2000

Biological Science in Conservation

David Johns
Portland State University, johnsd@pdx.edu

Citation Details
Johns, David. Biological Science in Conservation. USDA Forest Service Proceedings RMRS-P-15-VOL-2. 2000

Biological Science in Conservation

David M. Johns

Abstract—Large-scale wildlands reserve systems offer one of the best hopes for slowing, if not reversing, the loss of biodiversity and wilderness. Establishing such reserves requires both sound biology and effective advocacy. Attempts by The Wildlands Project and its cooperators to meld science and advocacy in the service of conservation is working, but is not without some problems. Scientists and advocates have differences in methods of work, different understandings of the origins and place of values in conservation, and differing expectations about the efficacy of biological information in achieving protection. Despite these differences, successful relationships can be forged where these differences are recognized and made part of the conservation planning process.

> Albert Einstein was asked one day by a friend "Do you believe that absolutely everything can be expressed scientifically?" "Yes, it would be possible," he replied, "but it would make no sense. It would be description without meaning—as if you described a Beethoven symphony as a variation in wave pressure." (Clark 1971)

If nature is the symphony, and conservationists are those who love it and want it to remain alive and intact, what can biological science contribute? Perhaps not a perfect analogy. Nature is more complex and sublime than a symphony, even one of Beethoven's. But it does suggest that while science is central, it also has limitations. These limitations are understood differently by scientists and advocates, often confounding cooperation between the two groups. I will examine below the experience of The Wildlands Project and its cooperators in attempting to marry science and advocacy to achieve large-scale conservation goals. (I use the term "science" throughout this paper to mean the biological sciences, especially conservation biology. Cooperators includes dozens of grassroots groups and networks of such groups; scientists; local chapters of national groups; and national and international conservation groups; and others.)

The Wildlands Project (TWP) was founded in 1991 by prominent conservation biologists such as Michael Soulé and Reed Noss and activists such as Dave Foreman, Jamie Sayen and Mitch Friedman. Both groups had come to realize that existing protected areas—given the historic criteria for their selection and their increasing islandization–were proving inadequate to stem the loss of biodiversity in the face of burgeoning human numbers and consumption (Foreman 1992). The Wildlands Project set out to design and implement a series of regional reserve systems across North America (from Alaska and Greenland to Panama) that would achieve the following conservation goals: 1) the protection or recovery of all indigenous species in natural patterns of abundance, emphasizing top predators, 2) the protection of all ecosystem types and ecological processes in a healthy state, 3) the unencumbered operation of natural disturbance regimes such as fire, and 4) resilience in the face of anthropogenic change, such as global climate change (Noss 1992).

For a reserve system to achieve these goals, it would need to be science-based. Just as conservation biology, ecology and island biogeography had helped to identify the causes for biological decline of species and the unraveling of ecosystems, so they could contribute to the design of solutions. The biological sciences, in the view of TWP, could answer questions such as: What areas need to be protected? How much needs to be protected? How should protected areas be connected to maintain genetic and other flows? What management regimes should govern protected areas and connections?

To answer these questions, scientific findings would at least inform and at best be the basis for, a concrete vision of what the conservation movement needed to advocate to realize its goals. Advocates and their organizations would provide the political muscle to make the reserve systems a reality.

This marriage of science and advocacy has been successful in many respects—several science-based large-scale reserve designs are in the final stages of peer-review (Wild Earth 2000). All marriages have problems, however, and simple in concept doesn't mean simple in practice. Partners come to this relationship with differing expectations, backgrounds, training and experience, but their goals and motives are much the same: a love of the natural world and a desire to protect it (Foreman 1992, Society for Conservation Biology 1999). The problems TWP and it's cooperators have experienced in integrating science and advocacy fall into three categories: 1) differences between scientists and advocates in methods of work, 2) differences in understanding the origins and place of values, and 3) differences in expectations about the efficacy of biological information in the political world.

These abstract categories translate into complaints like the following: "Advocates treat scientists like lawyers, looking for quick answers and easy certitude." "Scientists take too long and cost too much; all you really need to do is draw a circle in the dirt and fight like hell for it."

