HUMBOLDT JOURNAL OF SOCIAL RELATIONS
Volume 21:1— 1995

# USING BIODIVERSITY AS A JUSTIFICATION FOR NATURE PROTECTION IN THE US

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## INTRODUCTION

To fathom the last twenty-five years of growth in awareness of biological diversity in the US, take this simple test. Ask yourself the following questions:

1) What were two primary goals of environmental activists in 1970?
2) Name three species that were threatened with extinction at the time.
3) Did you have a definition of "ecosystem" in your personal lexicon on Earth Day 1970?

Your response to the first question likely includes air and water pollution as these problems were receiving much attention at the time of the first Earth Day. Congress had already passed several laws to address such concerns and additional legislation was forthcoming. The second question was probably more difficult to answer—the Endangered Species Act as we know it today did not exist. You might have mentioned whooping cranes, bald eagles, or bison, but most citizens were just beginning to wake up to the loss of species as a critical problem. As for the final question, you probably would not have had a solid working definition of "ecosystem" unless you had taken a college course in biology. In 1970, few activists in the nascent environmental movement had yet to embrace ecology as an organizing principle.

If you were to ask yourself these same questions today your answers would be surprisingly different. Though pollution is still perceived as a threat by most Americans, environmentalists would almost certainly highlight the loss of biological diversity as a key problem. For question #2 you would have no trouble listing numerous species—peregrine falcon, grizzly bear, snail darter, Mission blue butterfly, Kirtland's warbler, or any of a dozen commonly known endangered lifeforms. And though your definition might not pass muster with a Ph.D., you would have little trouble describing an ecosystem as a community where plants and animals interact with the physical environment.

In 1995 on the 25th anniversary of Earth Day, loss of biodiversity is on center stage for many environmentally concerned citizens, activists, academics, and managers. This was not the case in 1970. The current emphasis on biodiversity has grown from a complex mix of cultural factors that are easy to highlight but difficult to untangle. First and foremost, there has been since the first Earth Day an unprecedented growth in scientific understanding of the biological consequences of environmental deterioration. But this new knowledge has been bolstered by trends in US environmentalism that, in turn, reflect broad changes in American social values.

As historian Samuel Hays (1987) has observed, the first Earth Day marked the transition from conservation to environmentalism in the US. Americans, with greater amounts of education, disposable income, and leisure time, began to view game as wildlife, value nonconsumptive outdoor activities (e.g. photography) equally with consumptive pursuits (e.g. hunting), and voice concern about resource **protection** as well as resource **management**. During the 1970s and 1980s as environmental groups gained members, larger budgets, and lobbying clout, their agenda expanded from countering threats to specific parks and wildernesses to include concern for general environmental problems such as population growth, resource consumption, pollution, and energy policy. Arguments challenging human-centered values also surfaced and the field of environmental ethics was born and flourished. Overall, Americans began to actively question whether **Progress**, defined as endless material growth, could really be sustained into the future.

Today, many people believe that a further evolution in American environmental values is taking place spurred by new conceptions of biodiversity. If the original Earth Day marked the beginning of a more inclusive approach to managing nature for humans, Earth Day 1995 may come to represent the rise in importance of biodiversity protection as the cornerstone of resource management.

In this article, out of the diverse trends mentioned above, I trace how biodiversity has evolved to its present position as a compelling scientific framework for protecting nature. I focus on two related trends—the development of the ecological roots of knowledge about biodiversity and the evolution within environmentalism of scientific justifications for protecting nature. I also recognize that biodiversity is a potent symbol for defining a more appropriate relationship between people and nature. Biodiversity is not just about science—it's about values as well (Grumbine 1992).

## DEFINING BIODIVERSITY AND THE BIODIVERSITY CRISIS

Biodiversity has become a central rallying cry of the US environmental movement. The term and its cousin, ecosystem management, are referred to so often that the media portrays them as "buzzwords," empty phrases that everyone employs but few understand. But open any recent textbook and biodiversity is easily defined. Noss and Cooperrider (1994:5) provide a standard definition:

> [Biodiversity is]...the variety of life and its processes. It includes the variety of living organisms, the genetic differences among them, the...ecosystems in which they occur, and the ecological and evolutionary processes that keep them functioning, yet ever changing and adapting.

Where did the modern concept of biodiversity come from? Part of the answer is that biodiversity has appeared today because it is disappearing so rapidly. Conservation biology, the science of scarcity and diversity that blossomed during the 1980s, could not exist without significant physical loss of life across many scales. A science exploring

extinction and habitat fragmentation cannot develop without destruction of species and ecosystems.

