July 22, 2008

VIA MAIL AND EMAIL

Mike Stockton, Wildlife Refuge Manager
Bitter Creek National Wildlife Refuge
P.O. Box 370
Maricopa, CA 93252
Mike_Stockton@fws.gov

Re: Comments on the US Fish and Wildlife Service's *Environmental Assessment for Grassland Habitat Management and Restoration Plan* for the Bitter Creek National Wildlife Refuge

Dear Mike Stockton:

Thank you for this opportunity to provide the U.S. Fish and Wildlife Service with our comments on the *Environmental Assessment for Grassland Habitat Management and Restoration Plan* (EA) for the Bitter Creek National Wildlife Refuge (Refuge). Please accept and fully consider the following comments on behalf of Los Padres ForestWatch and Defenders of Wildlife. We appreciate your agency's efforts to manage the Refuge to "promote the establishment of native plants and enhance the habitat for native species, with an emphasis on threatened and endangered species and species of special concern" (EA p. ii, Abstract), and look forward to participating in the planning process. Please continue to provide us with copies of all future environmental documents as well as a copy of your agency's final decision and plan.

Los Padres ForestWatch is a community-based nonprofit organization working to protect and restore the natural and cultural heritage of the Los Padres National Forest (LPNF), Carrizo Plain National Monument, and other public lands along California's Central Coast. The Refuge, and the Hopper Mountain National Wildlife Refuge Complex as a whole, falls within our area of concern as it provides crucial habitat linkages between the Carrizo Plain and the LPNF. The Refuge also provides important foraging habitat for endangered California condors that nest and roost in the LPNF.

Defenders of Wildlife (Defenders) is a non-profit, conservation organization with over one million members and supporters nationwide, more than 100,000 of which reside in California. Defenders is dedicated to protecting all wild animals and plants in their natural communities. To this end, Defenders employs science, public education, media, legislative advocacy, litigation, and proactive on-the-ground solutions in order to impede the accelerating rate of extinction of species, loss of biological diversity, and habitat alteration and destruction.

In this letter we would like to express our support for the Refuge's efforts to remove invasive non-native plants from Refuge grasslands and increase the abundance and diversity of native plants. It has long been recognized that invasive, non-native plants are a serious problem in California grasslands and the Refuge's proposed *Grassland Habitat Management and Restoration Plan* is a step in the right direction. However, we would like to express some concerns regarding the potential consequences of using grazing and other tools to remove non-native plants and restore native species. Scientific studies to date leave much room for debate regarding the effectiveness of grazing, mowing, burning, and other restoration tools suggested in the Refuge EA at increasing the abundance and diversity of native plants, and the Refuge's restoration plan will require close monitoring and management, as well as specified benchmarks, to prevent any negative impacts.

We support the use of all tools suggested in the Refuge EA to manage non-native species when they are effective, but we advise Refuge managers to use caution in their implementation of this program, establish rigorous monitoring of the program, and maintain the option of ceasing operation of grazing and other restoration tools if Refuge goals are not being met. In particular, we feel that grazing should only be used if it is indeed resulting in an increase in the abundance and diversity of native plants and a decrease in that of non-native plants. Grazing should be terminated if it fails to meet these criteria. The scientific literature on this subject suggests that each grassland community responds in a unique way to grazing, mowing, burning, and other tools and that the most important aspect of any management and restoration plan is flexibility. The Refuge's plan must be able to adapt quickly to prevent negative impacts on native plants and wildlife, and must be closely managed and monitored to do so. The design of the plan, moreover, should consider the invasiveness of most non-native plants and the risks involved in further spreading these invasive species.

The following includes a synthesis of the scientific literature on this issue, and our concerns regarding managing Refuge grasslands.

Non-native plants are a serious threat to California's grasslands and should be managed to improve habitat for native plants and animals.

Seabloom et al. (2003a) declare that "the invasion of native perennial grasslands in California by annual species from the southern Mediterranean region is one of the most dramatic invasions worldwide" and Stromberg et al. (2007) state that "invasive non-native species represent the single greatest impediment to grassland restoration in California." Germano, Rathbun, and Saslaw (2001) similarly note that "establishment of alien taxa is a leading cause of endangerment of native species worldwide" (National Research Council

1995, *as cited in* Germano, Rathbun, and Saslaw 2001) and that "in California, exotic grasses are established widely and constitute a major threat to the survival of many native plants" (Mooney et al. 1986, Schierenbeck 1995, *as cited in* Germano, Rathbun, and Saslaw 2001). Rosentreter (1992) further suggests that "exotic grasses are displacing both rare and common plant species on western rangelands" and "case studies of several rare plants . . . illustrate the challenge these species have in surviving in environments modified by exotics."

Considering the extensive impact non-native species have had on native grasslands in the western U.S., we strongly support a comprehensive plan for removal of non-native plants on Refuge grasslands.

Year-long intensive livestock grazing, as was permitted on the Refuge until 2005, has contributed to the current dominance of non-native plants and should be terminated on Refuge lands.

Stromberg et al. (2007) suggest that the last 250 years of intense, year-round grazing on California grasslands has likely contributed "to the loss of native perennial grasses and changes in soil structure" leading to dominance by the alien grasses we see today. The introduction of exotic, annual grasses from the Mediterranean region coincided with the introduction of European cattle to western North America, and studies suggest that livestock grazing has contributed to the spread of alien plants via numerous mechanisms, including:

1) "transporting weed seeds into uninfested sites on their coats and feet and in their guts,
2) preferentially grazing native plant species over weed species,
3) creating patches of bare, disturbed soils that act as weed seedbeds,
4) destroying microbiotic crusts that stabilize soils and inhibit weed seed germination,
5) creating patches of nitrogen-rich soils, which favor nitrogen-loving weed species,
6) reducing concentrations of soil mycorrhizae required by most western native species, and
7) accelerating soil erosion that buries weed seeds and facilitates their germination" (Belsky and Gelbard 2000).

USFWS (2005) further details the mechanism of conversion from native grassland to non-native grassland as follows:

> Livestock grazing during the growing season of plants can result in the trampling or consumption of the above-ground portion of the plant, preventing the plant from reproducing via seed in that year. Grazing can also indirectly affect plant habitat if there is excessive grazing or trailing activity, which results in accelerated erosion. The loss of soil and its accompanying nutrients and seed banks exacerbates the degradation of

> habitat. The disturbed condition of the substrate and the continued grazing pressure maintain a condition that is much more favorable to introduced annual grassland species than the native communities that once covered many grazing allotments (Stephenson and Calcarone 1999, *as cited in* USFWS 2005).

Other studies report that livestock grazing can alter the species composition of plant communities, as well as ecosystem function and structure, and that these changes can affect the animal community through lack of food, changes in plant cover, etc. (Painter 1995). DiTomaso, Enloe, and Pitcairn (2007) likewise report that "intensive grazing can also disturb soil and enhance weed seed germination, reduce competition from more desirable species, and increase soil compaction" (Elmore 1992, *as cited in* DiTomaso, Enloe, and Pitcairn 2007). Additionally, Leonard, Rosentreter, and Karl (1995) state that "continuous season long grazing is shown to be deleterious to microbiotic crusts," which Painter (1995) suggests are "essential to ecosystem function and structure in semi-arid and arid ecosystems" (Fleischner 1994, *as cited in* Painter 1995). Further, "loss of plant cover, soil crusts, and litter can increase loss of soil to erosion" and "loss of plant cover, together with decreased water infiltration (related to soil compaction) can contribute to flooding and gullying" (Fleischner 1994, *as cited in* Painter 1995).

