“Making Medicine For The Land: Indigenous Cultural Survival, Traditional Ecological Knowledge, and Ecological Restoration”

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By

Dennis Martinez

Who are “indigenous” peoples?

- The “original” or oldest surviving inhabitants of an area; have lived in a traditional homeland for many generations
- Their sense of themselves as peoples is based on shared homeland and shared language, history, values and customs
- Homelands become imbued with increasing significance as the history of peoples becomes encoded in local geography—in the cultural meaning of place—as well as in myth, oral tradition, and oral history; they live in a landscape of meaning and which constitutes their identity as a people

Conservation Through Cultural Survival, (ed.) Stan Stevens, pp. 19, 20

"Indigenous" came out of the 1970s struggles of the American Indian Movement (AIM), and the Canadian Indian Brotherhood, coming to mean a term that internationalizes the experiences, issues, and struggles of some of the world's colonized peoples

- The final "s" in "indigenous peoples" carries the symbolic content of the right to self-determination as cultural groups—not just individuals deserving of human rights
- The world's indigenous populations belong to a network of peoples who struggle together for self-determination on local and global stages—transcending their own colonized context and experiences

Indigenous peoples can be tribal or non-tribal (e.g. peasant farming cultures) peoples who still maintain at least some of their traditional cultural practices

- 5,000 to 8,000 languages\societies
- 600 million indigenous persons constitute 10 to 15% of the world's population, account for 90 to 95% of the world's cultural diversity, and occupy 20 to 30% of the earth's surface
- 80 to 85% of global biological hotspots are in indigenous traditional territories

- Of the more than 6,000 languages spoken today, half are spoken by communities of 10,000 speakers or less (8 million people, or less than 0.2%) of the world's population)
- half of these languages are spoken by communities of 1,000 or fewer speakers
- 95% of the world's population account for over 5 billions speakers of 300 languages
- "Nearly extinct" languages are estimated to make up between 6 and 11% of those currently spoken, with greatest losses in Australia and the U.S.

Luisa Maffi, On Biocultural Diversity, 2001, pp. 4, 5

Linguistic assimilation means the “extinction of experience” for indigenous peoples, and is the fastest way to assimilation—schooling, media, government affairs, denigration of local languages and the cultures they embody as “defective”

With language loss comes losses in traditional knowledge, identity, and capacity to utilize centuries-long experience working with and caring for the land—with concomitant loss of biodiversity as indigenous peoples become economically assimilated into dominant cultures.

Map 1.1. Overlap of biological and cultural diversity: Endemism in higher vertebrate species and languages. Figures for Ethiopia include Eritrea. Higher vertebrates include mammals, birds, reptiles, and amphibians; reptiles not included for the United States, China, and Papua New Guinea because the numbers were not reported in the source table. Original art by David Harmon. Source: Harmon (1996a), based on data from Groombridge (1992:139–141) for species and Grimes 1992 (passim) for languages.

What is Traditional Ecological Knowledge (TEK)

TEK is a local place-based
belief\knowledge\practice complex
of pre-modern lineage
that is capable of adapting
to changing environmental conditions
without sacrificing time-honored cosmologies,
beliefs, and principles of environmental
management

An extended definition of TEK

"TEK is a cumulative body of knowledge, know-how, practices and representations maintained and developed by peoples with extended histories of interaction with the natural environment. These sophisticated sets of understandings, interpretations and meanings are part and parcel of a cultural complex that encompasses language, naming, and classification systems, resource use practices, ritual, spirituality and worldview."

International Council for Science (ICSU), Study Group on Science and Traditional Knowledge, 2002

Other names used: Local knowledge, traditional knowledge, indigenous knowledge, native science, farmers' knowledge, fishers' knowledge, folk knowledge

What is Western Ecological Science (WES)?

The classic description: “Native is analogous to a machine…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 [i.e. self-organizing] complex of merely physical forces acting on colorless, tasteless, and odorless particles of hard, dead matter.”

Paul Santmire in *Historical Dimensions of the American* Crisis, pp. 70, 71

TEK and WES are both embedded within specific world views

- WES is anchored in a specific view about the human relationship to nature that is strongly instrumental (International Council for Science, 2003). Humans and nature are opposed in Western thought. Through the design of replicable experiments with which to test explanatory hypotheses, scientists believe that they can predict natural phenomena and therefore bend nature to their will
- TEK is embedded in a world view which emphasizes the symbiotic nature of the relationship between humans and the natural world. Rather than opposing humans and nature as in Western thought, traditional knowledge holders tend to view people, animals, plants, and other elements of the universe as interconnected by a network of social relations and obligations.

International Council for Science, Study Group on Science and Traditional Knowledge, 2002

Summary of differences between TEK and WES

Caveat: there are actually many ways in which TEK and WES overlap; this overlap will be presented later when we discuss a new paradigm in the ecological sciences which fits well with traditional indigenous perspective on nature.

TEK	WES
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 is 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

Traditional Knowledge has often played a role in the development of modern science

Examples include:

- Linneaus' use of folk taxonomies developed by the Saami of the European arctic (the now universal binomial plant and animal classification system)
- Galileo's use of knowledge of ballistics developed by craftsmen at the military arsenals in Venice, Italy (astronomy \ physics)
- Darwin's observations of plant and animal breeding by local persons suggested the theory of evolution by natural selection

TEK will continue to play a role in the development of modern science in the future

- Botany developed from traditional knowledge of herbal medicine beginning in the 16th century in Europe (e.g. botanical gardens and publication of herbals)
- TEK continues to inform modern science in taxonomy, medicine, agriculture, natural resource management, and conservation
- New plant and animal species recently described by modern science:

  Central and South America (primates), SE Asia (ungulates), and throughout the tropics under the guidance of traditional people and their knowledge

- Western medicine founded on Greek traditions
- As many as 80% of the world's people depend on traditional medicine World Health Organization

  – 25% of all prescriptions in U.S. contain plant materials

  – Traditional Knowledge is providing scientific insight into bioprospecting by pharmaceutical companies, and crop domestication, breeding, and management

  – Principles and practices of swidden agriculture, agroecology, agroforestry, permaculture, crop rotations, pest and soil management have been documented by ethnoscientists

ICSU, 2002

What are some examples of the negative ecological effects of removing indigenous peoples from their ecological role as caregivers to their homelands?

- The legal prohibition of intentional fire by national governments as a multi-faceted tool used by indigenous peoples—in some places as a supplement to lightening-ignited fire and in others as virtually the only occurrence of fire—to rejuvenate habitat; modify plants in order to render them culturally useful; keep prairies, savannas, wetlands, woodlands, forest meadows and gaps open; to facilitate hunting and travel; and much more.

