



California's grasslands span over 10% of CA's land area (5,640,400 ha). The grasslands are also a key understory component of California's woodlands and coastal scrub, so grassland species cover at least 18% of CA's land area.

California grasslands range from the North Coast to the Southern Interior, and span a diverse set of climate conditions, with mean annual precipitation ranging from 12 to 200 cm/year.

They also span across areas differing greatly in soil type, hydrology and aspect.

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Strong site and year-specific needs, particularly driven by annual systems
Well drained, <1200 m, over diverse soil types



So not surprisingly, California's grasslands are extremely diverse, varying in the relative dominance of species and functional groups, such as forbs vs. grasses, annuals vs. perennials, and natives vs. invasives.

Even within a site, there can be high heterogeneity in grassland structure and function due to disturbance regimes, and the activities of key fauna such as gophers, voles, earthworms, slugs and ants.

Regional controls differ

Highest NPP with wet and warm winters in N. CA

Highest NPP with wet springs in San Joaquin foothills

Small scale heterogeneity from:

Gophers (given area of soil turned over every 3-15 years)



Grasslands are CA's most altered system

- Historically, there have been large changes in hydrology- with grasslands being largely cut off from their historic flood plains by levees and dams

- In terms of land conversion, they are the most threatened system in CA, with over 190km² a year being converted to orchards, vineyards, low-density housing, and urban uses
- 88% of our grasslands are privately owned- meaning that conservation and restoration depends on land owners
- Changes in fire and grazing has had profound effects on grassland diversity and function (both increases and decreases- both are a part of the system)
- And the most significant change occurred over 250 years ago, with the replacement of native species by non-natives, which now comprise over 90% of vegetation cover in these grasslands



Despite the dominance by invasive species, our grasslands are a diversity hotspot
A 30 x 30m area typically contains more than 50 plant species
These grasslands are the core habitat for 90% of our state-listed rare and endangered species



Important contributions for ecosystem services

75% of livestock forage is provided by the grasses in our Grasslands + oak woodlands

This supports the 3rd largest livestock industry in the US

High water infiltration rates- decrease flooding rates, maintain stream flow into dry season

Water quality- filter pathogens, nutrients, sediments

Critical pollinator habitat to support adjacent crops

High C storage (as much as mid-Western grasslands), and high area

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CA- Third in the nation for cash receipts for livestock and products (\$6.3 billion in 2000), second in sheep inventory (650,000 head in 2006), and fourth in cattle inventory (5.5 million head in 2006) (www.nass.usda.gov).

As of 1999- in top 5 commodities in 33 CA counties



One of the most unique aspects of these grasslands is that they are one of the only ecosystems in the world that are stable as an annual system, in the absence of a frequent disturbance regime

The dominant exotic species we have in CA are early successional species in their home countries, but here, stable as annuals

This presents opportunities and challenges in understanding and managing these systems

1. On one hand, we know that California's climate is extremely variable across space and time. The annual nature of these systems, along with a diverse set of species, allows a lot of flexibility in maintaining plant cover, with different species being dominant in different sets of conditions. For example, same site dominated by legumes vs. grasses, depending on the year.
2. On other hand, this level of variation can be difficult to manage –
 1. NPP can vary by 50% within a given site
 2. Efforts for restoration/ vegetation management can reset each year
 3. Particularly of concern with climate change- in most other grasslands, perennial grasses are critical for maintaining plant cover and erosion control in the face of multi-year droughts, an option which we don't have in most of our grasslands.

Annual-dominated grasslands are becoming more common across the entire Western US. So our relatively long-term annual grassland can provide the important case study for new

frameworks needed to understand annual systems.

Some cool insights:

- Seed and seedling dynamics- small mammals, slugs, pathogens
- Seed bank dynamics
- Photodegradation of litter
- Rapid evolutionary responses
- Boom/bust cycles in soil c and nutrient dynamics with dry/wet dynamics
- Huge fluctuations in small mammal populations (e.g. their impact on seed production can range from 0-70% loss of seed production), biomass loss of 40%

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Long-term annual system- at least last 250-300 years once exotic dominated. But most of Western US is becoming dominated by annuals, such as cheatgrass, our system may provide critical insights into controls and management of these systems in general