

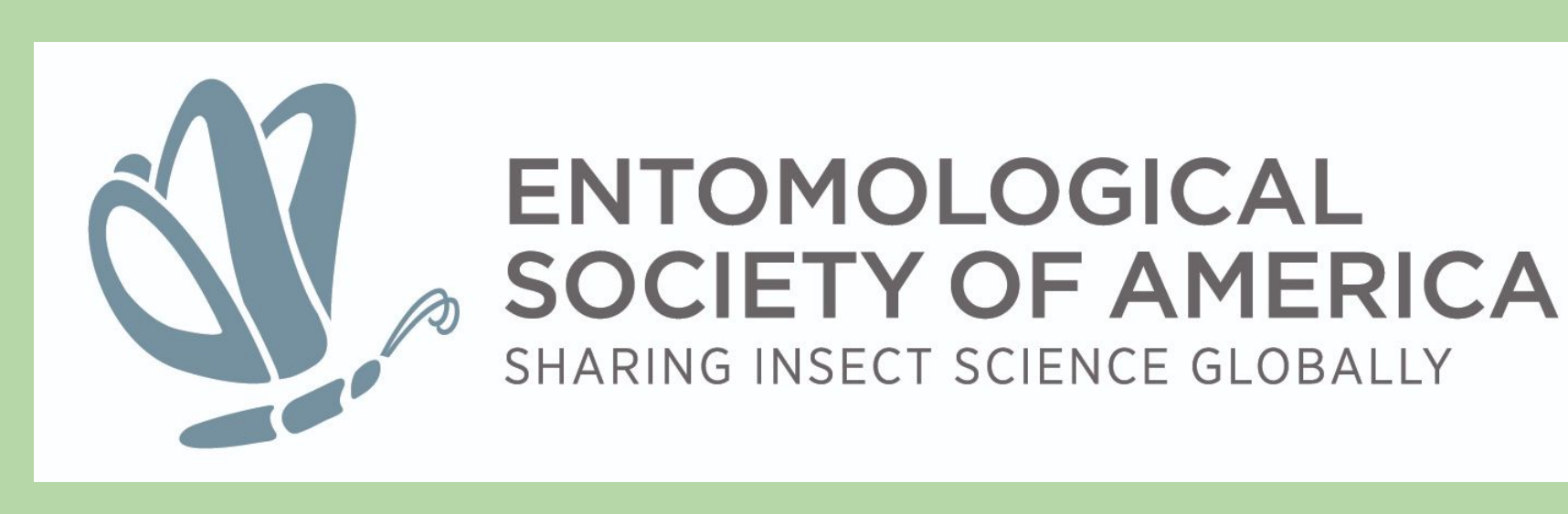
Dispersal status and current range of *Parafreutreta regalis*, a biological control agent for Cape Ivy in California



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Background

Cape ivy (*Delairea odorata*) is an invasive perennial vine native to South Africa. Cape Ivy has invaded extensive areas across California's coastal counties, including sensitive riparian habitats. Classified as a high-priority invasive species (Cal-IPC 2024), Cape Ivy reduces native plant diversity and disrupts ecosystem function.

The first biological control agent was approved for release in California in 2016. *Parafreutreta regalis*, a tephritid gall forming fly was found to reduce plant vigor in pre-release efficacy testing (Fig. 1). Since its approval, *P. regalis* has been released at 22 sites in California and established at 11 of those, spanning most of California's coastal counties.

Agent releases and seasonal monitoring have continued since 2018, however little was known about the ability for *P. regalis* to disperse and colonize new patches. This ongoing study set out to map and characterize the patterns of *P. regalis* dispersal from release points and among diverse landscapes and geographies. Dispersal from six release points was mapped for comparison.



Figure 1.



Figure 2.



Figure 3.

Figure 1. *Parafreutreta regalis* on a Cape Ivy leaf (Portman, 2020). Figure 2. A 'windowing' gall found at a field site. Figure 3. Undergraduate field assistants amongst Cape Ivy, conducting a survey at Toro Canyon State Park.



