College of Natural Resources and Sciences, Department of Wildlife

Examining the effects of songbird nest boxes and land use on avian community composition and functional diversity in Napa Valley vineyards

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INTRODUCTION

- Birds consume up to 28 million metric tons of insect prey per year globally in croplands.[5]
- Insectivorous birds can provide important pest control services in agricultural systems[1,3], potentially reducing reliance on harmful insecticides.
- Winegrapes are vulnerable to insect pests and grown in Mediterranean regions marked by high biodiversity, extensive agriculture, and comparatively little habitat protection.
- Sustaining insectivorous birds within agricultural landscapes could benefit biodiversity and farm productivity alike.[2,4]
- The addition of songbird nest boxes and local habitat on the abundance of these insectivorous birds within vineyards remains unresolved.
- Objectives here are to conduct preliminary analyses of point counts in Napa Valley winegrape vineyards (not accounting for imperfect detection probability).

HYPOTHESES

1. The addition of songbird nest boxes to winegrape vineyards attracts insect-eating bluebirds and swallows, and this effect is mediated by local and/or landscape habitat heterogeneity.
2. Avian community diversity, richness, and insectivore abundance increases with local and landscape habitat heterogeneity.

STUDY DESIGN

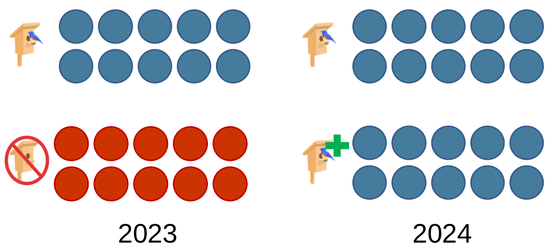

Figure 1. Survey birds & insects on 20 vineyards before & after addition of nest boxes to 10 of them. BACI-design experiment

STUDY SITES

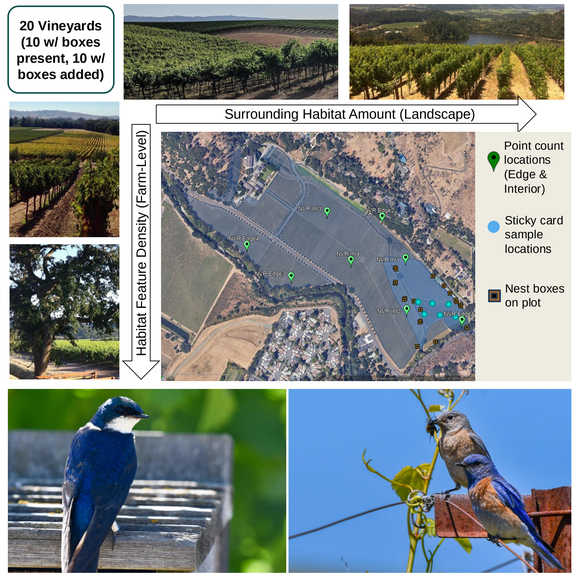

Figure 2. Study design schematic. Point counts distributed to capture variation in habitat heterogeneity. Birds that utilized nest boxes in the vineyards. Bottom right: Male and Female Western Bluebirds, Bottom left: Tree Swallow.

METHODS

- Point counts April – July 2023 & 2024, 10 with existing nest boxes and 10 with nest boxes added between field seasons (BACI design, Figure 1).
- GLMs of mean Western Bluebird and Tree Swallow abundance (# detections per point count) with year x treatment x habitat heterogeneity.
- Landcover (urban, vineyard, grassland, oak savannah, riparian, forest) was assessed at local (25m radius, visual estimate) and at landscape levels (200 m radius, GIS 4-m raster).
- Calculated landcover heterogeneity (Shannon Diversity) at the local and landscape levels at each point count location.
- Calculated avian Shannon Diversity, species richness, and insectivore abundance.
- GLMs to examine relationships between avian species richness, diversity, and insectivore abundance with the association of landcover heterogeneity at the local and landscape scale.

3-min video about our work in Napa!

