



Santa Monica Mountains

National Recreation Area
California



Edge effects: native and exotic plant distribution on single and multi-use trails in Santa Monica Mountains National Recreation Area, California

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Background

✧ Recreational impacts on surrounding biotic communities are dictated by trail usage

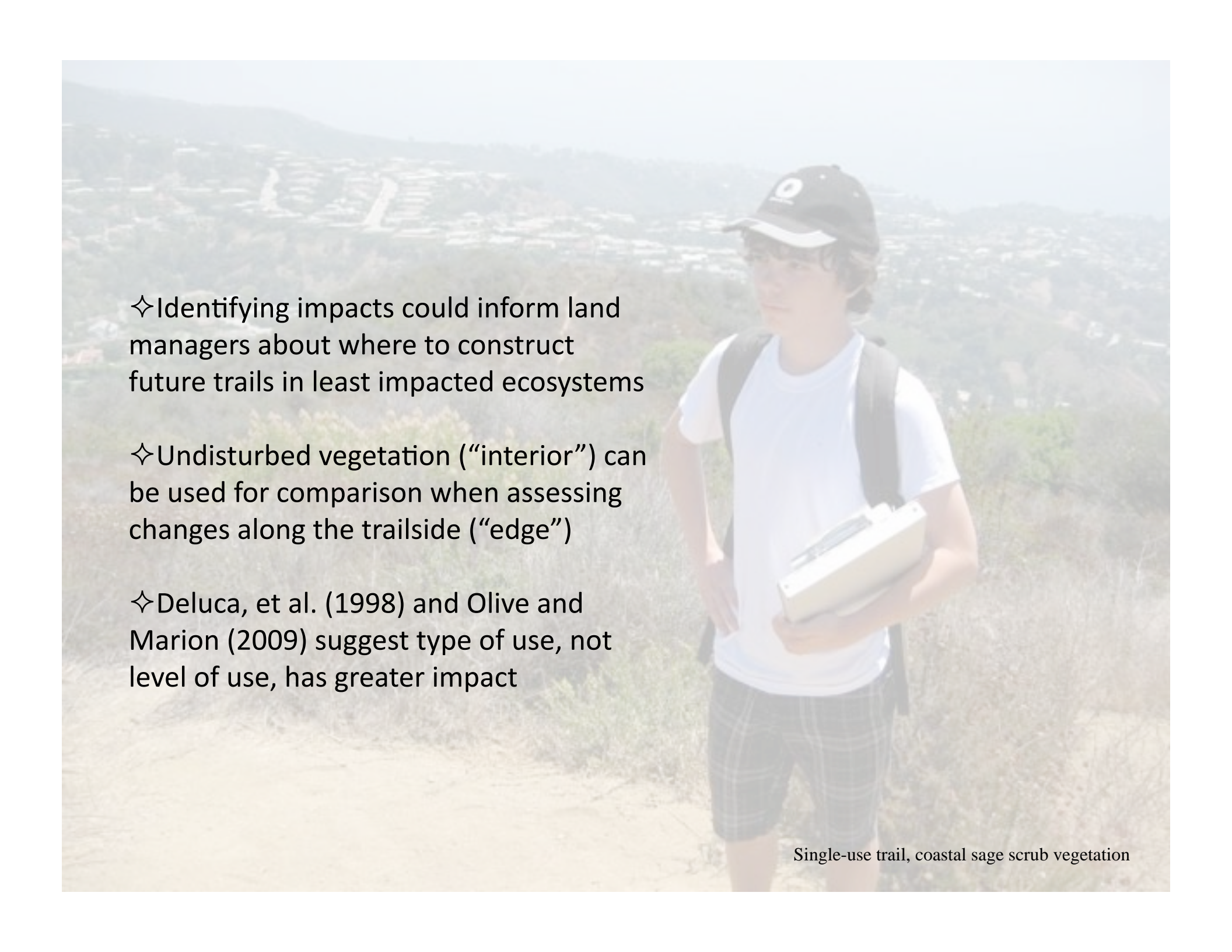
- ✧ Hiking,
- ✧ Biking,
- ✧ Horseback riding

✧ Disturbance from repeated trail use can contribute to:

- ✧ Introduction of exotics
- ✧ Reduction in leaf litter
- ✧ Change in drainage patterns
- ✧ Soil erosion



Multi-use trail in coastal sage scrub



✧ Identifying impacts could inform land managers about where to construct future trails in least impacted ecosystems

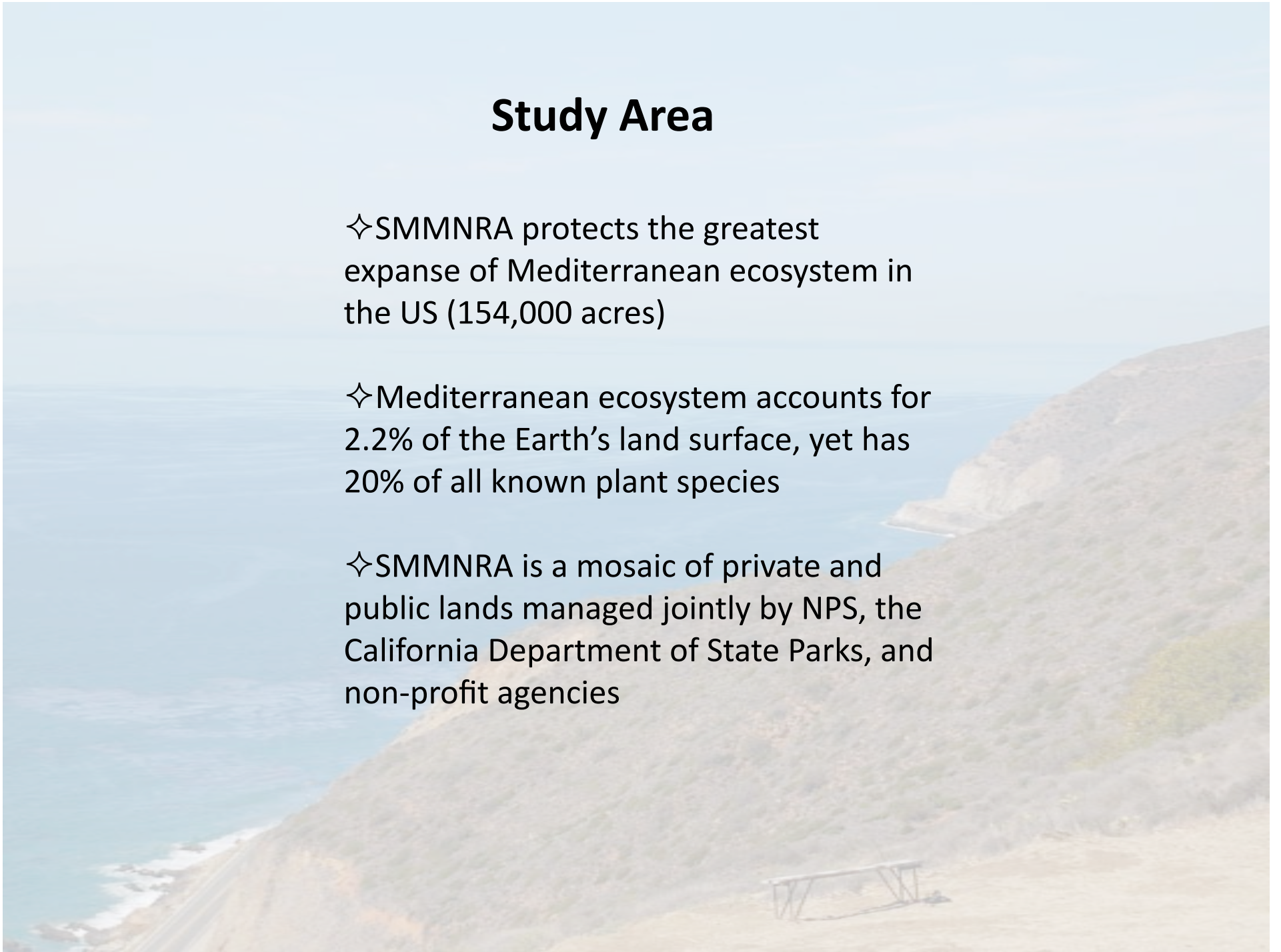
✧ Undisturbed vegetation (“interior”) can be used for comparison when assessing changes along the trailside (“edge”)