- Intentional fire definitely increased biodiversity, relative stability, resiliency, and integrity of ecosystems

How lack of human intentional fire and local fire control strategies (plus modern fire suppression) have led to both negative ecological and economic\cultural impacts

- The banning of ***traditional*** swidden agriculture (fire agroecology or “slash and burn” agriculture) in SE Asia and Indonesia has reduced biodiversity and species richness in the world’s wet tropical forests; while burning by ***non-traditional*** groups has led to huge fires which burn uncontrolled until put out by monsoon rains.

- Cessation of intentional fire in Asian and Australian savannas, bushlands, eucalyptus forests (Australia), etc. has led to both loss of biodiversity and increase of catastrophic fires.

- Boreal forest meadows and wetlands have closed up, making trapping and hunting increasingly difficult as animal habitat is lost to invading trees, or by the lack of the rejuvenating effects of regular low-severity fires. Uncontrolled fires can burn for months in peat bogs and tundra, depriving caribou and moose of quality habitat.

- Temperate forest prairies, savannas, wetland, ridges and gaps ;have closed up with invading brush and trees, leading to loss of habitat, biodiversity, and species richness, as well as exponential increases in the rate of catastrophic fires.

How loss of traditional indigenous agroecology and agroforestry has negatively impacted both local farming\forestry\livestock economies and biodiversity

- Traditional hardwood forestry of central and eastern Europe has virtually disappeared as multi-national corporations have bought up local timber land and planted biologically sterile monocultures of fast-growing conifers.

- “Green Revolution” inspired eucalyptus and conifer monocultures have replaced the 160 crops and swidden agriculture of the Lua tribe in Thailand; also the agroecology of the Hanunas in the Philippines (who can divide plants into 1,600 categories compared to 1,200 by Western botanists); as well as other tribes in India, Kenya, SE Asia, Papua New Guinea, and Borneo

- The “Chipks” movement in India (Vandana Shiva) and the Greenbelt Movement in Kenya (Wangari Maathai) are examples of resisting the establishment of pine and eucalyptus monocultures in their local forests which supply them with food, fodder, fertilizer, medicines, fiber, and fuel—and through this reliance on forest diversity—maintain and enhance biodiversity without unsustainable external inputs like chemical fertilizers, etc.

- Multinational corporations, aided by huge government subsidies in the U.K., are planting monocultures of rye and corn right to the edges of fields, destroying edge habitat for insects, birds, reptiles, etc. as well as removing old hedgerows high in biodiversity. Traditional practices like using hand scythes—which cut grass unevenly and thereby create habitat diversity—or rest-rotation grazing by livestock—which maintains meadow forb diversity—are disappearing.

Beginning with the establishment of Yellowstone National Park in the U.S. in 1872, the "Yellowstone model" of complete removal of indigenous peoples from their homelands has been exported internationally—with concomitant losses in biodiversity and cultures.

- Yellowstone suffered major stand-replacing fires in 1987 which sterilized soils and killed wildlife
- The Bannock-Shoshone ("sheep-eaters"), Blackfeet, and Crow—who utilized Yellowstone extensively and burned on a regular basis—were forced out at gunpoint
- Fuel accumulations exceeded the ***historical range of variability*** and led to the 1987 Yellowstone fires
- Indian hunters killed elk, mountain sheep, deer, and bison during the summer in high elevations and together with wolves kept ungulates from over-browsing riparian vegetation, thereby promoting high biodiversity, which now has been severely reduced due to herds of elk popular with park visitors, without natural predators, exceeding the carrying capacity of the land

- Yosemite National Park (in the Sierra Nevada Mts. of California, (U.S.) which only allowed native Ahwaneechee Miwok Indians to live in the park if they were employed there, has suffered major losses of meadows and oak woodlands due to invasion by firs—shade-tolerant conifers which has led to losses in species richness and increased fire hazard following suppression of indigenous intentional fire

- Despite living sustainably for thousands of yeas as an ecologically integral part of Ngorongoro Crater in Tanzania as communal cattle herders, the Maasai were forced out of their homelands. Allowed to graze their cattle only in small restricted areas, rangelands became quickly degraded. Studies have shown a loss of biodiversity in Ngorongoro National Park since Maasai removal in 1974, although they remain controversial in today's politically charged environment.

The cultural and social disruption caused by the relocation of indigenous peoples throughout the world from their homelands to make way for protected areas for wildlife protection and scientific research has resulted in increased loss of wildlife

- Government claims of ownership of wildlife has weakened local internal authority which traditionally regulated hunting, including taboos for hunting certain species
- Government imposition of hunting license fees which local persons cannot afford
- Encouraged cash-cropping of maize, cotton, etc., which has caused changes in traditional farming methods and crops resulting in increased reliance on external oil-based inputs, poor nutrition, market dependency, and poverty; promoted by national governments to generate hard currency with which to pay off World bank and multi-lateral debt as a result of restructuring required by global monetary policies.
- Increased poaching and bush-meat trade

Topdown government policies, together with discrimination against indigenous "minorities", has led to ecological degradation which parallels cultural degradation and weakened traditional conservation strategies and social controls employed in resource management.

- The Miskito Indians of Nicaragua and Honduras, who once sustainably harvested sea turtles and ocean fish in one of the richest and most diverse Caribbean marine habitats, have switched to lobster
- Following deforestation, over fishing, and over-harvesting of sea turtles by the U.S. backed dictator Somoza and attempts by the revolutionary Sandanista to assimilate the culture and language, and take over Miskito communal lands, the Miskito are still practicing swidden agriculture

The U.N. Convention to Combat Desertification (Second Conference of the Parties, Dakar, Senegal, 1998) openly acknowledged the value of traditional indigenous knowledge and resource management systems in combating desertification in Africa's Sahal—where a breakdown in traditional grazing regulatory authority, coupled with drought, contributed to desertification—a result of World Bank restructuring of national economies in favor of global market dependency for hard currency to service debt.

- Grassland regions of Inner Asia (Mongolia, China, Russia) were severely degraded by the imposition of communist government policies to increase livestock production while destroying nomadic common property practices of indigenous herding; change to mechanical farming during Soviet collectivization resulted in severe degradation to grasslands; Chinese attempts to plow the virgin steppe were also ecologically devastating.

- Native herders in Mongolia—where some herders still follow traditional common property livestock management—use TEK to classify pasture areas using a number of different criteria, including the season in which they are grazed, their nutritional quality and suitability for different types of livestock, topography and elevation, ecological zone and plant community, soil characteristics, water quality and quantity, distance from camp, and degree of utilization by livestock, and the positive and negative characteristics of grassland plants.

