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# CALIFORNIA INDIAN HORTICULTURE: MANAGEMEMT AND USE OF REDBUD BY THE SOUTHERN SIERRA MIWOK

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ABSTRACT.—A survey of California ethnohistoric literature reveals that the native shrub, western redbud, *Cercis occidentalis* Torr. ex Gray., was highly valued by many California Indian tribes as a source of material for basketry. Observations of redbud regeneration after lightning fires and a study in Sierra National Forest of redbud sprouting after coppicing offer evidence that redbud is adapted to periodic fires in the riparian and foothill woodland plant communities. The generous presence of redbuds in proximity to major Southern Sierra Miwok archaeological sites suggests that some element of human activity was responsible for its successful regeneration at these sites. It is proposed that the introduction of anthropogenic fire, pruning, and weeding historically maintained and enhanced populations of redbud, extending its range and distribution. Some California Indian basketmakers remember how their elders managed redbud populations with burning, and today they manipulate redbud with pruning or coppicing to encourage specific morphological and physiological properties (e.g., elongation of branches suitable for basketry; wine-red branch color for basketry designs). Drastic curtailment of burning by law has greatly reduced the extent to which this human/plant symbiosis can occur. Public land agencies are alerted to the importance of this plant in maintaining tribal ethnicity and to the need for active management of the species to meet contemporary Indians' cultural needs.

RESUMEN.—Una revisión de la literatura etnohistórica de California revela el valor que tenea el arbusto native *Cercis occidentalis* para muchas tribus indias de California, como fuente de material para la cestería. Hay evidencia que siñala que *Cercis occidentalis* es una especie adaptada a fuegos periodicos en comunidades de vegetación riparia y bosques de pie die montaña; esta evidencia se basa en observaciones sobre la regeneración de *C. occidentalis* despúes de fuegos causados por relámpagos y en un estudio que se llevó acabo en el Bosque Nacional Sierra, sobre rebrotamiento despues de podar. La presencia abundante de *C. occidentalis* cerca de las zonas arqueológicas principales de los Mowok de la Sierra Sur, sugiere que algun elemento de actividad humana fué responsable por la regeneración exitosa de la planta en estas localidades. Se propone que la introducción de prácticas tales coma el fuego de origen antropogénico, las podas y el deshierbe, mantuvieron y fomentaron las poblaciones de *C. occidentalis* a través de la historia, asi mismo extendiendo su rango y distribución. Algunos Indios de California que producen cestería, recuerdan como sus antepasados manejaban poblaciones de *C. occidentalis* a través de prácticas de fuego y actualmente las manipulan a traves de prácticas de poda y roza para fomentar ciertas propiedades morfologicas y fisiológicas (por ejemplo: elongación de ramas para canastas y color rojo oscuro para sus diseños). La actual prohibición del uso de fuego en parques

ha reducido en gran medida esta simbiosis entre humanos y plantas. Se debe alertar a las agencias públicas a cargo del manejo de recursos, sobre el papel importante que juega esta especie en la etnicidad de las tribus y de la importancia de realizar un manejo activo de la especie que satisfaga las necesidades culturales de los pueblos indios contemporáneos.

RESUME.—Une évaluation ed la literature ethnohistorique de Californie montre que l'arbuste natif l'arbre de Judée (*Cercis occidentalis* Torr. ex A. Gray) était de grand valeur chez plusieurs tribus indigènes de Californie comme une source de materiel pour les paniers. Les observations de la régénération de l'arbre de Judée après les incendies causées par les foudres et une étudie de bourgeonnement après le talis dans la Forêt National Sierra donne de l'évidence que l'arbre de Judée se soit adaptée aux incendies périodiques dans les communautés végétales fluviales et dans les forêts des contreforts. La présence copieuse de l'arbre de Judée presqu'aux lieux archéologiques importantes des Miwok de la Sierra du Sur ṣuggère qu'une partie de l'activité humaine soit responsable pour sa régénération réussi dans ces lieux. On propose que l'introduction des incendies anthropogeniques, l'élagage, et le sarclage aient maintenu et rehaussé les populations de l'arbre de Judée, et aient étendu sa distribution géographique. Quelques indigênes de Californie qui font des paniers se souviennent la méthode comme ses aînés ont empoyé les incendies pour diriger les populations de l'arbre de Judée. Aujourd'hui ils manipulent l'arbre de Judée avec le talis et l'élagage pour encourager des caractères spécifiques morphologiques et physiologiques (par example, l'élongation des rameaux pour des paniers; le couleur du vin rouge pour les dessins artistiques des paniers). La prohibition legale des incendies a réduit dans une grande mesure cette symbiose entre les plantes et les gens. On alerte les agences publiques de l'importance de cette plante dans l'entretien de l'ethnicité des tribus et du besoin du maniement actif de cet espèce pour satisfier les besoins culturels des indigènes contemporaines.

