Final Report for World Wildlife Fund/U.S. Forest Service Upper Glade National Pilot Stewardship Project

By Dennis Martinez

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> *"We believe that as a community of ecologists living in times of unprecedented ecological change, we can no longer afford the questionable luxury of working solely within our own traditions if we are to learn to live sustainably. Conserving our options means, in part, conserving the diversity of ways of thinking about problems."*
> -Jesse Ford and Dennis Martinez
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> (from Invited Feature on Traditional Ecological Knowledge in Ecological Applications, vol. 10, October 2000, by the Ecological Society of America, Introduction, p. 2)

Introduction

The objective of this report is to define and develop a forest ecosystem restoration strategy for the Little Applegate / Upper Glade drainages based on a blending of traditional Native American ecological knowledge and management practices with the sciences of restoration ecology and conservation biology in order to test the feasibility of a larger proposed Klamath - Siskiyou Ecoregion conservation plan.

Conservation biology now includes restoration ecology in its conservation prescriptions but has been slow to recognize the positive contributions of indigenous societies to the conservation of biodiversity. (See Research Priorities for Conservation Biology, eds. Michael Soule and Kathryn Kohm, chapters 2 and 7) However, "ethnobiology" - - the study of how different societies interact with the natural environment - - is recognized as having some potential for conservation in areas of low to moderate human economic activity. For example, Soule and Kohm state on p.66:

> *"Ethnobiology must give more emphasis to dynamic and open models of human knowledge systems and behavior that include factors that were considered exogenous in earlier models. An inevitable consequence will be to make ethnobiological research more inclusive, complex, and messy."*

This relatively new direction in conservation biology is supported by the emerging field of ecological anthropology (See Ecosystem Ecology in Biology and Anthropology: a Critical Assessment in the Ecosystem Approach in Anthropology, ed. Emilio Moran, pp. 3-40)

Still, as Moran points out, the historical emphasis by ecologists of the self - maintenance and self - regulating characteristics of ecosystems has contributed to a view that man's role was essentially disruptive of natural processes. This remains the dominant view of conservation biology, particularly in those ecosystems thought to be "wild". Conservation biology may now recognize that some systems of agroforestry, for example, conserve biodiversity better than other systems, but not that some wildland systems have very high levels of biodiversity *because* of sustainable human cultural practices.

It is the task of this document to take forest restoration and conservation planning into that "inclusive, complex, and messy" area of ethnobiology which deals with how human economic use affects the natural environment - for better or for worse. In the case of the Klamath - Siskiyou Ecoregion, I will argue that Native American land - use practices and values in interaction with non-human ecological factors (topography, soils, climate, lightning fires) have contributed to the high degree of biodiversity of the Klamath - Siskiyou Ecoregion in general and to the Little Applegate / Upper Glade Watershed in particular - - not everywhere but in enough places to have virtually created or co-created unique habitats which, along with the species of plants and animals they support, are facing eminent extinction, endangerment, or are so poorly and unevenly distributed that ecological structure and composition are fragmented to the point of diminished ecosystem function. **I hypothesize that high biodiversity and ecological integrity correlate with sustainable indigenous forest management practices. If this is found to be a highly probable hypothesis, any conservation or restoration planning which ignores or minimizes millennia-long indigenous contributions to ecosystem integrity cannot claim to have considered all relevant ecological factors.**

Part 1 of this report will compare Native American beliefs, values, and worldviews with those of the dominant Euroamerican society. The classic Western industrial-scientific paradigm will be briefly examined followed by a closer look at its recent rapid metamorphous in the biological sciences into an ecosystem science which appears, in part, to be converging with some key aspects of Native philosophy, as is Western environmentalism which unfortunately still espouses values from the industrial-scientific model but which also relies on the ecosystem science model.

Part 2 will then show how these different belief complexes have led to different ways of viewing forest ecosystem dynamics even while beginning to converge in some fundamentally important ways. I will focus on Native American burning practices but in a wider social, cultural and economic context than is usual in ethnography and fire ecology when referring to Indian burning. In particular, I will show that cultural resiliency was mirrored in ecosystem resiliency and vice-a-versa; that lightning fires alone would not have been sufficient to maintain the material basis of the culture over time; and, finally, that most Indian forest management practices had significant and positive ecological effects on forest structure, composition, and function at virtually all elevations.

Part 3 will discuss the implications of traditional indigenous ecological knowledge (TEK) for conservation and restoration planning, focusing on how to conceptually reconstruct a reference ecosystem using both TEK and western ecological science (WES). We will be looking for enough common ground to assist in building a restoration/conservation baseline that includes the Native American managed forest structure, composition and function and which can be relied upon as the ecological component in any local community values/ issues/beliefs discussion which may contribute toward the "future desired conditions" of the forest in the Applegate Watershed.

Finally, Jeff Borchers will apply Bayesian Decision Analysis (BDA) - in another paper - to the interplay between ecological and human-value factors in the decision-making process which will guide the agencies in determining which conservation/restoration approach will best meet community expectations while hopefully leading to recovery of ecosystem integrity to the greatest degree possible. It is because of the incompleteness of our knowledge of how ecosystems work - both past and present - that BDA quantifiable "belief-causality" modeling, or "knowledge maps" may prove a useful tool for dealing with the uncertainties and probabilities inherent in our subject (Eugene Charniak, "Bayesian Networks Without Tears", a publication of the American Association for Artificial Intelligence). Further, BDA offers a transparency to decision-making which, through numerical ranking, shows clearly where certainty and value intersect: e.g. if certainty is low and value is high, more research is needed (personal communications, Jeff Borchers and Carol Spinos).

BDA is structured as a feedback loop which goes from values (beliefs, worldviews) to objectives or actions (e.g. ecosystem management or cultural survival of Native Americans through particular land-use practices) and back to values. That is, from ultimate "why" type causality to "proximate" causes and back again. (per. com. Jeff Borchers). The objective is to test quantitatively the "fit" between, say, indigenous land management or practical cultural survival strategies, their knowledge and spiritual base (TEK), and the effects of that knowledge/value complex on biodiversity and ecosystem integrity under more or less changing environmental conditions; to test the resiliency and adaptability of both landscape and culture under Euroamerican and American Indian management. As Borchers *et al* note (in "Decision Support for Implementing, Monitoring, and Achieving Forest Landscape Goals: A Proposal for the Upper Glade Project, Applegate Adaptive Management Area, Rogue River National Forest, R-6, Jan. 23, 1999):

> *"The use of BDA reveals areas of scientific ignorance and uncertainty by asking decision makers to state their beliefs in the likelihood of events that influence the outcome of management activities. The use of BDA is a tacit admission that all decisions are ultimately structured by beliefs, however well informed, which may require constant updating."*

It is hoped that BDA will accomplish three objectives listed by Borchers *et al* in the above quoted document:

(1) decrease the risk in achieving future desired conditions;
(2) systematically optimize trade-offs among multiple land-use objectives; and;
(3) improve resource allocation in monitoring efforts.

A beginning was made in the Applegate Adaptive Management Area (AMA) to involve the local community and their values or beliefs in joint decision-making with the Rogue River National Forest in 1999 is an as yet unpublished paper authored by J. Borchers, G.A. Bradshaw, C. Spinos, B. Johnson, and D. Apostle ("Toward an Integrated Design for Collaborative Decision-Making and Landscape Planning: Applegate Adaptive Management Area"). See also " Learning to Collaborate, Collaborating to learn: A Civic

Science Strategy for Adaptive Management" by J. Borchers and J. Kusel (USDA Forest Service, Wash. DC. Aug. 2000).

Part 1

Beliefs, Values, Worldviews - Native Americans

Traditional Ecological Knowledge (TEK) of indigenous peoples is deeply embedded in spiritual worldviews. That is why some scholars add the word "wisdom" to TEK making it Traditional Ecological Knowledge and Wisdom (TEKW).
While we are interested in the more practical realm of indigenous land practices, the entire context of TEKW, including its spiritual bases, must be recognized and respected in order for TEKW to be incorporated appropriately and credibly into current ecosystem-based management strategies (Nancy Turner, "Traditional Ecological Knowledge and Wisdom of Aboriginal Peoples in British Columbia" in Biological Applications, October, 2000). While some scholars have asserted that Indigenous peoples did not possess a conservation ethic, at least in the Western sense, our examination of Native spirituality will show that it created very strong practical imperatives for taking care of their environment.

In spite of all the many variations within and among Aboriginal cultural and linguistic groups throughout the Americas, there are also many commonalities. Anthropologist Joseph Epes Brown notes, for example, *"…this common binding thread is found in beliefs and attitudes held by the people in the quality of their relationships to the natural environment."* "Modes of Contemplation through Action: North American Indians" p. 60)

E. Richard Atleo, Chief Umeck of the Ahousaht First Nation of the Nuu-Chah-Nulth, and ethnobiologist Nancy Turner, with 30 years experience working with tribes all over northwest North America, articulate the belief system from which traditional aboriginal values derive as follows:

The creator made all things one.
All things are related and interconnected.
All things are sacred.
All things are therefore to be respected.

(Nancy Turner and E. Richard Atleo "Pacific North American First Peoples and the Environment" in Traditional and Modern Approaches to the Environment on the Pacific Rim: Tensions and Values, ed. Howard Coward.)

Leroy Little Bear, a member of the Blood Tribe of the Blackfoot Confederacy and former director of the Native American Program at Harvard University, states succinctly:

"In Aboriginal philosophy, existence consists of energy. All things are animate, imbued with spirit, interrelationships between all entities are of paramount importance, and space is a more important referent than time…there is enough similarity among North American Indian philosophies to apply the concepts generally, even though there may be individual differences or differing emphases. "

("Jagged World-views Colliding" in Reclaiming Indigenous Voice and Vision, ed. Marie Battiste. P.77) Continuing (p. 78), Little Bear sums up the basic attributes of American Indian philosophy:

*"The idea of all things being in constant motion or flux leads to a holistic and cyclical view of the world…constant motion, as manifested in cyclical or repetitive patterns, emphasizes process as opposed to product…The Earth cannot be separated from the actual being of Indians. The Earth is where the continuous and/or repetitive process of creation occurs. It is on the Earth and from the Earth that cycles, phases, patterns - - in other works, the constant motion or flux - - can be observed. Creation is a continuity. If creation is to continue, then it must be renewed…**All of the above leads one to articulate Aboriginal philosophy so being holistic and cyclical or repetitive, generalist, process-oriented, and firmly grounded in a particular place."***

James Sakej Youngblood Henderson, born to the bear clan of the Chickasaw Nation and Cheyenne Tribe in Oklahoma and one of the leading tribal philosophers, advocates, and strategists for North American Indians, delves even further into Native worldviews, emphasizing cosmologies common to most tribes:

"Most aboriginal world views are founded on two understandings. First, they understand the ecosystem as an eternal system tolerant of flux and refined by endless renewals and alignments. Second, they understand that each ecosystem encapsulates and enfolds many forces or parts, none of which can enfold or encapsulate the whole. The forces express nature instead of creating it. These two understandings focus on the inter-dependence of the life forces. They also express the need for respectful behavior to all parts of the sacred spaces. Thus, Aboriginal people perceive all the various forces of nature as connective fibers in a larger pattern that enfolds a fluctuating ecological system."

("Ayukpachi: Empowering Aboriginal Thought" in Reclaiming Indigenous Voice and Vision, ed. Marie Battiste, p. 260.)

This larger "objective" reality, which could be viewed as the sum of all of the interacting parts, which are always in a state of flux or becoming, is never fully grasped by humans. Rather, "it" (often called the Great Silence, Great Mystery, or Great Spirit) is approached, in humility, through the establishment and maintenance of relationships -

both spiritual and physical - which are experienced rather than fully understood intellectually. All of life - not just those natural entities which sustain us physically - is perceived as a gift, the misuse of which unleashes destructive forces which can harm individuals or whole tribes. As Henderson explains:

> *"The deepest part of earth is said to provide sustenance to life on earth. This lodge is also analogized to grandmother, which is often translated as Mother Earth. In the deep earth lodge are sacred caves where seekers may receive and be instructed by the animating forces (mntu). These forces work in all the realms but are said to belong or reside in either the deep earth or the sky lodge. The physical forms of rocks, plants, animals, and humans are made possible by the potencies of these forces. These potencies can be known to humans, but only in prayers or appropriate ceremonies. There is an enigmatic side to animating forces that come into existence by the abuse or manipulation of the material resources: often these destructive forces are created by the misuse of gifts by humans. In the deep caves (wlnusukek), the original visions were given to the humans. They are the oldest spirit lodges and provide the models for all other spirit lodges or ceremonies on the surface of the earth. Each force is said to have a keeper or protector (nujotekwti) who can punish or grant privileges to humans for their conduct toward the plant or animal form; these mntu can make themselves visible to humans on important occasions."*

A Wintu prayer (north central California in the southeastern part of the Klamath-Siskiyou Ecoregion) made on the morning of a deer hunt captures the essential spiritual relationship between the hunter and the universe:

> *Behold the sun south above.*
> *Look at me down to the north.*
> *Let me wash my face with water; let me eat, let me eat food.*
> *I have no pain.*
> *Let me wash my face with water.*
> *Today let me kill a deer and bring it home to eat.*
> *Look at me down to the north, grandfather sun, old man.*
> *To the south and north I am active.*
> *Today I shall be happy.*

(In David Suzuki and Peter Knudtson, Wisdom of the Elders: Sacred Stories of Nature, pp. 120-123.)

He prays for harmony with the larger order of things in his request of the sun and "old man" (this is what they call the Creator in this region) for luck in the hunt. If he fails to kill a deer, it is not because he is not skillful but because it is simply not in the larger scheme of things for the deer to give itself to him. Forces larger than he must be daily reckoned with and appeased. Native people live in a forest of eyes, watching how humans treat their non-human relatives.

Thus, Indigenous peoples strove to respect and live in harmony with the spirit essences of rocks, trees, rivers, coastlines, lakes, springs, ocean, plants and animals

It is useful at this point to remember that we are not talking about some mystical "Noble Savage" (a European construct) perfectly in tune with his/her environment. While such relationships are seldom achieved, they are the purpose of life. Sacred relationships with all life forms were cultural ideals which some managed better than others (Henderson, p. 258), but which, if ignored by too many for too long, inevitably led to extinction. This is not so different from the high value put on individual property rights in Western society - despite the existence of a gaggle of cheats, crooks and other assorted violators of the private property ethic. **The perspective which I would encourage is that of these spiritual ideals as an integral part of the larger environment which played a role just as important as the natural or physical realm of ecosystem-cultural interactions in the maintenance of cultural resilience and, consequently, I would argue, in the resilience of the ecosystems in which tribal people lived.**

One important purpose of comparing and contrasting Native American beliefs with those of the dominant Euroamerican society is the search for enough common ground upon which to construct a working synthesis which is more ecologically complete than the model that Western ecosystem science (WES) currently is using.
WES does not have to incorporate Native spirituality into its paradigm in order for this proposed synthesis to work. But WES, as a whole, has been particularly resistant to according much credence to the notion that Indians were conservationists, or that, conservation ethic or not, Indians had any real effect on precontact forest vegetation structure and composition. (Michael Soule and Gary Leace eds. "The Social Siege of Nature", Reinventing Nature: Responses to Postmodern Deconstruction, pp. 137-173, 1995; (See also work by Dave Forman; Reed Noss; Jared Diamond; Paul Martin; Shepard Krech III; Daniel Guthrie; and Tom Regan).

While one fundamental weakness of these critics is their general lack of contact with and/or understanding of Native spiritual leaders and spirituality, some have argued that there was no conservation ethic in its current utilitarian sense *because* of these spiritual beliefs (e.g. Calvin Martin and Tom Regan). I would argue that it is possible for *any* human society to base its behavior, at least to some degree, on spiritual principles, including spiritual penalties for failure to respect other life forms, and on a systematic, disciplined, and meticulous observation of nature for the purpose of maintaining sustainable levels of culturally important resources. This view was questioned initially by leading environmental philosopher J. Baird Callicott (In Defense of the Land Ethic: Essays in Environmental Philosophy, p. 193), who based his skepticism on the fact that classic conservation thinking (e.g. Gifford Pinchot) was based on nature-as-human-commodity, which differed fundamentally from the Native holistic sense of belonging *to* the land (p.196). Conversations with scientists who had actually lived with tribal people, however, modified his views to the point that he reversed his judgment on indigenous conservation ethics (p.217). Koyukon ethnographer and author Richard Nelson wrote in a letter to Callicott: "*the Koyukon people…had a well-developed, empirically based system of ecological knowledge and conservation prior to contact with Europeans. It is definitely my impression that people like the Koyukon [i.e. most hunter-gatherers] approach their environment as much from a scientific, empirical point of view, as from an animistic and symbolic perspective."* (p.217)(See also, "A Conservation Ethic and Environment: the Koyukon in Alaska", in Nancy Williams and Eugene Hunn, eds. Resource Managers: North American and Australian Hunter-Gatherers, pp. 211-228.)

