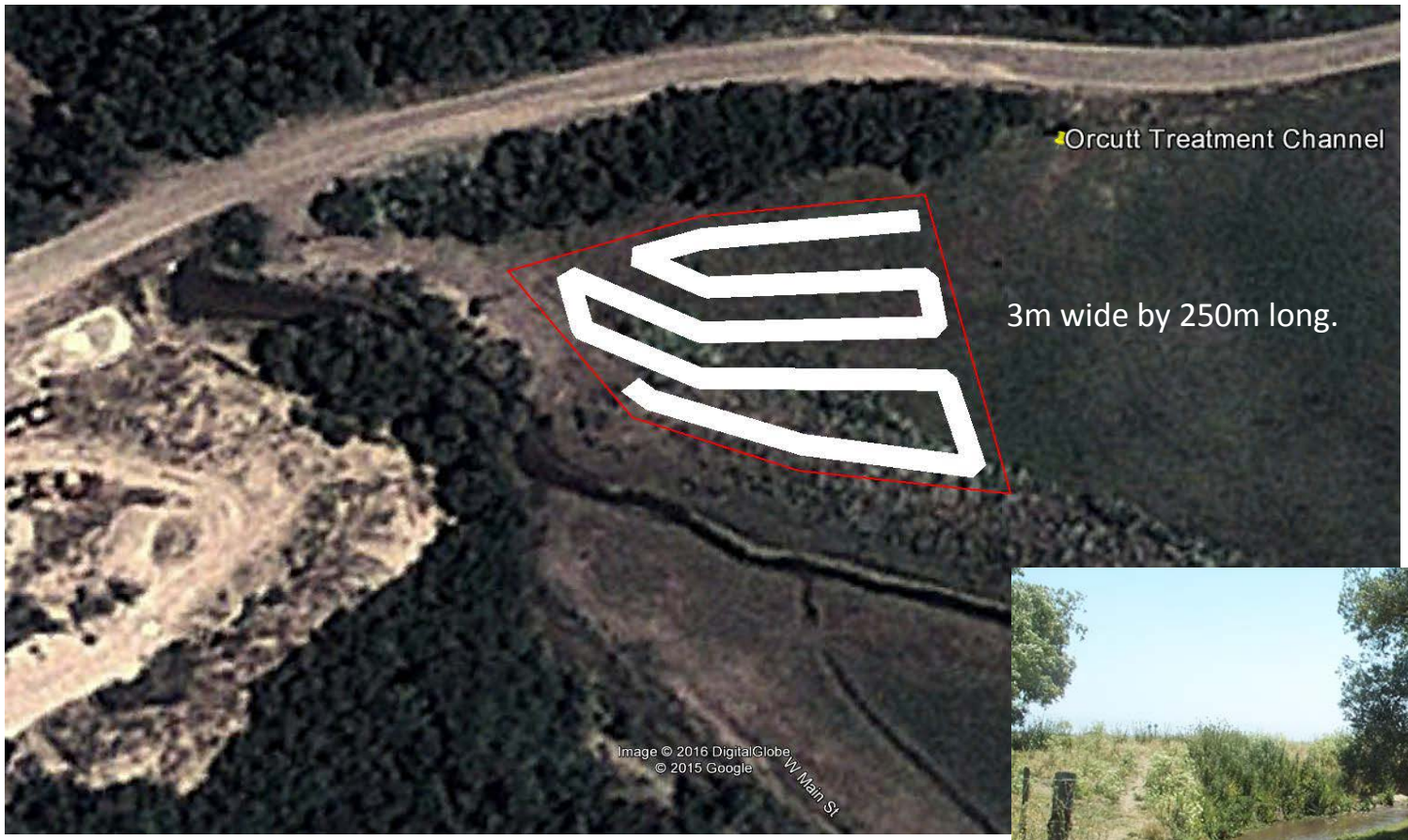
1. Intensive Site Study – Monitoring four stations (2 DPR and 2 SPoT) for significant decreases in concentrations of pyrethroids as a result of new label laws implemented by DPR. New labels went into effect in 2012.
    1. Results so far show no significant decrease in pyrethroid concentrations.
2. Regional Water Board Studies – Conducting toxicity testing with alternative species at DPR surface water monitoring stations (Regions 3 and 7).
    1. Results show significant toxicity at many of DPR's agricultural monitoring stations when tested with *Hyalella azteca* or *Chironomus dilutus*.
    2. Agricultural monitoring in Region 3 through the Cooperative Monitoring Program showed no toxicity when tested with EPA 3-species.
    3. Results led to SWAMP memo on toxicity organism recommendations.

