Pesticide Detections and Toxicity in Urban Runoff from Neighborhoods in Northern and Southern California

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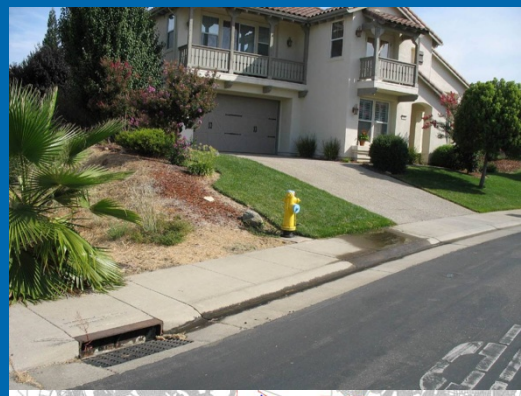
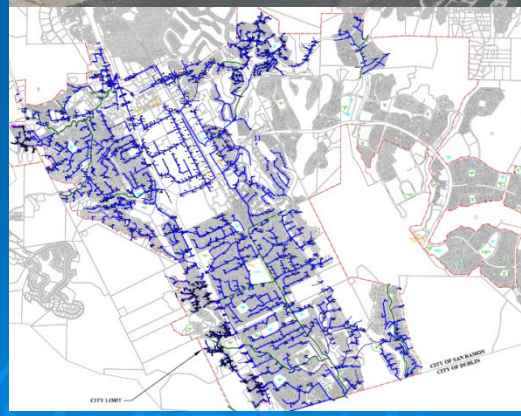
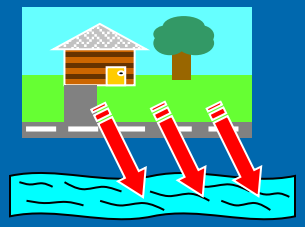
Introduction

- DPR involved in urban monitoring since 2008
  - High unreported urban pesticide use
    - Homeowner use not reported
    - Estimated ~20% total pesticide use
    - High potential for runoff in urban areas
    - Urban runoff may exceed Ag runoff
- Concern: toxicity to aquatic organisms
  - Toxicity testing since Fall 2011
    - Ongoing





Objectives



- Detection frequency of main urban pesticides

- Stormdrain outfalls and mainstem urban streams

- Rain and dry season monitoring
- Toxicity studies

  - Do more pesticides/higher concentrations (chemistry TUs) equate to higher mortality in toxicity testing?

Methods - Aquatic Toxicity Testing

- UC Davis Aquatic Health Program (AHP)[1]

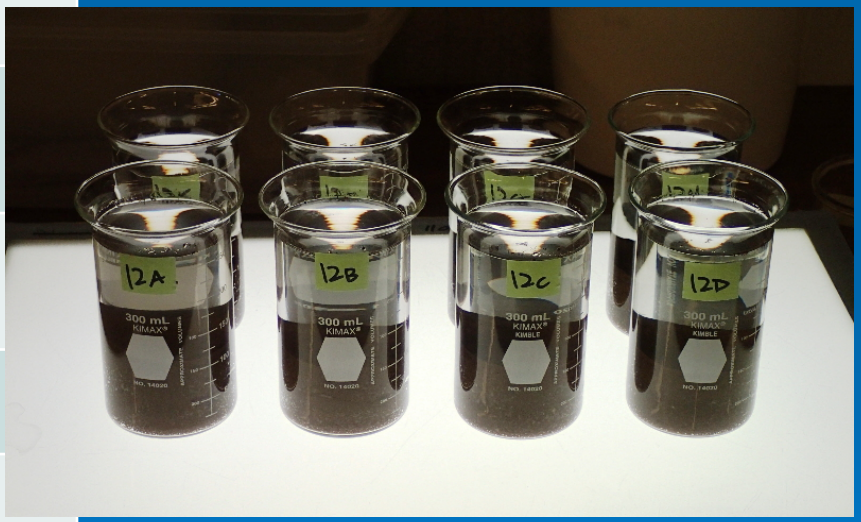
Parameter	Water
Organism	*Hyalella azteca*
	10 7-14 day old individuals in 250 ml beakers
Environment	23°C, 16:8 hour photoperiod
Water renewal	1X on day 2
Feed	2X, on day 0 and day 2
Test Length	96-hour
Data	Survival

[1]http://www.vetmed.ucdavis.edu/aquatic_health/services/aquatic_testing_capabilities.cfm

Methods - Aquatic Toxicity Testing

- UC Davis Aquatic Health Program (AHP)[1]

Parameter	Sediment
Organism	*Hyalella azteca*
	10 7-14 day old individuals in 300 ml beakers
Environment	23°C, 16:8 hour photoperiod
Water renewal	2X daily
Feed	Daily
Test Length	10-day
Data	Dry Wt. and Survival



[1]http://www.vetmed.ucdavis.edu/aquatic_health/services/aquatic_testing_capabilities.cfm