Western philosophers like Callicott emphasize logical consistency in their discipline, but life is not always so neat. As he notes:

> *"Christianity coexists more or less comfortably with modern science, Euro-Americans function in an empirical, technical, material, and mechanical world, and at the same time many believe in God, heaven, hell, miracles, possessions, the power of prayer, life after death, and the other general doctrines of Christianity…Why should I be reluctant to suppose, therefore, that the traditional Koyukon or Ojibway could at once represent their environments as animate, personal, and social <u>and</u> as a systematically integrated pool of impersonal resources which must be calculatively sustained and prudently conserved?"*(pp.217,218)

Thomas M. Bonnickson, M. Kat Anderson, Henry T. Lewis, Charles E. Kay, and Ruthann Knudson, in "Native American Influences on the Development of Forest Ecosystems", <u>Ecological Stewardship: A Common Reference for Ecosystem Management</u>, N.C. Johnson, A.J. Malk, W.T. Sexton, and R. Szaro (eds.) p. 458:

> *"Unlike religious knowledge and ritual practices, in terms of adaptation, the knowledge of hunters and farmers, like that of scientists, ultimately has to come to terms with the ways that the real world operates; environmental users have to adjust how they affect and are affected by local environments. No matter how much a forager may ritually infuse his or her activities with spiritual beliefs and ritual practices - - and anthropology is replete with descriptions of such beliefs and practices - - they must at numerous points relate to real things and observable events in the world around them. Thus, whereas hunter-gatherers may annotate their skills with mystery and ritual magic, they must in the long run have a broad knowledge of environmental events and relationships."*

Other objections commonly heard are the alleged megafauna extinctions caused by paleolithic hunters following the last ice age, overharvesting of trees for fuelwood and construction (Anasazi), soil erosion from poor agricultural practices of Aztec and Mayan farmers, etc. Although these issues are by no means scientifically settled and the evidence is still quite ambiguous, I'm prepared to admit that these kinds of abuses did in fact occur in those situations in the past - - and in the present with tribes like the Native Alaska Corporations under the natural resource leadership of "progressive" tribal members with encouragement from the U.S. government in defiance of traditional values and traditional elders - - where traditional beliefs and values were ignored for economic expediency. (Certainly if paleolithic hunter-gatherers had population and technology sufficient to cause extensive magafauna extinctions, they also possessed population and technology sufficient to effectively manage forest ecosystems and even create surpluses.) Clearly, where tribes failed to live sustainably in their environment they failed to survive. Or, as is perhaps the case with the Aztecs and Mayans, they survived through empire building which held off the day of ecological reckoning only a few more generations. Indeed, most Native American cultural groups have stories of times when humans became arrogant and forgot their traditional lifeways, and were destroyed. And with respect to the Little

Applegate Watershed, it is clear that the Da-ku-be-te-de did survive until historic times fundamentally unchanged as hunter-gatherers for at least 4000 years and perhaps as long as 12,000 years. (Jeff LaLande, An Environmental History of the Little Applegate River Watershed, 1995, p.5)

However, to conceive of the fundamental problem in either/or terms - - either Indians were spiritually centered or practically centered - - is too simplistic. Other factors played important roles in their cultural strategies for survival. In other words, cultural resiliency, like ecological resiliency, is multi-dimensional with enough diverse strategies to buffer particularly hard times (resource failure) and climatic anomalies and natural cycles (very long droughts or a series of particularly cold winters, failure of animals to appear, etc).

Those "other factors" include a complex set of social taboos with beneficial ecological effects. And, as we have already discussed, these taboos are motivated by both spiritual and practical conservation concerns. Scholars call these "resource and habitat taboos"(RHTs). Researchers studying indigenous hunter-gatherer communities found seven categories of RHT's:

(1) segment taboos - regulate resource withdrawal through specific food taboos
(2) quantity taboos - regulate the amount of resource withdrawal, set quotas
(3) temporal taboos - regulate access to resources in time, imposed sporadically, daily, weekly, or monthly
(4) method taboos - regulate the methods and techniques for withdrawal of species
(5) life history taboos - regulate withdrawal at vulnerable stages of a species' life history based on its age, size, sex or reproductive status
(6) specific species taboos or general food taboos - to protect plants and animals in space and time (Note: of 70 taboos of this kind surveyed, 30% were of species listed as threatened by IUCN (The International Union of the Conservation of Nature) and included endemic and keystone species)
(7) habitat taboos - regulate both access and use of resources from particular habitats in space and time

(See Johan Colding and Carl Folke, Social Taboos: 'Invisible' Systems of Local Resource Management and Biological Conservation 1998.)

(1) Included in cultural resiliency is the "turf" concept of most indigenous societies, where tribal elders act as local authorities in regulating fishing, hunting, and gathering as well as particular families or clans responsible for the care of particular resources or places. (Where this local decentralized authority structure has been replaced by U.S. government enforced centralized "councils" or "corporations", resource abuse is more likely to occur.)

(2) An important resiliency factor is the inclusion within tribal ancestral lands of entire watersheds and drainages - from ridgetop to ridgetop - - so that a variety of aquatic and terrestrial resources were available through much of the year.

(3) The "ecological partitioning" at the regional level of tribal territories which exploited, for example, different parts of the same riverine system. An example in southwestern Oregon is the use of the lower Rogue River by the Gu-sla-dada with richer supplies of salmon and eel, versus the use of the Applegate River by the Da-Ku-be-te-de who relied more on deer than on salmon due to poorer runs on the Applegate River. A corollary to this partitioning is the existence of "grey" or buffer zones between tribal territories that were less exploited, especially during war time.

(4) Another element of resilience was the extensive trading networks in place, for example between the Da-ku-be-te-de in the Applegate and the Shasta in northern California or the Gu-sla-dada in the Illinois Valley of southwestern Oregon. These trade relations depended on inter-marriage between tribes and operated especially when the resources in one area failed at the same time that another tribal area had an abundance. Because different regional ecosystems usually held somewhat different resources (e.g. Shasta grey pine (*Pinus sabiniana*) nuts could be traded with the Takelma for salmon from the Rogue River), trading tended to be heavier between tribes from different ecosystems.

(5) This kind of intertribal trade network was mirrored at the band or village level among most Pacific northwestern tribes by a potlatch or "wealth display dance" which had the effect during hard times of redistributing tribal wealth. "Give-aways" in one form or another are practiced by most tribes in North America. Typically, sharing was a dear Native value and stinginess was considered on of the basest of traits. In extreme cases, individuals could be permanently ostracized for refusing to share during times of need. (See Reg Pullan, "<u>Overview of the Environment of Native Inhabitants of Southwestern Oregon, Late Prehistoric Era</u>", USDA Forest Service, Rogue River NF, Siskiyou NF, DOI, Bureau of Land Management, Medford, Oregon, Appendix I, pp-11 and iv-20,21.)

(6) Widely practiced birth control measures kept populations during good times low enough to be environmentally sustainable.

If periodic birth control measures (which could also include occasional starvation from multiple resource failure or disease pandemics as may have actually occurred in the 1830's in the Applegate area (Reg Pullen, <u>*Overview*</u>, and p. IV-19) helped maintain a good fit between Indian populations and the carrying capacity of the land, **were these precontact human populations then low enough to have prevented any Native resource management from having significant effects - positive or negative - on forest structure and composition?** It is generally recognized by ethnographic researchers that diseases introduced by Euroamericans decimated Indian populations (up to 90% in some cases) in several waves between 1770 and 1830 in the Pacific Northwest. Population estimates made in postcontact time may therefore be far lower than they actually were. Since the 1930's Indian population numbers have been revised upward for US/Canada from 2 million to 18 million (See H.F. Dobyns, <u>Their Numbers Become Thinned: American Indian Population Dynamics in Eastern North America</u>, 1983; A.F.

Ramenofsky, Vectors of Death; The Archaeology of European Contact, 1987; S.J. Fiedel, Prehistory of the Americas, 1987.)

Recent research indicates that European diseases may have spread rapidly enough to decimate Indian populations in the Pacific Northwest between 1550 and 1600 (S.K. Campbell, Post-Colombian Cultural History in the Northern Columbia Plateau AD 1500-1900, 1990.). Reg Pullen (*Overview*, p. IV - 19) quotes ethnographer Melville Jacobs, Notebook 125, in which the Indian informant refers to the time before the last great famine (1830's?): *"Long ago lots of people lived in Applegate River in one village there…"* He goes on to explain how inter-marriage with the Shasta allowed the Da-ku-be-te-de to go to the Shasta, near Yreka, California, and obtain food and avoid starvation. This suggests a larger population than the usual low estimates noted in the literature. Deserted villages were commonly seen. (See Reg Pullen, p. IV - 2, Melville Jacobs, Notebook 130). Pullen (p. IV-3) quotes early southwestern Oregon resident Dr. Lorenzo Hubbard who speaks about Tututni of the Lower Rogue River in 1856:

> *"According to tradition, many years ago they were far more numerous than at the present time, wars and diseases having in some instances destroyed whole tribes. The marks of old towns and large settlements everywhere found, now entirely deserted, are strong evidence of their traditions. (Hubbard, 1861)."*

While the evidence for significantly higher population levels of Indians than traditionally accepted is circumstantial for our study area, it seems to be consistent with recent continental research which is continually revising its precontact population figures upward as more is understood about the effects of European diseases on Aboriginal populations. In short, there very probably were sufficient numbers of Native Americans for extensive landscape modification. In fact, the material presented in Part 2 of this report on Indian management practices could serve as additional evidence of higher precontact populations because these practices probably led to a higher carrying capacity of their environment. Still, it is problematic just how far back it was that "lots of people" were effectively managing their lands. I will return to this subject in Part 2. Suffice it to say at this point that any serious decline in local populations would have undoubtedly destroyed for some time (until population recovery) the capacity for extensive or intensive forest management. This could have happened more than once in the period 1500 - 1830. Since most hunting and gathering activities were dependent on the social capacity and sheer numbers to carry out all of the work of harvesting, transporting, processing, distributing, storing and cooking as well as on the leadership and coordination by knowledgeable elders of the whole enterprise, starvation was added to the miseries of disease.

But, Reg Pullen points out, just avoiding starvation was not the whole story (p. IV - 21)

> *"The relationship of the people and the resources they relied upon for subsistence transcended the concern of avoiding starvation, however. There existed an integration of the practical necessity of utilizing resources with the recognition that those resources were spiritual entities that needed to be honored before they could be consumed. Because of this concern, ceremonies and rituals were a vital part of all harvesting and gathering activities."*

<u>Euroamerican Values, Beliefs, Worldview's</u>

The Euroamerican "values, beliefs, worldviews" which we are discussing in this section can be broken down for our purposes into: (1) "industrial-scientific", or the classic Western synthesis of Greek, Judeo-Christian, and Early Modern European philosophy, and which is presently experiencing a radical paradigm shift in the physical sciences, including ecology, that is leading to (2) "environmental-scientific" which itself is evolving as the "good ecosystem science" that (3) "Western environmentalism" relies on in its critique of (1).

We will be looking at the resiliency factor in particular in our comparison of Euroamerican beliefs - actions with those of Native Americans. Resiliency is a function of adaptability, which leads to what we call "sustainability" - of both ecosystems and cultures. USDA Forest Service researcher Gaye Bradshaw, in an unpublished paper, "Restoring the Landscape: An Analysis of Native American Approaches to Ecological Restoration", uses the concept of "complex adaptive systems" (CAS) in her comparison of Euroamerican industrial and Native American cultures:

> *"…land-use practices and decision-making processes in industrialized societies have developed many <u>maladaptive</u> features that have (1) diminished the complexity and resilience of landscape structure and functioning of natural landscapes, and (2) encumbered decision making processes in natural resources management."*

(USDA Forest Service Pacific Northwest Research Station and Dept. of Forest Science, Dept. of Computer and Electrical Engineering, Oregon State University, Corvallis, Oregon 97331, p.1) Bradshaw goes on to say that "the goal [of society] is to create a compatible, sustainable relationship between two complex systems: human society and ecosystems… From the perspective of complex adaptive systems (CAS), land-use conflict and severe environmental degradation may be regarded as <u>maladaptive traits</u>…

> *"Maladaptive traits can arise: "…from a process of adaptation [where] time scales are mismatched, when circumstances change much more rapidly than the response time of the CAS" (GellMann, 1994). Ecologically, this corresponds to human activities that exceed natural environmental change (e.g., the rate, extent, and intensity of human disturbances in North America over the past century). The human dominance of ecosystems represents a maladaptive social trait that has engendered corresponding maladaptive traits in ecosystems (e.g., losses of resiliency and diversity; see Gunderson et al, 1995)."*

Human domination of ecosystems has indeed characterized European-derived industrial societies. With the rise of mechanistic or reductionist science based on the idea of the separation of soul or spirit from material matter (Greek and Judeo-Christian concept) and the consequent characterization of nature as a machine (a fitting analogy for a developing industrial society), the way was open for resource exploitation without traditional ethical restraints (See Daniel Botkin, <u>Discordant Harmonies: A New Ecology</u>

for the Twenty-First Century; Dennis Martinez, "Wilderness vs. Sustainable Forestry" in Winds of Change, Spring, 1994, published by the American Indian Science and Engineering Society; Carolyn Merchant, The Death of Nature; H. Paul Santmire, "Historical Dimensions of the American Crisis" in Western Man and Environmental Ethics, ed. Ian G. Barbour; Thomas S. Kuhn, The Copernican Revolution: Planetary Astronomy and the Development of Western Thought.) Paul Santmire (pp. 70,71 in "Historical Dimension of the American Crisis") sums up the classic industrial-scientific belief complex:

> *Nature is analogous to a machine; or in the more popular version nature is a machine. Nature is composed of hard, irreducible particles which have neither color nor smell nor taste…Beauty and value in nature are in the eye of the beholder. Nature is the dead res extensa, perceived by the mind, which observes nature from a position of objective detachment. Nature in itself is basically a self-sufficient, self-enclosed complex of merely physical forces acting on colorless, tasteless, and odorless particles of hard, dead matter. That is the mechanical view of nature as it was popularly accepted in the circles of the educated [white Americans] in the nineteenth century.*

A corollary of the machine analogy is the perception of nature as being composed of discreet particles (Domocritean atomism), the motion and nature of which could only be understood mathematically (Pythagorean quantitative analysis). Nineteenth and 20th century natural philosophers, the intellectual ancestors of modern ecologists, applied classical Newtonian mechanics to theoretical ecosystem studies, and finally to forest management. Beginning with Gifford Pinchot, Euroamericans complacently believed that, like a machine, parts of natural systems were interchangeable and replaceable, and therefore resources like timber could be extracted because the natural system, acting like a machine, would automatically repair itself and reestablish its natural harmony and balance or homeostasis. This concept still appears in university textbooks (e.g. the Lotka-Voltera predator-prey model) and even in the Gaia Hypothesis.

The idea of a self-regulating, self-organizing, and autonomous system - a system which works best without humans - has influenced not only generations of ecologists and forest scientists, but still maintains a tenacious hold on Western environmentalism which criticizes industrial exploitation even while unknowingly laying claim to the very mechanistic philosophy which has led to the kind of resource exploitation characteristic of industrial society. A large proportion of environmentalists - but certainly not all - believe that a "hands-off" policy is best for forest recovery. This view is at least partly based on the machine analogy, which views natural systems as essentially homeostatic and self-organizing. Therefore ecosystems disrupted, say, by industrial logging will reestablish equilibrium on their own (e.g. overstocked timber stands will self-thin to ecologically optimum levels).

