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NEW PERSPECTIVES ON CONSERVATION AND PRESERVATION IN THE KLAMATH-SISKIYOU REGION[1]

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Abstract. *The unique biological diversity of tree species, fish and wildlife in the Klamath-Siskiyou region of northwestern California found refuge from the ice sheets during the last glacial period, but a century-and-a-half of extractive resource management has left populations of many of its indigenous species in serious decline.*

The relationship of human communities to the land is discussed with special reference to management and regulatory frameworks and their contribution to the loss of biological diversity. A Biosphere Reserve Model (BRM) for regional management is offered as framework for maintenance/restoration of biodiversity in the Klamath-Siskiyou region and as a reasonable alternative to the existing fragmented approach to management and land tenure.

Design elements which the authors and associates have utilized in developing an Ancient Forest Reserve Proposal for the Klamath-Siskiyou Region are reviewed. A proposed model reserve system proposal is described with special reference to its relationship to a BRM. Possible economic and social strategies for adapting to a BRM are discussed. Economic diversification, local government fiscal policy and "new forestry" are discussed in light of their relationship to biodiversity protection. And special attention is given to changing institutions, societal paradigms and world views in relation to the ecosystem function of the Klamath-Siskiyou region.

Introduction

The Klamath-Siskiyou region or province of northwestern California and southwestern Oregon is one of the world's unique places. It is set in a region of old and geologically complex and rugged mountains. It is an island in a way—disjunct, and yet connected to its rich biological and cultural heritage. Its pre-history is old, according to the region's indigenous Native Americans. Its Euro-American history is recent, its rugged mountains, coastal and riverine flatlands having only been "discovered" and settled by Euro-American prospectors, ranchers and timbermen some 140 yrs ago. Its economic history epitomizes interplay of indigenous, Euro-American pioneer, metropolitan and now cosmopolitan economies in the western United States. Here the Euro-American Pioneer and metropolitan extractive economies of mining, ranching and farming, and logging, which displaced many of the Native American economies for more than a century, now find themselves being overshadowed by the emerging global economy of the 21st century and the dominance of urban population centers in the western states.

The biological uniqueness of the Klamath-Siskiyou region is widely known, even among the region's human population. Whittaker (1960) marked this significant uniqueness in his pioneering study of the vegetation of the Siskiyou Mountains. He discussed several aspects of the "central significance" of the Klamath region: 1) its geological antiquity, compared to most of the west, has allowed vegetation to cover the area continuously for at least the entire Cenozoic Era (the last 65 million years); hence, it has been a refugium for plant populations destroyed in other areas by submergence, glaciation, desiccation, or lava flows, and contains modern vegetation most nearly related to the widespread Arcto-Tertiary forests of the early Cenozoic; 2) it has, like the southern Appalachians, one of the most complex vegetation patterns in North America; all western plant associations dominated by trees occur in the region, as in no other area; 3) it is a biological meeting ground and a linkage between two major western vegetation types: the coniferous forests and the sclerophyll and oak pine woodlands; 4) it is extremely rich in plant species, including one of the greatest concentrations of narrow endemic taxa in the temperate zone.

While the Klamath-Siskiyou region is most noted for plant diversity, it also provides habitat for many rare animals including the northern spotted owl, Pacific fisher and wolverine. Populations of other large mammals, such as the elk, wolf or grizzly bear, have been sharply reduced in numbers or extirpated from the region. The Klamath-Siskiyou region has also seen marked reductions in amphibian populations. The Del Norte, Olympic and Siskiyou Mountain salamanders and the tailed frog are among the species which biologists believe are threatened or declining in the region (Welsh, 1990).

The Klamath-Siskiyou region contains several species of anadromous fish which are at "high or moderate risk of extinction" (Nehlsen *et al.*, 1991). Of greatest concern are stocks of spring chinook salmon and summer steelhead (these runs have declined by more than 90% in the South Fork of the Trinity River, for example). If we include the Eel River within its boundaries, the Klamath-Siskiyou region contains all of the California streams that retain significant runs of summer steelhead. Northern

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California's Salmon River appears to retain the largest run of wild spring chinook remaining in California. Current run size is less than 200 fish. Present adult population levels place this stock group at high risk of irretrievable genetic loss from randomly occurring natural or man induced events (West, 1991).

As early as 1960 biologists called for preservation of this uniquely important area. Whittaker, who had conducted parallel studies in the Great Smokey Mountains National Park, noted that "the biological interest and scenic appeal of the Klamath region equals that of the eastern center of vegetational and floristic diversity, the southern Appalachians, and suggests further consideration of preservation of parts of the region for the future" (Whittaker, 1960). A large section of the southern Appalachians, including Great Smokey Mountains National Park, has since been designated a World Biosphere Reserve.

There has been some preservation in the Klamath-Siskiyou region and some reserve areas, such as the Kalmiopsis, Siskiyou and Russian Peak wilderness areas, harbor unique and important vegetation types. In general, however, reserved areas are at higher elevations, often dominated by montane and sub-alpine forest and vegetation types. These vegetation types are the least threatened in the west. Low elevation forests, on the other hand, have been difficult to preserve because of their value as wood products. The low-elevation forests continue to be liquidated at an alarming rate, with potentially grave consequences to the region's ecosystems. Why have we failed to preserve more of the unique biology of the Klamath-Siskiyou region? An explanation must be sought in the human cultural context.

The First Waves of Development

The Gold Rush of 1849 brought the first sustained effort by Euro-Americans to settle the rugged and isolated area, which is characterized even today as being "behind the redwood curtain" or beyond the "lost coast." While mining penetrated the region's interior, the mines were largely played out by the 1880s. Ranching mostly took hold in areas on the fringes of the forest where grasslands were found on the "bald hills" or in scattered oak woodlands. The elk that had once roamed these "prairies" had, by and large, fallen prey to market hunters supplying the mining trade. Logging and lumber production began shortly after the region's initial settlement, but redwood lumbering was slowed by a lack of technology to easily move or mill the giant logs. With the development of "steam donkeys" and new sawing technology in the 1870s and 1880s, the timber economy began its rise to dominance. The "management paradigm" of the early "land managers" was utilitarian and the forests were considered to be infinite in their extent, an assertion sometimes made to this day.

The period of early lumber expansion, regionally, and the building of the railroads, nationally, left a lasting imprint on the pattern of land ownership in the region. In addition to the internal development by Euro-American pioneers, the expansion of corporate capitalism in the west left its mark. Timber speculators, abusing the purpose and provisions of the Timber and Stone Act of 1876, set about to fraudulently acquire tens-of-thousands of acres of the most productive redwood timberland. Land grants to railroads established a pattern of tens-of-thousands of acres of alternate square mile sections in California and Oregon. Later these "O and C lands" reverted to the federal government as the Oregon and California railroad was never built. Today the "O and C lands" are managed by the Bureau of Land Management (BLM).

