

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

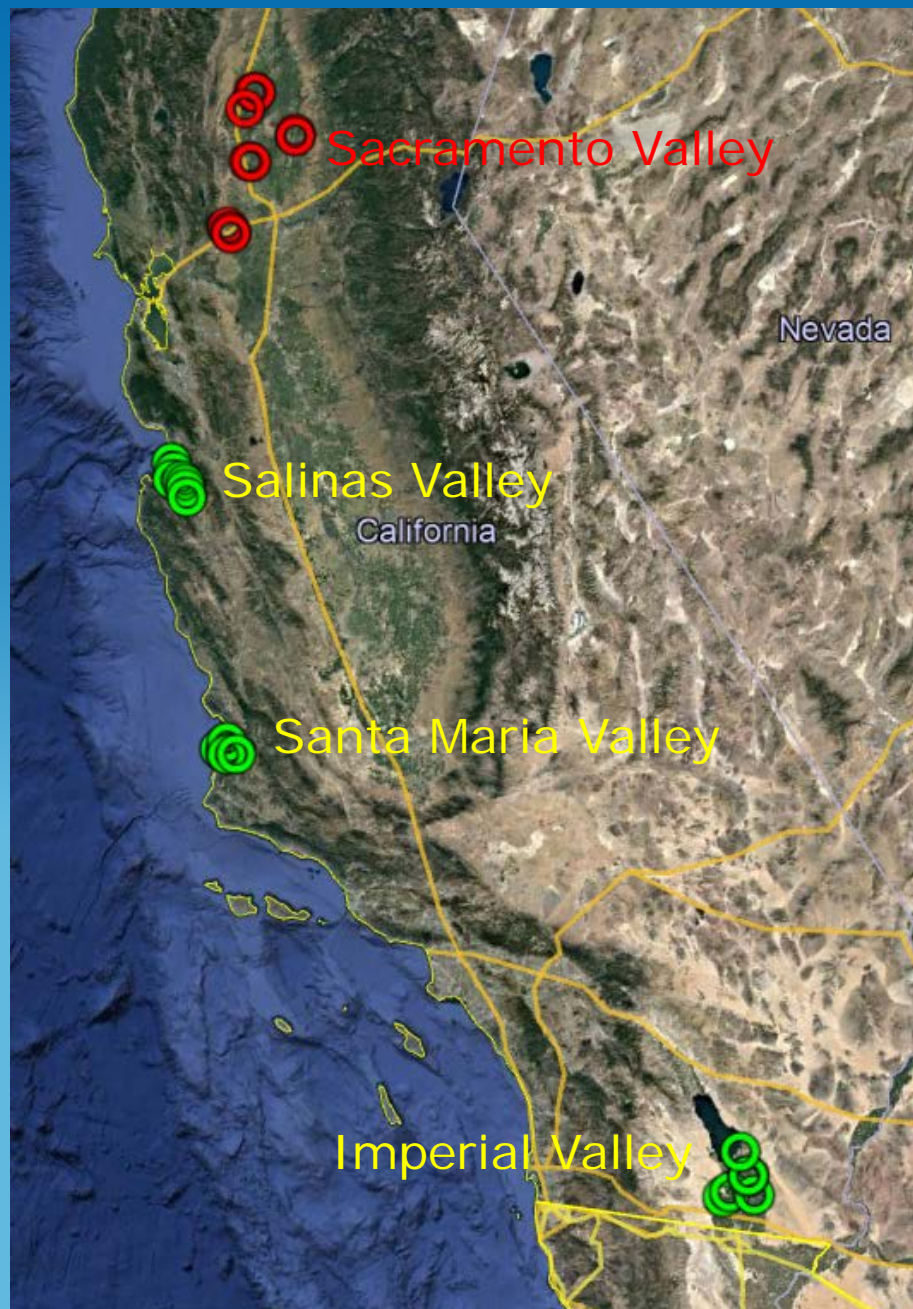
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California Department of Pesticide Regulation



AWQA Meeting, Salinas, CA  
March 20, 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*

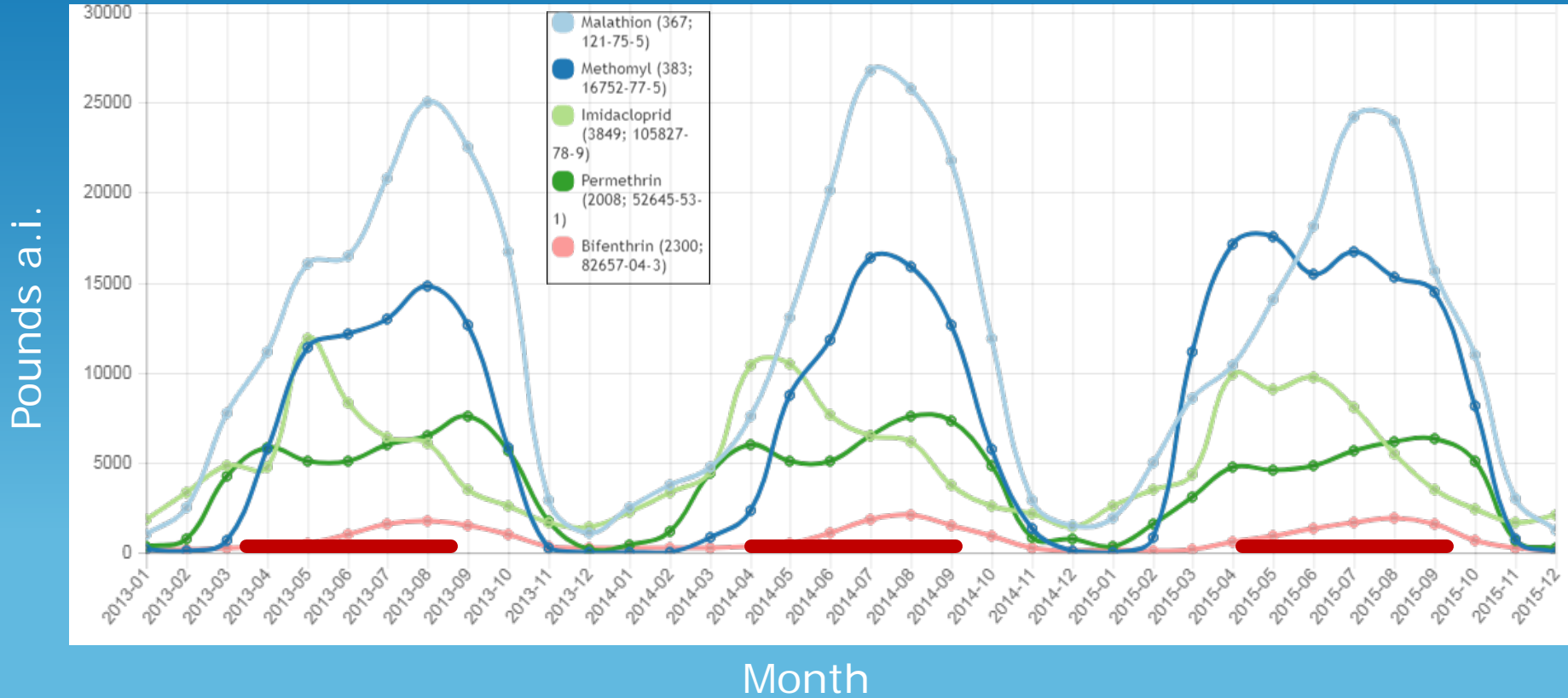
Orcutt Creek – 4 sites  
Oso Flaco Creek – 2 site  
Main St. Ditch – 1 site  
Bradley Channel – 1 site