It is difficult to argue against the facts of environmental deterioration. In the US, thousands of species are either listed or await protection as candidates for listing under the Endangered Species Act. Estimates of species at risk over the next decade range from 2.5-15 percent of all lifeforms on Earth (Primack 1993). Beyond individual plants and animals, 19 percent of all US ecosystem types have been reduced to critical levels (Noss *et al.* 1994). Yet only about 6 percent of the US is in some kind of protected classification. Loss of biodiversity has direct consequences for humans. The US is losing excess amounts of topsoil on 44 percent of its cropland (Brown and Wolf 1984). As of 1995, the two richest North American fisheries, in New England and the Pacific Northwest, have all but disappeared (Egan 1994). Biologists are beginning to describe not only species and ecosystems at risk but also endangered biological phenomena including cessation of large mammal and song bird migrations, river system deposition patterns, and forest health issues (Brower 1994). Some scientists estimate that entire faunal groups may "all but disappear" within the next century including primates, large carnivores, and most hoofed animals (Soulé 1986). In both direct and indirect ways, human activities are causing a biodiversity crisis—the largest mass extinction in the last 65 million years.

## SCIENTIFIC ROOTS OF BIODIVERSITY

The modern definition of biodiversity derives from the development of the science of ecology. To fathom why scientists and environmentalists did not comprehend biodiversity fully in 1970 first requires a glance at how ecology has matured as a discipline. There have been at least four developmental stages in ecology: formative, descriptive, quantitative, and non-equilibrium (for full treatments see Worster (1994), Golley (1993), and McIntosh (1987)).

Several people stand out as formative influences on ecological thinking long before the field coalesced into a unified discipline. Charles Lyell, the father of geology, contributed insights in his book *Principles of Geology* (1830)

that helped to overturn Linnaean concepts of a static nature under strict Divine rule. Lyell was one of the first to understand that geologic change occurred gradually over eons, that species dispersed actively around the world, and that competition was a driving wheel in biotic interactions. Lyell was a major influence on Charles Darwin. In *On the Origin of Species* (1859), Darwin built upon Lyell and advanced natural selection as the primary mechanism of evolution. Contemporary with Darwin but living in the New England woods, Henry David Thoreau was one of the first naturalists to understand succession as a major force of change in ecosystems. Thoreau also was one of the first to glimpse the loss of species and habitat and its cultural ramifications at the onset of the Industrial Revolution. Finally, George Perkins Marsh contributed a pioneering global account of humanity's role in reducing the capability of Earth to support life in *Man and Nature* (1864).

By the early 20th century ecology had entered a descriptive, holistic period. The key themes were the balance of nature and succession toward a stable, climax state. Frederick Clements dominated the field with his idea of communities as interdependent superorganisms evolving collectively.

By the time A.G. Tansley coined the term ecosystem in 1935, Clements' views were falling from favor. Qualitative, descriptive ecology was being superseded by the quantitative ecology of energy flows, nutrient dynamics, food chains, and trophic levels. Natural history was out, mathematical models were in. The science of interrelationships was becoming subject to compartmentalization and reductionism to fit the needs of a burgeoning humanity looking to produce commodities from nature efficiently.

Since the 1970s, as knowledge of natural patterns and processes has accumulated and the biodiversity crisis has grown, a new ecological worldview is emerging (Pickett *et al.* 1992, Botkin 1990). Ecology is moving away from a reductionist approach toward a more contextual, non-equilibrium perspective. Where in the past scientists (and environmentalists) characterized ecosystems as orderly and in relative balance, current viewpoints consider natural systems to be dynamic, changing at different space/time scales, and full of uncertainty. Nature is episodic as often

as it is homeostatic. Nature is not always in "balance" and changes are difficult and sometimes impossible to predict.

The definition of biodiversity has reflected these changes. No longer is diversity just about numbers of species or types of ecosystems. The new emphasis on non-equilibrium processes (especially natural disturbances such as fires, floods, etc.) has resulted in a comprehensive definition that includes not only the diversity of life from genes to landscapes, but also the fundamental patterns and processes of nature that weave living forms together.

## EARLY ECOLOGICAL JUSTIFICATIONS FOR PROTECTING NATURE

Like the word ecology at the time of the first Earth Day, the concept of biodiversity has yet to be grasped by many Americans. There were also few biologists visionary enough to offer scientific arguments for protecting nature at the dawn of the conservation movement in the early decade of the 20th century.

