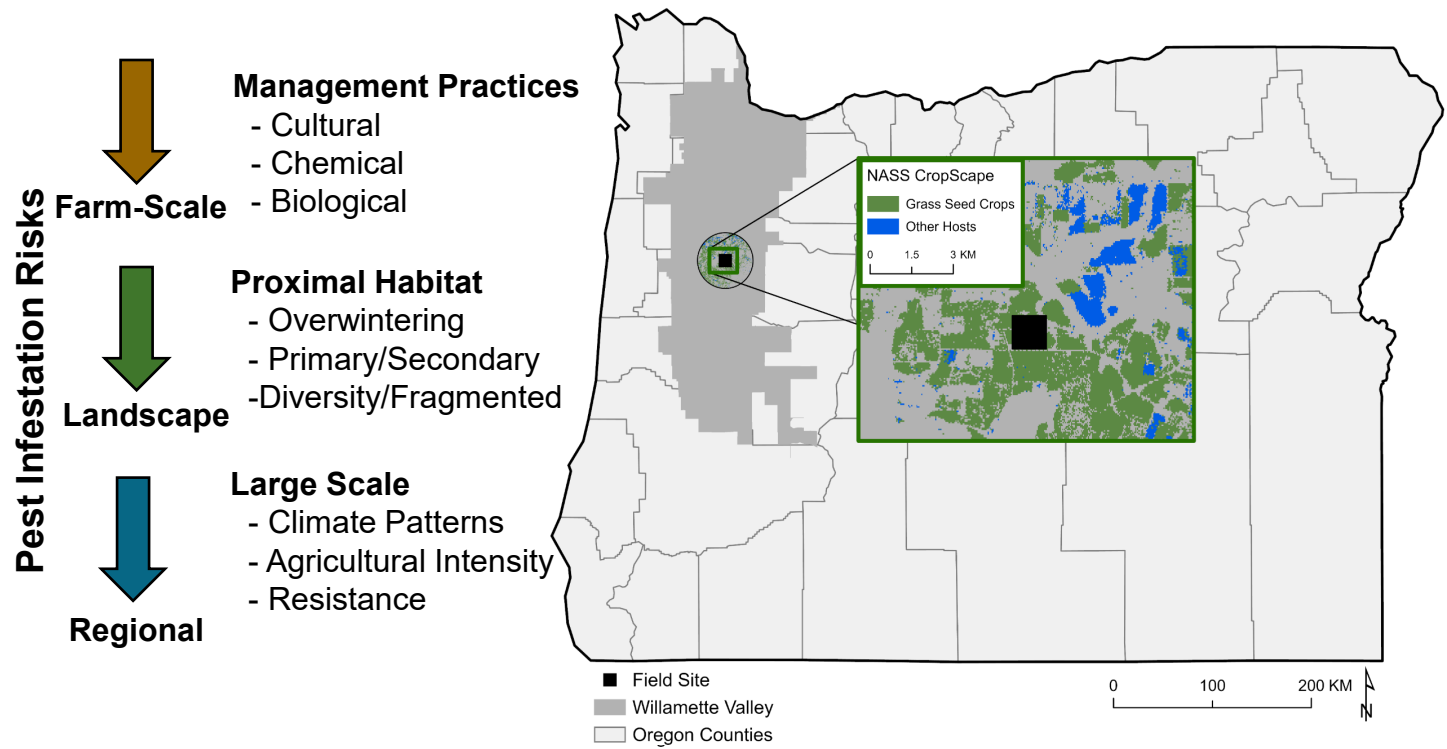


Climate and landscape drivers of an invasive pest in Oregon and New Zealand: the red clover casebearer moth

Navneet Kaur, Nicole Anderson, Richard Sim, Christy Tanner, Darrin Walenta,
Rodney Cooper

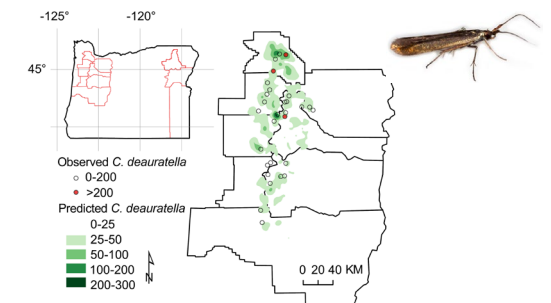
Seth Dorman
Research Entomologist
USDA-ARS
Forage Seed and Cereal Research Unit
Oregon State University
seth.dorman@usda.gov