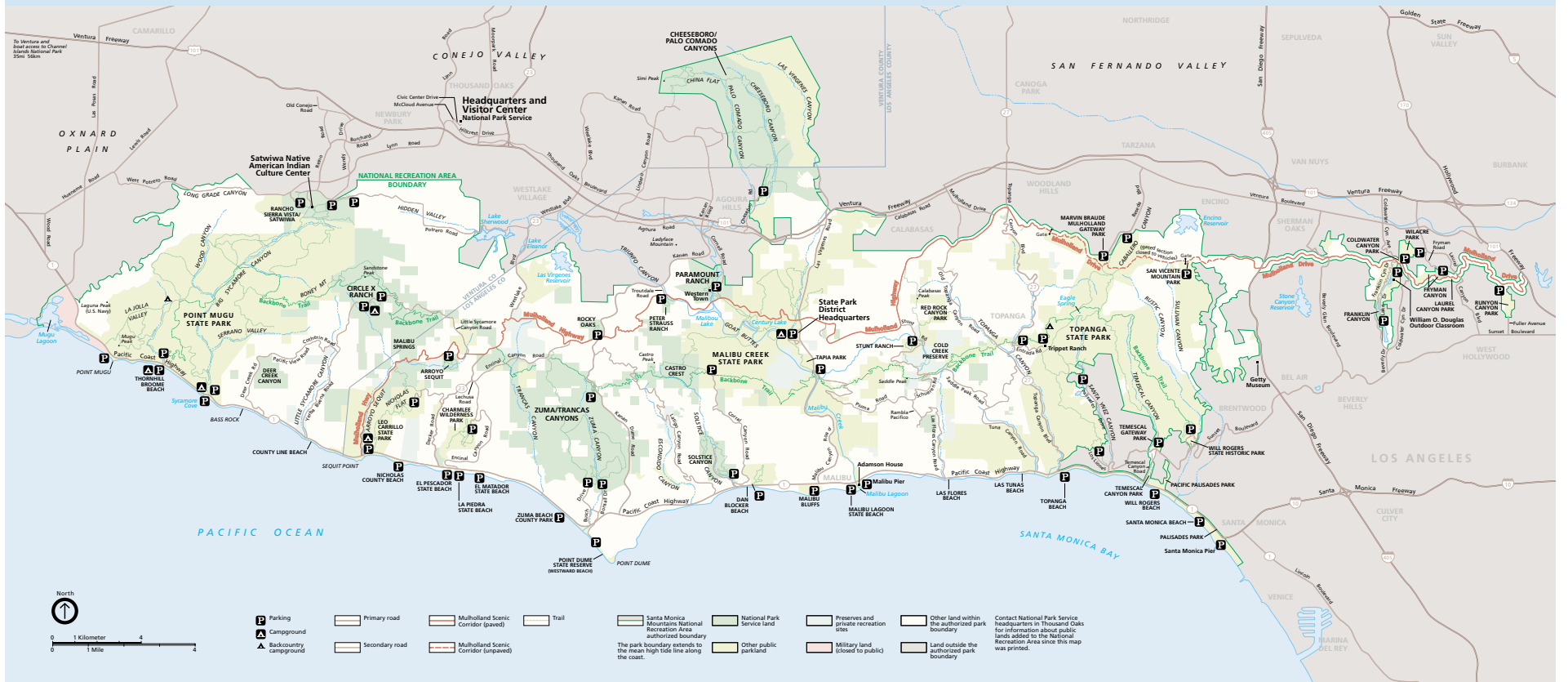
✧ Deluca, et al. (1998) and Olive and Marion (2009) suggest type of use, not level of use, has greater impact

Single-use trail, coastal sage scrub vegetation

Study Area

- ✧ SMMNRA protects the greatest expanse of Mediterranean ecosystem in the US (154,000 acres)
- ✧ Mediterranean ecosystem accounts for 2.2% of the Earth's land surface, yet has 20% of all known plant species
- ✧ SMMNRA is a mosaic of private and public lands managed jointly by NPS, the California Department of State Parks, and non-profit agencies





Map of SMMNRA

2 Dominant Native Communities:

Northern mixed chaparral (51%)

- ✧ evergreen shrubs
- ✧ 2-4 m tall with deep roots
- ✧ little understory
- ✧ accumulates leaf litter



Coastal sage scrub (CSS) (33%)