In the first decades of this century, the balance of nature view reigned supreme for biologists and citizens alike. Aesthetic and recreational justifications for protecting the new national parks and forests prevailed. Two of America's greatest naturalists, Joseph Grinnell and Tracy Storer (1916:377), wrote in an early *Science* article that mammals in parks added "the witchery of movement" to the "natural charm of the landscape." These distinguished biologists believed that the national parks' highest purpose was to "furnish examples of the earth as it was before the advent of the white man" (377).

A few short years later views were beginning to change. Beginning in the 1920s, several professional ecologists published papers calling for nature protection for the sake of science. In 1920, Victor Shelford (1920) criticized the Park Service and the Forest Service for an unecological approach to management. Francis Sumner (1920, 1921) called for "nature conservation" over resource management. Both Shelford and Sumner were members of the new Ecological Society of America and advocated setting aside representative examples of all US ecosystems in a comprehensive national system. Other ecologists joined them publishing articles such as "The

Preservation of Natural Areas in the National Forests" (Pearsons 1922) and "The Importance of Preserving Wilderness Conditions" (Adams 1929). In 1921 the American Academy for the Advancement of Science endorsed the Ecological Societies' policies on reserves.

What sparked this outcry from a few influential scientists? Wilderness historian Craig Allin (1982) suggests that it resulted from a massive upsurge in roadbuilding on public lands between 1916-1921. During this period both the Forest Service and the Park Service favored roads—the former for logging and fire protection, the latter to bring tourists to the parks. It is also likely that Shelford and his colleagues, on the cusp between Clementsian and quantitative ecology, recognized the need for protecting representative ecosystem types as both examples of steady state conditions and as baselines for gathering new scientific data.

Shelford's efforts led to the remarkable paper "The Preservation of Natural Biotic Communities" (Shelford 1933). This visionary work outlined a national strategy for preserves that included protection for both species and ecosystems, expansion of park and reserve boundaries to match species habitat needs, managing for ecological "fluctuations" (i.e. natural disturbances) and a core/buffer zoning approach to planning. Shelford also understood that cooperation between agencies would be required for success.

Reading Shelford's paper more than 60 years later, one can only dream of what condition US public lands would be in today if policymakers of the time had embraced Shelford's bold vision. But no sanctuary system was forthcoming. What did result from Shelford's work was the beginning of the Forest Service's Research Natural Area program where examples of different timber types were declared off-limits to commercial logging. This small political gain, the final product of a far-reaching ecological policy recommendation, became the first example of a pattern in American environmental politics that is still much in evidence today (Grumbine 1994b).

While Victor Shelford developed his nature sanctuary plan, three other biodiversity pioneers, George Wright, Ben Thompson, and Joseph Dixon, were focusing on the national parks. As wildlife experts studying the habitat

needs of park fauna, Wright and his colleagues discovered that every single park was far too small to sustain large mammal populations over time. At the conclusion of their landmark *Fauna of the National Parks of the United States* (1933:37-39) they made one of the first statements suggesting biodiversity as the *raison d'etre* for parks: "...perhaps our greatest natural heritage," rather "than just scenic features...is nature itself, with all its complexity and its abundance of life." Wright *et al.* believed firmly that scenery was secondary to science: "The enduring obstacle to ecological management [is] the prior emphasis on setting aside purely scenic wonders."

Wright and his colleagues were proved correct in both their scientific and policy assessments by the debate that surrounded the creation of Everglades National Park in 1934. Wildlands advocates count Everglades as the first park where wilderness preservation was used to justify protection. Furthermore, the park was established for the "preservation intact of the unique flora and fauna and the essential primitive conditions" (US Statutes at Large, 1934). But this legal language obscures the true justification behind the protection of the park. Instead of wilderness and ecosystem protection, the record shows that conservationists convinced Congress to accept wildlife as "scenery" since the river of grass had no magnificent mountains or gorges (Runte 1987). Though the Everglades bill does represent a statutory milestone for accepting wilderness and wildlife, Romantic ideas of the balance of nature continued to hold sway.

## BIODIVERSITY FROM ALDO LEOPOLD TO EARTH DAY

As ecology developed into a modern science in the 1930s-1940s and the American industrial juggernaut spread west, there remained a need to consolidate ecological justifications for protecting nature into a coherent whole. The person who accomplished this was Aldo Leopold. Best known for *A Sand County Almanac* (1949), Leopold wed together the science of ecology with a land ethic where humans were "plain members and citizens" of Earth.

Leopold's thought took several decades to reach maturity. In 1921, he was using standard recreational justifications for protecting wildlands. But beginning in 1939 and continuing to his death, Leopold published a series of papers which provide the basis for much of the current definition of biodiversity as well as the ethical foundations of conservation biology. Leopold made four key contributions. In 1939, he offered one of the first inclusive definitions of biodiversity: "...the biota as a whole is useful, and biota includes not only plants and animals, but soils and water as well" (Leopold 1939:727). Leopold expanded on this in 1944 by adding the concept of health to conservation (Leopold in Flader and Callicott 1991:310).