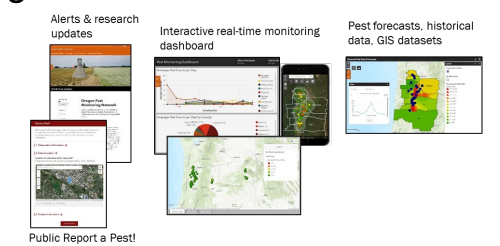
Red clover casebearer moth

- » Phenology
- » Spatial prediction

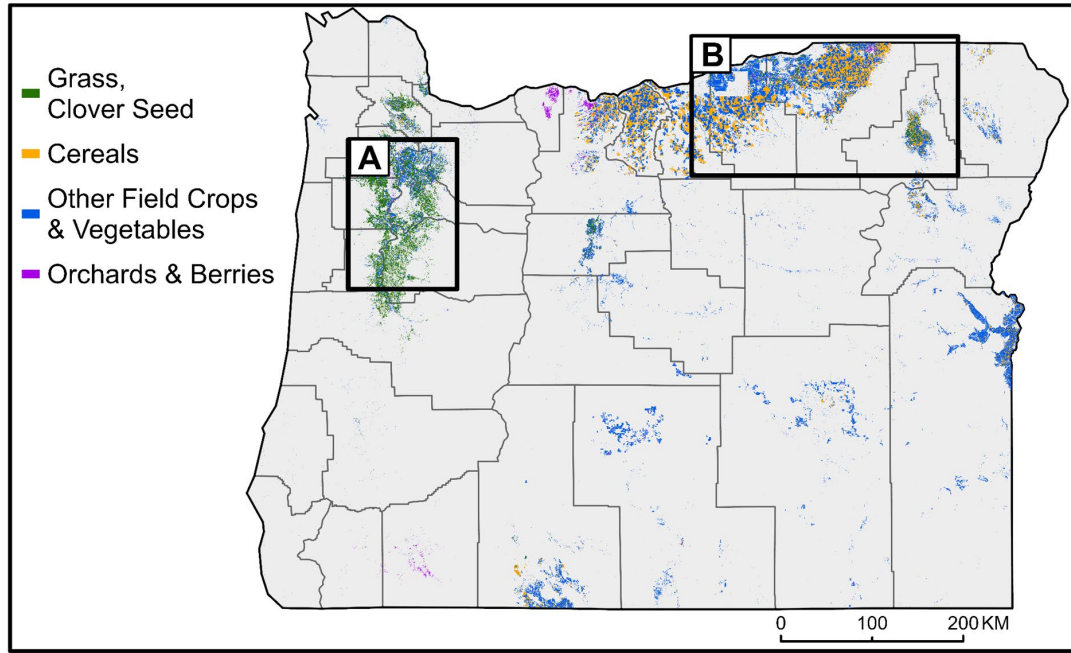


Monitoring and forecast tools

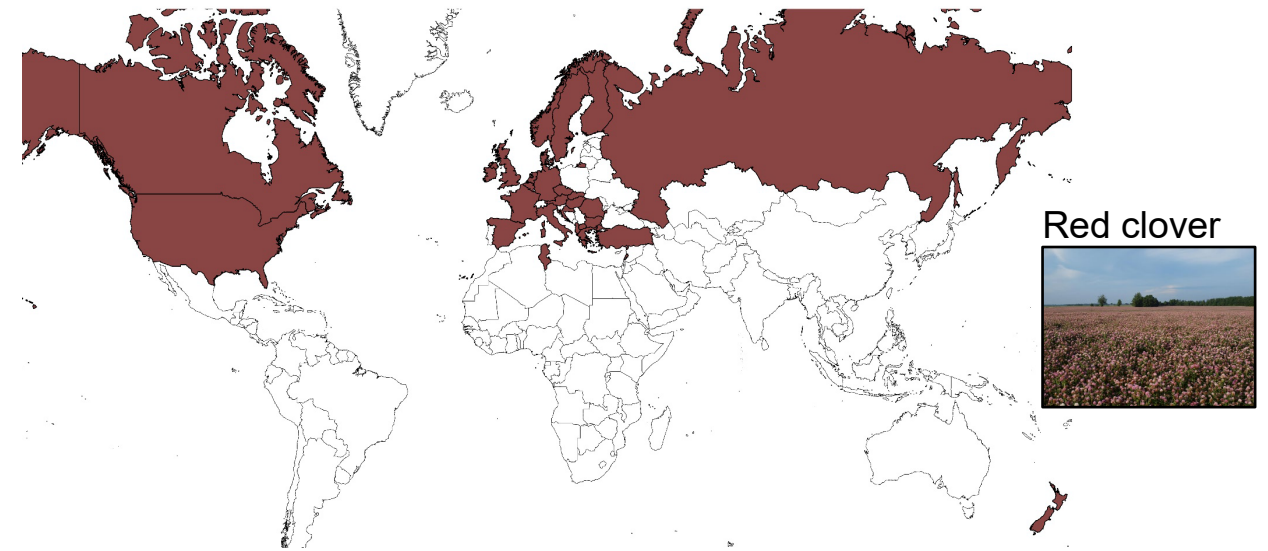
- » Real-time monitoring data
- » Pest forecasts



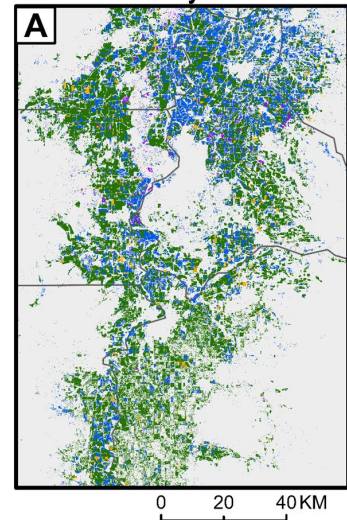
Red clover casebearer moth: Introduction



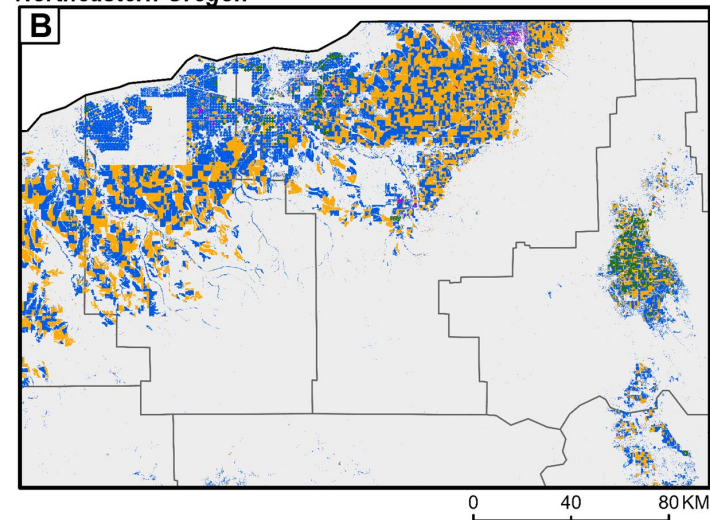
Red clover casebearer distribution



Willamette Valley



Northeastern Oregon



Floret damage

Early

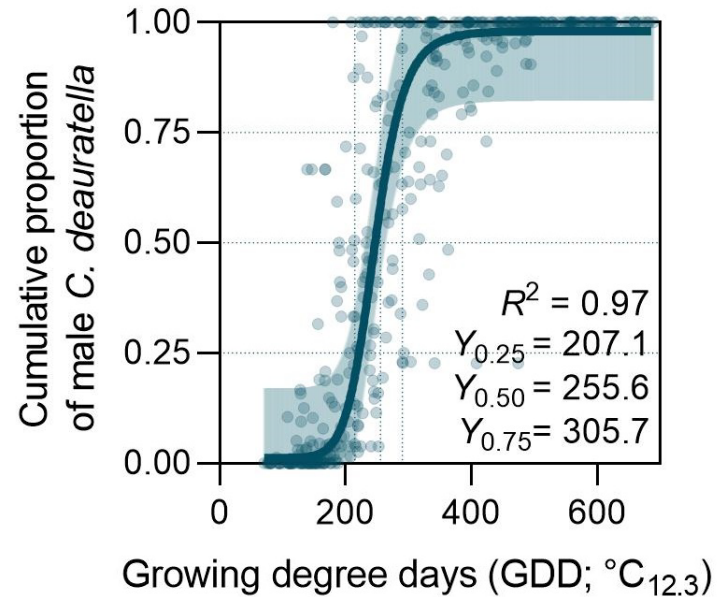


Advanced

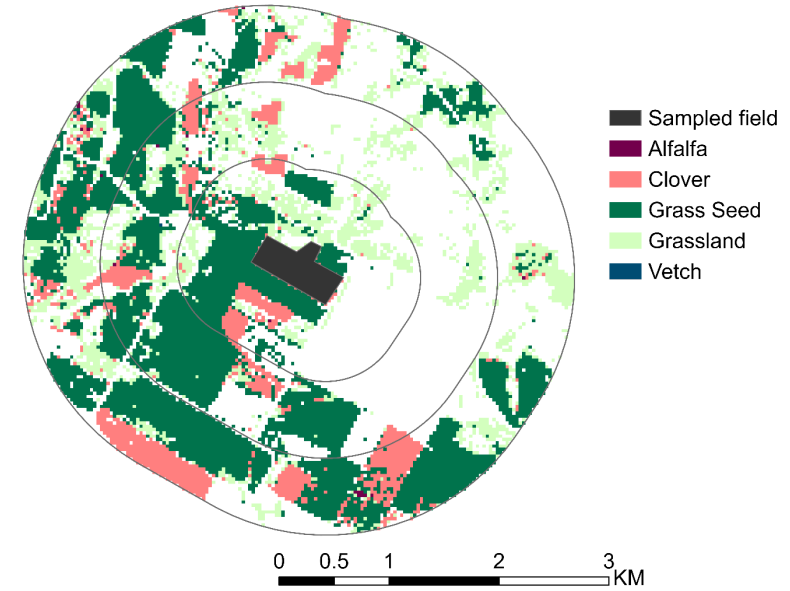




1. Flight phenology of RCCB populations in Oregon and New Zealand



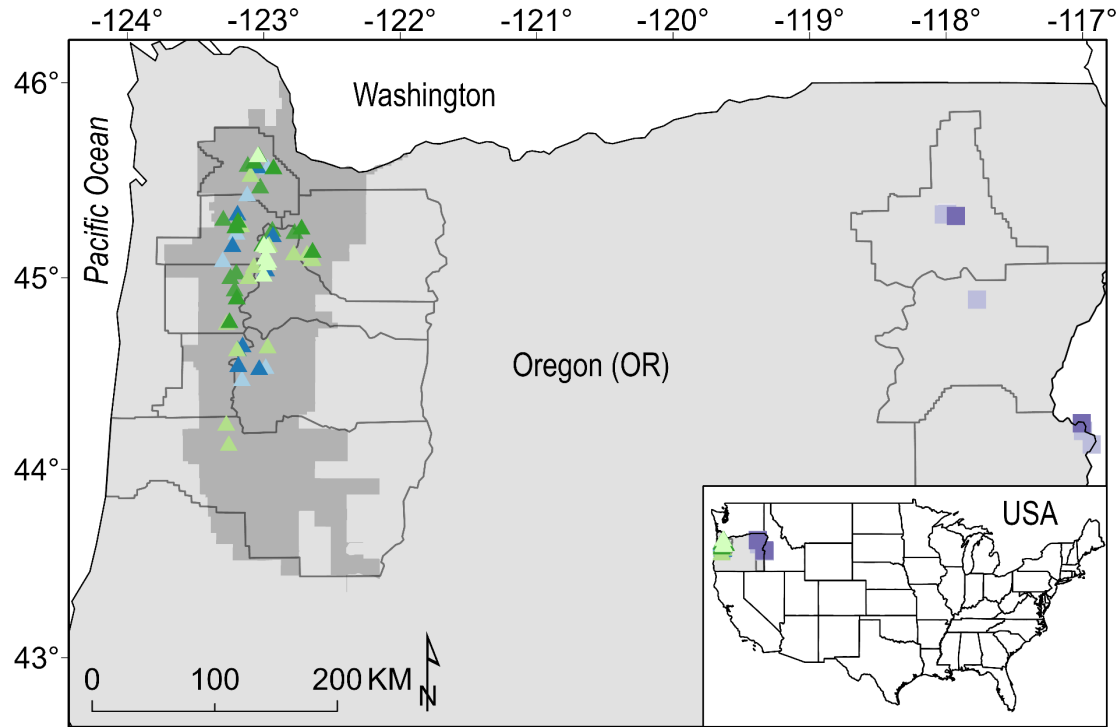
2. Alternate hosts and landscape-level risk factors of RCCB outbreaks



