The following notes constitute a special section of this issue of Conservation Biology on the role of advocacy in the science of conservation biology.

Conservation Biology, Values, and Advocacy

The tension between scientific objectivity and public responsibility (expressed as advocacy) as cornerstones of conservation biology has stirred endless debate among practitioners and observers of our discipline. Emotions run high on this issue, and a wide range of opinions has been expressed in this journal; at the annual meetings of the Society for Conservation Biology (SCB); and in countless seminars, chats around the coffee machine, and heated discussions over beer. Few conservation biologists today claim that science in general or our science in particular is value-free, but that is about where the common ground ends. Or so it would appear. Perhaps as this healthy discussion continues to develop in open forums, we will find that we agree on more than we thought—or at least that the values underlying our disparate points of view can be exposed and clarified.

Although some SCB members have told me that they do not think discussions on "nonscientific" topics belong in the journal, this seems to be a minority opinion. Both David Ehrenfeld and I, as successive editors, have sought to encourage dialogue on philosophical, social, and practical issues that affect how our science operates and how it is perceived among professionals and the general public. Readers frequently tell me that the opinion pieces on these topics are among the most interesting items in the journal. Discussion of the proper behavior of conservation biologists in the arena of public policy intensified recently after our publication in the September 1994 issue of a review article, opinion piece (*Diversity* column), and editorial about livestock grazing on public lands. At last summer's meeting of the SCB in Fort Collins, a roundtable discussion on advocacy—the third on this topic held at our annual meetings over the years—attracted a large and lively group of participants. During the Board of Governors' meeting it was suggested that the journal publish a forum on science and advocacy consisting of a core article and several responses representing a range of viewpoints. By chance, a potentially suitable article arrived unsolicited a couple months later, was handled by our assigning editor for philosophy, Holmes Rolston, and ultimately was accepted after revision. Responses to the article by Barry and Oelschlaeger were solicited from a diverse set of scientists and philosophers who, in these pages or elsewhere, have expressed interest or expertise in this issue. Several responses arrived, and we are pleased to publish them in this special section. You will see that, although viewpoints differ, most contributors believe that the role of values and advocacy in conservation biology is central to our field and deserves continued, serious discussion. May the debate rage on!

Reed F. Noss

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A Science for Survival: Values and Conservation Biology

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Abstract: *Practice of conservation biology that does not actively and continuously question the values that shape it is self-defeating: Conservation biology is inescapably normative. Advocacy for the preservation of biodiversity is part of the scientific practice of conservation biology. If the editorial policy of or the publications in* Conservation Biology *direct the discipline toward an "objective, value-free" approach, then they do not educate and transform society but rather narrow the focus to the "object of knowledge" (be this species, gene pools, landscapes, or ecosystems). To pretend that the acquisition of "positive knowledge" alone will avert mass extinctions is misguided. Conservation biologists should reflect on the constitutive values (especially contextual, but also methodological and bias) underlying their research programs and policy recommendations. Such reflection is itself an inherent element of scientific objectivity and takes into account the social nature of scientific knowledge. Without openly acknowledging such a perspective, conservation biology could become merely a subdiscipline of biology, intellectually and functionally sterile and incapable of averting an anthropogenic mass extinction.*

Una Ciencia para la Supervivencia: Valores y Biologia de la Conservacion

Resumen: *La practica de la biologia de la conservacion se autoderrota si no considera activa y continuamente las questiones de valores que la moldean. La biologia de la conservacion es inevitablemente normativa. Si la politica editorial de o las publicaciones en Conservation Biology conducen a la disciplina hacia una aproximacion "objetiva y libre de valores", entonces no educa ni transforma a la sociedad y reduce el enfoque sobre el "objeto de estudio" (ya sea especies, pozas genicas, paisajes o ecosistemas). Es equivocado pretender que extinciones masivas se evitaran con la adquisicion del "conocimiento positivo" por si solo. Los biologos de la conservacion deben reflexionar acerca de los valores constitutivos (especialmente los contextuales, asi como los metodologicos o sesgos) que subyacen en sus programas de investigacion y recomendaciones. Tal reflexion es por si sola un elemento inherente a la objetividad cientifica que considera la naturaleza social del conocimiento cientifico. Al no reconocer tal perspectiva abiertamente, la biologia de la conservacion se volveria una mera subdisciplina de la biologia, intelectual y funcionalmente esteril e incapaz de evitar una extincion antropogenica masiva.*

Introduction

If the state of conservation biology can be judged by the pages of this journal, our science is becoming an exercise in applied ecology or biology. In contrast to the often overtly normative papers (e.g., Naess & Mysterud 1987) that appeared in the early volumes, the research presented in the contributed papers of *Conservation Biology* (arguably the pulse of the day-to-day practice of the science) increasingly lacks evaluative judgment—even implicitly. This lack of appreciation for the importance of values has carried over into other sections of the journal; some writers are overtly hostile to advocacy as a necessary part of conservation biology. Although normative statements and commentaries about the role of value judgments and advocacy in the practice of conservation biology appear in the journal, these are almost exclusively confined to letters, essays, and editorials. We believe that normative judgment and advocacy are "en-

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dangered species," increasingly pushed to the edges of the *Conservation Biology* habitat. Their extinction will be harmful to the preservation of biodiversity: conservation biology is inescapably normative.

Positivism, the belief that genuinely scientific discourse is value-free, appears to have gained the upper hand. If positivism undergirds conservation biology, prescriptive statements and moral arguments are nonscientific and irrelevant to conservation-oriented study (Walker 1992). Further, a "measurable distance" should be maintained between the scientific investigation of biodiversity and activism on its behalf (Brussard et al. 1994). Thus, conservation biology provides scientific knowledge to resolve the technical questions of policy formulation, and nothing more (Murphy 1990). Advocacy for the preservation of life is "outside of our professional society" (Brussard et al. 1994:921). This trend moves the practice of conservation biology in the wrong direction. Conservation biology may succumb to the positivistic tendencies that dominate ecology and molecular biology (Worster 1977; Mayr 1982). The normative beliefs that set conservation biology apart as a new approach to conservation are in danger of being forgotten.

What is New about Conservation Biology?

To some, conservation biology is a crisis discipline grounded in the recognition that humans are causing the death of life—the extinction of species and the disruption of evolution. Soulé (1986:11, our emphasis) suggests that this "planetary tragedy is also a personal tragedy to those scientists who *feel compelled* to devote themselves to the rescue effort." Being a conservation biologist is "a way of pledging our support for life" (Soulé 1991:255). Wilson (1984, 1992, 1994) asserts that conservation biology is rooted in a loving concern for life (biophilia), an explicit ethical (evaluative) orientation. Soulé concurs (1986:8): "No one has more expertise on loving nature than the professional naturalist or manager who has spent his or her career (or lifetime) studying and admiring plants and animals." Masi (1994: 21) avows that our "science is not neutral, because we care about the outcome." Further, Wilson (1992) argues that insofar as there is hope of averting an anthropogenically caused mass extinction, clarifying the ethical grounds underlying conservation biology is essential. "The future of the conservation movement depends on such an advance in moral reasoning" (Wilson 1984:119).

