Educator's Guide to American Indian Perspectives in Natural Resources

Northwest Center for Sustainable Resources
Education for a Sustainable Future

Chemeketa Community College
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Acknowledgements

There are many things that have to come together to produce a manual such as this. First and foremost, I would like to acknowledge the two key contributors to this manual. It has been a privilege to get to know and work with Frank Lake and Dennis Martinez. Their ideas and conversations were educational and stimulating for me. I also appreciate their patience with me as they explained their work. I hope I have represented their work accurately in this manual. I have included some background information on both of them along with contact information should you wish to contact them with questions regarding this manual.

Dennis Martinez

Dennis Martinez is of O'odham/Chicano/Anglo heritage and is 63 years old. He studied the History and Philosophy of Science (Darwinian evolution) at the University of California at Berkeley. He has worked in ecological restoration and forestry for 34 years as a contractor, nurseryman, consultant, teacher, international writer and speaker and university lecturer; and has worked in the field in most temperate ecosystems in western North America, as well as in dry tropical forest ecosystems in Hawaii. He was formerly on the Board of Directors of the Society for Ecological Restoration International (SERI), was SERI Policy and Science chair and co-chair, and is currently chair of SERI's Indigenous Peoples' Restoration Network (IPRN), an international working group dedicated to assisting indigenous tribal peoples in cultural and ecological restoration, and is on the International Restoration Awards Working Group. He is co-director (with Agnes Pilgrim of the Confederated Tribes of Siletz in Oregon) of the Takelma Intertribal Project (TIP), which is restoring cultural landscapes in southwest Oregon and has restored the Salmon Homecoming Ceremony after an absence of 150 years. He serves or has served on the steering committee of the Kaho'olowe Island Reserve Commission; advisory council of the Institute for Sustainable Forestry; the Traditional Knowledge Council of the American Indian Science and Engineering Society; co-founded Design Associates Working With Nature (the first major restoration and native plant contractor and supplier on the West Coast); nursery manager and reservation liaison for Ya-Ka-Ama Indian Education and Development Corporation (Forestville, CA); restoration consultant for the Intertribal Sinkyone Wilderness Council (Northern California); the Board of Directors of Baca Institute of Ethnobotany (Durango, CO); Black Mesa Permaculture Project (Navajo Reservation, AZ); restoration

consultant to Dine CARE (Chuska Mts., Four Corners); advisory council to Native Food Systems (Bellingham, WA); and numerous other advisory councils and committees in the fields of Traditional Knowledge, forest certification (finished Forest Stewardship Council tribal forest assessors training at San Carlos, November, 2002) and did FSC and Scientific Certification Systems peer reviews for tribal forestry programs at the Hoopa, San Carlos and White Mt. Apache, Warm Springs, and Ft. Hall Shoshone/Paiute reservations. He is a certified permaculture instructor and is a member of the Alliance of Forest Workers and Harvesters, National Network of Forest Practitioners, and conducts restoration forestry workshops in the Pacific Northwest. He has contracted with both public agencies and private woodlot owners for pre-commercial and commercial restorative thinning, prescription fire, endangered plant and wildlife surveys, native seed collecting, aquatic and fisheries restoration and restoration of prairie, savannah, woodland and wetland habitats. He grows and harvests native herbs and wildcrafts as part of his income; he also uses native foods and medicines on a regular basis.

Dennis is co-editor (with Jesse Ford of Oregon State University) of a Special Feature on Traditional Knowledge in *Ecological Applications*, the journal of the Ecological Society of America (October 2000); has authored restoration, forestry and ethnographic reports and assessments for a variety of public and private as well as tribal and NGO clients, including the World Wildlife Fund, The Applegate Partnership, U.S. Forest Service, Bureau of Land Management, tribes in Canada and the U.S., and Native NGO's. He has been published in a variety of scientific; environmental, and Native journals; written several book chapters; and has presented more than 100 papers at scientific, environmental, and Native conferences. He has a current contract with Island Press to co-author (with Dr. Don Falk of the University of Arizona) a book on international indigenous ecological-cultural restoration projects. Dennis has been a guest teacher in Dr. Dave Perry's 4-unit Ecosystem Science class each fall at Oregon State University and H.J. Andrews Experimental Forest; and serves as an advisor to OSU's Pacific Northwest Traditional Knowledge Institute. Dennis has been awarded SERI's John Reiger Service Award; two environmental justice fellowship awards and scholarships from the Collective Heritage Institute (Bioneers) (Santa Fe, NM); was a finalist for the Ecotrust Buffett Award (Portland, OR) for outstanding American Indian conservation leadership in northwestern North America; and is noted in the *Who's Who of American Environmental Leaders*.

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Frank Lake

Frank Kanawha Lake was born and raised in Northwestern California. He is mixed blood Native American and Mexican American. Frank was influenced in his life by the local tribes, mountains and rivers of Northwestern California. His father is part Karuk, Seneca and Cherokee and his mother is Mexican American. He has acquired a rich appreciation of the environment from both sides of his family. Frank was taught and has learned many of the traditional beliefs and customs of the Yurok and Karuk people. He received a bachelors degree from University of California, Davis in 1995 in Integrated Ecology and Culture with a minor in Native American Studies. Since graduation, Frank has worked as a fisheries biologist for the U.S. Forest Service in southwest Oregon and for the Hoopa Tribal Fisheries Department in northwestern California on the lower Klamath-Trinity River drainage. Currently, he is earning his Ph.D. in the Environmental Science program at Oregon State University. He is a founding graduate student of the Pacific Traditional Ecological Knowledge Program in the Intertribal Programs Office. He has spoken nationally and internationally on the subjects of Ethno-biology and the integration of Traditional Ecological Knowledge and Western Science to conserve biodiversity. His current research includes cultural management, restoration ecology, fuels reduction and fire ecology of riparian areas in the Klamath-Siskiyou bioregion. He consults as an ethno-ecologist part-time and keeps active with cultural arts and traditions. He has contributed to a *Journal of Forestry* special issue on fire (Volume 99, No. 11).

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As with past manuals, Wynn Cudmore, Ph.D., (NCSR, Principal Investigator) has been invaluable to the production of this manual with his suggestions and editing skills. Ensuring a quality and useable product has been his goal in all Northwest Center for Sustainable Resources (NCSR) publications. More information on NCSR and access to many of their other publications can be found in the appendix.

Introduction

It has always been a desire of mine to be able to include Native American perspectives into the environmental and natural resource courses I teach. With current curricular demands, little or no background, and few resources this can become a difficult task and one easily omitted. However, if we are to provide students with a complete understanding of how natural resources can be used and managed, then we need to include the Native American perspective. The purpose of this manual is to provide educators with information and resources so they can become better equipped to do this.

There are numerous resources available regarding American Indian life with their surrounding environment from a historical standpoint but little if anything is available to educators that describes how this historical perspective manifests itself in the modern technological world we live in today. The focus of this manual is to provide this tribal perspective.

I have asked two individuals with a wealth of information on this topic to contribute their ideas and perspectives. I first met Frank Lake and Dennis Martinez at the Native American Ecological Symposium at Southern Oregon University. When I heard them both speak at the symposium I realized that their message needed to be a part of every environmental and natural resource class. I have asked them to submit responses to a series of questions about Indian perspectives generated by teachers attending week-long summer institutes I conducted over a six-year period for the Northwest Center for Sustainable Resources (NCSR). In addition I have requested the two contributors to submit information on their own personal work in this arena.

Past NCSR institute participants felt that the following questions would need to be addressed for educators to feel empowered and at ease teaching about Native American perspectives.

1. What is the rationale for including Native perspectives into a natural resource program? Why is this an important component of study and understanding?

2. What are some of the similarities and differences among tribes?

3. What is sovereignty? What are some of the laws and treaties between the tribes and the U.S. that determine the use and management of natural resources.

4. What are some similarities and differences between the historical and modern use and management of natural resources by tribes?

5. What are the current conflicts within and among tribes regarding management practices today?

6. What are some differences between scientific and Native American ways of knowing or understanding of the environment?

7. Did low population densities affect the historical use and management of resources? How do current population stresses affect tribal use and management practices?

8. In what ways can tribal approaches to natural resource management be applied to the large landscapes, large populations, and large urban centers of our society today?

9. What are the best and most appropriate ways to partner with local tribes? What ethical considerations may be necessary?

Our hope is that with the responses by Frank and Dennis to the teachers' questions, information on their current work, and with the resources that are listed at the end of the manual, educators will feel empowered to include this topic in their school programs. In addition, contact with local tribes in your area will be a crucial step in making this a complete experience for your students. We have included some things to remember as you consider doing this. If you would like more information from Frank and Dennis or see some of their other work, contact information is provided in the acknowledgements section of this manual.

Jon Yoder
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Northwest Center for Sustainable Resources

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What is the rationale for including Native perspectives into a natural resource program? Why is this an important component of study and understanding?

Dennis Martinez:

The short answer is because Native Traditional Ecological Knowledge (TEK), including especially sustainable resource management practices which extend back thousands of years, can provide important information which modern Western Ecological Science (WES) is not methodologically able to access, and which lacks the long-term intimate experience with the North American environment that Native peoples have had.

A second important reason is that the more WES knows about TEK and Indian management practices which are relevant to modern resource management, the more likely it is that government environmental policies will value TEK, and therefore help support the survival of indigenous cultural diversity by promoting collaborative management of ancestral lands ceded to public lands agencies such as the U. S. Forest Service, Bureau of Land Management, and National Parks or enforcing "reserved treaty rights" (pre-existing rights of Indians guaranteed by treaties to hunting, fishing, and gathering on public lands). This is important not just for Native peoples but also for modern resource management because TEK is a "knowledge/belief/practice complex" rooted in specific local environments and transmitted orally from generation to generation, like a living library of knowledge that could benefit WES in ways in which I will discuss below. Saving endangered species requires in part setting aside protected habitat reserves. Protecting the reserves from poaching or inappropriate economic activities requires the support of local Native people in policing as well as their knowledge of their environment. Co-management is the preferred solution, not relocation, which usually happens unless local people and their knowledge is valued by science.

A third reason is that traditional indigenous cultures offer holistic models which integrate ethical, economic, ecological, and social factors in land management. Above all, these models are derived from the histories of particular Native cultures that lived sustainably in particular environments over long stretches of time.

But before I discuss these three reasons in more detail, I want to explain why WES is

methodologically inadequate to access Native cultural practices that may assist WES in doing better science.

The Limits of Western Ecological Science (WES)

Modern Western science can be generally characterized as a powerful methodological tool within a relatively narrow field of focus, especially in those physical sciences like applied physics and chemistry, which are completely quantifiable. With the exception of some subfields of theoretical physics such as quantum mechanics, these so-called "hard" sciences deal with physical laws which are constant and dependable over time. Natural resource management like timber, livestock grazing, water, endangered species and habitat is, or should be, based on ecology. Ecology is not "rocket science" but instead is far more complex. There are no readily discoverable consistent and binding laws. Principles do exist, but are not reducible to quantification in most cases. Ecology is also an historical science. History is qualitative knowledge.

Ecology as practiced today can be divided into two subfields, highly mathematical "*theoretical ecology*" and the more qualitative and historically based "*descriptive ecology*". Theoretical ecologists over the last half-century have attempted to put their science on the same quantifiable basis as the hard physical sciences (*New Ecology*). Theoretical ecology including experimental lab work, is what most universities teach while descriptive field-based ecology is less valued professionally, and therefore relatively few students enter field ecology, or what used to be called "natural history". Theoretical ecologists are interested in making accurate predictions about ecological phenomena. They therefore reduce natural complexities, as much as possible, to data sets that can be replicated experimentally in order to test hypotheses. However, there is always a trade-off between predictive reliability and information content. Replicable experimental tests are only reliable when the scope of their questions has been greatly limited. Therefore, theoretical ecologists' predictive capabilities are limited to either short intervals of space and time or very broad generalizations without much reliability.

Why Native TEK and Land Management Practices Are Important For Modern Resource Management

Native Americans have been interacting with their environments for probably well beyond 12,000 years. Both theoretical ecologists and descriptive ecologists ignore this very important historical fact, the former because of the limitations of their methodologies and the latter because

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of the Western attitude that indigenous peoples lived passively in their environments as well as the peculiar North American myth (which is unique to English-speaking societies) that this continent was a "pristine wilderness" unaffected by humans.

I would argue that 12,000 or more years of interdependency between tribal cultures and their environments has probably had ecological consequences that are relevant to modern resource management. Can we claim to be doing "good science" if we ignore the role of Indian cultural practices in forest history? The Precautionary Principle tells us that we can't.

When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically. In this context the proponent of an activity, rather than the public, should bear the burden of proof.

The documentary evidence concerning Indian forest management practices is extensive. Unfortunately, natural scientists tend not to read anthropology or ethnography. But, were Indian populations sufficiently large and their technologies sophisticated enough to have had far-reaching effects on forest structure and composition such as vegetation structure and distribution, kinds of species present, and animal populations? The answer to both questions is "Yes".

Estimates of both pre-European settlement (pre-contact) Native population size and length of occupancy in Canada and U.S, have been revised consistently upwards over the last century, especially in recent decades because of better scholarship. Once estimated to be around one million, current estimations of Native populations in North America (excluding Mexico and Central America) run up to 12 million. Estimates of the length of time that Native Americans have occupied North America have escalated from a few thousand to at least 22,000 years with some estimates a high as 35,000 years or more.

What about technology? The principal management tool of most Native societies was intentional (prescription) fire. Both Indian fire and natural lightning fire influenced the structure and composition of many kinds of plant communities or vegetation types (woodlands, savannas, shrub lands, prairies, wetlands and riparian areas) except the very highest elevation forests (subalpine and alpine zones). Lightning fires are not predictable in their timing, location, extent,

and effectiveness. While lighting 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. This was usually conducted in a rotational pattern of varying fire return intervals, to meet different resource needs dictated by a variety of environmental and societal imperatives.

In the Pacific Northwest of the U.S. and from S.W. Canada to S.E. Alaska, where wealth and wealth display were culturally important, increasingly effective resource management strategies led to cultural complexity that in turn led to more effective management strategies. This is why Indians in California and northwestern North America never developed Old-World type agriculture. They didn't need to. In the absence of draft animals, fire was utilized to prepare the ground for planting; recycle nutrients (in temperate regions of the earth, decomposition is a slow process, so fire speeds up the fertilization of crops); control disease and insect pest life cycles; rejuvenate cultural plants and animal habitat; open up and maintain sunny forest openings and meadows; increase water quantity by reducing ground water loss through evapotranspiration to the atmosphere after young trees and brush were thinned by light ground fires; facilitate deer and elk hunting by setting fires which encircled herds; produce bigger and more abundant seeds, tubers, corms, fruits, and nuts; and reduce fire hazard. Indian fires were generally cool forest underburns that reduced fire hazard by eliminating "ladder" fuels (lower vegetation which reach into the canopies of larger trees and carry fires into their crowns) and thick brush or dense doghair patches of young trees. Large stand-replacing fires we experience today are due to huge fuel buildups resulting from fire suppression. This rarely happened in the Indian-managed forest below the subalpine zone in most forest types outside of coastal Northwest rain forests.

Different patches, and 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. Agro-ecological diversity contributed to both cultural and ecological resiliency, the capacity to return to a pre-disturbance state relatively quickly without permanently impacting integrity and stability. The result was a mosaic across the landscape of forest openings (patches) of varying sizes and shapes containing diverse plant species of different ages.

Many areas were rarely or never burned. These remained places where fire-sensitive and shade-tolerant species thrived. The combination of Indian fire and lightning fire produced a

diverse forest structure and composition with diverse animal habitats, accounting for the incredible numbers of animals and birds commented upon by most early settlers, soldiers, priests, scientists, and artists.

Why is this knowledge of past practices relevant to present and future resource management? Today's natural resource disciplines and management are almost completely focused on present forest dynamics. Theoretical ecologists, including conservation biologists whose mission is to save enough habitat to conserve endangered species and whose discipline rests to a large degree on theoretical ecology, focus on the ecological function of existing vegetation types or animal populations. Function is determined by methodologies that are ideally quantifiable such as measuring animal population demographics and genetics or ecological processes like nutrient cycling and productivity. Often scientific questions are reduced to whether a particular species is absent or present on the landscape; and if present, how large a population can conservation reserves sustain using mathematical formulas. However, applied ecological sciences like conservation biology or restoration ecology also need qualitative information like detailed knowledge of animal habits and habitat preferences.

Native Americans, who live in places where conservation science is planning land set-asides (reserves or protected areas) to save habitat, and who still depend to some degree for their livelihoods or cultural needs on animals and plants, possess an intimate knowledge of these resources. They have seen historical changes in native and exotic species abundance. Western scientists who study animal populations usually work within the constraints of the academic teaching calendar and foundation or university funding cycles, spending only limited time doing actual field work. Indian peoples living in these environments, by contrast, have been doing what scientists call long-term ecological studies just by the fact of their intergenerational dependency on their local environments and resources.

I could cite many examples of Native knowledge of animals such as where moose or whales are calving; caribou migration patterns; and the role of animal "elders" in maintaining herd stability and security that greatly exceeded scientific knowledge. One example in Oregon that I know of was when the Winema National Forest had to ask local Klamath Indians where the deer fawning grounds were located following termination of the tribe in 1953 and the dispossession of over one million acres of treaty-guaranteed ancestral lands by the U.S. government (the local mule

deer population once thriving under Native management, took a downward turn under U.S. Forest Service management). The newly emerging science of behavioral ecology is validating long held Indian beliefs about the social and cultural dimensions of animal behavior.

Forest managers also look only at the present forest condition to predict site potential for timber productivity. Ecosystem management, a more holistic approach to forest management which attempts to integrate ecological concerns with economics and which ideally considers the larger landscape scale ecology in its site planning, relies on present trends in forest vegetation development called "seral succession" in designing harvest prescriptions or planning endangered species protective measures. That is, they take as a given present "secondary successional" trends. However, there is a history behind current forest conditions.

"Secondary succession" occurs when a plant community or forest is disturbed (fire, logging, hurricane) and a series of vegetation developmental stages ("pioneer" or early successional, mid-successional, and final or "climax" stage) bring the forest back to something like what was there before. Scientists used to think that one final climax state always occurred and it always led to a stable forest of optimum function and biodiversity. We now know that there are multiple possible successional pathways following disturbance, and that a steady-state forest is rarely seen. Change is the fundamental characteristic of ecological systems. Native peoples, due to their longtime occupancy of their homelands, were well acquainted with and accepting of change. In western Washington, the Creator was called simply, "Changer".

Today's secondary forest is far from optimum and is very different from what was there before. It is completely outside what ecologists call the "historical range of variability" where it has a radically different structure and composition, and is subject to rates, scales, and intensities of "foreign" disturbances (catastrophic fires, insect and disease pandemics, and extraordinary floods) with which it is not ecologically familiar (did not co-evolve with gradually over time). Today's over-harvested and fire-suppressed forest lacks sufficient resiliency to bounce back to a pre-disturbance state.

Because the present secondary forest is so unstable and unpredictable, we need to anchor resource management in something historically real and long lasting. Even the most sophisticated computer modeling lacks real long-range predictive capabilities. Still, the environment is very different today. How do we then use historical information in current resource management?

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The short answer is: develop a historical ecological reference or baseline model of what to restore, and balance that model with present conditions. We know through numerous descriptive studies looking at tree ring and fire scar evidence of past fires and insect or disease infestations that the pre-contact forest was very stable compared to today. Yet we also know that we cannot bring it all back due to changed environmental conditions like habitat fragmentation, exotic species invasions, loss of keystone species like Native Americans, and jurisdictional differences in management philosophy.

The Society for Ecological Restoration International (SERI) defines "ecological restoration" as the process of assisting the recovery and management of ecological integrity. Ecological integrity includes critical range for variability in biodiversity, ecological processes and structures, regional and historical context, and sustainable cultural practices. (See Holistic Restoration Forestry Manual)

The Native historical reference model is not a landscape untrammeled by man but a kind of cultural landscape heavily influenced by management. I applied this hypothesis to the Klamath-Siskiyou ecoregion and found that most of the critically important cultural plants at middle and high elevations were scarce or poorly distributed (some on endangered or "watch" lists) since Native management ceased over 150 years ago. (See "Upper Glade National Pilot Stewardship Project/Report to U.S. Forest Service and Worlds Wildlife Fund")

But how do we know what part Native management played in environments also subject to non-anthropogenic disturbances (e.g., lighting-ignited fires)? In a study authorized by the World Wildlife Fund and completed in 2001 (Final Report for World Wildlife Fund/U.S. Forest Service Upper Glade National Pilot Stewardship Project), I examined the effects of indigenous management in the Klamath-Siskiyou ecoregion of southwestern Oregon and northwestern California. I began the process by asking the following 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 extensively and intensively were natural resources managed 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?"

In other words, a rough idea of the quantities of fire-modified cultural plants and fire-rejuvenated animal habitat could tell us something about the extent of resource management required to sustain the tribal economies of relatively high pre-contact Indian populations.

M. Kat Anderson and Thomas Blackburn, in their 1993 book, *Before the Wilderness: Environmental Management by Native Californian*s (p. 23), point out the enormous quantities of raw materials required to support Indian communities over long periods of time.

> "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, Maidu, Western Mono, Foothill Yokuts, Southern 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 (*Apocynum* spp.) or milkweed (*Asclepias* spp.) 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."

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I then looked at animal habitat requirements. Deer and elk habitat was burned every three to five years to rejuvenate browse. As is typical of Indians inhabiting interior montane forests, deer and elk hunting was more important than salmon and steelhead fishing. It is difficult to overestimate the importance of deer to tribal economies in the interior Klamath-Siskiyou Mountains. In addition to meat, 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 (burning hundred of acres in one fire), thus enhancing the natural carrying capacity of the range. Ridges (travel corridors) were kept open to facilitate deer and elk drives and to provide easy access for packing large quantities of meat back to villages where it was smoked for winter use. Ridges also were important bear grass sites, another reason for regular burning of the ridges. Up to three hunts were undertaken per year utilizing 150 deer snares and nets per hunt. One 40-foot deer net took 35,000 stalks of milkweed or dogbane, which had been burned the year before.

I recommended that the World Wildlife Fund incorporate the kind of forest structure and composition that resulted from Indian fire management in their conservation planning for the Klamath-Siskiyou ecoregion. I suggested that the larger forest matrix be restored using the Native reference model. If reserves failed to provide adequate protection, the matrix would then be suitable alternative habitat. After all, scientists were guessing that their habitat "islands" would be used by animals in the way that their theories assumed. It was clear from my research that we were losing numerous species and much habitat from the closing up of forest openings and meadows due to fire suppression and the homogenization of the forest as a result of industrial logging.

The Native historical reference model derived from my ethnographic research on the quantities of plants and the diversity of plant species, which would have been required to maintain tribal economies, suggested a forest landscape of great heterogeneity. The forest was once perforated with patches or openings of various sizes including large meadows which supported not only enormous quantities of cultural plants that required fire and sun but also non-cultural associated species which provided quality animal habitat. This kind of forest could gradually be restored, along with the Native fire regime, by designing timber harvest prescriptions that not only provided local income but furthered conservation and restoration at the same time.

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In light of the above information about Native resource management in the Klamath-Siskiyou ecoregion (and in many other places as well), we could conclude that Indian people were in fact a "keystone" species, a species which exerted an important ecological influence and without which other important ecological processes would be negatively affected and possibly even eliminated. For example, removal of Natives as top carnivores would lead to an overabundance of game which in turn could result in over-browsing or over-grazing of native vegetation, and an unsustainable increase in other secondary carnivores like mountain lions, which is what we see happening today in western North America. This outcome highlights the way indigenous humans, just like other natural species, have co-evolved and co-adapted with natural systems.

The Importance of Native Cultural Survival and Traditional Ecological Knowledge to Modern Resource Management

It is important to define "traditional ecological knowledge." Traditional ecological knowledge (TEK) is an integrated body of spiritual and practical knowledge that has evolved over vast stretches of time through the successful adaptation of an indigenous people to their particular ecosystem. TEK includes tribal myths and stories which contain important ecological information encoded in deep metaphors; tribal remembrances in the oral tradition of climatic and other significant environmental changes in ecosystems; specific management practices, techniques and knowledge of agroecology; and spiritual/ceremonial knowledge and practices of thanksgivings and world renewal. This knowledge is highly unique and ecosystem-specific.

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Generic differences between Western Ecological Science (WES) and TEK are summarized in the following table:

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

Note: This characterization of TEK and WES masks some of the essential similarities between the two knowledge systems.

TEK is transmitted orally. It is also the subject of scholarly books and papers by academia. This scholarship, of course, comes after the fact of oral transmission; and in its original form comes from interviews with knowledgeable Native consultants. TEK is therefore a "living library" which resides in the hearts and minds of living indigenous persons before it is turned into the written word by scholars.

Indigenous cultural survival depends on legal access to traditional hunting, fishing, and gathering places; legal protection from exploitive development; and sufficient resources for sustainable economies. All of these requisites for continuance of traditional life ways rest upon the acknowledgement of the value of an indigenous presence to the maintenance and protection of biodiversity. And that depends on the value that science places on TEK.

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The following is based on "Indigenous and Traditional Peoples and Protected Areas: Principles, Guidelines and Case Studies" in *World Commission on Protected Areas, Best Practice Protected Area Guidelines Series No. 4*, Adrian Phillips (Series Editor):

> "The World Conservation Union (IUCN) and World Wildlife Fund (WWF) estimate that over 80% of the world's biological "hot spots" (places with exceptional biodiversity) are located on the ancestral lands of indigenous peoples. Increasingly, international environmental organizations like the IUCN and WWF are paying attention to the need to enlist the support of indigenous peoples, tribal and peasant societies, in protecting wildlife preserves. Local support is viewed as absolutely essential to the successful protection of habitat. Yet few in Western conservation circles go a step further and acknowledge that Native cultures have been, and in many cases where traditional ways are still strong, still are responsible for the maintenance of high levels of biodiversity.
>
> In 1992 the UN Conference on Environment and Development (Rio "Earth Summit") included indigenous cultural rights in the protection of biological diversity. Article 8 (j) states: "[each contracting nation state shall] subject to its national legislation, respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity and promote their wider application with the approval and involvement of the holders of such knowledge, innovations and practices and encourage the equitable sharing of the benefits arising from the utilization of such knowledge, innovations and practices." (The U.S. has never signed the Rio Convention.)
>
> In line with current understanding of the concept of sustainable development, as well as with several international agreements and dispositions, IUCN/WCPA and WWF have recognized that:
>
> - Protected areas will survive only if they are seen to be of value, in the widest sense, to the nation as a whole and to local people in particular;
> - The rights of indigenous and other traditional peoples inhabiting protected areas must be respected by promoting and allowing full participation in co-management of resources, and in a way that would not affect or undermine the objectives for the protected area as set out in its management plan;

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- Knowledge, innovations and practices of indigenous and other traditional peoples have much to contribute to the management of protected areas;
- Governments and protected area managers should incorporate customary and indigenous tenure and resource use, and control systems, as a means of enhancing biodiversity conservation.

Based on the advice in the protected areas management categories, on established WWF and IUCN policies on indigenous peoples and conservation, and on conclusions and recommendations of the Fourth World Congress on National Parks and Protected Areas, the two organizations, WWF and IUCN\WCPA, have adopted principles and guidelines concerning indigenous rights and knowledge systems, consultation processes, agreements between conservation institutions, decentralization, local participation, transparency, accountability, sharing benefits and international responsibility. The five principles are as follows:

Principle 1:
Indigenous and other traditional peoples have long associations with nature and a deep understanding of it. Often they have made significant contributions to the maintenance of many of Earth's most fragile ecosystems, through their traditional sustainable resource use practices and culture-based respect for nature. Therefore, there should be no inherent conflict between the objectives of protected areas and the existence, within and around their borders, of indigenous and other traditional peoples. Moreover, they should be recognized as rightful, equal partners in the development and implementation of conservation strategies that affect their lands, territories, waters, coastal seas, and other resources, and in particular in the establishment and management of protected areas.

Principle 2:
Agreements drawn up between conservation institutions, including protected area management agencies, and indigenous and other traditional peoples for the establishment and management of protected areas affecting their lands, territories, waters, coastal seas and other resources should be based on full respect for the rights for indigenous and other traditional peoples to traditional, sustainable use of their lands, territories, waters, coastal seas and other resources. At the same time, such agreements should be based on the recognition by indigenous and other traditional peoples of their responsibility to conserve biodiversity,

ecological integrity and natural resources harbored in those protected areas.

Principle 3:
The principles of decentralization, participation, transparency and accountability should be taken into account in all matters pertaining to the mutual interests of protected areas and indigenous and other traditional peoples.

Principle 4:
Indigenous and other traditional peoples should be able to share fully and equitably in the benefits associated with protected areas, with due recognition to the rights of other legitimate stakeholders.

Principle 5
The rights of indigenous and other traditional peoples in connection with protected areas are often an international responsibility, since many of the lands, territories, waters, coastal seas and other resources which they own or otherwise occupy or use cross national boundaries, as indeed do many of the ecosystems in need of protection."

This kind of progress in international law for Native peoples has happened in no small part from recent interest by a small but influential group of scholars within the Western scientific community in the value of TEK concerning biodiversity. I have been personally involved in this struggle for indigenous cultural and human rights. There is still a long way to go in practice, despite these recent developments in international law and consciousness. The principle problem has been, and still is, the failure of governments and environmental NGOs to include indigenous peoples and perspectives at the very beginning of the planning process for protected areas. Conflicts inevitably occur if local people are brought in after the process has begun.

The participatory planning and management strategies of developing nations, the establishment of partnerships not just with indigenous interests but with all stakeholders, is being implemented in many areas of the globe. (See "Indigenous and Traditional Peoples and Protected Areas: Principles, Guidelines and Case Studies" in *World Commission on Protected Areas, Best Practice Protected Area Guidelines Series No. 4*, Adrian Phillips (Series Editor), IUCN-The World Convention Union, 2000 for 12 case studies in the developing world.) This emerging model of collaborative and integrative planning may prove to be very relevant and appropriate for parks in the U.S. How-

ever, except for the 1980 Alaska Lands Act which guarantees subsistence hunting, fishing and gathering activities on public lands for both Native and non-Native persons, the U.S. has been generally very resistant to accommodating indigenous cultural practices, both religious and management or subsistence, on public lands. However, the Timbisha Shoshone Band is actively negotiating with the Death Valley National Monument to implement a directive from the end of the Clinton administration (1999) to co-manage their ancestral lands within the parks.

Traditional Indigenous Resource Management as a Holistic Model

Western science is in need of models for resource management that integrate current quantitative reductionist methodologies into a broader economic, social, ethical, and historical context if modern society is going to be able to continue to develop technologically without continuing to generate unforeseen negative environmental consequences. Science does have an important role to play, but within social, environmental, ethical, and economic limits. A hallmark of industrial culture is "reverse adaptation", the means we employ to achieve our ends tend over time to dominate our thinking and become the reasons for our actions. The tail wags the dog; the means become ends.

In my travels to indigenous meetings and communities, I have learned about the different ways Native peoples have managed to live sustainably in their environments. Even today, in the face of unprecedented rapid and challenging changes to their culture and environment, many communities scattered around the globe continue to strive to adapt without scuttling their traditional values and practices. We are urgently in need of these kinds of models. Our children in particular need to hear about positive environmental models instead of the steady diet of ecological calamities that they now are being reared on. They need hope and inspiration.

Perhaps the greatest value for modern resource management of holistic Native models is the way production of food, fiber, etc. was integrated into a functioning ecosystem. Why is this important? Conservation biology, in its attempt to preserve suitable animal habitat and save endangered species, chooses to think in terms of conserving islands of habitat reserves embedded within a larger matrix which is a kind of sacrifice zone for commodity production like wood fiber. This is risky because we are not really sure if animals will actually use that habitat and because catastrophic events like fire could burn them up (This happened to the White Mt. Apache when the Rodeo-Chedisky fire burned up all of their Mexican spotted owl reserves).

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The matrix, long regarded by island biogeography theory as neutral or hostile habitat, could be suitable habitat if not subject to heavy-handed timber harvesting and fire suppression to save commercially viable tree species. Lighter touch logging could actually contribute to conservation and restoration and harvest prescriptions that put ecology at least on par with economy. In Native management systems, human use furthered the maintenance of animal habitat and other natural processes and species in our shared environment.

We will not be able to save species and habitat if we don't change the way we produce food, wood fiber, and other commodities. We need to reconnect agricultural systems to ecosystems. Presently, all of our commodity-producing systems are unsustainable because of their disconnect with natural systems and their reliance on inputs, which come from outside natural systems. It is technically feasible to change the way we farm and harvest timber enough to be ecologically more appropriate and sustainable. Native resource management models, some of which have been sustainable for very long periods of time, could inspire us to experiment with more adaptive systems.

Finally, Western science usually raises questions and hypotheses that are culturally conditioned even if quantitative analysis is utilized to test these hypotheses. By using different cultural perspectives, getting outside our own cultural box, we may be able to raise new and creative hypotheses, which will lead to new and creative solutions to environmental problems.

When we think of "conservation", we usually think about saving or preserving the physical environment. We think of "resources". Most don't link cultural diversity with natural diversity. Of the world's approximately 5,000-6,000 languages, most are disappearing fast. Some scholars estimate that only around 100 languages will still be spoken regularly within two or three decades. These disappearing languages are mostly ones spoken by indigenous societies. Their languages embody the long-term adaptation of their cultures to particular and unique places and often contain ecological information encoded in particular linguistic expressions and words; names of animal and plants often incorporate information about relationships between animal and animals, and animals and plants. Environmental knowledge (TEK) is being lost in the process of losing languages.

Conservation includes preserving languages and the different ways of thinking about the

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environment. As Jesse Ford and I said in the headline quote for the Upper Glade National Pilot Stewardship Project and in Ecological Society of America's (ESA) October 2000 issue of Ecological Applications: (from invited feature on Traditional Ecological Knowledge in Ecological Applications, vol. 10, October 2000, by the Ecological Society of America, Introduction, p. 2):

> "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."

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Frank K. Lake

> "Better knowledge of Native American realities will allow young Americans, of whatever cultural background, to take responsibility for their history and to assume their own creative place in American culture - to find their place in the right picture" (Sullivan 1989:x).

The justification for including a Native American perspective into natural resource curriculum can be broken into two practical reasons: 1) Native Americans have lived in and managed various areas of North America for thousands of years affecting "Nature" as Europeans knew it and "discovered" it, 2) Contemporary Native American tribes, organizations, and groups compose a significant proportion of the management of natural resources today.

1. Most native ecological systems in North America developed with Native cultural systems.

Geological and environmental development of ecosystems was closely followed by Paleo-Native American cultures. Since the beginning of the arrival of humans to North America, the formation of traits that developed into cultural adaptations led to effects on ecological conditions, which in turn led to the refinement of social systems. The environment molds us and we shape the environment. These social institutions helped early Native Americans define the sustainable capacity of ecological systems, the fine balance between knowing how to live in a place or perish. Early Paleo-Indian societies learned to adapt and live within the ecological constraints of a variety of ecosystems, coastal-marine to desert.

Most archeological information places the first ancestors of modern Native Americans, so-called "Paleo-Indians" as arriving in North America approximately 12,000-13,000 years ago (Maston and Coupland 1995). Some of the greatest factors to affect the development of Native cultures in different regions of North America were the effects of climate change, sea level rising, and shifting plant communities. As Native peoples settled along different places of the Pacific and Atlantic coasts they had to adapt to changing environmental conditions.

The cultures of Native people had to conform to the physical settings and biological communities they inhabited. Over time, the environment and Native societies blended together. Plant communities were manipulated by Native American practices in ways that specifically

fostered the abundance and the types of plant species present in selected areas across the landscape (Blackburn and Anderson 1993). Native environmental management practices even began to influence local physical processes as they built weirs and sophisticated traps to harvest estuarine and riverine fish and mammals. Human-built structures modified the physical structure of river banks, changing the course and flow of tidal and river flows, and affecting the habitat structure of fish and other wildlife found in those modified environments (Byrham and Witter 2000). As large scale processes like climate change and earthquakes affected sea and ground levels, Native people adapted their subsistence lifestyle and management practices to secure goods and services to maintain and/or increase biodiversity (Ibid).

Development and refinement of sustainable harvesting practices.

Fisheries management:

In order to live in the same place for hundreds to thousands of years it was necessary for Native Americans to evolve their societies and modes of living to the local environments. Early Native Americans were able to observe, understand and predict ecological processes, thus increasing their chances of survival and adapting as necessary. As glaciers retreated in the Pacific Northwest, salmon and other fish species colonized river drainages and the populations of salmon species began to increase. Native Americans adjusted their lifestyles and developed sophisticated social systems to efficiently harvest and manage the salmon fisheries (Litchatowich 1999, Swezey and Heizer 1993).

On the Columbia River and the Klamath River as large runs of anadromous fish, mainly salmon, steelhead, sturgeon, and lamprey eels, expanded territories and increased in populations, Native people developed cultures and economies dependent upon the fisheries resources. Native people had to develop different harvesting practices and technologies to secure fish resources (Kroeber and Barrett 1960).

Indigenous uses of fire as a land management tool:

Even more important than localized changes to physical environments and adaptive practices to harvest fish and other animals was the use of fire by Native Americans to modify vegetation across many areas of the landscape (Williams 2000). As climates changed so did the factors affecting the distribution and abundance of vegetation at a coarser scale. At a finer scale, the use of fire by Native Americans modified the composition, structure, and most importantly, the

function and productivity of plant communities. Lighting ignition is the most common natural source of fire in many ecosystems of North America (Pyne et. al. 1996). Yet, it is the specific and intended application of fire by Native Americans on the land to augment natural ignitions that has been most commonly overlooked by the development of modern day ecology, natural resource management and forest science.

The complexity of traditional ecological knowledge about fire and fire effects within a multitude of habitats and ecosystem has only been superficially cited in the scientific literature, and for the most part resource managers, wildlife biologists, and ecologists have not examined cultural burning well enough to designed prescribed fire research that would simulate Indian burning. "Instead, scientists have developed the principles and theories of fire ecology, fire behavior, and effects models, and concepts of conservation, wildlife management and ecosystems management largely independent of native examples" (Lewis and Anderson 2002:4).

It has been proposed that many of the fire-adapted ecosystems in North American in part also owed their existence to Native American burning practices. Early Native Americans, or Paleoindians most likely feared wildfire, and had limited tools to stop them. Contrary to what most scholars have reported, fire burned more often after the arrival of humans into North America. The effects of human-set fire, accidentally or intentionally, would have affected forests and grasslands potentially during any season of the year in which vegetation was susceptible to burn. Native American fires were employed at different seasons under various environmental conditions. Native American fires, and the frequency in which they were set in the same area would have affected the amount of fuel and composition, structure, and diversity of vegetation, which in turn influenced wildfire effects. "So, Paleoindians and modern Indians not only increased the frequency of fires, but they also changed the size and behavior of fires, the time of the year when fires they burned, and even the places they burned" (Bonnicksen 2000:147). Productivity of selected habitats when needed were increased by Native Americans. Fire was an effective tool used by Native Americans to induce changes in the environment. Classic successional theory of plant communities in North America first described by early ecologists such as Whitaker and Clements, were developed without consideration of Native American land management practices. Native people effectively used fire to affect the successional stages of plant communities and could prevent succession in plant communities by the use of fire. The plant and animal resources that Native Americans depended upon for survival benefited from

fire which recreated at patchy landscape, or mosaics which included a variety of successional stages. This is an important point, because most plants or animals require two or more kinds of habitats at various successional stages for reproduction, water, and nutrients. Based on their dependence on the same habitats and ecosystem, Native American knew from experiences the benefits of fire. "Thus the forests and the Indians sustained one another. They were inseparable" (Bonnicksen 2000:224). Not only were the successional stages of various habitats manipulated, but the extent, or potential area, of the habitat was modified through burning to create ecotonal boundaries between different habitats or ecosystem which facilitated food, shelter, and rearing requirements for key wildlife species (Lewis 1993).

California floristic diversity at the time of settlement by the Spanish, Russians and several years later by the Americans was considered to be some of the greatest in North America, from coast to valleys to mountains. "California has been sculpted by prehistoric human hands, as well as by earthquakes, lava flows, floods, lighting fires, and windstorms…Native Americans—through the pattern and timing of harvests, as well as through the burning, pruning, weeding, and planting of places—favored certain mixtures and frequencies of plant and animal species" (Anderson 1993:151).

Examples of long-term and the scale area of changes in plant and animal communities potentially attributable to the effect of Native Americans:

Most biology lessons regarding North American wildlife populations at the time of European settlement attribute those factors controlling wildlife populations to disease, and carrying capacity. With the exception of Pleistocene megafauna extinctions which took place thousands of years before European settlement, Native Americans were given very little credit for having any influence on wildlife population levels. While in fact, what most teachers are unaware of, is that Native American populations through management, harvesting and utilization heavily influenced wildlife populations across North America. Besides the modification of habitats created by Indian burning, hunting pressure influenced the distribution and abundance (population levels) of many big game species. The rationale for considering a Native American perspective in wildlife management should move past the arguments of Paleoindians' role in the extinction of North America Pleistocene megafauna, and focus instead on what was contributing to the distribution and abundance of North American wildlife at the time of European/American settlement. Native Americans have been described as the ultimate keystone

species due to their high populations in the millions (before European diseases) and their effects on the environment and plant and animal populations. "However, researchers have only begun to document the extent and magnitude of aboriginal use and management of wildlife" (Bonnicksen et. al. 1999:445).

For example, research on historical vegetation distributions and archeological data of the Greater Yellowstone Area in the Rocky Mountains provides evidence that elk populations were lower than present due to the hunting pressure of American Indians. Lower elk populations limited the browsing pressure on riparian willow and aspen communities that beavers depended on for food and materials. Hence, there was a whole food web effect that was not formerly attributed to Native American hunting.

> "Prior to the early 1800's, for example, millions of beavers (*Castor canadensis*) occupied lush riparian zones throughout the West…Yellowstone too once contained large numbers of beaver, but that species is now extinct on the park's northern range. Without American Indian hunters, the park's burgeoning elk population has nearly destroyed the willow and aspen communities that beaver need for food and dam-building materials. So American Indian hunting benefited all species by preventing habitat destruction by large populations of ungulates" (Bonnicksen et. al. 1999:446).