Ecological Applications, October 2000, special Invited Feature on TEK, (eds.) Jesse Ford and Dennis Martinez

Since the positive ecological impacts of indigenous cultural practices in land management are well-documented, we must now ask: why has Western science, especially in English-speaking societies, tended to ignore or marginalize these contributions to ecological integrity?

- Western philosophy has actually perceived humans and all of their activities, including thought processes, as part of nature until only relatively recently (last 150 years in North America). Several leading 19th century environmental thinkers—e.g. Catlin, Marsh, Audubon, Thoreau—called for national parks in the U.S. to preserve both wild nature and the traditional way of life of American Indians.

- The separation of humans from nature coincides with the growth of cities where people were no longer directly dependent on nature for their livelihoods and sustenance. Ironically, the separation of humans from nature led to a growing appreciation of “wilderness”.

- Following the establishment of Yellowstone National Park in 1872, American park politics began to focus on controlling land use for tourism, and later, for “pure” scientific ecological research which until the 1930s meant exterminating carnivores lid cougars, coyotes, ravens, and wolves to protect popular ungulates like elk and deer.

- 19th century Western intellectuals began using the “machine metaphor”—a natural model in an industrial age—with which to describe nature. Nature works best when left alone, without human interference. Alternately, if resource extraction occurs, nature will in time automatically rebalance herself because nature, like machines, always returns to its predisturbance “steady-state”.

The Judeo-Christian \ Islamic Context

- The 16th century Papal Doctrine of “Terra Nullius”—based on St. Thomas Aquinas’ Labor Theory of Labor and given secular authority in English political theory by John Locke—held that ownership of land resulted from the labor one put into cultivating the land, and bringing it up to its full productive capacity. The cultural land practices of indigenous peoples were virtually invisible to European eyes.

- The Judeo-Christian-Islamic view of nature separates a Darwinian jungle or “wilderness” from an “Eden” or paradise which is fully under the dominion of humankind. The devil inhabits wilderness; god rules paradise.

The Western Imperialism context

- Global imperialism by European powers, in line with the "best" of 18th and 19th century Western science, rationalized the genocide and dispossession of indigenous peoples with Darwinian "survival of the fittest"—i.e. Europeans who had evolved to the pinnacle of civilization had a Divine Right to conquer "barbarians" and "savages" lower down on the evolutionary scale and bring them up to European standards of civilization.
- The American Doctrine of Manifest Destiny—the Divine Mandate to dispossess Native Americans—sanctioned the conquering of North America and the genocide of its indigenous peoples. Since American colonists saw themselves as God's chosen people, there could be no other culture that God favored. There could be but *one* Chosen People and *one* way of relating to the land.

The idea—well-documented in both the scientific literature and in indigenous oral traditions—that native peoples have been an integral part of nature, and through their cultural practices, contributed in a *positive* way to ecosystem functionality, is not romanticizing indigenous peoples as "noble savages".

- The "noble savage" concept is a construct of the European Enlightenment (e.g. Rousseau)

- Indigenous peoples undoubtedly made ecological mistakes, suffered the consequences, and may have failed to survive; those that did survive learned a painful survival lessonl

The current academic controversy over whether or not indigenous peoples were conservation-minded or were the world's "first ecologists" is not the real issue; it is part of a larger postmodern political controversy by which Western academics are making reputations as they challenge the present perceived romantization of native people.

- Many Western scientists fear a weakening of the "objective" foundations of their science through "subjective" inroads of the "deconstructionist" social sciences and humanities, as both camps struggle to define the boundaries between nature and humans: E.g., if nature is a mere cultural construct, what are we trying to save? Who defines "nature"? Is nature being reinvented to serve privilege and power, or to serve the cause of indigenous social justice?

- A related question is: (see Michael Soulé and Gary Lesse, *Reinventing Nature: Responses to Postmodern Deconstruction*) Do perceptions and conception of nature differ enough between cultures to affect the way these cultures would wish to maintain or manage nature in the remnants of remaining habitat? Can they be trusted to save “real” (i.e. out there) nature?

- Some Western environmentalists fear that subjective cultural concerns about social justice will distract us from core environmental issues, e.g. Saving “wild” nature, controlling population and immigration, studying “pure” natural processes (without humans messing things up) in reserves and parks—from which indigenous peoples have been repeatedly removed throughout the world.

The perceived conflict between "objective" natural science and "subjective" indigenous cultural defenders is false and misleading: the real issue—to be determined empirically by science—is whether or not indigenous cultures have interacted with nature in such a way as to maintain or enhance ecosystem function, biodiversity, and integrity.

- 80 to 85% of the world's biological hotspots occur on indigenous ancestral land. WWF\IUCN
- Environmental degradation has occurred in many places when indigenous peoples have been prevented from practicing ecologically appropriate traditional land management
- Ecological integrity has been maintained where indigenous peoples have been allowed to continue their cultural practices.

Current rationalizations by WES for not including the positive ecological effects of traditional land management systems of indigenous peoples on ecosystem structure, composition, and function in their surveys of and conservation planning for protecting\restoring biodiversity.

- Past environmental abuses by indigenous peoples, e.g. alleged megafauna extinctions following the last ice age; destruction of forests by the Anasazi of the SW U.S.; collapse of the Mayan empire in so. Mexico and Central Mexico, etc.

- Current environmentally destructive resource extraction practices by some tribal peoples, e.g. Alaska Native corporations; U.S. “progressive” tribal and Canadian band councils; wildlife poaching and bush meat trade in Africa and Asia; slash and burn swidden agriculture in the tropics; use of non-traditional modern technology in hunting, etc.

- The culturally entrenched belief that lack of sophisticated technology, low population levels, and the “natural bounty” of some biologically rich biomes and ecosystems available without human assistance, virtually eliminates any need for indigenous management, e.g. ocean fisheries, salmon runs, areas of high lightening frequencies, non-human predator-prey balances

Internal scientific barriers to recognizing contribution of indigenous peoples

- Skepticism about indigenous peoples as "the first ecologists" or even possessing a conservation ethic—but in fact there has been little systematic work by WES on indigenous peoples' ethnoecological knowledge and its effects on biodiversity; few studies of biogeography take humans into account as agents of co-evolution.
- Lack of appreciation of TEK limits WES ability to test its validity (not on radar screen)
- Prevailing focus of WES on species rather than an ecological interactions, i.e. the focus of conservation biology on "species richness" to the exclusion of other levels of biological organization (e.g. habitat heterogeneity or diversity) has led to species losses in protected areas and reserves

Gary Nabhan in *On Biocultural Diversity*, (2001)

Western utilitarian environmental ethics—i.e. “sustainable” natural resource use and ecosystem services for the benefit of humans—fails to convey the traditional indigenous spiritually-based reciprocal relationship between humans and the non-human world. Indigenous relationships with the environment are neither biocentric nor anthropocentric—but rather are *kincentric*.

