Conservation Strategy for Coastal Prairie Conservation

Issue Identification

Humans have severely directly and indirectly impacted grasslands in California during the last 300 years such that conservation of this ecosystem should now be a priority. The vast majority of California's original grasslands have been converted to agriculture or urban development (Huenneke and Mooney 1989). Remaining undeveloped grasslands face continued development pressure and are severely impacted by exotic, invasive organisms (Bartolome 1989). These remaining grasslands are recognized as one of the most endangered ecosystems in the United States (Noss et al. 1995).

The most in tact remaining grasslands lie in the fog belt along the coast and have variously been referred to as "coastal prairie" "northern coastal prairie" "coastal terrace prairie (Heady et al. 1988a)." These grasslands are thought to contain the most plant diversity of any grasslands in North America (Stromberg et al. 2002). The core habitat of many species of plants and animals is contained the habitat matrix including coastal prairie (Appendix 1). Coastal prairie is home to most populations of at least 30 species of endangered plant and animal species (Appendix 2).

Conservation of remaining coastal prairie requires recognition and protection of remaining prairie areas as well as an understanding of the threats to the system from invasion, changes of disturbance regimes, and fragmentation. Much is already known about grassland ecology, but there has been little published research focused specifically on California coastal prairie (Foin and Hektner 1986, Heady et al. 1988b, Marvier 1998, Hatch et al. 1999, Maron and Jefferies 2001). The following section should serve as a basic methodology for recognizing coastal prairie areas so that conservation measures can be put in place to protect their remaining habitat.

California Coastal Prairie Composition

Grasslands in coastal California vary depending on slope, aspect (Harrison 1999), and hydrology, but there appear to be community composition divisions between "xeric" and "mesic" types (Appendix 3). As with many plant community types in California, there is a great deal of community composition variation at local and landscape scales.

In describing the community composition of California grasslands, there has been much focus on the density of perennial grasses (particularly "bunchgrasses") (Barry 1972, Burcham 1975). The emphasis on perennial grasses is probably a mistake rooted in the presupposition that California grasslands, in their pristine state, would have been similar to Midwestern grasslands (Blumler 1992, Holstein 2001). However, the Mediterranean climate of California has driven the evolution of a diverse assemblage of annual grassland plants, particularly forbs, many of which are endemic to these grasslands . These annual species respond to a variety of germination cues so that they are not present in all years or under all management regimes (Talbot et al. 1939, Duncan 1975, Pitt and Heady 1978). The variation in abundance of this species has created the popularly

recognized "wildflower years" that make California so famous. However, it is this variation that also makes it difficult to recognize the conservation value of what are, in many years, fields devoid of wildflowers. Therefore, it is present policy to assess grassland habitat value based on perennial grasses. In this respect, coastal prairie is widely recognized as containing two species of perennial grass: Danthonia californica (California oatgrass) and Nassella pulchra (purple needlegrass). However, a few other perennial grass species may be equally important in various coastal prairie sites (Appendix 3).

Assessing Conservation Value of California Coastal Prairie

It has been common practice to assess the conservation value of a given grassland site by recording a visual estimate of the percent cover of California oatgrass and purple needlegrass. Usually, this estimate is derived by walking a site and mapping variously sized patches as containing these species. Then, the percent cover within those patches is enumerated with a non-plot based ocular estimate or, more rarely, by recording visual estimates from quadrats placed within the patch.

For conservation purposes, scientists and agency personnel do not recognize a threshold value for percent cover of native grasses (Todd Keeler-Wolf, pers. comm). Data collected in the spring from numerous locations throughout the geographic extent of remaining coastal prairie areas suggest that few areas contain more than 15% relative cover of all native perennial grasses (Grey Hayes, unpublished data). Most of the cover in coastal prairie, as with all California grasslands, is exotic species. There is no data on the cover or extent of native grasses prior to the advent of these species, so it is difficult to assess potential cover for native perennial grasses at any site. There is, however, sufficient literature on the perennial native grasses to state a few important conclusions:

1) Even in relatively in tact areas, there have been historic factors such as overgrazing, disease, drought, and competition with exotic, invasive species (in combination or alone) that has caused native perennial grasses to decline;
2) Perennial grasses experience extreme competition with exotic species, especially exotic annual grasses;
3) Otherwise, reestablishment and growth is limited primarily by edaphic factors in xeric areas and by seed dispersal and in mesic areas;
4) Perennial grasses, like most grassland species, are patchily distributed through any given patch of grassland;

Given these conclusions, it is evident that the conservation value of a given grassland site is well indicated by the presence, even in low numbers and in diffuse patches, of perennial bunchgrasses. It should be remembered that, even in the absence of native perennial grasses (and in the presence of abundant weeds) a diverse flora of native grasses and forbs may exist in the seedbank- but, this it is beyond the presently accepted regulatory framework to assess this possibility. At present, the following assessment criteria are suggested.

Assessment Criteria

There are two types of grasslands that will have little potential to contain much native plant diversity. First, there are areas degraded by prior agriculture ("old fields"): if an area has been intensely cultivated, irrigated, or fertilized, the chance that it maintains much, if any, native plant diversity is slight. In such cases, there will be no native grasses in the center of the field as dispersal will be very slow and only along the fields' border (Stromberg and Griffin 1996). Historic photographs are a primary source of this information, but old hay fields appear as cultivated in photographs, but may have only been marginally disturbed may still maintain stands of native species.

The second type of grassland with little potential for native plant diversity is an area that has been type converted from other community types. It was historically common for ranchers to convert oak and scrub habitat to rangeland, and these areas may have recovered little plant species diversity typical of more intact grassland (Huenneke and Mooney 1989). In this case, historic photographs will be the only means of assessment.

If an area does not meet the previous two criteria, then it is necessary for a more intensive survey. The first stage of assessment should be a thorough mapping of the density and distribution of native perennial grasses. Coastal grassland areas that are of conservation value will, most likely, have individual native grass plants distributed in varying densities throughout the extent of the site. Because of varying topography, soils, hydrology, and so forth, there may be very few to very many individual bunchgrasses per acre. Mapping the distribution and densities of perennial grasses may help identify historic management boundaries that impacted the system (eg., old fields and type conversion). There is no known correlation between biotic values of dense vs. diffuse stands of native perennial grasses. The purpose for mapping perennial grass distribution and density is to assess site history. The presence of native perennial grasses may serve as an indicator for the potential for the site to contain other, more diverse species in the soil seed bank and for the site to offer the habitat for an array of animals which depend on this ecosystem.

Bibliography

Barry, W. J. 1972. The Central Valley Prairie. report California Department of Parks and Recreation, Sacramento, California.

Bartolome, J. W. 1989. Ecological history of the California Mediterranean-type landscape. Pages 2-15 *in* J. W. Clawson, editor. Landscape Ecology: Study of Mediterranean Grazed Ecosystems. Proceedings of the Man and the Biosphere Symposium XVI International Grasslands Congress, Nice, France.

Blumler, M. A. 1992. Some myths about California grasslands and grazers. Fremontia **20**:22-27.

Burcham, L. T. 1975. Climate, structure, and history of California's annual grassland ecosystem. Pages 16-31 *in* R. M. Love, editor. The California Annual Grassland Ecosystem. The Institute of Ecology, University of California at Davis, Anaheim, California.

Duncan, D. A. 1975. The San Joaquin site of the grassland biome: its relation to annual grassland ecosystem synthesis. Pages 9-13 *in* R. M. Love, editor. The California Annual Grassland Ecosystem. Institute of Ecology, University of California at Davis, Anaheim, California.

Foin, T. C., and M. M. Hektner. 1986. Secondary succession and the fate of native species in a California coastal prairie community. Madroño **33**:189-206.

Harrison, S. 1999. Native and alien species diversity at the local and regional scales in a grazed California grassland. Oecologia **121**:99-106.

Hatch, D. A., J. W. Bartolome, J. S. Fehmi, and D. S. Hillyard. 1999. Effects of burning and grazing on a coastal California grassland. Restoration Ecology **7**:376-381.