Many plant populations commonly thought of as "naturally occurring" at time of Euro-American settlement have since been determined to be linked to Native American planting and management.

These so called "ecological anomalies" of particular plant species or habitat distributions and diversity can be attributed to Native Americans fostering the establishment and maintenance of such species. In California many landscapes were affected to a considerable extent by Native cultures (Heizer and Elsasser 1980, Blackburn and Anderson 1993). Recent research has provided data which refutes the idea that American Indians "lived lightly on the land" (Anderson 1993). The recognition that many geographically diverse areas of California have relict characteristics from former Native American cultures does not imply that the environment was therefore, "tainted" or, by default, "degraded". The assumption that humans can only have a degrading exploitive relationship with Nature is a self-defeating attitude which prevents society, or for that matter natural resources managers and educators, from exploring a sustainable relationship with nature based on an indigenous model (Anderson and Barbour 2004). The same

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could be said about many other landscapes and Native American tribes across North America.

Humans as an integrated species to many diverse ecological systems:

Native Americans developed specific cultural and social adaptations to diverse environments across North America. Nearly every aspect of Native American cultures was dependent on natural resources obtained within local environments. The development of sophisticated methods for the utilization of plant and animal parts allowed Native peoples to exploit and survive in a variety of ecosystems. For most of the tribes of the Sierra Nevada Mountains, over 75% of their material culture was plant-based items that were modified, manipulated or constructed from re-sprouting branches or shoots from different plant species (Blackburn and Anderson 1993). "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" (Ibid:23). As the technology and sophistication of plant uses increased among Native Americans, so did the intensity and area of management they employed on plant communities.

Ethnobotany and ethno-pharmacology are described as the knowledgeable and intimate ways in which Native Americans used and managed plants for material and medicines for millennia to survive.

Native Americans over time learned how to manipulate and manage vegetation to produce goods for a variety of ceremonial, subsistence, and recreational needs. Plant materials were used for basketry, clothing, construction, cordage, dyes, cooking and food preparation, foods, fuel and firewood, medicines, tools, and weapons. They were able to obtain what they needed to survive and flourish without severely degrading or destroying the plants. The ability to intensively manage and exploit different plants or modify plant parts or materials "required an intimate knowledge of each species and the restraint that comes from a respect for living Curriculum that provides the bases of acknowledgement of Native peoples as having sophisticated land use practices provides bases for them today to be co-managers (Anderson 1993 and Turner 1997). Native American tribes have been provided considerable standing globally as indigenous people through programs conducted by the United Nations. Several of the main programs are Convention on Biological Diversity and Indigenous people contained within section 8(j), United Nation Forum on Forest, and support elsewhere with the global recognition of indigenous peoples and biodiversity conservation found with in several UNESCO reports.

> "The 1992 Convention on Biological Diversity, which for the first time established international protocols for protection and sharing of national biological resources, specifically addresses issues of traditional knowledge. It binds the signatory nations to three laudatory goals: (I) to respect, preserve, and maintain traditional knowledge (ii) to promote wide application of traditional knowledge, and (iii) to encourage equitable sharing of benefits from traditional knowledge" (Cox 2000:45).

Survival of indigenous cultures and indigenous knowledge systems are threatened by globalization. Indigenous societies are eroding at an unprecedented pace. Despite the contributions of Indigenous people to biodiversity conservation and to the diversity of human cultures little is being done to preserve and maintain them. The greatest threats of the loss of traditional ecological knowledge are those associated with biological diversity conservation. Western or westernizing countries are facing the greatest rates of language extinction. "During the next century, at least half the existing indigenous languages are projected to disappear, erasing the ecological knowledge accumulated by countless generations" (Weber et. al. 2000:9). Embedded in each unique indigenous language is the descriptive understanding of that local environment that should be of great value to humanity.

2. Species adapted to Native American-induced ecological processes in ecosystems:

Migrating wildlife are thought to have been freely distributed as a result of the adaptations those species took to survive and flourish. This is not necessarily the case. Many wildlife species that were undertaking long migrations at the time that Euro-Americans witnessed such events may in fact be a consequence of Native American management. For example, waterfowl that migrated along the Pacific flyway benefited from Native American burning of valley bottom-lands and wetland prairies (Boyd 1999b).

Other migratory species of considerable value to Native cultures and economies were anadromous fish found throughout the Pacific West Coast from central California to Alaska. Salmon, in particular, were central to sustaining Native American cultures. As a result of the intimate relationship between salmon species and Native American harvesting and management practices, a co-dependency developed where the survival of each was enhanced by the relationship. In many coastal streams of northern California different tribal groups would breach sandbars allowing the surface water of streams and rivers to escape and pass into the ocean. This,

in turn, would allow the salmon to migrate up into the estuaries and up drainages at an earlier time than would have occurred under natural conditions. Later, fall rains would increase stream flow and wave action removing the sandbar and allowing improved freer passage for salmon (Kroeber and Barrett 1960). To allow salmon and other fish species access to costal waterways, it was sometimes necessary for Native Americans to dig through sandbars which blocked the entrance of the stream and river systems. After initial digging by people, the force of the water would soon scour a channel, which allowed the fish to enter the drainage. The breaching of the sandbar for many tribes along the Northern California coast was a communal and ceremonially-important event (Kroeber and Barrett 1960:7).

Many species of plants utilized and managed by Native Americans were more abundant and widely distributed than would occur naturally. "Natural" plant communities witnessed by early explores and settlers were, in fact, influenced by Native American land management practices. Many areas where culturally desirable plants naturally grew were manipulated with fire and horticultural practices. Not every part of the landscape offered the same potential. Through intensive management by Native peoples, selected areas were transformed through time into valued gathering sites. Native peoples increased the potential for plant resources in these areas. "Wild plant populations at favored gathering sites persisted and flourished as a result of human manipulation, technology, labor requirements, and indigenous conservation rules, rather than purely as a result of natural processes" (Anderson 1993:155).

Wilderness and humans as part of Nature:

Most current ecology approaches to "systems thinking" include social systems as an integral part of biological and physical system processes. There are many misconceived notions that the wildlands of North America were indeed "wilderness", a place uninhabited by Native Americans. Some of these beliefs arise out of the fact that diseases had preceded Europeans into areas formerly occupied and managed by Native Americans. Many areas were left vacant after as much as 90% of the Native American population died in California and Oregon (Cook 1955). For example, Native Americans of the Chinook and Kalapuyan tribes living in the lower Columbia River and Willamette Valley, Oregon experienced up to 92% population declines between 1830 and 1841, before the massive immigration of Americans into Oregon Territory of the Pacific Northwest (Boyd 1990).

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Many National Parks currently manage lands under a system called Simulated Wilderness Management Model (SWMM), yet this approach may not preserve the intended values and environmental attributes .

An alternate form of management would be the implementation of a Simulated Indigenous Management Model (SIMM). This new model would incorporate Native American land management practices restoring the long absent human-use component of National Parks beyond economic development, refuse, and trampling of specific high use areas. Anderson and Barbour (2003) propose:

> "that some areas within our national parks be set aside, protected, restored and managed under a different model than the SWMM. These areas would be restored and managed under valuing and application of historical indigenous traditional ecological knowledge and land management practices in combination with Western scientific knowledge. We call this conceptual model the Simulated Indigenous Management Model (SIMM). Under this model, specific Indian-ecosystem associations, such as gathering and management regimes, would be reconstructed and maintained as defined units within designated park areas. At present, park management has no name for such areas, but these landscapes could be called 'eco-cultural landscapes' in that they combine a concern for perpetuation of both natural and cultural values" (page 270).

Examples of possible use of simulated indigenous land use practices are most likely in those areas less developed and inhabited by large populations of humans. Likely areas are national parks, and other preserves or reserves where a more natural, less industrially degraded, condition exists. Emulating Native American burning practices, horticultural plant management practices and conservation practices are all applicable to resource management and restoration objectives today. Natural resource managers should be taught and trained in these Native American knowledge systems and practices to best achieve an integration of social and ecological values related to sustainable environmental management.

3. Most natural resource programs of federal, state, or county agencies are required by law to work cooperatively with or account for tribal governments having a legal title to valued or limited natural resources within or under their jurisdiction.

Federal lands are a significant part of the land base in the western United States. Management of

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the natural resources on these lands most likely has some obligation or legal relationship to tribes and tribal member uses of the natural resources (USDA Forest Service 1997). Tribes secure and retain rights through treaties and other doctrines (Pevar 1992).

Recently, issues described as "environmental justice", concern how the environment is managed and how cultural or ethnic groups dependent or living in that place have been disproportionately affected by natural resource management policies (Harris and Harper n.d). Environmental justice issues have arisen when Native Americans have not had inclusion as sovereign tribal governments into decision making processes regarding natural resource management or land management practices. Policy decisions have often disproportionately affected Native Americans compared to the greater western society, i.e. pesticides or herbicide spraying for forest or agricultural management on resources used by Native Americans for subsistence (Ibid). It is common for governments and industry to plan the management of natural resources without consulting tribal groups because of the lack of historical recognition and ignorance of contemporary entitlement to participate in natural resource planning.

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Question #2

What are some of the similarities and differences among tribes?

Dennis Martinez

Differences among tribes:

Introduction and Context

The story of tribal interactions with U.S. government policies, laws, and treaties constitutes the legal environment. It interacts with the natural environment, giving unique context to a particular tribe's history of resource use and management. The natural environment—a tribe's ancestral land or the new land on a reservation following relocation—accounts for most differences among tribes with respect to cultural land practices, social structure, economic programs and resource use, material culture, origin and migration stories and myths, and ceremonial life. Other important categories of comparison between tribes, which contribute to differences among tribes, include military and political history with the U.S. government, particularly with the Bureau of Indian Affairs (BIA); intactness of family, clan, band structure; tribal size and demographics; economic and political geography; historical intertribal alliances and conflicts; size of tribal lands; population size; access to ancestral lands; whether a tribe is a treaty or non-treaty; tribe federally recognized or not; degree of market dependency; degree of cultural complexity; whether or not a tribe is on a reservation; tribal membership criteria (each tribe sets its own blood quantum minimum, most commonly between 1/16 and ½); whether a tribe shares its reservation lands with historical allies or enemies; governance structure; and the influences of pan-Indian politics and spirituality (e.g., Native American [peyote] Church or Protestant evangelicals, American Indian movement [AIM], and Indian NGOs which espouse various indigenous causes.)

I will focus on the following categories of tribal differences: (1) physical environment; (2) size of land base and population density; (3) material culture and cultural land practices; (4) social structure; (5) economics and resource use; and (6) ceremonies and spirituality. The physical environment has a lot to do with the other five categories. I will begin with the physical environment and then go on to show how that unique environment influences size of land base, population density, material culture and cultural land practices, social structure, economics and resource use, and ceremonies and spirituality.

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The Physical Environment and Its Effects On Cultural Differences

Anthropologists invented "tribes" as a heuristic aid, a convenient way to simplify cultural complexities for presentation of research in publications and university courses. Six hundred and fifty tribes are recognized in the U.S. and Canada by scholars. The idea of a "tribe" is loosely based on the Western idea of a political entity (nation state) with a relatively homogenous dominant culture, political system and shared language. Environmental differences may vary considerably within the anthropological "tribe", but are not viewed as important as linguistic and cultural similarities. Many tribes occupy similar ecological niches and have nearly identical cultural practices—based on their shared physical environment—but belong to totally different linguistic families, e.g., the Athabascan Hoopa and their non-Athabascan Karuk neighbors of northwestern California. Others occupy radically different physical environments but speak basically the same language, e.g., both the Navajo of the arid southwest and Dene of the boreal forests of North America speak an Athabascan language and can understand one another.

Resource-Poor Tribal Lands

Size of land base in aboriginal times was a direct result of the carrying capacity of the physical environment. Population density was low because of the low carrying capacity of the land. Historical population densities were lowest in the Great Basin and Columbia Plateau—often one person per several hundred square miles. Tribes occupying resource-poor lands had to be mobile over relatively large areas (e.g., Paiute and Shoshone of the arid Great Basin; Apaches of the Greater Southwest; Wasco, Cayuse, Spokane of the Plateau country of the Pacific Northwest; and tribes in the Arctic. Tribes of the Great Plains and Rocky Mountains enjoyed a higher carrying-capacity on their lands, but spent part of the year following herds of bison, antelope, and elk, and so were also highly mobile. Many bands in these poorer environments had permanent or semi-permanent villages where they over-wintered.

While some version of the Shoshone language, for example, was spoken from Utah and Idaho west to California's Channel Islands, place-based bands did not consider themselves to be the anthropologically invented "Shoshone Tribe". Like almost all mobile peoples living in arid or resource-poor environments around the globe, their allegiances were local. Many bands consisted of only a few families (although families from a particular place often visited other bands for ceremonies or other festive occasions, and intermarried with other clans, often widely scattered through a number of other bands).

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Sacred Geography especially tied peoples to their local places. Sacred Geography is the physical expression in the land—rocks, hills, mountains, trails, etc.—of tribal spiritual history described in stories and myths; these stories were heard from youth to old age. They were the myths that lent meaning and sense to the homeland, and, along with the remains of tribal ancestors buried near living sites, were the glue that anchored the people to their land.

These kinds of Indian societies were quite egalitarian in their political and social structure. Survival in harsh environments depended on the capabilities of everyone in these small bands. While there were "headmen" in each mobile group, they were listened to only as long as they were competent leaders. There was no social hierarchy, as with the richer tribes of the Pacific Northwest or in the Mississippian cultures. Tribal resources were shared equally. Material culture was relatively simple and highly adaptive to their particular environments. Cultural land practices were adapted to the local landscapes, plants, and animals. Fire was used by most of these bands, but different environmental conditions and resources dictated how and when it was used.

Resource-Rich Tribal Lands

Resource-rich tribal lands include coastal Pacific Northwest (including the lower Columbia River), California, lower Mississippi River drainage, the eastern woodlands, the Great Lakes bio-region, and Southwestern "Old World" style agricultural societies based on corn-beans-squash.

Eastern forests are dominated by hardwoods, and in many places, a rich herbal understory, and along with productive tall grass prairie and oak savanna biomes, marine, lacustrine, and riverine systems, provided a rich variety of resources, including Native agriculture (corn-beans-squash).

The forests of the Pacific Northwest (including northern California) are dominated by conifers, and are relatively resource poor, although the many valleys and prairies within this bioregion provided quality animal habitat and were high in biodiversity. But the richest environments were the coastal and riverine fisheries and shellfish beds. Tribes in the interior montane regions of the Northwest as well as in the coastal redwood/Douglas-fir forest zone used the slash and burn method of agroecology in order to open up "yards" and "corridors" (forest openings and prairies of various sizes) and to maintain oak savannas and woodlands in these resource-poor forests to create animal habitat and cultural resource "gardens". Conifer-dominated forests, especially redwoods, hemlock, and cedar, are poor in an understory herbaceous layer which provides most

cultural resources. These were the classic "acorn-salmon" cultures described by anthropologists. The term, however, is misleading because forbs (flowering plants) and grass seeds, corms, and roots, and deer and elk (along with a wide variety of small mammals), berries and nuts were also utilized. In some cases, grass and forb seeds were as important as acorns, and deer were more important than salmon.

California has a varied but generally rich resource environment, with the exception of the eastside of the Sierra Nevada Mountains (Great Basin) and the arid southeastern Mohave Desert (except for the lower Colorado River tribes who were agriculturalists). Coastal regions the length of the state and interior Central Valley are particularly resource-rich, with a great variety of marine and terrestrial cultural plants and animals.

All of these biomes and regions supported high populations of Native Americans living on relatively small tribal lands because of their high carrying capacity. Western Washington, the Lower Columbia River and valley California had particularly high populations, with numerous adjacent cultural groups packed into small territories. California is estimated to have had over 300,000 Indians; the actual figure was arguably much higher, perhaps approaching one million.

Because of the environmental diversity of these regions, a wide variety of social and political structures, land cultural practices, material culture, resource uses, and spiritual practices occurred. There is a continuum of culture from so-called "hunter-gatherer" egalitarian groups in the resource poorer regions who managed and harvested each year in seasonal rounds from low to high elevations, to highly stratified societies with two or three distinct classes and, in the case of southeast Alaska, coastal British Columbia, western Washington and Oregon, the Lower Columbia River, and northern California, a slave class. People lived in permanent (often very large) villages on the coast at the mouths of rivers, bays and estuaries, on inlets in coastal British Columbia and southeast Alaska, and on mainstem river confluences with smaller tributaries. Chieftainships were usually hereditary, and depended more on blood line for their continuance than on special leadership abilities of the chiefs.

Fire was the principal management tool, but Native fire regimes varied with local terrain, climate, and vegetation types. Burning occurred even in the cool, humid areas of coastal western Washington, Oregon, coastal British Columbia, and southeast Alaska for rejuvenation of important cultural plants and animal habitat. But on a much smaller scale compared to interior

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montane and southern montane/valley tribes, and because of cooler temperatures and greater rainfall, fires had less impact on general forest structure and composition.

Material culture in the Northwest reflected the materials supplied by their environment: wood and bark from giant cedar and redwood trees for housing planks, longhouses, canoes, and household items; shells and bone from the sea (e.g. dentalia necklaces for money); shrubs and ferns burned the year before for baskets and cordage; etc.

Ceremonies and celebrations in the Northwest also reflected the environment as well as the social structure of tribes. Wealth redistribution to the poorer members of the community occurred in the Potlatch Ceremony, which like many ceremonies throughout North America—including the drum—were illegal until recently. This ceremony was conducted to honor the one who gave gifts away to his fellows and served as well to validate songs and other properties that the person owned (and not, as anthropologists used to say, to simply display wealth for ego gratification as in capitalism). As with all tribes everywhere, first rites thanksgivings for important foods were held (e.g. Salmon Homecoming and Root or Acorn Festivals).

Northwest California was the home of World Renewal ceremonies. Klamath River and coastal tribes—Yurok, Hoopa, Karuk—still hold their White Deerskin and Jump Dances in September in order to make the world right and renew the land and the people.

Eastern tribes, more dependent on a stable agricultural economy of corn-beans-squash, also developed a high degree of cultural complexity and a sophisticated governance structure. For example, the American system of representative democracy was copied from the Iroquois League or Haudenausaunee. However, the important role of women was not emulated, including their ability to veto plans to go to war. The Haudenausaunee was based on clan divisions; women headed the clans and were (and still are) known as "clan mothers". War captives could end up as slaves. Indian slavery was very different from the slavery of black Africans by Europeans; slaves could rise above their status in some tribes, lived as members of their owners' families, and were generally treated well, although some could be sacrificed and buried with their owner if he were a very important chief.

The Mississippian Mound Culture, which disappeared in the 16th century, may have been the most hierarchical Indian society in North America (not counting the Aztecs and Mayans).

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Anthropologists have long puzzled over the passing of this culturally complex group found from Minnesota and Ohio to Mississippi and Georgia. Present day tribes of that region believe that the Mound Builders were their ancestors. Some anthropologists suspect that European diseases, coming into their country in the 1500's ahead of European invaders, decimated up to 90% of Mississippian Indians, and from which the culture never recovered. The culture was probably something like that of the ancient Middle East and Egypt. The mounds were burial chambers for important chiefs and also had astronomical significance .

California tribes were highly diverse culturally because of the environmental diversity of the region, occupying all parts of the poor-rich resource continuum. Scholars have questioned why Old World style agriculture never developed in California with its high population density, particularly in the central and southern parts of the state. (The Mono Lake Paiute, living on the arid, high elevation eastern Sierra Nevada Mountains did invent an irrigation complex of ditches which watered fields of Ookow [bluedicks brodiaea corms] and yellow nutsedge.) California tribal horticulture based on fire management and selective harvesting—as distinct from the agriculture of plowed fields and seed-sowing - is often called "proto-agriculture" because scholars assume that agriculture proper developed out of more "primitive" hunter-gatherer horticultural cultures. But the fact is, Native peoples in California (and elsewhere where fire was the primary management tool) didn't need to go to the trouble of working their lands with a garden hoe (although some bands sowed seeds and transplanted cultural plants) because fire made the job a lot easier. Indians did intentionally select for favored plant—and even animal—characteristics in much the same way as Old World cultures. But, with no draft animals available and living in a completely fire-dominated environment, they did the logical thing: set fires. There are around 25 reasons why Indians burned, often the same place each year, but one reason that stands out, particularly in light of our current age of frequent catastrophic fires, is the need to reduce fire hazard. Moreover, storage technology for edible seeds, nuts, and acorns. was as sophisticated as Old World agriculture. This technology allowed a high degree of cultural complexity generally in California, which in turn created surpluses (as in standard agricultural societies) which in turn led to more sophisticated land management practices, which also allowed for very high populations in spite of relatively small territories.

In conclusion, what we see in California very clearly is the relationship between environmental diversity and cultural\linguistic diversity. In the mountains where topography has placed barriers

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between cultural groups living closely together, linguistic and cultural diversity is very high, but in places like the Central Valley many different tribes and bands speak the same language over a very large, flat area (e.g., Yokuts and Maidu) and share a common culture. Also, the great diversity of vegetation types, natural fire regimes, and soils, coupled with elevational differences, led to a greater diversity of cultural land practices and other local adaptations. The tragedy of loss of linguistic diversity is the loss of local environmental knowledge often encoded in words and phrases (e.g., relationships between animals and plants).

Similarities Among Tribes

Love of Place

American Indians share a number of basic life orientations despite the differences discussed above. Like all people-of-place the world over, Native peoples are very attached to their homelands. The history of U.S. government-tribal military conflicts is a history of extraordinary courage and tenacity in defense of people and land in the face of overwhelming odds in numbers, firepower and loss of subsistence game (e.g., the decimation of bison by whites). Indians have fought with U.S. forces in every conflict since the Revolutionary War, and have contributed more warriors to U.S. causes in relation to their population size than any other ethnic group. While high unemployment is certainly an important motivation for joining the military forces, when Indians have been asked why they support the U.S. in its causes—many of which in reality have nothing to do with defense of their own lands—they invariably state that they are helping defend their country like any other citizen. The U.S. flag in the hands of an Indian veteran always leads the opening procession ("Grand Entry") into the pow wow arena. Veterans have a place of great honor at pow wows and other gatherings. It has always been so.

Land Ethic

In the same spirit of defending their homelands, Indians everywhere have a deep respect for and love of the land they call home. The land is their drugstore, hardware store, supermarket, and spiritual center. And, to leave their birthplace, as has happened to so many tribes who have been resettled on reservations, is to leave the final resting places of their ancestors for whom they have the utmost respect and love, and who they sometimes talk to at the gravesite. Cemeteries are visited frequently and periodically cleaned up. That is why repatriation of bones of ancestors stored in museums is such an important Indian cause.

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Taking good care of the land is another important shared trait. Scholars have often asserted that Indians have no land ethic. This is probably a reaction to the prevailing romantization of the "Noble Savage" and the political correctness of the portrayal by_some of Indians as the "first ecologists" who "walked lightly on the land." This kind of romantization—an insidious kind of racism in its reduction of Native humanity to a political or environmental cause—was a European invention of the 18th century Enlightenment. It is not a Native construct. And so, some academics are making a reputation by trying to debunk the myth of the "Noble Redman". The truth, however, lies in neither of these extreme views.

As I have argued elsewhere in this manual, native land ethics are distinct from the Western utilitarian ethics of "wise" resource use but share some of its concerns about the conservation of these resources which livelihoods and survival are dependent on—as indeed most of humanity is capable of doing. Thinking of tomorrow ("unto the seventh generation" in Indian thinking) is a human phenomenon, and because we humans have the gift of foresight, we have the special responsibility to be a voice for the voiceless and respect our other plant and animal family relatives on this earth. Indigenous peoples everywhere think of the earth as a living source of sustenance—sometimes using a rough equivalent in their own language of "mother", but sometimes employing words which combine "father and mother" and are difficult to translate directly into English. But these Indigenous words in the end simply mean that we are dependent children of the earth and therefore, need to honor the earth as we would our own mother and father; we need to take care of our mother's other children, the plants and animals which sustain us. If we bring up our children right and take good care of them, they will take good care of us in our time of need. But, as the elders say: "If you don't take care of the plants and animals, they won't take care of you."
All tribes had strong taboos against wasting resources. You never harvest more than you need, and if you do, you should share with others in need. Contrary to the beliefs by most Western scientists (the great exception being ethnographers, especially those working with Indians in eastern North America in the decades following contact), Native peoples used to, and many still do, *quantify* the numbers of animals or plants that could be harvested in a particular place in a particular kind of season (e.g., dry vs. wet years). In all but the smallest mobile bands of poor-resource biomes, certain persons—usually, but not always, elders—were specialists in some area of environmental knowledge. These tribal leaders might determine, for example, when and where to fish, what gear to use, how many fish could be caught, etc.

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All tribes took special pains to dispose of animal remains in a respectful way. Bones were placed in the crotches of trees instead of being thrown to the dogs. Some animal dependent tribes, like the Cree of Canada, required the total consumption of certain animal species as a kind of ritual in order to please the soul of the animal eaten. Animals had souls, and would observe your behavior toward their carcasses. If you were disrespectful, the animals would perhaps not come back again, or something bad would happen to your family. The forest was not dead, as in the Judeo-Christian-Islamic worldview, but alive, a forest of eyes watching you all the time.

Western academics frequently claim that if indigenous peoples had had higher population numbers and more sophisticated technology, they too would have caused the extinction of many animal species. (Ironically, many of these same scientists assert that paleo-Indians caused the extinction of North American megafauna—with low population numbers and nothing more than spears or bows and arrows—while also claiming that Native peoples had very little impact in the post-extinction environment.) Indians could have wiped out a number of animals with their simpler technology had they not been subject to the kind of restraints described above. In a spiritual sense, hunters used ritual and dreams to divine where their prey would be; the arrow or bullet was simply the anti-climatic *coup de grâce*. Hunting was a spiritual, not a technological, enterprise. Most tribes believed that there was a kind of compact between animals and humans—made long ago when animals and humans could talk to each other—that entailed certain responsibilities and privileges. If humans treated animals respectfully, the animals would submit to harvest by humans; if humans were disrespectful, animals could refuse to be taken, and in fact, could turn against humans. During the fur trade, following a de-spiritualizaiton process by Christian missionaries (Jesuits) and coupled with up to a 90% death rate from European diseases, Indians in northeastern North America thought that the animals had turned against them. Feeling that their sacred compact had been broken, they over-harvested beaver and other fur-bearing animals to the point of near-extinction before they recovered sufficiently to stop over-killing and regained their spiritual balance. (It should be kept in mind that alcohol addiction and easy credit, as a deliberate policy of the Hudson Bay Company for conscripting tribes into their alien market enterprise, hooked Indian hunters already in despair spiritually and psychologically.)

Wealth Distribution

While most tribes from resource-rich environments developed stratified societies with high social

status for those at the top, wealth was still shared with lower status community members ("status", not "class", because class is a Western socio-economic term which describes *economic* disparities which often lead to class conflicts). I have already mentioned wealth redistribution ceremonies, like the Potlatch of the Northwest, where everyone attending received material support through gifts. Even slaves and war captives were well taken care of, and could rise to be war chiefs, although usually not principal chiefs. Once they had been adopted and learned their new tribal languages and culture, even if non-Indian, they were considered to be one of the "people". Culture, not biology, determined tribal membership. Blood quantum, a concept based on livestock and imposed on Indians by whites, was a foreign idea.

Cultural Resiliency

Tribal territories, especially in areas of great topographic and environmental diversity, captured as many different elevations, vegetation or habitat types and ecosystems as possible—from coastal inshore wetlands to mountain tops. In this way resource use was maximized, but without the danger of over-exploiting any single resource since so many were utilized.

Nature's productivity often goes in cycles of plenty followed by scarcity. For example, deciduous oaks only produce well every four or five years, fish runs vary by ocean currents and animal migration routes change. If resources failed in one place, others would be available in another place. Intermarriage between neighboring bands occupying somewhat different environments, especially those in a west-east orientation or at different elevations, facilitated resource exchanges during hard times. Moreover, extensive trade networks existed throughout Indian country. Many of our major cross-country highways were once Indian trade routes. These cultural adaptations to natural diversity contribute to a high degree of cultural resiliency. It was in keeping with the spirit of the universal Native ethic of reciprocity.

Ceremonies and Spirituality

All tribes shared ceremonies which, although different in form, seasonality and adapted to their own unique environmental conditions and resources, were about giving thanks to the plants and animals they depended on. They renewed the natural environment and the people so that they would prosper for another season. Examples include the Sun Dance of the Plains and Rocky Mountain tribes, the Green Corn Dance of the eastern woodland tribes, the World Renewal ceremonies of northwest California, the Salmon Homecoming Ceremonies of the Northwest, the

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Yaqui Deer Dance of the Southwest, and numerous First Fruits celebrations of important tribal resources (e.g. acorns, beans, roots, corns). While Western religions teach that God created the world in six days and is now resting, Indians believed that Creation is never finished and that our purpose on earth as humans is to take responsibility for the renewal of the earth through ceremonies and practical care-giving activities (like fire, which was also a ceremonial act) every season as co-creators with the plants and animals—each species having its own unique role in the re-creation of the world.

Myths and Stories

Origin and migration myths were universal, although quite different in content, and included origins in both the stars (usually the Pleiades) or the underworlds of the earth (e.g., Hopi). The Creator was usually a wiley and unpredictable animal like Coyote, Raven, Spider or Rabbit reflecting the changeability and moral ambivalence of both the natural world and human nature. Nature was the great teacher; lessons about how to behave were learned from the animals. Unlike the three great Western religions—Islam, Christianity, and Judaism—which had early on separated the world into a 'good" God and "bad" Devil (the forces of light and darkness in a black and white world), Indians saw Nature in shades of moral grayness: capricious and wise, chaotic and stable, unpredictable and orderly. An important spiritual objective through ceremony was the balancing or harmonizing of these natural forces—including human nature—and setting the world right and in order for another season. Spirit and Matter were seen as inseparable. While Western religions are morally dualistic, dividing the world up into earthly and heavenly realms, Indian spirituality saw the earth as the natural home of humans, and imbued with Spirit, making it possible, as Native people used to tell Christian missionaries, to enjoy heaven on earth without waiting for death.

The Role of Women

The popular idea of the role of subservient Indian women has been influenced by early European observers, who came from a stratified and patriarchal, male-dominated culture, and who naturally thought that the hard work of women carrying heavy loads of firewood or dressing and skinning animals that they saw in visits to villages was a result of some kind of second-class gender role. What they didn't understand, being mostly from large urban areas of Europe, was that women had the primary responsibility for the children while on their seasonal rounds—some lasting for months. They were therefore, camp-based and dealt with all domestic work in the

camps. Men were then free to hunt and fish. While traveling, men needed their arms free and weapons at the ready in order to either defend women and children against enemy attacks or to bring down game. Women were, and still are, held in high regard in Indian cultures because they, like the mother earth, give birth to and care for the tribal future: the children.
Women often owned the family lodge and other properties, could divorce their husband, and either had veto power over war decisions made by men or could be very morally persuasive in their opinions. Many tribes were matrilineal, with family inheritances going to their female heirs, or matrilocal with the new husband going to live with his wife's family.

Most tribes divided the world into feminine and masculine parts. Women in many tribes spoke their own languages distinct from what men spoke. Woman's world complemented man's world, and was based on the perceived complementary active (male) and passive (female) forces of nature. Together they made one world.

Other Similarities in Cultural Traits

Other practically universal Native cultural traits, include respect for elders and children (who were rarely spanked and on whom constant attention was lavished); love of sports; love of music, songs, and dance; a down-to-earth, practical and irreverent sense of humor, the result of having lived at times close to the edge of survival; and until the reservation days of poor food (U.S.D.A. commodities) and the adoption of a more sedentary lifestyle, a healthy and hygienic people whose healthy habits many newly arrived Europeans adopted. Indians bathed everyday and ate a wide variety of plant and animal foods while settlers were eating salt pork, hardtack biscuits, and drinking whiskey or beer, while rarely bathing.

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Frank K. Lake

There are many similarities among tribal groups across North America today as a result of relocation, intermarriage, and "Pan-Indianism". Pan-Indianism generally refers to the collective cultural traits shared by North American tribes today due to historical factors that have brought many tribal groups or individuals closer together. The historical factors most responsible for "Pan-Indianism" are trade, genocide, warfare, relocation, political relations with the United States, urbanization, and intermarriage between tribal groups and with other ethnic groups.

Historical Factors:
Trade between tribal nations before and after European conquest resulted in many tribes exchanging goods, services, political alliances, cultural traits, and genes between themselves which bounded them more closely with each other. Examples include the Iroquois confederacy in eastern North America and the "fisheries, root, and berry" exchange along the Columbia River in the Pacific Northwest. Genocide and warfare were more common after the settlement of Europeans in areas of North America. The "French and Indian War" and the "American Revolution", for example, pitted tribal nations having alliances with European nations against each other.

Relocation of tribes to new areas, territories or later reservations resulted in part from the effects of warfare and genocide. European nations often used tribes against each other, and then would later disempower tribal control over land and resources once tribes were weakened politically and demographically (Buan and Lewis 1991). Relocation of tribes to areas, territories or reservations that were less desirable to European nations or Americans was common from 1600-1900. The resulting effects were that tribes that were formerly different geographically, in language, and cultural traits were now forced to assume a common identity, often politically, and in subsistence/survival lifestyles. Relocation to new territories and reservations often forced tribal groups of different subsistence lifestyles to learn or adopt common land use and management practices to survive in their new location. For example, many of the tribes living in southern Oregon were forced to learn to live in the northern Oregon coast after being moved to the Siletz or Grand Ronde reservations in the 1860's (Viles and Grigsby 1991). One of the most common examples was forced removal of tribal nations from their homelands across the United States to Oklahoma, then known as "Indian Territory". Native Americans who were fisherman, hunters, and gatherers of many diverse ecosystems were forced to be farmers or labors. Once placed on

reservations, tribal groups began to homogenize, losing many of their former differences related to land use practices and cultural traits.

Later in U.S. history after the reservation era, the U.S. government instituted urban relocation programs, which either removed Indian children and sent them to "Indian boarding schools" or relocated adults to cities to learn "trade skills". These actions usually resulted in children not learning place-based ecological knowledge related to natural resources, and for adults often meant that finding employment and earning income with a newly learned trade in urban centers. In boarding and trade schools many Native Americans were not taught skills that would enable them to manage and/or have gainful employment in natural resource fields back in their aboriginal territory or reservations.

Ecological and Social Determinants:

Knowing the geography and climate of areas where tribal nations were located will provide students with a better understanding of how cultural adaptations to place developed. Often environmental conditions and ecological productivity determined socio-cultural organizations of tribal groups. Two different approaches have been taken by science, one ecological and the other archeological, to explain the relationship between Native Americans and their environment.

Elevational gradients described as "life zones" influenced some tribal boundaries before the arrival of Europeans. An example from the Sacramento Valley best exemplifies the differences between tribes known as Valley or Foothill/mountain peoples. (Heizer and Elsasser 1980:8-11). "California Indians had a strong tendency to stake out their tribal territory as to cover several life zones. Life zones are areas characterized by a combination of elevation, rainfall, climate, and certain plants and animals" (Ibid:9).

Besides geographic separation, language was a strong determinate of nationality among Native Americans. Tribal nations could have lived in similar environmental settings and utilized similar environmental subsistence practices, but differed in language. Examples of different languages among tribes living in similar geographic setting can be found with tribes in the American Southwest and California (Heizer and Elsasser 1980).

Similarities and differences can be and have been a subject of archeological and anthropological investigation. Many anthropologists have documented the material characteristics of tribal groups.

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Anthropologists have compiled lists of cultural traits, or a trait dendrogram which displays the overall similarity between groups. Examples of cultural traits complied by Jorgensen (1980) are provided for the tribal groups of the Pacific Northwest coast in a trait dendrogram (Matson and Coupland 1995**:**16-17).

Differences or similarities in myths may be at the foundation what unifies some tribal groups. Worldviews may be held differently by neighboring tribes living in a similar ecological condition. In addition to revealing differences among tribes, within tribes myths were and still are an effective way to communicate about ecological processes, life histories of plants and animals, and humans' understanding and relationship to the environment and management of natural resources. In many ways myths, legends, and stories can be our "ecological prescriptions of how to live in place" and can assist us in developing a better understanding of our natural resources by making learning of the environment interesting and personified. Often there are many parts and specific details to a myth that accurately describe environmental relationships, animal and plant behavior under various conditions that only become apparent when experienced in person in the environment. The lessons become apparent in the context of one's relationship to the natural world. For example, the lessons of the story about greedy Coyote and how he over-harvested berries and was turned into a rock by the birds is revisited when we humans go to the berry grounds. We see the pile of weathered crumbled rocks where Coyote freed himself and are reminded to practice sustainable harvesting practices and leave some berries for the bird people.

Political Organizations:

Levels of organization within tribes determined village, group, or tribal nation identity. Before the settlement of North American by non-Native peoples, tribal nations and groups were organized by various leadership systems. Many of the tribal groups in southern Oregon and California had leadership by village headman. It was the often the village headmen who determined how environmental land use practices were conducted. In comparison, other areas in North America utilized a system of Chiefs in natural resource management. Chiefs were more common among seasonally migrating peoples, such as the Plains tribes who followed buffalo.

Some of the differences among tribes today can best be explained by the history of the tribe's relationship with the U.S. government. When the government began treaty negotiations with tribes across America, Congress and the president were most familiar with the

eastern and mid-west Plains tribal system of Chiefs. Presidents of the U.S. were inclined to negotiate treaties with "Chiefs" of tribes. "Chiefs" may or may not have been individuals who accurately represented the tribe, but instead were Native individuals of some tribal rank who were more inclined to have relations with the U.S. government in exchange for personal empowerment. Many "Chiefs" who were signatories to treaties with the United States, did so under distress, imprisonment, or force. Formation of treaties often occurred after the genocide, forced removal, and starvation of Indian people (Buan and Lewis 1991**)**.

In California and southern Oregon, village/tribal headmen often negotiated directly with the State Superintendents of Indian Affairs or a designated political official. In some instances, only a few village headmen were present at tribal-U.S. government negotiations, which were assumed by the U.S. to represent the whole "tribe". Examples of this were present in the formation of treaties in western Oregon, Table Rock reservation, and Oregon Coast reservation (Buan and Lewis 1991, Suttles 1990).

Differences observed in tribal nations or tribes today reflect who signed the treaty and what the U.S. government failed to uphold in keeping its promise. Native individuals or families known as "Hang-around-the-Fort Indians" often received better governmental benefits and entitlement to land and resources without persecution from "Whites". "Wild renegade" Indians or those tribal people who often took up arms against the United States, fled from the U.S. Army or volunteer militia, refused to come to the reservation or U.S. forts, and were less likely to be recognized by the U.S. government. The outcome of this U.S.-tribal relationship resulted in some Native individuals, their families and subsequent heirs gaining access to natural resources or political power over other Natives of the same tribe.

The U.S. often promised resources and political power to selected Native individuals, then later did not honor (ratify) those treaties. Un-ratified treaties complicate a number of issues related to Native Americans and the management of natural resources. The U.S. relocated many tribal people to places other than their aboriginal territory. The location of where tribes relocated was determined by U.S. government's policy in dealing with the tribes in different areas. For example, in the western U.S., treaty negotiations were driven by American's access to natural resources-furs, gold, timber and fish. The United States government has a shameful record of removing, relocating, removing, and relocating tribal people or establishing policies that have taken away the

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ability of Native people to govern and control natural resources.

American settlement and genocide often accompanied access to natural resources during times of social strife among Native peoples. The political climate often determined why and how tribes were placed on reservations or rancherias. One of the most effective policies instituted by the U.S. government to take additional lands from Native peoples following the reservation era was the General Allotment (Dawes) Act of 1887. This act affected tribes by supporting the segregation of tribal land holding as communally managed lands into individual non-state taxable sections. Furthermore, this act resulted in a "checkerboard pattern of ownership by tribes, individual Indians, non-Indians, causing serious jurisdictional and management problems" (AILTP 2000:9).

The U.S. government also placed in political power certain "Chiefs" or favored U.S. loyal tribal members into political positions. These "Chiefs" were viewed by some Native people to be merely political puppets of the U.S. government. This instituted scheme of political appointment led to the eventual formation of tribal government, following American settlement. The Bureau of Indian Affairs (BIA), a branch of the U.S. government, was created to manage American Indian individuals and tribes.

It was not until the 1980's that the concept of self-governance, where tribal people manage themselves in relative political autonomy of the BIA was put into effect. Management of natural resources, such as timber, was radically changed on tribal lands. Under BIA management, many tribal timberlands were unsustainably harvested for economic gain of the U.S. people and at the detriment of environmental and economic quality of tribal lands (AILTP 2000:60).

Some tribes are autonomous political units that are independently financed from self-generated revenues. Other, usually small, tribes with a smaller land-base, prior to casinos, were dependent upon federal funding which provided expanded opportunities in natural resource management. Tribes who accept federal funding for natural resource management may limit their ability to exercise self-governance. Self-governance related to natural resource management is addressed in: Public Law 83-280. In recent times tribes have had the ability to move beyond the constraints of PL 280. The development of forest management plans and integrated resource management plans by tribes has increased their ability to manage their own natural resources.

Question #2

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Question #3

What is sovereignty? What are some of the laws and treaties between the tribes and the U.S. government that determine the use and management of natural resources?

Dennis Martinez:

Federal Indian law in the U.S. consists of countless laws, treaties, agreements, and court decisions that involve tribes and individual Indians. Much of it may be located in Title 25. *U.S. Code*, but it also applies to other federal agencies, states, and local governments. It is not a separate body of law ordained by the Constitution or by Congress. Federal Indian law is not tribal law, which is unique to each tribal nation.

Sovereignty

American Indian sovereignty is characterized as inherent but is less than that of other nations such as the United States and Canada. Tribes have some autonomy within their borders, and this suggests the limited meaning of sovereignty. Tribes have no federally recognized foreign authority affairs, even if they address the United Nations and other international tribunals. Existing tribal sovereignty is being challenged by cases that seek to diminish tribal authority or jurisdiction over areas within tribal reservation borders which are dominantly non-Indian in ownership and occupation.

