"A Mission-Driven Discipline": the Growth of Conservation Biology

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Abstract: *Conservation biology emerged in the mid-1980s, drawing on established disciplines and integrating them in pursuit of a coherent goal: the protection and perpetuation of the Earth's biological diversity. Opportunistic in its borrowing and application of knowledge, conservation biology had its roots within the established biological sciences and resource management disciplines but has continually incorporated insights from the empirical experience of resource managers, from the social sciences and humanities, and from diverse cultural sources. The Society for Conservation Biology (SCB) has represented the field's core constituency, while expanding that constituency in keeping with the field's integrative spirit.* Conservation Biology *has served as SCB's flagship publication, promoting research, dialog, debate, and application of the field's essential concepts. Over the last 20 years the field, SCB, and the journal have evolved to meet changing conservation needs, to explore gaps in our knowledge base, to incorporate new information from related fields, to build professional capacity, and to provide expanded opportunities for international participation. In turn, the field, SCB, and journal have prompted change in related fields, organizations, and publications. In its dedication to advancing the scientific foundations of biodiversity conservation and placing that science at the service of society in a world whose variety, wildness, and beauty we care for, conservation biology represents both a continuation and radical reconfiguration of the traditional relationship between science and conservation.*

"Una Disciplina Dirigida por una Misión": el Crecimiento de *Conservation Biology*

Resumen: *Conservation Biology emergió a mitad de la década de 1980, derivada de disciplinas establecidas e integrándolas en persecución de una meta coherente: la protección y perpetuación de la diversidad biológica de la Tierra. Oportunista en el préstamo y aplicación de conocimiento, la biología de la conservación tiene sus raíces en las ciencias biológicas y disciplinas de gestión de recursos establecidas pero continuamente ha incorporado información de las experiencias empíricas de gestores de recursos, de las ciencias sociales y humanísticas y de diversas fuentes culturales. La Sociedad para la Biología de la Conservación (SBC) ha representado al núcleo de la comunidad, al tiempo que la expande con el espíritu integrador del campo.* Conservation Biology *ha fungido como la publicación bandera de SBC, promoviendo la investigación, el diálogo, el debate y la aplicación de los conceptos esenciales. En los últimos 20 años la biología de la conservación, la SBC y la revista han evolucionado para enfrentar necesidades de conservación cambiantes, para explorar vacíos en nuestro conocimiento básico, para incorporar información nueva de campos relacionados, para incrementar la capacitación profesional y para proporcionar oportunidades expandidas para la participación internacional. A su vez, la biología de la conservación, la SBC y la revista han promovido cambios en campos relacionados, organizaciones y publicaciones. En su tarea de establecer bases científicas para la conservación de la biodiversidad y colocar a la ciencia al servicio de la sociedad en un mundo cuya variedad y belleza nos preocupa, la biología de la conservación representa una continuación y una reconfiguración radical de la relación tradicional entre la ciencia y la conservación.*

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> Our job is to harmonize the increasing kit of scientific tools and the increasing recklessness in using them with the shrinking biotas to which they are applied. In the nature of things we are mediators and moderators, and unless we can help rewrite the objectives of science we are predestined to failure.
>
> Aldo Leopold (1940, 1991)

> Conservation in the old sense, of this or that resource in isolation from all other resources, is not enough. Environmental conservation based on ecological knowledge and social understanding is required.
>
> Raymond Dasmann (1959)

> Conservation biology is a mission-driven discipline comprising both pure and applied science. . . . We feel that conservation biology is a new field, or at least a new rallying point for biologists wishing to pool their knowledge and techniques to solve problems.
>
> Michael E. Soulé and Bruce A. Wilcox (1980)

Introduction

Conservation biology, although rooted in older scientific, professional, and philosophical traditions, has gained its contemporary definition only in the last three decades. Any observer seeking to understand the growth of conservation biology thus faces inherent challenges: the field has formed too recently to be viewed with historical detachment and the trends shaping it are still too fluid for it to be easily assayed. Conservation biology's practitioners and interpreters remain embedded within a process of change that has challenged conservation "in the old sense," even while extending conservation's essential commitment to the future of life, human and nonhuman, on Earth.

There is as yet no comprehensive history of conservation that allows us to evaluate the causes, sources, timing, and radical nature of conservation biology's emergence and growth. Over the last several decades environmental ethicists, environmental historians, and historians of science have provided essential studies of particular conservation ideas, disciplines, institutions, individuals, ecosystems, landscapes, and resources. We still lack, however, a broad and fully integrated account of the dynamic coevolution of conservation science, philosophy, policy, and practice (Reiger 1990; Meine 2004). The rise of conservation biology marked a new "rallying point" at the nexus of these domains; exactly how, when, and why it did so are questions still to be asked and debated.

Among those who have sought to provide answers, interpretations vary. For the authors of one of the first textbooks in the field, conservation biology was a reaction to the limited scope of prior conservation efforts, which "had not embraced the intricacies of complex ecosystem function and the importance of all the 'minor,' less charismatic, biotic components" of those ecosystems (Meffe & Carroll 1994:13). Quammen (1996) embedded the creation story of conservation biology within his widely read book, *Song of the Dodo: Island Biogeography in an Age of Extinctions*. Referencing Michael Soulé, Quammen (1996:529) showed conservation biology filling a critical gap: before its arrival "there was no common forum for scientists concerned with extinction and how to prevent it." Takacs (1996:2) deconstructed the term *biodiversity*, describing conservation biology as an effort by "an elite group of biologists" who "[aimed] to change science, conservation, cultural habits, human values, our ideas about nature, and ultimately, nature itself." Noss (1999) saw conservation biology as a response to the failure of older disciplines to address modern conservation problems, yet noted that its success required that it "build on the strengths of other disciplines, both basic and applied." Meine (2004:75) viewed conservation biology "not so much as a new science as a more comprehensive, better-integrated response to problems that were themselves more extensive, more urgent, and more complicated than most had realized in 1970."

These and other attempts to understand conservation biology's historical context have only tangentially considered the question in broader geographical terms. The advent of conservation biology tends to be seen largely through the lens of North American institutions, individuals, and experiences. This raises key questions: How does the growth of conservation biology in North America contrast or converge with traditions of conservation science, philosophy, policy, and practice arising on other continents and within other cultures? Why did the field as such emerge as it did in North America? Could it have emerged as it did only in North America? But just as we lack a comprehensive history that places conservation biology in context, we lack a comparative history that could illuminate these questions by contrasting and connecting North American traditions and innovations with those of other regions.

Prelude: Historical Foundations of Conservation Biology

Since conservation biology's emergence in the mid-1980s, commentary on the field has emphasized its departure from past conservation science and practice. The main "thread" of the field, however—the description, explanation, appreciation, protection, and perpetuation of biological diversity—can be traced back much further through the historical tapestry of the biological sciences and the conservation movement (Mayr 1982; Grumbine 1996; Quammen 1996). That thread weaves its way through related themes and concepts in conservation, including wilderness protection, sustained yield, wildlife protection and management, the diversity-stability hypothesis, sustainability, ecosystem health, and ecological restoration (McIntosh 1985; Jordan et al. 1988; Golley 1993; Callicott 1996; Chapin et al. 1998; Holling 2000; Burley 2002). By focusing on the thread itself, conservation biology has in the last 20 years brought the theme of biological diversity to the fore.

In so doing, conservation biology has reconnected conservation to deep sources in western natural history and science and to cultural traditions of respect for the natural world (within and beyond the Western experience). Long before environmentalism reshaped "conservation in the old sense" in the 1960s and 1970s—even before the Progressive Era conservation movement of the early 1900s—the foundations of conservation biology were being laid over the course of biology's epic advances: through the early microscopes of van Leeuwenhoek and Malpighi; through the detailed studies of a host of European entomologists; through the wide-ranging voyages of discovery of von Humboldt, Bonpland, Forster, and Kotzebue; through the natural history studies of Buffon and Gilbert White; through the early biogeographical speculations of Zimmerman, Willdenow, and deCandolle; through the novel classification and taxonomic schemes of Ray, Linnaeus, and Cuvier; through the geological and paleontological breakthroughs of Lyell, Owens, Marsh, and Cope; through the evolutionary synthesis of Darwin and Wallace; through the variations in Mendel's peas; and through the dawning ecological insights of Haeckel, Drude, Forbes, Cowles, and Warming (Mayr 1982; Grove 1995). The "discovery of diversity" (to use Ernst Mayr's phrase) was the driving force behind the growth of biological thought. Mayr wrote (1982:133), "Hardly any aspect of life is more characteristic than its almost unlimited diversity . . . . Indeed, there is hardly any biological process or phenomenon where diversity is not involved."

