Habitat connectivity

Ways to address climate change?

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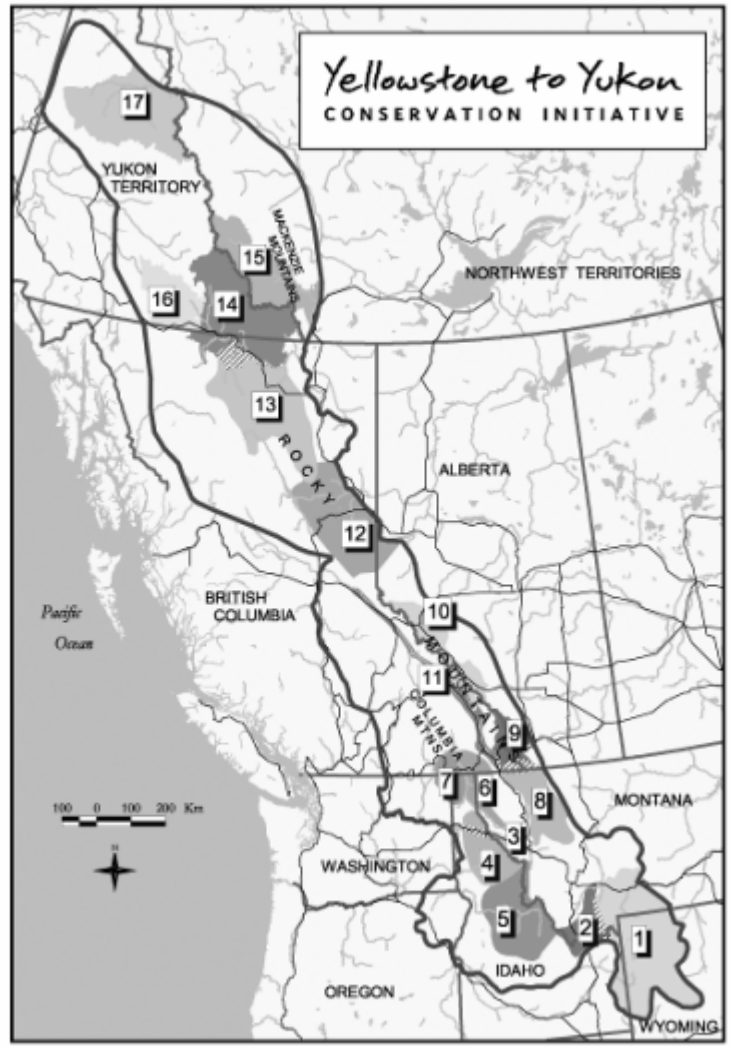
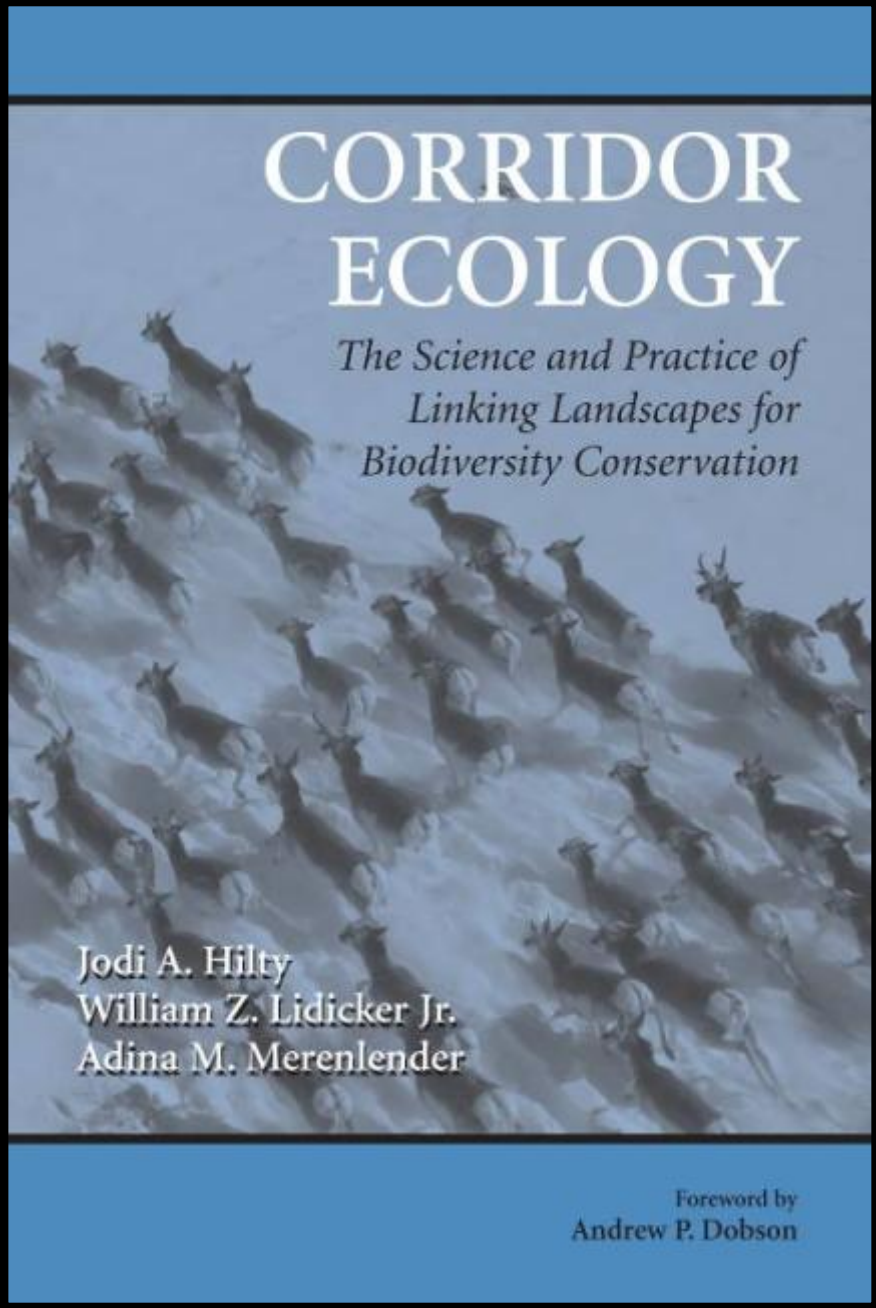
Today's talk

1) Connectivity science and practice
2) Identifying continuous connectivity to assist corridor conservation planning
    1) Our current approach to connectivity analysis
    2) Mayacamas mountains and surrounds
3) Future directions including resilience to climate change

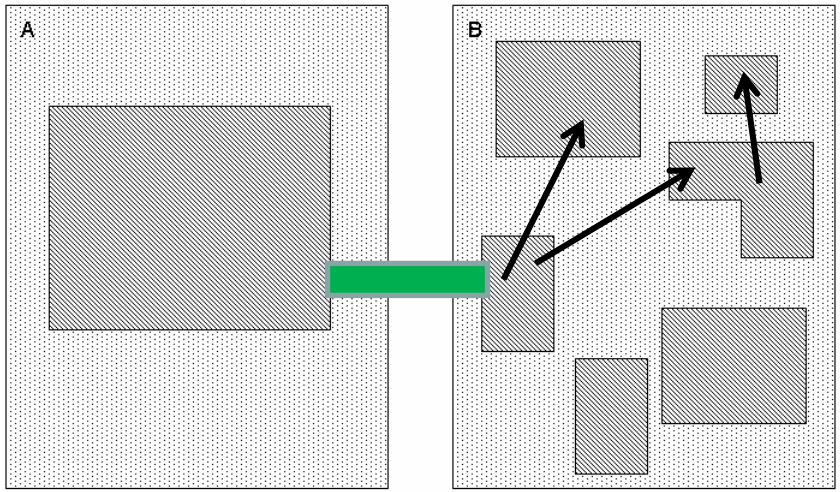
Practice ahead of the science

"Corridors are a hot topic, perhaps even a fad, in conservation planning these days. Planners and environmentalists from county to federal levels are busy drawing 'greenbelts' and other habitat corridors into their designs, sometimes with only a vague awareness of the biological issues underlying the corridor strategy." Noss 1987