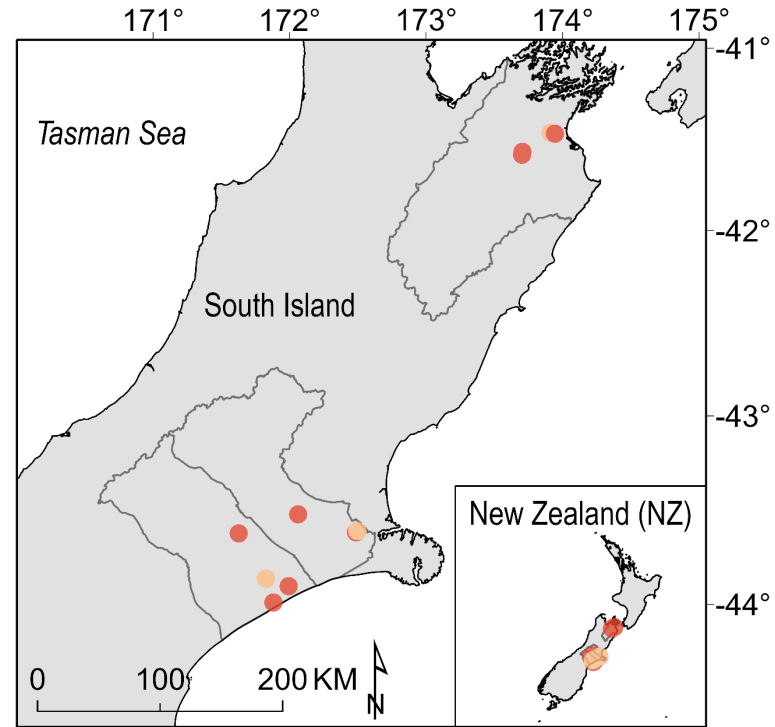
Red clover casebearer moth: Methods



Commercial red clover field sites

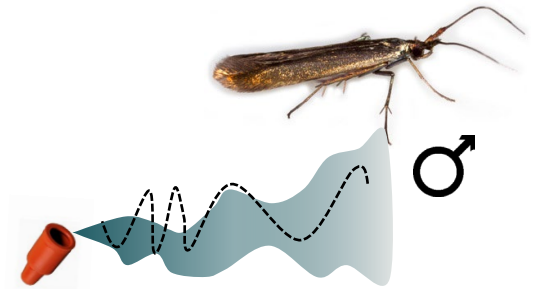


- Sampled counties
 - ▲ Western OR site-years (n = 54)
 - Eastern OR site-years (n = 10)
 - Willamette Valley
- | Year sampled | | | |
|--------------|--------|--------|--------|
| ▲ 2013 | ▲ 2020 | ▲ 2022 | ■ 2019 |
| ▲ 2014 | ▲ 2021 | ■ 2018 | ■ 2020 |



- Sampled territorial authorities
 - NZ site-years (n = 12)
- | Years sampled | |
|---------------|-----------|
| ● 2019-20 | ● 2020-21 |

Bucket traps

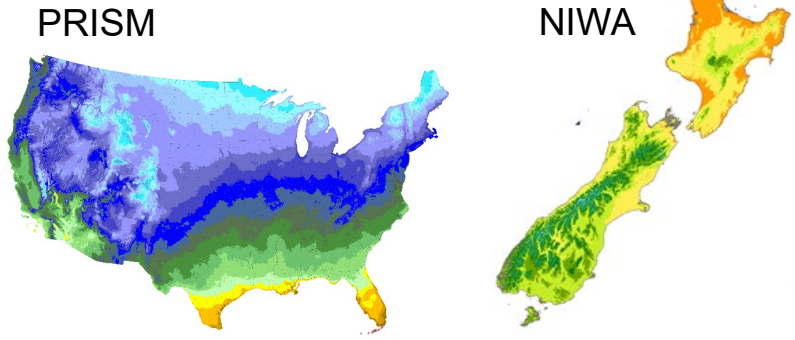


Z7-12:Oac and Z5-12:Oac (10:1)

Red clover casebearer moth: Phenology methods (Obj. 1)

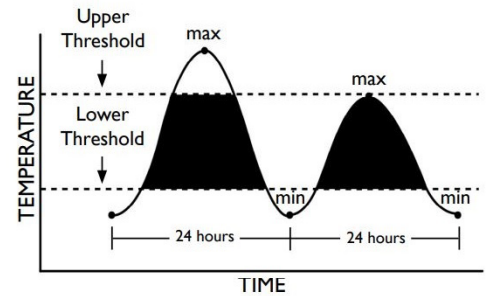


Extract temperature data



Accumulated growing degree days

1. Simple average
2. Single triangle
3. Single sine

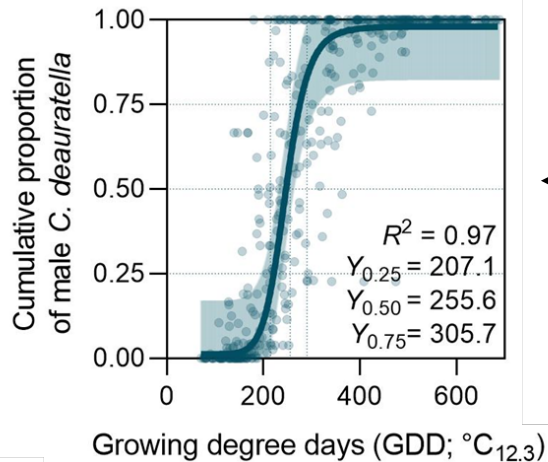


Three parameter nonlinear logistic regression

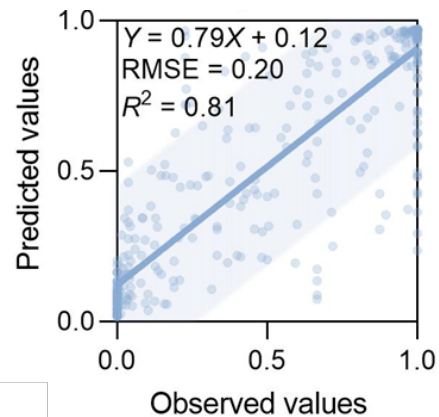
$$Y_{ij} = \frac{a_i}{1 + e^{\left[\frac{b_i - x_{ij}}{c_i} \right]}} + \varepsilon_{ij}$$

a = upper asymptote
 b = inflection point
 c = growth rate
 ε = variance structure
LDT = 9 to 13°C
UDT = 25 to 40°C