### *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:

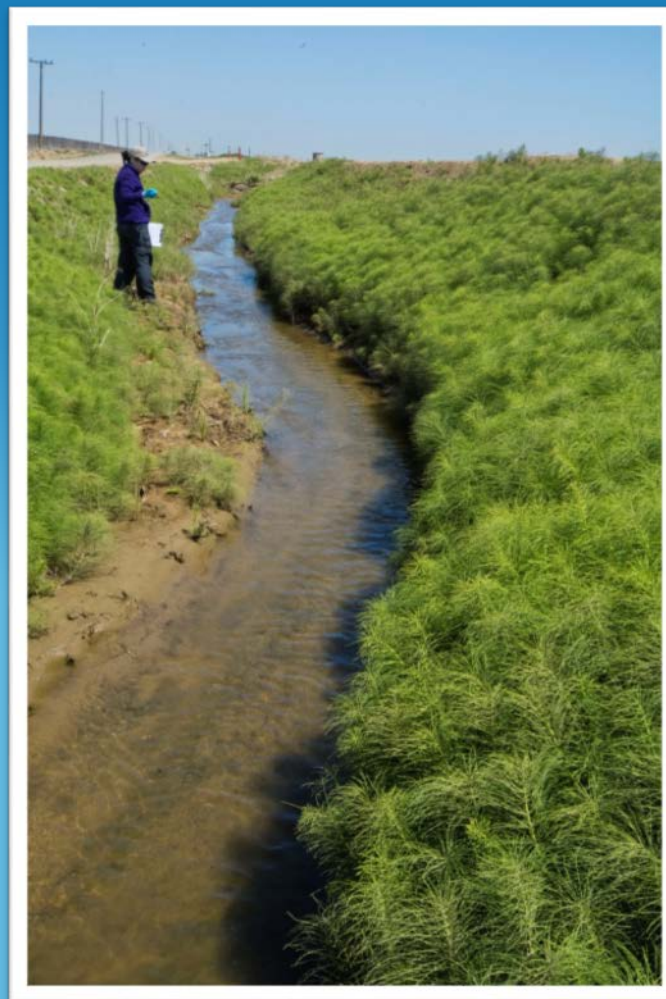
Bifenthrin,  $\lambda$ -cyhalothrin, Cyfluthrin,  
Cypermethrin, Permethrin,  
Fenvalerate/Esfenvalerate