The Refuge EA likewise states that "overgrazing can lead to erosion, water runoff, sediment movement, soil compaction, and water contamination" (Beetz 2002, Bellows 2003, Roberson 1996, *as cited in* EA p. 108), and that "unmanaged livestock grazing can lead to creating paths, congregation in certain areas, and selective feeding which can lead to monocultures of non-native species" (Bellows 2003, *as cited in* EA p. 108). "Excessive trampling by livestock has also been shown to increase the density of YST [yellow starthistle, *Centaurea solstitialis*]" (Miller et al. 1998, *as cited in* Huntsinger, Bartolome, and D'Antonio 2007), a particularly invasive forb found on Refuge grasslands (EA p. 7). Under the current year-round grazing program, Refuge managers have also observed depleted water resources, compacted soil, and increased water runoff, which has reduced the availability of water resources to Refuge wildlife (EA p. 27).

Additionally, Painter (1995) declares that livestock grazing threatens 225 taxa of plants (Skinner and Pavlik 1994, *as cited in* Painter 1995), and Seabloom et al. (2003a) indicate that livestock grazing has forced most native grasses to "low-fertility, marginal habitat" throughout California. Seabloom et al. (2003b) also suggest that "a century or more of heavy grazing may have either extirpated native perennials or have so greatly reduced their abundances from such a large proportion of their range that they no longer provide a significant seed source in many localities, especially when coupled with low rates of seed production, establishment, or dispersal." Painter (1995) expresses concern that continued grazing can further impact native plants through direct impacts, such as "defoliation, pull-up, breakage and trampling," and indirect impacts, such as "animal-induced changes in habitat, changes in competitive relationships among plants, destruction of seedlings, or changes in conditions so that seeds don't germinate, etc." The author also suggests that "impacts on juveniles may be greater than on adults, greatly reducing or eliminating reproductive success" (Painter 1995).

The reason for such sensitivity in native plants to livestock grazing, and the resistance of non-native plants to grazing, is of much debate in the scientific literature, but one argument is that many non-native plants have an evolutionary adaptation due to thousands of years of grazing in their native Mediterranean habitat (Kimball and Schiffman 2003). While some argue that in certain California grasslands native plants likewise evolved with herds of grazers, such as prehistoric bison during the Pleistocene and large herds of Tule elk before European arrival (D. Clendenen, Pers. Comm., May 28, 2008), Painter (1995) explains that there is an important difference between native grazers and browsers, such as Tule elk, pronghorn, and mule deer, and introduced grazers, such as cattle. Tule elk, for example, "are highly versatile and opportunistic in diet choice, utilizing a broad range of herbaceous and woody vegetation" (Murie 1951, Jenkins and Starkey 1991, *as cited in* Painter 1995), while cattle "are grazers and, whenever possible . . . feed primarily on grasses" (Vallentine 1990, *as cited in* Painter 1995). Pronghorn and mule deer likewise feed on woody plants and other vegetation, with grasses comprising only a small portion of their diet (a very small portion in the case of pronghorn), and it is probable that prehistoric bison both browsed and grazed, rather than strictly grazing. Painter (1995) claims, therefore, that "livestock behavior does not mimic that of either Pleistocene or modern native California herbivores," and thus, "while herbivory probably is a natural part of all terrestrial ecosystems, livestock herbivory is not a natural part of California natural ecosystems" (Baker 1992, *as cited in* Painter 1995).

Painter (1995) also notes that while "some native California plant species appear to have limited tolerance of livestock grazing," this tolerance is better explained as responding to many different types of damage (Belsky et al. 1993, *as cited in* Painter 1995), "including fire, wind, and freezing," rather than grazing alone (Painter 1995). Additionally, others suggest that the ecosystem of the San Joaquin Valley is so dry that it never could have supported much grazing (P.M. Schiffman, Pers. Comm., June 10, 2008), especially as there is evidence that before invasion by alien grasses, most of the San Joaquin Valley "was a desert vegetated by saltbush scrub with sparse cover of native annual grasses and forbs" (Germano, Rathbun, and Saslaw 2001).

Whatever the reason, observations of the negative impacts of year-round livestock grazing on California grasslands suggest an end to year-round grazing on the Refuge would be appropriate. Regardless of other steps taken to manage non-native plants on Refuge grasslands and restore native plants, intensive year-round grazing should not be allowed, as it would continue to exacerbate the spread of alien species, and result in continued negative impacts to the land and the ecosystem.

Removing grazing entirely, however, may have negative impacts on native plants and wildlife and allow non-native plants to persist.

While year-round intensive grazing has been found to have substantial negative impacts on native ecosystems, there is controversy over the consequences of removing livestock grazing entirely from non-native grasslands. Seabloom et al. (2003b), for example, note that “exotic annuals have maintained their dominance in many areas that have now been excluded from livestock grazing for decades” (Stromberg and Griffin 1996, *as cited in* Seabloom et al. 2003b), and Germano, Rathbun, and Saslaw (2001) state that the “absence of livestock grazing does not eliminate exotic annuals” (Biswell 1956, Heady 1977, George et al. 1992, Stebbins 1992, *as cited in* Germano, Rathbun, and Saslaw 2001), nor does it “allow perennial grasses to regain dominance” (Bartolome and Gemmill 1981, Keeley 1990, *as cited in* Germano, Rathbun, and Saslaw 2001). Germano, Rathbun, and Saslaw (2001) go so far as to state that “it is likely that cessation of grazing only exacerbates the problem in habitats where annual exotic grasses are naturalized.” Painter (1995), similarly, suggests that “abrupt changes in livestock herbivory can bring new problems,” such as “a major increase in *Foeniculum vulgare* [fennel] on Santa Cruz Island when cattle were removed” (Junak et al. 1995, *as cited in* Painter 1995).

Additionally, Germano, Rathbun, and Saslaw (2001) express concern that removing grazing entirely from some systems could negatively impact certain rare native plants and animals that are already struggling in the San Joaquin Valley. The authors suggest that thick cover of invasive plants can negatively impact rare plants, such as Kern mallow (*Eremalche kernensis*), California jewelflower (*Caulanthus californicus*), and San Joaquin woolly-threads (*Lembertia congdonii*), “annual species that germinate in late winter and usually set seed by April or May” (Taylor and Davilla 1986, United States Fish and Wildlife Service 1997, *as cited in* Germano, Rathbun, and Saslaw 2001). They note that “the invasion by nonnative herbaceous plants . . . has forced these native annuals to compete for light and soil moisture with exotic plants that are capable of 100% ground cover and heights of 50 cm” (Germano, Rathbun, and Saslaw 2001). The authors also observe that “the herbaceous cover of these introduced grasses and forbs often creates an impenetrable thicket for small ground-dwelling vertebrates,” species which “evolved in sparsely vegetated habitats and rely on open ground to forage and avoid predation” (Germano, Rathbun, and Saslaw 2001).

Germano, Rathbun, and Saslaw (2001) suggest that “populations of giant kangaroo rats (*Dipodomys ingens*), San Joaquin kangaroo rats (*D. nitratoides*), San Joaquin antelope squirrels (*Ammospermophilus nelsoni*), and blunt-nosed leopard lizards (*Gambelia sila*), all listed as threatened or endangered, are affected negatively by thick herbaceous cover.” The authors, for example, attribute a precipitous decline in small mammal populations in the San Joaquin Valley since 1994 (Single et al. 1996, *as cited in* Germano, Rathbun, and Saslaw 2001) in part to “greater than normal rainfall and associated dense grass growth that probably makes foraging harder and leads to increased risks of predation.” Williams et al. (1998a) likewise suggest that a “lack of grazing or fire to control density of vegetation (including shrubs) may be a threat to giant kangaroo rats” (Williams and Germano 1993, *as* *cited in* Williams et al. 1998a). Germano, Rathbun, and Saslaw (2001), therefore, suggest that "although livestock may have contributed originally to habitat destruction and introduction of exotic plants . . . in some years, moderate to heavy grazing by livestock is the best way to decrease the dense cover created by these exotics."

