

Current Pesticide Occurrences and Trends in Surface Water of the Central Coast, California

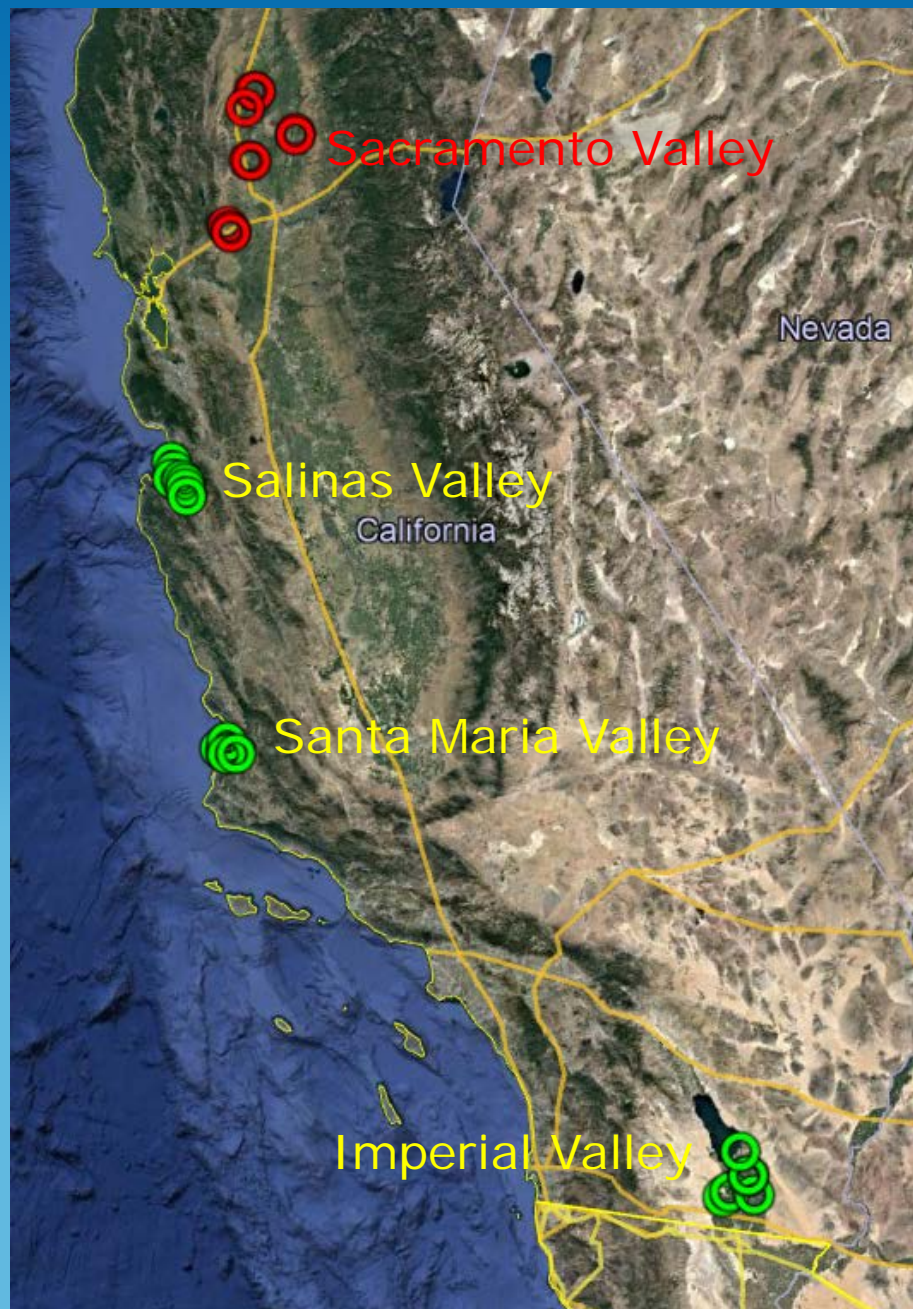
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California Department of Pesticide Regulation



California Central Coast Water Board Meeting
Santa Barbara County Offices
March 22, 2018

DPR's Ag Monitoring Regions

- High Ag productions with row crops
- High pesticide uses
- High runoff potentials via irrigation
- High pesticide detection frequencies and concentrations



DPR Surface Water Monitoring Program

Objectives

- Determine presence of pesticides in surface waters
- Evaluate spatial and temporal trends in detection frequencies and concentrations
- Evaluate potential risk of detected concentrations to aquatic organisms

Watersheds Monitored in the Central Coast

Sites in 2011-2016:

Salinas Valley

Salinas River - 5 sites
Tembladero Slough - 5 sites
Old Salinas River - 2 sites

Santa Maria Valley

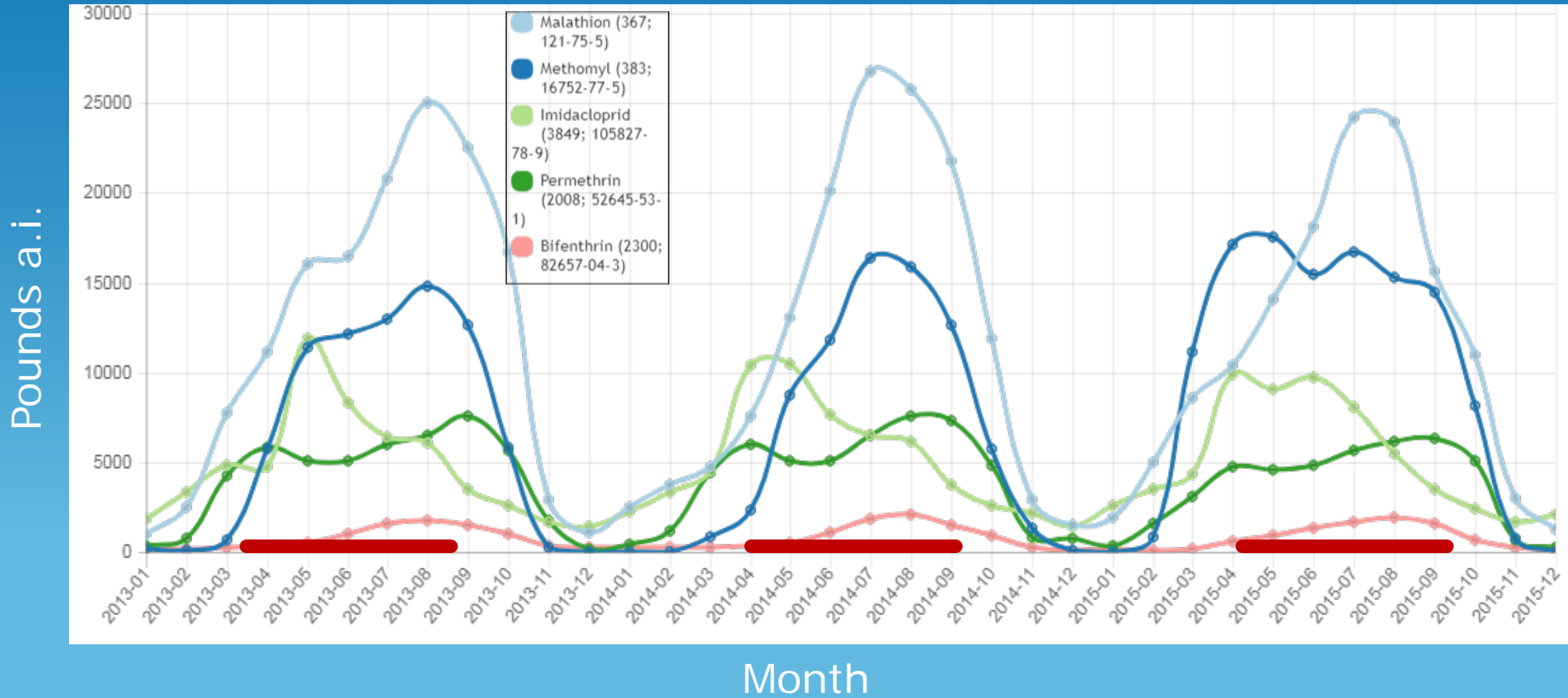
Orcutt Creek – 4 sites
Oso Flaco Creek – 2 site
Main St. Ditch – 1 site
Bradley Channel – 1 site

