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THE ETHNOBOTANY OF DEERGRASS, *MUHLENBERGIA RIGENS* (POACEAE): ITS USES AND FIRE MANAGEMENT BY CALIFORNIA INDIAN TRIBES[1]

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Anderson, M. Kat (*Natural Resources Conservation Service, American Indian Studies Center, University of California, Los Angeles, 3220 Campbell Hall, CA 90095-1548*). THE ETHNOBOTANY OF DEERGRASS, *MUHLENBERGIA RIGENS* (POACEAE): ITS USES AND FIRE MANAGEMENT BY CALIFORNIA INDIAN TRIBES. *Economic Botany* 50(4):409–422. 1996. *Deergrass* (Muhlenbergia rigens, *Poaceae*), *a once abundant and widespread native perennial bunchgrass in California, was utilized extensively by at least twenty tribes for its flower stalks, incorporated into many types of coiled baskets. The craft of coiled basketry required the annual harvesting of thousands of culms by each village and the frequent setting of small-scale fires in many plant community types to eliminate detritus, recycle nutrients, increase culm production and prohibit shrub or tree encroachment. Detailed examination of Native American past fire management practices will provide insights into the cultural processes that shaped various ecosystem states, and unravel the ecological principles embedded in ancient land management systems. There are at least 300 contemporary Native American weavers and the successful revival of basketry in California is inextricably tied to access to and availability of plant resources on public lands.*

Le Caractere Ethnobotanique de L'herbe Cervidee (*Muhlenbergia rigens* angl. deergrass, Graminées): Son Utilisation et la Gestion du Feu parmi les Tribus Amerindiennes Californiennes. *L'herbe cervidée* (Muhlenbergia rigens, angl. deergrass, Graminées), *une espèce d'herbe touffue anciennement abondante et répandue en Californie, était utilisée considérablement pour ses tiges en fleurs par au moins vingt tribus qui employaient ceux-là dans la fabrication de leurs corbeilles enroulées. L'artisanat de la vannerie enroulée nécessitait que chaque village amérindien menât une récolte annuelle des chaumes d'herbe et que l'on mît fréquemment des feux d'étendue limitée dans beaucoup de genres de communautés des plantes pour y occasionner l'élimination des détritus, le recyclage des élements nutritifs, l'augmentation de la production de chaumes et l'entrave de l'empiètement des arbres et des arbustes. Un examen detaillé des pratiques de la gestion du feu parmi les amérindiens nous permettra de mieux connaître les procédés culturels qui influaient sur des divers états des écosystèmes et de démêler les principes écologiques ancrés dans les systèmes anciens de la gestion du terrain. Il y a aujourd'hui quelques trois centaines de tisserands amérindiens, et la reprise de leur ancienne vannerie en Californie dépend inextricablement de l'accès à et l'existence de ressources des plantes dans les terres publiques. On devrait attirer l'attention de ceux qui mènent la gestion du terrain et qui formulent des politiques sur la grave diminution de l'habitat adéquat pour des populations de l'herbe cervidée.*

Key Words: *Muhlenbergia rigens*; basketry; ethnobotany; Native Americans; fire management; bunchgrass.

Fire has been recognized as a significant ecological factor in grassland ecosystems and specifically in the maintenance of perennial grasses (Daubenmire 1968). Ignition sources include lightning, spontaneous combustion, sparks from falling rock, volcanic eruptions, and humans (Sauer 1975; Vogl 1974). On a longer time scale, humans had little to do with the evolution and maintenance of natural grasslands (Barry 1972; Heady 1988). Even though Native Americans set fires in grasslands for millennia, this was considered too recent to have been a factor in the evolution of the native grasses (Hatch, Bartolome, and Hillyard 1991).

With new paleoecological, ethnographic and ethnohistoric evidence, it is now clear that human-set fires were an important factor in the en-

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hancement of native grassland distribution, size and vigor in many parts of California. For example, California Indian tribes expanded coastal prairies of northern California, and influenced grassland extent and sparse tree appearance of the Chumash environment in coastal south-central California (Bicknell et al. 1992; Timbrook, Johnson, and Earle 1993). Additionally, repeated burning expanded small patches of grasslands in natural openings of woodlands and forests, creating derived or anthropogenic grasslands that maintained a distinct form and character (Vogl 1974). Formerly, native grasses were of importance to Indian economies in the form of seeds for food (e.g., *Leymus* spp.; *Elymus* spp.; *Deschampsia* spp.; *Bromus* spp.; and *Melica* spp.), leaves and stems for thatch (*Leymus* spp.) and culms for arrows (*Phragmites* spp.; *Leymus* spp.) (Chestnut 1974; Duncan 1961; Timbrook 1990; Zigmond 1981). Few studies have attempted to elucidate the role of Indians in the use of fire to maintain or enhance populations of grass species important to their material culture.