### Diacylhydrazine:

Methoxyfenozide, Tebufenozide

### Anthranilic diamide:

Chlorantraniliprole



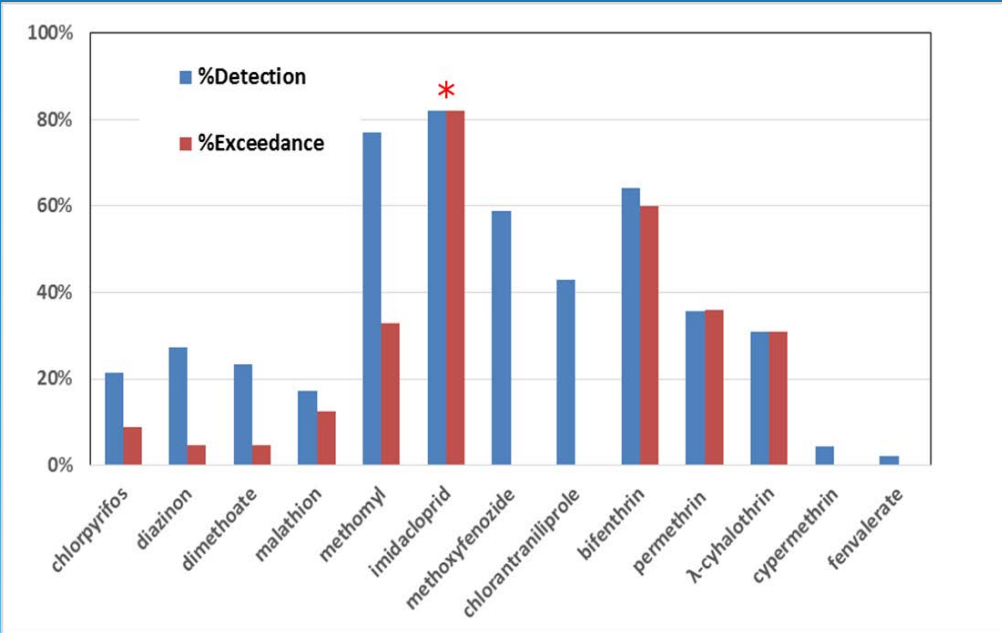
# US EPA Aquatic Life Benchmarks

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



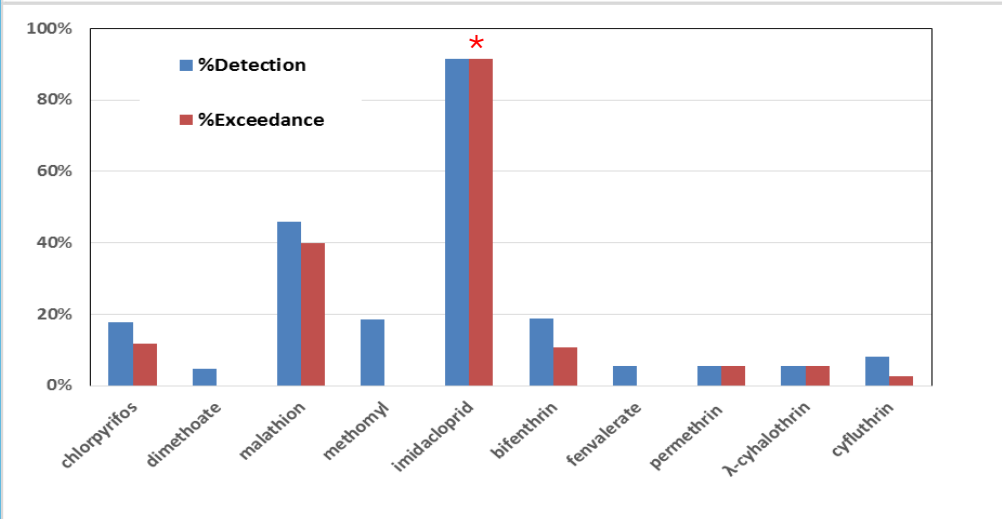
Insecticides >5% detections

Salinas: 13  
Santa Maria: 10

Insecticides >20% benchmark exceedances