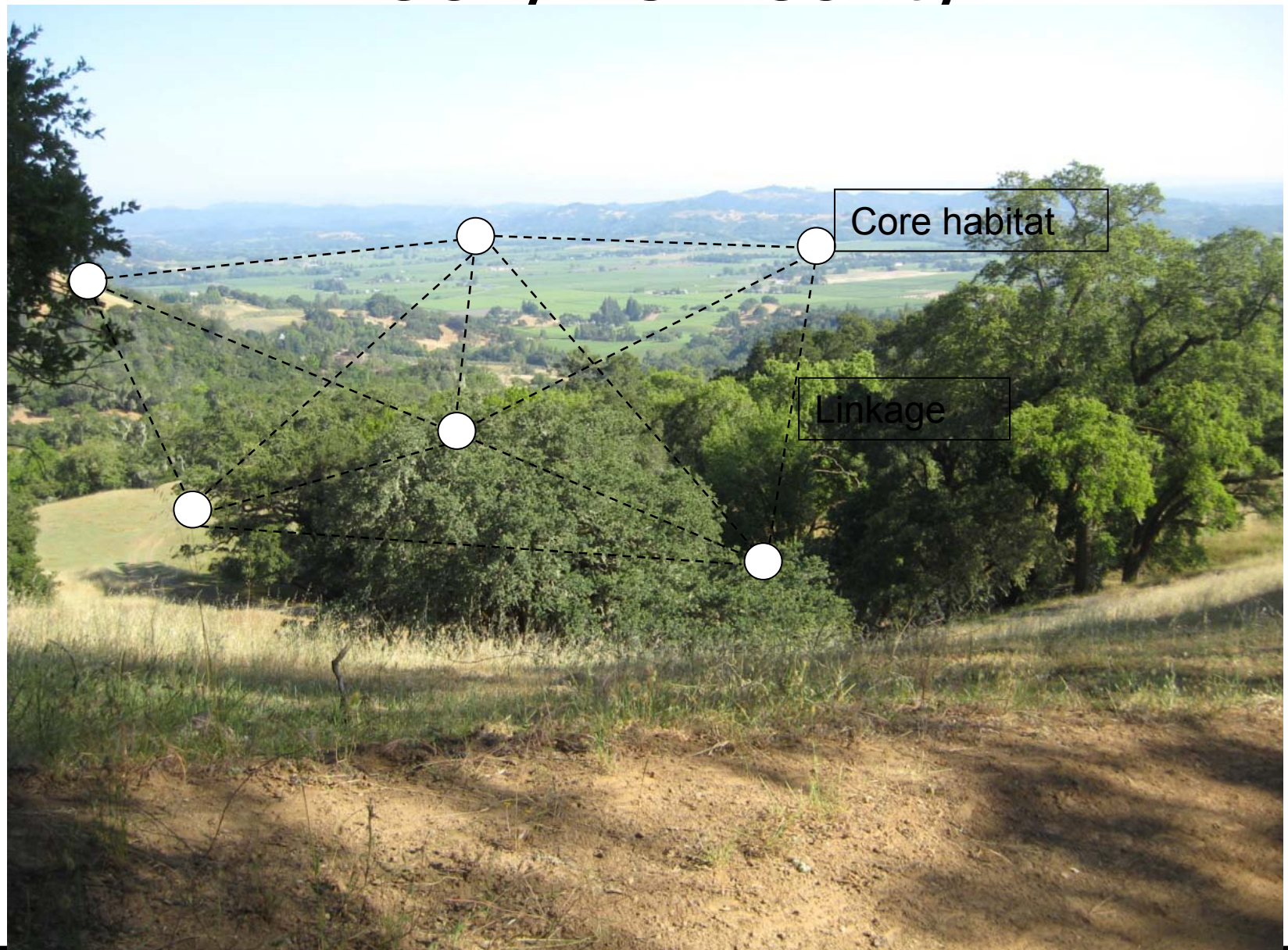

CORRIDOR ECOLOGY
The Science and Practice of Linking Landscapes for Biodiversity Conservation
Jodi A. Hilty
William Z. Lidicker Jr.
Adina M. Merenlender
Foreword by
Andrew P. Dobson

Why corridors?



- More isolated and smaller fragments are less likely to maintain viable populations of species and therefore harbor fewer species in total.
- Corridors are thought to mitigate the impacts of fragmentation and may be necessary for climate change adaptation.
- Connectivity is a measure of the extent to which plants and animals can move between habitat patches.

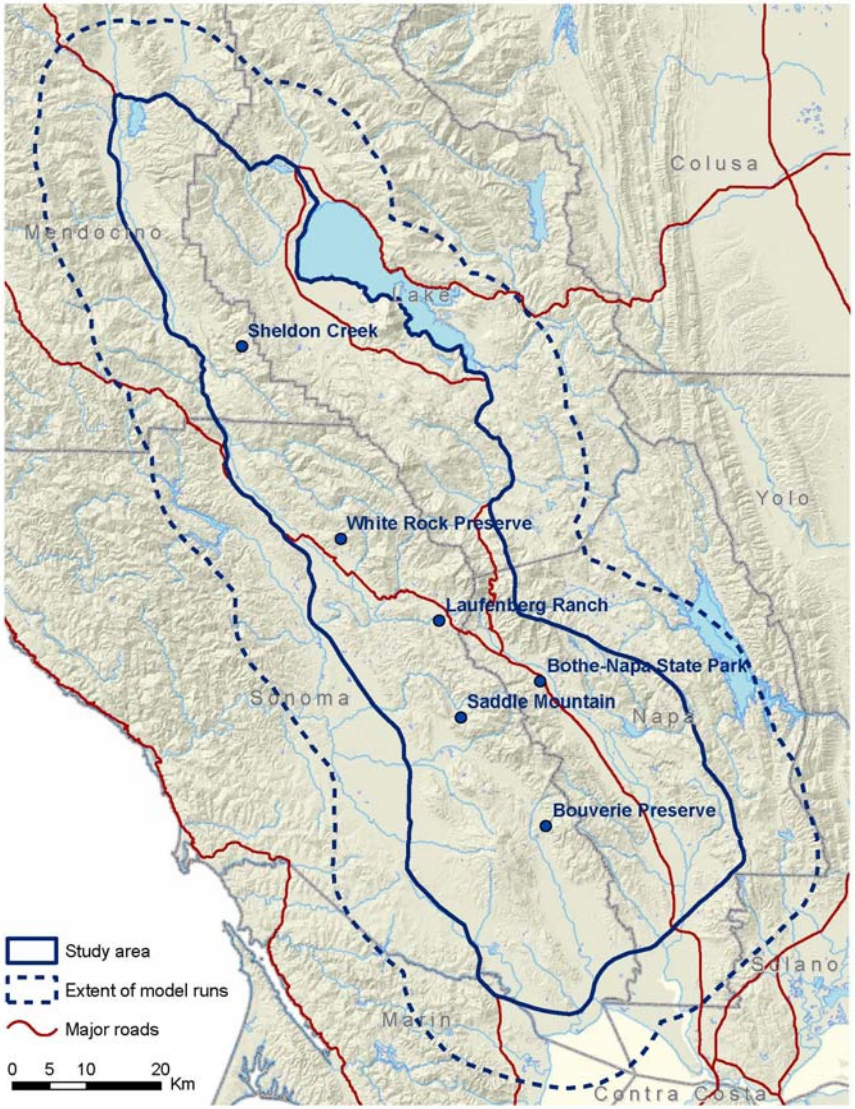
Theory vs. reality



Our approach to date

- Habitat conservation (habitat connectivity rather than focal species)
  - Heterogeneous matrix of land use types
- Connectivity as a continuous surface not as discrete corridors
- Use graph theory-based program FunnConn (Theobald et al. 2006)
  - treats core patches and linkages as a network
- Include field surveys to test functional connectivity

Mayacamas Mtns C, California



Quercus spp., Pseudotsuga menziesii, Arbutus menziesii, Umbellularia californica, Sequoia sempervirens, Lithocarpus densiflorus

