

# Grazing for Biodiversity in Californian Mediterranean Grasslands

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## On the Ground

- California's Mediterranean climate zone supports grasslands that are biologically diverse.
- Livestock grazing is being increasingly used to promote native species diversity at both the pasture and landscape scales.
- Several federally and state-listed vertebrates and insects respond positively to grazing to improve habitat by opening and lowering grassland vegetation. More work is needed on enhancement of native plants.
- Research results need to be more extensively applied, tested, and monitored under variable conditions.

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California's diverse environments contribute to its status as an internationally recognized biodiversity hotspot (see Box 1) with more than 4,800 native plants, 29% of which are endemic to the state. Approximately 1,000 native vertebrates occur in the state, including 125 federally or state-listed species.<sup>1</sup> The environments of Pleistocene Epoch, which began 1.8 million years ago and ended 10,000 years ago, were profoundly different from the prior 50 million years. More than 20 ice ages with associated ice caps and much lower sea levels dominated this epoch 90% of the time, alternating with short interglacial periods such as the present, which would be at an end soon except for anthropogenic global warming. California's ice-age climates supported more conifer forests, and although glaciation was extensive in the mountains and the rest of North America, much of California was an ice-free refugium for

grassland and savanna plants and animals. Many of the surviving plant and animal taxa date from the origin of the true Mediterranean climate about two million years ago.<sup>2</sup> California's endemic blue oak (*Quercus douglasii* Hook. & Arn.), for example, likely retreated to small areas during the long glacial periods, then spread out with warming and became the most widespread and abundant savanna oak only during the past 10,000 years.

Californian rangelands during the Pleistocene supported a diverse fauna of grazing and browsing vertebrates, including camels, ground sloths, mammoths, mastodons, peccaries, and deer. We know that their numbers were high enough to support large populations of predators such as the North American lion, saber-toothed cat, short-faced bear, and dire wolf, as well as many scavengers such as numerous vulture species. These representatives of ice-age Pleistocene biodiversity survived many previous interglacials but not the Holocene. The oaks persisted, but only a handful of the large vertebrates did, including humans (*Homo sapiens* L.), who had joined the list about 14,000 years ago and may have contributed to the extinctions. Grazing pressure and native herbivore diversity both peaked during the most recent Pleistocene ice age, decreasing dramatically when humans arrived and the ice retreated 10,000 years ago. Native diversity in California decreased again with European settlement and the introduction of livestock and alien plants starting in 1769. The few remaining native vertebrate herbivores such as Tule elk (*Cervus elaphus nannodes* Merriam), pronghorn (*Antilocapra americana* Ord), and ground squirrels (*Spermophilus* spp.) were eliminated or reduced; the California grizzly (*Ursus arctos californicus* Merriam) and wolf (*Canis lupus* L.) were trapped, poisoned, and hunted to extinction; and alien plants spread rapidly. The evaluation of managed grazing effects on native species diversity should be viewed against this dramatic, intricate, and relatively recent background of changes in climate, human impacts, and grazing animals.

In this paper we examine the relationships between grazing and native species biodiversity for selected taxa, groups of species, or communities. For each example, we provide a brief

## California's Mediterranean-Type Grasslands: A Hotspot of Biodiversity

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Listed below are national and international reports recognizing California's Mediterranean-type grasslands as among the world's "hotspots" of native species rarity and richness, despite their general dominance by non-native species. Appreciating this paradox can aid communication between conservation biologists, environmental regulators, and ranchers about managing California rangelands for conservation and sustainable development.

Description	Source
<b>1. Designation of California grasslands among world hotspots</b>	
The six recognized hotspots of highest native species rarity and richness in the United States include two regions of California within the Mediterranean climate zone (the San Francisco Bay area and the coastal and interior Southern California hotspots) that support grasslands.	Stein, Kutner, and Adams 2000 <sup>18</sup>
The California Floristic Province ranks among the world's 25 hotspots of biodiversity for richness of native plants and vertebrate species and endemism and risk of extinction.	Myers et al. 2000 <sup>19</sup>
California's native grasslands rank among the 21 most-endangered ecosystems in the United States. The native prairies, other grasslands, and savannas, including those in California, are the most reduced ecosystems in terms of acres lost since European settlement.	Noss and Peters 1995 <sup>20</sup>
<b>2. Temperate grassland biomes endangered</b>	
Temperate grasslands and savannas are among the world's biomes that have suffered the most extensive habitat loss in terms of percent converted and are critically endangered (the highest crisis ranking).	Hoekstra et al. 2005, <sup>21</sup> Peart 2008 <sup>22</sup>
<b>3. California grassland biodiversity statistics</b>	
Currently 75 California grassland-associated native species, including 10 vertebrates, 14 invertebrates, and 51 plants, are listed as threatened or endangered under the federal Endangered Species Act.	Jantz et al. 2007 <sup>23</sup>
The numbers of native animals and plants with federal, state, and/or other special status associated with California grasslands include 23 mammals, 18 birds, 9 amphibians, 5 reptiles, 46 invertebrates, and 479 plants (2006 data from California Natural Diversity Database and the California Native Plant Society's Electronic Inventory of Rare and Endangered Vascular Plants of California).	L.D. Ford, personal communication
California's hardwood rangelands (including grasslands) provide habitat for more than 300 vertebrate wildlife species, more than 2,000 plant species, and ~5,000 insect species.	Standiford, Klein, and Garrison 1996 <sup>24</sup>
<b>4. California habitat structural diversity and connectivity</b>	
Grassland habitat structure affects diversity of micro-habitats available for different native animals and plants, including critical host plants, prey, and bare ground. As examples, the endangered Ohlone tiger beetle requires bare or sparsely vegetated soil surfaces for larval burrows, feeding, and adult mating and ovipositing, which can be maintained by grazing; and the threatened Bay checkerspot and other butterflies require host plants in openings that are maintained by grazing.	Knisely and Arnold 2013; <sup>11</sup> Weiss, Wright, and Niederer 2007 <sup>25</sup>
Grassland use changes, such as reduction or abandonment of livestock grazing on grasslands, reduced frequency of wildfire, reduced rancher stewardship, roadside pesticide use and scraping, and intensification of nearby agriculture, can reduce habitat diversity for native grassland species and lead to natural succession to woody vegetation; a useful indicator of grassland biodiversity is butterflies and other invertebrates that respond readily to changes in the structure of grassland habitat.	European Environment Agency 2013 <sup>26</sup>
Habitat connectivity between undeveloped grassland sites in the highly developed San Francisco Bay region is a critical objective for the conservation of viable populations of numerous grassland dependent special-status species.	Penrod et al. 2013 <sup>27</sup>

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