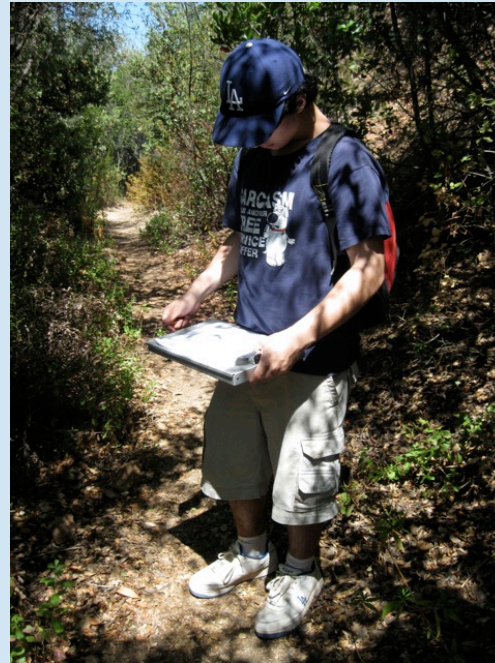
- ✧ soft-leaved, drought-deciduous shrubs
- ✧ 0.5-2 m tall
- ✧ open canopy
- ✧ drier substrates & lower elevations



Trail Type

The NPS designates:

- ✧ Single-use trails = hikers only
- ✧ Multi-use trails = mtn. bikers, hikers, equestrians
 - ✧ Impacts from equestrians tend to be more localized and extreme than those caused by hikers
 - ✧ Detailed comparisons between users on multi-use trails are rarely possible



Single-use trail
 0.95 ± 0.39 m
Chaparral



Multi-use trail
 2.6 ± 1.6 m
CSS

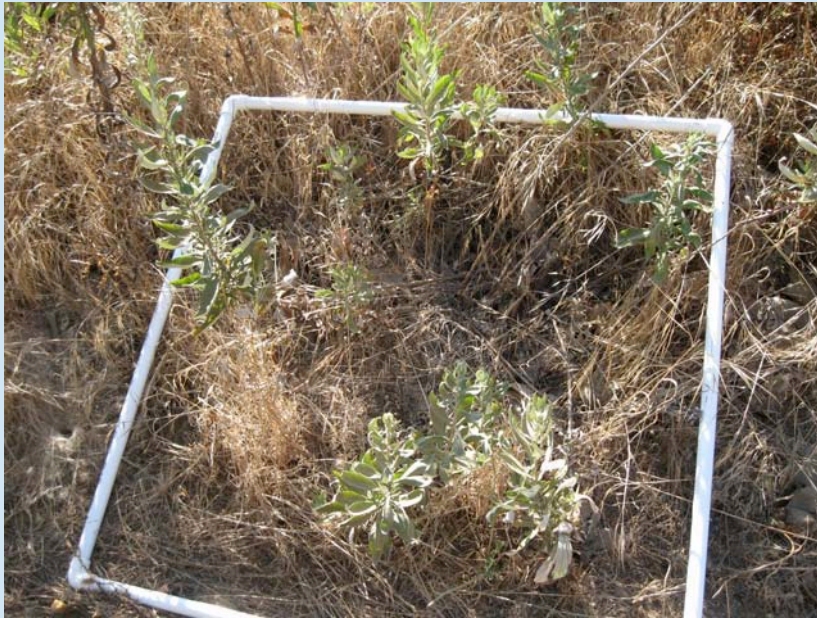


Our Questions:

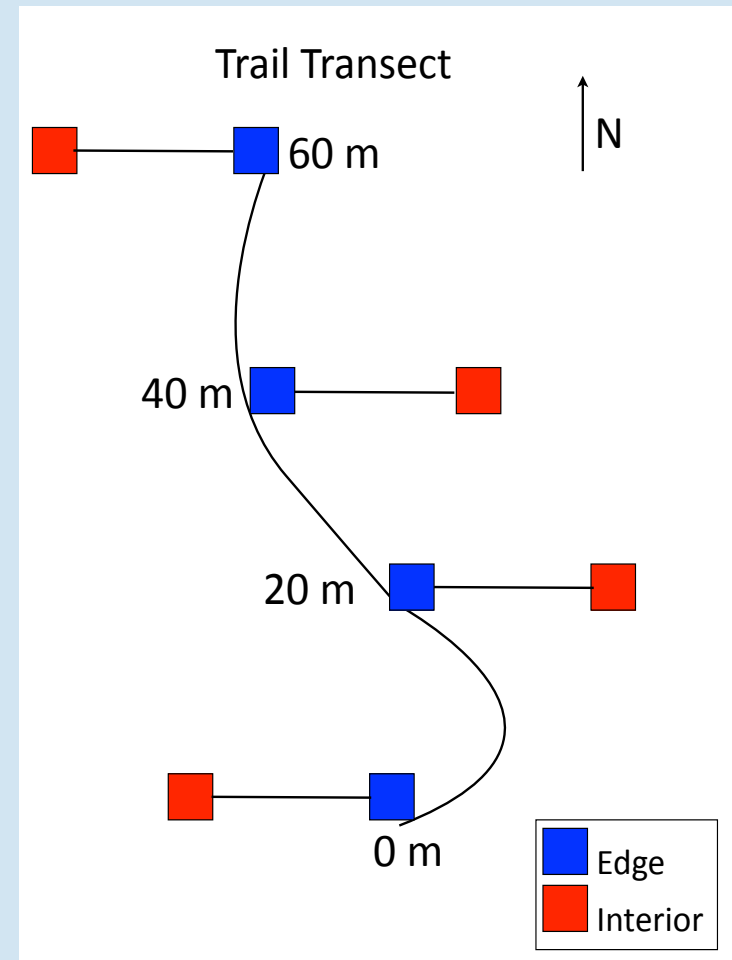
1. Will trailside (edge) vegetation have more exotic species (species richness and abundance) than interior vegetation on single and multi-use trails?
2. Will chaparral or CSS communities for each trail type exhibit differential diversity and composition due to their differences in litter cover?