Today's pattern of land ownership is a product of history. Lands that were not otherwise homesteaded, patented as mining claims, acquired by the timber interests or railroads, or set aside for Indian reservations eventually became National Forests. Today the Siskiyou, Rogue, Klamath, Six Rivers, Shasta-Trinity and Mendocino National Forests contain almost 10,000 square miles of public lands.

The Coming of Jefferson

Politically the region has had an identity crisis since the time of its settlement by Euro-Americans. Much of the California portion of the region was initially part of Klamath County, the only California county to be totally dissolved by the state legislature. Editorials proposing that a new state be created from Northern California and Southern Oregon appeared as early as 1853. These proposals were variously called, the "State of Klamath," Territory of Jackson," the "State of Shasta," and the "State of Siskiyou." Some bills were actually introduced in the California legislature where they died. One Judge John C. Childs, in Crescent City, California—very near to the Oregon border—facetiously declared himself the Governor of Jefferson in 1935. Economic development languished in the region between World War I and World War II.

By 1941 the sense of isolation felt by some residents manifested itself in a short lived "secession" that was joined in principle by Del Norte, Siskiyou and Trinity Counties in California and Curry County in Oregon. Feeling neglected by their respective capitols, in Sacramento and Salem, their county governments vowed to secede unless they got more state monies for roads and bridges for their isolated and rugged region. The "rebellion" garnered national media attention, as some residents with rifles and cowboy garb stopped traffic on U.S. Highway 99 near Yreka, California to hand out fliers proclaiming that the travelers were entering the State of Jefferson that "is now in patriotic rebellion against the States of California and Oregon." Though the Hollywood

newsreel coverage of the new state was set to run in theaters nationwide on December 8th, the bombing of Pearl Harbor on December 7th ended that movement toward statehood.

Randolph Collier of Yreka later became one of the most powerful members of the California State Senate. Known as the "Silver Fox of the Siskiyous," Collier delivered increasing amounts of road and highway money to the region after World War II.

From Bangs to Boom

World War II, functionally, was the most significant single historic event to affect the region in this century. World War II fundamentally altered the demographic patterns in the western United States (Clary, 1986). Industrialization and staging areas associated with the war in the Pacific theater brought renewed growth to urban areas on the west coast. After the War's end, the passage of the "GI Bill" provided subsidies for veterans, including low interest loans, which in turn fueled the post-war housing boom. Populations in some of the rural counties of the Klamath-Siskiyou region doubled between 1940 and 1950. Lumber mills sprang up almost overnight to meet the new demand for building materials throughout the west.

Ranch lands that had significant stands of Douglas-fir, which were seen as of little value for raising cattle, were largely cut-over within the span of a decade. Production on timber industry ownerships also mushroomed. Regional lumber production peaked about 1960 on the coast. As old-growth trees began to decline on private timber lands, political pressures built-up to increase logging on public lands, both in the Klamath-Siskiyou region and throughout the Pacific Northwest.

Timber production and associated road building increased dramatically during the late 1960s, the 1970s and 1980s on public lands in the region. As cutting on public lands intensified, public controversy grew proportionately.

Threats to Biodiversity

The effects of the Euro-Americans had important but localized impacts. Broad upland valleys such as the Round, Hayfork, Scott, Shasta, Illinois and Applegate Valleys were settled by Euro-American ranchers and farmers. Beaver-dominated riparian systems in these valleys were destroyed first by trappers, and later by farmers, who drained the flat lands and diverted the streams to irrigate crops and pasture. After the elk were gone ranchers began running cattle and sheep in the mountains, severely impacting dry and wet sub-alpine meadows. Ranching also lead to the elimination of the large predators like the grizzly bear and wolf. Impacts of agricultural water diversion on anadromous and other fisheries were limited at first, but later became significant, especially with the construction of the Trinity River dam and diversion to the Sacramento River in the early 1960s.

Beginning in the middle 1800s, mining wreaked havoc in some steep river canyons, by dewatering entire streams, smothering spawning beds under acres of silt, and by decimating entire fish runs—it was the heyday of hydraulic mining. Mammoth dredges operated during the early days of the 20th century, but declined thereafter. Anadromous fish runs that survived the early mining impacts apparently recovered much of their original abundance by World War II. Impacts of the mining era, however, are still visible in many areas. In recent years a new generation of small suction dredges has renewed localized threats to aquatic and riparian ecosystems.

Because the biological significance of the region is primarily associated with forest ecosystems and their linked watershed and water quality characteristics, logging and associated roadbuilding is the preeminent threat to the region's biological heritage. As discussed above, logging in the bulk of the region was highly localized around towns and mines until after World War II. High grading biggest trees from the most accessible sites was the preferred early method for supplying logs to local mills. After World War II clearcutting became increasingly popular. Thousands of miles of logging roads were built and paid for in the quest for more and more logs. These roads also supported fire suppression, another major focus of federal forest management after 1948.

In the Klamath Province fire plays a major role in the life history of native forest ecosystems. Natural forest fires typically burn in a mosaic pattern. For the most part they are underburns—understory vegetation is reduced and the stand is thinned as weaker and diseased trees are killed. Forest openings are created where the fires flair up (because of fuel, wind and other factors) to kill patches and "stringers" of forest. In this way fire helps create a diversity of successional stages. Some foresters have theorized that clearcut forest management can act in the same way, creating a mosaic of stands of different ages. However, comparison of natural and managed portions of the forest reveals basic differences in the size of openings and pattern of forest stages. Prior to human intervention the native forests of the Klamath Province were dominated by the older age classes while human management has resulted in the dominance of young growth trees.

Logging and fire suppression create unnaturally high levels of dead woody fuels in the forest. When a fire escapes immediate suppression in such an area it often "blows up" becoming a fire storm which can kill all vegetation over a large area. Catastrophic fires have become more typical and larger as the forest area under clearcut and plantation management has increased. A single fire complex in the Klamath Province can now cover over 60,000 acres. Salvage logging and replanting after such fires have created large plantations of young trees all approximately the same age and height. The combination of extensive clearcut/plantation management

and large catastrophic fires has created a forest landscape in the Klamath Mountain Province distinctly different from native conditions.

In 1989 the Klamath Forest Alliance in cooperation with the Marble Mountain and National Audubon Societies mapped the coniferous forests and tree plantations of the entire Klamath National Forest. The project utilized timber strata data compiled by the Forest Service from aerial photographs and representing ground conditions in December 1988. The maps graphically demonstrate the extent to which forest fragmentation has progressed on the Klamath Forest. For the most part wilderness areas appear as islands of natural habitat in a sea of clearcuts, young tree plantations and isolated stands of older trees. Research has amply demonstrated the limitations of small, isolated forest fragments as habitat for interior forest species. The maps also reveal a few areas where the natural habitat connectivity of the forest has not been compromised. These watersheds and ridge systems have not yet been reached by the network of logging roads which covers most of the forest to facilitate the extraction of logs. They are the last remaining source of connectivity between reserved lands. In February 1991 The Wilderness Society (TWS) published maps of Northern California national forests that display the location of remaining ancient forests. While ground checking has revealed some limitations in this database (for example forest stands with a high hardwood component are not identified) the TWS maps have deepened our knowledge of where the older conifer forests are located. This information has been essential in designing a reserve system to protect the region's forest ecosystems.

