Factoring Pesticides of Emerging Concern in the TMDL Process

Bryn Phillips, Brian Anderson – University of California Davis, Granite Canyon Laboratory
Robert Budd, Xin Deng – Department of Pesticide Regulation
Dawit Tadesse, Noelle Patterson – State Water Resources Control Board
Mary Hamilton, Karen Worcester – Central Coast Regional Water Quality Control Board
Debra Denton – U.S. Environmental Protection Agency

Pesticycle

Denton D, TenBrook P, Anderson BS, Phillips BM, Moran K, Tadesse D, Breuer R, Yuzhou L. In Preparation. Mitigating Pesticide Impacts By Building a Better Pesticycle. Environ Toxicol Chem.

Changing Use of Insecticides

1950	1960	1970	1980	1990	2000	2010	2020
Organochlorines (e.g., DDT)							
		Organophosphates (e.g., Chlorpyrifos)					
			Pyrethroids (e.g., Bifenthrin)				
				Phenylpyrazoles (e.g., Fipronil)			
					Neonicotinoids (Imidacloprid)		

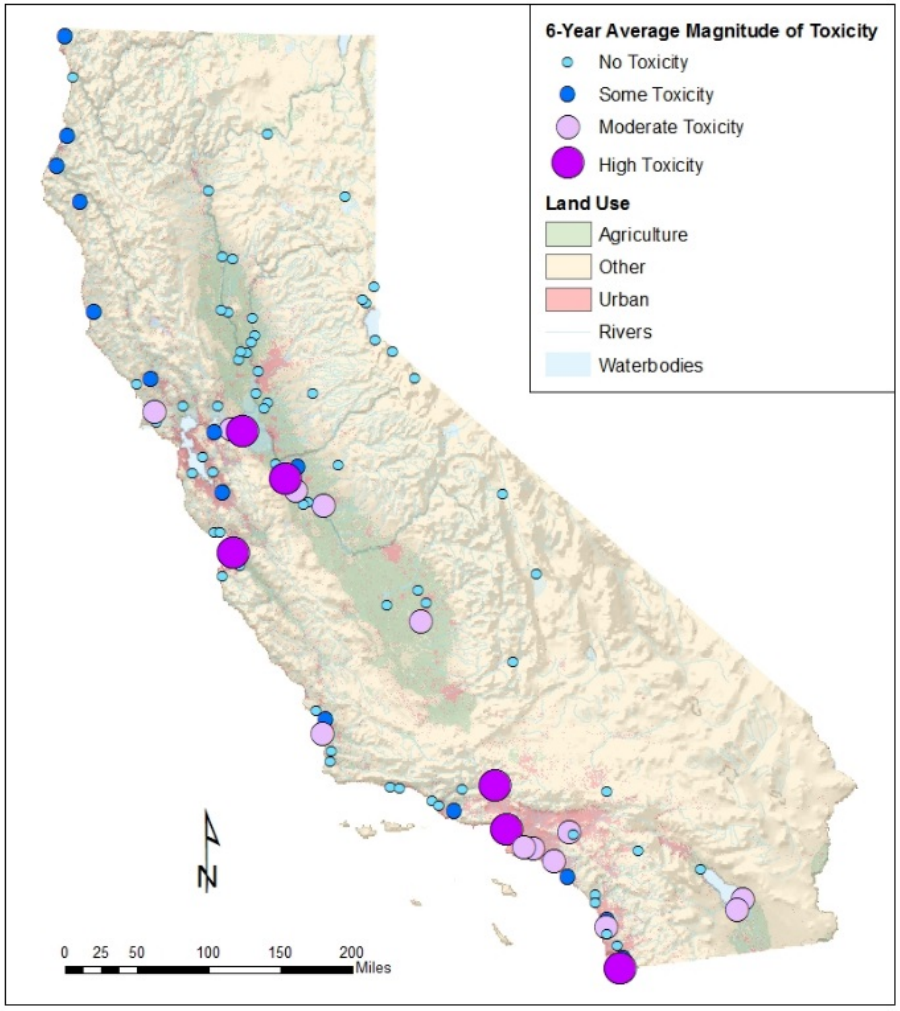
Pesticide	*C. dubia*	*H. azteca*	*C. dilutus*	Fish and Algae
	LC50 (ng/L)			
Chlorpyrifos	54	86	290	>
Bifenthrin	142	9.3	69	>
Fipronil	17,700	728 [c]	32.5 [c]	>
Imidacloprid	2,070 [d]	65,430	2,650	>

