Pesticide contamination of butterfly host plants in the modified landscapes of California's Central Valley

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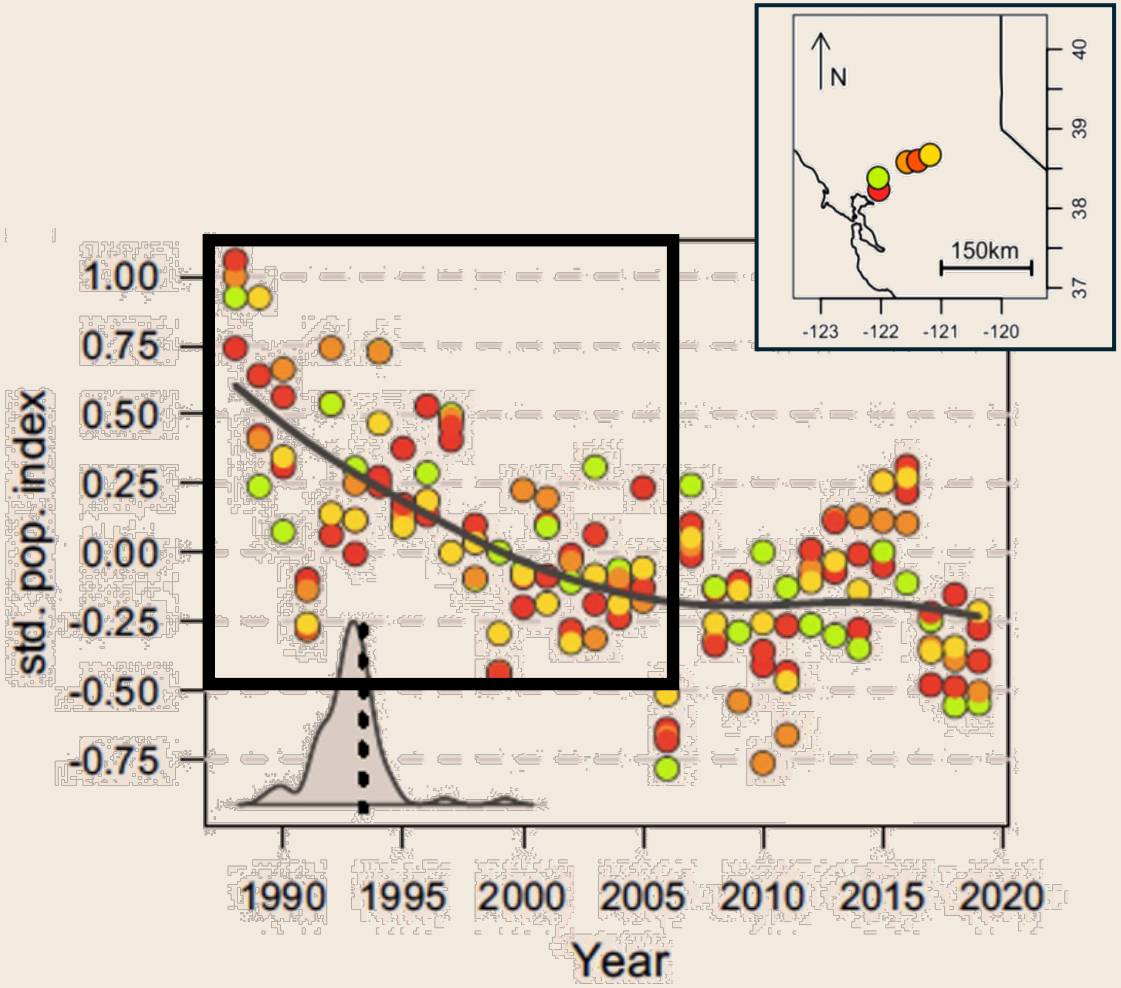
NCB Symposium, January 14, 2025

Using **monitoring data** to understand declines

Long term data (50+ years) in the western U.S.

Monitoring butterfly populations reveals **widespread declines**

Determine relative effects of anthropogenic stressors



Halsch et al. 2021 *PNAS*

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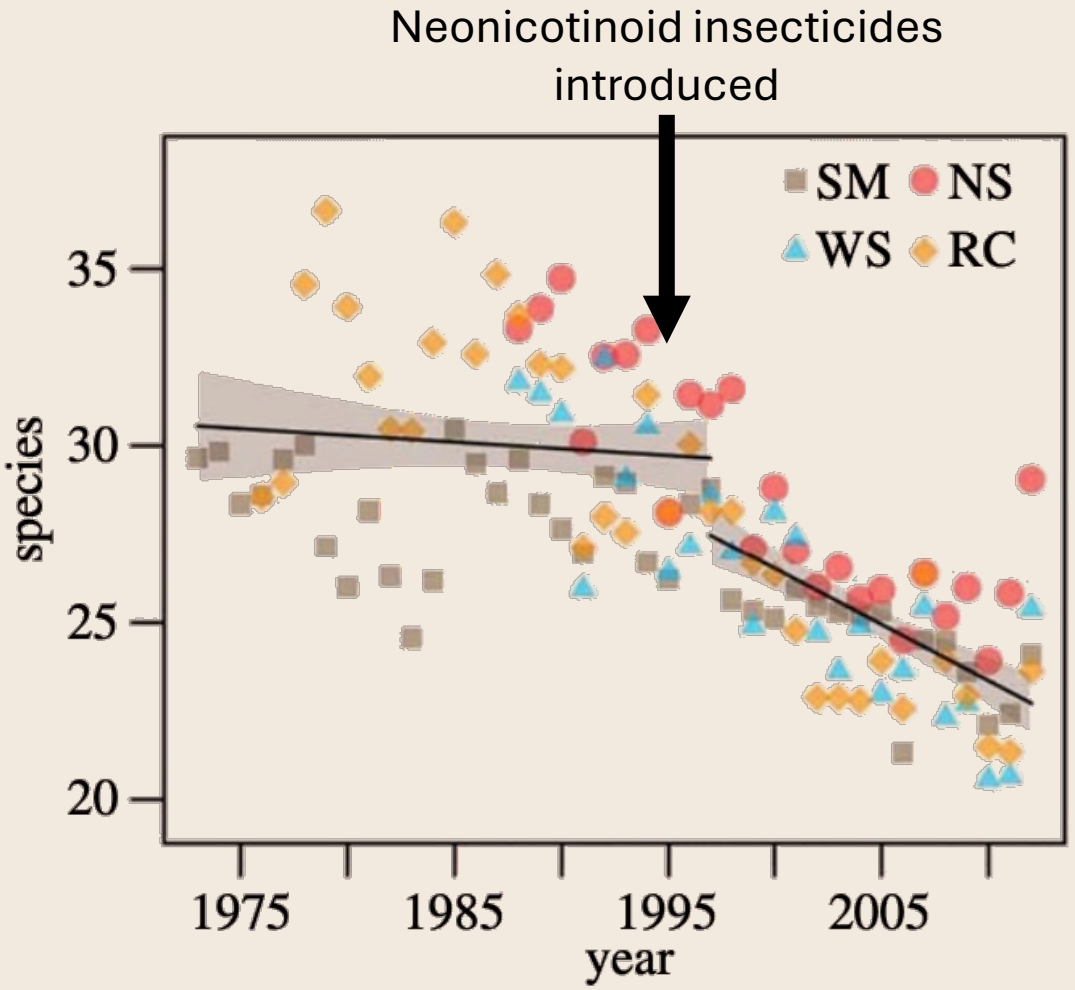