One of the native perennial bunchgrasses associated with Indian burning in California is deergrass [*Muhlenbergia rigens* (Benth.) A. Hitchc., Poaceae]. This study presents the results of 24 months of field work among the Sierra Miwok, Western Mono, and Foothill Yokuts tribes, review of the ethnographic and ethnohistoric written record, and ecological field studies, to elucidate the past and present uses and fire management of deergrass by California Indian tribes (Aginsky 1943; Anderson 1992a; Gifford 1932; Smith 1978).

Deergrass is a perennial bunchgrass found in scattered colonies in dry or damp places below 2150 m elevation from Shasta County south to San Diego County. The major plant communities it inhabits include valley grassland, riparian, and meadow (Hickman 1993; Munz and Keck 1973) (Fig. 1). Additionally, deergrass is somewhat shade-intolerant and also occurs in anthropogenic grassland openings within chaparral, mixed conifer forests, and oak woodland plant communities, maintained with indigenous burning. On most soil types, these grassland areas quickly revert to the surrounding dominant vegetation type without human or natural disturbance.

Historically, this grass had a wide distribution in 15 California counties (Sampson, Chase, and Hedrick 1951). This distribution roughly corresponds to its wide historical use as a basketry material by at least 20 California Indian tribes such as the Salinan, Tubatulabal, Western Shoshone (Panamint), Miwok, Yokuts, Serrano, and Gabrieliño (Driver 1937; Drucker 1939; Kroeber 1925; Latta 1977; Mason 1912; Merrill 1923) (Fig. 2). This widespread use made deergrass one of the most significant basketry materials in California, and it was the most important native bunchgrass utilized for foundation material in coiled baskets.

Fig. 1. Deergrass (*Muhlenbergia rigens*) growing in Big Meadow (4,300 ft.), Yosemite National Park, California.

Deergrass culms for coiled basketry were gathered extensively in the central and southern Sierra Nevada, Great Central Valley, Outer South Coast Ranges, Transverse Ranges, Peninsular Ranges, and Mojave Desert (Fig. 3–6). Today weavers in various tribes utilize deergrass in coiled baskets, but the grass is increasingly difficult to find in part because of conflicting land uses. Although deergrass occurs in the High Cascade Range and northern Sierra Nevada foothills (Hickman 1993), there is no record of it being gathered by the Maidu, Atsugewi, Yana, or other tribes that frequented those areas (Barrett and Gifford 1933).

The Cahuilla, Foothill Yokuts, Kumeyaay (Tipai-Ipai), Sierra Miwok, and Western Mono tribes historically and probably prehistorically enhanced deergrass populations through firing deergrass stands and gathering flower stalks (Anderson 1992a; Lee 1989; Shipek 1989). Indian-set fires increased flower stalk yields, recycled nutrients, cleared away detritus, and promoted seedling production in the midst of reduced competition from other plants. According

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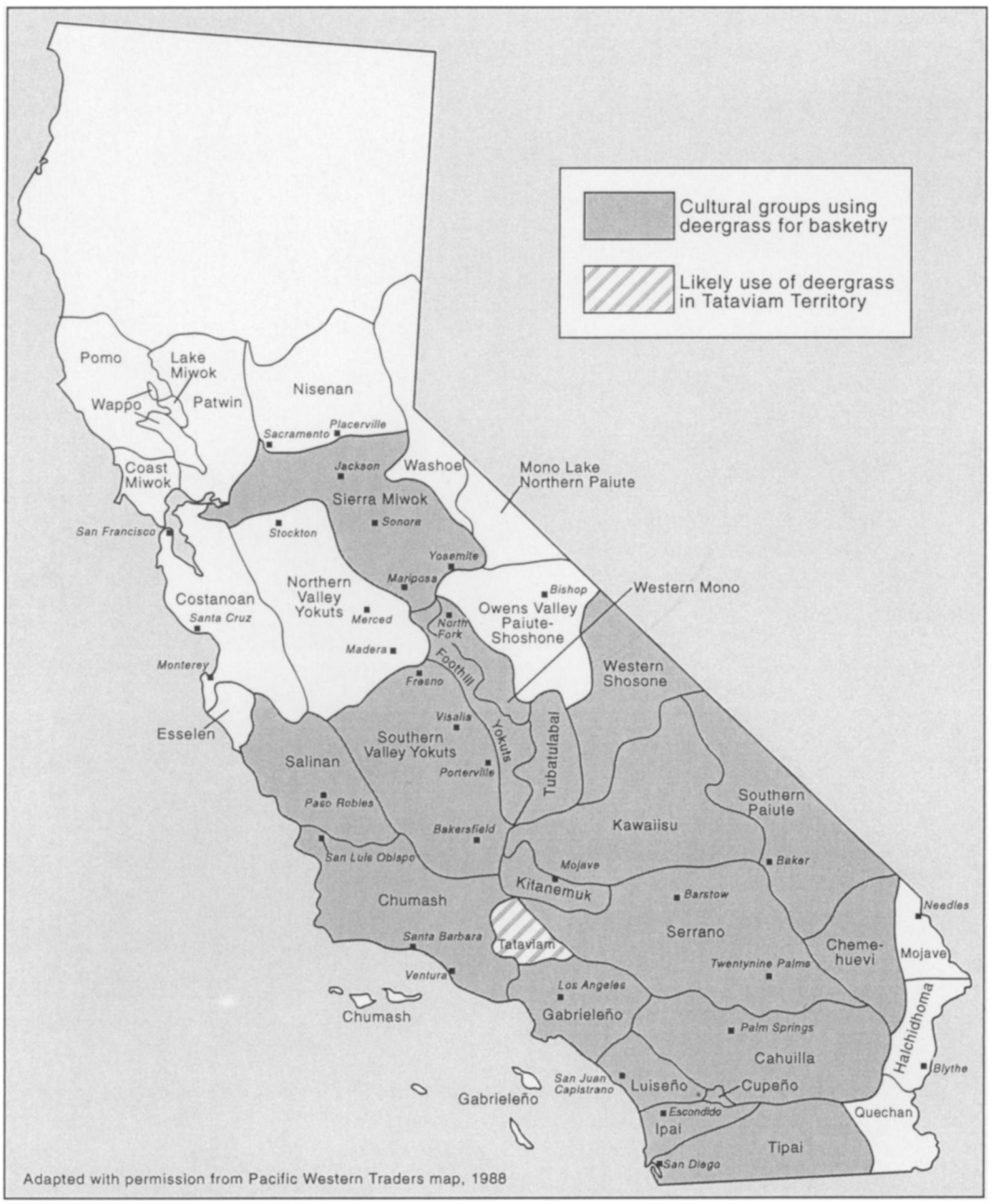