Field Methods

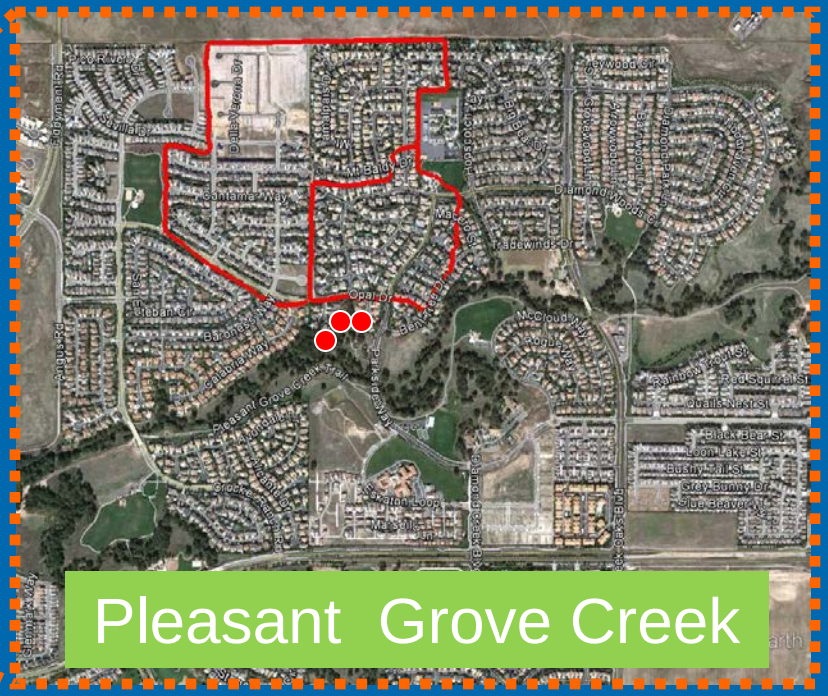
Tox Sampling

- Rain: Oct 2011 (NC), Jan 2012
- Dry: June, July (NC) and Aug 2012 (SC)

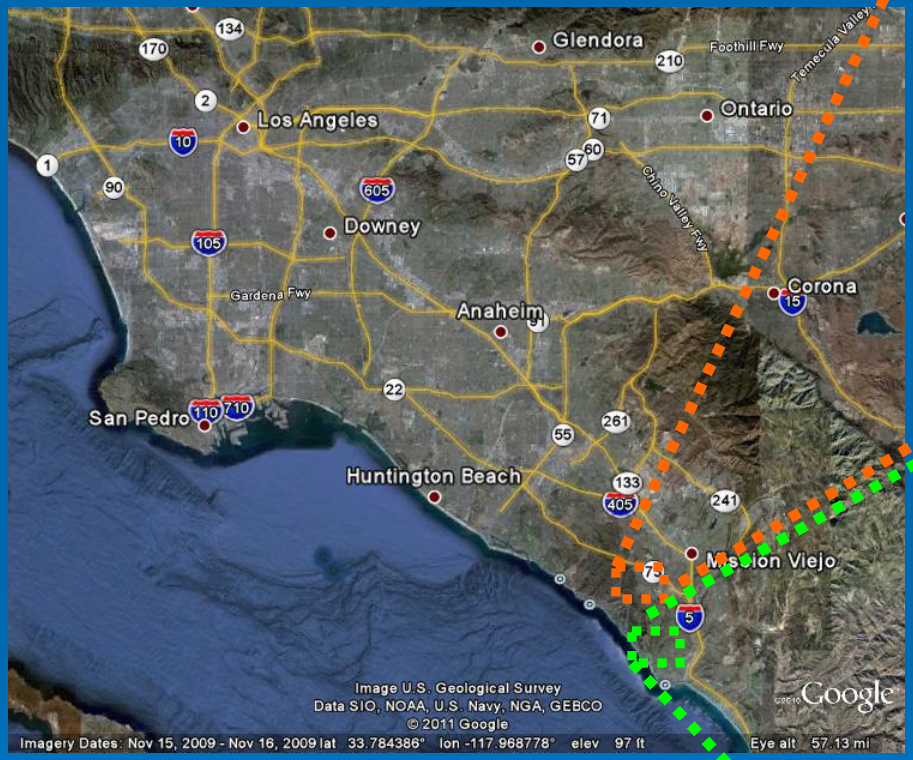
Pesticide Analytes

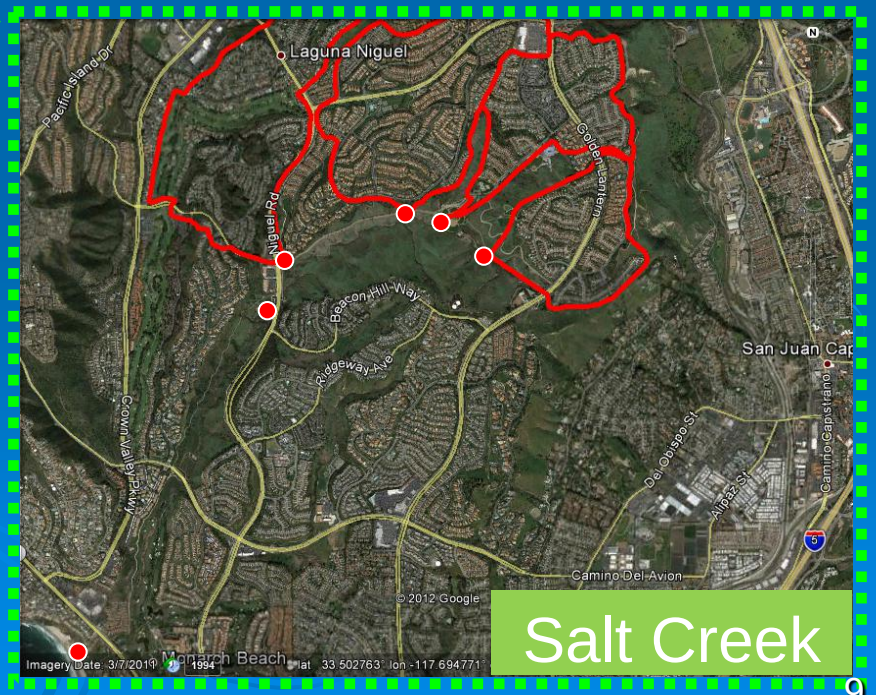
Pesticide or Pesticide Group	NorCal	SoCal
Chlorothalonil	X*	X
Fipronil + 5 degradates	X	X
Imidacloprid	X	X
OPs (Chlorpyrifos, Diazinon, Malathion)	X	X
Pyrethroids (Water [6] and Sediment [11])	X	X
Pendimethalin		X
Synthetic Auxin Herbicides (2,4-D, Dicamba, MCPA, Triclopyr)	X	X

