State Of The Klamath Knot: How Far Have We Come And Where Are We Going?

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Introduction

The Klamath-Siskiyou ecoregion of northwest California and southwest Oregon has been long-regarded for its extraordinary biodiversity (see DellaSala et al. 1999; Jules et al. 1999 for reviews). Many pioneering botanists, the likes of Alice Eastwood, Edward Greene, Lois Henderson, and T.J. Howell, combed the region in search of plants unknown to science that today bare their names. But it was not until the 1950s through the seminal work of Robert Whittaker that the ecoregion began to garnish its notoriety within scientific circles. Whittaker's ecological studies put both the Klamath-Siskiyou and the southern Appalachia ecoregions on a national map of botanical importance. In addition, Whittaker (1960) aptly noted that logging in the Siskiyous was beginning to degrade the landscape:

"with the relative depletion of more available timber farther north and the consequent shift of lumbering activity toward the south, much of the forest area of the Siskiyous is being rapidly cut; and conservation and sustained-yield programs are little in evidence."

Whittaker (1960) was witnessing the early stages of forest fragmentation ushered in after World War II with accelerated logging on public lands. Logging and road building continued largely unabated for decades until the listing of the northern spotted owl (*Strix occidentalis caurina*) and the completion of the Northwest Forest Plan in 1993 that set aside significant tracks of late-successional reserves throughout the Pacific Northwest while reducing the annual cut on federal lands such the Siskiyou National Forest from around 165 million board feet to an average of 27 million board feet.

Since Whittaker's time, however, the Klamath-Siskiyou has received growing recognition from conservationists concerned about its unique conservation status. The groundbreaking essays of David Rains Wallace (1983) inspired a folklore-like affinity for the region while popularizing its name as the "Klamath Knot." More recently, the ecoregion has been regarded as an area of global botanical significance by the World Conservation Union (IUCN – 1992), a proposed "World Heritage Site" and UNESCO "Biosphere Reserve" (Vance-Borland et al. 1995), a global "center of plant diversity" (Wagner 1997), and a "Global 200" ecoregion by the World Wildlife Fund (Ricketts et al. 1999, DellaSala et al. 1999).

In spite of its many global accolades, the area is under enormous pressure from unsustainable land and water management practices that threaten to unravel the biological tapestry of the Klamath Knot. Here, I summarize the "State of The Knot" by: (1) reviewing the scientific literature on the biology of place; (2) synthesizing research on the status, condition, and threats to biodiversity; and (3) outlining challenges to a sustainable future for the ecoregion. This paper provides the context for this second conference on

the "Ecology of the Siskiyous," the first which took place in 1997, and lays out conservation priorities that need to be embraced by scientists, the public, land managers, and decision makers if we are going to save this magnificent place.

The Biology Of Place

Delineating boundaries - the specific geographic boundaries of the Klamath-Siskiyou ecoregion depend on the type of ecoregional classification system used by researchers. Ricketts et al. (1999) described the ecoregions of North America using terrestrial classifications developed mainly by Omernick (1995). In a related study, Abell et al. (2000) classified North American ecoregions based on freshwater features. Notably, an ecoregion is defined as a relatively large land or water area that contains a geographically distinct assemblage of natural communities that share a large majority of their species, ecological processes, and environmental conditions (see Ricketts et al. 1999, DellaSala et al. 1999). The Klamath-Siskiyou ecoregion, in particular, represents the grouping of mountains with similar geological origins south of the Klamath River (i.e., "the Klamaths"), and the Siskiyous that are considered a geological subset of the Klamaths to the north. Previous studies (Ricketts et al. 1999, DellaSala et al. 1999) delineating the ecoregion relied on boundaries derived mainly from land-based classifications. This presented some disagreements among taxonomic experts in determining which aquatic species to include in the Klamath-Siskiyou because aquatic distributions did not line up precisely with terrestrially derived boundaries (DellaSala et al. 1999). Thus, the ecoregional descriptions provided by Noss et al. (1999) are a hybridization of terrestrial and freshwater classifications more appropriate for the Klamath-Siskiyou ecoregion and are therefore used herein (Figure 1). While the mapping of ecoregions is widely accepted in scientific circles, precise boundaries are often in dispute. However, Ricketts et al. (1999) noted that different classification systems often yielded common centroids (central position of the ecoregion) regardless of the classification system used.