Fig. 2. California Indian groups that gather deergrass (*Muhlenbergia rigens*) culms for the foundations of coiled baskets.

to native elders, these fires maintained the bunchgrass in greater densities and abundance than would have occurred under natural conditions (Anderson, interview notes, unpublished). Deergrass occurs adjacent to archeological sites, and this may mean that humans acted as dispersal agents, carrying seed/vegetative propagules from one camp or village site to the next, increasing the geographic range of the bunchgrass. Knowledge of past indigenous fire man-

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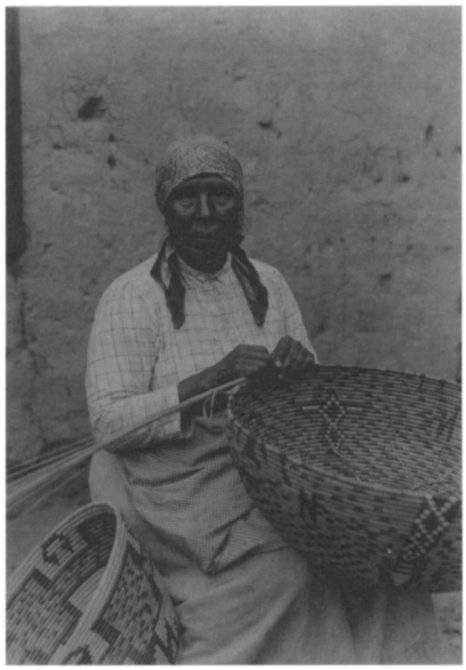

Fig. 3. Upper left corner. Mary Jack, Yokuts weaver, making a basket with a deergrass foundation. Album 56 D-17-4. Grace Nicholson Collection. Courtesy of the Huntington Library.

Fig. 4. Upper right corner. Cupeno basket maker, Dolores Patiencio, weaving a large olla with a deergrass foundation. Courtesy of the Palm Springs Desert Museum.

Fig. 5. Lower left corner, Cahuilla weaver, Maria de los Angeles, making a basket with a warp of deergrass. Courtesy of the Palm Springs Desert Museum.

Fig. 6. Lower right corner, Callipene, Southern Sierra Miwok basket maker, constructing a basket with deergrass warp. Yosemite Valley in 1901. Ym-8355. Photo by J. T. Boysen. Courtesy of the Yosemite Museum.

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Fig. 7. Margaret Baty, contemporary Western Mono weaver, holding a gambling tray made with sedge rhizomes, designs of bracken fern, and deergrass foundation.

agement of deergrass has important implications for mountain meadow habitat management for wildlife and maintenance of grassland openings within shrublands, woodlands, and forests for preservation of indigenous cultural traditions.

Deergrass Harvesting, Preparation, and Use for Basketry

The most valuable parts of deergrass to Indian cultures were the culms, which were gathered in the late spring while still green, or summer or early fall when golden brown. Harvest spanned from May to November, depending upon the tribe, the individual family preference, and the elevation of the deergrass site (Farmer 1993; Zigmond 1981; and pers. obs.). Today contemporary weavers in various tribes still gather deergrass for basketry material. Plants are also transplanted from wildlands to be conveniently tended in gardens adjacent to weavers' houses. Deergrass is not only important to weavers, but also deer. Dense patches of deergrass provide cover during the fawning period of mule deer (*Odocoileus hemionus*) in mountain meadows and grassland openings and the younger palatable tufts are grazed (Bowyer and Bleich 1984; Crampton 1974).

