

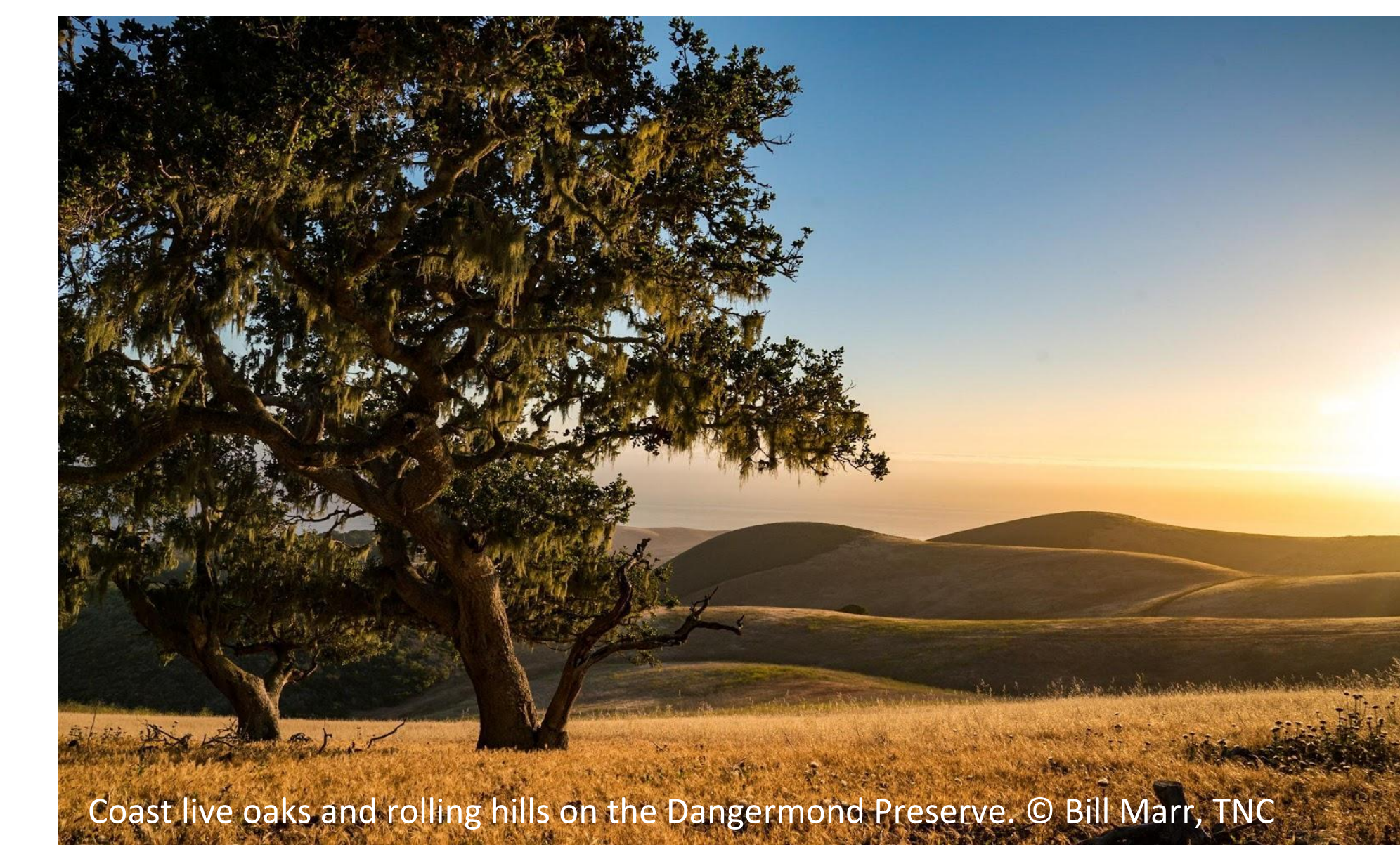
Managing the Impacts of Environmental Education in Protected Areas

A Case Study at the Jack and Laura Dangermond Preserve near Lompoc, CA

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Coast live oaks and rolling hills on the Dangermond Preserve. © Bill Marr, TNC

I Trade-offs on the Dangermond Preserve

Protected areas offer meaningful life experiences for the people who visit them and often allow access for the purpose of environmental education. However, protected areas also support numerous plant and wildlife species. This presents a challenge for managers of protected areas. The same lands that can be important for introducing students to the natural world also play a key role in conserving native biodiversity.

