Evaluating effects of artificial light at night (ALAN) on biological control agents of Yellow star thistle (*Centaurea solstitialis*) in California

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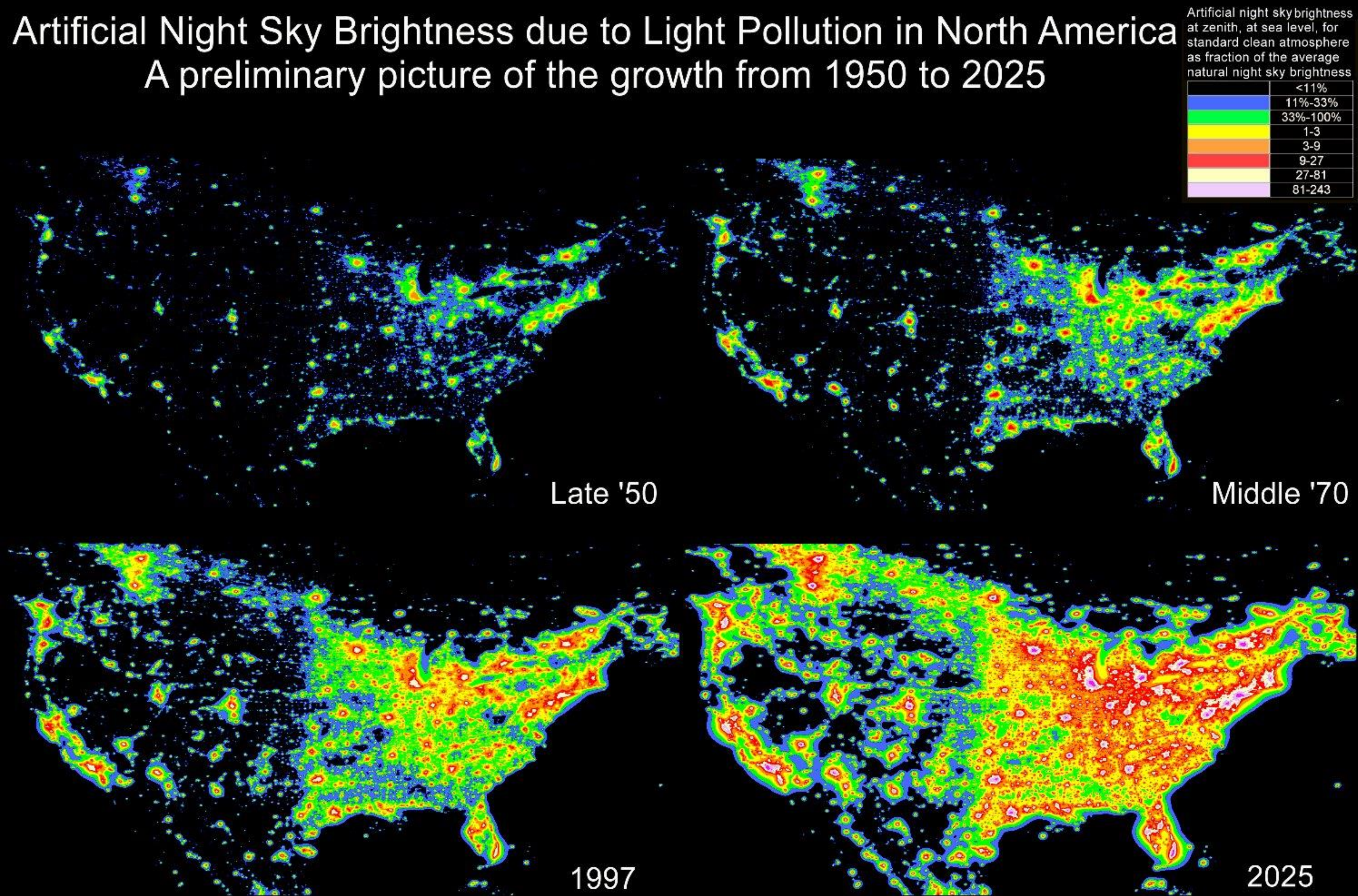
Artificial Night Sky Brightness due to Light Pollution in North America
A preliminary picture of the growth from 1950 to 2025