Site Type

Stream, Creek, Ditch, Ag Drain



Cyclical Agricultural Pesticide Uses in the Central Coast



Sampling Schedule:

Salinas: April - September

Santa Maria: May, July, September

Sampling Method:

Grab samples

Agricultural Pesticides Monitored by DPR

Insecticides

Organophosphate:

Chlorpyrifos, Diazinon, Dimethoate,
Malathion, Methidathion

Carbamate: Methomyl, Carbaryl

Neonicotinoid: Imidacloprid

Pyrethroids:

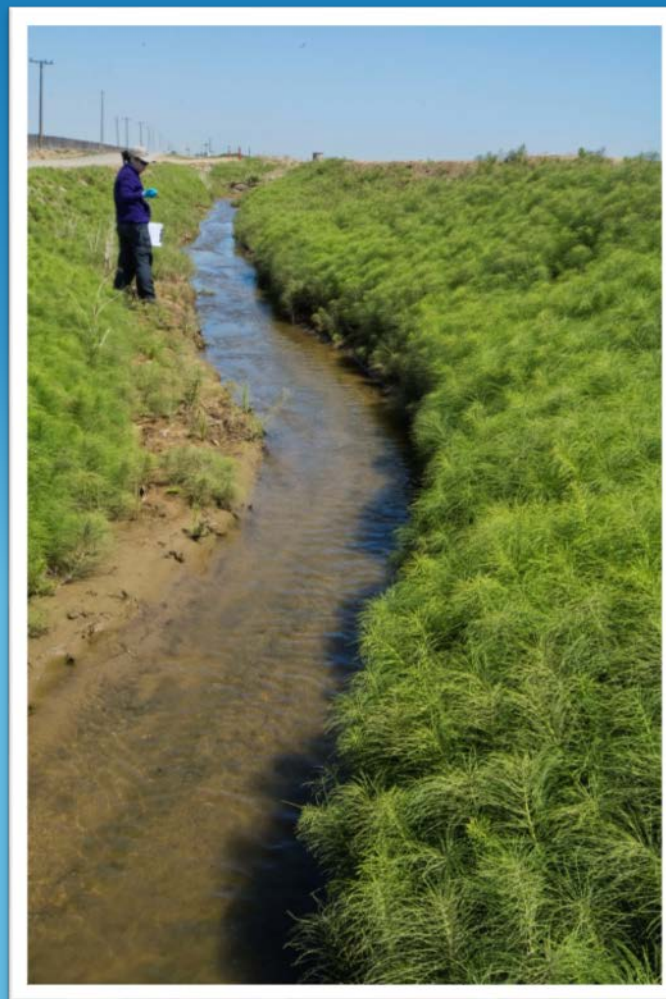
Bifenthrin, λ -cyhalothrin, Cyfluthrin,
Cypermethrin, Permethrin,
Fenvalerate/Esfenvalerate

Diacylhydrazine:

Methoxyfenozide, Tebufenozide

Anthranilic diamide:

Chlorantraniliprole



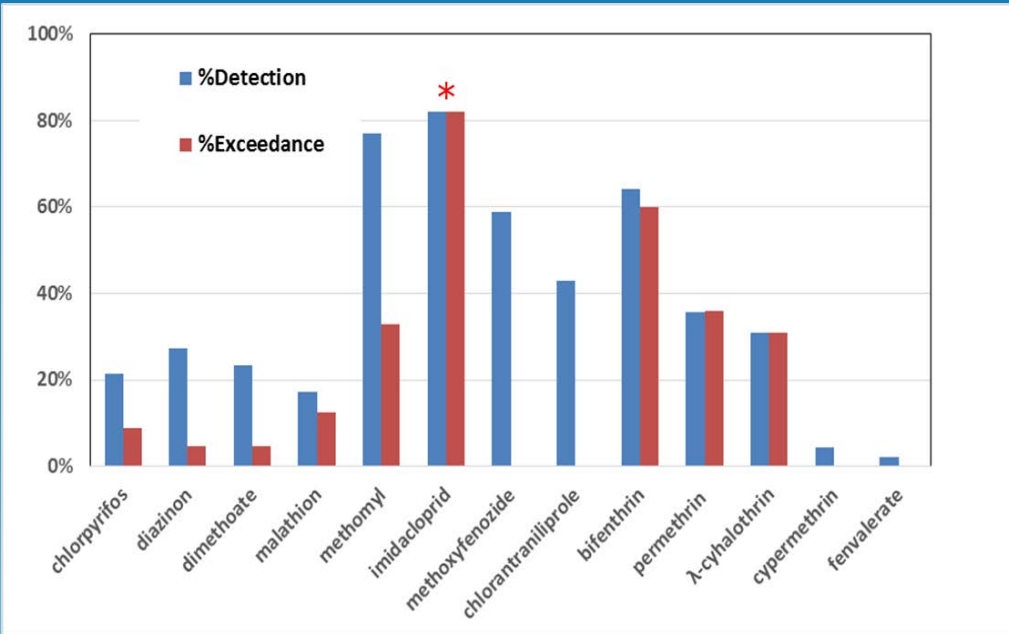
US EPA Aquatic Life Benchmarks

Pesticide	Fish (µg/L)		Invertebrate	
	Acute (µg/L)	Chronic (µg/L)	Acute (µg/L)	Chronic* (µg/L)
Imidacloprid	114500	9000	0.385	0.01
Bifenthrin	0.075	0.04	0.8	0.0013
Cyfluthrin	0.034	0.01	0.0125	0.0074
Cypermethrin	0.195	0.14	0.21	0.069
Esfenvalerate	0.035	0.035	0.025	0.017
Lambda-cyhalothrin	0.039	0.031	0.0035	0.002
Permethrin	0.395	0.0515	0.0195	0.0014