Classic Western scientific forest succession theory - - disturbed ecosystems will return to a stable state with the natural progression to a "climax" forest if left undisturbed - - has also supported the hands - off policy of the environmental community. As we will see in Part 2, Native American use of fire kept some kinds of habitats in a more or less permanent state of "arrested seral succession" which actually led to a more stable state without even reaching natural climax. Ecological restoration through the appropriate kinds of human intervention is only just now beginning to be embraced by the environmental movement but still mainly as a strategic attempt to head-off any co-optation of that increasingly popular concept by industry and government agencies. (Forest Activists Restoration Summit, Boulder Colorado, Feb. 16-18, 2001, sponsored by American Lands Alliance, Wash. D.C.). "Good" ecological science is relied upon by forest activists for baseline information and performance standards with which to guide forest restoration or conservation. There is an irony here: as WES leaves the comfort of the old machine analogy - as it is now doing - for the brave new world of chaos theory, fuzzy logic, and ecosystems in "dynamic disequilibrium" (pers. com. Ariel Lugo, Tropical forest ecologist. USDA Forest Service, Puerto Rico), and as restoration ecology continues in its present increasingly popular trajectory as a new scientific discipline on an academic par with descriptive ecology, "good" science will gradually but surely come to change preservationist environmentalism from a hands-off to a hands-on policy.

The following is a concise stereotypical summary of the essential differences between WES and TEK:

WES	TEK
1. Employs the written word	Is recorded and transmitted orally
2. Taught and learned in abstracted context	Learned through hands - on experience
3. Natural world is inanimate	Natural world is animate, spiritual
4. Humans can control nature	All life has kinship, is interdependent
5. Reductionist in approach	Holistic in approach
6. Analytical thinking mode	Intuitive thinking mode
7. Mainly quantitative	Mainly qualitative
8. Specialist / selective information	Inclusive / user - based information
9. Hierarchical / vertically organized	Reciprocity / communally organized
10. Hypotheses / theories / general laws	Spiritual / cumulative / collective / annually validated

(From Fred Clark, Subsistence Council Coordinator, Southeast Alaska, USDA Forest Service in " A Protocol for Acquiring, Using, and Disseminating Traditional Environmental Knowledge for Region 10, Alaska ", October 10, 1996.)

While the elements of TEK/WES presented in the above chart are more true than not true, they by no means convey all of the differences or shades of grey between the two knowledge-belief systems, and more importantly, they don't reveal the commonalities. In particular, the stereotypical categories in the chart fail to show how the classic Western scientific goals of predictability and reliability and the use of inductive-deductive reasoning are not so very different from Native or "ethno-science" in the way Indigenous peoples actually practice TEK in resource management. We will return to the practical similarities in Part 2.

The really significant differences between the two systems of knowledge - even while recognizing the practical methodological similarities - are in the way Native spiritual beliefs are congruent with practical actions and those of Western

society are not. Classic Western thinking is, and has always been, ontologically dualistic. Traditional Western religious thought is at odds with Western economic philosophy because spirit is at odds with flesh. (Callicott, p. 218). There is no such inherent separation or conflict in Native philosophy (TEKW) as we have already shown.

Modern ecosystem science is a rapidly evolving discipline with the potential to become a new paradigm in Western science. It has formally accepted the notion of the inherent changeability of natural systems. It is moderately holistic and inclusive - to a point. It is systems-oriented. However, it is still reductionist to a large degree, prefers mechanistic analytical categories (e.g. "habitat type", "climax succession theory", and "potential vegetation") abstracted out of real but messy and complex ecological phenomena and simplified in order to make timber management easier, and has yet to include humans as *significant* players in wildland ecosystem dynamics. (The role of restoration ecology in ecosystem science will be discussed in Part 3.) There is enough significant common ground, however, between WES and TEK to construct a working restoration/conservation synthesis (See Part 3).

Fikret Berkes, Mina Kislalioglu, Carl Folke and Madhav Gadgil, in "Exploring the Basic Ecological Unit: Ecosystem-like Concepts in Traditional Societies" (in Ecosystems, 1998, 1:409-415), note the similarities between TEK and the newly emerging ecosystem sciences:

> *"Traditional ecological knowledge, based on detailed observations of the dynamics of the natural environment, feedback learning, social system-ecological system linkages (Berkes and Folke 1998), and resilience-enhancing mechanisms (Folke and Berkes 1998), seems akin to adaptive management (Holling 1978; Gunderson and others 1995).*
>
> *Many indigenous ecological views are in line with the shifting scientific view on the nature of ecosystems. As characterized by Hollin (1986), the classic view holds that ecosystem processes are linear, equilibrium centered, and therefore predictable and controllable. It is a view that is closely related to the Age of Enlightenment ideal of "mastery over nature." An alternative view of ecosystem science is that ecosystem processes are nonlinear, multiequilibrium, and full of surprises, threshold effects, and system flips (Gunderson and others 1995; Holling and others 1998). Predictability and controllability are not limited by the scientific data available but by the very nature of ecological systems [see also Ludwig and others (1993), Carpenter and Cottingham (1997), and Johannes (1998)].*
>
> *All traditional ecological knowledge systems with which we are familiar are at odds with the view of linear, controllable ecosystems, but many are compatible with the alternative view. Some traditional peoples seem to have perceived the essential unpredictability of ecosystems and their nonlinear nature."*

But there are problems too. Some scholars have suggested that ecosystem science (and here we include its practical application in ecosystem management) has the potential for widening the gap between people and nature. Restoration Ecologist Thomas M.

Bonnicksen *et al*, in "Native American Influences on the Development of Forest Ecosystems", 1999, p. 440, writes:

> *"Subdividing landscapes into ecosystems could create the false impression that ecosystems are real things. This illusion becomes more dangerous when people think that they live on the outside and nature exists on the inside of ecosystems… Because management decisions come from outside, ecosystem management may reinforce the myth that nature exists apart from people if it does not explicitly state otherwise."*

Bonnickson *et al* also question the notion that climate has dictated the structure and function of ecosystems. They state that:

> *"human innovations in technique and technology [e.g. intentional fire] can and do push back [habitat and climatic]…limits, therefore, climate is not the sole determinant nor even in many cases the dominant force in guiding the development of particular ecosystems. American Indians selectively hunted, gathered plants, and fired habitats in North America for at least 12,000 years. Unquestionably, humans played an important role in shaping North America's forest ecosystems."* (p.440).

It is the role of Native Americans in shaping forest ecosystems in the Klamath-Siskiyou Ecoregion that we will be looking at in Part 2. As Bonnickson *et al* have indicated, there is a sense in which definitions of most "ecosystems" are somewhat arbitrary at the larger landscape level. Yet we all continue to use the term despite its ambiguity, along with "habitat type", "biotype", etc. The ecosystem or habitat type concept, while useful to a point, is particularly difficult to apply in the complex Klamath-Siskiyou Ecoregion. The same is true for the widely used "potential vegetation" idea. (Potential vegetation is considered to be the natural end-point or climax in vegetation succession if disturbance does not set back succession to an earlier point.) **Since climax is relatively rare in nature due to frequent disturbance, and since ecosystem boundaries are somewhat arbitrary, I would propose following ecological anthropologist Roy Rappaport in defining ecosystems as tribal ancestral lands managed in culturally distinctive ways** ("The Flow of Energy in an Agricultural Society", Scientific American p.224, 1971). We will return to this subject in Part 3 after establishing that Native peoples of the Klamath-Siskiyou Ecoregion were keystone players in ecosystem dynamics.

"And there was too much fire. Which last nobody could deny."
-Gifford Pinchot, Breaking New Ground, p. 36

"To save the forests the main thing is to make laws to prevent fires."
-F. Weyerhaeuser, to Congress, (1908) Ralph Hidy *et al*, Timber and Man: The Weyerhaeuser Story. P. 382

"It is often assumed that the American Indian was incapable of greatly modifying his environment and that he would not have been much interested in doing so if he did have the capabilities. In fact, he possessed both the tool and the will to use it. That tool was fire…without which most Indian economics would have collapsed."

-Steven Pyne, Fire in America: a Cultural History of Wildland and Rural Fire, 1982:71.

Part 2

Western Forest Science and Forest Industry vs. Native American Cultural Landscapes: The role of Indian Fire Re-examined From a Cultural Perspective

Western Ecosystem Science (WES) values knowledge both as an end in itself and for its potential usefulness in managing forests. But why manage forests? Forests have been managed traditionally for wood fiber and watershed conservation. In the latter part of the 19th century, as Stephen Pyne notes in Fire in America: A Cultural History of Wildland and Rural Fire (pp. 59,60, emphasis added):

> *"a veritable fever for forests swept the country. Nurseries were established and millions of acres reforested… The process continued through the 1930's under the New Deal impress of legislation that created such agencies as the CCC. The Tree Farm program after World War II extended industrial forestry and reforestation even to the farm woodlot. The establishment of forests had been as much a product of agricultural settlement as landclearing,* ***but such reforestation had come inadvertently as a product of the suppression of Indian fire practices.*** *The counterreclamation [the entry of industrial forestry into marginal farm lands and the "reclamation" of forest lands by agriculture reversed] proceeded deliberately, and it created yet another mosaic of fuel complexes and demanded yet another set of fire practices."*

Part of the industrial "counterreclamation" described by Pyne was the removal of both Indian tribes and Euroamerican settlers from forests. A series of disastrous fires from 1880-1910 (in both the Northeast and Northwest) made an easy rationale for the exclusion of settlements: removing Indians and settlers would control fires since both groups regularly burned in the forest (but in very different ways). But, by excluding settlement, it excluded the traditional ways by which agricultural lands had regulated fire (Pyne, p. 60). Where ranchers and farmers had defended their burning methods by recalling that Indians too had burned, now proponents of early industrial forestry defended fire suppression by holding that Indians did not intentionally burn. Indeed, those who did advocate light, cool forest underburns Indian-style were disdainfully labeled as "Paiute foresters". (Now that prescribed fire has been revived, it has been discovered that Indians did indeed burn.) It is instructive here to remember that it was European inspired "scientific forestry" that began fire suppression primarily to save trees for industry (Pyne, p.60). In an ironic historical parallel to today - - where appeals to Indian burning are suspect to environmentalists who fear that industry will use the thinly stocked "open forests" of historic Indian burning as justification for removing more trees - - so early Eastern academy-trained industrial foresters looked with cynicism at stockman, miners, railroaders, and loggers who appealed to remote Indian fire practices as justification for their burning methods (Pyne, p. 82).

Another irony of history is the almost *exclusive* focus by environmentalists on saving trees. This is largely because of the nearly total liquidation of old-growth trees by industrial forestry. Those "old-growth" trees are of course *commercially* valuable conifer species like Douglas-fir, hemlock, pine, cedar, true firs, etc. Old-growth non-conifer species (hardwoods, shrubs, forbs, and grasses) are usually not accorded the same sense of urgency, nor is early or mid-successional forest vegetation. We will see below that Indian burning patterns led to a mosaic of all seral stages at the landscape level. The environmental community is, in one sense, in about the same position as early industrial forestry - - which still believed that "good science" would result in sustainable forestry practices - - in its concern for protection of Late Successional Reserves (LSR's) and other old-growth preserves from anthropogenic fire. ("Natural" lightning fires are acceptable to many environmentalists - - as well as managers of wilderness preserves and parks - - even in forests with unnaturally high fuel accumulations and tree stocking rates much higher than before fire suppression began.)

The most obvious difference in values as seen from our discussion in Part 1 is the inclusion of humans in forest ecosystem dynamics by TEK and the exclusion of humans by Western ecosystem science (WES). (The United States is one of the few nations in the world where humans do not live on public lands; Western environmentalists are exporting that model globally, causing the removal of Indigenous peoples from ancestral lands when parks and preserves are set aside.) TEK is then both an experiential and a knowledge based lifeway. WES is a more detached way of knowing the natural world; a methodology and epistemology in which the observer is separated from the observed. WES relies on the replicability and predictability of carefully controlled experiments, generally in very short timeframes, and which ideally can be abstracted from particular parts of ecosystems in order to formulate ecological principles which are universally valid and testable. The other characteristic feature of WES (and science in general) is the general literature search and synthesis which relies mainly on research material acceptable to a particular discipline within a particular paradigm which the current generation of scientists find acceptable. (Thomas Kuhn, Scientific Revolutions, 1962) Again, the time frame of acceptable knowledge is short because information with potential for application in WES but which is anomalous with respect to the current paradigm is considered outdated. This is in contrast to TEK where knowledge is cumulative and always relevant.

When we apply this definition of science to the study of how a particular indigenous culture group like the Da-ku-be-te-de managed its ancestral lands, some scientists would claim that it is not "science" simply because no general principles can be derived from the study. It is too singular of a study from the standpoint of our definition. But, as we know, studies of particular ecosystems or species are routinely done by WES. Therefore, the methods of the natural and the social scientists are not really so different in practice. Still, the ultimate objective of WES is to derive testable general principles from several particular studies through comparative analysis.

But, as Bonickson *et al* note (p. 457):

> *"…throughout the history of anthropology, ethnographic data have been tested in order to derive general propositions, specifically through the use of cross-cultural comparisons, with more-or-less general propositions covering a wide diversity of topics such as kinship; religious beliefs; concepts of causality, space, and time; economic exchange and marketing; marriage and exogamy;* ***plus (increasingly) a wide range of parallels in the ways that technologically similar societies have related to similar environments involving parallel strategies of adaptation."***

We will still be within the generally accepted definition of Western science if we use the comparative method to test empirically the hypothesis put forward in Part One: Da-Ku-be-te-de Indian forest management in the Little Applegate/Upper Glade Watershed had significant and positive effects on ecosystem structure, composition, and function. Again, as Bonnickson *et al* point out (p.456):

> *"[some scientists]…have difficulty accepting the fact that the actions of hunting and gathering peoples - - societies which existed in different environments for hundreds of thousands of years before the emergence of environmental sciences - - were relatively successful ecological stewards, or brought about significant environmental changes.*
>
> *Whether we accept or reject such ideas, the only conclusive answer to such questions is whether or not the more detailed studies of indigenous knowledge and practice - - in contrast to uncritical claims that denigrate or extol what aboriginal peoples did - - can be verified. Two ways of verifying (or falsifying) are available:*
> ***(1) showing that the conclusions from indigenous knowledge are replicated in like and, in some cases, even unlike regions, and (2) showing that such knowledge compares well with the conclusions of science."***

The principal Indian management tool was intentional fire. It is generally agreed by both ethnographers and fire ecologists that precontact anthropogenic fire was - - together with lightning fire - - a significant factor in the maintenance of lower elevation grasslands, chaparral, oak woodland and savanna, and ponderosa pine forests.

In a recent World Wildlife Fund sponsored study by Evan J. Frost and Rob Sweeney, (Fire Regimes, Fire History and Forest Conditions in the Klamath-Siskiyou Region: An Overview and Synthesis of Knowledge, Dec. 2000, p.27), the authors, in an excellent and exhaustive literature synthesis on "natural" fire dynamics, have the following to say about Indian fire:

> *"In general, fires were ignited more frequently at lower elevations and decreased as elevation increased (Anderson and Moratto, LaLande 1995)….outside of oak and pine-dominated forests, little convincing evidence exists that aboriginal ignitions were ecologically significant across large landscapes. As stated by*

Lalande and Pullen (1999), 'Within the vast mid-elevation, mixed conifer and mixed evergreen forests [comprising
the largest vegetation types in the Klamaths], ***the extent of anthropogenic fire likely was limited and localized - i.e. confined to creating scattered, small openings. Aside from these localities, lightning-caused fire probably deserves more of the credit for the formerly open, park-like stands of most mid-elevation, mixed conifer stands'. While further investigations may shed light on the relative importance of Native American burning, at present the case for widespread influence in conifer-dominated forests in the Klamath-Siskiyou region is not convincing****."*

This conclusion by Frost, Pullen and LaLande reflects the present state of knowledge by most ecosystem scientists as well as some ethnographers and ethnohistorians. That is partly because of the inherent difficulty of separating anthropogenic fire (which often does not show up as fire scars because of their low intensities) from lightning fires; and partly because of the Western cultural blindspot that seems to prevent science from recognizing tribal peoples as competent and sophisticated land managers, and/or simply because of lack of familiarity with the field of ethnography. Yet Reg Pullen, in his comprehensive ethnographic study of Native southwestern Oregon (Overview of the Environment of Native Inhabitants of Southwestern Oregon, Later Prehistoric Era, 1996), has assembled ethnographic data which is often ambiguous or even contradicts the conventional view on the significance of Indian burning. One obvious ambiguity is the statement above by Frost that "fires were ignited more frequently at lower elevations and decreased as elevation increased". And yet he (and others) maintain that lightning was the principal architect of the "open and parklike" middle to high elevation forests. Most forest historians and scientists agree that lower elevation prairie, savanna, and oak/pine woodland were maintained at least partly by Indian fire. **While Frost and others leave the subject of low elevation burning with the conclusion that it is simply not possible to separate anthropogenic from lightning fire, it is very instructive to note, as LaLande and others have noted, that oak stands are rapidly being overtopped by invading Douglas-fir despite no changes in lightning frequency and with fuel loads significantly higher now than in the past. With respect to "scattered small openings", we will see below how maintenance of Indian material culture required numerous openings of various sizes.**

We will return to Reg Pullen's excellent study below because it is, in my opinion, the most comprehensive ethnography of southwestern Oregon. First, however, we need to look at Henry Lewis' groundbreaking work on Indian fire, and in particular at his methodology. Similarly, USDA Forest Service historian Jeff LaLande, in his "An Environmental History of the Little Applegate River Watershed ", (1995), gives examples of landscape changes within the Little Applegate Watershed which suggest far more extensive ecological effects of Indian fire, particularly at high elevations, than generally admitted. However, in Henry Lewis' classic 1973 study, Patterns of Indian Burning in California: Ecology and Ethnohistory, different conclusions are reached about the extent and beneficial ecological effects of Indian burning (including the Klamath - Siskiyou Ecoregion). What is the key difference in these studies? Unlike Frost, Pullen, and LaLande, ***Lewis (1) shows that the conclusions from Indigenous knowledge are***

replicated in both like and in unlike regions; and that (2) such knowledge compares well with the conclusions of science.

