Demonstration of a Wildlife Modeling Tool for Predicting Species Presence and Viewing Habitat Suitability across a Landscape

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Abstract:

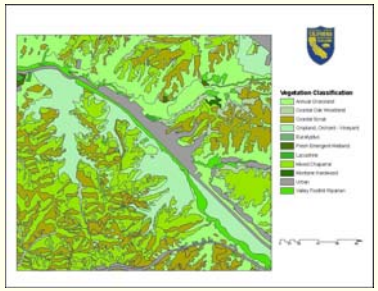
Bioview[3] is a modeling tool added to the California Wildlife Habitat Relationships (CWHR) System[4] Version 8.0 software in 2002. CWHR is a comprehensive wildlife information system and predictive model for vertebrates in California-- containing life history, geographic range, habitat relationships, and management information on 692 species of amphibians, reptiles, birds, and mammals known to occur regularly in the state. The system uses a standardized habitat classification scheme containing 59 habitats with structural stages, and rates the suitability of these habitat stages for the reproduction, cover, and feeding requirements of each of the modeled species. Bioview uses habitat suitability ratings from the CWHR database for user-selected species and applies them to a user-provided data file.

Methods and results of two analyses are presented. Each uses Bioview with Geographic Information System (GIS) vegetation and habitat data sets to model suitable habitat for a species. The first analysis joins a fine-scale vegetation data set for Western Riverside County with average habitat suitability values for reproduction, cover, and feeding taken from CWHR for the Red-shouldered Hawk (*Buteo lineatus*). The second analysis joins a different habitat data set for two habitat conditions in the Jackson Demonstration State Forest (JDSF) in Mendocino County with average habitat suitability values taken from CWHR for the Northern Spotted Owl (*Strix occidentalis caurina*) and evaluates changes in the configuration of habitat patches from one condition to another. The models are validated in each case with a GIS data set of occurrences of the species. Such results show that Bioview can be part of an effective strategy for modeling species presence and viewing habitat suitability across a landscape.

View of the Model Structure of the CWHR System from the CWHR Software Application
CWHR is a matrix model. Here suitability values for the Red-shouldered Hawk (*Buteo lineatus*) are shown for the structural stages of Valley Foothill Riparian habitat. In the CWHR System, a species expert assigns suitability values of high (1.00), medium (0.66), low (0.33), or unsuitable (0.00) to each structural stage of each habitat for the reproduction, cover, and feeding requirements of a modeled species. CWHR users may choose to calculate average suitability values across these life requirements using either an arithmetic or a geometric method.

Sample 1: Viewing Suitable Habitat for the Red-shouldered Hawk (*Buteo lineatus*) in Western Riverside County, California

Beginning with a Vegetation Mapping Product



The vegetation map of Western Riverside County, California was created at the alliance-level using 2-acre minimum mapping units. It was produced in 2006 by the California Department of Fish and Game (CDFG) and contractors (California Native Plant Society and Aerial Information Systems) to be used in habitat conservation planning in Western Riverside County.

Preparing the Vegetation Data for Bioview

CWHR Habitat	Size Class	Cover Class	ID
CSC	1		16049
VRI	4	P	16050
AGS	1	D	16051
CSC	1		16052
AGS	1	D	16053
VRI	3	P	16054
COW	4	D	16055
COW	3	S	16056

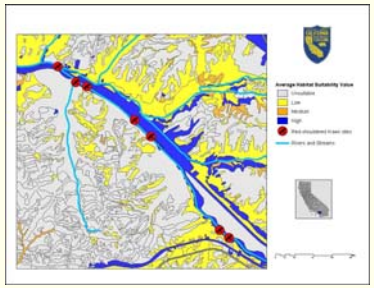
Vegetation alliances in the database of the mapping product were then crosswalked with equivalent CWHR habitats. Structural information about each vegetation polygon was also added to the database. Here, for example, polygon #16050 is the equivalent of VRI 4P – or CWHR habitat Valley Foothill Riparian with small trees and open cover. Bioview requires as input CWHR habitat, size class, and cover class for each identified polygon.

Linking Bioview Output with Vegetation Data Input

ID	RPO	CVR	FRG	ARM	QDM
16049	0	0	0	0	0
16050	100	100	100	100	100
16051	33	33	33	33	33
16052	0	0	0	0	0
16053	33	33	33	33	33
16054	100	100	100	100	100
16055	100	100	100	100	100
16056	66	66	66	66	66

The table was then entered into Bioview and analyzed for the Red-shouldered Hawk. Bioview returns reproduction, cover, and feeding values for the selected species to the table of identified polygons. Arithmetic and geometric means of average habitat suitability are also calculated.

