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





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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

Satico

EI RIC

RIO LINDO



Somis

Moorpark



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

Key Questions

- 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

Approach

Pine Tree Ranch: Avocado and citrus orchard Bird counts and foraging tests Camera trapping Small-scale vegetation restoration Crop damage assessments Insect collection

Santa Paula

118

TNC properties: Citrus orchard + restored riparian by Car Bird counts and foraging tests Camera trapping Insect collection

Fillmore

Bardsdale

126

Somis



Saticoy

232

Monitoring bird diversity, habitat use, and foraging



- 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



Distinct bird communities associated with different habitats

Bird communities in all five habitats are significantly different



Dietary niches and habitat types



- 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

- 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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