The traditional gathering method among the Western Mono and Southern Sierra Miwok is to take the culms at their tops and pull them out of their sheaths. The stalks break at the lower node. Frequently the lowest portion of the culm is disgarded, because of its stubbiness. Also at the point where the lower leaves join the stalk, the culm does not break away readily. If gathered while still green or slightly golden in summer or early fall, the stalks can be pulled out, but when older, weavers have to cut them. The stalks are then sorted and sized according to length and fineness, because culms of different sizes and thicknesses were used for different types of baskets (pers. obs.).

There is very little information concerning the collection of deergrass in the ethnohistoric or ethnographic literature. When collection sites are mentioned, it is usually in reference to areas that had traditional ownership (Shipek 1993). Contemporary Western Mono weavers confirm that the same areas had repeated use from the same families (Anderson, interview notes, unpublished). Among the Cahuilla, locations were frequently kept secret to discourage gathering by others (Bean and Saubel 1972).

The culms were incorporated into many kinds of California baskets such as bread molds, eating dishes, burial baskets, cooking baskets, acorn flour-sifting trays, storage baskets, flat plaques, gift baskets, coiled burden baskets, basket hoppers, and loosely woven bread baskets (Bates 1982; Harrington 1942; Zigmond 1978; and pers. obs.). The woman's basketry cap, worn in parts of southern California, was also made on a foundation of deergrass and worn to protect against the chafe of the pack strap (Kroeber 1951). Additionally, the young tillers were used by some tribes in the making of leaching mats and small acorn granaries (Hudson 1901a; 1901b). Grace Tex (North Fork Mono) remembers her mother using the *monop* [deergrass] for the covering of the acorn granary and in olden times it was used for a mat and for bedding if there were no pine needles. Hudson (n.d.) also recorded the Yosemite Miwok use of deergrass leaves for the making of a kind of pocket for worm bait in fishing. Among the Kawaiisu, when ears were pierced, stems of deergrass were inserted in the holes so as to keep them from growing together again (Zigmond 1981).

Today weavers from different tribes still use deergrass in gambling trays, gift baskets, and other kinds of baskets (Fig. 7). Some Western

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Mono families, after gathering the stalks, lay them out in the sun to dry for one to three weeks. They are available for use without requiring a storage period to season the material, or without soaking the culms in water. According to Norma Turner, (Mono), it is important to dry them because they shrink considerably while lying in the sun and the panicle of seeds comes off more readily. The last preparation step is to remove the panicle of seeds by rubbing a piece of thick leather, deerskin, or denim along the stalk from the apex toward the base. The florets have barbs and there are barbs along the panicle branches that can burrow their way into fingers (Beecher Crampton, pers. comm. 1992). Thus, cleaning is done with caution. According to some Western Mono consultants, the flower stalks, after drying, are then bundled to avoid a brown discoloration resulting from exposure to the air.

When the material is used, slight dampening periodically keeps it pliable so it will curve with the basket. Sometimes the deergrass is split to accommodate the bending as was the case with the Tubatulabal (Voegelin 1938). As the coiling base is used, new pieces of deergrass are added. A uniform bulk is maintained by inserting new stems whenever needed (Zigmond 1981).

Other Grasses in California Indian Basketry

Articles about Indian basketry proliferated in the late 1800s and the early 1900s in such magazines as *The House Beautiful, Everybody's Magazine,* and *Demorest's Family Magazine.* There was a curiosity and interest in Indian basketry as an art form, though it was largely superficial, particularly with regard to plant identification. Many of the plant materials reported carried the generic names "grasses," "rushes" or "roots" (Blanchan 1901; Francis 1904; Percival 1897).

Because of the difficulty in identifying grasses, some anthropologists relied on professional botanists to identify the grasses used in California Indian baskets (Barrows 1967). Interestingly, *Sporobolus* is the only other native grass genus mentioned in the ethnohistoric and ethnographic literature besides *Muhlenbergia.* Powers (1976) who was visiting with Native Americans on the Tule River in the summer of 1871 or 1872 noted the use of *Sporobolus.* This could have been alkali sacaton [*Sporobolus airoides* (Torr.) Torr.], depending upon the elevation at which it was gathered. It was widespread at one time in alkali flats, especially on the west side of the San Joaquin Valley and the culms are very similar to deergrass (Barry 1972). In describing California Indian baskets Jeanne Carr (1892) also mentions the genus *Sporobolus.*

If the identifications were correct, then the vast majority of California tribes that used a grass in baskets used deergrass. After the introduction of exotic grasses, there are a few examples of their incorporation into Indian baskets. Wild oats (*Avena fatua* L.) was utilized as a foundation in coiled baskets in some instances by the Southern Sierra Miwok (Bates 1982; Hudson n.d.).