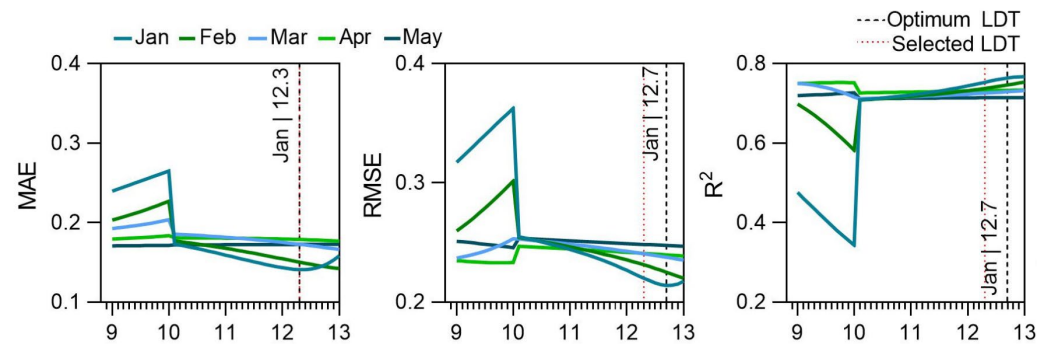
Phenology model output



Model validation



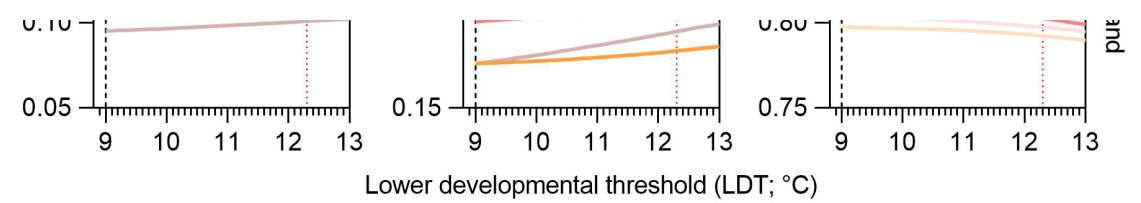
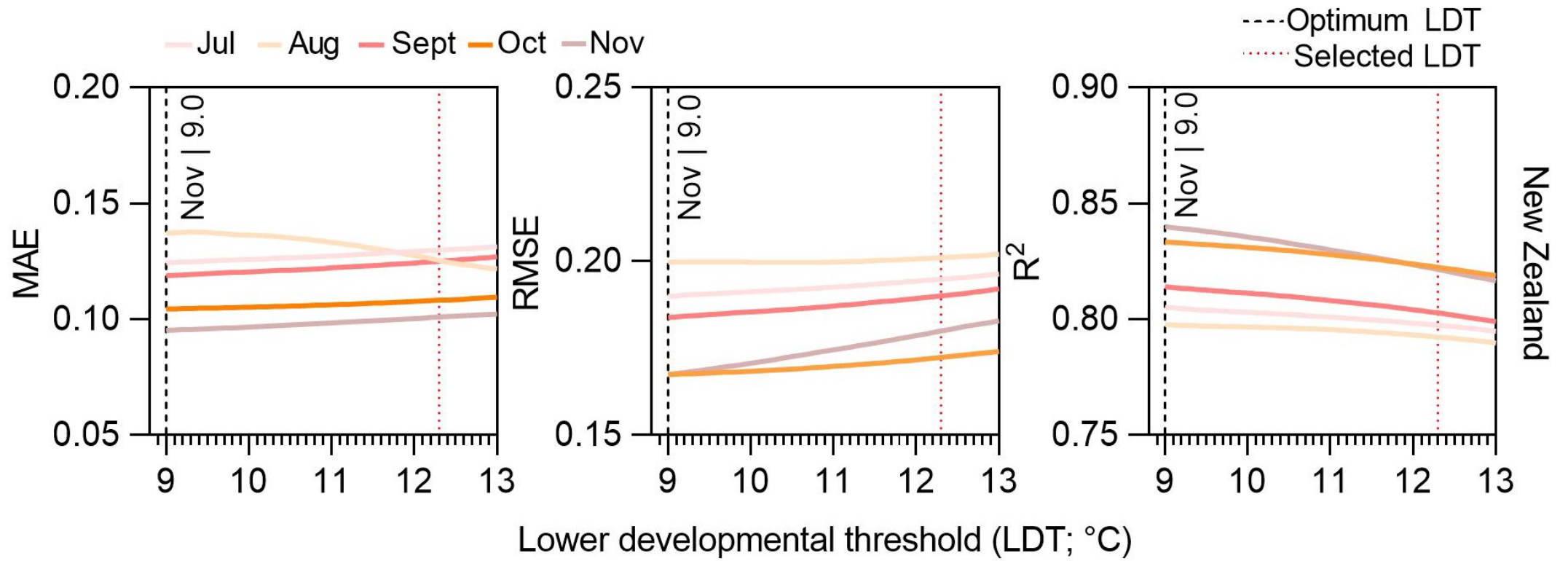
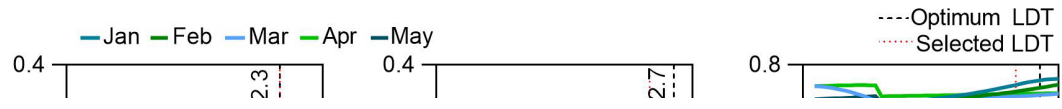
Evaluate start dates and thresholds



Red clover casebearer moth: Phenology results (Obj. 1)



