

# Traditional Ecological Knowledge: An Important Facet of Natural Resources Conservation



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Yerba mansa  
(*Anemopsis  
californica*), an  
important medicinal  
plant cultivated  
by California  
Indian tribes.

## Abstract

For over 10,000 years, American Indians from diverse tribes have lived in the United States. Natural resource management is not a modern invention; Indians have practiced the roots of this applied discipline for millennia. Our North American landscapes, a reflection of historical processes, both natural and cultural, bear the indelible imprint of a medley of lifeways. The native peoples harvested and tended the wilds for millennia: replanting cornlets of brodiaeas to ensure future production, burning under oaks to discourage insect pests, allowing for rest periods between sedge rhizome harvests, and maintaining native grasses and wildflowers with edible seed with fire in tallgrass prairies, montane meadows, and the understories of open oak and conifer forests. Some of our rare and endangered plants and early successional landscapes depended upon deliberate well-informed American Indian action. Therefore those landscapes and plants are at risk now, because we've forgotten about this essential component of those ecosystems—humans. These Technical Notes give a step-by-step guide of how to delve into our rich human past, to reconstruct historic land use and management practices in different landscapes, using examples from California. Land managers and restorationists are discovering that ancient cultural practices—burning, pruning, thinning, weeding of native plants—are not passé. These techniques have direct application to the restoration and management of our natural resources and biodiversity today.

## Definition of Ethnobiology

The collective storehouse of human knowledge about the natural world is commonly called “traditional ecological knowledge” (TEK) and it can be defined as “the knowledge base acquired by indigenous and local peoples over hundreds of years through direct experience and contact with the environment.”

This rich knowledge of how nature works and how to *judiciously* harvest and steward nature without destroying it is hard-won—the product of keen observation, patience, experimentation, and long-term relationships with plants and animals. It is knowledge built on a history—gained *through many generations of human beings* teaching their children practical techniques that underscored this crucial human-environmental relationship upon which culture and life itself depended. Many people in indigenous cultures displayed a remarkable knowledge about the natural history of places and they were directly involved in gathering, making products from, and using plants and animals. Thus the biological world, the source of the plant or animal, and the cultural world, the human context for using that plant or animal, were tightly intertwined.

Today the study of this knowledge base and the resultant human-nature interactions is called *ethnobiology*. The field encompasses the totality of the place of nature in a culture—from the role of plants and animals as tribal characters in legends, songs, or rituals designed to regulate resource use, to innovative ways in which humans have used plants and animals and their constituent parts, and to the manners in which human activities have altered the natural environment and augmented or decreased plant and animal populations.

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*This is the first in a series  
of technical notes about  
Traditional Ecological  
Knowledge.*



Figure 1 Many plants need periodic fire to regenerate. American Indians throughout the United States knew this and thus, set frequent light surface fires to augment plant populations and shape the structure and composition of myriad ecosystems. Paiute men making a fire with traditional methods on the Kaibab Plateau in northern Arizona. Photo courtesy of the Smithsonian Museum #1619A .



Figure 2 Pomo woman in California picking wild grapes (*Vitis californica*) prior to 1924. Photo courtesy of the Smithsonian Museum #76-5710.

## Why is Rediscovery of Indigenous Traditional Knowledge Important?

Traditional ecological knowledge is meaningful and relevant to modern Western society on at least four major levels.