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

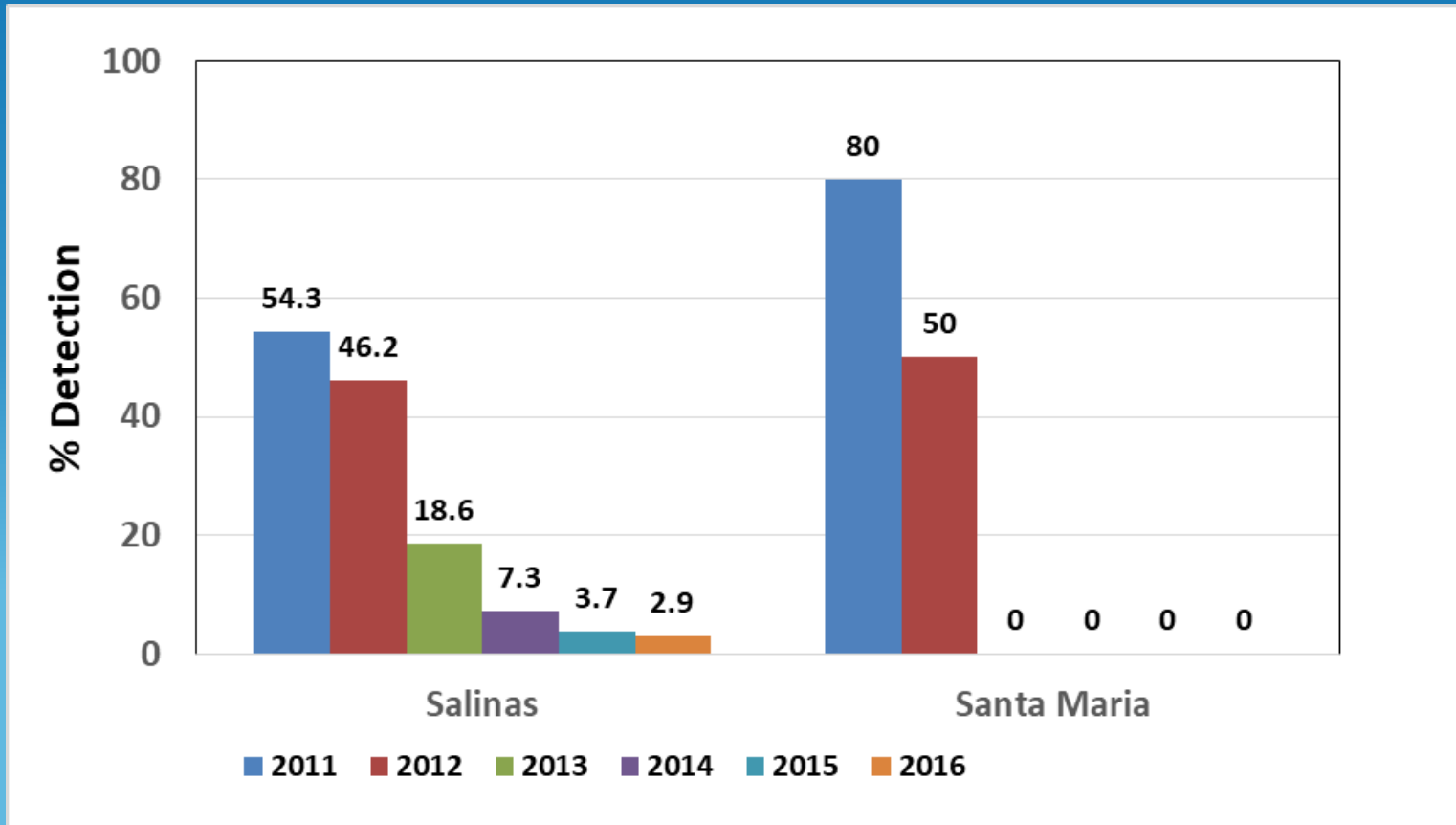
Santa Maria



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

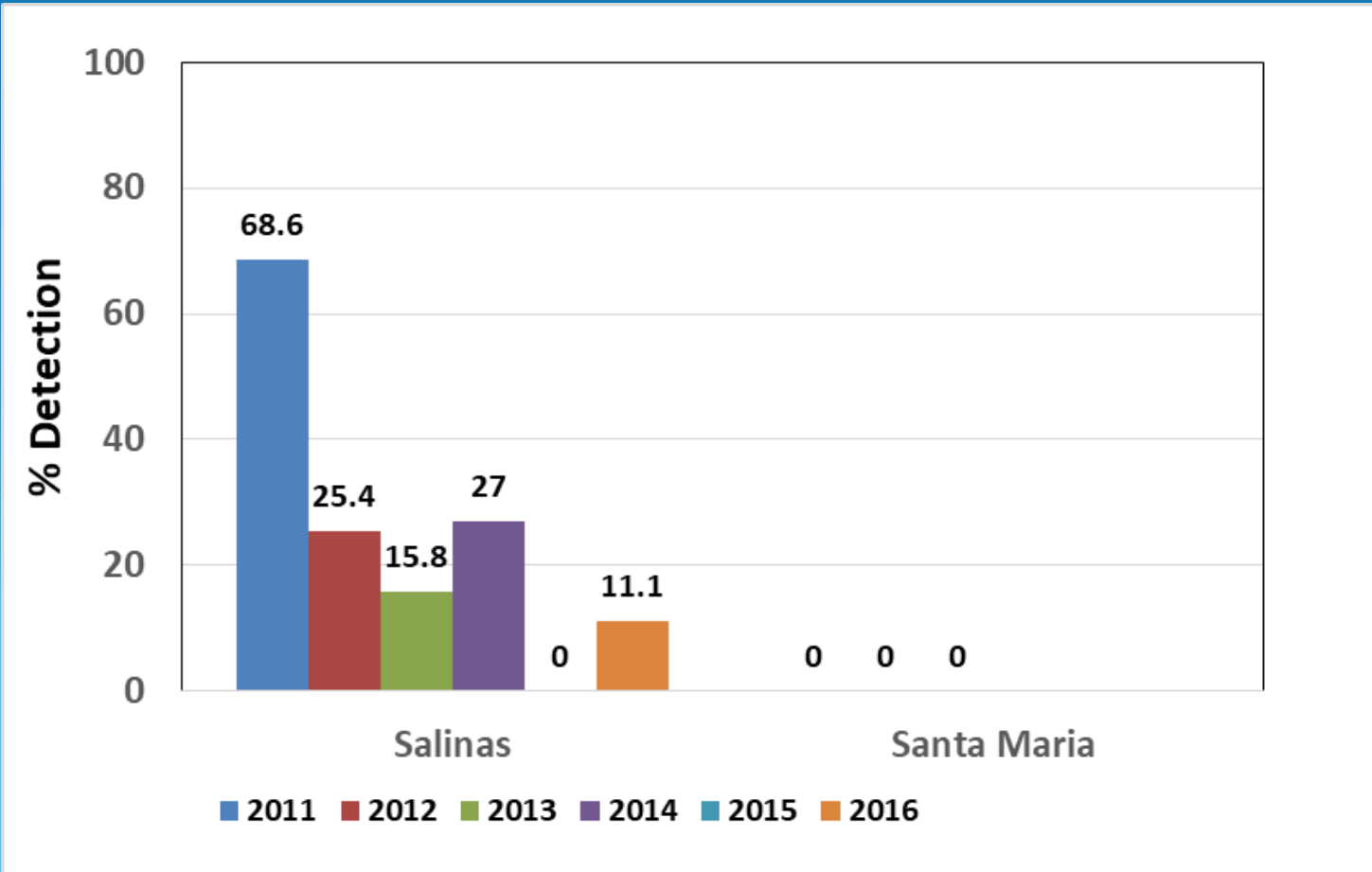


# Detections by Year: Chlorpyrifos



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

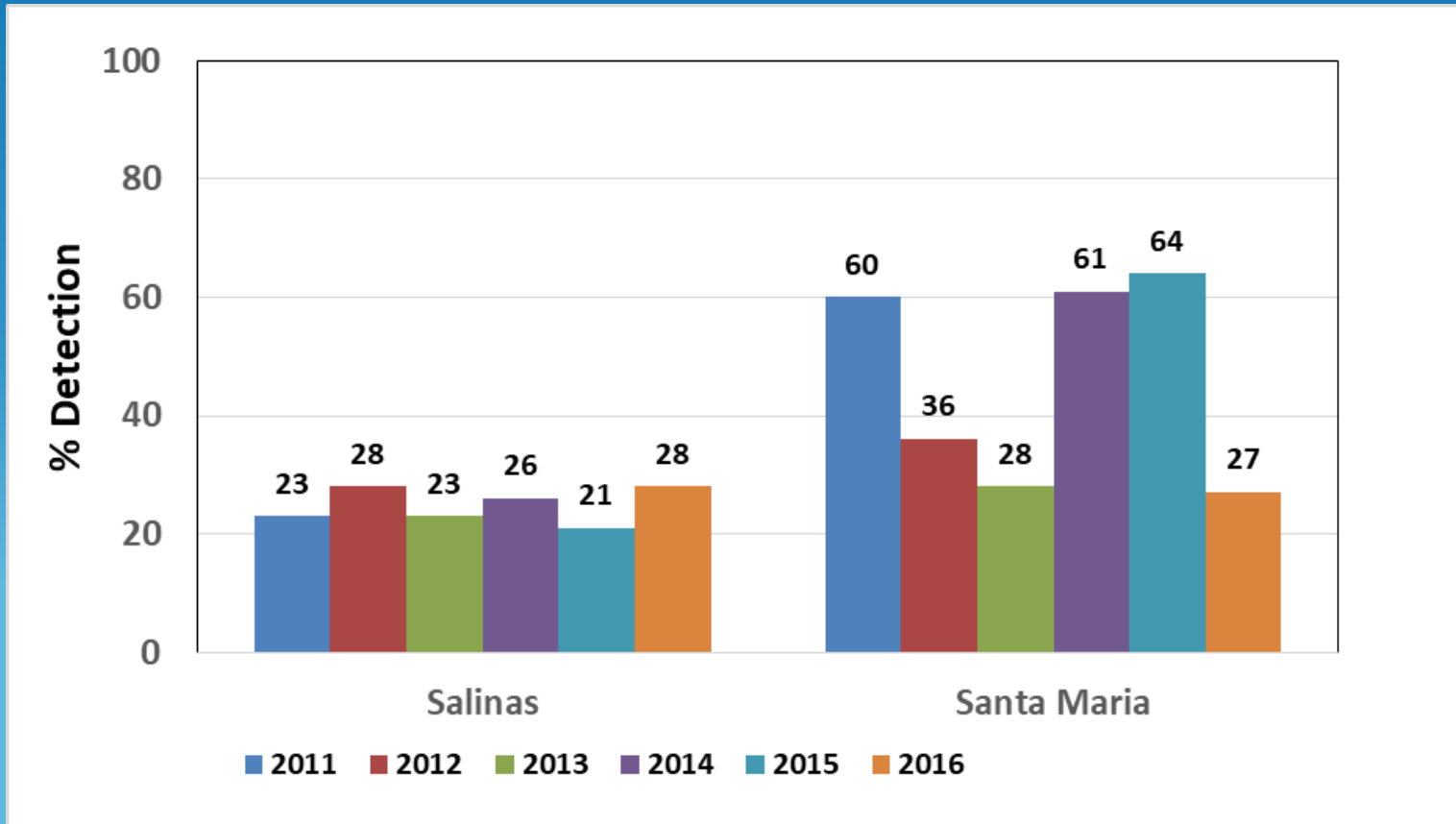