It is useful to remember that, until Lewis' study, *"the significance of the burning process in the large inventory of techniques of environmental manipulation used by California Indians was not demonstrated [scientifically] and considered by most authorities to be conjectural at best." (*Lowell John Bean and Harry W. Lawton, *"Some Explanations for the Rise of Cultural Complexity in Native California with Comments on Proto-Agriculture and Agriculture"*, in Patterns of Indian Burning, p. xxxvi)*"*. Lewis pioneered a novel approach in California ethnographic studies: he combined general ecological theory - - particularly fire ecology, wildlife biology, and native vegetation management - - and specific environmental field studies with ethnography (especially documented interviews with Native informants) in such a way as to build a mutually reinforcing and interacting evidence - complex of ecological science and ethnography which established the strong probability of California Indian burning on a scale previously thought not to exist at all. (Lewis, 1973. Pp. 5-13) Lewis, then, showed that his ethnographic conclusions - which would have been otherwise somewhat speculative because of poor documentation in the literature - compared well with WES and indeed were amplified by WES.

In another important 1988 study, "Yards, Corridors, and Mosaics: How to Burn a Boreal Forest" (Human Ecology, vol. 16, no. 1), Lewis and Theresa A. Ferguson compared Aboriginal burning practices in widely separated and disparate ecological zones (northwestern Alberta, northwestern California, western Washington, Tasmania, coastal New South Wales, and northwestern and western Australia) and found parallel burning strategies employed. The common feature of these very different ecoregions was low primary productivity (redwood forest, mulga scrubs, eucalyptus woodlands, boreal forest, etc.) and marginal subsistence opportunities. For example, in the redwood forest of northwestern California, small prairie openings ("yards") were maintained with fire within a resource-deficient forest in order to attract elk and deer to fire-rejuvenated browse as well as to provide suitable habitat for cultural plants which would have been scarce if the forest closed up (as it has now already done except in the larger "bald hills" prairies). L. L. Loud (1918) described these yards maintained by Wyot Indians in what is now Humboldt County (Lewis "Yards, Corridors, etc.", p. 61):

> *"**Within the forests, at all elevations from sea level to the top of the ridges, there were small open patches, known locally as "prairies", producing grass, ferns, and various small plants. These prairies are too numerous to mention in detail**…Most of these patches if left to themselves would doubtless soon have produced forests, but the Indians were accustomed to burn them annually so as to gather various seeds, especially a species of sunflower…[probably Tarweed, or Madia sp.] The statement of Professor Jepson that "there is today more wooded area in Humboldt County than when the white man came over a half a century since," was confirmed by reports made to the writer that some of the old prairies had come up to young growth of forest. **These prairies were of incalculable value to the Indians, not alone for their vegetable products, but also for the game found upon them. A sharp contrast is drawn between the animal life in the forests and on these prairies**"*

(pp. 230-231). ("Ethnogeography and Archaeology of the Wiyot Territory", Univ. of California Publications in American Archaeology and Ethnology, 14: 221-223.)

Ridges and trails ("corridors") were also kept open by regular fire for the same reasons. Lewis documents meadows, streamsides, sloughs, swales and lakeshores in all of his study areas. (See also Lewis, A Time for Burning, Occasional Publication No. 17, Boreal Institute for Northern Studies, Univ. of Alberta, 1982.)

Lewis has demonstrated a kind of convergent evolution of fire strategies in very different ecosystems - - by comparing unlike regions with similar resource deficient habitats - - and thereby shows that conclusions from his earlier comparison of ecologically comparable habitats in California (1973) are applicable on a much larger global scale. I will apply Lewis' methodology and conclusions concerning the significance of Indian fire to southwestern Oregon where, like in his earlier 1973 study of California Indian burning patterns, ethnographic documentation is incomplete and ambiguous.

But first I would propose additional research questions: ***Given the apparent longevity of the Indigenous societies of the Klamath-Siskiyou Ecoregion (perhaps as long as 12,000 years and at least 4000 years), how extensive and intensive were what kinds of resources managed in order to ensure cultural survival? Would intentional fire in lower elevation valleys and foothills have been sufficient for all of their fire-dependent cultural needs? What kinds of important cultural resources would then have gone unmanaged? Would these resources have required fire management to have been culturally useful? Would lightning fires have been sufficient to prepare culturally important plants at higher elevations for human use?***

Related questions with reference to the adaptability and resiliency of the Indigenous cultures of the Klamath-Siskiyou Ecoregion are: ***How did cultural values and actual management activities contribute to positive ecological effects, which in turn sustained the cultures? Were there any negative effects? Did the resiliency of Indian cultures (outlined in Part One) contribute to the resiliency of the ecosystems in which they lived?***

Ethnobiologist M. Kat Anderson and ethnographer Thomas C. Blackburn (eds.) in Before the Wilderness: Environmental Management by Native Californians, (1993), p. 23, suggest a similar research direction and methodology:

> *"quantitative models - - based upon the detailed study of museum specimens [e.g. Indian baskets made of plant materials that had been burned before use and which therefore were significantly straighter and with longer internodes than unburned materials], as well as careful experimentation and replication - - need to be developed to better understand the sustained resource needs of a typical community in precontact California, and test the hypothesis that only careful and effective management could have supplied the phenomenal quantities of raw materials required to support such a community over long periods of time."(emphasis added)*

Anderson and Blackburn point out (p. 23) the enormous quantities of burned plant material which would have been required to maintain the material culture of California Indian societies:

> *"The following figures, drawn from a variety of sources, suggest the magnitude of the supply problem faced by many groups in the state. Approximately 65% of the material culture items utilized by the Chumash were manufactured entirely or primarily from plant materials (Hudson and Blackburn 1982-1987). Among the Sierra Miwok, Western Mono, Foothill Yokuts, Southern Maidu, Washo, and Paiute, over 75% of such plant-based items were made from epicormic branches or adventitious shoots from several different species; this special type of material was required for making ten different categories of objects: baskets, cordage, clothing, tools, weapons, structures, games, musical instruments, snares and traps, and ceremonial items (Anderson 1992:49). Making a single cradleboard would have required 500 to 675 straight sourberry sticks from six separate patches that had been burned or pruned prior to being harvested (Lorrie Planas, personal communication 1991; Norma Turner, personal communication 1991; Anderson 1992). Craig Bates of the Yosemite Museum has estimated that approximately five stalks of Indian hemp (<u>Apocynum spp</u>.) or milkweed (<u>Asclepias spp</u>.) would have been required to manufacture one foot of cordage (Craig Bates, personal communication 1992); a Sierra Miwok feather skirt or cape contained about 100 feet of cordage made from approximately 500 plant stalks, while a deer net 40 feet in length (Barrett and Gifford 1933:178) contained some 7000 feet of cordage, which would have required the harvesting of a staggering 35,000 plant stalks (Anderson 1992:164-165). If one considers the fact that an "average" tribelet in Central California probably consisted of some 850 people almost totally dependent upon a territory of approximately 150 square miles (Kunkel 1962), the large quantities of food, fuel, and raw materials that were necessary to maintain such a group over an extended period of time can begin to be appreciated."*

Since it is generally accepted that Indians burned lower elevation valleys and foothills regularly, as often as every year, to enhance culturally important plants like corms, acorns, grass and forb seeds, basket plants, etc., I will focus on cultural resources at middle and upper elevations in the Applegate and Rogue Watersheds. (For more detail on lower elevation burning see Reg Pullen in <u>Overview</u>; Jeff LaLande, <u>An Environmental History of the Little Applegate River Watershed</u> (1995), pp. 6-25.) It should be kept in mind that due to the absence of the frequency, seasonality, intensity and spatial selectivity of Indian fires in lower elevation valley and foothill habitats like prairie, oak savanna and woodland, pine savanna and woodland, chaparral and wetlands, these fire-maintained habitats are rapidly disappearing and/or experiencing poor to zero reproduction, loss of species, and loss of biodiversity in general. (I will return to this subject in Part 3.)

Conventional wisdom on the fire history of the Klamath-Siskiyou Ecoregion holds that lightning was the primary ignition source for middle to high elevation mixed evergreen/conifer forests. (One wonders how lightning fire could be separated from anthropogenic fire at higher elevations but not at lower elevations.)**I will argue that Indian burning was in fact done in these higher elevation forests, and that both lightning and Indian fire shaped forest structure and composition. I will base this argument on the kinds of cultural plants and animals, which needed to be fire-managed in predictable and effective ways for the material culture to be maintained. Lightning fires are not predictable in their timing, location, extent, and effectiveness. While lightning fires did affect forest conditions, the result was far too random for Native resource managers who required regular fires at specific intervals in particular places (patches or "yards"), usually in a rotational pattern of varying fire return intervals, in order to meet different resource needs dictated by a variety of environmental and societal imperatives.**

The main cultural barrier that prevents Western scientists from recognizing this ethnographically obvious fact is the assumption that tribal societies were too primitive to manage resources consciously and effectively with a variety of complex strategies. As cultural anthropologists Bean and Lawton point out in Patterns of Indian Burning, p. xxxvi:

> *"The technological processes and complex organizations [the resiliency factors mentioned in Part one: trade networks, storage technology, spiritual ceremonies, internal redistribution of wealth, political confederacies, social organization, social taboos, etc.] of California's hunters and gatherers were integrated with value systems which encouraged increased productivity and the acquisition of surpluses."*

In other words, wealth and wealth display (remember the Wealth Display Ceremony mentioned in Part 1) were cultural values, common to nearly all northwestern North American tribes, which promoted the acquisition of surpluses. Even though, like the Potlatch Ceremony further north, wealth redistribution was the main result, there was a strong social motivation to accumulate personal wealth (as well as intangibles like songs) in order to publicly verify ownership and to display it and give it away. Sharing and acquisition of wealth thus were mutually reinforcing. As Bean and Lawton note, this encouraged productivity, which in turn led to more intensive and extensive forest resource management.

Thus, increasingly effective resource management strategies led to cultural complexity which in turn led to more effective management strategies. This, Bean and Lawton suggest, is why California Indians never developed agriculture (although they did practice a kind of agroecology). They didn't need to. With Spanish and Anglo domination coupled with European diseases, the traditional social and intertribal hierarchies and networks which maintained these complex adaptive societies were reduced in importance and finally completely fell apart. It was then that effective forest resource management ceased, and the fire regime of the Klamath-Siskiyou Ecoregion changed in fundamental ways.

Information on Indian burning for southwestern Oregon - - in contrast to northwestern California - - is fairly scantly because (1) anthropologists who interviewed Indian informants were mainly linguists who were not directly interested in vegetation; (2) the genocide and relocation of local tribes at the time of the gold rush, occurred in only six years; and (3) white settlers, fur trappers, explorers, soldiers, etc. were poor observers of both nature and Indian cultural practices (Pullen, p. ii-1). I have, however, already established the scientific validity of both cross-cultural comparisons of tribes in comparable habitats (e.g. Karuk with Takelma or Da-ku-be-te-de) and cross-cultural comparison between tribes from different environments (e.g. Yurok of northwestern California with Slavey Indians from boreal forests of northern Alberta). In sum, we have seen already sufficient commonalities between most indigenous "hunter-gatherers" to establish a probable framework of lifeways and resource management that can be applied to some of the ambiguities and knowledge gaps in the ethnography of the Da-ku-be-te-de of the Applegate Watershed.

Because I am defining "ecosystem" as the distinctively managed ancestral lands of the Da-ku-be-te-de, ecological dynamics and interactions will be viewed within the framework of a "cultural landscape" ("Reference Points for Restoration: Identifying Links Between Ecology and Culture": Poster Display by Laurie S. Monti, Kristin D. Huisinga, and Kambria Breck of Northern Arizona Univ. Ecological Restoration Institute, at 24th annual meeting of the Society of Ethnobiology, Durango, Colorado, March 7-10, 2001).

The cultural landscape approach to ecosystem science assumes that indigenous humans were keystone predators and players in their ancestral lands long enough to have co-evolved with cultural plants and animals. As ethnobotonist M. Kat Anderson notes:

> *Seeds, roots, rhizomes, fruit, bulbs, tubers, corms, leaves, flowers and stalks of numerous plants were utilized. Gathering sites were manipulated annually, biennially, triennially, or quadrennially to enhance plant populations and create shifting mosaics of different vegetation types. Small and large patches of vegetation were burned and individual plants were pruned, dug, shaken, knocked or weeded. A variety of horticultural techniques were utilized, including coppicing, pruning, selective harvesting, transplanting, vegetative propagation, sowing and weeding. Individual plants, plant populations and habitats were manipulated in accordance with ecological principles that caused changes in plant abundance, diversity, growth, longevity, yield and quality to meet cultural needs.*
>
> *There were three broad areas in which hunter-gatherers acted as agents of environmental change:*
>
> *(1) Plant dispersal (conscious or inadvertent) that rearranged the distribution of various groups, creating distinctive plant distributions and polymorphisms.*
> (2) *Habitat modification leading to quality habitat for enhancement for selected animals and facilitating management of the movements of these animals.* Authors note: [Indigenous game management included reducing chance encounters with dangerous animals like grizzly bears and cougars, and improving chances for selective harvesting of large game like deer and elk.]
> *(3) Genetic modification effecting genetic structures and gene pools of plants through selective harvesting and transplanting over thousands of years. Intended or unintended selection of labile character traits led in turn to evolutionary modifications in plants such as enlargement of favored plant*

parts, reduction of potential for reproduction by seed and color changes in fruit or seed.

(M. Kat Anderson, "Reconstructing an 1800's Sierran Landscape", 1995, The Sierra Nevada Ecosystem Project, Team Leader Michael Barbour, U.C. Davis.)

A large variety of shrubs and herbaceous plants were utilized by Native peoples of the Klamath-Siskiyou Ecoregion in ten cultural use categories (Anderson, 1993, p.23) Sara M. Schenk And E.W. Gifford, in Karok Ethnobotony (vol. 13, no.6), found 239 mostly herbaceous plants used by Karuk people in a 1939 summer survey. Anderson estimates that approximately 50% of the plant material culture from shrubs, trees, ferns, grasses, sedges, and wildflowers was for basketry and cordage, and therefore required frequent burning ("The Fire, Pruning, and Coppice Management of Temperate Ecosystems for Basketry Material by California Indian Tribes", Presentation at 24th Annual Conference of the Society of Ethnobiology, Durango, Colorado, March 7-10, 2001).

