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Purple needlegrass at Point Molate with Mt. Tamalpais in background. Photograph by Mitchel P. McClaran

STIPA PULCHRA, A SURVIVOR FROM THE PRISTINE PRAIRIE

by James W. Bartolome

California's grasslands demonstrate dramatically both the deliberate and accidental impacts of man. Beginning with the arrival of livestock at mission San Diego in 1769, new land uses affected not just a few dominant species but changed the entire flora of the grasslands.

Livestock and alien animals had replaced the pristine grassland before scientific botanical observers arrived. Students of vegetational changes are handicapped by the lack of even a small surviving piece of exclusively native grassland. Introduced species are everywhere present. Historical records are scanty and lack sufficient detail to permit reconstruction of the original vegetation.

When the American ecologist Frederick Clements rode the train to California in 1917 he noted bunchgrasses along the fenced rights-of-way. Near Fresno he recorded the dominance of purple needlegrass (*Stipa pulchra*) where livestock were excluded. It is generally thought that California's grassland was formerly a bunchgrass type, with *Stipa pulchra* as the dominant native species, contrasting with today's annual-dominated vegetation. Yet many scholars doubt that the driest areas were ever densely populated by perennial grasses and suggest that the density of perennial species in the pristine grassland was correlated with rainfall: the grasses of the wetter areas to the north and nearer the coast perhaps were almost exclusively perennial; the drier inland areas had few and scattered perennial grasses. Native annual grasses occupied the spaces

between, fluctuating in abundance with the years and the seasons as do the introduced annuals now.

For countless centuries before European man brought livestock to California, the grazing of herbivores—deer, elk, antelope, and rodents—exerted minimum pressure on the vegetation. The native bunchgrasses were adapted to light grazing and to defoliation by fire, but they could not stand the tremendous impact of Mexican-style cattle ranching. By 1860 livestock occupied all the major California grassland areas in numbers not sustainable by the range. Periodic droughts, such as struck in the 1860s, reduced available forage, further increased grazing pressure and further added to the destruction of the perennial bunchgrasses.

Concurrently with the introduction of livestock came alien annual plant invaders, mostly from the Mediterranean region. A new flora spread rapidly through the depleted grasslands. Plants which had evolved along with pastoralism in a climate similar to California's, such as soft chess (*Bromus mollis*), filaree (*Erodium* spp.), and wild oats (*Avena* spp.), arrived in packing materials, hay, and ballast. No areas are now without the introduced annuals, nor is there any prospect of their elimination. Livestock precipitated the destruction of the pristine grassland; the addition of alien annuals has made that change permanent. Removal of livestock grazing may result in an increase in native perennial species; but it does not result in the elimination of naturalized annuals. Any attempts at grassland restoration and the encouragement of native grasses must face this fact.

At Hastings Reservation in Carmel Valley, Stipa pulchra grassland, which has not been grazed by livestock since 1937, shows bunchgrass interspersed with annual grasses. Photographs by the author

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A Persistent Survivor

Clements believed *Stipa pulchra* to have been the dominant plant of the pristine grasslands. Clearly today this species is the most common native bunchgrass in Northern California and, along with several closely related species, widespread in the south as well. Stands of *Stipa pulchra* are not uncommon in areas protected from livestock. Well-known sites include La Jolla Valley in Point Mugu State Park, Hastings Natural History Reserve in Carmel Valley, and Mount Tamalpais State Park. Smaller, less conspicuous, natural stands of purple needlegrass are common—remnants of the former bunchgrass prairie.

Why is *Stipa pulchra* more common than other native bunchgrasses? This question may best be answered by examination of some of the ecological characteristics of the species. One such characteristic is that Stipa pulchra produces large quantities of viable seed. In dense vigorous stands the seed output may exceed two hundred kilograms per hectare. Seeds are relatively large and highly viable. The twisting awn and pointed seed ensure self-burial, and seedlings grow vigorously. These reproductive characteristics enable the species to colonize disturbed sites rapidly, provided a seed source is present. The occurrence of *Stipa pulchra* along road cuts and similar disturbed habitats reflects this superior colonizing ability. Other native perennial grasses seldom become established so vigorously. Once established, young *Stipa pulchra* plants quickly produce seeds. Under favorable conditions, two-year-old plants may flower and set seed.