World-class accolades - perhaps the most striking aspect of the Klamath-Siskiyou's diverse ecology is that the more scientists explore it, the more diverse and unique the ecoregion appears. While the ecoregion lacks the "charismatic megafauna" of other nationally regarded areas (such as bison *Bison bison* and gray wolf *Canis lupus* in Yellowstone), the biology of place is subtle but nevertheless most evident.

The following attributes, also summarized in DellaSala et al. (1999), place the Klamath-Siskiyou among the top ten temperate conifer ecoregions on Earth:

- approximately 3,500 plant species, including 220 endemic vascular plant taxa (including ssp and var.) within northwest California and southwest Oregon (pers. commun. J. Sawyer; http://www.Humboldt.edu/%7Eherb/);
- nearly two-thirds of the entire California floristic province (Smith and Sawyer 1988);
- at least 30 conifer species (depending on specific boundaries some researchers report as many as 40 species; J. Sawyer, personal communication);

- up to 115 species of butterfly (Cascade-Siskiyou National Monument, E. Runquist, unpublished data);
- at least 235 mollusk taxa, including 60% of which are endemic (Frest and Johannes 1999);
- the most diverse herpetofauna of any similarly sized mountain range in the Pacific Northwest, including 79% of all herp species in the Northwest (Bury 1999);
- among the highest diversity of dwarf misteletoe (11 taxa) in the United States (Mathiasen and Marshall 1999);
- one of the greatest concentrations of ultramafic bedrock geology in western North America (Coleman and Kruckeberg 1999);
- exceptional beta-diversity (changes in plant communities along environmental gradients; Whittaker (1960), Ricketts et al. (1999));
- high levels of fish richness (33 taxa) and endemism (42%); and
- the largest complex of unprotected roadless lands along the Pacific Coast from the Baja to Canada (e.g., Siskiyou Wild Rivers Area; Strittholt and DellaSala 2001).

Because of its geographic position, the Klamath-Siskiyou ecoregion is of central significance (Whittaker 1960, Smith and Sawyer 1988). The ecoregion is juxtaposed with several nearby ecoregions of global importance, including the Northern California Coastal Forests (to the west); Central Pacific Coastal Forests (to the north); and Sierra Nevada Conifer Forests (to the southeast). In addition, the ecoregion is transitional to the Great Basin, Oregon Coast Range, Cascades Range, and California's Central Valley. Mixing of plant communities from vastly different regions has contributed to the area's exceptional beta-diversity and this can be clearly seen in places like the Cascade-Siskiyou National Monument (Odion and Frost 2002).

Biodiversity Formula - the formula for the Klamath-Siskiyou's extraordinary biodiversity can be simplified as follows:

Complex Geology + Ancient Landscape + Varied Climate + Ecological and Evolutionary Processes = "Galapagos of North America."

The analogy to the Galapagos is warranted in the sense that the Klamath-Siskiyou originated from subduction that plunged large amounts of buoyant trench sediments deep into the subduction zone, leading to an uplift of the ecoregion as the first of coastal mountain ranges (an ancient island system) to spring up from the sea floor some 150 million years ago (Coleman and Kruckeberg 1999). What began as an island is now an ancient and twisted assortment of mountain ranges whose evolutionary significance is arguably as important as the Galapagos. The element of time (ancient landscape) in the biodiversity formula and the considerable topo-edaphic gradients have contributed to adaptive radiations in many taxa, placing the ecoregion on similar footing with the Galapagos as a "maternity ward" for speciation. This is most evident in the exceptional levels of plant and invertebrate endemism (particularly snail endemism and richness that are much lower in younger geological landscapes surrounding the ecoregion; T. Frest, pers. commun.). No doubt evolutionary processes will continue to remain at work here, generating new species through allopatric or sympatric speciation events. For instance,