## INTRODUCTION

Found in five plant communities, redbud is a widely distributed native shrub in California. Before Anglo contact, Native American weavers used redbud branches and ground stems in the construction and decoration of baskets (Merrill 1923). At least 20 different tribes utilized the branches and ground stems of redbud, spanning 22 California counties. The horticultural techniques used historically by Indians to manage redbud were burning, pruning and coppicing (Anderson 1988–1989). Coppicing is severe pruning of plants just above ground level. Knowledge of the uses and management of redbud persist in some parts of California today, having been passed down from earlier basketmakers. Southern Sierra Miwok perceived effects of coppicing on redbud are that it "strengthens the shrub."

This paper reports results from a study conducted in Sierra National Forest which quantifies the regeneration of redbud in response to simulated management practices of the Southern Sierra Miwok. A goal of the study was to test to what extent the Indians' cultural knowledge of redbud can assist scientists in their understanding of ecological systems, and also increase their appreciation of native cultures and horticultural practices. Indian horticultural practices may

prove to be a valuable source of knowledge for managing noncommercial native plant species on public lands; yet the effects of many of these cultural techniques (i.e., burning, pruning, or digging) on the vegetation have never been accurately measured by plant ecologists or resource managers.

## METHODS

A series of ethnographic interviews were conducted with selected families in the Sierra Nevada at their homes and in the field during the period 1986–89. These informants totaled 32 persons and are of Southern Sierra Miwok, Central Sierra Miwok, North Fork Mono, Chukchansi Yokuts, Mono Lake Paiute, and Western Mono ethnic backgrounds. Questions were asked regarding memory and current use of specific horticultural techniques (burning, pruning, coppicing, tillage, etc.) employed to manipulate shrub species and the frequency, time of year, and intensity of these practices. The cultural purposes (i.e., straighter branches, bark color, branch length, branch diameter) for using these techniques were recorded as well as any information regarding the former abundance and distribution of native plant species. Ethnographers have published detailed accounts of California Indian plant material culture. From 1986–89 I've attempted to locate and document vegetation management information through extensive ethnohistoric research in various government, university, and private libraries.

## MORPHOLOGICAL CHARACTERISTICS OF REDBUD

There are in all seven species of redbud native to North America, southern Europe and Asia, but only one, *Cercis occidentalis* is native to California (Synge 1956). The Southern Sierra Miwok Indians called the California species, Tap—pah-tap-pah (Merriam 1902).

Western redbud is a leguminous shrub that grows from 2 to 5 m tall with a dense rounded crown that almost reaches the ground. The leaves are simple, thick, round or reniform, and cordate at the base, and have from seven to nine prominent veins. They are deciduous (Sudworth 1967); their autumn display of yellow turning to red and brown rivaling that of some eastern hardwoods. Similar to riparian trees, this species loses its leaves and bears the strain of complete spring refoliation, if the substrate retains some moisture throughout the warm season (Bakker 1971).

The striking pea-shaped flowers appear before the leaves, in small fascicles along the branches (Peterson 1966). Each flower has five petals that range in color from magenta pink to reddish purple (Weeden 1981). Pollination is by bees (Dr. Herbert Baker, pers. comm. 1988).[1] Although the pink sprays can be seen from February through April, any one shrub will remain in flower only about two weeks (Munz and Keck 1973).