Northern California Sampling Locations (Toxicity)



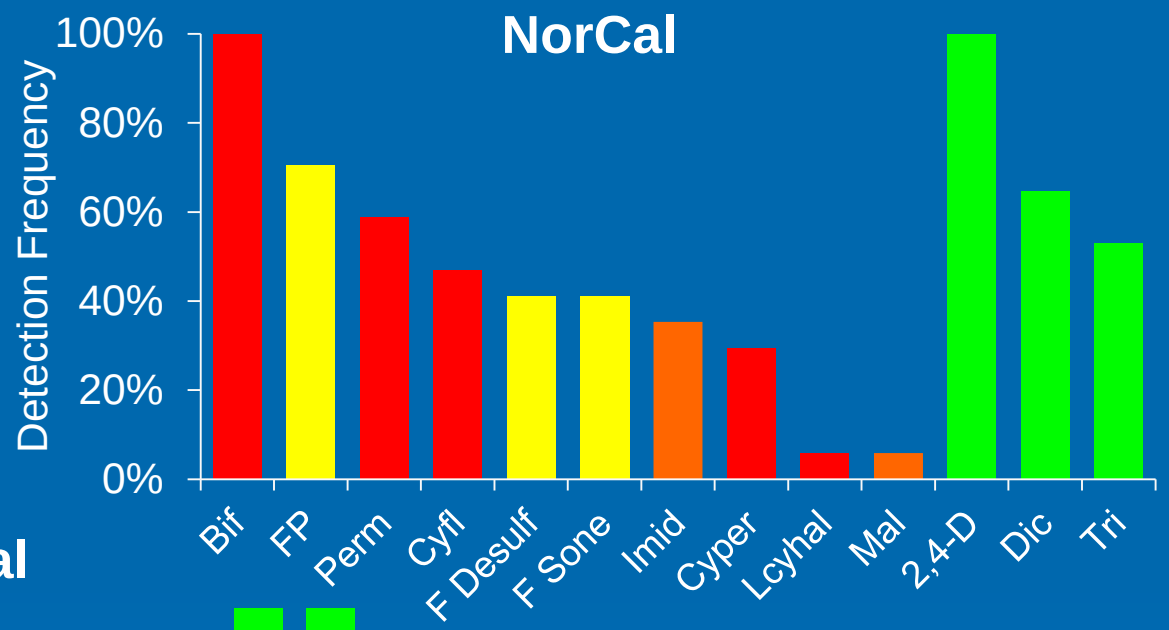
Southern California Sampling Locations (Toxicity)