52 mi (84 km), northwest-southeast

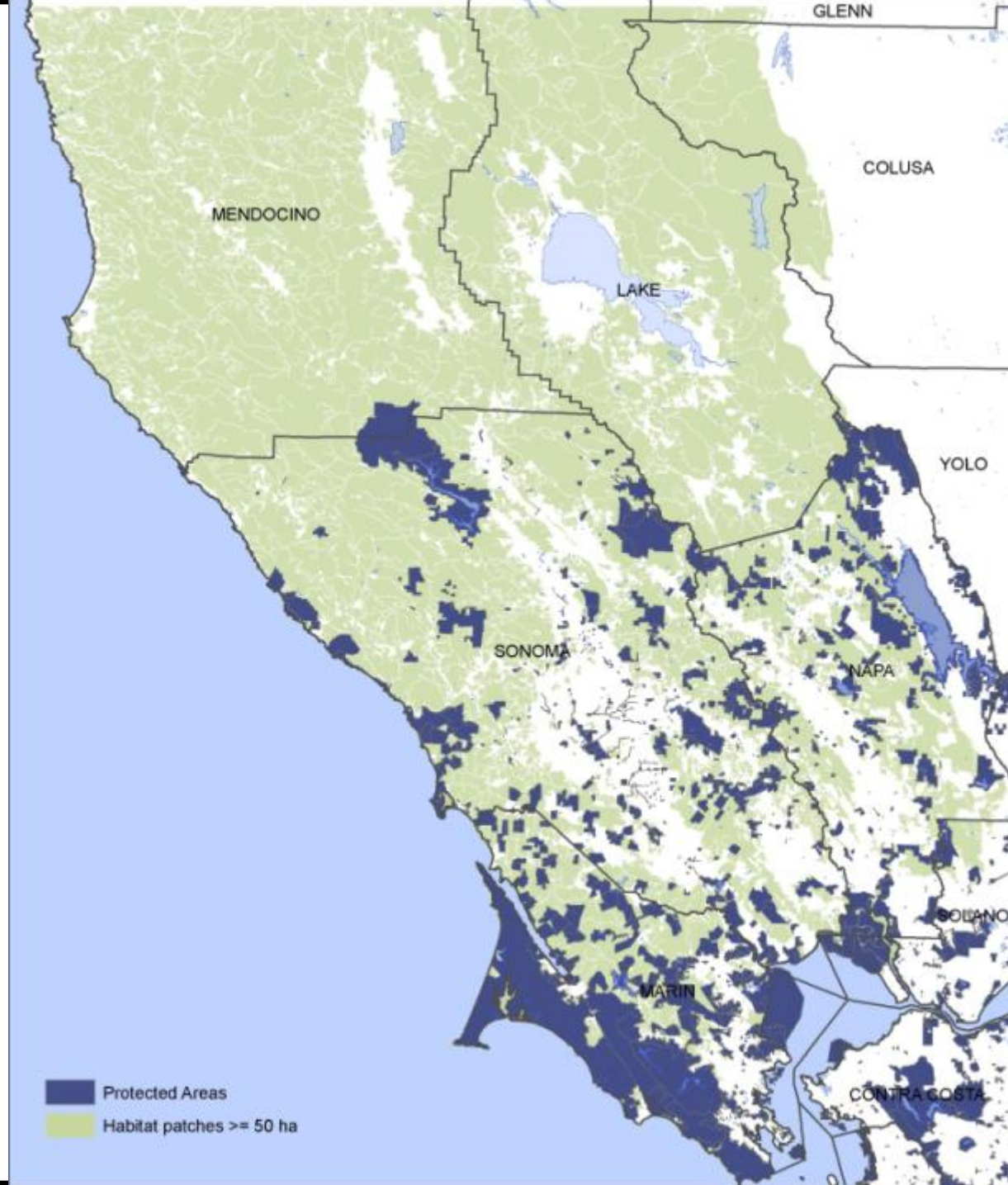
38°40′9.663″N 122°37′59.948″W

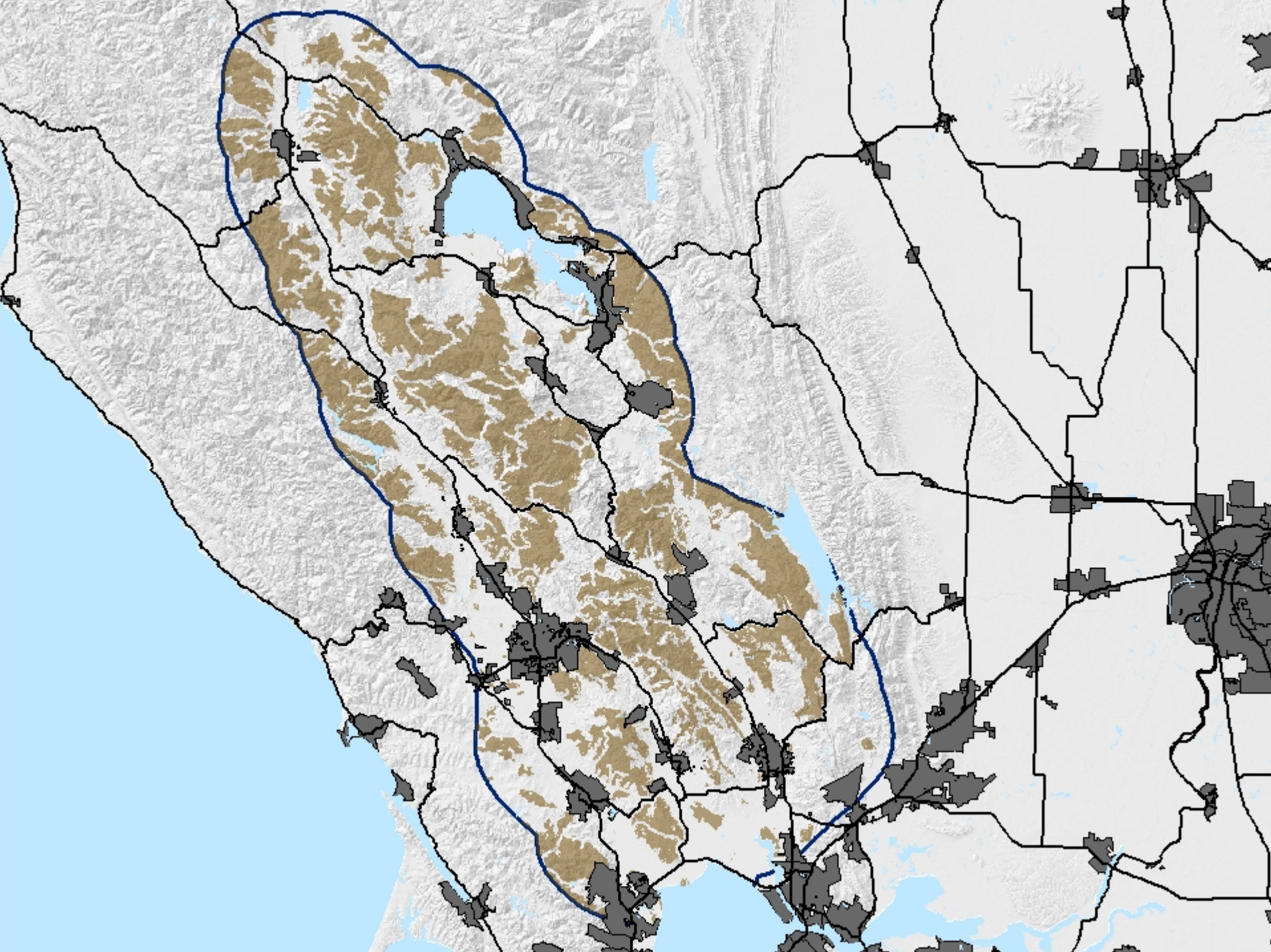
Native people: Wappo and Pomo

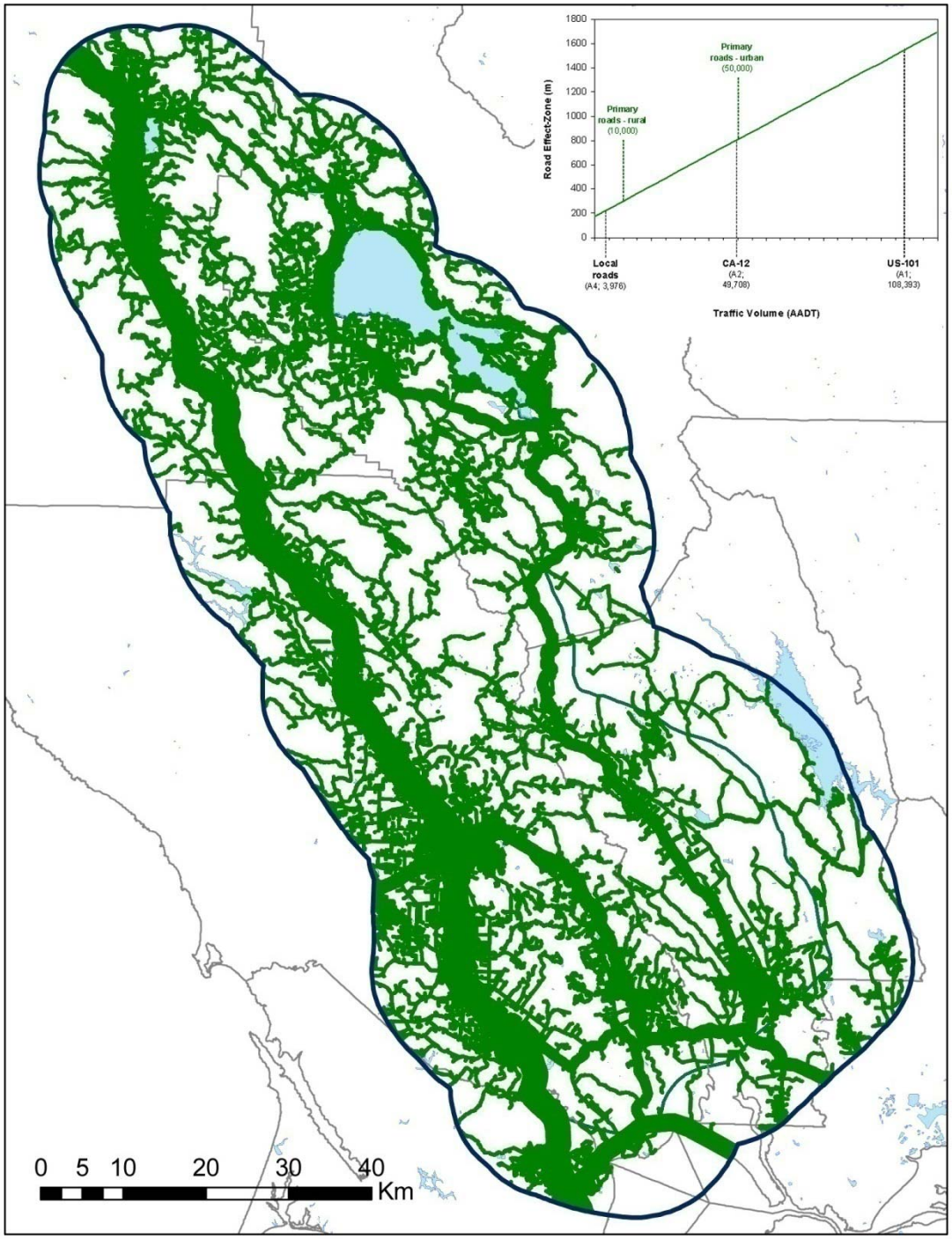
Funded by: Community Foundation So. Co. & So. Co. Ag. Preservation & Open Space District

Which patches are core habitat?