This "discovery" unfolded as colonialism, the Industrial Revolution, human population growth, expansion of capitalist and collectivist economies, and developing trade networks transformed human social, economic, and ecological relationships ever more quickly and profoundly (Crosby 1986; Ponting 1992; Grove 1995; Diamond 1997; Hughes 2001; Adams & Mulligan 2003). Technological change accelerated humanity's capacity to reshape the world to meet human needs and desires and amplified essential tensions along basic philosophical fault lines: mechanistic/organic; utilitarian/reverential; imperialist/arcadian; reductionism/holism (Thomas et al. 1956; Worster 1985). As recognition of these human impacts grew, an array of nineteenth-century Western philosophers, scientists, naturalists, theologians, artists, writers, and poets began to regard the natural world within an expanded sphere of moral concern (Nash 1989). In 1863, for example, Alfred Russel Wallace (1863:234) warned against "extinction of the numerous forms of life which the progress of cultivation invariably entails." He urged his scientific colleagues to assume the responsibility for stewardship that came with knowledge of diversity: "If this is not done, future ages will certainly look back upon us as a people so immersed in the pursuit of wealth as to be blind to higher considerations. They will charge us with having culpably allowed the destruction of some of those records of Creation which we had it in our power to preserve; and, while professing to regard every living thing as the direct handiwork and best evidence of a Creator, yet, with a strange inconsistency, seeing many of them perish irrecoverably from the face of the earth, uncared for and unknown." Through the veil of nineteenth-century language, modern conservation biologists may recognize such common intellectual ancestors.

The following year the first edition of George Perkins Marsh's *Man and Nature* appeared. Marsh devoted his second chapter, "Transfer, Modification, and Extirpation of Vegetable and of Animal Species," to the question of human influence on biotic diversity. Marsh described human beings as a "new geographical force" and surveyed human impacts on "minute organisms," plants, insects, fish, "aquatic animals," reptiles, birds, and "quadrupeds." "All nature," he concluded, "is linked together by invisible bonds, and every organic creature, however low, however feeble, however dependent, is necessary to the well-being of some other among the myriad forms of life . . . ." He concluded his chapter with the hope that people might "learn to put a wiser estimate on the works of creation." By "studying the ways of nature in her obscurest, humblest walks" we could "derive not only great instruction . . . but great material advantage" (Marsh 1864).

Marsh's landmark volume appeared just as the post-Civil War era of epic resource exploitation commenced in the United States. A generation later, Marsh's account undergirded the Progressive Era reforms that gave conservation in the Unites States its modern meaning and turned it into a national social, economic, and political movement. That movement rode Theodore Roosevelt's presidency into public consciousness and across the American landscape. Conservation efforts in the Progressive Era were famously split along utilitarian-preservationist lines. The utilitarian Resource Conservation Ethic, realized within new federal conservation agencies, was marked by its commitment to the efficient, scientifically informed management of resources, to provide "the greatest good to the greatest number for the longest time" (Pinchot 1910:48). The Romantic-Transcendental Preservation Ethic, overshadowed but persistent through the Progressive Era, celebrated the aesthetic and spiritual value of contact with wild nature and inspired campaigns for the protection of parklands, refuges, forests, and "wild life." Both ethical camps were "essentially human-centered or 'anthropocentric' . . . [and] regarded human beings or human interests as the only legitimate ends and nonhuman natural entities and nature as a whole as means" (Callicott 1990).

Moreover, the biology on which both relied had not yet experienced its twentieth-century revolutions. Ecology had not yet fused the abiotic, plant, and animal components of living systems. Evolutionary biology had not yet arrived at the Modern Synthesis of genetics, population biology, and evolutionary biology. Geology, paleotonology, and biogeography were just beginning to provide a more coherent narrative of the temporal dynamics and spatial distribution of life on Earth. Although explicitly committed to and informed by the natural sciences, conservation in the Progressive Era was primarily economic in its orientation, reductionist in its tendencies, and selective in its application.

Emerging concepts from ecology and evolutionary biology began to filter into conservation and the resource management disciplines in the 1920s and 1930s. "Protoconservation biologists" from this period include such key figures as Henry C. Cowles, whose pioneering studies of plant succession and the diverse flora of the Indiana Dunes led him into active advocacy for their protection (Engel 1983); Victor Shelford, who prodded his fellow ecologists to become active in establishing biologically representative nature reserves (Croker 1991); Arthur Tansley, who similarly advocated establishment of nature reserves in Britain, and who in 1935 contributed the concept of the "ecosystem" to science (McIntosh 1985; Golley 1993); Charles Elton, whose text *Animal Ecology* (1927) provided the foundations for a more dynamic ecology through his definition of food chains, food webs, trophic levels, the niche, and other functional concepts; Joseph Grinnell, Joseph Dixon, C.C. Adams, Paul Errington, and Adolph, Olaus, and Margaret Murie, field biologists who first challenged prevailing notions on the ecological role and value of predators (Dunlap 1988); and George Wright, Ben Thompson, and Joseph Dixon, who sought to place national park management in the United States on a more ecologically sound footing (Sellars 1997; Shafer 2001). The crisis of the Dust Bowl in North America invited similar ecological critiques of agriculture through the 1930s (Worster 1979; Beeman & Pritchard 2001).

By the late 1930s, a broad range of conservation concerns—soil erosion, watershed degradation, urban pollution, deforestation, depletion of fisheries and wildlife populations—had brought academic ecologists and resource managers closer together and forced on them a new awareness of conservation's ecological foundations, in particular the role of biological diversity. In 1939 Aldo Leopold, then teaching wildlife ecology at the University of Wisconsin, summarized the point in a speech to a symbolically appropriate joint meeting of the Ecological Society of America and the Society of American Foresters:

> The emergence of ecology has placed the economic biologist in a peculiar dilemma: with one hand he points out the accumulated findings of his search for utility, or lack of utility, in this or that species; with the other he lifts the veil from a biota so complex, so conditioned by interwoven cooperating and competitions, that no man can say where utility begins or ends. No species can be "rated" without the tongue in the cheek; the old categories of "useful" and "harmful" have validity only as conditioned by time, place, and circumstance. The only sure conclusion is that the biota as a whole is useful, and [the] biota includes not only plants and animals, but soils and waters as well (Leopold 1991:266–267).

With appreciation of "the biota as a whole" came greater appreciation of the functioning of ecological communities and systems (Golley 1993). For Leopold and others, this translated into a redefinition of conservation's aims away from the primarily social and economic goals of Progressive Era conservation, with their narrow goal of sustaining supplies of particular commodities, and toward the more complex goal of sustaining "a state of health in the land." "The land consists of soil, water, plants, and animals," Leopold wrote in 1944, "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" (Leopold 1991:310).

As conservation's aims were thus being redefined, its ethical foundations were being reconsidered. The accumulation of revolutionary biological insights, combined with a generation's experience in fragmented policy, short-term economics, and environmental decline, yielded Leopold's declaration of an Evolutionary-Ecological Land Ethic (Callicott 1990). A land ethic, Leopold (1949:204) wrote, "enlarges the boundaries of the community to include soils, waters, plants, and animals, or collectively: the land"; it "changes the role of Homo sapiens from conqueror of the land-community to plain member and citizen of it. It implies respect for his fellow-members, and also for the community as such." These new scientific and ethical concepts only slowly gained ground in forestry, fisheries management, wildlife management, agronomy, range management, outdoor recreation, and other resource management disciplines; indeed, these concepts remain controversial.

In the post-World War II years, as consumer demands increased, technologies evolved, and resource development pressures grew, resource managers responded by expanding their efforts to increase and sustain yields of their particular commodities. Leopold lived just long enough to notice the trend of the times. He observed that resource managers fell into two broad categories (the "A-B cleavage"). One group looked through an economic lens and saw land "as soil, and its function as commodity production." The other looked through an ecological lens and saw land "as a biota, and its function as something broader" (Leopold 1949:221). As pressures mounted in the postwar years and commodity production came to dominate resource management, those who held an ecological perspective were marginalized. The tensions between the two groups—and the two world views they represented—increased as the political tide of environmentalism rose in the 1960s and early 1970s (Aplet et al. 1992; Pister 2002).

These same post-war years saw the pace of scientific change accelerate in disciplines across the biological spectrum, from microbiology, genetics, systematics, and population biology to ecology, limnology, marine biology, and biogeography (Mayr 1982). As these advances accrued, maintaining healthy connections between the basic sciences and their application in the resource-oriented disciplines proved as challenging as the scientific work itself. It fell to a diverse cohort of scientific advisors, interpreters, and advocates to enter the public arena and the policy fray. Among these were Marston Bates, Rachel Carson, Jacques-Yves Cousteau, Ray Dasmann, Paul Ehrlich, Paul Errington, Joseph Hickey, G. Evelyn Hutchinson, Julian Huxley, Hugh Iltis, Charles Kendeigh, A. Starker Leopold, Lewis Mumford, Eugene Odum, Howard Odum, Fairfield Osborn, Ruth Patrick, Peter Raven, Carl O. Sauer, Peter Scott, William Vogt, and George Woodwell. Although many of these people were scientists working within the United States, their influence reached beyond national boundaries through their publications and students, their scientific collaborations, and their ecological concepts and methodologies. Working from within traditional disciplines, government agencies, and academic seats, they stood at the complicated intersection of conservation science, policy, and practice—a position that would come to define the new generation of conservation biologists.