I will look at each category, exploring the sources of friction and how these have been addressed in the field. The findings are limited to English-speaking North America. Although TWP works in Spanish-speaking North America, project work is less developed there and the nature of advocacy is different than in English-speaking North America (Riding 1985). What the findings suggest is that if these differences between scientists and advocates are ignored,

In: McCool, Stephen F.; Cole, David N.; Borrie, William T.; O'Loughlin, Jennifer, comps. 2000. Wilderness science in a time of change conference—Volume 2: Wilderness within the context of larger systems; 1999 May 23–27; Missoula, MT. Proceedings RMRS-P-15-VOL-2. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

David M. Johns is Assistant Professor of Political Science, Hatfield School of Government, Portland State University, and a founder and director of The Wildlands Project, P.O. Box 725 McMinnville, OR 97128-0725 U.S.A., e-mail: djohns@viclink.com

progress in conservation planning can be confusing and slow. Where the differences are addressed directly, it is much easier to achieve clarity of vision and purpose, and conservation work is thereby more effective and timely. Given the human onslaught against the natural world, time is critical.

Methods of Work

Scientists and advocates have different methods of work. Mission-oriented sciences like conservation biology are not essentially different than "pure" science—they aim to adhere to generally accepted standards of investigation and analysis (Schrader-Frechette 1996). Biologists, like other scientists, generally aim to avoid type-I errors, or false positives. Avoidance of finding an effect when there isn't one is considered a conservative approach—best serving the development of a reliable body of knowledge. But for advocates—and increasingly for many conservation biologists—being conservative means something else. Because species loss and much ecosystem damage is irreversible, it is better (from a policy standpoint) to assume there is an effect and place the burden on developers, road builders and others who seek to alter the world to prove their actions will have no adverse biological effect. This precautionary approach provides the same sort of safety for species and ecosystems the U.S. Food and Drug Administration tries to ensure for people by not allowing drugs to be sold until they've been tested.

Other examples of important differences can be identified by the statements of activists and biologists involved in conservation planning. Advocates grumble about scientists' skepticism, and sometimes see their pointed questions as hostile. Some advocates are wary of science generally with its history of Cartesian dualism, reductionism, mechanism, and ties to institutions (business and government) that have destroyed or degraded much of the natural world. Many agree with David Ehrenfeld's critique of the Enlightenment assumptions of science: he argues that the belief that we can always solve problems is false, and in fact each problem "solved" creates many new and more difficult ones (Ehrenfeld 1978). Reality suggests that we are not smart enough to model the complexities of nature and successfully manage it. Our minds are not good substitutes for the evolutionary process. Advocates are often used to acting with partial information—it is the political process not the scientific process that sets the timetable. Much scientific works seems needlessly complex or time-consuming. And at times it is intimidating.

Biologists and ecologists also have their complaints. Aside from a (healthy) dislike for politics in general, many fear that their work will not be understood in its complexity or used properly. They fear a different sort of reductionism as their findings are transformed into "sound bites" for a broader public. Biologists have complained of being treated as "hired guns" by advocates, rather than as full partners in the conservation planning process. There is also fear that by being associated with advocates their scientific credibility will be hurt with peers, funders, employers and other institutions. This fear exists despite their wish that the results of their work have a positive impact on policy.

Some differences between scientists and advocates result from constraints imposed by institutions or forces external to the conservation planning relationship: universities, the press or legislatures. Funders or tenure committees may punish scientists for activism, the press does demand sound bites, and Congress operates on *its* schedule. Conservationists must accommodate these factors. In other cases differences are about matters internal to the conservation planning process. Perceptions and behaviors can be explored and changed because they are under the control of the participants. In either case the successful development of a conservation plan requires that these issues be placed on the agenda in each region and addressed. Resolution does not occur in one meeting, but over time, as trust is built and as issues are dealt with concretely in an ongoing process. Issues seemingly once resolved resurface and need to be addressed again. Sometimes this is due to new participants; other times it is due to the difficulty in overcoming long held beliefs or habits.

Resolution of these differences and complaints rest upon the shared goals of the work: to create reserve systems that have a high probability of restoring and protecting natural systems. Only biologically-based reserve design can provide a concrete vision for attaining the goals of large-scale conservation outlined above. Biologically-based reserve design does take time and can be complex, although methods are being developed that allow reserve design to be accomplished more quickly and less expensively. While the science is never complete, at some point it becomes defensible—perfection is not required (Shrader-Frechette 1996). There will be times, however, when action must be taken before the science is defensible, simply because opportunities exist. Educated scientific guesses with a healthy dose of the precautionary principle are often the best that conservationists can do at a particular time. In such cases biological work continues, so conservationists can identify or anticipate, and fix any problems.