Protected areas



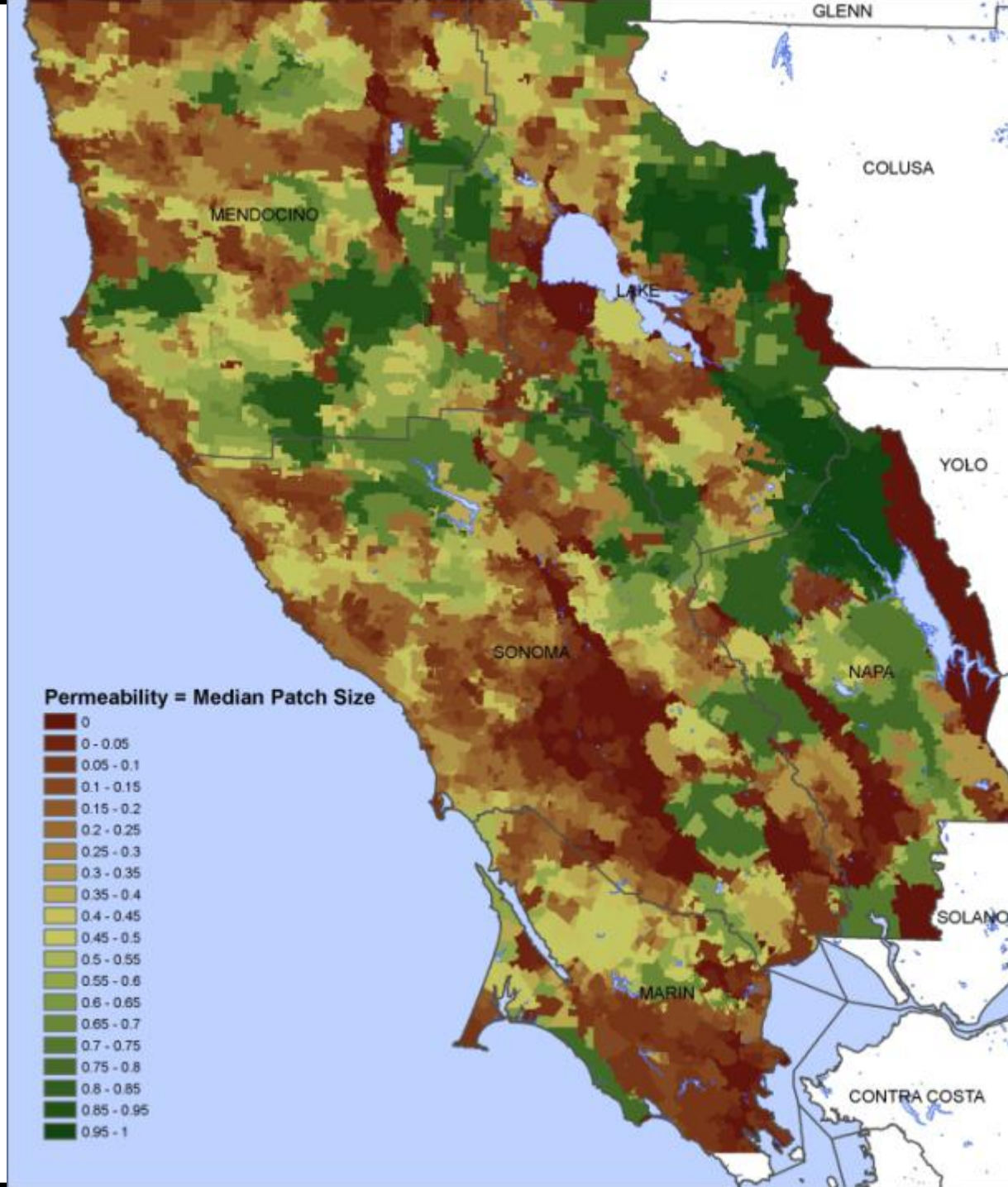


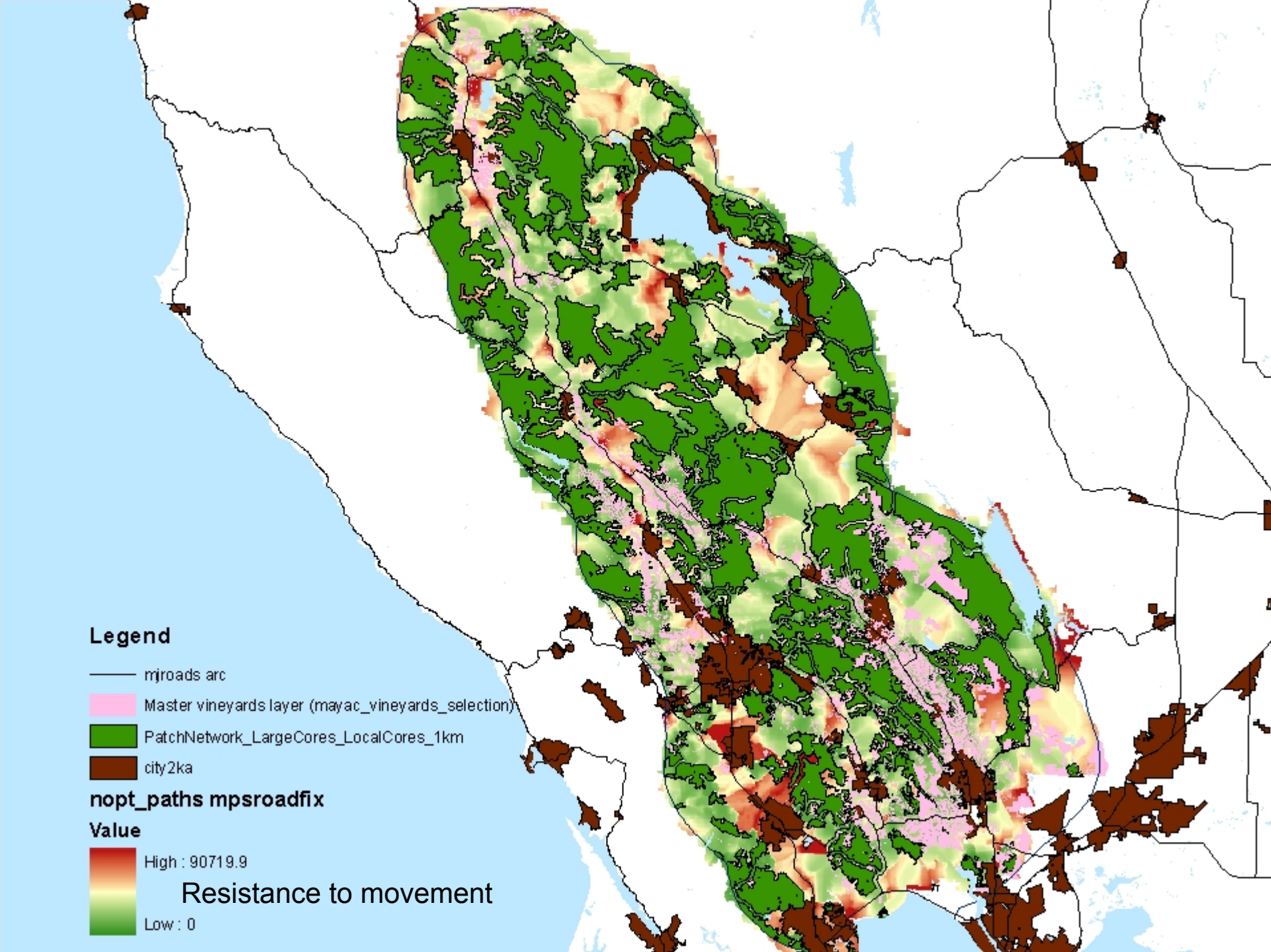

1800
1600
1400
1200
1000
800
600
400
200
0
Road Effect Zone (m)
Primary roads - urban (50,000)
Primary roads - rural (10,000)
Local roads (A4; 3,976)
CA-12 (A2; 49,708)
US-101 (A1; 108,393)
Traffic Volume (AADT)
0 5 10 20 30 40
Km

What factors affect permeability?