Figure 4. *P. regalis* release sites span the range of Cape Ivy in California (Cape Ivy distribution based on iNaturalist research-grade observations, 2024).

Methods

Surveys and Data Collection

- Dispersal data were collected between May-October of 2024 and 2025.
- Survey sites cover a broad range of latitudes and habitats; riparian, coastal bluffs, and woodlands.
- Two approaches for surveying: systematic surveys with progression along 500m buffer rings including environmental data; and opportunistic gall detection mapping at Cape Ivy patches.
- Cape Ivy stands were surveyed in roughly 5m² quadrats for 10 minutes.
- If a single gall was observed within a stand, the survey would progress to the next 500m buffer ring. If no galls were observed within 3 consecutive stands, the dispersal was assumed to have reached its boundary.

Spatial Analysis

- Maximum dispersal distance was measured from nearest release location.
- Colonization area based on convex hull analysis
- Environmental characteristics: canopy cover, host patch size, host patch percent cover.
- Dispersal rates estimated as maximum distance or area divided by years since release

Results

Release Site	Confounding releases	Year of first introduction	Primary Habitat Type	Dispersal Survey: Gall Detections	Max Distance (km)	Colonization Area (km ²)	Dispersal Pattern
Timber Cove	No	2016	Coastal bluff	4	1.3	N/A	Linear
Bolinas Lagoon	No	2020	Coastal bluff/ riparian mix	4	3	N/A	Linear
Garrapata	Yes	2018	Coastal bluff	9	14	21.8	Linear
Atascadero Creek	Yes	2019	Riparian	64	5.8	38.6	Dendritic
Toro Canyon Park	No	2017	Riparian and woodland	44	3.6	12.8	Dendritic
Rincon Creek	No	2022	Riparian	2	0.14	N/A	N/A