Forister et al. 2016 *Biology Letters*

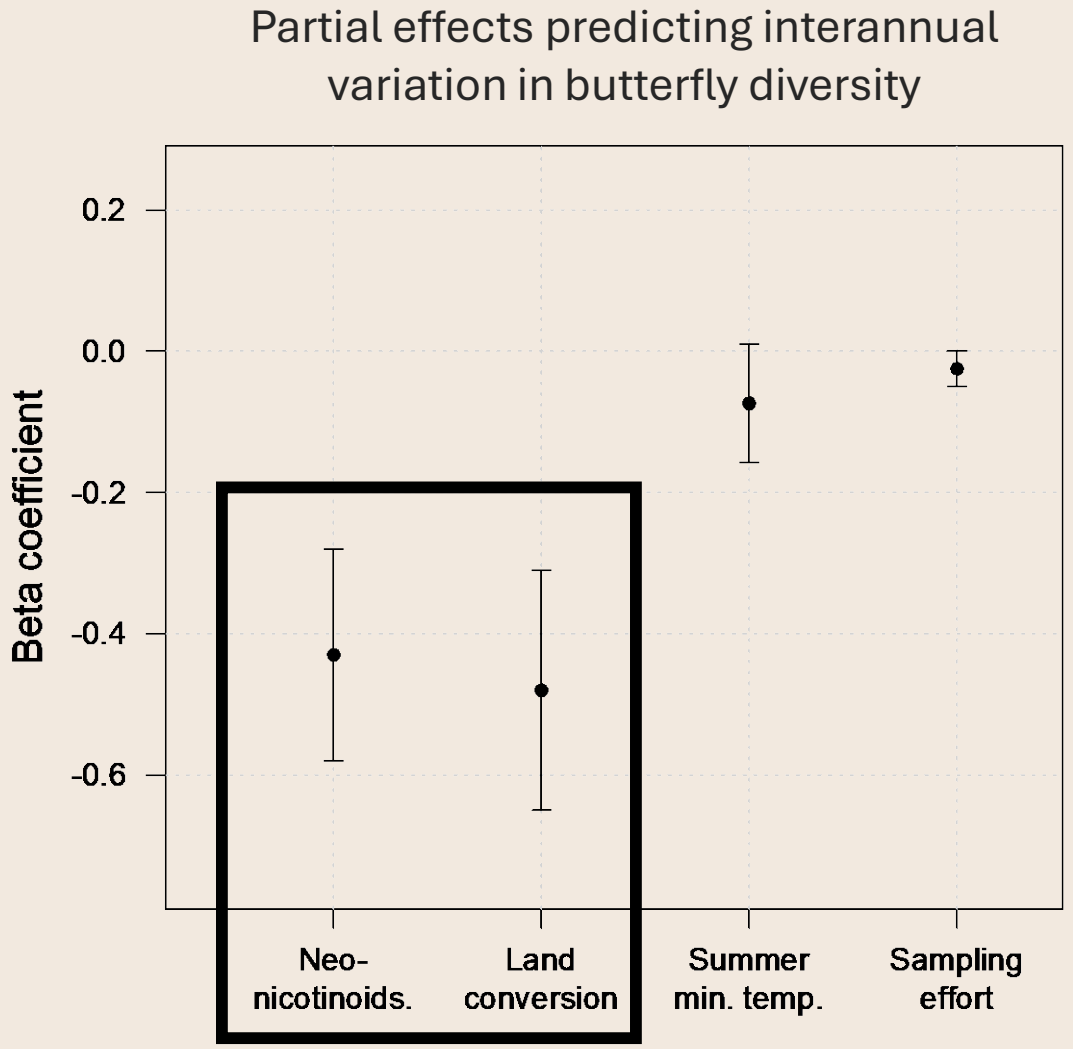
Pesticides and **land conversion** are important drivers of butterfly declines

Both variables are important in agricultural and urban environments

Much is unknown about pesticide contamination in terms of its impact on green spaces