the spatio-temporal isolation characteristic of the ecoregion may be an important factor in allopatric speciations (i.e., speciation resulting from geographical isolation of populations from the parent species) as evident by the numerous narrowly restricted endemics. However, rarer sympatric speciation events also may occur for populations that overlap but eventually develop distinct adaptations resulting in reproductive isolation and population divergence. Examples include several subspecies of *Lewisia* (endemics) known to hybridize in the western Siskiyous and thus this species maybe in the early stages of a sympatric speciation event. Notably, Coleman and Kruckeberg (1999) indicated that the preponderance of neoendemics (i.e., newly arisen endemics) in this ecoregion is indicative of rapid speciation events. Further, they state that the ecoregion's central position provides refugia for certain elements of the western flora to migrate during changing climatic periods (Coleman and Kruckeberg 1999). In particular, during the dry late Tertiary climatic period, many mesic-associated species migrated into the more mesic portions of the Klamath-Siskiyou accounting for some of its relict species (e.g., Brewer's spruce *Picea breweriana*, foxtail pine *Pinus balfouriana*, and *Kalmiopsis leachiana*; Coleman and Kruckeberg 1999). Notably, the varied climate of the ecoregion may be especially important as climatic refugia for species otherwise affected by global warming.

The complex geology of the Klamath-Siskiyou, particularly its ultramafic geology is the foundation for a botanical oasis. Ultramafic bedrock is an important mountain-forming rock consisting of serpentinite and peridotite rocks and soils typically deficient in certain minerals (calcium, nitrogen, phosphorus, and potassium) yet naturally toxic to plants in others (iron, magnesium, chromium, cobalt, and nickel; Coleman and Kruckeberg 1999). Coleman and Kruckeberg (1999) report at least 40 plant species considered endemic "serpentine taxa" of the Klamath-Siskiyou, however, this number was considered conservative. Moreover, DellaSala et al. (1999) indicate 11% of 154 species with state- or federal-listing status are confined to ultramafic areas within the ecoregion. In fact, the largest concentration of ultramafic bedrock in western North America occurs along the Josephine ophiolite, which spans southwest Oregon's Siskiyou National Forest and portions of northern California. Additionally, the varied climate in the Klamath-Siskiyou contributes to major differences in environmental gradients that in turn drive patterns in species distributions and hence the ecoregion's high levels of beta-diversity. This phenomenon originally was described by Whittaker (1960).

Many ecological processes are at work influencing species distribution patterns across the Klamath-Siskiyou. Most notably, fire and hydrology are major drivers of ecosystem dynamics and the area's remarkable diversity. While fire history in the ecoregion has not been thoroughly documented (however see Frost and Sweeney 2000 and Odion et al. in press for reviews), historic burning practices by Native Americans combined with frequent lightning-caused fires have been largely responsible for an incredibly varied landscape. The Silver Fire in 1987 and Biscuit Fire in 2002 are but two examples of large fire events that continue to shape the ecoregion's complexity and integrity. Likewise, hydrological processes play a key role in structuring the composition of aquatic communities with periodic flooding and scouring events contributing to diverse riparian areas and healthy aquatic ecosystems. Notably, beavers (*Castor canadensis*) are

architects of riparian areas, providing habitat such as shallow ponds for many aquatic species. This species has been on the decline in much of the Northwest.

Finally, much of the information about the ecoregion reflects new research that has come about in the time between Siskiyou Ecology conferences (1997-2003). There is no question that as this area receives additional interest from researchers more of its outstanding qualities will be discovered.

Is The Klamath Knot Beginning To Unravel?