Biological work is not the be-all and end-all of conservation—rather it helps to establish the floor for protection. Beyond biological criteria there are other bases for protecting additional areas: for wilderness values per se (e.g. solitude, aesthetics), for primitive recreation, to preserve sacred sites.

Advocates ultimately do recognize the advantage of asking the hard questions internally first. This opportunity strengthens the case for a protection proposal before going into the public arena where conservation opponents will attack it.

The role of biologists in conservation planning and implementation will vary. A number of factors play a role, from the comfort level of particular scientists with advocacy, to well-founded concerns about the reaction of peers and funders. Some are needed in the trenches doing battle; others are needed to speak at a distance from the fray. Their primary task in conservation planning, however, is investigation and analysis that results in recommendations based on clearly articulated and shared conservation objectives.

Science as an institution (and scientists) does carry baggage that has historically been antithetical to conservation (Merchant 1983, Berman 1983). It is well to remember that conservation is fundamentally about values, not science.

Values

For conservationists the evolutionary process, biodiversity, and ecological processes are good things. Public and private policy should reflect and value this goodness. Einstein stated that science is driven by the notion that knowledge is good—a judgment or value he regarded as outside the ability of science to falsify (Barry and Oelschaeger 1996). Since both science and conservation are driven (proximately, if not ultimately) by values, some advocates look to science to generate or provide justification for the values underlying conservation. Some advocates look to science to not only tell them what lands need to be protected to ensure the survival of grizzlies, but also to say that protecting grizzlies is good.

The relation of science—and specifically the biological sciences—to values is a broad discussion. In this paper I seek to explore only that part of the discussion directly pertinent to large-scale conservation and wildlands planning.

Science does not generate values, although the knowledge it generates may influence values. Certainly many discoveries in cosmology (Galileo) and evolutionary biology (Darwin) have had an enormous influence on how humans think and feel about the world they inhabit, including what they consider important and valuable. Knowing we share more than 98% of our DNA with chimps may influence our values, but such knowledge does not directly require us to love chimps as family. Values are products of the human heart and mind and the many social, cultural, and biological forces that shape heart and mind.

Science does not stand apart from values. Scientists have values and these values are part of what draws them to a life in science in the first place. Values shape the questions scientists have an interest in investigating. Other values also shape research and the direction of science, including the values and interests of those who pay for it (mostly government and business), faculty tenure and promotion committees, peers who review the work of a particular scientist, and other elements of society like the media. (Science as an institution or process consisting of thousands of individuals, universities, and research labs will therefore evince values that are often in conflict with each other. Within most disciplines, however, there is general agreement on central values most of the time.)

It is unavoidable and appropriate that values do influence the questions being asked. It is also appropriate that these values be made explicit and be discussed (Conservation Biology 1996). However this is too often not the case.

Discussions among those involved in large-scale conservation planning are fortunate that conservation biologists have been addressing these issues for some time and bring much to the table (Conservation Biology 1997, 1998). As a mission-oriented science, conservation biology has been compared to medicine. Both have explicit goals: in the case of medicine to heal or prevent disease and injury, and in the case of conservation biology to protect and restore biodiversity and ecosystem function (Soulé 1986, Ehrenfeld 1989, Primack 1995). While both disciplines debate values—and the role of their practitioners as advocates in the political process—they are explicit about being mission oriented, value driven, and acknowledge that these values are not the product of science per se (Conservation Biology 1996).

Whether mission oriented or not, science aims to minimize how these motivating values might bias results. Values rightly shape the questions. But they must not distort the answers to those questions. So the design of research, the observation of results, and the analysis of results and conclusions are subject, in the scientific process, to various forms of review or testing. These include peer review, replication, or the ability of findings to predict future outcomes in the world. It is this aspect of science that must be assessed for bias and degree of objectivity.

Thus, mission and values rightly influence questions science seeks to answer. (And getting the questions right is critical to the success of conservation.) However, the process of investigation, testing hypotheses, and seeking answers requires that the motivating values be compartmentalized so that defensibility of findings can be ensured. This critical distinction is finding widespread acceptance as it becomes understood.