The Jack and Laura Dangermond Preserve — a 24,000-acre nature preserve located in western Santa Barbara County, CA — represents a case study in balancing the trade-offs of environmental education in protected areas. Bordered by the Pacific Ocean, the preserve includes one of the last stretches of coastline spared from development in Southern California. It contains habitats such as oak woodland, chaparral, coastal sage scrub, and annual grassland and supports nearly 60 special-status species. The Nature Conservancy (TNC) is currently developing an environmental education program to introduce students from nearby Lompoc, CA to this biologically diverse area. The goal of this project is to help guide TNC's decisions about trail use for environmental education on the preserve.

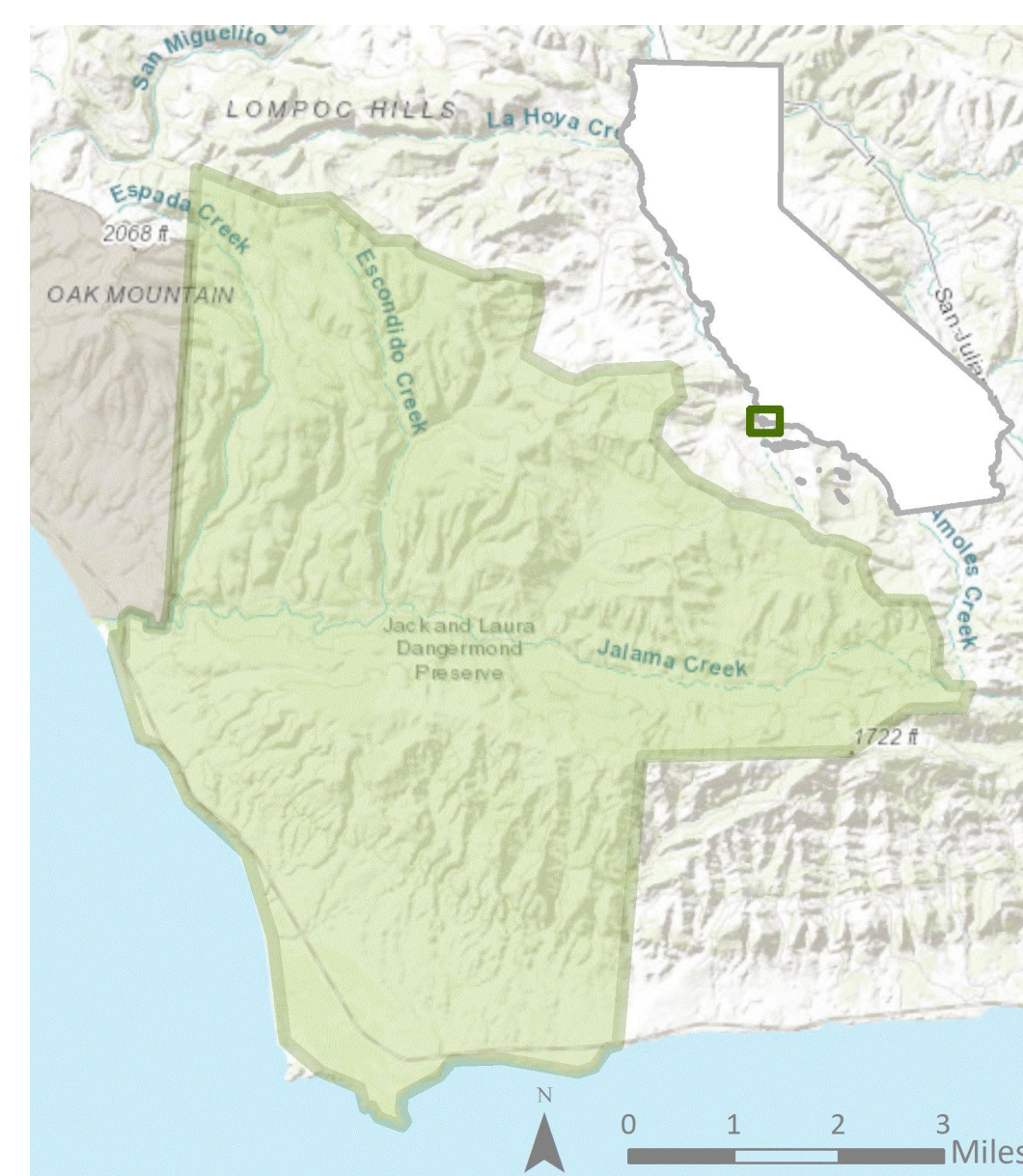


Figure 1. The Dangermond Preserve in western Santa Barbara County, CA.