Status, Condition, And Threats - the Klamath-Siskiyou ecoregion is at a critical juncture. On the one hand, many impacts largely occurring over the past four to five decades have had a cumulative effect on the ecoregion's integrity. But on the other hand, the ecoregion still has relatively large tracts of unroaded lands central to its integrity (Strittholt and DellaSala 2001). While periodic natural disturbances (largely fire and floods) are the norm here, recent anthropogenic disturbances have fragmented otherwise intact terrestrial and aquatic systems, disrupted key ecosystem processes like fire and hydrology, introduced invasive exotics, and eliminated several species. Collectively, the rate and scale of human disturbances are beyond the capacity of the ecosystem's ability to self-repair (see below). Such cumulative impacts are often underestimated or under-appreciated by land managers and decision makers as they seek to balance socio-economic interests with fish and wildlife concerns.

In World Wildlife Fund's global assessment, the biodiversity of the Klamath-Siskiyou was ranked as endangered based on a number of indicators of anthropogenically induced ecosystem degradation, as summarized by DellaSala et al. (1999):

- Low levels (12%) of protection – compared to other temperate conifer ecoregions in the United States, the Klamath-Siskiyou ecoregion has low levels of protection. Although several large Wilderness complexes exist (e.g., Kalmiopsis, Siskiyou, Marble Mountains, Trinity Alps, Yolla Bollys), a representative network of reserves, fundamental to conservation planning, is missing from the ecoregion (Noss et al. 1999). Further, the Northwest Forest Plan is facing rollbacks in protection through weakening of the Aquatic Conservation Strategy and Survey and Manage requirements that will further remove the ecoregion from having a representative reserve network.
- Extensive habitat fragmentation – over 30,000 miles of roads criss-cross the ecoregion and logging has replaced biologically diverse old-growth forests with sterile-tree plantations at an average annual rate of about 50,000-acres per year since the 1970s (Staus et al. 2002). Fragmentation from road building and logging is a major problem facing all ecoregions across the United States as well as many across the globe (Heilman et al. 2002).
- Many (154) terrestrial species with state or federal conservation status –at risk species in this ecoregion are largely the result of habitat fragmentation and degradation. Plants by far comprise the majority of at-risk species (75%), followed by birds (13%), herpetofauna (7%), mammals (4%), and invertebrates

(1%); although this list undoubtly reflects listing preferences among researchers and agencies. Further, 11 fish taxa have official conservation status under federal or state programs and most mollusks have experienced extensive (>90%) range contractions (T. Frest, pers. commun.).

- Several (5) known extirpations – gone from the ecoregion are the grizzly bear (*Ursus arctos*), gray wolf (*Canis lupus*), pronghorn (*Antiolocapra american*), California condor (*Gymnogyps californianus*), and big horn sheep (*Ovis canadensis*). These species were extirpated in the early part of the last century as settlers cleared land and eliminated competing species.
- Extensive degradation of key ecosystem processes (fire and water) – over half of the ecoregion's 877 watersheds show extensive degradation and are in rapid decline (Staus and Strittholt 2001, Bredensteiner et al. 2003). Road building, logging in the uplands, numerous barriers to fish passage (e.g., over 1,100 on the Rogue River alone), livestock grazing, and over-allocation of instream flows and water quality problems contribute to poor watershed health. Fire suppression and logging contribute primarily to shifts in fire intensity toward more severe fires in some portions of the ecoregion, mainly low to mid elevation areas (Frost and Sweeney 2000).
- Exotic species invasions – exotic species have replaced native plant communities in many places. Most notably, the endemic Port Orford cedar (*Chamaecyparis lawsoniana*) has been devastated by an exotic root-rot fungus (*Phytophorus lateralis*) that is threatening the functional role of this cedar as a keystone species of riparian areas. Reports of Sudden Oak Death Syndrome are starting to turn up in Curry County, Oregon and may pose risks if this destructive *Phytophorus* spreads. Yellow-star thistle (*Centaurea solstitalis*) and other exotic thistles and medusahead (*Taeniatherium caput-medusae)* are spreading rapidly throughout the Shasta Valley into southern Oregon, particularly within the Cascade-Siskiyou National Monument.
- Decline of endemics and globally imperiled communities - More than half (56%) of the at-risk taxa are endemic and most (92%) are plants (DellaSala et al. 1999). Ten plant communities listed by the Heritage Program as G1 (globally critically imperiled) and G2 (globally imperiled) occur in the ecoregion. Many of these are on private lands.