Basket and Cordage Plants

Of the large number of plants used for basketry and cordage, several species formed the bulk of use (and still are commonly used by contemporary weavers): beargrass (*Xerophyllum tenax*); hazelnut (*Corylus californica*); iris species (*Iris chrysophylla, I. douglasiana*); grey willow (*Salix hindsiana*); milkweed (*Asclepias sp*.); and Indian hemp or dogbane (*Apocynum androsaemifolium)* are found in scattered locations up to around 5000 ft. Milkweed (*Asclepias cordifolia*) is seen occasionally up to 4500 ft., but is not common at any elevation (per com. Barbara Mumblo, Applegate Ranger District Botanist). Clearly, basketry and cordage plants which once were heavily depended on are now mostly difficult to find, and when found, often consist of only a few individuals and/or are not reproducing satisfactorily, and are in the process of being shaded out by encroaching conifers. *Iris chrysopylla* was on the California Review List until 1994 (Report by Richard Brock and Richard Callahan, 1994, on file with the Applegate RD). All of the above species require either full sun or filtered sun to light shade. One finds them today mainly in forest openings and edges and with difficulty. Beargrass (noted most often in the ethnographic literature; see Reg Pullen pp. iv-4, iv-6, v-5, v-13, v-16, 17, 43, Appendix 11, pp. 6,7,8.), usually found on dry ultramaffic (serpentine) soils, is found from 2500 to 5500 feet and higher in the Little Applegate Drainage. (per. com. Barbara Mumblo, Applegate RD botanist). Patches consisting sometimes of only a few plants - - many not flowering due to deep shade - - are scattered at middle (2500-4500 ft.) and higher (over 4500 ft.) elevations (I am following elevational divisions by Jeff LaLande, 1995). A few large patches can still be found on the Siskiyou Crest (over 5500 ft.) in full sun near USFS Road 20. Beargrass was probably the principal basket and cordage plant for the Da-ku-be-te-de; it also had edible rhizomes for both humans and bears. (Bears were considered close relatives to humans, and so their dietary and medicinal preferences were keenly noted by Native peoples everywhere; animal habitat needs were - - and still are in many places - - considered equal with humans: the Nle'Kepmx Tribe in British Columbia, in treaty co-management negotiations with Canada, include bears as "co-managers" [per. com. Verna Miller, Nle'Kepmx Tribe, British Columbia]. Bears were also an important winter food.)

Assuming far higher precontact Indian populations than generally estimated (before European diseases), and considering the need for a constant and predictable supply of culturally-modified basketry material and cordage (fire-induced straight, long, and supple epicormic sprouts and adventitious shoots), one can imagine the phenomenal quantities of burned plants required to maintain the material culture. For example, Anderson estimates that a deer snare 40 ft. long required 7000 ft. of cordage which in turn required 35,000 fire-induced shoots of *Asclepias* or *Apocynum* species (Before the Wilderness, p. 23). Beargrass, the most important basket and cordage plant, required biennial burning to be acceptable for human use. Besides the extensive use for deer snares (the importance of deer to the Da-ku-be-te-de will be discussed below), it was an important trade item with the Rogue Valley Takelma where it was scarcer (Pullen, p.1).

As we have seen, the most important basket and cordage plants are found at middle to high elevations. (Grey willow, which grows along low elevation streams, has taken on more importance only in recent decades by basket weavers because the roots - not tops - are harvested so doesn't require regular burning.) Pullen, in Overview, p. iv-6, quoting Harington, Reel 28, notes: *"Snare rope was constructed from iris and from beargrass, which in Applegate territory could be collected only in the uplands at the head of the Applegate River, and in the Wagner Buttes area."* Regular fire was required to maintain and enhance these iris and beargrass patches (Pullen, v-4). Iris species are scattered in forest openings at most elevations. Only one good patch of *Iris douglasiana* is known in the Upper Glade Watershed at 5300 ft. in the upper reaches of Yale Creek (per. com. Barbara Mumblo). *Iris chrysophylla* is found sparingly up to around 4500 ft. None are found in large numbers. Since *Iris chrysophylla* is found only up to 4500 ft., it could be that *Iris douglasiana*, a much larger iris than the other two species, and with longer leaves which would make for faster rope-making (it took one person one year to make a rope five-eighths of an inch thick and 15 ft. long since only the two outer leaf fibers could be used, George Riddle in Early Days in Oregon, pp. 43-44), is found in only one patch at 5300 ft. at Upper Yale Creek. It could be a floristic anomaly (it grows naturally closer to the coast) which previously was much more common due to Indian fire management, and in fact was the iris referred to by Harrington.

Deer Hunting with Iris and Beargrass Snares

The Upper Glade/Little Applegate Watershed is situated in the rainshadow of Grayback Mountain to the west. The Applegate is therefore classified as an interior valley of the eastern Siskiyous (Pullen, iii-1). As is typical of interior Indians, deer and elk hunting were more important than salmon fishing (the Applegate and Little Applegate rivers were known more for steelhead than salmon runs and had no eels which were only found in the middle to lower Rogue River). (See Dennis Gray, The Takelma and Their Athabascan Kin: An Ethnographic Synthesis of Southwestern Oregon", 1985, pp.123-124; Philip Drucker, "The Tolowa and Their Southwest Oregon Kin", Univ. of Calif. Publications in American Archaeology and Ethnology, 1937, vol. 36, p.283; and Gordon

Hewes, "Aboriginal Use of Fishery Resources in Northwestern North America", Ph.D. Dissertation, Anthropology Dept., Univ. of Calif., Berkeley, 1947, p.89.)

Deer were usually caught with snares. There were up to three major hunts each year, with the major snare hunts from August to November (Pullen, pp.17,18). Sometimes as many as 150 *"rope-traps"* were set (Pullen, p.17) and *"miles of brush fences were made across the heads of canyons"*, (George Riddle, 1953, pp. 43-44, emphasis added). Riddle states that "*a fibre taken from a plant - - a kind of flag [iris] - - growing in the mountains*" (p. 43-44) was used for snares by the Cow Creek Takelma. Also snared were martin, fisher, mink, raccoon, and otter. Melville Jacobs, Notebook 128, p.42, notes that "*snares of white grass [beargrass]*" were used. Fire was used to drive deer into the brush fences where they were caught in snares set in openings in the fence. Among the Shasta, notes C. Mart Merriam in Field Notes, Reel 130, "*a thousand acres or more*" were burned in deer drives; "*After each hunt, two or three years were allowed to pass in order to give the pine needles time to accumulate before the next.*"

Deer and elk found cover from winter cold and summer heat in middle elevation mixed evergreen/conifer forests, but relied on higher elevation meadows in summer, low elevation prairie and oak/pine woodland in winter, and middle elevation forest openings for forage - - all of this was maintained primarily by Indian fire. Lightning fire is too random to fit into a sophisticated deer management program that included situating deer fences near salt licks and certain creeks (Edward Spir in Notes on the Takelma Indian of Southwestern Oregon, 1907, p.259), linking forest openings favored by deer with a trail network for easy access, and especially because they worked with set deer and elk migration patterns and customary trails. Had these openings not been maintained by regular anthropogenic fire, the forest would most certainly have closed up and shaded out the highly palatable, newly burned shrub sprouts and seedlings (e.g. *Ceanothus integerrimus* and *C. cuneatus*; both of these species doubled as important basket plants and deer browse.) and new grass, clover, and forb growth. (Native perennial grasses were important for contributing to digestion of tannin in acorns which deer ate in the fall - per. com. David Peri, Pomo/Coast Miwok.)

It is difficult to overestimate the importance of deer to tribal economics in the interior Klamath-Siskiyou mountains. Besides meat - - probably more important than fish - - deer supplied sinew for sewing, leather for clothes, and a vast miscellany of bone and antler tools and implements. High deer populations were maintained by creating forest openings (yards) through intentional fire, thus enhancing the natural carrying capacity of the range (Pullen,p.3). (Wolves were common then, and competed directly with humans for deer; cougar populations were probably kept down by wolf packs.) When snows were deep at highest elevations, middle elevations were the only place deer could find cover and food (lower elevation range was populated by hungry hunter-gatherers during the "starvation moons" and deep snows of February and March). Tribal people understood the importance of unburned sectors of forest for deer and elk winter cover, and, like the Calapooya of the Willamette Valley to the north, deliberately left certain Douglas fir stands unburned (Peter G. Boag, Environment and Experience: Settlement Culture in Nineteenth Century Oregon, 1992, p.14).

Ridges(corridors) were often kept open to facilitate elk and deer drives and to provide easy trails for packing large quantities of deer and elk meat back to villages (most meat was smoked for winter). (John Harrington, Reel 28). This too would have required regular fire. Ridges were also important beargrass sites.

A social taboo came into play during deer and elk season: a man could not hunt if his wife was having menses because his wife accompanied him on communal hunts in order to dry meat. (Cora DuBois, Tututni Field Notes, Notebook 6, 1934.) Since women living in close proximity often have menses at around the same time, most men in the village could not hunt for several days. This probably contributed at least a little to deer and elk conservation, especially if heavy snows occurred at the same time.

Hazelnut

Another important middle to high elevation cultural plant was hazelnut - useful for its edible nuts, but principally maintained for basketry and cordage for lodge and weir construction, and miscellaneous domestic uses. Hazel patches were burned every year by the Karuk and Tututni for nut production in midsummer; the Coquile burned some hazel patches annually and some patches every five years for both nuts and basketry materials and cordage, generally at higher elevations (Pullen, p. v-4). The Shasta "*gathered hazed from areas that had been burned to remove the growth of fir and hemlock… The Karuk burned patches of hazel, iris, ceanothus, and beargrass in midsummer annually or bi-annually to obtain the best basketry materials*" (emphasis added, Pullen,p.v-4).

Oaks

Other important cultural plants found at middle to high elevations include Sadler's oak (*Quercus sadleriana*), considered the most desirable acorn - - and worth going some distance to find - - which grows in the Applegate at high elevations on Studhouse Creek near Elliott Creek at the eastern limit of its range in the Siskiyous (per. com. Barbara Mumblo). Sadler oak acorns are naturally sweet and don't require the laborious process of leaching. Black oak (*Quercus kelloggii*) grows to 4500 ft. and is considered second best. (White oak, *Quercus garryana*, is commonly found at lower elevations but was not considered very desirable.) All of these oaks require regular burning to enhance acorn production, reduce overwintering insect predators, facilitate finding acorns on the ground, stop encroachment by conifers and brush, and maintain good seed production of understory forbs and grasses used for food (pinole), cordage, and medicine for humans and forage for deer and elk.

Medicine Plants

Several important medicine plants are also found at higher elevations. Osha root (*Angelica arguta*) - - on the California Review List - - is found on the Siskiyou Crest at over 5500 ft., while *Lomatium nudicaule* is found in forest openings at all elevations, as is *L. triternatum* (per. com. Barbara Mumblo). These species are all-purpose medicine plants still extensively used by Indians today - - even transplanted to home sites. *Angelica arguta* is a strong anti-viral medicine. I use this plant on a regular basis, visiting high elevation sites to dig the roots, weeding encroaching vegetation and preparing seedbeds, just the same as Da-ku-be-te-de did in order to be sure they were there for years to come. But it is not regenerating well in the USFS Botanical Reserve on Rd. 20 due to lack of fire and encroachment by unburned chaparral. Mules-ears (*Wyethia angustifolia*) is another still popular medicine plant and food found at all elevations, but which, like osha root, requires fire for good reproduction. Tracts of these species are rapidly contracting.

Tobacco

Another important medicine plant whose range has contracted to a fraction of its former size is tobacco (*Nicotiana attenuata* and *N. quadrivalis*). *N. attentuata* tends to grow at most elevation on dry gravelly sites, but the preferred tobacco, *N. quadrivalis*, propagated by hand-sown seed in ash following burning in middle elevation forest openings, is difficult to find (Donn Todt, "Two Tobaccos" presentation at Society for Ethnobiology Conference, Durango, Colorado, March 7-10,2001). Another paper at the same conference, "The Post Fire Population Dynamics of Mountain Tobacco, *Nicotiana attenuata*", by Wm. Litzinger *et al*, explains why burning is critical for its survival. "Inhibitory molecules" present in pre-fire soils keep *N. attenuata* seeds from germinating. These are destroyed by fire but rapidly build up in post-fire soils. Light inhibits germination. This ensures that the minute seeds will germinate below the soil surface. Because of the importance of these two species of tobacco to Native Americans, regular intentional fire was necessary, with hand-sowing of seeds in the prepared ash beds to be sure that they were covered and would germinate.

Berries

Finally, several higher elevation species of berries were burned to enhance berry production and to prevent overshading by encroaching conifers since production is low in shade. These include green leaf manzanita (*Arctostaphylas patula*), serviceberry (*Amalanchior alnifolia*), elderberry (*Sambucus caerelia*), thimbleberry (*Rubus parviflorus*), gooseberry (*Ribes sp*.)- - *Ribes marshallii* is on ONHP List 2 and California Watch List - - and huckleberry (*Vacinum*). The two most important were manzanita and huckleberry. Both need either full sun or filtered light to produce well. They grow at middle to upper elevations and were maintained by Indian fire. While manzanita is common - - having filled up forest openings formally kept open for a variety of useful herbaceous plants - - huckleberry is now found only on Steve and Sturgis Fork near Carberry Creek in the Applegate (per. com. Barbara Mumblo).

Huckleberries are so universally preferred by Indians in northwestern North America that it is difficult to believe that the Da-ku-be-te-de - - living apparently on the eastern limit of huckleberry in the Siskiyous - - would not have encouraged its distribution into the eastern part of their territory with seed propagation, transplanting, and fire.

Manzanita berries (perhaps a substitute for scarcer huckleberries) were so important to Indians of the Klamath-Siskiyou Ecoregion that the Karuk have a story that links times of famine with lack of abundance of manzanita berries along with acorns and fish (A.L. Kroeber and E.W. Gifford in Karok Myths, 1980, p.145). They were the only berry found in quantity in excavated village sites now covered by Applegate Lake (David Brauner, The Reevaluation of Cultural Resources Within the Applegate Lake Project Area, 1983, pp. 69-70). Since manzanita patches are nurseries for invading tree species on sites with good soils, they require regular fires to survive, regenerate, and produce good quantities of berries. Older unburned tracts gradually die back and berry production ceases as invading conifers replace the manzanitas.

One cannot overestimate the importance of berries as sweeteners and flavoring in a diet that was often bland and monotonous, like acorn mush or dried deer meat. Pemmican is a famous Indian food where berries are added to animal fat for a long-lasting and tasty trail snack. The universal human sweet tooth was satisfied mostly by a variety of berries added to all sorts of Indian foods, even a "cider" drink from manzanita berries. I eat acorn mush regularly and add honey for flavor, but honey was hard to find in tribal times.

Recalling an earlier quote from Loud (1918) - - and a source which Henry Lewis (1988) referred to when comparing similar management practices of tribal peoples living in different kinds of habitats - - in this case, in the redwood forest of northwestern California: ***"Within the forests, at all elevations from sea level to the top of the ridges, there were small open patches, known locally as "prairies", producing grass, ferns, and various small plants."*** Richard A. Gould, an Indian elder, described these kinds of forest openings for other tribal peoples of southwestern Oregon and northwestern California (Tolowa, Tututni, Yurok, Karok, and Wyot) as "very small", with none larger than 1/4 mile long (in Lewis, 1973, p.69). Compared to the much larger "bald hill prairies" of the same coastal region, a quarter mile would seem small. They were located in a *"zone of extremely poor resources for that region"* (Gould, in Lewis, p.69). In other words, they were cultural yards and corridors which were created by Indian fire within primarily middle elevation mixed conifer and evergreen forests which are characterized by low net primary and secondary productivity (relatively few understory herbaceous plants and animals).

Indian Potatoes, Tarweeds, and Clovers

It is known that interior mountain tribes also made forest openings (Lewis, 1973, "Coniferous Forest Belt" and "Montane Coniferous Forest" sections, pp.60-86). Many cultural plants grew in these fire yards and corridors, which would otherwise have been shaded out by an encroaching conifer forest. Besides the species already described, root crops at varying elevations included camas (only one patch is known, on the Wagner Gap road, near USFS Rd. 22, in a wet meadow near the cattle corral, per. com. Chant Thomas), mariposa lily, tiger lily, yampa, brodiaea (*Trilelia crocea* and *T. laxa* are on the ONHP Review List and Calif. Watch List), soaproot, fritillaria, balsamroot, and clover (*Trifolium howellii* - Calif. Watch List); native grasses; and a wide assortment of other food plants (perhaps most important of which was tarweed, or *Madia elegans* which is now scarce, (per.com. Barbara Mumblo); medicinal and ceremonial plants; etc., Pullen, p. iv-14). Today, most of these cultural plants, along with their pollinators, seed-carriers, and plant community associates, are slowly disappearing from fire-suppressed stem-exclusion forests. Overgrazing by cattle has been a major reason why these brodiaeas and clovers have become endangered (Richard Brock and Richard Callahan, 1994); the other principal reason is lack of Indian fire management plus lack of harvesting: geophytes like brodeaes, camas, mariposa lillies, true lillies, etc. - - require digging to loosen small cormlets from mother corms which increase reproduction; tracts actually increase in size due to the appropriate kind of human disturbance.

