Seeing the 'Random Forest' for the Trees

Predicting Riparian Vegetation in Mark West Creek

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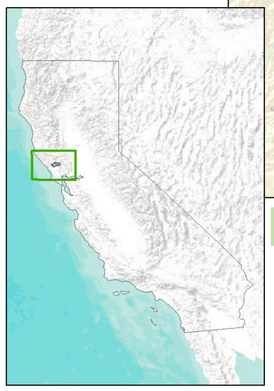
Introduction

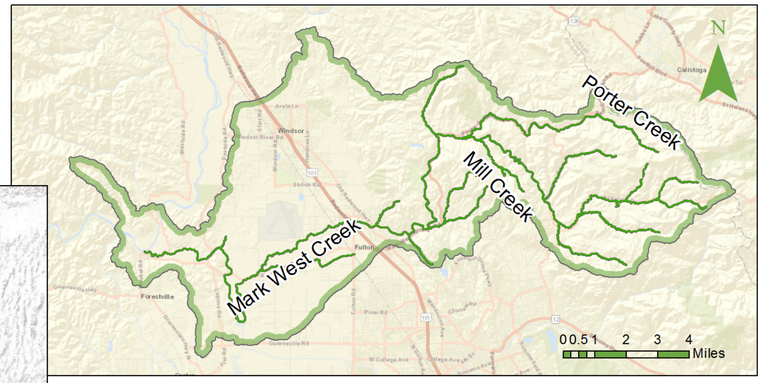
Riparian vegetation decreases the amount of sunlight hitting a creek, reducing water temperatures and promoting beneficial conditions for aquatic life. This effect is linked to regulatory action in streams that exceed temperature thresholds. One objective of the North Coast Regional Water Board's Temperature Policy, adopted in 2014, is to estimate site-potential effective shade conditions within the stream, or the amount of effective shade that riparian vegetation growing at its full potential would provide. In order to estimate site-potential effective shade conditions, regulators must also determine potential riparian vegetation.

To achieve this goal, we developed a model that relates environmental factors to vegetation types, and used it to predict vegetation along the riparian buffer of Mark West Creek. We then used these predictions to estimate riparian shade and compare it to present-day conditions.

Mark West Creek is a 40-mi^2 watershed that drains into the Russian River after joining the Laguna de Santa Rosa. It has also been deemed critical habitat for Coho salmon and steelhead trout by NOAA Fisheries (CEMAR 2014)



Study area

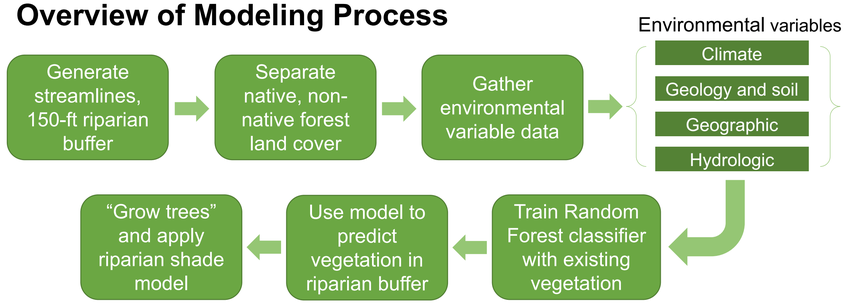


Mark West Creek watershed in Sonoma County.