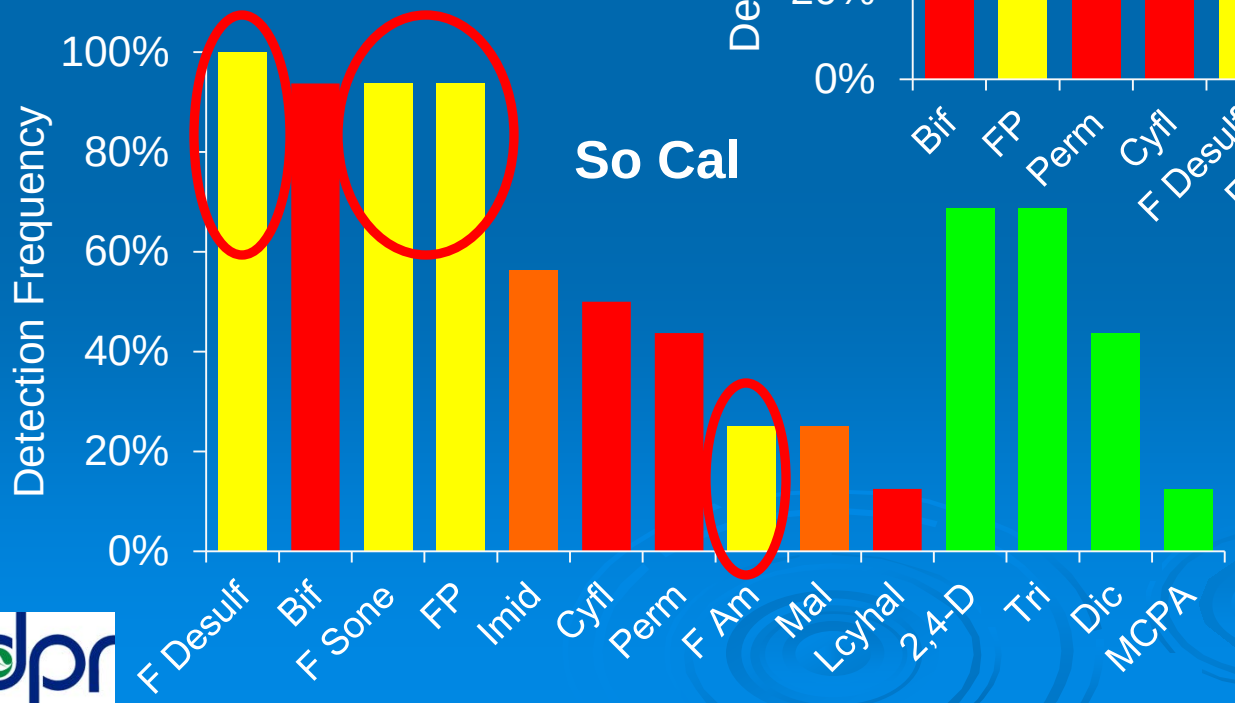




Results

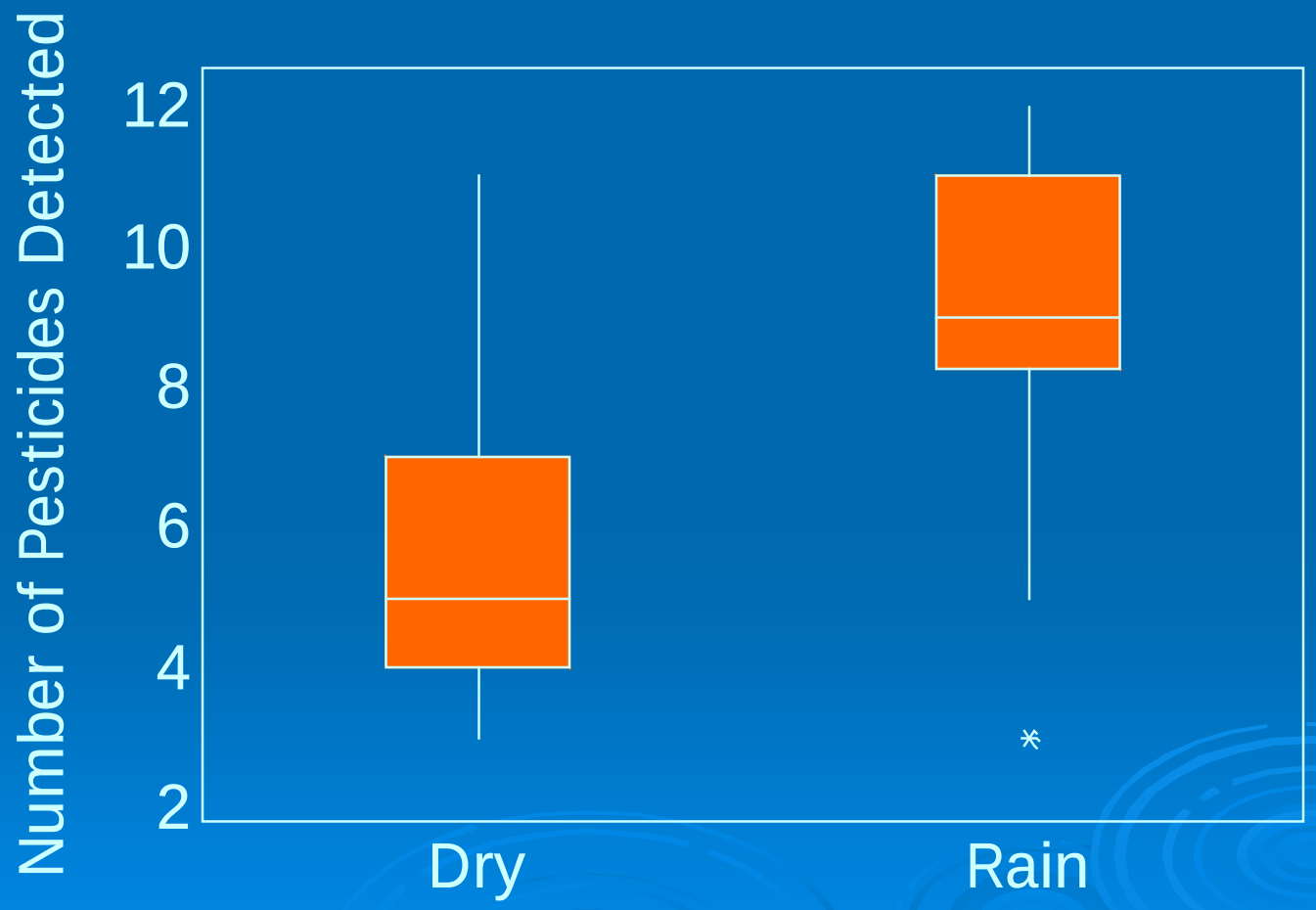
- Pyrethroids and Fipronil(s) - prime candidate for aquatic toxicity