The spotted owl is perhaps the best known species native to the Klamath Province whose fate is tied to forest fragmentation. However, there are many other animal species still present in the Province which find optimal conditions in forests dominated by old growth trees. The Pacific fisher and other furbearers are of particular concern because of their solitary habits and large home ranges while several amphibians are of concern because of the high degree of habitat specificity which they exhibit.

While the decline of our fisheries is multi-causal, prospects for survival of our most sensitive wild stocks seems clearly linked to forest management decisions. It is no accident that summer steelhead and spring chinook salmon survive only in those watersheds or portions of watersheds which have not been extensively clearcut and roaded. Unless we preserve this handful of watersheds and restore many others we can expect extinction of wild spring chinook salmon and summer steelhead in our lifetimes.

Concerns about plants are less specific. Some tree species (Port-Orford-cedar, sugar pine) are threatened by diseases which can be spread by logging. Others like the pacific yew are threatened by logging itself. Impacts on other vascular plants are difficult to assess. When we protect isolated populations of rare plants in RNAs or in small protected areas within clearcuts, are we truly guaranteeing their survival? Impacts of roads on plant distribution, and the impacts of climate change at the local and global levels are poorly understood.

Although animals considered "sensitive" by state and federal wildlife agencies have been identified as "management indicator species" by the Forest Service, data on their status in the Province is limited. However, there are indications that conversion from native to managed forests in the Klamath Province and elsewhere is having a significant impact on population and other factors which bear directly on long-term survival of these animals (Steinhart, 1990).

Regulatory Chaos

Lumbering had been in decline in the Klamath-Siskiyou region for little more than a decade when the national observance of Earth Day came to pass on April 22, 1970. Earth Day didn't just happen, but was itself the culmination of many environmental crusades during the 1960s, which in turn had grown out of the rapid growth of outdoor recreation after World War II (Hays, 1987). But with Earth Day, pollution issues joined preservation issues on the conservationist agenda. Issues were evolving as were the laws and regulations adopted to resolve them.

Chief among these new laws was the National Environmental Policy Act (NEPA) that forced agencies to conduct interdisciplinary analysis of the possible environmental effects of their actions. The courts' interpretation of NEPA has been to enforce its procedural requirements rather than to rule on substantive issues as to the merits of a project or the demerits of its environmental effects. One of the subtle but profound effects of NEPA is that the federal agencies have had to employ thousands of interdisciplinary professionals.

NEPA, and its many state counterparts, requires agency resource managers and decision makers to evaluate the environmental context of their planned actions. This change is revolutionary because it requires a more holistic view rather than a purely mechanistic or reductionistic one. Klamath-Siskiyou region land managers have held a largely mechanistic world view during the post-World War II era—one that abstracts a unique geographical setting in a reductionist way. Some unique attributes are characterized as "natural resources" that then are converted to commodities (*e.g.*, timber, fish or minerals, for example) which are further abstracted as quantifiable "outputs." The forests of the Klamath-Siskiyou region, as elsewhere, become timberlands and the trees on those timberlands become board feet of lumber or cubic feet of fiber produced as outputs. Further tinkering with the mechanical model produces the notion of "sustained yield." A complex terrain and biological system is conceptually simplified along the lines of an agricultural analogy (*e.g.*, a corn field or a crop of cabbages).

The thrust of forestry, as we currently understand it, is to "regulate" the forest. To "regenerate" "decadent" ancient forest stands into "plantations" of "thrifty" fast growing, perhaps "genetically superior" or "super trees." The focus is on a few theoretically quantifiable elements of the larger system. Less quantifiable elements may be "intangibles" or "amenities," and though these elements may have qualitative value they are systematically "traded off" for more quantifiable outputs. This is the case in the Klamath-Siskiyou region. Commercial timberlands have been converted to plantations and National Forests have been "regulated" and "regenerated" to the point that less than 15% of their area remains in relatively unfragmented natural old-growth forest stands.

Landscapes express unique qualities that need evaluation. In the Klamath-Siskiyou region, mechanistic resource management masks the uniqueness of place with open-ended terms like "general forest," or with fragments of site specific research data not relatable to the whole of the place. Or management asks the public to accept that land management is done in the name of "sustainability," without discussing the question of, "Sustainability for what and for whom?" Or even further, asking the question, "Is sustainability possible?" Warren and Liss (1983) argue that worthwhile sustained yield models are realistically impossible.

An indefinite number of physical, biological, and cultural factors must be involved in determining the production and yield of any product of interest. How then are we to explain, even at steady-state, any particular yield value, if even simple models give us indistinguishably different results for very different levels and kinds of factors? In a sense, we can say, mechanistic models are inclined to be analytically ambiguous and empirically indeterminate. And this would be so for systems in steady state. What are we to say at all about systems in dynamic behavior?

Contextual or holistic ecologists argue that mechanistic models are, at best, tools for helping to explore natural-cultural systems which are composed of a hierarchy of culture, climate, biota, water and substrate (*e.g.*, geology). So though the mechanistic world view predominates in resource management, the global environmental change it fosters is now viewed with alarm by increasing numbers of scientists. The effects of human intervention in global processes is believed to equal or exceed the magnitude of natural processes.

Current knowledge and patterns of research will not result in sufficiently accurate predictions of the consequences of potentially harmful influences on forests, including forest-management practices that lack a sound basis in biological knowledge. This deficiency will reduce our ability to maintain or enhance forest productivity, recreation, and conservation as well as our ability to ameliorate or adapt to changes in the global environment (National Research Council, 1990).

If we somewhat arbitrarily pick four Oregon counties (Curry, Josephine, Jackson and Klamath), and four California counties (Del Norte, Siskiyou, Trinity and Humboldt) as the basis for the Klamath-Siskiyou region, we then have forestry being regulated on the landscape by two state forestry agencies, the Forest Service (FS), the Bureau of Land Management (BLM), the Bureau of Indian Affairs (BIA) and Indian tribes. Water-related forestry impacts involve two more state water pollution agencies and the federal Environmental Protection Agency (EPA). The agencies are charged to implement state forest practice laws, state and federal environmental quality and policy laws, the Clean Water Act, the National Forest Management Act, the Federal Land Planning and Management Act and other laws.