Our team focused on three objectives:

- Identify vegetation and wildlife that are sensitive to human presence and map their suitable habitat on the Dangermond Preserve.
- Rank trails for environmental education on the Dangermond Preserve based on their ecological impact to sensitive vegetation and wildlife.
- Create a management tool to select trails on the Dangermond Preserve that offer suitable educational opportunities while minimizing ecological impacts.

II Assessing the Ecological Impact of Trails

Our team performed a literature review to identify vegetation and wildlife on the Dangermond Preserve that could be negatively impacted by the presence of humans. Many of the species we identified also have special-status at the federal, state, or local level. We grouped these species into four Conservation Criteria that are important to protect on the preserve:



Next, our team used a method known as a Multi-Criteria Analysis to rank trails on the preserve based on ecological impact. We conducted our analysis using ArcGIS and conservation planning tools such as MaxEnt. Our analysis involved four overall steps:

- Map habitat for the species included within each Conservation Criterion on the Dangermond Preserve.
- Assign weights to the Conservation Criteria using an Analytical Hierarchy Process based on TNC's preferences and seasonality.
- Combine the Conservation Criteria into one map of cumulative ecological impact using a Multi-Criteria Analysis.
- Calculate the ecological impacts and rank trails from lowest to highest.

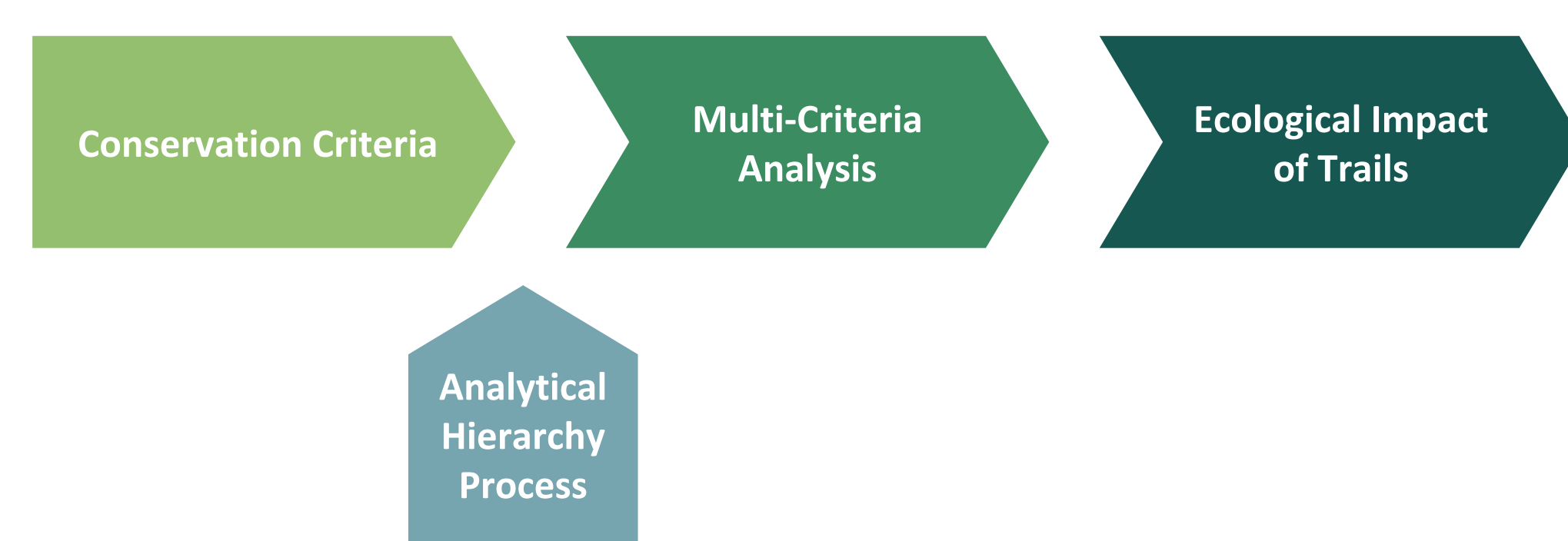


Figure 2. Methods Schematic. An overview of the steps used to rank trails for environmental education on the Dangermond Preserve based on ecological impact.