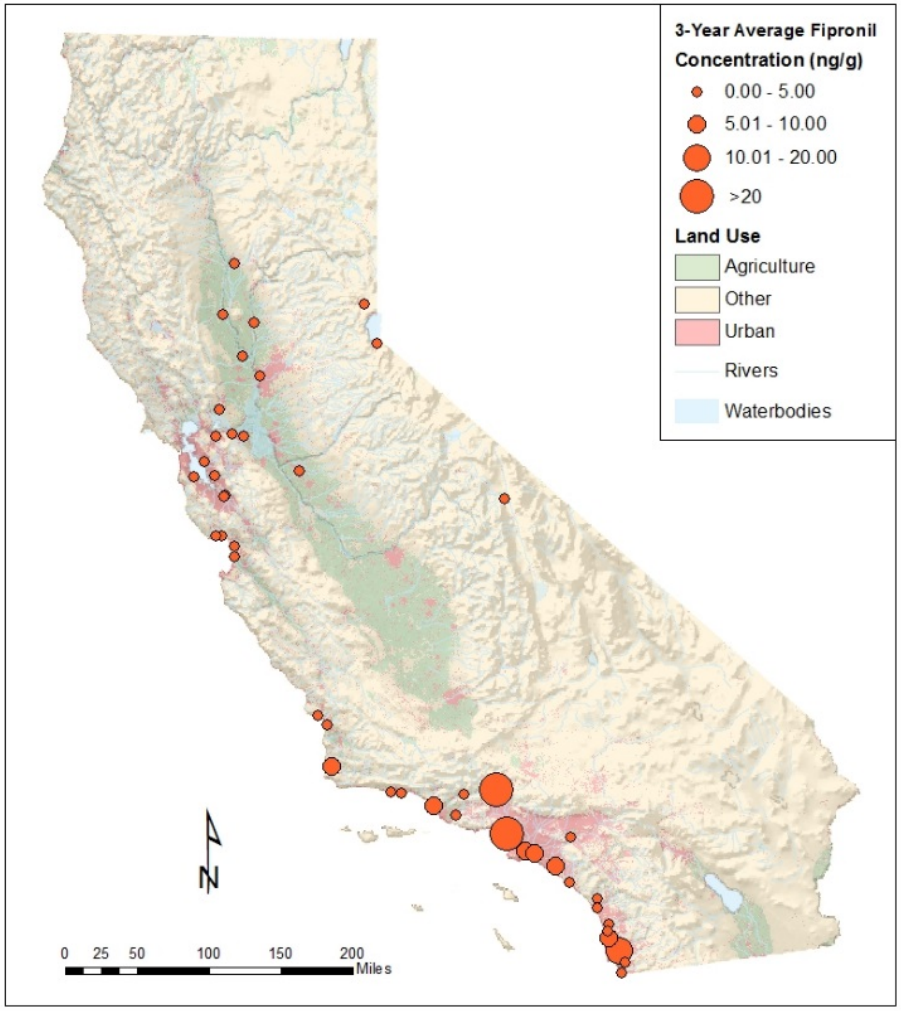
Pesticides and Toxicity

- "In monitoring conducted between 2001 and 2010, greater than 50% of collection sites have shown some degree of toxicity in fresh water and fresh water sediment samples…"
- Pesticides are associated with most of the ambient toxicity.
  - Anderson et al. (2011) – Toxicity in California Waters

- One in five sediment samples are significantly toxic every year, and toxicity has the strongest correlation with urban pesticides.
- Since 2008, median concentrations of pyrethroids have more than doubled, and median concentrations of fipronil have doubled between 2013 and 2015.
  - Phillips et al. (2017) – Stream Pollution Trends (SPoT) – Fourth Report

Toxicity and Pesticides





Central Coast Pesticide TMDLs

- Arroyo Paredon - Diazinon (Additive Toxicity w/ Chlorpyrifos)(2013)
- Pajaro River Watershed - Chlorpyrifos and Diazinon (2013)
- Lower Salinas River Watershed - Chlorpyrifos and Diazinon (2011)
- San Antonio Creek Watershed – Chlorpyrifos (2012)
- San Lorenzo River Watershed – Chlorpyrifos (2014)

- Santa Maria River Watershed – Pesticides (2014)

- In Development – Salinas River Watershed – Sediment Toxicity and Pyrethroids

Hazard/Risk Assessment

EVIDENCE OF PESTICIDE IMPACTS IN THE SANTA MARIA RIVER WATERSHED, CALIFORNIA, USA

BRIA

‡Cen

SOLID-PHASE SEDIMENT TOXICITY IDENTIFICATION EVALUATION IN AN AGRICULTURAL STREAM

BRYN M. PHILLIPS,*† BRIAN S. ANDERSON,† JOHN W. HUNT,† SARAH A. HUNTLEY,† RON S. TJEERDEMA,†

The contribution of pyrethroid pesticides to sediment toxicity in four urban creeks in California, USA