*Benchmark exceedances are based on invertebrate chronic benchmark values

Insecticide Detections and Benchmark Exceedances in 2011-2016

Salinas



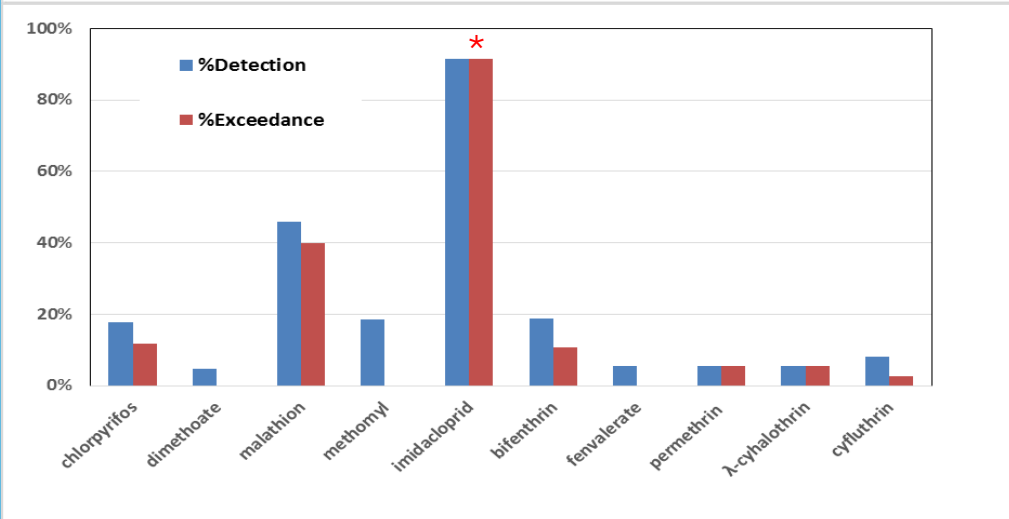
Insecticides >5% detections

Salinas: 13
Santa Maria: 10

Insecticides >20% benchmark exceedances

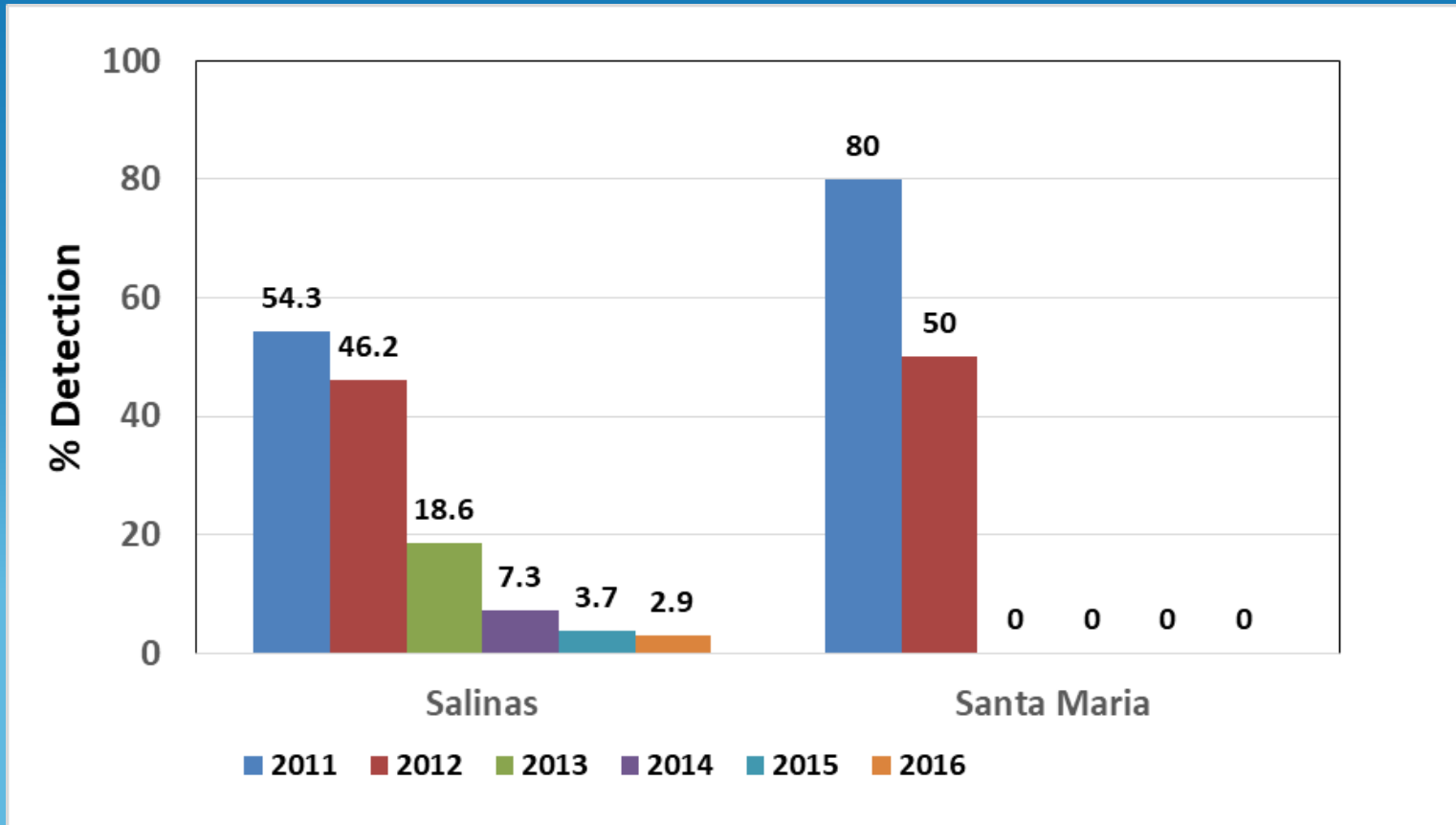
Salinas:
Methomyl, Imidacloprid,
Bifenthrin, Permethrin,
Lambda-cyhalothrin
Santa Maria:
Imidacloprid, Malathion

Santa Maria



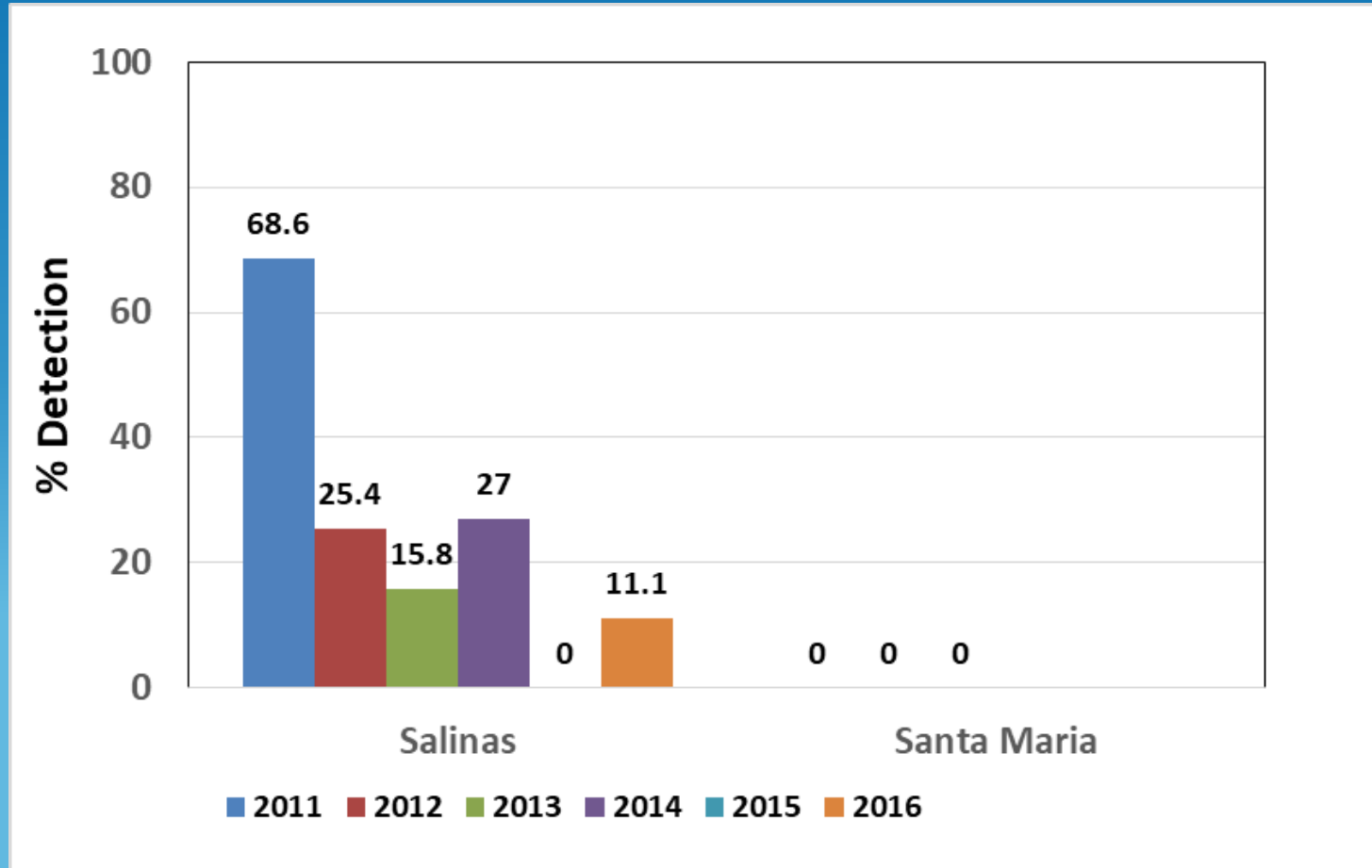
* % exceedances to current US EPA lowest aquatic life benchmark 0.01 ppb, imidacloprid RL = 0.05 ppb

Detections by Year: Chlorpyrifos



Significant downtrend in % detection frequencies
(Chi-square test, $p < 0.0001$)