Ehrenfeld (1995:148) argues that conservation biology "does not claim to be value-free" and is on that basis different from other conservation sciences. Conservation biology is in part distinguished from other conservation sciences by its character as a mission-oriented, crisis discipline. What is its mission? According to Ehrenfeld (1995:148) (and others, such as Wilson and Soulé), "conservation biology has the goal of preserving the health of the biosphere and is empowered by the looming crises of global habitat alteration and mass extinction." In this context the term "conservation" is normative, connoting a commitment by humanity to the goal of protecting habitat and preserving biodiversity. Rolston (1989:240) clarifies this point by distinguishing between various connotations of "conservation." In physics, the term is not normative, but in conservation biology humans affirm "a more comprehensive, moral role in their conservation of biological values."

In an oft-cited paper, Soulé (1985) lays out the evaluative basis of conservation biology, pointing to ethical norms he believes most conservationists share. Naess (1986) contends that those who share such beliefs are obligated to affirm them publicly. Norton (1988:238) argues that a conservation biologist is necessarily an advocate, and that conservation biology as a discipline "must not hide behind a false facade of value-free science." (Consensus on the goal of preserving life can be achieved without either assuming a single, underlying belief system or making a commitment to moral monism. Oelschlaeger [1994] illustrates this point by comparing the shared commitment of Wilson, a scientific materialist, and Prance, a theist, to the protection of biodiversity.)

Lovejoy (1989) and Noss (1993) affirm the importance of scientists taking an advocacy role, arguing that they have the responsibility to explain what they are learning to the general public (Wilson 1992) and to articulate a program that uses knowledge for the protection of biodiversity (Noss 1992). More directly, Willers (1992: 605, 607) claims that conservation biologists—if they are "truly interested in preserving diversity"—must "learn to play hardball" and stand by their ethical principles. If we do not provide such leadership, he claims, no one will: Our efforts today will be for naught, and the world will become biologically impoverished. Two new textbooks (Primack 1993; Meffe & Carroll 1994) affirm the integral role of values in conservation biology. Primack (1993:507) identifies conservation biology's "active role in the preservation of biological diversity" as a criterion that distinguishes it from other bodies of knowledge.

The point is that to deserve its title conservation biology must be ethically overt—that is, it must affirm its mission to be the protection of habitat and the preservation of biodiversity. Otherwise its name is as linguistically dishonest as the claim that "war is peace" (Orwell 1949). Without an evaluative component conservation biology is merely science applied in conservation efforts—a subdiscipline of biology, as Drew (1994) has it. To those who think that science is value-free, conservation biology should be considered a subdiscipline of, for example, molecular biology or restoration ecology. As such, conservation biology could fulfill its role simply by providing the knowledge necessary to build habitat into which genetically engineered "replacement species" could be introduced. The notions that habitat should have been protected from degradation and that species should have been protected from extinction simply do not figure into this idea of conservation biology as applied biology.

Evernden (1992*a*) helps clarify the notion that conservation biology is not value-free by examining the differences between ecology in *conservation* and ecology in *conversation*. In the former, society's prevailing, anthropocentric value scheme, which reduces nature to a standing reserve for human appropriation, prevails. So framed, conservation biology is simply an instrument for the intelligent exploitation of the earth, rooted in "techno-arrogance" and a "self-defeating" managerial philosophy (Meffe 1992). With ecology as conversation, conservation biology challenges the prevailing world view by affirming that nature is more than a resource, that it has inherent worth beyond exclusively human, instrumental values.

A conservation biologist who says "I want to conserve *x* as a narrowly human resource" is outside the consensus of the epistemic community constituted by Ehrenfeld, Wilson, Soulé, Noss, and others. There is nothing in conservation biology per se that militates against the economic utilization of the earth by humankind. For example, Wilson (1992) uses conservation biology to guide the economic utilization of habitat consistently with the preservation of biodiversity. Similarly, but more generally, Leopold's land ethic points toward a major theoretical task for conservation biology: discovering how it is that humans might derive their livelihood from the land without spoiling it for other creatures (Meine 1992). But an anthropocentric conservation biology would be dedicated largely to the task of gaining knowledge and formulating policies that would save either economically useful (including agricultural and pharmacological uses) or aesthetically pleasing species. In short, it would be a conservation biology governed by the philosophy formulated as the turn of the century by Gifford Pinchot and others: progressive resource conservation, otherwise known as resourcism.

Values in Conservation Biology

Every science is driven by value assumptions (Putnam 1981, 1987, 1995; Longino 1990; Shrader-Frechette & McCoy 1993). Kuhn (1970) argues that science requires values for its very structure, procedures, and products. The function of values has not been widely acknowledged within the conservation biology community, however, perhaps partly because of the belief that the lay public and politicians either distrust or ignore information that appears tainted by values. (As numerous studies show, environmental policy issues fundamentally turn on value questions [McCann 1986; Paehlke 1988; Clark et al. 1994].) Conservation biologists, such as Soulé and Wilson, who publicly affirm the role of values in their work are more the exception than the rule. At best, the role of values has been understated; because of this, many conservation biologists are held in the thrall of positivism.

The view of conservation biology as value-driven does not discredit its scientific legitimacy. Investigators argue that there cannot be an intelligent practice of science apart from a self-reflective awareness of the evaluative judgments upon which it rests. Shrader-Frechette and McCoy (1993:82, 83, 86) argue that "no science can avoid completely the difficulty of methodological value judgements associated with interpretations of confirmation"; that although "in principle it might be possible to avoid contextual values, in practice it would be almost impossible to do so . . . because science is [always] done in some context"; and that positive science alone "is not sufficient to ground environmental policy." Longino (1990:81) argues that values enter into science either through "an individual's values or through community values." Allen and Hoekstra (1992) argue that scientific accounts of biogeophysical process are a function of subjective decisions (observer choice), whether these are consciously articulated or not.

Arguments that emphasize the importance of values in science do not contravene criteria such as peer review and replicability that provide objective standards and control individual bias. Such criteria are themselves methodological values, thus underscoring the idea that objectivity is not constrained by positivism. Positivism itself, we emphasize, is a point of view: Any science that hitches its wagon to positivism rests on the claim that scientific knowledge is value-free and thus disguises (at the risk of forgetting) its normative commitments. To a positivist, science provides the observer an objective account of the world as an object, one that stands apart from human intention and purpose. Thus, scientific knowledge is representational, a picture of the way things actually are, good for all people in all places at all times. One problem with positivism, Longino argues (1990:81), is that "it is hard to understand how theories purporting to describe a nonobservable underlying reality, or containing descriptive terms whose meaning is independent of so-called observational terms, can be supported." For this reason and others, the positivistic view of science has been laid to rest by many critics, such as Prigogine and Stengers (1984), Golley (1993), and Shrader-Frechette and McCoy (1993).

A clear account of the centrality of values and observer choice in scientific inquiry, one that acknowledges the value-laden nature of science without falling into relativism, has been offered by Putnam (1981, 1987, 1995). Putnam's theory of pragmatic realism rests on an evolutionary epistemology that rejects the notion of a "brain in a vat," an intelligence that is sensorially disconnected from the blooming, buzzing confusion of experience and contemplates reality as a purely theoretical object. Rather, human intelligence is engaged with the world, the things in the world, and the relations among the things in the world, including the relations between culture and nature. The human endeavor to know the world is guided by our needs and interests; there is no other comprehensible account of either science or common sense. With pragmatic realism there is no longer any need to keep what Putnam calls "double books," that is, one set of first-class epistemic accounts consisting of scientific knowledge grounded in objective reality (hard science) and another set of epistemic accounts grounded only in human subjectivity (soft science). All knowledge claims reflect human interests and choices; there is no comprehensible argument that scientists know what is out there independent of human agency and intentions. To paraphrase Putnam, every fact loads some values, and every value loads some facts.