Professor Paula M. Schiffman, Ph.D., of California State University, Northridge, on the other hand suggests that giant kangaroo rats are such "ecosystem engineers" and clip so much of the vegetation that excessive "thatch" will not have a negative impact on their populations (P.M. Schiffman, Pers. Comm., June 10, 2008). Schiffman (2007) indicates that giant kangaroo rat activities, "which include trampling of vegetation in runways and near burrows, clipping nesting materials, cutting and discarding herbage, and covering-up of plants with excavated soil, can considerably reduce a grassland's total biomass." The author agrees that, at least at Carrizo Plain National Monument, "relatively cleared areas can be important habitat for mountain plovers (*Charadrium montanus*), blunt-nosed leopard lizards, and other grassland species that are apparently not well adapted to environments with heavy accumulations of non-native grass biomass" (Knowles et al. 1982, Williams et al. 1992, Knopf 1998, *as cited in* Schiffman 2007), but argues that other native species such giant kangaroo rats can create these needed areas, and that grazing may not be necessary (Schiffman 2002; P.M. Schiffman, Pers. Comm., June 10, 2008).

To determine if in fact small mammals and lizards are negatively impacted by thick herbaceous cover, and attempt to improve their habitat with well-managed livestock grazing, the Western Ecological Research Center (WERC) is conducting an on-going experiment at the Lokern Natural Area in western Kern County (WERC 2001). Each year WERC publishes an annual report of results at the Lokern Natural Area, and the 2006 annual report indicates that giant kangaroo rats, San Joaquin antelope squirrels, and blunt-nosed leopard lizards in fact are consistently more abundant on grazed plots than on un-grazed plots. The report also indicates, however, that other species are more variable, and some, such as McKittrick pocket mice (*Perognathus inornatus neglectus*) and Heermann's kangaroo rats (*Dipodomys heermanni*), are more abundant on un-grazed control plots than on grazed plots (Germano et al. 2006). Similarly, other studies suggest that while some species benefit from grazing, others prefer habitat that is ungrazed. The EA, for example, suggests that western meadow larks (*Sturnella neglecta*) "seem to prefer ungrazed areas, while horned larks (*Eremophila alpestris*) are more abundant in grazed areas" (Boarman et al. 2001, *as cited in* EA p. 36). Sideblotched lizards (*Uta stansburiana*), western whiptails (*Cnemidophorus tigris*), and short-nosed kangaroo rats, additionally, "seem to prefer grazed plots," while "Heermann's kangaroo rats (*Dipodomys heermanni*) and San Joaquin pocket mice (*Perognathus inornatus*) prefer ungrazed plots" (Boarman et al. 2001, *as cited in* EA p. 36).

The results of these studies, while inconclusive, suggest that removing grazing entirely from grasslands dominated by invasive, non-native plants may negatively impact some native plants and animals. Germano, Rathbun, and Saslaw (2001) conclude that "recent decisions to decrease or eliminate livestock grazing on conservation lands without definitive studies of grazing in these habitats may lead to further declines of native species and possible local extinction of some listed plants and animals." The authors suggest that "well-managed grazing by livestock may be used to reduce these exotic grasses and thus sustain populations of the native plants and animals that are at risk of becoming endangered or extinct" (Germano, Rathbun, and Saslaw 2001).

Perhaps, therefore, depending on the abundance of native and non-native plants and animals in different areas of the Refuge, a well-managed grazing program may be appropriate for Refuge grasslands.

Since it may prove harmful to remove grazing entirely from Refuge grasslands (as suggested by Germano, Rathbun, and Saslaw 2001, Germano et al. 2006, Painter 1995, Williams et al. 1998a, 1998b, etc., above) some well-managed grazing, such as the seasonal rotational grazing suggested under Alternatives B and D (the Preferred Alternative) in the Refuge EA, may be appropriate for the Refuge. Moreover, some studies indicate that forms of rotational grazing can be successfully used to control invasive plants. Jackson and Bartolome (2007), for example, suggest that "grazing can be effectively applied as a tool for native grass enhancement, invasive species control, fuel load reduction, and habitat management," and Huntsinger, Bartolome, and D'Antonio (2007) state that "grazing can be used to manipulate plant community structure, decrease fuel loads, control invasive weeds, create wildlife habitat, and enhance species diversity" (Marty 2005, Pyke and Marty 2005, *as cited in* Huntsinger, Bartolome, and D'Antonio 2007). Huntsinger, Bartolome, and D'Antonio (2007) also suggest that rotational grazing "remains a tool available *if rotational patterns of grazing are known to be more beneficial for a particular species or setting*" (emphasis added). The authors suggest that "having more than one pasture also allows animals to be herded in ways that may cause them to consume plants they would not ordinarily consume, to avoid grazing some plants at certain times of year, to keep from overusing an attractive area, to control weeds, or to benefit native perennials" (Huntsinger, Bartolome, and D'Antonio 2007).

Menke (1992), additionally, supports "time-controlled, short-duration, high intensity sheep or cattle grazing" to manage alien plants, suggesting that if applied in early spring, such managed livestock grazing can remove "substantial amounts of alien annual plant seed while it is still in inflorescence," thereby reducing competition by invasive annuals. DiTomaso, Enloe, and Pitcairn (2007) similarly argues that "high-intensity, short-duration grazing, practiced on a rotational basis . . . has been shown to provide much better control of specific weeds than season-long livestock grazing," and Painter (1995) states that "many of the negative impacts of grazing can be mitigated with careful, well planned management."

The key word from the above studies, however, is *well-managed*, as unmanaged or poorly managed grazing has been proven to have profound negative impacts on native vegetation, water resources, soil, etc. (e.g., Stromberg et al. 2007, DiTomaso, Enloe, and Pitcairn 2007, USFWS 2005, EA p. 108, etc.). Properly managing a grazing program, however, depends on numerous factors, such as timing, rainfall, and the abundance and diversity of native and non-native plants. Huntsinger, Bartolome, and D'Antonio (2007) state:

> Understanding the effects of grazing on vegetation in the California grassland is complicated by a large climatic gradient, pronounced interannual variation in weather, strong variation in topography and land-use history, and regional variation in the species pool. At any one site, the impact of grazing arises out of the interaction of land use history, the current and recent grazing management scheme, the abiotic environment, and the species pool in the local plant community (Heady 1984). The influence of the abiotic environment, including soil type, elevation, precipitation, and temperature, is particularly important in the California Mediterranean environment. Because so much of the grassland is composed of annual species, composition, density, and productivity are highly influenced by the annual pattern and amount of rainfall, with production varying by orders of magnitude among years. California's heterogeneous soils also add to the heterogeneity of the grassland and response to management actions.

DiTomaso, Enloe, and Pitcairn (2007) further caution that while "grazing can be an effective way of managing undesirable species in some grasslands . . . the effectiveness depends on the plant species present, the type of grazer used, and the timing and intensity of the grazing program." The authors also specify that "under some conditions grazing can increase undesirable nonnative species" (DiTomaso, Enloe, and Pitcairn 2007), and Huntsinger, Bartolome, and D'Antonio (2007) suggest that "improperly timed grazing can benefit the wrong species."