Archaeologist Nan Hannon (in Pullen, pp. 1v-18) has asserted that:

> *"where southwestern Oregon has a diverse flora because of its transitional environment, most of these species are at the limits of their ranges, and far from the optimum conditions they require in order to reliably produce edible parts. Plants which are poor producers in this region include such potentially important species as California black oak, Klamath plum, hazel and serviceberry."*

Joseph L. and Kerry L. Charticott quote pioneer botanist W.L. Jepson in "Late Period Settlement of the Middle Klamath River of Northwest California", <u>American Antiquity</u>, 4,0 (2), 1975, p.173;

> *"The steep slopes of the Klamath Mountains…are covered by dense stands of Douglas fir. Although these forests have a high biomass, in terms of human need they provide comparatively small quantities of edible plant and animal resources. Nevertheless, the variety of animal and plant species is very high".*

Given the characterization of mid-elevation forests as *"fairly uniform, mature coniferous forest with a brush understory"* (Pullen, p. vi-19), and of low species diversity and richness, it is understandable that we read statements like this:

> *"Anthropogenic burning was concentrated at lower elevations near villages and higher elevations near camps. However, the mid-elevation zone, which comprises the greatest geographic area, was probably affected more by lightning-caused fires. Less frequent burning of this zone allowed for a considerable amount of downed, woody debris on the forest floor and a shrubby understory, <u>as evidenced by early historical descriptions of the region</u>."* (Pullen, p.4, emphasis added).

A careful reading of Pullen, Appendices ii and iii, however reveals quite contradictory statements about montane coniferous forest structure with "heavy brush and undergrowth" balanced by "open and park-like". No doubt both were included in the same forest, depending on slope aspect and topography, how long it had been since the last fire (remembering that diseases may have crippled Indian burning capacity decades before whites came), how complete a fire had burned, whether an area had been deliberately left unburned, and what was meant by the term "brush".

It seems to me that the critical factor in untangling conflicting and ambiguous observations is the extent and frequency of intentional fire needed to maintain the material resources that the culture depended on for survival. Our previous discussion of resource use suggests, at least at precontact population levels, that enormous quantities of culturally modified plant materials and deer were necessary. Different patches, and even parts of patches, were burned rotationally and selectively, depending on needs which varied from year to year. If one or more important resources failed at any given time, others were prepared for human use with fire. **Agroecological diversity contributed to cultural resiliency. As we have seen, low and high elevations alone could not have met all cultural needs, especially when times were hard and/or trade networks were interrupted by war. Lightning ignited fires also were too random and undependable for prudent resource management.**

Agroecological diversity of various sizes and shapes of forest openings created a complex mosaic of repeating edges or transitional ecotones which in turn created diverse kinds of animal habitat as well as ecological niches which supported a rich flora of conservative and generalist species supporting complex food webs. Ecosystem function, then, would have been enhanced by Indian fire. As pioneer ecologist Eugene Odum noted in <u>Fundamentals of Ecology</u> (Third Edition), 1971, p. 159: "…it seems likely that ecotones assume greater importance where man has greatly modified natural communities". (See also Lewis, 1973,pp.82-86) In this way, middle elevation coniferous forests of low productivity contained "hot spots" of biodiversity.

Many places were left unburned for a variety of reasons, including animal habitat needs (e.g. thermal cover for deer and elk) and the fact that it was unnecessary to burn everywhere in order to satisfy cultural needs. Spatial selectivity of Indian fire would have been sufficient to create refugia for animal and plant species which otherwise would have been rare in montane coniferous forest. (Riparian zones are only a fraction of the land area of typical watersheds, but often contain most of the species diversity. I tend to find greatest plant diversity at present on serpentine opens - - most in the process of closing up with chaparral and invading trees - - and on roadcuts within middle elevation coniferous forests when I do T.E. and S vegetation surveys.) The spottiness of regular low intensity fires was the key factor in creating productive ecotones. Major stand-replacing fires - - probably rare in the precontact Klamath-Siskiyou Ecoregion, due to lack of fuel buildup - - burn more uniformly and thus, as Lewis (1973, p.84) notes:

> *"the very 'spottiness' and much higher frequency of very localized Indian burning seem to have affected a much more complex overall ecosystemic pattern than would have been the case with only natural fires."*

The practically exclusive focus on wood fiber production of traditional Euroamerican forestry and forest science has left a cultural legacy of thinking of forests - - and their preservation by Western environmentalism - - mostly in terms of trees. Monocultures of mind - - economics as sole guiding principle - - has led to monocultures of forest trees which have come back around to reinforce monocultures of mind (Vandana Shiva discusses this phenomenon on a global scale in <u>Monocultures of Mind</u>). Meadows and other kinds of forest openings are too often seen as island anomalies in a sea of trees (and in need of plantings of Douglas fir or other commercial species). Traditional succession theory has contributed to a view of forests as <u>always</u> tending to late successional climax vegetation. The evidence presented suggests that Indian fire kept much of the forest - - <u>at all elevations</u> - - in a continual state of arrested succession, with all seral stages being continually "recycled" by fire. The Indian fire regime - - together with lightning fires - - contributed to ecological stability and integrity by rarely allowing fuels to build up to the point of a major stand-replacing crown fire. The Western distinction between field and forest, meadow and trees, human use and pristine wilderness, was blurred by repeating ecotones created by humans who lived within the forest. Where traditional indigenous peoples have been removed from their ancestral lands, biodiversity has been replaced by tree plantations. (Shiva, Chapter 1) The removal of tribal peoples from the Klamath-Siskiyou as well as the suppression of Indian cultural fire among traditional harvesters and hunters still living there today is leading to both cultural genocide and ecological simplification.

Part Three

Toward An Integrated TEK/WES Reference Ecosystem For Ecological Restoration and Conservation Biology With Emphasis On Middle Elevation Matrix Mixed Conifer Forest in the Klamath-Siskiyou Ecoregion

In Parts 1 and 2 we have established a strong probability that Native management in the Klamath-Siskiyou Ecoregion had extensive positive ecological effects on forest ecosystem structure, composition and function. Certainly more research is needed (See Pullen p. vii-1), but the cultural landscape perspective has, I think, cast a shadow of reasonable doubt on the conventional wisdom that asserts that lower valley/foothill and highest elevation mountain crests were sufficient to maintain the material culture of tribal societies. If this hypothesis is indeed largely true, then any ecological restoration/conservation biology plan that ignores the middle elevation (2500-4500 ft.)

forest matrix structure and composition under Indian cultural management runs the risk of being <u>ecologically</u> incomplete.

Since the Endangered Species Acts of 1966 and 1973, more scientific attention has been given to the subject of endangerment and extinction, particularly of old-growth. Timber sales on public lands have been stopped or modified to accommodate rare late successional species. By 1981, the public had become concerned in the Pacific Northwest about the management of old-growth forests following the near liquidation of old-growth in the logging frenzy of the 1960's and 1970's (<u>Wildlife and Vegetation of Unmanaged Douglas-Fir Forests</u>, eds. Leonard F. Ruggiero *et al*, 1991, p.5). The "Old Growth Program", which came out of the public meetings of the early 1980's, had three objectives: (1) define old-growth Douglas-fir forests; (2) identify wildlife species closely associated with these forests; and (3) determine the biological relationships of closely associated species. Information about wildlife habitat relationships in old-growth forests was considered important because the remaining Douglas-fir old-growth had very high economic and social value. But instead of the $10 million necessary for extended community studies of species interactions and associations, only $2 million was received by the study group (Ruggiero *et al*, p.6). There wasn't enough funding to holistically study old-growth community species interactions or earlier seral communities. Only selected old-growth stands and late successional single species studies were given attention because these stands are regarded by foresters as the last stage before harvest (Andrew Carey and Thomas Spies in Ruggiero *et al*, p.13). This more limited approach to forest development - - selective late successional studies alone - - also rested on the assumptions that wildlife species diversity was highest in old-growth conifer forests and that, because most forest stands were in the old-growth stage in historic times, some species of wildlife have evolved largely in old-growth (Jack Ward Thomas in Ruggiero *et al*, p.2).

Since the Clinton Forest Plan of 1993, forest scientists (e.g. FEMAT) have concentrated on the endangerment of a limited number of late successional indicator species associated with old-growth conifer forests. The northern spotted owl and salmon have emerged both as symbols of wilderness and as management indicators of ecosystem integrity.

The relevance of the Indian-managed forest, in light of this brief history of the scientific study of and environmental concern with old-growth, is that cultural landscapes typically contain all seral stages at the landscape or watershed level due to the pervasive effects of Indian fire, and to a lesser extent, of natural lightning fire. And in terms of traditional indigenous values, the forest was perceived as one indivisible whole, and not, as in the Western mechanistic view, a collection of individual entities. The whole was seen as more than the sum of its parts.

"Old-growth", like "ecosystem", is more of an analytic category, for management purposes, than a real description of energy flows and species interactions in forests. Because Euroamericans place a high social and economic value on old-growth forests, they are studied more intensively. Old-growth <u>is</u> important, and some species have evolved in classic old-growth conifer forests, but too many other species requiring <u>both</u> late and earlier successional stages of forest development in the large mid-elevation matrix are falling through the cracks of current societal and scientific preferences.

The Klamath-Siskiyou Ecoregion is acknowledged globally as a mountain complex of exceptional biodiversity. (Erik S. Jules, Dominick A. DellaSala, and Jennifer K. Mareden, "The Klamath-Siskiyou Region" in Natural Areas Journal, 19:4, October 1999; R.H. Whittaker, "Vegetation History of the Pacific Coast States and the 'Central' Significance of the Klamath Region", in Madrono, vol.16, 1961) We shouldn't however, be complacent because of the region's natural tendencies toward diversity (soils, topography, lightning fire regime, regional location and climate). Simply setting aside large pieces of land and/or preserving special and representative rare habitats may be necessary, but probably won't be sufficient to meet the goals of conservation biology. Similarly, all seral stages need to be included in the conservation biology planning for species preservation and restoration (See "A Conservation Plan for the Klamath-Siskiyou Ecoregion" by Reed Noss *et al* in Natural Areas Journal, 19:392-411).

It is the thesis of this report that the mid-elevation matrix should be restored to the greatest extent possible - - with the assistance of the appropriate public land agencies - - using a reference ecosystem based in part on the conceptual reconstruction of the precontact cultural landscape.

The four basic goals of conservation biology are: (1) represent all kinds of ecosystems; (2) maintain viable populations of all native species in natural patterns of distribution and abundance; (3) sustain ecological and evolutionary processes; and (4) maintain a conservation network that is resilient to environmental change. (Noss, 1999, p. 393) Certainly, cultural landscapes are relevant here. We only have to enlarge the definition of "natural" to include indigenous humans. They are part of "natural patterns" and "evolutionary processes". Anthropogenic landscapes are one "kind of ecosystem". Indian peoples recognized change as a fundamental ecological feature of forests and developed cultural strategies which enhanced resiliency of both their cultural adaptations and the ecosystems upon which they depended.

Steve Packard, successful tall grass prairie restorationist from Chicago, formerly of The Nature Conservancy and a member of the Society for Ecological Restoration (SER), sums up the above concept in William Stevens' Miracle Under the Oaks (pp. 286, 87):

> *"… the loss of people from a natural system in which we have played an essential role can be as destructive to the function and survival of that community as the loss of a key predator, pollinator, herbivore, or any other key species [a "keystone" species is a species whose role in an ecosystem is so important to the survival of many other species, that when it is eliminated - - like Indians - - other species disappear and the whole system begins to unravel]."*

Packard continues:

> *"…If people - - or anything else - - change the environment sufficiently rapidly so that substantial numbers of species die instead of evolve, then what we have is degradation (or "development") rather than nature…[R]egardless of whether Homo sapiens is or is not present, if nothing causes changes so as to eliminate*

species from any long-evolved community, this is nature. In fact, if people intervene and go to great lengths to restore the conditions of relative stability which allow the continual existence and evolution of these ancient lineages and interdependencies, the result is still nature."

Packard was successful in rescuing a number of threatened midwestern tallgrass prairie/oak savanna plant species from extinction by understanding this ecosystem as a degraded cultural landscape and not as the simplified woodland that his scientific colleagues claimed. (There are parallels here with Klamath-Siskiyou Ecoregion mid-elevation forest: what we see now is not necessarily what it used to be.) By resurrecting an early 19th century botanical field notebook, Packard was able to put together a group of associated prairie species no longer on site, and with the use of this reference ecosystem, find those missing species in the greater ecoregion and successfully restore savanna/prairie communities. By defining as "savanna" what most scientists considered to by merely a ecotone or transition from woodland to prairie, Packard was able to rescue from imminent extinction species which required a particular place in the sun-shade continuum (i.e. modal species) and could not flourish anywhere else. This would not have been possible without first defining "savanna" as an ecosystem in its own right. Could this also be the case in the mid-elevation matrix forest? Could some species have similar niches within the sun-shade continuum?

The Society for Ecological Restoration (SER) defines "ecological restoration" as *"the process of assisting the recovery and management of ecological integrity. Ecological integrity includes a critical range of variability in biodiversity, ecological processes and structures, regional and historical context, and sustainable cultural practices".* (Rutgers University, 1996, by SER Science and Policy Working Group, co-chaired by Dennis Martinez and Eric Higgs, University of Alberta, Edmonton).

The "critical range of variability" (or, "historical/natural range of variability") implies specific and limited parameters in forest structure, composition, and processes. Not just any human assisted successional pathway of vegetation development constitutes a baseline or reference ecosystem for restoration. Multiple successional pathways in forest vegetation development are now recognized by WES. Pioneer ecologist A.G. Tansley (1924) was the first to develop a "polyclimax" theory. As James Agee notes in Fire Ecology of Pacific Northwest Forests, (1993), p.139:

" The polyclimax approach did not assume eventual community convergence, and climate was not the sole controlling factor of vegetation change. Tansley defined multiple (poly-) climaxes, recognizing fire and edaphic climaxes (serpentine soils), among others. Succession led toward a mosaic of different climax communities, reflecting the mosaic of habitats rather than a single climax community."

However, other competing succession theories have emerged over the past half century which have reestablished the primary role of climate and have relied more on analytic or mechanistic models of "habitat types" (Daubenmire, 1952) where plant communities are defined on the basis of *"potential overstory and understory dominants in* *the absence of disturbances"* (Agee, 1993,p. 140). The concept of succession of discrete communities or habitat types lends itself to management activities, and can act as a convenient theoretical baseline model in which to apply disturbance scenarios.

R.H. Whittaker, working in the Siskiyou Mountains, with its highly complex vegetation patterning, developed the "prevailing climax" model which he defined as a

> *"mosaic of populations representing positions along complex environmental gradients. Disturbance gradients, such as fire, were considered equivalent to climate, soil, and other gradients…He attempted to bridge the gap between systems defining discreet communities, which were favored in management application, and those recognizing continuous patterning on the landscape."* (Agee, 1993, p. 140)

Silviculturists managing timber production, however, were not interested in complicated and comprehensive theories, and so Whittaker's model was never widely adopted. The mechanistic analytical models of habitat types have been more easily integrated into timber management scenarios, while the older idea of plant "community" has given way to emphases on individual plant responses to climate, disturbance, etc. Populations of individual species are now studied more that communities, particularly with respect to mechanisms of succession.

The key phrase in SER's official definition of ecological restoration is "a critical range of variability" in <u>key</u> ecological and cultural features. Once an ecosystem is simplified, it can never be <u>entirely</u> restored to its original complex condition. The best we can do is restore the key features of structure and composition and reintroduce missing processes like fire. This kind of human <u>assisted</u> restoration is dynamic and is not intended to be a restoration to some static state of the past. In other words, the real restoration takes place naturally - - nature heals herself - - with the ecologically appropriate kinds of human assistance done initially and usually periodically. This is not the equivalent of traditional ideas of homeostasis, however, since the ecologically appropriate kinds of human intervention are required. Periodic maintenance is usually required because (1) humans did manage cultural landscapes; (2) relatively small restoration projects are like islands in a sea of weedy exotics and other degrading influences; and (3) landscape scale fragmentation of forests.

Unlike classical mechanistic succession theories useful for guiding timber management, Whitaker's "prevailing climax" model, which implicitly recognizes cultural factors and is more ecosystem-based, is better suited for integration with ecological restoration or ecosystem management. R.E. Grumbine, in "What is Ecosystem Management?", <u>Journal of the Society of Conservation Biology</u>, 8:27,31 (1994), states:

> *"Ecosystem management integrates scientific knowledge of ecological relationships within a complex sociopolitical and values framework toward the general goal of protecting ecosystem integrity over the long term."*

The Key point here is that there is sufficient common ground between ecosystem management, Whittaker's prevailing climax theory, restoration ecology, chaos and

disturbance theory, patch dynamics, and the cultural landscape model for constructing a reference ecosystem based on a synthesis of TEK and WES, which could guide both ecological restoration and conservation biology planning in the Klamath-Siskiyou Ecoregion. While both traditional scientific-industrial forestry and indigenous tribal peoples have viewed the forest from a human-use perspective, we are talking about the difference between <u>one</u> forest product - - wood fiber - - and hundreds of plant and animal resources. This is the difference between ecosystem management and timber management. Even current plant habitat type models are used primarily to manage timber. Further, Indian societies viewed "use" as implying reciprocal obligations to the plants and animals used which were actually honored by their cultural selection, as they were honored before harvesting with prayers of thanksgiving.

