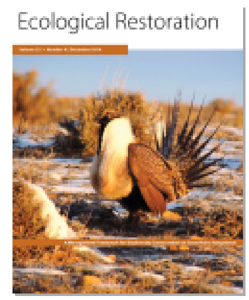
Restoring Native Perennial Grasses by Changing Grazing Practices in Central Coastal California



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While burning effects did not persist through time, reinstituting burning at appropriate intervals would be feasible given the abundance of grassy fuel present and positive response of native grasses to burning (Packard and Mutel 1997). If additional knapweed suppression was desired, residual knapweed densities on restored plots remained low enough where hand pulling would be an effective and practical treatment (MacDonald et al. 2013). Our results are most applicable to the restoration of native warm-season grasses on degraded, knapweed-infested sites in the upper Midwest, and demonstrate that these native grasses can effectively suppress knapweed for extended time periods even in the absence of fire. Where the restoration of more diverse native plant communities is an important goal, the inclusion of these native grasses in a broad seed mix may similarly facilitate the gradual suppression of spotted knapweed.

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The conversion of California grasslands from a system dominated by perennial bunchgrasses to one dominated by exotic annual grasses is recognized as an ecologically significant biological invasion (D'Antonio and Vitousek 1992). The invasion by exotic annual grasses has drastically altered ecological structure and functional processes through the competitive suppression of native grass seedlings and adults, altering community response to disturbance, and causing changes in soil carbon, other soil nutrients, soil microbes, and soil water profiles (Holmes and Rice 1996, D'Antonio et al. 2007, Koteen et al. 2011).

Given the impact that exotic annual grasses have on California biodiversity and ecosystem function, there is great interest in developing strategies for restoring native perennial grasses (Corbin and D'Antonio 2004). One opportunity for restoration is planned grazing designed to focus the timing and intensity of grazing pressure on exotic annuals and allow native perennial grasses to grow and seed as much as possible (Biswell 1956, Menke 1992, George et al. 2013). Despite the promise of this approach, the efficacy of using grazing to promote native perennial grasses remains unclear (Bartolome et al. 2004, Stahlheber and D'Antonio 2013).

To evaluate the efficacy of a planned grazing program to restore native perennial grasses, we have been conducting vegetation monitoring at TomKat Ranch in Pescadero, California. TomKat Ranch is a 728 hectare (1,800 acre) property located south of the San Francisco Bay Area in San Mateo County, 27 kilometers (km) south of Half Moon Bay and 2.6 km from the Pacific Ocean. The area is characterized by steep forested slopes, deep canyons, a fertile coastal valley, and grasslands and coastal scrub. The elevation ranges from 12 to 380 meters. Like other central California coastal locations, TomKat Ranch experiences a maritime, Mediterranean climate characterized by cool, wet winters and mild, mostly dry summers. Fog and low overcast skies are common throughout the year, particularly during the summer months. Average annual precipitation is 750 mm (29.5 in), mostly falling as rain and fog. The rain year (precipitation for July–June, what is often reported in California) for July 2010 to June 2011 was 757 mm (29.8 in), for July 2011 to June 2012 was 503 mm (19.8 in), and for July 2012 to June 2013 was 655 mm (25.8 in). TomKat's grasslands comprise approximately

324 hectares (800 acres) and are dominated by annual exotic grass species, with some native perennial grasses, mostly purple needlegrass (*Stipa pulchra* (synonym *Nassella pulchra*) and California oatgrass (*Danthonia californica*).

TomKat Ranch has a cow-calf operation (a permanent herd) with approximately 100–150 head grazing the grassland portions of the Ranch year-round that supplies beef to their grass-fed/grass-finished beef business. Beginning in 2008 and continuing until 2011, the Ranch employed season-long continuous grazing practices where cattle were often split into multiple herds and were left out over large portions of the ranch for several months at a time providing plants with little rest in between grazing periods. In 2011, the ranch adopted a planned grazing approach where they increased cattle density (112,085–168,128 kg/ha or 100,000–150,000 lbs/acre) by putting them in small blocks and moved them quickly through subdivided fields (20 permanent fields further subdivided into paddocks using temporary electric fence). Grazing periods typically ranged from one day to one week in each paddock, providing plants with 70–120 days of rest (no grazing) in between grazing periods. The amount of rest depended on time of year, the growth phase of grasses, and on field quality. Rest periods are typically longer during the non-growing season (approximately July until first fall rains, but depending on year) when plants experience little to no growth. In each field, the timing of grazing varied by year.

To monitor changes in grassland plant community, we measured vegetation composition across all grasslands each July from 2011 to 2013. For vegetation monitoring, we subdivided the 20 permanent fields into a total of 74 vegetation survey units (Figure 1) based on similar slope and aspect. The vegetation survey units ranged in size from 1–10 ha (mean = 3.4 ha) and varied in plant community composition. For each survey unit we walked the entire area in a zigzag pattern two times, recorded all vegetation species present and visually estimated percent cover to the nearest percent for each species. We acknowledge that this method may not be sufficiently accurate to detect changes in percent cover for rare species (<10 percent total cover). Thus, we evaluated change in native perennial grasses by considering both the proportion of survey units on which native perennial grasses were detected and the percent cover of native perennial grasses.

From 2011 to 2013, the number of vegetation survey units where native perennial grasses were detected increased from 6 (8%) to 58 (80%) out of 74 (Figure 1). The percent cover of native grasses remained small (< 5%) but increased in the survey units from 2011 (mean = 0 %, range = 0–10%) to 2013 (mean = 3 %, range 0–20%). Although the percent cover for native grasses was subject to error because of their rarity, the increase in percent cover was consistent with other observations. We observed only single, dispersed individuals of native grasses present in the survey units in 2011 and found numerous small, but dense stands of multiple individuals of native grasses present in 2013.