One example of this consequence is the invasive forb yellow starthistle (YST), which is "among the most problematic invasive plants in California's valley grasslands" (DiTomaso, Enloe, and Pitcairn 2007). Huntsinger, Bartolome, and D'Antonio (2007) suggest that "livestock grazing in late winter or early spring will primarily feed on young grasses . . . causing little damage to seedling YST rosettes. This increases the amount of light reaching the rosettes and stimulates their growth. By contrast, intensive grazing in late May and June, when starthistle plants are bolting, can reduce YST growth, height, survivability, canopy size, and seed production" (Thomsen et al. 1989, 1990, *as cited in* Huntsinger, Bartolome, and D'Antonio 2007). Huntsinger, Bartolome, and D'Antonio (2007) also suggest that by mid to late summer, "livestock will selectively avoid the now spiny mature plants, allowing ample seed production," and thus, "if it is not grazed in the bolting stage prior to spine production, YST will not be successfully controlled by livestock grazing."

Other studies have also identified further impacts from improperly managed grazing. In a study of grasslands in the adjacent Carrizo Plain, for example, Kimball and Schiffman (2003) found that while "cattle grazing may temporarily reduce mulch and the cover of European species such as *B[romus] madritensis* . . . it also reduces native cover and increases the amount of bare ground. This bare ground provides open space for the regeneration of alien plants such as *E[rodium] cicutarium* and for highly competitive annual grasses." Painter (1996) also indicates that, though Germano, Rathbun, and Saslaw (2001) suggest removing mulch can benefit small mammals and lizards, this can have a negative impact on the soil. The author suggests that "the problem is often not having enough cover from mulch and living vegetation to protect the soil from large herbivore impacts" (Ellison 1960*, as cited in* Painter 1996). Huntsinger, Bartolome, and D'Antonio (2007) likewise suggest that mulch is important in slowing invasions of alien plants such as YST, "as shading has been shown to reduce YST seedling survival rates" (Roché et al. 1994, Gerlach and Rice 2003, *as cited in* Huntsinger, Bartolome, and D'Antonio 2007). Additionally, rebutting the spring grazing suggested by Menke (1992), Kimball and Schiffman (2003) suggest that some native plants may germinate even before the early-germinating non-natives; thus, spring grazing could heavily impact some native plants in addition to the non-natives. The authors conclude: "In the [Carrizo Plain] grassland . . . the strategy of livestock grazing for restoration is counterproductive. It harms native species and promotes alien plant growth" (Kimball and Schiffman 2003).

Huntsinger, Bartolome, and D'Antonio (2007), additionally, suggest that, while "grazing can benefit some native plant populations . . . a positive response is not universal even across locales for any one species." The authors also indicate that grazing can negatively impact other native plants—Hayes and Holl (2003), for example, found that "grazing has negative effects on native perennial forbs"—"but responses, again, are not universal across species or sites" (Huntsinger, Bartolome, and D'Antonio 2007). Painter (1995) likewise suggests that "livestock herbivory does not have equally negative effects on all native plants." The author notes that "some plants apparently can tolerate a certain amount of herbivory," though that tolerance is "not necessarily predictable" and "can vary among closely related species, and even between populations of the same species" (Painter 1995).

Bartolome et al. (2004), for example, conducted a study of grazing (and burning) impacts on native perennial grasses on a site in Coast Range Grassland, and found that while purple needlegrass (*Nassella pulchra*) increased the greatest under spring grazing, foothill needlegrass (*N. lepida*) increased the greatest when grazing was removed. California oatgrass (*Danthonia californica*) similarly experienced little change with seasonal grazing, but increased when grazing was removed. In another study specifically of *N. pulchra*, Hamilton, Griffin, and Stromberg (2002) similarly found that "non-native annuals, by themselves, did not seem to cause decline in *Nassella* stands, but light grazing did cause reduction in *Nassella* basal cover."

Painter (1995) cautions further that if moderately tolerant native plants "are preferred foods, the resulting stress may put them at a competitive disadvantage with unpalatable plant species and with more grazing tolerant species, leading to a decline in number or even a loss from the community." The author suggests that "in areas where livestock herbivory is going to continue, selection for damage tolerance might allow for increased success in revegetation with natives" (Painter 1995).

Lastly, studies have also found varying impacts on grasslands depending on stocking density. Holechek et al. (2000) indicate, for example, that short-duration grazing can increase impacts to soil and increase erosion if the stocking density is too high, though the authors agree that short-duration grazing can be a "useful grazing system for some ranchers if applied at conservative to moderate stocking rates." DiTomaso, Enloe, and Pitcairn (2007) found, however, that "lower stocking rates will generally allow livestock to graze preferred plants and avoid less palatable species," which can result in the spread of invasive species. This suggests there may be very narrow parameters in the stocking density on Refuge grasslands. The Refuge must be careful to use stocking densities in the rotational grazing program that are low enough to prevent excessive erosion, soil compaction, and other impacts, but high enough that the livestock graze down all the non-native species, rather than promote their spread by consuming competing native plants and creating disturbances that can be readily colonized by invasive plants.

A seasonal rotational grazing program, as suggested by the Refuge EA, must therefore be closely monitored and enforced, and maintain the flexibility to adapt to changing conditions.

As noted in the above studies, each site and grassland community responds differently to the restoration tools proposed in the Refuge EA. This means that monitoring of the management and restoration program, and particularly of the seasonal rotational grazing program, is of the utmost importance. The program must be managed closely and monitored regularly to ensure that grazing and other management measures do not result in negative impacts to native plants and animals found on the Refuge. If grazing is to continue on Refuge grasslands, even in the form of the proposed seasonal rotational program, Refuge managers must ensure that it does not result in the spread of non-native invasive plants, lessen the suitability of habitat for native wildlife, or cause local extinction of any native plants or animals. This also means that managers must maintain the flexibility to adapt rapidly to the responses of plants and animals found on the Refuge.

To ensure that the seasonal rotational grazing program maximizes positive benefits to native plants and wildlife, and minimizes negative impacts, the Refuge must monitor all aspects of the program, including changes in native and non-native plant abundance and diversity, wildlife populations, soil compaction and other impacts, fencing, livestock activities, etc. Refuge managers should regularly monitor grazing to ensure livestock are not trespassing into fenced areas and that grazing permit conditions are being adhered to. For monitoring plants the Refuge has proposed using Residual Dry Matter (RDM), an accepted measurement used to determine and prevent overgrazing. Painter (1996), however, suggests that this measurement "is the least appropriate" for restoring native plants and the "most prone to error." The author declares that with RDM there is a very real potential for over-estimating production, and recommended levels can vary widely—from about 400 lb/acre to 1100 lb/acre. Additionally, "most RDM monitoring regimes are designed to be used in alien-annual-dominated grasslands on privately owned ranches to maximize profit while minimizing impacts on forage production" (Painter 1996). The author instead recommends a "combination of stubble height and level of utilization," although these measurements do encounter similar problems, with some stubble heights, for example, being tolerated by some species but severely stressing others (Painter 1996). Refuge managers should therefore monitor native and non-native plants using a combination of these different measurements, and ensure that grazing does not severely stress any rare native plants found on the Refuge. Managers should also conduct surveys of individual species and community inventories regularly to ensure that management measures are indeed resulting in an increase in abundance and diversity of native plants.

