



California's Coastal Prairies

A PROJECT OF THE SONOMA-MARIN COASTAL PRAIRIE WORKING GROUP

Ecology

GRAZING

GRAZERS IN PRAIRIES

Coastal prairies may have evolved with intense levels of grazing and browsing by large and small animals. In prehistoric times, coastal prairies were alive with large migratory and resident herbivores including mammoths, horses, camels, llamas, and bison that became extinct in the late Pleistocene.

In more recent times, elk were a major contributor to grazing in coastal prairie. It is estimated that over 500,000 elk once roamed California. The *Californios* (California residents under the Spanish government centered in Mexico City) hunted elk for meat and for tallow, which was highly valued for cooking (Livingston 1995). Lieutenant Joseph Warren Revere (1812-1880), grandson of Paul Revere and an officer in the US Navy, Union Army and later the Mexican Army, (Revere 1849:81-87), describing his participation in an elk hunt at Point Reyes, writes that his party of Americans and Californio's encountered a herd of over 400 "superb fat animals." The elk hunt occurred in August when the elk were "fatter than any other, and cannot compete with the horse in speed; whereas, a couple of months later, the fleetest horse could hardly overtake them" (Revere 1849).

Revere remarks on the "wholesale slaughter" of elk that he inferred from the bones and horns he observed strewn about the landscape from previous years. Livingston (Livingston 1995) reports, "The beleaguered elk already were dwindling in numbers, and according to an account related by Rafael Garcia, the surviving herds swam across Tomales Bay to the wilderness of Sonoma County sometime in the late 1850's or early 1860's."

According to Revere (1849) the Californio's from the rancheros hunted elk with a lariat and used a crescent shaped blade on a pole called a "luna" to hamstring the elk, with which they hunted quite successfully; the Americans used guns. The horses were unused to gun fire and the horse which Revere was riding jumped 20 feet or more upon hearing the report from Revere's gun. Revere managed to stay on the horse, but dropped his gun and inadvertently killed a doe with calf.

Rafael Garcia was a veteran of the Mexican army who owned the *Rancho Tomales y Baulines*.

Completely eliminated from Marin County by the 1860, the National Park Service in cooperation with the California Department of Fish & Game reintroduced eleven tule elk to Tomales Point In 1978. Two bulls and eight cows were brought to Point Reyes from San Luis Island Wildlife Refuge near Los Banos, California. By 1995, the population had grown to over 500 individuals (Dobrenz and Beetle 1966). The Point Reyes herd is now one of the largest populations in California with over 400 counted during the 2009 census (National Park Service 2009).

DOMESTIC GRAZERS

With the arrival of the first Spanish colonists in 1769 (Mission San Francisco de Asís in San Francisco was established 1776) new grazers entered California grasslands: domestic cattle, horses and sheep. Widespread livestock grazing began with the Mexican land grants in 1824 (Bartolome, et al. 2007). The establishment of the ranchos, vast cattle ranches, accelerated the decline of large, migratory herds of elk and pronghorn antelope and ushered in a new grazing regime in California's prairies.

More information about large coastal prairie grazers and browsers:

- ▶ Elk (*Cervus canadensis nannodes*)
- ▶ Domestic livestock (cattle, sheep)
- ▶ Black-tailed deer (*Odocoileus hemionus columbianus*)
- ▶ Pronghorn antelope. (*Antilocapra americana*)

SMALL GRAZERS

The effect of small grazers in coastal prairies is often underestimated. For example, pocket gophers have high energy requirements and can consume from 18-49% of above ground vegetation and more than 30% of below ground primary production (e.g. roots, bulbs, rhizomes) in some areas (Andersen and MacMahon 1981; Foster and Stubbendieck 1980; Williams and Cameron 1986).

For more information, see sections on species:

- ▶ Pocket gophers (*Thomomys bottae*)
- ▶ Black-tailed rabbit (*Lepus californicus*)
- ▶ Brush rabbit (*Sylvilagus bachmani*)
- ▶ California meadow vole (*Microtus californicus*)

SURVIVAL STRATEGIES FOR GRAZING

Grassland plants have evolved with animal disturbances and have developed strategies to evade or persist in spite of tissue loss. Likewise, animals have adapted to their environment as well. Some plants and animals have intimately coevolved together so that one or both may be dependent on the other for its livelihood. In coastal prairies, coping mechanisms that species use to deal with the effects of grazing include:

AVOIDANCE

- ▶ Flowering culms (stems) lean obliquely or horizontally from the plant.