On a more pragmatic level, new federal legislation in the United States and a growing list of international agreements expanded the role and responsibilities of biologists. In the United States the 1970 National Environmental Policy Act required analysis of environmental impacts in federal decision making. The provisions of the 1973 Endangered Species Act called for an unprecedented degree of scientific involvement in the identification, protection, and recovery of threatened species. Other laws of the period that broadened the role of biologists in conservation and environmental protection include the Marine Mammal Protection Act (1972), the Coastal Zone Management Act (1972), the Clean Water Act (1972), the Forest and Rangeland Renewable Resources Planning Act (1974), the National Forest Management Act (1976), and the Federal Land Policy Management Act (1976). Beyond the United States the roles and responsibilities of biologists were expanding as well in response to adoption of bilateral treaties and multilateral agreements, including the UNESCO Man and the Biosphere Program (1970), the Convention on International Trade in Endangered Species of Wild Fauna and Flora (1975), and the Convention on Wetlands of International Importance (the "Ramsar Convention") (1975). In 1966 the International Union for the Conservation of Nature (IUCN) published it first red-list inventory of threatened species. In short, the need for rigorous science input into conservation decision making was increasing even as the science of conservation was changing. This state of affairs challenged the traditional orientation of resource managers and research biologists alike.

Quickening: toward Establishment of a New Interdisciplinary Field

In the opening chapter of *Conservation Biology: an Evolutionary-Ecological Perspective* (1980), Soulé and Wilcox described conservation biology as "a mission-oriented discipline comprising both pure and applied science." The phrases *crisis-oriented* and *crisis-driven* were soon added to the list of modifiers describing the emerging field (Soulé 1985). This characterization of conservation biology as a mission-oriented, crisis-driven, problem-solving field resonates with echoes of the past. Especially in the North American experience, conservation has been characterized by a pattern of crisis and response. In the late 1800s the crisis of deforestation (especially in the Upper Great Lakes) led to the emergence of professional forestry in the United States. In the early 1900s depletion of game and fish populations generated broad support for game (later *wildlife*) and fisheries management; extensive soil erosion and degradation of watersheds and rangelands gave rise to watershed management, range management, and soil and water conservation programs; and the accelerated loss of roadless wildlands prompted organized campaigns for wilderness protection. In the 1960s unchecked pollution and environmental contamination stimulated advances in environmental toxicology, integrated pest management, monitoring, and environmental technologies. Since the 1960s global environmental change has motivated earth, marine, and atmospheric scientists to integrate entire fields of knowledge. History suggests that the emergence of problem-solving fields (or new emphases within established fields) invariably involves new interdisciplinary connections, new institutions, new research programs, and new practices. Conservation biology would follow this pattern in the 1970s, 1980s, and 1990s.

In 1970 David Ehrenfeld published *Biological Conservation*, one of the early texts in a generation of publications that would alter the scope, content, and direction of conservation science (MacArthur & Wilson 1963, 1967; Cox 1969; Ehrenfeld 1972; MacArthur 1972; Myers 1979; Council on Environmental Quality 1980; Soulé & Wilcox 1980; Ehrlich & Ehrlich 1981; Frankel & Soulé 1981; U.S. Department of State 1982; Schonewald-Cox et al. 1983; Harris 1984; Caughley & Gunn 1986; Soulé 1986, 1987*b*; Wilson & Peter 1988). (The journal *Biological Conservation* had begun publication a year earlier in England.)

In his preface Ehrenfeld (1970:vii) stated, "Biologists are beginning to forge a discipline in that turbulent and vital area where biology meets the social sciences and humanities. The need is now very great for a scientifically valid presentation of the biological problems that are most relevant to the life of modern man." Those problems had expanded beyond earlier concerns about sustained yields of timber trees, game populations, sport and commercial fisheries, crops, forage, and livestock. The suite of modern concerns now included "the fate of communities of animals and plants and of individual species . . . the impact of the population and technology explosions on the natural world within the context of western, urban society . . . environmental changes that are likely to be significant to man . . . the relationship between conservation and ecology" (Ehrenfeld 1970:viii).

Ehrenfeld (1970:1) recognized that "the acts of conservationists are often motivated by strongly humanistic principles," but cautioned that "the practice of conservation must also have a firm scientific basis or, plainly stated, it is not likely to work." Constructing that "firm scientific basis" required—and attracted—researchers and practitioners from varied disciplines and backgrounds (including Ehrenfeld himself, whose professional background was in medicine and physiological ecology). The common concern that transcended their disciplinary boundaries was biological diversity: its extent, its role, its value, and its fate.

By the mid-1970s the recurring debates within theoretical ecology over the relationship between species diversity and ecosystem stability were intensifying (Pimm 1991; Golley 1993; McCann 2000). Among conservationists the theme of diversity, in eclipse since Leopold's day, had begun to reemerge. In 1951 renegade ecologists created The Nature Conservancy for the purpose of protecting threatened sites of special biological and ecological value. In the 1960s voices for diversity began to be heard within the traditional conservation fields. Ray Dasmann (1968:vii) lamented "the prevailing trend toward uniformity" and made the case "for the preservation of natural diversity" and for the diversity of cultural environments and expressions. Pimlott (1969) detected "a sudden stirring of interest in diversity," noting that "not until this decade did the word diversity, as an ecological and genetical concept, begin to enter the vocabulary of the wildlife manager or land-use planner." Hickey (1974) argued that wildlife ecologists and managers should concern themselves with "all living things" and that "a scientifically sound wildlife conservation program" should "encompass the wide spectrum from one-celled plants and animals to the complex species we call birds and mammals." Conservation scientists and advocates of varied backgrounds increasingly framed the fundamental conservation problem in these new and broader terms (Farnham 2002).

As the theme of biological diversity gained traction among conservationists in the 1970s, the key components of conservation biology began to come together around it.

- Within the realm of the sciences proper, the synthesis of knowledge from island biogeography and population biology had greatly expanded understanding of the distribution of species diversity and the phenomena of speciation and extinction.
- Increasing attention to the fate of threatened species (in situ and ex situ) and the loss of rare breeds and plant germ plasm stimulated interest in the heretofore neglected (and occasionally even denigrated) application of genetics in conservation.
- Driven in part by the IUCN red-listing process, the commitment to captive breeding programs grew, and zoos, aquaria, and botanical gardens began to expand and redefine their role as partners in conservation.
- Wildlife ecologists, community ecologists, and limnologists gained greater insight into the role of keystone species and top-down interactions in maintaining species diversity and ecosystem health.
- Within forestry, wildlife management, range management, fisheries management, and the other applied disciplines, ecological approaches to resource management gained more advocates.
- Advances in ecosystem ecology, landscape ecology, and remote sensing provided increasingly sophisticated concepts and tools for land-use and conservation planning at larger spatial scales.
- As awareness of conservation's social dimensions increased, discussions of the role of values in science became explicit, and interdisciplinary inquiry gave rise to environmental history, environmental ethics, ecological economics, and other hybrid fields.

As the broad trends unfolded, "keystone individuals" had an impact. Peter Raven and Paul Ehrlich (to name only two) made fundamental contributions to coevolution and population biology in the 1960s before becoming leading proponents of conservation biology. Michael Soulé recalls that Ehrlich encouraged his students to speculate across disciplines and had his students read Thomas Kuhn's *The Structure of Scientific Revolutions* (1962). The intellectual synthesis of population biology later (around 1976) led Soulé to adopt the term *conservation biology* for his own synthesizing efforts.

For Soulé that synthesis especially entailed the merging of genetics and conservation (Soulé 1980). In 1974 Soulé visited Sir Otto Frankel while on sabbatical in Australia. Frankel approached Soulé with the idea of collaborating on a volume on that theme (published several years later as *Conservation and Evolution*) (Frankel & Soulé 1981). Soulé's work on that volume, supplemented by brainstorming conversations with Bruce Wilcox, Thomas

Lovejoy, and other colleagues, led to the convening of the First International Conference on Conservation Biology in September 1978. The meeting brought together what looked from the outside like "an odd assortment of academics, zoo-keepers, and wildlife conservationists" (Gibbons 1992). Inside, however, the experience was more personal, among individuals who had been led there through important, and often very personal, shifts in professional priorities. The proceedings of the 1978 conference were published as *Conservation Biology: An Evolutionary-Ecological Perspective* (Soulé & Wilcox 1980). The conference and the book initiated a series of meetings and proceedings that defined the field both for its growing number of participants and for those outside the circle (Table 1) (Brussard 1985; Gibbons 1992; Quammen 1996).

Attention to the genetic dimension of conservation continued to gain momentum into the early 1980s (Schonewald-Cox et al. 1983). Meanwhile, awareness of threats to species diversity and causes of extinction was reaching a much broader professional and public audience (e.g., Iltis 1967, 1972; Ziswiler 1967; Ehrenfeld 1972, 1981; Terborgh 1974; Ehrlich & Ehrlich 1981; Diamond 1982). In particular, the impact of international development policies on the world's species-rich humid tropical forests was emerging as a global concern. Field biologists, ecologists, and taxonomists, alarmed by the rapid conversion of the rainforests and witnesses themselves to the loss of research sites and study organisms, began to sound louder alarms (e.g., Gómez-Pompa et al. 1972; Janzen 1972). By the early 1980s, the issue of rainforest destruction was highlighted through a surge of books, articles, and scientific reports (e.g., Myers 1979, 1980; National Academy of Sciences 1980; National Research Council 1982).