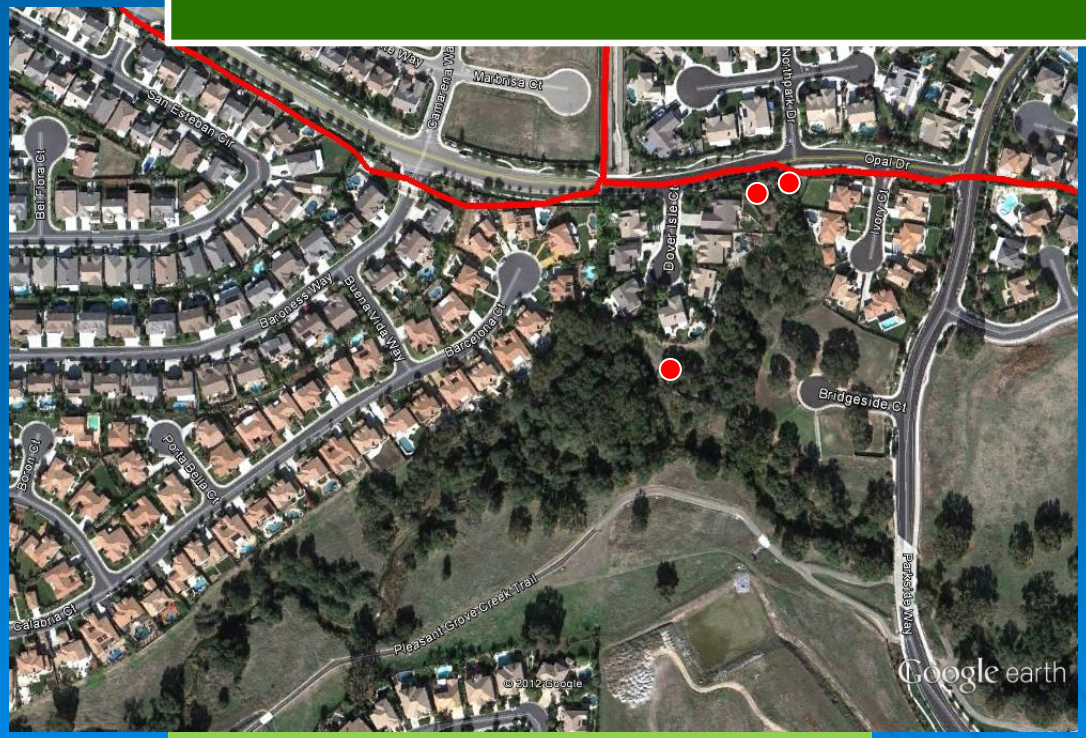
Results

- …as is rain runoff



Water Toxicity Results - Northern California

- TUs calculated as [pesticide]/ LC50 or benchmark
  - Pyrethroids and fipronil, LC50's
  - Others, lowest US EPA acute benchmark
  - For pyrethroids, bioavailability estimated from TSS, TOC, and Koc
- TUs additive



Pleasant Grove Creek

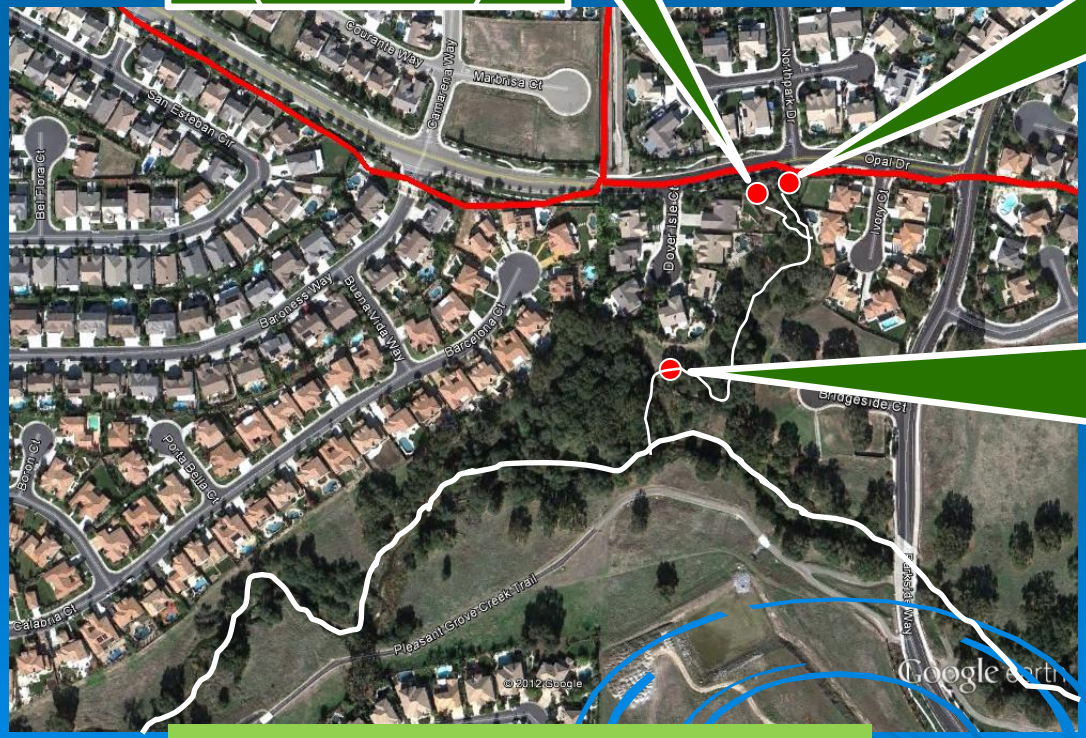
Water Toxicity Results - Northern California