Kincentric ecology—a term I had to coin (1995, *Karuk Tribal Module*) and that has now entered the ethnoecological literature (See Enrique Salmon in *Ecological Applications*, Oct. 200 (eds.) J. Ford and D. Martinez; and Nancy Turner, *The Earth's Blanket*, 2005)—rejects the Western dichotomy between biocentric preservationism and anthropocentric resource exploitation. Instead, it describes the reciprocal relationship of mutual obligations and privileges between animals\plants and humans when using natural resources—which are not to be understood in Western terms of human-use alone, but in indigenous understandings of our familial (kin) relationships with plants and animals

Kincentric ecology harmonizes human use with conservation\restoration: just as plants and animals take care of us, we have an obligation to take care of them. Protocols and "rules of respect" govern indigenous relations with the relatives (kin) who provide for us; if those rules are ignored, if animals and plants are disrespected, they may not allow us to harvest them. Or something bad may happen to us and our families\tribes

- The "environment" is not something "out there". The ecological roles of humans, animals, and plants, while different, are of equal importance. Plants and animals are co-creators with humans in both the maintenance of ecosystem function and in spiritual ceremonies of world renewal.

Some scientists have asserted that any restraint in harvesting that may have occurred was due to fears of spiritual retribution and not from a conscious strategy to conserve resources. However, simple survival over millennia required cultural resiliency which employed diverse and multi-faceted strategies in order to weather climatic anomalies and resource failures which occurred from time to time and could last decades or centuries

- Social taboos were motivated by both spiritual and practical conservation concerns; they are termed “resource and habitat taboos” (RHT).
- Researchers studying indigenous hunter-gatherers communities found 7 categories of RHTs:

1. **Segment Taboos** (specific food taboos)
2. **Quantity Taboos** (setting harvest quotas)
3. **Temporal Taboos** (seasonal restrictions on harvest)
4. **Life history Taboos** (no harvest at vulnerable stage of a specie's life history based on age, sex, size, or reproductive status)
5. **Method Taboos** (harvest methods and techniques)
6. **Habitat Taboos** (access and use from particular habitats in space and time)
7. **Specific –species or general food--Taboos** (protect plants and animals in space and time: e.g. IUCN noted 70 taboos of this kind surveyed; 30% were of species listed as threatened by IUCN and included endemic and keystone species

J. Colding and C. Folke, 1998

Cultural Resilience continued

1. **“Turf” responsibilities** of individuals, families, or clans for resource management with elders \ knowledge specialists regulating fishing, hunting, and gathering
2. **Inclusion within tribal territories of entire watersheds and drainages** for maximum resource diversity E.g. the Hawaiian Ahu’a’pua lands extended from the ocean to the mountain tops; it was similar for many other indigenous peoples
3. **Dependence on high diversity** of plant and animal species spread risk of resource failure or over harvesting over large areas

4. **Extensive trading networks**—facilitated by inter-marriage between bands—enabled a community experiencing the failure of an important resource to trade for its replacement or substitutes found in another community's territory—as part of the "ecological partitioning" of a larger region such that trading could increase diversity of plants and animals utilized and prevent local resource depletion.
5. **Redistribution of wealth** held by richer band members during times of plenty through social give-aways, e.g. Potlatch of NW North America ("wealth display")
6. Widely practiced **birth control measures** kept populations low enough to be environmentally sustainable.

Indigenous peoples typically manipulated ecosystem structure and composition to ensure optimum biodiversity for survival of tribal economies—targeting plant and animal species in 15 cultural categories

(e.g. NW No. America)

- Ceremonies
- Structures
- Clothing
- Cordage
- Basketry
- Medicine
- Food
- Household/Cooking implements
- Animal habitat
- Traps and snares
- Fishing and hunting Gear
- Weapons
- Tools
- Games
- Musical instruments

California Indians used a variety of horticultural techniques to modify culturally favored species to make suitable for use (e.g. fire modified plant species)

- Seeds, roots, rhizomes, fruits, tubers, corms, bulbs, leaves, flowers, and stalks were utilized and manipulated annually, biannually, triennially, or quadrennially
- Small and large patches of vegetation were burned and individual plants were pruned, dug, shaken, knocked, or weeded
- Horticultural techniques included coppicing, pruning, selective harvesting, transplanting, vegetative propagation, sowing, and weeding

Kat Anderson in *Before The Wilderness* (1993)

Enormous quantities of cultural plants as well as animal habitat had to be burned rotationally for tribal economies to survive

- A deer net 40 ft (12.2 m) in length contained some 7000 ft (2133.4 m) of cordage, which required the harvesting of 35,000 plant stalks from *Apocynum* spp. (dogbane) or *Asclepias* spp. (milkweed)
- 150 deer nets and snares were required in one deer or elk hunt when encircling fires to concentrate the herd sometimes burned several thousand acres, and were done every 5 to 10 years in the same locale
- A single cradleboard required 500-575 straight plant shoots from patches burned the year before

Kat Anderson, *Before the Wilderness* and Reg Pullen, *Overview of the Environment of Native Inhabitants of SW Oregon*, U.S.D.A. Forest Service\Bureau of Land Management

Individual plants, plant populations and habitats were manipulated in accordance with ecological principles that caused changes in plant abundance, diversity, growth, longevity, yield and quality to meet cultural needs

- Shifting mosaics of different vegetation types in different stages of seral successions and at different ages and structures resulted from rotational burning patterns of from 1 to 25 or so years depending on the target species and the burn objective
- 65% of material culture in coastal southern California (Chumash) came from plants and over 75% of such plant based items were fire-induced epicormic branches or adventitious shoots

Kat Anderson

Landscapes all over the globe once thought to be "pristine" are now known to be the result of indigenous cultural practices or a combination of human management and natural process

The Beni of Amazonia created 30,000 square miles (77,700 km^2) of forest mounds surrounded by raised fields and linked by straight causeways up to 3 miles (4.8m) long; the Beni also burned regularly, creating over time an intricate ecosystem of fire-adapted plant species dependent on native fire; they also erected dense zigzagging networks of earthen fish weirs between the causeways during flood time

Ch. Mann, *1491*, 2005

Fire has been employed by indigenous peoples in more-or-less marginal environments in which primary productivity is relatively low. Natural fire mosaics are characterized by larger, less frequent but usually hotter burned stands of vegetation; man-made fire mosaics entail smaller, more frequent, and less severe burning. These burning patterns occurred globally in a number of unrelated indigenous groups in very different kinds of environments: monsoon savannas, spinifex and deserts (Australian grasslands) muga scrubs, boreal forests, , and temperate conifer forests. From the perspective of Western science, showing replication and predictability of similar functional practices (burning) in very different vegetation types increases its credibility as well as comparing favorably with the conclusions of Western fire ecology: **indigenous peoples had to manipulate their environments with fire to survive economically**