1. On the personal level indigenous people teach ways to reestablish more intimate relationships with the natural world. Making a musical instrument from native hardwoods, or a piece of furniture from small-diametered native conifers, or weaving a basket satisfies American Indians' inner urge for self-expression and reenacts hand movements and hand, heart, eye linkages familiar to their ancestors. It is these kinds of rich ties to the land expressed through the senses, that set the very foundation to begin to build a true culture of place.
2. American Indians offer us many examples of tempered use of the natural world over many successive generations of humans without destroying it. The study of harvesting and management strategies for different native plants—season, frequency, aerial extent, and intensity of harvest or management—offer Western culture the opportunity to experimentally assess, through conservation field trials, American Indian interactions with nature that lead either to plant conservation or to extirpation. According to American Indian elders in different tribes, plants that are not beaten with a seedbeater often retain their seeds and insects eat them. Seedbeating helps to disperse the seeds around the area to perpetuate the plants. Bulbs, corms, and tubers that are not dug and propagules replanted, disappear. Bunchgrasses whose flowerstalks are plucked, produce many more culms.
3. The current paradigm in the fields of conservation biology and restoration ecology is that the use of nature is always the *antithesis* of preservation. Thus, restoration groups throughout the United States work to restore biodiversity on wildlands during a finite time period, and then humans are removed and nature is left alone. This may not be the best scheme for the long-term restoration of native plants that require periodic intermediate disturbance to rejuvenate their populations. Those ancient indigenous harvesting and management practices and regimes that prove beneficial can be reintroduced as strategies to restore and maintain biodiversity on certain private and public wildlands. Wilderness is defined by the Wilderness Act as areas “affected primarily by the forces of nature, with the imprint of man’s work substantially unnoticeable” (Wilderness Act of 1964). But there are many areas in the country where indigenous interactions with nature are an important part of the land’s ecological history.
4. By studying nature interactions among cultures that didn’t adopt agriculture or domesticate plants, which are the majority of California, Plateau, and Great Basin tribes, we can gain a greater understanding of the foundation upon which agriculture rests.

What becomes apparent from studying burning for straighter, longer dogbane stems for cordage, popping off and replanting bulbets of edible bulbs, or pruning hazelnut to create long sprouts for basketry—is that domestication and agriculture in North America should be placed within a much richer and more complex extended history of cultivation and stewardship. The birth of plant domestication in North America is a very recent phenomenon, perhaps 7,000 years old in the northeastern United States and younger still in the American Southwest. Cultivation of native plants is ancient, and it undoubtedly extends far beyond the brief history of domestication and the rise of agriculture.

### Typical Methods Used To Rescue Ancient Human Knowledge

**Oral Interviews** American Indian elders and long-term non-Indian residents hold much knowledge about the natural world and what plants, animals, and mushrooms are now missing from various landscapes (Figure 3). They also remember former management techniques that their grandparents or parents applied to landscapes, and some are continuing these practices.

To build a rapport with these individuals requires persistent, long-term contact, a sensitivity to cultural values, and an explanation of the ways in which the information gained will be used to further the well-being of their communities. Participants are often financially remunerated by the interviewer for their time and knowledge given. Unpublished reports and articles generated from interviews are copied and given back to the Native participants and tribal councils. If herbarium collections are done, an extra set that is laminated or preserved under glass is presented to the tribe (Figure 4).

Two types of interviews are utilized: qualitative, loosely structured interviews, that guide the respondent to talk freely on suggested subjects, and highly structured interviews, that involve the design of a questionnaire with a cluster of specific questions surrounding particular topics. If permission is granted by the respondent, both kinds of interviews would be recorded with a tape recorder and the tapes transcribed. A reference collection of photographs can be assembled for respondent identification and recall of harvesting, management and use information. This is extremely helpful in substantiating and enriching information gained from oral interviews. Additionally, visits are made to different sites, and interactions between native people and plants are witnessed firsthand. This is called “participant observation” and American Indians are asked to identify plants in the field and their particular uses, harvesting, and management.



Figure 3 Five bags of wildflower seeds that Mono elder Melba Beecher has from her mother’s seed collection that were gathered formerly in valley grassland, blue oak woodland and in mixed conifer forests. These include: kaseen (*Calandrinia ciliata*); Hall’s wyethia (*Wyethia elata*); farewell-to-spring (*Clarkia spp.*); chia (*Salvia columbariae*); and popcorn flower (*Cryptantha spp.*).