Fire and Water Related Degradation - in addition to the above threats, pre- and post-fire management have now risen to the top of the list as causes of ecosystem degradation. The proposed Biscuit Fire salvage operation and "restoration" program of the Forest Service represents the largest timber sale on federal lands in nearly a century (over ½ billion board feet is proposed). While the agency claims salvage logging is a "restorative" action, and that only about 5% (29,000 acres) of the burn area will be entered, this proposal could alter recovery processes and the area's unique plant communities for decades. Many scientists (e.g., Conservation Biology Institute 2003, ECONorthwest 2003) have questioned the validity of this proposal as being ecologically destructive, economically questionable, and inconsistent with the body of literature on salvage logging impacts (e.g., Beschta et al. 1995, Minshall et al. 2003, Beschta et al. in press). At stake is over 12,000 acres of inventoried roadless areas and up to 57,000 acres

that could be disqualified from future wilderness designations. Equally alarming is the agencies' proposal to plant over 50,000 acres with conifers or seed mixtures. The conversion of a biologically diverse landscape that has been shaped by fire for centuries, to one that will be more characterized by biologically simplified and flammable tree plantations (Odion et al. in press) may be irreversible and should not be considered a "restorative" action. However, limited tree planting and seeding may be necessary along bulldozed fire lines and roads using native species mixes characteristic of the site and planted in low, variably spaced densities, but only after monitoring indicates lack of nearby seed sources (DellaSala et al. in press). Notably, a GIS mapping analysis of potential "source areas" (i.e., areas of trees and vegetation that survived the fire) indicate that most potential natural seed sources are within 660 feet of severely burned areas; thereby, negating the need for massive re-planting and artificial seeding (Strittholt and DellaSala, in review). Finally, the Biscuit Fire recovery area has been proposed by the Forest Service as an experiment in salvage logging with nearly 70% of the entire volume coming from late-successional reserves and roadless area. Such a grandiose experiment for the Siskiyous is ill-conceived, particularly with the preponderance of lands (especially private lands) already undergoing salvage operations. A globally significant region is no place for large-scale salvage logging experiments and instead the area should receive a combination of truly restorative activities (such as plantation thinnings and prescribed fire, see Conservation Biology Institute 2003) and new protected areas designations (e.g., Fire Research Natural Areas where natural recovery processes can be studied; National Conservation Area which is managed for biodiversity and ecosystem recovery). Notably, DellaSala et al. (in press) indicate that post-fire early successional habitat is one of the rarest habitat types in the Pacific Northwest and such areas should be allowed to recover with little or no intervention.

Conservation Challenges

To promote sound investments in an ecologically sustainable future, the Klamath-Siskiyou ecoregion is in need of "CPR"– conservation, protection, and restoration – and an ecoregional ethic that builds on Aldo Leopold's land ethic. The following are seven key conservation priorities key to such a vision:

- Achieve an ecologically representative network of reserves – the Roadless Conservation Rule of 2000 was a landmark decision to protect 58.5 million acres of inventoried roadless lands, including over 1 million acres in the Klamath-Siskiyou ecoregion. Roadless areas perform many vital ecological functions (Strittholt and DellaSala 2001, DellaSala and Strittholt 2001) and fire regimes in these areas are most likely to be operating within historic parameters (DellaSala and Frost 2001). When combined with Wilderness, roadless areas are key components to an ecologically representative reserve network for the ecoregion (Noss et al. 1999, Strittholt and DellaSala 2001). Unfortunately, the roadless rule has been challenged by the Bush administration, which is failing to defend the rule in the courts and is proposing large-scale salvage logging in post-fire recovering landscapes (e.g., Biscuit Fire) while seeking exemptions for the Tongass and Chugach national forests in Alaska. Notably, both the California

