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## Western Ecological Research Center

## *Publication Brief for Resource Managers*


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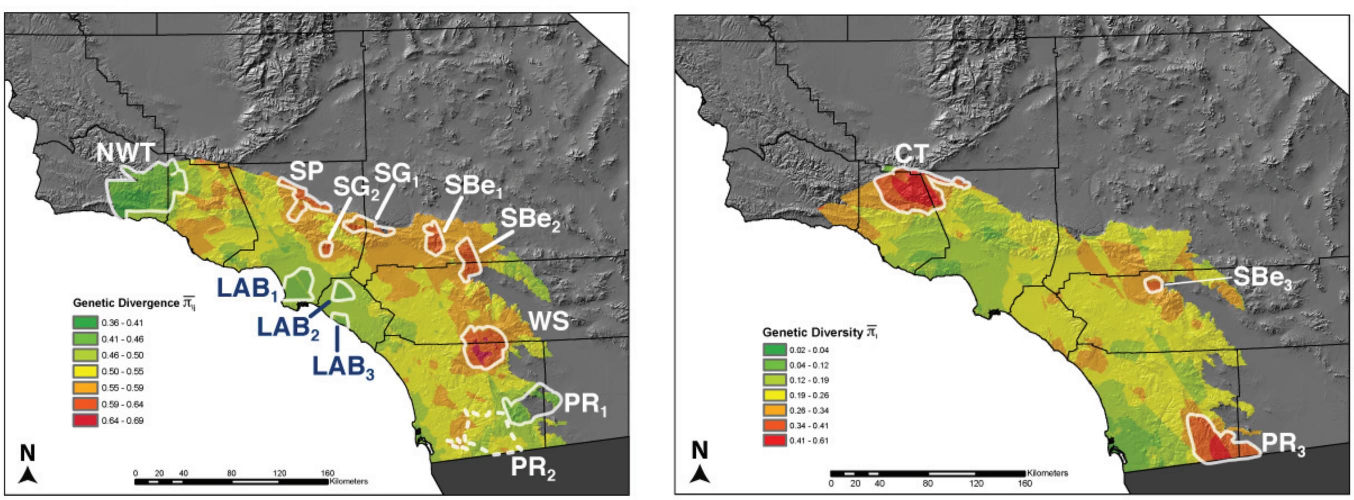
# Evolutionary Hotspots for Conservation Planning in Southern California

Effective biodiversity conservation is centered around the identification, protection and management of a reserve system at the level of the landscape. Reserves are most often designed to protect either rare habitats or typical exemplars of ecoregions and geomorphic provinces. These criteria focus on current patterns of organismal and ecosystem-level biodiversity, rather than the evolutionary processes that control the gain and loss of biodiversity at these and other levels (e.g., genetic, ecological). To add evolutionary processes to the list of criteria that are used in land-based conservation efforts, their spatial components must first be identified and mapped.

As a first approximation, the potential for many evolutionary processes may be estimated by examining the spatial distribution of genetic variability within species.

### Management Implications:

- The multi-species genetic landscape approach provides an avenue to incorporate evolutionary process into GIS-based conservation assessments and land-use planning efforts.
- Five geographic regions in southern California contain evolutionary hotspots that require additional consideration in terms of protection: 1) the Sierra Pelona, 2) the San Bernardino Mountains, 3) the Los Angeles Basin, 4) Warner Springs, and 5) the southern Peninsular Ranges.
- With the exception of the Los Angeles Basin, most of these unprotected hotspots remain relatively undeveloped, but may be threatened by future development pressures.




Multi-species genetic landscapes for genetic divergence and diversity across the southern California coastal ecoregion. Regions of extremely high or low divergence and high diversity are circled and abbreviated as follows: NWT = northwestern Transverse Range; SP = Sierra Pelona Mountains; SG = San Gabriel Mountains; SBe = San Bernardino Mountains; WS = Warner Springs; LAB = Los Angeles Basin; PR = southern Penninsular Range; CT = Central Transverse Range.

Areas that retain adequate genetic variability are more likely to facilitate both adaptive and nonadaptive evolution as the environment changes. By studying concordance in landscape genetic patterns among multiple species, it is possible to identify the geological and ecological processes that have shaped contemporary diversity patterns, and map their geographic locations (evolutionary hotspots). USGS scientists Amy Vandergast, Stacie Hathaway and Robert Fisher, and colleagues Andrew Bohonak and Joshua Boys (San Diego State University) have developed a novel GIS-based comparative genetic approach for explicitly mapping patterns of genetic divergence and diversity for multiple species. Their study of "multi-species genetic landscapes" is published in a recent issue of *Biological Conservation*.

In a Geographic Information Systems (GIS) framework, the authors analyzed mitochondrial DNA sequence datasets from 21 vertebrate and invertebrate species from southern California to identify areas with common patterns of genetic divergence or high genetic diversity. The multi-species genetic landscape approach pinpointed six geographic areas where interpopulation genetic divergence is high, five areas where interpopulation genetic connectivity is high, and three areas where intrapopulation genetic diversity is high. Using a newly constructed GIS overlay of lands that are protected by various landowners, the authors highlighted five regions that contain evolutionary hotspots that are largely unprotected.

Multi-species maps of complex genetic diversity patterns provide a powerful tool for land-based conservation applications. Spatial concordance among genetic patterns allows identification of regions where common evolutionary processes are likely to have impacted entire faunal groups in the past, and where the potential for future evolutionary change is high. The consideration of evolutionary hotspots should complement other criteria when selecting lands for reserves (e.g., species richness and diversity, complementarity, land availability, restoration potential).

*Vandergast, A. G., A. J. Bohonak, S. A. Hathaway, J. Boys and R. N. Fisher. 2008. Are hotspots of evolutionary potential adequately protected in southern California? Biological Conservation 141:1648–1664.*