> Conservation is a state of health in the land. The land consists of soil, water, plants, and animals, but health is more than a sufficiency of these components. It is a state of vigorous self-renewal in each of them, and in all collectively... In this sense land is an organism and conservation deals with its functional integrity, or health.

It is this commingling of biodiversity conservation and land health that serves as the root of current attempts to define ecological health and ecological integrity.

Leopold's second contribution was to use the new ecological concepts of biotic pyramids, energy flows, and food chains to point out defects in prevailing balance-of-nature perspectives on ecosystems. He suggested that balance implies "only one point at which balance occurs, and that balance is normally static" (Leopold 1939:727).

Third, Leopold used his awareness of the dynamics of nature to provide a scientific rationale for wilderness protection. In 1941, he wrote that "all wilderness areas...have a large value to land-science" (Leopold 1941:3) and that their principle utility was as a "base-datum of normality, a picture of how healthy land maintains itself..." Recreation no longer served Leopold as the principle reason to protect nature.

The fourth and most important contribution of Leopold to understanding biodiversity was that he placed people squarely in nature as "plain members and citizens of the land community" (Leopold 1949:204). He had already recognized this intimate relationship as early as 1933 when he defined civilization as "a state of mutual and

interdependent cooperation between human animals, other animals, plants, and soils..." (Leopold 1933:635). With this conception Leopold became the first modern-era ecologist to link the health of land with the health of culture.

Like Shelford and Wright before him, Leopold's ideas had little immediate influence on policy. By the 1960s, however, as the pace of environmental deterioration quickened, other ecologists were beginning to catch up with Leopold. Science was increasingly being used in environmental policy debates. Rachel Carson in *Silent Spring* (1962) built her argument against pesticides using both their negative effects on human health as well as on ecosystem functioning. Ecologist Raymond Dasmann (1959) wrote the first science-based conservation textbook. By 1968, the international scientific community was becoming active. The United Nations Educational, Scientific, and Cultural Organization (UNESCO) in that year sponsored a global conference on the use and conservation of the biosphere. This led to the biosphere reserve model of ecosystem protection. Influenced by the UNESCO Conference, F.F. Darling and N.D. Eichhorn published *Man and Nature in the National Parks: Reflections on Policy* (1969) and argued that the "ecological well-being of parks must come before recreation" (54). Human ecologist Paul Shepard recognized in a famous 1969 essay that ecology was the "subversive science" challenging the very ethos of modern society (Shepard 1969). Biologist David Ehrenfeld wrote the textbook *Biological Conservation* in 1970 in which he critiqued resource conservation and development using arguments from evolutionary ecology. All these works forged links between Leopold's view of science and the environmental problems of the day.

Congress and the administration, too, were beginning to act for biodiversity. In 1966 the Endangered Species Preservation Act was passed. This prototype of more powerful laws to come protected only vertebrates and contained many other loopholes. A year before Earth Day in 1969, as the environmental movement gathered strength, Congress extended protection to invertebrates. In 1972 President Nixon stated that "even the most recent act to protect endangered species simply does not provide the kind of management tool needed to act early enough

to save a vanishing species" (Nixon 1972). Nixon went on to sign the Marine Mammal Protection Act that same year.

The groundswell of presidential and popular support for ecology and endangered species following Earth Day 1970 led to Congress passing the 1973 Endangered Species Act with but 12 no-votes in both legislative houses. The Act, still the strongest American environmental law, validated Aldo Leopold's "ecological consciousness" toward species and ecosystems and set the stage for future policy debates.

## BIODIVERSITY AND THE ENVIRONMENTAL MOVEMENT

Environmental protection did not gain a lasting place in American values due only to the development of the science of ecology. Nor did biodiversity come to the fore simply because of individual biologists such as Shelford, Leopold, and Carson. It also took the concerted efforts of a few leaders within the environmental movement to fathom the implications of ecology and render these ideas accessible to the American public.

Just as ecology has developed as a science, so have environmentalist arguments evolved for protecting nature. When Robert Marshall, Aldo Leopold and their colleagues founded The Wilderness Society in 1935, they focused only on wilderness and roadless areas. They also believed that wildlands should be protected primarily for the benefits they conferred on people. Marshall's views, in particular, were influential: wilderness offered a respite from civilization, encouraged spiritual contemplation, and offered a unique aesthetic experience (Marshall 1930). During this period Leopold was only beginning to voice his biotic view of land and the conservation movement had little scientific ecology on which to base political prescriptions.