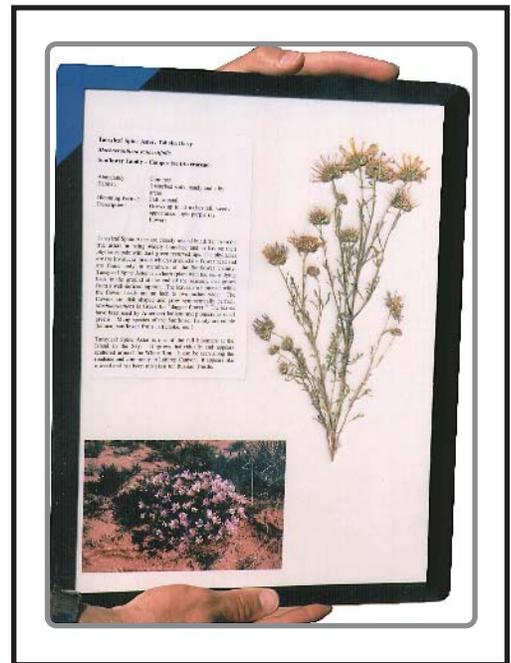


Figure 4 Riker mounts, presented to the tribes for use in environmental education and as thanks for their effort and time in sharing their knowledge.

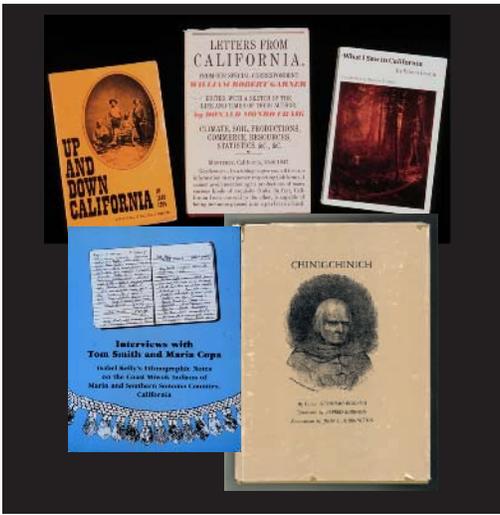


Figure 5 A sampling of the large corpus of published diaries, letters, and ethnobotanies from California that provide insights into reconstructing land use history and historical landscapes.

“...Cultivated by aboriginals—burnt, rich spot chosen and scratched with brush harrow, hulled by squaws. Seed sown broadcast—...”

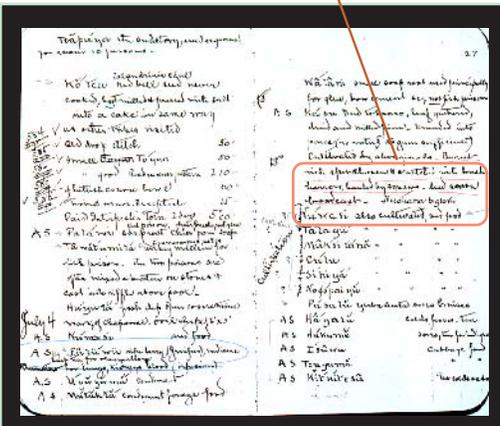


Figure 6 An excerpt from ethnographer John Hudson’s 1900 unpublished field notes that reveals Central Sierra Miwok cultivation of wildflower seeds with burning, sowing, and brush harrowing in the Sierra Nevada.

*Historic Literature Reviews* Ethnographers, explorers, missionaries, and early settlers wrote detailed accounts of indigenous life and plant material culture in different regions (Figure 5). Much of this information is housed at libraries, museums, historical societies, and government archives across the country. This material also is not in forms that are easily accessible to NRCS field offices (e.g., obscure journals; unpublished manuscripts; microfilm; and on notecards). Anthropologists and naturalists, such as John P. Harrington, Joseph Bird Grinnell, Melvin Gilmore, James Teit, C. Hart Merriam, and John W. Hudson, left us rich and detailed accounts of the lifeways of American Indians, including keen observations of plants and animals and their uses (Figure 6). Yet most of this information was never published. John P. Harrington alone left *one million* pages of unpublished field notes on California Indian tribes.