Prior work in milkweed showed ubiquitous contamination

raises question if there are protected areas for butterflies in this region



Pesticide contamination in green spaces surrounded by…

Agriculture

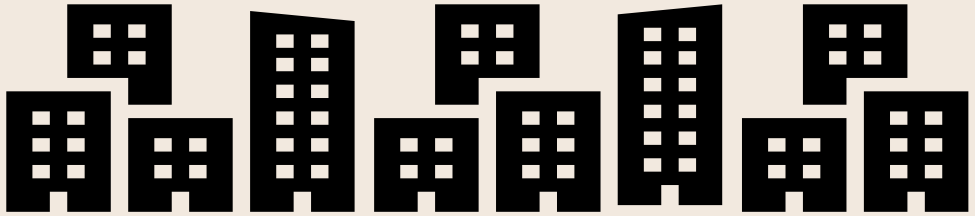
National wildlife refuges

Embedded in agricultural landscape

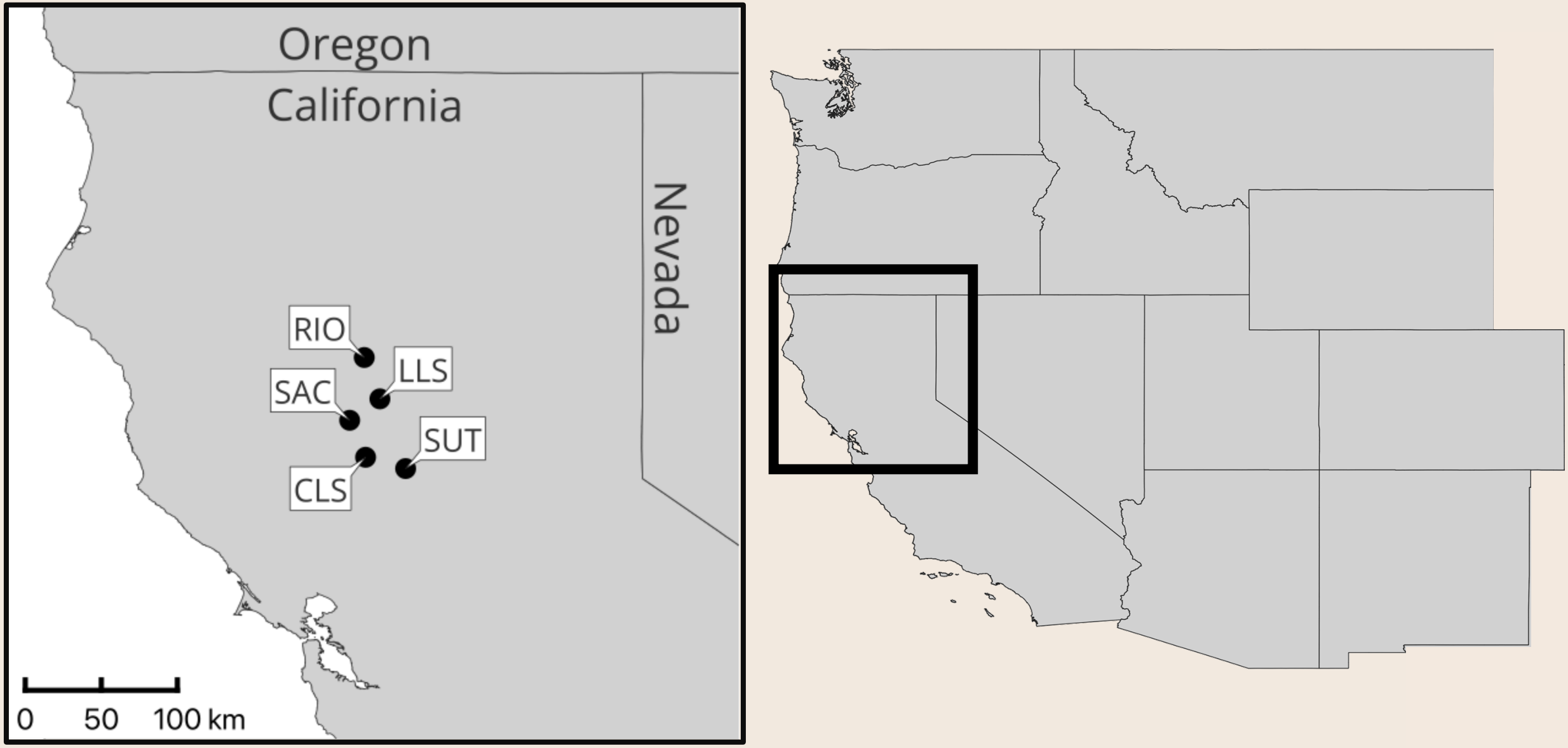
Passive sampling devices

US FWS and USGS collaboration

Urban areas



Sacramento National Wildlife Refuge Complex



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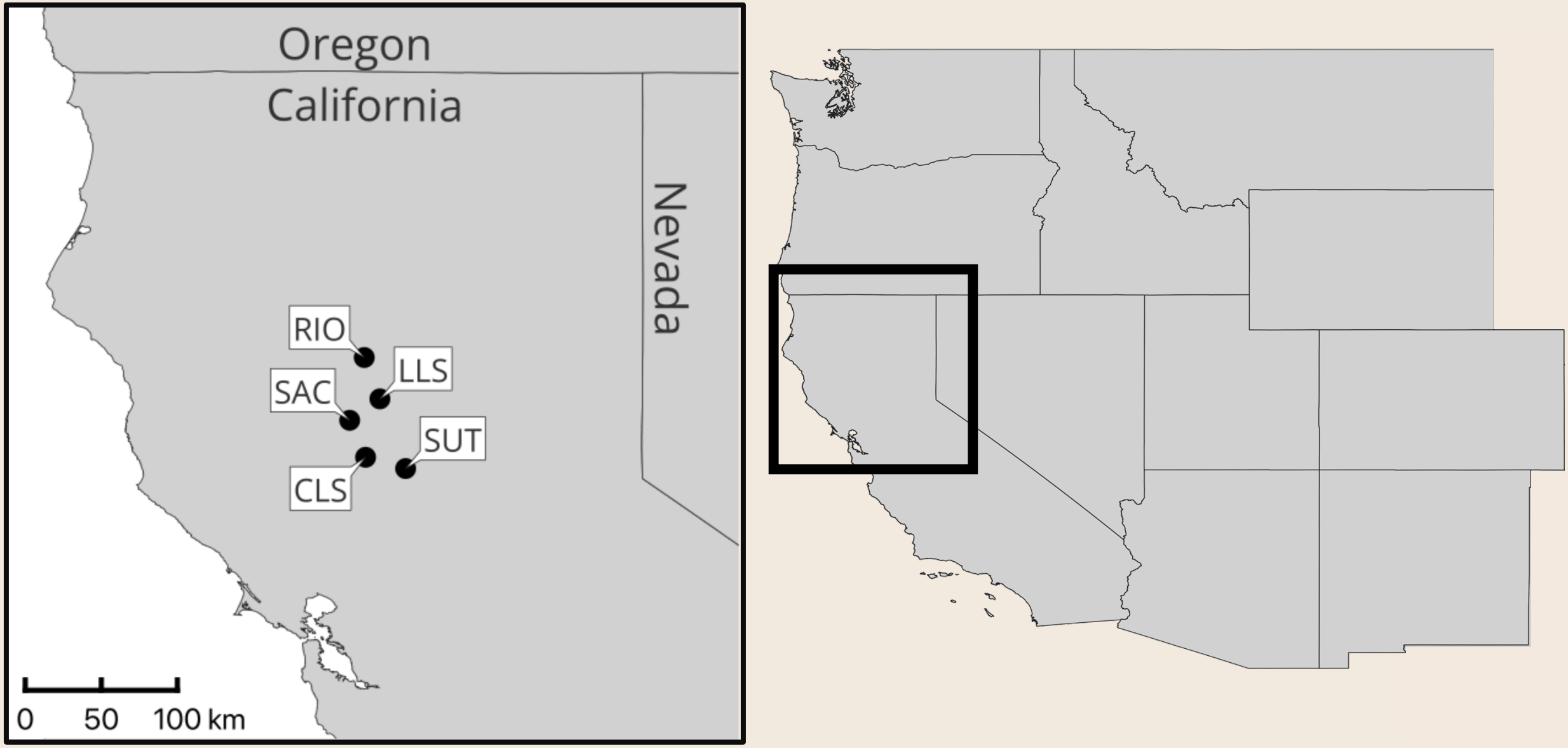

