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Predictive Geospatial Habitat Modeling Of The Rare Sedge, Carex idaho, In The Southern Blue Mountains Of Oregon

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Inventory and management of rare plants and their respective habitats is an increasing priority for State and Federal land management agencies in the Pacific Northwest. Predicting the habitat and distribution of rare plants can be a great aid in discovery and conservation of populations that are susceptible to anthropogenic processes and management activities. Here, geospatial habitat prediction models are utilized to predict habitats and populations of a rare plant on National Forest lands in the Southern Blue Mountains of Oregon.

Idaho sedge (Carex idahoa) is considered globally imperiled and is arguably the rarest native sedge in the Pacific Northwest. Prior to 2010, less than 50 populations were known worldwide, with the only documented population in Oregon and Washington being on the Malheur National Forest. Despite its rare status, there is a wealth of information on the specific habitat requirements of Idaho sedge. The type and quality of this information makes this species an ideal candidate for predictive habitat modeling.

A model was developed using geospatial and statistical techniques to predict potential habitat based on environmental factors such as elevation, slope, aspect, rainfall, geology, infrared reflectivity, watershed characteristics, and vegetation composition. Field crews surveyed areas that were identified as potential habitat in order to validate the model and determine if populations were present. Over 4,000 aces of predicted habitat were inventoried and the initial results of the project were an overwhelming success: > 70% of the predicted habitat was correctly categorized and 27 new populations were discovered.

Predictive Geospatial Habitat Modeling of the Rare Sedge, *Carex idahoa*, In the Southern Blue Mountains of Oregon

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Introduction

Conservation of rare plants and habitat is an increasing priority for State and Federal land management agencies. Predicting the distribution and habitat of rare plants can facilitate their discovery and conservation. Here, geospatial habitat modeling is utilized to predict habitat of a rare plant on the Malheur National Forest in the southern Blue Mountains of Oregon.

Documenting new population

Carex idahoa

Idaho sedge is considered globally imperiled and is one of the rarest sedges in the Pacific Northwest. Prior to 2010, less than 50 populations were known worldwide, with the only known population in Oregon and Washington occurring on the Malheur National Forest. Despite its rare status, there is a wealth of information on its specific habitat requirements (Lesica 1998*). The type and quality of this information makes this species an ideal candidate for predictive habitat modeling.

Methodology

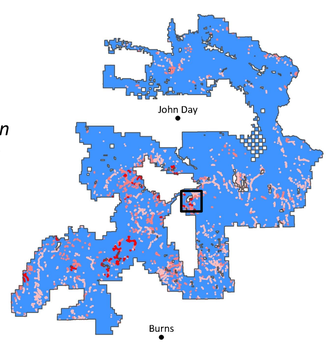
Geospatial modeling and analyses were accomplished using ArcMap 10 and the Forest Service's corporate spatial database. Two different approaches were used to create habitat probability maps: the *Local Vector Approach* and the *Global Raster Approach*. The initial model used the Local Vector Approach which identifies local habitat maxima by the intersection of polygons with specified parameter values; the total parameter space only includes areas where specified values intersect. The final model used the Global Raster Approach; all lands are categorized by probability index scores for each of the 100 m^2 cells in the study area. Score values are determined by summation of assigned cell values of overlain rasterized data sets.

Initial Model

The parameter space included over 20,000 acres classified as low, moderate, or high probability of potential habitat. Field validation of the initial model indicated that the three probability classes had no significant difference in the ability to detect habitat or populations. Additionally, the model was too restrictive; new populations were documented in some areas identified as having no habitat potential. This necessitated a revised model that considers all lands (global approach).

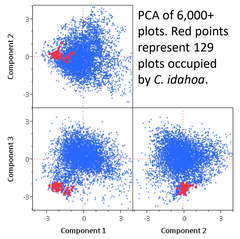
Parameters

- *Stream Proximity*
- *Wetland Proximity*
- *Annual Precipitation*
- Near IR Reflectivity
- RBG Reflectivity
- Geologic Material
- PNV
- *Canopy Cover*
- *Slope*
- *Elevation*



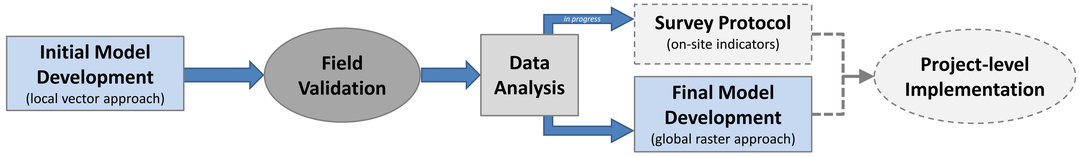
Field Validation

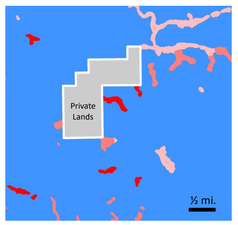
Areas identified as potential habitat were surveyed in order to validate the model and determine if populations were present. Over 4,000 acres of predicted habitat were inventoried, 70% of which were correctly categorized. Surveys resulted in the **discovery of 27 new populations** covering a total of 151 acres.