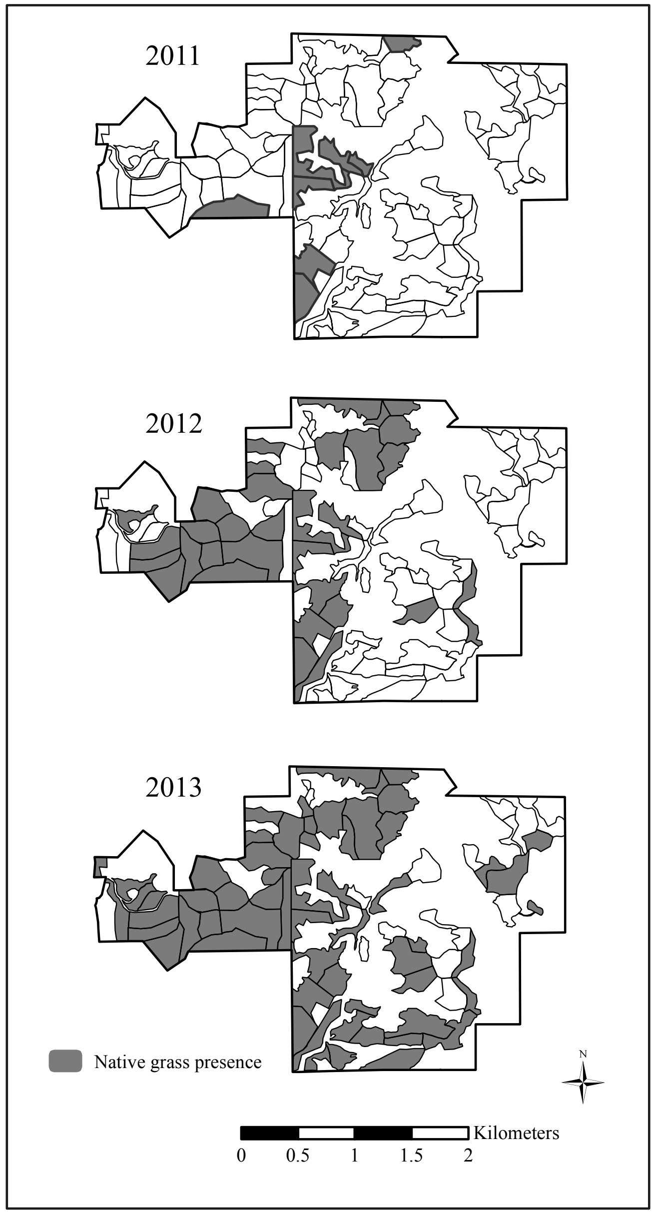

Figure 1. 74 vegetation survey units with native grasses detected (shaded areas) during vegetation surveys from 2011–2013 at TomKat Ranch, Pescadero, CA.

Based on these results, switching from season long-continuous grazing to planned grazing (with higher cattle density and longer rest) appears to have facilitated the restoration of native perennial grasses. Planned grazing can benefit native perennial grasses in two ways. Depending on timing, grazing may reduce competitive advantage of invasive annual grasses and free resources for native perennials grasses and promote tiller formation (Menke 1992, Bartolome et al. 2004, George et al. 2013). Additionally, periods of rest with no grazing, especially during plant flowering, allows for native perennial grass seed production and adequate regrowth, resulting in increased plant numbers, vigor and size (George et al. 2013). It is likely that native perennial grasses were present in and prior to 2011 throughout much of the area, but were severely diminished in size and vigor, making them difficult to detect. Perennial grasses (both native and introduced) are the only palatable, green grass at TomKat Ranch during some times of year, making them a targeted forage for livestock and susceptible to being grazed at a frequency that does not allow for adequate shoot and root regeneration and seed set. Hence we are likely documenting an increase in distribution of native perennial grasses as well as an increase in detectability of existing stands.

Timing of grazing has been highlighted as the most important aspect in promoting native grass restoration (Menke 1992, George et al. 2013). In the grazing plan described here, the timing of grazing was varied so that the same fields were not grazed during the same phenological period every year. Grazing was not specifically timed to promote native perennial grasses across the whole area but all pastures should have received rest during native grass seed production at least once every two years. We hypothesize that this rest facilitated perennial grass recovery and establishment even in the absence of careful timing in any single year.

Our results suggest that changing grazing practices was associated with the expansion and increased detectability of native grasses at TomKat Ranch. We need to further understand the effects of season, frequency and duration, and intensity of grazing for native grass restoration in California. It is likely that the grazing effects will depend on local site conditions and weather patterns and therefore grazing management must take an adaptive approach as we learn and respond to observation(s). Furthermore, we recognize one shortcoming of the information presented here is a lack of specific grazing management data. We recommend grazing managers keep accurate records of their grazing management so that we may further learn and understand grazing effects.

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Russian Olive Fruit Production in Shelterbelt and Riparian Populations in Montana

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Russian olive (*Elaeagnus angustifolia*) became a common ornamental plant in the southwestern United States in the early part of the 20th century and escaped cultivation in all southwestern U.S. states by the early 1950s (Stannard et al. 2002). Russian olive was introduced in the 1930s in the Great Plains of the U.S. for soil conservation. Few native trees are found in open, windswept areas of the northern Great Plains, and planted Russian olive windbreak populations provide shelter to humans and livestock. However, Russian olive is invasive in riparian areas throughout the western United States (Nagler et al. 2011). Riparian populations of Russian olive prevent