After ranking trails on the Dangermond Preserve using a Multi-Criteria Analysis, we developed a management tool with Shiny App in RStudio. We designed this tool to have an easy user interface with which TNC managers can select trails for environmental education based on school group needs, scenic landmarks, number of vegetation communities, and ecological impact.

III Balancing Environmental Education with the Conservation of Native Biodiversity

Takeaway: New trail development should avoid coastal areas and riparian habitat

Many of the species included within our Conservation Criteria have suitable habitat near the coast and along creeks on the preserve.

For example, the coastal area around Government Point provides critical habitat for Gaviota tarplant (*Deinandra increscens ssp. villosa*), while riparian habitat along Jalama Creek supports species such as the California red-legged frog (*Rana draytonii*).

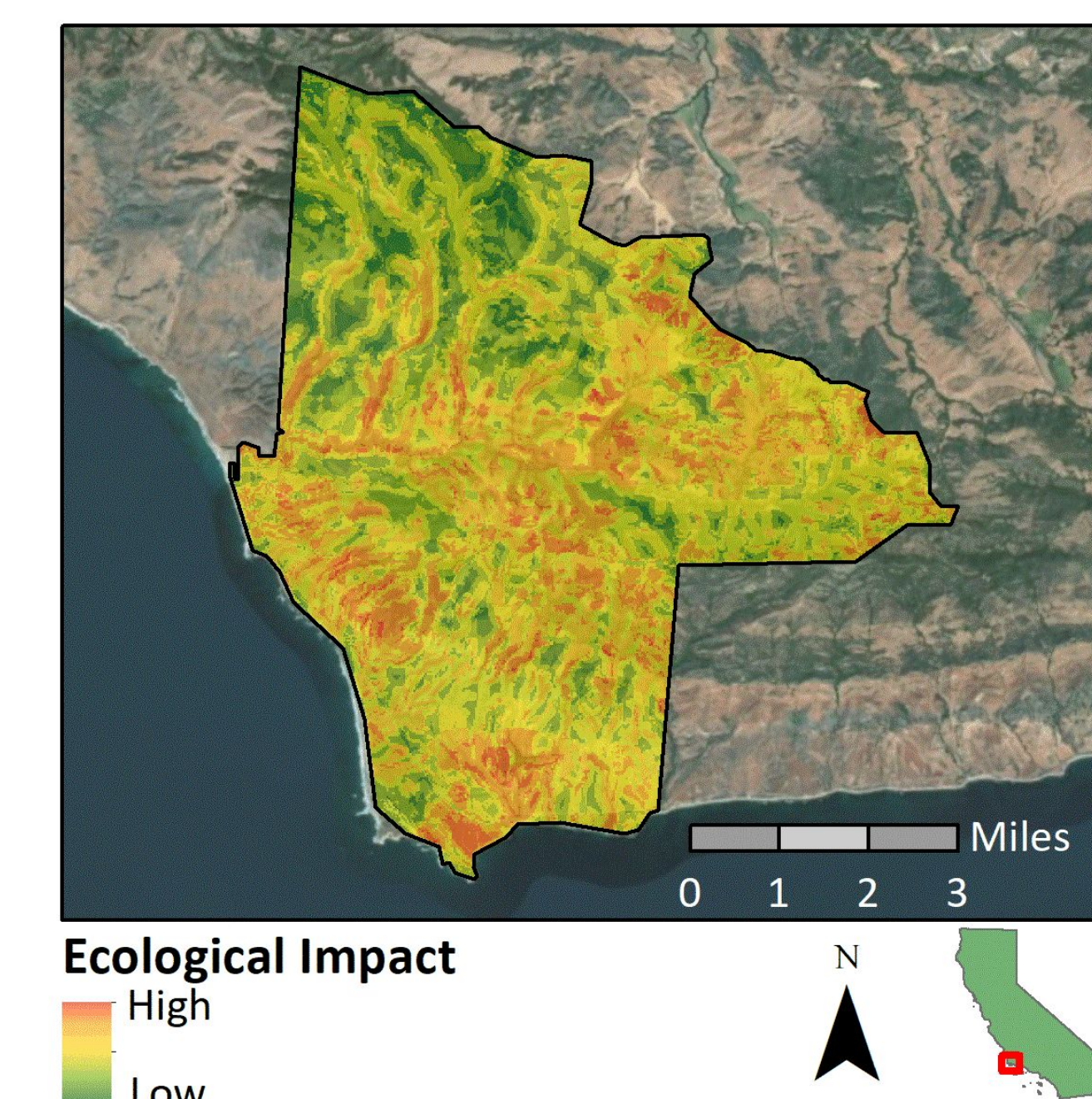


Figure 3. Cumulative ecological impact to Conservation Criteria on the Dangermond Preserve. The northern end of the preserve has less overlap in suitable habitat for sensitive species. This is indicated by a low ecological impact.

Takeaway: Trail ecological impact depends on seasonality and TNC's priorities