# Detections by Year: Diazinon



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

No detections in 2011-2013.  
Stopped monitoring since 2014

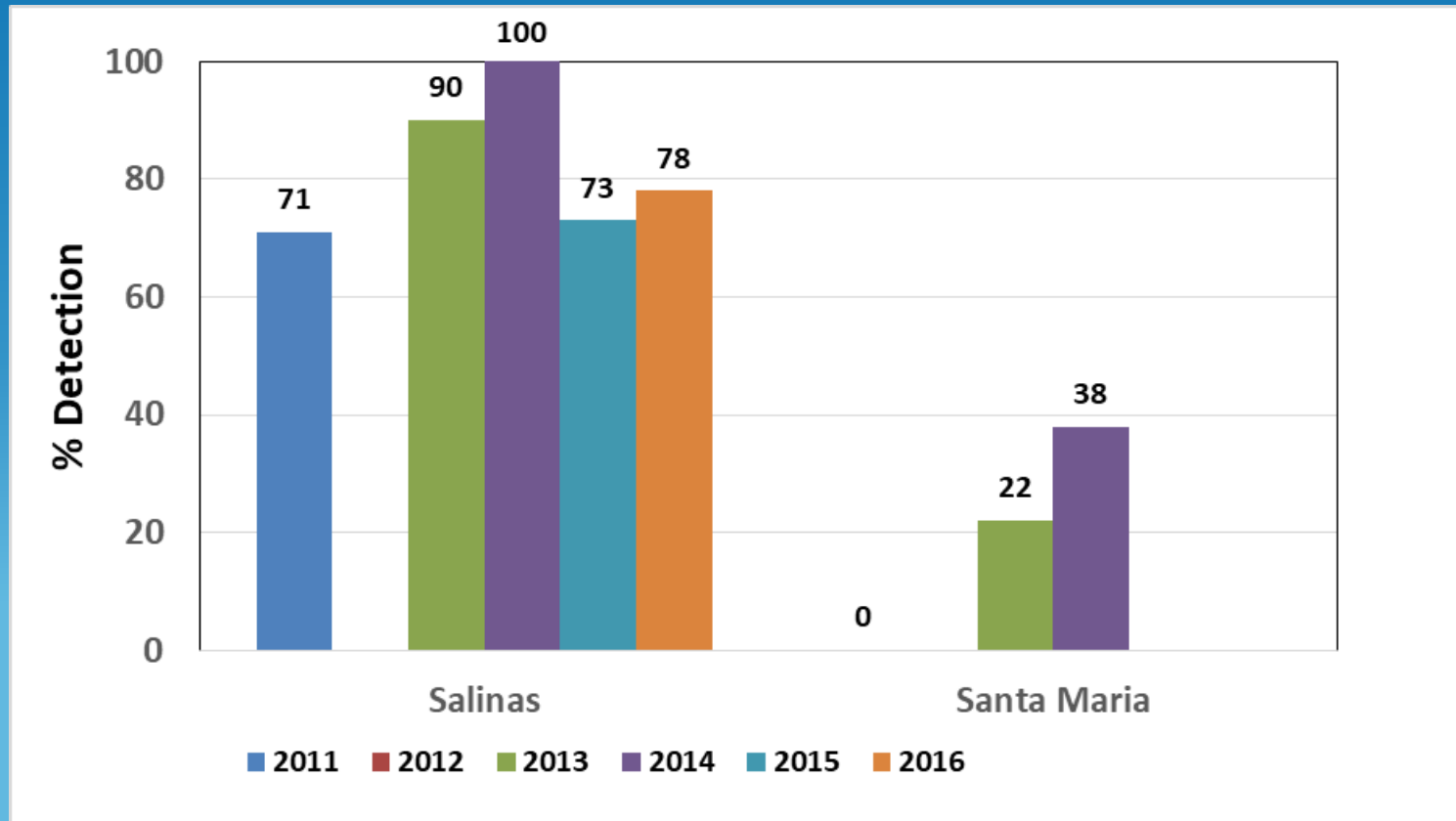
# Detections by Year: Malathion



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

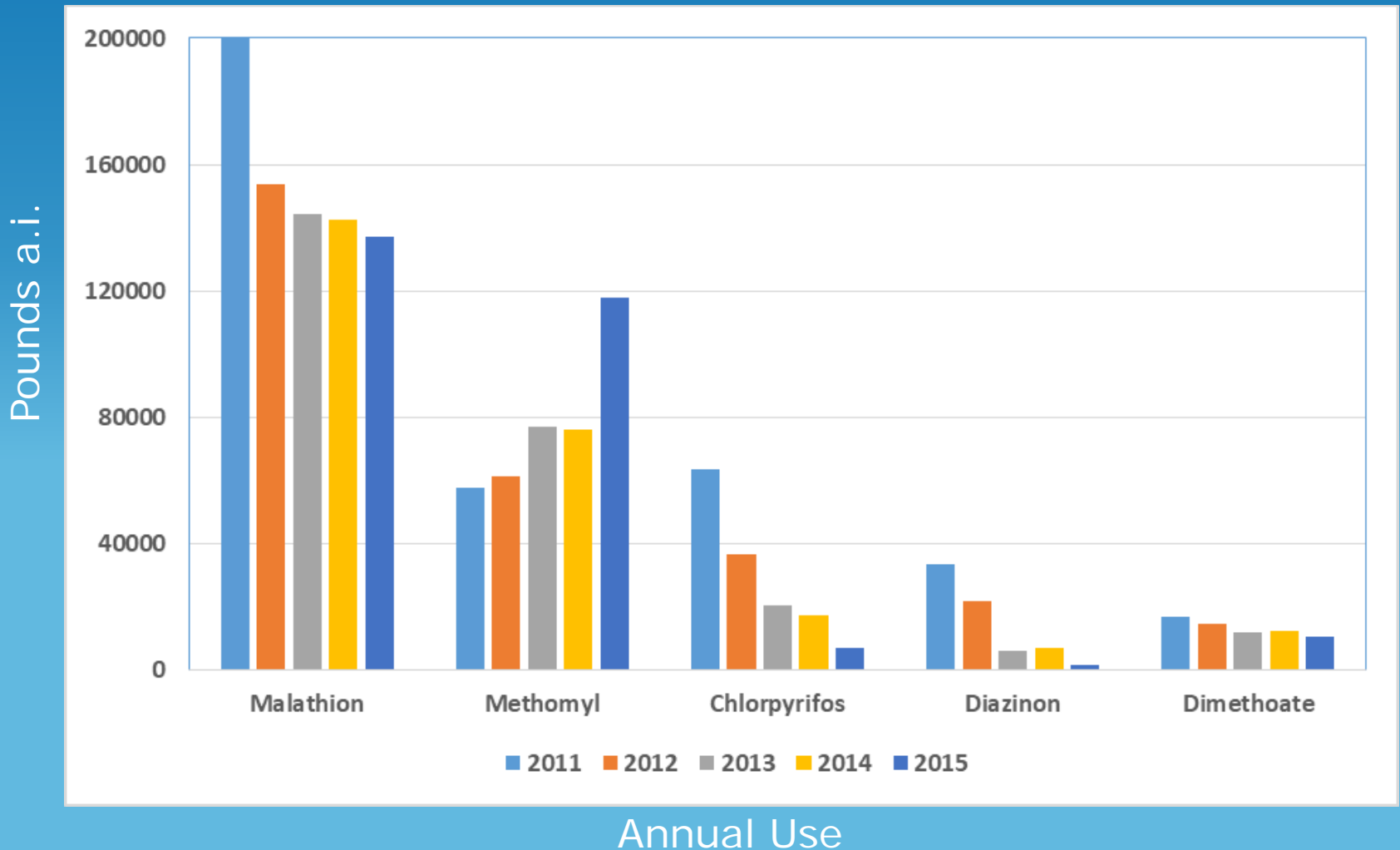
Santa Maria: No significant  
difference (Chi-square,  $> 0.1059$ )