During these same years, recognition of the needs of the world's poor and of the developing world was prompting new approaches to the integration of conservation and development. This movement was embodied in a series of international programs, meetings, and reports, including the Man and the Biosphere Program (1970), the United Nations Conference on the Human Environment in Stockholm (1972), and the World Conservation Strategy (World Conservation Union 1980). These approaches eventually came together under the banner of sustainable development, especially as defined in the report of the World Commission on Environment and Development (the "Brundtland Report") (World Commission on Environment and Development 1987). The complex relationship between development and conservation created tensions within conservation biology from the outset but also drove the search for deeper consensus and innovation (Meine 2004:63–85).

Michael Soulé and colleagues organized a Second International Conference on Conservation Biology in May 1985 (Soulé 1986). Before the meeting, two committees were formed to consider establishing a new professional society and a new journal. The attendees endorsed these steps. A motion to organize the Society for Conservation Biology was approved at the conclusion of the meeting (Soulé 1987*a*). In March 1986 SCB's board of governors convened for the first time and defined the mission of the organization: "to help develop the scientific and technical means for the protection, maintenance, and restoration of life on this planet—its species, its ecological and evolutionary processes, and its particular and total environment." One of the board's first acts was to choose David Ehrenfeld as editor of SCB's new journal, *Conservation Biology* (Ehrenfeld 2000). In the immediate aftermath, the zoo community (represented by William Conway, George Rabb, and Katherine Ralls) played an especially important role in SCB's development, garnering financial support and providing administrative expertise for the fledgling organization.

The founding of the SCB coincided with planning for the 1986 National Forum on BioDiversity, held in Washington, D.C. The forum, broadcast via satellite to a national and international audience, was organized by the U.S. National Academy of Sciences and the Smithsonian Institution. Although coordinated independently of the process that led to SCB's creation, the forum represented a parallel convergence of conservation concern, scientific expertise, and interdisciplinary commitment. Many of the same scientific elders who had prepared the way for conservation biology—including Ernst Mayr, G. Evelyn Hutchinson, E. O. Wilson, Peter Raven, Hugh Iltis, Paul Ehrlich, Harold Mooney, William Conway, Michael Soulé, and David Ehrenfeld—contributed to the forum's planning and program. While organizing the event, Walter Rosen, a program officer with the National Research Council, began using a contracted form of the phrase *biological diversity*. The abridged form *biodiversity* began its etymological career.

Papers from the forum were published as *Biodiversity* (Wilson & Peters 1988). The broad impact of the forum and its proceedings ensured that the landscape of conservation science, policy, and action would never be the same. But, as Wilson remarked in his foreword, the momentum for change had been building for years. "Two more or less independent developments" accounted for this momentum. "The first was the accumulation of enough data on deforestation, species extinction, and tropical biology to bring global problems into sharper focus and warrant broader public exposure. It is no coincidence that 1986 was also the year the SCB was founded. The second development was the growing awareness of the close linkage between the conservation of biodiversity and economic development" (Wilson & Peters 1988:v). From one angle, conservation biology appeared as a new, unproven, and—for some, at least—unwelcome kid on the conservation block. Others, however, saw it as the culmination of trends long latent within ecology and conservation,

Table 1. Conservation biology and the Society for Conservation Biology: a timeline.

1978	First International Conference on Conservation Biology held at University of California-San Diego; papers published in Soulé and Wilcox (1980)
1980–1981	Series of United Nations (FAO/UNEP) conferences in Rome on conservation of genetic resources (fish, other animals, forests, crops)
1981	International Strategy Conference on Biological Diversity convened in Washington, D.C., under the auspices of the U.S. Department of State
1982	Washington, D.C., conference on the application of genetics to conservation of wild plant and animal populations; papers published in Schonewald-Cox et al. (1983)
	Planning Workshop on Minimum Critical Habitat and Population Sizes for Significant and Indicator Species held in Nevada City, California, under the auspices of the USDA Forest Service
1984	October workshop on viable populations held at the University of Michigan, Ann Arbor; papers published in Soulé (1987*b*)
1985	Second International Conference on Conservation Biology held at the University of Michigan, Ann Arbor, 5–8 May; Society for Conservation Biology founded at the conclusion of this meeting on 8 May; papers published in Soulé (1986)
1986	First SCB board of governors meets in Washington, D.C., on 20 March; David Ehrenfeld chosen as founding editor of *Conservation Biology*
	SCB Articles of Incorporation filed in California, on 8 April; initial bylaws drafted
	National Forum on BioDiversity held in Washington, D.C., under the auspices of the U.S. National Academy of Sciences and the Smithsonian Institution; forum is broadcast via satellite to participants around the world; papers published in Wilson and Peter (1988)
1987	Volume 1, issue 1 of *Conservation Biology* published (May)
	First annual meeting of the Society for Conservation Biology, held at Montana State University, Bozeman, 23–26 June; Michael E. Soulé serves as first president of SCB (1987–1989)
	First SCB Distinguished Service Awards presented at the annual meeting; recipients are Norman Myers, Paul Ehrlich, Michael Lannarty, and the New York Zoological Society (A complete list of award recipients is available from http://www.conbio.org/SCB/Activities/Awards.)
1988	Second annual meeting, University of California, Davis; held in conjunction with other groups in the American Institute for the Biological Sciences
	April meeting leads to publication of *Research Priorities for Conservation Biology* (Soulé & Kohm 1989)
1989	Third annual meeting, University of Toronto, Toronto, Ontario; first annual meeting held outside the U.S.A.; held in conjunction with other groups in the American Institute for the Biological Sciences; Thomas Lovejoy serves as second president of SCB (1989–1991); Stephen Humphrey begins 15-year tenure (1989–2004) as SCB chief financial officer
1990	Fourth annual meeting, University of Florida, Gainesville
1991	Fifth annual meeting, University of Wisconsin, Madison
	Stanley Temple serves as third president of SCB (1991–1993)
	First local chapters of SCB organized at Yale University, Madison, Wisconsin, and Colorado State University (A complete list of local chapters and their status and activities is available from http://www.conbio.org/SCB/Activities/Chapters.)
1992	Sixth annual meeting, Virginia Polytechnic Institute and State University, Blacksburg; combined meeting with The Wildlife Society; first SCB Student Awards presented; SCB's Distinguished Service Awards Committee established
1993	Seventh annual meeting, Arizona State University, Tempe
	Peter Brussard serves as fourth president of SCB (1993–1995)
1994	Eighth annual meeting, University of Guadalajara, Jalisco; combined meeting with the Association for Tropical Biology (now Association for Tropical Biology and Conservation)
	Reed Noss assumes editorship of *Conservation Biology* after beginning duties in 1993 as incoming editor
	First issue of SCB Newsletter published in February under editorship of Erica Fleishman
1995	Ninth annual meeting, Colorado State University, Fort Collins; SCB Policy Committee formed (committee discontinued in 2004)
	Conservation Biology begins publishing six issues per year
	SCB hires an executive coordinator, Alice Blandin, and establishes membership office at the University of Washington, Seattle
	Reed Noss presented with first SCB LaRoe Award (LaRoe Award recipients are included in the list available from http://www.conbio.org/SCB/Activities/Awards.)
	Dennis Murphy serves as fifth president of SCB (1995–1997)
1996	Tenth annual meeting, Brown University, Providence, Rhode Island; combined meeting with the American Society of Naturalists, Association for Tropical Biology, Ecological Society of America, and International Society for Ecological Modeling-North American Chapter
	SCB Membership Committee established
1997	Eleventh annual meeting, Victoria University, Victoria, British Colombia
	April SCB meeting convened at White Oak Plantation, Florida, to develop a research agenda for conservation biology, published as *Conservation Biology: Research Priorities for the Next Decade* (Soulé & Orians 2001)
	Dee Boersma serves as sixth president of SCB (1997–1999)

continued

Table 1. (continued)