For most of the history of Indian affairs, tribes have been treated as dependent wards, and the government has been both trustee and guardian. Although some tribes assumed or were granted greater autonomy to run their own affairs, today's freedom to function in a relatively autonomous way came with the Indian Self-Determination and Education Assistance Act of 1975. As a result, many tribes negotiate grants and contracts nearly free of interference from the Bureau of Indian Affairs (BIA) and often seek funding from other agencies such as the Administration for Native Americans (ANA) and the Environmental Protection Agency (EPA). Self-determination makes possible tribal planning of conservation projects and resource management. The law specifically calls for "an orderly transition from federal domination of programs for and services to effective and meaningful participation by the Indian people" [88 Stat. 2203-04 919750].

Important advances in economic development and self-governance have occurred over the past

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0 years that "self-determination" policy has set in motion. While tribes now are better able to influence national policies that affect them, they still do not control all of their reservation lands. Recent U.S. Supreme Court decisions have tied tribal sovereignty within reservations to land ownership. Tribes cannot control activities of non-Indians within these boundaries unless they occur on Indian-owned property (trout lands) or under a specific contract.

"Sovereignty" isn't really sovereignty unless tribes can assert *equity*, (e.g., co-management of ancestral lands currently managed by public lands agencies), *access* (e.g., treaty-guaranteed rights to gather, fish, and hunt), or *sustainable management of tribal resources* (e.g., use of fire to produce plant material suitable for cultural use, as in basketry). Without control of non-Indian private properties within reservation boundaries, tribes cannot manage and protect all of their land, water, wildlife, and cultural resources. The role of the U.S. as trustee should be to promote tribal control of their resources by providing technical and financial support and by restraining attempts by other governments (especially states) and other interests to intrude on tribal sovereignty.

The use of the English term "resource" is problematic. In Western culture resources are limited to naturally occurring materials which can be exploited (either wisely or unwisely) for economic use as in the Anglo-utilitarian tradition. However, resources for indigenous peoples everywhere are more than useful objects. The holistic nature of indigenous worldviews doesn't allow any clear separation between natural, cultural, spiritual, and historical resources. They are of a piece. This simple and pervasive fact about the Native mind has been the source of repeated misunderstandings by the courts, Congress, and the states in legislating or adjudicating religious, tenancy, environmental, and cultural conflicts with the dominant culture.

The U.S. federal government has traditionally been the legal guardian or trustee of tribes, which have been defined as "domestic dependent nations", nations within a nation, with a qualified kind of "sovereignty" whose limits have been defined and redefined by case law, congressional legislation, and presidential orders over time.

With the passage of the Indian Self-Determination Act of 1975, tribes were allowed more control of their natural resource and land use planning. The Act did not, however, empower the tribes in the very real sense of turning over *total* authority to them to run their own affairs without government intervention. The 1975 law intended an "orderly transition" from the traditional

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dependence on the Bureau of Indian Affairs to "meaningful participation" with government. President Clinton promulgated an executive order in 1994 that, charged public land agencies with the responsibility to accommodate Indian access and ceremonial use of sacred places and to avoid adverse physical impact. However, the order also declared that "…nothing in this order shall be construed to require a taking of vested property interest…[or]…to impair enforceable rights to use of federal lands that have been granted to third parties through final agency action… but, while intending to improve management, does not create any right, benefit, or trust responsibility…enforceable at law or equity…against the United States."

In other words, it leaves open-ended the protection of sacred sites and other cultural (natural) resources, despite provisions for Indian access. Exclusive use of *any* kind of cultural site on public lands is not granted by this executive order. The policy of "multiple-use" guides government land use decisions. Transfer (i.e., restoration) of ownership of culturally significant places from public lands to tribes is difficult. Each tribe must marshal support and labor for years without the expectation of a successful transfer. The "government-to-government" relationship which is now evolving following President Clinton's order is more rhetorical than real, and can be trumped by another executive order.

Nevertheless, tribes are increasingly taking over resource planning from the BIA. An important example of this shifting of responsibility to tribes is in wood fiber production. I know a fair amount about the changes in tribal timber programs because I work sometimes in the recent field of certification of sustainably harvested timber ('green lumber").

Since around 1990, tribes that I've worked with (White Mountain and San Carlos Apache in Arizona, Warm Springs in Oregon, and Hoopa and Karuk in California) have scaled down their annual cut by decreasing the amount of clearcutting while incorporating principles of "ecosystem management" in their forest management programs. These as well as other tribes that I know about (around 25 tribes are now in process of becoming certified as sustainable forestry managers) are returning to a more traditional holistic approach to forestry.

Tribes now have the opportunity to maintain their own Environmental Protection Agency (EPA) offices on reservation lands, where tribes are protected under the same Clean Air and Clean Water Acts and Endangered Species Act (ESA) that protect the environments of non-Indians.

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Tribal EPA personnel participate actively with the federal EPA as well as with organizations like the State Association of Wetlands Managers, Intertribal Fish and Wildlife Commission, Columbia Intertribal Fish Commission, and interagency watershed/fisheries conservation and restoration teams. However, the ESA has been controversial in Indian country because it trumps the sovereign right of tribes to manage endangered species in their own way. An interesting conflict occurred at the Warm Springs Reservation when the culturally important, but unlisted, coho salmon were being preyed upon as young fry by the endangered bull trout.

The good news is that when "resources" are defined the way that the dominant culture defines them, naturally occurring materials that are economically useful, there are relatively few conflicts *as long as these resources are on designated Indian trust lands.* (Congressionally allotted reservation lands under Indian control).

> "Note: Most reservations are a checkerboard of at least four kinds of land tenure: collective tribal allotted trust lands or trust tenancy in common; individual Indian trout allotments; Indian fee simple ownership (non-trust properties); and non-Indian fee simple, or private ownership parcels. To date, Congress has not permitted Indian control of land-use by non-allotted, white-owned private holdings within reservation boundaries. These fee simple parcels were purchased from Indians and in some cases constitute the greater part of reservation lands; they can, like individual allotments, but not collective tribal allotments, be alienated (sold); and unlike Indian individual allotments, can be used as collateral for loans. The inability of Indians to mortgage their properties in order to procure funding for a business or agricultural enterprise has resulted in two unintended negative consequences: (1) non-Indian fee simple holders on reservations usually do far better in their business enterprises than Indians who can't get a business loan, and this contributes to the perpetuation of Indian poverty (unemployment on reservations typically ranges from 30% to 90%); (2) although it is legal for individual Indian allotees to sell their allotments, getting a consensus from all of the hundreds of heirs to the one parcel is usually impossible. (Allotments originally were 160 acres—regardless of the environmental circumstances—but most are much smaller or have been leased out to non-Indians, and cannot be realistically divided among several generations of heirs.)"

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Conflicts arise when the concept of "natural resources" is expanded to include spiritual or sacred, cultural, and historical resources, and tribes attempt to gain protection of these resources under federal or case law. Again, indigenous peoples do not see these resource categories as mutually exclusive. For example, a sacred site is more than a specific place where ceremonies are conducted or vision quests occur. It is seen as part of a greater landscape which is also sacred. It includes the route by which Native persons access the site, which may pass through private or public properties. While public land agencies follow a policy of equal access for all and multiple-use, Indians usually want exclusive and/or permanent use. Non-Indians often fail to understand that use of sacred sites is incompatible for Native peoples with logging or other kinds of economic activities which destroy the natural beauty of sacred places.

The 1978 American Indian Religious Freedom Act (AIRFA) is supposed to protect Indian religious freedom. But it is a law that was developed in an alien cultural context. AIRFA invokes a policy to protect and preserve freedom to believe in, express, and exercise religion, but lacks the capacity to protect sacred places. The environment is not perceived as something separate from people. In the dominant culture, a church or synagogue is a legitimate place of worship, not a mountaintop or rock outcropping. This derives from the Western separation of humans from nature. Belief is separated from practice. Multiple-use is founded on the Western ideology that rules must apply to everyone, since everyone in a modern democracy is regarded as interchangeable. Society is seen as a collection of individuals, not a coherent community as in the Native view. To date, American Indians have never won protection of a sacred site from the courts on the basis of First Amendment rights to religious freedom. To date, Congress has not enacted any comprehensive sacred lands protection statute, although specific legislation authorizes the temporary closure of sensitive areas to the public at large.

Finally, Indian historic and sacred places may be eligible for listing on the National Register of Historic Places and can be entered as traditional cultural properties (TCP) under the National Historic Preservation Act (NHPA). Government agencies under NHPA must consult with tribes (and Native Hawaiians) before developing plans for areas that embrace special sites. And, under the National Forest Management Act (NFMA), the Forest Service must also coordinate with tribes on future management plans. California's Native American Heritage Commission (NAHC) and Arizona's State Museum have been particularly successful in protecting sacred sites, but these are exceptionally empowered state agencies.

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Environmental Impact Statements (EIS) and sometimes Environmental Impact Reports (EIR's) are required by the National Environmental Policy Act (NEPA) to be conducted by any federal agency before project implementation if there are serious concerns about potential negative environmental effects. An Environmental Assessment (EA), without the necessity for surveys or public hearings, is generally adequate if there are no serious environmental concerns *by the agency*. In the past, tribes have raised serious concerns which were ignored by agencies, and which failed to require an EIS; tribes often had to go to court to be sure that an EIS was done. Cultural resources like artifacts, and especially burials (and the artifacts buried with the body), have received a measure of protection through the Native American Graves and Repatriation Act (NAGPRA) and the Archaeological Resources Protection Act (ARPA). States can enforce these acts through their state historic preservation officer (SHPO) if a tribe so desires.

Tribes are also permitted under NAGPRA to repatriate artifacts residing in museums, i.e., to return artifacts, and in some cases, bones to the tribe for proper disposal or burial. Unfortunately, most tribes lack the financial wherewithal to properly house repatriated objects. Still, a 1992 amendment to NHPA directs the National Park Service (NPS) at least to assist tribes in preserving and managing such resources and provides for grant monies through the Historic Preservation Fund (HPF). This program authorizes tribes to assume all or certain functions of a SHPO, and as of summer 1996 approximately a dozen tribes were also approved to assume a role equivalent to that of state governments. As for repatriation of Indian remains, tens of thousands of bones still reside in private and public collections and museums. The Smithsonian alone has 30,000 unrepatriated remains.

The problem with the Natural Historic Preservation Act (NHPA) and other laws addressing cultural or archaeological resource protection such as the acts which govern the U.S. Forest Service (USFS) and Bureau of Land Management (BLM) is *their failure to address the preservation of natural resources which are also cultural resources*. The stone mortars and pestles which ground seeds and acorns, for example, are legally protected, but the plants that produce the seeds and nuts are not. We have *environmental* impact statements but no *cultural* impact statements. Amending NHPA to include culturally important biological species could be a legal base for tribal co-management of ancestral lands ceded to and managed by public land agencies.

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Access to cultural plants is also problematic, even on public lands, and even if access is guaranteed by treaties. In practice, it all depends on the good will of a particular BLM Resource Manager or a USFS supervisor. Some tribes have signed Memoranda of Understanding (MOU's) and Memoranda of Agreement (MOA's) which permit traditional harvesting on agency lands within certain prescribed spatial and temporal limits. Too often, however, the sympathetic manager or supervisor is transferred after several years and the tribe is forced to begin the permitting process all over again.

An example close to home for me is the relationship between the Applegate Ranger District (Rogue River National Forest) in southwestern Oregon and the Takelma Intertribal Project (TIP) that I co-direct with Agnes Pilgrim of the Confederated Tribes of Siletz. We brought back the traditional Takelma Salmon Homecoming ceremony after an absence of over 150 years in 1994. We gather every June on USFS land to hold this ceremony. We received good support initially because we spent two years negotiating with the district staff. However, over the past 10 years, the original ranger was transferred with no permanent replacement and most of the original staff also left. We have had to restart the education process all over again several times. To date, nothing of significance has been committed to by the Rogue River National Forest although we have finally been allowed to gather without paying the usual $50 fee. From what I have seen and heard, this is a fairly typical state of affairs. Yes, there are now procedures in place to access traditional places on public lands, but they are too often trumped by the inability of agency culture to respond effectively to tribal requests.

Perhaps the feature of government institutional culture most egregious to American Indians historically has been its cavalier top-down style of tribal policy enforcement. Sovereignty is, and has always been, *the* central issue. Indigenous peoples have been known to even violate their own traditional environmental taboos and constraints when they have been treated disrespectfully and not as an equal. Two notable cases of this kind of treatment stand out. The first case is the Navajo's stock reduction program of the 1930's and 1940's when ninety percent of their sheep, cattle, and horses were slaughtered, and prairie dog colonies were eradicated by poison. The horses and prairie dogs were winter survival food, so resistance to the program was met by imprisonment and compliance by starvation. The program enacted by the Soil Conservation Service (SCS), has resulted in the permanent crippling of the Navajo economy. The second case is the unsuccessful attempt by SCS and BIA superintendent John Collier to do the same to the

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Tohono O'odham (Papago) reservation livestock herds at Sells, Arizona, in the 1930's. Erosion control and range restoration were, of course, legitimate national concerns during the drought years of the Depression. But the Papago and Navajo rightly demanded that *they*, not the U.S. government, deal with the problem in their own sovereign way.

In the heyday of the Progressive Era and the New Deal, and under the more "enlightened" leadership of John Collier of the BIA, project after project was thrown at Native American tribes. Flood control, irrigation and range improvements, water and soil conservation were just a few examples. Inevitably, most of these projects, even when embraced by the tribes, benefited non-Indians while Indian homelands were submerged by dams, reservation timberlands deforested, and vital wartime materials like uranium and helium conscripted without fair compensation, leaving the Indians with tragic environmental and health effects.

The Indian Reorganization Act (IRA) of 1934, still in force today, put tribal political control in the hands of tribal councils and thereby centralized political authority where it had been decentralized under the traditional political structure. The U.S. government could now more conveniently deal with a handful of politicians instead of going through the slow, deliberate, and often frustrating process of getting consensus among traditional elders who were scattered around the reservation. Traditionals actually refused to vote, so the IRA was ratified by only a small minority of "progressive" Indians who voted.

The IRA did, however, reverse the government policy of breaking up tribal communal lands established by the Allotment Act of 1887, also known as the Dawes Act. This legislation limited Indian allotments to 160 acres usually resulting in the break up of extended families, and the selling of "surplus" lands to white settlers. The IRA established a revolving fund for low interest loans to Indians who wanted to buy back land lost under the Dawes Act.

The intent of the Dawes Act was to break the back of Indian culture by breaking up their communal lands and thereby speed up the new national policy of assimilation. And it did just that. The IRA was too little, too late. Assimilation policy reappeared under Eisenhower and most tribes were terminated beginning in 1953. Oregon tribes were particularly hard hit (over 60 were terminated). The Klamath tribe, for example, lost 1.2 million acres to the Winema National Forest. Government policy changed again in the Nixon years and the process of legal restoration to government trust status began in the 1970's and continues to the present.

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The Bureau of Indian Affairs has lost credibility with most tribes. Under the BIA, Indian resources that were leased for royalties to mining and timber companies and to private non-Indian landowners have been squandered with minimal compensation. Ninety percent of the BIA budget has gone to maintaining the bureaucracy. And recently, when BLM computers were shut down for fear of someone being able to hack into Indian trust funds held by the Department of the Interior (which governs BLM), it was discovered the BIA owes American tribes *80 billion dollars* in lost revenues from leased resources (the U.S. claims that it is only around two billion in arrears). It is easy to see that tribes have few grounds for trust in the federal government.

States have taken on more legal responsibility for tribal governance in the last few decades in criminal jurisdiction, infrastructure maintenance, and casino regulation. However one feels morally about casinos, tribes that were terminated in the 1950's and legally restored to trust status beginning in the 1970's did not get their land back following federal restoration. Casinos are often the only economic base still available and provide monies with which to buy back lost lands. This has led to a situation where case law more than congressional legislation or statute is determining state and local Indian policies. For example, California treaties were never ratified by Congress and therefore, Indian law is a patchwork of conflicting laws and regulations.

Indian water law is perhaps the most complex in the entire field of jurisprudence because of conflicting state, federal, and municipal laws relating to water rights and usage in the water-scarce West. The Winters doctrine, established in 1908 by the Winters v. United States Supreme Court case recognized inherent water rights of tribes. The court determined that the U.S. pursued a policy of encouraging agriculture on allotted and tribal lands within a reservation, and that necessitated the protection of water rights to guarantee that public policy would be supported. Of course, inherent water rights or not, the historically heavy losses in water quantity to agriculture in the West has all but dried up rivers and streams in some parts of Indian country.

The heart of the problem in terms of access, equity, and sustainability for American Indian tribes continues to be the simple philosophical inability of the Western mind to think holistically, to link cultural with natural resources while considering the broader historical, spiritual, and ecological context. The situation is further exacerbated by the favoring of the property rights of

non-Indian land owners within reservation boundaries over the ability of tribes to exercise their sovereign right to regulate the reservation environment. Individual rights trump cultural group rights in liberal democracies.

This is an issue of environmental justice, the inequitable distribution of harms and benefits along lines of class and race. Environmental justice brings together two of the most powerful social movements of the late 20th and early 21st centuries: environmentalism and civil rights. Natural resource (cultural resource) equity issues, as distinct from environmental issues, are typically outside the scope of traditional environmental justice inquiries. Expanding the concept of environmental justice to include a broad range of natural resource issues and fusing the agendas of the environmental and civil rights movements are compelling, but problematic, goals. Environmental justice is rooted in claims of *cultural* rights that invoke corresponding obligations that can outweigh majority interests.

Three federal laws may offer a way to unite environmentalism with civil rights toward the goal of protecting cultural resources which are also natural resources: The National Environmental Policy Act (NEPA); Title VI of the 1964 Civil Rights Act; and the Environmental Protection Act (EPA). The federal government has recently played a valuable role in defining environmental justice. In 1994, Clinton's Executive Order 12898 declared that every federal agency should make "achieving environmental justice part of the mission by identifying and addressing… disproportionately high and adverse human health or environmental effects of its programs, policies, activities on minority populations and low-income populations." Minority rights and civil rights, in liberal democracies; are *individual* rights; left undone is the incorporation of group cultural rights into environmental justice law. This lack weakens tribal sovereignty when tribes are in direct conflict with a dominant nation state. "Minority" implies a majority reference point, while tribal sovereignty is a law unto itself.

A national task force was appointed to examine and recommend measures to be employed not only by EPA but also by a wide range of state and local agencies receiving federal funding and therefore are covered by Title VI of the Civil Rights Act. To date, EPA has continued to base its regulatory framework on the narrow traditional focus of environmental pollution. However, a few tribes have gone to court over environmental impacts of a given development project on tribal cultural *and* natural resources. For example, in *Mattaponi Indian Tribe v. Commonwealth of*

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Virginia, the Mattaponi tribe alleged violations of Title VI because a reservoir constructed by Virginia would flood the tribes' cultural and natural resources.

The Warm Springs Tribal Code, § 490. 010 [4] defines "cultural materials" to include "eagle feathers, fish, game, roots, berries, cedar bark, Indian medicines, and water having special significance." In the famous G-O Road case in northwestern California (*Lying v. Northwest Indian Cemetery Protective Association*), Indian plaintiffs argued that a particular section of Six Rivers National Forest was a cultural resource and that "disruption of the natural environment caused by the G-O road will diminish the sacredness of the area in question" and that "scarred hills and mountains and destroyed rocks destroy the purity of the sacred areas."

It is important to pause here and remind the reader that protection of natural resources under existing laws is spotty at best. The bedrock principle of natural resource management is "multiple use"; it is not *sustainable* use. The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, or better known as Superfund) makes provisions for natural resource damages. But claims under CERCLA can only be brought by state or federal trustees of these damaged resources, or by trustees of Indian tribes. Tribes or private entities cannot bring such claims. Cultural resources, on the other hand, have more protection at the federal, state, and tribal levels, but coverage is still uneven (e.g., protection of archaeological resources on private land is problematic). Even where statutory protection is provided at the local level, there are basically no procedures or mechanisms that facilitate enforcement while at the same time protect the location of the site or artifact from public knowledge. Sometimes *intent* to damage must be proven.

Title VI of the Civil Rights Code requires the plaintiff to prove *intent* in order to receive compensation. "*Impact"* can be used as a defense, but lacks specific definition in the civil rights context. EPA has favored a narrow interpretation of "impact," one equivalent to an environmental "stressor" that causes adverse health impacts on a human body such as a toxic substance. To creatively push the tight EPA envelope, one could argue that negative impacts to cultural or natural resources caused mental or emotional harm to a person. (i.e., a "stressor" under the EPA definition).

The Sandia Pueblo of New Mexico used Title VI in this broader sense to protect an important petroglyph site from a proposed highway by the city of Albuquerque through the center of the

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site, a National Monument. They filed a complaint with the Department of Transportation (DOT) and the Department of the Interior (DOI) under Title VI. It noted that construction and operation of the road as well as planned horse and bike trails would "disturb the sanctity of the Monument, which is essential to the Pueblos' practice of their religion; the Pueblos view the monument as a whole, not as a group of discrete cultural resources." The Title VI complaint has not yet led to major action by either DOI or DOT, but the tribe shifted the focus off environmental impact to one of discrimination.

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Frank K. Lake:

Sovereignty

"More than four hundred independent nations were prospering in what is now the United States when Europeans first arrived here….Each nation controlled its own territory and had its own government, culture, and language" (Pevar 1992:1, 2 The Rights of Indians and Tribes).

"The Doctrine of Tribal Sovereignty-Indian tribes are not foreign nations, but distinct political entities, governing themselves, and making treaties with the United States. Their relationship to the United States Government is that of domestic, dependent nations-the relationship is similar to that between wards and their guardians. Indian Nations had always been considered distinct, independent political communities, retaining their original natural rights, as the undisputed possessors of the soil…The very term 'nation' so generally applied to them as means 'people distinct from others'." John Marshall, 1832 Worcester v. Georgia 31US (6Pet.)515, 561.

Most tribal governments possess and exercise inherent self-government powers unless such powers have been extinguished. Tribal governments frequently have considerable powers that are separate and equal to those of state and local governments, particularly civil and criminal jurisdiction over individuals and corporations. The following are fundamental categories of tribal government power that have been recognized under federal law. These are the attributes of sovereignty:

- The power to establish a form of government
- The power to determine membership
- The power to legislate or otherwise adopt substantive civil and criminal laws
- The power to administer justice
- The power to exclude persons from the territory or reservation
- The power to charter business organizations
- The power of sovereign immunity

Treaty

"A treaty is a contract between sovereign nations. The Constitution authorizes the President, with the consent of two-thirds of the Senate, to enter into a treaty on behalf of the United

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States…Until 1871 treaties were the accepted method by which the United States conducted it relations with Indian tribes….In 1871 Congress passed a law that prohibited the making of treaties with Indians. This law (Title 25, United States Code, Section 71) declared that Indian tribes were not sovereign nations with whom the United States could make treaties. Since 1871 Congress has regulated Indian affairs through legislation, greatly preferring this approach because laws, unlike Indian treaties, do not need the consent of the Indians…Tribes were no longer considered sovereign nations by the federal government…If Congress, for example, wanted to take land from the Indians, all it had to do was pass a law to that effect"(Pevar 1992:37-39).

Tribes have a unique relationship with the federal government. Tribes and tribal members retain rights that are not afforded to other non-Indian U.S. citizens. The following example applies to tribes regarding conservation versus tribal livestock grazing on federal lands, such as national forests:

> "Give Indian Tribes fair and reasonable opportunity to enjoy any treaty grazing rights reserved to them by treaty on ceded lands. Grazing rights reserved by treaty are a continuing privilege beyond that enjoyed by other citizens. The Forest Service shall not deprive Indians of treaty rights; but the Regional Forester, acting on behalf of the Secretary of Agriculture, may regulate enjoyment of the treaty grazing right for the purpose of protecting and conserving Forest Service administered resources" (USFS 1997:45).

One of the most valuable natural resource commodities is water, and the rights to access and utilize water. In western North America water rights are reserved for American Indian tribes by the federal government with the Winters Doctrine. The Winter Doctrine was a Supreme Court case affirming that sufficient water be available for reservation use. Another case, *Arizona v. California*, the Supreme Court clarified the relationship between state and federal jurisdiction regarding Indian reserved water rights and reserved water rights for federal, non-Indian reserves such as national forests (AILTP 2000).

Other treaty examples from the Pacific Northwest related to natural resources involve hunting, fishing, and gathering. Many Indian tribes retain the right to hunt, fish and gather off their reservation lands in areas formally within their aboriginal territory. Generally, these rights were the result of the United States government reducing the size of the reservation and not removing

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the rights to maintain traditional practices on the land or waterways within their aboriginal territory, which are no longer included within the reservation boundaries. Congress has granted the continuance of such rights to the Indians. Some tribes retain the treaty rights to hunt and fish on unsettled federal lands where hunting or fishing would be otherwise prohibited or with restrictions by federal or state law to non-Indians. (Pevar 1992:197).

Many tribes can exercise the right to fish by any means or method "at all usual and accustomed grounds and stations" (Pevar 1992:198). Many of these tribally important fishing grounds and stations were not specifically identified in the treaties. This has caused significant problems as to the jurisdiction over such places. To prove the existence of a traditional fishing location, the tribe must show where its members fished generations ago. Proving historical use of fishing sites has been difficult for tribes in some circumstances. Other problems arise when states try to intervene on traditional fishing practices and harvest levels of fish. This issue has been bitterly contested and in the majority of the cases the federal government has supported the tribes. The only case in which a tribe may need to limit its fishing practices and harvest levels are in the conservation of the fish species or stock. Then, the tribes are supposed to be the least burden of conservation, when all other conservation measures have failed. This is not usually the case and because of the lack of knowledge about retained "usual and accustomed" practices of the tribes, state and special interest groups (e.g., commercial fishermen) have targeted limiting tribal rights.

Non-Indians usually oppose the designation of a location as a traditional Indian fishing ground or site if: 1. The land is privately owned and Indians retain the right to enter and cross private property to access the fishing ground. 2. The river bank is where the Indian fishing ground is located, then Indians retain the right to fish there without the consent of the private non-Indian landowner (Pevar 1992:1998).

In addition to the better-known hunting and fishing rights, tribes also retain gathering rights. Gathering rights usually apply to the collecting of plant-based resources, such as firewood, berries, medicinal plants, or poles for structures.

> "The traditional way of life for many American Indian and Alaskan Native Tribes involves the gathering and using products from their natural surroundings. In some treaties, these rights were included under the term 'gathering rights'. In negotiating treaty terms, many tribal governments reserved off-reservation rights to gather miscellaneous forest products

such as berries, roots, bark from trees, mushrooms, basket making materials, tepee poles, cedar for totem poles, and medicinal plants. These products were often bartered, traded, or sold between tribes for fuel, transportation, food, shelter, clothing, and cultural utilitarian items. In some western treaties tribes reserved the right to cut fuelwood, and firewood for domestic purposes on off-reservation land" (USFS 1997:46).

An important point that is not often mentioned in regards to hunting or gathering rights is the ability of tribes to exercise traditional practices such as burning that once were employed to drive game, or to rejuvenate berry patches, or clear meadows from the encroachment of young trees and shrubs that would obstruct "gathering" of traditional plant products used as food, medicines, and materials (Anderson 1993, Williams 2000). It may be that in the near future, tribes may try to legally challenge fire restrictions in order to reinstate such historical cultural burning practices as part of their natural resource management tools.

Tribes often feel that they should have equal decision-making power over the natural resources in their aboriginal territory, ceded lands, or "usual and accustomed" grounds. The U.S. government interprets their trust responsibility as one of higher authority than that of the tribe, hence the guardian and the ward relationship.

The United States with the management of national forests and parks has to consider a multitude of rights, in addition to Indian treaty rights. Conflicts are inherent between the different rights. Matters of Indian rights versus that of doctrine usually require mediation or legal council. Tribes strive to have more liberal interpretation of joint and co-management with the federal agencies, such as the USDA Forest Service and DOI Bureau of Land Management. "The tribes have interpreted joint or co-management to mean co-decision-making. Others interpret it to mean shared management in the sense of sharing information and ideas on management actions." (USFS 1997:58). The Forest Service has not accepted interpretations that limit their control of the final decision making.

Secretarial orders

One important legislative action that provided increased management responsibility with federal and state natural resource managers was Secretarial Order #3206, signed on June 5, 1997. Excerpts of language from this document are included under Sec. 5. Responsibilities: "To achieve the objectives of this Order, the heads of all agencies, bureaus and offices within the

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Department of the Interior, and the administrator of the National Oceanic and Atmospheric Administration (NOAA) within the Department of Commerce, shall be responsible for ensuring the following directives are followed:

> **Principle 1.** The Departments shall work directly with Indian tribes on a government-to-government basis to promote healthy ecosystems [and language contained within].
>
> **Principle 2.** The Departments shall recognize that Indian lands are not subject to the same controls as Federal public lands [and language contained within].
>
> **Principle 3.** The Departments shall assist Indian tribes in developing and expanding tribal programs so that healthy ecosystems are promoted and conservation restrictions are unnecessary.
>
> (A) The Departments shall take affirmative steps to assist Indian tribes in developing and expanding tribal programs that promote healthy ecosystems.
>
> (B) The Department shall recognize that Indian tribes are appropriate governmental entities to manage their own lands and tribal trust resources.
>
> (C) The Department, as trustees, shall support tribal measures that preclude the need for conservation restrictions [and language contained within].
>
> **Principle 4.** The Departments shall be sensitive to Indian culture, religion and spirituality [and language contained within].
>
> **Principle 5.** The Departments shall make available to Indian tribes information related to tribal trust resources and Indian lands, and, to facilitate the mutual exchange of information, shall, strive to protect sensitive tribal information from disclosure [and language contained within].

Responses to natural resource regulations

The Multiple Sustainable Use/Yield Act, and Organic Act are examples of tribal responses to regulations over tribal forestry management. Many tribal forest management plans follow federal examples, although several important differences arise. Most tribes have integrated resource management plans, under which their forest management plan is included. Tribes have to go through a lengthy and often heavily debated development period to construct the integrated resource management plans. Many of these plans include set aside areas of the tribal land base for exclusive cultural, spiritual or subsistence activities. These types of measures are not often found in similar management plans implemented by federal or state agencies and private landowners.

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What are some similarities and differences between historical and modern use and management of natural resources by tribes?

Dennis Martinez

Indian country today can be broadly characterized as a battleground between "progressives" who favor sometimes unrestrained and fast-track economic development and "traditionals" who want economic activities to be restrained and guided by traditional spiritual values. This is a kind of microcosm of battle lines drawn internationally between liberal free trade economics (i.e., globalization) and the indigenous defense of their traditional subsistence or quasi-subsistence ways of life and livelihoods. Indeed, it mirrors the economic conflicts between the poorer nations of the south and the richer nations of the north. Past and present similarities and differences need to be seen in the context of tribal adaptation to vastly changed and constantly changing economic, ecological, legal, and social conditions. At the same time tribes have been trying to maintain traditions which, because of these changes, may no longer be tied directly to a relationship to the lands from which they originally sprang.

In sum, many of the similarities between past and present are largely the result of the persistence and resilience of the traditionals in the face of government suppression of spiritual and cultural practices, use of native languages, and almost total disruption of traditional land tenure and resource management.

I will outline a brief history of how tribes have had to adapt to the natural resource management policies of intellectual imperialism by the dominant culture, while at the same time trying to resist total assimilation and loss of Indian culture and identity. [Frank has discussed some of the basic physical aspects (e.g., diet and subsistence activities) in his answer to this question; I will deal more with changes in tribal sovereignty and land tenure with respect to natural resource management, which is really a history of changing U.S. government Indian policies over time.]

Perhaps the greatest difference between the past and the present is the loss of sovereignty over ancestral lands. Related to that loss is the loss of the capacity for taking care of their lands in the old way, mostly with intentional burning and selective harvesting (agroecology). Some tribes, newly emerged from underneath BIA control since the 1980's and 1990's have begun to use prescription fire to manage cultural resources, such as their basketry and cordage plants. Indian

women have demonstrated considerable organizing skills by banding into associations such as the California Indian Basket Weavers Association to influence fire and herbicide policies of both their tribal governments and U.S. public lands agencies.

Another significant change is in land tenure including how responsibility toward specific places and resources is allocated within the tribe and how ownership of land parcels within reservation boundaries is organized. Communal lands for most tribes have been greatly reduced or lost since the General Allotment Act of 1887 and the selling of so-called "surplus lands" to non-Indians, resulting in a checkerboard pattern of ownership on most reservations. Tribal councils, established with the Indian Reorganization Act of 1934, have taken political and economic power away from local families and clans. Tribal societies that used to work in a decentralized way in consensus decision-making, now elect representatives who serve as the only decision-makers for the tribe (although many tribes refer at times to a council of elders or a culture committee or call a "general council" meeting (all tribal members vote)).

The legal restrictions on access to off-reservation ancestral lands and on the ability of tribes to manage resources sustainably, even on reservation lands, has contributed to the loss of traditional foods for many, and concomitant loss of health. The average Indian life expectancy is under 45 years. The health of the people was traditionally tied to the health of the land and land health was maintained by traditional cultural activities like intentional fire and selective harvesting of plants and animals. Government policies of assimilation have denied Indians access to most of their former resource base, and have made cultural land practices like fire illegal. Still, many traditionals in a number of tribal communities maintain some of these traditional practices where and when possible, sometimes suffering the legal consequences of maintaining their cultural identity.

Still persisting are important spiritual ceremonies, songs, dances, and stories. Many Indians still think of the earth as mother; believe that you shouldn't take more than you need and that wealth should be shared by all community members; believe in family and take special care of both young children and elders; care for the land which cares for them; respect as well as talk to ancestors; and plan for the future with the seventh generation in mind. There is a resurgence of interest in and respect for Indian languages, traditional crafts like basket weaving and plant medicines, and traditional foods, which the elders in particular still harvest, process, and cook.

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This cultural revival began in the 1970's and 1980's and shows promise of growing into the future. It is a strong testimony to the spirit and cultural resilience of Indian people. As I discuss elsewhere, people left to their own devices often manage to adapt to and even surmount adverse conditions. The government top-down approach to tribal governance has not only failed to support the cultural and spiritual survival of Native societies, but has put unnecessary obstacles in the way of survival.

The challenge for the future is the maintenance of this cultural and spiritual renaissance in a world where the economics of tribal reservations are forcing Indian youth to leave reservation communities and seek employment in alienating urban environments, causing a break in the traditional youth-elder relationship, and loss of Native languages and knowledge. Ways need to be found for tribes to develop natural resource dependent jobs that incorporate ecological and cultural ("eco-cultural") restoration as a guiding light and vision. Culture and land need to be reconnected for future generations to survive with dignity and identity intact.

This vision for the future will not be possible without a fundamental change in government Indian policy. As I argue in the following historical narrative, law and geography need to be brought together to strengthen Indian sovereignty. Sovereignty includes access to and protection of natural and cultural resources, equity in management opportunities on ancestral lands ceded to U.S. public lands agencies, and the ability to manage resources sustainability with traditional cultural methods. Indian societies are land-based societies. Healthy land means healthy people—spiritually and materially.

I discussed historical management of natural resources by Native peoples in my answer to Question 1 in a descriptive way to make a case for their inclusion in building a reference historical model for modern resource management, conservation, and restoration. Before going on to discuss modern tribal resource management, I will discuss some of the generic features of historical management. Of course, tribes vary a lot in some of their practices because each tribe has adapted its resource management and use to its own particular environment and environments vary widely in North America.

Still, there is much that tribes have in common, especially with respect to what Westerners would call "environmental ethics." While most Native persons are more or less dependent on the dominant market economy, many elders and even youth (who are learning the older ways) still

gather cultural plants and harvest game and fish in an environmentally sustainable way, as well as participate in Thanksgiving and World Renewal ceremonies and rituals. Many elders also prefer the traditional Indian diet of wild foods over denatured USDA commodities like white sugar, white flour, and lard which have resulted in rampant obesity, diabetes, and heart disease, and kept American Indian life expectancy at less than 45 years. BIA-managed tribal forestry practices have reduced dramatically the availability of wild foods and medicines. It is the burden of this section to show why market dependency has dominated tribal resource management and subsistence livelihoods based on non-timber forest products.

Anthropologists typically draw broad distinctions between "hunter-gatherers" and "agriculturists". In realty, there is no hard and fast line between the cultural divisions. The term "agroecology" may better capture the way most tribes blended their subsistence activities to optimize the use of their environments.

The use of an "Old World" standard is dubious since this assumes a kind of cultural evolution that follows the 19th century European belief that their civilization was the culmination of an inevitable and universal progression from primitive cultures through "barbarism" to "civilization". While few, if any, modern thinkers consciously believe in this older script, it is an unconscious assumption still informing our perceptions of non-industrial cultures.

Agroecology has various meanings and often connotes the modern industrial agricultural practice, especially in third world countries, of planting monocultures of a commercial plant species like eucalyptus, which are not connected ecologically to the surrounding environment. Such systems are not sustainable without external inputs. If we use the criterion of sustainability to judge the ultimate worth of any agro-ecological system, then we would have to say that most traditional indigenous systems are the standard, and not Old World modernized agriculture. Many Old World systems were indeed sustainable in the era before industrial agriculture; but their techniques and crops were still substantially different than Native New World agroecology.

Native agroecology was holistic, integrating wildland patch and agricultural field with game management of species such as elk, deer, bison. This was connected to the greater ecosystem of which they were part and which their cultural practices helped in some measure to sustain in a reciprocal relationship that was at once spiritual, economic, social, and ecological.

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Lacking both draft animals and the wheel, most tribes without a strong field agriculture (corn-squash-bean) economy used intentional fire in place of tillage for planting preparation and maintaining soil fertility. Those southwestern and eastern U.S. tribes whose economies included corn-squash-beans (using a digging stick for cultivation) also used fire in wildlands. Like the tribes that fit more of the hunter-gatherer stereotype, they harvested a wide variety of wild plants and animals. Hunter-gatherer women also used the digging stick to harvest underground edible corms, bulbs, and roots, which were also burned periodically. They sowed seeds and transplanted useful species. By selectively harvesting plants and animals, they modified their size, shape, palatability, harvestabiliy, and color, affecting, like Old World agriculture, the genetic material of species over time. New World agro-ecologists have given the world over 500 new foods. Native management affected the distribution and abundance of culturally favored species, creating and re-creating habitat and modifying vegetation structure and composition across the landscape.

The English term "management" as it is used in the context of natural resource management fails to capture the spiritual relationship between Native peoples and their environment. I prefer a word which elders often use: "care-giving". The elders say: "If you take care of the plants and animals, they will take care of you; if you don't use them, they will disappear." Reciprocity is probably the most salient feature of the indigenous relationship to nature. Traditional spirituality and holistic thinking about the environment is still alive and well among many traditional Native persons. The "environment" is not perceived as something objectified and separate from humans.

The resiliency of traditionals in the face of the unprecedented rate and magnitude of change in Indian Country is heartening. Considering the almost unbelievable complexity of the relationship of Indians to governmental jurisdictions and laws, the loss of most of their productive lands and sustainable cultural practices, and the nearly continuous government policy of cultural genocide and assimilation, this is indeed a testimony to the spirit of a people who simply want to be themselves and enjoy their own cultural uniqueness while maintaining a relationship with the dominant culture on their own terms - one that promotes their economic and political survival in a greatly changed lifescape.

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I will narrow the field of modern tribal resource management to two prominent and problematic recent historical developments: (1) tribal timber management policy; and (2) the response of tribes to the plethora of environmental protection laws of the last 60 years.

Tribal Responses to U.S. Environmental Protection Laws and Policies since the New Deal Era of the 1930's

The conservation movement began in the last decades of the 19th century. "Conservation" at that point in American history meant the wise use of resources like timber, water, and soils. It was strictly utilitarian in its scope. At the same time the U.S. government embarked on a resource management blunder when it attempted to "civilize" Indians; national assimilation took precedence over efforts to conserve resources for land utilization. The General Allotment Act of 1887 reduced and fragmented tribal land bases and associated resources. Indian timberlands were clearcut to make fields ready for farming. Poorly arable forest soils were exploited and arid grazing lands were plowed, exposing both habitats to the forces of soil erosion. The opening of reservations to non-Indian homesteaders, the so-called "surplus land" left over after individual and collective trust tribal allotments, reduced the availability of acreage for tribal use and displaced tribes from the best cultivable acreage. The ecology of Native lands changed in response to this kind of fragmentation, impacting traditional resources.

Prior to the General Allotment Act, most Indians had tried hard to adapt to the white way of land use. Receiving virtually no technical assistance from the government in farming or ranching methods, their traditional communal land tenure system enabled them to pool and effectively use resources. They relied on many informal rules that provided positive rewards and negative penalties for individuals who failed to conserve resources. This and the family or clan responsibility for their turf on communal lands prevented the "tragedy of the commons" which happens on unregulated communal lands. This productivity was a direct result of successful institutional innovation that started from the bottom up, utilizing traditional systems of resource ownership and land tenure.

Aboriginal land tenure was based on local people taking responsibility for the care of the resources they depended on for their survival. An individual, family, or clan would be responsible for their own "turf". Compared to tribal resource management today, it was a very decentralized governance arrangement structure. Since the institution of the Indian Reorganization Act of 1934, governance power for most, although not all, tribes has been vested in a centralized tribal

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(U.S.) or band (Canada) council which then delegates some measure of authority to natural resource committees. These tribal committees or agencies then manage tribal timber, fishing, hunting and other extractive activities such as mining and grazing. The advantage of the traditional land tenure system was that no locale in the larger ancestral territory was neglected and no resource was over-harvested. This prevented the so called "tragedy of the commons" where management responsibility was everyone's, and therefore, no one's concern.

When the bottom-up tribal decision-making was replaced with top-down institutional imperialism from Washington, reservations were left with a land tenure mosaic not conducive to sustainable agricultural productivity. By 1987, 47% of reservation acreage was in fee simple ownership (owned mostly by non-Indians) not subject to BIA tribal authority. The net result was that Indian trust lands were far less productive than fee simple land in and around reservations. Heirship restrictions mean that each allotment is inherited by a large number of individuals, each of whom has a share in land use decisions. Attempts by tribes to consolidate all trust allotments have been prevented by recent court decisions that have invalidated the Land Consolidation Act of 1983 by declaring it unconstitutional. Restrictions on alienation of trust allotments means that the land cannot be used for collateral for loans to improve farming and ranching operations. Parcel sizes are usually too small for efficient operations. Per-acre value of agricultural output on allotted trust lands is 90% lower than fee simple land and 30% to 40% lower on individual trust lands.