# Detections by Year: Methomyl

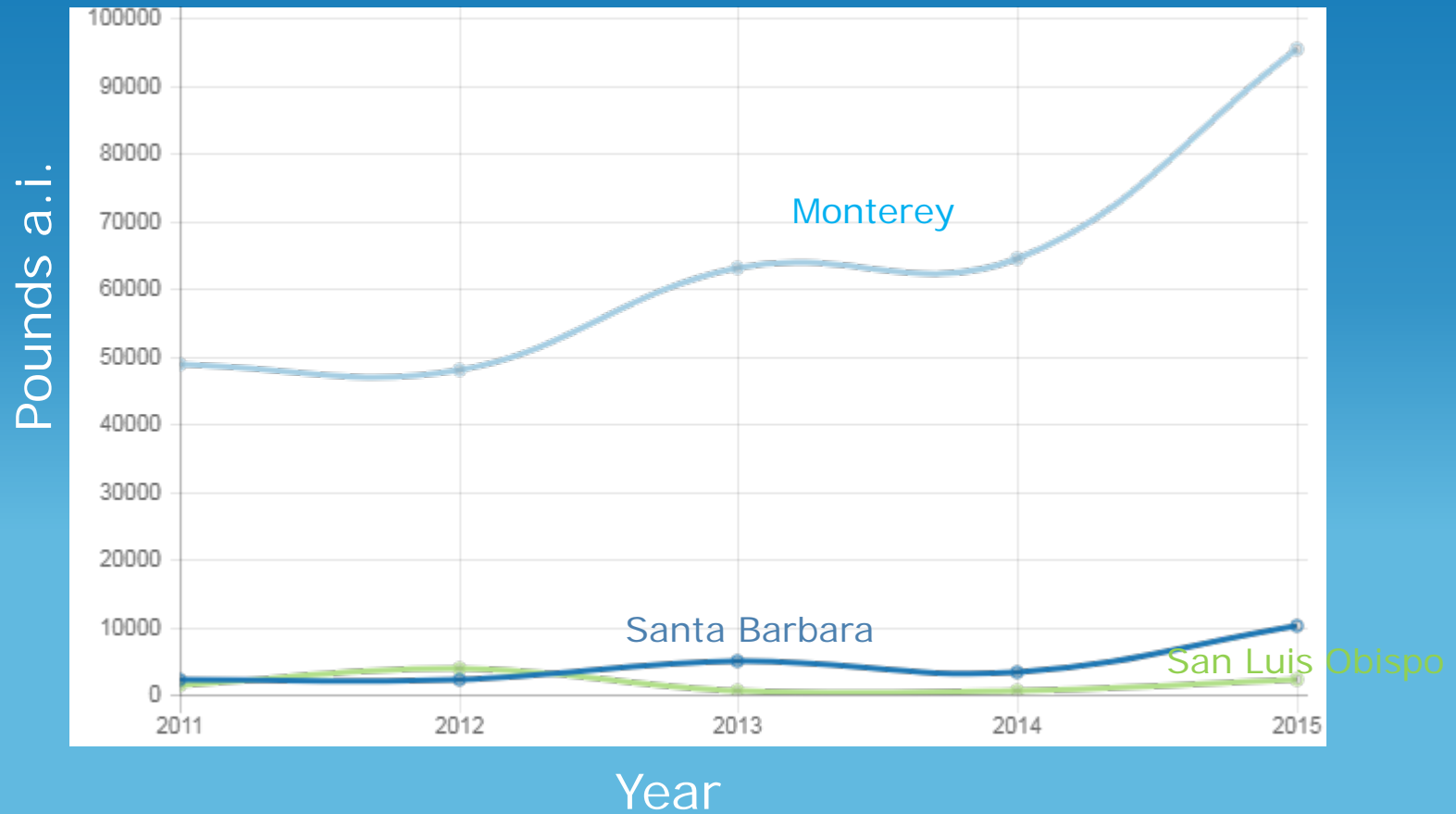


No significant difference among the years in both regions

# Organophosphates and Carbamate Agricultural Uses in the Central Coast



# Methomyl Agricultural PUR Records in 2011-2015

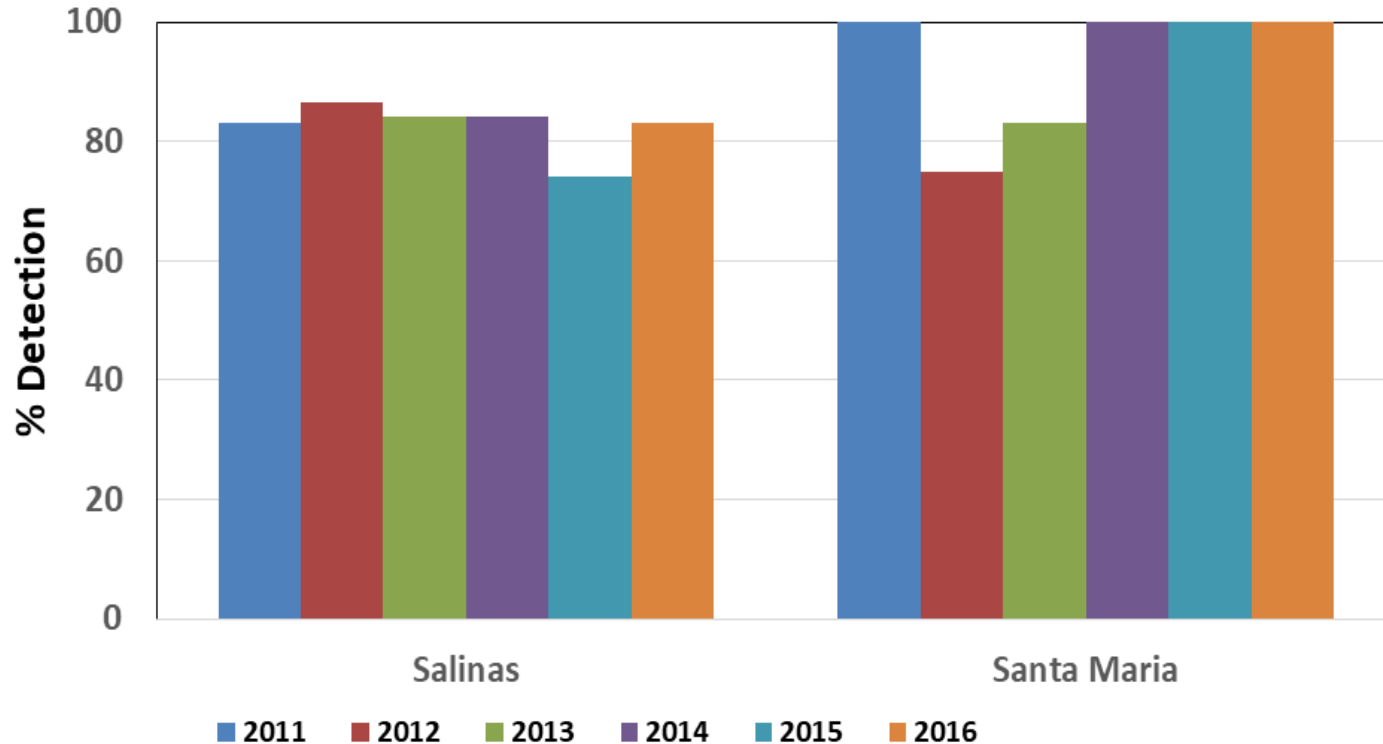


# Summary: Organophosphates and Carbamate

- 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 are significantly higher in Santa Maria
- Methomyl detection frequencies and uses are significantly higher in Salinas



# Detections by Year: Imidacloprid

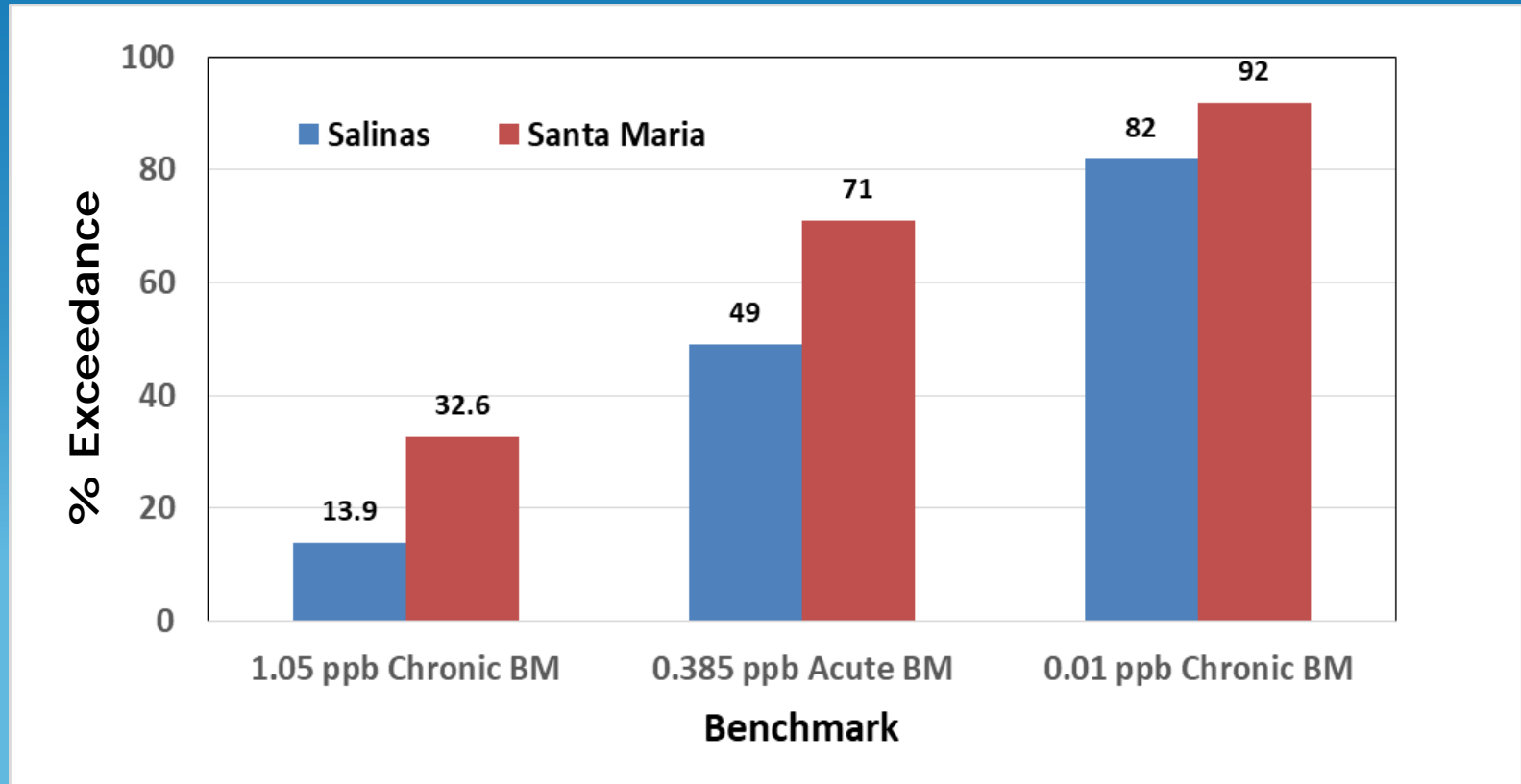


No significant differences in Salinas (N = 240, Chi-square test,  $p > 0.6730$ )