The Fish and Wildlife Service (FWS) and state wildlife management agencies are faced with the same crisis found in forestry. The education of many wildlife managers is rooted in the same commodity sustained yield concepts, for trophy or game animals, which also affect forest land managers. The problem of non-game species (like owls), as a non-commodity at risk, just doesn't fit the classical training. Fish and wildlife responsibilities are divided between state fish and game agencies, the FS, BLM, FWS, the National Park Service (NPS), respective state park agencies, and even the National Marine Fisheries Service (NMFS) in the case of threatened and endangered fish species. Thomas *et al.* (1990) in attempting to develop a conservation strategy for the northern spotted owl surmised that its weakest link would be coordination between concerned agencies. In fact, the team attempted to diagram the inter-relationship between concerned agencies and "concluded that it is so confused as to preclude clear description."

Native American cultural uses in the Klamath-Siskiyou landscape have also caused multi-agency conflict between the tribes, the Forest Service, state Native American Heritage Commissions, and the President's Advisory Council on Historic Preservation.

Added to the mix of agency interests are county planning departments, boards of supervisors and commissioners, numerous economic development entities and a host of other regulatory bodies, each with an influence on the landscape.

Elements of Preservation

Beginning in 1920, the Save-the-Redwoods League began to purchase superlative groves of coast redwoods in Humboldt and Del Norte Counties. These groves became the foundation for several California redwood state parks. Redwood National Park (RNP) was not established until 1968. The creation of RNP raised the conflict between commodity production and preservation to a level that has not abated, pitting family members, friends and strangers, one against another. RNP was expanded by 48,000 acres in 1978, for fear that cumulative watershed effects, from logging upstream in Redwood Creek, would lead to the

world's tallest known tree being undermined and toppled. The expansion law provided $30 million for logging road removal and watershed restoration, and the Park has become a living laboratory for restoration ecology.

In 1981 several of the Klamath-Siskiyou's rivers were designated as segments of the federal Wild and Scenic Rivers System. However, this action failed to abate controversy over how to protect their water quality or declining runs of native anadromous fish.

In 1984, the passage of the California Wilderness Act by Congress designated several new additions to the federal wilderness system including the Red Buttes, Russian Peak, Siskiyou, and Trinity Alps Wilderness Areas. The existing Marble Mountains and Yolla Bolly Wilderness Areas were expanded. Wilderness areas and additions in southwestern Oregon, including the Kalmiopsis Wilderness have been instituted.

In spite of all of these actions, the manifestations of biological deterioration have continued to grow along with the multitude of agencies and regulations.

The Biosphere Reserve Model

Given that a tortuous array of agencies, laws and regulations have proliferated in the face of growing ecological impoverishment, with little apparent effect, we offer what Warren and Liss (1983) term a good "natural-cultural system." We might think of this scheme as a management paradigm analogous to our form of democratic/republican government—a system of checks and balances. What is envisioned here for the Klamath-Siskiyou region, is patterned after a "biosphere reserve," as described by UNESCO for the Man and the Biosphere Program (MAB). Such a reserve would consist of three basic zones of management intensity (and implicitly management discretion): core preserve areas, buffer zone areas—what the MAB calls transition areas, and a zone of greater management intensity that could be called "traditional use area."

The core areas could be monitored in an effort to understand the baseline conditions of the preserve zone. Here management discretion would be limited to regulatory schemes that insure that the biological diversity and processes of core reserves remain intact. Human uses of the core areas would be limited to fishing, hunting and gathering, spiritual and cultural renewal, scientific and nature study, and outdoor recreation compatible with protection.

Buffer or transition areas would allow for intermediate management intensity and discretion. These are areas where new forestry and other untried "new perspectives" type management schemes can be proven or perfected over time.

Areas outside the boundaries of core or transition zones would necessarily be "traditional use areas" subject to intensities of management and discretion consistent with basic environmental standards of air and water quality and community land-use standards.

It is often said that power corrupts and that absolute power corrupts absolutely. It must be the same with discretion. Under our system of government, political power and discretion are checked by the countervailing powers of the judicial, administrative and legislative branches of government. The U.S. Constitution is the core area reserve of our human freedom, theoretically off limits to our abuses. If there is natural law at the roots of our freedom and we are part of nature, should we not extend our paradigm of freedom to nature? We offer a biosphere reserve model based on this premise.

Principles of Reserve Design

Past preservation efforts in the region have been motivated by recreational and aesthetic considerations. Wilderness areas, state and national parks and national recreation areas have been proposed and designated with less regard for ecological factors. As a result certain habitats and ecotypes, as discussed above, are well represented in existing reserves while others, for example sclerophyllic and other low-elevation forest types, are poorly represented. Our objective in designing a biosphere reserve is to insure that, to the greatest extent possible, the core biological and ecological processes of this region are preserved. Our reserve proposal emphasizes forest ecosystems because 1) forests dominate the region, 2) the region's greatest biological significance is associated with forest ecosystems, 3) forests significantly affect both water supply and quality, and 4) most of the non-forest habitats have been extensively altered and are now dominated by human activities.

Success in designing a biological reserve depends on the quality of the data available and on proper application of reserve design principles. During the past few years the Northcoast Environmental Center, Klamath Forest Alliance and other environmental organizations have collected extant databases on the biota of our region. These include FS timber type and strata maps, TWS ancient forest maps, FS and FWS northern spotted owl habitat maps and California DFG Natural Heritage Databases. Volunteers have constructed hundreds of maps which display existing data on overlays. The maps also display information on ownerships, location of roads, location of existing reserves and other pertinent information. When new or improved information becomes available new map layers are constructed or older layers updated. While additional and improved information, including some under development, would be desirable, we believe currently available information, combined with extensive field knowledge, is sufficient to guide development of a World Biosphere Reserve.

In constructing our reserve proposal we have applied generally accepted principles and methodologies of

landscape ecology and conservation biology to the existing situation as displayed on the database maps.

Core Reserve

Many conservation biologists have concluded that even the largest reserves in Western North America are not large enough to maintain all current resident species and certainly not large enough to successfully reintroduce species already extirpated. As they become increasingly isolated by development of surrounding areas, reserves become seriously impaired and lose species. In California, for example, Lassen National Park has lost 43%, Yosemite 25%, and Sequoia-Kings Canyon 23% of the total mammalian species found historically (Newmark, 1987). Larger reserves are widely recognized as more effective in maintaining ecosystem function as compared to smaller reserves.

Reserves in the region are small by western North American standards. Our largest reserve, the Trinity Alps Wilderness, is only 500,000 acres. Many of our reserves are extremely small (*e.g.*, Russian Wilderness at 15,000 acres and Red Buttes Wilderness at 11,000 acres). Larger core reserves must be created if we are to maintain late-successional forest ecosystems over time. Existing reserves do have the advantage of being relatively closely spaced. This provides the opportunity to create larger core areas by protecting lands between existing reserves.