Plant-plant interactions
Direct effects on physiology & phenology
Plant-animal interactions

Fig. 8. Hairy weevil (*Eustenopus villosus*) adult Credit: Charles Turner, USDA-ARS, Bugwood.org

Fig. 11. Hairy weevil egg hole and post-bloom signs of infestation Credit: Baldo Villegas, CDFA

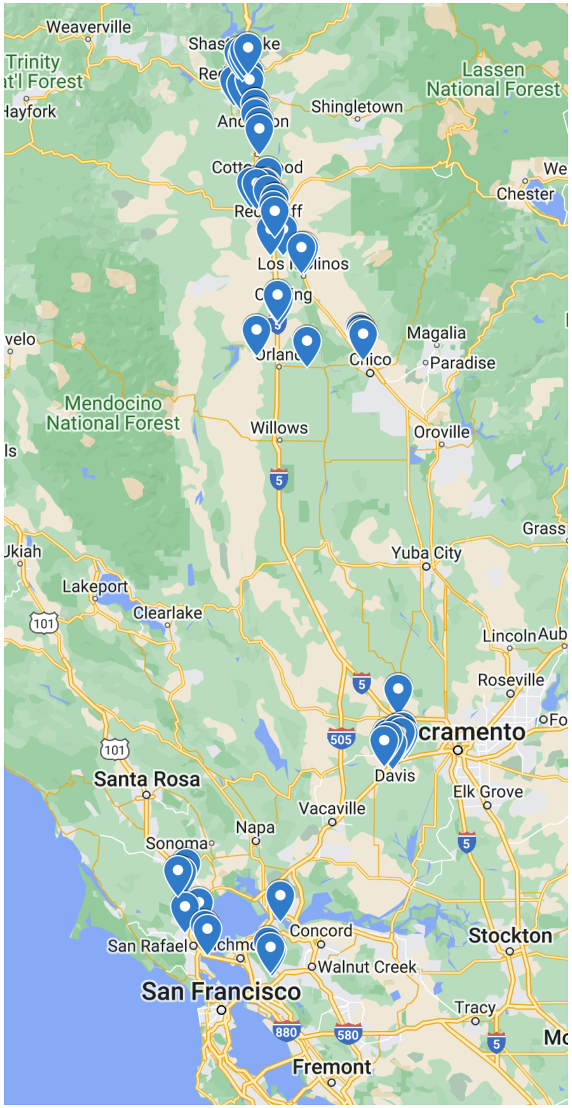
Yellow star thistle (*Centaurea solstitialis*)

YST Study System

(a) Yellow starthistle flower head; (b) *Bangasternus orientalis* adult; (c) *Eustenopus villosus* adult; (d) *Larinus curtus* adult; (e) *Chaetorellia* spp. adult; (f) *Urophora sirunaseva* adult; (g) *Puccinia jaceae* var. *solstitialis* (images: USDA-ARS)

YST Site Selection

- Identified potential study sites using a light pollution map, iNaturalist, CalWeedMapper, and Calflora observations
- Scoped out sites to confirm presence of YST, accessibility, artificial light sources
- Aimed for half low light sites (0-5 lux) and half high light sites (5-20 lux) in each city/region
- 70 sites total



