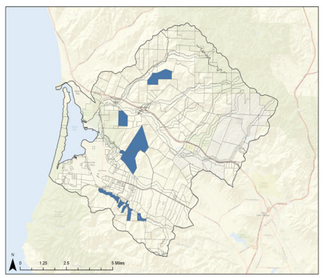
Recommendations

Biodiversity Conservation

1. To efficiently work towards conservation goals, the Estuary Program should begin conservation of parcels selected across multiple Marxan scenarios, as highlighted in blue in the map to the right.



Parcels selected in multiple scenarios

2. Population viability analyses (PVA) should be considered for particularly vulnerable species to ensure an adequate conservation target is set that best ensures the species' long-term persistence.

Water Quality

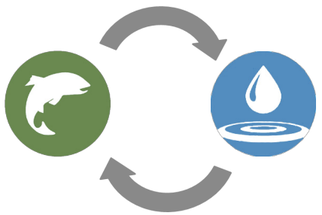
1. **Chorro Valley**: Address phosphate loading from the California Men's Colony effluent and increase cattle exclusion fencing and rural road management.

2. **Los Osos Valley:** Reduce fertilizer application on croplands, increase cattle exclusion fencing, monitor the town of Los Osos' transfer off septic.

3. Increase frequency and spatial distribution of nitrate, phosphate, and *E.coli* monitoring. Expand storm event monitoring to better assess sediment loading.

Future Steps

The culmination of these biodiversity and water quality analyses identified priorities for addressing the biodiversity and water quality conservation goals of the Estuary Program. These are typically treated as separate objectives and these results present the Estuary Program with the opportunity to explore the synergies of how multiple conservation goals, such as biodiversity conservation and water quality management, can be combined together into a single conservation plan to efficiently achieve multiple goals.



Acknowledgements

We would like to acknowledge our client, the Morro Bay National Estuary Program and especially Jennifer Nix, Adrienne Harris, Lexi Bell, and Ann Kitajima for supporting this project. In addition we would like to thank our advisor Ben Halpern who provided invaluable support and guidance throughout the entire process and our external advisors Frank Davis and Aaron Sims. We would also like to recognize the contributions of Arturo Keller, Kendra Garner, Michael Walgren, Daniel Bohlman, Jon Hall, and Nicole Smith.

For more information, visit our web site:
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Informing Biodiversity Conservation and Water Quality Management in the Morro Bay Watershed

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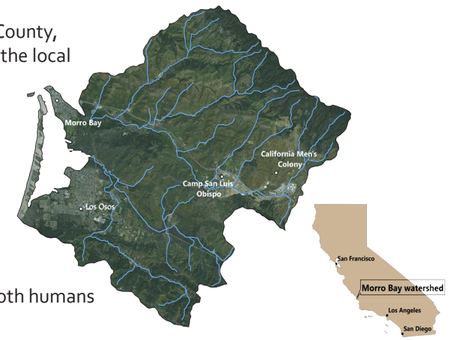
Faculty Advisor: Ben Halpern | **Client:** Morro Bay National Estuary Program

Morro Bay Watershed

The Morro Bay watershed is located in coastal San Luis Obispo County, California and is critical for supporting regional biodiversity and the local economy. The 48,000-acre watershed drains into the Morro Bay estuary—one of the largest, relatively intact coastal wetland regions in California.

Land use changes including urban development, cattle operations, and cropland conversion impact the health of the watershed through habitat loss and water quality degradation. Given the biologic and economic significance of the region, protection and restoration of the watershed and its resources is necessary to conserve the ecosystem services they provide to both humans and nature.



Problem Statement

The Morro Bay National Estuary Program (Estuary Program) aims to improve biodiversity conservation and water quality management in the Morro Bay watershed and estuary. However, due to limited resources, they must prioritize efforts to achieve these goals. This project identified areas of the watershed to focus conservation and management efforts so the Estuary Program can strategically priortize efforts.

Project Objectives

Biodiversity - Address biodiversity loss in the watershed by determining areas of highest conservation priority for sensitive species.

Water Quality - Identify source areas of nitrate, phosphate, and *E. coli* pollution that contribute to water quality degradation.

Approach

To meet these objectives, two tools were utilized: 1) Marxan, a conservation prioritization software and 2) WARMF (Watershed Analysis Risk Management Framework), a watershed model and analysis program.

Marxan identifies a network of conserved areas that maximizes conservation benefits while minimizing economic costs. Conservation benefits are measured by whether user-defined conservation targets for each species of interest are achieved in the final reserve network.

WARMF models daily water quality parameters for each catchment within the watershed using observed water quality and hydrology, topography, soil, meteorology, land cover, air quality, point source, and agricultural data.

What is a conservation target?
If there are 10 sites where a species occurs, and the conservation target is 30%...

... then Marxan must select at least 3 sites where the species occurs to include in the reserve network to achieve the target.

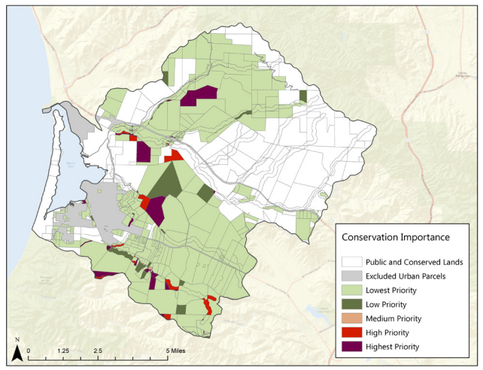
Biodiversity Conservation

Objective

To address biodiversity loss in the watershed, our objective was to determine areas of highest conservation priority to inform future conservation actions and land acquisition efforts dependent upon conservation objectives.