BMPs to Reduce Contaminant Loading

1. SWAMP Regional monitoring at DPR agricultural monitoring stations have provided toxicity and chemistry data on current-use and emerging pesticides.

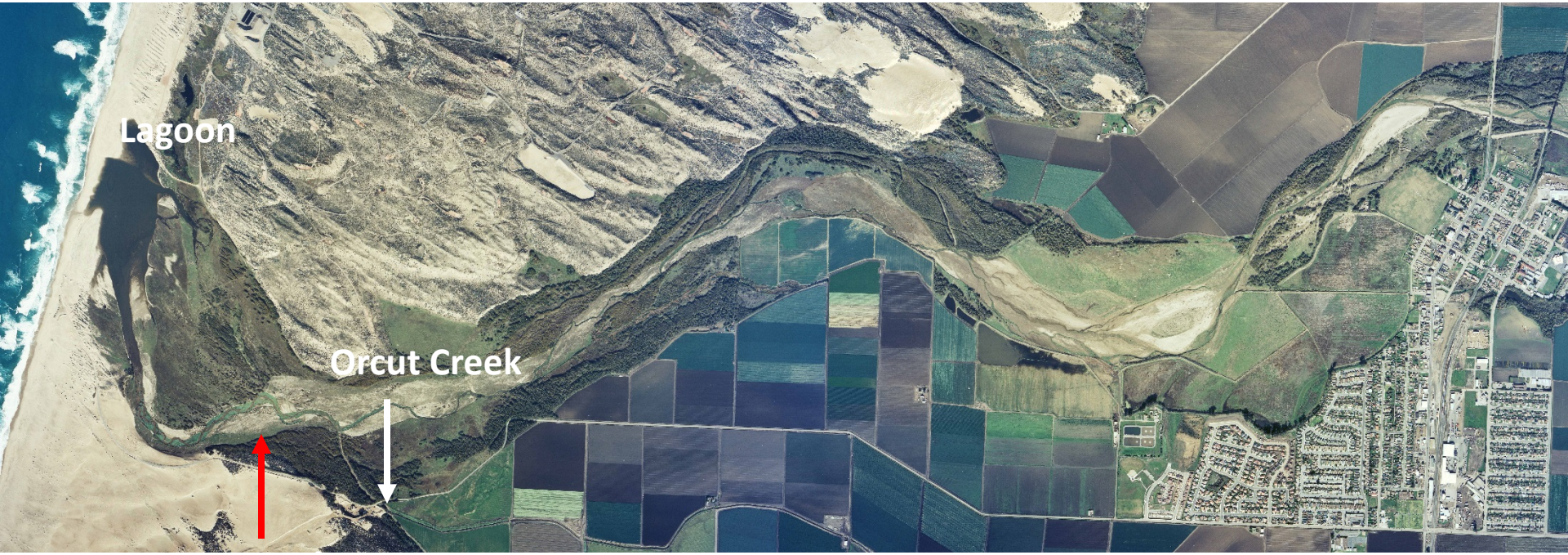
2. Management practice effectiveness projects demonstrate the treatment of contaminants associated with toxicity.

Orcutt Creek Treatment Channel



OC Discharge = 27-159 L/s
Previous projects = 5-10 L/s
Targeted treatment volume = 3-37%