States had taken over the management of fish and game. Treaty-guaranteed rights to subsistence hunting by tribes were ignored in their zeal to police Indian hunters encouraged by the same white hunters who blamed wolves, cougars as well as Indians on "depredations" inflicted on deer and elk herds. Indian hunters traditionally went on communal hunts to bring back enough meat to feed a whole village. The number of animals taken, of course, exceeded the legal limit. Whites, who were not subsistence hunters like Indians, would frequently leave carcasses on the ground, taking only trophy antlers. Then they would blame the waste on the Indian hunters. The net effect of this kind of harassment was some very hungry winters for tribes. This conflict between Indian hunters and state game wardens continues unabated to the present time. Canneries were situated on rivers in the Pacific Northwest and fish were harvested day and night during the course of a run. Indians were no longer allowed to place weirs across rivers, their main fishing technique. Deliberate and intentional conservation practices were followed in the few weeks that

the weirs were in place; fish were allowed through every day for upstream tribes as well as to enable anadromous fish like salmon to reach their spawning areas. The canneries took entire runs that were scooped up in gigantic paddle-buckets.

The newly enacted federal agencies, Forest Service, National Park Services, and the Soil Erosion Service (later renamed the Soil Conservation Service and now known as the National Resource Conservation Service), had their own conservation agendas and were not responsive to tribal conservation needs. Those who invoked the early conservation ethic were different from those who espoused the cause of the Indian (well-intentioned whites who believed that assimilation, not conservation, would save Indians). Indians were not yet perceived as ecologists or conservationists. National Park policies embraced a "pristine" view of nature and promoted the view that Indians had not had in the past nor did they now have any conservation or resource management role in national parks.

The 1928 Merriam Report (*The Problem of Indian Administration*) urged reforms in Indian affairs. The study concluded that after tribal resources were reduced through land allotment, heirship land sales, and leasing, "the Indian Service has rendered much valuable service in conserving Indian property." But the damage to tribal resources had already been done. On the eve of the gigantic government conservation programs of the New Deal in the 1930's, tribes had lost so much that when asked to conserve (i.e., lose more resources in the name of conservation) their response was overwhelmingly negative.

New Deal conservation goals included soils, forests, rangelands, and wildlife. Following recommendations of the Merriam Report for more technically trained resource conservation specialists, small armies of technicians were dispatched to reservations to advise Indians on water conservation through improved irrigation systems, range improvement and soil conservation measures, and forest harvest and silvicultural techniques. The top-down government approach was considered an affront to Indian sovereignty and dignity, and was resisted wherever possible.

"Wilderness", a place unaffected by human culture, is a foreign concept to indigenous peoples who have learned to live within and with the natural world. However, for a nation barely recovering in the 1930's from resource exploitation without limits, and a national crisis in soil erosion and range degradation, the establishment of roadless wilderness preserves seemed like an idea whose time had come. As part of the role of trustee, Secretary of the Interior Harold Ickes

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issued a proclamation in 1936, which tribes could not review, creating roadless areas within reservations.

Wilderness advocates included Aldo Leopold, John Collier, the progressive new commissioner of Indian Affairs, and Bob Marshall, chief forester of the Indian Office. Collier was motivated by the desire to revitalize traditional culture, one of the objectives of the IRA. He associated "wilderness" with traditional culture. But, like the IRA, his own ideas of what Indians needed were not necessarily what Indians wanted. Still reeling from the loss of most of their resources as a consequence of well-meaning but misguided government policies of assimilation, the prospect of loss of even more resources, such as tribal timber programs in the name of a concept that they didn't even understand, was unacceptable.

Ironically, while Collier was linking traditional Indian culture with wilderness, the National Park Service was claiming that Indians did not belong in their wilderness parks. The New Ecology of the 1930's that so inspired Leopold and other advocates of wilderness preservation would become the scientific rationale for removing Indians from national parks and preventing co-management of their last homelands.

In October 1937, Ickes approved an administrative order from the Indian Office that established 12 "roadless" areas, each over 100,000 acres, and 4 smaller "wild" areas on undeveloped reservation lands. Marshall, the leading wilderness advocate in the United States, drafted the policy. It affected a dozen reservations and encompassed 4.8 million acres of Indian land. Included was the 125,000-acre Mission Range Roadless Area on the Flathead Reservation which comprised about 10% of the reservation's total area. The largest was Navajo's Rainbow Bridge Roadless Area, covering 1.6 million acres in both Arizona and Utah.

Conservation groups all over the U.S. expressed great satisfaction. But on the reservations, reviews of the new roadless and wild areas were not so enthusiastic. Tribal members were never asked if they wanted the kind of "privacy" their white advocates thought they needed or if they wanted the economic limitations that accompanied these road-building moratoriums. The response of one tribal leader from Warm Springs to the notion that Indians wanted privacy from whites was that it seemed more likely that whites wanted to get away from other whites.

Tribes with roadless designation had to appeal case by case to the Indian Office over the next 20

years. The Department of the Interior granted few requests for even minor improvements. But federal insistence on reservation wildness areas began to wane in the face of Indian resistance and because of changing attitudes toward wilderness by the Department of Interior. The first wilderness bill introduced to the U.S. Congress in 1958 included the existing Indian roadless areas if tribal governments "consented", but the final bill that became law in 1964 made no mention of Indian lands. Indian reservation lands were no longer part of the national blueprint "to secure for the American people of present and future generations the benefits of and enduring resource of wilderness."

The Interior's anti-wilderness stance in the 1950's and 1960's did not hurt the Indian cause. On October 10, 1959, the Mission Range Roadless Area ceased to exist. By 1962, only the Wind River Roadless Area on the Wind River Reservation in Wyoming remained intact, since the Shoshone and Arapahoe tribes did not request its elimination. It remains roadless to this day.

BIA foresters of the Flathead Reservation had entered the gentler slopes of the Mission Range Roadless Area in the 1960's and 1970's, removing 131 million board feet of timber between 1966 and 1976, putting $5.6 million into the tribal treasury. To entice loggers to tackle the higher cost of constructing roads into the higher elevations of the Mission Range, only to extract the lower-value alpine species, the reservation's forestry office prescribed clearcutting as the primary harvesting method for the area. But by 1971, tribal and non-tribal residents alike were beginning to question the wisdom of this kind of intensive logging. The beautiful Mission Mountains were being defaced.

Spearheaded by Thurman Trosper, a retired Salish Indian U.S.D.A. Forest Service forester, a movement within the tribe to preserve the Mission Range gathered steam. In November 1979, the tribal council approved a BIA-amended set of wilderness boundaries for the Mission Range. Logging would continue between 3,500 to 4,500 feet. But within the boundaries, timber harvest was banned, along with nearly all other developments. The annual allowable cut (AAC) would be reduced only 5% -3 million board feet compared to the reservation's total yield of 54.6 million board feet.

The BIA influence on timber harvesting of Flathead began to dissipate with the passage of the Indian Self-Determination Act of 1975. Today, federal money flows directly to the tribal government of the Flathead Reservation, funding tribally-run programs that are phasing out BIA

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operations. The 1982 management plan for the tribal wilderness states: " The needs and values of tribal members take precedence over those of non-tribal members. A common thread through all management considerations is the tribe's own cultural and spiritual ties to wilderness."

Bob Marshall's biographer, James Glover, noted: "The American people in general can afford much more easily than Indians to set aside wilderness." John Collier, in his idealistic but uninformed way, thought that wilderness would preserve culture. He apparently didn't think of the role economic opportunity would play in preserving culture. If there are few jobs in the reservation, what do young Indians do for work? They go where the work is, to large urban areas. The ties between the elders who are knowledgeable culture-holders and youth are broken. And as we see so clearly today, as tribes struggle with up to 90% unemployment, languages and culture are rapidly disappearing.

A new age of ecological consciousness began in the 1960's. The Environmental Protection Agency (EPA) was established. President Nixon encouraged tribal participation in resource issues in his 1970 Indian policy of self-determination. President Reagan's 1983 policy statement encouraged government-to-government relations. Many tribes successfully pursued litigation against the United States for mismanagement of tribal resources following the Menominee 1935 suit for improper handling of tribal stumpage. The Indian Claims Commission was set up in 1946 to compensate tribes for lands lost over the previous century although some tribes had been in litigation for over 40 years before their claims were processed. Some tribes received monetary resources that they used in their own resource planning process. To give one example among many, the Warm Springs tribes of Oregon contracted with Oregon State University to utilize claims award money to develop long-range environmental planning.

The advent of greater tribal resource and environmental planning accompanied the national policy of tribal self-determination. As a result, other agencies also cooperated with tribal governments. The Administration for Native Americans (ANA), an office in the Department of Health and Human Services, has independently funded various tribes for resource development and related environmental goals. Other important sources of Indian development and capacity-building funding include foundations like the First Nations Development Institute. EPA established an Office of Indian Affairs; now many tribes have their own EPA offices on their reservations. The Indian Environmental General Assistance Program Act of 1993 and the Indian

Environmental Enhancement Act of 1990 provide grants and technical assistance to tribes and intertribal consortia to develop the capacity to administer environmental regulatory programs delegated by the EPA. More recently, the Forest Service and the National Park Service created Indian affairs liaisons.

Despite the fact that co-management of public lands and common property resources are a reserved right implied in the wording of numerous treaties, public land agencies are not yet legally required to make tribes co-managers of off-reservation resources. The real issue today is the role of states in the enforcement of environmental regulations that encompass ceded land, water, and wildlife. States resist the argument that tribes continue to have treaty rights beyond reservation boundaries. However, as I pointed out earlier, EPA is preempting states in tribal environmental affairs.

Still, the 1986 *Survey of American Indian Environmental Protection Needs on Reservation Lands* mentions "poor water quality, inadequate solid waste management and disposal, sewage treatment". Tribal leaders added air quality management, erosion, and nuclear waste and radiation. In recent years, states and local governments have asserted authority over certain tribal land use zoning and environmental regulations. State laws govern most wildlife. Private in-holdings on reservation lands may be subject to county jurisdiction. Most law and order matters have been retained by state and local governments since the Civil and Criminal Jurisdiction Act of 1953 at the time of Termination.

Tribes have resisted the Endangered Species Act (ESA) in some cases over issues of sovereignty and resource development. I have already mentioned the case at Warm Springs where listed bull trout were preying on unlisted coho salmon fry. Yet, Yakima Forestry in Washington was protecting its spotted owl populations before ESA in 1973. Indian fishermen like Billy Frank, Jr. of the Nisqually tribe went to jail for exercising their treaty-guaranteed fishing rights. Years of activism finally led to the Boldt Decision, which allowed a 50% fish take in the Pacific North-west. The Columbia Intertribal Fish Commission has advocated for fisheries conservation in recent decades. The Yurok and Hoopa tribes have been plaintiffs for years in litigation to force San Joaquin Valley corporate farmers to give up part of their water allotment which comes from the Trinity River and which culturally important anadromous fish need to survive. Ninety percent of Trinity water went south until 2003, when it was reduced to around 50% by temporary order of the court. The Western Shoshone were able to successfully sue BLM in Nevada for

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tractor-chaining pinyon pines to increase range productivity for cattle lease allotments, thanks to a Ninth Circuit Court of Appeals decision in 1983 which declared that the tribe still held aboriginal title to the land. These are just a few recent examples of Indian commitment to natural resource conservation, which in the Native view were indistinguishable from cultural resources.

How have Indians and U.S. environmental advocacy organizations gotten along? In most cases, not very well. Western environmentalists generally perceive the environment, like the culture that they grow up in, as something separate from people. Most still think of North America as having been "pristine", with Native peoples "walking lightly on the land", passive like the natural world they inhabited.

Environmentalists have often joined forces with government agencies, especially the National Park Service, in opposing tribal development projects. In a much smaller number of cases, they have joined Indians in opposing environmentally harmful development. The Sierra Club, Friends of the Earth, and other groups joined the Klallem Indians of the Olympic Peninsula who were seeking the removal of Elwha Dam that had reduced their fisheries for decades. On the other hand, when the Havasupai sought an additional 185,000-acre land restoration in northern Arizona in the 1970's, the Sierra Club, Friends of the Earth, the Wilderness Society, and the National Parks and Conservation Association, among others, represented the opposition. Many environmentalists saw land transfers to the tribes as precedents for additional losses to parklands.

Alaskan Innuit leaders and environmentalists were allies in opposing the development of oil reserves on the North Slope of Alaska. But the Miccosukees of south Florida have sought to establish stronger water quality standards for the Everglades without support from politicians or environmentalists. The Forest Service and conservationists opposed returning Blue Lake on the Kit Carson National Forest in New Mexico to the Taos Pueblo. Environmentalists did not believe the Indians had the necessary experience to manage forest lands; the tribe held Blue Lake as sacred, the place where the people emerged from the underworld in their creation stories. Conservationists did support Indian rights to sacred ground within the Six Rivers National Forest in northern California, but in the name of wilderness protection.

While environmentalists frequently invoke the "noble savage" who "walked lightly on the land" as inspiration for their movement, few have a realistic sense of the Native relationship to the environment, now or in the past. Little support is given to the cultural survival of indigenous

peoples or their traditional ecological knowledge (TEK), because few understand the connection between cultural diversity and natural diversity. Most Native activists, while occasionally willing to join environmentalists in their cause, are deeply skeptical of their motives and agendas.

The reservation system, for all of its contradictions and difficulties, has been essential to the preservation of Indian culture. Any long-term preservation of tribal culture depends as much on the tribal conservation and management of trust lands and traditional aboriginal areas as it does on the foundation of law and justice. To date, the legal system has more often championed and supported Indian communities than it has Indian environmental management. The reservation system is both law and geography. The survival of Indian tribes is dependent on Indian Country as a durable place as well as institution in which to live and be Indian.

The environmental movement can no longer assume, like the general public, that the federal trustee has administered to *all* the basic needs of Indian residents on trust land and that conservation has been a working principle on reservations. The conservation and environmental movements have not benefited reservation residents.

The linkage of sustainable modern economics to careful stewardship of resources first captured international attention with the United Nations' Brundtland Commission report, *Our Common Future*, in the 1987. An essential part of sustainability is the engagement of the people of a place in determining how best to conserve and use resources. This demands new concepts of governance, new at least to the historically top-down structures of state and federal establishments. Actually, old ways of turf responsibility and decentralized governance need to be adopted to modern conditions.

Tribes need protection against states that would extend control into Indian country. They also need expertise that is neither too expensive nor too specialized for them to hire when dealing with other governments and with powerful economic interests. The role of a trustee for tribes would include firm legal protection for the integrity of the land base, including access to ceded lands for spiritual, subsistence, and cultural needs, and for the tribes' sovereign prerogatives and access to first-rate technical assistance.

In a modern democracy like the United States, minorities in a demographic sense can lose political power when their resources are leveraged against the will of the majority. This is why

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land tenure and jurisdiction go hand in hand. Establishing a clear line of jurisdiction better enables the principal stakeholder (regardless of size) to protect and manage their resources. Geography and law must be linked together for tribes to survive politically. For Native Americans, and for indigenous peoples everywhere, the survival of their ancestral place in the landscape is a precondition for both cultural survival and psychological identity.

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Frank K. Lake:

Natural resources as the supermarket, hardware store, pharmacy and church

Common stereotypes of American Indians by western society reflect very little how Indian peoples of the past up to the present utilized and managed natural resources. Some environmental activists and new-agers ascribe the portrayal of Native Americans as "children of Eden" or the "ecological noble savage". Native Americans in the past and the present utilize whatever available knowledge, skills, technology, materials, or resources were necessary to survive. Native Americans have been in many cases forcefully assimilated into western culture. Contemporary use and management of natural resources by tribes contain elements of historical practices, ceremonies or beliefs. Because of external forces from western society many tribes have not been able to completely retain their aboriginal land base, continuance of traditional environmental practices, or have not been granted or permitted access to natural resources. Native Americans continue to carry on, revive, and adopt new methods of harvesting, utilizing, and managing natural resources.

Anthropologists have studied tribal cultures through time and have developed methods of analysis that assist in the quantification of cultural traits, customs and practices. This is just one type of method employed to discern the degree of similarity and difference between historical and modern uses and management of natural resources by Native Americans. Most accounts or studies addressing this question developed from research conducted on ecological anthropology, cultural ecology, ethno-biology, and traditional ecological knowledge.

Seasonal life styles and environmental gradients

Studies on how hunting was conducted traditionally, pre-horse and post-horse, but before roads, by First Nations groups in interior British Columbia examined how they modified their social organization and subsistence activities (Alexander 1992). Traditionally, hunting parties of men would go deer hunting from spring through fall up in the mountains. Families would travel to particular mountain areas for gathering resources. Women would primarily dig and process bulbs, and the men would hunt and butcher deer. These practices have changed today. Women are less likely to harvest and process wild bulbs, and men hunt with friends or family. "Unlike salmon fishing, where task groups are usually based on the nuclear or extended family, hunting groups are based on a group of three to six men who know each other and are comfortable hunting

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together" (Tyhurst 1992:376-77).

Introduction of western materials has reduced reliance on natural products. For example, the introduction of iron and glass changed how tribes acquired and manufactured natural products for material cultural uses. Iron replaced bone and stone tools, which resulted in an increase in the knowledge and use of iron, but generally decreased the selective knowledge of stone and bone work of specific places or quarries, and bone structure of different animals. Glass and iron replaced obsidian or chert as arrow heads, knives, scrapers, and other tools.

Traditionally, many Native American nations, tribes, and groups had religious beliefs which revered and respected nature. When Christianity was introduced to Native Americans, often by force, many Indians changed their beliefs towards nature resulting in loss of natural resources as the sacred.

> "The arrival of the first colonists immediately pitched native peoples into a struggle that has not yet ended. They strive not only to preserve their land and resources, their biological well-being and material survival, but to control their own meaning and destiny. Nowhere is that destiny and meaning more clearly at stake than in depictions of Native American religions beliefs and practices. Each community transmits distinct traditions concerning the ancestors, spirits, and power active in its own physical landscape and social world. Through myth, art, and ceremonial life, native peoples created an authentic sense of themselves and remained agents of their own history…Even the widespread romantic notion that authentic ceremonial life long ago disappeared is an ignorant prejudice that has tried to play the role of a self-fulfilling prophecy. From first contact, invaders conjured up an image of the so-called Vanishing Indian, an image that conveniently justified the expropriation of land from peoples allegedly doomed to extinction and encouraged the disregard of ideas deemed unfit to survive in the modern world" (Sullivan 1989:ix).

People detached from any subsistence practices for survival can easily dismiss the belief that modern Native Americans can possess any "traditional" knowledge or practices if modern tools or weapons are used to harvest game or plant resource. Changes in technology do not confer changes in the conservation practices or spiritual beliefs of Native American towards their environment. For many of the tribes in California reliance upon acorns from several species of oaks constituted an important aspect of food necessary for survival. Many tribes continue to

practice "first fruits" or other similar ceremonies in honor of food resources. Each tribal group conducts the ceremony in their own way. Even though Native people have access to commercial grains, such as wheat, rice, and corn, it is important to pay respects to the acorn trees before harvesting, be there serious spiritual consequences on the individual, family or tribe (McCarthy 1993).

Fire: Culturally prescribed fire and government fire prevention policies

The first law in California by the Spanish was to outlaw Indian burning, the major tribal land management tool that influenced the quality of the environment (Timbrook et. al. 1993). Once California acquired statehood under the United States, the federal government enacted the Weeks Act of 1910, beginning active fire suppression (Pyne et. al. 1996). Some California Indians continued to practice cultural burning even though those fires were considered arson and could have resulted in imprisonment or being shot to death if an Indian was caught starting fires. Western societies ignorance and fear of fire as an important ecological process changed the composition, structure and function of ecosystems in North America, which limited the availability of fire-induced resources many tribal groups relied upon for survival (Ortiz 1993:209).

Cultural burning programs today

Most prescribed burning programs carried out today by American Indian tribes, do so with the intent of multiple objectives. Tribal forest programs on tribal lands or tribes working on federal and private lands in their aboriginal territory may carry out prescribed burns, for example, to reduce the threat of wildland fire to the Wildland-Urban-Interface (WUI's). This is accomplished by mechanically thinning fuels and vegetation around human dwellings, while also considering the enhancement of a currently rare habitat (Oak/Pine), improving wildlife habitat (elk/deer), and integrating cultural basketry management practices (hazel/redbud sprouts). This is being conducted with the Maidu, Hupa, Karuk, and Yurok tribes in Northwestern California.

Plant management and utilization

Reliance on plant materials for survival by many tribes is less today because of the availability of western manufactured goods. Fewer Native Americans harvest and manage plant resources for daily uses than they have historically. Generations of knowledge collected and developed over hundreds to thousands years began to erode with acculturation into western society.

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> "Practices of aboriginal peoples to maintain and enhance their lands, waters, and living resources are derived from generations of experimentation and observation, leading to an understanding of complex ecological and physical principles. In fact, aboriginal practices represent a dialectic relationship between those practices and people's belief system" (Turner et. al. 2000**:**1276-7).

The complexity of plant management and utilization by Native people naturally followed ecological scales. Individuals or groups of plant taxa were managed, tools such as fire influenced successional stages of forest development patches in mosaics having a landscape level effect. The same habitat or ecosystem may be visited for harvesting or management at different seasons and frequencies. "A host of strategies, including seasonal rounds leading to the variable harvesting regimes, conventions relating to ownership and authority over resources, and culturally mediated prescriptions for humans' relationship to plant and animals, influence landscape development" (Turner et. al. 2000:1276-7).

Forest management and use

Timber extraction methods and utilization are drastically different today than they were historically for many tribes. Historically, tree products such as split planks, poles, branches and bark were used for housing. Historical examples of timber utilization involved mostly canoes, structure materials, and food preservation (Bonnicksen 2000 and Suttles and Ames 1997). Today tree products are primarily in the form of sawn lumber, processed wood fiber, and poles that are utilized in housing. Tree logs today are primarily utilized for export off tribal lands for contemporary wood fiber uses nationally and internationally. Tribal members today are associated with timber extraction directly from jobs and per-capital payments (tribal type dividends).

Wildlife management and use

Historical harvesting of wildlife was dependent on the seasonality and age classes of prey. For example, individual head decoys were used for deer in the spring, while in fall deer were driven with the use of fire down hill sides which funneled deer down into large snares. Tribal community members were involved in the slaughter and harvesting of deer (Pullen 1996). Contemporary regulations off Indian reservations in those areas not included in "usual and accustomed lands," limit the season, number taken, and gender of deer hunted. On-reservation

hunting restrictions vary by tribe, and in the degree to which tribal game laws follow the western model.

Common ecological knowledge of the environmental conditions, habitat preferences, and life histories requirements of plants and animals has depreciated for many Native peoples. Changes in material culture and diet of many modern Native Americans to modern products and meats have reduced the frequency of interactions between natural environments and wild harvested animals and native peoples. Those "traditional meats" are generally now obtained from fewer individuals within Native American communities who have opportunities to hunt or fish.

Ceremonies using regalia made from wild harvested plants or animals has generally decreased among Native Americans. Historically, many different birds and animals parts would be used for making ceremonial regalia that individual or families would harvest from different species, in different habitats, at different times of the year. Now many Native people buy materials for regalia constructed from artificial, semi-natural, and to a lesser extent naturally harvested products from craft stores, "Native American-Mountain man traders" at pow-wows and other cultural events. For example, chemical-tanned rather than brain-tanned leather is often used to make traditional clothing or dances and ceremonies. Also, glass beads have replaced in many uses beads formerly made from bone, antler, shell, or nut.

Fisheries management and use

Harvesting of fish species at different seasons and age classes has probably changed little where opportunities for harvesting still exist. Historically, in the Pacific Northwest along the major rivers there were numerous runs of anadromous fish, namely Chinook salmon (spring, summer, fall), coho, steelhead (summer and winter), lamprey eels (late winter-early summer), smelt (eluchocen, surf, night), sturgeon, suckers, sculpins and other marine fish species that would enter estuaries. Each run or species of fish required a different type of gear to harvest as well as different locations and different flow or tidal regimes. Due to declines in fish species stocks, many tribal people today have only hatchery-supplemented runs of fish to harvest, namely salmon. (Tyhurst 1992:364).

Common knowledge, uses and understanding of the life history requirements for different fish species has depreciated. Reduction in the habitat quality, range, and population numbers of many fish species by industrial land management and commercial fisheries has led to reduced

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opportunities to harvest those fish species. Familiarity by Native peoples with riverine, estuarine, and marine environments under various seasons and conditions to pursue different fish species has also declined.

Ceremonies and taboos were historically used as conservation management tools. First-fish or First-salmon ceremonies and harvesting restrictions within and between tribes were developed for many fish species. These ceremonies were culturally instituted forms of conservation to maintain fish populations. These beliefs and ceremonies are practiced less today (Swezey and Heizer 1993).

Tribal fishery programs today follow similar western management models. Exceptions do arise though with the continuance of historical values which focus on key fish species and changes to aquatic environments. Many fisheries biologists and managers debate the appropriateness of management for icon species with the assumption that these are umbrellas for the rest. Historically, tribes did not have much direct control over flow conditions of major rivers and streams. Today, tribes have to work with other interests who manage in-stream flows and fish passage. Criteria developed for the commercially and recreationally important Chinook salmon may not account for flow conditions or passage requirements for lamprey eels (Close 2002). Tribal members continuing the harvesting and utilization of multiple fish species are more inclined to acknowledge flow conditions and habitat requirements for a healthier aquatic ecosystem.

Indigenous conservation practices, then and now

Generally, the strongest and most important attributes of knowledge, utilization, and management practices required to sustain habitat characteristics and populations of plants and animals have been retained by tribal practitioners. The following list of Indigenous conservation tenets and practices to conserve species are adapted from Anderson (1993:170):

1. The quality taken does not exceed the biological capacity of the plant or animal population to regenerate, reproduce or recover.
2. Hunting, harvesting, or gathering techniques sometimes mimic a parallel natural disturbance with which the plant or animal has coevolved, thus maintaining and sometimes enhancing plant production or animal fitness.
3. The harvesting tool is used in an appropriate manner to the resource. It does not deplete the plant or animal population of interest.

4. Horticultural and harvesting techniques are used to give plants and animals a competitive advantage during times of non-harvesting which can provide pathways for resources back into the ecosystem.
5. Often, plants are chosen that exhibit remarkable vegetative production, or animals with resilient qualities.
6. Management is frequently at a scale that maintains the integrity of the plant community, animal population, or key ecosystem properties and processes (fire).
7. Beliefs or other socio-cultural constraints are instituted to discourage depletion or over-exploitation and avoid waste thus, reinforcing conservation-minded behaviors.

Practical examples of sustainable human living practices in the utilization of natural resources

Forest management

Examples of sustainable forest management can be found with Native American forest management and timber harvesting associated with Forest Stewardship Council's Forest Certification. An example is the Menominee Forest Management Plan. The Menominee have a system of sustained-yield management. This is achieved through selective harvesting practices which were conceptualized by the Menominee leaders after the establishment of the reservation. "Their vision was a management process that would allow the forest to be harvested at a rate that would achieve a perennial balance between annual growth, natural mortality and the production of timber through select harvest" (Pecore 1992:13).

Another example is Northwest tribes' Forest Management Plans and Integrated Resource Management Plans. Sustainable timber harvesting is evaluated by principles and criteria related to economy, environment, and social issues requiring significant involvement from local communities and natural resource managers. Certification of timber and forest products provides incentives for tribes to uphold and continue sustainable land management practices. Certification can, and in most cases does, provide a better market price paid for the certified timber or forest products. In the eastern U.S. the Forest Stewardship Council has certified maple syrup produced by the tribes.

Wildlife management

James Bay Cree have developed a system of wildlife management that is different than western

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wildlife management practices. Based on the type of relationship that the Cree have with their environment they developed the practice of resting an area following heavy harvesting of beaver. The harvest-rest cycle keeps the particular area or ecosystem from reaching a "critical point at which food would be depleted and the balance will be lost. Thus, not only overuse can lead to a drop in productivity, but in the Cree worldview, so does under-use" (Berkes 1999:88). This harvesting system requires a significant amount of individual harvester restraint for the greater communal good. Because beavers are a keystone species affecting vegetation growth, hydrology, and aquatic habitat, it was necessary for the Cree to harvest at an appropriate scale of area so as to not affect other resources linked to the beaver.

Fisheries management

In northwestern California, Karuk tribal fishermen have special restrictions that protect summer steelhead integrated as part of the salmon ceremony. In May of each year the first or "spring" salmon ceremony, not only opens the fishery for tribal harvest of spring Chinook salmon, but also restricts the harvest of summer steelhead. This ceremony coincides with the changes in runs of steelhead from winter to summer runs. This "taboo" or restriction is followed by many Kaurk people until mid-September at which time the "World renewal" or "Pickyawish" ceremony lifts the restriction on steelhead. Although, ceremonially based, the belief and practice protect the more at-risks runs of summer steelhead during migration, a critical life history phase.

Plant management

An example is long-term harvesting of plant resources without depleting the populations.

> "Many Indians waited until after the camas plants dropped their seeds before digging up the bulbs. However, the Lummi Straits, Nooksack, and Nuuwhaha of the Pacific Northwest harvest camas while in seed, but they buried the broke seed stalks in the holes left after removing the bulbs. In addition, they usually took only the largest bulbs and left the smaller ones in the soil to grow. Using digging sticks also mimicked what gophers do when they dig with their claws, so it prepared the soil in a natural way that aided seed germination and replenished the plants" (Bonnicksen 2000:108-9).

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Question #5

What are the current conflicts within and among tribes regarding management practices today?

Dennis Martinez:

With the institution of the Indian Reorganization Act (IRA) in 1934 and the imposition of *non-traditional* governance through centralized tribal councils, the traditional decentralized governance structure was marginalized and weakened. The U.S. government wanted tribes to make spot decisions based on a simple majority in order to facilitate resource management and business decisions. The older, slower way of reaching consensus among elders representing families and clans scattered across reservation lands and beyond became the root source of Westerners' frustration with tradition and deliberation. It left the short-term impression that indigenous societies were unyielding in the face of modernization, when in fact they were fairly adaptive in the long-term. Modern colonial powers have all favored some kind of centralized governance because centralized governance is easy to access and control.

Certainly, in places like Indian reservations where poverty, social malaise, poor general health, and drug and alcohol addiction prevail, discontent and conflict run high. Where there are "haves" and "have-nots", competition by many for limited resources, employment, etc. is a daily fact of life, which is exacerbated by historic clan divisions—and in the many cases where several tribes, often historic enemies, are thrown together in one reservation—conflicts will occur and political "hardball" will be played. On most reservations, youth under 18 are in the majority. They have the highest suicide and homicide rate, and the lowest life expectancy of any ethnic group in the U.S. Youth are the miners' canaries in Indian Country, prime indicators of the failure of U.S. government assimilationist policies, and the legal obstacles to resource management.

While many tribes are now managing their natural resources more independently of BIA, and consequently in a more holistic way, the integration of traditional cultural or resource use with major extractive natural resource economic development is still problematic. Timber and mining, for example, do not double as traditional cultural resources. Small scale subsistence harvesting of non-timber products, which come from scattered patches in the forest understory, is a fundamentally different enterprise than large scale harvesting of over-story timber for the commercial market.

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The forest over-story removal has a greater ecological impact than understory plant harvesting since proper understory harvesting techniques can encourage more productive vegetative and seed or fruit response. The problem is how to harmonize or integrate traditional light touch, often historically fire-managed cultural gathering practices, with more impactful timber harvesting.

Most tribes have a natural resource oversight committee *and* a cultural resource committee. Both committees usually answer to the Tribal Council which has ultimate veto power. Communication is generally poor, and is a problem that I encounter frequently in the process of reviewing field assessments by sustainable forest certification organizations for tribal forest management operations. Tribal members are often in conflict over management policies of tribal councils. Since even tribes which are acting more independently of BIA management policies also collaborate with BIA staff when necessary, conflicts inevitably come up between the traditional BIA industrial approach and the lighter touch aspirations of the tribes. Some tribal members who work in forestry prefer the stability and additional benefits of BIA employment.

Another area of potential conflict is when two or more tribal natural resource programs have different management objectives in the same general area on the reservation. Grazing and forestry are typical examples. Conflicts can occur in the forest-meadow interface, in places where livestock cross through timberlands, and when stock congregate in riparian areas and pollute streams and rivers where water quality is the responsibility of tribal forestry.

The reader should note that, unlike typical resource conflicts between tribes and government land agencies, sacred sites, burials and archeological resources are rarely issues within the tribe. These sites are well-known and respected by tribal members. Cultural resources which are also natural resources are not so clearcut. Different tribal members (or different bands within the tribe, or different tribes) value plants and animals differently, while others are valued more universally. Different individuals may manage or harvest the same plant species and differently.

What these differences boil down to in terms of a general tribal resource management program is the inherent difficulty of managing, for example, a forest to provide both timber and non-timber cultural and subsistence opportunities to all tribal members. This is not that difficult technically. Variable density forest management, the designing of timber harvesting prescriptions in such a

way as to maximize diversity of vegetation structure and composition as well as variable light conditions while still providing wood fiber, can be done in most forest types. But getting people to agree on exactly how this should be done and how it will affect their patch (often kept secret) is another story.

There are also, what I would call, the "garden variety" kinds of conflicts that can also occur in non-Indian rural communities. Illegal trash dumping is a perennial problem on reservations. One important reason for this, besides lack of money to take garbage to a landfill many miles distant, is the unique way EPA handles tribal requests for technical and financial assistance to establish a landfill on reservation lands. EPA offers this kind of assistance only to incorporated municipalities. Tribes are legally allowed to open a dumpsite on reservation land, but they have to provide the money and technical expertise. The Kumyaay tribe (also called Diegueno) of eastern San Diego County, California, contracted with a landfill company anxious to break into the Western market to develop a site at their El Campo Reservation. They cut a very good deal, but opposition from the larger white community has been so strong that the tribe still has not been able to establish the landfill.

Relatively minor problems include timber theft, access to firewood, use of forest roads that are closed in the winter, wildlife poaching, and conflicts with tribal police. High police personnel turnover rates may indicate community dissatisfaction with tribal resource management policies.

As tribes began to take advantage in the 1970's of new opportunities, and governmental support networks for economic development, conflicts began to occur between progressives and traditionals over the ecological or spiritual appropriateness of these development goals. Crow and Navajo coal development, Mescalero Apache ski facilities and spent-uranium storage, Kumyaay landfill development, establishing casinos all over Indian County, Innuit industrial forestry methods in Alaska, for example, have produced fierce controversies on reservations. Pan-Indian NGOs like the Indigenous Environmental Network (IEN) have protested what they see as environmentally harmful development by both tribes and the U.S. government. Tribal lands have always been the first to be designated as "national sacrifice" lands, whether it was water impoundment which flooded rich agricultural bottomlands of numerous tribes in the northern plains or radioactive waste dumping at Yucca Mountain on Western Shoshone lands in Nevada. Government toxic waste dumping proposals are tempting to Indian communities with few

resources and little employment opportunity much like most rural non-Indian communities in the western U.S.

Intertribal conflicts also occasionally arise. Perhaps the best known case is the longstanding land dispute between Navajo and Hopi which resulted from the U.S. government imposed Hopi-Navajo Joint Use Area in Arizona. The government ordered the removal of Navajo from the Joint-Use Area and their relocation to the Flagstaff area near the Navajo Reservation. Navajo and intertribal activists and their non-Indian supporters struggled for years at Big Mountain to stop relocation, but by 2000, nearly all resident Navajo had left. Activists were probably correct when they blamed relocation on U.S. government and Arizona state interests in removing Navajo opposition to coal mining by Peabody Coal Company which was supported by both the Navajo and Hopi Tribal Councils but opposed by tribal members. This is a case where mining operations desecrated numerous burial sites and sacred places with total immunity. In particular places and times, raw economic power exercised through compliant government can still trump existing laws.

Sometimes, boundary disputes occur as in the case of the Yurok and Hoopa tribes of northwestern California. The Hoopa have the largest reservation in California, which includes rich timberlands. Downriver Yurok have significantly less land, but they control a mile-wide corridor on either side of the Klamath River. Beyond that are large holdings by the Simpson Lumber Company. The place where their corridor butts up against the upriver Hoopas was in dispute for years, but was recently resolved.

I'm not aware of many intertribal land disputes. But when they do occur, like the two cases above, it is usually resource-driven. Certainly, when foundation money is scarce, like at present, one would expect to see intense competition for limited funds. Tribes tend to be very independent-minded and try to rely on their own resources as much as possible. The other side of tribal independence is the difficulties tribes frequently have had in working together to achieve common goals.

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Frank K. Lake:

Conflicts within and between tribes over natural resource management today can be identified simplistically as those being traditionalists vs. progressives and individualistic vs. communal rights. Some aspects of these conflict dualities emerge from western societal influence, federal management regimes, and socio-economic interest. The most contentious natural resources issues with tribes today are with forestry, fire, wildlife, fisheries, water, and mineral extraction. Only a few of these topics will be discussed in any detail below.

Forestry

One of the most important differences to date that sets tribal resource management plans separate from state or private plans, is the integration of cultural and spiritual values into their land management plans. Most private land managers do not account sufficiently for non-timber forest species, let alone social belief systems that protect biodiversity. Examples of tribe's holistic sustainable management of natural resources are contained in the development of Forest Management Plans and Integrated Resource Management Plans. Although tribes incorporate a more holistic management process they are still a part of the modern economic world market. Questions are often raised as to what should be included in land base allocations. Tribes have included cultural use area, sacred sites, and often better protection for riparian areas, fish, water, and wildlife than private or federal land management policies.

Because of the low social-economic status of tribal communities, pressure to increase harvesting quotas versus the protection of natural resources is something that most tribes struggle to balance. One opportunity for tribes to find a middle ground is to pursue certification of their forest products, namely their timber. Forest certification, which is an outside independent review process of the tribe's land management/forestry program, can provide creditability to tribes for sustainable forest management. Certification can be one opportunity for tribes to bring traditional values and progressive economic marketing in line with each other. Many small private woodland owners are actively seeking forest certification, although they often do not account for the wide variety of issues that tribes inclusively do.

Issues arise with how the federal government desires to manage tribal forest resources versus that of the tribes.

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> "Much of North America's remaining forests are found on Native land, all of which appear to be up for grabs. Last summer, the Clinton administration announced a plan to provide federal assistance to bring to market backlogged timber sales from Indian reservations. Some Native activists have called this the Clinton administration's 'equal-opportunity logging policy.' Terry Virdon, Assistant Director of BIA Forestry, has remarked that 'the Clinton administration and federal government have always looked to tribal timber as 'their reserves.' They basically say, 'We'll carry on business as usual and have those [trees] for later....'" According to the BIA, U.S. Indian reservations contain an estimated 56 billion board feet of timber on some 15 million acres of Native forests and woodlands" (LaDuke 1994).

The National Indian Forest Resources Management Act (NIFRMA) requires the Secretary of the Interior to undertake management activities on Indian forestlands, in furtherance of the U.S. trust responsibility for these lands. These activities must incorporate the principles of sustained yield and multiple use, and include tribal participation. The purposes of this Act are to allow the Secretary of the Interior to participate in the management of Indian forest lands, increase the number of professional Indian foresters and related staff, and provide authorization of appropriations for the protection, conservation, utilization, management and enhancement of Indian forestlands.

Fire management

Fire management programs implemented by tribes or associated with tribal communities are incorporating social/cultural values into fuels reduction and prescribed burning projects, rather than relying upon a well-outfitted fire suppression system. Problems emerge for diverse values because funding is driven from fire suppression and not fire prevention. Prescribed burns are mostly supported by federal dollars. Western land management approaches to prescribed burning have not accounted for Native American perspectives related to fire use very well.

Many tribal fire management programs are closely aligned with forestry management practices. Traditional basket weavers and subsistence harvesters desire more frequent and widespread use of prescribed burning as a management practice. Some of these fires could potentially damage valuable timber resources, putting traditional practices at odds with economic potential that would benefit the whole tribal community. Historically, when more Native people practiced

subsistence methods at a widespread community level, individual values were more compatible with communal values. Industrial forestry practices on tribal lands are funded by federal dollars requiring the adherence to federal air quality standards. Tribal communities without a land base rely upon federal National forests. Burning at times of year when air quality is less degraded and fire escape potential is lowered, may not induce the desired burned response in the quality or character of the plant.

> "Where burn policies are established, they can be ineffective for weaving purposes. At times, burns are located in inaccessible areas difficult to find by map. Other times they aren't timed or located for optimal plant growth…The U.S. Forest Service, however, prefers to burn later in the year. While this stratifies local air quality control board standards for cool, slow burns with little impact upon on-the-ground vegetation, it leaves the weavers without a reliable supply of high quality materials" (Ortiz 1993)

When federal agencies or tribal forestry programs promise to burn for tribes or for tribal organizations like the basket weavers, and it does not happen, some tribal members take the initiative to go out and burn areas on their own. This type of unapproved or unauthorized cultural burning is legally arson and in the past many Native people have been charged with such crimes. Other times, some Native people will go out to set fires to create employment opportunities fighting fires. These types of arson fires can have variable environmental effects ranging from "good" low intensity fires to "bad" catastrophic large wildland fires that endanger property, life and degrade the quality of the environment.

Wildlife management and contemporary tribal uses

Big game hunting opportunities provide some revenue for tribes that allow non-tribal member hunting on their reservations. This has been an issue for some tribes in the Southwest, such as the Apaches who allow elk hunting by non-tribal members. Other perspectives arise concerning the human treatment of animals when wildlife damage other resources. In Northwestern California some Hoopa tribal members hold strong spiritual beliefs about killing bears. Each year black bears do a considerable amount of damage to conifer saplings planted to replace harvested trees. The majority of Hoopa Valley Indian Reservation tribal members have traditional values which do not believe in killing black bears, despite the loss of potential revenue in their future timber.

