VEGETATION ASSOCIATION: GRASSLANDS

VEGETATION SUBASSOCIATIONS: Valley and Foothill Grasslands, Non-native grasslands

DATA CHARACTERIZATION

The distribution of Valley and foothill grasslands is larger than that shown in the MSCHP mapping. Because native grasslands are typically small, difficult to differentiate from non-native grasslands using aerial photographs, and require field verification to identify, the true extent of native grasslands in the Plan Area remains unknown. A cost-effective method to estimate the location of existing native grasslands within the Plan Area would be to digitize maps of clay soils from the Riverside County soil survey (Knecht 1971) and combine these with the mapped extent of existing grasslands. This mapping also would be helpful to determine locations that may support Valley and foothill grasslands given future changes in the landscape. Without additional data it would be difficult to evaluate preserve designs in regard to the Conservation of native grasslands.

With the exception of differentiating potential native grasslands, the distribution of non-native grasslands is adequately represented. Grasslands are relatively simple to differentiate from other vegetation types using aerial photography. Some errors may be present due to recent type conversion or misinterpretation of agricultural fields.

BIOGEOGRAPHY

The historic distribution of Valley and foothill grasslands has been described from central California to Baja California Norte, from the coast into the Sierra foothills (Keeley 1990). Valley and Foothill grasslands have an elevational range from sea level to about 1200-1700 m (Heady 1977; Sawyer and Keeler-Wolf 1995). These native grasslands are widely distributed but are considered uncommon due to the long history of grazing and agricultural usage in lands previously supporting native grasslands. Non-native grasslands occur widely throughout the Mediterranean-type climate portion of California and Baja California, Mexico.

RANGE AND DISTRIBUTION WITHIN WESTERN RIVERSIDE COUNTY

Grasslands occur throughout most of Western Riverside County cover approximately 11.8% (154,421 acres) of the Plan Area. The only Valley and foothill grasslands mapped within the

Plan Area are distributed over approximately 2,736 acres (0.2 %) of the Plan Area on the Santa Rosa Plateau. Non-native grasslands occur throughout the majority of the Plan Area (11.6%), usually within close proximity to urbanized or agricultural land uses. Large patches of non-native grasslands occur in the Riverside east area near March Air Reserve base, Lake Mathews, Lake Perris, Lake Elsinore, near Banning, Cahuilla, and in the Terwilliger Valley south of Anza. Non-native grasslands are not common or extensive in high elevation areas that support large blocks of native vegetation (*e.g.,* the Santa Ana and San Jacinto Mountains). Because much of the Plan Area was mapped with the use of aerial photo interpretation, some Valley and foothill grasslands were included within the non-native grassland category. Additional Valley and Foothill grasslands are known from the Santa Ana Mountains (MARKEL and Associates 1982), the northwestern portion of the Agua Tibia Wilderness (Boyd and Banks 1995), and the Gavilan Hills (Boyd 1983). Additional ground truthing of areas supporting grasslands and clay or deep, well developed soils is necessary to determine the location of other important stands of Valley and foothill grasslands.

VEGETATION CHARACTERISTICS

The nature and extent of grasslands in California have long been subject to varying opinions ranging from Clements' (1920) view that much of the extent of contemporary non-native grasslands formerly was occupied by native perennial grasses, to Cooper's (1922) more restrictive view where most of the area currently supporting non-native grasslands was formerly shrublands or oak woodlands (cited in Hamilton 1997). Lacking definitive evidence to support either assertion most reviews of California grasslands have described two grassland associations: (1) a non-native dominated, primarily annual grassland; and (2) a native dominated, perennial grassland (Heady 1977; Keeley 1989; Sims and Risser 2000). These and other authors have suggested that the extant perennial grasslands represent relictual stands of "pristine" native grasslands. Hamilton (1997) has provided a critical review of past research in native grasslands in California, positing that most of the current distribution of non-native grasslands in central and southern California historically was not extensively perennial grasslands but shrublands, woodlands or desert scrub vegetation. Although there is debate about the distribution and pristine nature of native grasslands it is known that areas supporting native grasses in southern California are currently uncommon and support high diversity of both native and sensitive plant species.