RESULTS

- We detected 13,522 individuals of 96 bird species during 891 point counts at 161 point count locations across 20 vineyards over two seasons.
- Abundance of Western Bluebirds increased on sites with added nest boxes, but not control sites with existing boxes (Figure 3). This affect was not mediated by local or landscape heterogeneity.
- Addition of nest boxes did not significantly increase the abundance of Tree Swallows, which remained more abundant at control sites.
- Tree Swallow abundance was positively associated with local heterogeneity but not landscape heterogeneity.
- Shannon diversity, species richness, and insectivore abundance were positively associated with local and landscape heterogeneity (Figure 5).

NEST BOXES INCREASED BLUEBIRDS

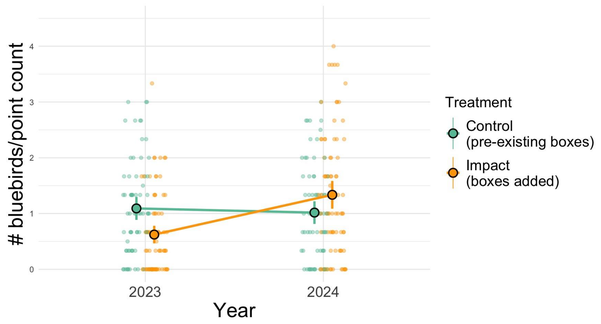

Figure 3. Mean abundance of Western Bluebirds at each point count location by year and nest box treatment (Control or Impact) fit with 95% confidence intervals.

SWALLOWS INCREASED VALLEY-WIDE

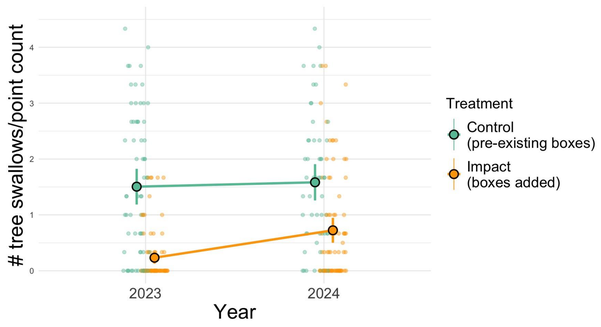

Figure 4. Mean abundance of Tree Swallows at each point count location by year and nest box treatment (Control or Impact) fit with 95% confidence intervals.

LANDCOVER ANALYSES

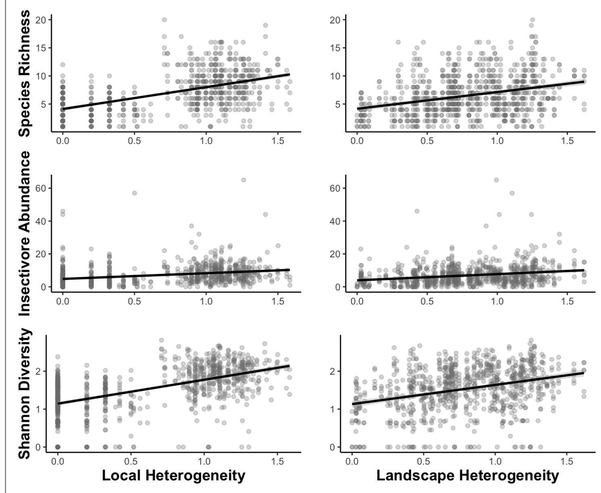

Figure 5. Linear regression models with log-transformed Shannon Diversity, insectivore abundance, and species richness plotted against landscape and local heterogeneity. Line shows fit with 95% confidence intervals.

DISCUSSION

- Adding nest boxes to winegrape vineyards can increase abundance of Western Bluebirds in just one year; this affect was not dependent on nearby natural habitat heterogeneity.
- Farms with more heterogeneity at both the local and landscape level may have a greater capacity to support avian biodiversity and insectivores for biocontrol, but nest boxes may be more essential to attract Western Bluebirds.
- Local heterogeneity may be important when attracting Tree Swallows to farms for biocontrol.
- Future steps include occupancy and N-mixture modeling for imperfect detection and will assess nest box effects on insect pests.

ACKNOWLEDGEMENTS

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