Dwindling Deergrass and Loss of Traditions

Apparently deergrass was an important associate in the purple needlegrass [*Nassella pulchra* (A. Hitchc.) Barkworth] bunchgrass prairie which covered portions of the Central Valley and the South Coast Ranges prior to Euro-American settlement (Barry 1972; Beetle 1947). The former extent of deergrass in the Sierra foothills is not known, yet two of the Sierran tribes—the Foothill Yokuts and the Western Mono—used deergrass extensively and there is little evidence that they traded for this plant material. While the Foothill Yokuts and Western Mono used deergrass as a foundation material in 100% of their coiled baskets, the Sierra Miwok used it in approximately 10% of their baskets (Craig Bates pers. comm. 1993). It is likely that deergrass was formerly much more abundant along some streams, in forest and chaparral openings, and in meadows in many parts of central and southern California. Indian elders can remember many sites where deergrass was formerly much more common than now.

In 1906, Barrett recorded deergrass or *hulup* as used by the Southern Sierra Miwok for the foundation of baskets and that it "grows all about this vicinity" [Bull Creek]. He also recorded its use by the Bear Creek Miwok and noted that it was "abundant all through this region" (Barrett 1906). Today, in surveying these areas, several small scattered colonies exist, hardly enough to accommodate a Miwok village. In the early 1900's John Hudson recorded that deergrass was found in "great profusion near Kingsburg" (Hudson 1901–1904). Holmes

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(1900:185–186) in a report to the National Museum in 1900 noted the sparse numbers of a grass which was probably deergrass used in Cahuilla basketry: "In making the better baskets she used a strong grass, which is scarce and much prized. It grows only high up in the mountains. Mr. Rust found it on the banks of a small stream at Bergman post-office at an altitude of about 5,000 ft. growing in bunches like pampas grass and resembling that variety closely."

Many factors have led to the decline of deergrass. One of the main reasons may be overgrazing by livestock. Apparently the young herbage is relished by cattle and horses and is eaten to a limited extent by sheep, while mature foliage is seldom grazed (Sampson, Chase, and Hedrick 1951). Studies have shown that the nutrient value is also higher in young herbage stimulated by fire in bunchgrasses compared to coarse rank growth of old plants (Komarek 1965). Frank Latta (ethnographer of Yokuts cultures) noted the preference of introduced ungulates for deergrass: "The grass [deergrass] itself was the old bunch-grass appreciated so much by cattle and horses in the early days of the Joaquin" (Latta 1942).

Early accounts often describe the mixed conifer forest openings and the California prairies as excellent pasture (Heady 1988). Deergrass can survive some grazing and probably is part of a grass flora that coevolved with large herbivores Edwards (1992), and Menke (1992) has reported that prescribed grazing of cattle and sheep can enhance native bunchgrass vigor, longevity, and abundance. Overgrazing by domesticated livestock, on the other hand, is linked by Cahuilla and Western Mono weavers to deergrass decline. Carr (1892) noted that "Where the grasses for her basketry grew thickly [Mission Indians] in the moist glades, there are now overstocked pastures and cultivated fields." Patencio, Cahuilla elder, stated that: "The places where the basket grasses grew are all ranches and the cattle stamp on the ground, and eat down the grass. There is not any more to be gathered" (Patencio 1971).

Other causes for the decline of deergrass include off-road vehicles, droughts, state or county scraping of roadsides, herbicide spraying, channelization and damming of streams, agriculture, and urban development (Institute of Archaeology U.C.L.A. 1988; and pers. obs.).

Many of the tribes in California have an insignificant land base or none at all, and therefore they must gather plants on public lands. In 1851–52 the United States Government negotiated 18 treaties involving about 25,000 California Indians. In each of the treaties the tribes were acknowledged as sovereign nations and the Indians were promised provisions and extensive tracts of valuable land to be set apart for reservations. In June 1852, the United States Senate, meeting in secret session, rejected the California treaties and the vast reservations proposed were never created (Heizer 1955; Anderson 1991).

Noss, LaRoe, and Scott (1995) and Barbour, et al. (1993) document the loss of ecosystem types in California. As coastal scrub, wetlands, valley grasslands, and coastal prairie continue to disappear, so too, will the cultural customs of indigenous tribes that depend on these ecosystems. The decline of deergrass drastically effects the continuance of the cultural tradition of coiled basketry in central and southern California. Native Americans must search widely to get enough material for a year's supply of their weaving material. Some elders stop along the road, whenever they see even one plant, because they are so difficult to obtain. Nonprofit organizations such as the California Indian Basketweaver's Association (CIBA) have expressed these and other gathering concerns of its members from different tribes. There are over 300 active weavers in the State. CIBA recognizes the urgency to set aside special sites to ensure that plant gathering will be protected long into the future.

Indigenous Fire Management of Deergrass

In order to complete coiled baskets it required many deergrass stalks. Old photographs sometimes depict women with large quantities of deergrass culms (Fig. 8). Since deergrass plants vary tremendously in numbers of culms per plant, many bunchgrasses were needed to accommodate this indigenous industry. For example, it would take over 3000 flowerstalks to make one Western Mono gambling tray. For a cooking basket one would use a quarter more, or 3,750 culms. A twelve inch Western Mono ceremonial basket takes six stalks for thickness and with the constant adding of material to keep the diameter constant, one thousand flower stalks are needed.