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

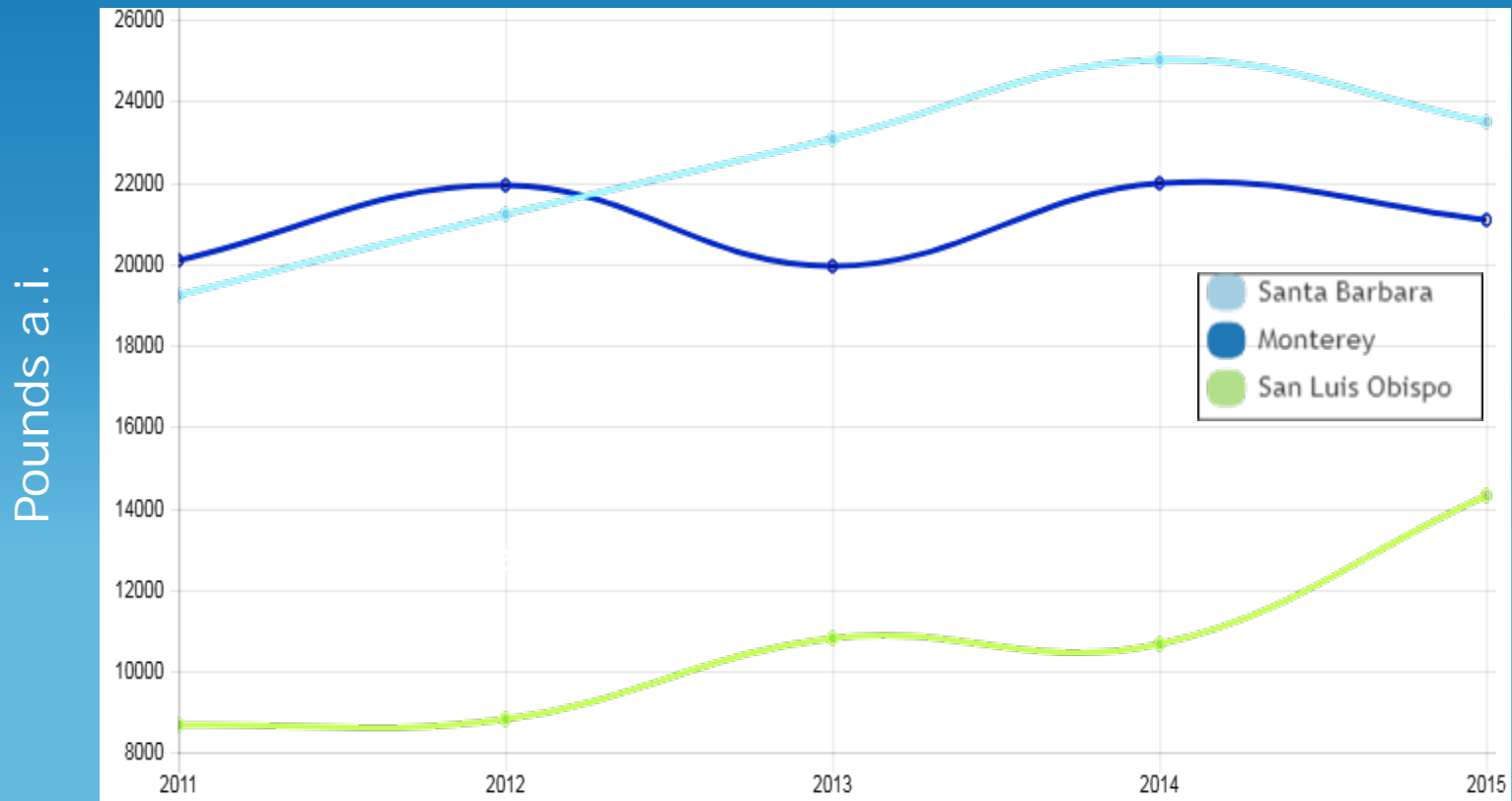


# Chronic and Acute Benchmark Exceedances between Areas: Imidacloprid



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)

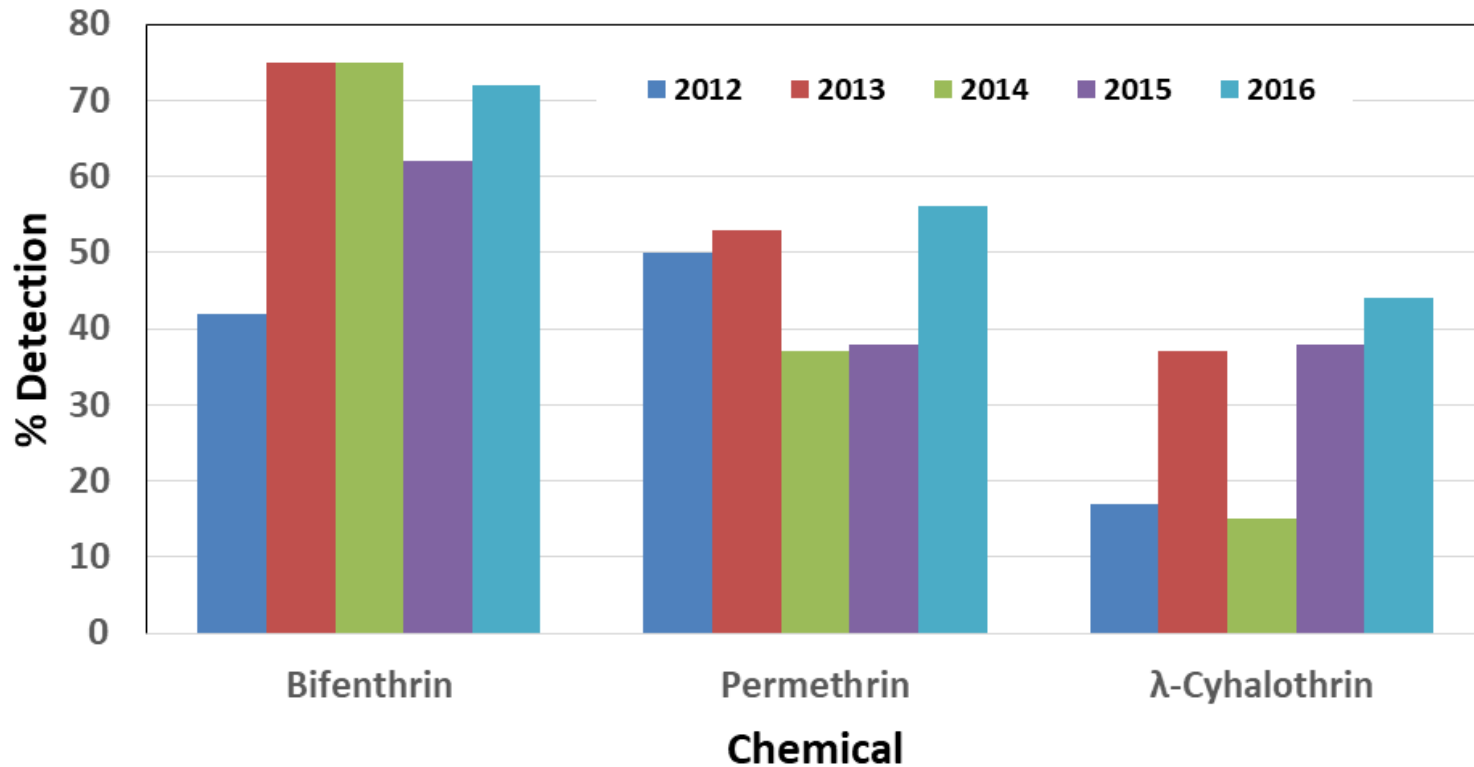
Kow (logP): 0.57 (21°C)