Acknowledging the subjectivity of scientific judgment and the reality of interpretation does not equate with vicious relativism—the belief that truth is a figment of the imagination and scientific knowledge is only the discourse of power. To the positivist if truth is not ultimately grounded "out there" beyond human choice, then the truth is whatever any interest group with enough power (political, economic, or military) to enforce its view claims. Acknowledging that values meaningfully figure into science, however, does not entail vicious relativism. Rather, a self-reflective account of the human factors and cultural circumstances that frame science place it on a realistic footing. So framed, we can acknowledge conservation biology as a social enterprise to conserve life on Earth. Soulé (1986:3) underscores the point: "Conservation biology began when a critical mass of people agreed that they were conservation biologists. There is something very social and very human about this realization."

An explicit value commitment to the preservation of biodiversity—"love the organisms for themselves, first..." (Wilson 1994:191)—precedes theoretical inquiry and practical application. Today the arguments that once supported positivism are unworkable: The pursuit of knowledge and the values held by a particular epistemic community go hand in hand. Thus, a self-reflective grasp of the values (especially the contextual, but also the methodological values) inherent in conservation biology are necessarily a part of our practice. Positivism has been displaced by an account of science as social knowledge (Longino 1990).

Science as Social Knowledge

The Structure of Scientific Revolutions (Kuhn 1970) offers a useful point of departure. Individuals choose a particular field of scientific study for many reasons, some of them value-driven. Few scientists, however, openly acknowledge subjective factors; Noss (1994) in his account of his motivations for becoming a conservation biologist and Wilson (1994) in his autobiography, *Naturalist*, are notable and important exceptions. Says Kuhn (1970:37), "these motives and others besides also help determine the particular problems that will later engage [a scientist]." In a similar vein, Engel (1990:7) states that there is an "increasing self-awareness of many scientists, resource managers, and development experts regarding their personal moral motivations for professional and public service." Sterling (1990:80) argues that "the classical disjunction between subject and object, fact and value, is invalid; the knower is implicated in the known and there can only be 'relative objectivity.' How facts are investigated, selected, and interpreted depends upon one's values, which are colored by how one sees the world." Clearly, values are implicit within science from the very beginning: Apart from individuals and their projects, there is no science.

Neither does science, as a social practice, occur within a valuational vacuum. Just as the individual's choice of career is driven by values, so too is the paradigm that directs research. Einstein (1954) argued that science presupposes the evaluative judgment that knowledge is good, a claim lying outside the process of scientific observation itself. Even so, in Einstein's account scientific judgment and evaluative judgment remain distinct. Kuhn's claim (1970:171) goes further. He contends that judgment of fact and judgment of value are intrinsically related. "Does it really help," he asks, "to imagine that there is some one full, objective, true account of nature and that the proper measure of scientific achievement is the extent to which it brings us closer to that ultimate goal?" Instead, Kuhn, and others such as Putnam, Longino, and Shrader-Frechette and McCoy, argue that knowledge should be conceptualized as embedded in the ongoing course of epistemic evolution (that is, evolution in the communal efforts to gain scientific understanding) rather than as correspondence to some metaphysical reality "out there," independent and separate from a scientific community of inquirers. Such a position does not constrain evaluative judgments that there are superior and inferior knowledge claims.

Paradigms have an explicitly normative component. In the case of conservation biology, the bedrock is to preserve biodiversity. The role of paradigms in shaping science is therefore one of direction—that is, to provide a specific agenda that research should follow. So conceived, "the perennial reluctance of scientists to discuss matters of ethics may imperil the very organisms and processes they hold most dear" (Soulé 1986:2). From an ethical standpoint one that acknowledges the human side of science, conservation biology cannot be a success apart from attempting to preserve or actually preserving the diversity of life (Norton 1988; Wilson 1992). Allen and Hoekstra (1992:281) suggest that a positivistic ecology (or conservation biology) "would not only be impotent when it comes to management, it would also be intellectually sterile."

Society itself influences the values that ground scientific paradigms. Kuhn gives several examples, such as Copernicus's heliocentric assumptions, which challenged the Christian belief that the earth was the center of the universe. Religious authorities viewed heliocentrism as blasphemy and forced astronomers to renounce their work or face the consequences. More directly, Leopold (1949), Botkin (1990), and Meffe (1992) offer examples of how societal perceptions of nature profoundly and detrimentally affect ecological science and therefore conservation-oriented management activities.

Clearly, societal (contextual) values can have blatantly negative effects on the practice of science. Yet no science stands outside society. Schrödinger (1952) argues that cultivating the relation between science and society is a requirement of its healthful practice. Ignoring the connectedness of science and society is akin to the ostrich burying its head in the sand. For good or ill, contextual values have an effect on the practice of conservation biology. If society does not value the preservation of life, conservation biology cannot prevent mass extinction. It will be little more than a rearguard action before a last surge of industrialism and a tidal wave of human beings swamp biodiversity. Alternatively, as Bowler (1993:553) suggests, "Science's [and thus conservation biology's] very adaptability to social influence, rather than its imagined [positivistic] objectivity, will allow it to be used constructively in a world that has..." affirmed the inherent goodness of the diversity of life. Such openness to societal influence may disturb some scientists; we believe, however, that a post-positivistic, self-reflective awareness of societal influence on science is a step forward.

Conservation Biology after Positivism

Conservation biologists readily understand that different communities hold different values. Thus, neoclassical economists and conservationists will inevitably talk beyond each other because their paradigms offer fundamentally different ways of seeing the world. To one, old-growth forest is a wasted asset. To the other, old growth is habitat for creatures and plants. Neither can accept the other's viewpoint, so both remain stuck in their own paradigms. This explains why some thoughtful conservation biologists are beginning to explore the importance of cross-disciplinary paradigms that transcend the inherent limitations of disciplinary thinking.

Bormann and Kellert (1991) argue that opposition among economists, ecologists, and ethicists creates false dichotomies, such as those between jobs and environmental preservation, population policies and the right to life, or the economic riches of capitalism and the ecological integrity of environmentalism. They believe that there can be no distinction between the scientific understanding of nature and the values of society (e.g., economic sufficiency, ecological integrity, and human dignity), as if culture and nature were separate entities. "For society to learn to act effectively, it must perceive the link between ecosystem function and human welfare. . . . Until we mend the cleavage in our understanding of the relationships among ecology, economics, and ethics, our willingness to make changes to maintain the long-term integrity and quality of the biosphere will not develop" (Bormann & Kellert 1991:xiv).

Such a paradigm shift, as envisioned by Bormann and Kellert as well as Ehrenfeld (1995), exemplifies the role of values in science. Narrowly construed, paradigm shifts occur only when scientific anomalies overwhelm normal science and usher in a period of revolutionary change. But many considerations influence paradigm change beyond the comparative judgment of the ability of competing paradigms to resolve anomalies. Although overcoming anomalies is the most effective and convincing type of argument within paradigm debates, it is not the only factor involved. Kuhn (1970:110) contends that "since no paradigm ever solves all the problems it defines and since no two paradigms leave all the same problems unsolved, paradigm debates always involve the question: Which problems is it more significant to have solved? . . . [T]hat question of values can be answered only in terms of criteria that lie outside of normal science altogether."