Within the Western Riverside MSHCP Plan Area perennial and annual grasslands were mapped as Valley and foothill grasslands or non-native grasslands (PSBS 1995). Currently used synonyms for these types include Valley needlegrass grassland (Holland 1986), purple needlegrass and foothill needlegrass series for the native grasslands, and California annual grassland series for the non-native grasslands (Sawyer and Keeler-Wolf 1995).

SPECIES COMPOSITION

Valley and Foothill Grasslands. Valley and foothill grasslands occur in a variety of forms ranging from scattered perennial bunch grasses (typically *Nassella pulchra*, *or N. lepida*) with high abundance of non-native grasses and forbs to stands dominated by native perennial grasses in an assemblage of geophytes (plants with underground bulbs or corms), and herbaceous annual species (Holland 1986; Keeley 1989; Sims and Risser 2000). *Melica* spp., *Leymus* spp, beard grass (*Bothriochloa barbinodis*), *Muhlenbergia* spp., and other native perennial grasses may also occur in Valley and foothill grasslands but typically not in high abundance (Holland 1986; Keeley 1989; Sawyer and Keeler-Wolf 1995; pers. obs.). The percent cover of perennial grasses in undisturbed Valley and foothill grasslands has been estimated at 50 to 75% cover (Keeley 1989). Some researchers have defined current stands of native grasslands as having as little as 10% percent cover of native grasses (California Department of Fish and Game; Keeley 1993). Valley and foothill grasslands usually support substantial cover of non-native grasses (see examples below) and exotic forbs but at lower abundance than in non-native grasslands. Valley and foothill grasslands also support native geophytes, including representatives from the following species or genera: onion (*Allium* spp.), wild-celery (*Apiastrum angustifolium*), common golden star (*Bloomeria crocea*), *Brodiaea* spp., *Calochortus* spp., blue dicks (*Dichelostemma capitata*), *Muilla* spp., *blue-eyed grass* (*Sisyrinchium bellum*), and *Dudleya* spp. (Holland 1986; Keeley 1989; pers. obs.). Native herbaceous plants commonly found within Valley and foothill grasslands include yellow fiddleneck (*Amsinckia menziesii*), *Calandrinia* spp., common calyptridium (*Calyptridium monardum*), suncup (*Camissonia* spp.), *owl's-clover* (*Castilleja* spp.), *Chinese houses* (*Collinsia heterophylla*), *Cryptantha* spp. *Delphinium* spp. *California poppy* (*Eschcholzia californica*), *Gilia* spp., *tarweed* (*Hemizonia* spp.), coast goldfields (*Lasthenia californica*), *common tidy-tips* (*Layia platyglossa*), *Linanthus* spp., *Lomatium* spp., *Lotus* spp., *Lupinus* spp., *Microseris* spp., *Plagiobothrys* spp., *Sanicula* spp., checker mallow (*Sidalcea malvaeflora*), and clover (*Trifolium* spp.) (Holland 1986; Keeley 1989; pers. obs.). Because this vegetation is primarily herbaceous it is relatively simple structurally, rarely exceeding one meter in height (Sawyer and Keeler-Wolf 1995). Mapped native grasslands support early successional sub-shrub and suffrutescent species (*e.g., Astragalus spp., Ericameria* spp., *Eriogonum* spp., gum plant (*Grindelia camporum*), *Hazardia* spp., golden bush (*Isocoma menziesii*), virgate cudweed aster (*Lessingia filaginifolia*), *and* deerweed (*Lotus scoparius*) but these species occur at low abundances.