Henry Lewis, “Yards, Corridors, and Mosaics: How to Burn a Boreal Forest” in *Human Ecology*, Vol. 16, No. 1, 1988

Examples of similar indigenous burning strategies in dissimilar environments

- NW California (U.S.) in redwood\mixed conifer forest where varying sized and shaped patches and prairies were created to attract game and maintain cultural plants
- Western Washington (NW U.S.) and coastal SW Canada where large prairies were fire-maintained in unproductive Douglas-fir forests for cultural plants (e.g. ferns and camas) and to attract game; after cessation of Indian burning, Douglas-fir forests re-occupied the prairies
- Queensland, Australia, tropical rain forest\SW Western Australia jarrah forest\Tasmanian tropical rain forest: grasslands, sclerophyll scrub, sedgelands maintained by productive fine-grained mosaics of corridors and opens in and around dense, unproductive (few animals) forest types

- Northern Territory, Australia, in the monsoon savanna region; the only areas not burned every 3 to 4 years are small stands of tropical rainforest, paperbark (*Melaleuca* spp.) swamps, and mangrove tidal flats, which are fire-protected and left unburned; 90% of floodplains, 50% or more of eucalyptus vegetation , and 30-35% of tall open forest are burned

- NW Alberta (Canada) boreal forest, where a mosaic of small prairies were kept open by indigenous burning on the same soil types as the boreal forest, as well as wet prairie and sloughs\creeks where Cree /Slavey and other Indian tribes burned to stimulate muskrat food plants, moose browse, etc. They did not burn extensively in forests inhabited by pine martens, mink, lynx, but did burn dying forests full of windfall, due to fire danger in late summer lightening season

Indigenous peoples used fire even in areas of very high lightening frequencies. E.g. on the Colorado Plateau of SW U.S., where lightening frequencies are as high as 2.5 years in the same locale, Indians still burned selectively: highly productive wetlands, swamps, riparian corridors, piñyon pine groves, mountain meadows, etc.

Despite the high lightening frequencies, lightening could not be depended upon to strike in a timely manner in culturally important ecological zones or plant patches. In spite of high lightening frequencies today, springs, wetlands, and meadows—important for a large number of cultural plants and associated native species—have closed up, choked with a small number of invading weedy exotic and native plant species, lowering species richness and biodiversity.

Some academics have argued that because of small indigenous populations, where the actual area of villages in the in the U.S., e.g. was only 0.02%, Native American burning would not have altered much beyond habitation sites

Thomas Vale (ed.), *Fire, Native Peoples, and the Natural Landscape*, 2002

- Indians in No. America burned nearly everywhere in a rotational pattern that followed their annual seasonal migrations from low to high elevations from snowmelt to snowfall

- The spatial selectivity of burning (where they burned) targeted very productive ecological zones and vegetation types—wetland, prairie, riparian, oak and pine savannas\woodlands. These were places where most of quality wildlife habitat and cultural plants were found Burning there produced a lot of ecological punch for efforts exerted. For perspective, consider that in W. No. America, 80% of wildlife species spends some time in their life cycle in riparian zones which constitute only 2% of the total land area.

Another common source of skepticism about the extent of indigenous management is the culturally conditional assumption that "pristine" nature—entirely "self-organizing and autonomous"—provided a bounty simply for the taking

We have shown, however, that indigenous burning had to occur selectively in unproductive vegetation types for tribal economies to survive; and that burning in productive ecological zones and plant communities targeted places where wildlife and culturally important plant species were concentrated, e.g. riparian zones and savannas

While many external and uncontrollable biotic and abioitic factors govern ocean and anadramous fisheries, First Nations peoples, e.g. in NW No. America still managed anadramous salmon and eel runs intensively

- Spawning beds were frequently cleaned-up following big storms and fires which brought debris and sediment to the gravel beds
- The mouths of rivers which filled up with sand and were closed off to migrating fish and eels were cleared before the first rains
- Highly productive estuaries were seasonally off limit for fishing as well as summer cold river waters
- Weirs were built to regulate fish runs, allowing fish through periodically to their upstream spawning areas, while concentrating fish below the weirs for harvesting—a form of intentional resource conservation

As ice retreated, some 10,000 stocks of salmon colonized 3,600 rivers and streams in what is now British Columbia, Canada (NW No. America). Nigel Haggan and others have argued that First Nations developed sophisticated political and legal systems linked to resource management and harvest technologies, contributing to the spread of salmon throughout NW No. America and increasing the complexity of habitats

Nigel Haggan “12,000 Years of Change: Linking Traditional and Modern Ecosystem Science in the Pacific Northwest”, Proceedings of the 15th annual meeting of the Society for Ecological Restoration International, Victoria, B.C., 2004 (on CD disc)

- Secure tenure and fishing places promoted individual, family, clan and band stewardship responsibility. Local people with detailed knowledge of their fisheries and habitat, passed down intergenerationally, compares favorably with heavy-handed and generalized modern fisheries management.
- Group fishers harvested small amounts from a variety of sources, with each family getting just enough fish to last the season by drying and smoking; different salmon species would be harvested by different groups, with trading providing a balanced diet
- Clams were farmed in “gardens” which occupied former fish traps filled in with clam and barnacle fragments, forming a firm substrate for the clams

Nigel Haggan

- Fish traps and hooks were designed to allow unwanted species and sizes out while retaining food species of the appropriate age and size
- Back eddies and side channels were created by felling trees into the main channel to provide a refuge for overwintering fish (e.g.; Coho salmon runs)
- Salmon spawn were transplanted in wet moss from one stream to another where access upstream was blocked or to keep favorite species close when moving to a new location
- Flumes have been built to allow salmon around rockslides (e.g. Sockeye runs on the Fraser River in B.C. in 1913)
- Herring are still farmed by submerging hemlock boughs in rivers—to which the reproducing herring attach their spawn

Nigel Haggan

Population densities of indigenous peoples in the Western Hemisphere have been grossly underestimated by Western scientists

- European diseases, to which indigenous peoples had no resistance, decimated up to 90% of the native population e.g. in eastern North America, smallpox occurred shortly after Columbus' landfall; typhus in 1546; diphtheria in 1614; measles in 1618
- Following DeSoto's visit to the SE U.S., the Caddo stopped building monumental community centers and began digging community cemeteries (Mound-builder culture); population estimated to fall from 200,000 to 8,500—a drop of 96%; an equivalent loss in New York City would reduce its population to 56,000—not enough to fill Yankee Stadium