Representative Reserve System

If it is to function to preserve all species present in the ecosystem a reserve must include sufficient and well distributed acreage of all ecosystem types present in the region. We have already noted that non-forest ecotypes in the region have been extensively altered and that, for various reasons, our proposed biosphere reserve focuses on forest ecosystems. In an effective forest reserve all forest types should be well represented and distributed. This is no small task. Forests change in the region along elevation and moisture gradients and with substrate (soil) (Whittaker, 1960). In addition there are several forest tree species which occur only in limited, and sometimes widely spaced, locations. Examples include Brewer's spruce and Port-Orford-cedar. Various researchers have attempted to define forest vegetation types for the region. Types suggested, for example, include the Siskiyou Enriched Conifer Forest and the Salmon Scott Enriched Conifer Forest. There does not, however, appear to be general agreement about typing. In addition, the location and extent of forest types has not been mapped. For this reason forest typing is of little use in seeking a representative forest reserve for the region.

A more promising approach is to utilize environmental gradients as surrogates for forest types. Because precipitation decreases dramatically as one moves inland in the region it is important to include areas that span the west-east regional axis. Because the region includes the southernmost range of some plants and the northernmost range of others a representative forest reserve should also span the north-south regional axis. Such a reserve should insure that all microclimates, soils, aspects and physiographic structures (canyons, ridge tops, bluffs, etc.) are represented.

Connectivity

Biologists agree that reserves which are effectively connected to other reserves with similar habitat are superior to reserves that are isolated. However, there is no scientific consensus on how best to provide for habitat connectivity in all situations. Some biologists favor the use of broad corridors of habitat which are managed in essentially the same manner as core areas which they connect. Such a scheme has been suggested for the Klamath National Forest (Pace, 1991). Other scientists suggest that habitat connectivity between reserves can be provided without preservation of corridors by maintaining certain minimum conditions in the matrix of managed lands located between reserves.

In areas where reserves are surrounded by landscapes dominated by humans (for example farms or urbanized lands) corridors of unmanaged habitat, usually centered on riparian areas, may be the only option for providing connectivity between habitat reserves. Where the habitat surrounding the reserve retains some characteristics of the reserve the issue is less clear. For some animals and possibly some plants a road can be a significant barrier. Other animals display road aversion. Hunting pressure and poaching increase with accessibility. For these reasons road location and density must be considered when designing for habitat connectivity.

Most forest reserve proposals for the west coast locate reserves within a matrix of intensively managed forests. Research has demonstrated that forests managed under current intensive management schemes, including the dispersed clearcut system with short rotation ages, can not provide habitat connectivity. Field experience also suggests that narrow travel corridors are not effective, primarily because they are subject to severance by fire and windthrow.

Maintenance and restoration of aquatic diversity is another goal with implications for connectivity strategy. Failure to exclude road building and logging from riparian zones has significantly impacted fisheries (Klamath River Basin Fisheries Task Force, 1991) and reduced aquatic diversity (Erman, 1977). Some grassroots environmental groups have suggested preserving 1/4 mile wide riparian corridors on all perennial streams as a means to both facilitate connectivity and preserve or restore aquatic diversity and fisheries.

The Interagency Scientific Committee on the Spotted Owl (ISC) recognized the need to maintain habitat

connectivity between spotted owl Habitat Conservation Areas (HCAs). In its strategy the area between HCAs is to be managed to maintain 50% of the forested acres at 40% crown closure and 11" average tree diameter at breast high (50-11-40 scheme). This is proving difficult for land managers to meet on the ground because of past overcutting. The committee considered the alternative of using corridors to link HCAs but rejected that strategy. Its mandate was to develop a strategy only for the spotted owl and in studies to date, spotted owls have shown no habitat preferences while dispersing. The ISC did recognize that other animals and plants would rely on the northern spotted owl areas for their habitat needs. It noted that maintenance of riparian zones to protect the beneficial uses of water and Wild and Scenic River corridors would aid spotted owls and other animals dispersing between habitat blocks.

The issue of connectivity is compounded because the region forms a natural linkage between forested regions to the north, south and east. The region historically linked Coastal, Cascadian and Sierran forest ecosystems. Because intensive human development has centered on the great interior valleys of California and Oregon, the region retains the best options for enhancing, maintaining or reestablishing connectivity between forest reserves in these other regions.

To summarize, strategies for maintenance of habitat connectivity between reserves fall into three categories: 1) broad watershed and ridge system corridors preserved between core habitat areas; 2) maintaining a forest matrix between core areas which provides for dispersal of all organisms, and 3) maintaining smaller riparian corridors on all perennial streams. Each strategy has advantages and disadvantages; various combinations of the three basic approaches are possible. In the Biosphere Reserve Proposal described below we propose wide habitat corridors to link the region with Coastal, Cascadian and Sierran forest reserves, long rotation, non-intensive management on national forest lands around the core reserve, and preservation of 1/4 mile-wide riparian corridors on all perennial streams. In light of the biological significance of the region, the extent to which that biological heritage is threatened, and because of the corollary benefits (watershed, fisheries, scenic, etc.) which will accrue), we believe a preserve strategy that combines all three of these approaches to maintaining connectivity is prudent.

The Reserve Proposal

Many regional environmental groups within the KSR have worked together over the past few years to develop this reserve proposal, which today is part of a network of such proposals to protect forest ecosystems in the Sierra Nevada, Cascade, Coast, Olympic and East Side Ranges of California, Oregon and Washington.

When the citizen-initiated reserve proposal is compared with the recent work of the Scientific Panel on Late-Successional Forest Ecosystems (Johnson *et al.*, 1991), one finds a high degree of relatedness between the proposal and the Panel's alternative 12, which would reserve late-successional and old-growth (LS/OG) areas 1 and 2, "owl additions" and provide a strict set of standards and guidelines for a watershed management emphasis.

Generally, the region reserve proposal establishes a broad north-south core area from the Yolla Bolly-Middle Eel Wilderness, at the north end of the Mendocino National Forest, encompassing most of the South Fork Trinity River watershed, with connectors north to the Trinity Alps Wilderness. LS/OG areas and Native American cultural areas to the west of the Trinity Alps would connect to the Hoopa Valley Indian Reservation. Further northwesterly extension of the core reserve along the Salmon Mountains connects to the Marble Mountains. North-south connections between the Marble Mountains Wilderness and the Red Buttes follow the watersheds of Grider, Portugese and Ft. Goff Creeks.

Major east-west linkages between the coast and the interior follow from Redwood National Park, Smith River National Recreation Area, Siskiyou Wilderness, Dillon and Clear Creeks, Ukonom and King Creeks, Marble Mountains Wilderness, Russian Peak Wilderness, Salmon-Scott Divide, and Trinity Alps and Eddies to the east. Work is continuing to develop sound linkages to the Goosenest Ranger District of the Klamath National Forest, the Shasta and Lassen National Forests.

The areas described and generally depicted on the thematic map (Figure 1) are intended to portray an ideal core reserve. Other zones of management intensity (see biosphere model discussion above) will be determined by the outcome of Congressional debate over the establishment of an ancient forest reserve system.

