

ECOSYSTEMS OF CALIFORNIA: THREATS & RESPONSES

Supplement for Decision-Making

EDITED BY HAROLD MOONEY AND ERIKA ZAVALETA



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Grasslands

VALERIE T. EVINER



Grasslands are one of the most altered ecosystems in California, with nonnative plant species comprising more than 90 percent of plant cover in most areas. Despite this, California's grasslands are a diversity hot spot, averaging greater than fifty plant species per 30-by-30 meter area and providing habitat for nearly 90 percent of state-listed rare and endangered species and seventy-five federally listed plants and animals. They also provide 75 percent of the state's livestock forage, the main direct economic benefit from these systems. These grasslands are critical in regulating water flow (e.g., flood prevention, maintaining stream flow into the dry seasons) and water quality, and contribute significantly to regional soil carbon storage. Grasslands also support a large portion of the pollinators needed in California's cropping systems.

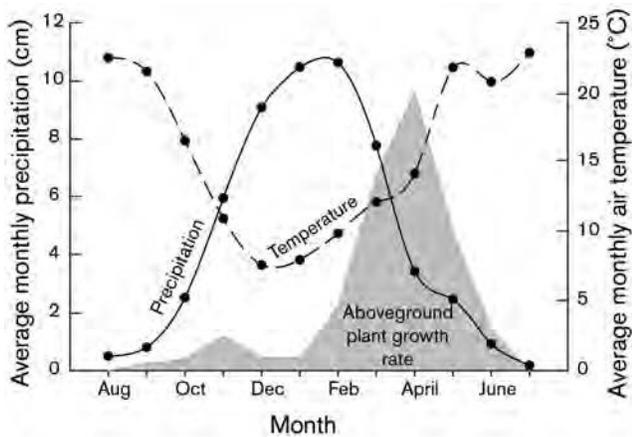
California's grasslands are distributed across a wide precipitation gradient, ranging from 12 to 200 centimeters per year. The drier interior grasslands tend to be dominated by nonnative annuals, while the wetter coastal grasslands tend to be dominated by a mix of native and nonnative perennials. Unique soil conditions (e.g., poor drainage, salinity, heavy metal toxicity) also define distinctive grassland types such as vernal pools, alkali sinks, and serpentine grasslands. Even within each of these grassland types, there is considerable variation in ecosystem structure and function, due to spatial and temporal variability in seasonal and annual weather patterns, topography, soil, disturbance regimes, and interactions among large herbivores, small mammals, insects, microbes, and plant communities. The predominance of annual species likely makes California's grasslands particularly

sensitive to intra-annual and interannual fluctuations in abiotic and biotic controllers.

The high variability in multiple controlling factors leads to both challenges and opportunities in land management. Successful management and policy will have to shift away from a one-size-fits-all approach and embrace the reality that different techniques and guiding principles are needed from site to site, due to variations in soil, topography, and weather. In addition, at a given site, management recommendations may vary from year to year, due to high weather fluctuations (see "Range Ecosystems"). Managers and scientists will need to collaborate on adaptive management approaches to understand how multiple environmental conditions interact to impact a given goal, while exploring the synergies and trade-offs associated with suites of species and ecosystem services needed from grasslands. The dominance of annuals over large areas of grasslands will require sustained management for many different goals but also provides a relative flexibility in "resetting" the system through adaptive management approaches.

Because 88 percent of California grasslands are privately owned, conservation and restoration of these grasslands largely depends on private landowners and how they balance management for livestock production, biotic diversity, and ecosystem services.

Currently, many ranchers actively manage grasslands to improve wildlife habitat, decrease noxious weeds, and enhance water quality.



Temperature and Precipitation in Parts of California

Seasonal variations in temperature (dashed line) and precipitation (solid line) drive plant growth rate (gray shaded area), with most production occurring when both moisture and ideal growing temperatures are present. Temperature and moisture data are from the California Irrigation Management Information System (CIMIS), averaged from 1985 through 2005 and across grassland sites, including: Sierra Foothills, San Joaquin Valley, Bay Area, Sacramento Valley, North Coast Valley, South Coast Valley, and Central Coast Valley. The left-side y-axis provides the precipitation scale, while the right-side y-axis represents the temperature scale. Aboveground growth rate is not present on either y-axis, but scales from 0 to 200 g/m²/month. Growth rate data is a seasonal average across experimental sites in the Central Valley and North Coast (Eviner, unpublished data). Source: Figure updated from Biswell 1956.

THREATS AND RESPONSES

THREATS

On average, over the past few decades, more than 190 square kilometers of grassland per year have been lost to vineyards, orchards, dispersed housing, and urban development, and this loss of grassland is expected to continue in the future, particularly with losses to vineyards and urban areas. Many large ranches are being subdivided, and these smaller parcels receive less management for species conservation and ecosystem services. This lack of management results in the loss of many key ecosystem services these systems provide, including pollination of adjacent crop systems and livestock forage.

Many grassland areas are now experiencing a lack of fire or grazing, leading to thatch buildup, domination by noxious species such as ripgut brome, and decline in key services such as productivity, wildlife habitat, pollination, and plant diversity (particularly wildflowers).

Reduced burning is causing thatch buildup, leading to lower plant diversity (particularly loss of wildflowers), and more intense fires.

Nitrogen deposition is increasing the spread of invasive species on approximately 44 percent of California's grassland areas.

While California's grasslands have been dominated by nonnative plants for more than 200 years, more recent invasions of harmful exotic plants (e.g., barbed goatgrass, yellow starthistle) are increasing in prevalence and range. These new invasions threaten plant diversity and livestock forage and productivity. Species like barbed goatgrass are also able to invade into previously uninvaded native refugia, such as serpentine soils, which provide hot spots for native plant diversity.

RESPONSES

Incentives to maintain these areas as rangelands (rather than being developed) are greatly needed to preserve grasslands. For all incentive programs, it will be important to foster site-specific management, rather than a uniform approach, because California's grasslands are extremely heterogeneous in climate, soil, and other environmental factors, and management for a given goal at one site may decrease that goal at another.

Expanding incentive programs (e.g., water quality approaches through the Natural Resources Conservation Service) can improve ecosystem services, including wildlife habitat, pollinator habitat, carbon sequestration, invasive species control, native plant species diversity, water quality, erosion control, and fire control.

Fire is a key management tool in conservation and restoration, but is nearly inaccessible to most land managers due to fire restrictions. Working with conservation managers to provide opportunities for burning can be critical for maintaining native diversity.

Of the many environmental changes California is experiencing, this may be the most straightforward to rectify by limiting nitrogen pollution from fossil fuel emissions and fertilizer.

While eradication of widespread invasive species may not be feasible, it is possible to limit spread of invasive species that are not yet widespread, and to prevent new invasive species. Key policy changes to limit spread include requiring practices to clean livestock and vehicles (e.g., construction, utilities) that can become contaminated with invasive seeds and disperse them widely to new sites. Restoration of native communities that are resistant to these invaders can also be an important tool for limiting their prevalence. Early detection and eradication programs are central to minimizing the spread of new harmful invaders.