This point is crucial because it bears directly on conservation biology and its future. Is conservation biology merely applied biology? If so, then it does not represent a paradigm shift. Or is conservation biology something else? Toulmin (1958:256) argues that any credible account of scientific argument, such as those some conservation biologists make about the urgency of the biodiversity crisis, is necessarily historical. "To think up new and better methods of arguing [and thus for inquiry and analysis] in any field is to make a major advance, not just in logic, but in the substantive field itself: great logical innovations are part and parcel of great scientific, moral, political, or legal innovations."

By this account conservation biology is not just applied biology but rather hinges on an explicit evaluative judgment: Biodiversity is good and should be preserved. Apart from such a value judgment, one must wonder why there would be any reason to invest effort in conservation biology. If biological research was judged only through the lens of positivism, molecular biology and its derivative, biotechnology, would be the cutting edge of research. Ecosystems and species would be of no consequence. Wilson (1994) observes in his autobiography, in a remarkably candid chapter entitled "The Molecular Wars," that ecology quickly became a dirty word around Harvard on the ascendancy of James Watson. "He arrived with a conviction that biology must be transformed into a science directed at molecules and cells and rewritten in the language of physics and chemistry" (Wilson 1994:219). The consequence is that systematists have "been largely eliminated from academic departments" (Wilson 1994:230).

Ecology (and conservation biology), although "pushed to the margin for years," has recently started to recover, largely "through the widespread recognition of the global environmental crisis" (Wilson 1994:231). Crucially, as Evernden (1992*b*) and others contend, the recognition of environmental crisis itself represents a point of view. The extinction of species, for example, can be construed as a byproduct of progress, as human beings develop formerly underutilized natural resources to sustain the economic development of a constantly growing population. On the other hand, for those who value biodiversity, such progress is an abomination. In the former view, the role of conservation biology is to facilitate the humanization of nature, ensuring that no economically valuable species are lost and that ecosystems are exploited in the most efficient manner—effectively, the Brundtland Commission philosophy (World Commission on Environment and Development 1987). In this role conservation biologists could define success in terms of grants received, awards won, dissertations completed, and papers published. In the latter view conservation biology has an entirely different function: to integrate the human species into an ongoing evolutionary process in ways that not only do not diminish biodiversity but allow for the possibility of its increase.

Kuhn (1970:156–157) argues that without the subjective factor, paradigm shifts would be few and far between. The perception of environmental crisis and the all too real possibility of an anthropogenic mass extinction of life are cases in point. Like Dutch children with their fingers plugging holes in the dike, conservation biologists have attempted to forestall what may be an inevitable outcome. Typically, new paradigms, such as conservation biology, present so many problems that they have little chance of success solely on their scientific merits. Uncertainty pervades our discourse. But "the risks of non-action may be greater than the risks of inappropriate action" (Soulé 1986:6). There is a greater chance for accomplishing an impossible mission if the value commitments upon which conservation biology rests are made explicit in all regards.

The policy implications are enormous. Scientific objectivity is enhanced rather than diminished by bringing values to the level of self-reflective awareness. There are two reasons that this is the case. First, hanging scientific practice on "the myth of scientific value neutrality" is irrational—that is, it substitutes a now-failed positivism for descriptions of the social determinants of scientific behavior. Second, the examination of the contextual values that drive conservation biology are crucial if we are to make any sense of the notion that conservation biology is normative and at the same time to defend the cardinal principle of scientific objectivity. Thus, the practice of conservation biology is strengthened rather than weakened by examination of the underlying values upon which a consensus has been reached within the scientific community. The alternative, endemic in all science that is tied to positivism, is that evaluative judgments remain hidden, outside the context of open discussion.

Conclusion

The trend towards positivism in conservation biology is self-defeating and should be reversed immediately: conservation is a normative term. Conservation biology, post-positivism, might be reconceptualized as an explicitly value-driven scientific enterprise whose aim is not causal control of nature to the end of dominating the planet but a Thoreauvian sympathy with biogeophysical process to the end of preserving biodiversity and ongoing evolution. The term conservation biology implies that we have an ethical obligation to provide decision makers with explanatory knowledge and prescriptive recommendations. The aim of conservation biology (post-positivism) in environmental policy making "is not prediction with precision, scope, and accuracy, a purpose which presumes a deterministic world with little or no latitude for choice" (Brunner & Ascher 1992:311). Its agenda is much larger and more complex, going to the core of the meaning of life. The purpose of conservation biology "is freedom through insight. Insight brings unconscious and unperceived factors in the self and the environment into the focus of conscious awareness, so that people are free to take them into account in making choices" (Brunner & Ascher 1992:311). The notion of conservation biology as merely applied biology actually circumscribes human freedom to envision and act on the possibility that an anthropogenic mass extinction of life can be forestalled consistent with the need to achieve economic sufficiency and social justice.

Conservation biologists should become more self-reflective in their day-to-day research. An exploration and understanding of the social values inherent to any field of study is essential for providing a picture of the full context in which this knowledge will be used. This will require extensive cross-disciplinary work—in essence, practical work toward a truly holistic paradigm—in order to fully realize the goals our science is attempting to attain. Failure to do so will render conservation biology intellectually and functionally sterile.

Without providing prescription along with the knowledge gained by our studies, we will have no basis for complaints that our knowledge is ignored in the policy arena. If we truly are concerned with the preservation of biodiversity, we should remember that "the best conservationist [can be] a biologist" (Hales 1987:80). As long as we explain the reasoning behind our prescriptions, we do not compromise our scientific credibility (Lovejoy 1989).

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Throwing out the Bathwater of Positivism, Keeping the Baby of Objectivity: Relativism and Advocacy in Conservation Biology

Barry and Oelschlaeger do an excellent job of explaining why conservation biology cannot be positivistic—devoid of value judgments—and free from social influences. Because all scientists work in a theoretical context and use particular methods and techniques, it is impossible for science to avoid contextual and methodological value judgments (Shrader-Frechette & McCoy 1993). But not all value judgments and social influences are good ones. And just because we cannot avoid methodological value judgments in science does not mean that all ethical judgments in science are acceptable. Although scientists are well aware of the empirical grounds, such as predictive power or heuristic fertility, for accepting one scientific hypothesis over another, they tend to be less clear about the rational reasons, such as consistency or coherence, for accepting one value over another. Without methods for assessing alternative value judgments, science runs the risk of throwing out the baby of objectivity with the bathwater of positivism.

Public Assessment of Ethical Value Judgments

When are ethical value judgments acceptable in science? As the National Academy of Sciences (National Research Council 1994: 34) recognizes, making science relevant to policy requires that it follow ethical and policy goals, such as preserving biodiversity or protecting public safety. To the degree that science is not relevant to policy, there is no justification for introducing avoidable ethical judgments into science, because only policy-related sciences have consequences that affect the common welfare and thus require ethical judgments.

Some physicists claim that because they are experts about nuclear fission and because the public is often scientifically ignorant, they alone have the right to make ethical judgments on the acceptability of nuclear reactors. On the contrary, in matters of the common good, if the public ox is getting gored, then the public has a right to decide how safe is safe enough, how safe is fair enough, how safe is voluntary enough, and how safe is equitable enough. The same is true in conservation biology.

The remedy for faulty public judgments is not expert control—which often includes "hired guns" hiding prejudiced value judgments behind the cloak of expertise—but better conservation education. The rationale for better conservation education is ultimately Jeffersonian: "I know of no safe depositor of the ultimate powers of the society but the people themselves; and if we think them not enlightened enough to exercise their control with a wholesome discretion, the remedy is not to take it from them, but to inform their discretion."

