Mediterranean Coast Network
Research Project Summary
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MEDN Climate Change Vulnerability Assessments

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ABSTRACT
To aid the National Park Service in protecting the native fauna of the Mediterranean Coast Network (MEDN), we conducted climate change vulnerability assessments for 60 terrestrial and freshwater species at Channel Islands National Park (CHIS), Cabrillo National Monument (CABR) and Santa Monica Mountains National Recreation Area (SAMO). **Native species were more vulnerable to climate change than non-natives, and federally threatened/endangered species were more vulnerable than unlisted native species.** Marine species were beyond the scope of the ecological response model that was used, and insufficient life history information excluded plants and invertebrates from this study.

Figure 1. *Urocyon littoralis* (island fox). Photo: NPS. *U. l. santarosae* (Santa Rosa Island fox) is federally endangered and scored Extremely Vulnerable.

BACKGROUND
To preserve biodiversity in the 21st century we must understand how changes in the physical environment will differentially alter species fitness. Climate change is expected to increase temperatures in the entire MEDN by mid-century, and decrease moisture in most of it (Table 1).

Management Implications

- Preventing the loss of native species (amphibians especially) will prove even more difficult with climate change.
- Threatened and endangered species require still more attention.
- Additional natural history information for plants and invertebrates is critically needed.
- Dispersal ability, barriers to movement, and sea level rise were the most important factors in assessing vulnerability, underscoring the importance of protecting and creating habitat linkages.

METHODS
This study used NatureServe's Climate Change Vulnerability Index, which incorporates modeled future temperature and moisture change, as well as species life history data. Species lists were obtained for each park, stratified by nativity classification, and further stratified by taxonomic group (amphibian, bird, freshwater fish, mammal, and reptile). A total of 46 species were then randomly and proportionally selected from each stratum.

Fourteen additional species—including seven federally threatened or endangered—were assessed to account for underrepresented groups. Eight species selected occurred in two parks and were separately assessed in each park. Every species was assessed independently by two team members. Out of five possible vulnerability scores (Extremely Vulnerable, Highly Vulnerable, Moderately Vulnerable, Presumed Stable, and

Increase Likely), the score pairs were in agreement >75% of the time, and were never more than one score apart. Where scores differed, a composite score was assigned (e.g. Highly-Moderately Vulnerable).

RESULTS

Native species were more vulnerable to climate change (T-test; $p < .01$), with 38% of natives scoring either MV or MV-PS, and all non-natives scoring PS. From greatest to least, the order of taxonomic groups by average native vulnerability score was: amphibian, reptile, mammal, and bird. The seven federally threatened or endangered species were more vulnerable than the remaining 46 native, unlisted species (Mann-Whitney test; $p < .001$). Average vulnerabilities of native species were greatest in CHIS and least in SAMO; however, park comparisons are limited due to differences in the emissions scenarios modeled (only A2 scenario data was available for CHIS).

Table 1. Climate model settings and outputs.

		Parks	
		SAMO & CABR	*CHIS*
Settings	*General Circulation Models*	Ensemble average of 16 from IPCC AR4	MPI ECHAM5, USGS GENMOM, and GFDL CM2.0
	Emissions Scenario	A1B (medium)	A2 (high)
	Resolution	12 km	15 km
	Past Time Period	1961–1990	1968–1990
	Future Time Period	2040–2069	2040–2069
Outputs	*Temperature Increase*	3.9–4.4	1.5–2.0
	Moisture Decrease (%)	2.8–5.0 & 7.4–9.6	–1.0–12.0 (some areas showed moisture increases of 1%)

Table 2 lists the most vulnerable species. *Sturnus vulgaris* (European starling) in CABR was the least vulnerable species, receiving a score of Presumed Stable-Increase Likely. Between parks, duplicate species did not vary in vulnerability by more than half a score.

DISCUSSION

Together, 4 of the 28 climate sensitivity and exposure factors accounted for 75% of the vulnerability score variability in the 136 assessments (multivariate regression; $R^2 = .75$; $p << .001$). The four factors were: dispersal ability, sea level rise, confinement by anthropogenic barriers, and confinement by natural barriers. These findings underscore the importance of creating and maintaining habitat linkages that allow migrating animals to track moving climate envelopes. Results also support the need to consider assisted migration strategies.

Table 2. List of the most vulnerable species.

Species	Vulnerability Score
Urocyon littoralis santarosae (Santa Rosa Island fox)	Extremely Vulnerable
Batrachoseps pacificus (pacific slender salamander)	
Charadrius alexandrinus nivosus (western snowy plover)	Extremely Vulnerable-Highly Vulnerable
Rana draytonii (California red-legged frog)	Highly Vulnerable
Gila orcuttii (Arroyo chub)	Highly Vulnerable-Moderately Vulnerable
Polioptila californica (coastal California gnatcatcher)	
Xantusia riversiana (island night lizard)	

Plants and invertebrates were not included in this study because available information about their life histories was insufficient to complete a single assessment. Further research on these species, which comprise the bulk of ecosystem biomass, is needed to more fully understand potential climate change impacts to the Mediterranean Coast Network of parks.

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