In autumn the branches often bear many clusters of pointed, flat, very thin pods, the upper suture with a conspicuous winged margin (Hopkins 1942). In ripening, the pods are first purple and then russet-brown, each containing an average of seven hard, bean-like seeds (Sudworth 1967). The mature pods persist into the next winter (Storer and Usinger 1963).

## RANGE AND DISTRIBUTION OF REDBUD

Redbud grows in 22 counties of California and is a component of five plant communities in the state: the oak woodland, the chaparral, the yellow pine forest, the riparian woodland and the closed cone forest (Barbour *et al.* 1980; Munz 1974). It grows at elevations of 4,000 feet or less, in canyons and on rather steep slopes, in gravelly, and rocky soils along streams, where it is never flooded (Sudworth 1967). It also grows in the bottom of ephemeral streambeds in little pockets, benches or crannies of boulder outcroppings. The plant is drought tolerant and grows in a wide variety of soils, but it is usually found in rather harsh environments with depauperate, nutrient-poor soils (Stewart Winchester pers. comm. 1988).[2] It grows mostly singly, but sometimes, in sheltered situations, in shrubby clumps (Sudworth 1967).

## THE VALUE AND USES OF REDBUD TO CALIFORNIA INDIANS

Redbud is of little economic importance to foresters and range managers, for it has no value as timber and receives a poor rating as browse for livestock (Sampson and Jespersen n.d.). However, horticulturalists have planted it in informal and formal gardens and landscapes since 1886 and it has been called one of California's most attractive flowering shrubs in gardeners' manuals and horticultural guides (Peterson 1966).

Although some Indian groups used other plant species (e.g., chain fern *Woodwardia fimbriata;* greenbriar *Smilax californica;* Joshua tree *Yucca brevifolia;* and rush *Juncus textilis*) to create red patterns in baskets, redbud bark was the most widely used fiber for red designs in California. In the past, at least twenty California Indian tribes utilized redbud as basketry material (Barrett and Gifford 1933; Kroeber 1976; Merrill 1923; Margaret Mathewson pers. comm. 1988).[3] Today, Indian people (i.e., Southern Sierra Miwok, Maidu, Pomo, Washo, Western Mono, Chukchansi Yokuts) still harvest these plants and use their rich red color in special patterns in their baskets (Anderson 1988-1989). The Miwok like other California Indian peoples valued redbud particularly for its branches and ground stems, which they used for structural as well as design purposes in making baskets. The plant is used in both the warp (the rods or foundation) and the weft which are structural elements of coiled and twined baskets (Fig. 1).

If used for the weft, redbud branches are split immediately after collecting or up to one month after harvesting. Branches are split in half from the thick to the thin end (Bev Ortiz pers. comm. 1987)[4] through the buds. The halves are then split again more finely to remove the pith. The material is coiled and stored for at least one year in a dry place. Later, it is soaked in water for several hours, and reshaped and cleaned before use.

Redbud is still gathered at least twice a year for different purposes. In the fall or winter, after its leaves have fallen, it is harvested for the red bark, the split fibers of which are to be used as wine-red sewing strands in decorative designs or the whole branches are used as the foundations of twined baskets. In the spring or summer redbud is harvested and the bark removed and the branch split, to be used as a white sewing strand (Anderson 1988).

# THE HORTICULTURAL MANAGEMENT OF REDBUD BY THE SOUTHERN SIERRA MIWOK

Many material culture items manufactured by California Indian tribes for domestic use (e.g., looped stirring sticks, arrows, baskets) required special types of branches and ground stems. Because such branches and stems seldom occurred naturally on mature "wild" shrubs, manipulation of the plants by burning or pruning was necessary to obtain shoots of the desired characteristics in sufficient quantity.

*Burning as a Management Tool.*—Redbud has morphological and physiological characteristics that allow it to survive disturbances and, in the case of fire, even thrive in the reduced competition of its new habitat. Experimentation in botanical gardens has shown that redbud seeds are adapted for prolonged periods of dryness and cold and that they require special treatment to germinate, owing to an impervious seed coat plus a dormant embryo (Everett 1957). These characteristics suggest that germination of redbud seed is favored by fire, which cracks the seed coat and generates the heat needed to stimulate germination (Spurr and Barnes 1980).