Progress and effectiveness of the grazing program must also be gauged against Refuge goals, and benchmarks must be set to keep the program on track. Additionally, the "Stipulations Necessary to Ensure Compatibility" for permitting livestock grazing must be strongly enforced to ensure that grazing does not result in negative impacts and compel the removal of livestock from the Refuge if grazing results in negative impacts. Livestock must be removed from the Refuge as soon as it is determined that minimum levels—whether they be RDM, stubble height, or other measurements—are being approached, regardless of what time of year or how long the cattle have been on the allotment (Painter 1996). Consistent and regular monitoring and enforcement of permit conditions by Refuge staff will ensure compliance with standards and conditions for livestock grazing under this proposed program.

To find optimal stocking rates and maximize positive benefits from any seasonal rotational grazing program, the Refuge must also maintain the utmost flexibility to allow management to adapt to the responses of native and non-native plants on Refuge grasslands. Bartolome et al. (2004) suggest:

> The most important characteristics for any restoration management scheme in California grasslands are flexibility and opportunism. Flexible schemes will adapt to changing conditions and improved understanding of system response to the environment and management. Opportunism implies that researchers and managers will embrace and learn from the nonequilibrium, variable nature of this dynamic ecosystem.

Many of the impacts of the current grazing program, such as compacting soil and displacing water resources, are attributed in part to a lack of flexibility in the program (EA p. 29). It is therefore imperative that the Refuge adapt their management to the unique responses of native and non-native plants on the Refuge and maintain the option to cease grazing if it is found to negatively impact native plants and animals.

Any grazing program must protect riparian and sensitive areas from grazing and trampling; these areas are vital to Refuge wildlife and the health of the ecosystem.

In addition to harboring native plant species, "riparian habitats act as filters providing and maintaining water quality, necessary for healthy ecosystems" (EA p. 14) and provide water and habitat to native wildlife. Riparian areas are also highly sensitive to grazing and trampling. USFWS (2005) indicates that tramping of streambanks can lead to "soil compaction, sedimentation, direct mortality, loss or reduction in vegetative bank cover, collapse of the stream banks, and increased instream water temperatures from loss of shade." Additionally, watering or grazing of livestock at stream crossings can lead to increased sedimentation, which can impact "eggs, fry, and aquatic insects that serve as a food source" (USFWS 2005).

In a study of grazing impacts on riparian vegetation in Arizona, Malcom and Radke (2008) documented considerable damage to a rare aquatic plant (*Lilaeopsis schaffneriana* var. *recurva*) after one bull spent just four days in a riparian area in Leslie Canyon National Wildlife Refuge. The authors estimate, based on this one bull, that "even a small number of livestock could eradicate most of the plant's population in Leslie Creek in several days to weeks" (Malcom and Radke 2008). Protecting riparian areas from any grazing program, even a seasonal rotational grazing program, is thus imperative to the health of the land, water resources, and the entire ecosystem.

Painter (1995) also notes that "livestock concentrate their activities in riparian areas, around margins of permanent lakes and ponds, and in and around vernal wetlands." Thus, the only way to protect these sensitive areas is to fence them off entirely from livestock. The EA indicates that Refuge managers began installing "permanent fencing around riparian and designated sensitive areas" (EA p. 2) in 1995, and under Alternatives B and D (the Preferred Alternative) "fencing would be installed to protect riparian and sensitive areas" (EA p. 8). We fully support building new fences as necessary to protect all riparian and sensitive areas and also stress the importance of maintaining and repairing existing and new fences alike.

Livestock grazing and associated infrastructure (i.e., fencing) should be maintained in a way that is compatible with native wildlife.

Livestock grazing can also affect the habitat selection and home range of native ungulates, such as Tule elk, pronghorn, and mule deer. Loft, Menke, and Kie (1991), for example, found that female mule deer "shifted habitat use by reducing their use of habitats preferred by cattle and increasing their use of habitats avoided by cattle." Kie et al. (1991) additionally found that mule deer "spent more time feeding and less time resting with increased cattle stocking rates."

We therefore encourage the Refuge to manage the seasonal rotational grazing program to minimize interactions between livestock and wild ungulates, and ensure that the grazing program results in increased populations of native wildlife on the Refuge. The EA also indicates that the seasonal rotational grazing program will make use of fencing that facilitates the movement of wild ungulates (EA p. 12, 35, 109, etc.), which include Tule elk, mule deer, and pronghorn. We support the use of these fences, and stress that they should facilitate movement of all wild animals found on the Refuge.

The Refuge should monitor the food supply for the endangered California condor, and modify livestock stocking densities to increase the population of native ungulates to the point that they can provide sufficient food for this endangered species.

The EA suggests that year-round grazing displaces native ungulate populations, having a negative effect on California condors (EA p. 30), but seasonal rotational grazing improves foraging habitat, resulting in "minimal enhanced effects to California condors" (EA p. 37). We support the proposed increase in native ungulate populations to provide food for condors, and encourage close monitoring of the condors' food supply to maintain and increase the population of condors foraging at the Refuge. It is unknown what stocking density will allow the greatest recovery of native wildlife that serve as food for condors; thus, the Refuge must monitor stocking densities closely and adjust the grazing program as appropriate to maximize benefits to the California condor.

Refuge managers should also monitor the populations of other rare, threatened, and endangered species and ensure that the management and restoration plan is resulting in an increase in their populations on the Refuge.

According to the EA, the current year-round grazing program impacts native wildlife via "displacement of water resources, compacted and eroded soil, and the removal of food and shelter" (EA p. 29). Cattle grazing can also impact San Joaquin kit foxes via crushing of burrows (EA p. 31), and blunt-nose leopard lizards and giant kangaroo rats via both underutilization, which leaves "two to three feet of vegetation, too thick to maneuver in," and overgrazing, which causes "bare soil, devote [*sic*] of shelter, resulting in the inability to escape predators" (EA p. 31). As suggested by the EA, a seasonal rotational grazing program, on the other hand, could avoid many of the potential negative impacts on native wildlife via low intensity grazing that is timed to the breeding, flowering, and other important activities of native species (EA p. 36). The EA further suggests that a well-managed seasonal rotational grazing program could even result in improved habitat for some species, such as blunt-nosed leopard lizards and giant kangaroo rats, via opening a patchwork of habitat, which allows these species to locate food and avoid predators (EA p. 38).

Germano, Rathbun, and Saslaw (2001), Germano et al. (2006) and Williams et al. (1998a; 1998b) support this assessment, with findings that some amount of grazing benefits giant kangaroo rats, blunt-nosed leopard lizards, and other species; however, the impacts of a seasonal rotational grazing program on threatened, endangered, and sensitive (TES) species found on the Refuge depend greatly on specific parameters, such as timing and stocking densities. USFWS (2005) indicates, for example, that "grazing during the breeding season can result in physical damage to avian nests," while the EA notes that grazing can result in potential abandonment of nests by burrowing owls (EA p. 38). Additionally, Williams et al. (1998b) states that grazing can impact blunt-nosed leopard lizards via "removal of herbaceous vegetation and shrub cover, destruction of rodent burrows used by lizards for shelter, and associated soil erosion if the stocking rate is too high," though the authors also indicate that "moderate grazing may be beneficial" to blunt-nosed leopard lizards.