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Fisheries management and restoration

There can be considerable difference in tribal fishermen's support and harvest quota of fish species versus that of Tribal Fisheries departments' quotas and program objectives for managing fish stocks. Many tribal fisherman support hatchery supplementation of fish runs that can provide them with commercial fishing opportunities and subsistence. Current western science practices raise concerns over the genetic fitness of hatchery fish to that of wild fish. Most tribal fishermen support hatchery production and out-planting of fish in drainages where wild stocks are threatened. Examples can be found with the Columbia River Intertribal Fisheries Commission and federal regulatory agencies or with the Hoopa Indian Valley Reservation's fishery program and Bureau of Reclamation over watershed restoration funding.

Tribal Environmental Protection Agency (TEPA)

TEPA newsletters are produced by various tribes across the United States in reservation communities. One of the major problems facing reservations is management of solid waste and infrastructure to recycle products. Solid waste programs on reservations focus on eliminating illegal dumps and increasing recycling. It is difficult for many native communities to consolidate trash. Some theories have been put forward that the reason why Indians just throw their trash out the back door or over the road bank is that during historical times this was common practice. Discarding trash in this manner was not a problem until the introduction of metals, papers, plastic, and processed foods with preservatives that would not biological or chemically break down quickly.

Professional management positions versus technical work force

A limited number of tribal members professionally trained or educated stay on reservations and work for their own tribe or for other tribes. The problem arises from the lack of western educated and trained Native people who bring their skills and knowledge back to their local communities. It is often said that once an Indian gets the White man's education and the improvement in socio-economic status, the Indian will rarely come home. Some Native people would agree with that statement. What would your choice be for your family? Stay on the reservation and make half of what you could off the reservation, with lower quality of schools and limited health care facilities or leave? In an effort to recruit and maintain tribal members on the reservation work force, Indian preference is often given to tribal members over equally or minimally qualified persons of another race.

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Question #6

What are some differences between scientific and Native American ways of knowing or understanding of the environment:

Dennis Martinez

Human domination of nature has 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, *Discordant Harmonies: A New Ecology 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 (Democritean 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, the first U.S. Forest Service Chief, Euro-Americans 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 re-establish its natural harmony and balance or homeostasis. This concept still appears in university textbooks (e.g., the Lotka-Voltera predator-prey model and the Gaia Hypothesis).

The idea of a self-regulating, self-organizing, and autonomous system, one 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, for example, by industrial logging will re-establish equilibrium on their own and over-stocked timber stands will self-thin to ecologically optimum levels without the need for human intervention.

Western scientific methodology in ecology is based on quantitative analysis and experimental replicability with the goal of explaining and predicting natural phenomena. While some ecologists of late have rejected rigid mechanistic methodologies—indeed the prevailing ecological paradigm is in such a state of flux that it is difficult to adequately and completely categorize—I think that it is also true that the main thrust of the ecology of the last half century, under the influence of modern technologically sophisticated economies and the cyber revolution of the 1970s and 1980s, has been to reduce the complexities of natural systems to the simplified and abstract bio-economics of food chains, niches, productivity, yields, etc., and simplified ecosystem analyses and indicators like focal species and species absence/presence models. Generally speaking, modern ecology has been individualistic in its conception of plant-to-plant and animal-to-animal interactions and mechanistic in its explanation of plant community development—many denying the ecological realty of "community" and the social-cultural dimension of animals (although the new science of behavioral ecology is already confirming some indigenous understandings of animal social behavior).

The problem with reductionist methodology for our purposes here lies in its exclusion of factors thought to be external to any given experimental focus. There is always a tradeoff between information content and reliability. Replicable experimental tests are only reliable or rigidly

determinate when the scope of their questions has been greatly limited (Kraus, 1974; Ehrenfeld, 1978). Putting ecology on an exclusively quantifiable basis necessarily leaves out qualitative analyses like the part that human culture and history have played in the development of forest structure and composition. Anchoring reference ecosystems in real past time, at least as a beginning point in forest restoration analysis, could overcome the predictive limitations of Western reductionist methodologies. We are currently experiencing a gigantic and unprecedented experiment in secondary succession as a result of industrial forest practices, overgrazing, and fire suppression, the outcome of which is highly unpredictable even with the most sophisticated computer modeling.

But, over the past three or four decades a new competing ecological model has emerged which sees nature in a very different light. 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 to make timber management easier, and has yet to include humans as *significant* players in wildland ecosystem dynamics.

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, and resilience-enhancing mechanisms, seems akin to adaptive management.
>
> Many indigenous ecological views are in line with the shifting scientific view on the nature of ecosystems. 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, multi-equilibrium, and full of surprises, threshold effects, and system flips. Predictability and controllability

> are not limited by the scientific data available but by the very nature of ecological systems.
>
> 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."

How Western Ecologists and Tribal Resource Users Learn about Nature

Ecology as practiced today can be divided into two subfields: highly mathematical "*theoretical ecology*" and the more qualitative and historically-based "*descriptive ecology*". Theoretical ecologists over the last half-century have attempted to put their science on the same quantifiable basis as hard physical sciences (*New Ecology*). Theoretical ecology, including experimental lab work, is what most universities teach while descriptive field-based ecology is less valued professionally and therefore, relatively few students enter field ecology or what used to be called natural history.

Theoretical ecologists are interested in making accurate predictions about ecological phenomena. They, therefore, reduce natural complexities as much as possible to data sets that can be replicated experimentally to test hypotheses. However, as we have discussed above, there is always a trade-off between predictive reliability and information content. Replicable experimental tests are only reliable when the scope of their questions has been greatly limited. Therefore, theoretical ecologists' predictive capabilities are limited to either short intervals of space and time or very broad generalizations without much reliability.

Even when *field* ecologists do on-the-ground surveys to gather the raw data which will be plugged into the computer models of theoretical ecologists, they do their field research within the time constraints of the academic calendar year and the budget limitations and research priorities of foundations and universities. Frequently, graduate or post-doctoral students do the actual field research. They may be as competent as Native hunters or gatherers in their observational skills, but are not able to observe one particular place over long enough time to sufficiently understand it. They get a synchronic view of nature—a cross-section in time—as opposed to the long-term diachronic view of Native resource-users who live and whose ancestors have lived in one place for a very long time.

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In 1995 I was a member of the Karuk tribal team which wrote a "Tribal Module" for the Klamath National Forest Final Management Plan in the Klamath Mountains of northwestern California. Ecosystem management, I pointed out, is a concept that bridges well with the holistic thinking of tribes toward the environment. But, I also reasoned, ecosystem management requires detailed knowledge of local plants and animals:

> "Since Threatened Endangered and Sensitive (TE&S) plant field surveys are relatively recent and GIS aerial surveys lack sufficient resolution to pick-up these herbaceous communities; reasonably accurate prehistoric or early historic herbaceous plant information is presently almost entirely dependent on indigenous people who still carry with them the knowledge of what types of forest plants and materials their parents, grandparents, and great-grandparents harvested and utilized. Thus, there are a considerable number of fire-dependent cultural resources—especially herbaceous plant species used for food, medicine and fiber—that are practically un-inventoried by the U.S. Forest Service and whose past and present distribution along with probable future survival is virtually unknown. This is a problem which is recognized by other government agencies as well." (*Karuk Tribal Module For the Main Stem Salmon River Watershed Analysis: Scoping of Tribal Issues for Karuk Aboriginal Territory*, December 5, 1995, p. 21)

Many Karuk tribal members still hunt and gather in their ancestral lands currently under the management of the Klamath National Forest. They know the plants and animals because they depend on them for food, medicine, basketry materials, ceremonial items, and more. They grow up with intimate firsthand knowledge of their environment because their subsistence livelihoods depend on that kind of knowledge. Knowledge was tied to use in the most natural way in contrast to Western views. TEK is an integrated body of spiritual and practical knowledge that has evolved over vast stretches of time through the successful adaptation of an indigenous people to their particular ecosystem. TEK includes tribal myths and stories, which contain important ecological information encoded in deep metaphors, detailed plant and animal knowledge, tribal remembrances in the oral tradition of climatic and other significant environmental changes in ecosystems, specific management practices and techniques, and knowledge of agroecology, and spiritual/ceremonial knowledge and practices. This knowledge is highly unique and ecosystem-specific, and as the Lakota thinker Vine Deloria notes, "comprising a wide variety of events or activities that are species, location and time specific" (Deloria, 1992)

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In traditional environmental knowledge, everything in the ancestral landscape is viewed holistically, and is important culturally and spiritually. As David Suzuki writes, "traditional native knowledge about the natural world tends to view all…of nature…as inherently holy rather than profane, savage, wild, or wasteland. The landscape itself…is seen as sacred and quivering with life, rather than seen as mere property to be partitioned legally into commercial real estate holdings" (Suzuki and Knudson 1992)

Richard Hanes sums up the entire indigenous people-land relationship succinctly: "…traditional American Indian perceptions are that nature possesses a symbolic content far more significant than the more visible material content…Attachment to a traditional cosmological perspective is maintained that produces sacred emotional attachment to native plants and animals and to natural landforms. The belief that people are one of thousands of species in a single common universal cosmological system is basic and contrasts dramatically to a detached science perspective held by U.S. society in general" (Hanes 1995).

The perspective stands in strong contrast to the Western view, which sees in the land a configuration of "resources." "Resource" is a concept borrowed from Western environmental economics which is commodity-oriented as in the producer-consumer scenario of neoclassical economics. Under the Western view cultural, ecological, and spiritual concerns are considered mere "externalities". Resources are also raw materials from nature and now, as a result of the strong advocacy of environmental and tribal lawyers of the past 30 years, resources even refer to endangered species and indigenous cultural plants.

The commodity view of the land is one factor which underlies the dilemma affecting land management policies in the Pacific Northwest today. Because there is a strong tendency in Western thought to dichotomize reality into mutually exclusive categories, the current argument regarding land use is framed as follows: either we manage our forest anthropocentrically (i.e., as commodities for human benefit), or we manage them eco-centrically (i.e., for the maximum benefit of the [non-human] ecosystem). The cultural models in place do not show a way to harmonize human use with resource protection.

A solution to this problem is offered in the views of indigenous peoples. Indigenous peoples think "kincentrically" about nature: we are all related in the family of life. We all have shared ancestry and origins. No species of life is above another, but each has unique and important roles

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to play in nature. These ecological roles are all equally important. Plants and animals are co-creators with humans in the maintenance of ecosystem function and in spiritual ceremonies of world renewal. This is both a spiritual and a natural community. It includes human culture and spirituality. As Pueblo Indian educator Gregory Cajete has written, it is a "spiritual ecology" we are talking about. Culture is "for life's sake" for all members of the natural community (Cajete 1994).

Question #6

Frank K. Lake

Time of experience with the resource under variable conditions

Most natural resource professionals gain familiarity with the natural environment through limited childhood experiences such as camping, hiking, or hunting or fishing. This youth experience with the natural world is often an influencing factor in causing these individuals to choose a natural resource profession. Then, as adults, there is limited academic "field work" or "field sampling techniques" course, with work experience in the field. This may allow the natural resource professional to accumulate a personal and professional familiarity with the natural world. But how much of this youth and adult relationship with the environment takes place in a localized area under variable seasonal conditions? In contrast, many Native Americans are raised interacting with their local environment through subsistence and ceremonial activities. These include the inheritance of generations of community collective knowledge about the local environment, which is further strengthened by personal experiences and insights. Furthermore, very often the experience that a Native person has with the natural world is one of survival and not recreational. Indians don't just go camping for camping sake, they go out to the mountains for a purpose: hunting, gathering, religious, etc. It is often the familiarity with the river, mountainous area, and stretch of the coast since childhood that is the divergence in types of experience and knowledge between Native and non-Natives. "White kids go to the beach to with their family to build sand castles, Indian kids go with their families to get clams, mussels, surf fish, or sea weed".

Dependency and reliance on the environment for survival

Many Native Americans regard their local environment as the hardware store, pharmacy, super market, and church. Most Native peoples have unique dependency and reliance on the environment for survival, which reinforces the maintenance of Traditional Ecological Knowledge (TEK). Because of rural locations, fewer economic opportunities, and choices to stay connected to aboriginal territories, many Native peoples rely on the natural resources of their local environment for survival. In comparison, many research scientists or natural resource professionals have an occupational relationship with the environment. Dependency and reliance for a non-Native is occupational, and not specific to place. Employment promotion often entails moving from place to place, across bioregions and various environments.

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Mechanisms of acquiring knowledge

Discussed briefly above, scientists gain their "expert" knowledge through organized, structured experimental designs that assist them in deducting the potential mechanisms behind an environmental process or phenomenon. Certainty and confidence is developed out of replication (i.e., statistical strength) of experimental testing of the same or very similar ecological process. This scientific method in comparison to TEK differs in that the "replication" is gained from a lifetime accumulation of personal and communal experiences. For example, a fire ecologist might burn 20 different sites in one year having similar ecological conditions in a dispersed geographic region to gain both statistical strength, and credibility with the "scope of inference" in that the 20 sites are spread out. By contrast, the Native American basket weaver may burn the same or several adjacent sites once every 3-4 years over their life time, under various climatic and adjusted conditions that consider broader holistic objectives.

Acquisition of knowledge

The western scientist would have taken only general biology with several field trips during grades 1-12. In college, the student would select a "field" such as, botany, forestry, or fisheries, from which course work and limited employment would have focused both literature and hands-on experience. Then, at age 24-30 the scientist would pursue a "professional" degree and career track job. The foundation of education would have been primarily based on literature or electronic data, with limited experiential "field" work. In comparison, most Native people acquire their TEK through subsistence activities, where attention to detail is vital to survival and preservation of culture. Until recently, quality detailed TEK was not available in literature, sound recordings or video form.

Species and habitat relationship

Western scientists generally learn about species-habitat relationships through literature and course lectures, then later recognize the physical relationships in the field. In contrast, Native peoples generally have broader understandings and ascribe species habitat relationships in the context of subsistence or ceremonial activities. For example on the lower Klamath River in northwestern California near the mouth of the Salmon River, the western-trained scientist may think nothing of the relationship between the flowering dogwood tree, crickets, and lamprey eels. Yet, for the local Karuk fishermen the white flowering dogwood signifies the timing of the arrival of lamprey eels up the Klamath River, a good time to start using basket traps. When the crickets start to sing,

it has become warm enough and the river flow likely low enough that lamprey eels will be at the local falls and then can be gaffed. Also, lamprey eels are more likely to migrate in greater numbers on the darker cycle of the moon, at the end of the dogwood flowering, and when crickets are singing along the river bank near the falls. This multi-species approach to river habitat relationship is a much different way of understanding the timing of anadromous fish migration than offered by western science fisheries. For the fisheries scientist to miss the key sampling period would require an "adaptive management" approach and a try again next year. For the local Karuk fishermen to miss the key harvesting period would mean the loss of important dietary marine-derived omega-3 fatty acids, which are nutritionally significant to members of the community. For nearly every indigenous group in North America, there are similar stories of multi-species approaches to unique habitat relationships that are understood and time-tested by Native peoples. Yet, most of western science is still focused on single species or habitats.

Differences between TEK and Western Science (Berkes 1999**)**

This multi-species association observed and connected by Native Americans is based on species phenology, or their different life stages.

TEK	WESTERN SCIENCE
Holistic	Reductionist
An oral tradition	Transmitted through written word
Based on local place over a long period of time	Based on large area over a short time period
Spiritual components	Is "Value Free"
Data obtained from resource users who have direct experience with environment	Data obtained by special researchers with limited experience with the environment

Understanding species life histories under variable conditions

Western scientists often study a species at only specific periods of the species' life. Generally western science will know a great deal about the habitat requirements of a species at one phase, such as nesting, but poorly understand requirements for another phase, such as feeding. Some understanding of all aspects of a species' life history will likely be common with TEK. Western science, in its contemporary state, generally has a better understanding of global, hemispheric, regional, and watershed-level biogeochemical interactions. Western science, in many cases have

less of an understanding of watersheds, ecosystems, and habitat-level associations compared to indigenous groups still closely dependent and tied to their environment. Western science relies on "modeling" and studies done on "reference areas" as bases of describing relationships at or across various scales. Native American people utilizing TEK describe relationships at or across various scales mostly dependent upon personally-observed or community-supported observations. This approach can have its shortcomings, should observers misinterpret what they witnessed.

Biogeochemical cycles

Western science with modern instrumentation generally has a better understanding of biogeochemical cycling and the mechanisms associated with succession and nutrient limitations in various habitats where this has been studied in detail. (e.g., decomposition of wood, litter, and duff of forest floors). Yet, traditional ecological knowledge of forest floor structure, composition, and quality may be highly developed as a result of gathering and harvesting activities in a diversity of forest habitats. Often, native peoples will not fully understand the physical or chemical process of nutrient turnover or decomposition, but understand the stages and implication for forest resources.

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Question #7

Did low population densities affect the historical use and management of resources? How do current population stresses affect tribal use and management practices?

Dennis Martinez

The first question assumes that Indian populations were low. Of course, they were lower than present populations in most, but not all, places. I discussed actual population estimates of pre-contact Indians (up to 12-18 million in North America) in my answer to the first question. Indians tended to be more densely populated in the same places as present-day inhabitants—coastal areas (especially California, and the Pacific Northwest), valleys close enough to the coast to have relatively mild winters (e.g., California's Central Valley), the Northeast, the Mississippi River drainage, the Great Lakes region; and parts of the American Southwest (e.g., southern Arizona and the Rio Grande region of northern New Mexico). These were usually places where resources were plentiful and/or where a high degree of social and economic integration resulted from centralized religious-political institutions (e.g., Hahokam in southern Arizona and Mound builder culture in the Mississippi and Ohio River drainages).

Population control through abortion, infanticide, birth control using plant medicines or various taboos such as not having intercourse during 3 or 4 years of breastfeeding, was universally practiced until conversion to Christianity. It is unlikely that very many tribes, especially hunter-gathers in resource-poor regions, exceeded the carrying capacity of the land, either with population numbers or environmentally-damaging practices. When that did occur, as may have happened to the Anasassi of northern Arizona and New Mexico or the Aztecs and Mayans, it was usually brought about more by over-extension of social and political infrastructure, resulting in diminishing economic returns, than by poor resource conservation practices which exceeded the land's carrying capacity. Unusually long and severe droughts or cold periods probably were also a factor.

In other words, for the most part, tribes tended to keep their populations in balance with available resources through population control and conscious conservation of their resources. In the previous question I dealt with the spiritual basis for restraint in harvesting as fear of punishment by the animal spirits. Additionally, the positive roles played by power animals in the

well-being of the individual and community were probably of some importance. However, it is possible in any society with strong spiritual ways and taboos to also have the universal and innate human capacity for thinking beyond the present (i.e., planning sustainable resource use). But, as I also argued, indigenous conservation is different is some respects from the Western utilitarian conservation tradition—especially the tribal definition of "resources" as family relations. It may come as a surprise to Westerners that some modern tribal peoples (e.g., in parts of Asia, especially India) have extremely dense populations *and* manage not to decimate wildlife—even dangerous species like poisonous snakes and tigers—because of their spiritual beliefs. This is in spite of possessing the technology to exterminate these species. Once their traditional culture and spirituality is discredited, as in conversion to Islam or Christianity or secular assimilation, traditional taboos and restraints are also discredited, and resource exploitation may occur. Cultural and spiritual belief systems are a stronger focus for conservation than limited technology and low populations.

How do current population stresses affect tribal use and management practices?

As I pointed out earlier, outright loss of productive ancestral lands and resources outside the reservation and loss of control over non-trust allotted lands within the reservation coupled with population growth and the legal prohibition against transferring or consolidating individual trust allotments without consensus among hundreds of mostly off-reservation legal heirs, has thwarted economic development and resource management in Indian country. This in turn has led to high unemployment, the main driver of the current Indian diaspora. It really is less a question of population stresses and more of a problem of the contradictory laws, policies, and jurisdictions inherent in the current trust relationship between the government and the tribes as far as tribal land use and management practices are concerned and, of course, its effect on community social and psychological well-being.

Population growth on reservations has been accelerating in recent decades, but significant land acquisitions have not occurred over this same time period. Most existing reservation lands were places whites didn't want to settle because of poor potential for economic development (i.e., poor soils, steep ground, aridity, etc.) The best reservation lands historically have already been lost through government policies which favored white settlements and resource exploitation. We should keep in mind that the Termination policies of the 1950's saw tribe after tribe lose its federal trust status along with its trust lands. Since the 1970's, tribes have sought legal restoration

of their trust status, but few have been able to get their land back. Casinos have been the only way for newly restored tribes to raise enough money to buy their lands back.

Social Stresses

The distribution of Indian populations on reservations has also changed in recent years. In some communities, Housing and Urban Development Agency (HUD) housing has concentrated formerly scattered family places of residence. Because electricity and hot and cold running water is provided, relatives who still live in the outlying areas of the reservation tend to hang around the new HUD neighborhood, sometimes causing family stresses in these relatively small HUD homes. This new concentration of residents has other problems, such as youth gangs which have proliferated in these HUD ghettos. Drive through many reservation communities with high unemployment and you will see youth hanging out on every block. Approximately 65% of present reservation residents are 18 years of age or younger. TV watching occupies the time now of many tribal members living in HUD housing. Drinking and drugs have increased dramatically since the 1980's. Because of the strong spiritual attachment to the land that many Indians still possess, sometimes getting back in the "bush" is the only way to stay sober. Towns have historically been very corrupting environments for Indian people. These town types used to be called "hang around the fort" Indians.

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Frank K. Lake

It is important to debunk the myth that North America had relatively low population densities of Native people in 1500. Estimates of pre-1942 North American human populations range from approximately 2 million to 18 million (Bonnicksen et. al. 1999:441). The myth of "vacant" lands perceived by Europeans and other settlers in North America was the result of several factors. First, most Europeans were unable to recognize features of the forest and grassland environments as being influenced by tribal management (Anderson 1993). Secondly, due to the extensive trading network among and between tribal groups, when disease hit one group the epidemic quickly spread along trade routes killing between 60-95% of the population of indigenous people (Cook 1955, Boyd 1990). Lastly, foreign and later United States policy was drafted to give the appearance that ownership and tenure of land by indigenous people was obsolete. The concept embraced by most governments was "Manifest Destiny" and "Terra Nullus", in which lands were unoccupied, and therefore, open to settlement and claim.

Understanding how current population growth stresses and affects tribal use and management practices can best be accomplished by focusing on several case studies. In most cases the main issues today concern land or property values, water rights, fisheries, hunting, timber, waste disposal and pollution. Population stresses are direct and indirect. Direct factors are governmental policies and infringement upon native subsistence and commercial practices. Indirect factors are cause and effect events that impact Native peoples, such as hydropower development to meet societal energy needs, and impacts to tribal fisheries resources due to water withdrawal and aquatic habitat loss.

Debunking the myth of low aboriginal populations in North America

One example of pre-disease population levels and social organization was in the Mississippi and Ohio mound builder cultures, which had one of the largest cities ever constructed by North American Indians in AD 1100-1150.

> "The city of Cahokia sits at the confluence of the Mississippi and Missouri River in Illinois, across from present-day St. Louis…(it) covers a total of 13 square miles, but the city's influence on surrounding forest and prairies extended even further. The development consisted of immense agricultural fields, as well as 40 hamlets and farmsteads, 5 small towns, 4 large towns, and the central city. About 20,000 people lived

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there. The core of the city covered 2000 acres. It contained numerous mounds and plazas surrounded by rows of thatched-covered pole houses with small gardens scattered here and there" (Bonnicksen 2000:130**).**

The California province had the highest known densities of aboriginal populations. It was not until the arrival of Europeans in the late 1700's introducing deadly disease and warfare did aboriginal populations begin to drastically decline. "The native Californian population plunged from over three hundred thousand to about thirty thousand by 1860. This appalling rate of decline resulted from disease, cultural dislocation, dispossession, and, to a lesser extent, out right homicide" (Hurtado 1974:V). The rich environmental conditions and Mediterranean-type climate of the San Francisco Bay delta fostered cultural development and supported large densities of aboriginal people. "At the time of European contact in 1769, about two-dozen tribes, with an estimated population of at least fifteen thousand to twenty thousand people, inhabited the margins of the bay. By 1820, tribal culture had largely disintegrated, and rapid modification of the landscape followed" (Grossinger 2001:425-426).

Native people were well aware of their carrying capacity. It was often physical constraints like river terraces above flood level, slope aspect, and proximity to water that limited the demographics of settlements, coupled with biological limitations in those natural resources that could be managed, harvested and utilized to their fullest extent without depreciating the populations of species to the point of extinction that controlled Native populations. There are even cases beyond such physical and biological constraints where Native people practiced restraint in overpopulating a given area. In 1500, North America could have been close to full occupancy. In the rugged mountainous region of northern California, tribes controlled and respected each other's boundaries (Kroeber 1984). Population densities of Native people per square mile by tribal group were determined by life zone and bioregion-coastal to interior dependent upon the availability and productivity of food and material resources (Baumhoff 1963).

Native American population effects on wildlife

Large Native American populations as determinates of wildlife populations can be shown by the top-down predator theory applied to wildlife in many areas of North American. One example is the passenger pigeons that were in part so abundant due to the release of Native

American competition of food resources following European diseases upon the Indians.

> "Passenger pigeons (*Ectopistes migratorius*) were relatively rare in pre-European settlement time because human populations in the eastern United States were so extensive that native people consumed most of the seed and berries, collectively called mast, that the birds needed. It was not until after European diseases decimated native populations ca. 1550 that most of the mast crop became available for wildlife. This led to increased numbers of passenger pigeons, until by the 17th century, flocks darkened the sky" (Bonnicksen et. al. 1999:440-41).

Contemporary issues affecting tribal use and management practices

In today's world Native people have limited access to national parks and federal reserves that are in their aboriginal territory. Unlike other places in the world (e.g., Australia, Kakadu Nation Park), where aboriginal people have co-management opportunities and access to practice traditional customs, the United States national park system often tokenizes Native people by allowing them to sell crafts, conduct demonstrations and other cultural performances. Meanwhile, it is likely that some of the "natural" products that went into making those baskets, crafts, native dress/clothing were not legally harvested or acquired on the national park lands, and most likely were collected on adjacent federal or reservation lands.

Before tribes contested the trust responsibility of the U.S. government upholding its commitment of good faith, many tribes were not in the position politically, economically, or socially to advocate for their own well being. Until Public Law 280, and self-governance, many tribal administrative programs were run by the Bureau of Indian Affairs (AILTP 2000). Over-harvesting of natural resources that tribal communities rely upon as a main subsistence resource have been degraded by western industrial development. Examples include degraded fisheries caused by dams used for irrigation and hydropower development, and pollution from industrial and urban centers going into the atmosphere resulting in off-site acidification of lakes in the Northeast. Acidification affects aquatic environments, fisheries, and degrades culturally significant plants. and forest resources. Plant materials used for basketry or food can be in competition with the floral industry which has in many areas been over-harvesting ferns, bear grass, and tree branches. Commercial mushroom harvesting and berry picking on public lands, affects tribal use and gathering for subsistence and ceremonial purposes. Even though tribal

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members may have treaty rights to cross private land or have access to private lands does not ensure that private landowners openly welcome Indians to do so (Pevar 1992). Land ownership access and society's accurate understanding of Native people's reliance on natural resources has been corrupted by incomplete or inaccurate portrayal of Native peoples in the western education system. For modern society to achieve a sustainable relationship with local environments, there must be an increase in cultural and ecological literacy. A level of ecological literacy, somewhat comparable to contemporary Native Americans still utilizing TEK for subsistence activities is needed by the contemporary natural resource management. The proposed model integrates humans back into Nature in a manner that involves respect and reciprocity. Respect comes from understanding the implications of utilizing or managing natural resources. Reciprocity comes in the form of social reform where humanity is inclined to "give back" an investment of self to the local environment (Berkes, et. al. 2000).

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In what ways can tribal approaches to natural resource management be applied to the large landscapes, large populations, and large urban centers of our society today?

Dennis Martinez

As the population grows and resources shrink, industrial society is even more in need of a holistic resource management model, which integrates use with conservation and restoration. Our relatively scarce resources will disappear under economic and political pressures as the population grows. We will have to find ways to live sustainably with and within our wildlands. We need to start learning how to do that *now*, before further population growth makes it impossible to harmonize agriculture production with wildland conservation. Farming and wood fiber production systems will have to be reconnected with ecosystems. The indigenous principle is: every economic use should further conservation and restoration with monetary income as a by-product.

It is technically possible to manage our natural resources with present relatively high populations in a sustained way. Indigenous peoples globally have demonstrated that. But it will take an adaptation of the historic indigenous holistic model which integrates resource use with conservation and restoration and where economy follows ecology.

The dominant Western model was, until Aldo Leopold's land ethic, one of resource management and extraction at what managers calculated as the maximation production possible or "optimum sustainable harvest". Timber harvest was limited to no more than the annual incremental growth of forest trees, or the "annual allowable cut". This has resulted in the simplification and homogenization of naturally diverse forest ecosystems into tree farms. This U.S. Forest Service policy began in 1905 with "scientific forestry" introduced from European silvicultural systems by Gifford Pinchot, the first Forest Service chief. The policy has now taken a backseat to the Clinton-era policy of "ecosystem management" beginning in 1993.

Aldo Leopold's famous land ethic—that we are plain citizens in the land community and have associated ethical responsibilities—has informed and moved the conservation and environmental community for half a century, in opposition to the dominant extractive paradigm. Leopold, having written about his land ethic in *A Sand County Almanac* in 1949, intellectually straddled a

major paradigm shift in Western ecological science: the change from a view that saw nature as always tending toward balance and stability to today's dominant paradigm of dynamic disequilibrium and instability where disturbance is the main driver of seemingly chaotic ecosystem dynamics. It fits well with today's ecosystem management.

The current scientific view fits well with the Native world view of constant flux in nature. Tribes in western Washington, for example, refer to the Creator as Changer. It is no accident that numerous North American tribes call unpredictable and wiley animals like Coyote, Raven and Spider: Creator.

But when it came to the human-nature ethical relationship, Leopold left out the fundamental indigenous concepts of kincentricity and reciprocity. While Leopold went beyond anthropocentricism to embrace the currently popular biocentrism paradigm, he failed to tell us what kinds of ethical obligations were required of humans toward nature within the larger context of a family of sovereign species, a League of Nations composed of articulate and moral animals, a kincentric relationship of equality between all species, a nature articulate instead of mute, active instead of passive. Kincentricity is a spiritual and reciprocal relationship, a kind of compact or contract requiring humans to play a particular and unique role in nature, or suffer the consequences of a land ethic with spiritual teeth.

From a Native viewpoint, this kind of spiritually stable relationship made sense out of apparent ecological chaos, and was a moral force in indigenous conservation of their "natural resources" (i.e., relatives).

Will a kincentric land ethic work in today's non-Native, scientifically materialistic, Judeo-Christian world? The first step is for Western science to recognize the historical contributions of indigenous cultures to the health and integrity of the land. The second step is to incorporate indigenous cultural land practices in our "natural" reference ecological models for restoration. Third, while recognizing the fundamental importance of change in nature, we also need to acknowledge the importance of spatial and temporal scales in change—i.e., the kinds, intensities, extent, and rates of change of the pre-industrial landscape with which our ecosystems have co-evolved over the last few thousand years, and which include indigenous agroecology as "natural". Along this line of reasoning, environmental philosopher J. Baird Callicott changed Leopold's famous dictum—"A thing is right when it tends to preserve the integrity, stability, and beauty of

the biotic community. It is wrong when it tends otherwise."—to " A thing is right when it tends to disturb the biotic community only at normal spatial and temporal scales. It is wrong when it tends otherwise".

"Normal" spatial and temporal scales include Indian fire regimes and other cultural activities on the land that are intense enough and long enough to have changed the genetic structures of many culturally important plants and animals. Put another way, we are not doing good ecological science without including indigenous management activities in forest history. Leopold, like ecologists today, looked to *unmanaged* landscapes for a reference restoration model. Besides the fact that we have very few of these kinds of places left, this view completely ignores indigenous contributions to ecological health and integrity and Indians as a "natural" keystone species and top carnivore, affecting the distribution, abundance, size, color, and palatability of favored plant species.

What about the spiritual ethics of Native peoples? Leopold's ethical legacy includes, for some, the notion that the earth is a living organism and that "the individual is a member of a community of interdependent parts". So far, so good. But here indigenous spiritual ethics, unlike Leopold's, embrace human use of nature without violating its ethics, provided it is done in a respectful, restrained, and ecologically (culturally) appropriate way. Indeed, the observation of reciprocal obligations toward plants and animals as dictated by Natural Law enhances, not diminishes, the spiritual meaning of use since it honors the plant or animal which is used, and in the process strengthens the relationship between the human and non-human worlds.

Leopold wrote: "[land] health is the capacity of the land for self-renewal. Conservation is our effort to understand and preserve this capacity." If we are truly members of the land community, then we humans have a perpetual earthly responsibility to participate—through prayer, ceremony, and sustainable use and care-giving—in the renewal of the world and ourselves and thereby strengthen the resiliency of the earth, and find a balance—a Third Way—between unrestrained resource extraction and the passive biocentricity of preservationism without use.

What this adaptation of the Natural model of holistic resource management and use really means is learning how to become native to place. Environmentalists and scientists alike tend to believe that U.S. history began with European settlement, and that American Indian history is of small consequence today. We as a people need to acknowledge aboriginal history as a part of our own

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history and heritage. Indian people have made important contributions to Euro-American culture in politics (democracy), hygiene, foods (500 kinds of edible plants developed though centuries of careful selection of favored plant characteristics, including such important world foods as corn, potatoes, sweet potatoes, chilies, tomatoes, and more), sports, and techniques for managing our environment. Americans need to pick up the environmental banner dropped by Native Americans when they were prevented from taking care of their homelands and make connections with their past practices and ethical orientation. We need to support Indian reserved treaty rights and co-management of lands ceded to U.S. public lands agencies. In sum, we need to support the cultural survival of Native peoples so that their traditional ecological knowledge (TEK) can survive as living libraries residing in the hearts and minds of the First Americans.

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Frank Lake

There are several ways in which tribal approaches to natural resource management can be applied to larger landscapes, populations of humans, and urban centers today. For each approach it is important to choose a scale, ecological or social, for which certain tribal approaches will be most likely to have greater success. Lastly, it is important to keep in mind that western society and contemporary Indian people have some considerable differences in values, beliefs, practices, and direct reliance on natural resources. The tribal approaches appropriate for western society today within a given scale can be accomplished by examples of living in a sustainable manner, the restoration and maintenance of degraded natural areas, adopting Native American land use practices, and a fundamental shift in the ecological consciousness and values of the dominant western culture.

Living examples of sustainability

Americans will have to become better acquainted and increase their overall knowledge about natural resources. There is a very low level of ecological literacy among western society. Ecological literacy is defined as: The ability of an individual or community to observe, understand, and predict ecological consequences and phenomena. Social and educational systems need to foster activities and curriculum that assist the public in becoming a person of place (re-indigenization). It is very difficult for a community of people to learn how to be sustainable if 1) they do not know what "sustainable" is, and 2) there is no frame of reference or scale to assist them in defining their ecological or social community. Many tribal groups adapted to live within the constraints of climate, geography, and ecological conditions within a bioregion. Bioregion can generally be described as areas having similar climates, geologic landforms, vegetation or forest/ grassland types and ranges of animals. Bioregions in the western United States are the "Klamath-Siskiyou" bioregion of southwestern Oregon/northwestern California, the "Pacific Northwest" bioregion of extreme Northwest coastal California, western Oregon, western Washington, and western British Columbia, the "Plateau" of eastern Oregon, eastern Washington, Idaho, and western Montana. Many of the tribal groups who historically lived in these areas for thousands of years, and who continue to live in their aboriginal territory can offer appropriate examples of sustainable living. An individual or community must learn to live within the general constraints of their local environmental conditions. For example, many of the coastal and interior tribes living in the Pacific Northwest within the range of salmon, learned through time how to modify and

adopt practices that ensured the survival of the salmon and water quality and quantity for salmon habitat. Development and infrastructure needs to be done with a greater ecological consciousness of non-human species and geological processes. A set of values or beliefs that respect and have high regard for the environment at a level high enough to impose social constraints is needed. Central to living in a sustainable manner with a local place is to utilize material locally managed and harvested with minimal import of resources. And what resources that are imported are not done at the degradation of habitat or loss of ecological integrity from the place in which they came. For example, the bounty of salmon from the coastal bioregions could be traded for agricultural food resources grown in the interior continent bioregions utilizing transport systems not reliant on fossil fuels.

Restoration and maintenance of natural areas with limited human use

Restoration of local habitats requires adaptation of local societies to place and adoption of eco-friendly lifestyles. Western society will need to understand environmental management practices of indigenous people on physical and biological processes of local ecosystems to restore and conserve biodiversity. A starting point is some innovative landscape eco-friendly living systems developed from permiculture and adopting aspects of agro-forestry. The concept of zoning should be incorporated, where the furthest zone away from human settlement is similar to wilderness preservation, and the closest zone is human living quarters that incorporate natural features or habitat. Land use planning and development zoning would have to utilize designs and development practices suitable for the local environmental conditions. Community residential and business development would have to utilize landscaping and open space that could accommodate human and the environment. An approach that works with Nature and does not dominate or modify physical conditions too drastically would have to be adopted. Many cities and towns utilize parks, bike paths, and other features to promote more natural open space. The next step would be to have these same areas restored to promote more native species and ecological features supporting biodiversity balance with human occupancy.

Adapting Native American land use practices for larger landscape management

It will take local communities who collectively organize as grassroots efforts and are supported by innovative federal financial support to coordinate activities on federal lands and adjacent private lands. Community groups or organization such as Fire Safe Councils or Watershed Councils, as

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well as Tribes and private contractors may apply for stewardship contracting agreements with federal agencies such as the Bureau of Land Management and the U.S. Forest Service. One type of approach would be with fuels reduction and prescribed burning projects that re-introduce Indian-type fire practices and support restoration of cultural fire regimes when and where appropriate to meet social and ecological objectives. Social objectives to fuels reduction projects would include work in the Wildland Urban Interface (WUI) as defined by the National Fire Plan, and ecological objectives would include working in the WUI and forest or grasslands further from dwellings, towns, and cities to increase wildlife habitat or to restore habitat for fire dependent species.

Recent advocates of sustainable living, and or "place-based living" have incorporated Native American land use practices. Adoption of Native American horticultural and other natural resource management practices are found in agro-forestry and permiculture which integrate human living systems with the environment to maximize land coverage for multiple uses. Another example is the integration of modern energy conservation tools (e.g., solar, recycling) with historical traditional practices of native people that fit the local environmental conditions. Many of the Native American land use practices described previously and the information contained below with the text from presentations have practical applications for sustainable management of natural resources today. Sustainability will be more easily achieved when practiced at a practical social and ecological scale.

Question #9

What are the best and most appropriate ways to partner with local tribes? What ethical considerations may be necessary?

Dennis Martinez

Personal Approach

The short answer to the first question is: Respectfully. And if sensitive information is provided (e.g., sacred site locations), confidentially. It takes time for many Indians to develop trust in outsiders. Relationship is the motherground out of which information is shared. It is usually best to talk directly on the phone. Don't begin with an e-mail or letter. Keep trying even when you don't receive a call back but, don't be pushy. Be respectful. Be sure the tribal consultant is respected by the community. Be aware of community politics; talking to the "wrong" person initially may end any further contact with knowledgeable persons. If you are dealing with the tribe as a whole, go through proper political channels, even if it is a roundabout process. A good place to begin is with the heads of tribal natural resource committees. In time, a presentation before a tribal council may be necessary. Sometimes finding a consultant who has been off-reservation (e.g., university educated but who has respect from the community) can help break the ice. Be patient. Listen well. Come prepared and learn about the resource issues of the tribe before you arrive. Get a handle on the principal federal laws that affect the tribe.

Opportunities For Tribal Networking

There are several intertribal or tribally-oriented non-profit organizations in North America whose missions include legal issues (Native American Rights Fund); environmental justice issues like toxic waste dumping on reservations (Indigenous Environmental Network); ecological restoration (Indigenous Peoples' Restoration Network of the Society for Ecological Restoration International); advocacy for U.S. Native Americans (Congress of American Indians); international tribal issues (International Indian Treaty Council); funding for Indian tribes and non-profits (First Nations Development Institute, The Seventh Generation Fund); and others. These kinds of organizations tend to be experienced in cross-cultural dialogue and could serve as both a source of information about issues and a way to find and contact tribal persons of interest.

Other resources include Native American Studies programs in community colleges and universities, as well as any of over 30 tribal community colleges nationally. Especially

recommended is Navajo Community College, Chinle, Arizona, which can provide you with one of the best introductions to Indian culture, *The Sacred: Ways of Knowledge, Sources of Life*, by Peggy Beck, Anna Lee Walters, and Nia Francisco. The National Park Service, U.S. Forest Service, and BLM all have Native American staff persons who are knowledgeable about tribal issues of resource management and use on public lands.

There are a few non-Native environmental organizations that partner with some tribal groups in opposing destructive land practices (e.g., International Union for the Conservation of Nature, World Wildlife Fund, The Nature Conservancy, and Conservation International.) There are also groups of mixed indigenous and non-indigenous staffs who work solely with tribal cultural survival issues internationally (Survival International and Cultural Survival, U.S. and Canada.)

Ethics

Knowledge is property. Intellectual property rights are issues of major significance in the indigenous world as they are in the corporate business world. Although not everyone who shares TEK expects to be paid, it is something to be sensitive to and prepared for. How many university scholars or pharmaceutical companies have gone on to achieve fame or fortune from shared TEK without a dollar in compensation given back?

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Frank K. Lake

If local tribes are available it is important that the education system consider using them as a resource if and when possible. Generally, tribes have limited opportunities to influence curriculum related to natural resources issues. Educational programs related to natural resources should consider contacting tribes for potential collaborative projects. The best and most appropriate way to partner with local tribes is to contact their education or social services department, as well as try individual departments such as forestry, watershed restoration or fisheries. There are many aspects of cultural survival dependent upon sustainable use and management of natural resources.

Ethical considerations to keep in mind are that some tribes may not have the capacity to work with educational programs from schools despite the strong interest to do so. In many instances, tribal natural and cultural resource programs are overworked and under-funded to effectively implement and participate in all the projects they would desire to. Initiative and patience are required from the educators. Below is a list of suggested ways of appropriate conduct that should be respectfully considered.