Bry

PYRETHROID AND ORGANOPHOSPHATE PESTICIDE-ASSOCIATED TOXICITY IN TWO COASTAL WATERSHEDS (CALIFORNIA, USA)

The Effects of the Landguard™ A900 Enzyme on the Macroinvertebrate Community in the Salinas River, California, United States of America

Bryn M. Phillips[1] · Brian S. Anderson[1] · Katie Siegler[1] · Jennifer P. Voorhees[1] · Robert Budd[2] · Ron Tjeerdema[1]

Changing Patterns…

Anderson BS, Phillips BM, Voorhees JP, Deng X, Geraci J, Worcester K, Tjeerdema RS. In Press. Changing patterns in toxicity associated with current use pesticides in agriculture runoff in California. Integrated Environmental Assessment and Management.

- A consequence of discharge requirements has been a shift in pesticide use patterns away from organophosphate pesticides, and toward use of pyrethroid and neonicotinoid pesticides.
- There has been no corresponding shift in water toxicity testing protocols with different chemical sensitivities; monitoring continues with the EPA three species tests and sediment toxicity is monitored with *H. azteca*.

Proactive Strategies

- Denton et al. (In Preparation)
  - Agency Cooperation
  - Modeling
  - Monitoring
  - Management Approaches

- Anderson et al. (In Press)
  - Integrate Monitoring and Regulatory Programs (Agency Cooperation and others)
  - Adaptive management of surface water monitoring programs for relevant analytes and current pesticide use
  - Relevant toxicity test organisms to accurately reflect potential for environmental risk

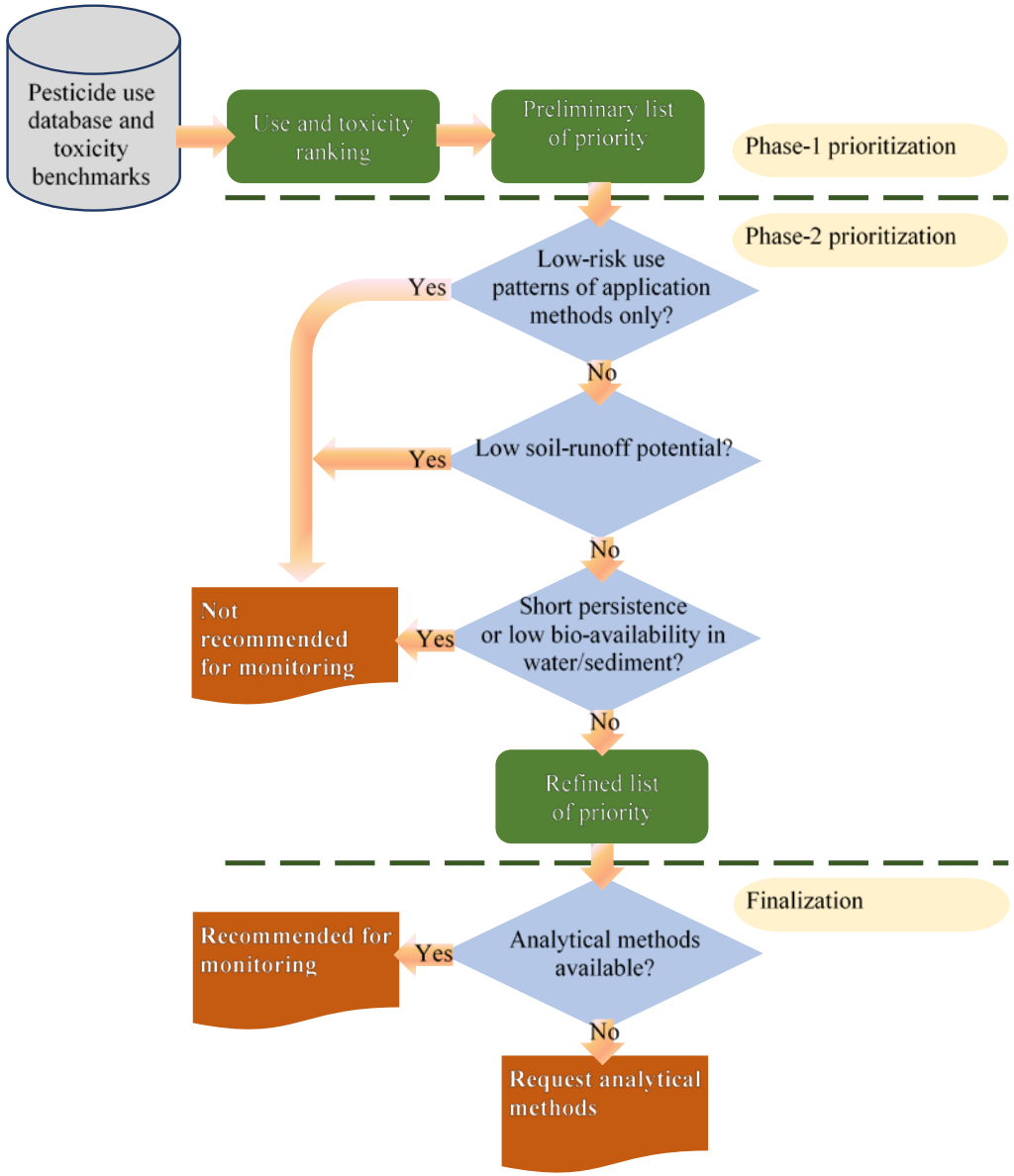
- Strategy to Optimize Resource Management of Storm Water (STORMs)
  - State Board Coordinates with U.S. EPA OPP and DPR
  - Minimum pesticides source control measures for MS4 dischargers
  - Coordinated Monitoring