Deergrass plants with very little residue might

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Fig. 8. Maggie Icho, Wukchumni Yokuts weaver, with two large bundles that contain over a thousand deergrass flower stalks apiece. Negative # 30530. Courtesy of the Southwest Museum.

contain as many as 100 or 200 flower stalks/per plant. But this phenomenon is rare and at most deergrass sites there are large amounts of accumulated dead material, and culm production is very sparse per plant. Furthermore, as mentioned earlier, the numbers of plants are declining compared to a century ago. Deergrass now occurs in small, scattered colonies in the state, such as along roadsides, but rarely are there good-sized populations of several hundred plants.

In order to gather deergrass flower stalks in sufficient quantity, of the type suitable for the making of coiled baskets, many tribes had to manage and maintain abundant populations of this plant with the use of fire. This is substantiated through recent ethnographic field work and historical accounts, together with observing deergrass plants at many sites in the field. Foliage of deergrass does not drop during senescence in autumn; it accumulates, shutting out sunlight to the new growth. It is removed only by fire, flooding, or grazing. I have noted that the centers of the larger deergrass tufts usually die out, leaving small, outside rings of green and active growth. Additionally, in the absence of disturbance, it is common and typical for entire bunches to choke out without green outside rings persisting (Steve Edwards, Director East Bay Regional Parks Botanic Garden, pers. comm. 1995).

Deergrass populations appear to be healthiest where they have been exposed to disturbance, such as plants on the periphery of streams that are scoured periodically. Barrows (1967) observed deergrass growing in the territory of the Cahuilla in a torrent-swept gorge in the mountains a few miles above the desert. This scouring seems to remove the dead material, rejuvenating populations of deergrass. Perhaps the dampened soil increases germination. It is recognized that many plant species will reach a degenerate or senescent stage in their life cycle unless subjected to periodic disturbance (Watt 1940). Fire, grazing, and other natural disturbances are now recognized as integral ecosystem processes to maintain productivity of grassland species by the removal of standing and fallen litter (Knapp and Seastedt 1986). Fire is essential in maintaining the vigor and vitality of grasses in most grasslands by also controlling the abundance of woody plants (Daubenmire 1968; McPherson 1995; Wright and Bailey 1980). Burning at intervals of 1–15 years, depending on the particular region, is essential for maintaining natural productivity (Barry 1972).

If subjected to herbivory, flooding, or fires, deergrass responds to the disturbance by vegetative reproduction in the form of leaf buds that occur in the axils of the old tillers or by vegetative buds activating on short rhizomes that gradually spread the plant (Crampton 1974). Various California Indian tribes took advantage of this plant adaptation using human-set fires to activate new tillering and culm production in deergrass colonies. Areas of deergrass were fired by different Indian tribes in late summer, fall, or winter when the leaves and stems were dry (Anderson 1992a). Fires destroyed insect pests, recycled plant nutrients, and eliminated competitive grasses and shrubs (Anderson, interview notes, unpublished).

Few ethnographic or ethnohistoric reports document the burning of deergrass and these provide little detail:

"If we [Diegueño] had not burned off the basket grass [*Muhlenbergia rigens*] last year, the stalks would not be tall and thick now" (Lee 1989:48).

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"Indians [Kumeyaay] managed basketry grasses [*Muhlenbergia rigens*] and arrow-reed resources in riparian areas by burning them every three to five years" (Shipek 1989:164).

Not only were proper native bunchgrass identifications lacking in the majority of the early articles pertaining to California Indian basketry, but management information was almost nonexistent. Yet numerous information sources (Chever 1870; Kroeber 1925:652; LaPena 1978: 337; Powers 1976:379) record Indians in different regions setting grassland areas or meadow areas on fire—but for the obvious purpose of driving and roasting grasshoppers—a highly visible *male* activity to the usually *male* nonIndian recorder. Perhaps this was for the dual purpose of driving grasshoppers and rejuvenating bunchgrass colonies. Lewis (1993) and Timbrook et al. (1993) document Indian burning in the grasslands and meadows for other purposes as well, and again the application of fire for other purposes may have also benefited deergrass.

Another record of former burning practices, lives in the memories of people in different tribes. At least fifteen families of Western Mono, Foothill Yokuts, Sierra Miwok, Cahuilla, and Diegueño descent remember their elders burning clusters of deergrass plants in the Sierra Nevada and southern California to increase culm production, decrease dead material, and to "make them healthier" in general. After contact, fire exclusion policies of the U.S. Forest Service and other government agencies have limited the ability of Native Americans to burn vegetation in conjunction with gathering. As a result of the absence of Indian-set fires and lack of other disturbance factors, deergrass populations are dwindling in areas that once were excellent traditional gathering sites.