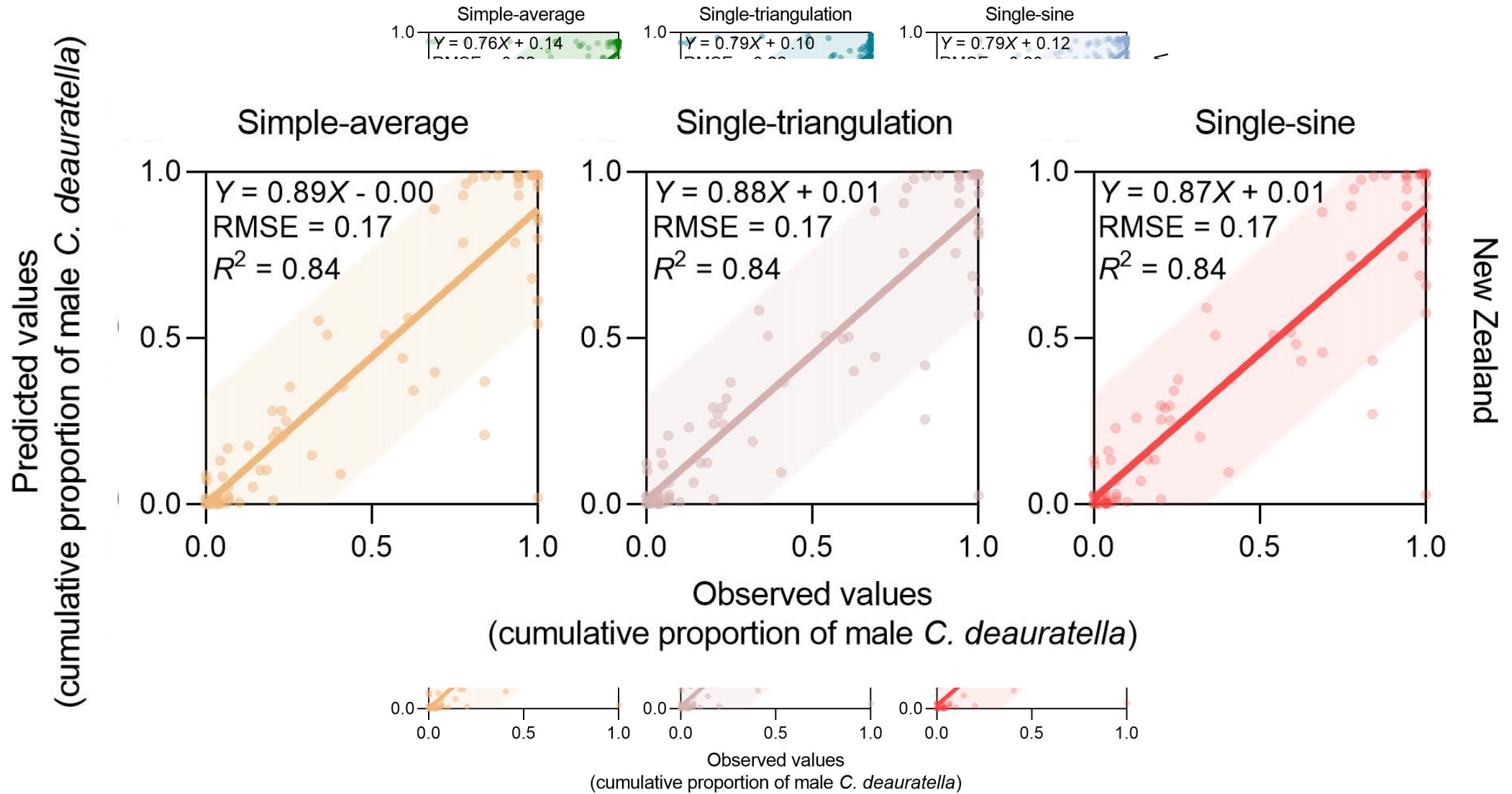
Evaluate start dates and thresholds



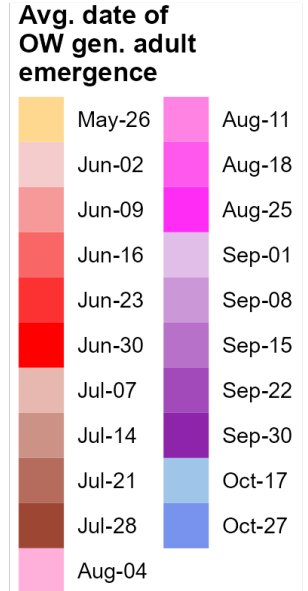
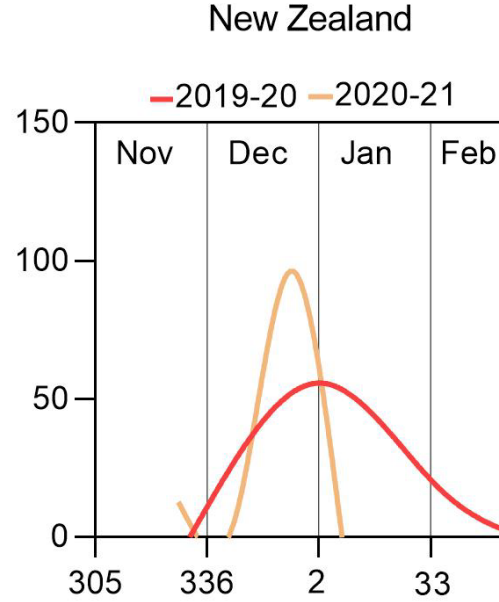
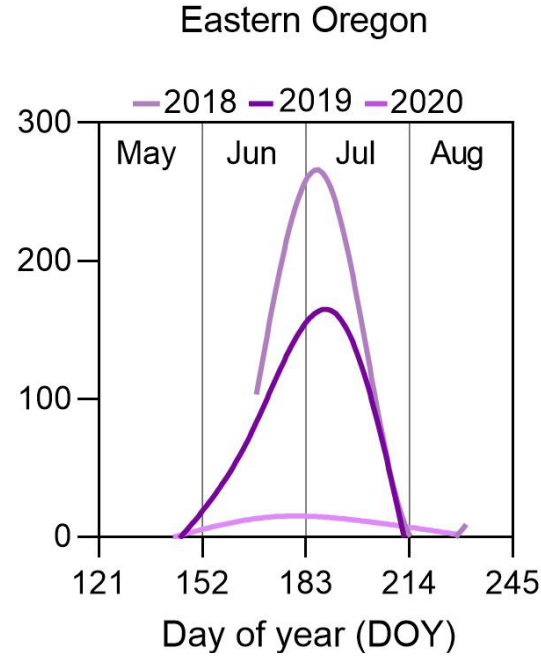
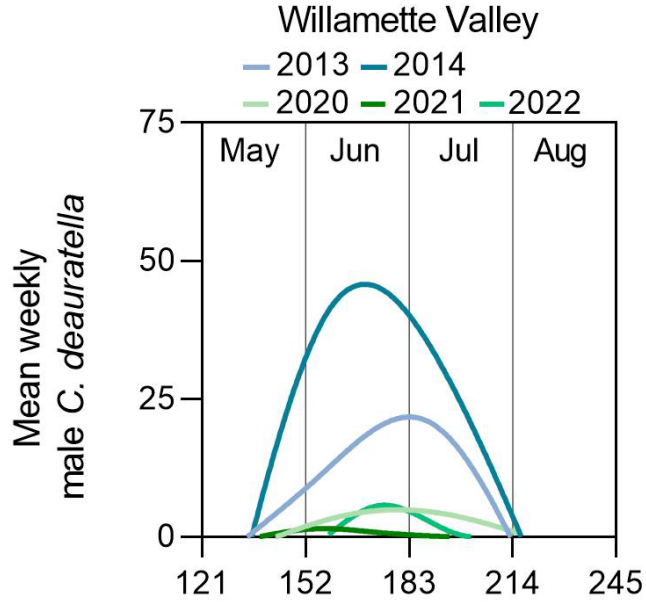
Red clover casebearer moth: Phenology results (Obj. 1)



Cross-validation with different GDD methods



Red clover casebearer moth: Phenology results (Obj. 1)

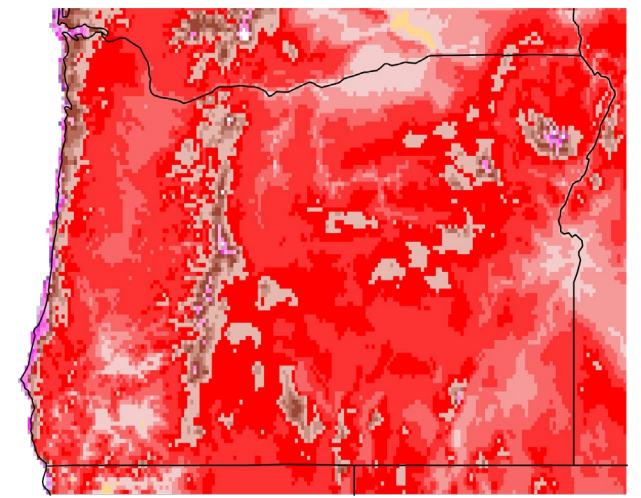


$R^2 = 0.97$
 $Y_{0.25} = 207.1$
 $Y_{0.50} = 255.6$
 $Y_{0.75} = 305.7$

$R^2 = 0.94$
 $Y_{0.25} = 216.7$
 $Y_{0.50} = 286.2$
 $Y_{0.75} = 360.4$

$R^2 = 0.98$
 $Y_{0.25} = 181.0$
 $Y_{0.50} = 222.3$
 $Y_{0.75} = 264.4$

2022 projection



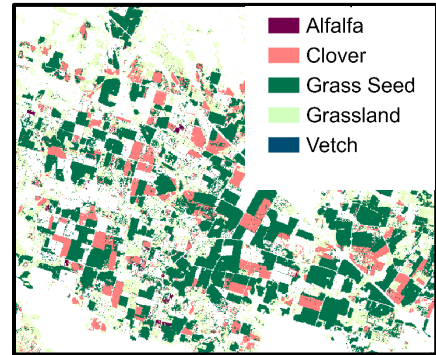
Red clover casebearer moth: Landscape risk factors methods (Obj. 2)



Gut-content analysis



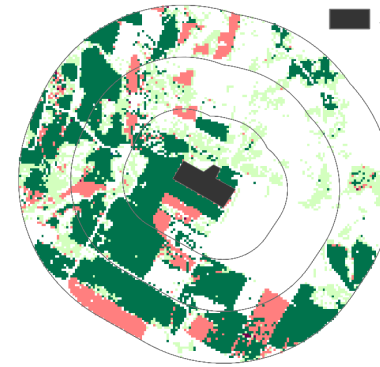
Data extraction (1 to 3 km radii)



NASS CDL



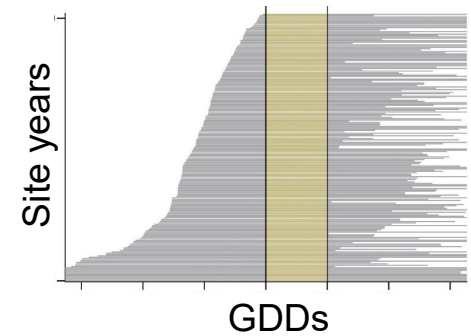
Inverse distance weighting (IDW)