Specific ethnographic studies also were conducted on certain aspects of native cultures such as language, kinship, ethnobotany, and mythology. For instance, a tremendous corpus of ethnobotanies which describe the plant uses of specific tribes have been published for tribes in California. The series *University of California Publications in American Archaeology and Ethnology* spans from 1903 to 1964 and runs to 50 volumes with many issues devoted to California tribes. *The University of California Anthropological Records* spans from 1937 to 1975 and contains numerous articles from student and faculty research with American Indian tribes. Another series, the *Culture Element Surveys of Native Western North America*, was launched in the 1930s. *The Journal of California and Great Basin Anthropology* also contains useful materials. All of these series are available at major libraries.

This vast collection of historic material for different regions of the United States can be assembled and mined and milled for a more thorough understanding of what plants, mushrooms, and animals were important to native people, where and how they were gathered and tended, and in some cases how abundant they were. This information could be gleaned and used for the vegetation reconstruction of different plant community types. Additionally, drawings, photographs, herbarium collections, and maps provide valuable information in the depiction of landscapes at the point of Euro-American contact.

Regional libraries that contain many of these works could be established for constant reference by the local people for continual use in restoration projects. Additionally, there is a great need for the establishment of ethnobiological databases that would be accessible to tribes, land planners, restorationists, and the general public. This information system would involve systematically surveying and cataloguing ethnographic and ethnohistoric information such as making an itemized list of the thousands of native plant species of indigenous groups in each region, and recording their traditional indigenous uses. A key feature of this database would be to enable the user to query the system to answer specific questions with regard to indigenous harvesting strategies (e.g., season, frequency, pattern of harvest) and management methods (e.g., pruning, burning, sowing, weeding). This system would also allow a cross-referencing of information, allowing the user to trace the number and variety of historical references that refer to specific plant uses or other facts--increasing the user’s ability to assess the validity and exhaustiveness of the data.

*Analysis of Museum Artifacts* Within our midst lies a wealth of ecological knowledge about our human past and historic landscapes in the United States that lies virtually untapped. This knowledge is embodied in the anthropological collections that are housed at many museums throughout the country. These collections include: (1) the completed artifacts of diverse indigenous cultures such as tumplines, baskets, rod armor, and arrows; (2) the partially processed materials such as pounded acorn flour, basketry coils of split branches or rhizomes, and scraped basketry sticks; and (3) the “raw” plant materials that have not been processed such as seeds, fruits, leaves, mushrooms, and insects. These collections when analyzed in detail with accompanying card catalogue entries, unpublished and published field notes, and oral interviews provide researchers with information relevant to the reconstruction of historic landscapes and historic land uses.

Anthropological collections, when they are inventoried and assembled with other kinds of information, they reveal powerful insights into the past flora and fauna and former human relationships with the biota of a region. For example, small seeds (less than a millimeter) of one plant species per jar, corroborated with elder testimonies and historic literature, reveal that they were part of historic diets and that they once grew in patches of one species, substantial in extent (Figure 7). Jars of insects also contain important information. Identification of a grasshopper species, combined with knowledge of its life history characteristics from western scientific journals, and knowledge of the best time in its life cycle to harvest it for food, will help managers reconstruct the burning regime (e.g., season, frequency) used to “drive” populations to a designated place or kill them outright. This is important information for reconstructing indigenous burning of meadows.

The color, anatomy, and form of stems and branches used for weapons, games, cordage, and basketry can change significantly after either human or natural disturbance. The morphology and anatomy of shrub and tree shoots are compared and analyzed from among several collections, including: the historical collections of a selected university herbarium; new herbarium collections that are made of mature and young growth for comparison; and the bundles of basketry and cordage rods/coils, game sticks, and weapons in a selected museum’s anthropological collections. The developmental changes are examined as a function of time since the last disturbance and changes in the tissues that have been laid down. This knowledge is used to formulate diagnostic characters (leaf scars, lenticels, anthocyanins) for identification of each different shrub and tree species used in basketry, games, weapons, and string-making, and it gives the investigator a rough idea of the age of the growth (if the shoot growth of the shrub or tree is young, it may have been managed with fire or pruning). The morphological and anatomical features of the shrub or tree shoots used to complete different cultural items or bundles selected are compared with the availability of that plant part/per shrub exhibiting those same qualities in an unmanaged or “natural” forest, woodland, grassland, or riparian community. Comparisons are made of the differences in morphology between the material used in the collection versus wild growth to elucidate the extent of indigenous management (Figure 9).