Seedlings of *Stipa pulchra* can be seen in the foreground invading an abandoned road in Tilden Park, Berkeley. Parent plants are growing on the bank above.

Sti*pa pulchra* also reproduces vegetatively. Although it is a bunchgrass and does not possess rhizomes or stolons, its tufts can break up, forming a clone. This process commonly follows heavy defoliation by burning or grazing. Nature-established plants can effectively compete with introduced species of annuals and persist even under moderate grazing. Nature-established plants

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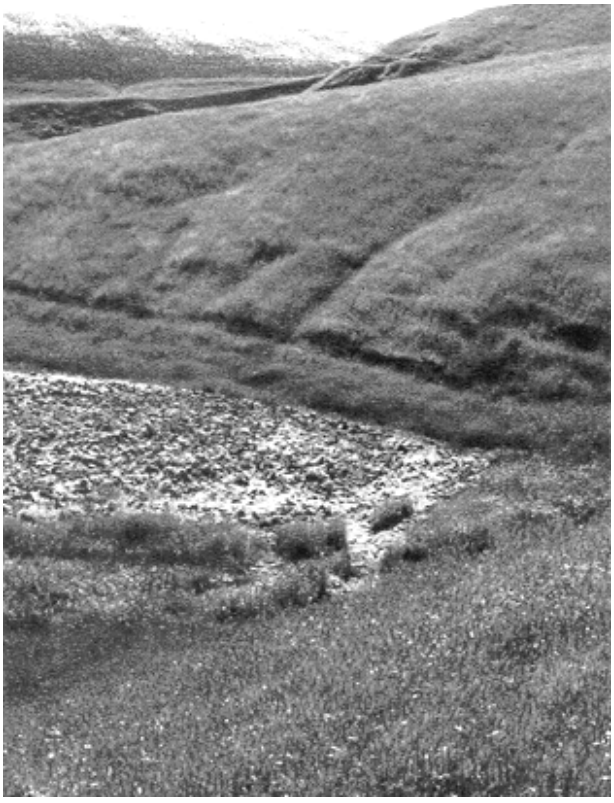
Why then does *Stipa pulchra* not occur more abundantly in annual grassland? I have demonstrated experimentally that although *Stipa pulchra* seedlings can survive in stands of annuals through their first fall and winter, the onset of rapid spring growth by the annuals normally kills the Stipa pulchra seedlings. Those few seedlings which survive the spring in dense stands of annuals are small and poorly equipped to survive the summer drought.

Even if seedlings could survive the competition of annuals, a seed source may not be present. Adult plants are severely affected if they are defoliated during the late spring at the time of flowering, suffering as a result reduced vigor and seed output. Such individuals may occasionally persist for years, surviving but without vigor and not producing culms. Current grazing practices in California rarely include a period without grazing in the spring. Because this is the time of best forage quality from the introduced annual range grasses.