In 1949, the year *A Sand County Almanac* appeared, the Sierra Club convened its first biennial wilderness conference. The conferences were to become the main philosophical and strategic forum for the movement. But through the first four gatherings there was little mention of ecology as having anything to do with wilderness protection. Recreational, spiritual, and aesthetic justifications

prevailed. From 1950-1976 in the *Sierra Club Bulletin* there are only two references to ecology, four to endangered species, and five to wildlife conservation (Sierra Club 1976).

But the power of scientific ecology in general and Leopold's ideas in particular were beginning to be felt. In 1950 journalist Bernard DeVoto, responding to the Echo Park Dam controversy in Dinosaur National Monument, proclaimed that the park deserved to be protected "as wilderness...for the field study of...the balance of Nature, the web of life, the interdependence of species..." (DeVoto 1950:44). Here is a classic attempt to incorporate Leopoldian ecology with Romantic ideas of balance in nature.

In 1951 and again in 1955, at the 3rd and 5th wilderness conferences respectively, Howard Zahniser of The Wilderness Society unveiled a national plan for wilderness protection that retained some elements of Victor Shelford's original nature sanctuary vision. Part of the Wilderness Society's strategy was based on an update of Shelford's work (Kendeigh *et al.* 1950-1951). Zahniser's plan became the precursor to the original Wilderness Act bill in 1956. In the opening rounds of Congressional hearings over the new bill, Zahniser mentioned scientific baseline data arguments in favor of the legislation. But these justifications were by no means highlighted by conservationists during the debate.

Sierra Club Executive Director David Brower was as responsible as any leader for bringing science to conservation. Even if he did not immediately grasp the significance of ecology, Brower controlled the agenda of the wilderness conferences. Beginning in 1959 with Raymond Cowles, he invited several professional ecologists to address the conferences. Cowles spoke of population growth from an ecological perspective and was followed in 1963 by James Gilligan, the author of the first Ph.D. dissertation on US wilderness policy. In his speech Gilligan (1963) described wildlands as "essential habitat for scarce species." Slowly, biodiversity was seeping into conservation arguments.

It was not easy, however, for conservationists to include ecology along with recreational and spiritual justifications for wilderness. Sharing the podium in 1963 with Gilligan

was forest ecologist Stephen Spurr. Spurr's view of ecology directly challenged Brower and the conferees. Spurr argued strongly against any wilderness preservation strategy that was grounded in a stable, balance of nature view of ecological harmony. "Stability is only relative, and only superficial," spoke the ecologist, and "natural succession will never recreate old patterns, but will constantly create new patterns" (60). Spurr used ecological theory to confront the conferees' "nostalgia" for a nature that never existed. Instead of drawing lines around roadless areas and lobbying Congress to designate new wilderness, Spurr argued for intensive management with greater use of science and technology to manipulate nature for human ends.

This conflict between ecology and preservation was manifest again in 1963 with the influential *Wildlife Management in the National Parks*, the so-called Leopold Report (Leopold *et al.* 1963). At the behest of Interior Secretary Steward Udall, a blue ribbon committee chaired by Aldo Leopold's son, zoologist A.S. Leopold, was convened to review wildlife in the parks. The committee's report was both revolutionary and paradoxical. Following ecology (and the 30 year old insights of George Wright) the report concluded that "maintaining suitable habitat is the key to sustaining animal populations, and...protection, though it is important, is not of itself a substitute for habitat" (1-2). But after verifying Spurr's assessment that ecosystems change over time, the Leopold Committee recommended that "the biotic associations within each park be maintained...as nearly as possible in the condition that prevailed when the area was first visited by the white man." Each park "should represent a vignette of primitive America" (4). As historian Alfred Runte (1987) has noted, these scientists could not escape their cultural values. Science required them to portray nature as dynamic but their worldview led them to advocate freezing nature into pre-European landscapes.

The Sierra Club, Wilderness Society, and National Parks and Conservation Association were all quick to endorse the Leopold Report. These groups supported the committee's **philosophy** while avoiding the committee's **ecology**. The following year the Wilderness Act was passed by Congress. Ecological values rated all of three words in the new law.

Despite these inconsistencies, support for endangered species and broad environmental protection continued to evolve within conservation. In 1968 the Sierra Club lobbied for a national ecological survey, but the bill died in Congress (McCloskey 1968). At the biennial wilderness conference in 1969, population biologist Paul Ehrlich proclaimed that population growth and resource consumption were inextricably linked to the loss of wilderness. And another speaker, John Milton, contradicted the Leopold Report by predicting that a "global system of wilderness reserves in isolation from the irreversible forces of environmental change is a tragic delusion" (Hall 1969).