Democratic Debate over Default Options

Even when value judgments in conservation biology are methodological and not ethical, the public may have the right to control whatever affects its welfare. Democratic debate over methodological value judgments is especially important in choosing default options, "which are essentially policy judgments of how to accommodate [scientific and mathematical] uncertainties" (National Research Council 1994:5). Default options are among the most important methodological value judgments in science because scientific conclusions are so sensitive to them. Whoever determines the default options determines the scope of the debate. Whoever frames the questions controls the answers. The U.S. court system provides a classic example of a default option: When people come to trial, juries are uncertain whether defendants are guilty or innocent. The default option is to assume that defendants are innocent until proven guilty, to put the burden of proof on the prosecution.

Although they are norms in science and law, several default options (maximizing average expected utility and minimizing false positives) arguably ought not be used in conservation biology. In a situation of scientific uncertainty, where the precise mathematical value for something is unknown, standard Bayesian statistical procedure dictates the default option of maximizing average expected utility (where expected utility is defined as the subjective probability of some event times its utility). Thus, if the subjective probability of massive species losses caused by development of a habitat is very small and the economic benefit is very great, the average expected utility will still be high. Using average expected utility judgments typically encourages pollution and development because it relies on averages, subjective probabilities, and ignores worst cases. Its proponents argue that it presents a moderate, realistic value in a situation where the real value is unknown.

In cases of uncertainty involving serious environmental threats, however, the more defensible default option appears to be maximin, avoiding the worst possible outcome. Maximin proponents argue that the subjective probabilities used in calculations of average expected utility are both uncertain (National Research Council 1994:263) and dwarfed by potentially catastrophic consequences such as loss of biodiversity, global warming, or toxic leaks. They also point out the asymmetry of zero-infinity risk problems: a small probability of environmental catastrophe does not outweigh its serious consequences (Shrader-Frechette & McCoy 1993).

Another standard default judgment is also questionable in conservation biology. In cases of uncertainty in which both types of error cannot be avoided, standard statistical and scientific practice dictates minimizing type-I statistical error (false positives) rather than type-II error (false negatives). Most scientists argue for minimizing false positives on grounds that this is a conservative approach that avoids positing an effect (such as species losses) where there may be none and that places the burden of proof on those attempting to confirm some harm. This default option seems a poor choice, however, because it gives less protection to public health and environmental welfare than to private developers or polluters. Also, it places the burden of proof on risk victims rather than risk imposers (Shrader-Frechette 1994).

Arguments for Advocacy

At least three kinds of arguments suggest that, just as there ought to be debate over default options in science, so also scientists ought to be advocates for particular value judgments and positions. First, advocacy often serves the interests of scientific objectivity. Because not all ethical and methodological value judgments in science are equally defensible, objectivity requires scientists to act as advocates and to represent indefensible positions as indefensible and less defensible positions as less defensible. As Aristotle recognized, equal or objective treatment does not mean treating everyone and every position the same, but treating equals the same. If scientists fail to be advocates and if they treat positions of different merit the same, they practice bias. Also, if scientists avoid advocacy, others may make careless value judgments in their work because they know they or their positions are unlikely to be criticized, unlikely to be tested in the marketplace of ideas. John Stuart Mill realized that debate among advocates for alternative positions is often the best way to arrive at the truth (Shrader-Frechette 1994).

Second, scientific advocacy is also necessary for the common good. If scientists never act as advocates, they can inadvertently serve the status quo, especially ethical and environmental errors in the status quo. For example, the U.S. Office of Technology Assessment claims that up to 90% of all cancers are environmentally induced and theoretically preventable, and we know that one in three of us will die of cancer. Had more scientists advocated reduction of suspected environmental carcinogens and followed the two default options just proposed, these cancer rates might be lower. Likewise, if more scientists had been advocates of biodiversity, species losses might not be what they are today. Because economic and political power creates a playing field biased against human and environmental interests, silence—failure to advocate needed change—serves whatever is wrong in the status quo. As Abraham Lincoln put it, silence makes men cowards. If they are cowards, then advocacy may become the prerogative of those who do not serve the public interest, just as a volunteer army has often become the prerogative of ne'er-do-wells and just as politics has often become the prerogative of the corrupt (Shrader-Frechette 1994).

Advocacy likewise can serve the common good by promoting democracy. Because democratic institutions are fed by education and by the free flow of information and criticism, both government and science require advocacy and a variety of independent perspectives. Saying Einstein should have remained silent and neutral, the 1937 Prussian Academy of Sciences condemned him for criticizing Nazi violations of civil liberties. Once an Einstein is condemned for advocacy in the public interest, however, then the narrowing of the ivory tower can strangle democracy as well.

Third, the special abilities of scientists also create special duties of advocacy. Often, only scientists have the requisite information to make an informed decision about the rights and wrongs of a particular situation or the ability to make a difference. When they do not use advocacy to make a difference, scientists become complicit in environmental harm. Scientists likewise are responsible for correcting environmental harm, through advocacy, to the degree that their luxuries or consumer goods have been made possible only through environmental degradation or using a disproportionate share of environmental resources. As professionals, scientists also may have special duties of public advocacy by virtue of the special benefits that they, as professionals, receive from society and from the environmental commons. Special benefits create special duties (Shrader-Frechette 1994).

Answering Objections

A major objection to scientific advocacy is that, if scientists become advocates, then this may encourage more rhetoric and politics instead of rational analysis of policy options. As a result people may become less objective, society may become weaker, and citizens may lose part of their democratic autonomy. Also, if advocates are wrong, objectors fear that scientists and science may lose credibility.

Such objections to advocacy amount to condemning the harm resulting from advocates who err. If knowing that we were correct were a necessary condition for acting, however, then we could never act. Rather, we have a duty to act when we have reason to believe that an action prevents a greater harm than its alternatives. Similarly, we have a duty to be advocates when we have reason to believe that doing so prevents more harm than all alternatives to advocacy. Besides, if being certain of a position were a necessary condition for advocacy, then by the time advocates were certain, many evils would be so advanced that it would be impossible to stop them. The obvious response to problems with advocacy is not to avoid advocacy, but for advocates to make their value judgments and positions explicit, to subject them to democratic debate, to admit their uncertainties, and to discuss default options for dealing with uncertainty. Advocates also need to assess the consequences of their stances so as to minimize possible harm and maximize benefits. Science requires defensibility, not infallibility, and advocates do not need standards higher than scientists.

Others may object that if advocacy is defensible and we all know things in a value-laden way, then Norton (1995) is right that there is no ontological distinction between knowing subject and object known, and that there is no reality "out there" against which we can test our value and advocacy judgments. But if Norton is right and there is no reality independent of the mind, there would be no way to test our scientific hypotheses and no reason that better theories should yield more-accurate predictions. There would be no reason for coherence between our scientific theories and the results of our instruments (from electron microscopes to cloud chambers), and this coherence would be an accident.

Although science is always imperfect and incomplete, scientific progress shows that we are able to get closer to reality. Although advocacy is always imperfect and incomplete, successful advocacy shows we are able to get closer to ethical behavior. Scientists need not have perfect knowledge, only the ability to improve that knowledge. Likewise advocates need not have perfect scientific behavior, only the ability to improve that behavior.