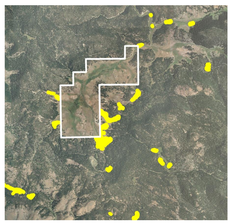
Data Analysis

Data was extracted from 6,099 existing vegetation inventory plots in the project area (129 plots with *C. idahoa*) to determine multivariate correlations of the parameters. Principal components and logistic regression were used to characterize the data and determine which parameters best predict the occurrence of occupied habitat. It was determined that 6 of the 12 parameters of the initial model should be included in the final model (parameters in italics below, left).

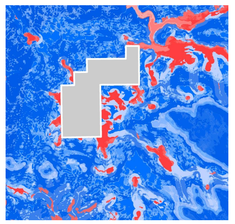




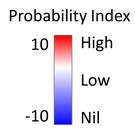
Initial model (red intensity indicates a higher probability of potential habitat)



Aerial photo showing populations documented as a result of this model (in yellow)

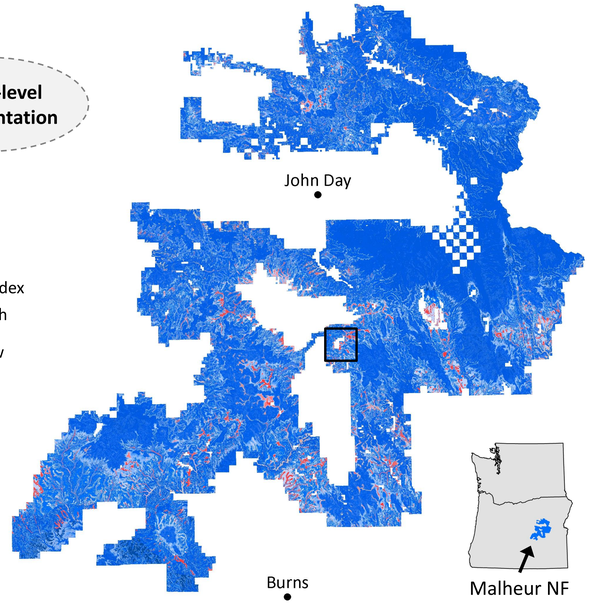


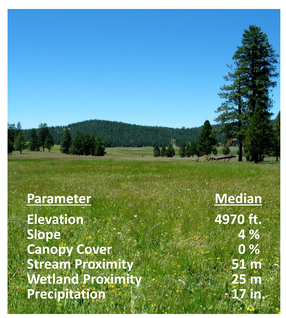
Final model (red intensity indicates a higher probability of potential habitat)



Final Model

The parameter space of the global raster model included 69 million cells covering 1.7 million acres. Probability index scores were generated for each of the 100 m^2 cells; values range from -10 to 10. Negative values have the lowest probability of potential habitat; these are areas where probability of occurrence increasingly approaches nil. Positive values indicate areas with higher probability of habitat or population occurrence. Approximately 72,000 acres (4% of the total area) are identified as having index scores ≥ 0.





Parameter	Median
Elevation	4970 ft.
Slope	4 %
Canopy Cover	0 %
Stream Proximity	51 m
Wetland Proximity	25 m
Precipitation	17 in.

Typical habitat in Blue Mountains

Conclusion

Overall, the final model correctly classified potential habitat ~70% of the time. Misclassification primarily occurs in areas that are too wet (e.g., marshes, fens, wet meadows) or in areas where anthropogenic processes have degraded the sites to an extent where habitat conditions no longer exist. For example, sites that have been converted to agriculture use in the past or areas where the water table has been lowered (see figure at right).

This project shows how predictive geospatial habitat modeling can be an effective and efficient tool for locating and conserving rare plant habitats and populations.

Degraded and Lost Habitat
These sites were predicted as high potential habitat, but stream erosion has lowered the water table and caused a loss of habitat and subsequent colonization of arid species.

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* Lesica, P. 1998. Conservation Status of *Carex parryana* ssp. *idahoa* in Montana. Montana State BLM Office. 33p.