Habitat integrity (MPS)

c **Median Patch Size:**




Legend
mjroads arc
Master vineyards layer (mayac_vineyards_selection)
PatchNetwork_LargeCores_LocalCores_1km
city2ka
nopt_paths mpsroadfix
Value
High : 90719.9
Low : 0
Resistance to movement

Compare structural models with focal species rule-based models

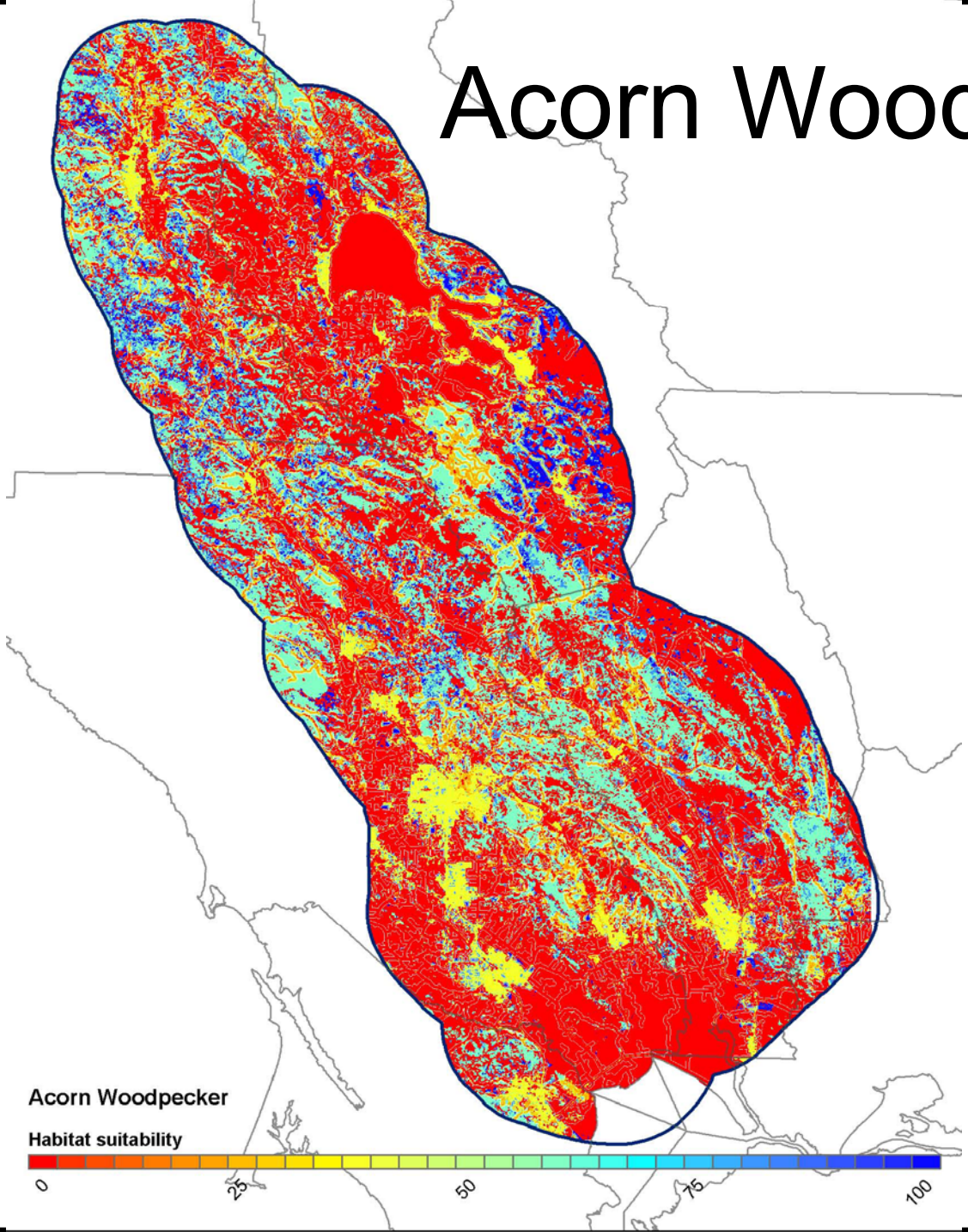
Methods

- "Habitat suitability" for each selected species following the methods defined by Paul Beier and colleagues (South Coast Missing Linkages Corridor-Designer)
- These species "cost" layers will be used for graph analysis (funncon) and compared to structural models.

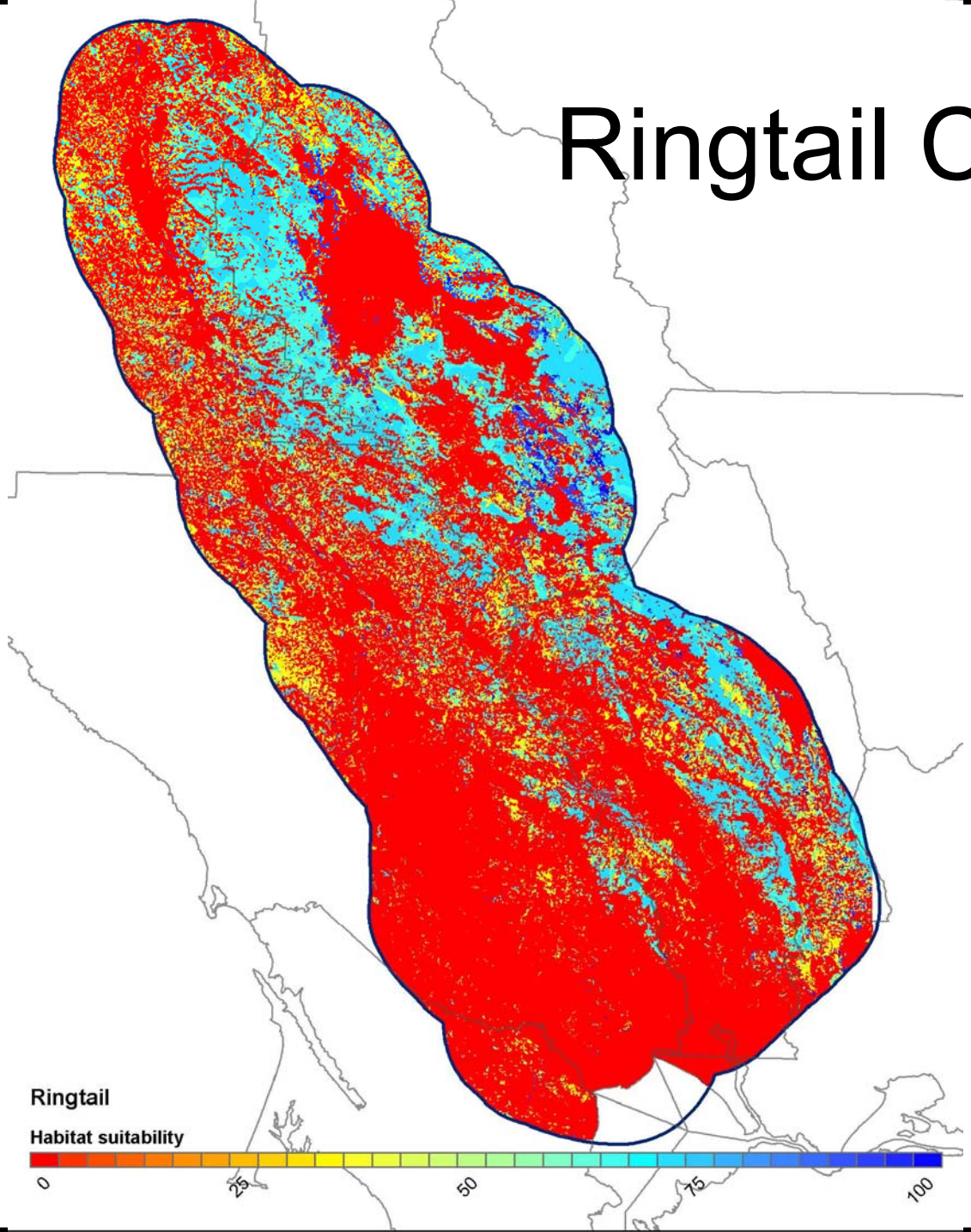
Species

Black bear
Mountain lion
Grey fox
Ringtail
California ground squirrel
Pallid bat
Townsend's big-eared bat
Spotted owl
Purple martin
Orange-crowned warbler
Acorn woodpecker
Northwestern pond turtle