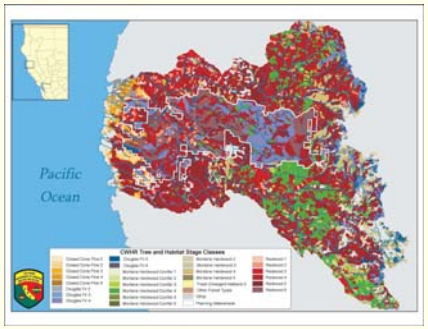
Preparing a Habitat Suitability Map and Validating the Model with Occurrence Data



The tables were then linked together in a database software program and a map created with a legend showing average suitability for the selected species. Finally, the resulting habitat suitability map was validated with observations of the Red-shouldered Hawk. The data points represent the riparian bird survey portion of a research monitoring program conducted by the Center for Conservation Biology between 2002 and 2005.

Sample 2: Projecting Future Conditions for the Northern Spotted Owl (*Strix occidentallis caurina*) in Jackson Demonstration State Forest, Mendocino County, California

Starting with a Mapping Product of Current Vegetation



The vegetation was mapped within the white boundary line of the JDSF. Equivalent CWHR habitats and stages were then added to the database of the vegetation layer.
The vegetation outside of the JDSF was derived from the FRAPVEG multi-source vegetation coverage, the details of which can be found at http://frap.cdf.ca.gov/projects/frap_veg/methods/Methods_Development_Habitat_Data_02_2.pdf

Projecting Suitability of a Potential Future Landscape with Current Owl Activity Sites

Vegetation maps of potential future landscapes were created and tables from each mapping product entered into Bioview and analyzed for the Northern Spotted Owl. Bioview maps were produced for several potential management scenarios of habitat and stage. Arithmetic mean of reproduction, cover and feeding values for each polygon of habitat and stage was used to develop each habitat suitability map.

Applying FRAGSTATS®[5] to Bioview Projections

In order to evaluate and report the magnitude of differences between Environmental Impact Report (EIR) alternatives over time, several common landscape measures available from the FRAGSTATS® software program were applied to the Bioview mapping products. These measures included total class area, number of patches, mean patch area, mean nearest neighbor, and total edge index. Each of these measures considered separately has limitations relative to assessing the biological needs of a species. However, when considered together they provide one means of EIR alternative evaluation and spatial quantification of habitat heterogeneity and trajectory over time.

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Table VII.6.6.33.g1 Landscape Metrics for Species of Concern by Habitat Suitability Class within JDSF at the End of the First Decade by Alternative.

Northern Spotted Owl	Inside JDSF		
	Low Suitability	Moderate - High Suitability	Fully Suitable
Total Edge Index	2,513	2,552	2,270
Alternative C1:			
Total Class Area	17,980	4,949	23,473
Percentage of Landscape	37	10	48
Number of Patches	221	144	161
Mean Patch Area	81	34	146
Mean Nearest Neighbor	141	189	123
Total Edge Index	2,597	2,612	2,443
Alternative C2:			
Total Class Area	17,968	4,812	23,622
Percentage of Landscape	37	10	49
Number of Patches	218	137	161
Mean Patch Area	82	35	147
Mean Nearest Neighbor	142	193	123
Total Edge Index	2,596	2,599	2,439
Alternative D:			
Total Class Area	17,184	4,964	11,468
Percentage of Landscape	35	10	24
Number of Patches	215	168	265
Mean Patch Area	80	30	43
Mean Nearest Neighbor	148	187	133
Total Edge Index	1,663	2,274	1,990

Landscape Metrics for Three of Seven Alternatives in the JSDF Management Plan

1. Department of Fish and Game, Biogeographic Data Branch, Sacramento , California. http://www.dfg.ca.gov/bdb
2. California Department of Forestry and Fire Protection, Fire and Resource Assessment Program, Sacramento, California. http://frap.cdf.ca.gov/
3. Bioview was originally produced by the United States Forest Service Pacific Southwest Research Station, Redding, California. Authors and editors are Robert J. Laacke, Neil Flagg, Dave Watkins, and Rose Leonard.
4. CWHR is managed by the California Department of Fish and Game. The current version and all of its components may be cited as: California Department of Fish and Game. California Interagency Wildlife Task Group. 2005. CWHR version 8.1 personal computer program. Sacramento, California.
5. McGarigal, K., S. A. Cushman, M. C. Neel, and E. Ene. 2002. FRAGSTATS: Spatial Pattern Analysis Program for Categorical Maps. Computer software program produced by the authors at the University of Massachusetts, Amherst. Available at the following web site: www.umass.edu/landeco/research/fragstats/fragstats.html5