	Boersma takes lead in extensive, SCB-organized review of endangered species recovery plans under sponsorship of the U.S. Fish and Wildlife Service and the National Center for Ecological Analysis and Synthesis (NCEAS); the project, involving 19 universities and more than 360 students, results in multiple peer-reviewed publications and changes in USFWS guidelines for recovery plans
1998	Gary Meffe assumes editorship of *Conservation Biology*, after beginning duties in 1997 as incoming editor
	Twelfth annual meeting, Macquarie University, Sydney, Australia; first annual meeting held outside North America
	SCB's Conference and Nominations committees established
1999	Thirteenth annual meeting, University of Maryland, College Park
	SCB board of governors votes to pursue development and planning for publication of *Conservation Biology in Practice* under the editorship of Kathryn Kohm and SCB president Dee Boersma
	Reed Noss serves as seventh president of SCB (1999–2001)
	SCB board of governors holds its first strategic planning meeting, in Santa Barbara, California
	SCB's Education Committee created as an ad hoc committee and becomes a standing committee by vote of the membership in 2001; Development and Student Awards committees established
2000	First issue of *Conservation Biology in Practice* published (spring)
	Fourteenth annual meeting, University of Montana, Missoula
	SCB board approves process to create seven new regional sections (including the Marine Section)
2001	Fifteenth annual meeting, University of Hawaii, Hilo
	Conservation Biology in Practice and *NeoCons* begin regular publication
	SCB executive office opens in Arlington, Virginia; Alan Thornhill selected as first executive director of SCB
	Mac Hunter serves as eighth president of SCB (2001–2003)
2001–2002	SCB's regional Africa, Asia, Australasia, Austral and Neotropical America, Europe, Marine, and North America Sections organized and hold meetings at 2002 annual meeting in Canterbury, Kent
2002	Sixteenth annual meeting, University of Kent at Canterbury; first annual meeting held in Europe
	Title of *Conservation Biology in Practice* changed to *Conservation in Practice*
	First board and members' meeting of the Australasian Section, Cairns, Queensland
	First board meeting of Austral and Neotropical America Section, Havana, Cuba
2003	Seventeenth annual meeting, University of Minnesota, Duluth
	SCB's Asia Section organized
	SCB Fresh Water Working Group and Social Science Working Group formed
	Deborah Jensen serves as ninth president of SCB (2003–2005)
	Pacific Conservation Biology, first published in 1995, becomes an affiliate publication of the SCB
2004	Eighteenth annual meeting, Columbia University, New York
2005	Nineteenth annual meeting, Universidad de Brasília, Brasília; first annual meeting held in South America
	John Robinson serves as tenth president of SCB (2005–2007)
	Asia Section holds first independent meeting by an SCB section (Kathmandu, Nepal, November)
2006	Twentieth annual meeting, Society for Conservation Biology, San Jose, California
	Biological Conservation, published in the United Kingdom since 1968, becomes an affiliate publication of the SCB
	European Section holds second independent meeting by an SCB section, Eger, Hungary (August)

a necessary adaptation to new knowledge and a gathering crisis. For its advocates in the SCB, conservation biology could legitimately be regarded as both a progressive continuation and a radical reconfiguration of the prior relationship between science and conservation.

By the time the first issue of *Conservation Biology* appeared in May 1987, the new field had gained its footing within academia, zoos and botanical gardens, nonprofit conservation groups, resource management agencies, and international development organizations (Soulé 1987*a*; Rabb 1994). This unusually rapid and positive reception of conservation biology begs several questions. What was missing in conservation's scientific foundations and institutional arrangements that made change necessary and possible in the 1980s? What were (and are) the essential qualities of conservation biology that set it apart from predecessor and affiliated fields? It may still be too soon to answer such questions with assurance, but even as the field was being christened its novel characteristics were apparent (Soulé 1985; Noss 1999):

- Conservation biology's scientific foundations lie at the interface of systematics, genetics, ecology, and evolutionary biology. As the Modern Synthesis reordered the foundations of biology and new insights emerged from population genetics, developmental genetics (heritability studies), and island biogeography in the 1960s, the application of biology in conservation shifted as well. This eventually found expression in conservation biology's focus, not first and foremost on those ecosystem components with obvious or direct economic value but on the conservation of genetic, species, and ecosystem diversity.
- Conservation biology paid attention to the entire biota, to diversity at all levels of biological organization, to patterns of diversity at various temporal and spatial scales, and to the evolutionary and ecological processes that maintain diversity. In particular, emerging insights from ecosystem ecology, disturbance ecology, and landscape ecology in the 1980s shifted the perspective of ecologists and conservationists, placing greater emphasis

on the dynamic nature of ecosystems and landscapes (Pickett & White 1985; Forman 1995; Pickett & Ostfeld 1995; Wallington et al. 2005).

- Conservation biology was an interdisciplinary, systems-oriented, synthetic, and inclusive response to conservation dilemmas exacerbated by approaches that were too narrowly focused, disciplinary, fragmented, and exclusive (Soulé 1985; Noss & Cooperrider 1994). It provided an interdisciplinary home for those in established disciplines who sought new ways to organize and use scientific information and who followed broader ethical imperatives. It reached beyond its own core scientific disciplines to incorporate insights from the social sciences and humanities, from the empirical experience of resource managers, and from diverse cultural sources (Grumbine 1992; Knight & Bates 1995).
- Conservation biology acknowledged its ethical content and its status as an inherently "value-laden" field. In the tradition of Leopold, Soulé (1985) asserted that "ethical norms are a genuine part of conservation biology." Noss (1999) regarded this as a distinguishing characteristic, noting that there is an "overarching normative assumption in conservation biology . . . that biodiversity is good and ought to be preserved." Leopold's land ethic and related appeals to intergenerational responsibilities and the intrinsic value of nonhuman life motivated growing numbers of conservation scientists and environmental ethicists (Thomas et al. 1956; Kozlovsky 1974; Ehrenfeld 1981; Samson & Knopf 1982; Devall & Sessions 1985; Nash 1989; Callicott 1990; Leopold 2004). This explicit recognition of conservation biology's ethical dimension stood in contrast to the careful avoidance of such considerations, even within ecology, in prior decades (McIntosh 1980; Barbour 1995; Barry & Oelschlaeger 1996).
- Conservation biology recognized the "close linkage" between biodiversity conservation and economic development and sought new ways to improve that relationship. As *sustainability* became the catch-all term for development that sought to blend environmental, social, and economic goals, conservation biology provided a new venue at the intersection of ecology, ethics, and economics (Daly & Cobb 1989). To achieve its goals, conservation biology had to reach beyond its base in the sciences and generate conversations with economists, educators, ethicists, advocates, policy makers, the private sector, and community-based conservationists.

Attentive observers recognized the emergence of conservation biology as an outward indicator of deeper currents of change in conservation. In his popular 1959 book, *Wildlife in America,* Peter Matthiessen provided a sweeping account of the transformation of North America's landscape, describing in elegiac tones the history of ecological degradation, declining wildlife populations, and extinctions. In his updated and expanded edition, Matthiessen (1987:270) pointed out that conservation concerns had expanded over the intervening years "from a small number of celebrated birds and mammals to the whole range of living things." He noted that "our understanding of the magnitude and gravity of species extinction has grown enormously in recent years" and that "conservation theorists" were gaining new insights into such phenomena as minimum viable populations, island biogeography, invasive species, and landscape fragmentation. Their insights offered hope "for averting at least some species losses" (Matthiessen 1987:275). The two editions of Matthiessen's book bracketed a period of fundamental change in conservation. In 1959 Matthiessen defined the conservation problem largely in terms of diminishing populations of wild vertebrates; in 1987, the problem involved nothing less than the "unprecedented impoverishment of the diversity of life" (Matthiessen 1987:279).

Consolidation: Conservation Biology Secures Its Niche

In June 1987 more than 200 people attended the first annual meeting of the SCB at Montana State University in Bozeman, Montana. In 1991, 650 gathered for the fifth annual meeting. The increased attendance was an indicator of the SCB's rising membership and influence (Gibbons 1992). Membership in the SCB had more than tripled, from 1500 to 5000. The growth of the field and of the SCB was tightly linked to the success of *Conservation Biology*, which quickly became essential reading for those involved in biodiversity conservation (Ehrenfeld 2000). As SCB president Stan Temple commented, "The discipline of conservation biology defines the scope of the journal, but it is also true that the journal has played an influential role in defining conservation biology" (Temple 1992:485). *Conservation Biology* would in turn induce other journals to take note of the emerging field.

During this formative period, a disproportionate percentage of SCB's members was under 40 years old. The SCB was tapping into a burgeoning interest in interdisciplinary conservation science among younger students, faculty, and conservation practitioners. New courses, seminars, and academic programs were established. The Pew Charitable Trusts provided an important boost through its "Integrated Approaches to Training in Conservation and Sustainable Development" program, which supported development of the first formal graduate programs (Jacobson et al. 1992). The Pew Scholars Program in Conservation and the Environment recognized and supported the work of many leading conservation biologists. The SCB published its first research agenda, *Research Priorities for Conservation Biology* (Soulé & Kohm 1989). Support for research came through a special National

Science Foundation program. A spate of conferences on biodiversity conservation brought together academics, agency officials, resource managers, business representatives, international aid agencies, and nongovernmental organizations. In remarkably rapid order, conservation biology gained legitimacy and secured a professional foothold.

This legitimacy was not gained without resistance, skepticism, and occasional ridicule. As the field and the SCB grew, complaints came from various quarters. Conservation biology was caricatured as a passing fad, a response to trendy environmental ideas and momentarily available funds. Its detractors regarded it as too theoretical, amorphous, and eclectic; too promiscuously interdisciplinary; too enamored of models; and too technique-deficient and data-poor to have any practical application (Gibbons 1992). Conservation biologists in the United States (it was said) were indifferent to the long-standing conservation traditions of other nations and regions. Conservation biology was simply a case of "old wine in a new bottle" (Jensen & Krausman 1993). Some regarded the new breed as naive and dismissive of the rich experience gathered over the last century in forestry, wildlife management, and the other resource-management disciplines. The SCB had "entered a niche presently filled by a number of professional societies," and its members could better spend their time and energy making common cause with existing disciplines and organizations (Teer 1988). *Biodiversity* itself was just too broad, or confusing, or "thorny" a term (Udall 1991; Takacs 1996). More pragmatically, what kinds of jobs could students with degrees in "conservation biology" expect to fill?