Having a good understanding of the need for compartmentalization does not mean either advocates or scientists always agree about the need for scientists to speak out about values. Many believe scientists need to do more than state the case for their findings. Because scientists have credibility with the public and policy makers, the reasoning goes, their value statements will carry more weight than those of ordinary citizens. Scientists debate this, concerned about the loss of individual credibility and the long-term erosion of collective credibility. Credibility here is seen as being based on the public perception of objectivity. Concerns about credibility are not easily resolved in the general or the abstract, but case by case. It is clear that some scientists, especially those with public stature, can authoritatively speak out about what moves them as well as about their findings. The popularity of the work of E. O. Wilson and Paul Ehrlich are two good examples of scientists that have entered the public debate and had significant acceptance and influence (Wilson 1992, 1993, 1996, Ehrlich 1970, 1980, 1990). Both also have their critics.

But not all scientists want to, or can successfully contribute to the debate. Nor is the role of advocate or public spokesperson one they are usually trained for. The experience of wildlands conservation planners is that the main burden will continue to fall on advocates. They need to formulate and advance the value and interest based arguments that will persuade people to accept the underpinnings of conservation biology as they do the underpinnings of medicine. Advocacy is primarily about making a case for values, not just providing information or data. Policy-making is about choices among values. (The values espoused by differing interests.) The public debate is largely about values: what is good, what is bad, what is, and what ought to be. Advocates are trained, experienced and hopefully suited to these tasks.

Biology and Advocacy

Biologists have been disappointed that “speaking truth to power” doesn’t have much impact on policy. Advocates have been disappointed that biological findings haven’t improved their success rate with Congress or other policy makers. If science can't help improve policy, just what is its value in conservation?

In the previous two sections I've suggested one important role: informing conservationists about what needs to be done. The experience of The Wildlands Project and its cooperators suggests that scientific findings and scientists also have a role to play in legal and administrative processes and in combating disinformation. Finally, science and scientists do have a role–albeit limited—in influencing decision makers.

Science Informing Activism

If science cannot tell us it is good to try to save all of creation, it can tell us that if we don't save at least substantial parts of the earth in a healthy condition, we may not be able to save ourselves (Bahn and Flenley 1992). But most conservationists, and perhaps most of the public, know that. Conservationists are interested in saving more than just what is necessary to keep humanity going in some minimal way. Conservation is about human needs, certainly: the need for solitude, for spiritual renewal, for protecting areas as a baseline for how nature works, and so on. Conserving wildness may be important for our survival in other ways: Paul Shepherd (1990) has argued that human beings do not mature apart from wild things and wilderness. Insofar as our survival depends on maturity and the wisdom that attends it, wilderness is extremely important. Conservation may also simply be about loving nature, which is after all our first home.

Conservation is about much more than humankind, however. Many conservationists recognize that we are but one species among millions and we do not have the right to destroy life for the sake of human convenience. In this view, all life is intrinsically valuable, as is that which sustains it—mountains, rivers, oceans, prairies, the great web of interconnection. It is this connection that gives life meaning. Love is about connection—connection to other living things and life-sustaining things. Everything else–including the accumulation of stuff–is a poor substitute.

Many conservationists—activists and scientists alike—do not believe we can constrain anytime soon the machinery that is destroying nature. There are now six billion humans and we are asking the earth to support another 80 million people a year. Our factories, mines, freeways, subdivisions and shopping malls feed like cancer on healthy tissue. Although these issues must be addressed, we cannot wait on their solution. In the interim vast areas of the earth must be set aside, off limits to industrial and agricultural activity, where whole systems can recover and flourish.

Since we can't protect every place we much choose. What places will best ensure functioning ecosystems and healthy populations of all native species into perpetuity? What places will allow the recovery of top predators so essential to ecosystem regulation, and allow disturbance regimes and succession to operate unencumbered? If habitat and fragmentation are problems, what habitat and connections do we need to recover and rewild places? What sorts of human uses are compatible in multiple-use or transition zones lying between human settlements and protected areas? Conservation biology, island biogeography, and ecology have helped to recognize and define the problems associated with species and ecosystem decline. They are also in a position, along with restoration ecology and other disciplines, to help define the solutions.

The single most important use of science in conservation is providing guidance to the protection movement about what must be done on the ground. Without that guidance we would not know what or how to protect. Even with guidance the precautionary principle must be incorporated into our reserve designs and campaigns for protection.