Few descriptions of the distribution and species composition of perennial grasslands in Western Riverside County appear in peer-reviewed publications. Many technical

documents from Conservation and development projects exist with descriptions of native grasslands in the Plan Area (*e.g.,* Lathrop and Thorne (1985); MARKEL and Associates 1982; Boyd and Banks 1995; Boyd 1983). Although these and other technical documents have not been peer-reviewed and may be uneven in quality, they are the best information available for specific places within the Plan Area.

The Valley and foothill needlegrass grassland within the Agua Tibia Wilderness area occur on cobbly clay soils and reportedly supports dense stands of foothill stipa (*Nassella lepida*) and nodding needlegrass (*N. cernua*) with lower abundance of other native grasses, such as California melic (*Melica imperfecta*), *junegrass* (*Koeleria macrantha*), Malpais bluegrass (*Poa secunda*), *Pacific fescue* (*Vulpia microstachys*), and six-weeks fescue (*V. octoflora*) (Boyd and Banks 1995). These grasslands are relatively rich in native geophyte and annual species, and support "well established" stands of non-native grasses and herbs (Boyd and Banks 1995). Additional unmapped Valley and foothill grasslands are reported within the southwestern portion of the Santa Ana Mountains including Elsinore Peak, Bluewater Flats, and Oak Flats area (MARKEL and Associates 1982). These grasslands were not surveyed for species composition but purple needlegrass was generally reported as the dominant native grass with occasional presence of geophyte species (MARKEL and Associates 1982). In a floral inventory of the Gavilan Hills, Boyd (1983) described a native grassland as dominated by foothill stipa and California melic with lower cover of California buckwheat, saw-toothed goldenbush (*Hazardia squarrosa*), virgate cudweed aster, and several herbs found on clay soils (*e.g.,* Munz's onion [*Allium munzii*], Cleveland's shooting-star [*Dodecatheon clevelandii*], and Palmer's grappling-hook [*Harpagonella palmeri*]).

Two additional native grassland types are known to occur within the western Riverside MSHCP Plan Area but were not specifically mapped: alkali playa and cismontane alkali marsh. Alkali playas support a native annual grassland type dominated by little barley (*Hordeum intercedens*) and annual hairgrass (*Deschampsia danthonioides*). Cismontane alkali marsh and disturbed alkali areas occasionally support small stands of saltgrass (*Distichlis spicata*) or beardless wild ryegrass (*Leymus tritichoides*). These grasslands were not specifically identified as part of the regional mapping effort but occur in small patches within their more broadly defined Habitats. These stands are addressed within the vernal pool and alkali playa, and cismontane alkali marsh descriptions.

Non-Native Grasslands. Non-native grasslands primarily are composed of annual grass species introduced from the Mediterranean basin and other mediterranean-climate regions with variable presence of non-native and native herbaceous species (Baker

1989; Mack 1989). Species composition of non-native grasslands may vary over time and place based on grazing or fire regimes, soil disturbance, and annual precipitation patterns (McNaughton 1968; Heady 1977; Keeley 1989). Non-native grasslands typically produce deep layers of organic matter which is inversely related to the abundance of non-native and native forbs (Heady 1956a). Non-native grasslands are likely to be dominated by several species of grasses: slender oat (*Avena barbata*), wild oat (*A. fatua)*, fox tail chess (*Bromus madritensis*), soft chess (*B. hordeaceus*), ripgut grass (*B. diandrus*), barley (*Hordeum* spp.), rye grass (*Lolium multiflorum*), English ryegrass (*L. perrene*), rat-tail fescue (*Vulpia myuros*), Mediterranean schismus (*Schismus barbatus*) that have evolved to persist in concert with human agricultural practices (Jackson 1985 *in* Sims and Risser 2000). Non-native grasslands also typically support an array of annual forbs from the Mediterranean-climate regions (*e.g.,* red-stemmed filaree [Erodium cicutarium]), broad-loabed filaree [*E. botrys*], mustard [*Brassica* spp.], short-podded mustard [*Hirschfeldia incana*], wild radish [*Raphanus sativus*], *Centaurea* spp., Italian thistle [*Carduus pycnocephalus*], artichoke thistle [*Cynara cardunculus*], common catchfly [*Silene gallica*]), *Medicago* spp., and *Hypochaeris* spp) (Keeley 1989; pers. obs.). Low abundances of native species are sometimes present within non-native grasslands. These species usually include disturbance specialists with several different growth forms: subshrubs (*e.g., Lotus* spp., *Eriogonum* spp., *Lessingia* spp, *Isocoma*, spp., *Ericameria* spp.); succulents (*Opuntia* spp.); perennial geophytes (*e.g., Dichelostemma capitata*); and herbaceous annuals (*e.g.,* doveweed (*Eremocarpus setigerus*), vinegar weed (*Trichostemma lanceolatum*), and tarweed (*Hemizonia* spp). (Holland 1986; Sawyer and Keeler-Wolf 1995; Keeley 1989).