Acorn Woodpecker

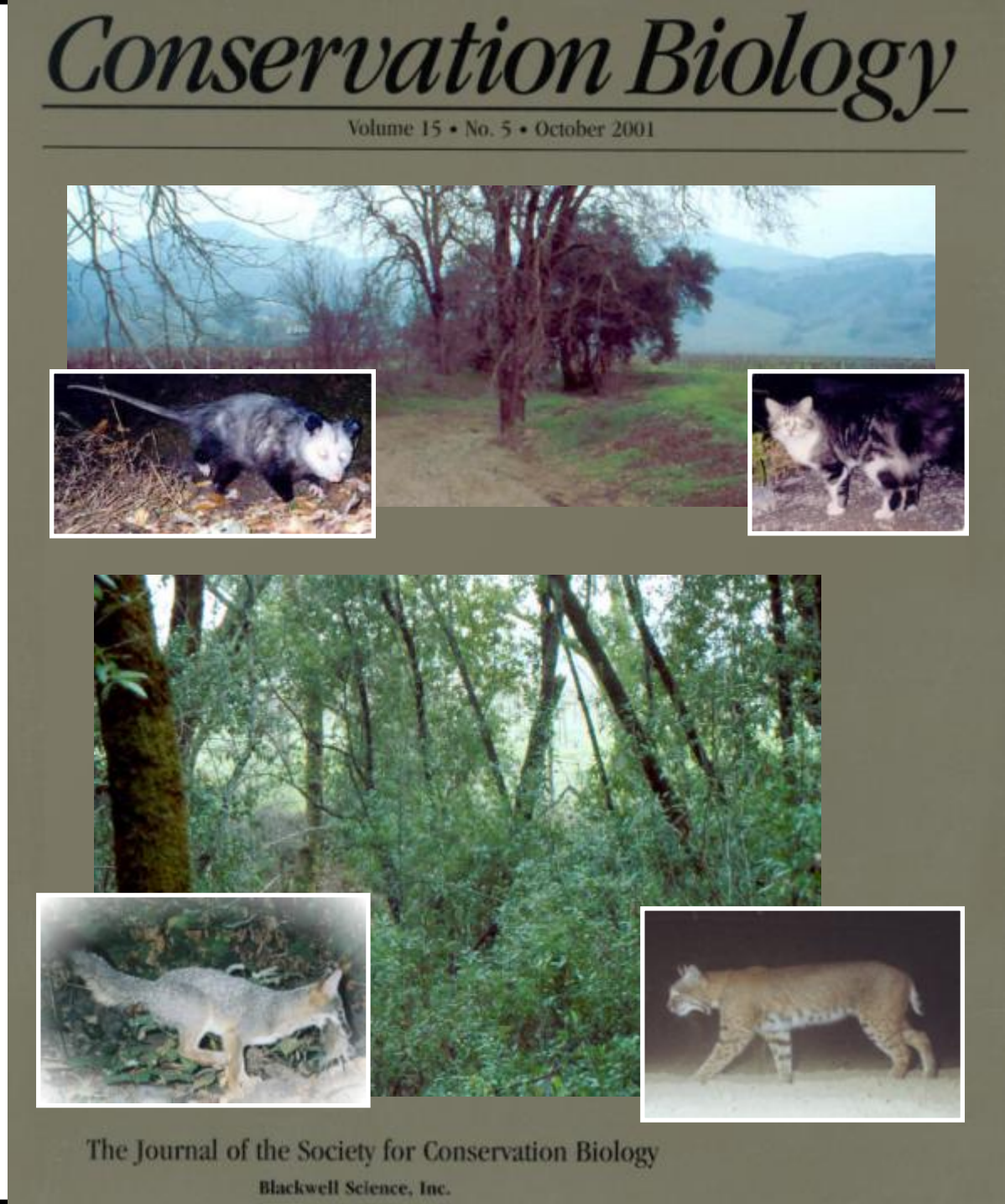


Ringtail Cat



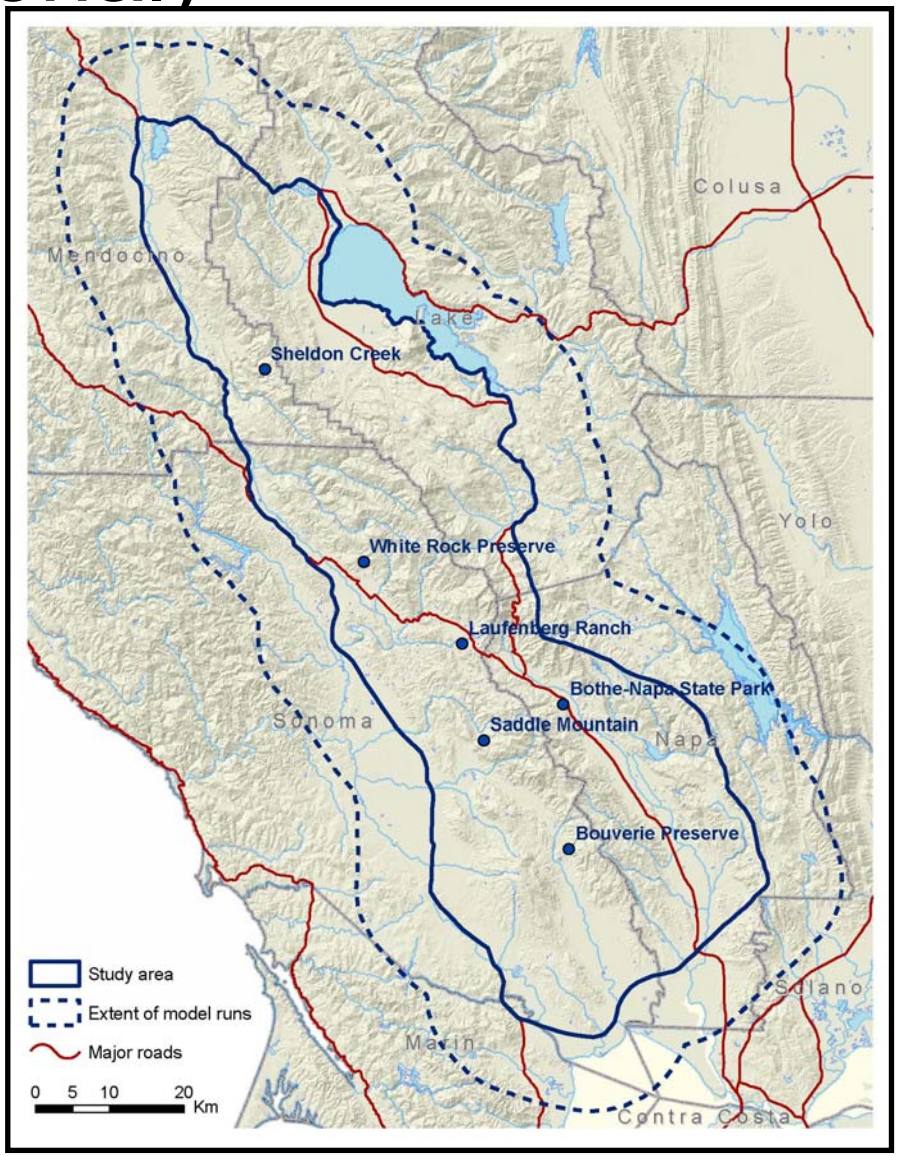
Do presumptive corridors actually serve as a conduits for movement of organisms (functional connectivity)?

HILTY, J. A. and A. M. MERENLENDER. 2004. Use of riparian corridors and vineyards by mammalian predators in Northern California. **Conservation Biology 18(1):126-135.**