Water-sediment half-life: 129 days

# Summary: Imidacloprid

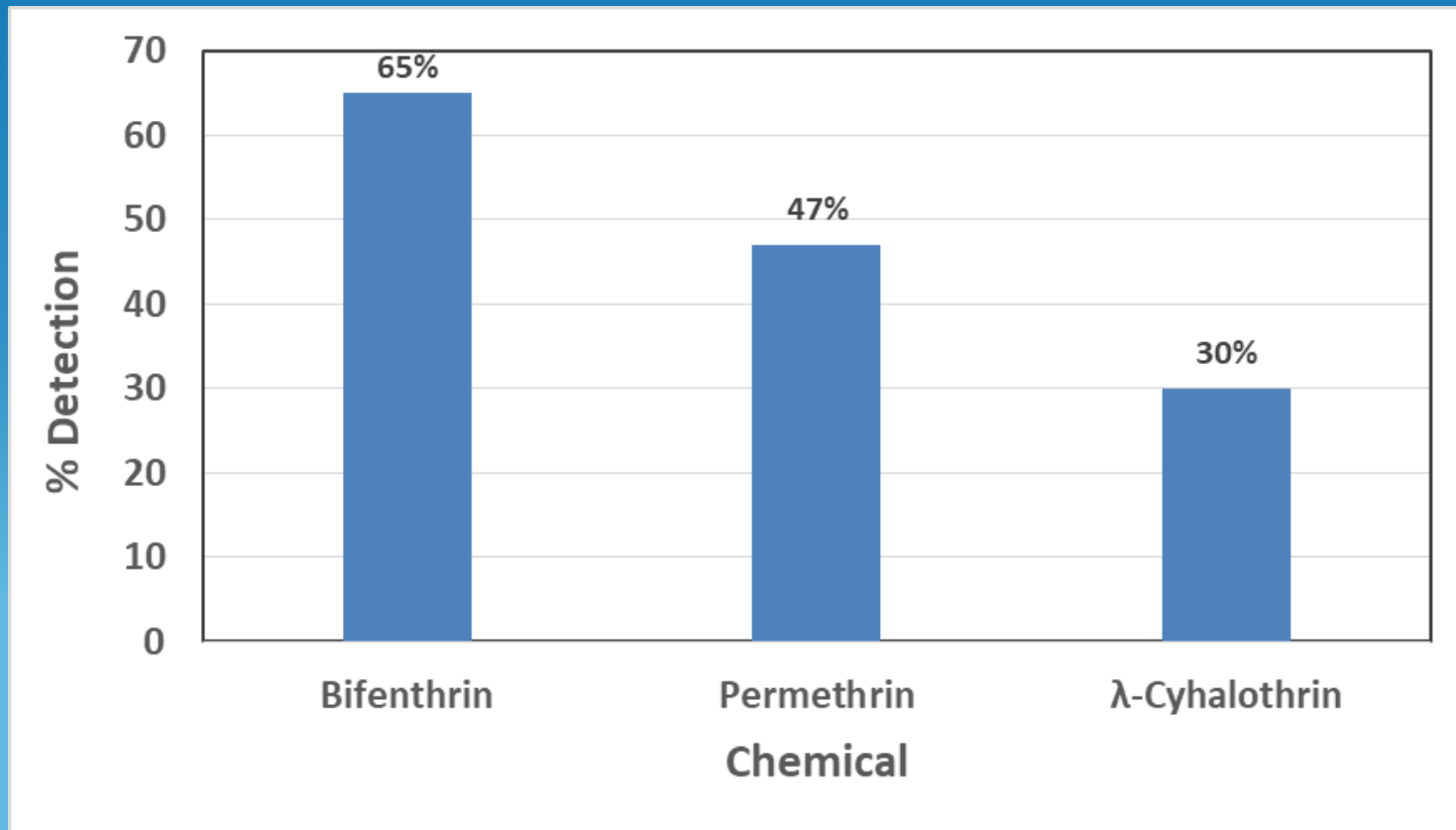
- Widespread detections with no significant temporal trends
- Recent change of the US EPA lowest chronic benchmark from 1.05 to 0.01 ppb result in high % exceedances:
  - 92% (32.6% at 1.05 ppb benchmark) exceedance for samples from Santa Maria and 82% (13.9% at 1.05 ppb benchmark) exceedance for samples 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: Pyrethroids



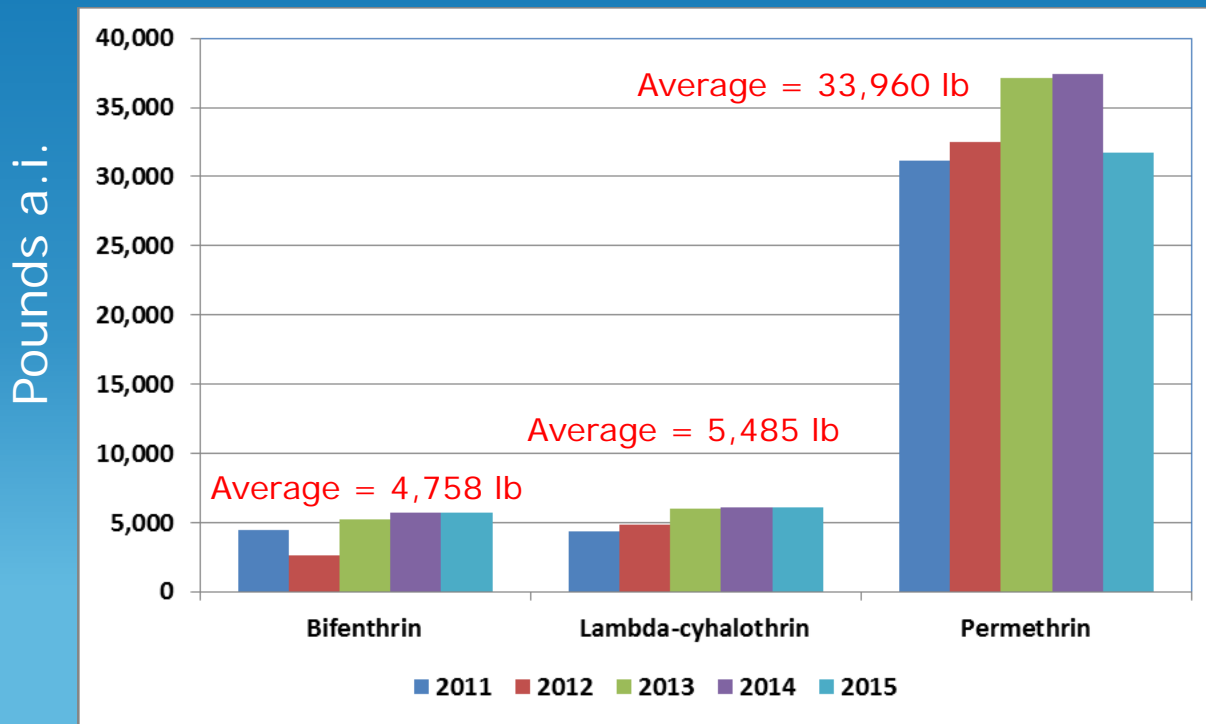
No significant differences detected for each chemical by year

# Detections in Salinas in 2012-2016



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  
(2017-2019)**

- 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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