PHYSICAL ENVIRONMENT

Because of a lack of agreement on the original Habitat and distribution of perennial (*i.e.,* native) grasslands in central and southern California, and because annual grasslands probably have developed from some form of disturbance (*e.g.*, grazing, discing, fire), the existing descriptions of the physical environment associated with native and non-native grasslands necessarily are vague. Discussion of the site preferences for this review consequently are limited to where perennial grasslands are currently known to occur rather than where they should occur or have occurred in the past.

Valley and Foothill Grasslands. Perennial grasslands have been described as occurring in many topographic locations within California (Sawyer and Keeler-Wolf 1995), with affinities toward more mesic north and east slope-aspects within a limited region (Keeley 1991; 1993). It is more likely, however, that perennial grasslands are closely

associated with soil characteristics particular to a local area. Statewide, perennial grasslands occur on a large variety of soil series; however, most of these support oak woodlands and other vegetation types (Barry 1972; Heady 1977). Most research has provided descriptive accounts of the soil conditions supporting perennial grasslands as deep, brown, fertile and having high clay content (Adams 1964; Heady 1977; Keeley 1989; Sims and Risser 2000). Soil affinities for Valley and foothill grasslands have been established within southeastern Ventura County where soil depth and percentage clay particles were positively related, and percentage rock was negatively related to percentage cover of native perennial grasses (Keeley 1993). Few soil chemical studies have been conducted within Valley and foothill grasslands and no strong relationship has been established between native grasses and soil nutrients (nitrogen, potassium or phosphate) (Keeley 1993). As part of this research, Keeley (1993) found a high fidelity of native grasslands to three soil series: Diablo, Santa Lucia, and San Andreas. None of these soil series occur within the MSHCP Plan Area; however, other series with clayey structure are known from Western Riverside County (*e.g.,* Altamont, Bosanko, Las Posas) (Knecht 1971). Another consistent theme in the physical environment supporting perennial grassland is that they occur upon soils that remain saturated during the winter and become completely dry during summer months (Keeley 1989; Holland 1986).

Non-Native Grasslands. Most non-native grasslands likely have developed as a result of past agricultural or urban development related activities including discing, brushing, grading, or overgrazing of native Habitats. Because non-native grasslands generally are associated with these disturbances, abiotic factors (excluding fire) probably play a diminished role in determining their distribution. Some large-scale physical environmental factors (*e.g.,* climates with summer drought) may facilitate development of annual grassland within native Habitats (Sims 1988; Keeley 1990). However, it is doubtful that non-native grasslands would develop in most Habitats in the absence of fire, grazing, or other form of disturbance. Species composition varies from one site to another but several annual grass species appear to show site preferences based on annual rainfall (Janes 1969). This research described grassland species along a rainfall gradient with soft chess and broad-lobed filaree on the mesic end (>20cm rainfall) with fox-tail chess and red-stemmed filaree in more xeric conditions(<19 cm) (Janes 1969). Abiotic factors are thought to influence the species composition of annual grasslands on a local scale. Seasonal variation in temperature, rainfall, and physical microsite differences have been shown to influence annual grassland species composition (Evans and Young 1989; [in S&K-W]).