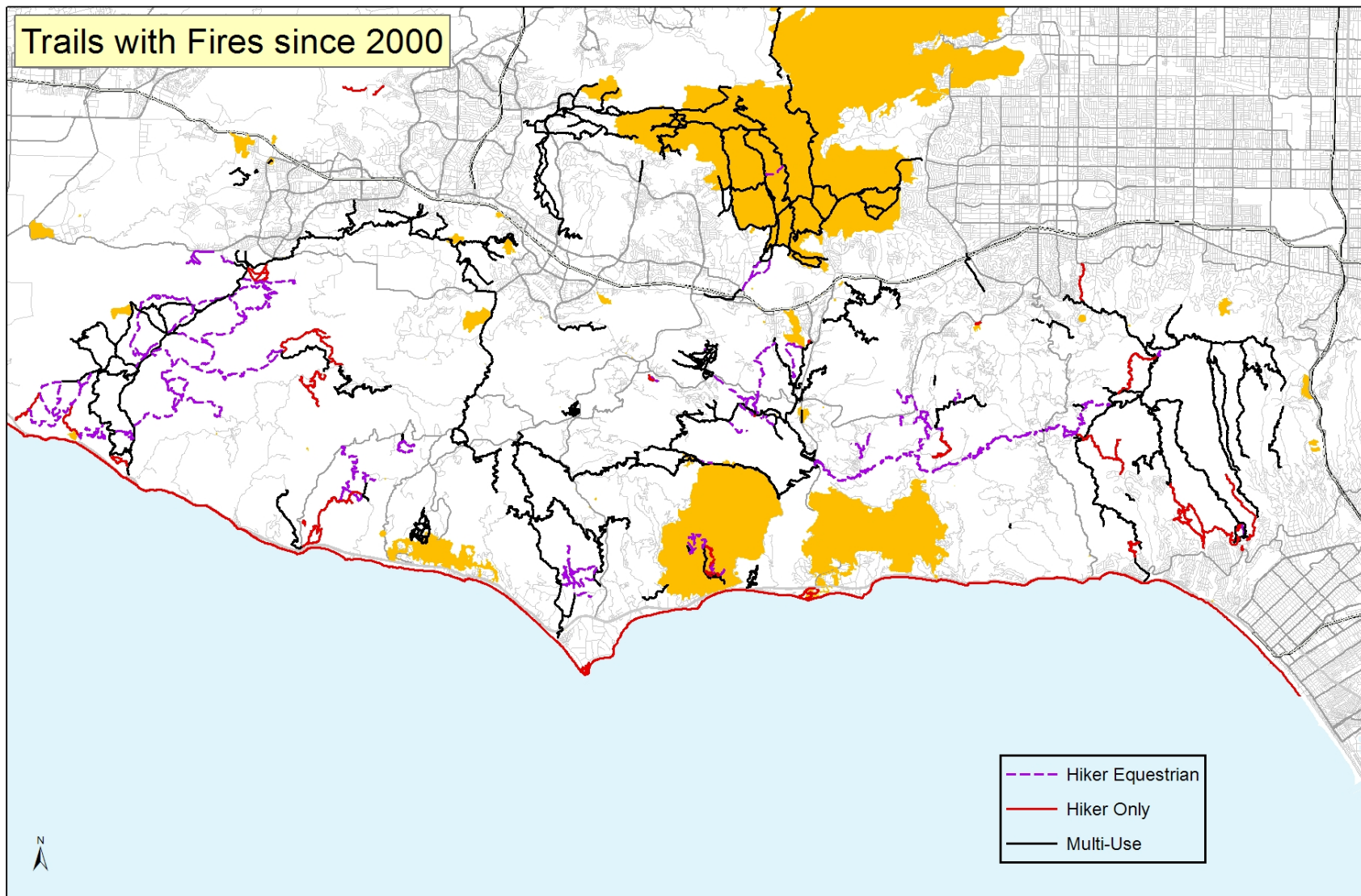
Methods

- ◇ 1 m² plots to estimate:
 - ◇ species richness
 - ◇ % cover
 - ◇ % cover leaf litter
 - ◇ % bare soil



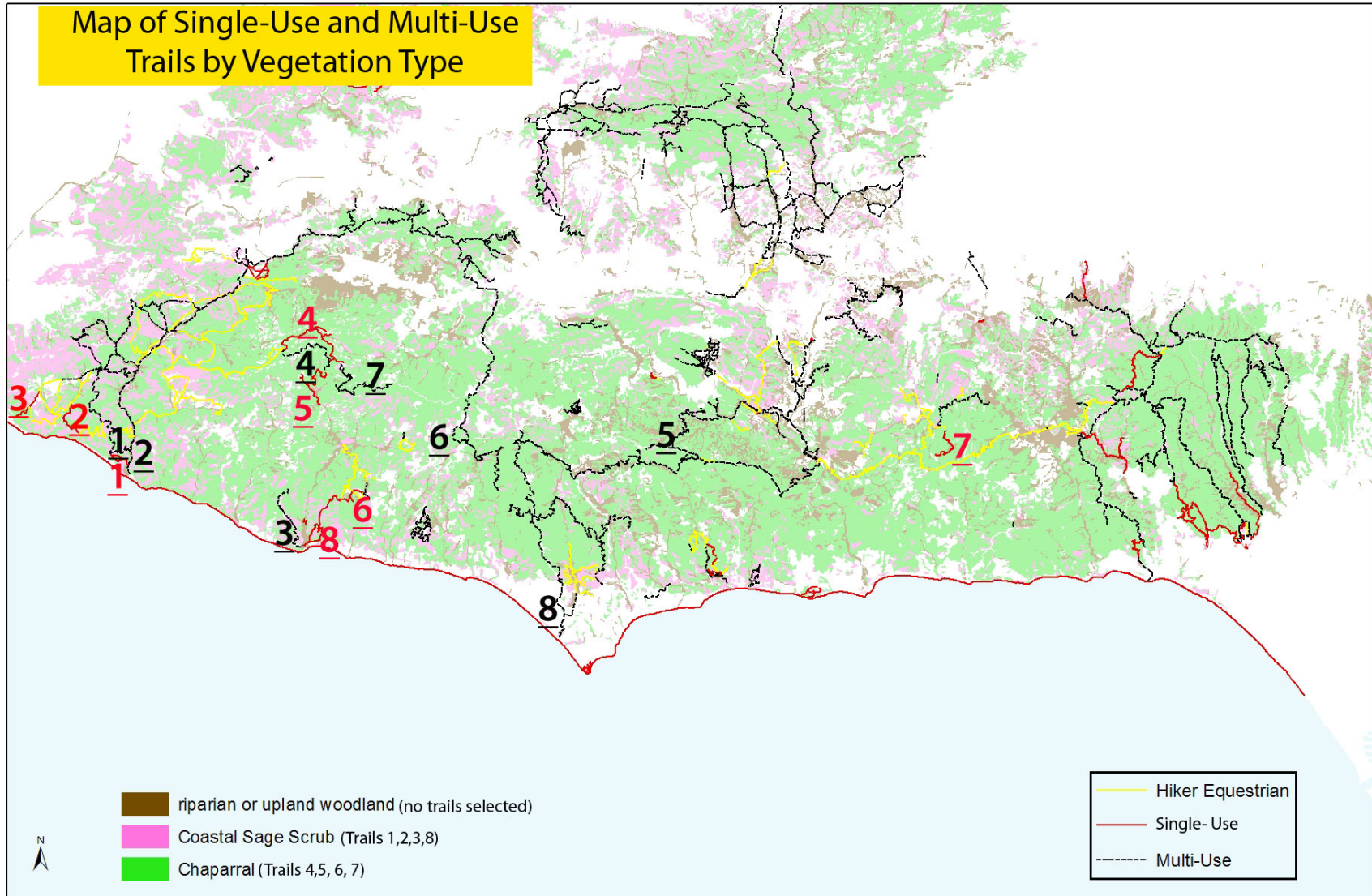
- ◇ 4 transects/trail
- ◇ 16 trails sampled Aug 2010 (N=128),
- ◇ 8 trails sampled (CSS only) Aug 2011 (N=64)
- ◇ Paired sites shared similar topography