Agency Cooperation

- Agencies that Regulate Pesticides
  - U.S. EPA Office of Pesticide Programs
  - Department of Pesticide Regulation
- Management Agency Agreement
  - State Water Resources Control Board
  - Department of Pesticide Regulation

Modeling

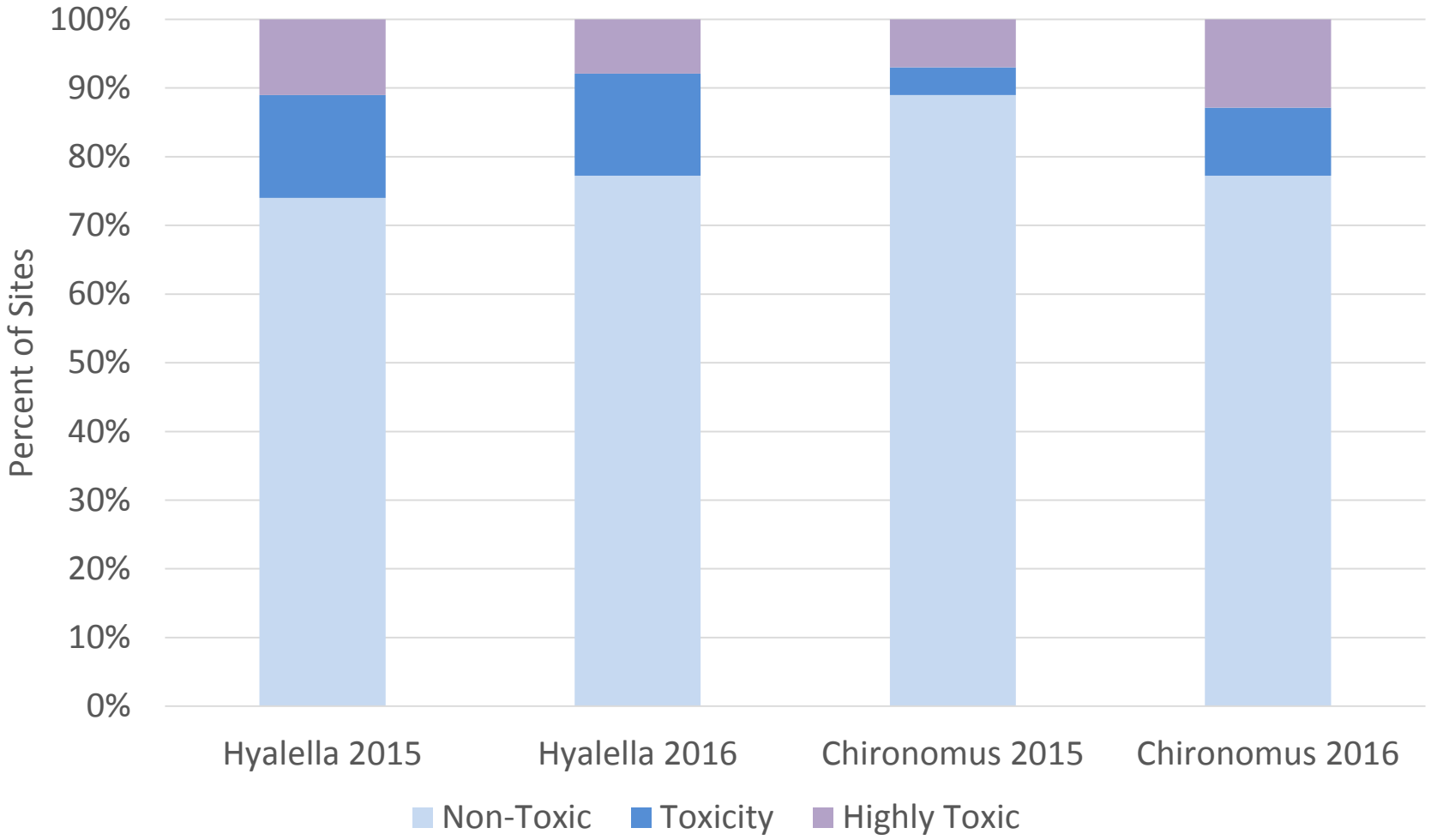
DPR Prioritization Model



http://cdpr.ca.gov/docs/emon/surfwtr/sw_models.htm

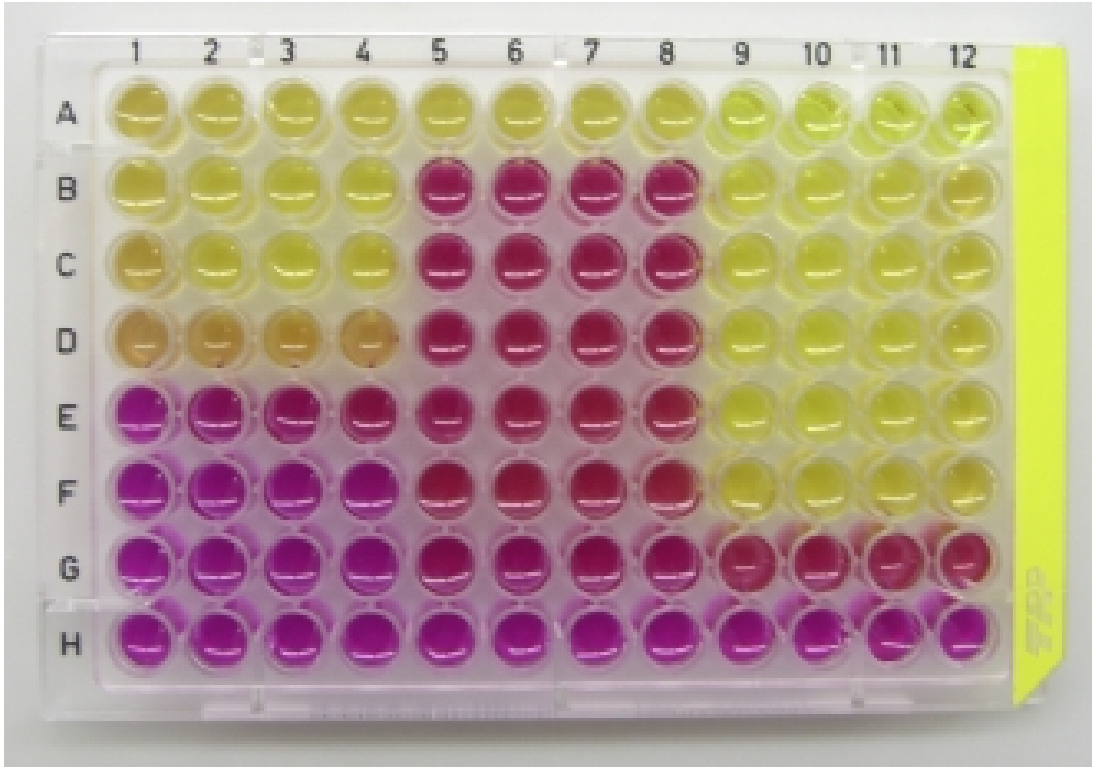
Monitoring – Hyalella vs. Chironomus Toxicity

- Percentages of toxic samples are similar in 2016, but the actual sites can be different.
- Increase in percentage of toxic sites for Chironomus between 2015 and 2016.



Monitoring – In Vitro Bioassays

- Cell lines respond to toxicants
- Potential for high throughput and low cost
- Develop versions for neurotoxic modes of action
- Link results to organism or community effects



Management Practices

- Trying to prevent pesticide movement into receiving water.
- In some cases the water needs to be treated with management practices.

Conclusions

- Create an alternative to TMDLs…
  - Ultimately avoid impaired water body listings
  - Become more proactive than reactive.
- Strategies for the pre-emption of negative outcomes and potential alternatives to pesticide TMDLs:
  - Agency Coordination
  - Modeling
  - Integrated and Coordinated Monitoring
  - Management Practices