Ch. Mann, *1491*, (2005)

European diseases devastated Indian communities even before European contact—creating the impression of an empty land

- The Lewis and Clark expedition of 1805-6 to the Pacific Ocean (U.S.) found bodies stacked like cordwood along the Columbia River (Washington and Oregon)
- Cortez easily conquered Tenochtitlán (Mexico City)—a city then larger than Paris or London—in 1519 because of smallpox which had killed or sickened over 80% of its native inhabitants
- English and French colonists in NE No. America (U.S.\Canada) found empty villages and fields everywhere
- Pacific Islander Polynesians, and Australian aborigines were also devastated by European diseases
- Francisco Pizarro conquered the Inca empire in So. America partly because smallpox killed half the population and its dictator Huayna Capac and his family—setting off a ruinous war of succession and leading to complete political and military chaos

Current population estimates of indigenous populations in 1491 are significantly higher than originally thought—but are very controversial among Western scientists

- The American anthropologist James Mooney, in 1910, estimated No. American (Canada/U.S.) native populations at 1.15 million
- The current highest estimates for No. America by Henry Dobyns (1966) is 10.5 million and 112 million for the hemisphere—i.e. 95% loss of population 130 years following contact—the worst demographic calamity in recorded history, which killed Indians from Mexico to Alaska

Ch. Mann, *1491*, (2005)

Western scientists have repeatedly increased their estimates of indigenous populations (from 1.15 million in 1910 to 10.5 million in 1966 in No. America); length of occupancy in the western hemisphere (from 8,000 to at least 22,000 with some estimates as high as 35,000 to 70,000 and more years). Indigenous peoples have had more than sufficient numbers and time in the Western hemisphere to have a significant impact on the land. Moreover, their technology was more than sufficient to have caused numerous species' extinctions had there been no ethical restraints. It is ironic that the same scientists who assert that paleo-Indians caused the megafauna extinctions also hold that they did not have sufficiently sophisticated technology, time, and numbers to impact the post-ice age Holocene landscape.

Returning to our earlier definition of Western science—materialistically and mechanically based, highly quantifiable, abstract and linear, empirically replicable and predictable, and assuming nature to work most optimally without human interference and in a “steady-state”, to which state it will return following human or other disturbances.

A new ecological paradigm has been emerging over the past several decades which is more in line with indigenous cosmologies—nature as non-linear, random to stochastic, complex beyond our human understanding and predictable only to a limited extent in time and space. ***Disturbances viewed as normal ecological events and not threat to the stability or biodiversity of ecosystems if the kind, rate, and intensity of disturbance events is within the historical\natural variability (HRV).***

Where indigenous peoples' cultural practices have occurred over time within the ***Historical Range of Variability (HRV),*** these practices can be assumed to be ***Disturbance Events or Stressors*** with which an ecosystem is ecologically "familiar" and therefore part of nature. We will come back to the concept of ***Indigenous Peoples As Natural Disturbance Agents*** after we look at current restoration ecology theory.

Indigenous traditional land management practices and knowledge—past and present—can help Western Science with its current conservation and restoration efforts.

After defining some basic ecological concepts and ecological restoration—i.e. what we are restoring—we will explore the role of indigenous cultural practices and knowledge in developing reference ecosystems for ecological restoration—i.e. *historical and functional guides to setting restoration goals*.

We will then discuss the importance of supporting the cultural survival of indigenous societies\local communities and their improtant to the modern practice of ecological restoration and conservation biology.

Defining what we are restoring

- " 'Biological Biodiversity': means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems."

- " 'Ecosystem' means a dynamic complex of plant, animal and microorganism communities and their non-living environment interacting as a functional unit."

- " 'Habitat' means the place or type of site where an organism or population naturally occurs."

The Convention on Biological Diversity\Conference of the Parties (Working Draft written by John Scott, U.N. convention on Biodiversity, Montreal, 2005)

- "Ecological Integrity should be defined as an ecosystem's undiminished ability to continue its natural path of evolution, its normal transition over time, and its successional recovery from perturbations"
- The concept of ecological integrity denotes the quality of the ecosystem and its biota that is the product of evolutionary biogeographical processes *with minimal influence from human society*

Ecological Integrity (Eds.) Noss, Pimental, Westra, 2001

- "Landscape" the larger scale in which ecosystems are embedded, often an integral part ecologically of the larger scale (i.e. the same kind of ecosystem structure, composition, processes, and function).

What is ecological restoration?

- The official SER-I definition is found in the SER Primer, (section 2) (2002) www.ser.org

  "Ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed

SER Primer "Overview" (section 1)

"Ecological restoration is an intentional activity that initiates or accelerates the recovery of an ecosystem with respect to its health, integrity, and sustainability….Restoration attempts to return an ecosystem to its historic trajectory. Historic conditions are therefore the ideal starting point for restoration design. The restored ecosystem will not necessarily recover its former state, since contemporary constraints and conditions may cause it to develop along an altered trajectory."

Natural vs. Cultural Landscape or Ecosystem

SER Primer, (section 4)

"A Natural landscape or ecosystem is one that developed by natural processes and that is self-organizing and self-maintaining."

"A Cultural landscape or ecosystem is one that has developed under the joint influence of natural processes and human-imposed organization."

Examples include:

- Global savannas, wetlands, open woodlands, and grasslands maintained by intentional fire
- European species-rich meadows maintained following forest removal through mowing and seasonal grazing by livestock
- North American forested landscapes\ecosystems formerly kept open by intentional fire and plant species utilization by indigenous peoples

The boundaries between natural and cultural landscapes are not as rigid as the SER Primer definition suggests

- (section 4) "Perhaps all natural ecosystems are culturally influenced in at least some small manner, and this reality merits acknowledgement in the conduct of restoration."

- We will now discuss the "gray zone" encompassing what Western science calls "natural" and "cultural". The survival of local and indigenous communities may depend partly on how we define these two traditionally mutually exclusive categories—most notably in English-speaking parts of the world, especially North America

1996 SER definition of Ecological restoration includes "sustainable cultural practices", and while superceded by the 2002 definition, remains as a viable restoration concept in the extended definitions found in the SER Primer (First Edition, 2002)

1996 definition:

"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

"Sustainable cultural practices" are traditional human land uses that maintain biodiversity and productivity. In this context, the biota is valued as much for its importance to ecosystem stability as ti is for the short-term worth as commodities."

The SER Primer is ambiguous about "self-organizing and self-maintaining" ecosystems and those like cultural landscapes which require periodic intervention.

If we include human societies with "sustainable cultural practices" of long duration as "natural", the boundaries between what Western science calls "natural" and "cultural" are significantly blurred. They are also blurred if we recognize—as the SER Primer notes—that "perhaps all natural systems are culturally influenced in at least some small manner".