Science Informing Judicial and Administrative Processes

In countries with effective legal systems such as the U.S., Canada, and Costa Rica, scientific information is important before courts of law and in administrative rule and decision making. Keiter and Locke (1996) surveyed laws that might be used to protect carnivores in the Rocky Mountains of the U.S. and Canada, including the U.S. Endangered Species Act (1973). Laws like the ESA set goals and general standards that agencies—and in many cases private entities—must adhere to. Scientific findings and the testimony of scientists have been important in numerous lawsuits to bring agencies and others to task for failing to list a species, failing to develop adequate recovery plans, or failure to properly administer them. Findings and testimony are critical in establishing whether or not agencies or others are complying with the law.

Science is important in other settings. The standards and goals set by the U.S. Congress are typically general. The agencies that administer them must develop more detailed standards and processes to carry out these mandates. Here again scientific findings and the testimony of scientists can make a difference in shaping what standards are adopted in agency rules. What is the standard for determining if a species is threatened or endangered? What constitutes the taking of an endangered or threatened species? Science is no magic bullet, and courts give great deference to agencies, which in any case are required only to have some basis in the record for their decision. Agencies are not required to listen to the "best" scientists, or the majority of scientists, and can ignore the best and the majority.

Scientific findings can fare somewhat better in conflicts over the proper application of those standards. Is a species, in fact, recovering? Was a species properly listed? Even in this circumstance sound science can be ignored. This is especially true when powerful interest groups and their Congressional allies—often with budget or other authority over an agency—dispute the logical policy implications of science (Wilkinson 1998). However, in this circumstance—which is quasi-judicial, rather than quasi-legislative—the courts are much less shy about overturning agency decisions (Strauss and others 1995).

Science and Disinformation

Scientists may differ in their views and predispositions. This can affect not only the questions they ask but how they interpret findings. These differences may themselves drive further research in an effort to resolve disputes. The generation and testing of hypotheses is part of the normal work of science. However, as previously stated, views, values and predispositions of scientists must not affect their findings. In some cases they do.

Conservation work has generated a backlash, especially from those that profit from the destruction of the natural world. The Ehrlichs (1997), in their book *Betrayal of Science and Reason*, have termed this a "brownlash." "(T)he brownlash has produced what amounts to a body of anti-science—a twisting of the findings of empirical science—to bolster a predetermined worldview and to support a political agenda." Such accusations are made against conservationists by brownlashers as well.

That both sides make similar accusations does not leave us in some relativistic swamp, however (Soulé and Lease 1994). There is a real distinction between good science and the "anti-science" of the brownlash. Good science is peer reviewed, makes clear its methodology and the data supporting its conclusions, relies on generally accepted methodologies, does not use data selectively to support a conclusion, does not rely on fabricated "data", and is generally acknowledged to be good science even by those in the scientific community who may disagree with its conclusions. It does not allow bias to influence findings (Ehrlich and Ehrlich 1997). Personal attacks are also typical of purveyors of "anti-science." (Flattau 1998) Examples of anti-science include claims that biodiversity is not threatened, extractive industries are benign, risks from toxic substances are grossly exaggerated, ozone depletion is a hoax (Ehrlich and Ehrlich 1997); Ray's defense of the nuclear industry and others (1993); Julian Simon's (a direct marketing economist) attempt to explain a dolphin die-off on the Atlantic coast without regard to marine biology (Flattau 1998); and efforts by non-climatologists to dispute the findings of climatologists on global warming. In the last case the (U.S.) National Academy of Sciences took the unusual step of formally and publicly disassociating itself from an unpublished article and petition being circulated with it. The unpublished article, which claimed greenhouse gases were a "wonderful and unexpected gift from the Industrial Revolution", was printed to look like an offprint from the Academy journal. (New York Times, 22 April 1998)

The public does not read scientific journals. It gets news from television, radio, and to a lessor extent from the print media. Proponents of the brownlash have made a concerted effort to use the popular media and have been effective in getting many of their views out to the public. If the popular media is abandoned to such views, the public—increasingly misinformed by the endless repetition of falsehoods—can be expected to support policies that flow from such falsehoods. Paul Ehrlich, Thomas Lovejoy, Norman Myers, Reed Noss, Peter Raven, Michael Soulé, E.O. Wilson, and many others have argued persuasively that scientists must speak out publicly about the crisis of biodiversity, and what must be done to avert it (Lovejoy 1989; Noss 1993; Soulé 1986; Wilson 1992). To be effective with the public and policy makers their voices cannot be restricted to professional journals. They must engage the media that people rely on. Scientists do enjoy significant prestige with both media and public, but it means little if it is not used. Two things would encourage scientists to speak out more: recognition by peers and employers for contributions to the popular press, and knowledge that they do not stand alone (Society for Conservation Biology Annual Business Meeting, 1995).