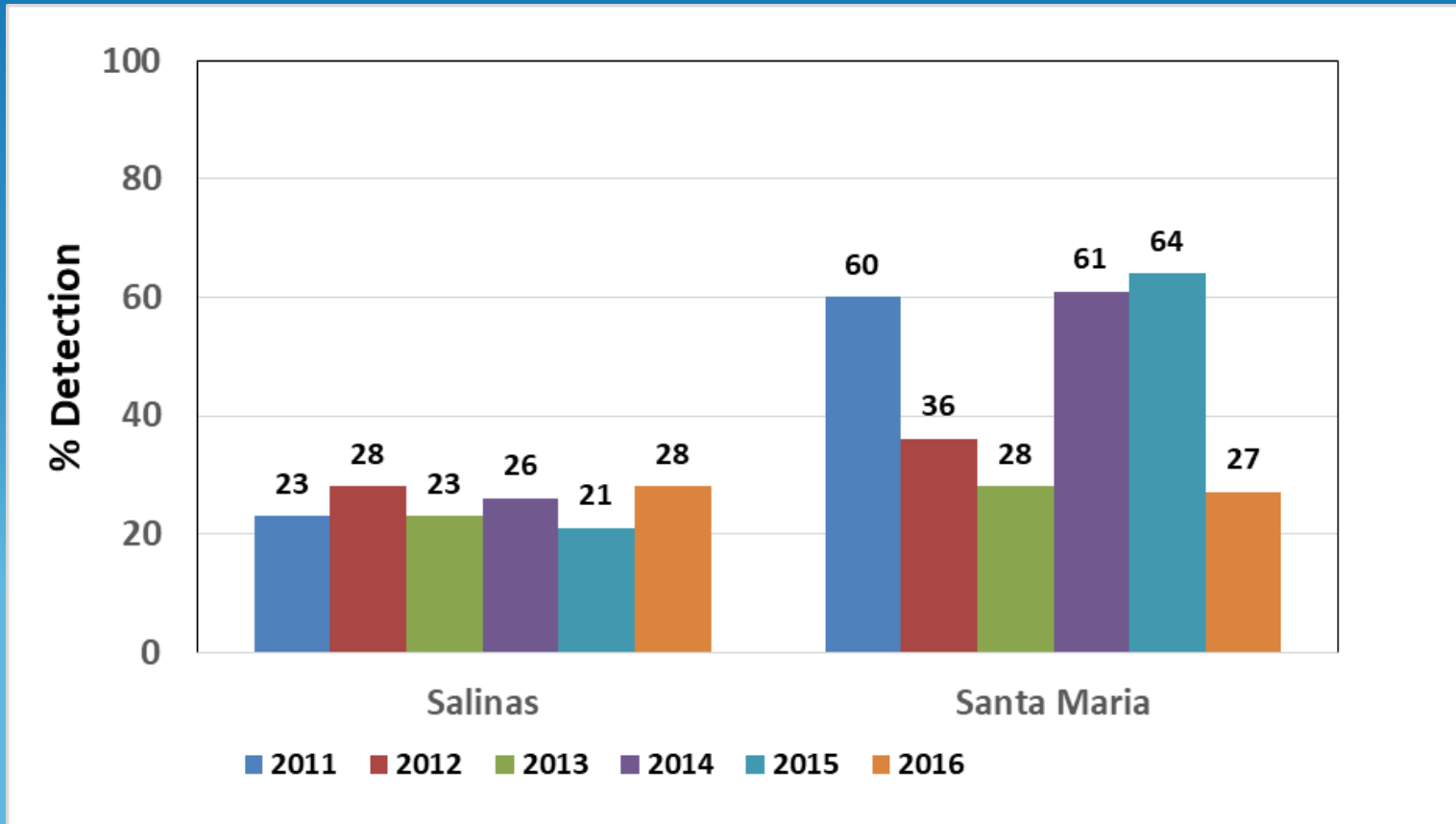
Detections by Year: Diazinon



Significant differences
(Chi-square, $p < 0.0001$)

No detections in 2011-
2013. No data since 2014

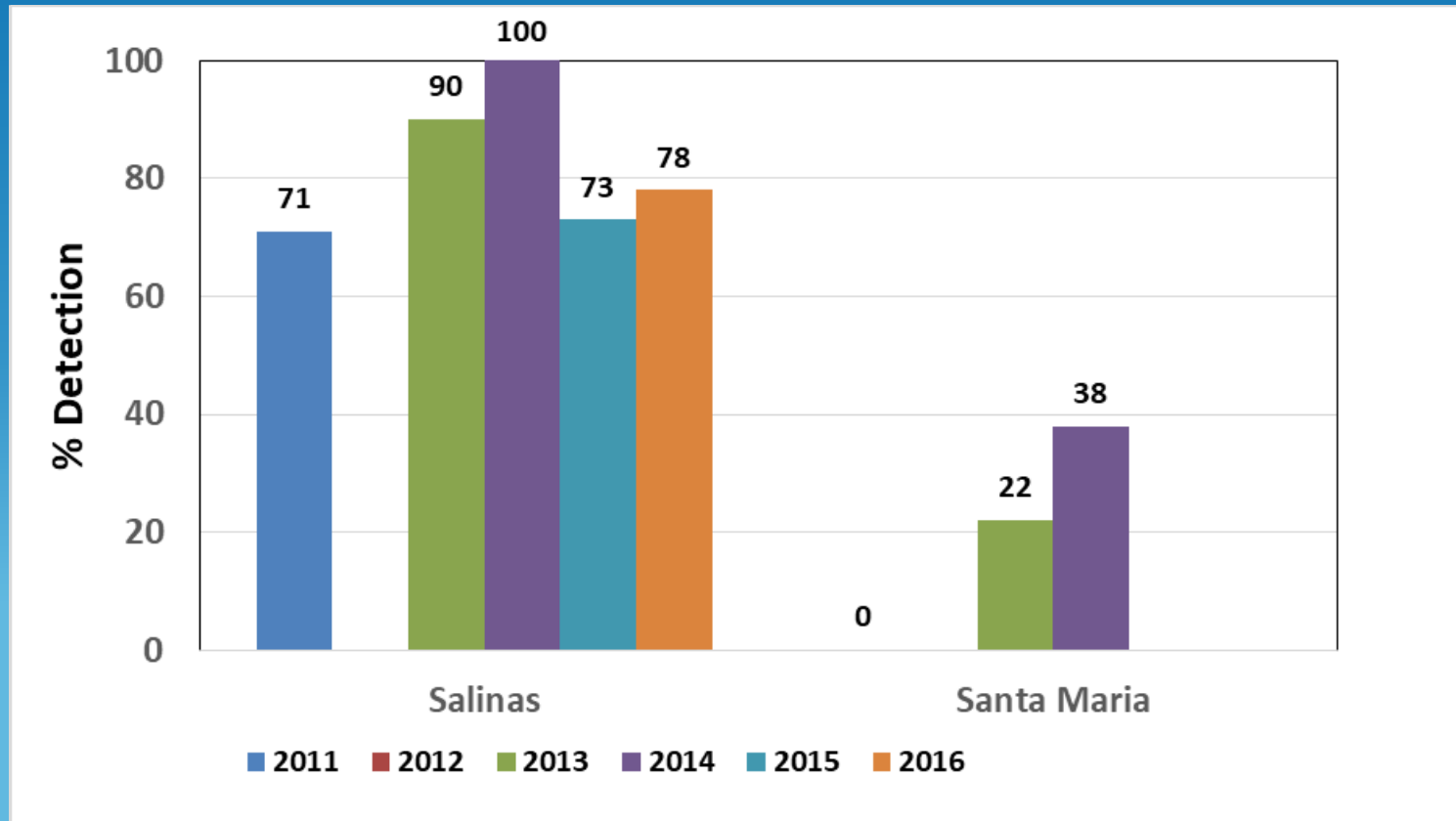
Detections by Year: Malathion



Salinas: No significant difference
Chi-square, $p > 0.9297$)

