The Potential for Native Vegetation Restoration to Improve Pest Management in Southern California

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Agriculture is the dominant form of human land use worldwide, covering > 40% of the surface of the earth.
Our global food system is the primary driver of biodiversity loss
Agriculture benefits from conservation and restoration

Global Assessment Report on Biodiversity and Ecosystem Services

World's food supply under 'severe threat' from loss of biodiversity

Plants, insects and organisms crucial to food production in steep decline, says UN
How can we integrate the goals of agricultural production and biodiversity restoration*

Biodiversity is critical to future health of California's ecology and economy

*While meeting the needs of the human population
Integrating restoration and biodiversity into agricultural landscapes

Habitat enhancement/ revegetation
Invasive species removal
Weed mitigation
Improved ecosystem services/function
**Focus on restored areas**

Pest management
Weed management
Fertilizer/ water use
Food safety
**Focus on individual fields**

Ecosystem service delivery/
Integrated pest management
Can we integrate restoration and agricultural objectives at a landscape scale?
The SCRV is a critical growing area for high-value strawberries, avocados, lemons, and nursery stock.
Ventura County applies the most pesticides per square mile of any county in California.
The SCRV is a heterogeneous mix of agriculture, natural habitat, and urbanization.
The Santa Clara River is a major conservation and restoration target

- Invasive vegetation
- Land conversion and development
- Poor water quality
• >4500 acres in easements/agricultural fee properties since 1999
• >$19 million in State funds to restore 800 acres since 2006
Restoration has focused primarily on *Arundo* removal

- Long-term, large scale restoration projects
- Extensive bird, mammal, arthropod and plant census data within restored habitats
- No data on biodiversity outside the restored areas
No coordination of agriculture and restoration objectives

Can restoration boost ecosystem services in agriculture, and can we use agricultural land to amplify the benefits of restoration?
Vegetation restoration on agricultural margins

Pros:
• Creates wildlife habitat
• Can attract beneficial insects (pollinators and natural enemies)
• Can attract insectivorous birds
• Reduces pesticide costs

Cons:
• Could attract pests/compromise food safety
• Cost of installation/maintenance
• Spatial scale of efficacy remains unclear
1. How does large-scale restoration of the riparian corridor- and the biodiversity it generates- impact surrounding agriculture?

2. Can small-scale native vegetation restoration on field margins amplify ecosystem services & biodiversity generated by the riparian corridor?
Approach

1. Survey wildlife diversity, activity, and habitat use across the SCRV

2. Restore native vegetation at a small scale on orchard margins

3. Assess biodiversity and biological control in orchards as a function of distance from large and small-scale restoration sites
Pine Tree Ranch:
Avocado and citrus orchard
Bird counts and foraging tests
Camera trapping
Small-scale vegetation restoration
Crop damage assessments
Insect collection

TNC properties:
Citrus orchard + restored riparian
Bird counts and foraging tests
Camera trapping
Insect collection
Ten survey points per habitat type (n=60 points)

Each point is visited three times per season

Point counts last for five minutes and identify all birds within 50m
Abundance and richness of birds in different habitat types
Distributions of native and non-native bird species

Species Status
- Orange: Non-Native
- Green: Native

Habitats:
- Riparian
- Scrub
- Orchard
- Suburban
- Urban

Percentages of Distributions:
- Riparian: 100%
- Scrub: 100%
- Orchard: 100%
- Suburban: 50% Non-Native, 50% Native
- Urban: 25% Non-Native, 75% Native
Distinct bird communities associated with different habitats

Bird communities in all five habitats are significantly different
Dietary niches and habitat types

- **Riparian**: Predominantly Grainivore, with small contributions from Insectivore and Nectivore.
- **Scrub**: Predominantly Grainivore, with a smaller proportion of Omnivore.
- **Orchard**: Predominantly Omnivore, with smaller contributions from Predator, Folivore, and Frugivore.
- **Suburban**: Predominantly Omnivore, with small contributions from Insectivore and Nectivore.
- **Urban**: Predominantly Omnivore, with smaller contributions from Folivore and Frugivore.
- **Edge**: Predominantly Omnivore, with small contributions from Insectivore and Nectivore.
1. Different habitats have unique bird communities

2. Restored riparian areas have the highest bird abundance and richness, and the most potentially beneficial species

3. There is limited spillover from riparian areas to surrounding agriculture: orchards have low diversity and distinct communities
Can small-scale vegetation restoration improve ecosystem services in orchards?

Three 10m x 10m plots, 30 plants/plot. Native shrub species chosen to maximize structural variety and floral composition.
Small-scale native vegetation restoration
Small-scale native vegetation restoration
Does insectivore foraging intensity increase closer to restored vegetation?

20% of models removed on citrus adjacent to restored plots, compared to 12% 100m away.

Sentinel insect experiments of beneficial and pest insects.
Diversity and habitat use of mammals
Mammals are abundant and diverse in orchards

- Thus far, diversity and abundance of mesocarnivores and other mammals is **higher** in orchards compared to restored riparian habitat.
- Activity patterns suggest home ranges rather than transit for many species.
- It’s possible that dense *Arundo* limits mammal activity in riparian corridor.
- Growers report no obvious negative impacts of mammals on crops.
- Orchards and natural areas may act synergistically to support robust mammal communities in the SCRV.
Summary

1. Bird communities vary dramatically among habitat types, with insectivores concentrated in natural habitats.

2. Mammals appear to be more abundant and diverse in orchards than in restored riparian areas.

3. There is not currently spillover of birds from restoration areas into the surrounding landscapes.

4. There is potential to improve biological control and increase biodiversity across the valley via small-scale restoration.
Future work

1. Expand monitoring and restoration to additional properties including orchards and row crops adjacent to, and distant from, the river.

2. Incorporate small mammal trapping to monitor potential mammalian pests & mesocarnivore control.

3. Determine costs and benefits to growers of proximity to small vs. large scale restoration plots.
The SCRV is a potential case study for landscape-level coordination of restoration and ecosystem service delivery in agricultural areas.
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