The broader culture (especially more educated segments) does absorb scientific findings. Over time this information can affect general perceptions and assumptions. It can shape future reactions to policy initiatives affecting conservation. Public awareness of the consequences of smoking and poor diet are two good examples, as are the billions spent on public relations and advertising (Paletz 1997, Paletz and Entman 1981).

No amount of knowledge is a substitute for biophilic feelings and values. Communicating with important constituencies about values is essential. But it is not enough. If the public lacks a good general understanding of how science works or what its findings are, lies and half-truths can flourish.

To reach the widest audiences, scientific findings need to be incorporated into the stories we all live by. We are storytelling animals and most of us understand the world best through metaphor–the currency of art more than science. Many scientists who write for a larger audience, such as Stephen Jay Gould in *Natural History* and Lewis Thomas (1974), spin a good story and deserve emulation.

Science and Decisionmakers

The ability to persuade decisionmakers can also be seen as the ability to make your problems their problems. Can scientists and scientific findings help with this? *Yes, but, their role in influencing legislators and other policy-makers is decidedly mixed.*

The Wildlands Project and cooperators are just completing several conservation plans. Implementation has started, but has not been undertaken in a broad way. The tools for implementation are not new and those involved have much experience using them to protect public and private lands. Based on that experience, including recent successes in changing management regimes and protecting some new areas, several themes have emerged.

For scientific information to have influence with legislators one or more of a number of factors need to be present. 1) Legislators have to care about the issue. They need to share some of the underlying values or at least the goals of conservationists. If, for example, a legislator does not care about protecting grizzly bears, the best scientific information about what habitat these bears need will not be persuasive. If, on the other land, legislators do care, then having that information can play a role in shaping proposed solutions, as it did in refinement of boundaries for the proposed Northern Rockies Ecosystem Protection Act and the now existing Muskwa-Kechika Protected Area and Special Management Areas. 2) Legislators must feel that their constituents care about the goals that conservationists advance. Constituents may be voters back in the district, organized interests that have a presence in the district, opinion leaders, or campaign contributors inside or outside the district. Those groups traditionally supportive of the legislator and that already have ties will fare better, but swing groups are also important. In short, where political muscle is adequate to gain legislative attention and support, science then has a window through which it can enter the process. Legislators can appear to hang their hat on "the facts." 3) If legislation has been introduced and a vote is pending, then legislators must make a decision. Concentrated pressure by a number of forces, including prominent scientists, can be important. So can the use of findings that resonate with constituent values. 4) Other factors also exist that create space for scientific influence in the legislative process. One conservationist proposal may be anathema to a legislator, but another proposal may be worse. In some cases legislators will support proposals because they believe later in the process–in rule-making or subsequent appropriation cycles, they can effectively undermine it. At other times, when values fade into the background because they are widely shared or cannot be challenged, information can make a difference. Legislators are often looking for issues and scientific findings can provide a hook (Allin 1982, Cohen 1992, Bryner 1993, Bimber 1997). In short, science has influence when legislators are receptive due to shared values or goals with those offering the information, or when science has power on its side and legislators have to pay attention. A proverb says that evil will triumph if good is merely good, and not also strong.

Scientific arguments that rest on assumptions about the value of biodiversity will not persuade those who do not share these assumptions, or if they don't have some other reason for going along, such as pleasing constituents, or staying in office.

Many decisionmakers rely on the kind of "anti-science" described above in the subsection on disinformation. Scientists and scientific findings can be important in debunking that "anti-science." The role of sound science in undermining the credibility of cigarette executives and their Congressional allies is a good example of how this can work. But it is also an example of the limits of science when it confronts those with more economic and political power.

Scientists and scientific findings can play a role in informing the critical mass needed to move elected and other decisionmakers. Important constituent groups and key elements of the public are mobilized by value-based arguments, arguments that touch their feelings, and appeal to self-interest, but good information is important in framing persuasive and sound solutions. Successful wildlands conservation requires support that is both deep and informed: people need to feel intensely about wildlands and also to understand why, for example, roads and oil exploration don't mix with wildlands.