## BIODIVERSITY COMES OF AGE: 1970-1990

During the 1970s and into the 1980s, scientific and policy conceptions of biodiversity continued to converge with environmentalist notions of ecology. Ecologists added to their knowledge of competition, diversity, stability and community dynamics (see Cody and Diamond 1975) and biogeography (MacArthur and Wilson 1967). R.H. Whitaker refined and broadened the concept of diversity to include within-habitat (alpha), between-habitat (beta), and regional (gamma) diversity (Whitaker 1972). The same year that Whitaker published his classic work, the United Nations Conference on the Environment was held in Stockholm. But for all the energetic debate in Sweden, there were few ecologists in attendance. Scientists were not ready to present their ideas in political forums.

Several national and international conferences and policy documents built upon Stockholm. Nineteen eighty-one saw the US Council on Environmental Quality produce the *Global 2000 Report to the President* (1981). The report was the first US policy document to attempt a definition of biodiversity. Both the genetic and species levels were described and recommendations to protect diversity were featured. The US Department of State, following the Council's lead, sponsored an International Strategy Conference on Biological Diversity in 1981. A World Charter for Nature was also produced during this period and later was ratified by the UN General Assembly in 1982. The charter included recommendations to protect parks and wildernesses but was most notable for its preamble

which tied protecting diversity to an ethical position: "Every form of life is unique, warranting respect regardless of its worth to man, and, to accord other organisms such recognition, man must be guided by a moral code of action." The US was the only voting member of the General Assembly to vote against the charter.

Yet by the time UN delegates were voting on the World Charter for Nature, biodiversity protection had already been codified in US law—at least on the national forests. The 1976 National Forest Management Act (NFMA) today remains the only US law that explicitly requires a federal agency to protect viable populations and ecosystems. But like wilderness in the Everglades legislation, the motives of Congress were not particularly clear. The NFMA was a response to excessive clearcut logging on the national forests; diversity was not a major focus of the complex legislation. Forest activists and Congress were concerned about stand conversions, the forestry practice of logging native forests to replace them with 1-2 preferred commercial species creating an industrial monoculture. Yet Congress did not understand biodiversity well enough to act decisively. In an extremely ambiguous section of the NFMA, legislators required the Forest Service to "provide for the diversity of plant and animal communities" (US Code 1982).

The diversity provision of the NFMA was clarified by a committee of scientists who wrote rules under the Code of Federal Regulations whereby the law would be implemented. These rules, completed in 1979 and revised in 1982, require the Forest Service to manage and preserve existing variety, maintain viable populations, recognize forests as ecosystems, and base management on ecological relationships. Clear as the rules were, it would take several decades and numerous appeals and lawsuits to force the agency to implement them.

Along with the NFMA, two additional factors in the late 1970s brought ecologists and activists closer together. As the pace of development continued, concerns were raised as to how "external threats" would impact protected areas. In 1979, the National Parks and Conservation Association (1979) published a national report documenting such threats. The Park Service (1980) released its own study highlighting similar problems. The following year,

Congress, in response to erosion and watershed degradation on lands surrounding Redwood National Park, amended the Park Service Organic Act to affirm park protection. While judicial interpretations have limited the effectiveness of the Redwood Park Amendments, the issue of external threats served notice that protected areas were in fact embedded in an ecological matrix which required protection as a whole.

Another factor that illuminated biodiversity in the late 1970s was a series of scientific reports warning of an extinction crisis. Norman Myer's *The Sinking Ark* (1979) was read widely and caused much debate. Paul and Anne Ehrlich titled a 1981 text *Extinction*. The Nature Conservancy, ahead of most groups in understanding diversity, began to build a national database that cataloged threatened and endangered species, habitat types, and more (The Nature Conservancy 1975).

By the beginning of the 1980s, a critical threshold was being reached in scientific comprehension and environmental awareness of biodiversity. The first International Conference on Conservation Biology, held at the University of California, San Diego in 1978, brought together a diverse group of geneticists, population biologists, evolutionists, and biogeographers. The conference resulted in the pathbreaking anthology *Conservation Biology: An Ecological and Evolutionary Approach* (Soulé and Wilcox 1980). The synthetic discipline of conservation biology was born. Soon thereafter, other books appeared linking conservation with genetics, evolution, and population biology (Frankel and Soulé 1981, Schonewald-Cox *et al.* 1983, Harris 1984). In 1986, a second conference of the newly formed Society for Conservation Biology was held, followed by the initial publication of a professional journal. In late 1986 in Washington, DC, the Smithsonian Institute hosted the first high-profile international gathering of professionals concerned with loss of biodiversity. From this time onward there has been a great outpouring of papers and reports covering all aspects of the new field.