Local tribes have a stake in local natural resource issues beyond the interest of many other stakeholders. It is important to recognize potential cooperative partnerships and co-management opportunities. This can result in the integration of culture and ecological health and economy issues.

There are appropriate ways to partner with tribes or tribal organizations:

- Research information on the tribal groups of interest. Become familiar with their issues related to natural resources, economic development, and health care.
- Contact by phone call or in person, followed up by a written statement of your interest to tribal councils, the tribal natural resource program director or department chairs of programs within natural resource departments.
- Follow up contacts with key Native individuals that seemed welcoming and interested in your project ideas or proposals.
- Disclose potential financial, time, and personnel requirements of the tribe or tribal programs and individuals.

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There are also ethical considerations that may be necessary for contacting and initiating working relationships with tribes. Ignorance of general local tribal issues and history is not acceptable. Learn about cultural differences and political issues between local tribes.

After introducing yourself and your interest in working with the tribe, ask them what similar needs or issues face them. Establish common ground. Demonstrate personal, not just professional interest in local tribal issues related to in diet from no longer consuming traditional foods and practicing traditional subsistence activities, that resulted from lack of access to productive and safe traditional foods and the ability to exercise traditional land use management techniques.

Do not assume that what western science or society decides are the priority or appropriate methods for natural resource management and/or ecosystem or species restoration, are the same for local tribes. Research tribal positions on natural resource issues. For example, in the Pacific Northwest the majority of tribes involved with salmon restoration are not against the use of hatcheries, and have less attention to issues related to genetic stocks. Within the tribal fisheries programs, western science-educated tribal biologists may subscribe to current scientific finding on the need to manage for local genetic stocks and genetic preservation while local tribal fisherman may not value or have little concern for genetic preservation over "fish" preservation which equates to maintenance of tribal fishing harvest opportunities, continuance fishing subsistence, trade, and commercial opportunities.

Do not assume that local tribes will fully agree on approaches to natural resource management. Try to become aware of intra-tribal and inter-tribal differences. Because of historically divergent cultural traits or experiences (languages, ceremonies, education experiences, etc.) two local tribes may have different perspectives on natural resource issues. Examples are the harvest quotas of fish species between upriver and downriver tribes and differences in the rates and amounts timber harvest on tribal lands or local federal lands between tribal council, tribal members, and tribal natural resource professionals.

Lastly, the most important thing to remember about trying to work with local tribes is that each is unique and will have their own set of issues. Learn as much as possible about the tribes, and approach them with an open mind. Strive to find common ground on education and natural

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resources issues. If your education program or project can be a service to the local tribe in any way, offer that opportunity early in the process of trying to establish relationship. It is important the tribes are respected as sovereign nations, and not tokenized.

Current Ideas on American Indian Natural Resource Use and Management

Introduction

In this section of the manual we will highlight some of the projects and work in which Dennis and Frank have been involved. Specific examples of some of the current ideas and practices regarding the use and management of natural resources from a tribal perspective are provided. Both students and teachers will benefit from this perspective and will allow for a broader understanding of human interaction with the environment.

If you have questions or would like more information, please feel free to contact either of the authors. In addition, they both have produced other works and papers that may be of interest to educators and their students.

Introduction to Holistic Restoration Forestry
by Dennis Martinez

The *Introduction to Holistic Restoration Forestry* is an attempt to develop a core curriculum resource for teaching restoration forestry to forest workers, wild crafters and cultural harvesters, restoration practitioners, agency and private forest managers, tribal foresters, environmental activists, and students in environmental studies. It is in outline form with each topic summarized or condensed in a running narrative. It could be called a "core outline summary". This summary is by no means complete. It does not deal with aquatic ecosystem restoration and considerable more research time is needed in at least two major areas: regional forest types and forest economics.

Native American burning is included in "ecosystem-based knowledge". Intentional fire, and the cultural landscapes that fire helped create and maintain, is not considered a special case here. Indigenous Traditional Ecological Knowledge (TEK) and forest management practices are treated the same as Western Ecological Science (WES). Both are necessary for successful restoration forestry. We simply don't know enough to somewhat arbitrarily exclude human cultural landscapes. They are legitimate reference ecosystems for restoration. An impressive amount of ethnographic research supports this assertion.

I have found it necessary to separate silvicultural techniques and timber harvesting systems from ecological restoration before reconnecting them in a new restoration framework. This is primarily because both industrial and its "light touch" counterpoint, such as individual tree selection cuts, are still more influenced by silviculture than ecological restoration. Silviculture is a tool, a means to restoration, not the end. Too often in restoration forestry, the means have become the ends. It is hoped by the author that a new, more holistic restoration framework will better address our present crisis in forest ecosystems. It just may be possible to restore our forests and our rural economies at the same time.

Introduction to Holistic Restoration Forestry

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Part I. Why We Need Forest Restoration: Assessment of Current Ecological Crisis

Defining Forest Health

Ecosystem scientists use several concepts to describe forest health. Among these are "integrity", "function", "resiliency", and "stability." *Integrity* is that which is whole or undiminished. That means that a healthy forest is one in which has all of its parts intact. "Parts" include forest structure, composition and ecological processes. *Structure* means the way in which aboveground living and dead biomass is configured or arranged in the landscape. Examples are age, size, and spacing of trees or shrubs; patches of herbaceous plants like ferns, grasses, and forbs; and down wood and snags. *Composition* means the above-ground kinds of plant species as well as mosses, lichens and liverworts, which make up the forest, and the kinds of animals (including insects), which live in the forest. It also includes the below-ground fungi and insects which decompose dead animals, litter drop, old plant parts, dead wood, etc., as well as kinds of rock and soil types. Ecological processes include all of the biogeochemical phenomena, which contribute to ecological *function*. These include fire, water quality and quantity, clean air, litter decomposition and nutrient cycling, genetic flow (exchange of genes between and within populations of a particular animal or plant species), drainage, and herbivory.

If enough of the key structures, composition, and processes are intact (i.e., the forest ecosystem has sufficient *biodiversity* to maintain its *integrity*) then we say that the forest functions well, possesses *resiliency*, and *relative stability*. Resiliency means that the forest has the capacity to resist normal disturbances like fire or insect and disease infestations (disturbances with which it is historically familiar) without losing its pre-disturbance function or stability; or, if these kinds of familiar disturbances are particularly intense, it can quickly recover to its pre-disturbance state. *Relative stability* is related to resiliency. It means that a forest ecosystem has enough resiliency to persist in its structure, composition, and processes which is its normal function over time. It does not mean that forests are static. Change is constantly occurring but it is happening at a rate which, barring the rare catastrophic disturbance, is fairly constant over time. We call this a "dynamic equilibrium".

The kinds of changes we are talking about are "familiar" to forest ecosystems. That means that forests have co-evolved with and adapted to certain disturbance thresholds like certain intensities, mean return intervals, and seasonality of fire. "Foreign" kinds of disturbances are those outside

of the historical range of variability. They are disturbances with which forests have had little evolutionary experience.

Why Our Forests Are Unhealthy

Loss of Resiliency and Evolutionary Adaptive Capacity

Forests today are experiencing disturbance events which are completely outside the historical range of variability. In other words, the rates and kinds of changes now happening exceed the adaptive capacity or resilience of forest ecosystems. Forest plants and animals evolve slowly. When change happens too rapidly, evolutionary adaptive opportunities are lost to those kinds of native plants and animals which prefer a relatively stable environment, while evolutionary opportunities are opened up for species which thrive in an unstable environment, such as opportunistic exotic (introduced) species or native generalist species. Generalist species are those which have a wide "ecological amplitude"; that is, they can establish themselves in a variety of forest habitats.

Loss of Beneficial Kinds of Forest Disturbances

1. Native American Burning

North American forests have adapted to human cultural practices as well as "natural" disturbances. In the Klamath-Siskiyou Ecoregion, southern Cascades, Coast Range, and northern Sierra Nevada of southern Oregon and northern California, Native Americans have been active forest managers for at least 12,000 years. Indigenous human cultures have been influenced by and have adapted to forest dynamics just as the forest has been influenced by and has adapted to human cultural activities. This is called human ecology. Human ecology overlaps with forest ecology.

What kinds of Native American cultural practices have influenced forest ecosystems? Tribal economies depended mainly on intentional or prescription fire. For example, in coastal California, 65% of Indian material culture was based on plants. Of that 65%, around 75% depended on plant species, which could not be used unless already burned. The burning stimulated new growth, which was more suited to cultural needs like epicormic sprouts and adventitious shoots. This was true of most of the Pacific Northwest.

Indians had to fire-manage a variety of cultural products (*culturally modified plants*):

baskets, cordage, clothing, structures, musical instruments, snares and traps, hunting and fishing gear, ceremonial items, firewood, games, weapons, tools and cooking implements, medicine, food, and wildlife habitat. To give you just one example of the enormous quantities of plants that needed to be burned on a regular rotational basis, one deer net 40 feet long took 7000 linear feet of cordage, which depended on 35,000 stalks of milkweed or dogbane, which had been burned the year before. Burning was done at all elevations and in all forest types. Fires were usually cool forest underburns usually done in the fall but sometimes in the spring. They burned mostly understory vegetation, litter, and tree seedlings or saplings without getting into the tree crowns and burning the entire forest.

But the burning was selective. Many places were left unburned for varying lengths of time. Some patches of cultural plants were burned every year, others every 2-20 years or more. Mountain ridges were kept relatively open with fire, with only a few scattered old growth trees. Open ridges served as fuel breaks, which prevented fires from moving from watershed to watershed. This pattern of Indian burning, along with natural lightning fires, helped maintain a very diverse kind of forest, with large and small sunny forest openings and meadows alternating with denser, shadier forest patches. Some forest types such as coastal Northwest Cedar/Hemlock or Redwood/Douglas-fir had relatively close tree spacing (*structure*) while others such as interior pine/oak and Douglas-fir had very open, park-like stands or even savanna structure. And, every several hundred years, particularly during prolonged droughts, the entire forest landscape burned to the ground such as the Oregon Coast Range in the mid-1800's and forest regeneration started all over again from ground zero. These kinds of fires are called "stand replacement" fires and are usually referred to as "catastrophic". Lightning fires were, of course, not dependable enough for managing, in particular places over a long time, the huge quantity of cultural plants and wildlife habitat that tribal economies depended upon. Tribal economies would have collapsed without regular and extensive prescription fire.

2. How Native American Fire Benefited Forests: In what ways did Indian fire-management benefit forest ecosystem function and resiliency?

Relative Stability:

The relatively open forest structure created and maintained by intentional, and sometimes lightning, fire helped stabilize the forest environment. Today's forests are increasingly

subject to catastrophic stand-replacing tires because trees grow very close together, smaller understory trees and brush called "ladder fuels" carry fires into the over-story that lead to "crown fires", and because too much down or dead wood and forest slash all contribute to a very high "fire hazard". Today's frequent stand-replacing fires, which are totally outside of the historical range of variability, are mostly the result of fire suppression. Modern industrial forestry, which we will see later has contributed the most to forest degradation, wanted to protect regeneration of commercially viable young trees, so Indians, along with ranchers, railroaders, and homesteaders, were forced to stop burning in the forest. Modern forestry could not have begun until Indian fires ceased.

Nutrient Cycling:

Fire contributed to optimum forest function. Nutrient cycling, the recycling of dead plant parts into fertilizer, takes place in several ways. When beetles invade trees they bring nitrogen-fixing bacteria with them. They take nitrogen, probably the most important fertilizer, out of the air and make it available to trees in the form of ammonia nitrogen. Insects, such as sow bugs, flat-headed wood borers, carpenter ants, and termites, along with bacteria decompose wood and release nutrients. Mychorrizal fungi help tree roots take up nutrients and water from the soil. Some species of fungi produce spores underground in fruiting bodies called "truffles". Some animals like the red tree vole and red-backed vole eat the truffles and inoculate soil, large down wood, and living tree roots with their droppings. Certain lichens and mosses, which grow on trees also contribute nutrients when they fall to the forest floor. And, of course, fire breaks down forest litter and needles into usable nutrients.

Most forest ecologists consider the above kinds of nutrient cycling to be the whole story. And they are important, especially in more closed forest types like coastal rainforests of the Pacific Northwest. But, in the historically more open forests of most interior regions because of Indian fire, other kinds of nutrient cycling occur. Perhaps the most important is the constant decomposition of herbaceous plant parts, especially roots. Grasses and forbs (flowering plants) which grew in the sunny openings created and maintained by regular intentional fires are now becoming scarce because fire suppression has led to tree encroachment into these opens and meadows which is rapidly shading these herbaceous plants out.

As dense stands of conifers replace the former abundant diversity of understory plants, only litter

and needles are found on the forest floor. Since conifer needles are saturated with chemicals used as a defense against insect defoliators, they decompose too slowly to be of much use for adequate nutrient cycling. Fire releases the nutrients in the needles as well as from other kinds of leaves rapidly, but without regular fire and/or sufficient herbaceous understory plants, the needle litter will slowly build up again. And nutrients, especially nitrogen, will stay locked up in the litter.

Hydrologic Function:

Another important function is the way water flows through forest ecosystems called hydrologic function. Indian fires thinned forest trees as well as understory brush. These tree and brush species all take up huge amounts of water in a process called "evapotranspiration". Water is pulled up to the leaves and released to the atmosphere. Little trees and brush today choke forest stands. Old trees suffer from competition by the younger trees. Consequently, many old trees die during droughts. Drought-stressed old growth is vulnerable to beetle infestations. Wood-boring beetles sense when a tree is in distress and send out "pheromones" (chemical messages) to other beetles to enter the targeted tree.

Indian fire kept older trees well-spaced while destroying much, but not all, tree and brush regeneration which now competes with the larger trees. Less water was lost to evapotranspiration, therefore more water was retained in the soil as ground water. An increase in groundwater kept springs, aquifers, and streams flowing well into the dry months. Many seasonal or "ephemeral" streams today used to flow all year long. More water quantity meant better quality habitat for aquatic species like salmon or trout. The water was also cooled as it flowed under-ground to the headwaters of streams, thus contributing to quality aquatic habitat as fish need cool water in the warm months. Water moved evenly and steadily through the system, and was released slowly into streams. The watershed acted like a giant sponge, absorbing and then releasing water slowly. Today, water is released too rapidly following heavy rains and causes flash floods. This is in part due to extensive soil compaction resulting from heavy logging equipment; partly due to abundant clearcuts in the snow belt where snow not intercepted by over-story trees piles up and then melts rapidly following heavy rains and partly due to the general imbalance in forest vegetation due to the cessation of Indian fires coupled with the degradation caused by industrial logging. These are examples of "foreign" disturbances with which the forest is not familiar.

Net primary productivity:

Net primary productivity measures the function of the whole forest ecosystem in terms of the total annual incremental growth of all plants. This should be distinguished from the annual incremental growth of commercially important tree species (timber productivity), which provides the silvicultural basis for so-called "sustainable" timber harvesting in which you cut no more each year than the new tree growth which is added each year. Net primary productivity measures the growth of all plant species not just trees. Good annual growth could mean good function. But this is not always the case. That is why we need to measure as many key functions as possible.

Fire suppression has encouraged more shade-tolerant tree species like grand fir, white fir, incense cedar, red cedar, and western hemlock to out-compete the more sun-loving and "intolerant" species like pines, oaks, and Douglas-fir. The shade-tolerant species can grow in the shade of the dominant intolerant species until they overtop and shade them out. Indian fires created a mosaic of diverse habitats, very shady to very sunny, across the landscape (*landscape heterogeneity*). Thus more kinds of species (*composition*) thrived in this more diverse kind of forest, a forest with numerous openings arid meadows of varying sizes and shapes (*structure*) as well as denser unburned places.

Secondary Productivity:

Secondary productivity measures the animal species, which are supported by forest plant species (*net primary productivity*) in their diversity (*species richness*) and their population levels. As we saw above, diverse forest habitat encourages species richness or diversity. Again, with the suppression of Indian fire management in order to save commercially important tree species for industrial logging, the forest lost a critical kind of familiar disturbance.

Why is animal species richness important to the function of forest ecosystems?

- We have already discussed the role of certain arboreal mammal species that spend at least part of their lives in trees, like red tree voles and red-backed voles in spreading fungal spores which inoculate tree root tips and thereby enhance the nutrient cycling function of the ecosystem. Lack of Indian forest underburning is leading to a lack of food sources for many arboreal mammals with some threatened with extinction.

- Insects and birds (as well as some mammal species) act as pollinators and seed-carriers

for numerous flowering plants. This contributes to genetic diversity and was the result of the widespread use of Indian fire. With the forest now closing up, sunny openings with flowering plant diversity are being lost.

- Herbivores like deer or rabbits can devastate forest vegetation unless kept in check by predators like cougars and wolves or coyotes. These predator species are called top carnivores. Large healthy populations of top carnivores prevent excessive grazing or browsing of forest plants, which preserves their roles in the ecosystem. One important role is herbivory which, in light to moderate amounts, assists in rejuvenating plant growth as well as stimulating optimum flower and seed production. Herbivory has an effect similar to cool forest understory burns on vegetation. Native Americans were key top predators along with wolves and cougars. Hunting served an important role in protecting native forest plants. We are now experiencing massive imbalances in predator-prey relationships. This is contributing to overgrazing and over-browsing of native vegetation. Many top predators are either extinct or threatened with extinction, including Native Americans.

- Several different animal species may perform the same function in the forest as shown by several insects and birds which may pollinate the same flowering plant. This is called *redundancy*. The more varied or diverse the forest habitat is and the more species there are that do similar ecological jobs the better the redundancy. Redundancy contributes to forest *resiliency*, because if one or two species are lost, there will still be others to take up the slack. Numerous species lack sufficient numbers to play an effective role in ecosystem redundancy because of lack of enough habitat diversity due to fire suppression.

Genetic Diversity:

Plants and animals adapt slowly over time to changes in their environment. If the rate of environmental change is familiar, species have time to adapt and evolve enough to keep pace with change. Therefore, those species that are better adapted will survive to reproduce. This is called natural selection. Natural selection is the principal mechanism of evolutionary development. Even subtle genetic differences in a diverse environment can confer a survival advantage on a population or species. That is why monocultures like plantations of the same

genetic population of a tree species are particularly susceptible to disease.

Habitat diversity coupled with environmental change, at a rate which does not exceed the historical range of variability, offers evolutionary opportunities for many forest species. But changes which are too rapid and/or of a foreign nature open up evolutionary opportunities for non- native and native weedy species which take hold and thrive in an unstable environment. That is why today weedy species are moving into excessively disturbed forest ecosystems and crowding out more stable or *conservative* species which are species that require specific and relatively stable ecological niches or habitats. The simplification and homogenization of forests (loss of diversity) as a result of plantation forestry and fire suppression bring evolution for conservative natives to a standstill. As a result, these species slowly drop out of the forest.

Scattered large clearcuts fragment the forest and separate populations of plants and animals. Species can no longer exchange genes between their scattered and separated populations. This lowers genetic diversity (*genetic fitness*) within each disjunct population. Species then exchange fewer genes including genes that have adaptive value resulting in inbreeding. Inbreeding causes physiological and behavioral problems, as well as lower survival and reproduction rates. Genetic variation enhances the ability of species to persist over evolutionary time even as their environment changes. Thus, habitat diversity leads to plant and animal richness, which can only thrive when we restore Indian patterns of burning.

As plant species slowly die out or become less abundant and poorly distributed across the landscape, pollinators also die out. An example is an insect that will visit flowers for nectar or pollen only to the point where enough individual plants in a population make it a "cost-effective" use of energy. When the plant population is too low, they will move on to another patch instead. The remaining plants in the patch will then go un-pollinated and die out. Pollinators too will eventually become extinct. That in turn will cause the loss of insect prey sources for birds and some mammals such as the northern flying squirrel and reptiles and amphibians, which will also experience survival difficulties. These prey-predator linkages are part of what ecologists call food chains or food webs. If they unravel too much, the whole ecosystem begins to lose integrity, which in turn causes loss of relative stability, function, and resiliency in an ever-descending spiral of degradation. At some point or threshold, damage is irreversible without the assistance of restoration.

The Western Concept of Nature and Its Role In Ecological Degradation

We have discussed ecological degradation caused by the cessation of Indian burning. We have shown that large-scale and intensive industrial timber harvesting could only begin to take its pervasive modern form with the stopping of Indian fires in order to save commercially important tree reproduction. We will now discuss the part played by western (European) philosophy of nature in the rise of and the justification for destructive industrial timber harvesting as well as the counter-industrial resource conservation and wilderness preservation movements of the past century.

We have said that the forest is constantly changing at a familiar rate, and that any disturbances or rate of change which is not familiar (outside the historical range of variability) can cause loss of resiliency such that the ecosystem is not able to recover to its pre-disturbance state.

European Christian philosophy has long held the view that God reveals Himself in nature. To know the universe is to know God. This has been a major driving force in the development of Western science, although the original motivation has been long forgotten. Sir Isaac Newton, the father of modern physics, believed that God made a perfectly balanced universe which, once created, would continue to function perfectly as long as it was not interfered with by anyone. God was like a master clock-maker in Newton's thinking, and nature was like a finely tuned clock, which needed no tinkering or repair. It was perfect just like God.

It is not surprising that in an industrial age a machine metaphor was used to describe nature. Nature, like a perfectly balanced machine, was capable of rebalancing herself if disturbed. Philosophers call this homeostasis. Homeostasis is based on the belief that nature operates like a machine. That belief has a religious or metaphysical basis. It is not the way that we now know nature to be ever changing and highly complex, yet vulnerable to damage and degradation caused by human cultural practices, which are ecologically inappropriate because they are foreign to the way forest ecosystems have evolved.

Modern cultural practices which are foreign to forest ecosystems include industrial exploitation and wilderness preservation. Putting "industrial" and "wilderness" together in the same philosophical stew may seem counter-intuitive to those of us who have grown up with the idea that they are opposites. But in fact the one is impossible without the other.

How is this so? Both embrace the traditional Western philosophical assumption that nature is static, and that if nature is disrupted by humans, she will balance herself like a machine without the need for human assistance or restoration. Gifford Pinchot, the father of modern "scientific" forestry, held that society could harvest timber indefinitely, because nature would rebalance herself as long as the annual cut didn't exceed the annual growth of trees ("*sustainable" forestry*). John Muir, the father of modern wilderness preservation, believed that as long as humans did not interfere in nature, she would continue to exist in an optimally functioning "pristine" state. Thus, if suppression of human ignited fires like Indian burning (but not "natural" lightning fires) which has now been in place for a century was practiced by industry to save trees or by advocates of wilderness preservation to preserve nature in a pristine condition, nature would continue to function optimally.

Since Indian fire was a familiar disturbance like lightning fires for forests, its suppression has in fact done the opposite. It has led to forest degradation, loss of resiliency, integrity, relative stability, and optimum function. So has large-scale timber harvesting. We will discuss the negative ecological consequences to forest ecosystems caused by the cultural belief in homeostasis in more detail, as well as how restoration forestry can assist in reversing forest degradation, in later sections.

Part II. The Role of Ecosystem-Based Knowledge in Addressing Forest Degradation

Native American Traditional Ecological Knowledge (TEK)

Indigenous peoples who have lived sustainably (in harmony with their environment) for long stretches of time in one place possess detailed knowledge of the ecosystems in which they live. This is called *Traditional Ecological Knowledge* (TEK). TEK is a belief-practice complex, which serves as a cultural guide on how to relate to the natural world. TEK includes detailed ecological knowledge of plants, animals, stars, etc. as well as tribal stories and spiritual knowledge. TEK is rapidly disappearing under the impact of global industrial culture, which is now threatening forest ecosystems as well as forest peoples and their languages, cultures, and knowledge. Unlike much of western scientific knowledge, which resides in written form in libraries, TEK is an oral knowledge system, which lives in the minds and hearts of living indigenous elders. Preserving TEK therefore requires the preservation of indigenous societies.

Like modern Western ecosystem science, which has become aware only very recently of the dynamic and changeable nature of forest ecosystems, native peoples understood and continually adapted to change. TEK accumulated knowledge regarding ecological changes over time, remembering even great global floods and giant beavers. Unlike western science, however, TEK was based on long-term observations of nature in one place.

Native American TEK in northern California and southern Oregon is badly fragmented because native societies have been badly fragmented, especially in southern Oregon. But much is still retrievable from cultural work done by anthropologists decades ago (*ethnography*) and which can be found in libraries and university archives. Assembling this knowledge from ethnographic accounts as well as from current ecological research by forest sciences who study forest history can contribute to our knowledge of historical forest structure and composition.

Western Ecosystem Science

Descriptive Ecology

The past 30 or so years of scientific research on forest ecosystem dynamics has led to a more complete understanding of how whole ecosystems function (*descriptive ecology*) and how they are connected with the greater landscape (*landscape ecology*). It is now recognized that ecosystems are far from static. While homeostasis continues to have a measure of influence as in the predator-prey balances and climax forest succession, it is now generally recognized that ecosystems change continually. *Dynamic equilibrium* is a more accurate description than homeostasis. Ecologists also know that foreign disturbances, which are outside of the historical range of variability of forest ecosystems, can diminish ecological integrity, relative stability, resiliency, and function.

But descriptive ecology has yet to seriously challenge the old western cultural belief that ecosystems function best when undisturbed by humans. Thus, the kind of structure and composition of historical Indian fire-managed forest ecosystems (*cultural landscapes*) is still not recognized as a legitimate ecological baseline (*reference ecosystem*) for conservation and restoration. Ecologists tend to study what is here now more than what used to be here. They take the present forest mostly industrially driven secondary succession (second-growth forest following logging or fire) as a given. Although the field of historical ecology is beginning to come into its own, it is

still too young to have been incorporated into most ecological descriptions of forests.

Landscape Ecology

A landscape is defined by Forman and Godron in their 1986 book, *Landscape Ecology,* as a "heterogeneous land area composed of a cluster of interacting systems that is repeated in similar form throughout." According to Diaz and Apostle in *Forest Landscape Analysis and Design*, landscapes include "areas drained by major streams, within which climatic regime, geomorphic processes and natural vegetation patterns are fairly uniform. A landscape is larger than a stand and smaller than a region, and thus can vary greatly in size." In the geographical area covered by this manual (southern Oregon and northern California), roughly four regional forested landscapes occur: (1) Klamath-Siskiyou Mountains, (2) Southern Cascade Mountains, (3) Northern Sierra Nevada Mountains, and (4) Coast Ranges.

Landscapes have three kinds of basic structures or "elements": *matrix*, *corridors*, and *patches*. The matrix is the most connected part of the landscape such as the vegetation type that is most contiguous (e.g., mature forest). Patches are areas of vegetation that differ from what surrounds them (the matrix or other patches). Examples are clearcuts, fragmented forest stands and wetlands. Corridors are landscape elements that connect similar patches through a dissimilar matrix (e.g., riparian zones and roads).

Landscape *heterogeneity* is measured by the amount of variation within and among landscape elements like matrix, corridors, and patches. Landscape structure influences function which in turn shapes structure in complex and continuous feedback loops. The historically and ecologically appropriate kinds of landscape diversity enhance the resiliency of the forest landscape.

Conservation Biology

Conservation biologists define their discipline as "science in the service of conservation". It is a mission-oriented, applied science, analogous to emergency medicine. Conservation biologists have a job to do and that job is to find out and demonstrate how to save the biodiversity of planet Earth. Biology and its sub-disciplines, especially ecology, systematics and genetics, are the core disciplines of conservation biology. The practice of conservation biology also brings in philosophy, sociology, political science, law, history, geography, the natural resource fields, and

other disciplines, as they relate to conservation problems. (Reed Noss in Wild Earth vol.2, no.1, Spring 1992, p.5)

Typically, conservation biology focuses on large-scale conservation planning across watersheds, ecosystems, and jurisdictional boundaries (private and public lands). It is concerned with saving threatened and endangered species and the habitats and niches that they occupy or formerly occupied. Saving at least some representatives of all ecosystems and habitats across an entire region is another important goal (e.g., the entire Klamath-Siskiyou Ecoregion). Other important goals are maintaining viable populations of all native species in natural patterns of distribution and abundance, sustaining ecological and evolutionary processes, and maintaining a conservation network that is resilient to environmental change. It is perhaps best known for its work in conserving or re-introducing top carnivores like wolves or grizzly bears by planning conservation "set-asides" to connect presently fragmented habitats (*dispersal corridors*) and to enlarge or protect "core" habitats.

Whereas wildlife biology has long been involved in conserving or restoring habitat for game mammals and birds, recent environmental laws protecting non-game species have resulted in an increase in funding for wildlife research. This led to the formation of the Society for Conservation Biology (SCS) in 1985. Wildlife biology's emphasis on practice and conservation biology's focus on scientific theory, are slowly merging into a unified discipline. What is missing still is within-site habitat restoration of core, corridor, and buffer preserves. Animals may not disperse through a corridor or re-inhabit a core reserve if their habitats are degraded. Conservation biology has moved from ecological theory to conservation practice, and seems to be attempting an integration or synthesis of the two very different approaches to conservation. But, as is the case with descriptive ecology, conservation biology has yet to recognize indigenous cultural landscapes as legitimate reference ecosystems (e.g., the Indian fire-managed forest landscape). As we shall see below, *restoration ecology*, the theoretical basis for the practice of *ecological restoration*, is now bringing its theory into longstanding restoration practice. Both practice and theory are now in place to influence conservation biology.

Restoration Ecology and Ecological Restoration

The Society for Ecological Restoration (SER), founded in 1988, defines ecological restoration as follows: "Ecological restoration is 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." Restoration ecology, as we noted above, is the scientific theory underlying ecological restoration.

Ecological restoration, like conservation biology, is a young discipline and there is not as yet one universally recognized definition. However, the definition quoted above recognizes that human cultures have influenced landscapes, for better or for worse, just as much as landscapes have influenced human cultures. "Regional and historical context" and "sustainable cultural practices" are concepts which most societies in the world can relate to. The great exception is North America where scientists generally look to reference ecosystems in forests, which have remained untouched by human cultural practices, sustainable or otherwise.

"*Critical range of variability*" means that not just any kind of biodiversity or ecological structures and processes, or cultural practices, will lead to ecological integrity. Forest vegetation development can take different directions, depending on a variety of variables in its history (multiple successional pathways).

Restoration requires performance standards by which to monitor progress, or lack of, toward a defined or desired future state based on a baseline or reference ecosystem. This baseline incorporates both historical authenticity and functionality; the conceptually reconstructed historical reference ecosystem must be checked or monitored for its ecological function by ecosystem science.

How far back do we go to find a reference point in time? Only as far back as the time of the last known state of good forest health. This past "state", of course, has changed just as our restored forest will continue to change. Reference ecosystems are not static. But we need some point in time, which is relatively stable, where change is fairly slow and fairly constant, with which to begin the process of restoration. As we will see below, ecosystem science can provide monitoring techniques, which can check or test the functionality of the ecosystem being restored. In North America, that is ideally just before contact between European colonists and Native Americans (i.e., pre-European settlement, usually shortened to "pre-settlement" or "pre-contact"). That time period is "ideal" for two reasons: (1) it predates the destructive forest practices of modern

industrial society and includes the time period in which Indian peoples were using the kind of fire management that maintained healthy forest structure, composition, and processes; (2) it falls within the last stable climate regime (the cooling trend of the last 4000 years which is most like our climate today).

But, we can only go back in time to a point where knowledge of the forest's past is still retrievable. It usually takes a combination of the science of historical ecology and Native Traditional Ecological Knowledge (TEK) to successfully reconstruct past forest conditions.

Once an ecosystem is degraded, it is not recoverable in its ecological details, just in its key features of integrity. In extreme cases it may not even be recoverable in its broad ecological features. That is why conservation is always the first step in protecting forest ecosystems.

Historical ecology uses a variety of scientific techniques to reconstruct the past, including pollen analysis (*palynology*), fire history of trees through fire-scar dating (*pyrodenchronology*), packrat midden analysis, study of silicon remains of grasses (*phytolith analysis*), archaeology, historical photograph interpretation, ethnohistory, and ethnography, early botanical and zoological surveys, old diaries, and land surveys.

Several different techniques are usually required to retrieve the known past of a forest, at least in its ecologically critical features. We can then begin to understand something about its fire history, tree stocking rate (how many trees per acre), tree spacing and age-classes, species composition of plants and animals, and more. Functionality is tested with techniques, which measure net primary productivity, secondary productivity, hydrologic function, nutrient cycling and genetic diversity.

Part III. Restoration Forestry: Integrating Ecosystem-Based Knowledge with Silviculture, Tree Harvesting Systems, and Forest Economics

"If you don't know where you're going, any road will take you there" goes a wise old saying. *Restoration forestry* could be defined as the harvest of forest products (both timber and non-timber) under the guidance of ecosystem-based knowledge. But unless we have some kind of ecologically appropriate baseline or reference ecosystem in mind as our restoration goal, the means in which we use to achieve our restoration goals, which in the case of restoration forestry are a variety of silvicultural systems and techniques, will dominate our goals. In the end, unless our ecology is sound, means will become ends. The tail will wag the dog. Calling a timber

harvesting project "restoration" doesn't make it so. On the other hand, unless there are forest by-products which can be sold in local markets at above-project cost, there may not be a way to finance forest restoration. Restoration forestry must be able to reverse ecological degradation and achieve its restoration goals while generating revenue from forest by-products.

This section describes how to integrate or synthesize ecosystem-based knowledge, TEK, descriptive ecology, landscape ecology, conservation biology and restoration ecology with ways to grow and tend trees (silviculture) as well as with timber harvest systems and forest economics.

Establishing A Reference Ecosystem Using Ecosystem-Based Knowledge

Regional Landscapes, Forest Types, and Biodiversity

This manual addresses forest restoration in southern Oregon and northern California. Landscape ecology tells us that a regional landscape is defined by its most dominant vegetation type or matrix together with major connected drainages, similar climatic regimes, and geomorphic structures and processes (topography, dominant rock and soil types), in the forested montane landscapes of our bi-state area. The dominant vegetation is usually conifer trees, which form most of the over-story. Patches and corridors of other vegetation types, less common than the matrix vegetation, integrate structurally as well as interact functionally across the landscape. The more variation in vegetation types and in patch size and shape, the more landscape heterogeneity. Ecologists assume that the greater the landscape diversity or heterogeneity, the greater the resiliency and the more optimum the function (structure influenced function).

The problem with the assumption that a diverse landscape structure necessarily leads to greater resiliency and better function, even while recognizing that structure influences function just as function shapes structure. An ecological assessment is incomplete without determining what kind of structure and composition lead to a healthy forest. In other words, high biodiversity in itself may not lead to better function. Remember the definition of ecological restoration. Since there are usually several possible pathways in forest succession (vegetation development following a disturbance like wildfire or clearcut logging), one successional mode may work better than another in contributing to ecosystem function. If vegetation development is outside of the historical range of variability, it may actually lead to ecological degradation and diminished function, even if there is high landscape heterogeneity or diversity.

The four principal regional mountain complexes covered by our manual are: Klamath Siskiyou Mountains, Coast Ranges, Southern Cascades, and Northern Sierras. The kinds of silvicultural and timber harvesting systems and techniques (e.g., individual tree selection or new forestry) with which we choose to pursue our restoration goals must be specific to both forest type and region. Too often, foresters use logging systems that are not appropriate for their region or forest type. We also need a historically authentic reference ecosystem, including a disturbance regime with which the forest is familiar to guide our restoration efforts. And, we need to monitor the ecological function of the historical model with ecosystem science.

Silviculturally-oriented Forest Types and Plant Associations

We have defined forest succession as vegetation development that occurs following a major disturbance event like volcanic eruptions, wildfire or clearcut logging. When biological legacies, such as plant seeds, spores, roots, and animals from the previous ecosystem are left following the disturbance, the forest begins to re-establish itself. This is called secondary succession. Primary succession is vegetation development from no more than bare earth, as for example, following strip mining.

Forest ecologists who are closely associated with timber harvesting such as those with the Forest Service, BLM, and corporate timber industry have developed forest classification systems to get a quick handle on timber productivity potential for a given forest type or stand. Foresters often use the term *potential vegetation* to denote climax vegetation. Climax, according to forest ecologists Thomas Atzet and David Wheeler (*Preliminary Plant Associations of the Siskiyou Mountain Province*), is "the end point of succession where neither plant composition nor stand structure changes. Net productivity in terms of biomass production is considered to be zero."

We know that the forest is not static because we rarely find climax on potential vegetation in the real world. Old growth forests, for example, are assumed by many in both the timber industry and in the environmental movement to be in a stable state. Yet, if left unmanaged by regular light burning, as in the pre-contact forest, these forests will be burned up by a catastrophic stand-replacing wildfire or endure devastating disease or insect epidemics.

We should be cautious when foresters describe forest types and plant associations, which serve as ecological shortcuts in the service of timber production. As Atzet and Wheeler state: "the [plant] association is used to resolve environmental differences [read "simplify"] for silvicultural

prescriptions. It can also be used to evaluate productivity [read "timber productivity"], management results, and to extrapolate biological response [read "tree regeneration"]. It is the finest level in the classification hierarchy."

These forest classification systems are not adequate for ecological restoration. They do have a role to play in assessing site tree productivity (site class based on soil fertility and depth and/or tree density), but need to be used cautiously when doing restoration forestry. They do not describe forests very accurately. Worse still, they are downright misleading because they assume that succession in the intensely managed forest will proceed inexorably to climax and then stop. From a timber perspective, it doesn't actually matter if it reaches climax or not because it is just a convenience in determining site timber productivity and regeneration direction. The short (40- 80 year) timber rotations make climax quite irrelevant.

How To Achieve Restoration Goals Using Ecosystem-based Knowledge and Silvicultural Techniques

We have established a reference point in time and space for the kind of forest structure and composition specific to our region and forest type that we wish to restore. We have done this conceptual reconstruction using what information is still retrievable from the existing literature and from our personal experience in our forest. Where necessary, we have filled in critical gaps in our knowledge with techniques from ethnography and historical ecology, including oral interviews with local elders. Even a simple mapping of old growth conifer stumps (hardwoods decompose much faster) will reveal important information about pre-contact forest structure. Selected tree borings may tell us about age-classes, fire history, and insect or disease epidemics. Our own experience in the forest may be the most valuable knowledge of all.

Limitations of Western Ecological Sciences (WES)

Western ecological sciences (WES) are important in this reconstruction process. But WES has its limitations. Like the conventional forest classifications we discussed above, science abstracts general principles or conceptual elements out of their specific historical contexts for replication and testability on a broad scale. Traditional Ecological Knowledge (TEK) is place-specific, incorporating the accumulated knowledge of many generations (*synchronic observations*). WES studies are usually short-term or cross-sectional (*diachronic*). WES does not yet recognize human cultural landscapes as legitimate reference ecosystems, even where indigenous sustainable cultural

practices have led over long stretches of time to high biodiversity, relative stability, resiliency, and enhanced function.

For these reasons, historically authentic baselines are more useful to restoration forestry than attempting to model future secondary successional outcomes. Systems theory and modeling do have a role to play. They can simulate various disturbance scenarios to find out what would happen, say, to fire behavior in a stand thinned with a certain silvicultural prescription. But their predictive powers are usually limited in space and time. There are too many unknowns about future changes in climate and other system factors. Forest ecosystems are too complex. The model is only as good as the accuracy of the information put into it. Too few scientists have long-term personal experience in a particular forest. Substituting abstract science for personal experience in the forest is not sufficient for good restoration forestry. Knowledge is more than technique; it is also experience.

Integrating Forest Stand Restoration With Landscape-scale Ecology

Our work reconstructing a reference ecosystem involves both forest stands and the greater landscape of which they are a part. Restoration forestry is an experimental field. There is much we do not know about how degraded forests will respond to our restoration efforts. We should not, therefore, attempt restoration beyond the stand level. On the other hand, we need information about the larger landscape because it is connected in many ways with stands. And, of course, we will not be prepared to restore landscapes unless we first experiment with stands.

The following is from Diaz and Apostle's, Forest Landscape Analysis and Design, which was used by the Rogue River National Forest to plan future desired conditions for the Little Applegate Watershed in the Siskiyou Mountains.

There are two phases to landscape level planning: an *analysis phase* and a *design phase*. The analysis phase identifies the following:

1) landscape elements (matrix, patches, corridors)
2) landscape flows (animals, humans, water)
3) relation between landscape elements and flows
4) natural disturbances and succession
5) functional linkages to adjacent areas

These are mapped, often with the assistance of Geographical Information Systems (GIS), on

mylar overlays.

The design phase for restoration, unlike Diaz and Apostle's Forest Service Forest Plan reference point, refers to our target forest reference condition developed from historical/ecological surveys of several different ecologically comparable stands, which may be scattered some distance across a landscape with a fairly homogenous matrix. In other words, our stand reference condition will usually turn out to be a composite of several stands within comparable habitats.

With the landscape scale mapping complete, we will have an informed notion of the ecological relationship between landscape and stand. Because those of us who work on private forestlands usually don't have any say-so about the greater landscape, unless we are a public land agency or large corporate holding, the ideal reference ecosystem may be considerably modified by severe forest fragmentation and degradation over which we have no control. We may have to sacrifice historical authenticity for ecological functionality. Restoration is often a question of balancing fidelity to an historical reference ecosystem with some measure of functionality, which may likewise be impossible to achieve in some degraded forest landscapes. For example, a woodlot that has a tree stocking rate many times higher than the reference forest, but which is surrounded by clearcuts, should not be thinned beyond the point where its role as a plant and animal refugia is compromised. It is because of these kinds of fairly common situations on private lands that knowledge of landscape flows, particularly wildlife movements, is critical. It also underscores the need for private landowner cooperation in restoration forestry (*community-based forestry*). Ecosystem management was endorsed by public land agencies because it was necessary to cross-jurisdictional boundaries (private, state, federal) to protect threatened species as required by tough environmental laws. Conservation biology has a similar problem protecting species like far-ranging top carnivores.