It is imperative, therefore, that Refuge managers consistently monitor populations of TES species on the Refuge and adjust livestock grazing to maximize positive benefits and minimize negative impacts to these species. The EA includes stipulations for protection of TES species on the Refuge, such as removing shrub communities from grazing to protect habitat for San Joaquin kit foxes; however, these protections must be enforced in order to be effective. Additionally, these protections should include exclosures around sensitive shrub species, kit fox and burrowing owl dens, and other sensitive habitats to ensure that these areas are not trampled by livestock, and Refuge managers should closely monitor cattle to ensure these protections are maintained. Stocking densities also must be closely managed to result in a decrease in the abundance and diversity of invasive plants and a patchwork of open areas that are beneficial to blunt-nosed leopard lizards and giant kangaroo rats, while not causing negative impacts such as soil compaction and crushed burrows and dens. The Refuge must also continuously monitor the populations of TES species on the Refuge to ensure that they are not being negatively impacted by grazing activities.

Other tools suggested in the EA also have substantial risk and should be further studied before implementation.

The other restoration tools proposed in the Refuge EA, including herbicides, mowing, and prescribed burning, can also involve substantial risk to populations of native plants and wildlife, and thus should be used with caution. Herbicides, for example, are non-selective and kill both non-native and native plant species. In a letter to the Carrizo Plain National Monument in 2002, Professor Paula M. Schiffman, Ph.D., of California State University, Northridge, suggests that herbicides, such as RoundUp, "would kill plants of all types and . . . be translocated to underground plant parts, putting perennials (bunchgrasses, *Dichelostemma*, *Allium*, shrub seedlings, etc.) at risk" (Schiffman 2002). Similarly, DiTomaso, Enloe, and Pitcairn (2007) suggest that the continued use of the herbicide clopyralid can "have undesired outcomes" and Germano, Rathbun, and Saslaw (2001) suggest that "the application of herbicides can negatively affect non-target plants and could depress numbers of invertebrates, some of which are important prey to the species of concern." Schiffman (2002) also expresses concern that "the indirect effects of herbicides on herbivorous and granivorous native animals (giant kangaroo rats, Kern primrose sphinx moths, grasshoppers, etc.) cannot be predicted."

Schiffman (2002) additionally suggests that mechanical treatment like mowing would probably be ineffective in the grasslands in the adjacent Carrizo Plain. The author cites studies in the Carrizo Plain that show that "mulch removal did not increase native cover" and "that growth and reproduction of native annual plants are harmed by clipping" whereas "some alien species were unaffected or, in some cases, increased if clipped." Kimball and Schiffman (2003) support this assessment, finding, in a study of simulated grazing on a grassland in Carrizo Plain, that native species, in general, were negatively affected by clipping but "alien species were unaffected." Similarly, in a study on Sedgwick Reserve in the Santa Ynez Valley, Seabloom et al. (2003b) found that "the abundance of annual species increased with increasing levels of disturbance," and "annuals decreased and perennials increased in abundance once mowing ceased." Germano, Rathbun, and Saslaw (2001), additionally, express concern that "mechanical treatments would likely crush burrows used by the species of concern." DiTomaso, Enloe, and Pitcairn (2007), on the other hand, suggest that "properly timed mowing has been demonstrated to be a successful tool for the control of yellow starthistle" (Benefield et al. 1999, *as cited in* DiTomaso, Enloe, and Pitcairn 2007).

With regards to prescribed burning, Keeley (2001) found that while spring burning might be an effective way to shift the landscape "away from the annual alien grasses towards increased native cover" this is only true "on sites with an existing perennial bunchgrass presence" and "may not be an appropriate community restoration technique because it inhibits native annuals as well." The author notes, for example, that "repeated prescription burning during summer has shown promise for reducing the level of infestation of yellow starthistle, although native bunchgrasses were unaffected and alien annual grasses increased" (DiTomaso et al. 1999, *as cited in* Keeley 2001). Keeley (2001) also notes that "there is no convincing demonstration that fire alone is an effective technique for diminishing the dominance by nonnative annuals" and that "generally burning of annual grasslands does not greatly alter the native to nonnative composition, unless accompanied by active native plant restoration."

In a study of serpentine grassland, Seabloom et al. (2003a) also found "there was no effect of burning or mowing on native abundance or richness in the absence of seeding." Germano, Rathbun, and Saslaw (2001), additionally, found in a study of the effects of fire in the Lokern Natural Area, that "fire often completely kills native saltbush," which provides "potentially important cover" for antelope squirrels and lizards. Germano, Rathbun, and Saslaw (2001) suggest further that "fire now maintains alien grasslands in habitats throughout the world, including the San Joaquin Valley, at the expense of native plant communities" (D'Antonio and Vitousek 1992, *as cited in* Germano, Rathbun, and Saslaw 2001). On the other hand, some studies indicate that "late season forbs, particularly yellow starthistle, can also be controlled by repeated early summer burns" (DiTomaso et al. 1999a, Kyser and DiTomaso 2002, *as cited in* DiTomaso, Enloe, and Pitcairn 2007). Additionally, in a study of the invasive annual grass barb goatgrass (*Aegilops triuncialis*) at the University of California Hopland Research and Extension Center (HREC) in Mendocino County, DiTomaso et al. (2001) found that two years of prescribed burning, conducted in late spring or early summer, "before barb goatgrass seeds had reached maturation," effectively controlled barb goatgrass "while increasing native perennial grass cover and native species richness, particularly legumes." The authors also found, however, that a single year of burning "is not sufficient to provide long-term management of barb goatgrass" (DiTomaso et al. 2001).

Lastly, we are also concerned about the potential impacts of herbicides, mowing, or prescribed fire on TES species found on the Refuge, specifically regarding the timing of these activities. For example, while the EA indicates that prescribed fire would generally have "long term beneficial effects" (EA p. 44) on certain species, this is dependent on a properly-timed and well-managed prescribed burn. If performed at certain times of the year, such as during the breeding season, fire, on the other hand, could negatively impact native wildlife found on the Refuge. Any prescribed burns, mowing, or herbicide treatments must be appropriately timed and closely monitored. These methods likewise must be ceased immediately if they are having adverse impacts on native species found on the Refuge.

The EA should be revised to include an additional restoration tool, that of active seeding of native plants.

While the Refuge EA analyzed a number of alternatives for managing non-native plants and promoting native plants on the Refuge, there are several alternatives that the EA overlooked. Recent scientific studies suggest (e.g., Keeley 2001, Seabloom et al. 2003b, Seabloom et al. 2003a), for example, that none of the management measures explored in the EA are effective without active seeding of native plants. Seabloom et al. (2003a) went so far as to suggest that active seeding of native plants without other management measures may be sufficient to "create viable populations of native annual species in areas that are currently dominated by exotic species." DiTomaso, Enloe, and Pitcairn (2007) similarly suggest that seeding of native perennial bunchgrasses "have been shown to reduce the growth and reproduction of weeds such as yellow starthistle" (Lym and Tober 1997, Roche et al. 1994, Dukes 2001a, Reever, Morghan, and Rice 2005, *as cited in* DiTomaso, Enloe, and Pitcairn 2007).

These arguments stem from observations that if disturbances are removed, some native plants can compete with non-native annuals, and that their failure to colonize areas dominated by non-native plants is due to their limited populations rather than any competitive advantages non-natives have over natives (Menke 1992; Seabloom et al. 2003b). Seabloom et al. (2003b) note that "in general, perennials are thought to be competitively superior to annuals in undisturbed habitats," while Menke (1992) suggests that "once perennials become established they are very strong competitors." In a study on Sedgwick Reserve in the Santa Ynez Valley, Seabloom et al. (2003b) found that native perennial species that "had lower requirements for deep soil water, soil nitrate, and light, were strong competitors, and they markedly depressed the abundance and fecundity of exotic annuals after overcoming recruitment limitations." The authors concluded that "exotic annuals are not superior competitors but rather may dominate because of prior disturbance and the low dispersal abilities and extreme current rarity of native perennials" (Seabloom et al. 2003b). This is not the case for all species, or all sites, however, as Hamilton, Holzapfel, and Mahall (1999) found that *Nassella pulchra* was not competitive with invasive annual grasses at their study site.