Such complaints made headlines within the scientific journals and reflected real tensions within resource agencies, academic departments, and conservation organizations. Conservation biology had thrown down an intellectual and philosophical gauntlet, and such responses were to be expected. Those who assumed the label "conservation biologist" did not necessarily or automatically relinquish their identities as zoologists or botanists or foresters or wildlife biologists. Rather, conservation biology gave them another hat to wear, one not associated with a particular subject, but with a conservation *need*. Defending the new field, Ehrenfeld (1992:1625) wrote, "Conservation biology is not defined by a discipline but by its goal—to halt or repair the undeniable, massive damage that is being done to ecosystems, species, and the relationships of humans to the environment.... Many specialists in a host of fields find it difficult, even hypocritical, to continue business as usual, blinders firmly in place, in a world that is falling apart." In 1949 Leopold described the "discontent" among conservation professionals who resisted the tenets of professional overspecialization, purely reductionist science, and economic dogma. At least some of them now found refuge in conservation biology.

Meanwhile, complex issues at the national and global level were drawing increased attention to biodiversity conservation. In North America, the Northern Spotted Owl became the poster creature in the deeply contentious debates over the fate of remaining old-growth forests and alternative approaches to forest management; the *Exxon Valdez* oil spill and its aftermath put pollution threats and energy policies back on the front page; the anti-environmental, antiregulatory wise-use movement gained in political power and influence; arguments over livestock grazing practices and federal rangeland policies pitted environmentalists against ranchers; perennial attempts to allow oil development within the Arctic National Wildlife Refuge continued; and moratoria were placed on commercial fishing of the depleted stocks of northern cod (Alverson et al. 1994; Yaffee 1994; Myers et al. 1997; Knight et al. 2002; Jacobs 2003).

At the international level, attention focused on the discovery of the hole over the Antarctic in the stratospheric ozone layer, growing scientific consensus and concerns about the threat of global warming (the International Panel on Climate Change formed in 1988 and issued its first assessment report in 1990), the environmental legacy of communism in the former Soviet bloc, and the environmental impacts of international aid and development programs. In 1992, 172 nations gathered in Rio de Janeiro at the United Nations Conference on Environment and Development (the "Earth Summit"). Among the products of the summit was the Convention on Biological Diversity. In a few short years, the scope of biodiversity conservation, science, and policy had expanded dramatically (see, e.g., McNeely et al. 1990; Lubchenco et al. 1991).

To some degree, the SCB had defined its own niche by synthesizing scientific disciplines, proclaiming its special mission, and gathering to itself a core group of leading scientists, students, and conservation practitioners. Nevertheless, the SCB was filling a niche that was rapidly opening around it, providing a necessary meeting ground for those with converging interests in the conservation of biological diversity. In the United States, where the society's membership was (and remains) largely based, the tensions between conservation biology and traditional resource management disciplines remained. Those differences began to settle out as professional exchanges continued, connections were established, and understanding of the evolution of conservation ideas deepened. In 1992, in an olive-branch offering, the SCB held its sixth annual meeting jointly with The Wildlife Society. Jensen and Krausman (1993) concluded that "conservation biologists' and wildlife biologists' efforts are complementary, not duplicative." Conservation biology was not alone in gaining ground for applied, interdisciplinary conservation research and practice. It joined restoration ecology, landscape ecology, agroecology, ecological economics, and other emergent fields in seeking solutions across traditional academic and intellectual boundaries.

Amid the flush of excitement over establishing conservation biology, it was sometimes easy to overlook the challenges inherent in the undertaking. The nascent field was, as Ehrenfeld (2000) noted, "controversy-rich." Friction was inherent not only in the relationship of conservation biology to related fields but also within the field itself and within the SCB that represented it. Some of this chafing was simply the result of high energy applied to a new endeavor. Some of it, however, involved deeper tensions in conservation: between sustainable use and protection; between public and private resources; between the immediate needs of people and obligations to future generations and other life forms. Conservation biology would be the latest stage on which these long-standing tensions would express themselves.

Still other tensions were more reflective of the special role conservation biology had carved out for itself. Conservation biology was largely a product of U.S. institutions and individuals, yet it sought to address a problem of global proportions (Meffe 2002, 2003). Effective biodiversity conservation entailed work at various scales, from the global to the local, and on various levels, from the genetic to the species to the community; yet actions at these different scales and levels required different types of information, skills, and partners (Noss 1990). Professionals in the new field had to be grounded firmly within particular professional specialties but conversant across disciplines (Trombulak 1994; Noss 1997). Success in the practice of biodiversity conservation was measured by on-the-ground impact, yet the science of conservation biology was obliged (as are all sciences) to undertake rigorous basic research and to delimit uncertainty (Noss 2000). Conservation biology was a "value-laden" field adhering to explicit ethical norms, yet it sought to advance conservation through rigorous scientific analysis (Barry & Oelschlaeger 1996). To achieve its mission, the SCB had to engage in policy formation, yet it had to remain a credible source of objective scientific information and expertise (Murphy 1990; Hagan 1995). These tensions within conservation biology were present at birth. They would continue to present important challenges to conservation biologists. They would also give the field its vitality.

Twenty Years of Growth and Change

Table 1 provides an overview of key events in the history of conservation biology. A thorough review of these events and the evolving scientific content of the field is beyond the scope of this article. It is possible, however, to identify and summarize at least several of the salient trends that have shaped the field and the SCB in its first 20 years.

Implementation and Transformation

Conservation biologists work in a much more elaborate field than they did two decades ago. Much of the early energy—and debate—in conservation biology focused on questions of the genetics and demographics of small populations, population and habitat viability, landscape fragmentation, reserve design, and the management of natural areas and endangered species. These topics remain close to the core of conservation biology, even as the field has grown around them. Thinking outward from these core questions, conservation biologists now tend to work more flexibly, at varied scales and in varied ways. Heated arguments (involving, for example, the "SLOSS"—single large or several small reserves—debate) that consumed many journal pages in the 1980s have since been reconciled to a considerable degree (Soulé & Simberloff 1986; Noss & Cooperrider 1994). Other research topics and concepts have gained in relevance. In recent years, for example, more attention has focused on landscape permeability and connectivity, the role of strongly interacting species in top-down ecosystem regulation, and the impacts of global warming on biodiversity (Hudson 1991; Lovejoy & Peters 1994; Soulé & Terborgh 1999; Ripple & Beschta 2005).

Innovative techniques and technologies have always played a role in the development of conservation biology. The early application of computer modeling to population viability analyses was among the driving forces within the field in its formative years. Beginning in the late 1980s the dissemination of geographic information systems (GIS) technology allowed conservation biologists to develop creative means of synthesizing data sets, communicating that information, and applying it in conservation planning. Other tools, from email and the Internet to global positioning systems and genetic mapping techniques, have dramatically altered the daily work of conservation biologists.

Yet the most revolutionary changes in the work of conservation biology have had less to do with hardware or software and more to do with reconceptualizing science's role in conservation practice. The principles of conservation biology have spawned creative applications among conservation visionaries, practitioners, planners, and policy makers (Noss et al. 1997; Adams 2005). This has come out of both necessity and opportunity: to safeguard biological diversity, larger-scale and longer-term thinking and planning had to take hold. Over the last two decades it has done so under many rubrics, including adaptation of the biosphere reserve concept (Batisse 1986); the development of gap analysis (Scott et al. 1993); the movement toward ecosystem management and adaptive management (Grumbine 1994*b*; Salafsky et al. 2001; Meffe et al. 2002); ecoregional planning and analogous efforts at other scales (Johnson 1999; Redford et al. 2003); state-level initiatives in the United States, such as statewide conservation planning in Florida and natural community conservation plans (NCCPs) in California (Hoctor et al. 2000); the Northwest Forest Plan and regional-scale habitat conservation plans (HCPs) in the United States; continental-scale proposals such as those advocated by the Wildlands Project and the Yukon-to-Yellowstone (Y2Y) Conservation Initiative (Soulé & Terborgh 1999); The Nature Conservancy's Conservation By Design program (The Nature Conservancy 1996); and the establishment of marine protected areas and networks (Roberts et al. 2001).

Even as conservation biologists honed tools for designing protected-area networks and managing protected areas more effectively, they looked beyond the boundary lines to the "matrix" of surrounding lands (Knight & Landres 1998). Since 1986 conservation biologists have played an important role in defining the biodiversity values of private lands, aquatic ecosystems, and agroecosystems. The result has been greater attention to private land conservation, more research and demonstration at the interface of agriculture and biodiversity conservation, and a growing watershed- and community-based conservation movement. Conservation biologists are now more active across the entire landscape continuum, from wildlands to agricultural lands to suburbs and cities, where conservation planning now meets urban design and green infrastructure mapping (e.g., Wang & Moskovits 2001; Center for Neighborhood Technologies & Openlands Project 2004).