Rain 2011-12
0% survival
(6.6, 8 TUs)

Dry 2012
35% survival
(1.3 TUs)

Rain 2011-12
0% survival
(5, 9 TUs)

Dry 2012
0% survival
(0.4 TU)

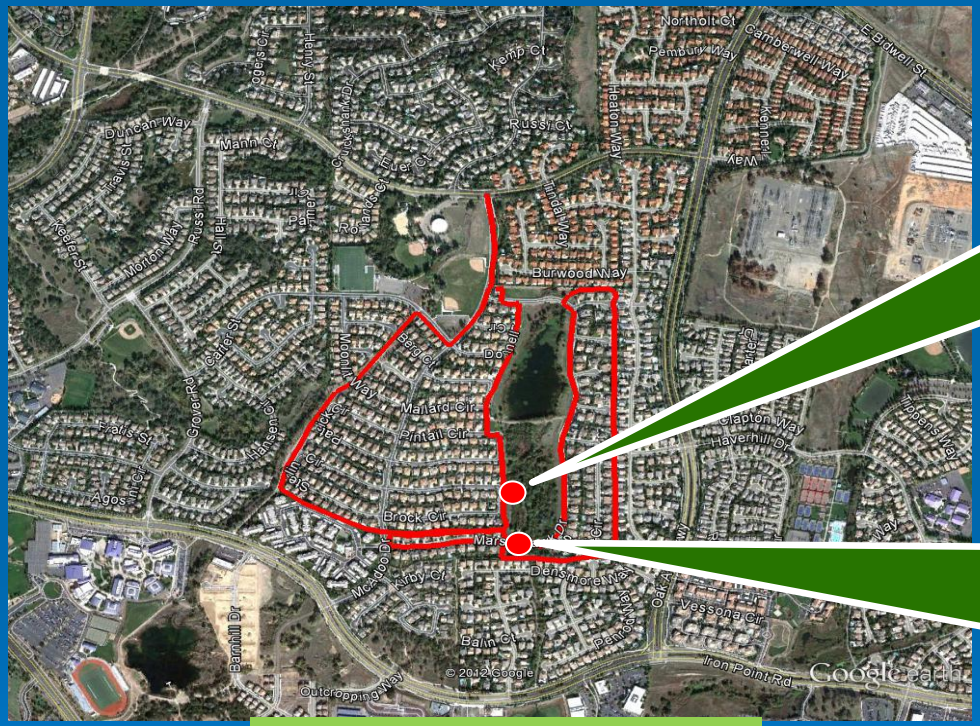


Rain 2011-12
0% survival
(5, 5.5 TUs)

Dry 2012
98% survival
(1.4 TUs)

Pleasant Grove Creek

Water Toxicity Results - Northern California



Willow Spring

Rain 2011-12
0% survival
(0.5, 2.6 TUs)

Dry 2012
2, 22% survival
(0.5, 4.3 TUs)

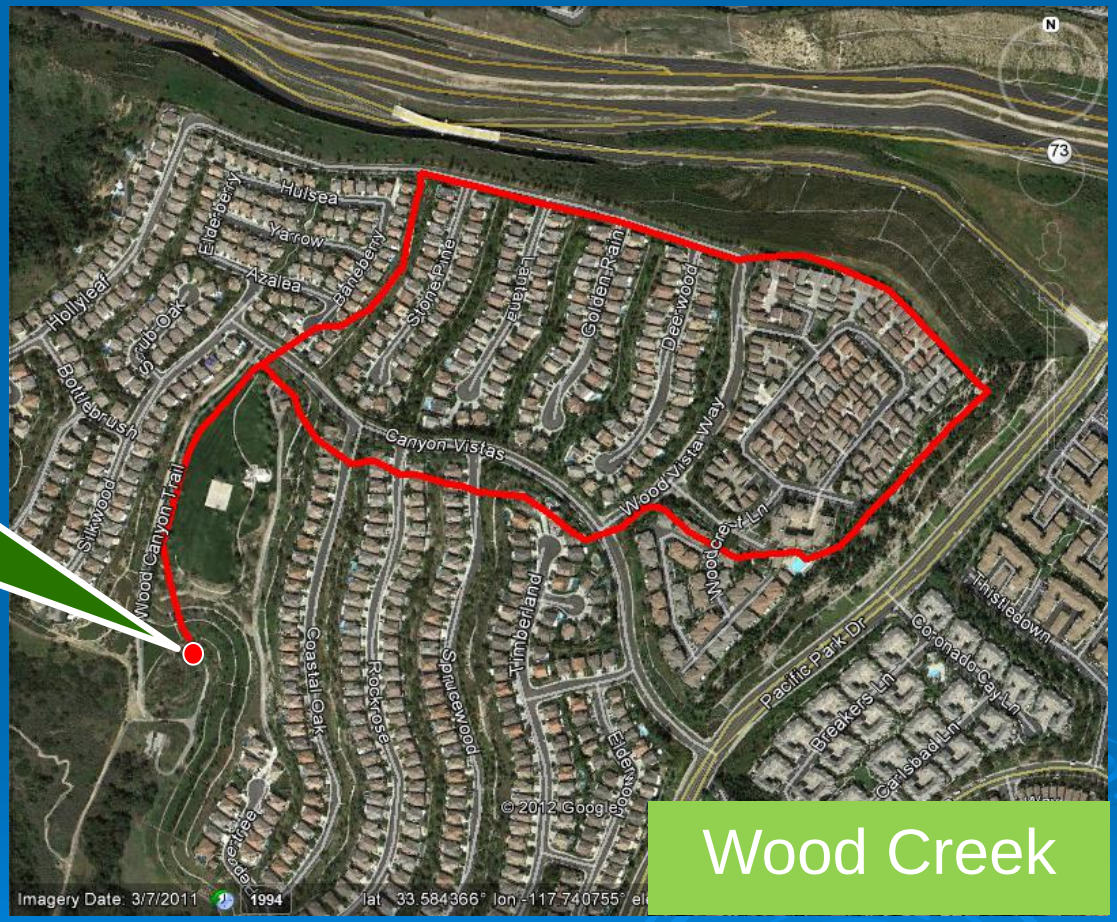
Rain 2011-12
0, 2% survival
(4, 0.8 TUs)