Figure 7 Many jars of different kinds of wildflower seeds and grass grains were gathered by the Pomo in the Clear Lake region. These seed types could be used for reconstructing and restoring the native plant life of that region. Public Museum of the City of Milwaukee, Wisconsin Anthropological Collections



Figure 8 Pomo coiled basket with young redbud for the red design. The shoots were harvested after vegetation burning (or in later times pruning). Counting numbers of managed shoots used in this and other baskets would yield valuable information in approximating the number of shrubs and acreage burned to accommodate this industry for an historic Pomo village.



Figure 9 Contrasting plant architectures and colors of wild versus managed redbud (*Cercis occidentalis*) for basketry material. The red pigment is only found in the young growth that is stimulated by pruning or burning.

Shown are samples of traditional plants.



Broad-leaved Yucca  
(*Yucca baccata*)

©J.S. Peterson, USDA, NRCS, NPDC

USES: Fruits for food; leaves for basketry, string, and ropes; roots for soap and shampoo



California Black Oak  
(*Quercus kelloggii*)

©M. Kat Anderson, USDA, NRCS, NPDC

USES: acorns for food; branches and trunks for firewood; sprouts for looped stirring sticks



California Fan Palm  
(*Washingtonia filifera*)

©M. Kat Anderson, USDA, NRCS, NPDC

USES: fruits for food and beverage; fruit stalks for fire drills; leaves for basketry material



Singleleaf Pinyon  
(*Pinus monophylla*)

©James L. Reveal, Courtesy of Smithsonian Institution

USES: branches for stirring sticks; pitch for waterproofing baskets; seeds for food



Soaproot  
(*Chlorogalum pomeridianum*)

©Gary A. Monroe

USES: bulbs for shampoo, glue, and food; leaves for food; old leaf sheaths for bristles for brushes



Sourberry  
(*Rhus trilobata*)

©W.L. Wagner, Courtesy of Smithsonian Institution

USES: branches for arrow shafts, basketry material, and snowshoes; branches and leaves for dye, fruits for food and beverage

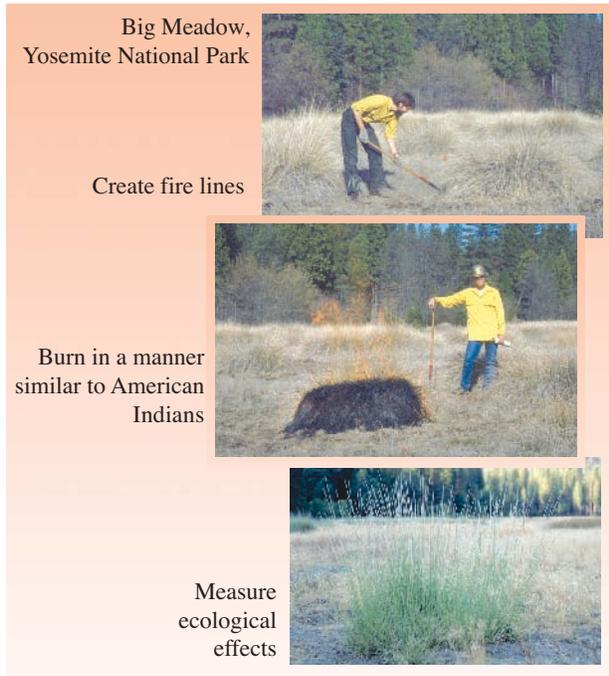
*Conservation Field Trials: Testing the Potential Conservation Value of Indigenous Practices* While much work in indigenous communities over the past decade has pointed to the significance of non-Western resource management practices for sustainable development, empirical evidence for the viability of these practices is scant. Conservation field trials that simulate cultural practices of traditional peoples could provide new data to test hypotheses regarding the possible ecological effects of harvest patterns and horticultural practices on plant species and plant community dynamics. These experimental harvests and management of native plant populations would contribute to our understanding of human-plant interrelationships and yield a set of harvesting and management techniques that enable this knowledge to be recovered for contemporary utilization by private landowners, public land managers, and restoration ecologists.