Adoption and Integration

Over the last two decades the conceptual boundary between conservation biology and other fields has become more porous, with increasing movement across that boundary in both directions. Researchers and practitioners from other fields have come into conservation biology's circle, adopting and applying its core concepts and contributing in turn to its further development. Botanists, ecosystem ecologists, marine biologists, and agricultural scientists (among other groups) were underrepresented in the field's early years. More recently the role of the social sciences has expanded within both the field and the SCB (Mascia et al. 2003). The SCB has always had economists, anthropologists, geographers, political scientists, and other social scientists in its ranks; although still a minority contingent, their numbers are increasing. One indicator of this growth was the formation of the SCB Social Sciences Working Group in 2003 to promote the application of the social sciences to conservation.

Meanwhile, conservation biology's concepts, approaches, and findings have filtered outward into other fields. This progressive "permeation" (Noss 1999) is reflected in the number of articles related to biodiversity conservation appearing in general science journals such as *Science* and *Nature*, and in the more specialized ecological and resource management journals. Since 1986 several new journals with related content have appeared, including *Ecological Applications* (1991), the *Journal of Applied Ecology* (1998), the on-line journal *Conservation Ecology* (1997) (now called *Ecology and Society*), and *Frontiers in Ecology and the Environment* (2003).

The influence of conservation biology is evident even more broadly in environmental design, planning, and decision making. Conservation biologists are now routinely involved in land-use and urban planning, ecological design, landscape architecture, and agriculture (e.g., Soulé 1991; Nassauer 1997; Babbitt 1999; Jackson & Jackson 2002; Miller & Hobbs 2002; Imhoff & Carra 2003; Orr 2004). Conservation biology has spurred activity within such emerging areas of interest as conservation psychology (Saunders 2003) and conservation medicine (Grifo & Rosenthal 1997; Pokras et al. 1997; Tabor et al. 2001; Aguirre et al. 2002). Lidicker (1998) noted that "conservation needs conservation biologists for sure, but it also needs conservation sociologists, conservation political scientists, conservation chemists, conservation economists, conservation psychologists, and conservation humanitarians." Over the last 20 years conservation biology has helped meet this need by catalyzing communication and action among colleagues across a wide spectrum of disciplines.

Marine and Freshwater Conservation Biology

Conservation biology's "permeation" has been especially notable with regard to aquatic ecosystems and the marine realm. Long-standing concerns over "maximum sustained yield" fisheries management, protection of marine mammals, depletion of salmon stocks, degradation of coral reef systems, and other issues have intensified over the last 20 years. Marine biologists, fisheries biologists, oceanographers, and limnologists have, like their terrestrial counterparts, recognized the need for more comprehensive, scientifically informed, and better-integrated approaches to conservation. This need was corroborated in the landmark reports of the Pew Oceans Commission (2003) and the U.S. Commission on Ocean Policy (2004).

Marine conservation biology has emerged as a distinct focus area within conservation biology and within the SCB (Norse 1993; Boersma 1996; Bohnsack & Ault 1996; Safina 1998; Thorne-Miller 1998; Norse & Crowder 2005). International symposia on marine conservation biology were held at the SCB annual meetings in 1997 and 2001. In 2001 a separate Marine Section was established as one of the seven new regional SCB sections. Outside the SCB the application of conservation biology in marine environments has been pursued by other nongovernmental organizations, including The Ocean Conservancy, the Marine Conservation Biology Institute, the Center for Marine Biodiversity and Conservation at the Scripps Institution of Oceanography, the Blue Ocean Institute, and the Pew Institute for Ocean Science.

Interest in freshwater conservation biology has also increased over the last two decades as intensified human demand continues to affect water quality, quantity, distribution, and use. Conservationists have come to appreciate even more deeply the essential hydrological connection between groundwater, surface waters, and atmospheric waters, and the impact of human land use on the health and biological diversity of aquatic ecosystems (Leopold 1990; Baron et al. 2002, 2003; Glennon 2002; Hunt & Wilcox 2003; Postel & Richter 2003). Conservation biologists have become vital partners in interdisciplinary efforts, often at the watershed level, to steward freshwater as both an essential ecosystem component and a basic human need. Within the SCB a Freshwater Working Group was formed at the 2003 annual meeting to promote freshwater conservation biology.

Building Capacity

In 1986 conservation biology was a newborn field, little known beyond the core group of scientists and conservationists who had created it. Twenty years later the field is broadly accepted and well represented as a distinct body of interdisciplinary knowledge in the United States and worldwide. New instructional textbooks appeared soon after conservation biology gained its footing (Primack 1993; Meffe & Carroll 1994; Noss & Cooperrider 1994; Hunter 1996). These are now into their second and third editions. Additional textbooks have been published in a variety of more specialized subject areas, including insect conservation biology (Samways 1994), conservation of plant biodiversity (Frankel et al. 1995), forest biodiversity (Hunter & Seymour 1999), conservation genetics (Frankham et al. 2002; Allendorf & Luikart 2006), and marine conservation biology (Norse & Crowder 2005).

As of February 2006 the SCB Web site listed 108 programs and 815 faculty members offering training in conservation biology in 99 colleges and universities. This compares with fifty-one university programs reported in 1995 (Jacobson et al. 1995) and 16 in 1990 (Jacobson 1990). Such programs have expanded in the United States and in countries around the world (Rodríguez et al. 2005). Graduates have found jobs after all, as the interdisciplinary skills of conservation biologists have found acceptance within universities, resource management agencies, nongovernmental organizations, and the private sector. Funders have likewise helped build conservation biology's capacity through support for students, academic programs, and basic research and field projects. Despite such growth, most conservation biologists would most likely agree that our capacity does not nearly meet our need, given the rate of change required to solve urgent problems in biodiversity conservation. Even the existing support is highly vulnerable to budget cutbacks, changing institutional priorities, and political pressures. (This was made apparent when the National Science Foundation's early support for conservation biology research was soon curtailed.)

An Evolving Organization

Since 1986 the SCB has evolved significantly as an organization. More than 100 individuals have served on the SCB Board of Governors. Membership in the SCB has increased steadily and now stands at more than 10,000. The first local SCB chapters formed in 1991, and its seven regional sections were established in 2001–2002. In 2001 the SCB centralized its administrative functions, hired Alan Thornhill as its first executive director, and opened an executive office in Washington, D.C.

The society has held meetings annually since the first gathering in Bozeman, with attendance continuing along an upward curve. The 2005 annual meeting in Brasília, Brazil, attracted more than 1600 attendees, the largest turnout to date. The first independent meeting by an SCB section was held in November 2005 when the Asia Section convened in Kathmandu, Nepal. Over the years, more than 120 of our most deserving colleagues and conservation organizations have been honored through the SCB's annual distinguished service and LaRoe awards.

The society's publications are its most visible assets. The flagship journal *Conservation Biology* appeared four times each year until 1995, when publication increased to six issues per year. The impact factor for the journal has shown a mostly steady increase over time. The *Society for Conservation Biology Newsletter* first appeared in 1994 and has been continuously (and voluntarily) edited by Erica Fleishman. Under the leadership of President Dee Boersma and Editor Kathryn Kohm, and with the support of many partners, the SCB began publishing *Conservation Biology in Practice* (now *Conservation in Practice*) in 2000. Since 2001 the SCB Austral and Neotropical America Section has published electronically the regional bulletin *NeoCons*. In 2004 the SCB Africa Section initiated its newsletter, *African Conservation Telegraph*. The society has also entered into affiliate partnerships with two journals, *Biological Conservation* and *Pacific Conservation Biology*.

Internationalization

Since 1986 conservation biology has greatly expanded its international reach (Meffe 2002, 2003). The scientific roots of biodiversity conservation are obviously not limited to one nation or continent. Despite the fact that formal international conservation measures date back over a century, the history of the science behind these measures has been inadequately studied (Blandin 2004). This has occasionally led to debate over the origins and development of conservation biology. Such debates, however, have not hindered the trend toward greater international collaboration and representation within the field (e.g., Medellín 1998).

Although the institutional and membership base of the SCB has been in the United States since its founding, the need to reach beyond U.S. borders was recognized at the outset. From its initial issue *Conservation Biology* included Spanish translations of article abstracts. Six of the 22 members of the inaugural editorial board of *Conservation Biology* came from outside the United States. Continuing efforts to diversify the editorial board and to encourage submissions from non-U.S. authors have made *Conservation Biology* an increasingly international journal (Meffe 2003; see also Harrison 2006 [this issue]). Especially in recent years, the SCB has sought to recognize conservation leaders from around the world through its distinguished service awards.

In 1989 the structure of the SCB board of governors was changed to ensure that it included at least one representative from outside the United States. That same year the SCB annual meeting was held for the first time outside the United States, at the University of Toronto. Subsequent meetings have been held in Mexico (1994), Canada (1997), Australia (1998), the United Kingdom (2002), and Brazil (2005). (The SCB is now committed to meeting outside North America every other year.) The most significant move toward greater international participation in the SCB came in 2000, when the SCB board voted to create seven regional sections (including the Marine Section) and to include representatives of those sections as voting board members. This process, led by SCB President Mac Hunter, came to full fruition in 2003 when the last of the sections, the Asia Section, was formed. At present, 8 of SCB's 27 board members (30%) reside in countries other than the United States.