Heady, H. F., J. W. Bartolome, M. D. Pitt, G. D. Savelle, and M. C. Stroud. 1988a. The California prairie. Pages 313-335 *in* R. T. Coupland, editor. Natural Grasslands: introduction and western hemisphere. Elsevier, New York, New York.

Heady, H. F., T. C. Foin, M. M. Hektner, D. W. Taylor, M. G. Barbour, and W. J. Barry. 1988b. Coastal prairie and northern coastal scrub. Pages 733-762 *in* M. G. Barbour and J. Major, editors. Terrestrial vegetation of California. California Native Plant Society.

Holstein, G. 2001. Pre-agricultural grassland in central California. Madroño **48**:253-264.

Huenneke, L. F., and H. A. Mooney. 1989. The California annual grassland: an overview. Pages 213-218 *in* L. F. a. H. M. Huenneke, editor. Grassland Structure and Function: California Annual Grassland. Kluwer Academic Publishers, Dordrecht, Netherlands.

Maron, J. L., and R. Jefferies. 2001. Restoring enriched grasslands: effects of mowing on species richness, productivity, and nitrogen retention. Ecological Applications **11**:1088-1100.

Marvier, M. A. 1998. Parasite impacts on host communities: plant parasitism in a California coastal prairie. Ecology **79**:2616-2623.

Noss, R. F., E. T. LaRoe, and J. M. Scott. 1995. Endangered Ecosystems of the United States: A Preliminary Assessment of Loss and Degradation. Biological Report 28, National Biological Service, Moscow, Idaho.

Pitt, M. D., and H. F. Heady. 1978. Responses of annual vegeation to temperature and rainfall patterns in northern California. Ecology **59**:336-350.

Stromberg, M. R., and J. R. Griffin. 1996. Long-term patterns in coastal California grasslands in relation to cultivation, gophers, and grazing. Ecological Applications **6**:1189-1211.

Stromberg, M. R., P. Kephart, and V. Yadon. 2002. Composition, invasability, and diversity in coastal California grasslands. Madroño **48**:236-252.

Talbot, M. W., H. H. Biswell, and A. L. Hormany. 1939. Fluctuations in the annual vegetation of California. Ecology **20**:394-402.

APPENDIX 1: Prairie dependent species of Santa Cruz County

Scientific name	**Common name**
Anagallis minima	
Brodiaea terrestris	
Brodiaea elegans	Elegant Brodiaea
Calandrinia ciliata	Red maids
Calochortus luteus	Yellow mariposa lily
Calochortus uniflorus	
Camissonia ovata	Sun cups
Carex brevicaulis	
Carex densa	
Castilleja castillejoides	
Castilleja densiflora var densiflora	Purple owl's clover
Castilleja densiflora var noctuinus	
Cicendia quadrangularis	
Cirsium quercetorum	Brownie thistle
Clarkia daveyi	
Clarkia purpurea purpurea	Four spot
Chorizanthe robusta hartwegiana	Scotts Valley Spineflower
Danthonia californica	California oatgrass
Deschampsia caespitosa	Tufted hair grass
Deschampsia danthonioides	
Dichondra donnelliana	
Dodecatheon clevelandii	Cleveland's shooting star
Hemizonia corymbosa	
Holocarpha macradenia	Santa Cruz Tarplant
Horkelia marinensis	Pt. Reyes Horkelia
Isoetes spp.	Quillworts
Juncus bufonius	Toad rush
Juncus occidentalis	Western rush
Lasthenia californica	Goldfields
Lilaea scilloides	
Linanthus parviflorus	
Lotus formosissimus	Coast trefoil
Lupinus nanus	Sky lupine
Microseris bigelovii	Bigelow's Microseris
Microseris paludosa	
Montia fontana	
Panicum pacificum	Pacific panic grass
Perideridia gairdneri	Gairdner's Yampah
Perideridia kelloggii	Kellogg's Yampah