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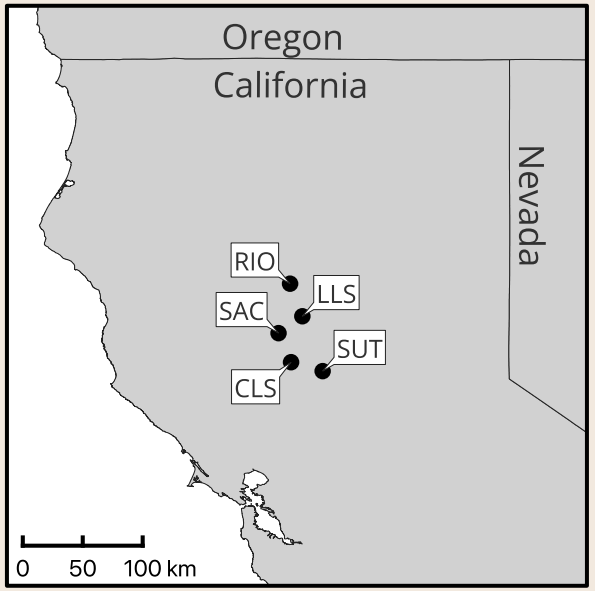
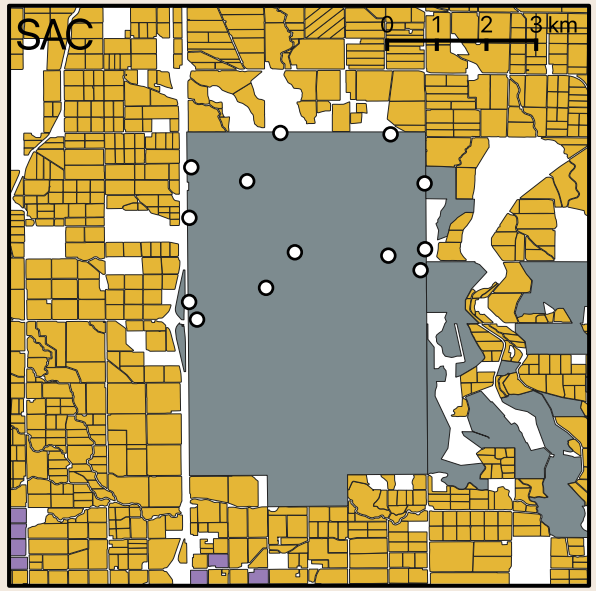
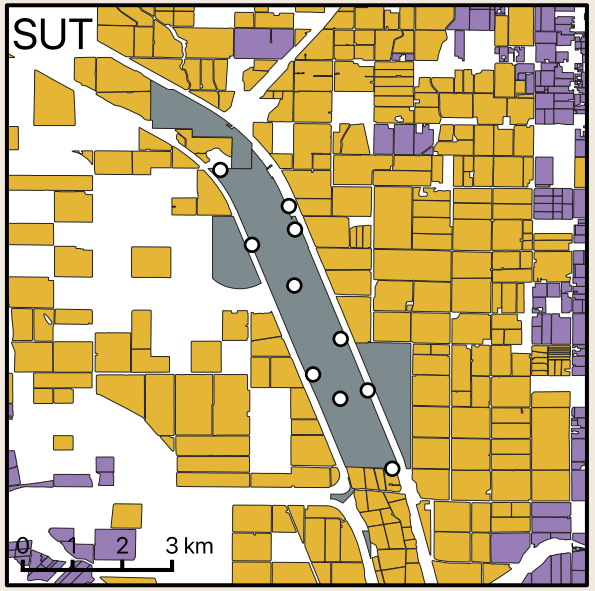