Seeking a Policy Voice

Conservation biology has long sought to define an appropriate and effective role for itself in the policy process (Grumbine 1994*a*). Most who call themselves conservation biologists feel, by definition, obligated to be advocates for biodiversity (Odenbaugh 2003). How that obligation should be fulfilled has been a source of continuing debate within the field, within the society, and within the society's publications. For several years in the 1990s it was cause for heated roundtable discussions and symposia at the SCB annual meeting. Some scientists were wary of playing an active advocacy or policy role, lest their objectivity be called into question. Some advocates responded to the effect that if we didn't use our science to shape policy, they would.

Conservation biology's inherent mix of science and ethics all but invited such debate. Far from avoiding controversy, Editor David Ehrenfeld built dialog on conservation issues and policy into *Conservation Biology* at the outset by instituting the "Comment" and "Diversity" features. The journal has regularly published letters and editorials on the question of values, policy, advocacy, and the role of SCB. Conservation biologists have not achieved final resolution on the matter; perhaps in the end it is irresolvable, a matter of personal judgment involving a mixture of scientific confidence levels, uncertainty, and individual conscience and responsibility. ***Responsibility*** is perhaps the key word because all parties to the debate seem to agree that advocacy, to be responsible, must rest on a foundation of solid science and must be undertaken with honesty and integrity (Noss 1999).

Still, the question remains whether and how the SCB as an organization ought to be involved in conservation policy. In its early years the SCB adopted occasional resolutions on specific conservation issues. From 1995 to 2004 a standing policy committee commissioned policy white papers and framed resolutions for consideration at the annual SCB business meeting. As the SCB's membership became larger and more diversified, the resolutions proved difficult to manage. (Members from Australia, for example, might be asked to weigh in on propositions regarding the future of the U.S. National Biological Survey or the conservation of biodiversity in Cuba.) More productively, several SCB initiatives aimed to provide stronger scientific input into policy formation, implementation, and review. A particularly successful example was the SCB-organized review in 1997–1998 of endangered species recovery plans in the United States. The project involved 19 universities and more than 360 students and produced multiple publications and substantive changes in guidelines for recovery plans (Boersma et al. 2001; see http://www.nceas.ucsb.edu/recovery).

A 2000 poll of SCB members indicated overwhelming support for the society playing a more assertive advocacy role. The SCB board directed its policy committee to develop guidelines and direction for the society's policy activities. The committee observed that the SCB was "limited in its ability to engage in policy by its structure as a volunteer-based association of professionals" but expressed hope that "the ongoing change to an organization-based model will improve this situation" (Society for Conservation Biology Policy Committee 2001). The decision to locate the SCB's administrative office in Arlington, Virginia (near Washington, D.C.) was based in part on the rationale that this would provide a platform for the SCB to engage more actively with policy makers on its own and in partnership with other scientific and conservation organizations. That role, however, remains limited; even as the crises of extinction and environmental degradation have continued to gain momentum, the policy environment has grown increasingly politicized and polarized, and official hostility toward science and conservation has intensified (Baltimore 2004; National Research Council 2004; Union of Concerned Scientists 2004).

These trends (and no doubt others) raise important questions for the future. Most conservation biologists would assert that growth for growth's sake is hardly justified. The same holds for our own field. As disciplines and organizations become more structured, they are prone to become more cautious and hidebound. They are liable to equate mere expansion with success in meeting their missions (Ehrenfeld 2000). Can conservation biology sustain its own creativity, freshness, and vision? Through its collective research agenda, is the field asking, and answering, the appropriate questions? Is it performing its core function—providing reliable and useful scientific information on biological diversity and its conservation—in the most effective manner possible? Is that information making a difference on the ground? What "constituencies" need to be involved and engaged more fully? At a time in U.S. history when science in the public interest and conservation as a shared national and global goal are under assault, can the SCB step into a more meaningful policy role?

While pondering these questions, conservation biologists cannot claim to have reversed the forces that threaten the diversity of life. Yet the field has contributed essential knowledge at a time when those threats have continued to mount. Over the last two decades conservation biology has focused attention on the full spectrum of biological diversity, on the ecological processes that maintain it, on our capacity to value it, and on steps that can be taken to conserve it. It has brought scientific information, long-range perspectives, and a conservation ethic into the public arena in new ways. It has organized scientific information to inform decisions affecting biodiversity at all levels and scales. In so doing, it has helped to reframe the relationship between conservation science and conservation practice.

Conservation Biology in a Changing World

As conservation biology has secured its place at the academic and professional table, and on the land and in the water, the world in which our field exists has continued to change. Since 1986, the U.S. population has grown from 240 million to 298 million, and the world population from 5 billion to 6.5 billion (U.S. Census Bureau 2006). The world's mean annual atmospheric CO_2 concentration rose from 347.15 ppm in 1986 to 377.38 ppm in 2004 (Keeling & Whorf 2005). Over the last century the years with the highest global annual average surface temperatures were (in order) 2005, 1998, 2002, 2003, and 2004 (National Aeronautics and Space Administration 2006). Between 1988 and 2005, a total of 296,000 km^2 of forests was cleared in the Brazilian Amazon (Fearnside 2005; Instituto Nacional de Pesquisas Espaciais 2006). In the late 1980s global marine fisheries landings peaked at 80–85 million metric tons annually; since then the total catch has declined by about 500,000 tons per year, with the catch coming from progressively lower levels of the marine food web (Pauly et al. 2002, 2003). The rate at which forest, cropland, and rangeland were developed in the United States increased from more than 0.5 million ha/year in the 1980s to almost 1 million ha/year through the 1990s; a total of approximately 13 million ha (roughly one Illinois) was developed between 1982 and 2001 (U.S. Department of Agriculture Natural Resources Conservation Service 2001). Conservation biology exists in a world that is experiencing unprecedented environmental pressures, and one that overlooks and undervalues biological diversity.

But, in 1987, 3 months after the first annual meeting of the SCB, 24 nations signed the Montreal Protocol on Substances that Deplete the Ozone Layer. Since 1992, 188 nations have become parties to the Convention on Biological Diversity (although the United States is not among them). In February 2006 the Brazilian government designated two reserves and two national parks, encompassing 16 million acres, in the Amazon. A total of 6.4 million ha in the Brazilian Amazon is now under some form of protection (Associated Press 2006). In 2003 there were 1537 land trusts active in the United States, more than three times as many as in 1985 (Land Trust Alliance 2005*a*). In November 2005 citizens across the United States continued to support land protection, voting overwhelmingly in favor of initiatives that raised $1.7 billion in revenues for conservation (Land Trust Alliance 2005*b*). The number of local farmers' markets in the United States has grown from 1755 in 1994 (when statistics were first gathered) to 3706 in 2004 (U.S. Department of Agriculture Agricultural Marketing Service 2006). Conservation biology also exists in a world where positive change is possible, from the local to the international level, when leadership asserts itself.

Over these 20 years the relationship between people and the larger community of life has been altered by breakneck technological change, economic globalization, and political upheaval (Lubchenco 1998). Conservation biologists have witnessed the impacts: loss of wild species, diminishing agricultural genetic diversity, spread of exotic species, degradation of landscapes and ecosystems and communities, erosion of the bonds between people and place, and the "extinction of experience" (Pyle 1993). As Ehrenfeld (2003) notes, the architects of globalization have paid little attention to these dangerous side effects and have ignored the social, biological, and physical constraints on the system they are creating (especially the diminishing supply of cheap energy). If we are witnesses to loss, we are also sentinels of change. Working with allies in related fields, conservation biologists are in the business of generating alternative pathways to the future. "We must do this," Ehrenfeld (2003:109) concludes, "before the chaos of resource exhaustion, ecosystem collapse, and global climate change makes the job even more difficult—or impossible. . . . The only form of globalization that is acceptable is one that unites nations in meeting global threats and in preserving the environments, life forms, and civilizations of this planet."

When we do our work well, we are also healers of broken places, stressed ecological relationships, and unsustainable economies. The analogy between conservation biology and medical science has a venerable history. Sixty years ago Aldo Leopold observed that to have an ecological education is to find oneself living "in a world of wounds. . . . An ecologist must either harden his shell and make believe that the consequences of science are none of his business, or he must be the doctor who sees the marks of death in a community that believes itself well and does not want to be told otherwise" (Leopold 1953:165). Twenty years ago conservation biologists came together to voice a conviction that all was not well within the community of life on Earth. The founders of the field saw the impoverishment of our ecological inheritance and the constriction of life's evolutionary potential as marks of social and spiritual disarray within our own human community. To provide a positive counterforce they established a new organization and created new avenues to share information. Conservation biologists can claim some successes over the last two decades. But the final measure of success is not whether the field or the SCB will be around for another 20—or 200—years. Success will be measured by the degree to which we can integrate scientific understanding into our community life, by the effectiveness of our approaches to sustaining the diversity of life and the health of ecosystems, and by the respect for the living world we are able to foster within our varied cultures and within the human heart.

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