Plagiobothrys chorisianus	Artist's popcornflower
Plagiobothrys diffusus	San Francisco popcornflower
Sanicula arctopoides	Footsteps of spring
Scirpus cernuus	
Scirpus koiolepis	
Sidalcea malvaeflora	Checkerbloom
Spiranthes romanzoffiana	Western ladies tresses
Trifolium buckwestiorum	Santa Cruz clover
T. variegatum, T. barbigerum, T. microdon, T. depauperatum, T. appendiculatum, T.grayi, T. truncatum	Many other clovers
Triphysaria eriantha eriantha	
Triphysaria eriantha rosea	
Triphysaria faucibarbata	
Triphysaria pusilla	
Triteleia hyacinthina	Hyacinth flowered Brodiaea
Viola pedunculata	
Zigadenus fontanus	
Zigadenus fremontii minor	Dwarf star lily

Non-native Plants

Scientific name	Common name
Avena barbata	Slender oats
Avena fatua	Wild oats
Bellardia trixago	
Brachypodium distachyon	
Bromus hordeaceus	Soft chess
Erodium botrys	Storks bill
Erodium cicutarium	Red stemmed filaree
Festuca arundinacea	Tall fescue
Holcus lanatus	Velvet grass
Hordeum murinum	Foxtail
Leontodon nudicaule	Hawk bit
Lolium multiflorum	Italian rye grass
Phalaris arundinacea	Harding grass
Plantago lanceolata	English plantain
Romulea spp.	
T. angustifolium	
T. dubium	
Trifolium subterraneum	

Native Animals
(common names)

American kestrel
Badger
Buckeye butterfly
Burrowing owl
California ground squirrel
California ringlet
Ferruginous hawk
Golden eagle
Gopher snake
Grasshopper sparrow
Northern harrier
Western meadowlark
Western racer
White-tailed kite
Horned lark
Lark sparrow
Meadow vole
Ohlone tiger beetle
Opler's longhorn moth
Oxeye satyr butterfly
Savannah sparrow
Western bluebird

APPENDIX 2: Listed and sensitive plant species in California Coastal Prairie

Blennosperma nanum var. robustum	Point Reyes Blennosperma
Campanula californica	Swamp harebell
Chorizanthe cuspidata var. cuspidata	San Francisco Bay spineflower
Chorizanthe cuspidata var. villosa	San Francisco spineflower
Chorizanthe howellii	Mendocino spineflower
Chorizanthe robusta hartwegii	Howell's spineflower
Chorizanthe valida	Sonoma spineflower
Eriogonum luteolum var. caninum	Tiburon buckwheat
Hemizonia congesta ssp. tracyi	Tracy's tarplant
Hemizonia parryi ssp. congdonii	Congdon's tarplant
Holocarpha macradenia	Santa Cruz tarplant
Limnanthes douglasii ssp. sulphurea	Point Reyes meadowfoam
Limnanthes vinculans	Sebastopol meadowfoam
Linanthus acicularis	bristly linanthus
Linanthus grandiflorus	large-flower linanthus
Micropus amphibolus	Mt. Diablo cottonweed
Plagiobothrys chorisianus	artist's popcornflower
Plagiobothrys diffusus	San Francisco popcornflower
Polygonum hickmanii	Scotts Valley Polygonum
Stebbinsoseris decipiens	Santa Cruz Microseris
Trifolium amoenum	showy Indian clover
Trifolium grayii	Gray's clover
Trifolium buckwestiorum	Santa Cruz clover
Trifolium polyodon	Pacific Grove clover
Triphysaria floribunda	San Francisco owl's-clover

APPENDIX 3: Indicator species for native prairies

Wet Meadows

Grasses:

Danthonia californica
Deschampsia caespitosa
Hordeum brachyantherum
Juncus occidentalis
Juncus bufonius
Carex breviculus
Carex tumulicola

Forbs:

Ranunculus californicus
Oenothera ovata
Lotus formosissimus
Trifolium wormskioldii
Hemizonia ssp.
Triphysaria ssp.
bulbs

More Xeric Sites

Grasses:

Nassella pulchra
Koeleria cristata
Festuca rubra
Bromus carinatus (grassland type)
Elymus glaucus (grassland type- less distinct than B. carinatus variations)
Juncus patens

Forbs:

Castilleja ssp.
Trifolium ssp.
Madia elegans
Linanthus ssp.
Clarkia ssp.
Amsinckia ssp.