Cultural Purposes for Burning

A major purpose for the setting of fires was to increase the quantity of the flower stalks. Deergrass becomes old and decadent, suffocating in its own dead material. The slow accumulation of litter causes deterioration of the plant's vigor, reducing the number of flower stalks, while periodic burning increases the number of flower stalks (Katherine Saubel, Cahuilla, pers. comm. 1991; Anderson, interview notes, unpublished; and pers. obs.). Ahmed (1983) and Payton and Mark (1979) have documented prolific flowering of perennial grasses in the first or second season after burning. There is substantial decrease in species' sexual reproduction when the detritus component is left undisturbed for long periods (Hulbert 1969).

Burning also modifies the morphological growth of the stalks, enhancing the qualities preferred by weavers. For certain size baskets, tribes preferred long, finer culms. Fires were set to increase the fineness and height of deergrass stems among the Western Mono and according to Clara Charlie, (Chukchansi/Choinumni Yokuts), fires also made the stalks stronger and more flexible.

In former times, it was not unusual to gather from large deergrass colonies. Contemporary weavers say that burning increased the quantity of deergrass bunches. Thus, fire not only stimulates better quality growth but may cause "fragmentation" in deergrass, whereby portions of the plant die out leaving small patches of active growth and these break off and become separate plants, which is a type of vegetative reproduction (Crampton 1974). Vegetative reproduction enables the plant to survive and reestablish itself in place after human disturbance and often expands the portion of the site it occupies (Spurr and Barnes 1980).

Deergrass also produces abundant viable seed (Sampson et al. 1951). Yet, this seed often does not get established in the wild. Beecher Crampton, Professor Emeritus, U.C. Davis, has not often seen seedlings of *Muhlenbergia rigens* in the field and concludes that it must be a difficult grass to get established naturally. Yet, it germinates profusely in nursery conditions without special treatment (Steve Edwards pers. comm. 1995). Periodic burning may also have prepared the seedbed, lowering plant competition and increasing seed germination rates. Results of a burn study in Cuyamaca State Park substantiate the spread of deergrass to new areas following the application of low intensity fires (Lathrop and Martin 1982). Studies conducted in conjunction with other native bunchgrasses, such as with purple needlegrass (Nassella pulchra), also demonstrated a significant increase in seed germination rates and seedling establishment on burned versus unburned plots (Ahmed 1983).

Burning also was carried out for the express purpose of keeping areas open to maintain deergrass habitat. The absence of Indian burning has caused frequent vegetation type conversions. The encroachment of chaparral species and/or

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ponderosa pine into formerly open deergrass collection sites support the view that these grassland areas were periodically burned over by the Indians. Sampson (et al. 1951) recorded that deergrass grew in ponderosa pine forests but also noted that it was found only in "thinly timbered areas." Eleanor Beemer, a non-Indian woman, kept a journal of her experiences with the Luiseño people and recorded in 1939 that deergrass "grew in clumps here and there in the chaparral" (Beemer 1980). These areas are probably now dense chaparral, unless recently exposed to wildfires. Today Indian elders can take interested individuals to many sites that demonstrate encroachment by other vegetation upon traditional deergrass collection sites.

Fire Frequency, Season of Burn, and Areal Extent

In parts of southern California, the Kumeyaay (Tipai-Ipai) burned deergrass every three to five years (Shipek 1989). In the Sierra Nevada, Indian women and men burned deergrass every two to five years depending upon the family preference and the condition of the plants, particularly when the plants "started looking old" and "did not produce a good crop of flower stalks" (Anderson, interview notes, unpublished). According to Menke (1992), burning to maintain and restore native perennial bunchgrasses should not occur every year; rather prescribed fires should be set every 3 to 4 years to eliminate exotics, and to avoid diminishing nitrogen and sulfur through volatilization.

Interview responses regarding burn timing ranged from the months of late August till February. Of the nine consultants who remembered specific seasons in which deergrass was burned, six said in fall, the months of October and November being mentioned most often. Timing often coincided with the rains. This burning refers to the central and southern Sierra Nevada. The timing of burning in the Central Valley or the South Coast Ranges is unknown. Two other Western Mono consultants remember that burning took place in the Sierra foothills in the new year in January or February. One Chuckansi/Choinumni Yokuts consultant mentioned burning in late August. Native Americans often said that it was important that the deergrass fires were set close to the onset of fall or winter rains, or after a rain, in a period when the deergrass was not too dry or too wet (Anderson, interview notes, unpublished).

The areal extent of fires set varied from the lighting of individual plants on fire, to the setting of whole areas or deergrass colonies on fire. Western Mono elders remember that in the olden days, Native Americans "would let the fires go" (Anderson, interview notes, unpublished).

Restoration of Native Grasses and Native Cultures

The continuance of cultural traditions and access to plant resources are inextricably linked. If a tribe cannot successfully attain the proper materials, in many cases the tradition dies (Martinez 1992). In order to continue their basketry traditions utilizing deergrass, California Indians need access to public and private lands to gather the plants for material and spiritual well-being, and the plants have to be available in the proper quantity and quality to be useful.