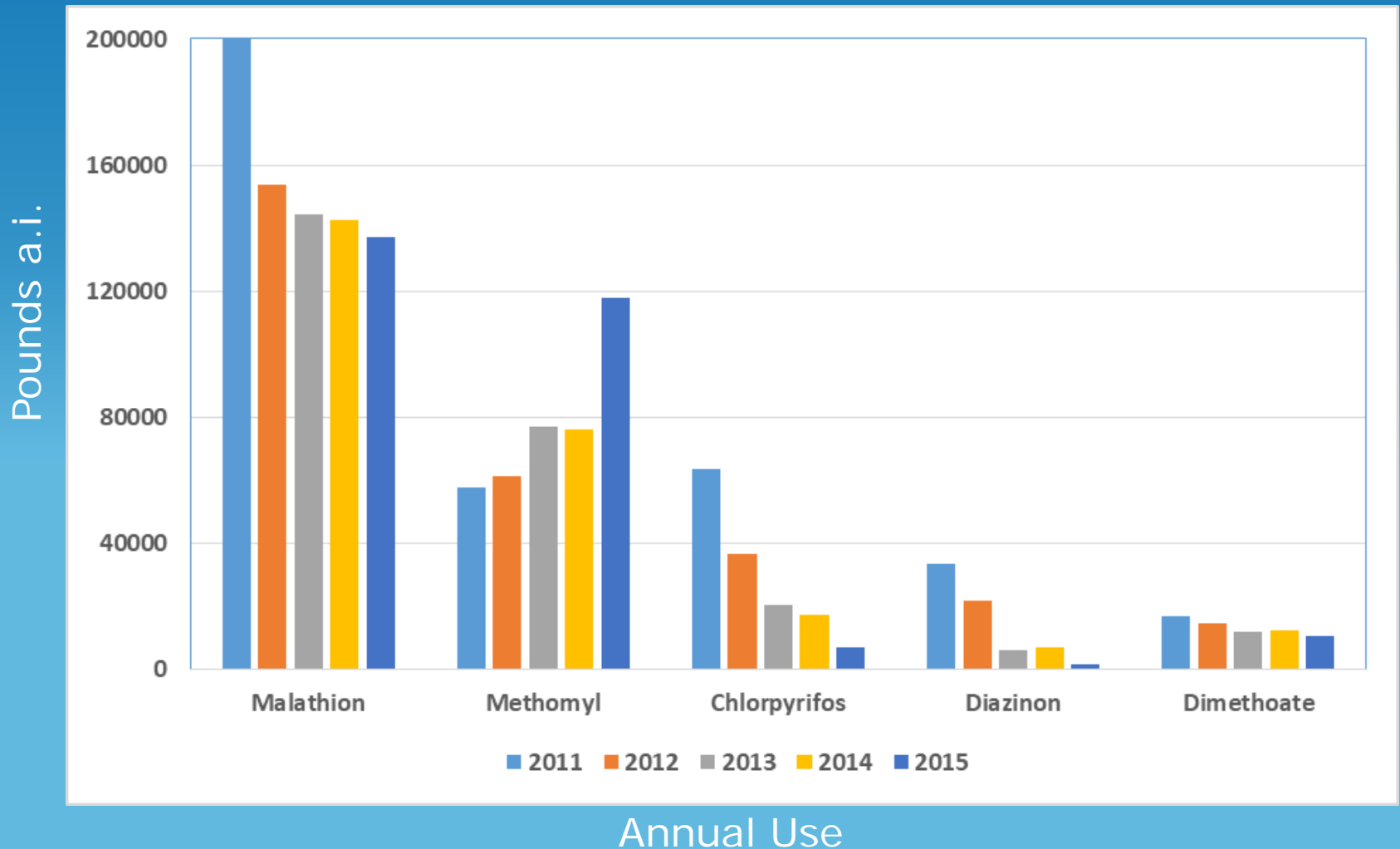
Santa Maria: No significant
difference (Chi-square, > 0.1059)