In working with private landowners good science can be important, but as in other cases, absent shared values or some other interest supporting shared goals, it doesn't carry much weight.

In the business sector decision-making is also about power. It is not the scientific evidence that persuades, but estimates of pain and gain. Bad press with the public, falling sales or falling stock prices, threats of litigation, civil disobedience—all of these can be persuasive (Johns 1998; Careless 1997). Science can help inform our arguments and debunk theirs if they rely on bad information. And when economic actors do support conservation–based on values or some other interest–science can be persuasive in framing solutions.

Summary

To protect and rewild much of the planet requires at root a passionate commitment to life—to the beauty, spontaneity and creativity of the evolutionary process. But our love must not only be deep. It must be an informed love, an intelligent love. The primary role of science is to make us informed.

Protection requires all the political muscle advocates can muster and sustain over the long haul. The biological sciences are essential as well: to understand the problem and in fashioning solutions, to combat disinformation, and to operate effectively before agencies and in the courts. They are one tool among many in making persuasive arguments. Scientists bring credibility to some fights in some fora.

Differences among scientists and advocates are real. Differing methods of work, of understanding the role of values, and of how science works in the political process are a potential source of friction. The less energy we have to put into correcting misunderstandings, the more effective we are. In the scheme of things, the problems I've discussed are small; too much is as stake for divorce to be an option.

References

Allin, Craig. 1982. *The Politics of Wilderness Preservation*. Greenwood Press, Westport, CT.

Bahn, Paul; Flenley, John. 1992. *Easter Island, Earth Island*. Thames and Hudson, London.

Barry, Dwight; Oelschaeger, Max. 1996. A Science for Survival. *Conservation Biology* 10:908.

Berman, Morris. 1983. *Reenchantment of the World*. Cornell University Press, Ithaca, NY.

Bimber, Bruce. 1997. The politics of expertise in Congress. SUNY Press, Albany, NY.

Bryner, Gary C. 1993. Blue Skies, Green Politics. Washington, D.C.: Congressional Quarterly Press.

Careless, Ric. 1997. *To Save the Wild Earth*. Raincoast Books, Vancouver, B.C. Careless provides a recent history of several successful campaigns for wilderness protection in British Columbia. U.S. and Canadian politics differ in a variety ways, two of the most important being Canada has a parliamentary system at both provincial and federal levels, and most conservation policy is made at the provincial level in Canada. The U.S. has a Presidential system at the federal level and similar systems at the state level; since most public lands in the U.S. are federal, and federal supremacy is more pronounced in the U.S., federal conservation law are often more important than state laws. Another important difference is that Canadian officials can often be embarrassed into to doing the right thing; most U.S. officials are beyond embarrassment.

Clark, Ronald. 1971. *Einstein: The Life and Times*. Cleveland, OH: World Publishing.

Cohen, Richard E. 1992. *Washington at Work: Back Rooms and Clean Air*. New York: Macmillan.

Conservation Biology. 1996. Special Section on the Role of Advocacy. *Conservation Biology*. 10: 904-920.

Conservation Biology. 1997. 1998. For example, the index for both of these years (11:1468,12:1431) show eight articles dealing with values and science or advocacy and science.

Ehrenfeld, David. 1978. *The Arrogance of Humanism*. New York: Oxford University Press.

Ehrenfeld, David. 1989. Conservation Biology in R. Paehlke (ed.): *Conservation and Environmentalism: An Encyclopedia*. New York: Garland Publishing.

Ehrlich, Paul; Ehrlich, Anne. 1970. *Population, Resources, Environment: Issues in Human Ecology*. San Francisco: W. H. Freeman.