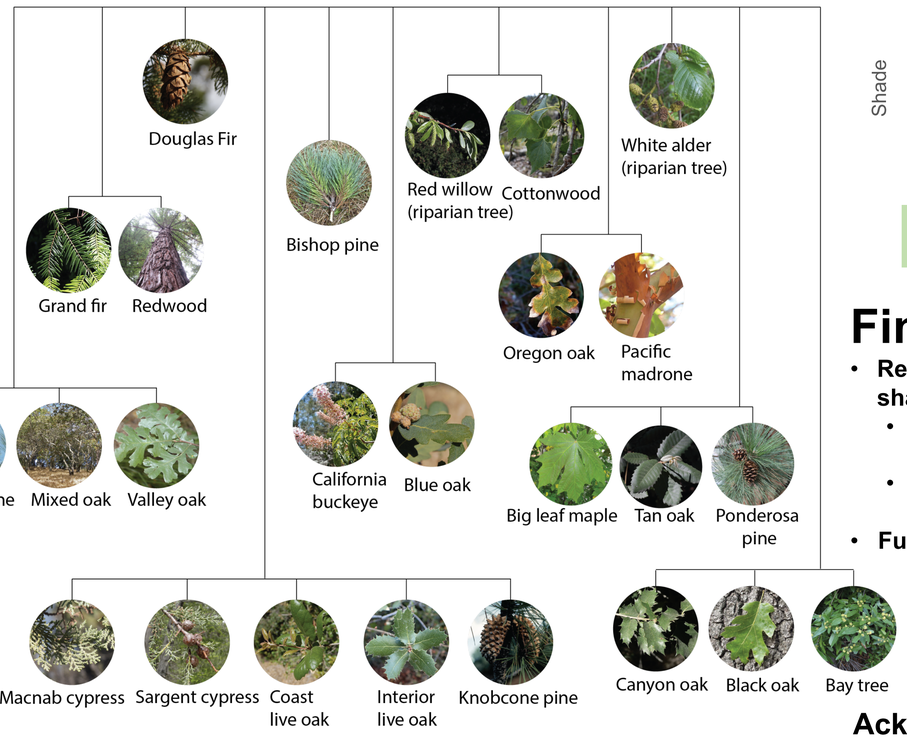
Model Development

To evaluate potential riparian vegetation for the shade model, we developed a classification model that takes environmental variable inputs and predicts a vegetation class. We reclassified all Sonoma County native forest vegetation into 11 classes based on US National Vegetation Classification macrogroups and hierarchical clustering. Aside from native forest, all other land cover was targeted for replacement. Our model employs the **Random Forest** ensemble learning method, which is an extension of classification tree techniques. We trained the model using existing native forest vegetation, labeled as one of the 11 clusters, and accompanying environmental variables such as climate and geology. The model was applied in a 150-ft riparian buffer on either side of Mark West Creek and its tributaries.

Overview of Modeling Process

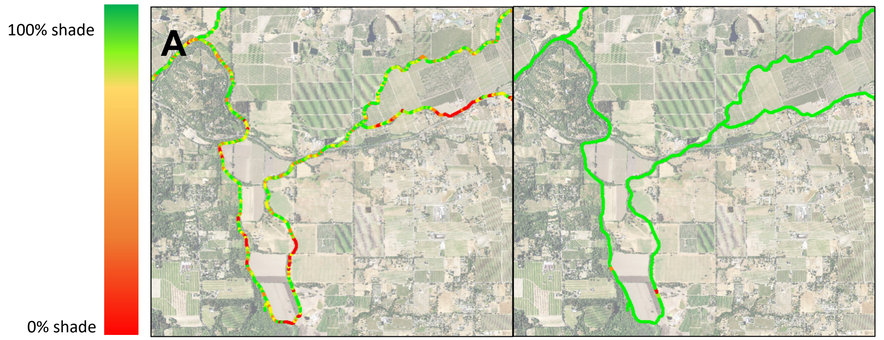


Vegetation clusters

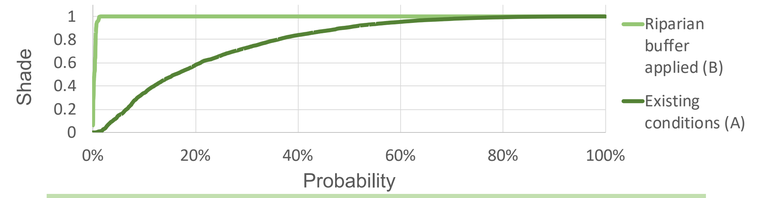


The 11 clusters of native forest vegetation used as labels in the Random Forest classification model.

Model Application



Scenario (A) shows present-day shade conditions on Mark West Creek near Laguna and River Road. Scenario (B) shows shade conditions with all land cover in a 150-ft riparian buffer zone replaced by native forest vegetation. Vegetation in (B) was grown to the 90th percentile of height and canopy density within each vegetation cluster to simulate the shade potential of mature trees.



Empirical distribution function of shade in Mark West Creek with the two scenarios.

Findings

- **Restoring riparian buffers has significant potential to improve shade in Mark West Creek**
  - Growing native forest vegetation in 150-ft buffer of the creek increased shading from an average of 78.2% to 99.6%
  - Note: The 2017 Tubbs Fire has transformed the Mark West Creek watershed, affecting the riparian buffer we have modeled
- **Further analysis**:
  - Explore the question of how to spatially represent potential vegetation more accurately, considering natural variation in canopy cover and vegetation height of mature trees
  - Incorporate shade results into a temperature model of Mark West Creek

Acknowledgements and references

Sonoma County Vegetation Mapping and LiDAR Program; Center for Ecosystem Management and Restoration, (2014). Report on the Hydrologic Characteristics of Mark West Creek; United States National Vegetation Classification, (2017); Riparian Shade Model, North Coast Regional Water Quality Control Board.