What was new about conservation biology? The discipline was synthetic with island biogeography, population genetics, and habitat fragmentation studies leading the way. There was an emphasis on applying

academic theory to management problems. And conservation biology was explicitly value-laden: diversity, complexity, and evolution were imbued with normative value (Soulé 1985). Conservation biologists supported shifting the burden of proof in environmental decisions from those who wished to protect diversity to those who desired to develop nature. But while conservation biology was mission-oriented, the methods used to gather data were objective, peer reviewed, and as value-free as any other scientific discipline. The field has contributed these general management goals to conservation (Meffe and Carroll 1994):

1. Critical ecological processes must be maintained.
2. Goals and objectives must come from a deep understanding of the ecological properties of the system.
3. External threats must be minimized and external benefits maximized.
4. Evolutionary processes must be conserved.
5. Management must be adaptive and minimally intensive.

The Earth First! movement was well out in front of almost all environmental groups in using conservation biology arguments as first principles in protecting nature. Evident in the earliest volumes of the *Earth First! Journal* (1981-1982), this ecological wilderness perspective was consolidated in *The Big Outside* (Foreman and Wolke 1989): "Protecting **natural diversity**, then, must be the major goal of the wilderness movement...natural diversity means that all indigenous species must be free to evolve under natural conditions, in as many different natural habitats as possible" (24).

But as conservation biology grew and became influential, not all environmental groups were quick to embrace the new field. It took the northern spotted owl and its old growth forest habitat to catapult biodiversity toward the forefront of environmentalism. The owl awakened activists (and managers and Congress) to several critical aspects of protecting biodiversity. First, what began in the 1970s as an owl-only issue was transformed by 1990 into an ecosystem protection issue. The first reports on the importance of old growth forests to the northern spotted owl were published in 1978 (LaFollette

1978, Juday 1978) yet it took another decade for environmental groups to awaken to the ecosystem-scale of biodiversity. Even up to the release of the conservation biology-based Thomas Report (1990) there was still debate over whether to focus political strategy on the bird or its habitat, as if the two could be separated. Second, once old growth ecosystems were adopted as a strategy focus, it became easier for activists to appreciate the role that ecosystem patterns and processes played in maintaining biodiversity. If habitat was the proper focus for species protection, then fires, floods, and population dispersal patterns must become working elements in an activist's toolkit. This connection first came to Congress in 1991 when two House committees directed a group of scientists to "develop interim protection alternatives for ecologically-significant old growth and late successional **ecosystems**, species, and **processes**" (emphasis added) (Johnson *et al.* 1991). Third, as scientific assessments on owls and old growth were joined by reports on marbled murrelets, salmonids and other species, activists were pushed toward another level of sophistication as the need for regional/landscape-scale protection emerged. As of Earth Day 1995 ecosystem management studies supported (in concept) by environmentalists were being conducted by the federal government in the entire Columbia River Basin and the Sierra Nevada Mountains in California.

## BIODIVERSITY BEYOND EARTH DAY 1995

Three years after Earth Day 1970, when Congress passed the Endangered Species Act, protecting diversity was perceived as "low-cost, no-lose" approach (Yaffee 1982:57). On the 25th anniversary of Earth Day it is by no means clear that the Act can withstand efforts to gut its most prohibitive provisions. Yet, from a scientific perspective, it is abundantly clear that the biodiversity crisis has worsened and that the law should be strengthened. The sum of our growing scientific understanding of biodiversity reveals a deep chasm between environmental policy and environmental protection.

The single major consequence of the revolution in awareness of biodiversity has been to deepen our appreciation of interrelationships. For ecologists, this trend

has been manifest in two important ways: the evolving definition of diversity from species to the current inclusive hierarchical view, and the change from balance to non-equilibrium theories of nature. In the environmental movement, biodiversity has nudged activists away from viewing nature as a series of special places (parks and wilderness) embedded in developed landscapes toward the protection of regional landscapes or greater ecosystems (Grumbine 1990) where use and protection are grounded in a sense of limits on human behavior.