Pesticide plot

Refuge

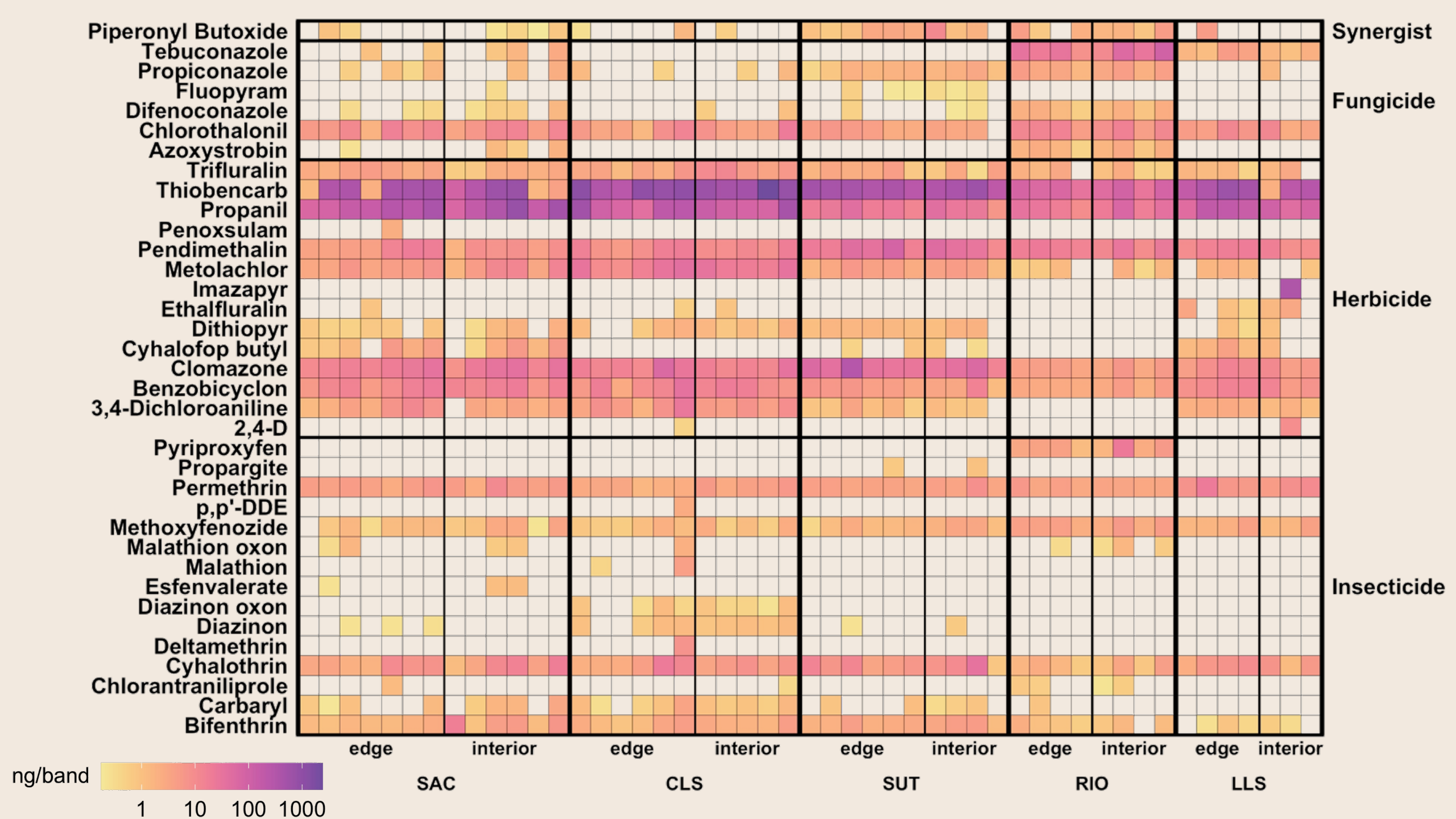
Rice

Orchard

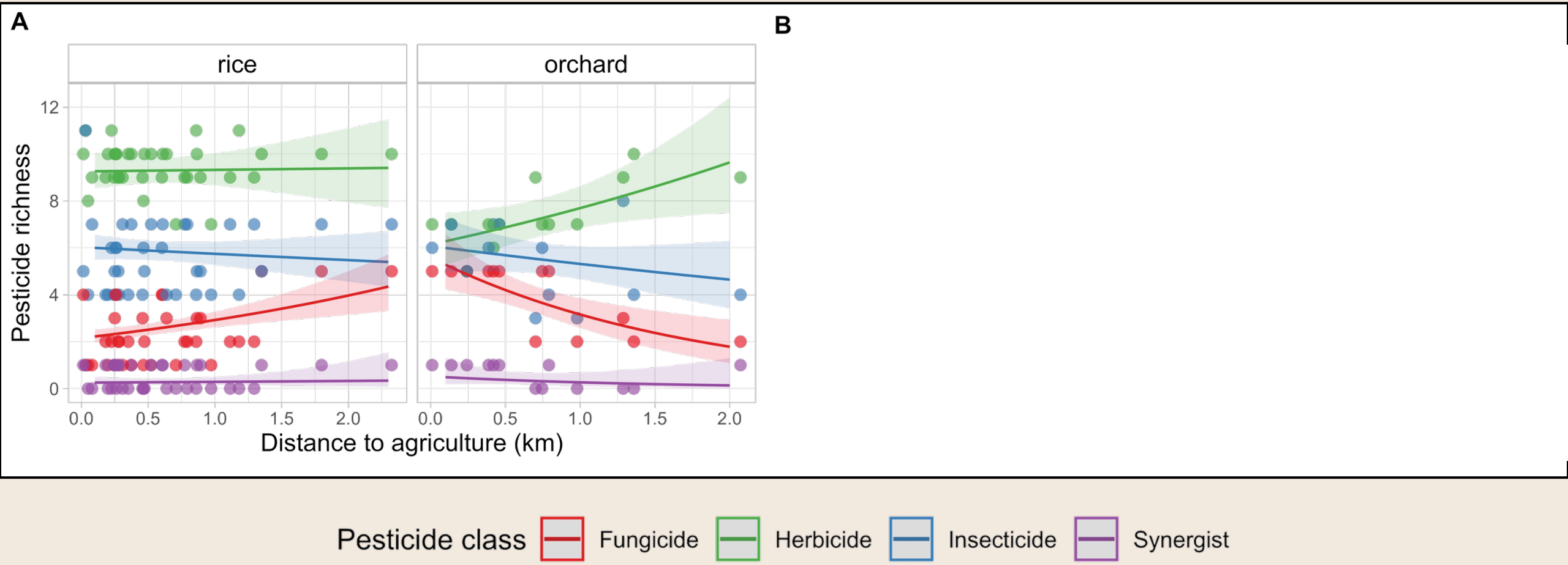
Measuring pesticide contamination on NWRs