Purposeful burning by Native Americans of chapparral and foothill woodland plant communities, where redbud commonly occurs, has often been reported in the ethnohistoric literature (Aginsky 1943; Driver 1937). This practice may have stimulated the germination of redbud and other species, increasing resources for basketry and other purposes.

There has been no scientific documentation of redbud's ability to sprout after fire. Yet in the Inner Coast Range, I have observed suckers from damaged boles vigorously resprouting after lightning fires. Indian informants affirm that this is indeed the case. In fact, burning was a traditional management practice of various tribes before the advent of modern pruning tools (Anderson 1989; Potts 1977; and Craig Bates, pers. comm. 1988).[5]

Prior to Anglo settlement, the initial management of large redbud shrubs required the use of fire. A sharp piece of chert or basalt was used for harvesting redbud ground stems and branches up to one centimeter diameter with ease, and up to two and one-half centimeters with more effort and time (Margaret Mathewson, pers. comm. 1989).[2] But the boles of large redbud shrubs often reach 10 or 12 cm. in diameter, and in such cases fire was used to reduce the shrub to a manageable stature. Thereafter, the resprouting stems could be kept small and straight with yearly harvesting with a basalt or chert tool or by tearing the branches from the boles (Anderson 1989).

Redbud occurs in large numbers around archaeological sites in the Sierra foothills. The shrubs decrease outward from the center of some of these archaeological sites, suggesting that the Southern Sierra Miwok utilized and maintained semi-wild redbud populations adjacent to villages. Studies are needed to interpret archaeological, ecological and historical data to determine if there is a correlation between redbud distribution and the occurrence of Indian village sites.

In the Sierra foothills, I have observed a lack of redbud regeneration, reflected in the absence of smaller size classes. Seedlings and saplings are scanty whereas

FIG. 1.—A Miwok coiled basket. The dark designs are made with split redbud bark.

most of the redbuds are mature and of tree size. The greatest number of immature redbuds are found along roadcuts. Furthermore, there are dying redbud shrubs under oak canopies. The shrub is not very shade tolerant and is outcompeted in such situations, by other species (Stewart Winchester, pers. comm. 1988).[5] Perhaps the current status of redbud reflects the absence of intense fires due to fire exclusion practices by public lands agencies, and the lack of Indian management of redbud at these sites.

*Pruning and Coppicing as Management Tools.*—At least two types of pruning of redbud were practiced by different tribes after Anglo contact. One technique was coppicing where the whole plant was cut within several inches of the ground (Fig. 2). The other was selective pruning within the canopy to direct the growth of the plant (Chestnut 1974; Anderson 1988). Today the Southern Miwok use both techniques to manage redbud. The shrubs are coppiced or selectively pruned one full growing season before harvest using tools such as hand saws or pruning shears (Fig. 4).

Redbud responds to pruning as it does to fire, by vigorously sprouting new shoots. The result is increased numbers of long, straight, slender switches with inconspicuous leaf scars, wine-red bark and no lateral branching. These are the

FIG. 2.—Coppicing redbud to induce rapid elongation of sprouts the following year.

characteristics most valued by the Southern Sierra Miwok and other California Indian peoples for basketry material (Fig. 3). Consistent, frequent pruning also keeps redbud shrubs of a smaller stature, with many slender boles that are easy to reach and cut, saving the basketweaver harvesting effort and time. In contrast, wild redbud has grey bark and twisted branches that are forked and often brittle; where the branches fork there is a notably more fragile area, making this section unsuitable for basketry.

Anthropologists and travelers, having spent little time in redbud habitat with California basketmakers, did not discern the difference between a "wild" plant and a "coppiced" plant, even though the shrubs display different architectures and vary in colors of bark. These observers probably did not perceive the breaking or cutting of plant parts as "management" *per se*, but rather as a destructive practice. Consequently, seldom in the ethnohistoric literature is there mention of pruning or coppicing of redbud by California Indians to meet cultural needs.