Map of fires in SMMNRA since 2000 (in yellow)

Map of Single-Use and Multi-Use Trails by Vegetation Type

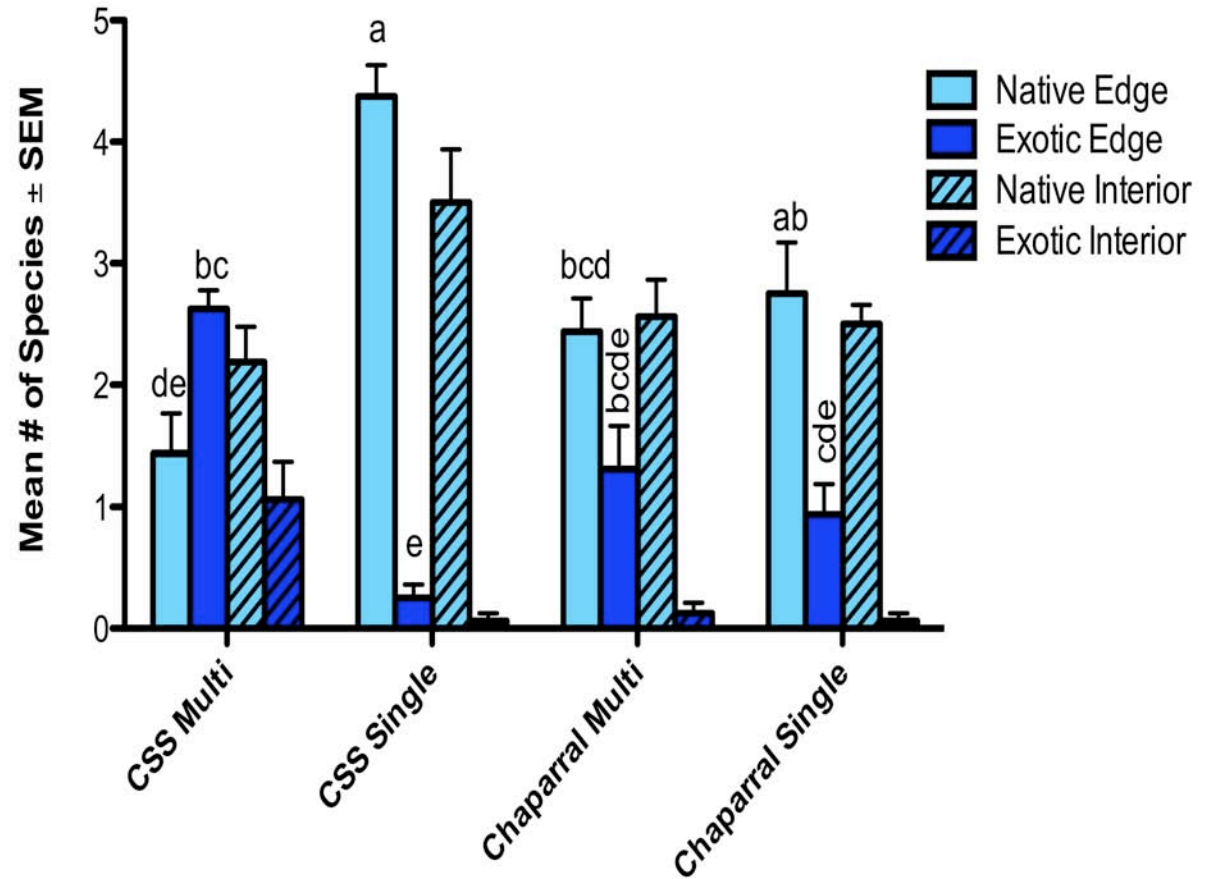


Trail sites selected. #1,2,3, 8 – CSS. #4,5,6,7 – Chaparral. Red – Single Use. Black – Multi Use.

Mean Species Richness

Site Level Effects:

✧ Edges had significantly \uparrow proportion of exotics compared to interior in all trail use and vegetation types



Difference of Species Richness (Edge – Interior)