By talking about “native” and “culture” as separate, we perpetuate the prevailing mindset of “wilderness” which needs preserving as if is a static state versus exploiting industrial “sacrifice zones”. The term “cultural landscape” is misleading. Our food and fiber production systems need to be re-connected to the ecosystems they are part of. Within certain limits—e.g. intensive agriculture on plantation forestry may show more ecologically appropriate ways to do agriculture in forestry on more land—the larger matrix” needs to be connected to smaller wildland reserves.

Whether we include humans in "natural" ecosystems or not, can we say that restoration is ever really finished—that it no longer requires periodic intervention?

- The SER Primer states (section 4, p. 5): "A common goal for the restoration of any natural ecosystem is to recover autogenic processes to the point where assistance from restorationists is no longer needed."

- And in the "Draft revised Restoration standards" (SER Policy and Science Working Group [SERPOL], March 2005, by Andrew Clewell): "The restored ecosystem shall be self-sustaining to the same degree as its reference…and shall have the potential to persist indefinitely under existing environmental and cultural conditions."

- But, can we expect relatively small restoration projects embedded in a vastly changed and degraded landscape to persist long enough for autogenic processes to take ;over completely without intervention?

- The SER Primer (section 1) separates “restoration” from followup “restoration maintenance”: “ the restored ecosystem often requires continuing management to counteract the invasion of opportunistic species, the impacts of various human activities, climate change, and other unforeseeable events…ecological restoration aims at assisting or initiating recovery [i.e. set on a trajectory which will eventually require no intervention], whereas ecosystem management is intended to guarantee the continued will-being of the restored ecosystem thereafter.”

There is no hard and fast line between "restoration" and "restoration maintenance" techniques, between traditional indigenous "cultural practices" and modern Western restoration techniques, and between "nature" and "culture". They form a "continuum" (as the SER Primer notes in section 1, p. 2)

The SER Primer reinforces this idea of a continuum (section 1, p. 2):

"Reciprocity exists in these cultural ecosystems between cultural activities and ecological processes, such that human actions reinforce ecosystem health and sustainability…***The restoration of such ecosystems normally includes the concomitant recovery of indigenous ecological management practices, including support for the cultural survival of indigenous peoples and their languages as living libraries of traditional ecological knowledge. Ecological restoration encourages and may be dependent upon long-term participation by local people."***

"But the nature that needs preserving…is better defined as *complex assemblages of species as they have evolved in their environments over the ages*. Whether people have played a role in this evolution is not key. [But] if people—or anything else—change the environment sufficiently rapidly so that substantial numbers of species die instead of evolve, then what we have is degradation (or "development") rather than nature…. [R]egardless of whether Homo sapiens is or is not present, if nothing causes changes so rapid as to eliminate species from any long-evolved community, this is nature. In fact, if people intervene and go to great lengths to restore the conditions of relative stability which allow the continued existence and evolution of those ancient lineages and interdependencies, the result is still nature.

U.S. restorationist Steve Packard in *Miracle Under the Oaks* by William K. Stevens, (1995) p. 287

Indigenous peoples have frequently been actively engaged as part of nature through their cultural practices in ways with which a particular ecosystem has familiarity in an ecological and evolutionary sense—part of "*complex assemblages of species as they have evolved in their environments over the ages*" (Packard)

- When indigenous peoples are prevented from carrying out their time-tested sustainable cultural practices—through national laws, relocation, assimilation, or ethnocide—ecosystems lose a keystone species, and evolutionary processes, which they have been part of, cease to function satisfactorily causing species and ecological\co-evolutionary adaptive processes to be weakened or lost.

The unavoidable conclusion is that, where indigenous peoples have been an integral part of ecosystem dynamics for a very long time, to ignore their co-evolutionary role in nature is to risk basing ecological restoration on bad science and miss the mark on achieving a new trajectory towards greater ecological integrity.

Reference ecosystems should include historically retrievable effects of indigenous management on ecosystem structure, composition, processes, and function. The newly emerging disciplines of historical ecology and ethnoecology/ethnobotany may help in achieving that objective

What is "historical ecology"?

Historical ecology employs a variety of techniques from several disciplines to reconstruct past ecological features which become part of a *reference ecosystem* that will guide ecological restoration—usually in combination with functional ecological goals when historical information is difficult to retrieve:

- Archaeology and Paleoecosystems
- Ethnobiology\ethnohistory
- Oral history through interviews
- Maps and photographs
- Government Land Office Survey/other early land surveys

- Inferring forest stand history from observational field evidence
- Dendrochronology
- Palynology
- Packrat middens
- Techniques for discovering historic animal assemblages
- Geomorphology, hydrology, and soils
- Inferring vegetation history from phytoliths

The Historical Ecology Handbook: A Restorationists Guide to Reference Ecosystems, (eds.) Dave Egan and Evelyn Howell, (2001)

What time period serves best as an historical anchor point for a reference ecosystem on habitat? How far back in time do we need to go?

- Our reference window is as large as 10,000 years—the post-glacial Holocene period—with particular attention paid to the last 4,000 years during which a gradual cooling trend has occurred and which is most like present climatic and ecological conditions, and the period during which humans have exerted the most influence on ecosystems.

- We are not attempting to restore environmental conditions from a fixed point in time in the past in a snapshot in time. We are restoring key features of ecological *trajectories* from any time before the impacts of industrial civilization—re-starting a *moving* picture that was interrupted at sometime in the past and which is played out within boundaries determined by historical trends –in disturbance regimes, i.e. its historical range of variability (HRV).

"Restoration uses the past not as a good but as a reference point for the future. If we seek to recreate the temperate forest, tallgrass savannas, or desert communities of centuries past, it is not to turn back the evolutionary clock but to set it ticking again"

Don Falk in *The Historical Ecology Handbook*, (2001)

Ecologists now talk about “shifting-steady-state-mosaics” instead of assuming some kind of perpetual static state unless disturbed. Humans, where their cultural practices have enhanced or maintained ecological integrity and biodiversity, can be included in ecologically appropriate disturbance events, i.e. where these disturbance or *stressors* are within the HRV