Wayne Thogmartin

Michelle Hladik

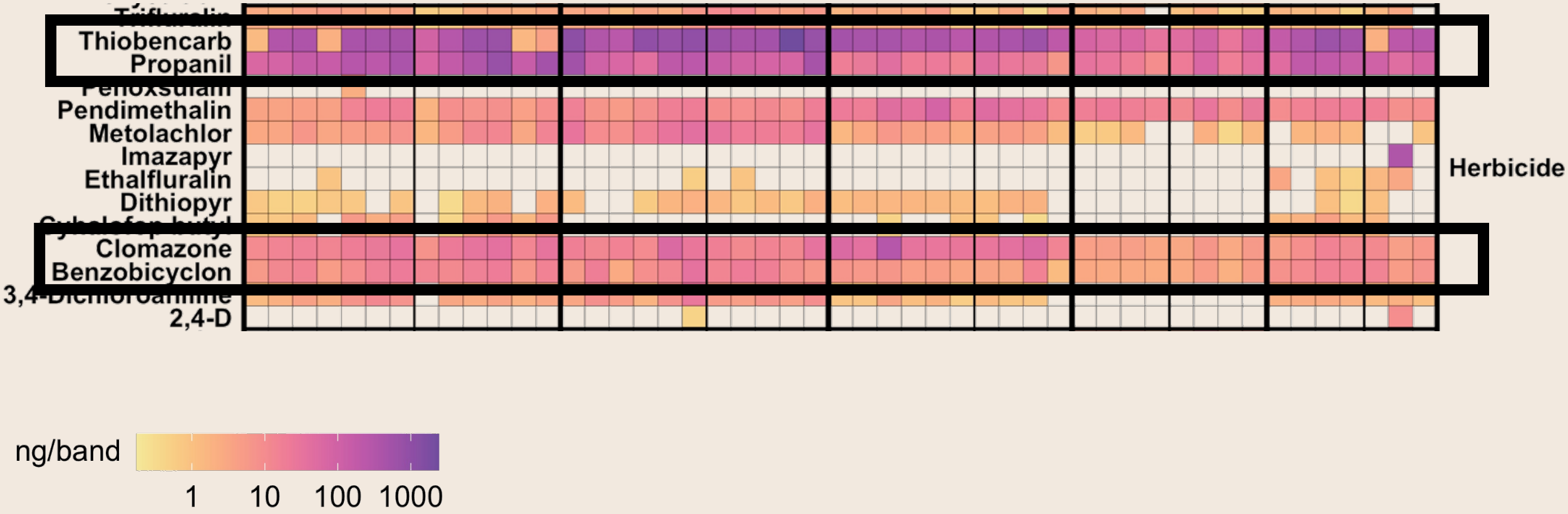

Piperonyl Butoxide
Tebuconazole
Propiconazole
Fluopyram
Difenoconazole
Chlorothalonil
Azoxystrobin
Trifluralin
Thiobencarb
Propanil
Penoxsulam
Pendimethalin
Metolachlor
Imazapyr
Ethalfluralin
Dithiopyr
Cyhalofop butyl
Clomazone
Benzobicyclon
3,4-Dichloroaniline
2,4-D
Pyriproxyfen
Propargite
Permethrin
p,p'-DDE
Methoxyfenozide
Malathion oxon
Malathion
Esfenvalerate
Diazinon oxon
Diazinon
Deltamethrin
Cyhalothrin
Chlorantraniliprole
Carbaryl
Bifenthrin
Synergist
Fungicide
Herbicide
Insecticide
edge
interior
edge
interior
edge
interior
edge
interior
edge
interior
SAC
CLS
SUT
RIO
LLS
ng/band
1
10
100
1000

Distance from agriculture is largely **unimportant**, especially near **rice fields**

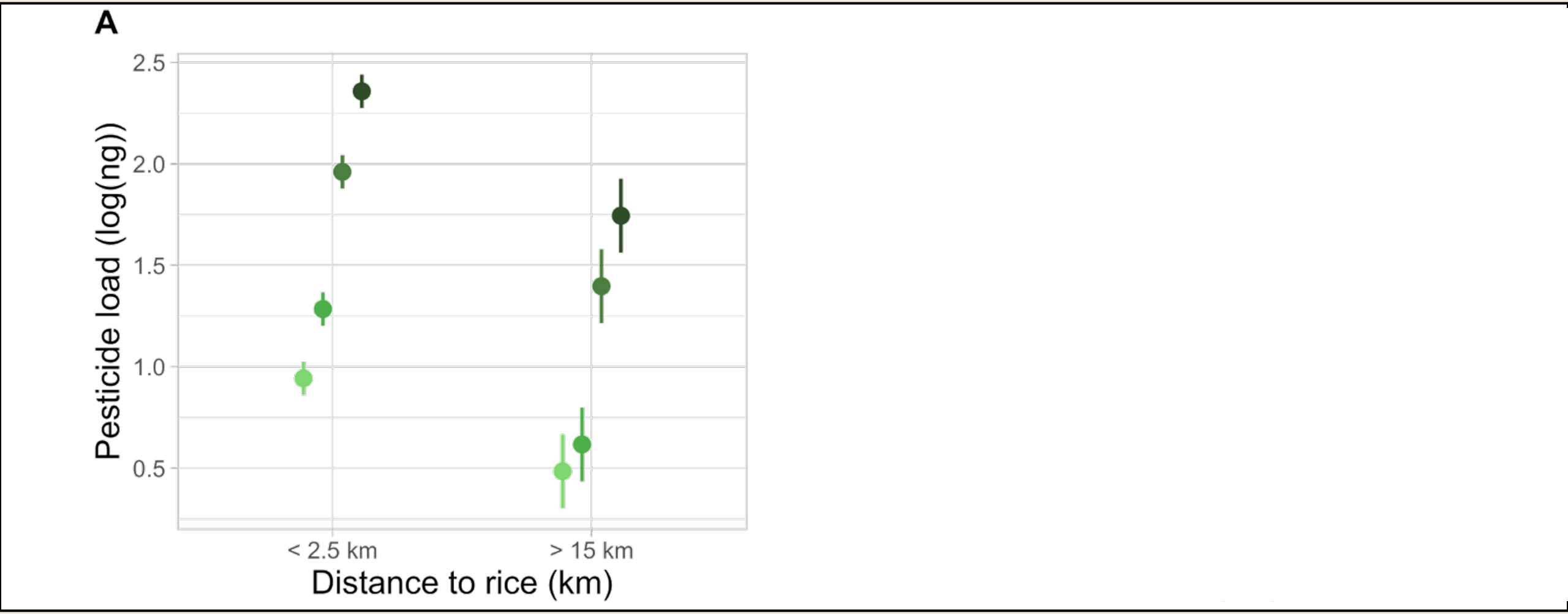


Rice-exclusive herbicides detected in high amounts

Four compounds found at all plots -- *Only applied on rice in California*



Rice-exclusive herbicides decrease with distance from rice, but only **at very far distances** (> 15 km)



Ongoing: pesticides on host plants at NWR

Butterfly **host plants** sampled during 2023 and 2024.