The type of sprouting that occurs on redbud after severe pruning is probably epicormic branching, which is defined as the release of suppressed buds along the bole. These suppressed buds are normal branches but submerged (Zimmermann and Brown 1980). Sprouting from the roots apparently does not occur. However, further studies are needed to understand the sprouting process fully.

The wine-red color of the redbud bark, so valuable in Indian basketry designs, appears only in juvenile wood tissue, and is the result of anthocyanin pigments.

FIG. 3.—Long, straight, slender switches of redbud with no lateral branches. These are the characteristics most valued by California basketweavers. (Switches harvested one year after initial pruning.)

These chemical substances are stored in the plastids in the cells of the cortical tissue just below the epidermis. As the branch ages it loses the color in either of two ways: (l) as the shoot expands it sheds the red bark and the cells in the mature tissue lose their ability to store or produce anthocynanins, or (2) the anthocyanins in the cortex cells are hidden by the production of bark (Richard Dodd, pers. comm. 1988).[6]

## THE RESPONSE OF REDBUD TO COPPICING AND PRUNING

Most native shrubs and trees are not harmed by pruning (Schmidt 1980). In fact, many trees and shrubs, as they approach maturity, accumulate dead twigs and branches, which if not removed, may harbor pests and diseases (Brown 1972).

Harvesting and horticultural methods used by the Southern Sierra Miwok are closely related to the annual growth cycle of redbud. The Indians are keenly aware of the dormancy period of redbud, referring to this period as the time "when the sap's down," and this is the preferred time for pruning. Harvesting redbud during this resting period usually is the least detrimental to its vital processes.

## MIMICKING INDIAN HORTICULTURAL PRACTICES

To better understand the methods for collection and management of redbud by the Southern Sierra Miwok and to determine the shrub's response to coppic-

ing practices, I conducted an ecological field experiment which simulated one of their horticultural techniques.

The objective of the experiment was to evaluate the effects of fall coppicing on the regeneration of redbud. Regeneration was estimated by determining the numbers of shoots, both ground stems and branches, produced after coppicing.

Two sites in the El Portal area at an elevation of approximately 640 m. were selected for the experiment: (1) Dry Gulch Creek in Sierra National Forest and (2) Merced River 19 kilometers west of El Portal in Sierra National Forest and on private property. I selected healthy, mature redbud plants for the experiment. Those with large amounts of dead material, symptoms of disease, or with flood damage were rejected. I chose plants in areas where the trees had never been pruned or coppiced, inspecting for evidence of previous cutting by thoroughly checking all basal stems. The sample size for the experiment was 15 coppiced and 15 non-coppiced redbud per site. These 30 plants per site were randomly allocated a coppice or non-coppice treatment.

Before plants were cut, two measurements were taken: (1) number of ground stems; (2) number of "usable" branches. "Usable shoots" were defined as shoots with no lateral branching and a minimum length of twelve inches. These same variables were measured again after one growing season in October 1987.

Coppicing consisted of cutting the plants off at the ground level or immediately above the root crown with pruning shears or a small power saw. All shoots were removed to within a stub length of five inches.

Observations on post-coppicing growth were recorded in October 1987. The same measurements were taken (number of stems and the number of usable shoots) and any mortality noted. The differences between cut and uncut plants were assessed using a student's t-test for unpaired replicates ($n = 30$ each per site). An analysis of variance was performed with the data from both sites to determine the significance of differences in shoot production and ground stem production between coppiced and uncoppiced shrubs.

Numbers of usable shoots increased significantly with coppicing (Table 1) on the Merced River/private property site. Numbers of usable shoots increased tenfold with coppicing on the Dry Gulch site (Table 2), but the increase was not statistically significant. Numbers of ground stems increased with coppicing, but the difference was not significant on either site (Tables 1 and 2).

An important outcome of this experiment was that none of the redbud shrubs that had been coppiced in 1986 died. Instead, coppicing was followed by vigorous resprouting on all 30 shrubs (15 per site). Rates of growth after coppicing were fairly uniform. In October 1987, eleven months after the cutting treatment, the general appearance of the coppiced plants was distinctly different from that of the uncoppiced ones: bark color had changed from grey to wine red, branches were much straighter, lateral branches were absent or in negligible quantity, and overall height of the shrubs was less (Fig. 4).