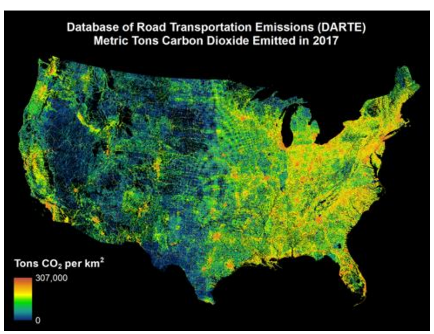
Map of study sites

Methodology

Environmental Measurements

Extech LT300 Light Meter

HOBO Pendant MX Temperature/Light Data Logger



Database of Road Transportation Emissions (DARTE)—Tons CO_2 per km^2

Parameter-elevation Regressions on Independent Slopes Model

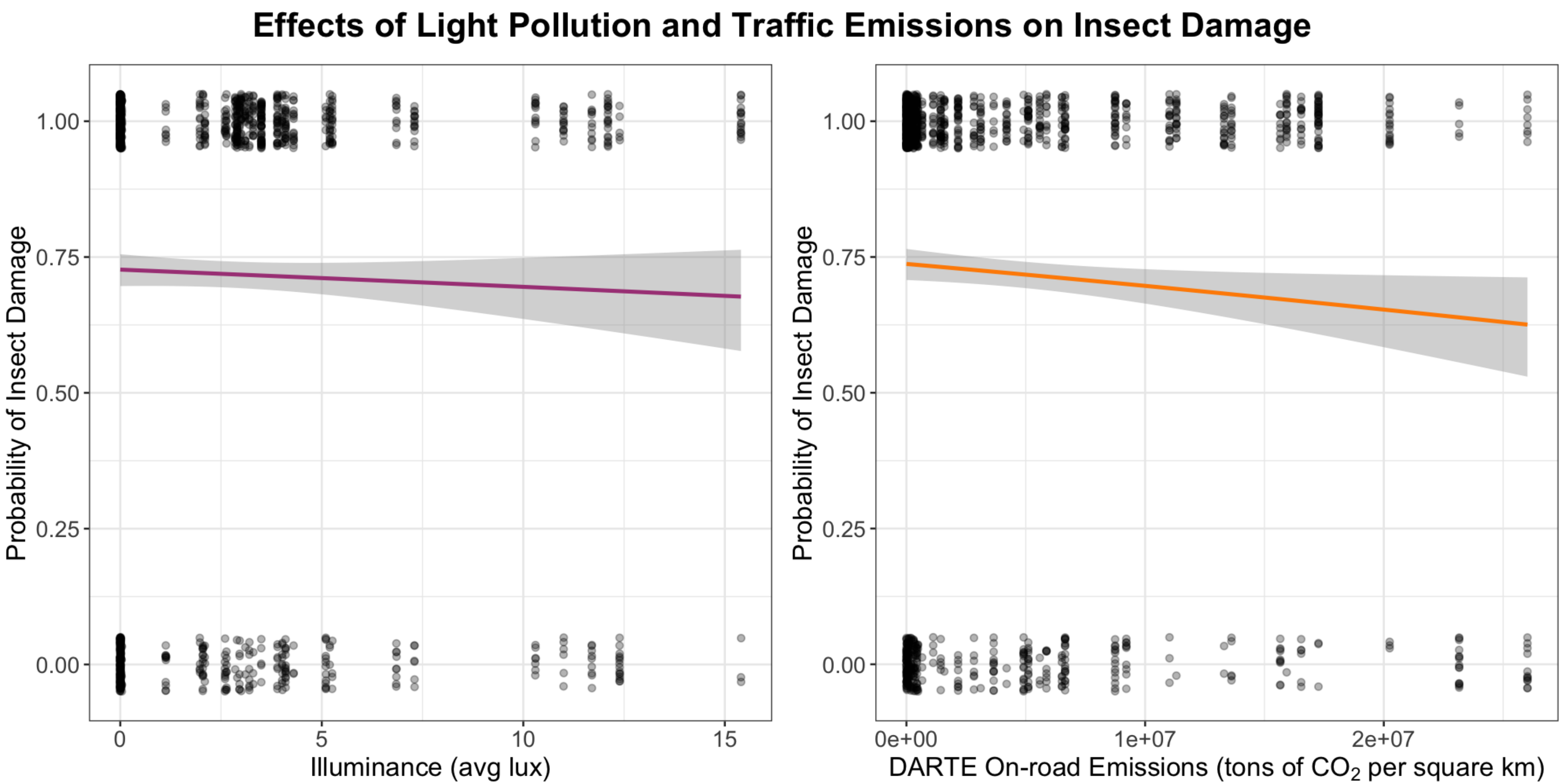
Biological Measurements

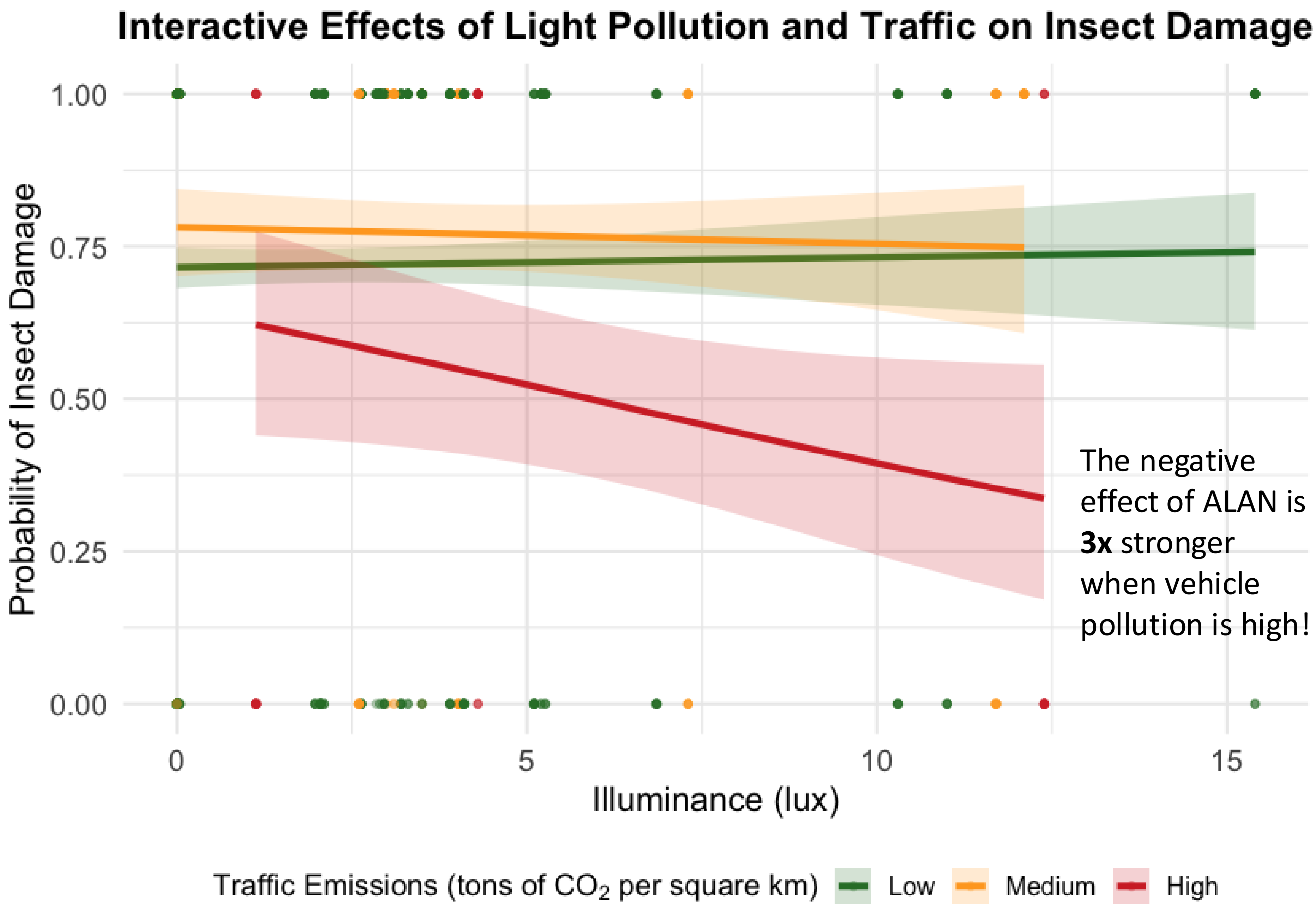
Chaetorellia spp. larva

Urophora sirunaseva empty gall

Eustenopus villosus oviposition scar (top) and late instar larva (bottom)

GLM model: insect damage presence ~ mean illuminance (lux) + site mowing status + seedhead diameter + mean temperature (between March and October) + total precipitation (between March and October) + seedhead developmental stage + DARTE vehicle pollution (1km buffer, tons of CO_2 per km^2)