How far back in time is it necessary to go with reconstructing reference ecological conditions? Why go back only as far as historical indigenous forest stewardship? Why not, say, go back to before the last ice age? Because the pre-contact, pre-European settlement time is still retrievable as the last known natural state and because the past 4000 years or so (since the cooling trend at the end of the last Xerothermic) includes the same forest community and species associations as the present - but without humans anymore as keystone species.

Major parts of the Klamath - Siskiyou Ecoregion are the result of at least 4000 years of co-evolution and co-adaptations between Indians and plant/animal species. Four thousand years is more than sufficient time for genetic changes to take place through natural and cultural selection.

The concept of eco-cultural restoration assumes substantial overlap of "cultural" and "ecological": what is good for the culture is good for the forest, and what is good for the forest is good for the culture. It is a whole systems approach to restoration. As in the SER definition, "sustainable cultural practices" and "regional and historical context" are linked to forest health and ecological integrity. Degradation of culturally important plants/animal habitat is linked to ecological degradation, and vice-versa. Restoring precontact forest ecosystem structure and composition and the Indian fire regime will probably enhance ecosystem function.

Steve Packard got conservation results - - the restoration of endangered oak savanna and tallgrass prairie species - - by first recognizing that an ecosystem like oak savanna even existed and then that it held characteristic modal species which were missing because he viewed ecological interactions within the conceptual framework of a cultural landscape. So did restoration ecologist Wally Covington of Northern Arizona University's School of Ecosystem Science. Covington saw pine savanna where crowded pine stands of up to 5500 trees per acre currently existed due to fire suppression. Lightning and Indian fire at historical frequencies of 2.5 - 5 years had created pine savanna with precontact stocking rates of 20-40 trees per acre. Covington tested his restored precontact northern Arizona ponderosa pine forest structure and composition by using WES to measure key functional attributes like net primary productivity (which doubled second year following thinning to precontact stocking rates despite loss of most tree biomass), secondary productivity, nitrogen mineralization, decomposition rates, resistance of foliage to insect damage, etc. **This is a good example of how to synthesize WES and TEK: determine precontact forest vegetation patterns using both WES and TEK; then measure ecosystem function using WES. Cultural criteria (e.g.**

cultural plant endangerment) can also be applied to the restored ecosystem. (Journal of Forestry, April, 1997

Similarly, if we accept the mid-elevation forest matrix in its present degraded condition of low primary and secondary productivity as "natural", and focus instead on endangered late successional species, especially the "charismatic magafauna" which command a great deal of sympathy from a public nostalgic for wilderness and wilderness symbols, are we not unwittingly letting other species (with limited forest refugia left) slip into endangerment and extinction? Isn't it conceivable that the Indian-managed matrix forest structure and composition was in place long enough o have contributed to evolutionary adaptations of plant species to that environment - - restricted now to small openings and edges like serpentine and roadcuts - - along with the food webs they supported? **Suppose, like Packard's modal savanna species which existed only within a certain previously unknown light-shade continuum, modal species, historically associated with Indian cultural plants in matrix forest openings of varying sizes and shapes and in different stages of succession, need that kind of light-shade spectrum to survive and reproduce?** Given the strong probability of intensive and extensive Indian fire management of the matrix, are we not risking species extinctions of plants and animals - - even if not currently listed - - if we don't consider ecological restoration for the mid-elevation forest?

Erik S. Jules *et al*, in "Ecological consequences of Forest Fragmentation in the Klamath Region" (Natural Areas Journal, 19:4, October 1999, pp. 368-378) has raised this issue with respect to the role of "island refugia" theory in forest fragmentation in the Klamath-Siskiyou Ecoregion. Species like California red-backed vole and western trillium were found to be closely associated with islands of remnant old-growth [In my experience, western trillium is not necessarily limited to old-growth, but red-backed vole is one of only two mammal species which do require only old-growth forest; more on that issue below.]. However, they also say:

> *"We also identified many species that do not fit the island-ocean analogy that is often applied to habitat fragmentation. For example, some species were found mostly in remnants, while other species were restricted to clearcuts, or were ubiquitous across site. Evidence from these studies suggests that the landscape matrix can provide important habitat for many species.* ***The conservation of biological diversity in this region will require not only knowing which species are adversely affected by fragmentation and what role remnant habitat plays in the viability of populations; it will also require a better understanding of the role of the matrix in providing both habitat and opportunities for dispersal of species between remnants****."* (p. 368, emphasis added)

Part of the problem is the tendency of conservation biologists to view dispersal between remnant patches as strictly a *"function of distance between patches, with no regard to the type of habitat between patches…the role of matrix has been largely overlooked as an important consideration.* (*Franklin 1993, Vanderman and Perfects 1997*)" (Jules *et al*, p. 376)

It is important now to look at the probable structure and composition of the matrix forest. The most important ecological effects of extensive Indian burning was enhanced nutrient cycling and fire hazard reduction, among many other positive affects. Nutrient cycling occurred mostly in the process of the growth, death and decay of herbaceous plant parts, especially the continual decomposition of perennial plant roots between fires, and the frequent intentional fires which were carried by and consumed forbs and grasses. Forest duff - - especially conifer needles, twigs, and small diameter branches - - is slow to break down in temperate forest ecosystems because of chemical inhibitors unless regularly burned, and so is not usually sufficient for optimum nutrient cycling. Down wood (large woody debris) is important as mycorrhizal innoculation sites and moisture reservoirs during the dry season, but probably was never as abundant in the Klamath Mts. As it was in more northern coastal forests.

Fire consumed tree seedlings and saplings leaving only occasional small saplings. Doghair regeneration was mostly burned up. Fire was the main architect of forest structure, creating irregularly shaped spaces of different sizes between different sizes of tree groupings of varying ages - - a forest of different aged even - aged stands started following fires occurring at different times. It is probable that the way in which trees were grouped - - different species in a more or less even - aged group or stand - - and the number, shape and size of the openings between the groups had at least two positive ecological effects seldom noted in the literature:

(1) the group tree associations - - as opposed to single trees - - seem to have had a group-enhanced positive effect on each individual tree within the group; and
(2) the way in which the groups were arranged within the stand and the way the stands were structured across the landscape had something to do with enhanced ecosystem function, especially nutrient cycling.

The way in which conifer species were clumped may have been the most important structural element having to do with system function. (For more information, see C.F. Cooper "Pattern in Ponderosa Pine Forests", Ecology, 42 (3): 493 - 499 (1961), and "Changes in Vegetation, Structure, and Growth of Southwestern Pine Forests Since White Settlement", Ecological Monographs, 30 (3): 129 - 163, (1960); J.K. Agee, "Fire History Along An Elevational Gradient in the Siskiyou Mountains, Oregon", Northwest Science, 65: 188 - 99. (1991).)

Marty Main, an experienced tree thinning contractor in southwestern Oregon, notes in his unpublished masters thesis (p. 21, Univ. of Washington, November, 1997):

> *"It is my suspicion that as stands age, mechanisms of mutualism or cooperation develop between trees that tend to reduce the importance of the more competitive influences felt by these at higher densities in stand development… It is also possible that many, if not most, stands in the pre -settlement era did not develop with the pattern of high density, high competition early in stand development following a major disturbance event. In fact, major disturbance (clearcuts and high intensity, large-scale wildfire) was rare in the pre - settler era, replaced by more frequent, but less severe disturbance events, principally fire. (Agee, 1991, 1993: USDA and USDI, 1994)…(p. 23)). If clumping of conifers is indeed a*

natural, expected, and even desirable response during stand development, changes in stand management practices may be appropriate… Maintaining intact aggregations of mature conifers may be more appropriate than creating more uniform spacing of leave trees by thinning those aggregations."

If the above is reasonably close to the truth, intentional Indian fire to maintain cultural plants and animal habitat may have helped create a clumped forest structure which probably enhanced the growth and vigor of forest trees. In the absence, however, of repeated low intensity fires after the U.S. government stopped Indian burning (to save commercial conifer species), thick doghair patches of more shade tolerant species like white fir and incense cedar began to slowly replace pine and oak and even Douglas- fir. Fuel loads increased. Catastrophic stand - replacement fires became more common. Herbaceous understory cultural plants and the communities they are part of are being shaded out and disappearing. Wildlife habitat is deteriorating. Local extinctions are increasing.

Present trends in the conifer regeneration favor more shade tolerant white fir and incense cedar, with Douglas fir favored over pine and oak. Oaks are increasingly being crowded and even overtopped by conifers.

The pre - contact forest structure and composition probably included clumped groups of trees within stands defining varying sizes and shapes of sunny openings filled with herbaceous plants - - all of which probably enhances ecological functioning and certainly allows forest underburns and encourages cultural plants at the same time. The Indian - managed forest reference ecosystem also contributes to maintenance of high biodiversity. This is because Indian burning encouraged non - conifer hardwoods, shrubs, grasses and forbs. One important effect of this kind of forest composition is the abundant prey - predator relationships - - a highly diverse and complex food web at all trophic levels.

In a study of forests in western Oregon; eastern Oregon and West Virginia by Paul Hammond and Jeffrey Miller of Oregon State University ("Comparison of the Biodiversity of Lepidoptera Within Three Forested Ecosystems", <u>Annals of the Entomological Society of America</u>, 91: 3: 323 - 328 (1998)), it was found that 90% of macrolepidoptera [large butterflys and moths] depend on non - conifer flowering plants. Conifers supported 9, 10, and 1% of the species richness, By contrast, hardwoods supported 57, 45, and 61% of the species richness [figures refer first to western Oregon, second to eastern Oregon, and third to West Virginia]. Seventy species of birds, 20 species of insectivores and rodents and 12 species of bats consume or are dependent on lepidoptera in western Oregon. Second - order vertebrate predators, such as hawks, owls, coyotes, and bobcats also may depend indirectly on Lepidoptera to some degree. For example, the northern spotted owl feeds primarily on the northern flying squirrel. The squirrel is insectivorous and probably feeds extensively on caterpillars in the spring and early summer when young squirrels are being reared. Of interest in the drier Klamath- Siskiyou ecosystems is that, as found in the eastern Oregon study, herbs and grasses growing on the forest floor are responsible for much of the moth biomass in drier climates. The authors also noted that a coniferous forest possessing an imbalance in the numbers of insectivorous predators might be even more vulnerable to epizootic episodes in the population dynamics of conifer - feeding species such as the western spruce budworm and the Douglas fir tussock moth.

The authors conclude: "… if maintenance of a certain level of diversity is a primary objective in the management of a given forest, then practices must be followed that promote diversity among angiosperms [flowering plants]. Recommended management practices include avoidance of herbicides; prescribed fire in "small local patches to improve growing conditions for herbs and grasses on the forest floor"; maintenance of natural open areas such as meadows and prairies within the forest; and multi - species plantings of hardwood trees and shrubs in forest restoration projects.

Similar arguments have been promoted by scientists with respect to arboreal mammals. Andrew Carey of the Pacific Northwest Research Station, USDA Forest Service, Olympia, Washington concludes in " Interactions of Northwest Forest Canopies and Arboreal Mammals " (in Northwest Science pp. 72 - 98, vol. 70, (1996)):

> *"My review [of 12 species of arboreal mammals including squirrels, bats, red tree voles, woodrats, etc.] clearly indicates that trees alone do not constitute a forest canopy. Various other organisms associated with trees - including fungi, mosses, lichens, and vascular plants in the understory - help determine canopy quality as habitat for arboreal rodents. The presence of arboreal rodents, keystone species, provide a prey base for many vertebrate predators and enhance ecosystem function through fungal spore and seed dissemination."*

In "Use of the Forest Canopy by Bats" by the same author (in Northwest Science, pp. 79 - 84, vol. 70 (1996)): " For many bat species, a mosaic of habitat types in close proximity to one another, including a mix of forest openings, and riparian areas, may provide optimal habitat." An unpublished study I made recently of the 40 or so common mammals (excluding bats) that live in the Klamath Mountains indicates that nearly all except California red - backed vole and red tree vole require a mix of forest habitats. A combination of early and late seral stages of vegetation development - - open, sunny areas for food in close proximity to closed, shady places for cover - - is optimum habitat. (See Chris Maser, Mammals of the Pacific Northwest (1998); Martin, Zim, and Nelson, American Wildlife and Plants: A Guide to Wildlife Food Habits (1951); Lloyd Ingles, Mammals of the Pacific States (1947); and Michael Amaranthus *et al*, "Interaction of Fungal Sorocarp Production with Small Mammal Abundance and Diet in Douglas Fir Stands of the Southern Cascade Range", Northwest Science, vol. 73, Special Issue, 1999.)

It is clear from the above research on animal habitat in montane coniferous ecosystems that maximum diversity across the landscape offers the most opportunities for animal survival and reproduction. This kind of horizontal stratification is in contrast to vertical stratification as in the classic old-growth model of western Washington Coast Ranges and Northern Cascades. Fire hazard in the drier Klamath-Siskiyou Ecoregion is too high for vertical layering from ground to crown (i.e. fuel ladders). We are working with a different kind of forest structure than Jerry Franklin's classic old-growth type. **The diversity of matrix structure and composition - - i.e. quality plant and animal habitat - - may be a key factor in providing dispersal links or habitat corridors for**

endangered animals moving through widely separated refugia "islands". As in traditional Indian resource use - - the maintenance of a variety of patches or yards of culturally important plants and animal habitats in case of multiple resource failure in any given time period - - the more ecological redundancy there is, the more buffering against climatic and other unpredictable stochastic events (e.g. drought-driven catastrophic fires or global warming) as well as against changing social and economic agendas which could imperil conservation preserves.

USDA Forest Service historian Jeff Lalande, in An Environmental History of the Little Applegate River Watershed, 1995, p. 47, summarizes the condition of middle and high elevation forests today:

> *"In the uppermost portions of the watershed, true fir species have become more dense and have expanded at the expense of glades and meadows. In the lower sections of the true fire forest, fire-intolerant white fir has especially benefited from fire suppression.*
>
> *The mid-elevation, mixed conifer zone of the watershed has witnessed a retreat of brush and open pine stands with a concomitant advance of Douglas-fir. Areas formerly containing mature pine, incense-cedar, and California black oak have now become blanketed by dense stands of pole-sized Douglas-fir and, at slightly higher elevation, white fir. Competition for moisture between ponderosa pine and the dense stands of younger Douglas-fir has stressed the pines, making young pine thickets and more mature individuals susceptible to bark beetles and flatheaded woodborers. This phenomenon has resulted in the proliferation of "red-top" (dying and dead) pines throughout the eastern Siskiyous during the 1980's-90's drought. The "densification" of the mixed-conifer forest has probably also resulted in large-scale changes to the understory component, with a reduction in the cover of those herbaceous species that prefer an open canopy.*
>
> *Overall, more of the Little Applegate River watershed is forested now (i.e., including post-1950's logged-over forest and young plantations in the total current amount of forested land) than was the case a century ago. And those areas that formerly were forested now tend to support a much more dense conifer cover than previously. Insect and disease infestations (e.g., dwarf mistletoe) are probably far more prevalent as a result of this high-density pattern."*

Compare this description with the remembrances of Bessie Tripp:

> *"According to Bessie Tripp, a Karuk woman born in 1876, the Karuk use of fire, as well as the cessation of Karuk burning practices, had profound social and ecological consequences.*
> *'Sets fire, that's the way they do. There all time fire and everything grow then like they used to eat here. All those things that they used to eat, y'know, you get in the ground. Now I don't think there is any, too much brush growing. That's only the way they used to grow plants. Lots of green stuff, I used to eat lots of green stuff. There's something that used to grow, looked like parsley. Where there are fire, it great big, great big plant. They used to set fire for everything, acorns too. They set fire, more acorns came back. Fire, no bugs. And that Kishwuf [osha root, or*

Lomatium and Angelica species] too, we used to eat that. Before, just pick it up, they dig it. I used to like it, I'd like to eat some, but I can't get there. There was a big patch up here, lots of it too; they'd pick it up. And another kind (of plant) that used to grow around here, but don't grow anymore. That looked like, they call them sunflowers, when they just about this high, that's when they eat it. Nothing grows now because no fire. They grow but they not good to eat, I don't think. And that hazed grow (first the sticks) small, that's what they make baskets with. Next year it be just full of those nuts. I used to have lots of that. There used to be a yellow jacket's nest sometime, (the fire would) cook (the grubs) and (we would dig up and) eat it (laughs). That was way up in Wooley Creek. Pepper nuts used to grow, but I don't think they set fire for that. But there ain't so many now. I don't ever see pepper nut trees. They don't grow anymore here. Soap Root, you know what, that was good to eat, but not every place…'"

(Karuk Tribal Module For the Main Stem Salmon River Watershed Analysis: Scoping of Tribal Issues For Karuk Aboriginal Territory, p. ii-6. Prepared for USDA Forest Service, Klamath National Forest, 1995, Ed. Robert Winthrop of Cultural Solutions. Karuk Tribal Team: Dennis Martinez, John F. Salter, Norman Goodwin, Harold "Littleman" Tripp, and Leaf G. Hillman.)