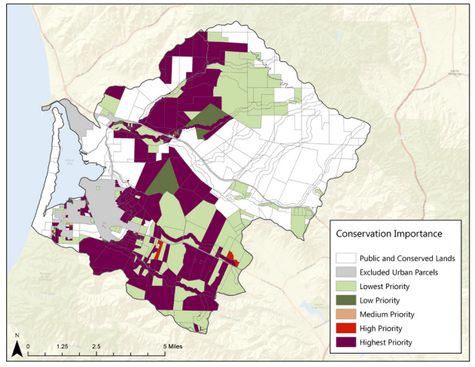
Results

1 Increasing the conservation targets for all species increased the number of parcels selected by Marxan for conservation.



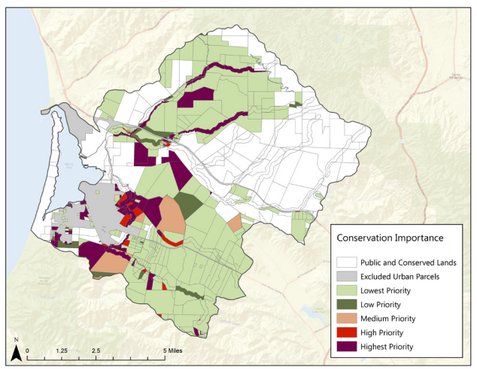
Baseline Scenario: 30% Species Target

2 Setting high targets for threatened and endangered species resulted in most of the parcels being required to meet conservation targets.



80% Endangered/Threatened Species Target

3 Reducing only the endangered willow flycatcher's target from 80% to 30%, dramatically reduced the quantity of parcels selected



80% Endangered/Threatened Species Target
30% Willow Flycatcher Target

Conclusions

1 Many of the same parcels were selected across scenarios. This indicates high conservation priority of these properties regardless of changing goals and constraints.

2 There are tradeoffs between a higher certainty in protecting species and the flexibility in the reserve network as well as the importance of practicality in setting objectives.

3 One endangered species' mobility and widespread local distribution can skew the amount and distribution of parcels selected. Variation in potential conservation reserve layouts is strongly driven by conservation goals and how species occurences and habitat suitability are measured.

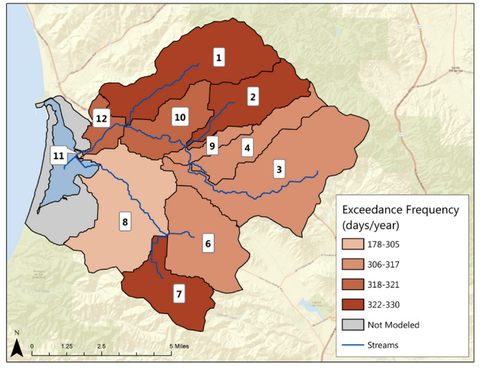
Water Quality

Objective

To address water quality degradation in the watershed, our objective was to identify major source areas of of nitrate, phosphate, and *E. coli* loading to inform the Estuary Program where to prioritize future water quality management efforts.

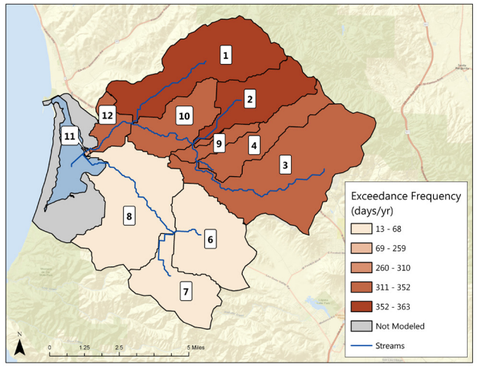
Results

1 Nitrate is of concern across the entire watershed, with particular concern in Los Osos Valley when seasonal median analyses are considered.



Nitrate Water Quality Standard Exceedance Frequency

2 Phosphate exceedance frequency is highest in Chorro Valley. Seasonal medians also identified Chorro as an area of high phosphate concentration.



Phosphate Water Quality Standard Exceedance Frequency

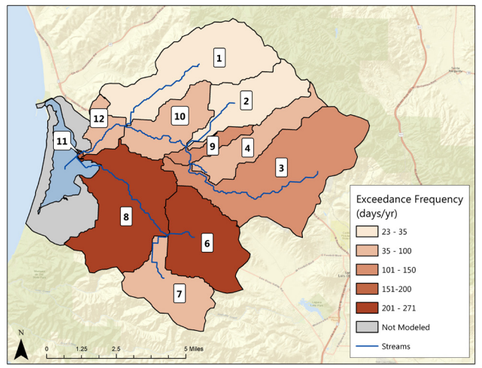
Conclusions

1 All catchments frequently exceed the water quality standard for nitrate, with particularly high levels of nitrate in Los Osos Valley (as shown by seasonal medians). Fertilizers to cropland, outflow from the California Men's Colony prision, and cattle operations may be primary contributors to nitrate exceedances.

2 Chorro Valley had higher frequencies and levels of exceedances of phosphates than Los Osos Valley. Cattle, soil erosion, and California Men's Colony outflow appear to drive this result.

3 Catchments 6 and 8 in Los Osos Valley had the highest levels of *E.coli* water quality standard exceedances. Lack of cattle exclusion fencing in Los Osos Valley and the septic system in the town of Los Osos are likely driving this result.

3 Los Osos Valley is of greatest concern for *E. coli* exceedance frequency and high seasonal median concentration values.



E. coli Water Quality Standard Exceedance Frequency