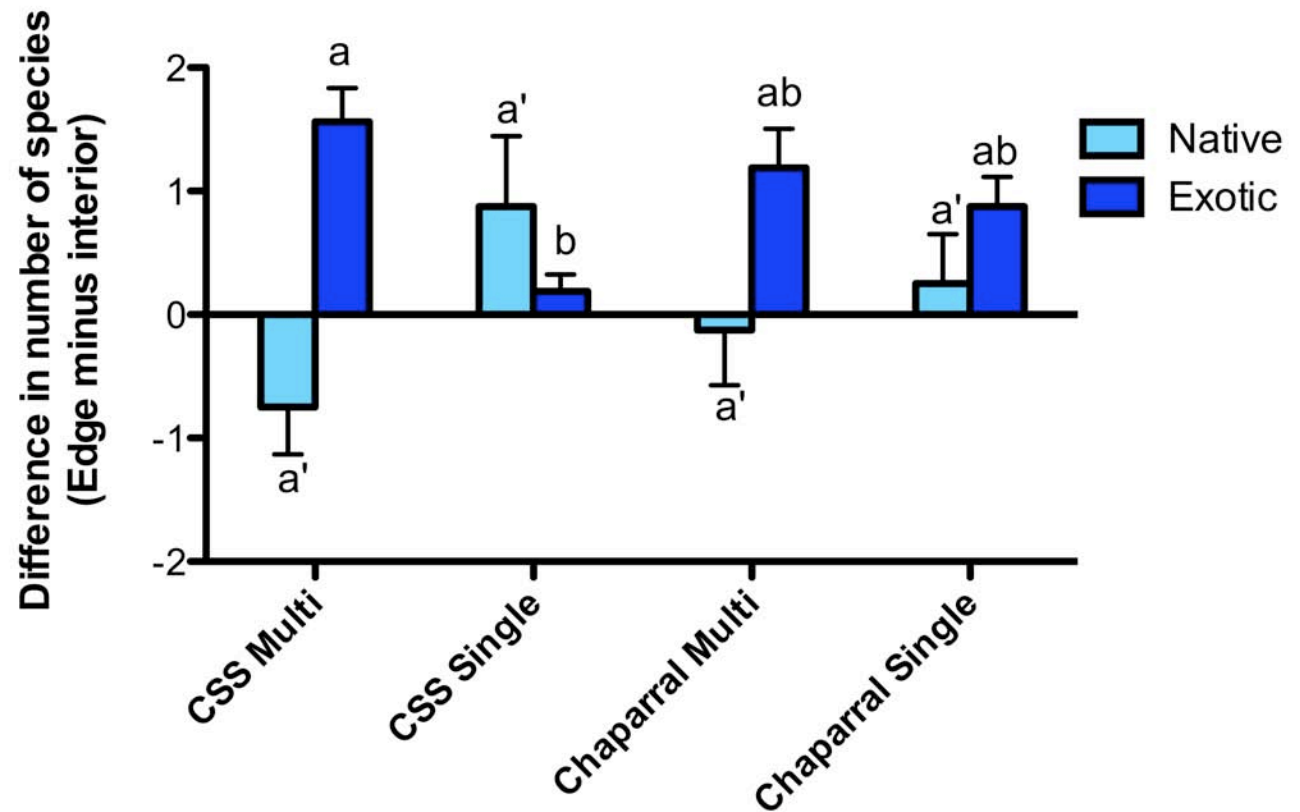
Plot level:

↑ numbers at edge
or ↓ numbers in the interior

↓ numbers at edge
or ↑ numbers in the interior

✧ Chaparral - similar pattern in native and exotics in both trail types

✧ CSS showed a larger difference in mean exotic richness

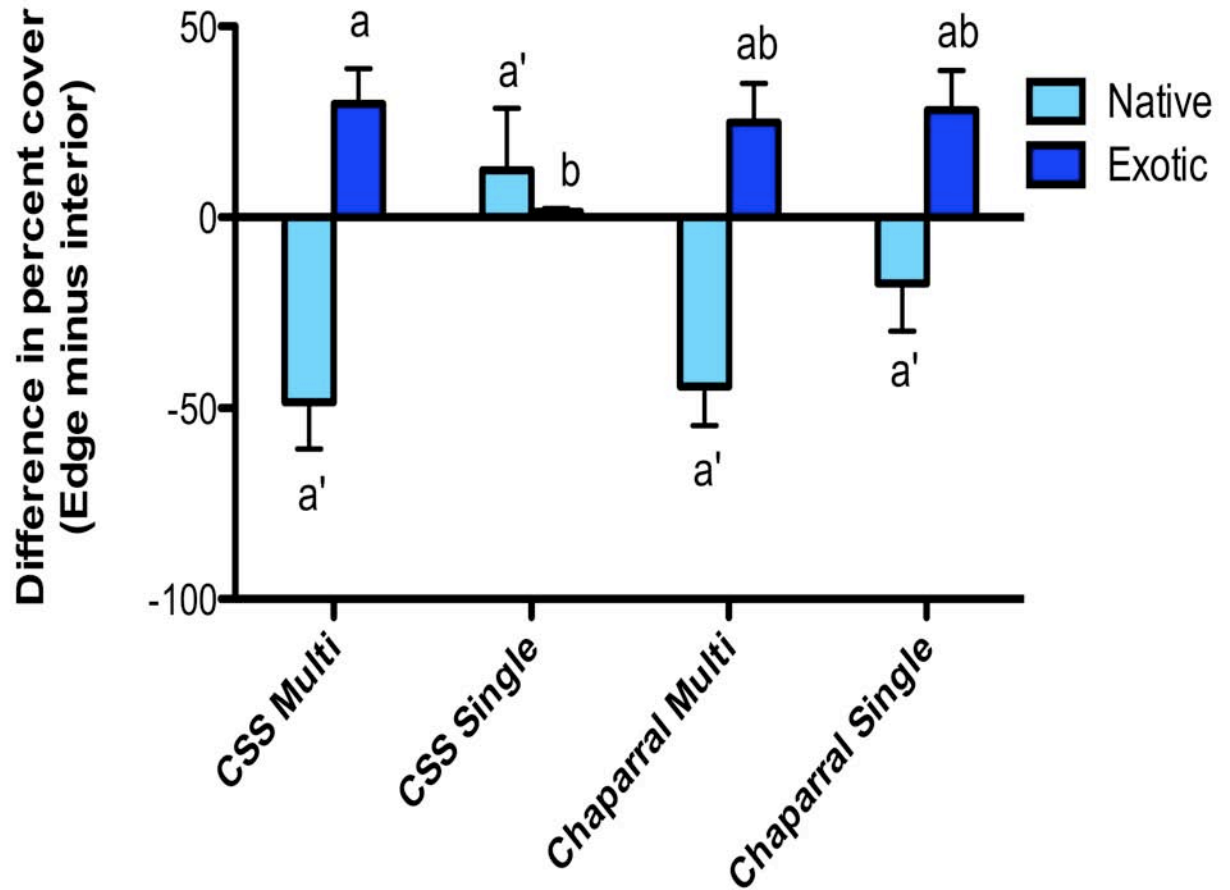


Difference in Percent Cover of Natives vs. Exotics

CSS:

