Species Delimitation in a Biodiversity Hotspot: Evolutionary History of the Ringneck Snake
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Earth's biodiversity is in trouble. Global changes, from habitat loss and invasive species to anthropogenic climate change, have initiated the sixth great mass extinction event in Earth's history. Conservation management is compromised by the absence of information on what species exist, abundance, ecology, and biogeography and has a direct impact on how state and federal governments utilize limited funding. The California Floristic Province (CFP) (Fig. 1) is a "biodiversity hotspot" containing more than 1500 endemic vascular plant species and greater than 70% habitat loss. Biodiversity hotspots face the highest threats because their resources and species cannot be replicated or found in any other regions on the planet. Studies of widespread species throughout the CFP have inferred pronounced fine-scale genetic differences among populations resulting from the adaptation to local environment. Since species are fundamental units of study, inaccurate assessments of species diversity may lead to errors in analyses that use species as units and hinder conservation efforts. Throughout California, seven sub-species have been traditionally recognized within the ringneck snake genus Diadophis based on morphological characters. Recent molecular studies using mitochondrial DNA recognized three distinct lineages within the CFP, leading many herpetologists to abandon the traditional morphologically-based subspecies. In this study, we take an integrative approach to species delimitation by combining genetic, morphological, and ecological data to assess the species diversity within the ringneck snake genus Diadophis distributed throughout the California Floristic Province. We utilized present-day climate models to project changes in endemic species' range sizes, distribution, and diversity under future climate scenarios. Our results provide new insights into the biodiversity of Diadophis within the CFP and identify potential future range contractions or shifts due to climate change. These results can be used to inform conservation status assessments, prioritize habitat reserves, corridors, and essential microrefugia for conservation.