Project Example: Orcutt Creek
Lower Santa Maria River

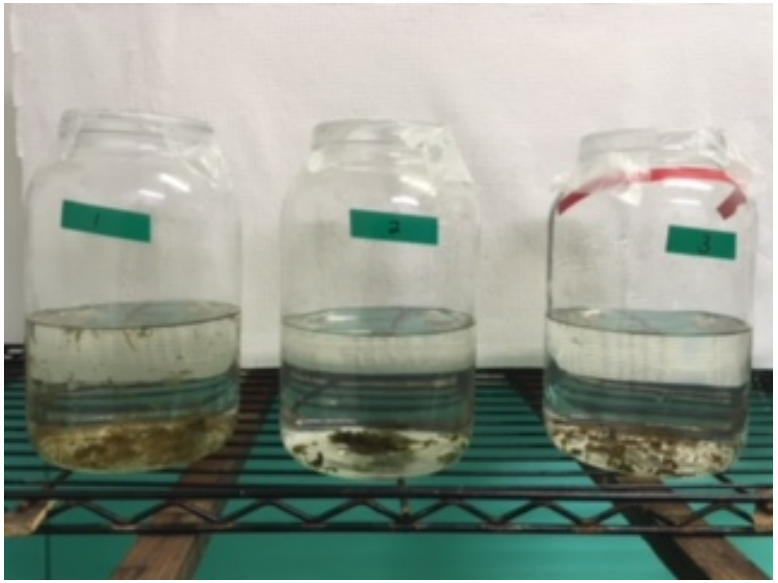


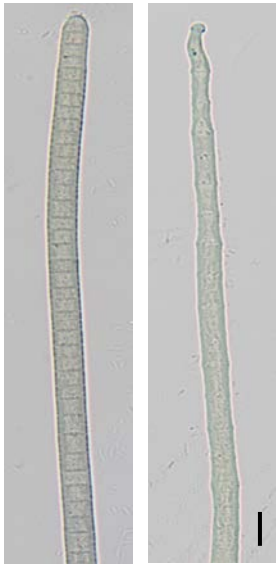
Lower SM River

Potential for Algal Toxins to Influence Field Monitoring Results -

- Toxin producing benthic algae
  - e.g., Anatoxin-A
  - Neurotoxin – nicotinic ACh binding
- Toxic to standard monitoring species?
- Recent concerns about unexplained toxicity in "reference streams" and possibility of impacts on in-stream benthic macroinvertebrates

Russian River Phormidium





Phormidium highly toxic to *C. dubia* –

Algal Strain	Anatoxin-A Conc. (ppb)	Anatoxin-A Estimated At 25% (ppb)	C. dubia % survival 24h	C. dubia % survival 48h
PTRS1	>525	> 131.3	60%	10%
PTRS2	343	85.8	40%	0%
PSRS3H	193	48.3	70%	0%

Next Steps: Dose response testing with *C. dubia*, *H. azteca* and *C. dilutus*

Phormidium also produces saxitoxin

SPoT and Integrated Monitoring

Stream Pollution Trends Program		
	Intensive Site Study with the Department of Pesticide Regulation	Determine the effectiveness of new pyrethroid pesticide label regulations (effective 2012)
	Agricultural Surface Water Monitoring with the Department of Pesticide Regulation	Collaboration with Regions 3 and 7 to determine toxicity to alternate species and presence of emerging pesticides
	Cyanobacteria CEC Monitoring with CSUMB Algal Toxicity with NCRWQCB and CSSM	Determine presence and potential effects of the cyanotoxin microcystin, and effects of algal toxins on invertebrates
	Collaboration with Bioassessment Monitoring Programs: SMC, PSA, NAWQA/CSQA(?)	Linking SPoT toxicity and chemistry data with bioassessment data to support causal assessments
	State and Regional Water Board 303(d) Listings through the Integrated Reporting Process	Water Boards assess water quality monitoring data for California's surface waters to determine if they contain pollutants at levels that exceed protective water quality standards
	Agricultural Monitoring for the Region 3 -Cooperative Monitoring Program	SPoT provides data for conditional waiver of waste discharger requirements
	Agricultural Monitoring for the Region 5 - Irrigated Lands Regulatory Program	SPoT provides data for the monitoring of agricultural runoff in the Central Valley
	Stormwater Monitoring for Region 2 Stormwater Permits	SPoT data provide long-term trends for San Francisco Bay Area municipal stormwater permits
	Regions 4, 8 and 9 Stormwater Monitoring Coalition Site Overlap	SPoT sites overlap with several SMC monitoring locations and provide additional data

Thank you.

Questions?

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http://www.waterboards.ca.gov/water_issues/programs/swamp/spot/

www.granitecanyon.org