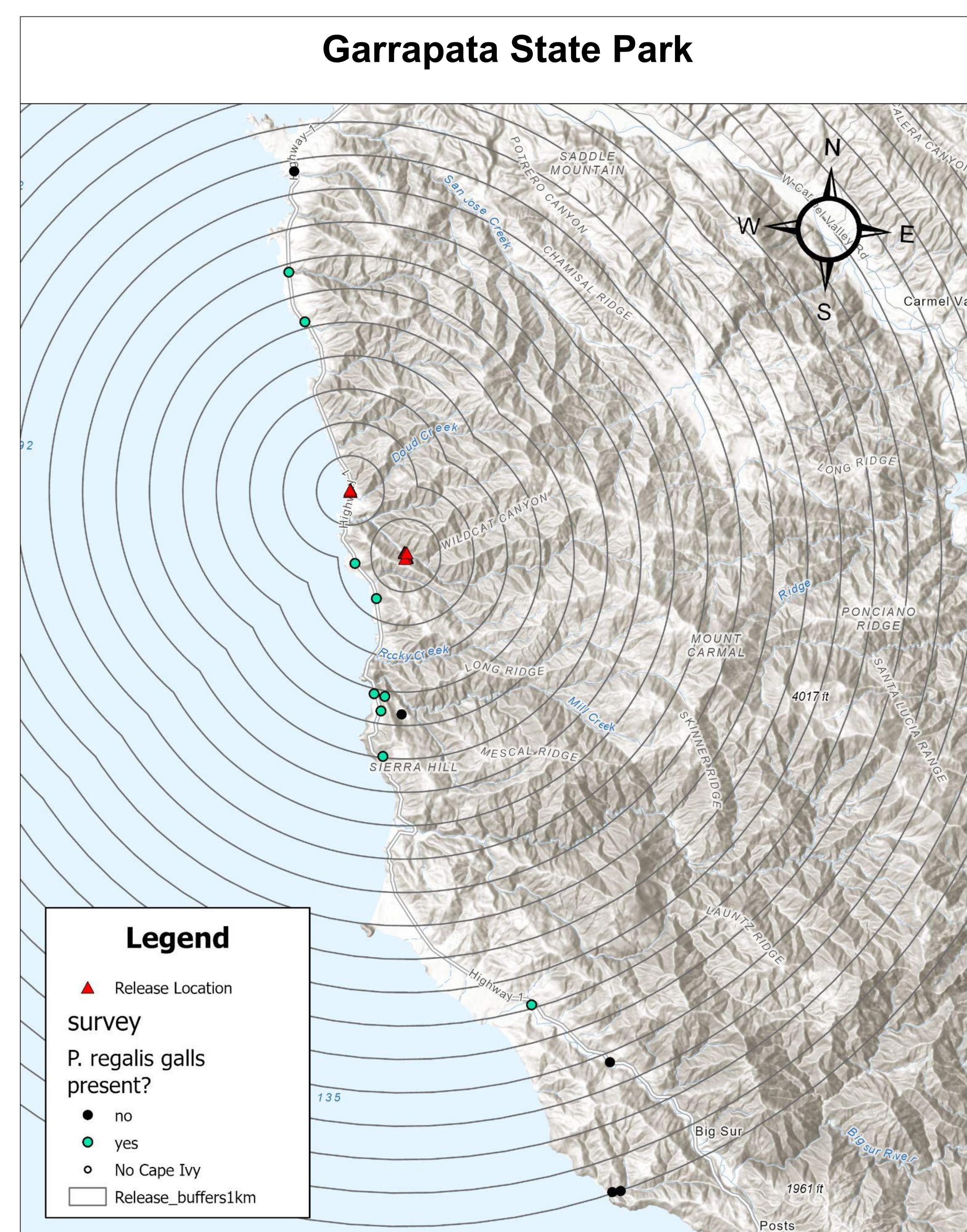


Figure 6. Survey results from Garrapata State Park. Buffer rings radiate from release locations at 1km intervals. Galls were found at a maximum distance of 14km from the original release.