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Making the Role of Values in Conservation Explicit: Values and Conservation Biology

Although I do not share Barry and Oelschlager's pessimism about the declining fate of values in articles published in *Conservation Biology*, I do find much to agree with in their article "Values in Conservation Biology." In particular, I like very much that they answer "Yes!" to the question of whether values influence conservation science and "Yes!" to the question of whether it is possible to judge conservation science as good or bad science. For me, answering "yes" to both of these questions sets conservation science squarely in the modern framework of the philosophy of science. Perhaps more important, answering "yes" to both questions sets the stage for making the role of values in both conservation science and conservation advocacy more explicit and a legitimate subject for discussion, which I believe can only enhance the quality of conservation science and the effectiveness of conservation advocacy.

Saying "yes" to the question "Is conservation science inevitably influenced by the values of its practitioners?" does not require that one subscribe to the straw position that if all science is influenced by values, there can be no standard for evaluating the quality of scientific information and any answer is equally valid. It is the express acknowledgment of the values that inform conservation science that provides the context in which the validity of its conclusions can be assessed. As evidence of the quality of conservation science, we should ask not for some (unattainable) absolute measure of validity, but rather for a thoughtful evaluation of the work in the context of the social-scientific community in which it was carried out. It shouldn't be too surprising, or too distressing, that the standards of appropriate procedure and relevant evidence used to evaluate conservation science based on molecular genetics differ from those used to evaluate conservation science based on animal behavior. We are familiar with the differences in types of evidence regarded as relevant in different branches of science. In keeping with modern concepts in the philosophy of science (Schrader-Frechette & McCoy 1993), we should extend that recognition to the less obvious normative values that underlie judgments made in the course of conducting scientific research and interpreting its results (e.g., why choose Neotropical migrants as the dependent variable of interest in forest fragmentation studies instead of other taxa?).

By being explicitly self-reflective about the underlying values that guide their choice of research subject, method of study, and interpretation of results, conservation scientists can illuminate rather than obscure the connection between values and science. They themselves, as well as others reviewing their work, can then understand and evaluate what's been done in its proper context. I think that the result of making the connection between values and conservation science more explicit is likely to be a recognition that, although some conservation science is being done "wrong" and produces bad results that will be untrustworthy as a basis for conservation advocacy, there are many different kinds of conservation science that are being done "right" and yield results that, viewed in the context of values, do provide a trustworthy basis for advocacy.

Barry and Oelschlager (1996) are wise to acknowledge the diversity of beliefs among conservation scientists and to assert that a common goal of preserving life can be pursued by scientists with otherwise disparate value systems. The same recognition is needed even more once conservation moves beyond the community of scientists and into the realm of advocacy. Conservation scientists and advocates can and must work with lots of people with widely differing views in order to get the job of conserving biodiversity accomplished (Maguire 1994). Explicitly acknowledging the diversity of values that inform others' views is essential to working together constructively. Conservation scientists and advocates who assume that right actions will follow automatically from an assertion of a research result (e.g., populations of some Neotropical migrants appear to be declining; large carnivore populations need a lot of roadless country) are going to be disappointed. To be effective they must learn to recognize where the values of essential collaborators in conservation action differ from their own and how to craft plans that meet the most important needs of all constituencies (the subject of interest-based negotiation).

One of the reasons I am enthusiastic about decision analysis (Maguire 1991; Maguire & Boiney 1994) as a guiding framework for both conservation science and conservation advocacy (and the linkage between the two) is that it encourages scientists and advocates to be self-reflective and explicit about the values they are pursuing and how those values influence their work. The explicit expression of values in a decision analysis makes the context of research and advocacy decisions accessible to the scientists or advocates themselves, and—more important—to others with whom they must work in order to be effective. This explicit reflection on values makes it easier for those who must evaluate the quality of conservation science to understand the context in which the work was conducted. For conservation practitioners, understanding the values that underlie the work sets a framework for presenting its implications to others with like, or differing, values.

I look forward to hearing conservation scientists and advocates talk more explicitly about the values that inform their work partly in order to stimulate more appropriate evaluation of what is good and bad about conservation science, partly in order to promote more-effective collaborations in conservation advocacy, and partly in order to prompt thoughtful reflection on values by those within the conservation community and beyond. Changing public values in favor of preservation of biological diversity is a task full of perils, but people sometimes do change what they value when they learn more about biological diversity, about the connection between biological diversity and other values they already care about, and about how their actions may affect biological diversity. People also change what they value when they are inspired by the convictions of others. So if it becomes more commonplace for conservation scientists, as well as advocates, to speak and write explicitly, articulately, and passionately about the values that motivate their work, perhaps those values will spread like...wildlands?

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Conservation Values, Conservation Science: A Healthy Tension

In their paper, A science for survival: Values and conservation biology, Barry and Oelschlaeger ask us to consider an essential question: Can conservation biology be true to itself and effective in its goal of conserving biodiversity if it does not "actively and continuously engage... value questions" and embrace advocacy as part of its practice? Their answer is a definitive "no": Conservation biology without these characteristics becomes "intellectually and functionally sterile."

Although we agree with their answer and believe that most conservation biologists would also agree, we find the question somewhat confining, even though it suggests themes that require our broadest response. We propose an alternative set of questions: How should we as citizen-scientists participate in the arena of public policy, as individuals and as a professional scientific society? How do we best meet the simultaneous demands of science and citizenship? How can scientists promote the timely and responsible use of scientific information and concepts in the policy-making process? These questions may allow us more leeway in exploring the fundamental question that Barry and Oelschlaeger ably raise.

We concur with most of the points they advance: that science is not and cannot be value-free but is driven by value assumptions of which practitioners may be unaware; that conservation biology by definition entails values that guide it in conserving biodiversity; that "admitting" the role of values does not discredit conservation biology, contravene standard scientific criteria, or open the door to a "vicious relativism" that denies the reliability of scientific knowledge; that scientists need to be alert to and think about how values affect the way they investigate, select, and interpret facts; that we cannot ignore the "connectedness of science to society"; that conservation biologists have an obligation to be advocates for biodiversity.

We disagree, however, on a number of subsidiary points. Barry and Oelschlaeger state that "the function of values has not been widely acknowledged within the conservation biology community." This seems to us an extraordinary statement. Quite to the contrary, explicit acknowledgment of conservation's value component was one reason that conservation biology coalesced, and it remains a starting point for continued and healthy dialogue within the society and its journal. The discussion, as we have observed it, has revolved not around the question of whether science entails values, but rather what the effective and appropriate balance of sciences and advocacy should be. Moreover, if there has ever been a lack of "self-reflective awareness" of the role of values in defining conservation biology, the recently published textbooks in the field certainly address the issue thoroughly and offer younger conservation biologists the opportunity to think through its complexities more clearly.

We do not agree that normative judgment and advocacy are growing scarce in *Conservation Biology*, but neither are they growing more profuse. A review of its first eight volumes (1987–1994) indicates that the amount of policy discussion neither increased nor decreased during this period (Meffe & Viederman 1995). This indicates that the journal has remained open to such discussion, but there has not been much movement by scientists to orient their research and writing to them. To that extent we agree with Barry and Oelschlaeger and join with them in calling for stronger reorientation of our collective efforts toward policy-relevant research.

We do not agree that the part of a conservation biologist's activities that aims to promote sustainability necessarily turns one into a raging anthropocentric resourcist, or a devotee of the "Brundtland Commission philosophy." As long as concepts of sustainability are understood within the broader context of biodiversity protection, maintenance, and restoration, we believe we are in a secure position. And we have yet to meet the conservation biologist who sees the aim of conservation biology as the "casual control of nature to the end of dominating the planet." If there are any with such a view, they will likely find themselves pursuing their goals more effectively through other organizations (e.g., the U.S. Congress).