Considering the above studies, we encourage the Refuge to revise the EA to include an analysis of active seeding of native plants on the Refuge, including combinations of the before-studied restoration tools in coordination with active seeding. As mentioned earlier in this letter, each site will have a unique response to restoration tools; thus, it is important to observe how Refuge grasslands respond to active seeding with or without other restoration tools as suggested by Seabloom et al. (2003a). We also caution, however, that if active seeding is pursued as a restoration tool, the Refuge must acquire seeds from local sources to maintain genetic uniqueness of native plants on the Refuge. Additionally, to be successful, managers must pay particular attention to the timing of planting. Stromberg et al. (2007) suggest, for example, that "restorations using seed are more successful if planted after the first germinating rain in the late fall or early winter," though conditions may be unique to Refuge grasslands, and the exact timing of planting would have to be optimized for the specific conditions of the Refuge. We would be willing to provide volunteers to assist Refuge managers in any future reseeding efforts.

The EA should also analyze an alternative that involves eliminating all external disturbances, including grazing, from Refuge grasslands.

Every Alternative identified in the Refuge EA analyzed the impact of an external disturbance on Refuge grasslands; however, there is no analysis of the impacts of eliminating all external disturbances from the Refuge. While the goal of the EA was to analyze the impacts of different methods of removing non-native plants and promoting native plants, removing all external disturbances could in fact be viewed as an active tool for restoring Refuge grasslands. If the native plants on the Refuge are found to be highly sensitive to grazing and the alien plants found to benefit greatly from disturbance, it may be most beneficial to the native plants to simply remove all disturbances—grazing, mowing, burning, herbicides, etc.—and allow the native plants to recover in the absence of disturbance.

Indeed, Refuge managers have already observed that "wetland and riparian habitats that were fenced from cattle are showing a dramatic comeback" and that "the wetland and riparian areas that were protected from cattle continue to rebound naturally, without employing active restoration practices" (EA p. 15). It may be possible that the native plants in other areas of the Refuge could similarly recover without "active restoration practices." Moreover, it is possible that elimination of all disturbances could further benefit native ungulates, resulting in a greater increase in their populations. The browsing and grazing of native ungulates could then perhaps manage the vegetation on the Refuge sufficiently to benefit native plants and animals.

These suggested impacts of eliminating all disturbances on the Refuge are, of course, just speculation, and need to be thoroughly evaluated by the EA before management takes the drastic step of removing all disturbances. As identified earlier in this report, drastic changes in management of grasslands can sometimes negatively impact native plants (e.g., Painter 1995), and excessive build-up of thatch caused by non-native plants can negatively impact some small mammals and lizards (e.g., Germano, Rathbun, and Saslaw 2001, Germano et al. 2006). Nevertheless we feel it is important that the EA evaluate a "No Disturbance" Alternative and determine whether that would be a more effective approach at promoting and restoring native species than the Preferred Alternative on Refuge grasslands. As also explored earlier in this letter, the responses of native plants and animals vary from site to site, and we feel it is imperative that the Refuge fully understand the impacts of all possible restoration tools and management measures specifically on Refuge grasslands, before the Refuge implement a management and restoration plan. At the very least, regardless of what Alternative is decided on for the Refuge, managers should maintain a network of control plots, which exclude all external disturbances, in order to have a baseline to compare the effects of restoration tools on native plants and animals on the Refuge.

Conclusions and Recommendations

If there is one thing that is evident in the current scientific literature, it is that each grassland site and plant community responds in a unique way to the restoration tools proposed in the Refuge EA. Thus, any management and restoration plan that is developed for the Refuge must be site-specific and maintain the utmost flexibility to change and adapt according to the responses of native and non-native plants observed on Refuge grasslands. Alternative D (the Preferred Alternative) is the most flexible of the proposed management schemes for removing non-native invasive plants from the Refuge and promoting native plants; however, the literature explored in this letter suggests that there are a number of alternatives that were left out of the EA which may perform equally as well, or even better, on the Refuge. These include an Alternative in which all disturbance is eliminated from Refuge grasslands; another in which active seeding of native plants (with local seed sources) is used in combination with elimination of disturbance; and others in which a combination of restoration tools are used along with active seeding (again with native plants from local seed sources).

We feel it is important that the Refuge consider and analyze the impacts of restoring the Refuge to a "natural" state without mechanical, chemical, or grazing disturbances, as well as consider the benefits of actively seeding or replanting native plants with or without removal of non-natives. As grazing has not been present on the Refuge for almost three years, this provides an opportunity to observe native plant response in areas of the Refuge where grazing occurred for decades and would facilitate any necessary studies to analyze the impacts of eliminating all disturbance from the Refuge. Additionally, this would facilitate analysis of active seeding, and permit the creation of a management plan that is specific to the Refuge, based on the unique response of Refuge plants to no disturbance, active seeding, disturbance with seeding, and other Alternatives. No matter what Alternative is decided upon, the Refuge should at least maintain a number of "control" plots, which remain free of external disturbances. This would permit comparative studies of control vs. managed areas on the Refuge, and allow managers to assess the success of restoration on Refuge grasslands.

In conclusion, we would like to reiterate our support for the Preferred Alternative described in the *Environmental Assessment for Grassland Habitat Management and*

Restoration Plan for the Bitter Creek National Wildlife Refuge, as it is the most flexible of the proposed Alternatives, but also suggest exploration of other Alternatives that could restore Refuge grasslands. The seasonal rotational grazing program we believe can potentially accomplish the Refuge goals of increasing the abundance and diversity of native plants if the program is managed closely and monitored regularly. We also feel the Stipulations provided in the *Compatibility Determination* will protect the Refuge from many of the negative impacts from livestock grazing if they are strongly enforced, and provide the Refuge with the necessary option of excluding livestock from the Refuge entirely if grazing is found to negatively impact Refuge grasslands. We also, however, caution that the proposed seasonal rotational grazing program comes with some risks, as it can have positive impacts on some native plants and animals but negative impacts on others. Again, the program must be monitored closely to ensure that it is benefiting native plants and animals on the Refuge, and maintaining the flexibility needed to adapt rapidly to avert any potential negative impacts to Refuge grasslands.

Thank you for your thoughtful management of these important public lands and for considering our concerns and recommendations. Please contact us if you would like to discuss these issues further.

Sincerely,

Zack Bradford
Program & Outreach Coordinator
Los Padres ForestWatch
P.O. Box 831
Santa Barbara, CA 93102
(805) 617-4610 x12

Pamela Flick
California Program Coordinator
Defenders of Wildlife
1303 J Street, Suite 270
Sacramento, CA 95814
(916) 313-5800 x105

Attachments

Literature Cited

Bartolome, J.W., J.S. Fehmi, R.D. Jackson, and B. Allen-Diaz. 2004. Response of a Native Perennial Grass Stand to Disturbance in California's Coast Range Grassland. *Restoration Ecology* 12(2):279-289.

Belsky, A.J., and J.L. Gelbard. 2000. Livestock grazing and weed invasions in the arid west. Published by the Oregon Natural Desert Association.

DiTomaso, J.M., K.L. Heise, G.B. Kyser, A.M. Merenlender, and R.J. Keiffer. 2001. Carefully timed burning can control barb goatgrass. *California Agriculture* 55(6):47-53.