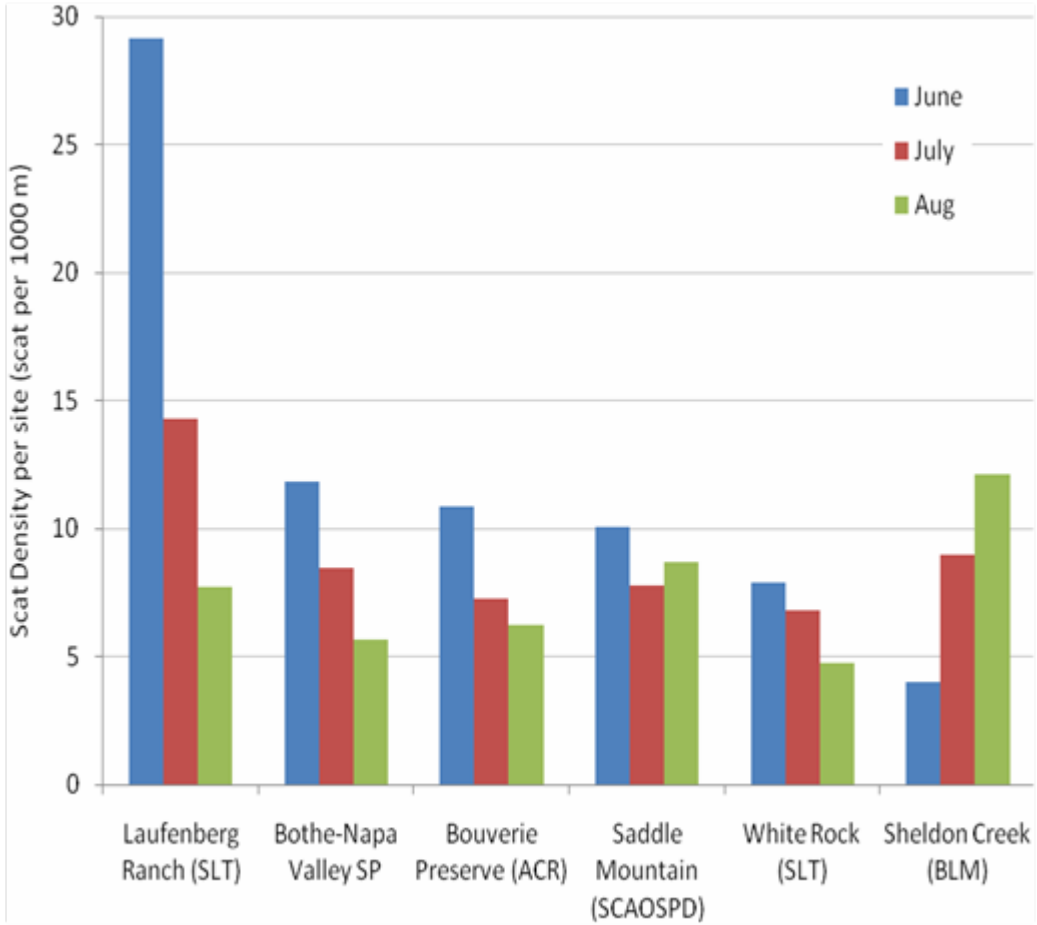


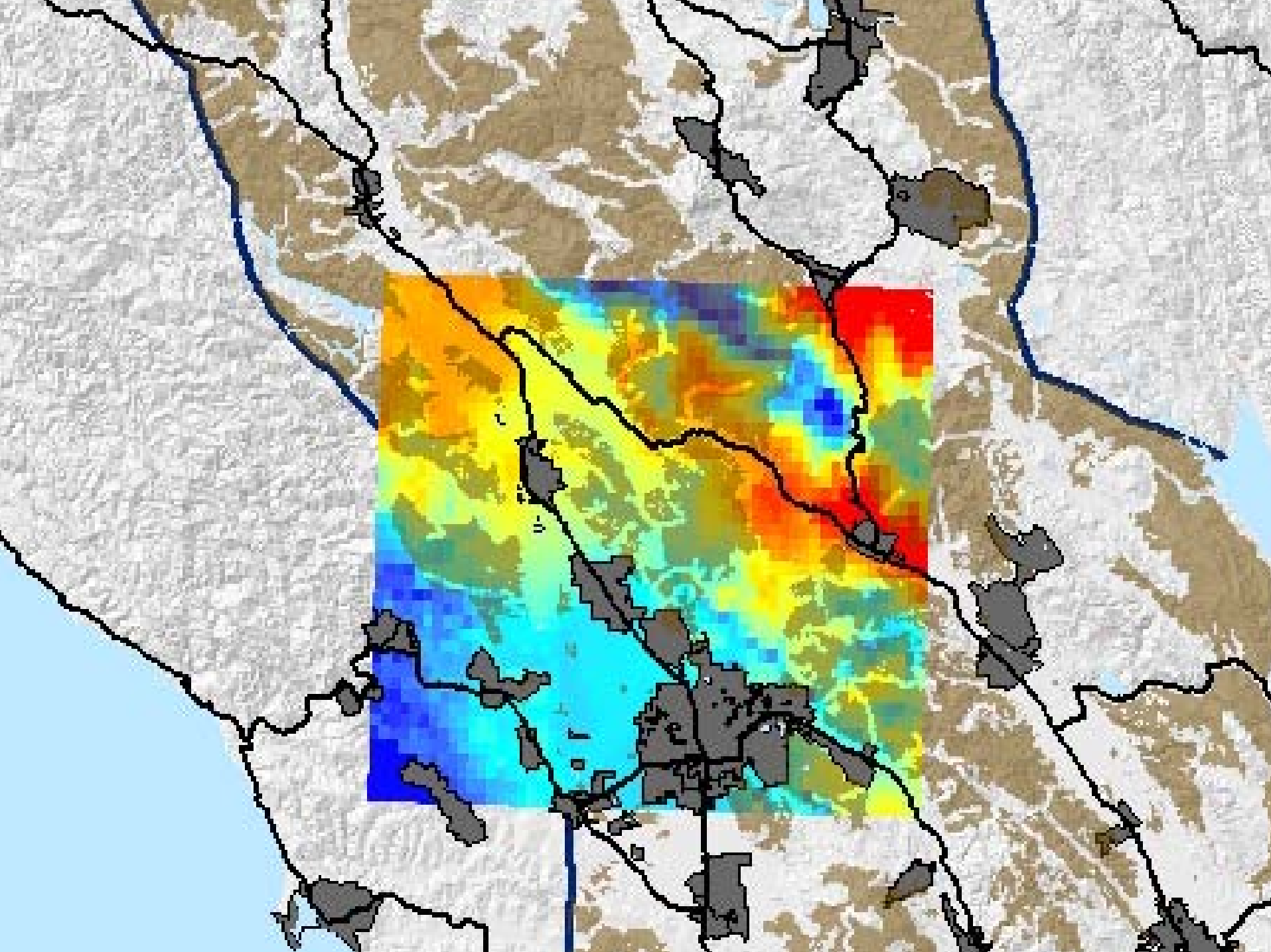
Assessment and validation (functional)

- Evaluate site characteristics and quality on the ground
- Survey animals and plants



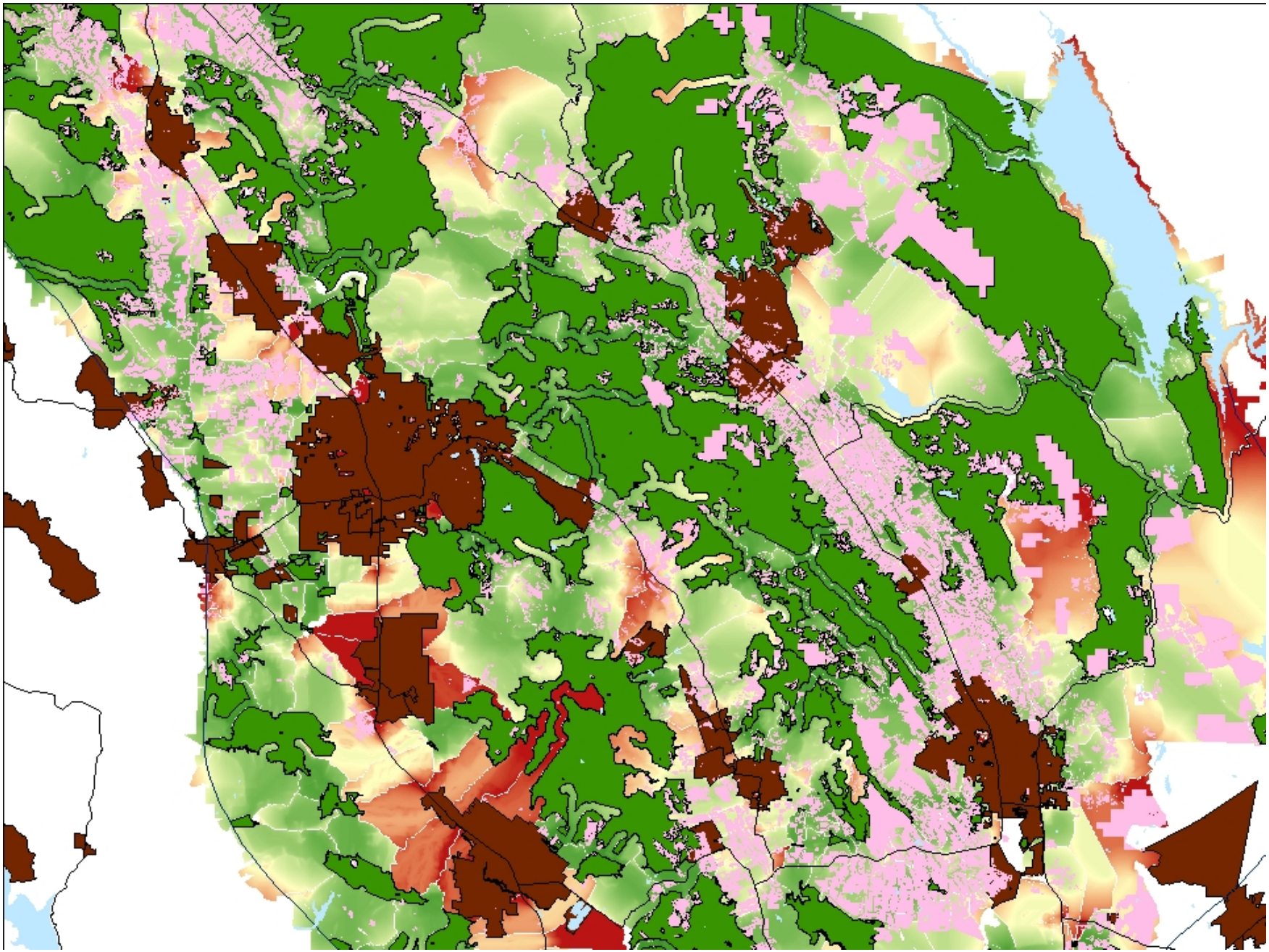
Pilot Field Studies





Merenlender Lab

http://nature.berkeley.edu/Merenlender



Targeting connectivity priorities

- probability of loss x **biodiversity benefit** / cost
  - to minimize the expected loss in benefits per unit cost, resulting in a more efficient allocation of conservation funds

- Use land use change models for estimating threat (prob. of loss)
- Use land valuation models for cost

