Modeling Velvetgrass (*Holcus lanatus*) Habitat Suitability in Kings Canyon and Sequoia National Parks

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Background

Velvetgrass (*Holcus lanatus*) is a non-native, invasive grass that threatens the biodiversity and function of ecosystems in the Sierra Nevada range of California by displacing native species. Kings Canyon and Sequoia National parks encompass 865,964 acres just east of Fresno, CA. The National Park Service (NPS) has prioritized the control of velvetgrass infestations to protect their wilderness ecosystems. Early detection and eradication is the most effective means of using park resources to prevent velvetgrass invasion.

Habitat suitability analysis is a form of spatial modeling that highlights geographic locations that are likely to be more suitable for a species based on shared attributes with known occurrences. Outputs can guide park managers in prioritizing early detection surveys and help them more efficiently use park resources to protect ecosystems.

Maxent software is a popular tool for habitat suitability analysis of invasive plant species because it works with presence-only data. Given occurrence data and environmental predictor rasters, Maxent splits the data into training/test data, parameterizes and runs a model, creating a predicted surface of likelihood of habitat suitability.

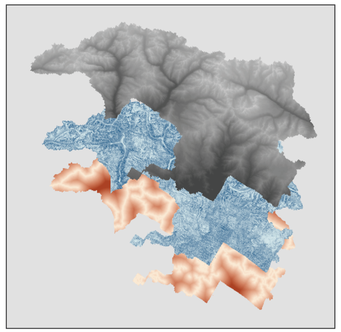
Above: Velvetgrass encroaching on a meadow of leopard lilies (*Lilium pardalinum*) in the Kern Canyon, Sequoia National Park.

Methods

Velvetgrass occurrence and predictor layer data was acquired from the National Park Service. Maxent software was used to create a predicted raster surface of likelihood of habitat suitability for velvetgrass. BlueSpray (www.schoonerturtles.net) was used to determine the best regularization parameter for Maxent and to jiggle the points to create an uncertainty surface.

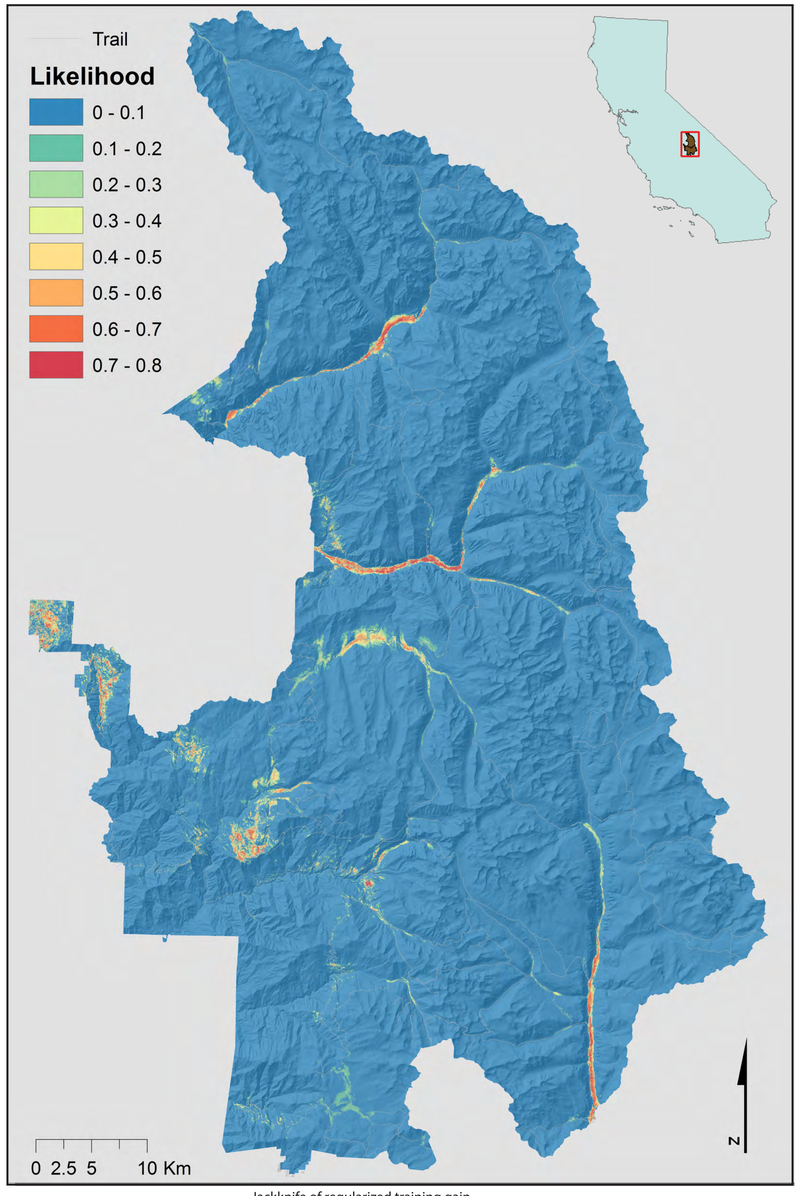
Model inputs:

