

California Department of Fish and Wildlife
Sierra Nevada Foothills Wildlife Connectivity Modeling Project
Goals and Objectives

Background: The Sierra Nevada foothills wildlife connectivity modeling project focuses on the northern Sierra Nevada foothills (NSNF), encompassing a narrow band (~20 miles wide) of low to mid-elevation habitat approximately 275 miles long that runs from Shasta County to Madera County. The foothills ecoregion is oriented approximately parallel to the coastline, ~125 miles inland, just east of the Central Valley and west of the Sierra Nevada mountains. The elevation in the foothills ranges from 100-5,000 feet, with a mean elevation of 1,200 feet. The majority of habitat in the foothills is a matrix of blue oak woodland (27 %), grassland (32 %), and chaparral (10 %). Of the 2,551,000 total acres in the NSNF, 423,000 (16 %) are in permanent protection, owned and managed by the US Bureau of Land Management, US Forest Service, California Department of Fish and Wildlife, and 55 other federal, state and local agencies; counties; cities; conservation NGOs and land trusts. An additional 74,000+ acres (3%) are under conservation easement (as mapped in the National Conservation Easement Database).

The foothills ecoregion represents an important movement corridor between the low elevations of the Central Valley and the mountains of the Sierra Nevada. The foothills provide key habitat areas for species such as mule deer that migrate seasonally between high elevations in the Sierra's during the summer and lower elevations in the foothills during the winter. The oak woodlands in the foothills also provide an important food source (acorns) for many species ranging from birds, to rodents, to large mammals. Furthermore, the foothills may provide important paths for movement as species adapt to climate change.

Objectives and Goals: The objective of this project is to build on the statewide California Essential Habitat Connectivity model completed in 2010, which provided a broad-brush look at potential connectivity areas between intact blocks of habitat 10,000 acres or greater in size. Our goals for this project will take a finer-scale look at connectivity within the NSNF and between the NSNF and adjacent lands in the Central Valley and Sierra Nevada, using species-specific data to model connections between blocks of protected lands. The models will identify important core habitat areas for focal species as well as least-cost-path connections between these core areas. We will also identify land facets, areas of land with uniform topographic and geologic features that will interact with future climate to support species and species movement under future climate conditions. We will combine the species specific and land facet corridors to build linkage designs for each connection.

Intended uses: Local and regional land-use planning, land use decision-making, conservation and habitat acquisition planning and decision-making, general education and information, example for other detailed connectivity-mapping projects.

Additional project information is available at <http://www.dfg.ca.gov/biogeodata/projects/connectivity.asp> or contact Crystal Krause (crystal.krause@wildlife.ca.gov) for additional information.

Definitions:

Focal Species: We will model habitat and connectivity areas for a subset of species that occur in the NSNF. Criteria for selecting focal species were based on movement and habitat requirements (Table 1), prioritizing species with movement as a key component of their life history as well as species whose habitat and movement needs would encompass those of multiple species. Species that met the selection criteria were stratified across taxonomic groups to represent the diversity of habitat requirements and movement needs across the ecoregion. We solicited expert opinion from our regional offices to narrow the list to 30 focal species (Table 2).

Land Facets: Land facets are areas of the landscape with uniform topographic and geologic characteristics. Land facets are used to predict areas of habitat that are expected to be suitable in future climates without relying on models of future temperature and precipitation. We plan to use land facet analysis to identify corridors with uniform topographic and geologic features that will support species and species movement as climate conditions change over time.

Landscape Block: Our connectivity modeling works by identifying suitable corridors between habitat areas called “landscape blocks.” Our draft landscape blocks, which may be any shape, include protected lands managed primarily for biodiversity conservation (based on USGS GAP Analysis conservation status designations GAP 1 and 2) and lands under conservation easement (Table 3). We are seeking input on additional lands to include as landscape blocks, which should be lands with high habitat value that are expected to maintain this habitat value in the foreseeable future (Table 4).

Linkage Analysis: We will create habitat suitability models for each focal species and least-cost corridor models for a selection of species. This will identify multiple swaths of habitat that species have the potential to reside in or move through. We will create a final linkage design for each linkage analysis area by combining multiple corridors from focal species and land facets.

Linkage Analysis Area: Each pair of landscape blocks to be connected represents a linkage analysis area. Blocks within the NSNF ecoregion may be paired with other blocks in the ecoregion, or with blocks in neighboring ecoregions within 30 km of the NSNF.