Table 1. Trails on the Dangermond Preserve ranked by ecological impact. The TNC column indicates trail rank when Conservation Criteria are weighted based on the preserve manager's priorities. The seasonality columns indicate trail rank when Conservation Criteria are weighted based on species' sensitivities at a given time of year.

Trail Name	TNC	Seasonality			
		Fall	Winter	Spring	Summer
Army Camp to Bunker	1	2	2	3	3
Army Camp Loop 2	2	5	5	7	7
Army Camp Loop 1	3	4	4	5	5
Bunker Out and Back	4	3	3	4	4
Water Canyon Loop	5	6	7	6	6
Coastal Bluffs	6	1	1	12	12
Jalachichi Oak Grove	7	7	6	1	1
Water Canyon Out & Back	8	12	12	11	11
Jalachichi Overnight	9	8	8	2	2
Jalachichi Lollipop	10	11	11	8	8
Jalachichi Loop	11	10	10	10	10
Jalachichi Pond	12	9	9	9	9

Impact Level: Low (Green), Moderate (Yellow), Moderately High (Orange), High (Red)

Example: The Jalachichi Oak Grove Trail is the least impactful trail during the spring and summer, but has a moderately high impact in the fall and winter. This is in part because the Jalachichi Oak Grove Trail mostly avoids areas with sensitive vegetation — one of the Conservation Criteria assigned a high weight during spring and summer months.

Takeaway: All trails pass through areas of both low and high ecological impact

While some trails have a higher ecological impact than others, there are not necessarily "go" or "no-go" trails on the preserve.

The Jalachichi Pond Trail, for example, starts in a low impact area but moves into high impact areas for three of the four Conservation Criteria: sensitive vegetation, sensitive raptors, and sensitive amphibians.

