Co-Occurrence Pesticide Species Tool (CoPST)

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Original Objective

- Identify the potential spatial and temporal co-occurrence of 40 pesticides with 12 threatened and endangered species
  - to guide future risk assessments (co-occurrence analysis piece)
  - Cited in the National Academy of Sciences on addressing pesticides to T&E species in the exposure section
  - Chapter in ACS on Pesticide Regulation and the Endangered Species Act
Current Analysis Objective

• To better understand the spatial and temporal distribution of 40 pesticides and their potential to cause toxicity (No co-occurrence species model runs)
• Enable state and federal agencies to identify and prioritize areas for refined assessments, monitoring, or mitigation.
• $M^5 = \text{monitoring, modeling, management, movement, and money}$
Original Model development Funded by CA Bay-Delta Science Program (CALFED)

Project Team

US EPA Region 9

Cramer Fish Sciences

Technical Advisory Panel

US EPA Region 9
CDPR
CVRWQCB
NOAA-NMFS
SWRCB
TDC Environmental
USDA–ARS
USDA-NRCS
USGS
Study Area

Sacramento River
27,000 sq mi (69,930 km²)

Bay-Delta Estuary
4,500 sq mi (11,691 km²)

San Joaquin River
32,000 sq mi (83,000 km²)
Pesticide List

- (s)-Metolachlor Herbicide
- Abamectin Insecticide
- Bifenthrin Insecticide
- Bromacil Herbicide
- Captan Fungicide
- Carbaryl Insecticide
- Chlomazone Herbicide
- Chlorothalonil Fungicide
- Chlorpyrifos Insecticide
- Copper Sulphate Fungicide
- Copper Hydroxide Fungicide
- Cyfluthrin Insecticide
- Cyhalofop-butyl Herbicide
- Cypermethrin Insecticide
- Deltamethrin Insecticide
- Diazinon Insecticide
- Dimethoate Insecticide
- Diuron Herbicide
- Esfenvalerate Insecticide
- Hexazinone Herbicide
- Imidacloprid Insecticide
- Indoxacarb Insecticide
- Lamda cyhalothrin Insecticide
- Malathion Insecticide
- Mancozeb Fungicide
- Maneb Fungicide
- Methomyl Insecticide
- Naled Insecticide
- Oxyflurofen Herbicide
- Paraquat dichloride Herbicide
- Pendimethalin Herbicide
- Permethrin Insecticide
- Propanil Herbicide
- Propargite Insecticide
- Pyraclostrobin Fungicide
- Simazine Herbicide
- Trifluralin Herbicide
- Ziram Fungicide
- Thiobencarb Herbicide
- Tralomethrin Insecticide
Model Approach

Pesticide Loadings (2000-2009)
1. Runoff from fields
2. Drift from spray
3. Discharges from rice paddies
4. Runoff from urban settings

Species of Interest
1. Eco-toxicological benchmarks
2. Life history assessment
3. Species distribution

Watershed Characteristics
1. Landscape patterns
2. Soils
3. Climate Conditions

Water Quality Monitoring

Spatial-Temporal Co-occurrence

Reporting
1. Species Distributions
2. Pesticide Loadings
3. Hotspots
4. Areas of Concern
5. Recommendations

Visualizations
Goal of Modeling

• Estimate potential pesticide edge-of-field loadings into nearby water bodies considering important factors in chemical fate and transport:
  – Agricultural modeling
    • Pesticide Root Zone Model (PRZM)
    • Edge-of-field mass
  – Rice modeling
    • Rice water quality model (RICEWQ)
    • Water management /release
  – Urban modeling (4 pyrethroids)
    • Pervious and impervious areas with PRZM
    • Pyrethroid “Kd “calibrated to hard surface washoff studies
  – Drift estimates
    • Application location, date, rate, method
    • Pesticide mobility / persistence
    • Site conditions – crop (land use), irrigation, soil properties, weather
Results Processing

- Pesticide mass loading
- PLSS water volume
- Spatial & temporal co-occurrence

Compare concentrations with benchmarks

- Benchmark
- No concern

Are there monitoring stations present downstream?

- Monitoring
- No concern

Determine co-occurrence

- Need further study
Uncertainty

- PUR precision / accuracy
- Pesticide properties
- Field-specific characteristics
- Hydrology / hydraulics
- Dissipation processes not represented
- Standardized assumptions

Edge of field predictions do **not** indicate adverse effects
Indicator Days

Distribution of Indicator Days for randomly selected PLSS Sections

Each line represents a unique PLSS

Function of which pesticide, when applied, method of application, soil properties, irrigation practices, rainfall patterns, etc.
Initial Finding: Certain Pesticides Need to be Monitored

- Abamectin
- Copper
- Mancozeb
- Maneb
- Pyraclostrobin
- Tralomethrin
Total Ag Heat
Total Ag Heat
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<th>Sample Time</th>
<th>Matrix Name</th>
<th>Analyte Name</th>
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Reasons why Monitoring and the Model May not Match

- Monitoring data for May not in historical record
- Parameters monitored may not match the 40 pesticides modeled (i.e. fungicides)
- Analytical method resolution may not be at the environmentally relevant concentration
- Model may over predict potential toxicity
- Edge-of-field pesticide concentration may be present but may not get to receiving water
  - BMP’s in place
  - Natural barriers
  - Chemical or physical degradation occurring
July Modeling Data

July Model Results Match Monitoring for:
Chlorpyrofos
Diazinon
Malathion
Esfenvalerate

CoPST Results
- Study Area
- Water Monitoring Sta
- Partial Barriers
- Total Barriers
- ESRI Detailed Rivers
  - Stream/River
  - Canal/Ditch
- January
- February
- March
- April
- May
- June
- July
- August
- September
- October

Pesticide Heat
- Total Heat Units: 804
- Month: July
- Heats by Chemical
  - Alachlor: 8
  - Bifenthrin: 0
  - Bromocarb: 0
  - Cypermethrin: 0
  -Cyproconazole: 0
  - Cypermethrin Bayer: 0
  - Cypermethrin: 0
  - Deltamethrin: 0
  - Diazinon: 73
  - Dithianon: 0
  - Diuron: 0
  - Esfenvalerate: 101
  - Hexazinone: 0
  - Imidacloprid: 0
  - Indoxacarb: 0
  - Lambda-Cyhalothrin: 9
  - Malathion: 7
  - Mancozeb: 0
  - Methomyl: 0
  - Metolachlor: 0

Change Background Map

Zoom to
Can change background map to satellite imagery for more detail
Uses of the Tool (Model plus Map layers)

- Identify temporarily and spatially, priority sections, areas and watersheds for further investigation
- Examine current water quality monitoring sites, frequency, and parameters for relevancy
- Identify areas as priority for BMP development and funding
- Aid in developing plans to improve ecosystem quality and water quality
What's Next?

• Outreach to NRCS and Waterboards
• Building up
  – Adding more pesticides as they emerge as a concern
  – Updating PUR data, and model runs
• Building out
  – Other geographic areas (Central Coast water board)
Contact Information

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To download report and see overview of project:
http://www.waterborne-env.com/projects_featured.asp