Finally, landscapes that consist of a balanced mix of forest plantation or farmland monocultures and natural forests with high restoration potential may in the end still achieve overall integrity. Success depends on the degree of fragmentation and whether or not there are enough large patches or stands with good interior-to-edge ratios (large enough for considerable interior habitat). Conservation biology plans buffers outside of its core preserves where human economic activities still allow the larger ecosystem to function reasonably well, with enough corridors to connect the large stands for wildlife habitat and dispersal. The landscape

may still be functional if not historically accurate. This is one reason why both conservation biology and restoration ecology prefer the use of the concept of *integrity*. The larger the landscape the greater the chances are that it will contain enough quality habitat to function adequately even with human economic activities. Integrity depends to a large degree on scale.

The Use of Ecologically Appropriate Silvicultural Techniques and Timber Harvesting Systems in Restoration Forestry

The logging methods of the past century have too often followed the "one size fits all" mindset It has been about efficiency, not ecology. The means have become ends. As research ecologists have learned more about how forest ecosystems function, some foresters and scientists have responded with alternative light touch silvicultural techniques and timber harvesting systems. We will discuss these alternative approaches to forestry below. It should be kept in mind that they are timber harvesting systems and do not necessarily have much to do with restoration forestry. Light touch systems like individual tree selection or uneven-aged management may be as ecologically degrading or inappropriate as industrial clearcut logging. It all depends on the regional forest type and the restoration objective and that depends on the historical reference forest.

Ecosystem Management

R.E. Grumbine defines ***ecosystem management*** in the Journal of the Society of Conservation Biology (March 1994, pp 27-31): "Ecosystem management integrates scientific knowledge of ecological relationships within a complex sociopolitical and values framework toward the general goal of protecting native ecosystem integrity over the long-term". With the advent of strict environmental laws beginning in the 1970's, federal and state resource agencies have been required to protect endangered or threatened species, especially old growth or late-successional species. They have needed to cooperate across jurisdictional boundaries in order to do this. The Northwest Forest Plan of 1993 mandated a balance between timber harvesting and ecosystem protection. A team of forest research scientists asked for $10 million to study complete (all seral stages) forest ecosystems as well as plant and animal community interactions. They received only $2 million. Both the general public and the timber industry put highest value on old growth forests so that is what was studied. The focus was put on protecting late-successional species like the northern spotted owl, and on protecting rapidly diminishing runs of anadromous fish. Both owls and salmon became "umbrella" indicator species of forest health with a powerful public

appeal. While this appeal has promoted protectionist aspirations of the environmental movement, it has also turned research attention away from early and mid-successional communities and species and on to late-successional ecosystems and species.

Keep in mind that ecosystem management is an ambitious attempt to continue harvesting timber, even some old growth, in the face of major reductions in the former level of harvesting, and protect ecosystem integrity. Late-successional reserves were established, although they are also entered periodically, and less mature forests which have the greater landscape matrix were sacrificed to intensive timber management and harvesting. The promise of ecosystem management has not been fulfilled in practice by public land agencies.

What about the concept? It is holistic in its approach to ecology and economy but it has some theoretical problems. Even if all forest seral stages were protected or restored, there is no historically accurate reference ecosystem. "Future desired conditions" are based more on current social values than authentic forest history and functionality. In addition, human values in the end determine how far to go ecologically as seen in the focus on old growth alone because of its high social and economic value. Grumbine's definition puts ecology within a "complex sociopolitical and values framework", whereas human economic activities should be put within a framework of ecological restoration. Silviculture and timber harvesting should further conservation or restoration.

The research focus on old growth forest types and species has trickled down from the current literature in forest ecology to field practices of alternative light touch foresters. Their reference ecosystems are often late succession forest structures and composition. Full canopy closure is the preferred structure. Little attention is paid to non-tree composition or early and mid-successional stages of forest growth. It is often assumed that there is too much early seral forest because of the high density of clearcuts. Opportunistic weedy species, often introduced "pioneer' annual plants, quickly colonize clearcuts. These species are not ecological analogs to more stable native species, especially perennials, which were maintained in forest openings for long periods of time by Indian burning. In fact, so-called early-, mid-, and late-successional species are often found together in unlikely associations. There is high initial species richness in clearcuts before they quickly close up and become plantation monocultures, but it is unstable, often non-native, and is short-lived. Our preferred reference ecosystem is the Indian fire-managed forest with

repeating mosaics of all seral stages within the matrix and which were relatively stable in time and space.

New Forestry

Jerry Franklin of the University of Washington and one of the intellectual fathers of "new forestry", considers its objective to be the "development of forest management systems which better integrate commodity production with maintenance of ecological values." Structurally-complex old growth is the reference system at the stand level. Like ecosystem management, it is an integral part of industrial forestry and seeks to mitigate some of the negative ecological effects of traditional practices like high-grading the biggest and best trees, clearcutting, intense slash fires following logging, and short timber rotations. A particular emphasis is put on retaining enough biological legacies for maintenance of the means of forest regeneration following timber harvesting, such as propagules like seeds and roots, down wood, snags, wildlife habitat, and seed trees. Attention is also paid to the effects of harvesting on the larger landscape ecosystem.

Chad Oliver, also of the University of Washington, thinks that industrial forestry can simulate forest disturbances like fire through thinning prescriptions which create at the landscape level all four of the typical stages of forest succession: (1) stand initiation following clearcutting, (2) stem exclusion, (3) stand reinitiation, and (4) old growth. This more balanced approach would satisfy society's need for wood fiber and its concern with conserving biodiversity as well as provide long-term carbon storage to mitigate global warming. However, it is still the kind of disturbance with which the forest is not familiar because of the scale of clearcutting, the lack of the ecologically appropriate fire based on Indian burning patterns, and the use of short rotations in the simulation of stand initiating wildfires. The rate of disturbance is outside the historical range of variability. Shelterwood cuts, which leave a few scattered trees in a clearcut for seed production or wildlife and are a preferred harvesting prescription of new forestry, still work on short rotations. The trees that remain are cut in the next harvest before reaching the old growth stage. Little permanent old growth is retained, and the old growth that is retained will still be cut on longer rotations. The old growth reference ecosystem for Franklin is based on Pacific Northwest coastal hemlock/fir/cedar forests but has been generalized throughout northern California, western Oregon and Washington, and British Columbia.

Uneven-age (All-aged) Individual Tree Natural Selection Ecoforestry.

This is the ultimate light touch forestry. In the eastern U.S., it's called "worst first" forestry. Only the trees that nature has already selected for removal are harvested, replicating natural selection. They are usually trees that are suppressed by taller over-story dominants, or are in some way marginal with a likelihood of early mortality. It should be noted here that we could be removing trees that possess genes for superior drought tolerance or disease resistance. We may be depleting the genetic diversity of our forest trees while assuming that nature has selected these trees out. Trees are harvested individually or sometimes in small groups. Full canopy closure is the rule. In other words, it is assumed that secondary succession completely outside of the historical range of variability, is the "natural" forest state. Historical reference ecosystems are ignored.

Individual tree harvesting favors uneven-aged stands. This can pose a fire hazard in drier interior forests because of "ladder fuels" from ground to crown. Full canopy closure encourages regeneration of shade-tolerant tree species so natural regeneration is preferred over artificial planting. Shade-tolerant conifers are more susceptible to disease and insect infestations, even in all-aged and multi-species forests. This also accelerates forest succession to its "potential" or "climax" stage. Pine and Douglas-fir tend to get shaded out by cedar, hemlock, grand fir, and white fir. Understory herbaceous plants soon drop out, especially those requiring more sun and regular fire. Structure and composition are more like the "stem-exclusion" forest phase than old growth. Stem exclusion forests result from a densely stocked stand that has grown up to full crown closure with little or no understory plants (40-100 years or more old) following a disturbance like clearcutting or very intense wildfire. Stand reinitiation is the next phase when the forest begins to self-thin and species diversity increases. Old growth, around 200 or more years, is more structurally complex with higher species diversity.

Forest underburns are risky in this kind of forest. In cool moist forest environments, it may be impossible to ignite a fire during the safer fall or spring burning seasons. Wildlife habitat deteriorates because of lack of fire. This kind of forest stand did exist under the Indian fire regime, but did not constitute the dominant matrix. It was more like a patch or corridor, especially on north aspects and in shady, moist canyons and flats that were large enough to supply adequate interior habitat but which also were interspersed with other forest seral stages at the landscape level.

Principles and Ecologically Appropriate Silvicultural Systems for Restoration Forestry

The silvicultural systems described above could have a legitimate role in restoration forestry if the scale and the rate of change is within the historical range of variability. It all depends on (1) the region, (2) the forest type, (3) the state of the surrounding landscape, and (4) a reference ecosystem, which is a balanced mix of historical authenticity and ecological functionality.

Before silviculture can be integrated with ecological restoration, it needs to be disconnected from timber harvesting, both industrial and light touch, where it has played a dominant role. Timber harvesting, whether even or uneven aged or individual or group, must further forest ecosystem conservation or restoration. Economy follows ecology. We need to reconnect silviculture to restoration in a fundamentally different way. Instead of systems driving restoration, restoration needs to drive systems. Means shouldn't drive ends, whether technique or economics.

We need to be very specific about our restoration objectives, choosing the appropriate system or technique regardless of whether it is perceived as politically correct or not. To illustrate how this integration process can work in the field, we will look at two widespread regional types: dry interior montane and moist coastal montane. "Dry" and "moist" are shorthand ways to describe relatively dry and moist forests.

Dry forests are typically interior types, often dominated by more drought-tolerant tree species like pines or drier-adapted, Douglas-fir. Fire was frequent where five to twenty-year mean return intervals were common. Historical tree stocking rates were low, ten to thirty trees per acre, although fire suppression has resulted in stands with stocking rates now as high as 2000 or more stems per acre (stem-exclusion seral stage). Catastrophic stand-replacing fires were rare due to the scarcity of ladder and ground fuels and more open tree spacing. More shade-tolerant species like white fir and incense cedar have come up in the understory and are now overtopping pines and hardwoods like oaks. Fire hazard is high and disease and insect epidemics are increasing in intensity and frequency. Drought stress for some tree species is common. Most stands are composed of more or less even-age second-growth trees, with some stands consisting of two age classes (mature and seedling/sapling). Little old growth is left and in some places, overgrazing has impoverished understory composition. Livestock have grazed out most of the palatable cool season bunchgrasses that checked woody shrub and tree regeneration and which used to carry the frequent light understory fires.

What is the restoration prescription? Broadly speaking, it is group tree selection thinning, restoring prescription fire, and locating and then seeding missing herbaceous understory species into the ashes following the first fire. The group selection cuts should be done in several harvest entries to minimize disturbance. This gives the leave trees some time, five to ten years perhaps, to adjust to their new environment. It also minimizes sunscald and wind-throw. It allows slow moving species like reptiles and amphibians some adjustment time. It does not disrupt underground relationships between mychorrizal fungi and forest trees or other plants, which serve to greatly enhance nutrient and water uptake as well as disease resistance of plants. How large should the group cuts be in the end? It depends on a lot of factors, but particularly the region, forest type, elevation, topography, and historical baseline information. It may not be possible to achieve low historical stocking rates of a few trees per acre if the greater landscape is severely cut over (stand initiation phase). On the other hand, if there are extensive surrounding stem-exclusion forests, historical stocking rates would be ecologically appropriate. Forest trees that have invaded meadows (meadows in montane forests have lost at least half of their pre-contact area) may require small clearcuts of five to ten acres in several entries. In the steep and complex topography of the Klamath-Siskiyou Mountains of Oregon in Douglas-fir forest below 4500 feet, smaller sized cuts could be made (1/4 acre or even less). At higher elevations larger size cuts would be appropriate such as red fir forest encroaching on meadows that require up to five or ten acres in several entries. Individual tree selection would not be appropriate in this kind of forest environment. It would only further the invasion of shade-tolerant species. Clearcuts larger than ten to ten acres would also be inappropriate.

Should we thin for even-age or uneven-age tree species? Again, it depends. If the second-growth stands are relatively even-aged, we may want to allow tree regeneration in our openings or patches by not burning there. Then, later we could open up a new patch. Our historical baseline suggests that this kind of forest consisted of fire-generated even-aged stands in an overall uneven-aged forest due to fire events staggered in space and time. For example, fire events in the Klamath-Siskiyou Mountains ranged from one to 1000 acres with an average of 50 acres. The rugged topography of the Klamath-Siskiyou was an important factor here, the forest consisted of mosaic of different aged stands.

Moist forests are found in coastal mountains of the Pacific Northwest. Typical dominant tree species are redwood (northern California), Douglas-fir, western hemlock, grand fir, and red

cedar. The fire cycle of 20-80 years was less frequent than the drier interior forest types. Stand replacement fires during drought years were more frequent because of more ladder and ground fuels, closer spacing of trees, and in general, more biomass. Fire suppression and industrial harvesting have resulted in an increase in stocking ratio from around 25-50 trees per acre to as high as 3000 trees per acre. There is more vertical heterogeneity (structural complexity) in the moist forest, with more fuel ladders, making fire hazard high. Hardwoods and herbaceous under-story plants are slowly being shaded out, although the more shade-tolerant species are still prevalent, except in the stem-exclusion phase. Insect epidemics are less frequent because of less drought stress on the trees but diseases are increasing in frequency and severity. The old growth phase is closer to the current late successional model than drier forest types.

Restoration prescriptions include group selection cuts varying in size from a few hundred square feet to about a quarter of an acre, except where meadows like the "Bald Hills" of the coastal mountains have been invaded by conifers due to fire suppression. Heavy ground fuels, including logging slash and large down wood, are common and far above levels in the pre-contact forest (15- 30 tons per acre is not uncommon). Native Americans burned these large balds on a regular basis for cultural plant materials and wildlife habitat such as elk and deer. They also kept smaller patches open at all elevations by burning. That kind of forest structure is similar to that created and maintained by fire in the drier montane forests of the interior, except that the cool moist climate of the coastal mountains mitigated fire effects on tree regeneration meaning fewer young trees were burned up and so tree spacing was closer.

Thinning prescriptions would be designed to mimic Indian burning patterns. A combination of small (up to an acre) patch cuts for the matrix and large patch cuts, up to ten acres, for "bald" or meadow restoration. Fire would be restored to its pre-contact seasonality, selectivity, intensity, and mean return interval. Missing understory plant species would be located and seeded into the ashes following fire.

This forest type is mostly second growth which is either even-aged or consists of two age classes (mature and seedling/sapling) due to extensive clearcut logging. The reference model suggests that this forest was made up of a range of age classes both within and between stands due to the uneven effects of fire in this moist environment. Ecological functionality requires structural diversity at the landscape level but less vertical complexity then the old growth model further

north in Oregon, Washington, and British Columbia. All seral stages and habitats will be represented and the full spectrum of shade and sun repeated throughout the forest, but particularly on upper slopes and at the ocean-forest interface.

Restoring Forest Understory Plant Composition

Most Native American burns occurred in the fall as most native shrubs and herbaceous grasses and forbs have set seed by September. Some seeds, like many native grasses, require a one to two month after-ripening in order to be viable. Grasses which set seed in July should be ready to use by September while others, such as high elevation types, may require waiting until as late as early November before using. Seeds of missing understory plants, species that our reference model tells us used to be in the forest, should be on hand for direct seeding into ashes following a fall prescription burn.

Burn piles, or slash, also offer opportunities for seeding. Burn pile seeding over time will provide islands of native understory plants which will provide future ***in situ*** seed sources for further restoration. Slash piles near leave trees where burning would be unsafe can be left for wildlife. As with forest tree seed collecting, care should be taken to collect seeds from a similar elevation (within 1000 feet), from a comparable habitat, and within a 50-mile radius if possible. However, it may be necessary to go further than 50 miles away or higher or lower than 1000 ft. in elevation. Current research suggests that comparable habitat may be a more important factor than distance or elevation. It is important that as much genetic diversity as possible be restored. Collecting should be done from as many different populations of a species as possible. This will ensure good genetic diversity within the restored population.

Some forb and shrub species require over-wintering treatments in a greenhouse or cold frame to break dormancy. This is called "stratification" and usually involves storing seeds in sterile peat moss at just above freezing for two or three months. Occasionally, chemical treatments are also required to break dormancy. Direct seeding into ashes following fire is the most efficient way to establish missing understory plants. Sometimes, however, out-planting container or bare rootstock is necessary, especially with shrubs and trees. Deciduous hardwood cuttings can be propagated in the greenhouse or cold frame over winter from fall cuttings. Evergreen plants can be propagated from cuttings taken in spring or summer, depending on the species, and then grown one year in the greenhouse or in field plots for later transplanting. Some moisture-loving woody species can

be directly planted in soil from cuttings taken in November or December. Examples are willows, alders, and mock orange.

Guidelines for Thinning Tree Groupings

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, and as a source for truffles for wildlife food.

1. Thin to release preferred tree species (sun-loving oaks and pines), especially on south and west aspects.
2. Thin to release future old-growth by favoring existing large young trees with noticeable old-growth characteristics such as rugged, rugose bark, 50% or more live crown, and good architecture for wildlife (dead limbs down bole as in a "wolf" tree or "grouse-ladder"). 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 culling on south and west aspects of preferred leave trees. Another problem area is invasion of dry 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, like Douglas-fir, white fir, and 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.
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 openings.

7. Thin some tree groupings down to one or two large leave trees 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, especially in moist coastal forest types.
9. Favor scattered leave trees that stand alone between groupings.
10. Do multiple thinning entries (every five to ten years) so as not to alter the forest environment too much at one time. This can avoid sun scald, wind-throw, disruption of mycorrhizal connections, and too rapid degradation of reptile and amphibian habitat.
11. Avoid thinning during bird-nesting season; favor thinning on frozen ground in winter.
12. Do not 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 down wood; post signs to discourage harvesters.
14. After falling trees, lop and scatter smaller branches and cut to within 12" of ground being sure not to scatter on patches of native plants; pile branches over 2" in diameter 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 won't be burned later by mistake); leave some limbs over 8" on ground for down wood and some 2 - 8" diameter sizes stacked for local firewood. More down wood should be left in moist coastal forest than dry interior forest.
15. Oaks are the number one preferred tree species: release oaks within conifer groupings as much as possible without disrupting group; prune oaks where they lean out from clumps to avoid snow breakage of leaning, horizontal limbs.
16. Avoid cutting any tree with nests, or with cone-leavings at base of tree, or with wood rat 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. Experiment by comparing one entry with two entry thinning (a) no thinning, (b) one entry thinning, and (c) two entry thinning (five to ten years); stratify stand habitat types so as to have environmentally comparable sites.

Photopoint Monitoring

Set out sets of two-way photopoints. 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 that is clear of vegetation so it can be easily seen some distance away. Put 60-penny nails with heads painted orange in ground at base of rebar in case rebar is removed. Use large-print forms of heavy paper (12" X 12") with date and time of day while taking photographs, which should be taken on the same date and at the same time each season or year.

Transect Photopoint Monitoring

Four short (18"), flagged or painted rebar stakes are driven into ground to make a square plot approximately 4 X 4 feet and situated every 25 meters or so along transect lines set out in random directions to monitor changes in herbaceous vegetation in meadows and forest openings. 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 and 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 fuel break 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 fuel banks around entire stands and in other strategic places to contain fires within relatively small areas.
4. Use intentional fire in early fall following a half-inch 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 over-story 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.
6. Cut fuel breaks around strategically-located dense "doghair" conifer stands for wildlife cover.
7. Have enough people on hand during a burn to put out fires smoldering in snags and logs, and especially one or two committed to night watch. Don't pile slash on stumps or logs. 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. 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 wash-out/exhaustion of soil organic matter caused by a lack of sufficient over-story trees. Plant sugar pine and ponderosa pine or hardwoods 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 that 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 tendencies of contemporary industrial societies to destroy ecological integrity as a result of human use. Instead, ecosystems are enhanced in the act of using. Traditional care giving 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, out-planting, selective harvesting, and intentional fire.

What about the non-cultural ecological associates of cultural plants? How do we determine what belongs together in a restored plant community? Experienced cultural harvesters know this from long intergenerational 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, 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. Paired experiments can be done where a comparison is made over time between the relative effectiveness of cultural care giving/harvesting and doing nothing on the health, vigor, and size of patches of cultural plants and their ecological associates.

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) and grow in nursery in cold frame; augment cuttings with seeds to maintain genetic diversity.
5. Take softwood cuttings (late spring to summer) and 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).

Traditional Ecological Knowledge and Cultural Environmental Management Practices

By Frank Lake

INTRODUCTION

Many American Indians historically and now rely on the ecological services provided by the environment. Human livelihoods are enhanced by a diverse and productive environment. Social status of Native peoples was often linked to how "rich" their lands or watershed was. The more productive and diverse a place is, the greater potential for ecological capital to be converted into social-economic capital. Ecological diversity and productivity equal wealth, good health and survival for Native people. Uses of the environment, which promote or maintain ecological integrity and services for human and non-human species, was encouraged. When American Indians could access and manage for materials, foods, and medicines in a manner that was integrated with spiritual teachings and beliefs, they prospered while also striving to maintain equity of the goods and services for the rest of the biological community. Plants, animals, and insects were considered "relations" and living or non-living entities shared a common genealogy of place.

TRADITIONAL ECOLOGICAL KNOWLEDGE AND CULTURAL ENVIRONMENTAL MANAGEMENT PRACTICES

Traditional Ecological Knowledge (TEK) is defined as the collective ecological knowledge of a local place learned by indigenous people living in close hands-on contact with their environment for thousands of years. "With it's root's firmly in the past, Traditional Environmental Knowledge is both cumulative and dynamic, building upon the experience of earlier generations and adapting to the technological and socioeconomic changes of the present" (Johnson 1992).

At the core of TEK is learning the role and value of each species or a unique part of the ecosystem or vegetation community spiritually, culturally, ecologically, and economically. This knowledge is often gained from direct experience with an ecosystem, habitats and species, as well as ecological processes, such as fire or flooding. Respect for all living things, the land and waters are taught through TEK. Reciprocity is a guiding principle where, tribal practitioners are instructed and encouraged to give something back for taking something from the environment. The "gift" given back can be tobacco, a sacred plant, food, a song or prayer of thanks. Also there

may be the "gift" of carrying out practices that sustain and maintain the resource, or sharing the harvested goods with members in the communities or to be used in ceremonies.

Cultural Environmental Management Practices (CEMP) mimic natural physical and biological disturbance processes in two important ways. First, with fire the seasonality and location may differ. For example, lighting may strike the majority of the time on high elevation ridge systems and ignite fuels during late summer thunderstorms, whereas Native peoples may burn for basket materials in the spring in lower elevations. The extent and duration of disturbances caused by animals may differ, also from cultural practices. Grizzly bears or gophers, for example, may dig and consume wild bulbs, such as camas, in meadows at all times of the year. In contrast, humans may harvest and consume bulbs in the spring before plants flower, or in the late summer/fall after seeds have ripened in those areas where they have burned and tilled the soil and considered their garden beds. CEMP may also help buffer against extreme ranges of natural variability. For example, frequent Indian burning of the forest understory in an area reduced the build up of fuels as well as the severity of wildland fire. When TEK is implemented through CEMP, it can foster biodiversity and productivity of selected areas across the landscape. TEK and CEMP are not things of the distant past; they have application for restoration forest, grassland, wetland, and marine environments today.

TEK and CEMP work with the "natural" conditions of the local environment across many different habitats. Practices employed by Indigenous peoples often mimic natural disturbance processes in the management and utilization of natural resources. The refinement of TEK and CEMP through time led to the maintenance and/or enhancement of ecosystem productivity, which is rarely considered by western scientists. The effects CEMP may vary in intensity, spatially and temporally across the landscape depending on the management objectives and desired outcomes of indigenous people.

INDIGENOUS PEOPLES ADAPTATION TO ENVIRONMENTAL CONDITIONS

Climatic Variations:

Paleo-Indians were present in North America at least 10,000 years ago. Most of the tribes of North American Indians today have a long history of residing in the bioregion for at least a thousand years. Archeological data and tribal oral histories provide information about climatic changes, and how vegetation or wildlife species responded to changing conditions through time.

Cooling and Warming Trends:
Traditional Ecological Knowledge of Native peoples' experiences with their environment help provide information about the effects of temperature changes over long periods of times.

Sea Level Changes:
Many of the early Paleo-Indians and generations of Native Americans to follow inhabited and adapted to coastal environments. About 3,000 years ago the sea level of the Pacific Coast stabilized to a level close to what we see today. Native Americans living along coastal lagoons, estuaries, bays, and coast lines moved their inhabitation sites, villages and seasonal camps, as needed to accommodate and adjust to sea levels.

Natural Disasters:
American Indian stories/accounts of volcanism, earthquakes, tidal waves, fires, and floods provide rough estimates of significant events, which impacted tribal groups. Changes in vegetation conditions and animal populations following natural disaster were observed and often recorded in the oral traditions.

RESPECT AND RECIPROCITY
Creation Accounts and Teaching:
Creation accounts and myths provide a context of how to live in place, as well as our responsibility to the natural world. Stories serve as the ecological prescription of how to live in place. Significant forms of ecological knowledge can be disseminated through stories and creation accounts. Well-told and information-rich stories can reach all age classes and genders teaching important lessons. The lesson of a story is remembered when we encounter a situation, place, or object in our environment serving to reinforce the principles and ethics of the story. The landscape and subsistence activities become a form of living in a reminding place. For example, if you were taught as a youth stories and beliefs that the forest watched you, would you be inclined to wantonly kill or harm animals, or practice other unacceptable behaviors when you were by yourself?

This teaching skill can be effective in education systems today if conducted appropriately. Kinship terms are used to describe plants, animals and places resulting in a sense of respect for the natural world. Youth are taught that they are related to the natural world and to respect things even if they do not understand it, and that in time through advanced training or personal

insights and experiences, some mysteries of the natural world will be revealed. The individual can gain respect from understanding the importance of care-giving and communal responsibility for the natural world. Reciprocity, or the need to give back for what one takes or uses is established over time. The notion, that if you take care of Mother Earth, she will take care of you is taught as part of the wisdom of traditional ecological knowledge. As an individual acquires knowledge, they have a spiritual and social responsibility for the knowledge.

Knowledge and Responsibility:
To inherit traditional ecological knowledge from elders, mentors, family and friends is an honor and with it comes a responsibility. Today, students are bombarded with information, and other than through the use of exams, are left to their own to decide what is significant or not to retain. Historically, and for many American Indian people today involved in subsistence activities, knowledge of the local environment is critical for survival.

Natural Laws:
Laws or codes of ethics related to natural resource use and management were handed down from the Creator or spirit beings to the people. For example, creation accounts for tribes in northwestern California reference a time when the first spirit beings/people taught humans the natural laws of how to live and manage the environment.

Ritualized Forms of Management:
Management and harvest practices became ritualized overtime unifying socio-cultural organization to ecological conditions. In contrast to society today, many American Indians had and have rituals and ceremonies that are integrated with land management practices.

World Renewal Ceremonies:
Many tribes practice ceremonies that acknowledged and honored plants, animals, and places on the land in a sacred manner. These ceremonies required that people acknowledge and respect their environment. The content of world renewal ceremonies of American Indians can be taught to students in a manner without setting a foundation for non-Native American eco-spiritual New Age practices. The teaching point would be that the most sacred regalia and items used in the ceremony are also ecologically very rare or important. To have the sacred objects, regalia, and foods to conduct the ceremony require careful and considerate management of the environment

and animal and plants used to conduct the ceremony. There is no equivalent in western modern society today.

Payment and Retribution:
The Native American philosophy of making payment, an offering to plants or animals utilized, was a way of recognizing the importance of the resources to the people. Retribution is the acknowledgement of wrongdoings and mismanagement by humans of the natural world. Retribution is a form of reflection on environmental history of place, and should or could accompany restoration of degraded habitats or ecosystems.

EDUCATIONAL EXPERIENCES AND TRADITIONAL ECOLOGICAL KNOWLEDGE
Nurturing Youth:
An investment in youth is an investment in the future. It is important that our western education system have some standardization method of education but steps must be taken to encourage the dormant talents that reside within the students, and encourage those individual students to pursue what they do best. It was common practice among Native peoples to observe youth, see what natural or gifted talents individual youth possessed, and then seek the appropriate mentors and skill-building opportunities for the youth.

Mentoring by Elders:
Native youth would be, and some still are, assigned to spend time with the appropriate elder, family members, or friends to have a loosely structured "master-apprentice" type program. Master-apprentice relationships were developed and served to retain and promote the maintenance of traditional ecological knowledge. Today, some tribes or tribal communities have programs funded under cultural heritage grants that teach basketry and language.

Social Rank and Opportunities:
Many American Indian tribes were hierarchical, where not every individual in the community or village had the same or equal right to do what they pleased. Youth born into wealthy families would be privileged with opportunities not available to youth born to lower class families. This point is important to consider and reflect upon today. It was possible for an under-privileged individual to make great advancements in life. Such modeled fame was a central theme of myths and legends.

Individual Experiences:

Beyond some initial or even strict training from elders, mentors, family or friends, individuals were encouraged to have a certain amount of self-discovery and time to figure things out on their own. This individual experience could come at puberty ceremonies, vision quests, or "self-training" to remote area away from the village. Today's youth are not really encouraged to have individual experiences. The social/educational system structures many aspects of students' educational environment rather than supporting or fostering individual expression and experiences.

Collective Community Knowledge:

Knowledge and understanding of the environment, collectively gathered and developed through time within a community, is "Collective Community Knowledge". This form of knowledge is a general way of knowing or understanding the environment within the community. No one person or family is responsible for the knowledge, it is just what is known and taught collectively by most or all of the community. Collective community knowledge is specific to a community for a local place, but not as specialized as what certain individuals or families have about specific places or things in that area. For example, individual fishermen or a fishing family may have a well-developed and specialized form of harvesting fish during up-stream migration at certain places along the river under certain flow conditions of the river. Yet, the community may collectively know that fishing is good after rains and the flow of the river as lessened and river clarity improved but not the specifics of where or how to successfully catch the fish.

INTEGRATED EDUCATION

Ecological literacy is defined as "the ability of an individual or community to observe, understand and predict ecological processes and phenomena of Nature at various stages in their development". This definition expands and is developed further than its other associated use regarding environmental education. This suggests that it is a way of learning to "read" and understand ecological processes, which help humans explain phenomena of Nature. It integrates TEK and Western Scientific Knowledge together in manners that begin to teach us how to live sustainably with our environment. Ecological literacy accumulates intergenerationally by individuals and community. Traditional ecological knowledge could be at the core of an integrated education based on a Native American education model. This education would involve elders and family members who invest in younger generations. Youth are taught from an early

age about the environment through stories and hands-on experiences. At the core of these teachings are respect and reciprocity. Subsistence activities and ceremonies served and continue to serve as the most effective tool in fostering a culturally-based, integrated education for many Native American youth.

Multiple members of the community are relied upon in many situations where the "Collective Community Knowledge" is tapped into. In today's world an "integrated education" for primary and secondary education often involves field trips several times a year to different places if funding and teacher enthusiasm exists. When students are qualified to attend college, they may get non-book experiences or alternative educational views through college course electives. Interdisciplinary programs have recently been developed and established in most public state college and university systems. Students may also gain considerable insights to sustainable living or TEK while participating in Education Abroad programs. Regionally there may be field schools, such as the Siskiyou Field Institute in southern Oregon and northern California, that offer a diverse of array of courses about local environments and cultures.

INDIGENOUS ENVIRONMENTAL MANAGEMENT PRACTICES

Prescribed Burning:

Fire use by Native Americans varied in seasonality, intensity, severity, specificity, and duration in comparison to lighting-ignited fires. Fire was used extensively in most areas of North America by Native American individuals or as part of communal practices. Understanding how Native peoples used fire in the past is important in the teaching of many aspects of forestry, ecology, and wildlife management, as well as, in addressing contemporary restoration needs. It has not been until very recently that major academic and agency researchers/lectures have acknowledged the potential role that aboriginal fire may have served in shaping North American ecosystems.

> "Indigenous people's detailed traditional knowledge about fire, although superficially referenced in various writings, has not been for the most part been analyzed in detail or simulated by resource managers, wildlife biologists, and ecologists…Instead, scientists have developed the principles and theories of fire ecology, fire behavior, and effects models, and concepts of conservation, wildlife management and ecosystems management largely independent of native examples" (Lewis and Anderson 2002:4).

Landscape-level Effects:

It has been commonly assumed, and is still regarded by some, that aboriginal burning practices were much localized and did not influence larger or even vast areas of North America (Vale 2002). There were indeed varying levels or scales of influence on ecosystems by Native burning (Anderson and Barbour 2003).

Lighting versus Anthropogenic:

Natural resource managers may be familiar with and even refer to the "Natural" fire regime, but fewer have yet considered or heard of the concept of "Cultural Fire Regimes" (Lewis 1982). Cultural fire regimes are generally composed of alternate seasons of burning for different kinds of settings. For example, some basketry areas are burned in the spring and food resource areas in the fall, outside of the "normal" fire season for natural lighting fire ignition. Frequencies in which fires are set and reset over varying periods of time by Native peoples vary across the landscape compared to natural ignitions. Corresponding intensities in which fuels can be burned vary from the natural potential intensities. Indigenous people may find it desirable to burn some selected areas more intensely than others. There are "corrective" fires, which may drastically shift the structure of a habitat enabling the future use of "maintenance" fires to maintain ecologically and culturally-desirable habitat conditions (H. Lewis in Bonnicksen et. al. 2000). The specific selection of sites fired and those that are not are almost always tied to resource and cultural objectives. There is a range of natural and artificial controls that humans employ in limiting the spread of fire, such as the time of day. Mornings are generally cooler with more moisture present in the fuel. Winds can have a mixed effect on fire behavior. The type, structure, and quantity of fuels are considered. The aspect and gradient of the slope influences potential fire spread and activity. The relative humidity of fuels is considered. Various natural/human fire breaks created by topographic features and human construction can contain and limit the extent of the area burned. (Lewis 1982 in Bonnicksen et. al. 2000).

FIRE ADAPTED ECOSYSTEMS AND HUMAN COMMUNITIES

Many ecosystems assumed to be "fire-adapted" may be more adapted to the types of Native burning practices formerly practiced than available by true natural ignitions. In many areas of North American where Native Americans used fire, their socio-cultural material and religious practices had adapted to burning (Anderson 1999, Williams 2000). Social adaptations or rather many nations and tribes being "socially-adapted" to fire is a perspective that is rarely accounted

for by anthropologists and natural resource managers. It is more common to understand and accept "ecologically adapted" plant and wildlife communities or species rather than human societies. There are many great challenges faced today by society struggling to become "fire-adapted".

World Renewal Ceremonies practiced by some tribal groups of North America developed over time to be connected with burning practices. Ceremonial regalia reflected the wealth of the place and people. The regalia was often constructed from specific materials which required growth forms or conditions resulting from fire-induced changes. Ceremonial use of fire to promote ecological integrity represented a highly evolved and integrated socio-cultural and ecological system. All aspects of community acknowledge fire as an important ecological process.

PRESCRIBED BURNING VS. NATURAL LIGHTNING IGNITIONS

Frequency:

Prescribed burning may be employed at times more or less frequent than the ignition of natural lighting leading to fire.

Extent:

The extent (area burned) of prescribed burning can vary from project to project to meet desired objectives. The extent of most natural lightning ignition started fires are very small, sometimes limited to an isolated tree. However, when these fires spread and become larger conflagrations the extent is much greater.

Seasonality:

Prescribe fire can be utilized at almost any season. Depending on the bioregion or area, Natural lighting fire ignitions usually occur at a certain time of year. In the Pacific Northwest, the Natural fire season is usually mid-to late-summer.

Intensity or Severity:

Generally, the intensity and associated severity of prescribed burning is carefully predicted and modeled, with low intensity being preferred due to containment and control issues. Wildland fires started from lighting, given the present condition of most western forests as a result of fire suppression and industrial forest management will be more intense and generally more severe.

Ecological Consequences:
The ecological consequences associated with prescribed burning are generally better understood and predictable. Wildfires/lighting-ignited fires generally have more detrimental ecological consequences, by radically changing the forest/grassland structure and function related to wildlife habitat or ecological goods and services.

REASONS FOR INDIAN FIRE USE (Fire 21-Management Today Vol. 60 No. 3 Summer 2000 Page 11 Gerald W. Williams USFS/WO - modified from H. Lewis)
Hunting:
Indians burned large areas to force deer, elk, antelope, rabbits, and other prey into small, unburned areas for easier hunting. Fire was also used to drive game over cliffs or into impoundments, narrow chutes, and rivers or lakes where the animals could be easily killed. Indians used fire for hunting both directly when driving game and indirectly, by reducing, modifying or increasing habitat quantity and quality to influence the location of game.

Crop Management:
Native Americans used fire to harvest crops, such as tarweed, greens, grass seed and to improve yields of camas, brodiaeas, lilies, yams, seeds, berries (especially raspberries, strawberries, and huckleberries). Fire was used to prevent grasslands from being grown over by undesired vegetation, and to clear areas for planting tobacco and grass seeds. Burning facilitated the gathering of acorns by clearing the ground of vegetation under oak trees. Often, as soon as enough fuels had accumulated or undesired vegetation had encroached on desired crops, the area would be burned. The timing of patch burns can be generally inferred by the length of time it took for fruits and berries to set, ripen, and be harvested, or the appropriate time to clear land for root digging or fiddlehead picking (Peacock and Turner 2000). Crops were maintained and harvested in discrete locations in which the dominant species was established. This approach creates an "even-aged" management condition of diversified mosaics (Kimmerer and Lake 2001). Access to croplands was provided by foot trails and/or canoes, depending on location. The harvest of fire-induced foods was not insignificant, and productivity of many habitats can be increased with the appropriate frequency and severity of fire. "Practices such as landscape burning, pruning, tilling, and even picking are said to improve the resources, making them more bountiful and enhancing their quality" (Peacock and Turner 2000:134).

Insect Collection:
Fire was used in meadows to round up and roast grasshoppers, kill adult yellow jackets, roast larvae in combs, and smoke out Pandora moth larvae and adults.

Pest Management:
Burning was used to reduce pest populations, including rodents, poisonous snakes, ticks, black flies, mosquitoes, seed/nut weevils, basket plant parasites, forest beetle infestations, and to kill mistletoe in mesquite and oak trees, tree lichens and mosses, and invasive native species. Many tribes prescribed fire to patches of vegetation when insect infestation was observed. Fire was commonly used to reduce seed weevils in important nut crops, stem borers in basketry plants, and to reduce tick densities in leaf litter and forest duff where wildlife bedded (Strike 1994:164, Anderson 1999).

Range Management:
Fire was used to keep prairies and meadows open from encroaching shrubs and trees and to improve browse for deer, elk, antelope, horses, and waterfowl, and to increase the quality of vegetation structure, forage, palatability, and nutrition. Many of the plants and wildlife species used and managed by people were also important to other plants and animals for habitat, cover, or forage (Norton et al. 1984). Thus, burning changed the value of vegetation patterns to other species (often desired species) that used the same foods, or took advantage of improved conditions of mobility, visibility, and cover.

Fireproofing:
Some Indians used fire to clear vegetation from areas around settlements and near special medicinal plants to protect them from wildland fires. Indians used frequent low intensity fires to alter the structure of different plant communities to reduce the buildup of fuels decreasing catastrophic wildland fires. During wildfire occurrences, these Indian burnt areas functioned as "refuges" for threatened wildlife species. Even in severe, stand-replacing events, fields of grasses, berry patches, riparian meadows, and fern prairies often remained unburned, or only slightly singed. Many “patches” or areas that required frequent burning also served as fuel breaks against unintended or undesired effects of wildfire (Lewis and Anderson 2002:15).

Tree Felling/Fuel Wood:

Indians used fire in different ways to fell trees. After fire swept through chaparral or woodland areas, branches or stems were broken off for firewood. Target species used for fuel were dependent on location and cultural activity. In the Pacific Northwest Cascade Mountains, large amounts of smaller diameter conifer logs would be burned in the yearly processing of huckleberries. In northwestern California, and other mountainous regions of the Pacific Northwest, hardwood logs and branches would be utilized for the smoking and preservation of meats.

Clearing Areas for Travel:

Indians used fire to clear overgrown trails for travel. In forests and brush-lands burning improved visibility for hunting, reduced attacks by predators and enemies, and assisted in warfare. Ignition locations and fuel breaks were located along trails. Trail systems divided the landscape up into large scale patches that could be burned as fuels and weather conditions permitted. Many important resource patches were in close geographic proximity to trails. Trails were about two feet wide, worn down to bare mineral soil, and would have served as fire lines in many cases.

Clearing Riparian Areas:

Indians commonly used fire to clear brush and other debris from riparian areas and marshes to stimulate new grass, plant growth, and tree sprouts. Target species included cottonwoods, willows, tules, cattails, sedges and grasses. Villages were located at low gradient, lower elevation sites near the confluence of major stream and river systems. Riparian areas around villages were one of the most intensively managed areas on the landscape. Fire often served a similar role to flooding as a disturbance agent (Anderson 1999). Riparian areas were a source of firewood.

Basket Materials:

High quality and quantities of materials for baskets were needed to support the material culture of Indian people. The majority of materials needed to support the cultures of American Indians required fire for maintenance and to increase quality. Examples of target species and objectives for burning including the following: Willows, to increase straight shoots and reduce pests; Bear grass, to reduce thatch and increase leaf pliability; Deer grass, to reduce thatch and increase stem pliability; Hazel, to reduce deformed growth and increase the number of straight shoots (see Anderson 1999).

Aquatic-Headwater Springs:
For many Native American groups, headwater areas, springs, waterfalls and other unique water formations were considered to be very sacred. For many tribes, and wildlife species associated with springs were also sacred. For example, the Karuk in northwestern California considered the Pacific giant salamander to be the purifier of water. When this salamander is observed in the springs or creeks, the water is considered healthy and safe. Springs and creeks were and still are utilized as food processing sites. Many tribes in California used springs and creeks for leaching the tannins out of acorn flour, in the processing of acorn meal for food. Burning was used to clear the forest and brush lands above and around springs to increase and maintain the flow of water during the year. Clearing vegetation reduced evapotranspiration from vegetation, allowed snow packs to sit longer on the soil adding to water percolation into the soil, and allowed access to watering sites for humans and wildlife.

The following selection of work is taken from a presentation on Cultural Environmental Management at Southern Oregon University in the spring of 2002 at the Native American Ecological Symposium.