ECOSYSTEM PROCESSES

Valley and foothill and non-native grasslands within the MSHCP Plan Area occur within a landscape mosaic consisting of native shrublands and woodlands (primarily chaparral and coastal sage scrub, and oak woodlands), and wetland vegetation (*e.g.,* riparian scrub, forest, and freshwater marsh) and urban and agricultural lands (PSBS 1995). The ecosystem processes regarding Valley and foothill grasslands and non-native grasslands are not well understood. The interacting roles of fire, grazing, cultivation, non-native species invasions, pollution, and urban development combined with only speculative understanding of the pre-European state of grasslands, complicates understanding the underlying formative and sustaining processes of grasslands. In light of these complications, discussion of ecosystem processes must address what is known currently about the known extent and nature of grasslands. Primary driving forces within grasslands in terms of changes in distribution, species composition, and ecosystem function probably include fire, grazing, and human settlement. Other ecological processes, including competition between species, nutrient cycling, and variation in precipitation and temperature probably are also important factors but many of these are difficult to analyze because of the changes introduced by humans.

Valley and Foothill Grasslands. The current distribution of Valley and foothill grasslands within southern California is limited to areas supporting deep clayey soils that have not been heavily disturbed by mechanical disturbance (Keeley 1993). Research concerning the ecosystem processes with Valley and foothill grasslands should focus not only on extant native grasslands, but also should consider other vegetation types that are currently present on or have acted to form heavy or clay soils similar to those that currently support native grasslands.

No conclusive evidence has emerged concerning the relationship between Valley and foothill grasslands and other shrubland or woodland Habitats within the same landscape. Research concerning the role of fire in the distribution and maintenance of Valley and foothill grasslands has offered few conclusive facts. Some research has suggested the distribution of native grasslands was related to a long history of burning by native Americans (Sampson 1944; Bean and Lawton 1973; Timbrook *et al.* 1982). Others dismiss native American burning as not playing a significant role in the distribution of native grasslands suggesting that lightning-caused fires were more likely in the process maintaining grassland ecology (Heady 1977). Evidence supporting this assertion includes the finding that more common perennial grassland dominants (*Nassella pulchra, N. lepida*) are adapted to fire; resprouting and producing greater volumes of seed following fire (Ahmed 1983; Keeley and Keeley 1984). Several field studies have reported an increasing cover *Nassella* spp. based on burning treatments (Hatch *et al.* 1991; Dyer *et al.* 1996; Wills pers. comm. 1995), while other studies have

shown mixed effects on species abundance from burning (Hatch *et al.* 1999). Though preliminary research has pointed to increasing abundance of perennial grasses following fire, there is little research describing the role of fire on maintaining the role of fire on other native species within Valley and foothill grassland Habitat.

The effects of grazing on Valley and foothill grasslands also remains unclear. In spite of the fact that a long history of intensive grazing in California has been cited as one of the primary reasons for the demise of perennial grasslands (Burcham 1957; Dasmann 1966 *in* Keeley 1990; Bartolome and Gemmill 1981) most research has found evidence suggesting that some intensity of grazing is beneficial to or does not negatively affect perennial grasses (Huntsinger *et al.* 1996). Several researchers have documented cases where native grasses have not increased in abundance on sites that have been excluded from grazing over relatively long (*e.g.,* 20 to 40 year) periods (White 1967; Bartolome and Gemmill 1981; Goode 1981; Heady *et al.* 1991). Heady (1968 1977) has suggested that large native herbivores present prior to European colonization may have been an important factor in grassland formation and ecology. This assertion supports studies that have found that some form of grazing may be necessary to maintain native perennial grasses (Heady *et. al.* 1991). Two related field studies have produced mixed results with respect to grazing. Hatch *et al.* (1991) found perennial grasses to increase in abundance with the exclusion of grazing, while more recent study, in a more coastal location, found no relationship between grazing exclusion and perennial grass cover. Much of the research that has been conducted concerning grazing and native grasslands has focused on the cover of perennial grass species. Additional research is needed to determine the effects of grazing on the abundance and diversity of the other native plant and animal species within perennial grasslands. Based on these studies, it appears that the interactive effect of grazing and native grassland reflects local conditions, and patterns and intensity of grazing. A generic grazing or burn management program may not work for all sites, and proper management treatments would have to be determined on a site-by-site basis.