The ecological restoration of the mixed conifer matrix is a formidable task compared to drawing circles around biological hotspots and relying on those boundaries to remain intact during times of political and social change. (Every Indian treaty ever made with Canada or the U.S. has been broken and reserve boundaries erased or contracted.) It is going to require the efforts of tribal and non-tribal communities as well as public land agencies, conservation biologists and restoration ecologists - - all cooperating in restoration/conservation planning.

The Karuk Tribal Module was a serious effort by the Karuk tribe to include all ancestral lands (now under the jurisdiction of the Klamath, Six Rivers, and Siskiyou National Forests in California and Oregon) in a co-management treaty with the U.S. government. Tribal natural resource management is not separable, in Indian eyes, from cultural resource management. Tribal holistic resource management is currently at odds with agency compartmentalization and specialization:

"The use by agencies of specialists parallels in its divergence from the holistic tribal perspective the division of cultural resources on maps. Such compartmentalized perspectives are in fundamental conflict with Tribal approaches to the land and have been shown not to function as the basis for effective land management."

(Karuk Tribal Module, p. vi-60). There are no guarantees that those widely scattered delineated culture resource areas are going to survive very long into the future, especially given the high likelihood of catastrophic fire and global warming. Because change is such a fundamental feature of forest ecosystems, it must be accommodated in design of conservation strategies.

The Xerothermic warming interval which, since the last ice age, favored oak and pine woodland and savanna, ended around 4000 years ago. A cooling trend has favored

Douglas-fir and other conifers over oak and pine, with their ranges contracting in northern latitudes. It was probably Indian fire that maintained and even advanced (in more southerly latitudes) oak and pine range by *"[holding] the fir forest at bay"*. (LaLande, p.5) The very real probabilities of future extensive droughts or global warming can be mitigated against by emulating the resilient "multiple resource strategies" of Indian adaptive management.

Little is going to be possible in restoration/conservation planning without the reinhabitation by responsible forest stewards of the Klamath-Siskiyou Ecoregion, including tribal co-management. (See Dennis Martinez, "An Analysis of Ecosystem and Indigenous Management Principles: Karuk Ancestral Lands and People as Reference Ecosystem for Eco-Cultural Restoration", section iii, in Karuk Tribal Module.) The Karuk Tribe offered this advice:

> *" That first-level mission, that deeper reality is that the forest requires a population base in order to institute and conduct ecosystem management. Although our first concern in relation to community enhancement is that of aiding in development of means by which Karuk people can once again live in their ancestral territory, earning a dependable living and benefiting the forest. We recognize that the forest is in fact of such size and so much degradation has occurred that we also strongly support the development of administrative perspectives and strategies which would allow non-Indians to live within the Forest, not as extractors of resources, but as necessary workers in the rehabilitation efforts which we are discussing in this document."*

We are in need now of experimental work in ecological restoration closely linked with conservation biology strategies in the matrix. In 1994, Agnes Pilgrim, Takelma elder from Siletz Confederated Tribes, and I organized the Takelma Intertribal Project (TIP) First Rites Salmon Homecoming and Thanksgiving Ceremony after an absence of 150 years. Descendants of relocated Takelma and other southwestern Oregon tribes came together with Rogue Valley intertribal and non-tribal supporters on Applegate RD (Rogue NF) land at Kanaka Gulch on the Applegate River. We proposed a cultural landscape restoration project in collaboration with the USDA Forest Service. (This was one of Pullen's suggestions for future research where he mentions TIP's involvement in experimental fire studies, p. vii-2.) I designed thinning prescriptions for recovering oak and pine woodland/savanna and prairie in an encroaching conifer forest. BLM range ecologist Paul Hosten and I, with funding from USDA Forest Service Pacific Northwest Research Station in Corvallis, Oregon, wrote a oak woodland/savanna/prairie restoration plan. These documents are on file with the Applegate RD. Some thinning, fire and seeding work has been done (2000/2001) on site with Challenge Costshare funding. My restoration prescriptions and priorities for the Karuk Tribal Module (pp. iii-23-30), as well as the prescriptions described in the International Journal of Ecoforestry (Dennis Martinez and Mike Barnes, 1998), are applicable to similar interior forests of the Applegate. I will summarize those suggested restoration prescriptions below.

Guidelines for Thinning Tree Groupings

Note: Landscape scale conditions surrounding the site need to be taken into consideration when designing thinning prescriptions. For example, overstocked conifer stands surrounded by significantly open areas or meadows may be retained without heavy thinning for wildlife cover, source for truffles (for wildlife food), etc.

(1) Thin to release preferred tree species, especially on south and west aspects of sun - loving oaks and pines.

(2) Thin to release future old - growth; favor existing large young trees with noticeable old - growth characteristics such as rugged, rugose bark, 50% or more live crown, good architecture for wildlife (e.g. dead limbs down bole as in a "wolf" tree or "grouse - ladder"), etc. **It is difficult to prescribe exact minimum diameter sizes for leave trees because of the great variability of forest environments. If I have to give an exact figure, I would say 24 inches dbh or greater as off-limits to cutting. However, in cases where a significant number of cultural/wildlife trees are in danger of being overtopped by trees over 24" in diameter, I would recommend some selective cutting on south and west aspects of preferred leave trees. Another problem area is invasion of <u>dry</u> meadow and balds or opens by conifers larger than 24" dbh; here I would recommend leaving scattered leave trees or leave tree clumps. Another factor to consider is the commercial value of larger trees if cultural or ecological considerations require their removal. This could at least partly offset the costs of slash piling and fire ($300 an acre is not uncommon).**

(3) Thin to release commercially valuable species (douglas fir, white fir, ponderosa pine) to be available in a subsequent thinning entry.

(4) Leave most well - defined clumped tree groupings intact unless favoring a preferred species needing release or removing very suppressed young trees, especially conifers which are susceptible to beetle infestations because of low vigor, or releasing commercially valuable trees or releasing any tree for future old growth.

Note: Suppressed Douglas fir or ponderosa and sugar pines not released early enough or with a very poor sap - to - heartwood ratio may never achieve their original genetic potential for size or vigor (personal communication from Tom Sensinig, Medford, Oregon BLM Resource Area Ecologist).

(5) Consider wildlife cover: leave some tree / shrub clumpings intact.

(6) Consider forest canopy escape routes for arboreal mammals: leave some branches, which arch over roads or opens.

(7) Thin some tree groupings down to one or two large leave trees in order to keep balance between denser, shadier areas and open, sunnier areas, favor future old - growth, and significant wildlife or culturally important trees.

(8) Favor multi - aged leave trees where possible

(9) Favor scattered leave trees which stand alone between groupings.

(10) Do multiple thinning entries (every 5 - 10 years) so as not to alter the forest environment too much at one time (e.g. to avoid sun scald, windthrow, disruption

of mycorrhizae connections, too rapid degradation of reptile and amphibian habitat etc).

(11) Avoid thinning during bird - nesting season; favor thinning on frozen ground in winter.

(12) Don't enter stands with heavy equipment to avoid soil compaction; do cable logging from roads.

(13) Create snags by girdling live trees (in groups if possible) and cut trees over 12" dbh for down wood. Protect from firewood harvesters by putting sand on and / or nails in snags and downwood; post signs to discourage harvesters (see no. 14).

(14) After falling trees, lop and scatter smaller branches (be sure not to scatter on patches of native plants); pile branches over 2" in diameter and cut to within 12" of ground for either wildlife piles or burn piles (determine which kind of pile by proximity to leave trees: make wildlife piles where too close to leave trees to safely burn and flag wildlife piles so they wont be burned later by mistake); leave some limbs over 8" on ground for downwood and some 2 - 8" diameter sizes stacked for local firewood.

(15) Oaks are the number one preferred tree species: release oaks within conifer groupings as much as possible without disrupting group and prune oaks where they lean out from clumps so as to avoid snow - breakage of leaning, horizontal limb. (Personal communication from Warren Gorbett, Maidu elder, Greenville, Calif.)

(16) Avoid cutting any tree with nests, or with cone - leavings at base of tree, or with woodrat nests at base of tree.

(17) Cover rusty junk piles with slash for wildlife habitat.

(18) Consider, if possible, acorn productivity during good mast years as a guide to how much attention to pruning and releasing is needed to maintain best acorn producers.

(19) Before logging, salvage any native plants or trees, which may be impacted by the thinning operation. Mark with irrigation flagging before beginning work.

(20) Possible experiment in comparing one entry with two entry thinning

  (1) no thinning
  (2) one entry thinning
  (3) two entry thinning (5 - 10 years)

Note: Stratify stand / habitat types so as to have environmentally comparable sites.

Photo - point Monitoring

Set out 25 sets of two - way photo - points. Set a four foot long No. 4 (1/2") rebar in ground with orange flagging fastened to top. Set another rebar in a particular line of view (clear of vegetation so it can be easily seen) some distance away but in sight. Put 60 penny nails with heads painted orange in ground at base of rebar in case rebar is removed. Put direction arrows on flagging in indelible black ink pointing to opposite rebar.

Transect / Photo - point Monitoring

Four short (18 "), flagged or painted rebar stakes are driven into ground to make a square plot approximately four + four feet and situated every 25 meters or so along transect lines set out in random directions in order to monitor changes in herbaceous vegetation in meadows and forest opens. Before and after photos are taken in the way described above.

Fire Preparation and Prescription Fire Guidelines

(1) Do as much structural fire prep work during thinning operations as possible: limb trees: remove "jackpots" from around leave trees / groupings; pull back duff, especially pine needles over 2" thick, from base of leave trees; cut lop - and - scatter small diameter limbs down to at least 12" from ground

(2) Cut three-foot wide fuelbreak lines down to mineral soil around leave tree groupings so as to both retain vegetation and limbs down to ground level when appropriate for wildlife cover and protect grouping from fire.

(3) Cut similar fuelbanks around entire stands and in other strategic plans so as to contain fires within relatively small areas.

(4) Use intentional fire in early fall following 1 - 2" of rain or sufficient rain to wet mineral soil surface just below duff (2"). Shady areas adjacent to fire unit will probably need more than two inches of rain because the denser overstory canopy will intercept more rain.

(5) Spring burns to control non-sprouting brush and reduce fire hazard could be used as an interim or temporary strategy until more risky fall burns can be done safely.

Note: The preferred approach is to thin before burning and not use fire for thinning. It is too unpredictable and risky. It also leaves too much standing dead wood that will still have to be thinned later.

(6) Have enough people on hand during a burn to put out fires smoldering in snags and logs, especially one or two committed to night watch. Don’t pile slash on stumps or logs.

Note: Many places lack sufficient fine fuels to carry fire (except pine needle cover; white fir, incense cedar and douglas - fir needles lie too flat and dense to burn easily.) Herbaceous plant restoration in the forest understory and in open places, especially on south and west slopes, should first address the problem of soil compaction, and heavy water runoff, and litter washout / exhaustion of soil organic matter caused by a lack of sufficient overstory trees. Recommend planting sugar and ponderosa pine on these hard, sun - baked slopes with sparse vegetation so as to create more of a savanna or open woodland. This should help establish a more favorable, semi - shady to filtered sun environment for forb and grass establishment.

Cultural Harvesting as Vegetation Management

It is expected that public land agencies harbor certain reservations about the ecological value of indigenous cultural plant harvesting, and about the general competence of traditional Native Americans as natural resource managers. But there are experienced individuals in the indigenous community who possess a detailed knowledge of forest dynamics, cultural plants and animals, and plant - animal interactions because they depend to some degree on the resources they regularly use. There is also a millennia - long body of TEK which has been passed down through generations and is a product of long collective experience in the forest ecosystem in which they still live.

Indigenous traditional harvesters can be trusted to know how to enhance and expand existing patches of cultural plants. (See Kat Anderson, Before the Wilderness, "Native Californians as Ancient and Contemporary Cultivators ", pp. 151 - 174.) Here is a counter - example to the propensities of contemporary industrial societies to destroy ecological integrity as a result of human use: ecosystems are enhanced in the act of using. Traditional caregiving and harvesting techniques (a part of TEK) for " Indian potatoes " (edible corms and bulbs) and basket plants are expected to increase plant population size and health through digging for harvest, pruning, outplanting, selective harvesting, and intentional fire.

What about the purely ecological associates of cultural plants? How do we determine what belongs together in a restored plant community? Experienced cultural harvesters know this from long inter - generational experience in the field. This kind of local knowledge and TEK is particularly sensitive to ecological association as indicators of where to find cultural plants. Harvesters who use the resources are best equipped to monitor changes in vegetation over time. In fact, as I point out in the Karuk Tribal Module, it would be very difficult to practice ecosystem management without this kind of detailed local knowledge. The same holds for tracking local extinctions and invasions by weedy plants and animals.

Note: Paired experiments can be done where a comparison is made over time between the relative effectiveness of cultural caregiving/harvesting and doing nothing on the health, vigor, and size of patches of cultural plants and their ecological associates (Kat Anderson, personal communication).

Suggested Seasonal Work Schedule for Key Tasks in Restoration

(1) Forest thinning - - winter to early spring.
(2) Fire Prep - - winter to early spring.
(3) Remove weedy plants following thinning - - late spring to late summer
(4) Take deciduous hardwood cuttings - - early fall to mid winter (grow in nursery in coldframe; augment cuttings with seeds to maintain genetic diversity).
(5) Take softwood cuttings - - late spring to summer (grow in nursery; augment cuttings with seeds).
(6) Collect seed from remnant on site and off site patches - - summer
(7) Finish fire prep and burn following 1 - 2" rain - - early fall.
(8) Burn piles - - early to mid fall (covered piles can be burned in winter).
(9) Sow seed in ash following burning and plant out nursery - grown container plants - - early fall.

(10) Grow nursery plants all year; need shadehouse from late spring to early fall.

I would suggest experimental field application of these prescriptions in the Upper Glade/Little Applegate Watershed within the matrix at elevation of approximately 2500 to 4500 feet. It is hoped that the Rogue River NF will fund this study which is in a NEPA-ready key watershed in the Applegate Adaptive Management Area (AMA).

Finally, I would suggest future collaborative lines of research which use both WES and TEK in the reconstruction of a reference ecosystem for the matrix in the Upper Glade/Little Applegate Watershed. The goal is to encourage the interplay of ecological field studies/experimentation and ethnographic literature search/field studies in developing reference conditions. The following lines of ecological-cultural research are needed (See also Pullen, pp. xii-1,2):

(1) Quantitative data on tree species changes since contact times based on selected age-class studies.
(2) Dendrochronological studies to determine relative frequencies of drought, insect infestation, and fire. (See LaLande, 1995, in Appendix). As Frost et al (2000) point out, the Klamath-Siskiyou Ecoregion fire history is poorly known compared to the Cascades and Coast Ranges.
(3) Survey and assess the relative importance of Indian cultural plants, animals, and management practices in the literature;
(4) Find remnant cultural plant populations in the forest and use those locations as restoration and/or salvage priorities.
(5) Experiment with propagation techniques for cultural plants (stem-cuttings and seed germination) for nursery or field propagation.
(6) Identify wildlife dietary and habitat preferences as reference or baseline for restoration/conservation prescriptions; identify dispersal modes for endangered species from <u>all</u> seral stages of forest vegetation development.
(7) Identify pollinators and seed-carriers for rare cultural plants.
(8) Apply theoretical population genetics to known cultural plants in order to track plant population modifications under traditional Indian management; locate and study floristic anomalies from a cultural landscape perspective (i.e. plants outside their normal range and/or ecological niche).
(9) Assess relatively undisturbed sites in comparison with restored sites in similar habitat conditions.
(10) Further studies of precontact Da-ku-be-te-de population levels and disease epidemics (See Pullen, pp. xii-1).