Atascadero Creek

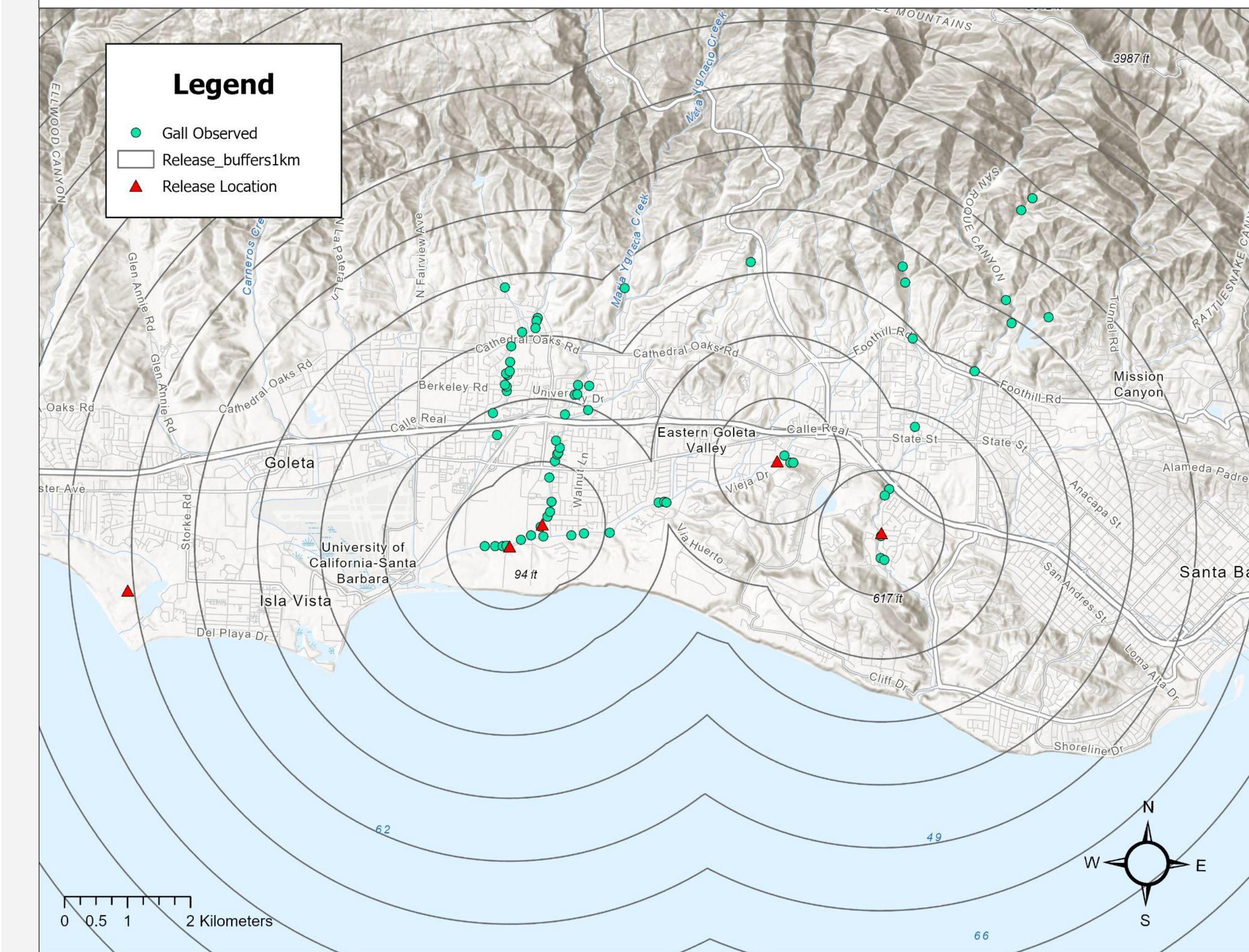


Figure 5. Dispersal map from multiple release points. Buffer rings radiate from release locations at 1km intervals. Shows dispersal of *P. regalis* into higher elevation foothills of Goleta and Santa Barbara, CA. The colonized area of this site is 38.6km².

Key Findings

- Maximum straight-line dispersal: 14 km (Garrapata State Park)
- Maximum colonized area: 38.6 km² (Atascadero Creek)
- Range of straight-line dispersal: 0.14-14 km
- Range of total colonized area: 12.8-38.6 km²
- Dispersal rate: 0.05-2 km/yr.
- Area colonization rate: 1.6-6.4 km²/yr (three sites with sufficient data)

Discussion

Dispersal dynamics and rates

Actual dispersal rates are likely faster than calculated, as the onset of dispersal is unknown. However, Rincon Creek (2022 release) shows high density of galls at the release site with little dispersal (0.14km) after 2-3 years, supporting a potential lag time from initial release to onset of dispersal. Older sites tended to show greater dispersal than more recent releases, suggesting that dispersal improves over time following a phase of initial establishment.

Landscape influences on dispersal

Broad habitat type (coastal bluff, riparian, or woodland) did not appear to have a clear effect on dispersal. Based on these limited data, sites with large tributary networks (Atascadero, Toro Canyon) showed 20-50x greater colonization area when compared to isolated sites. It should be noted that the release site at Atascadero Creek is near two other release locations and the dispersal likely reflects contributions from those sites.

Management implications

These findings demonstrate the importance of post-release monitoring to assess the success of biological control programs. The results suggest that sites with connected riparian corridors may facilitate higher dispersal and should thus be prioritized for future release locations.

Future Directions and further inquiries

- Does high dispersal correlate with more or less impact on the host plant?
- Modeling spread, what site characteristics are likely to promote maximum dispersal?
- Does predation or parasitism impact dispersal?

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