Ehrlich, Paul; Ehrlich, Anne. 1980. *Extinction: The Causes and Consequences of the Disappearance of Species*. New York: Random House.
Ehrlich, Paul; Ehrlich, Anne. 1990. *The Population Explosion*. New York: Simon and Schuster.
Ehrlich, Paul; Ehrlich, Anne. 1997. *Betrayal of Science and Reason*. Covelo, CA: Island Press.
Flattau, Edward. 1998. *Tracking the Charlatans*. Washington D.C.: Global Horizons Press.
Foreman, Dave; Soulé, Michael; Johns, David; Davis, John; Noss, Reed. 1992. The Wildlands Project Mission Statement in *Wild Earth Special Issue on The Wildlands Project.*
Johns, David. 1998. A Political Strategy for the Yellowstone to Yukon Conservation Initiative. Canmore, Alberta: Yellowtsone to Yukon Conservation Initiative. An abbreviated version has also been published as "The Politics of Y2Y" in *Wild Earth* 8:2, 8:3, and 8:4. See Careless 1997 citation for a comment on some differences between Canadian and U.S. politics.
Keiter, Robert; Locke, Harvey. 1996. Law and Large Carnivore Conservation in the Rocky Mountains of the U.S. and Canada. *Conservation Biology* 10: 1003-1012. This study is a good example.
Lovejoy, Thomas. 1989. The Obligations of a Biologist. *Conservation Biology* 3: 329-330.
Merchant, Carolyn. 1983. *The Death of Nature.* New York: Harper and Row.
New York Times. 1998. Science Academy Disputes Attack on Global Warming (April 22).
Noss, Reed. 1992. A Wildlands Land Conservation Strategy. *Wild Earth on The Wildlands Project*. More recently Noss and Michael Soulé have published a paper on rewilding as an approach to wildlands conservation, emphasizing the importance of top-down regulation. (Soulé, Michael; Noss, Reed. 1998. Rewilding and Biodiversity: Complementary Goals for Continental Conservation. *Wild Earth* 8:3: 19-28.)
Noss, Reed. 1993. Whither Conservation Biology? *Conservation Biology* 7: 215-217.
Paletz, David L. 1997. *The Media in American Politics*. New York: Addison, Wesley, Longman.
Paletz, David L.; Entman, Robert M. 1981. *Media, Power, and Politics*. New York: Free Press.
Primack, Richard. 1995. *A Primer of Conservation Biology*. Sunderland, MA: Sinauer Associates.
Ray, Dixie Lee. 1993. *Environmental Overkill: Whatever Happened to Common Sense*? Washington D.C.: Regency Gateway.
Riding, Alan. 1985. *Distant Neighbors*. New York: Knopf.
Schrader-Frechette, Kristin. 1996. Throwing out the Bathwater of Positivism, Keeping the Baby of Objectivity. *Conservation Biology* 10: 914.
Shepard, Paul. 1990. *Nature and Madness.* San Francisco: Sierra Club.
Society for Conservation Biology Annual Business Meeting. 1995. A special session of the SCB business meeting spent several hours discussing advocacy and ways in which conservation biologists could be more persuasive with the public and policy makers. Two themes emerged from scientists' statements. Academic scientists stated the need for support and credit from their departments for addressing public audiences in the popular media. Generally scientists said they felt most inclined to speak out knowing that there were others that could follow through on the policy process.
Society for Conservation Biology. 1999. Goals and Objectives of the Society for Conservation Biology. *Conservation Biology* 13: unnumbered.
Soulé, Michael, 1986. Conservation Biology and the 'Real World' in Soulé (ed.): *Conservation Biology: The Science of Scarcity and Diversity.* Sunderland, MA: Sinauer Associates.
Soulé, Michael; Lease, Gary. 1994. *Reinventing Nature? Responses to Postmodern Deconstruction*. Covelo, CA.: Island Press. This book offers a thorough discussion of values, relativism, and the ability to know the world.
Strauss, Peter S.; Gellhorn, Walter; Farina, Cynthia R.; Schotland, Roy A.; Rakoff, Todd; Byse, Clarke. 1995. Administrative Law. Mineola, MN: Foundation Press.
Thomas, Lewis, 1974. *The Lives of a Cell*, New York: Viking. *Wild Earth* Special Issue on Reserve Implementation (forthcoming 1999).
Wild Earth. 2000. Special issue No. 3 on the wildlands project.
Wilkinson, Todd. 1998. *Science Under Siege: The Politicians' War on Nature and Truth*. Boulder, CO.: Johnson Books.
Wilson, E.O. 1992. *The Diversity of Life.* Cambridge, MA.: Harvard University Press
Wilson, E.O. 1993**.** *The Biophilia Hypothesis***.** Covelo, CA.: Island Press**.**
Wilson, E.O. 1996. *In Search of Nature*. Covelo, CA.: Island Press.