Private lands present a special problem for the establishment of reserves. While the vast majority of core areas identified are exclusively within the public domain, some private timber ownerships are within the broad boundaries and would best be managed for ecological services.

Perhaps the greatest barrier to watershed reserve design is that the pattern of private ownership is based on a system of 80, 160 and 640 acre squares, or some bigger or smaller sized ones that divide the hydrologic process into a patchwork of squares with different regulatory direction, history and purpose, creating basic fragmentation.

A reconfiguration of the ownership pattern along hydrologic boundaries would be ideal. Achieving such an objective would be fraught with conflict and great expense, unless a vehicle for land exchange (perhaps a semi-public corporation) can be created that is driven by incentives for cooperation, in order to arrive at common goals. Cooperation should be emphasized over condemnation.

The clarification of the regional land base would provide a solid framework for the region to move into the

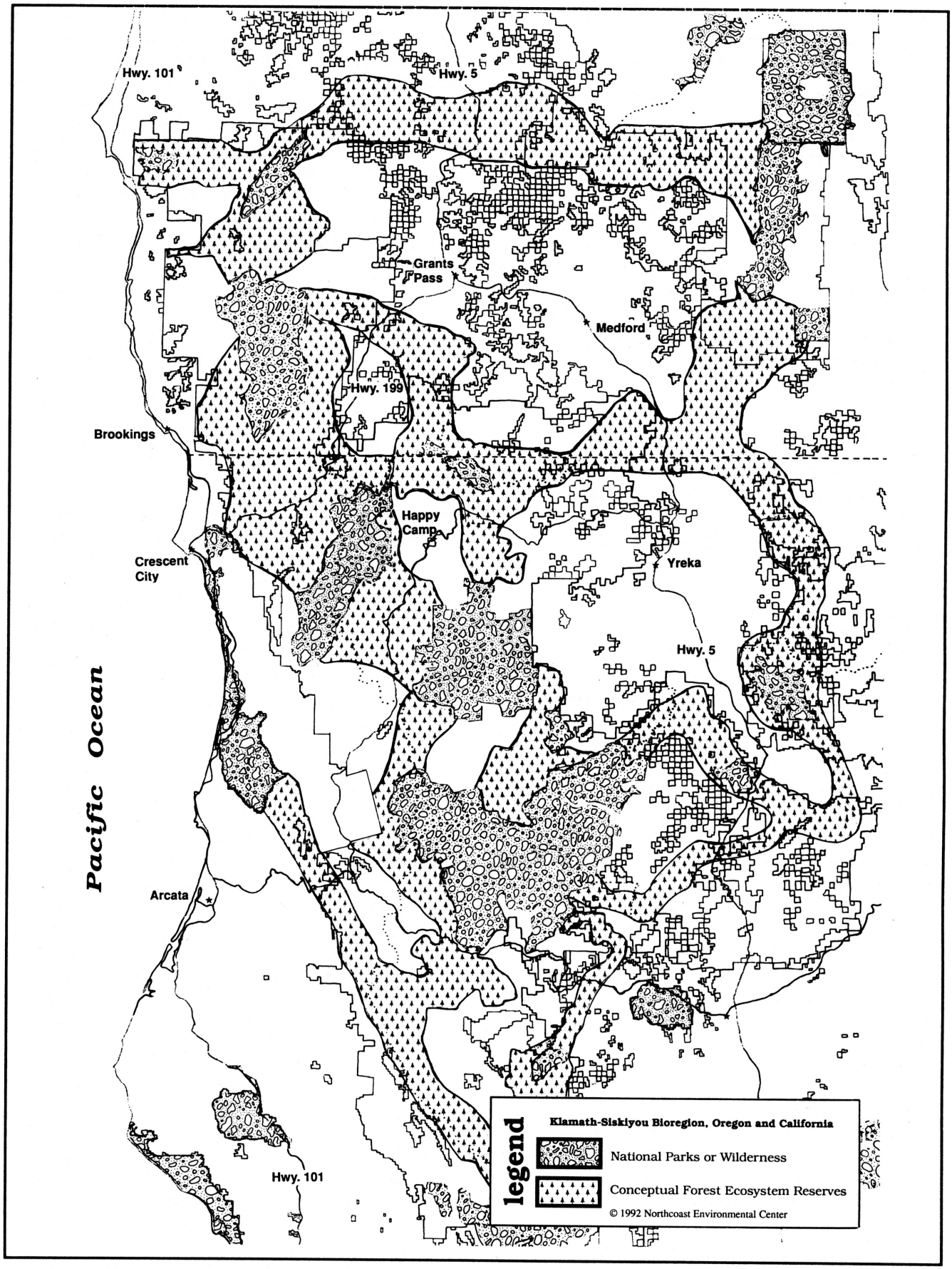

Figure 1. *Core area reserves for the Klamath-Siskiyou Bioregion.*

21st century, and it could also help to clarify various social and interest groups' equity in the landscape.

Economic and Social Restructuring

Since the coming of the Euro-Americans, rural economies have been largely based on exploitation of natural resources. Mining, agriculture and logging each have reduced biodiversity. With current practices, it is doubtful that such industries can be sustained at current levels without further degrading the region's biological heritage. On the other hand it is possible to conceptualize how each of these industries could be conducted on a self-sustaining basis while also preserving and restoring biological diversity. The legal and regulatory authorities necessary to move to sustainable practice are not yet in place. Likewise, public awareness of the region's biological significance and public commitment to sustainable development need to be expanded both generally and within the human population of the region. Public education is key to developing human residents with the values necessary to achieve sustainability. When fully developed our Biosphere Reserve Proposal will provide a vision of a future in which a stable regional economy develops in conjunction with preservation and restoration of the region's forest ecosystems.

The top priority must be for achieving a sustainable timber industry. For at least the last decade and probably longer, private industrial and public timber lands in the region have been cut at rates far exceeding growth (California Department of Forestry and Fire Protection, 1988). Elimination of overcutting through regulation is needed. A Biosphere Reserve as proposed above will further reduce the cut on federal lands. As cutting is reduced stumpage prices may rise. This should be thought of as a necessary market mechanism to include the full cost of log removal in stumpage prices. Essentially we need to remove the subsidy (paid for by impairment of ecosystem functions) which we have been providing the timber industry. As stumpage prices rise, small, nonindustrial timberland owners will bring their logs to the market. In recent years timber growth on these lands has exceeded removal (California Department of Forestry and Fire Protection, 1988). Timber from small holdings will partially offset logging reductions on industrial and public lands. Non-industrial timber owners will need proper regulation and technical assistance to insure that their lands are managed in a manner that sustains timber production while protecting ecosystem functions.