Non-Native Grasslands. Without question the distribution of non-native grasslands has increased to the former distribution of native grasslands (*sensu.* Clements 1920) or beyond, occupying lands formerly consisting of coastal sage scrub (O'Leary and Westman 1988; Minnich and Dezzani 1999), chaparral (Zedler *et al.,* 1983), and oak woodlands (Callaway and Davis 1993). The literature describing this type conversion of native systems generally has shown that altered fire frequencies, grazing pressure or other physical disturbance combined with competitive exclusion by non-native species have caused the expansion of annual grasslands into native Habitats previously occupied by perennial species. Recent work by Minnich and Dezzani (1999) has

documented changes in the distribution of coastal sage scrub and annual grassland within a portion of Western Riverside County. This research has shown that non-native grasslands currently are increasing in distribution in areas formerly supporting coastal sage scrub. Some authors have noted that these grasslands have remained stable to an extent over time that it has been proposed to accept many non-native grassland species as "new natives" and manage non-native grasslands as though they were natural systems (Heady 1977). Acceptance of the current distribution of annual grasslands may be shortsighted because recent research in the coastal sage scrub/annual grassland interface has shown that the stability of non-native grasslands may be related to permanent changes in soil nutrient and moisture regimes caused by the presence of exotic species (Heunneke *et al.* 1990) and air pollution (Allen *et al.* 1996; Padgett *et al.* 1997) (Minnich and Dezzani 1998). Because non-native grasslands appear to be invading other Habitat-types and are themselves stable over long periods of time, management is necessary to stabilize or reduce their extent. Preserve design and management also must consider the fact that non-native grasslands have been present long enough to develop as Habitat, forage, and Habitat linkage for native animal species including listed species such as the Stephens' kangaroo rat. Management strategies should focus on reduction in the abundances of exotics that displace native species in other Habitats, increasing the abundances of native herbaceous species in grasslands, and minimizing the effects that cause non-native grasslands to be self-perpetuating.

THREATS

Valley and Foothill Grasslands. Threats to Valley and foothill grasslands may include disturbance of clay soils by agricultural activities, invasion of exotic species, grazing, fire, and urban development. Although Habitat management may be necessary for the preservation of native grasslands, it is also a potential threat to Valley and foothill grasslands because the character of Valley and foothill grasslands, and the processes that control them have not been established. Inappropriate grazing and fire treatments may not be productive and could result in Habitat degradation. Further study is needed to determine whether fire or grazing are necessary to maintain or develop native grasslands. If grazing and/or fire are necessary to maintain existing or to develop new perennial grasslands, studies must also determine the proper regimes under which native grasslands will persist. Because these regimes are not likely present under current and future conditions, management likely will be required to maintain or develop native grasslands. Quantitative descriptions of the extant native grasslands should be used to develop goals for what types of management would be implemented (*i.e.,* species composition, cover, *etc.*).

Non-Native Grasslands. Threats to non-native grasslands largely include direct loses due to urban development, increased agricultural activity, and invasion by noxious weedy species (*e.g.,* artichoke-thistle) that reduce the Habitat qualities necessary for native species.

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