1625 tissue samples

39 host species

7 wildlife refuges

Seasonal variation

Pipevine swallowtail eating CA Dutchman's pipe

Monarch eating narrowleaf milkweed

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Passive sampling devices

US FWS collaboration

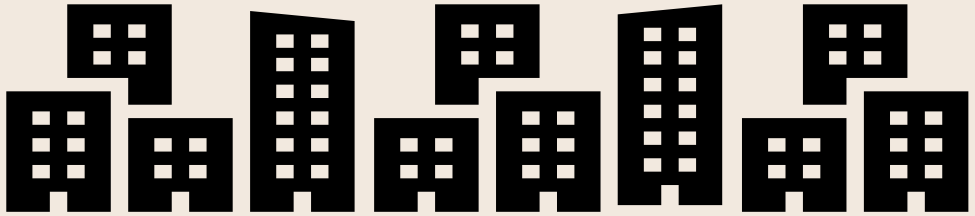
Urban areas

Public parks and private yards

City of Sacramento, CA (and Albuquerque, NM)

Butterfly host plants

Xerces Society collaboration

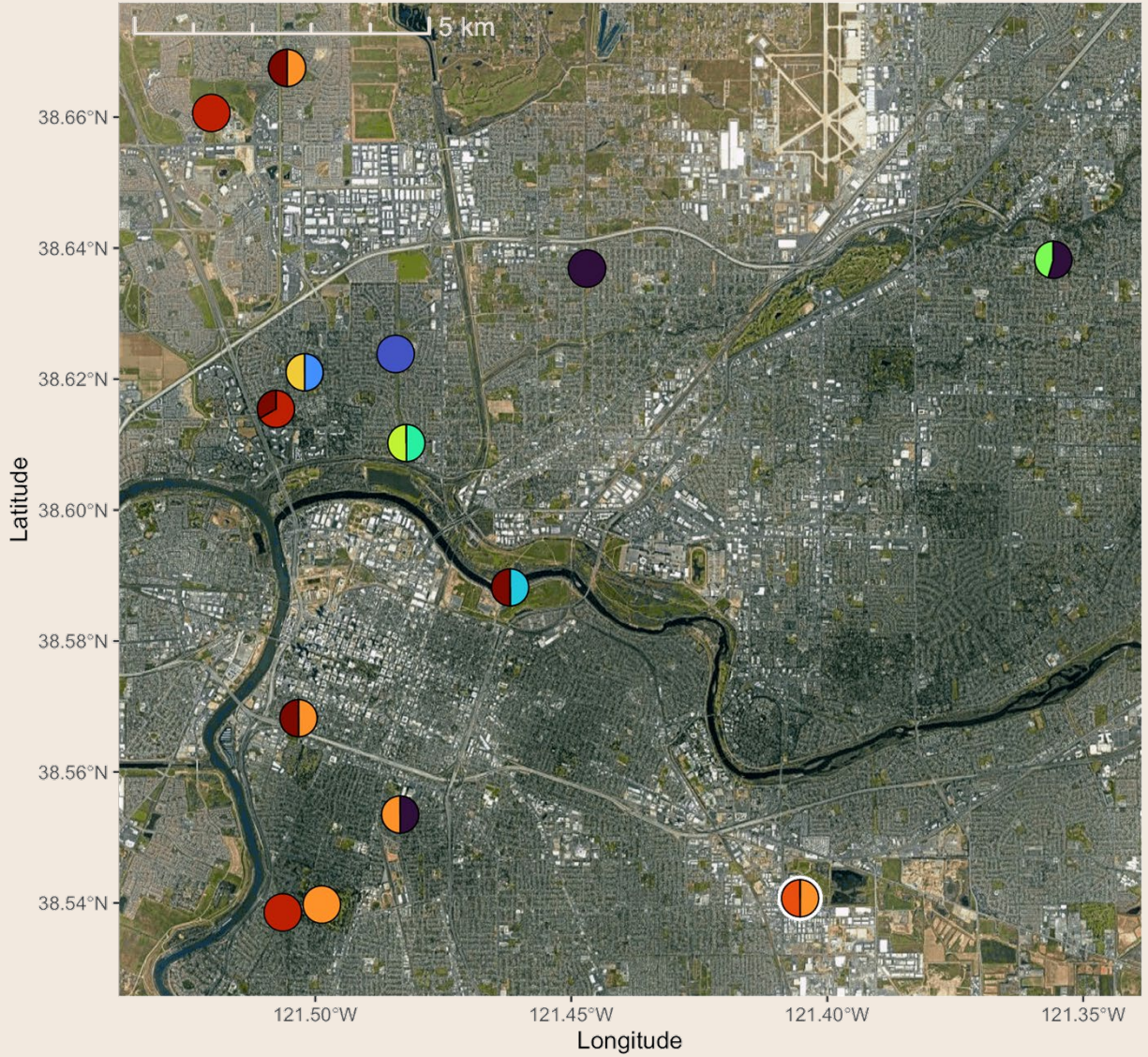


Agricultural pesticides detected in urban areas

Clare Dittemore

Sampled plant genera

- Achillea
- Aesculus
- Aquilegia
- Artemisia
- Eriogonum
- Frangula
- Lupinus
- Penstemon
- Plantago
- Populus
- Quercus
- Salix