The more basic point that Barry and Oelschlaeger advance—that conservation biology is falling into the grips of positivism and its illusory devotion to pure objectivity—we find somewhat illusory itself. Positivism, to the extent that conservation biologists are "held in its thrall," could be a problem, but we do not think this is the case.

There is a tension inherent in the field of conservation biology and in the term itself. "Conservation" is a collective term used to embrace our diverse efforts to make the people-nature relationship an enduring one. As such, it entails—indeed, requires—a commitment to biodiversity, full consideration of human values in defining that relationship, and participation in the forum of public policy. But it also requires a firm scientific understanding of the natural world and the impact of people within it. "Biology" we recognize as a science, as the disciplined and systematic study of life. As such, it requires adherence to accepted methods and rigorous standards for gathering and interpreting information.

Successful conservation biology, then, is defined by a necessary mixture of verifiable, reliable scientific knowledge, cultural values, and civic responsibility. As conservation biologists, we emphasize mainly the first of these, but not to the exclusion of the others. Moreover, we believe that the biodiversity crisis calls for greater overlap among these spheres. Conservation biology's strength is in the mixture, but only as long as the tension remains healthy and vitalizing, rather than divisive and weakening. Conservation biology's most effective foremothers and forefathers—John Wesley Powell, George Perkins Marsh, John Muir, Theodore Roosevelt, Aldo Leopold, Rachel Carson, to name just a few in the American experience—were those who recognized the tension, maintained their scientific attitude, and responded effectively to the issues of their day.

The day has passed (if it ever existed) when conservation scientists could pursue their research interests with limited attention to conditions (socioeconomic and environmental) in the landscape beyond the laboratory, library, field plot, and study area. It they do undertake such research, they are doing it as zoologists, botanists, ecologists, anthropologists—not as conservation biologists. Although the pursuit and application of scientific understanding is made more complex by these other demands, the basic functions of science remain the same. The work of scientists—the process of discovery, the choice of research topics, the sifting and winnowing of information and evidence, the dispassionate interpretation and extrapolation of data—still provide the foundation upon which sound conservation policy rests. But the cultural milieu of the times strongly influences how scientists choose their studies, and this is where values play such an important role.

We therefore reject the notion that one can be either an effective conservation advocate or a credible and respectable conservation scientist, but not both. To be a proficient conservation biologist one must indeed be both. We should beware, however, of an overly stringent equation of values and advocacy. There are many ways to express and act upon values, and the most effective are not necessarily the most visible or audible. Values express themselves differently among different people, and our chosen modes of expression necessarily change from time to time and according to circumstances. To use Barry and Oelschlaeger's term, we may well (and in our own view need to) "play hardball" more vigorously, but it is not the only game in town. A reasoned discussion and handshake can be a powerful form of advocacy and no less a demand upon our energies. Where one can best devote one's energies, what points one chooses to advocate, and when one should shift strategies are matters of personal conscience, insight, and choice. That is the human drama, dilemma, and challenge of conservation.

Barry and Oelschlaeger come close to this point when they note that foundational maxims (in the case of conservation biology, "to preserve biodiversity") "[do] not always point to ready answers," neither in terms of prescriptions, nor in terms of strategies to formulate and implement them. Two equally astute conservation biologists may come away from the same problem and the same scientific assessment with different prescriptions and different modes of advocacy. We can take a lesson from our own science here: In preserving the diversity of approaches, we preserve our options.

As citizen-scientists we must fulfill our responsibilities to scientific integrity, the public interest, and that broader constituency of future generations, other lifeforms, and the communities of life in which we participate. Balancing those responsibilities is no easy task, and much more difficult than the unadorned "search for knowledge" that we were taught to believe science is. In the end, our acceptance of these varied responsibilities is what makes us conservation biologists.

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The Importance of Science in Conservation Biology

Barry and Oelschlaeger imply that science is an inappropriate foundation for the field of conservation biology. Instead, they assert that conservation biology should be defined by its "sympathy with biogeophysical process to the end of preserving of biodiversity and ongoing evolution." The fact that essays such as this are published in *Conservation Biology* indicates that some conservation biology remains to be defined. We provide an opinion on the balance between values, science, and advocacy because they are important in structuring a unique and important niche for the Society for Conservation Biology and its journal, *Conservation Biology*.

Essayists like Barry and Oelschlaeger opine strongly that conservation biology is value driven and that, when science is invoked, bad things will occur—intellectual sterility and importance to serve management. It is certainly a myth that scientists are generally dispassionate practitioners of a valueless enterprise. The vast majority of those who call themselves conservation biologists were attracted to their field out of a love for nature and its components. Science requires honest and objectivity, not the absence of feelings or passion. Indeed, one of the most famous ecological scientists of this century said as much in evaluating the mythical conflict between science and love of nature. "Doing science is not such a... dehumanizing influence as is often made out. The only rules of scientific method are honest observations and accurate logic. No one should fee that honesty and accuracy...have any power to take away nature's beauty" (MacArthur 1972: 1).

There is much confusion among both scientists and activists about the roles of science and advocacy in conservation. Our model describing the elements of this confusion includes three dimensions: conservation, knowledge, and advocacy (Fig. 1). The conservation dimension ranges from preservation to environmental abuse, and any of these actions can involve the full range of the remaining two dimensions of the model. Knowledge about biological resources can come from a continuum that includes science, dogma, or some combination of methods comprising the knowledge dimension. The advocacy dimension deals with the extent to which conservationists or abusers use knowledge to promote action on environmental issues. This advocacy dimension is a continuum ranging from apathy at one extreme to zealotry at the other. Of course, many conservationists are proudly zealous about being environmental advocates, and they see science as an excuse by some to be apathetic. Actually, science requires an open-minded approach that can accept new models of what is known, supported by new data and analyses. Thus, it is difficult for a scientist zealously to advocate singular solutions to environmental problems except under the simplest of circumstances. It also follows that it would be difficult unswervingly to advocate a particular solution to a complex environmental problem without depending upon a certain amount of dogma as a source of knowledge. Thus, in the extreme, the knowledge and advocacy dimensions interact such that objective scientists cannot ordinarily be zealous activists, and zealous activists cannot be constrained by objective science as a sole source of knowledge. This does not mean that scientists cannot or should not become advocates; it only means that advocates need to be aware of the extent to which the positions they advocate are supported by science and dogma. This is important in deciding upon the future directions of the Society of Conservation Biology (SCB) and the journal *Conservation Biology*.

Barry and Oelschlaeger are not unlike others who have prescribed a particular direction for the SCB and for its journal. Their prescription would minimize science as an important cornerstone of the SCB and could mean employing methods from the knowledge dimension that are less objective. In the extreme, when zealotry takes over, unsubstantiated dogma is substituted for scientific rigor. When this happens, an environmental advocate loses power to persuade because the advocate is seen as not being open-minded and objective about solutions to environmental problems (even if his or her mind is already closed concerning the need for conservation). All this points to the importance of employing science as a way of knowing, and it points to the way to producing an effective journal dealing with conservation biology.

We already have many conservation magazines "to educate and transform society," such as those of the Sierra Club, the Wilderness Society, the Natural Resources Defense Council, the Environmental Defense Fund, and other organizations devoted to the many dimensions of the goal of preserving biodiversity. Barry and Oelschlaeger's prescription for the SCB would apparently simply add *Conservation Biology* to this list of magazines.