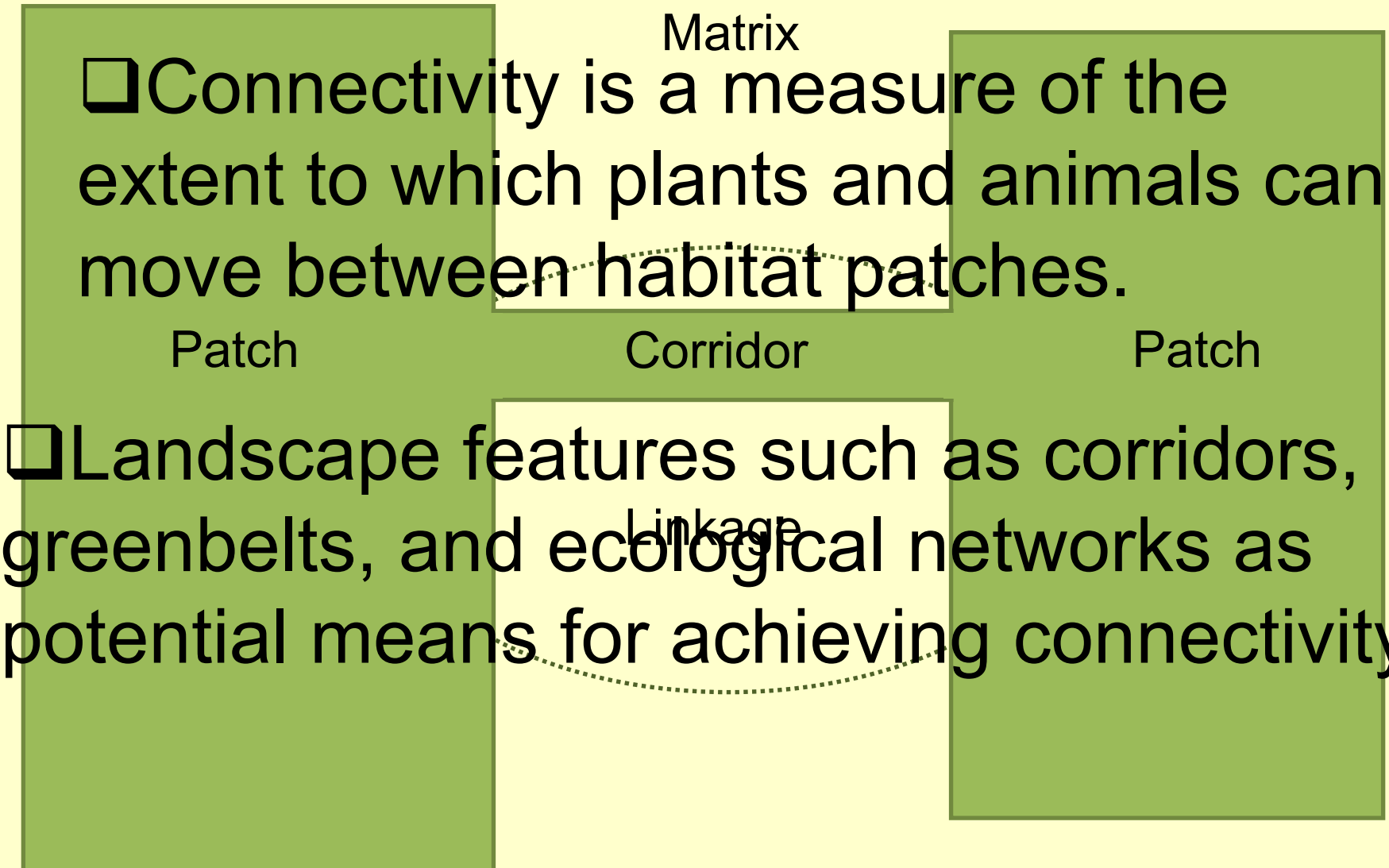
NEWBURN, D., REED, S., BERCK, P. and A. M. MERENLENDER. 2005. Economics and land-use change in prioritizing private land conservation. **Conservation Biology, 19(5):1411-1420**

NEWBURN, D., BERCK, P., and A. M. MERENLENDER 2006 Habitat and Open Space At Risk of Land-Use Conversion: Targeting Strategies for Land Conservation American **Journal of Agricultural Economics 88(1):28-42**

Future directions for connectivity science

- Integrate connectivity (landscape ecology) with community and macro-ecology
  - Spatially explicit metapopulation models
    - Replace least cost path with Euclidean distance (Chardon et al 2003; Verbeylen et al 2003)
  - biodiversity scaling metrics (macroecology)
    - MaxExt and other null theories (John Harte et al. 2008)
    - Ecological drift (Hubbell “Unified Neutral Theory”)
- Moving away from “patch-matrix” and focusing on maximizing continuous permeability
- Address climate variability over space and time to make reserve networks more resilient to climate change.

Connectivity and corridors?



- Connectivity is a measure of the extent to which plants and animals can move between habitat patches.
- Landscape features such as corridors, greenbelts, and ecological networks as potential means for achieving connectivity.

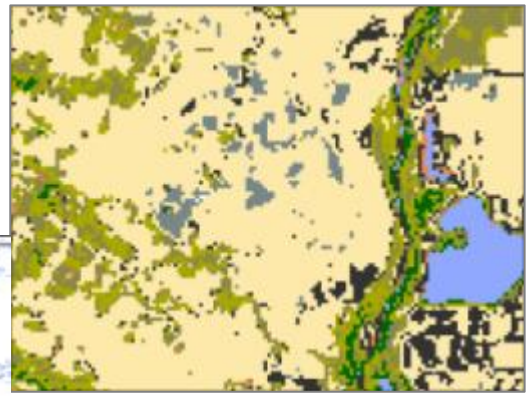
Methods in landscape ecology to identify potential corridors

- Structural
  - Habitat vs non-habitat
  - Graph theory
- Functional
  - Focal species modeling
  - Habitat suitability
  - Simulate movement

What counts as habitat?

Land cover (*natural vegetation present*)

+ Land use (*human disturbance absent*)

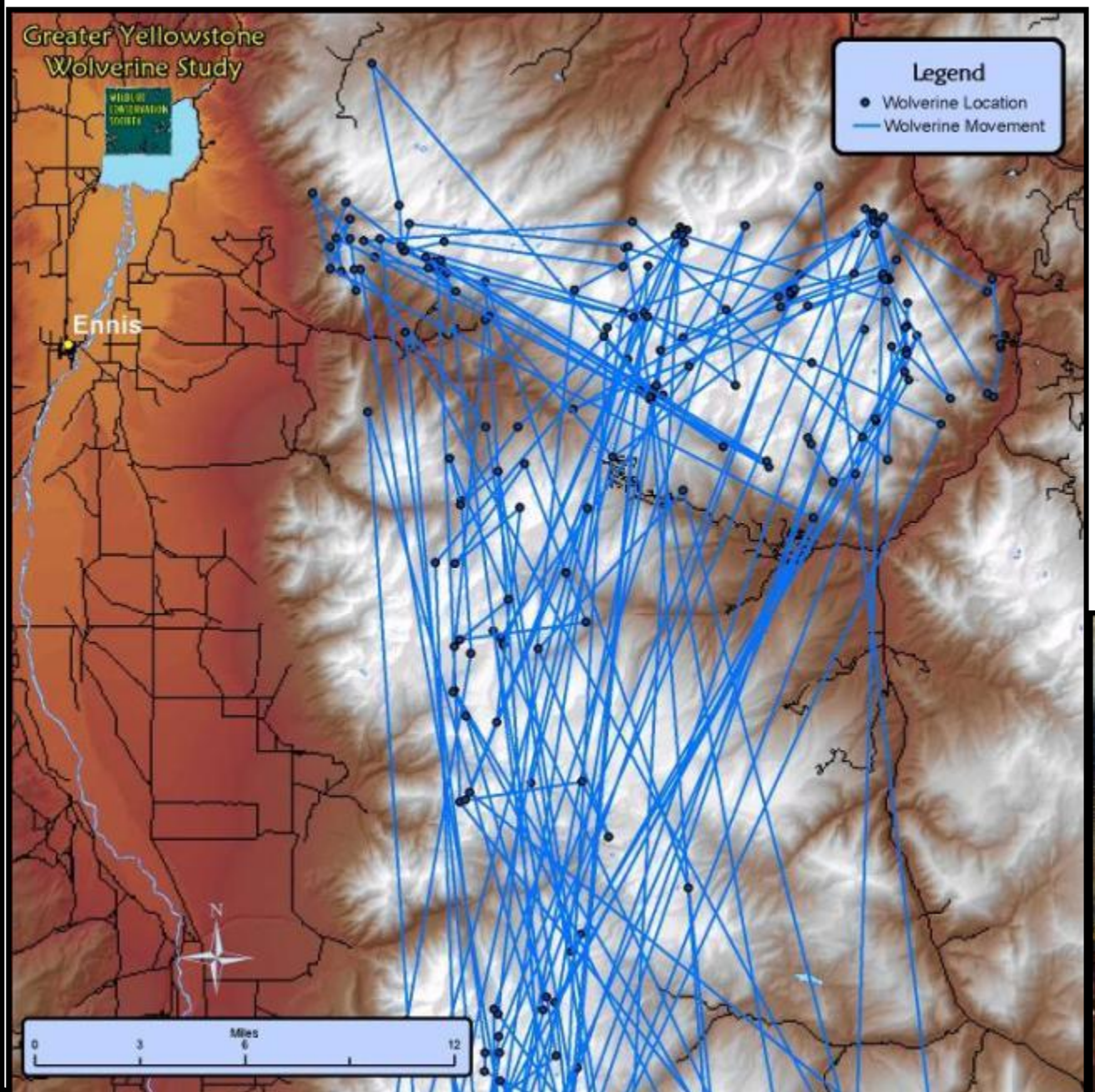


Vegetation classification

Land use codes

Combined classification

Focal species occurrences



Key questions:

1) How to identify core habitat patches?

2) What affects landscape permeability or cost of moving through the landscape?