◇91% ↑ in the # of exotics

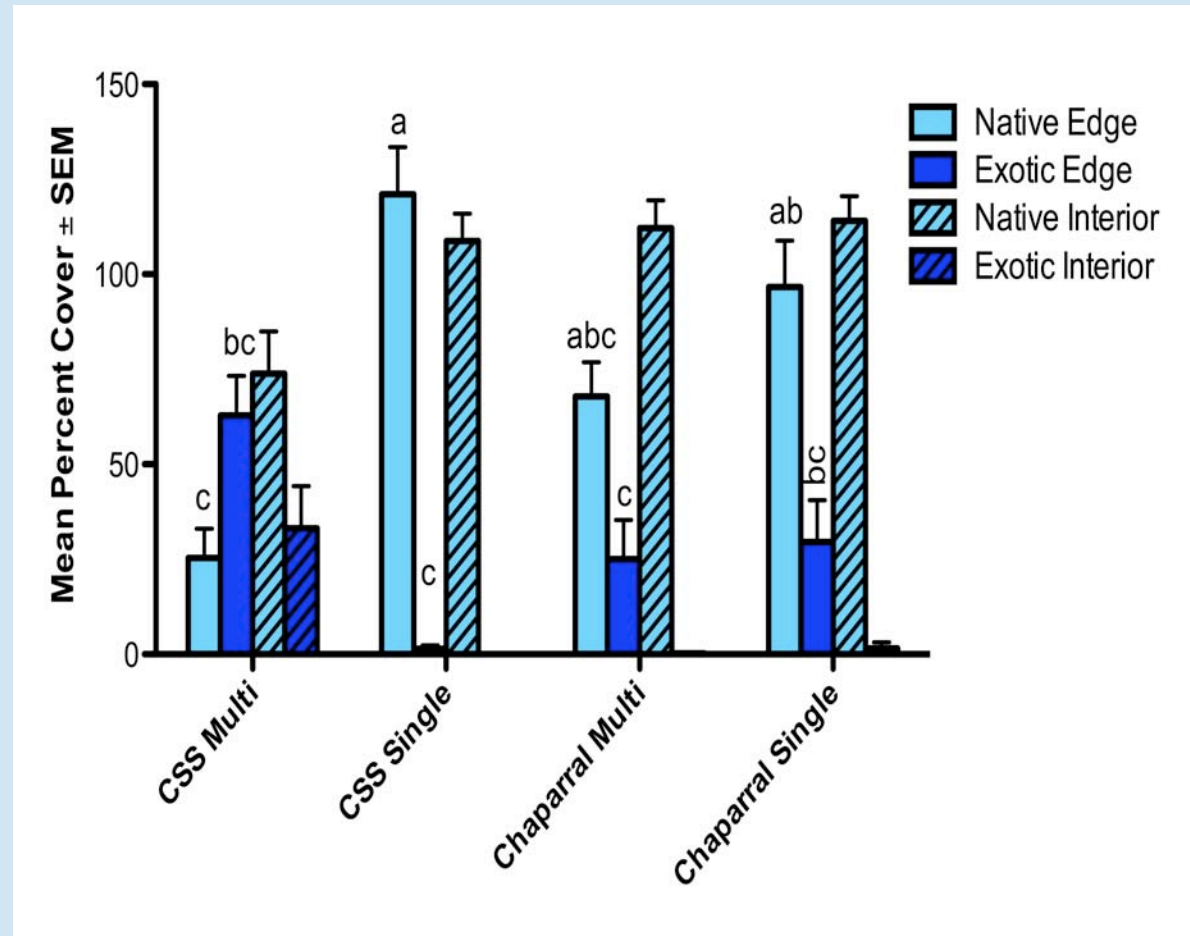
◇98% ↑ in % exotic cover on edges in multi-use trails compared to single-use



Mean Percent Cover of Exotics

✧ <25% change (NS) in the # and % cover of native species between the edge and interior of both trail/vegetation types

✧ # of (P=0.03) and % cover of (P=0.02) exotic species $\geq 80\%$ at the edge compared to the interior of both trail and vegetation types



SUMMARY: COASTAL SAGE SCRUB

✧ The # of ($P < 0.0001$) and % cover of ($P = 0.0008$) exotics depends on both trail use and vegetation type:

✧ A $\geq 91\%$ \uparrow proportion of exotics on edges in CSS multi-use than in CSS single-use in both # of and % cover

✧ A pattern quite different than chaparral

SUMMARY: CHAPARRAL

✧ 31% ↑ in # of exotics on edges in multi-use compared to single-use

✧ % cover of exotics 16% ↓ on edges in multi-use compared to single-use

✧ % cover of natives 30% ↑ on edges in single-use compared to multi-use

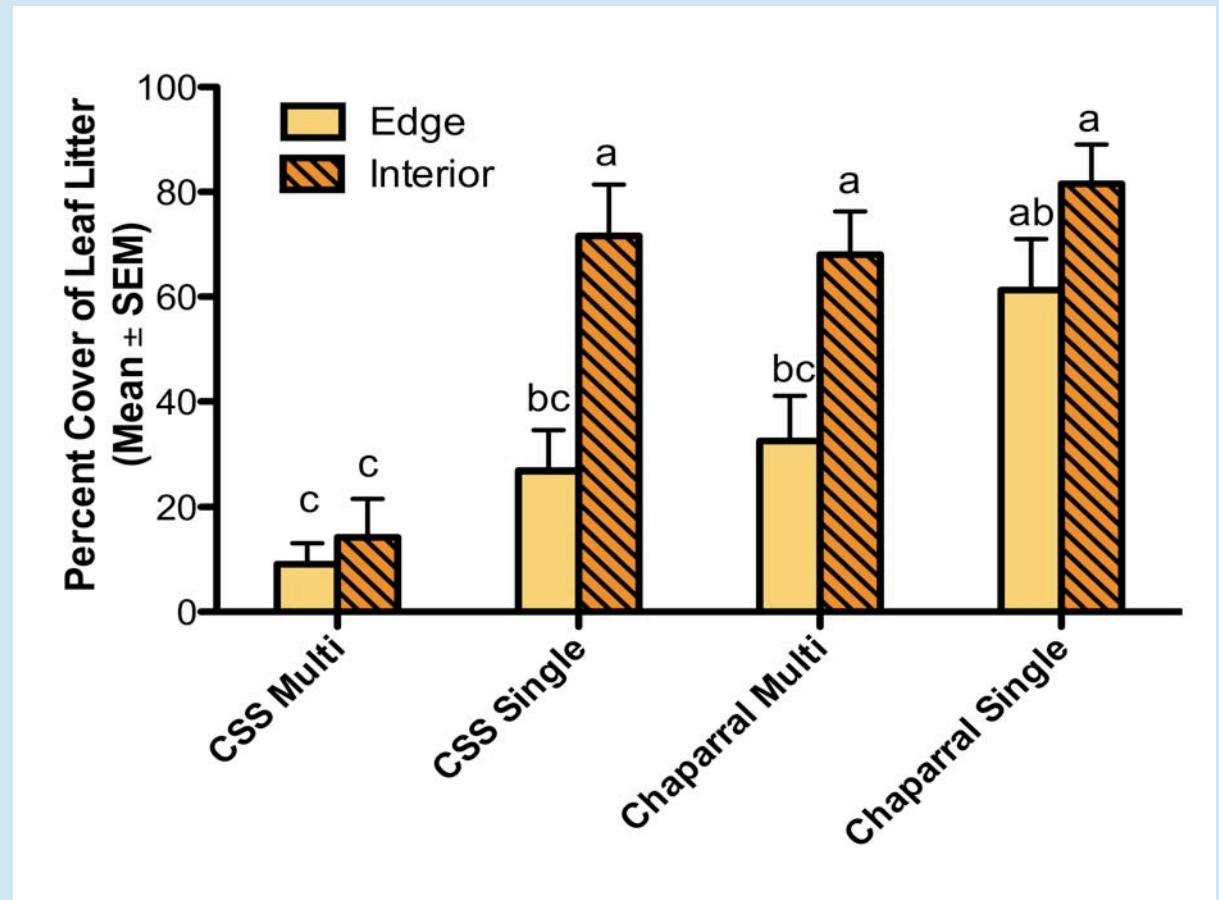
✧ Single-use had <50% ↓ in both the # of and % cover of exotics ($P < 0.0001$) on edges compared to multi-use