Wild Heritage (www.calwild.org) and Oregon Wild (www.oregonwild.org) campaigns seek to protect unroaded landscapes that qualify for wilderness designation under the Wilderness Act. With over 800,000 acres of potential lands in the California portion of the ecoregion (e.g., additions to the Marble and Trinity Alps Wilderness) and an additional 140,000 acres in southern Oregon portion (e.g., Soda Mountain, Elk River, Zane Grey, Siskiyou Crest and proposed additions to the Kalmiopsis and Rogue-Umpqua divide), these areas are indeed the "crown jewels" of what remains of relatively intact systems in the Klamath-Siskiyou. Finally, many rural communities have resisted protected area designations due to socio-economic concerns. However, recent economic analyses indicate that protected areas can have a net positive effect on rural economies by serving as a "magnet" for attracting new businesses and residents concerned about relocating to the area for quality of life reasons (Southwick Associates 2000).

- Strengthen protections for existing conservation areas such as the Cascade-Siskiyou National Monument– this nearly 53,000-acre national monument is the only high elevation land bridge joining the globally outstanding Siskiyous to the Cascades. It harbors one of the most diverse (115 species – recent surveys by E. Runquist) butterfly populations in the western U.S. and contains up to 12 endemic mollusks (recent surveys by T. Frest, pers. commun.). The monument's land-bridge function, however, is threatened by widespread logging on private lands (see Odion and Frost 2002) that warrant conservation-incentives (e.g., Forest Stewardship Certification of private lands management; fee title acquisitions and conservation easements from willing landowners). In addition, livestock grazing has been recognized as a potential threat to the area's unique plant and wildlife species, requiring well-designed field studies to assess impacts and develop appropriate mitigation strategies (Odion and Frost 2002).
- Protect "hot spot" areas such as the Siskiyou Wild Rivers Area –the 1.1-million acre Siskiyou Wild Rivers Area was proposed as a national monument in 2000. This area received acknowledgments for its incredible biodiversity from Pulitzer Prize winner Edward O. Wilson and former Interior Secretary Bruce Babbitt. The Siskiyou Wild Rivers area is: (1) a "hot spot" of biodiversity and evolutionary processes in the ecoregion, (2) contains the highest concentration of rare plants of any national forest in the nation (Strittholt et al. 1999), (3) the best wild salmon fishery along the Pacific Coast, and (4) largest complex of unprotected roadless areas along the coast from the Baja to Canada (www.siskiyouproject.org). In 2000, the Forest Service, under an Executive order, withdrew new mining claims so that the incoming administration could study it for future protections. Unfortunately, the Bush administration has lifted the mining moratorium and now is proposing large-scale salvage logging in response to the Biscuit fire. Clearly, an area considered a "cradle of evolution" for the ecoregion, warrants increased protections especially following a major fire event like the Biscuit.
- Protect remaining late-successional and old-growth habitat - old-growth forests have declined precipitously throughout the Northwest and in the Klamath-Siskiyou (Heilman et al. 2001, Strittholt et al. in review), and legislation has been proposed (www.nwoldgrowth.org) to protect these areas. These forests harbor

species absent from or in lower numbers in plantations (see FEMAT 1993 for over 1,000 species associated with late-seral forests). Many businesses have made commitments to source wood from forest areas not considered endangered (see www.ran.org), including Home Depot and Staples, and recently Boise Corporation has agreed in principle to suspend logging operations in old-growth forests. The Forest Stewardship Council (www.fscus.org) is an organization backed by consumers, conservationists, and some timber companies because their management standards appropriately balance ecological, economic, and social interests in forests while avoiding logging in endangered forests. Such measures show promise for shifting logging away from mature and old-growth forests and toward more responsible forestry practices.