Detections by Year: Methomyl

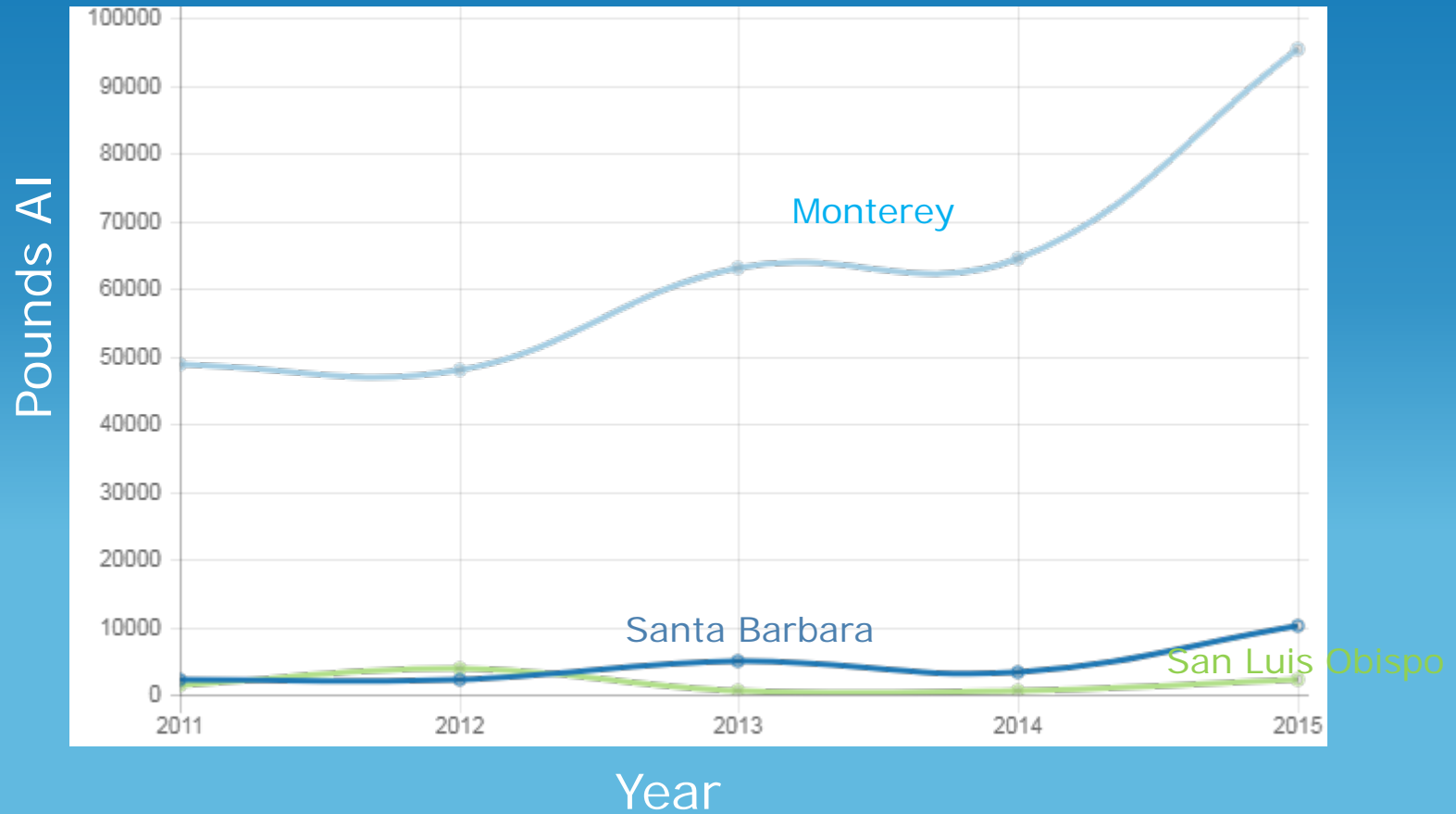


No significant difference among the years in both regions

Organophosphates and Carbamate Agricultural Uses in the Central Coast



Methomyl Agricultural PUR Records in 2011-2015

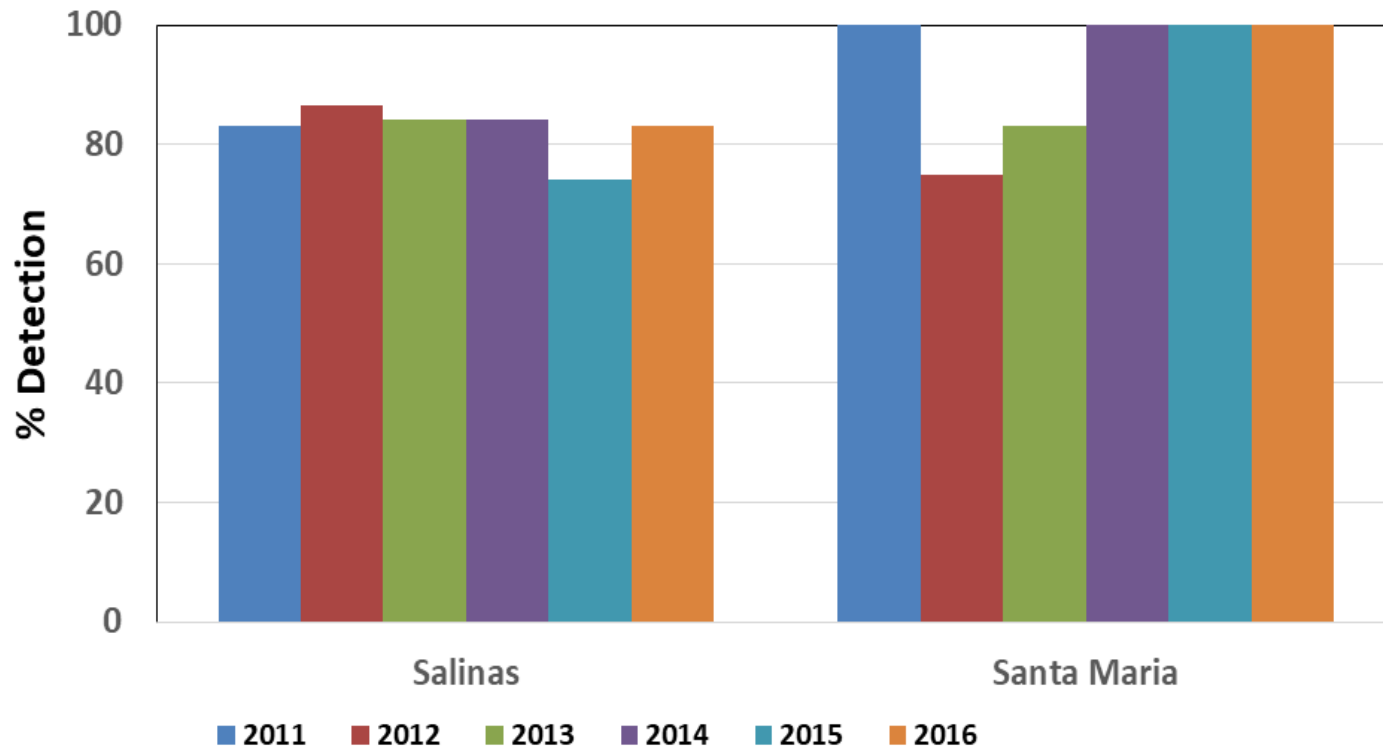


Summary: Organophosphates and Carbamate

- Significant temporal downtrend on chlorpyrifos and diazinon uses and their detection frequencies
- No temporal trends observed for malathion and methomyl detection frequencies
- Malathion detection frequencies and uses are significantly higher in Santa Maria
- Methomyl detection frequencies and uses are significantly higher in Salinas



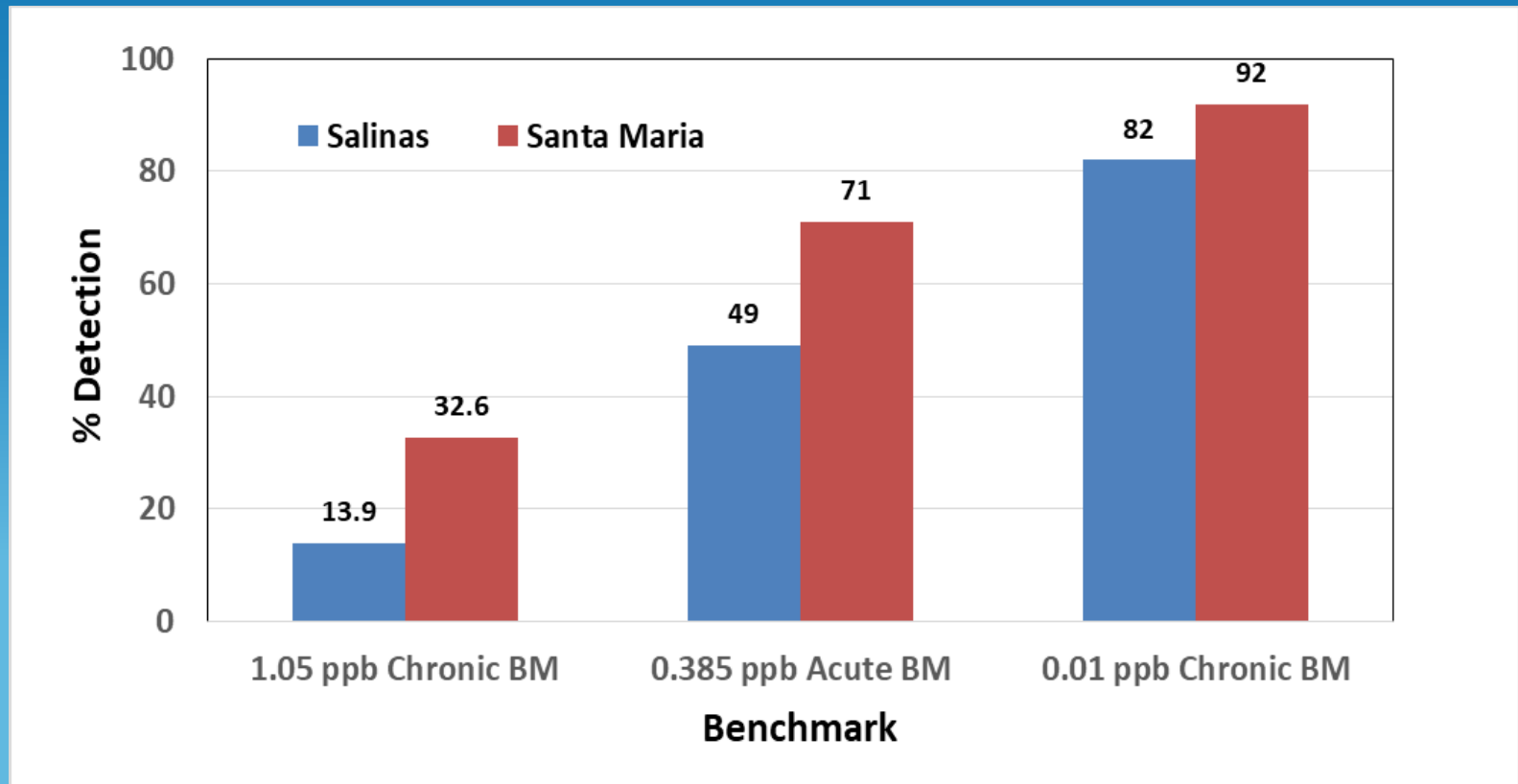
Detections by Year: Imidacloprid



No significant differences in Salinas (N = 240, Chi-square test, $p > 0.6730$)