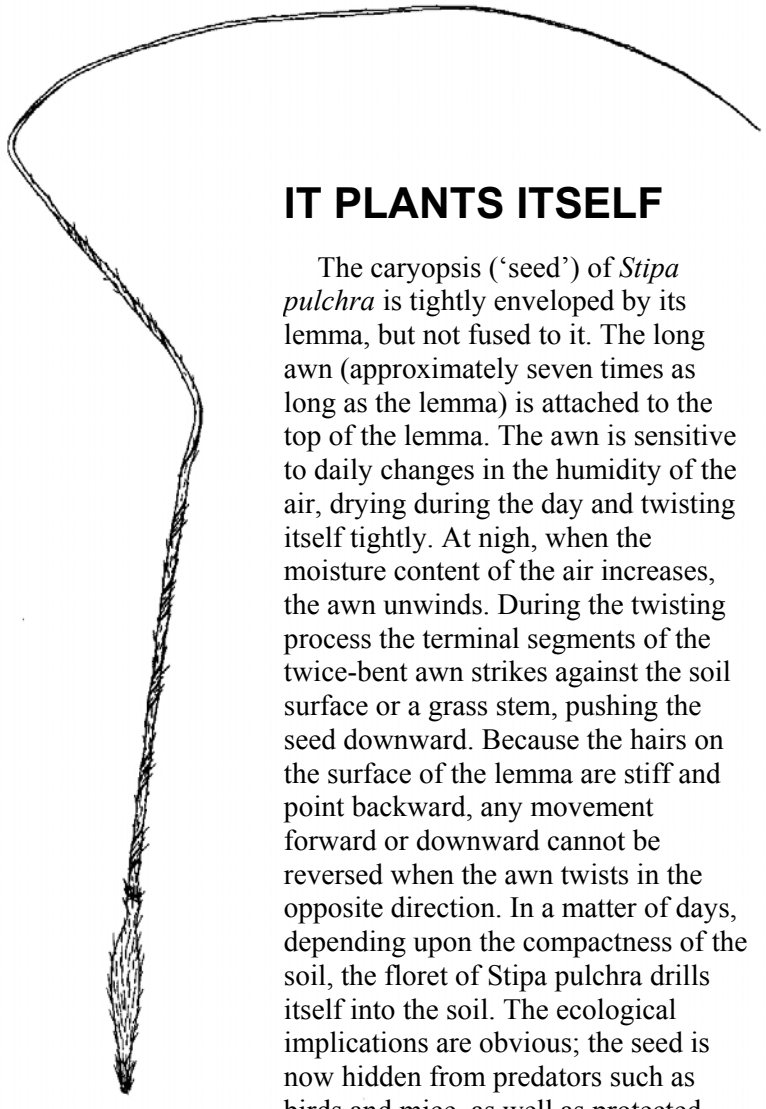
Relict stand of Stipa pulchra in Yolo County. Photograph by Peter Sands.

The foregoing suggests several ways to favor native perennials on sites for which they are suited. First, to favor vigorous seed output by mature plants, it is important to avoid defoliation at the time of flowering, either by grazing, mowing, or burning. Defoliation at other times will not severely affect the plant's vigor. This response reflects the adaptation of Stipa pulchra to fire rather than to grazing. Fires occur more frequently in the summer and fall when the plants are dormant and the vegetation dry. The grass crowns survive to sprout with the return of the rains.

Second, although *Stipa pulchra* may set abundant seed, with relatively vigorous seedlings, those seedlings usually fight a losing battle against the introduced annuals in the spring. Thus, to

increase stands of *Stipa pulchra*, it is necessary to reduce the competition of introduced annuals that prevent the seedlings from becoming established. Fire, tillage, chemicals, and even grazing are some of the methods which can reduce the number of annuals. In the pristine grassland, natural disturbances, such as land slips and gopher mounds, doubtless reduced the density of annuals and provided Stipa pulchra with opportunities for colonization.

Stipa pulchra persists in the California grassland because of a set of characteristics enabling it to colonize rapidly and occupy disturbed sites. These same characteristics, including abundant seed production, numerous seedlings, and the vigor of its mature plants, also make Stipa pulchra the best candidate for the restoration of native grasslands.



Drawing by
Holly Hauptli

IT PLANTS ITSELF

The caryopsis ('seed') of *Stipa pulchra* is tightly enveloped by its lemma, but not fused to it. The long awn (approximately seven times as long as the lemma) is attached to the top of the lemma. The awn is sensitive to daily changes in the humidity of the air, drying during the day and twisting itself tightly. At nigh, when the moisture content of the air increases, the awn unwinds. During the twisting process the terminal segments of the twice-bent awn strikes against the soil surface or a grass stem, pushing the seed downward. Because the hairs on the surface of the lemma are stiff and point backward, any movement forward or downward cannot be reversed when the awn twists in the opposite direction. In a matter of days, depending upon the compactness of the soil, the floret of Stipa pulchra drills itself into the soil. The ecological implications are obvious; the seed is now hidden from predators such as birds and mice, as well as protected from any wildfire which may sweep over the grassland during the dry summer and fall

Tom Griggs

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NOMINEE FOR STATE GRASS

Stipa pulchra (purple needlegrass) has been proposed by a joint resolution of both CNPS and the California section of the Society for Range Management as California's State Grass. Peter Sands, chairman of the society's State Grass Committee, is seeking sponsorship for legislation to make this proposal official.

Nine of the western states at present have official state grasses, and six more, including Californica, are working toward naming one.