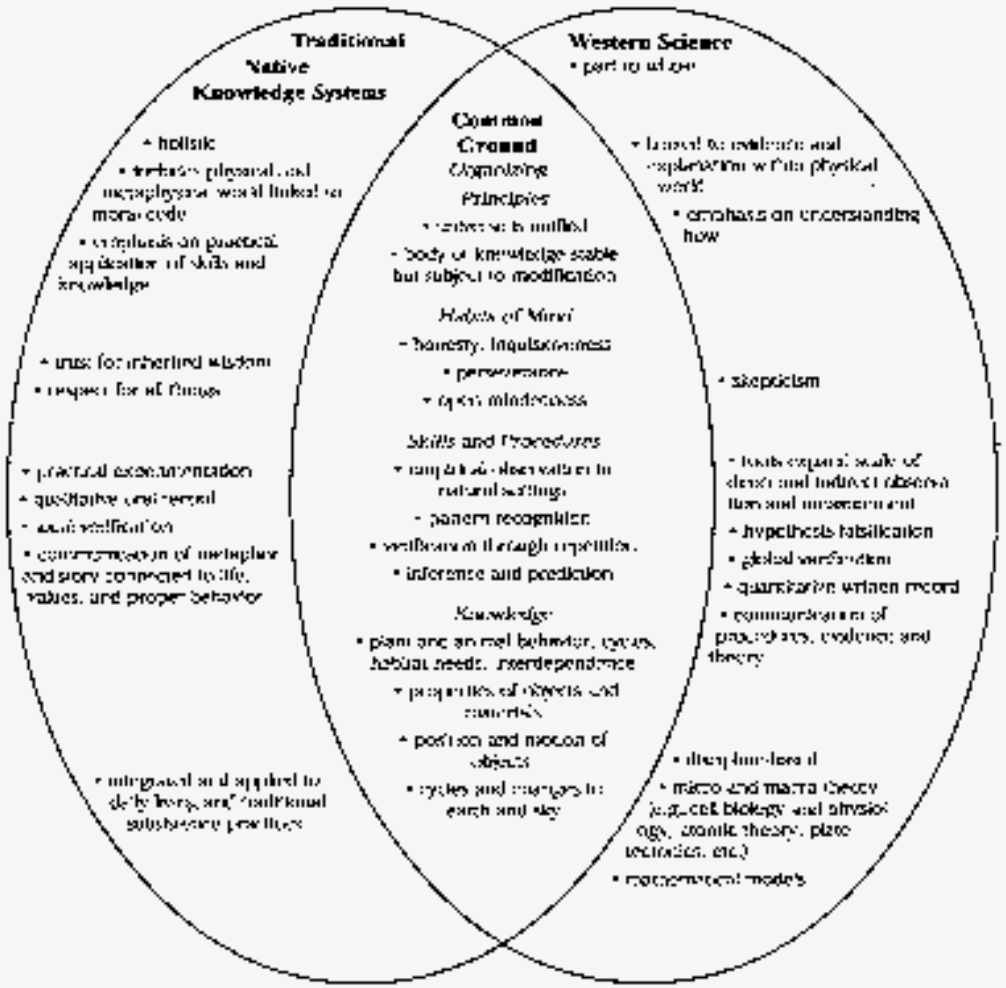

Figure 2.
Qualities associated with traditional (Indigenous) knowledge systems and Western

Indigenous knowledge systems in the communities in which schools are situated. In so doing, the AKRSI has attempted to bring the two systems together in a manner that promotes a synergistic relationship such that the two previously disparate systems join to form a more comprehensive holistic system that can better serve all students, while at the same time preserving the essential integrity of each component of the larger overlapping system. The implications of this approach extend far beyond Native communities in Alaska, as indicated by Battiste in her comprehensive literature review on *Indigenous Knowledge and Pedagogy in First Nations Education* (Canada):

> Indigenous scholars discovered that Indigenous knowledge is far more than the binary opposite of western knowledge. As a concept, Indigenous knowledge benchmarks the limitations of Eurocentric theory—its methodology, evidence, and conclusions—reconceptualizes the resilience and self-reliance of Indigenous peoples, and underscores the importance of their own philosophies, heritages, and educational processes. Indigenous knowledge fills the ethical and knowledge gaps in Eurocentric education, research, and scholarship. [2002:5]

Examples of what this "fresh vantage point" looks like are provided in recently developed curriculum materials that integrate Western and Indigenous knowledge

Examples of human disturbances which are or were ecologically appropriate and can therefore be included in reference ecosystems for eco-cultural restoration: both wildland systems and connection (or reconnection) of those ecosystems to agroecology systems

- Indigenous burning regimes which either augmented lightening ignitions or where those regimes are or were the principal ignition source—emulating their seasonality, spatial selectivity, intensity, and frequency to the extent possible
- Indigenous and local agroecology systems which managed natural resources within an ecosystem context and which enhanced biodiversity and species richness while providing for cultural and economic needs. Some ecosystems can be defined by cultural practices as well as non-human process, etc.

Under the current economic regime of industrial size globalization, local kinds of farming, timber harvesting, fishing, etc. are being sacrificed for scale and efficiency—but with unsustainable external inputs for monocultures totally disconnected to wildland ecosystems. Eco-cultural restoration can harmonize extractive industry and ecological integrity\biodiversity while saving local and indigenous cultures and knowledge from extinction.

- The World Conservation Union (IUCN) proposes a mixed strategy: increase agricultural production on currently farmed land, enhance wildlife habitat on farms—and I would add cities—establish protected areas near farms, and mimic natural habitats within farming systems. (2001)

Conservation Biology also supports local agroecology and sustainable farming or timbering systems from sacrifice extractive zones. But they are guessing that reserves and parks will have sufficient suitable habitat to attract target species and that there are enough reserves big enough to accomplish their conservation goals. Conservation biologists lack the local detailed knowledge of wildlife habits and habitat

- An example in temperate forest ecosystems of the disconnect between forest ecology and silvaculture (growing merchantable trees) where the “matrix” in which resources are embedded is managed for only economic values. Timber harvest prescriptions can be designed in many forests which mimic historic cultural practices into the reference ecosystem, and which both restore\conserve biodiversity and return economic benefits to the local community (community-based forestry”)

Most Western restorationists work in areas where indigenous peoples have been long-removed from their homelands, and where it is very difficult to access their TEK or where scientific data is poor or missing. But it is still possible to reconstruct a reference model through a combination of:

1. Archival and current ethnoecological literature
2. Detective work in historical ecology
3. Use knowledge of indigenous peoples living in environmental conditions comparable to the landscape in which the missing native people lived (from literature or oral interviews)
4. Use of indirect or proxy lines of cultural\economic evidence to reconstruct key features of ecosystem structure and composition and reintroduce critical processes like fire.

Another PowerPoint presentation will show , in a case study from NW U.S., methodology I used to reconstruct key ecosystem features of a temperate forest using proxy evidence.

1. Determine from the literature\archives\oral interviews (where possible) the most important cultural/economic plants and their uses and animal species utilized by the indigenous group on whose land you are doing your restoration project
2. Determine through field surveys the abundance\presence of important cultural plants\animals and the quality of their habitat.