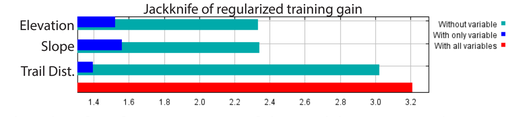
- 1,223 velvetgrass occurrence points
- 10m resolution predictor layers:
  1. Euclidean distance to nearest trail
  2. Slope
  3. Elevation



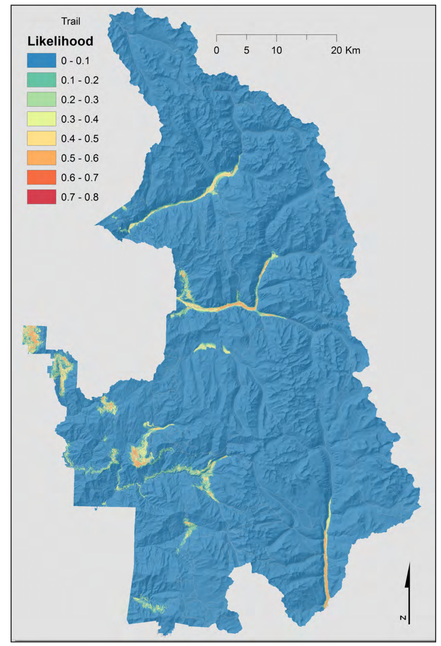
Above: Examples of rasters used for environmental predictor layers: elevation, slope, and distance to nearest trail.

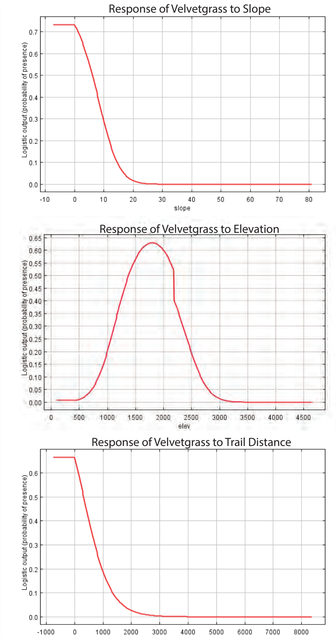
Results





Top: Mean predicted surface for 25 iterations of the model using a regularization value of 12. Values between 0 - 1 represent likelihood that a pixel represents suitable habitat for velvetgrass. Mean Area Under Curve (AUC) value was 0.988. Bottom: Jackknife results for environmental predictor layers.





Above left: Predicted surface with uncertainty using point jiggling of 30 meters, showing a broader area and lower values. Above right: Response curves for individual environmental predictor layers.

Discussion (Caveats)

- The model has a good mean AUC, makes sense, and could be of useful to park managers in prioritizing early detection surveys. However, it is fitted to a limited range of occurrence data would not be appropriate to generalize and use beyond the parks.
- It must be noted that just because velvetgrass is not currently present, it does not mean the area is not suitable habitat - the species is actively invading and has not reached its full potential range.
- Elevation more likely represents climatic conditions which were not available at a fine enough resolution for this model.
- Inaccuracies will always be present in the data due to instrument and human error. This should be incorporated into error/uncertainty surfaces.
- Distance to trail was a useful predictor, but there is unavoidable bias: there are more people on trails, thus areas near trails are both seen by people more and have a higher chance of people introducing velvetgrass seeds to the area.

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