There is a number of ways in which former territorial lands can be opened up and Indian-land relationships revitalized. For example, public agencies are beginning to rethink their role. Since the creation of national and state public agency charters, their role was to passively allow Indians to gather plants through a permit process, or without a permit. Recently agencies have begun to take a more active role by becoming advocates of maintaining, tending, and encouraging growth of plants important to Native Americans. Projects have been designed on several national forests in California to maintain and enhance deergrass and bear grass [*Xerophyllum tenax* (Pursh) Nutt.] cultural resources (Anderson 1992b; CIBA 1993; Hunter 1988). This involves the blending of indigenous folk science and western science in on-the-ground applications in resource management. The cultural resources are surveyed, their conditions and numbers recorded, and the ancient management technique of fire is reintroduced to enhance the quality and quantity of the resource (Fig. 9).

A major step toward the encouragement of Indian cultures would be through agreements to maintain areas. Policies could be developed, which address forest and range management practices, to assure the availability and preservation of cultural resources. This is not passive permission of access, but rather active integration of the management of traditional plant resources for Native Americans as a component of

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Fig. 9. A prescribed burn of deergrass to stimulate indigenous fire practices in the Sierra National Forest. December 1991.

public lands management programs. Native American gathering sites would have land use status equal to that of other land use categories. In other words, this category would have its own research and management unit within each of the agencies that administer our public lands. Co-management agreements have been formulated both in Canada and Australia (Lewis 1989; Usher 1987). Additionally, indigenous knowledge regarding the use and fire management of deergrass, could provide important information for the following potential wildland management programs: (1) maintenance and restoration of meadow and riparian habitats, and grassland habitats within chaparral and lower mixed conifer forest openings; and (2) historical vegetation reconstruction. Simulating indigenous horticultural practices in long-term field experiments could elucidate the effects of aboriginal activities upon natural resources and disclose the extent to which ecosystem productivity and health is tied to former native economic and management activities (Blackburn and Anderson 1993).

Conclusions

Deergrass was an extremely important native bunchgrass to the basketry economies of many Indian tribes throughout much of central and southern California. Its incorporation into many basket types, coupled with large numbers of culms needed to complete each basket type, elevated deergrass to an extremely important cultural resource. Today deergrass is still a highly valued plant among contemporary Native American weavers, yet populations on public and private lands are dwindling, with scanty flower stalk production. In the past, Indians in the Sierra Nevada and southern California periodically burned deergrass plants to increase flower stalk production, remove accumulated dead material, increase the size of colonies, and keep surrounding vegetation from encroaching.

New information revealing frequent indigenous burning in deergrass habitats in the Sierra Nevada and the south coast ranges suggests that many of these so-called natural grasslands are in fact, in part anthropogenic grasslands created and/or maintained within lower mixed conifer forest, oak woodland, and chaparral plant communities through Indian management. Thus, habitat spatial configurations, species composition, abundance, and structure of these habitat areas have been influenced by human-set fires. The critical loss of habitat suitable for populations of deergrass is brought to the attention of land managers and policy makers. As contemporary weavers exercise their gathering rights on public lands and are increasingly disappointed with the quality and quantity of the resources, they are beginning to work together with resource managers to manage these plant resources with fire. Tribal historical approaches to the use and management of biotic resources may provide a significant knowledge base for conserving biodiversity, enhancing wildlife habitat, and maintenance of culturally-significant plant populations.

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Book Review

Encyclopedia of Common Natural Ingredients Used in Food, Drugs, and Cosmetics, ed. 2. Albert T. Leung, and Steven Foster. 1996. John Wiley & Sons, 605 Third Avenue, New York, NY 10158-0012. xxxv + 649 pp. (hardcover). $150.00. ISBN 0-471-50826-8.

According to the authors, one of the reasons a second edition of *Encyclopedia of Common Natural Ingredients* was needed after 15 years was to provide information on the "expanding fields of health foods and herbal teas," with special emphasis on Chinese products. This volume was obviously designed for utility. After a short glossary, the natural ingredients are arranged alphabetically by product. Natural ingredients range from absinthium (*Artemisia absinthium*) to yucca (*Yucca schidigera*), with a separate section for Chinese cosmetic herbs. For each entry there is a list of species from which the product is derived, with authors, synonyms, and families. A general description gives the distribution and parts used. Perhaps the most valuable component is that of chemical composition and pharmacology or biological activities. The literature is especially complete for these. Two indices conclude the work. The indices are well organized and clear, important features in any book claiming to be an encyclopedia.

My complaints are minor. I find it difficult to believe that Job's tears, *Croix lacryma-jobi* (Poaceae) is marketed as pearl barley (p. 323)! A few references cited in the text are not in the literature. The separate section for Chinese cosmetics could have been incorporated into the body of the book.

What is not minor is the price! At about twenty-five cents per page, it is truly a valuable book.

This volume has already been a helpful reference tool for my research on Bible plants and no doubt will be well used. I recommend it for anyone working in ethnobotany, medicine, or cosmetics.

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