Interior vs. Edge Litter Cover

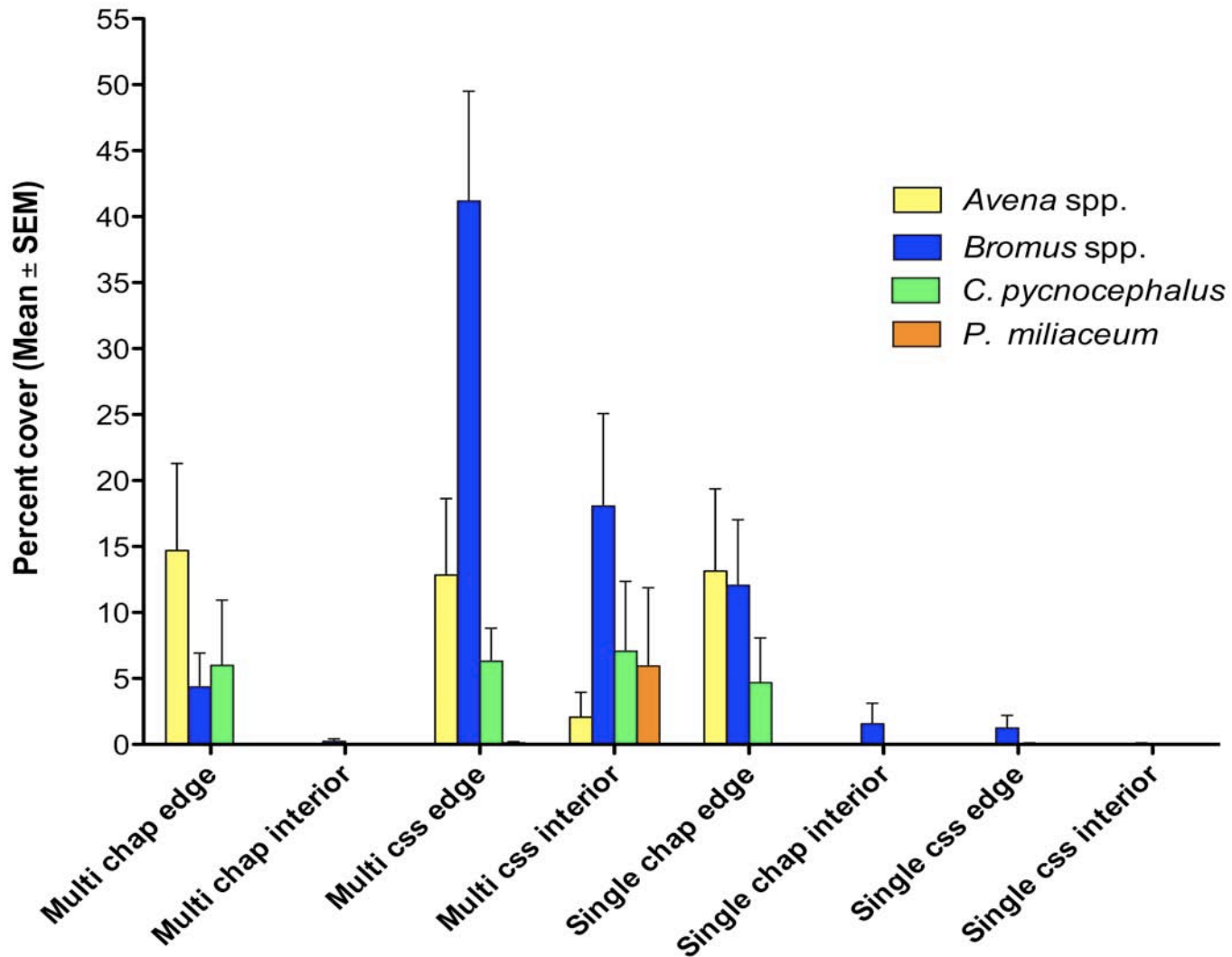
✧ Interior: >40% ↑ in mean % litter cover compared to the edge (P<0.0001)

✧ Interior chaparral both trail-use types and the interior of CSS on single-use had higher mean % litter cover than the interior of CSS on multi-use

✧ Chaparral >60% ↑ mean % litter cover than CSS edges (P=0.0176)



Mean Percent Cover of Dominant Exotics



Mean % cover of species $\geq 5\%$ in both trail and vegetation types included

Conclusions

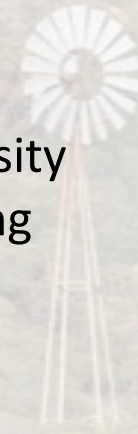
- ✧ At plot and site level there were significant differences between edge and interior with similar patterns, reinforcing findings of other researchers
- ✧ Multi-use trails may require more maintenance than single-use trails, but schedules are inconsistent so difficult to determine whether maintenance would have an effect on the presence of exotic species
- ✧ The lower percent litter cover in CSS in comparison to chaparral may influence its susceptibility to invasions by exotics

Conclusions

- ✧ CSS, where a majority of annual grass was identified, is drier than chaparral, making it susceptible to competition for available water as suggested by Eliason and Allen (1997)
- ✧ CSS habitat could be impacted during its germination period by lower litter cover and the presence of annual grasses

Management Implications

- ✧ Concentrate multi-use trails in chaparral rather than CSS
- ✧ Step towards understanding trail placement to conserve native biodiversity while balancing the needs of the visiting public



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