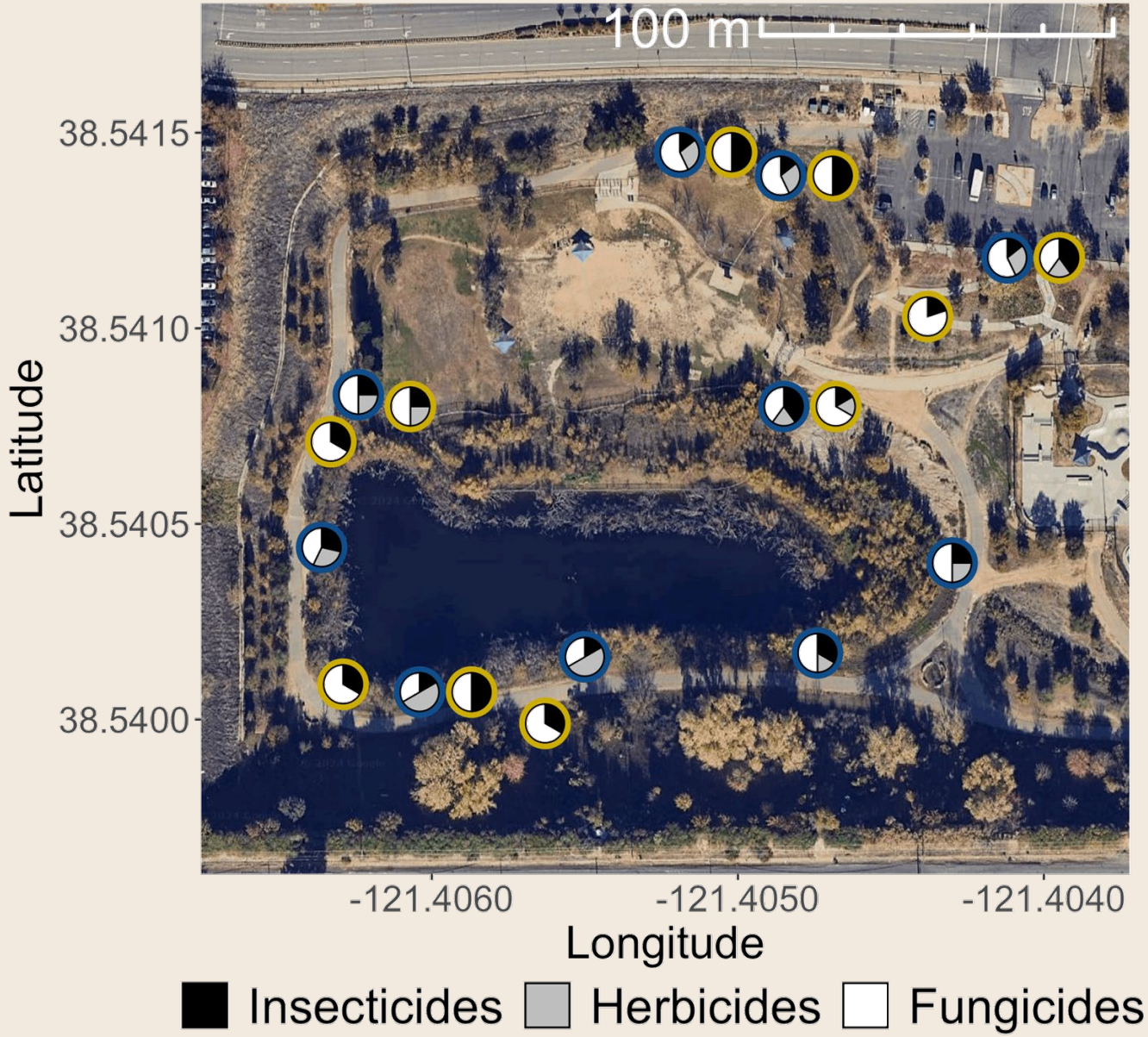


Pesticide contamination was found on **nearly all host plants**

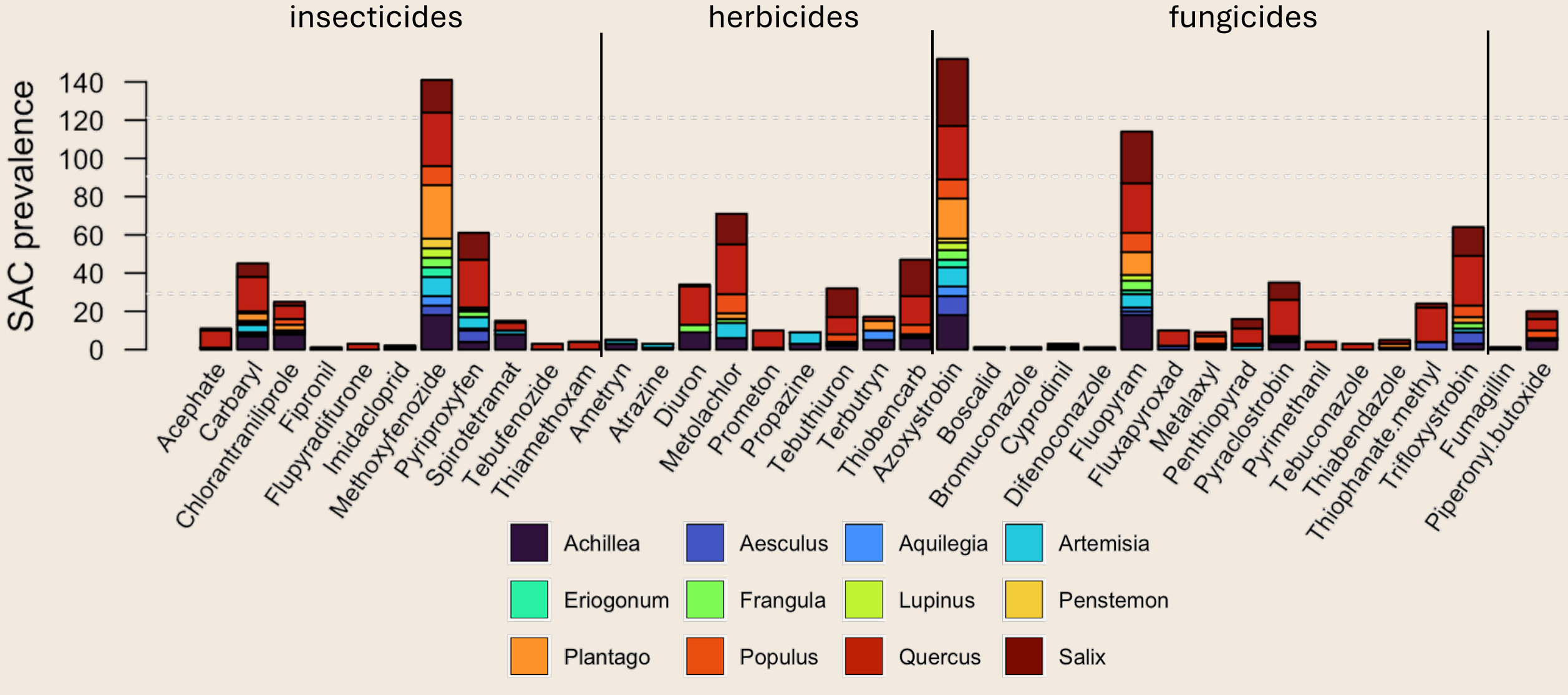
Mixtures of insecticides, herbicides, and fungicides

Average 5.5 compounds per plant

Only 10 plants of 181 total had no trace of pesticides (all *Plantago*)



Compounds are detected on **multiple host plant genera**



Green spaces within agricultural and urban systems are contaminated

Distance from agricultural and urbanization level had **little effect on pesticide contamination**

Variation by crop type could be from differences in **application method** (e.g., fungicides from orchards)

Incomplete understanding of the **effect of contamination on non-target pollinators**

USGS

Michelle Hladik

Wayne Thogmartin

USFWS

Thérèse Burns

Brit Hilleson

Jennifer Isola

Michael Derrico

Kaylene Keller

Samantha Marcum

Xerces

Aimee Code

Aaron Anderson

Community science volunteers

Forister lab

UNR EECB and Biology Department