- Promote watershed conservation initiatives of local communities – efforts to restore anadromous fish are picking up steam in local communities, many of which have organized as watershed councils (in Oregon). Watershed councils show promise as "bottom-up" community-led initiatives that largely address instream conservation. However, for such efforts to maximize recovery of salmonids and other aquatic organisms they must address upland management practices also influencing watershed integrity. In addition, watershed restoration efforts need to be multi-scaled, including development of basin-wide recovery and prioritization strategies to achieve maximum recovery benefits (see Staus and Strittholt 2001, Bredensteiner et al. 2003).
- Encourage responsible forestry and fish-friendly farming practices – in many ways, conservation in this ecoregion needs to embrace the social and economic interests of people, particularly the incredibly socially diverse rural communities, in order to achieve a sustainable future. Two programs that show much promise in addressing rural community needs while providing habitat for fish and wildlife are Salmon Safe (www.salmonsafe.org) and the Forest Stewardship Council (www.fscus.org) certification programs. Both programs rely on transparent, verifiable standards to define stewardship activities while providing access to "green markets" where consumers can make a conservation difference at the point of purchase. Such programs, however, continue to suffer from an inability to gain market access due to low consumer demand and limited interest on the part of landowners. Considerable efforts at national, ecoregional, and local levels will be necessary to create additional exposure for the pioneering efforts of responsible landowners so that they and others can eventually enjoy the market place benefits.
- Restore degraded lands and watersheds and link such projects to a restoration-based economy – restoration has the potential to act as an "olive branch" for bringing together diverse interests concerned about public lands. However, for approaches to be effective ecologically and socially they need to weave social and economic desires within the appropriate ecological framework (see DellaSala et al. 2003). There is much promise in the field of restoration and its ability to proactively "heal" the land, however, these efforts must begin with an emphasis on ecological integrity and an understanding that economic benefits are a by-product of restoration projects and jobs in restoration are sound investments in an ecologically sustainable future. The Lomakatsi Project in Williams, Oregon, for example, prides itself on sound principles of ecosystem restoration while

employing local people in fuels reduction and vegetation management. Other restoration projects include an exemplary partnership between Redwood National and State Parks and Save-The-Redwoods League in northern California designed to restore ecological integrity to large landscapes (e.g., Mill Creek, CA) within the redwood portion of the Klamath-Siskiyou ecoregion.

Conclusions

Whittaker's concerns about ecosystem degradation echoed in the 1960s are even more evident today. If current land-use trends continue, the ecoregion's integrity will be irrevocably compromised at the expense of both ecology and economy. Only through a sound investment in conservation and stewardship that begins with the recognition of global importance of place that is put into practice at the local, watershed, and ecoregional levels can we begin to turn these alarming trends around. In addition, we must examine our actions and impacts across generational time lines – as measured by the Seven Generations Concept of Native Americans.

The ecoregion is one of remarkable superlatives originally explored by the 19th century botanists, embraced by early ecologists, and now marveled by many. It is an ecoregion whose unique biological diversity lies concealed behind unusual rocks and soils, and hidden in its contorted mountains where the often difficult to find, un-charismatic species reside. While the ecoregion is a "cradle of evolution," it is on an unsustainable trajectory toward continued degradation and species extirpations. In Aldo Leopold's historic treatise of a land ethic, he lamented about how well or poorly we treat the land is evident by the scars we leave behind. Humanity's scars on this ecoregion are many; they unmistakably show up on landsat images and aerial photos or simply from above through the window of an airplane. While the clock is ticking on this ecoregion, and the ecological stakes have never been greater, there is hope for a sustainable future. **A vision of wild rivers packed with spawning wild salmon, restored species, recovered ecosystems, abundant ancient forests, untrammeled solitude, the "birthing" of new species, and a truly sustainable society are but a commitment away.** Science has a definitive role to play in explaining what is at stake, but an ecoregional ethic needs to emerge and be embraced by society if we are truly going to create a more sustainable future for both its current occupants and our children's children.

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