Dry 2012
71, 100% survival
(4.6, 0.3 TUs)

Water Toxicity Results - Southern California

<u>Rain 2012</u>
0% survival
(20 TUs)

<u>Dry 2012</u>
0, 6% survival
(5, 7 TUs)



Wood Creek

Water Toxicity Results - Southern California

Rain 2012
0% survival
(4 TUs)

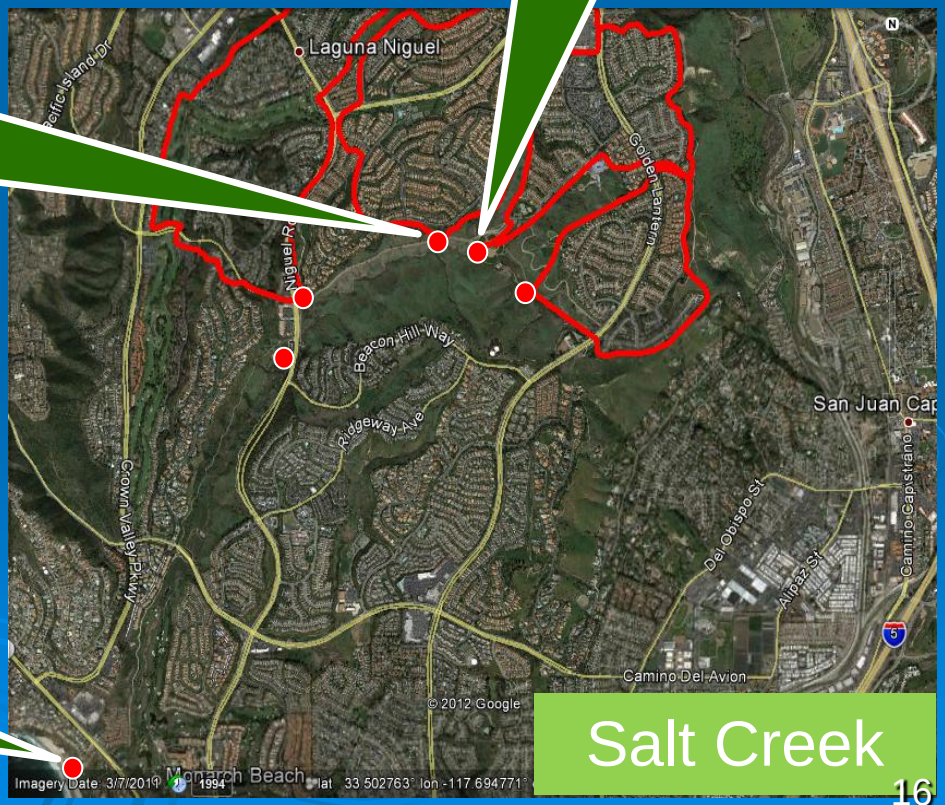
Dry 2012
58% survival
(2.9 TUs)

Rain 2012
0% survival
(58 TUs)

Dry 2012
2, 10% survival
(4.8, 3 TUs)

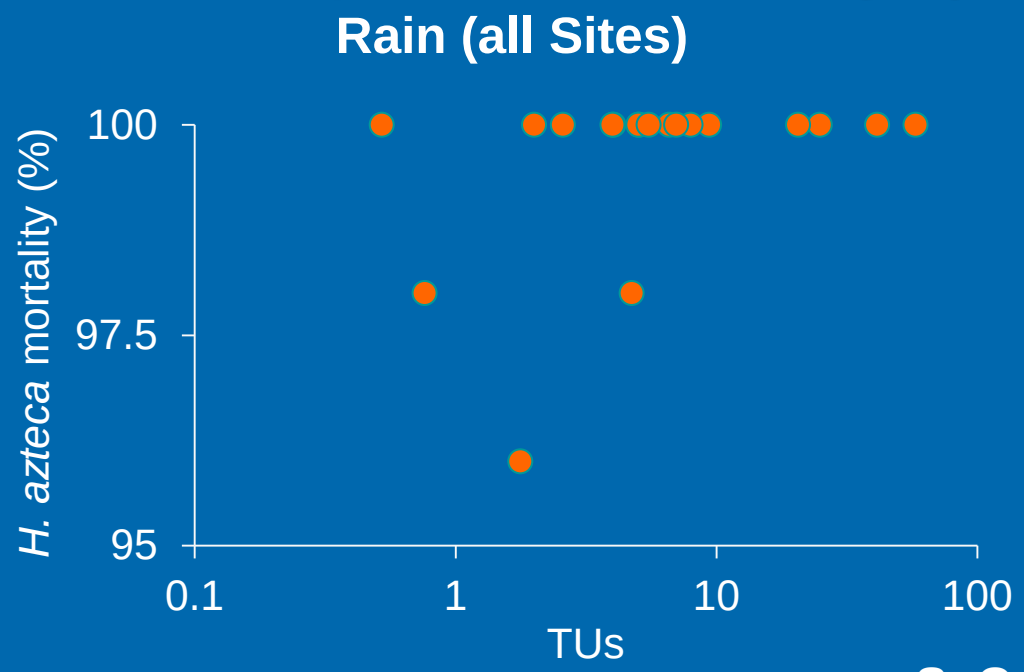
Rain 2012
2% survival
(4.7 TUs)