Modeling steps:

- 1) Select focal species and create habitat suitability models
- 2) Define landscape blocks
- 3) Conduct least-cost-path modeling connectivity models for subset of focal species
- 4) Conduct land facet corridor analysis
- 5) Final linkage analysis
- 6) Field investigations to evaluate models
- 7) Produce final report and GIS layers for distribution

Table 1: Selection criteria for focal species. Each criterion was ranked by importance (1 very important, 6 less important). Species that meet more than one selection criteria had a higher selection potential. Listed species were used to add more weight to a species selection potential. Corridor dwellers were not ranked, those that met other criteria had a higher selection potential. Final selection of focal species was stratified across taxonomic groups to represent the diversity of habitat requirements and movement needs across the ecoregion.

Ranking	Description
1	Area sensitive species that occur in lower densities but require large areas.
2	Barrier sensitive species that are specifically sensitive to road development
3	Umbrella species that are representative of a trophic group/guild, related species, rare species, mobility class, key ecological process or other collection of species.
4	Dispersal limited species require seasonal migration (fine scale movement).
5	Habitat specialist are highly sensitive to habitat loss or fragmentation
6	Listed status species are of greater conservation need based on conservation status rankings.
Corridor Dwellers	Corridor dwellers are species that will live in the corridor for multiple generations or use habitat patches throughout the corridor.

Table 2: Focal species list includes: 3 amphibians, 5 carnivores, 4 reptiles, 1 bat, 1 hoofed animal, 4 rodents, 10 birds and 2 lagomorphs.

Acorn Woodpecker	California Thrasher	Lark Sparrow	Southern Alligator Lizard
Arboreal Salamander	Coast Horned Lizard	Limestone Salamander	Spotted Towhee
Black Bear	Cooper's Hawk	Mountain Lion	Western Gray Squirrel
Black-tailed Jackrabbit	Dusky-footed Woodrat	Mountain Quail	Western Pond Turtle
Bobcat	Foothill Yellow-legged Frog	Mule Deer	Wood Duck
California Ground Squirrel	Gopher Snake	Northern Pygmy-owl	Yellow-billed Magpie
California Kangaroo Rat	Gray Fox	Pallid Bat	
California Quail	Heermann's Kangaroo Rat	Racer	

Table 3: Definition of lands selected for draft landscape blocks.

GAP 1*	An area of permanent protection from conversion of natural land cover and a mandated management plan to maintain a natural state and disturbance events.
GAP 2*	An area of permanent protection from conversion of natural land cover and a mandated management plan to maintain a primarily natural state, but may receive uses that degrade the quality of existing natural communities, including suppression of natural disturbance.
NCED	Privately owned conservation easement lands from the National Conservation Easement Database, which represents approximately 60% of the conservation easements in California. Data are from land trusts and public agencies. Conservation easements are legal agreements voluntarily entered into between landowners and conservation entities (agencies or land trusts) for the express purpose of protecting certain societal values such as open space or vital wildlife habitats.

*USGS GAP Analysis program protected areas conservation status code

Table 4: Definition of other lands that may supplement draft landscape blocks.

GAP 3*	Multiple use public lands. An area of permanent protection from conversion of natural land cover for most of the area, but subject to extractive uses of either a broad, low intensity type, i.e. logging, or localized intense type, i.e. mining; protection to federally listed species throughout the area.
Vernal Pools	Mapped vernal pools in the Great Valley region based on 2005 and 2010 NAIP imagery, from Witham, Holland and Vollmar (2013).