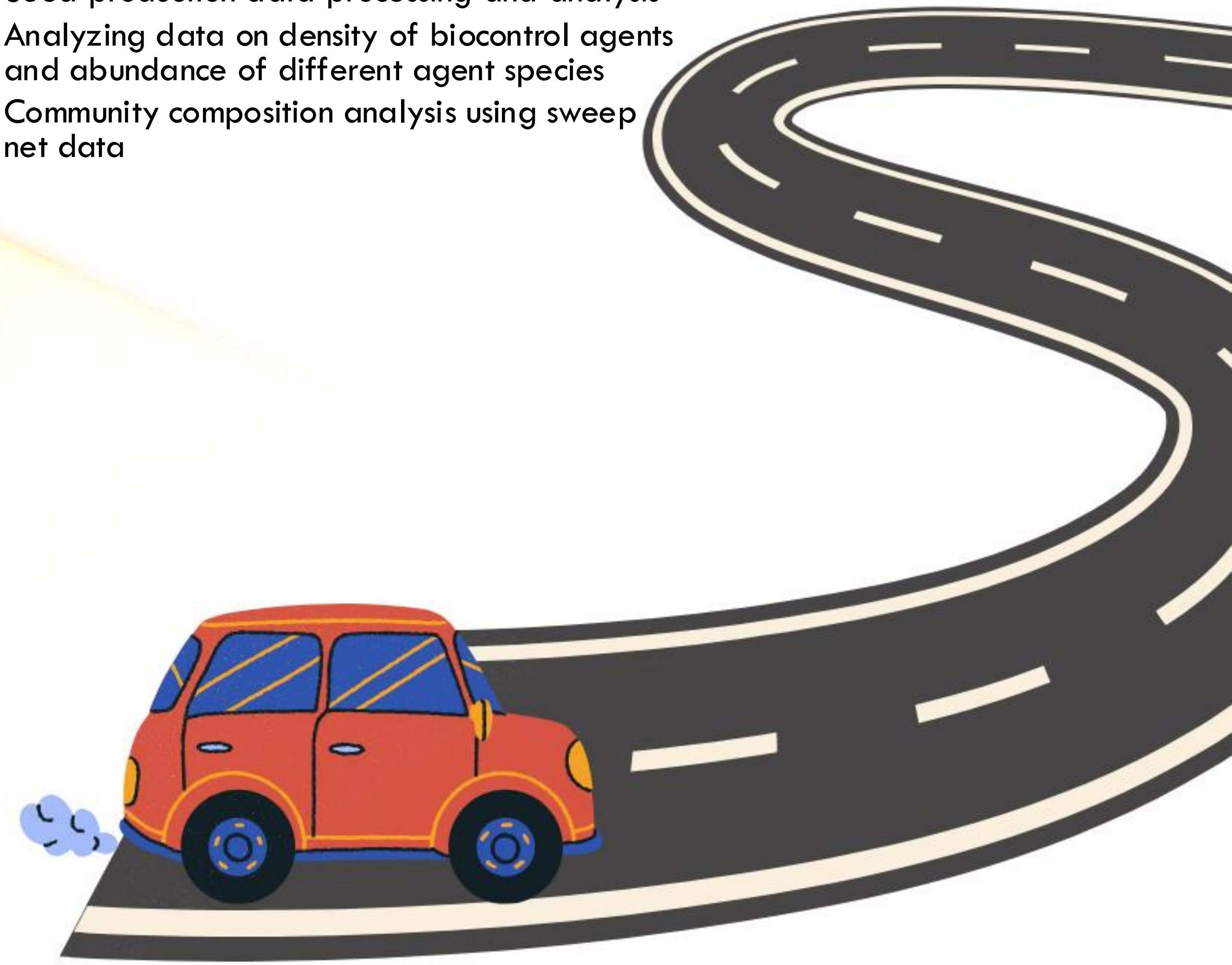


Interactive Effects of Light Pollution and Traffic on Insect Damage
Probability of Insect Damage
1.00
0.75
0.50
0.25
0.00
0
5
10
15
Illuminance (lux)
The negative effect of ALAN is **3x** stronger when vehicle pollution is high!
Traffic Emissions (tons of CO_2 per square km)
Low
Medium
High

ALAN and vehicle pollution significantly reduced the probability of insect damage

Next steps:

- Seed production data processing and analysis
- Analyzing data on density of biocontrol agents and abundance of different agent species
- Community composition analysis using sweep net data



Thank you!

Please email me with any questions/comments!

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My website

Meineke lab website