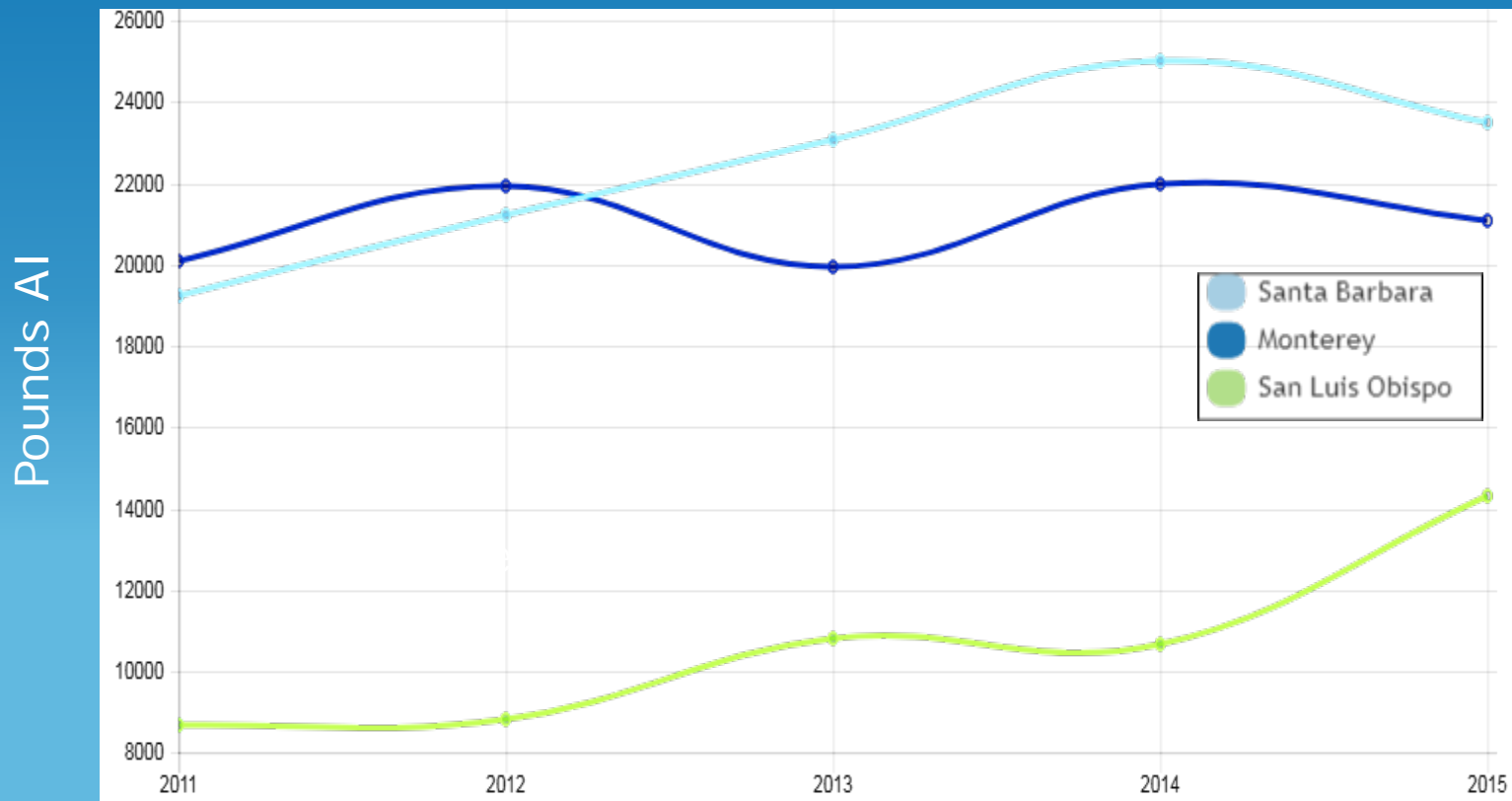
Significantly high detections in 2011 and 2014-2016 in Santa Maria (N = 84, Chi-square test, $p < 0.0095$)

Chronic and Acute Benchmark Exceedances between Areas: Imidacloprid



Significantly higher benchmark exceedances in Santa Maria
(Chi-square test, $p < 0.0006$)

Imidacloprid Agricultural PUR Records in 2011-2015



Solubility: 610 mg/L (20°C)

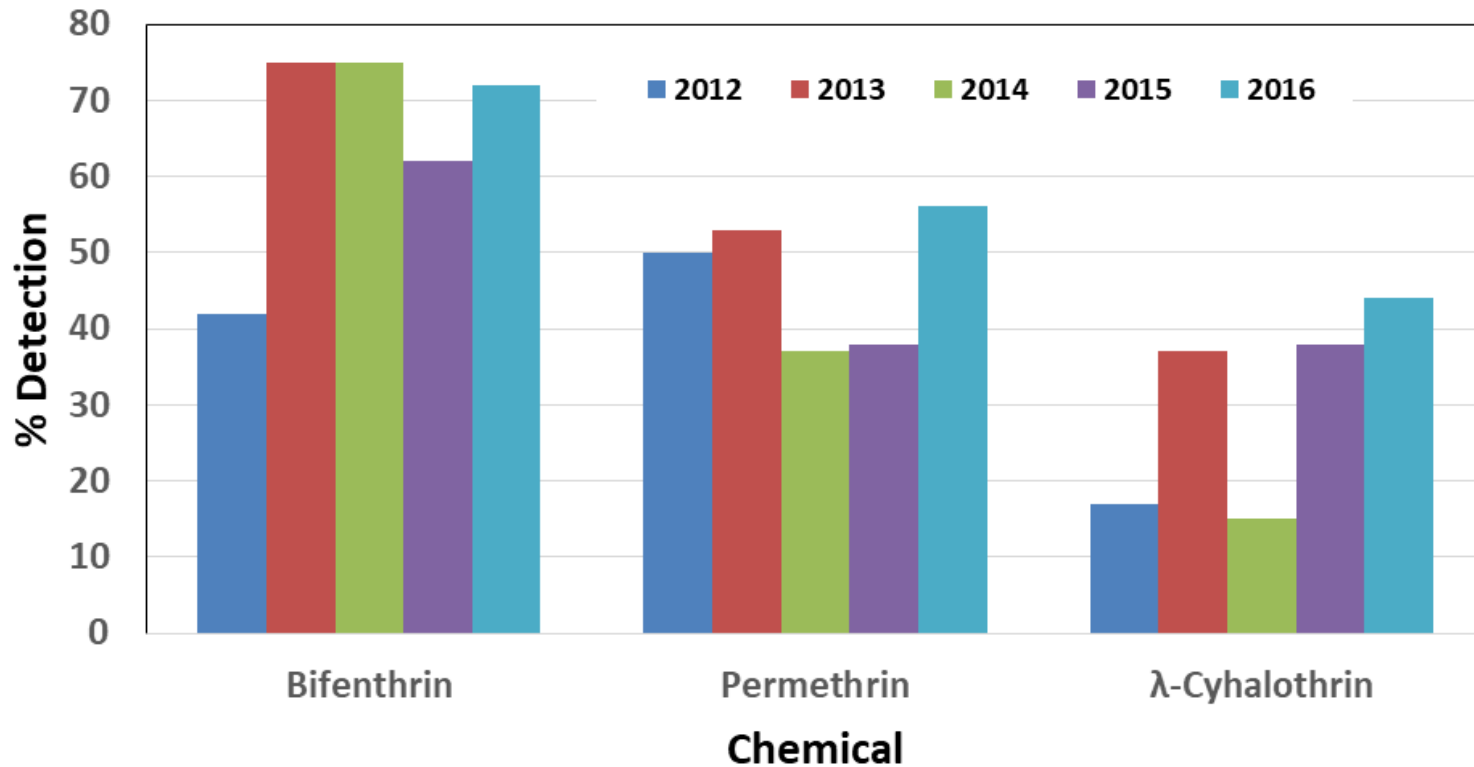
Kow (logP): 0.57 (21°C)