Only the SCB is devoted to providing a scientific basis for conservation efforts. Thus, the journal *Conservation Biology* has the potential to play a qualitatively different and necessary role in the daunting task of preserving ecosystems, species, and genetic diversity. The SCB can be an important force in developing scientific principles for preserving biodiversity in the face of habitat loss, habitat fragmentation, global cosmopolitanization, global climate change, and all of the many ways in which humans have changed the rules by which life has evolved and persisted on this planet.

Without these scientific principles, we often resort to simplistic solutions to the relentless assault on global biodiversity. For example, we might incorrectly decide that habitat reserves are the only required solution to impending extinctions, when in some cases invasions of exotic species is the primary threat to biodiversity. We might incorrectly decide that the methods by which we preserve large, generalist carnivores such as gray wolves are equally applicable to the preservation of butterflies that are specialists on particular species of host plants and nectar sources. In other words, out of our ignorance, we could very well accelerate extinctions rather than prevent them. Just as we are suspicious of simplistic technological fixes to the problems created by massive exploitation of our forests, fisheries, and watersheds, so too should we be suspicious of simplistic ecological fixes to the loss of biodiversity.

Scientific knowledge and understanding will help us to be more successful in our common goal of preserving global biodiversity. If the Society of Conservation Biology is not devoted to the accumulation of scientific knowledge and understanding about how to preserve biodiversity, who will be?

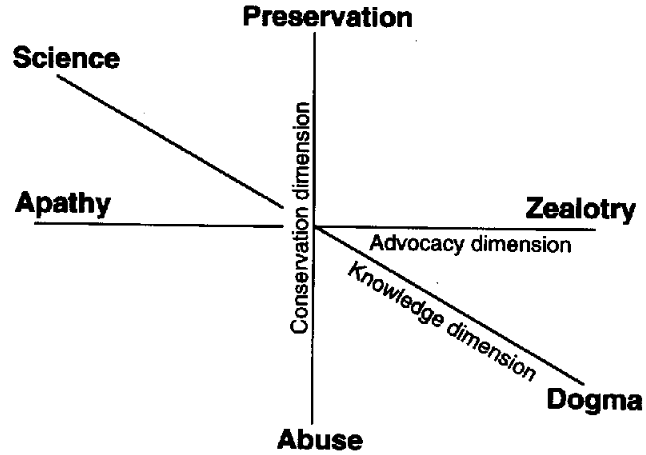

Figure 1. Dimensions important to the enterprise of preservation of biological resources.

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Advocacy as Part of Conservation Biology

In a perfect world, advocates would be those who spoke or wrote in support of something and scientists would be those who spoke or wrote in support of nothing. Advocates would care deeply about what they advocated because they would be convinced of its worth. Their conviction could be based partially, largely, or entirely on belief, intuition, group pressure, and many other things having little or no basis in fact. Scientists, on the other hand, would not care deeply about what they hypothesized because they could never be absolutely sure of its worth and may actually have to abandon it in the face of counter-evidence.

In the real world the distinction between advocate and scientist is much less clear. Real-world scientists rarely, if ever, behave like their perfect-world counterparts; in fact, they sometimes behave essentially like advocates. This advocatory behavior of some scientists may have spawned, at least in part, the currently popular campus debates about the differences between science and belief systems. Often, such debates focus on the topic of evolution, and we hear how evolutionists Darwin and Gould have said that one can approach evolution scientifically and still believe in a God. Now, conservationists Barry and Oelschlaeger say that one can approach conservation scientifically and still have values.

Barry and Oelschlaeger's basic position is easy to swallow, but they go much farther. They also propose that conservation biology is inherently normative and, therefore, that advocacy actually should be part of its scientific practice. I agree with some of this extended position, but not with all of it. I agree that conservation biology is normative. Indeed, it would seem that unless its practitioners were in favor of conservation and thought that it would provide the means of preserving biodiversity, conservation biology would not even exist as a separate discipline. Likewise, unless medical practitioners were in favor of human well-being and believed that medicine would provide the means of improving the human condition, medical science would not exist as a separate discipline. Many other disciplines, even ecology, are not based on values, but conservation biology, as well as medical research, are. Given this difference between conservation biology and many other disciplines, it would seem appropriate for any research carried out under its umbrella to specify how the results should be used to further the aim of conservation. No one would think for a moment that medical researchers should not specify the practical application of their results; I suggest that the same reasoning should apply to conservation biologists. I do not necessarily agree, however, that because conservation biology is normative, advocacy should be part of its scientific practice.

My partial disagreement concerning advocacy may stem from the failure of Barry and Oelschlaeger to define the terms they use. In particular, they have failed to define "conservation biology" itself, as well as "applied biology" and "advocacy." The failure to define the last term is of primary importance here, a problem I shall return to in a moment. First, in my opinion, the dichotomy between conservation biology and applied biology that Barry and Oelschlaeger erect is a false one. When a precise definition of applied biology is employed (McCoy 1994), conservation biology may serve perfectly well as an example. On this view the applied biologies are those branches in which the research has both attendant benefits and attendant costs; therefore, such research could not be value-free de facto. In any kind of applied research, if the type-II error has such high costs that they outweigh the costs associated with the type-I error, then the type-I error should be preferred. We call this situation decision making under "ethical rationality" (Shrader-Frechette & McCoy 1993), and it may well apply to many examples of biodiversity loss (Shrader-Frechette & McCoy 1994). The problem with this kind of decision making, of course, is in assessing potential costs to ensure proper balance between its scientific and ethical aspects (McCoy 1994). Assessing potential costs is relatively easy when a shared value system exists—in medicine, for example—but relatively difficult when value systems conflict, which is often the case in conservation.

Returning to advocacy, I submit that Barry and Oelschlaeger have used the term in at least two different ways, one probably innocuous and the other probably not. The first use of the term is reflected in quotations such as the following: ". . . they [scientists] have the responsibility to explain what they are learning to the general public," and ". . . we have an ethical obligation to provide decision makers with explanatory knowledge and prescriptive recommendations." Who could argue that explaining our research, using our scientific understanding to educate others, and even making practical recommendations based on our findings are inappropriate scientific undertakings? Scientists do these things regularly, when they write discussion sections in their research papers, submit final reports for contractual work, give talks to civic groups, and engage in many other activities. Explanation and informed speculation do not necessarily constitute advocacy.

The second—and I suggest, the controversial—use of the word advocacy is reflected in quotations such as the following: ". . . those who share such [conservation] beliefs are obligated to affirm them publicly"; "conservation biologists . . . must 'learn to play hardball' and stand by their ethical principles"; and "Insight brings unconscious and unperceived factors in the self and the environment into the focus of conscious awareness." This use of advocacy seems to be close to what I have suggested an advocate would do in a perfect world, so it should not be surprising that scientists, even those firmly grounded in the real world, would find it objectionable. It does not display a proper balance between science and ethics (McCoy 1994). Although it is true that conservation biologists should acknowledge the role of values in what they do (McCoy 1994; Shrader-Frechette & McCoy 1994), it is also true that they should not harbor the notion that their individual commitments to conservation are appropriate substitutes for a strong scientific bulwark in the defense of living things. If conservation biologists lose sight of the importance of the basic tenets of scientific inquiry, then they risk losing the support of their fellow scientists, as well as that of the general public (McCoy 1995).

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