Fewer people will be employed, either directly or indirectly, in the timber industry. This is a necessary step to achieve sustainability and halt ecosystem degradation and should be undertaken immediately. Local economies need to be diversified to absorb the excess labor force. Diversification is needed both within the timber industry (increased product diversity, secondary wood products, increased utilization) and other industries need to be introduced or developed. Destination recreation and tourism are growth industries in the region. There is also potential to expand agriculture, food processing, light industry, and home-based service industries.

Economists identify insufficiency of venture capital as one of the main impediments to economic diversification in rural areas. Old growth can be thought of as the capital of these rural communities. Most of this old growth capital has been exported from local economies with little coming back to replace it. Profits of large timber companies are rarely invested in these rural areas. For this and other reasons rural economies are capital poor.

Overcutting and improper management of private and public lands have lowered the productivity of our forests and watersheds. As a result, west coast rural lands have less ability to provide economic benefits. Timber, fish and forage are all in a degraded state. Restoration of our forest and range watersheds is needed to return these lands to their full potential to sustain local, rural economies. Restoration can employ many of the skilled workers whose jobs in the timber industry are eliminated. For example, heavy equipment can be used to remove logging roads which are silting streams as well as for logging road construction. However, restructuring of public expenditures is needed to fund restoration activities. Budgets of national forests are dominated by funding for timber removal and road building. Congress must be persuaded to redirect this funding into restoration activities. Road budgets must be shifted from construction (of new logging roads) to road removal.

Community Stability

Economies based on resource extraction or a single industry are unstable. Diversifying local economies and reducing economic dependence on the timber industry will increase stability. However, one aspect of community stability, local government finance, is related directly to timber extraction. Payments in lieu of taxes from federal land are low ($.75 per acre) but local governments receive 25% of the gross receipts collected from activities on federal lands (75% on some BLM lands) when this exceeds the per acre in-lieu payment. Federal receipts include recreation and other user fees but most receipts come from timber sales. These payments have been a significant source of local government finance in the region primarily because timber sale programs have been large. Bray and Lee (1991) offer a detailed review of federal forest revenue sharing in Washington, Oregon and California and discuss options for reform.

Federal receipts for schools and roads vary with the amount of timber actually cut, not with the amount offered or purchased. Federal timber contracts are multi-year affairs. When demand slackens in a recession timber companies defer cutting on contracts. If the recession continues, contracts can be extended or bought back by the government. For these reasons the amount of federal

timber cut in any year can and has varied widely and receipts to local government have been unstable. Figure 2 shows federal receipts to Siskiyou County over a recent ten-year period. Local officials must grapple with these fluctuations. Essentially, we are funding rural roads and the education of rural children by a method subject to the instability of the market for wood products. Is this a proper way to fund the education of our children? Reform of in lieu payments to provide adequate and stable compensation to local governments for the large federal ownerships within their boundaries is essential to community stability within the region.

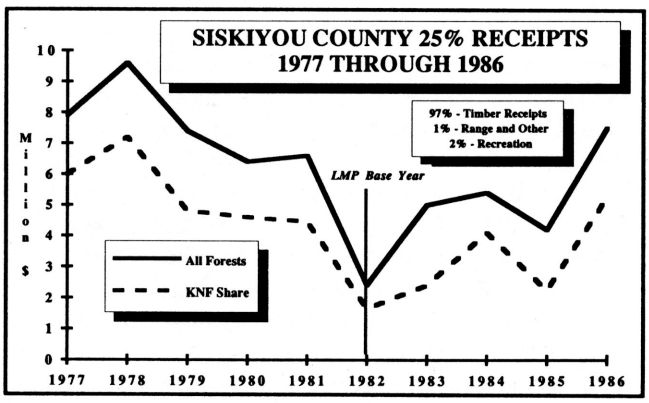

Figure 2. *Twenty-five percent of gross federal timber sale receipts is distributed to local governments in federal forest areas as an in-lieu of property tax disbursement.*

Restructuring Regulatory Institutions

As described above, regulatory chaos stems from fragmented and overlapping jurisdictions that are divided between federal, state and local governments. Compounding this problem often times is the spatial location of decision makers. Additionally, agency funding levels affect their ability to achieve mission goals.

On September 19, 1991, leaders of ten state and federal agencies signed a Memorandum of Understanding (MOU) for an Executive Council on Biological Diversity. Within the MOU are provisions for the establishment of Bioregional Councils and "an adaptive approach in the development of bioregional strategies." While the language of the MOU is contemporary, exciting, and promising, nothing in the document binds the signatories to cooperate. In fact, the sole provision of section "IV. Authority" is that "This Memorandum does not modify or supersede existing statutory direction of the signatories."

Without fundamental reform in the controlling landbase, brave new rhetoric aside, such initiatives would likely be an exercise in rearranging the deck chairs of discretion. Regulatory frameworks alone, by and large, are captured by the economic interests they are intended to regulate (Clark, 1989). Reforming the landbase will remove much of the conflict that is a barrier to cooperation between citizens and the various agencies and economic interests.

All that the warring parties want is certainty in an uncertain world! Philosopher Daniel Kemmis (1991) suggests that the possible outcomes for the adversaries are limited by their conflict and their expectation that their objectives can be obtained through what he calls the "procedural republic." Kemmis believes that they can gain more by engaging each other and working together for their common good, what Warren and Liss (1983) might call a good natural-cultural system. Alternatives to negative sanctions for asocial environmental behavior must be considered.

Given that our society is a pluralistic one, it should not be surprising that it sends mixed messages. Trends would seem to indicate, however, that bureaucracy's growth curve is slowing. The government that governs least is still the ideal for many, and increasingly cost is a major factor. If indeed this is a trend, the implications are that simply creating more "agents of reform" to be paid for out of general funds is unlikely.

Remembering that crisis and opportunity have shared symbols in Chinese, even in times of cost cutting the effort should be made to achieve program goals. A major cost in regulatory agency redundancy must be the duplicative costs of administrative sites. Other cost savings can be made by moving germane agency personnel closer to the terrain they monitor or regulate.

This quest for efficiency might be listed under what we can call "consolidation of agency work centers." In addition to savings in travel costs and duplicated administrative facility costs, savings can be made by sharing information through a shared Geographical Information System (GIS) data base. This new drive to efficiency could also help in conjunction with other efforts to provide economic programs to offset the effects of declining timber revenues in those areas most dependent on those revenues. For example, possible locations for shared administrative work facilities in the region would be Happy Camp, Hayfork, and Hoopa, areas that are isolated from the general economic diversification and expansion associated with the Interstate 5 and Highway 101 transportation corridors.

Such shared agency work facilities should include functional representatives of all agencies who are the real parties at interest—the ten signers of the MOU for example: California Resources Agency, BLM, California Department of Fish and Game, Forest Service, California Department of Forestry and Fire Protection, the Fish and Wildlife Service, California Department of Parks and Recreation, National Park Service, State Lands Commission and University of California.