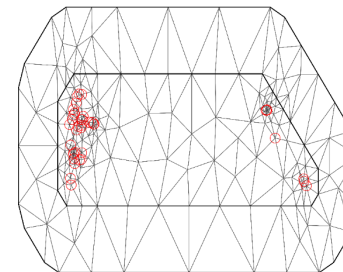
$$IDW = \sum_{t=1}^3 \sum_{d=1}^3 \left[\text{area}_{dt} \frac{1}{(5d)^2} \right]$$



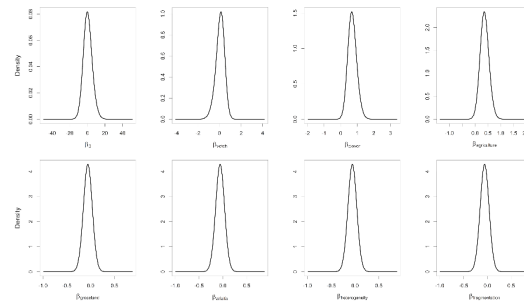
Count standardization (300 GDD window)



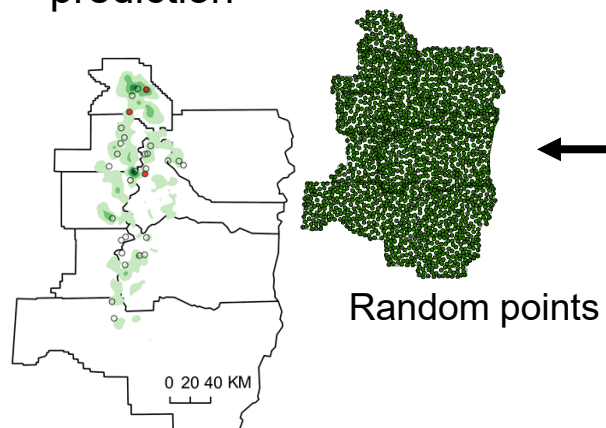
Stochastic partial differential equations (SPDE)



Hierarchical spatial Bayesian GLMM



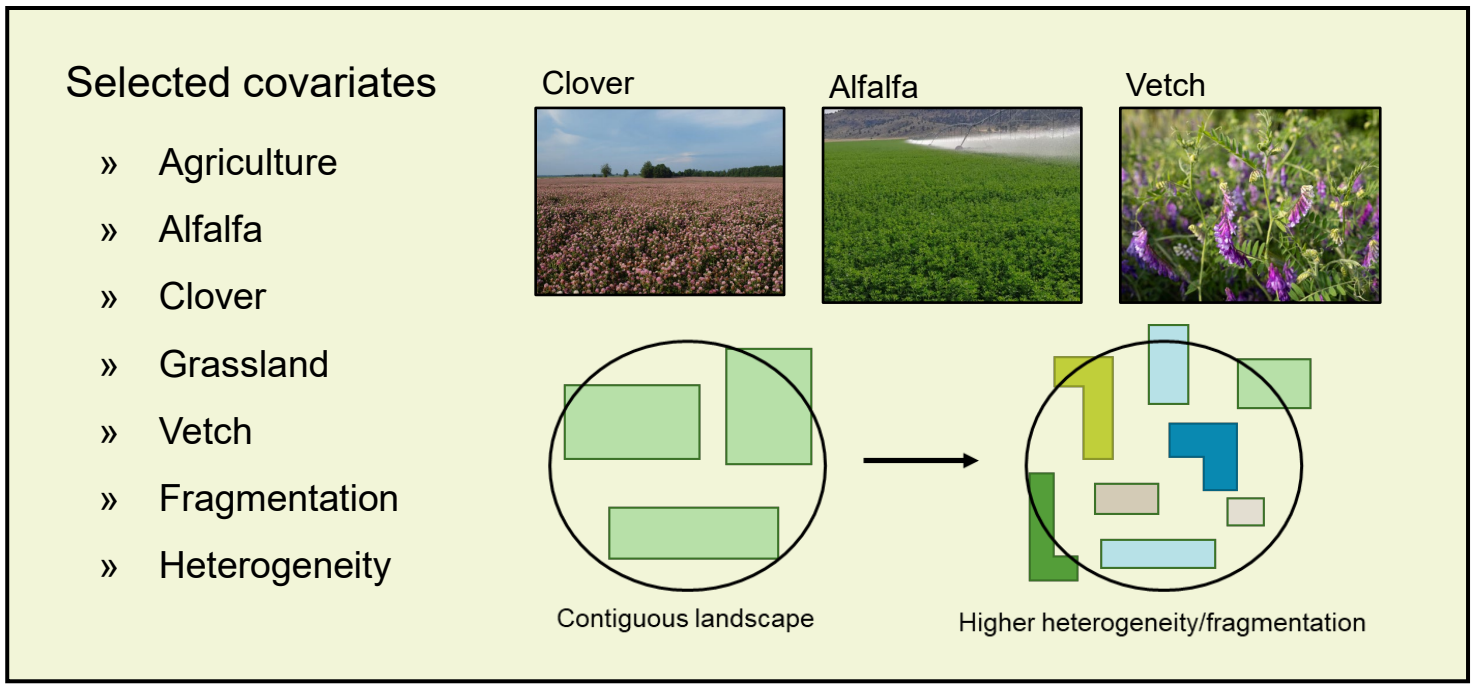
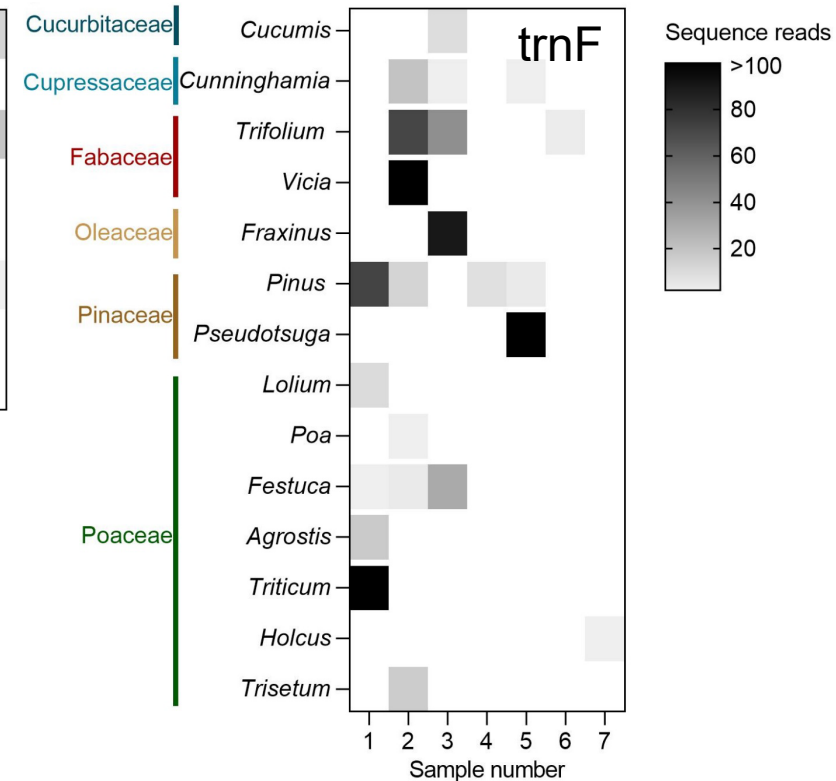
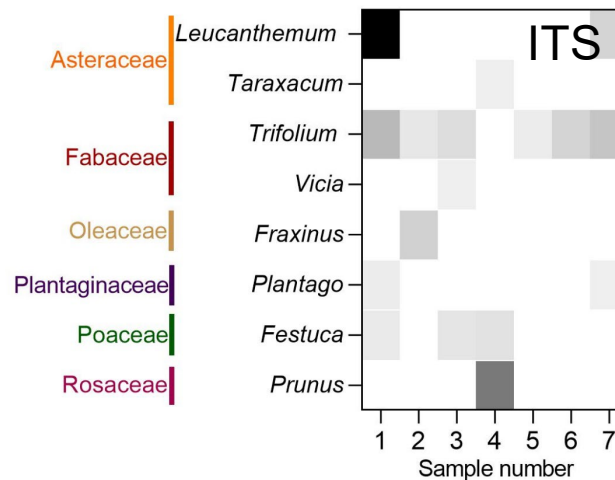
Model validation and prediction