The results from the experiment suggest that the effects of one year of coppicing were not detrimental to the target plant species and were possibly beneficial. Furthermore, the coppicing treatment at the Merced River/private property site

TABLE. 1.—Effects of coppicing on plant variables of redbud *(Cercis occidentalis)* along the Merced River, Sierra National Forest and El Portal private property.

| | No Treatment | | Coppiced | |
|---|---|---|---|---|
| | Mean ± S.E. | | | |
| Variable | 1986 | 1987 | 1986 | 1987 |
| Average no. of usable shoots per plant | 9 ± 2*a | 4 ± 1 a | 21 ± 6 a | 107 ± 15 b |
| Average no. of ground stems per plant | 29 ± 5 a | 26 ± 4 a | 28 ± 4 a | 32 ± 3 a |

*Numbers for the same treatment in 1986 and 1987 followed by the same letter are not significantly different according to the student t-test ($P<.05$).

TABLE 2.—Effects of coppicing on plant variables of redbud *(Cercis occidentalis)* at Dry Gulch Creek, Sierra National Forest.

| | No Treatment | | Coppiced | |
|---|---|---|---|---|
| | Mean ± S.E. | | | |
| Variable | 1986 | 1987 | 1986 | 1987 |
| Average no of. usable shoots per plant | 4 ± 1*a | 2 ± 1 a | 5 ± 2 a | 49 ± 13 a |
| Average no. of ground stems per plant | 8 ± 2 a | 9 ± 2 a | 18 ± 5 a | 22 ± 4 a |

*Numbers for the same treatment in 1986 and 1987 followed by the same letter are not significantly different according to the student t-test ($P<.05$).

showed that significantly higher numbers of usable shoots could be produced by this practice.

Recommendations which incorporate Indian management practices cannot as yet be made based on these data. In order to maintain and manage redbud, the manager must know how the plant responds to repeated coppicing through several years. Frequency of manipulation could be an important factor influencing plant vigor and productivity, requiring a multi-year study. Questions which require further research include: (1) How does coppicing in several consecutive

FIG. 4.—Vigorous sprouting of redbud on Sierra National Forest one year after experimental coppicing.

years affect the growth of a redbud shrub? and (2) What frequency of coppicing will result in maximal production of shoots of optimal quality over the normal lifespan of the plant?

## CONCLUSIONS

The Southern Sierra Miwok and other California native peoples had an active role in manipulating the plant architecture of redbud with pruning, coppicing, and fire management. This offers further evidence that hunter-gatherers had the capabilities for effecting environmental changes in California plant communities. The extent to which aboriginal burning and pruning effected redbud distribution and abundance needs to be further investigated. The management of redbud for the production of branches and ground stems suitable for basketry is still practiced by members of the Southern Sierra Miwok and other California Indian tribes. The shrub remains integral to many modern tribal cultures. By repeated pruning or coppicing of redbud, Indians ensure a sustained yield of high quality shoots for basketry and simultaneously maintain he health of the plant. Public land managers, in managing redbud, should take into account this knowledge possessed by Indians.

Indian horticultural practices and resulting impacts on vegetation cannot be reliably assessed solely through the interpretation of ethnohistoric literature and ethnographic research. Vegetation productivity resulting from or related to

Indian cultural practices must be measured by experiments using methods similar to those of specific Indian groups if the cultural needs of the Indian community are to be taken seriously by public lands agencies. Ecological field experiments, therefore, can provide new data to test hypotheses regarding the possible effects on plant communities of past and present California Indian vegetation management. Specifically designed experiments also could substantiate historical and ethnographic reports regarding certain Indian plant management techniques.

Land managers have to be better informed by becoming acquainted with Indians and understanding their current cultural needs, and by conducting studies to learn about Indian harvesting and management practices and their appropriateness for public lands. During this process, resource managers will have to weigh carefully conflicts with other values and redefine cultural preservation to include the concerns of living Indians.

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