INDIGENOUS HUNTING PRACTICES
Hunting varied in seasonality, location and number of animals that would be harvested by individuals or groups. Hunting of different animals species developed into a very specialized practice and tribal hunters strived to honor and respect their prey.

Purification:
Sweating and fasting served as a preparation method that strengthened the relationship between the hunter and the prey.

Training:
Spiritual, physiological and physical training was important and reinforced the discipline needed to track, harvest and prepare game.

Prescribed burning to direct game:
See Indian uses of fire and hunting above.

Methods:

Animal hides or head decoys were often used. The use of animal hides or head decoys required special skill in stalking the animals at close quarters. Knowledge of animal behavior was important. Spears, bows and arrows of high quality required detailed knowledge of plants, animals, and rock types to construct weapons. The manufacture and use of these hunting implements required skill and knowledge of plants and animal products. For example, to make a sinew backed bow, the hunter had to know the ideal conditions for yew tree growth for tight grain wood free of branches or knot holes. The hunter also had to study and learn of the grain and moisture properties of wood. And lastly, the hunter had to learn ungulate or big game tendon and muscle anatomy to select the best sinew material to prepare the bow. Similar knowledge was required to facilitate the growth of arrow shafts from certain shrubs.

INDIGENOUS FISHING PRACTICES

Fish harvesting practices employed by Native Americans varied with seasons, location/habitat type, and the number and type of fish species that would be harvested at any given time. Some types of fishing were and still are conducted by individual fishermen. Typically, fishing is conducted in a communal manner among immediate family members, friends, or members of the same tribe at a given location. A significant diversity of harvesting methods are utilized for an array of fish species.

Traps and Snares:

Detailed knowledge of prey movements, migration patterns, behavior and response to environmental conditions is necessary to develop, design and construct traps or snares to harvest fish. Knowledge of the quality or strength of materials is essential to effectively harvest fish for survival.

Nets:

Nets were some of the most effective tools available to harvest fish species and several types including seines, gill nets, set nets, dip nets and hoop nets were used. Each style of net required knowledge of where it was most effectively used in marine, estuarine, or riverine environments. Historically, twine material used to make nets was constructed from carefully prepared plant materials, usually fibers contained in leaves or stalks. Contemporary tribal fishermen mostly use synthetic line or twine. Knowledge of knots and the strength of different knot types was and

continues to be important to fishermen.

Weirs (Fish Dams):
Weirs constructed primarily of rock, wood and plant materials was utilized to capture or detain fish. A diversity of weir styles and sizes were constructed in marine intertidal, estuarine, and riverine environments. In tidal areas, weirs were placed in estuary slough channels and tidal gates were used to trap fish. In rivers, weirs were placed on wide shallow gravel sections. For many tribal groups across North America, the construction and use of fish weirs was one of the most effective methods for harvesting fish. Social organization and manipulation of the physical and biological environment were required to be effective. Natural laws were followed and prayers of thanks were given after the harvest.

INDIGENOUS GATHERING PRACTICES
Gathering practices varied by season, location/habitat-type, and the amount of products that would be harvested given the productivity or capacity of the area. Individual harvesters/gathers usually worked in organized units consisting of small to large groups depending on the abundance of the resource being gathered. The following methods were commonly employed:
Digging/Tillage:
Bulbs, roots, and shellfish were usually gathered by the use of digging or pry stick and hands. When harvesting underground bulbs and roots digging served to till the soil fostering the aeration of soils, helping to distribute plant fragments and increase vegetative propagation. Digging and tilling also helped to reduce competition among plant species within the soil profile. Digging and tillage of below-ground plant parts or scraping off shellfish was a form of intermediate disturbance that could, if done appropriately, provide food and material for Native people and increase the diversity and vigor of areas harvested. For plants, digging often aerated the soil, reduced competition among plants, and in some cases stimulated plant growth. Shellfish harvesting similarly reduced competition among shellfish and algae by opening up new area of colonization and thinning clumps of shellfish.

Picking:
Berries, herbs, seeds and shells would be picked off or up. These harvesting methods where conducted in manners that stimulated re-sprouting or fostered the distribution of seeds leading to the expansion of the local population.

Coppicing and Pruning:
The majority of plants used for basket materials were at one time or another coppiced or pruned for quality enhancement. The management and use of plant sprouts, roots, and stems for basket material was often conducted in ways that did not completely kill the whole plant. Additionally, these activities often provided direct and indirect benefits for wildlife (see examples above).

Thrashing and Winnowing:
Grass seeds were collected in this manner. Collecting seeds also distributed the seeds, fostering the spreading of plants to new sites.

Knocking:
Acorns, pine cones, and fruits were commonly knocked from branches by Native Americans as a gathering or harvesting method. Sometimes it was necessary to knock fruits off limbs. It has been hypothesized that the breaking of terminal branch tips, stimulated multiple tip branch growth leading to the increased production of nuts, seeds, or fruit (Ortiz 1993, Acorn Crop in *Before the Wilderness*).

Prayers of thanks and following Natural Laws accompanied harvesting or gathering.

IMPACTS OF EURO-AMERICAN SETTLEMENT AND COLONIZATION
Diseases:
In western North America, diseases brought by Europeans, Africans, and others decimated aboriginal populations of American Indians. Sometimes up to 90% of the local population of a tribe would be killed or inflicted by non-Native diseases. This massive reduction in population affected the extent, intensity, and duration of American Indian land management practices at the time of contact with Europeans, Asians, and Africans.

Genocide:
Many Europeans/Americans killed American Indians to access Indian lands and natural resources. Many civilian groups were organized to hunt down and collect bounties for killing Indians. European countries also organized alliances with different Native American tribes that were enemies to track, capture and kill each other.

Relocation:
Many American Indian tribal groups were relocated out of their aboriginal territory on to temporary or permanent reservations or reserves.

Outlawing Ceremonies:
The U.S. and Canadian governments outlawed the assembly of Native peoples for religious purposes, prohibiting ceremonies due to religious and safety concerns. Many of the ceremonies, as mentioned above, were tied to natural resource management practices.

Acculturation:
"Kill the Savage to Save the Indian" was a common policy among the U.S. government and civil service programs of American and Canadian governments. American Indians and First Nations peoples were required to give up traditional indigenous languages, dress, and living practices to become more like the civilized white race.

Social Reorganization:
After diseases, genocide, relocation and acculturation programs, many American Indians had to scrape together what they had left to socially reorganize as a survival method. Multiple tribes from diverse geographic regions were forced to co-habitate in a new area. Social organization and structure was important for them to survive in the face of Euro-American and Euro-Canadian western pressures.

Over-hunting:
Once indigenous people were partially or fully removed from an area, Europeans began to exploit natural resources and wildlife for profit and greed. In the late 1800's in the western United States, cattle were often used as beasts of burden rather than food. Whites often killed wildlife utilizing only select parts of animals leaving the rest to waste or to prevent Indians from obtaining the game.

Over-fishing:
The same thing that happened to wildlife applied to fish species and runs.

Landscape Reconfiguration:
As Europeans/Americans settled areas, sudden and dramatic changes began to take place on the landscape. Land surveys, farming, water diversions and the hydrological mining of rivers or riverine areas were most noteworthy.

Exotic introductions:
Europeans, Asians, and Africans brought plants, animals, insects, and germs new to North America that began to change ecological and cultural communities.

Fire Suppression:
Society's fear of fire, and the government's policy to protect forest resources led to the development of fire suppression policy in the early 1900's. Fire suppression began to change the structure, composition, and diversity of grasslands and forested ecosystems.

Water course manipulations:
Dams and irrigation systems dramatically altered natural hydrologic systems affecting important ecological processes such as flooding as well as fish and wildlife habitat and populations.

AMERICAN CONSERVATION MOVEMENT
Natural History-Species Identification:
Many of the species that were new to science were already understood and described by indigenous people in the details of their language.

Establishment of National Parks, National Forest System and Refuges:
In efforts to protect areas from Euro-American settlement, development, and exploitation the national park, federal forest reserve and wildlife refuges systems were developed. The creation of these "parks for conservation" often involved the removal of indigenous people and the suppression of indigenous land use and management practices in these areas (i.e., hunting and burning).

Fish and Game Protection Laws:
Fish and game laws enacted to protect Euro-American over-harvesting exploitative methods. Laws were often imposed on American Indian tribal groups regardless of treaty rights.

Fire Suppression Laws:
Fire suppression laws made it illegal for American Indians to continue traditional burning practices. Indians found setting fires were often persecuted by the law. Fear of Indians and fire contributed to enforcement of this policy.

Conservation Organizations:
Early conservation organizations were nothing more than rich, elite gentlemen hunting clubs that aimed to reduce utilization of wildlife, fish, and lands by other groups. Aldo Leopold's land ethic, was a cornerstone in American identity of natural resource preservation. Review and critique of

Leopold's conservation ideas are reminiscent of early American Indian concerns and understanding of natural resources.

Restoration:
A community rally for restoration of degraded habitats and ecosystems became prominent after the Dust Bowl, the Depression and soil conservation effort, and then 60 years later for grassroots activities in the western United States for fisheries, forest health and watersheds.

BEGINNING OF RESTORATION
Nurseries-Vegetation and Soil Conservation:
Most of the early work for watershed or soil restoration involved the development of nurseries to propagate local native plants to be used for reforestation or restoration to protect soils.

Hatcheries-Supplementation of Stocks:
The first hatchery in the western U.S. was established in the 1870's in northeastern California along the McCloud River to supplement the depressed populations of salmon after mining and commercial harvesting. Soon after and for the next century, hatcheries were perceived as the way to save salmon on developed and impacted rivers.

Mitigation-(Destroy the original, create a replacement):
Out of development, and in an effort to alleviate restoration, the concept of mitigation banking was formulated. Essentially, mitigation involved the destruction of the natural environment or habitat and the artificial creation of something humans thought approximated the originally destroyed area.

Government-Directed Programs:
Funding for restoration was very often from government funding and funding followed trends or popularized issues.

Citizen Groups:
Citizen groups were often grassroots organized collectives that became concerned about what was happening in their local area.

Environmental Quality, Health and Safety:
The citizen groups were often the ones to bring about the concerns about reduced quality of the environment.

RECENT RESTORATION EFFORTS THAT MAY ACCOMMODATE TRADITIONAL ECOLOGICAL KNOWLEDGE: PASSIVE AND ACTIVE

The concept of passive versus active restoration was put forward by Boone Kauffman and colleagues in the late 1990's. Passive restoration is the removal or stopping of the action causing habitat degradation, and letting nature take its course for ecosystem recovery without human intervention. For example, stop grazing cattle in riparian areas, and let the willows and sedges grow back on their own. Active restoration is human intervention to facilitate the recovery of ecological diversity and productivity. For example, after the cattle are removed, design in-stream structures for fish habitat, stabilize bank erosion with heavy equipment using a more "engineered" approach, and /or directly replant or seed vegetation.

Degraded Fisheries Habitat:

In the Pacific Northwest, many active approaches were taken to restoring fisheries habitat by building in-stream structures. These structures were constructed from gabions, rocks, root wads, logs, and smaller trees.

Reforestation and Thinning:

After planting areas that were formerly clearcut, restoration thinning involved manipulation of the age, type, and size classes of trees to facilitate a more "natural" collection of trees to recover forests.

Prairie/Grassland:

Thinning of shrubs and trees, followed by prescribed burning, is commonly practiced to restore prairies and grassland ecosystems. Reseeding of native grasses and forbs is often needed. Control of exotic plants by herbicides or hand pulling as well.

Wetlands:

Wetland restoration involved water allocation and vegetation management or planting.

Erosion Control:

Creative methods were developed and employed to preserve topsoil. Hill slopes were stabilized by planting grasses, shrubs and trees, and applying geo-textile or "eco-fiber", a type of coconut fiber netting that covers the soil and allows planting.

Species Re-introduction:
Species that were formally extirpated, were re-introduced following some restoration attempts of the species habitat.

Prescribed Fire:
It has taken quite a while for society and natural resource managers to accept fire as a management tool. Social acceptance of smoke and modification of the Clean Air Act will be necessary to expand prescribed burning.

Community-Watershed Councils:
Who is better qualified to prioritize and institute restoration projects than the local people? Grass-roots organizations of diverse land-owners and local residents have formed into watershed councils and fire-safe councils that have developed collaborative agreements to restore the areas in which they live.

DEGRADED FISHERIES HABITAT
Vegetation Planting:
Streamside planting is used to facilitate shade, and recruit large woody debris in the future. Planting trees provides a future structural component to denuded or cleaned streams.

Enclosure Fencing:
Fencing was targeted to remove excessive grassing of stream side/riparian vegetation and allow for recovery of riparian vegetation and improve habitat quality.

Gabions:
Rock-cobble and chain-link fence material is used to stabilized banks. This is an early engineered approach to stream restoration.

Rock Weirs:
Boulder-constructed weirs or rock deflectors were the next progression in the stream restoration/bank stabilization projects.

Logs, Root Wads, and Boulders with Cable:
In an effort to mimic what was being observed and studied in "reference reaches", areas considered to represent more natural, healthy fish habitat, fisheries biologist, geomorphologists,

and hydrologists collaborated to develop more "natural" human engineered and designed structures. These types of projects were showing relatively good success until several large flooding events in the Pacific Northwest in 1996 and 1997, at which time these human "log complex structures" and natural woody debris were washed out and were blamed for flood damage.

Uncabled:
In response to the log complex structures being considered as "un-natural" in their ability to move with hydrologic events (floods), government fisheries (NOAA) programs required criteria for log size and length that could be used for fisheries restoration projects in the Pacific Northwest.

Riparian Thinning/Planting:
A long-term perspective of recruiting large woody debris was to employ silvicultural techniques to thinning in riparian areas, and replant areas with desired conifer and hardwood species.

Instream Flows:
All the work in the world could be done to restore fisheries habitat, but fish still need water. Restoration of stream flows to a more historical and natural flow regime is necessary to satisfy fisheries recovery efforts at various scales and life stages of fish.

REFORESTATION AND THINNING
Planting of Native Species:
Select native species that more effectively survive the local conditions.

Post-fire Rehabilitation:
Salvage logging only in areas that will create minimal soil disturbance, and retain larger and/or live trees. Replant with local tree stock.

Thinning:
Select tree compositions and age classes to satisfy a diversity of forest habitat requirements, i.e., commercial wood production and wildlife habitat.

Mixed Species Forest:
A more diverse forest offers better wildlife and human use habitats.

Reduce Competition and Increase Diversity:
Thinning is necessary to improve physical and biological conditions of forests and maintain forest productivity. Thinning increases light, water, and nutrients to remaining healthy vigorous trees, reducing the change of insect infestation and disease.

Post-beetle Infestation:
Insect epidemics should be targeted early to prevent spread to adjacent stands of forest.

PRAIRIE AND GRASSLANDS
Removal of exotic species:
Contemporary restoration efforts have targeted the removal of exotic or invasive species in prairies or grassland ecosystems. Examples include the removal of scotch broom and younger Douglas-fir in western Oregon White oak savanna and woodlands.

Prescribed Burning:
Fire was used by Indigenous people to maintain prairies and grasslands, and fire ecologists are using fire as tool in a similar way for similar objectives.

Re-vegetate:
It may be necessary to plant rare native shrubs, forbs or grasses following exotic or invasive plant removal and prescribed burning.

Grazing Regime:
Limited and careful grazing may be used to maintain diversity of grasslands. This is being done in selected areas in California's Sacramento Valley.

WETLANDS
Mitigation and Recreation:
Wetland mitigation has served to create wildlife habitat as well as birding and hunting opportunities for people.

Purchasing and Protection:
Some conservation groups have purchased wetlands in an effort to protect them from development.

Water Management:
Integrated resource planning is necessary to provide water critical to the maintenance of wetlands. Flood management is a large part of this.

Vegetation Planting:
Planting important native plant species back into areas of wetlands that may have been removed during prior development.

Prescribed Fire:
Natural resource managers are learning that fire was a critically important component to wetland vegetation community diversity and associated wildlife habitat. (e.g., Klamath Marsh for tule/ waterfowl habitat).

EROSION CONTROL
Landslide Stabilization

Road and Culvert Removal:
Road de-commissioning and contouring back as close as possible hillsides will prevent erosion. Under-sized culverts were a significant contributor to landslides and erosion during high precipitation events.

Vegetation Planting:
Seedlings, plugs, stakes and bundles are all used to prevent erosion.

Wetlands:
Many wetlands are threatened by siltation or erosion due to water channelization.

SPECIES RE-INTRODUCTION
Natural Colonization of Restored Habitat:
Some species were suppressed and then flourished after restoration treatments facilitate conditions for their growth and reproduction.

Captive Breeding Programs:
What is the price of extinction? For example, millions of dollars have been spent on efforts to save the California Condor. The condor was and still is a very sacred species to many Native

American groups. How much money should be spent breeding a species in the laboratory when the habitat has not been restored at a scale or condition that would support the species? Is the habitat suitable? Some environmental historians and fire ecologists claim that the southern California wildlands were formerly more open areas of grass and forbs, which since the Spanish and American settlement has grown in and over with brush fields due to fire suppression. The condor used the former openings as feeding places on carrion. Despite urban population growth, landscape scale restoration and prescribed burning would be necessary to improve condor habitat.

Trophic-level Interactions and Food Webs:
In Yellowstone National Park, re-introduced wolves reduced elk populations through predation, and caused elk to be more transient. Elk browsed less on the willows and aspen. Willow and aspen re-sprouted and grew. Riparian habitat expanded, benefiting migratory/neotropical birds and beavers. Beavers moved in to feed on willow and aspen growth, built dams, increased size, quantity, and quality of pool and pond habitat which benefited aquatic organisms, especially native trout.

PRESCRIBED FIRE
Because most ecosystems were burned by Indigenous people, most species contained within them are adapted to fire. Fuel conditions and vegetation communities have changed as a result of suppression of anthropogenic and natural fire ignitions. Seasonality and location may differ from Indigenous prescribed burning.

Ecological Fire Debt:
Ecological fire debt was a concept developed to describe the number of times an area should have burned, but has not since fire suppression has been enacted. Fire may have been set by lightning or other natural sources and humans. Integrate Indigenous knowledge and practices where practical.

COMMUNITY-WATERSHED COUNCILS
Becoming a Person of Place:
Local community residents are learning to have a place-based identity. This model in some ways mimics the way indigenous people identified themselves - thinking bioregionally, while acting at the watershed level. Informed and motivated community members are working with

governmental agencies, private landowners, and others to address the environmental issues facing them.

Becoming Ecologically Literate:
Learning to live with a place takes experience, knowledge and the capacity to control human actions that would otherwise degrade the quality or health of the environment.

Community Building with an Investment in Place and Future Generations:
It has been difficult for many Americans to develop a sense of place. Some families who have homesteaded the lands and stayed in the same area for several generations begin to develop this identity and look to the place to support them in the future.

Shared Responsibilities for Environmental Consequences:
When watershed councils composed of diverse individuals make collaborative decisions and take actions, they have to jointly own the outcomes of their choices.

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Provides a description of traditional ecological knowledge (TEK) and makes the case for its inclusion in science curriculum. The article explores several aspects of multicultural science and pedagogy and provides examples of contributions to science, environmental understanding and sustainability by indigenous people from around the world. Instructional strategies for blending Western modern science and indigenous science in the classroom are also included.

Curriculum Activities

Caduto, Michael and Brunchac, Joseph. 1998. Keepers of Life-Discovering Plants Through Native American Stories and Earth Activities for Children. Golden, Colorado. 265 pages.

Caduto, Michael and Brunchac, Joseph. 1988. Keepers of the Earth-Native American Stories and Environmental Activities for Children. Golden, Colorado. 209 pages.

These books include stories and activities that teach children respect and stewardship for the Earth and all living things.

Completing the cycle –It's up to you: responsibility for the environment. Indian Dept. of Education. 1993 (Eisenhower National Clearinghouse 000 099)

This instructional module has activities designed to provide students with a variety of concrete ways to study the relationships between behaviors and consequences. Hands-on activities focus on development of many content areas such as language arts, social studies, mathematics, science, fine arts, and health. Investigations also look at how the people, events, and decisions of the past influence the present and future by examining Native Americans, pioneers, and people of today.

Project Willow: Understanding Native American culture through environmental education. Developed through a partnership between the Washoe Tribe of Nevada and California and schools districts in Nevada and California. 1995 (Eisenhower National Clearinghouse. 002-744)

Ecological concepts such as resources, carrying capacity, competition, niche, range, flow of energy, and ecological change are highlighted. The effort of Euro-American

settlement on Washoe lands along with how the loss of traditional lands has had a profound effect on Washoe people are examined.

Videotapes

Chinook Trilogy: My strength Is From the Fish, Empty Promises Empty Nets, and Matter of Trust. Videocassette. Columbia River Inter-Tribal Commission, Distributed by Wild Hare Media P.O. Box 3854 Portland, OR 97208.

This three part video collection focuses on Indians of the Columbia River. *My Strength Is From the Fish* reveals that salmon are both the core of the culture and the key to its survival. *Empty Promises Empty Nets* touches on landmark legal decisions concerning treaty-bound fishing rights of Columbia River Indians. The final part of the series, *Matter of Time*, looks at current pressures and issues shaping salmon populations and an impassioned plea for change.

The Mohawk Legacy: A matter of survival. Project Future, Potsdam College of the State University of New York. 1992 (ENC 000-231)

Produced by American Indians, the video is designed to be a teaching tool for middle school curricula related to biology, environmental studies, technology, culture or history.

After discussing the Akwesasne culture and historical settings, a Mohawk artist and story-teller talks about the creation story, Mohawk tradition, symbolism, and their matrilineal social structure.

The Huckleberry. Videocassette. Oregon State University College of Forestry. Forestry Media Center 248 Peavy Hall Oregon State University Corvallis, Oregon 97331-5702

This video provides an in-depth look at the huckleberry's importance in Native American life.

A Yurok Tribal Legend, Why Coyote Has The Best Eyes. Videocassettes. Title V Indian Education Program, Hoopa, California.

This series of videotapes covers a wide variety of stories and issues important to northern California tribes.

EPA and Indian Country: Building Pesticide and Toxics Programs In Indian Country. Videocassette. Environmental Protection Agency, United States.

Web Sites

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www.indians.org/Resource/resource.html

American Indian Resources
www.uwec.edu

American Indian Education Links
www.jan.ucc.nau.edu

Native American Indian Resources
www.kstrom.net

Native American Home Pages
www.nativeculture.com

American Indian Environmental Office
www.epa.gov/indian/index.htm

Native Americans and the Land
www.nhc.rtp.nc.us

The American Indian Higher Education Consortium
www.aihec.org

Appendix I

A Brief History of Tribal Timber Management Policy With Case Studies: Menominee, Quinault, and Karuk Tribes

The stated Indian policy of the U.S. government for most of its history has been assimilation. The General Allotment Act of 1887 broke up communal lands into fee simple and alienable parcels. The intent of the law was to speed up the assimilation process by privatization, which it was believed would shorten the time it takes for "primitive" cultures to evolve to civilization by skipping the intermediate stage of barbarism. Privatization was thought to have a magical force, and as an ideology, it still carries considerable weight in today's America. But privatization was an unmitigated disaster for Indians, from which they have never fully recovered.

Hand in glove with private property ownership went private enterprise. Resource extraction in the Western mind was purely about economics. Nature had long been rendered dead and exploitable by Western Christian-industrial culture. Indians then, as many do now, were forced to live in two very different worlds: nature alive with spirits, stories, history; and nature lifeless, passive, and exploitable for personal financial gain. I will now turn to U.S. timber management policy as a tool of assimilation as well as a source of tribal income.

If one defines "forestry" narrowly as scholars who study Native resource management as well as modern forest managers, Indian forestry can be said to basically reflect the dominant U.S. timber policies through all of its changes and developments over the last century. But if we take a Native perspective on forestry, there has always been tension between imposed U.S. government timber policies and the struggle to maintain traditional cultural practices on tribal timberlands. The legal prohibition against Indians exercising their millennia-long practice of forest under-burning changed forest structure and composition in ways that favored shade-tolerant species, effectively eliminating many important cultural plants and animal habitat, and contributing to poverty and market dependence on the reservations which continues to the present time. With the imposition of industrial forestry on reservations, wood fiber production for tribal income has taken precedence over diversified use of non-timber, non-softwood (conifers) forest products. Indian fire extended the tall grass prairie biome and bison herds from the Western plains all the way to Massachusetts, creating highly productive oak savannas and woodlands which enhanced the Native resource base. Only 1/10 of 1% of tall grass prairie remains; even less oak savanna has survived, with significant loss of species diversity. Saving forest softwood regeneration from fire has remained the dominant forest management policy to the present time, even with the

rediscovery by whites in the 1970's of the important role of light underburns in creating and maintaining forest diversity and stability. As we will see, tribes were not even allowed to utilize green trees until 1890.

The tension exists because many tribal persons still maintain a traditional relationship with the forest in their much restricted harvesting activities which sometimes come into conflict with tribal timber harvesting. It is similar to the "social forestry" of most indigenous peoples around the world. The forest is still viewed by traditionals as more than trees, more than wood fiber production alone. The forest provided food, medicine, spirituality, forage, fodder, building materials and tools. It still provides food, medicine, materials for spiritual ceremonies, basketry and cordage needs, as well as a subsistence livelihood in non-timber products for the commercial market. It is a place that humans inhabit and use, even as imposed one-dimensional modern resource management generates tribal income. The people say the forest is their "drugstore and supermarket".

In 1856, President Pierce began the policy of restricting the area occupied by each Indian tribe to the amount of land that was considered sufficient to meet the needs of the members of the tribe on the basis of an agricultural or a grazing economy. Government "farmers" were appointed on each reservation to instruct Indians in farming techniques, which also included timber matters. The General Allotment Act of 1887 continued this policy after allotting 80 or 160 acres to each adult male Indian. But the greater part of these allotments were on land not suited to farming; most lands were range or forest. The Act placed Indian lands under an explicit trust management mandate, which was extended indefinitely by the Indian Reorganization Act (IRA) in 1934. The precursor to the Bureau of Indian Affairs (BIA) was the Indian Service under the Department of Interior (DOI). The Service was charged with guiding Indian forest management.

Initially, logging was viewed as destructive to the forests. Once cut, government managers thought the forest would never grow back. Timber cutting was allowed only to clear land for farming (the traditional government policy of "the plow following the axe" as a stepping stone to civilization). But timber demand began to outstrip supply as the West was opened up to development. Consequently, timber thievery was conducted by whites on a scale that eventually forced the government to act to protect forests in the public domain, including reservation lands. Besides, the Indians needed to feed and clothe themselves. It is very important to emphasize

again the fact that Indians had been deprived of most of their former resource base either through outright loss of ancestral lands or by the prohibition of Indian burning in resource-poor closed forests, and had thereby become almost completely dependent on the market economy for basic goods. It was an act of necessity, not choice.

As an example of how critical intentional fire was to the productivity of Indian homelands, consider what happened when Indian burning was suppressed in California. When reservations were established in California the government counted on agriculture to save Indians from starvation. But between poor productivity of reservation land, the lack of technical assistance, and thievery by Indian agents and contractors of Indian commodities, California Natives continued making their seasonal rounds of harvesting plants and animals as well as performing periodic day labor on ranches to survive. But when efforts by white farmers and others to stop Indian burning were intensified, natural resources were impacted. It was like telling a farmer not to fertilize his crops, and many Indians went hungry. This dire situation was exacerbated by live-stock damage to Indian "gardens" of edibles like camas and other important corms, roots, and bulbs. This illustrates the high level of adaptability by Indians to difficult and changing circumstances if allowed to devise their own ways of survival. Forced reservation life and rigid assimilation policies ended Indian independence, and consequently, made adjustment to their new circumstances extremely difficult.

As white timber thievery increased on reservation lands, the government reversed its longstanding prohibition against cutting green timber and allowed the Menominee tribe of Wisconsin to take, in 1890, 20 million board feet annually. Previously, only down and dead timber was allowed to be utilized. One-fifth of the proceeds were to be used for the benefit of the tribe at the agent's discretion, while four-fifths were to be deposited in the U.S. Treasury to be paid at the Secretary's discretion to the Menominee on a per capita basis while accruing 5% interest annually. This was the beginning of tribal forestry. It was the first national law that provided for the management of "public" forestlands for economic purposes, authorizing the regulated sale of timber growing on lands of the United States without sale of the land itself. And it established the precedent that proceeds from the sale of tribal timber should legally accrue to the Indians. Unfortunately, while relieving poverty to some extent on the Menominee Reservation, white loggers were contracted to manage most of the logging, and then promptly began selling alcohol on the reservation as a lucrative side business.

Forest protection on public lands had, up to then, been the job of the military. But in 1891, Congress passed the Forest Reserve Act, which allowed the President to establish forest reserves on the public domain. Then, in 1897, Congress passed the Forest Service Organic Act, which finally allowed the taking of "carefully designated dead or matured timber…for the sole purpose of preserving the living and growing timber." The Menominee Act of 1908 extended the cutting of "ripened" green trees on the reservation. The Menominee had, like most eastern North American tribes, followed a "slash and burn" forest management regime historically. This kept a rotating mosaic of forest openings available for gardens of corn-squash-beans and for animal habitat, wild plant foods, and medicines that were more shade intolerant, and for other important cultural plants for cordage, basketry, oaks for wildlife and food, and numerous nut and fruit producing tree species. This burning regime favored certain cultural hardwoods, such as green ash for baskets, over conifers like hemlock and white and red pine. The forest was the "drugstore and supermarket". Institutionalized professional forestry, beginning shortly after the passage of the Forest Resource Act, put the final nail in the coffin of Native diversified forest use.

By 1910, most Indian forests were opened to regulated timber sales under the now accepted principles of European inspired "sustainable forestry" (tree farms), facilitated by European-trained foresters, Bernhard Farnow and Gilford Pinchot. Pinchot had taken over the Division of Forestry from Farnow in 1898. By 1903, Pinchot's division managed 20 million acres of forest resources, including reservation timberlands. With the vital assistance of his friend President Theodore Roosevelt, Congress passed the Transfer Act in 1905, which moved the resources from Interior to Agriculture and established the modern Forest Service with Pinchot as its first chief. Indian forests, however, stayed under the Department of the Interior. Disregarding the 1897 Organic Act, which restricted cutting to only those trees about to go to waste, Pinchot favored the European model where foresters could cut any and all trees necessary to secure the highest growth rate of the standing timber and to provide a high-level sustainable yield over the long run. Pinchot initially proposed selective logging to ensure a seed crop for regeneration, but a series of bad experiences with trees blowing down in windstorms led him to adopt clearcutting.

In 1908, Pinchot secured a cooperative agreement between the Departments of Agriculture and the Interior that gave the Forest Service supervision of timber on Indian reservations. As a result, 2.5 million acres of Indian land were transferred to national forests, including part of the

Menominee timberlands. Menominee also lost land through the illegal government practice of selling not only timber, but the land that the timber was growing on. Pinchot also got control of the administration of Indian timber. This and other political conflicts over resource jurisdiction led to Pinchot's dismissal in 1910. But his influence remained enormous in Indian timber policy. The cooperative agreement between Interior and Agriculture for Forest Service administration of Indian forest was cancelled in 1910, returning authority to the Land Division of the Indian Service. Although clearcutting without replanting violated Pinchot's 1905 *Primer of Forestry* which recommended only selective logging, it was the dominant practice on the reservations until 1927. This paralleled the dominant form of logging for most Western lands, public and private, due to the inefficiencies and expenses with railroad logging and river log-rafting. With the advent of road-logging in the 1930's and the lowering of expenses, selective logging came back into favor because of its economic feasibility and management flexibility.

Menominee instituted successful selective cutting in 1927, and the Forest Service also began long-term monitoring of selective cutting in the Lake states at about the same time. But it didn't catch on in the Pacific Northwest. Selective logging was tried on the Quinault Reservation on the Olympic Peninsula in western Washington in the 1930's, but for the most part it failed because heavy cedar slash prevented regeneration. The Forest Service began "staggered setting" or "checkerboard" clearcuts at the end of World War II characterized by small 40 acre or larger blocks small enough to achieve natural regeneration from the surrounding seed trees but large enough to check the spread of wildfires. Indian Service forests adopted this practice on the Quinault Reservation beginning around 1950. The checkerboard cutting pattern worked well in Douglas-fir forests of the Pacific Northwest, but in the Quinault part of the region, where the cedar component was very heavy, it failed.

With timber prices soaring by the late 1950's, forest managers would not take a chance on natural regeneration. They adopted the universal practice of site preparation by controlled burning of logging slash, followed by planting with fast-growing Douglas-fir. This practice was economically very successful but also simplified naturally diverse forests by creating endless monocultures of Douglas-fir tree farms. These intensive management practices were not adopted on the Quinault Reservation, where the widening discrepancy between acceptable practices and actual Quinault forestry became evident. In 1936 and again in 1971, Indian allottees filed a successful lawsuit against the U.S. government for negligent mismanagement of the Indian forest.

Quinault was the exception. The "high-yield forestry" pioneered by the Weyerhaeuser Timber Company was quickly adopted by the BIA on six Northwest reservations (plus Navajo) between 1962 and 1967. The IRA of 1934 mandated that Indian lands be managed according to the principles of sustained yield. Sustained yield was of course embraced in the beginning under Pinchot, but not practiced until over-production in private timber lands severely depressed prices. Sustainable forestry slowed down production and thereby raised prices. Then began a slow expansion of traditional forestry into "multiple use" which was put into law (The Multiple Use Act) along with sustained yield in 1960. Yet the European forestry model of highly regulated tree farm monocultures continued to dominate forestry practices. Tribes as usual followed suit, with IRA-instituted tribal councils rubber-stamping BIA management policies. The traditional opposition lacked any legitimate political power under IRA.

Then, around 1990, forest ecologist Jerry Franklin of the Forest Service Pacific Northwest Experiment Station proved scientifically that the so-called "scientific" forestry of the past 100 years was producing simplified and unhealthy forests when compared to the complexity of natural forests. The scientific reductionism of the past was trumped by the new postmodern complexity theory. Franklin coined the term "New Forestry", which was embraced theoretically in 1992 by the Forest Service following President Clinton's "Forest Summit" in Portland, Oregon. It was renamed "ecosystem management". The policy of multiple use was no longer confined to just economic uses, but now was expanded to include non-economic values like species diversity and healthy ecosystem function, as well as scenic, recreational, and spiritual values.

The Indian Forest Management Assessment Team (IFMAT), which had been mandated by Congress in 1990 under the National Indian Forest Resource Management Act (NIFRMA), was applauded in an article in the *American Indian Law Review* for its recommendation that tribes adopt ecosystem management "as a tool for an overall approach to protecting the health and productivity of Indian Forests…Tribes have a vested interest in the stability of their land to provide them with economic, spiritual, and aesthetic values." Gary Morishima, technical advisor to the Quinault Nation embraced the concept of ecosystem management but he also stated: "Although this concept has recently become fashionable, Indian tribes have been practicing it for thousands of years before they were displaced from their territories." Indeed, BIA-style forestry had cost the Quinault and the neighboring Quiliute dearly. Getting only around 10 cents on the

dollar in revenues generated from logging, they lost virtually all of their inshore marine resources from siltation caused by excessive logging on steep, unstable slopes, including seaweed, shellfish, anadromous fish and eels, as well as most of their non-timber cultural and subsistence forest products.

The on-the-ground history of forest management on Indian lands is a litany of failures, many of which have been the subject of congressional hearings and court cases. The Menominee successfully sued the government in 1990 for lost revenue resulting from the failure of Congress to raise the annual cutting limit above the 20 million board feet first set in 1890. The Menominee were recently certified by Smartwood of the Forest Stewardship Council for their outstanding sustainable forest management record. This was accomplished by the tribe, not the BIA. There are still some residual effects stemming from over a century of industrial forestry. I find this to be true of most tribes coming into their own in forest management. Herbicide use is still thought necessary because of the problem of shade-tolerant hardwoods like sugar maple regenerating in the forest understory following small group selection cuts of the preferred white pine. Historically, the Menominee utilized fire to create and maintain forest openings, but today's tribal forestry has yet to reintroduce forest underburning. Yet, just fly over west-central Wisconsin, and the Menominee Reservation is an oasis of green forest in an ecological desert of agriculture and dairy farms, the only forest in the whole region.

If there is any doubt about the ability of tribes to manage their own resources, as is often claimed by environmentalists and government, consider one forest productivity study which found in 638 tribal forestry programs that "tribal high-skilled labor" increased harvest by 24,000 board feet (bf) per worker per year. This compares with the addition of "BIA high-skilled labor" which reduced harvest by 14,000 bf per worker per year. "BIA low-skilled labor" increased harvest by 40,000 bf per year per worker, while "tribal low-skilled labor" was 75% more effective.

I served on the Karuk tribal team, which produced the Karuk Tribal Module in 1995 as required by the Klamath National Forest in northwestern California - the "Final Forest Management of Mainstem Salmon Watershed Analysis". The concept of ecosystem management dovetails nicely with traditional holistic Native perspectives on the environment. I will briefly outline my arguments for co-management by the Karuk Tribe and the Klamath National Forest based on the acceptance of ecosystem management by the Forest Service in 1992.

The tribe had prepared a map showing where their cultural use areas were located within ancestral lands, which the Klamath National Forest currently administers. My question to the Forest Service was: Given the probability of global warning coupled with extremely high forest fire hazard and risk, what guarantees does the tribe have that its existing cultural (and natural) resources will not be burned up in a likely catastrophic stand-replacing wildfire? It's the same question that I raise in the "Upper Glade National Pilot Stewardship" study for the World Wildlife Fund and Rogue River National Forest with respect to managing the forest matrix as potential animal habitat in case the smaller reserve habitat islands are insufficient or get burned up. This happened to the Mexican spotted owl reserves at white Mt. Apache when the Rodeo-Chedisky fire took out half of the tribe's timber in 2001. The Karuk were being asked to stake their economic and cultural future, their capacity for adaptation to change (cultural resiliency), on tiny islands of cultural-natural resources. Nature, unlike maps, is not static. Co-management of all ceded ancestral lands would be in the tribe's best long-term interest.

What, then, about the long-term interest of the Klamath National Forest? If they were really serious about ecosystem management, especially with down-sized personnel and budgets, they needed input from local Karuk tribal members who were intimately acquainted with plants and animals that they depended upon regularly to meet their cultural needs as well as subsistence livelihoods. For example, a Forest Service botanist will conduct a Threatened, Endangered, Sensitive (TES) plant survey that may be legally required before a timber sale. However, there are at least three major bloom windows (opportunities to identify plant species) at each of at least four elevation zones, most of which are rarely surveyed. Many locals, on the other hand, visit these plant communities on a regular basis to harvest plants and to hunt. They know their turf far better than the Forest Service.

The bid for co-management was rejected by the Klamath Forest. The Karuk do participate and exchange information in frequent meetings with the staff of the Klamath Forest. They provide input to project planning including the design and execution of timber harvests, prescribed burns to improve hazel and bear grass production, recreation site improvements, and special-use permits. Trained tribal members also monitor archaeological resources and sites along with the Forest Service archaeologists. Tribal members currently are contracting with the Forest Service to put several miles of roads to bed. But the Karuk still maintain the holistic and traditional view that all tribal lands are important culturally and spiritually. Sacred sites and trails occur

throughout the Klamath Forest jurisdiction.

Ecosystem management as core Forest Service policy is presently not happening; the agency's reach has exceeded its grasp. Co-management is still theoretically possible under treaty law if enforced by the courts. Court decisions by some tribes in the Pacific Northwest have strengthened tribal claims for treaty-guaranteed pre-existing rights to subsistence hunting, fishing, and gathering on ceded lands. The Boldt Decision, affirming the right of treaty tribes to 50% of the potential fish take in the Pacific Northwest, is a powerful legal precedent.

NORTHWEST CENTER FOR SUSTAINABLE RESOURCES — NCSR

What is the Northwest Center for Sustainable Resources?

The Northwest Center for Sustainable Resources (NCSR) is a collaborative effort among educators, employers, and others which is enhancing natural resources programs at community colleges and high schools and providing a clearinghouse for information on sustainable natural resources. A Center of Excellence funded by the National Science Foundation's Advanced Technological Education program, the Center is incorporating innovative teaching methods, state-of-the-art technology, knowledge from cutting-edge research, and hands-on field experiences into natural resource technology programs. Major goals for the project include integrating community college programs into a "seamless education" from K-12 through university, working closely with employers in curriculum development, emphasizing work experience for students through internships, and developing core programs that prepare students to work as technicians for organizations dealing with aquatic and terrestrial ecosystems. Programs feature environmental monitoring, mapping, instrumentation, and other related skills woven within the context of managing complex ecosystems. Program graduates are receiving technician degrees, and have advanced skills, or they are receiving degrees which transfer to four-year colleges and universities. Combining improved curricula with an information clearinghouse for natural resources education, the Center is providing an effective model for education/employer alliances for the nation.

KEY OBJECTIVES:

Curriculum development: Five "lead site" colleges and six "test site" colleges have developed and tested advanced technological curricula for use in natural resource-based associate degree programs.

Faculty and teacher enhancement institutes: Field- and laboratory-based experiences are being offered for teachers from all levels of education around the country, along with tours of world-class research sites, and other professional development activities.

Promotion and dissemination: NCSR materials are being showcased at key national and regional conferences and symposia, and are being posted in an electronic clearinghouse. Promotional products are being disseminated, including a videotape and reports entitled "Visions for Natural Resource Education and Ecosystem Science for the 21st Century" and "American Indian Perspectives: Nature, Natural Resources, and Natural Resources Education."

NCSR has over 100 partners from education, employment, Native American tribes, professional societies, and research groups.

RESOURCES WE CAN PROVIDE:

— Field- and lab-based faculty development institutes, including the Ecosystem Institute, Natural Resource Institute, and Adaptation Institute.

— Curriculum materials for use in natural resources technology programs that reflect an ecosystem approach, and advancements in science, mathematics, and technology. Programs include agriculture, fisheries, forestry, geographic information systems, and wildlife.

— Up-to-date publications, videotapes, and other materials for institute participants and other NCSR partners.

— A website with connections to model research sites, Native American tribal home pages, national secondary education ecology-based projects, job sites, and other natural resource-related information.

— A national model for natural resource educational programs which incorporate employers' needs, science and research-based activities, Native American perspectives, and working partnerships.