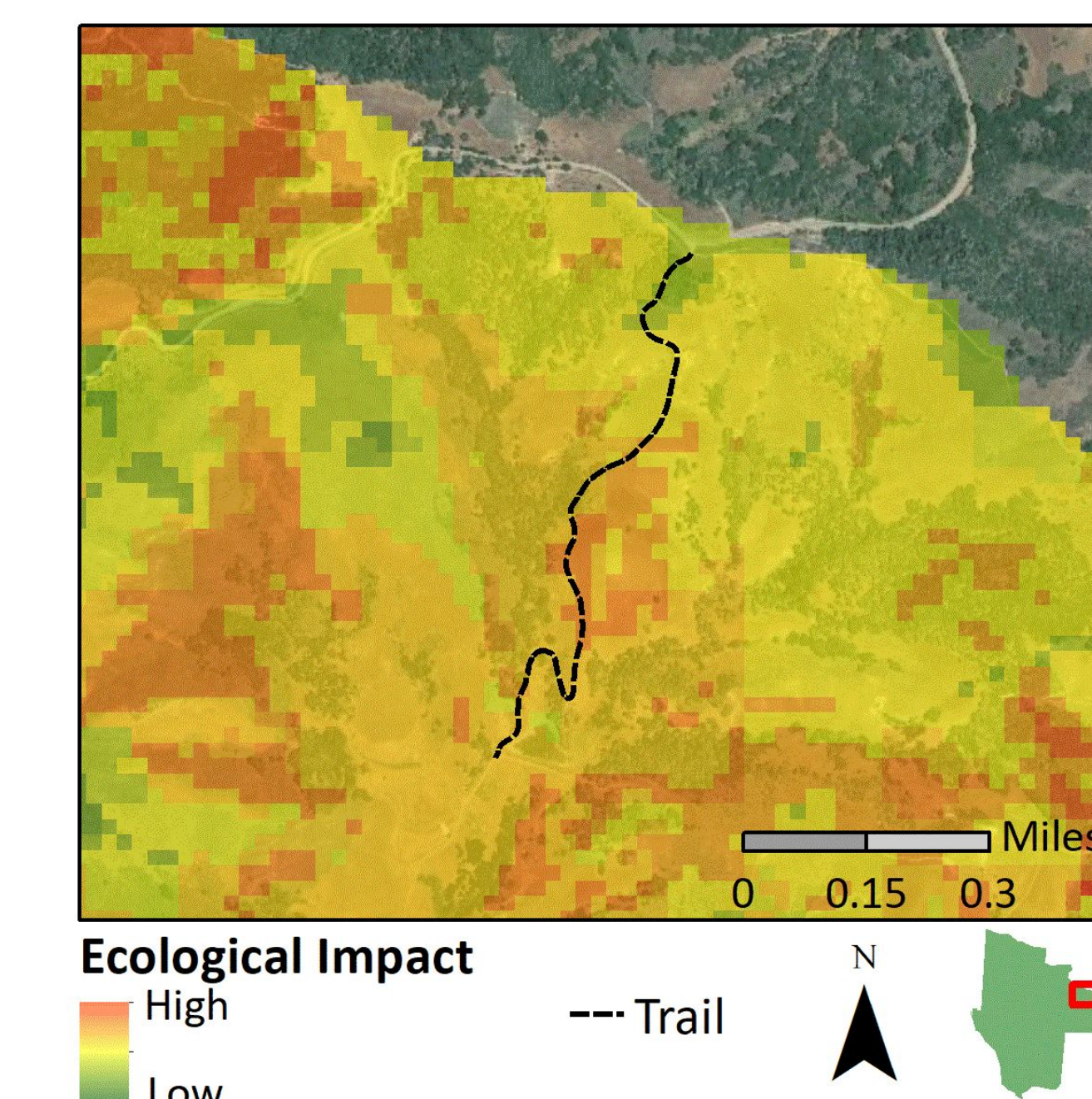


Figure 4. Ecological impact along the Jalachichi Pond Trail. The area of high ecological impact along this trail is in part due to the occurrence of purple needlegrass (*Stipa pulchra*), a native bunchgrass.

Takeaway: Tradeoffs must be made to meet the needs of all students

Coastal Bluffs Trail

Trail Length: 1 mile

Landmarks: Government Point, Point Conception

Vegetation Communities: Menzie's Goldenbush Scrub, Brownheaded Rush Seeps, Seaside Golden Yarrow Patches, Semi-natural Stands

Ecological Impact: Low

Army Camp Loop 1 Trail

Trail Length: 4.5 miles

Landmarks: Wells

Vegetation Communities: Coast Live Oak Woodland, California Sagebrush Scrub, Coyote Brush Scrub, Deer Weed Scrub, Menzie's Golden Brush Scrub, Purple Sage Scrub, Annual Grassland

Ecological Impact: Moderate

Figure 5. Example of two trail options for a fall environmental education program on the Dangermond Preserve.

In the example above, the lower impact trail may be too easy for middle and high school-level students who are interested in a more challenging hike. The Coastal Bluffs Trail has little change in elevation and is under one mile round-trip. Older students may prefer the Army Camp Loop 1 trail, which is about 4.5 miles round-trip. The trade-off in using this trail is that while it meets the needs of older students, it has a higher ecological impact than the Coastal Bluffs Trail.

IV A Case Study in Protected Area Management

Well-planned access on the Dangermond Preserve will help to conserve native biodiversity while providing students from Lompoc, CA with opportunities to engage with nature and learn about local plants and wildlife. Although the Dangermond Preserve is a unique area, the methods used in this project offer an approach that land managers elsewhere can use to balance the trade-offs of environmental education in protected areas. Notably, developing a management tool to identify trails that meet student needs while avoiding or reducing ecological impacts can help land managers make informed decisions about trail use.



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V Acknowledgements | Contact

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