CONCEALMENT OF REPRODUCTIVE OR GROWTH TISSUES

- ▶ Many perennial grassland plants survive grazing because they have perennating structures or storage organs (e.g. rhizomes, tap roots, tubers, bulbs, corms) that lie below the ground. When the top portion of the plant is destroyed by grazing, the plant retains the ability and resources to re-sprout and grow. During the long summer drought, the underground structures store the energy needed to grow when the rains begin. The growing parts of grasses (basal meristems) are at the base of the plant. When the tops are grazed, the plant continues to grow from the bottom.
- ▶ The stems conceal hidden seeds that form at the base of the plant.
- ▶ California oatgrass (*Danthonia californica*) produces one to eight cleistogamous (hidden self-fertilized auxiliary seeds) inside the flowering stem just above the nodes (Prasad, et al. 2005). This means that the plant can still produce seeds even if the terminal seed heads are eaten away.
- ▶ Sun cups (*Taraxia ovata*) also hide their seeds at the base of the plant; the seeds develop in the ovary which is located below the soil level at the bottom of the long stem-like flower tube.

COMPENSATION AND RESISTANCE

- ▶ Grazing stimulates the formation of new stems (tillers) in bunchgrasses and stimulates the growth of horizontal stems of rhizomatous grasses (rhizomes and stolons).
 - Rangeland specialists refer to the new growth stimulated by grazing or cutting as “stooling”; tufted hairgrass (*Deschampsia caespitosa*) “reproduces well by stooling and is resistant to heavy grazing” (Sampson, et al. 1951).
 - Some grasses form a mat-like sod when moderately heavily grazed.

- ▶ Many grasses, such as California oatgrass (*Danthonia californica*) have stems that readily disjoint at the nodes, freely breaking away from the plant leaving the other stems and roots intact. This allows seeds attached to the stem either in the flowers or those hidden side of the stem to be transported by grazing and other passing animals where they are dispersed into other areas, if not eaten with the stem.
- ▶ Cattle and other large animals assure good germination in large seeded grasses such as California oatgrass (*Danthonia californica*) by trampling the seed into the ground (Sampson, et al. 1951).

CHEMICAL OR STRUCTURAL DEFENSES

- ▶ Awns—many grasses have sharp needle-like awns on their flower spikelets that deter potential grazers.
- ▶ Spines—the flower heads of coyote thistle (*Eryngium armatum*) have sharp, spiny bracts.
- ▶ Hairs reduce palatability of plants—e.g. *Trifolium* spp., velvet grass ((*Holcus lanatus*)).
- ▶ Toxins—some plants produce toxic compounds that give them a disagreeable taste, act as a poison or are hard to digest (Lyons and Hanselka n.d.).
- ▶ Silica—
 - Grasses have cell walls composed of silica that helps them to tolerate and sometimes avoid grazing by making the leaves coarser and less palatable to some insects and animals. Grasses may have evolved to incorporate silica in their tissues over 65 million years ago as a response to dinosaur herbivores (Sullivan 1996).
 - Grazers, such as horses, cows, and deer have evolved hypsodontic teeth in order to process the abrasive silica rich grasses. Hypsodontic teeth have high crowns that extend into the jaw and emerge to replace wear. Modern horses that do not graze on enough grass must have their teeth filed down to prevent their teeth from growing too long, which causes dental problems.

GRAZING AS A MANAGEMENT TOOL

Grazing can have positive, negative, or neutral effects on grassland plants and animals dependent on the species and how grazing is managed (Hatch, et al. 1999; Hayes and Holl 2003; Lyons and Hanselka n.d.). To complicate matters domestic livestock have different dietary and topographic preferences and

behavior patterns that vary by species, breed and even by individual (Bush n.d.; Huntsinger, et al. 2007).

Species respond differently to grazing disturbance. Hayes and Holl (2003) recommend using a mosaic of grazing and other disturbance regimes for a single site in order to maintain biological diversity in coastal grasslands. They studied the effects of livestock grazing on coastal prairie plants in various coastal prairies from northern Mendocino County to Moro Bay, San Luis Obispo County. They found that livestock grazing has varied effects on plants depending on various factors including the type of species (grass, forb; native, introduced) and the life history strategy (annual, perennial):

- ▶ Native annual forbs increased in grazed sites compared to ungrazed sites,
- ▶ Exotic annual grasses and forbs also increased in grazed sites,
- ▶ Native grasses performed similarly in grazed and ungrazed sites,
- ▶ Native perennial forbs were more abundant in ungrazed sites.

Removal of domestic grazing not only can change the plant community but can adversely affect some of the animals that inhabit coastal prairie (Marty 2005). Other species, such as pocket gophers, increase when grazing is removed, presumably due to increased foliage for forage and cover.