Water-sediment half-life: 129 days

Summary: Imidacloprid

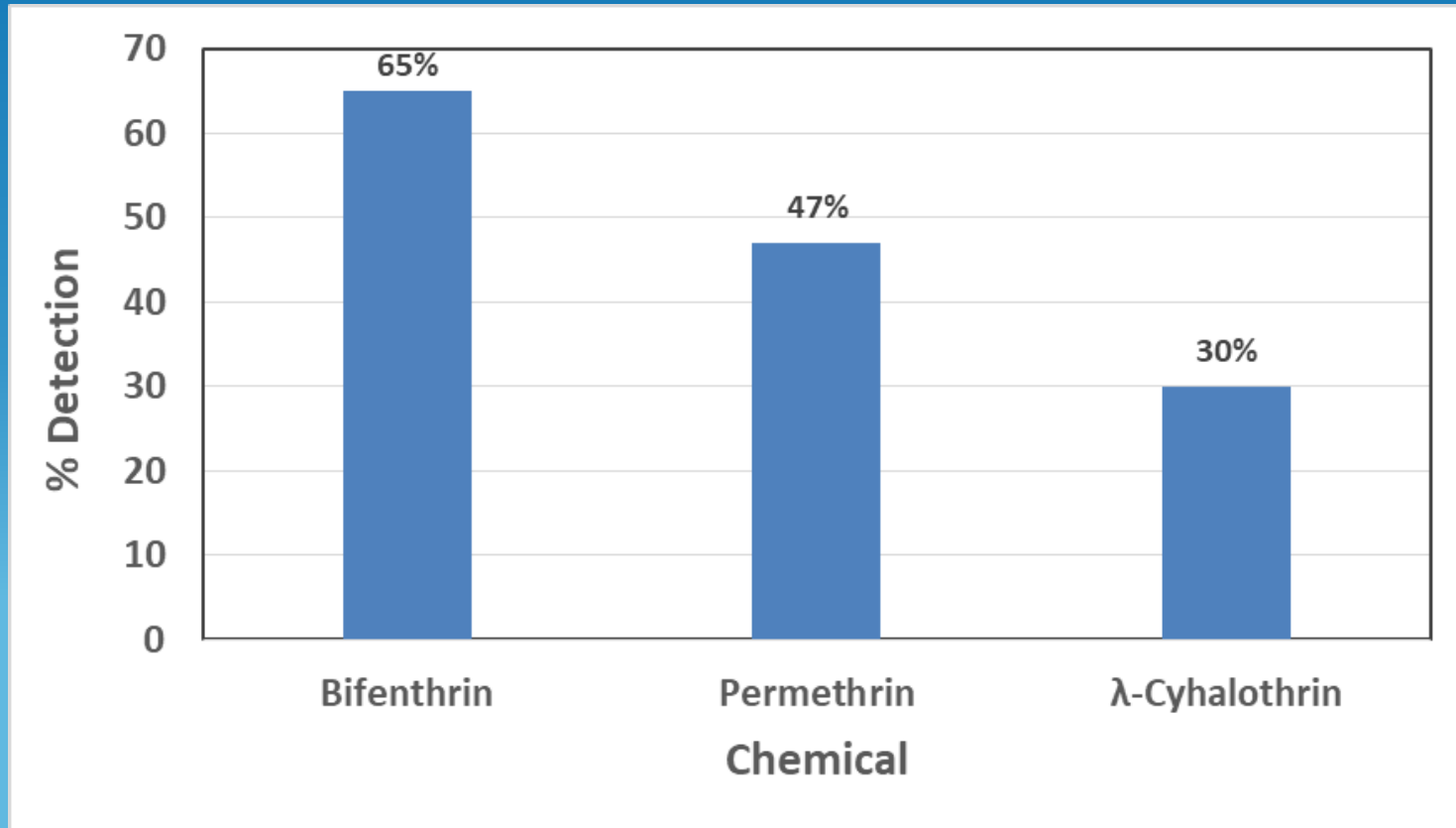
- Widespread detections with no significant temporal trends
- Recent change of the US EPA lowest chronic benchmark from 1.05 to 0.01 ppb result in high % exceedances:
 - 92% (32.6% at 1.05 ppb benchmark) exceedance for samples from Santa Maria and 82% (13.9% at 1.05 ppb benchmark) exceedance for samples from Salinas
- Samples from Santa Maria area had significantly greater % detections and % benchmark exceedances
- Causes of widespread detections:
 - high water solubility and persistence
 - constant high use amounts

Detections in Salinas by Year: Bifenthrin



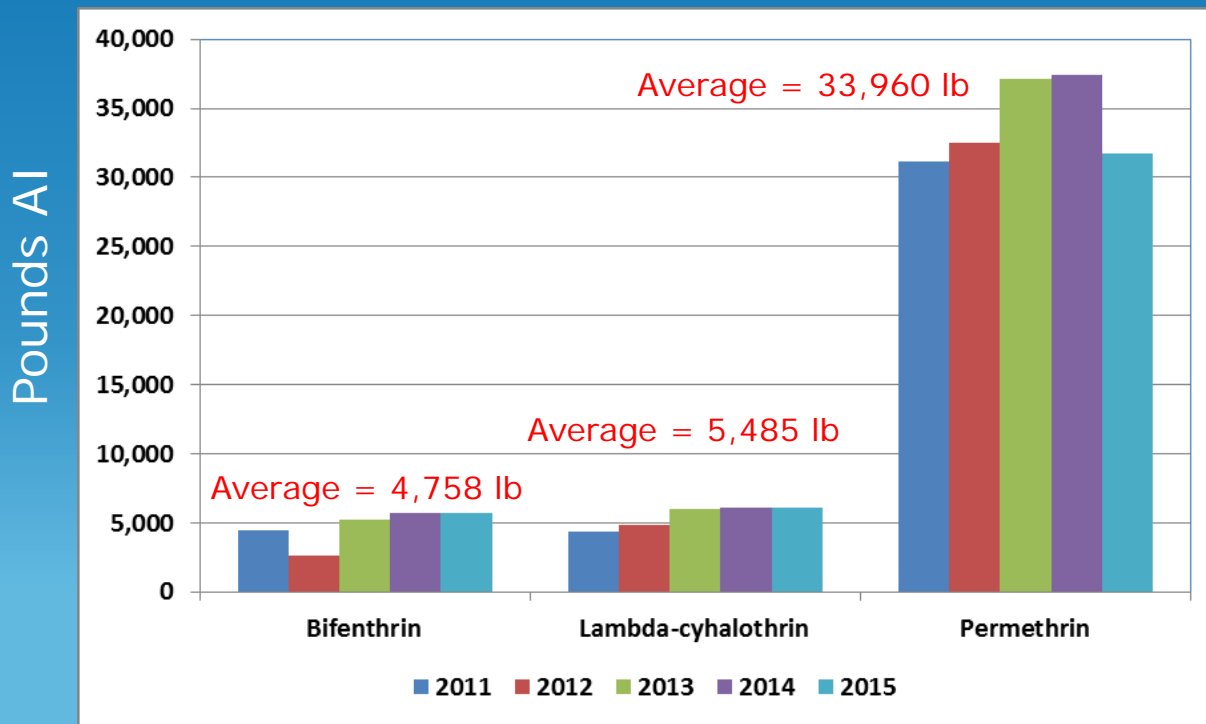
No significant differences detected for each chemical by year

Detections in Salinas by Chemical



Significantly higher detections for bifenthrin, followed by permethrin and lambda-cyhalothrin (N=271, Chi-square test, $p < 0.0001$)

Pyrethroids Agricultural PUR Records in Monterey County 2011-2015



Property*	Bifenthrin	L-cyhalothrin	Permethrin
Solubility (mg/L, 20°C)	0.001	0.005	0.2
Koc (L/Kg)	236,610	283,707	100,000
Water-sediment Half-life (day)	261	15.1	40

*from IUPAC Pesticide Properties Database

Summary: Pyrethroids in Salinas

- No temporal trends on detection frequencies observed for any of the pyrethroids due to constant widespread uses
- Bifenthrin has the highest detection frequency despite the lowest average use amount
 - Likely due to its high persistence and Koc



Data Assessment

- PUR data analyses for use patterns at watershed level
- Monitoring site-specific analyses in linking monitoring results to PUR data and other parameters such as land use/crop, hydrology, topology and soil information



Mitigation Research

- Characterizing microbial remediation of pesticides in woodchip bioreactors

**Dr. Arlene Haffa, CSUMB
(2017-2019)**

- Developing molecular biomarkers to assess chlorantraniliprole and imidacloprid impacts in aquatic species

**Dr. Richard Connon, UCD
(2017-2018)**



Mitigation Research

- Evaluation of an integrated system to mitigate pesticide and their toxicity in Tembladero Slough

**Dr. Anderson/Phillips, UCD
(2017-June, 2019)**

- An integrated vegetated treatment system for mitigating imidacloprid and permethrin in agriculture irrigation runoff

**Dr. Cahn/Phillips, UC
Extension & UCD**

- Woodchip bioreactors in the Central Coast





Thank You!
Questions?

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Salinas River at Davis Rd.
by Kean Goh