*USGS GAP Analysis program protected areas conservation status code

Scientific Name	Common Name	Taxonomic	Distribution Model	Connectivity Models
Priority Species				
<i>Melanerpes formicivorus</i>	ACORN WOODPECKER	bird	X	
<i>Aneides lugubris</i>	ARBOREAL SALAMANDER	amphibian	X	
<i>Ursus americanus</i>	BLACK BEAR	carnivore	X	X
<i>Lepus californicus</i>	BLACK-TAILED JACKRABBIT	lagomorph	X	X
<i>Lynx rufus</i>	BOBCAT	carnivore	X	X
<i>Spermophilus beecheyi</i>	CALIFORNIA GROUND SQUIRREL	rodent	X	
<i>Dipodomys californicus</i>	CALIFORNIA KANGAROO RAT	rodent	X	
<i>Callipepla californica</i>	CALIFORNIA QUAIL	bird	X	
<i>Toxostoma redivivum</i>	CALIFORNIA THRASHER	bird	X	
<i>Phrynosoma coronatum</i>	COAST HORNED LIZARD	reptile	X	
<i>Accipiter cooperii</i>	COOPER'S HAWK	bird	X	
<i>Neotoma fuscipes</i>	DUSKY-FOOTED WOODRAT	rodent	X	X
<i>Rana boylei</i>	FOOTHILL YELLOW-LEGGED FROG	amphibian	X	
<i>Pituophis catenifer</i>	GOPHER SNAKE	reptile	X	
<i>Urocyon cinereoargenteus</i>	GRAY FOX	carnivore	X	X
<i>Dipodomys heermanni</i>	HEERMANN'S KANGAROO RAT	rodent	X	
<i>Chondestes grammacus</i>	LARK SPARROW	bird	X	
<i>Hydromantes brunus</i>	LIMESTONE SALAMANDER	amphibian	X	
<i>Puma concolor</i>	MOUNTAIN LION	carnivore	X	X
<i>Oreortyx pictus</i>	MOUNTAIN QUAIL	bird	X	
<i>Odocoileus hemionus</i>	MULE DEER	hoofed animal	X	X
<i>Glaucidium gnoma</i>	NORTHERN PYGMY-OWL	bird	X	
<i>Antrozous pallidus</i>	PALLID BAT	bat	X	
<i>Coluber constrictor</i>	RACER	reptile	X	
<i>Elgaria multicarinata</i>	SOUTHERN ALLIGATOR LIZARD	reptile	X	
<i>Pipilo maculatus</i>	SPOTTED TOWHEE	bird	X	
<i>Sciurus griseus</i>	WESTERN GRAY SQUIRREL	rodent	X	X
<i>Actinemys marmorata</i>	WESTERN POND TURTLE	reptile	X	X
<i>Aix sponsa</i>	WOOD DUCK	bird	X	
<i>Pica nuttalli</i>	YELLOW-BILLED MAGPIE	bird	X	
Secondary Species				
<i>Taxidea taxus</i>	AMERICAN BADGER	carnivore	X	
<i>Sylvilagus bachmani</i>	BRUSH RABBIT	lagomorph	X	
<i>Erethizon dorsatus</i>	COMMON PORCUPINE	rodent	X	
<i>Mustela frenata</i>	LONG-TAILED WEASEL	carnivore	X	
<i>Tamias merriami</i>	MERRIAM'S CHIPMUNK	rodent	X	
<i>Aplodontia rufa</i>	MOUNTAIN BEAVER	rodent	X	
<i>Glaucmys sabrinus</i>	NORTHERN FLYING SQUIRREL	rodent	X	
<i>Bassariscus astutus</i>	RINGTAIL	carnivore	X	
<i>Contia tenuis</i>	SHARP-TAILED SNAKE	reptile	X	
<i>Masticophis lateralis</i>	STRIPED RACER	reptile	X	
<i>Spea hammondi</i>	WESTERN SPADEFOOT	amphibian	X	
<i>Spilogale gracilis</i>	WESTERN SPOTTED SKUNK	carnivore	X	

Northern Sierra Nevada Foothills Stakeholder Meeting Datasheet

Your Name: _____

Email: _____

Landscape Blocks

<u>Region Map</u>	<u>Landscape Block #</u>	<u>Description of Area</u>	<u>Why is this area important for connectivity?</u>
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Land ownership/management:
(please circle)

Private Easement State Federal other:

<u>Region Map</u>	<u>Landscape Block #</u>	<u>Description of Area</u>	<u>Why is this area important for connectivity?</u>
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Land ownership/management:
(please circle)

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<u>Region Map</u>	<u>Landscape Block #</u>	<u>Description of Area</u>	<u>Why is this area important for connectivity?</u>
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(please circle)

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<u>Region Map</u>	<u>Landscape Block #</u>	<u>Description of Area</u>	<u>Why is this area important for connectivity?</u>
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Land ownership/management:
(please circle)

Private Easement State Federal other:

Are there draft blocks that should be excluded? _____

Are there important areas of connectivity inside a landscape block? _____

Do you have maps of connectivity or conservation priority areas that may be useful for our block selection or modeling? _____

If so please include contact and email information. _____

Comments or suggestions on landscape blocks. _____

Northern Sierra Nevada Foothills Stakeholder Meeting Datasheet

Your Name: _____

Email: _____

Focal Species: _____

<u>Region Map</u>	<u>Area #</u>	<u>Description of Area</u>	<u>What is this area important for? (breeding, migration)</u>
Land ownership/management: (please circle) Private Easement State Federal other:			

<u>Region Map</u>	<u>Area #</u>	<u>Description of Area</u>	<u>What is this area important for? (breeding, migration)</u>
Land ownership/management: (please circle) Private Easement State Federal other:			

<u>Region Map</u>	<u>Area #</u>	<u>Description of Area</u>	<u>What is this area important for? (breeding, migration)</u>
Land ownership/management: (please circle) Private Easement State Federal other:			

<u>Region Map</u>	<u>Area #</u>	<u>Description of Area</u>	<u>What is this area important for? (breeding, migration)</u>
Land ownership/management: (please circle) Private Easement State Federal other:			

Are there particular habitat types or natural corridors that the species uses for movement? _____

Are you aware of other habitat or connectivity projects for this species in the state? _____

Would you like to be contacted to review habitat model results? _____

Comments or suggestions on focal species. _____