Red clover casebearer moth: Landscape risk factor results (Obj. 2)



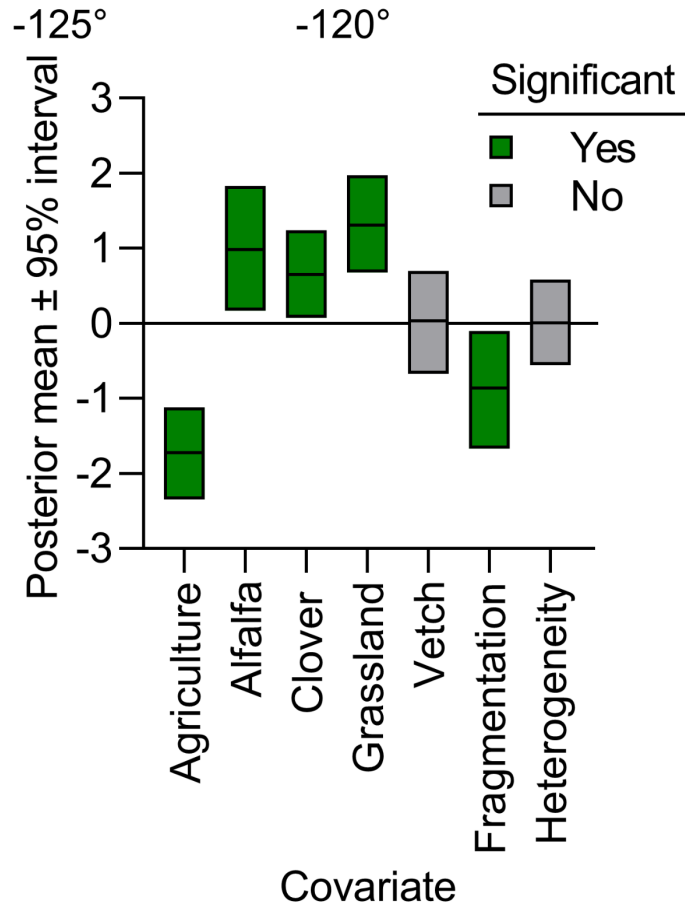
| Family/Genus | Percent positive samples |
|--------------------------------------|--------------------------|
| Fabaceae (clover, alfalfa, vetch) | 85.7 % |
| Poaceae (grasses) | 71.4 % |
| <i>Trifolium</i> (clover) | 85.7% |
| <i>Festuca</i> (fescue) | 42.9% |
| <i>Vicia</i> (vetch) | 28.6% |



Red clover casebearer moth: Landscape-level risk factors (Obj. 2)



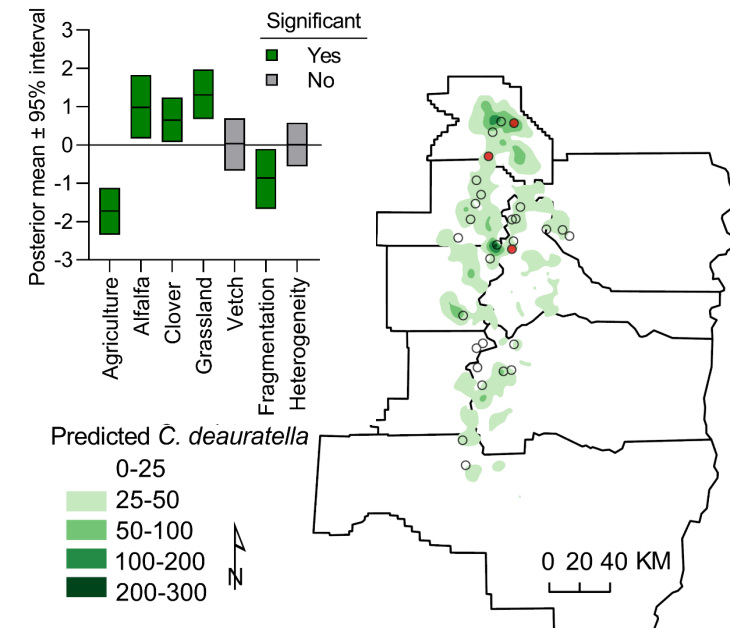
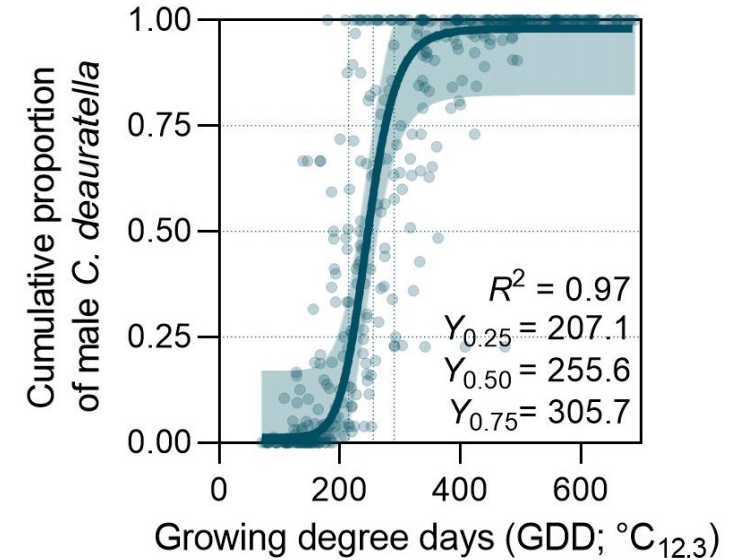
Posterior distribution





Summary

- » Regionally specific phenology models predict RCCB seasonal flight
- » Farms near greater clover and grassland weighted land area predict greater risk of RCCB
- » Complimentary phenology and landscape analyses present insights into local and landscape-level effects of abiotic and biotic risk factors influencing pest population dynamics