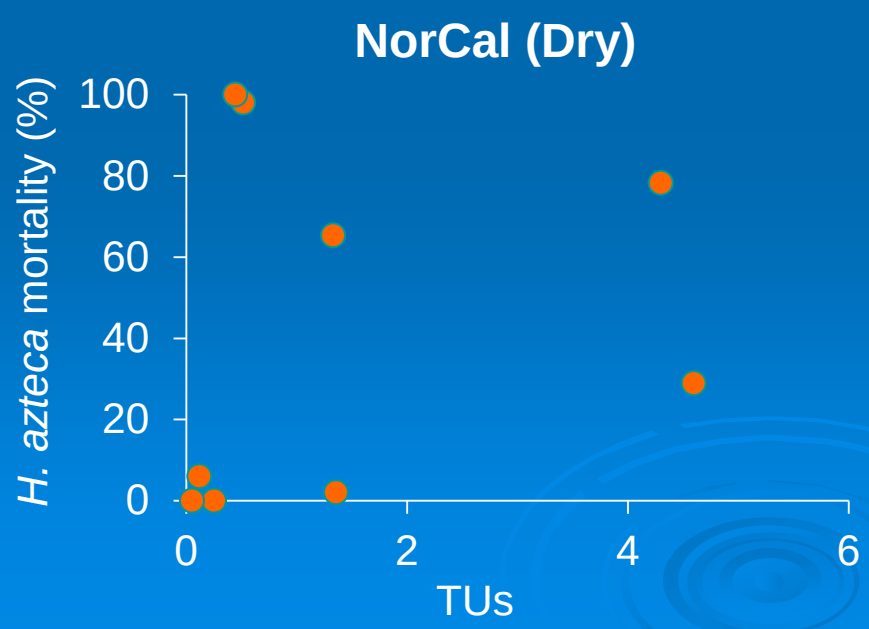
Dry 2012
96, 100% survival
(0.2, 1 TU)

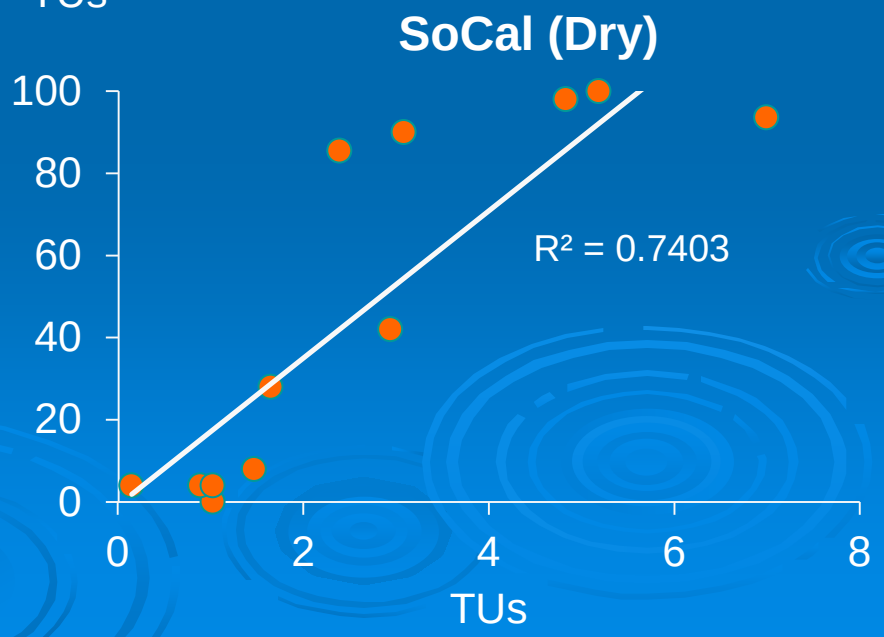


Salt Creek

Results – Aquatic Toxicity (Water)







Conclusions

- DPR Monitoring Program incorporate water and sediment toxicity testing
  - UC Davis AHP
- Pyrethroids (bifenthrin), fipronil(s) major detections
- Rain water samples highly toxic
  - First flush storms
  - More frequent pesticide detections

Conclusions

- Dry season water samples less toxic
  - NorCal – poor correlation TUs and toxicity
  - SoCal – good correlation TUs and toxicity
- Sediment toxic to *H. azteca*
  - Sampling in Oct 2011 and June 2012 at four sites: 100% mortality (6-21 TUs)
  - Bifenthrin – most frequently detected pyrethroid and largest contributor to TUs

Questions?