DiTomaso, J.M., S.F. Enloe, and M.J. Pitcairn. 2007. Exotic Plant Management in California Annual Grasslands. In: *California Grasslands: Ecology and Management*, J. Corbin, M. Stromberg, and C.M. D'Antonio (editors). UC Press.

Germano, D.J., G.B. Rathbun, and L.R. Saslaw. 2001. Managing exotic grasses and conserving declining species. *Wildlife Society Bulletin* 29(2):551-559.

Germano, D.J., E. Cypher, L.R. Saslaw, and S. Fitton. 2006. Effects of livestock grazing on a community of species at risk of extinction in the San Joaquin Valley, California. Lokern Study Area Annual Report, 30 December 2006. 25 pp.

Hamilton, J.G., C. Holzapfel, and B.E. Mahall. 1999. Coexistence and interference between a native perennial grass and non-native annual grasses in California. *Oecologia* 121:518–526.

Hamilton, J.G., J.R. Griffin, and M.R. Stromberg. 2002. Long-term population dynamics of native *Nassella* (Poaceae) bunchgrasses in central California. *Madroño* 49(4): 274-284. Abstract at: http://apt.allenpress.com/perlserv/?request=get-abstract&doi=10.1043%2F0024-9637(2002)049%5B0274%3ALPDONP%5D2.3.CO%3B2&ct=1

Hayes, G.F. and K.D. Holl. 2003. Cattle Grazing Impacts on Annual Forbs and Vegetation Composition of Mesic Grasslands in California. *Conservation Biology* 17(6):1694-1702.

Holechek, J.L., H. Gomes, F. Molinar, D. Galt, and R. Valdez. 2000. Short-duration grazing: the facts in 1999. *Rangelands* 22(1): 18-22.

Huntsinger, L., J.W. Bartolome, and C.M. D'Antonio. 2007. Grazing Management on California's Mediterranean Grasslands. In: Corbin, J., M. Stromberg, and C.M. D'Antonio (eds.). 2007. California Grasslands: Ecology and Management. UC Press.

Jackson, R.D., and J.W. Bartolome. 2007. Grazing ecology of California grasslands. In: Corbin, J., M. Stromberg, and C.M. D'Antonio (eds.). 2007. California Grasslands: Ecology and Management. UC Press.

Keeley, J.E. 2001. Fire and invasive species in Mediterranean-climate ecosystems of California. Pages 81–94 *in* Galley, K.E.M. and T.P. Wilson (eds.). Proceedings of the Invasive Species Workshop: the Role of Fire in the Control and Spread of Invasive Species. Fire Conference 2000: the First National Congress on Fire Ecology, Prevention, and Management. Miscellaneous Publication http://jfsp.nifc.gov/invasive%20publications/ttrs_22pr_06_81_94_c.pdf

Kie, J. G., Evans, C. J., Loft, E. R. and Menke, J. W. 1991. Foraging behavior by mule deer: the influence of cattle grazing. J. Wild. Manage. 55: 665-674.

Kimball, S. and P.M. Schiffman. 2003. Differing Effects of Cattle Grazing on Native and Alien Plants. *Conservation Biology* 17(6):1681-1693.

Leonard, S., R. Rosentreter, and M. Karl. 1995. Microbiotic Crusts: Ecological Roles and Implications for Rangeland Management in the Interior Columbia Basin and Portions of the Klamath and Great Basin. Interior Columbia Basin Ecosystem Management Project Science Integration Team Terrestrial Staff Range Task Group.

Loft, E.R., Menke, J.W. and Kie, J. G. 1991. Habitat Shifts by Mule Deer - the Influence of Cattle Grazing. Journal of Wildlife Management 55(1): 16-26.

Malcom, J.W., and W.R. Radke. 2008. Livestock trampling and *Lilaeopsis schaffneriana var. recurva* (Brassicacea). *Madroño* 55(1):81.

Menke, J.W. 1992. Grazing and Fire Management for Native Perennial Grass Restoration in California Grasslands. *Fremontia: A Journal of the California Native Plant Society* 20(2): 22-25.

Painter, E.L. 1995. Threats to the California flora: ungulate grazers and browsers. Madroño 42(2):180-188.

Painter, E.L. 1996. Effects of herbivory (grazing/browsing) on plants and vegetation. California Native Plant Society, Sacramento, CA.

Rosentreter, R. 1992. Displacement of rare plants by exotic grasses. Paper presented at the Symposium on Ecology, Management, and Restoration of Intermountain Annual Rangelands, Boise, ID, May 18-22, 1992.

Schiffman, P.M. 2002. Scoping Comments – Carrizo Plain National Monument. Paula M. Schiffman, Ph.D. Professor of Biology (and Carrizo Plain researcher). California State University. Northridge, CA.

Schiffman, P.M. 2007. Ecology of Native Animals in California Grasslands. In: Corbin, J., M. Stromberg, and C.M. D'Antonio (eds.). 2007. California Grasslands: Ecology and Management. UC Press.

Seabloom, E.W., E.T. Borer, V.L. Boucher, R.S. Burton, K.L. Cottingham, L. Goldwasser, W.K. Gram, B.E. Kendall, and F. Micheli. 2003a. Competition, Seed Limitation, Disturbance, and Reestablishment of California Native Annual Forbs. *Ecological Application* 13(3):575-592.

Seabloom, E.W., W.S. Harpole, O.J. Reichman, and D. Tilman. 2003b. Invasion, competitive dominance, and resource use by exotic and native California grassland species. *Publication of The National Academy of Sciences of the USA* 100(23):13384-13389.

Stromberg, M.R., C.M. D'Antonio, T.P. Young, J. Wirka, and P.R. Kephart. 2007. California Grassland Restoration. *in* Corbin, J., M. Stromberg, and C.M. D'Antonio (eds.). 2007. California Grasslands: Ecology and Management. UC Press.

USFWS (U.S. Fish and Wildlife Service). 2005. Biological and Conference Opinions on the Revised Land and Resource Management Plans for the Four Southern California National Forests, California (1-6-05-F-773.9). http://www.fs.fed.us/r5/scfpr/projects/lmp/docs/bo.pdf

WERC. 2001. Can livestock grazing weed out invasive grasses that threaten endemic species? Western Ecological Research Center. USGS WERC Fact Sheet. U.S. Department of the Interior. U.S. Geological Survey. Last updated May 21, 2001. http://www.blm.gov/pgdata/etc/medialib//blm/ca/pdf/pdfs/bakersfield_pdfs.Par.d37c106d.File.pdf/ibarnum.pdf

Williams, D.F., E.A. Cypher, P.A. Kelly, K.J. Miller, N. Norvell, S.E. Phillips, C.D. Johnson, and G.W. Colliver. 1998. *Recovery plan for upland species of the San Joaquin Valley, California. 2.H. Giant Kangaroo Rat (*Dipodomys ingens*)*. Region 1 U.S. Fish and Wildlife Service. Portland, OR. http://esrp.csustan.edu/publications/pubhtml.php?doc=sjvrp&file=chapter02H00.html

Williams, D.F., E.A. Cypher, P.A. Kelly, K.J. Miller, N. Norvell, S.E. Phillips, C.D. Johnson, and G.W. Colliver. 1998. *Recovery plan for upland species of the San Joaquin Valley, California. 2.K. Blunt-Nosed Leopard Lizard (*Gambelia sila*)*. Region 1 U.S. Fish and Wildlife Service. Portland, OR. http://esrp.csustan.edu/publications/pubhtml.php?doc=sjvrp&file=chapter02K00.html