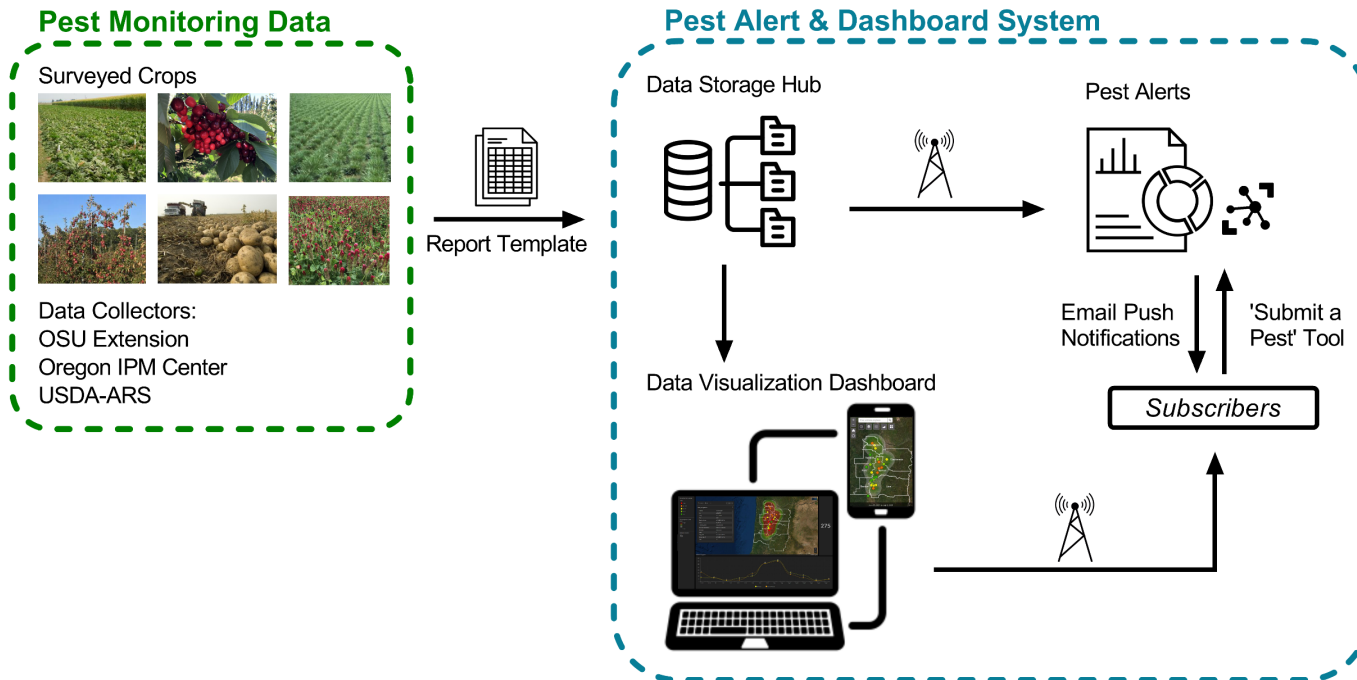


Monitoring and forecast tools: Oregon Pest Monitoring Network



Objective

- » Real-time pest alerts and management recommendations
- » Share pest forecasts and research updates
- » Expand to major commodities/pests in Oregon



Collaboration



Site link



Monitoring and forecast tools: Oregon Pest Monitoring Network



<https://oregonpests-usdaars.hub.arcgis.com>



Email alerts: pest & crop updates

Join Mailing List
Receive email notifications when a pest/crop alert is published for selected crops.

Select Crops

- Grass Seed
- Vegetables
- Clover Seed
- Milk
- Other

Name: _____

Email: _____

Profession: _____

Join Email List

Oregon Pest Monitoring Network

A new collaborative project between Oregon State University, USDA-ARS, Partnerships for Data Innovation (PDI), VegNet, and Oregon IPM Center

Pest & Crop Updates

Noctuid Monitoring Update | September 19, 2022 | Field Crops

Posted by: Eliza Hernández & Seth Dorman

Sampling Week: 2022-07-03
True Armyworm (*M. unipuncta*)

Adult count per week

- 250
- 200
- 150
- 100
- 50
- 0

Dashboard: real-time & historical pest data

Pest Monitoring Dashboard

Filter by Pest Species | Filter by Crop Type | Filter by Date | Filter by County | Filter by Field Crops | Filter by Vegetable Crops

Average Pest Count per Day

Sampling Date: May to Nov

- Variegated Cutworm
- True Armyworm
- Glassy Cutworm
- Black Cutworm
- Diabrotica
- Cabbage Looper
- Sod Webworm
- Seedcorn Maggot

Average Pest Count per Day by County

- Baker 4.9%
- Clackamas 3.5%
- Marion 14.1%
- Union 0.2%
- Lane 3.4%
- Linn 13.3%
- Jefferson 20.8%
- Polk 11.7%
- Yamhill 7.5%
- Washington 8.2%
- Benton 12.3%
- Clackamas 0.4
- Jefferson 2.3
- Polk 1.3
- Yamhill 0.8
- Washington 0.9
- Benton 1.4
- Linn 1.5
- Lane 0.4

Interactive Map | Time Series | Map Legend

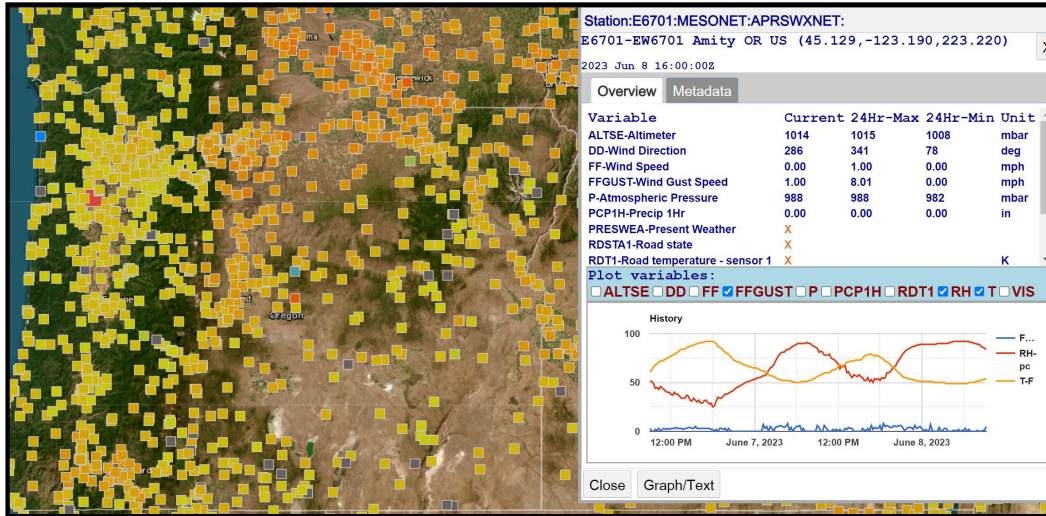
Monitoring and forecast tools: Oregon Pest Monitoring Network



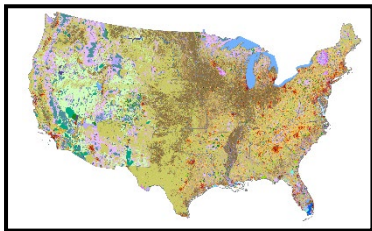
<https://oregonpests-usdaars.hub.arcgis.com>



MADIS mesonet weather stations



Land use data



Observational datasets



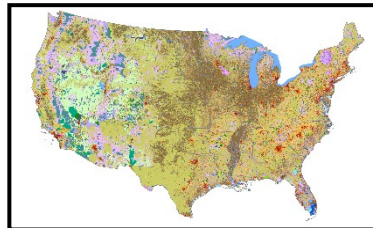
Monitoring and forecast tools: Oregon Pest Monitoring Network



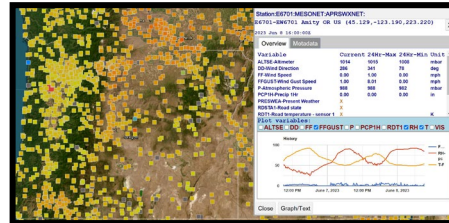
<https://oregonpests-usdaars.hub.arcgis.com>



Land use data



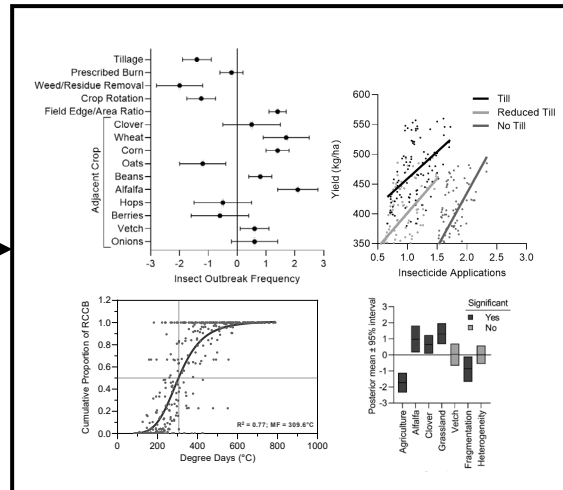
Real-time weather data



Observational datasets



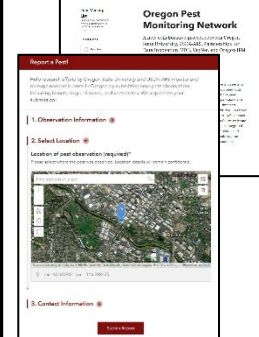
Analyses to model trends



- Environmental & spatial predictors of pests
- Crop rotation effects on pest outbreaks
- Soil conservation impact on pests

Oregon Pest Monitoring Network

Alerts & research updates to email subscribers



Public Report a Pest! fe

Interactive real-time monitoring

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Climate and landscape drivers of an invasive pest in Oregon and New Zealand: the red clover casebearer moth

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