In American society at large the concept of protecting biodiversity continues to challenge cherished but outmoded images of people vs. nature. While anthropocentric values and resourcism still hold sway with the majority, a growing number of citizens are asking provocative questions. Are there limits to private property rights when biodiversity is at risk? Is industrial-scale resource depletion a sustainable ideal of Progress? What should give when human activities are exposed by conservation science as endangering species, ecosystems, and landscapes? Who should decide what constitutes acceptable levels of risk in losing elements of biodiversity? These questions were not part of the discussion on Earth Day 1970. We had no name for biodiversity, no Endangered Species Act, and property owners were unconcerned about their "rights." Sustainability was not part of the environmental lexicon. There were no conservation biologists to decry threats to viable populations and "plenty" of old growth remained to be cut. Environmental protection was perceived as either/or, cut-and-dried, not replete with uncertainty and multiple levels of risk.

These issues cannot be avoided as Earth Day 1995 passes into history and society is beginning to make adjustments. Conservation biologists confront several complex issues. In a society that considers science to be value-neutral, how do you practice objective science and yet advocate for biodiversity (for example see Noss 1994 and Brussard *et al.* 1994). And how do you create a tighter link between science and policy? In the 1930s, Victor Shelford designed a national reserve system using science and the political response was Research National Areas. In the 1990s, several scientific panels affirmed a

moratorium on old growth logging and the result was President Clinton's Option Nine which continues the cutting.

Activists, too, are adjusting to the new world of diversity. They are becoming less hesitant to employ scientific arguments in their strategies regardless of the perceived political costs. The history of US environmentalism reflects a tendency by activists to downplay scientific rationales in favor of ethical justifications. The normative standards of conservation biology can help to overcome this tendency. But activists must not accept science uncritically. The history of the concept of biodiversity makes clear that along with evolving scientific "fact," ecological theory is also dependent on cultural context. The balance of nature steady-state model was a partial product of Romantic values at the last turn of the century just as chaos, uncertainty, and non-equilibrium theories are tied to current circumstances. The process of science suggests that the current definition of biodiversity provides an improved picture of how nature works. But there remains a great tension in American culture to develop nature through technology with little thought for species and ecosystems not deemed "essential" to ecosystem functioning. The views that Stephen Spurr expressed at the 1969 Sierra Club wilderness conference are alive and well today; the influential ecologist Daniel Botkin believes "We can engineer nature at nature's rate and in nature's way..." (Botkin 1990:190). The current debate over defining ecosystem management provides another indication of American's ambivalence over new concepts of biodiversity (Grumbine 1994a). Is it people over nature or people in partnership with nature? Ecosystem management or ecosystem protection? The goal of biodiversity protection considers all human use of nature as flowing from ecosystems **only after** basic patterns and processes are maintained and restored. If ecosystem management for native diversity is to take hold and flourish beyond 1995, the relationship between the new goal of protecting biodiversity and the old standard of providing natural resources for human use must be reconciled. This is a values and political question that does not depend exclusively on science for resolution.

One hundred thirty-six years ago, Charles Darwin ascertained that humans were subject to the forces of

evolution. Three decades before the first Earth Day, Aldo Leopold, working a cutover sand county farm in Wisconsin, saw through the delusion that people are separated from nature. In 1962, Rachel Carson published her blockbuster against pesticides. In the late 1980s, American school children became aware of the northern spotted owl and its old growth home. But a century after *The Origin of the Species* many US citizens do not believe in evolution. Twenty-five years passed between the appearance of *A Sand County Almanac* and a law to protect species from extinction. DDT, banned in the US since 1969, is still manufactured by US companies for export. And even as we celebrate Earth Day 1995, the owl, salmon, and a host of other old growth-dependent species do not have sufficient secure habitat. The pace of change is painfully slow. Sociologist Bill Devall (this volume) is correct to note that though Americans have been quick to support environmental reforms, changes that require difficult behavioral and values adjustments remain incomplete.

Biodiversity protection represents the single issue that may bring Americans to the necessity of protecting all species, human and nonhuman alike. Noting the tension between scientific and environmentalist views of ecosystems, ecologist Frank Golley (1993:205) remarked that "It is not clear to me where ecology ends and the study of the ethics of nature begins, nor is it clear to me where biological ecology ends and human ecology begins. These divisions become less and less useful." Moving from a 19th century model of preserving nature toward a 21st century image of protecting biodiversity will help to break down further the delusion that people and nature are two. The hope is that adjusting management goals to reduce extinction and habitat destruction will not only eliminate the present biodiversity crisis but also begin to provide the opportunity for people to forge a new relationship with nature. Hope and time are intertwined—most biologists do not believe that we have the luxury of an additional 25 years to wait for biodiversity to become mainstreamed into society as ecology was from 1970 to 1995. Long before Earth Day's 50th anniversary, Americans must learn that there can be no alternative to protecting the native sources of life—healthy, functioning wild ecosystems.

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