Monitoring Reserve Management Impacts

The Forest Service is directed by the National Forest Management Act (NFMA) to monitor environmental conditions on the national forests. But Brown and Roughgarden (1990) say that no adequate environmental monitoring program exists in any agency, except perhaps the Weather Service. They report the findings of a December 1988 meeting of 23 scientists and 14 others who were brought together by the National Science Foundation and the Department of Energy to "consider what ecological research is necessary to understand and to predict how we should cope with global change." That group advocates that a U.S. Ecological Survey (USES) be established because, among other things, "the ecological condition of the United States is virtually unknown." This new agency would be charged with acquiring, analyzing and interpreting data on the ecological state of the environment. The authors note that a particular problem of current ecological research is that it does not address the issue of scale. A survey of ecological studies published over a seven year period "found that 50% of all studies were done on plots less than 1 m in diameter, and 25% used plots less than 25 cm in diameter!" As discussed above, Newtonian reductionist science is a barrier to network ecology. Portraying complex evolving systems in terms of their constitutive networks will be an enormous aid to viewing new perspectives on reality. Several workers have noted that landscape functions exist that are not well recognized by existing conservation and preservation strategies. Landscape ecology, conservation biology and restoration ecology will depend on a vast increase in research that is focussed on the regional and global scale.

If new forestry is to be tried and understood it will have to be evaluated against some set of existing conditions, some baseline. A large ancient forest core area reserve system will assure that there remains a set of natural forest attributes to evaluate when a real monitoring program comes into being.

Mountains of data do not a monitoring program make! Imagine a group of researchers gathering data for the health of an ecological subsystem—a human being. One counts body hairs, another measures earlobes, while still others measure toes and fingerprints. None of these measurements will provide a quick picture of the human's health.

In spite of all of the advances in medical technology and science, doctors still rely on some basic measures of human health to assess the immediate situation: body temperature, pulse rate, heart rate and so forth. We have yet to establish basic measures of health for the ancient forest ecosystem, and we believe a reserve system is necessary to realize those measures.

In discussion of the biosphere reserve proposal above three basic zones of management intensity are suggested: 1) core preserve areas, 2) buffer zone areas or transition areas, and what we have called 3) traditional use areas. We have asked the reader to consider this management paradigm to be somewhat analogous to our form of government—a system of checks and balances.

The core areas could be monitored in an effort to understand the baseline conditions of the preserve zone. Based on 20 yrs work with regional environmental groups, broad connected core areas have been identified.

The buffer zone areas, as envisioned here, would embrace the core areas and would be managed to provide for experimental techniques, like the so-called "new forestry" and landscape restoration ecology. Monitoring here could help us understand the baseline conditions of the buffer zone and how they relate to those of the core area.

The traditional use area would embrace the buffer zones and is described by the MAB as "a usually undelimited, dynamic zone of cooperation..." As envisioned here the traditional use area is the area of highest management intensity. Monitoring objectives for this area would also be to gain baseline environmental information for the intensively managed zone, to be compared with that obtained in the core area and the buffer zone area.

Regulations need a factual basis to be meaningful and equitable. Baseline conditions under varying management intensities can, over time, provide useful information for modifying regulatory schemes. Without well distributed reserves that provide for ecosystems large enough to maintain themselves, science will have a hard time in the future determining what environmental health is. Reserves provide a baseline from which we can compare the effects of management in non-reserved areas. Theoretically, a bank will not loan money to an individual or business without first gauging their net worth, their baseline—if we don't where we are, how will we know where we are going?

Sustainable Communities

The Biosphere Reserve Model allows us to envision a future in which human communities exist as integral parts of functioning ecosystems rather than at the expense of ecosystem values. This is particularly important because the patterns of growth resulting from the urban fired regional economies of the west coast assure that growth will be the key challenge facing the region. There is a growing number of human residents who understand this vision. Today, however, many residents remain convinced that their personal and family well being requires protecting the status quo of exploitative relationships between extractive industries and native ecosystems. Senegalese conservationist Baba Dioum has pointed out that "In the end, we will conserve only what we love, we will love only what we understand, we will understand only what we are taught." The success of efforts to preserve functioning native ecosystems in the region will depend to an extent on developing within the residents a

consciousness which identifies personal well being with preservation of healthy native ecosystems. In our opinion, scientists, land managers and other public servants who understand what is at stake have a responsibility to help educate residents about the importance of maintaining and restoring the ecological integrity of this important region.

Conclusion

Some of the historical roots of the biological impoverishment within the Klamath-Siskiyou region have been described. The pioneer extractive economies of mining, ranching and logging are in transition, as urban growth and the rise of a global post-industrial economy penetrate this once-isolated region.

A system for tempering the transition by restructuring the region's land base along the lines of a Biosphere Reserve Model has been proposed. The importance of economic diversification and aid programs and the urgent need for a cohesive system of ecological monitoring and research have been stressed.

Historical factors have left the ownership pattern of the Klamath-Siskiyou region in a fragmented jumble of management intensity and overlapping regulatory authority. The pattern of landownership and management has no ecological basis. It would be in the best interests of the public forest land management agencies, industrial forest landowners, and environmentalists if they fostered land exchanges to achieve beneficial landscape purposes—not a call to expropriate private property, but to create positive incentives for organizing land use in a more ecological if not economical way.

There is a human need for reserves and corridors of relatively unmanaged or restored land to be a baseline for biological function and to assure what some have referred to as ecosystem services. The Forest Service needs lightly managed land to help it discern new perspectives for sustainable conservation forestry. The forest industry needs more intensively managed land to help it produce commodities to meet the needs of the people (market demand). All three management intensities must contribute knowledge about negative and positive feedback loops through an ecological monitoring network. All three must be compared and contrasted within the framework of the reserve network over time...some long scale of time.

Until such a network and framework is established, pesky environmentalists will doubtless complain in the name of the spotted owl, the fisher and the wolverine; and in the name of the pine marten, goshawk, and willow flycatcher. And doubtless in the name of the Port-Orford-cedar, the sugar pine and the Pacific yew. In the name of the aquatic invertebrates, the summer steelhead, the spring run chinook and even in the name of the black bear and the human being.

The crisis of the Klamath-Siskiyou region is one not unlike some in less developed parts of the world, and some elements of crisis are like those in any part of the human-dominated world. A long-term solution that lessens conflicts while promoting environmental health is badly needed, and could suggest a new relationship between humans and their environment that could be applied elsewhere.

In the years ahead we hope to further develop the proposal presented in this paper. Hopes include publication and distribution of an expanded written plan and production of a video that highlights both the biological significance of the region and presents the biosphere reserve vision. The proposal is an educational tool which can help build international, national and local support for preservation of biodiversity in this important region. It can also help human residents of the region envision secure ecosystems as the necessary foundation of personal and family security. We invite others who share this vision, and especially the biologists, land managers and agency specialists who share our regard for the region, to join with us in efforts to achieve an ecological reserve in the region on the scale of what we have proposed in this paper.

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