Conservation field trials launched by NRCS field offices could be used to demonstrate that there are types, scales, and frequencies of human interaction with small-scale technologies that maintain or even enhance native plant populations. Experiments would help inform land managers, landowners, and scientists that the “leave it alone and put a fence up around it” scenario is not always the best solution for the conservation of common, or rare and endangered plant species, particularly those that have evolved under an indigenous fire management and harvest regime.

Two sample experiments are explained (see page 7).

## Western Science and Native Science: A New Synthesis

Two conservation field trials designed to mimic indigenous horticultural practices to determine if indigenous management techniques would provide *predictable* and *desirable results* for landscape management.



### Simulate Indigenous Burning of Deergrass (*Muhlenbergia rigens*)

*The flower stalks are still gathered by many tribes for the foundations of coiled baskets.*

#### Objective

- To increase flower stalk production

#### Burning Treatments

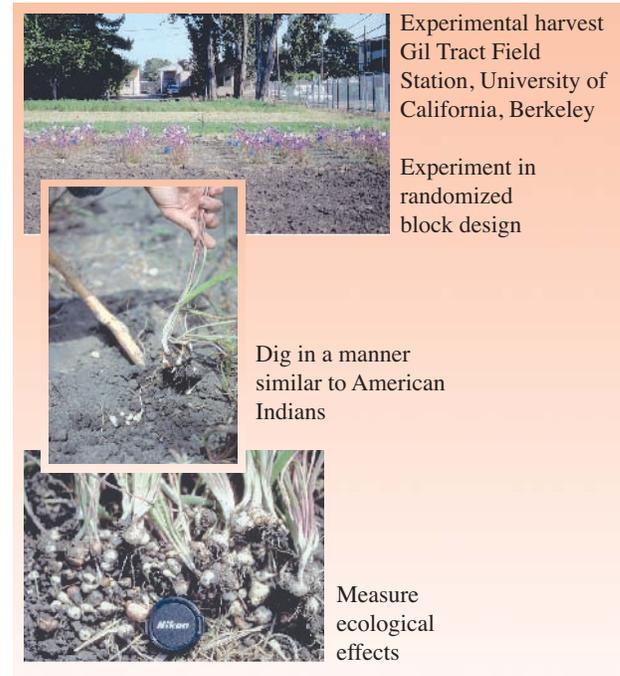
- Burn tufts of grasses with a backfire across the clusters started with drip torch at edge of fire line.
- Control: leave unburned tufts of grasses.

#### Null Hypotheses Tested

- Burned deergrass colonies do not differ significantly in area than unburned clusters.
- Burned deergrass colonies do not produce a significantly different number of flower stalks than unburned colonies.

#### Results

One year after treatment, the mean number of stalks was greater in the burn units than the controls, and this difference was significant.



### Simulate Indigenous Tilling of Blue Dicks (*Dichelostemma capitatum*)

*The edible corms were gathered in large quantities by many tribes.*

#### Objective

- To investigate if a certain harvest regime will maintain or increase numbers of corms and cormlets

#### Treatment Options

- Harvest intensity: 50% or 100%
- Harvest time: flowering or seed stage
- Replant or don't replant cormlets
- Control: leave unharvested plots of blue dicks

#### Null Hypothesis Tested

- There is no difference in mean number of corms/cormlets produced per plot.

#### Results

The combined treatment which consistently produced the greatest number of corms and cormlets was harvesting at medium intensity (50%) in the flowering stage, with cormlet replacement. This suggests that this regimen could very well produce sustained yields at traditional collection sites.



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