

whelming majority of circumstances transactions costs will be avoided. This approach also limits debate over the magnitude of a potential harm that has not yet eventuated. The creator of the risk has the incentive to gauge accurately, for he is the one who must pay if harm does occur.

While in principle it provides efficient results, the torts approach encounters at least four difficulties when applied to many of the risks that are encountered in a modern technological society. The option of declaring bankruptcy allows the responsible party to avoid paying and so to impose risks that it should not impose. Causality is often difficult to assign for misfortunes that may have alternative or multiple (and synergistically related) causes. Did the individual contract lung cancer from air pollution or from his own smoking, or both? Furthermore, the traditional torts requirement that individuals be made whole cannot be met in many instances (death, loss of a limb). Finally, paying compensation after the fact may also produce inappropriate incentives, and hence be inefficient. Workers who can be more or less careful around dangerous machinery, for example, are likely to be more careful if they will not be compensated for losing an appendage.

Our normal market and legal system tends to break down when substantial health risks are imposed on a relatively large population. These are, therefore, precisely the situations in which the cost-benefit approach is and should be called into play. Cost-benefit

analysis is typically used in just those situations where our normal risk decision processes run into difficulty. We should therefore not expect it to lead to outcomes that are as satisfactory as those that evolve when ordinary market and private contractual trade are employed. But we should be able to expect better outcomes than we would achieve by muddling through unsystematically.

We have defended cost-benefit analysis as the most practical of ethically defensible methods and the most ethical of practically usable methods for conducting public decision-making. It cannot substitute for—nor can it adequately encompass, analyze, or consider—the sensitive application of social values. Thus it cannot be made the final arbiter of public decisions. But it does add a useful structure to public debate, and it does enable us to quantify some of the quantifiable aspects of public decisions. Our defense parallels Winston Churchill's argument for democracy: it is not perfect, but it is better than the alternatives.

This article is substantially condensed and adapted from "Cost-Benefit Analysis Applied to Risks: Its Philosophy and Legitimacy," by Herman B. Leonard and Richard J. Zeckhauser, Center for Philosophy and Public Policy Working Paper RC-6 (College Park, Md.: Center for Philosophy and Public Policy, 1983). The original includes a wide variety of illustrative examples, which could not be reprinted here. To order this paper and other newly released working papers from the Center's project on risk and consent, see page 15.

America's Public Lands: To Use or Not to Use?

The federal government owns about three-quarters of a billion acres—approximately one-third of the land area of the United States. Although something approaching one-third of these public lands (or one-ninth of all U.S. lands) can be considered preserved lands, only a fraction of these lands are fully protected. The remaining 150 million acres of public lands now set aside from use are either recommended for permanent designation, under study, or under planning. The continuing battles over the final decisions regarding the use of these lands constitute some of the major land-use decisions our country faces.

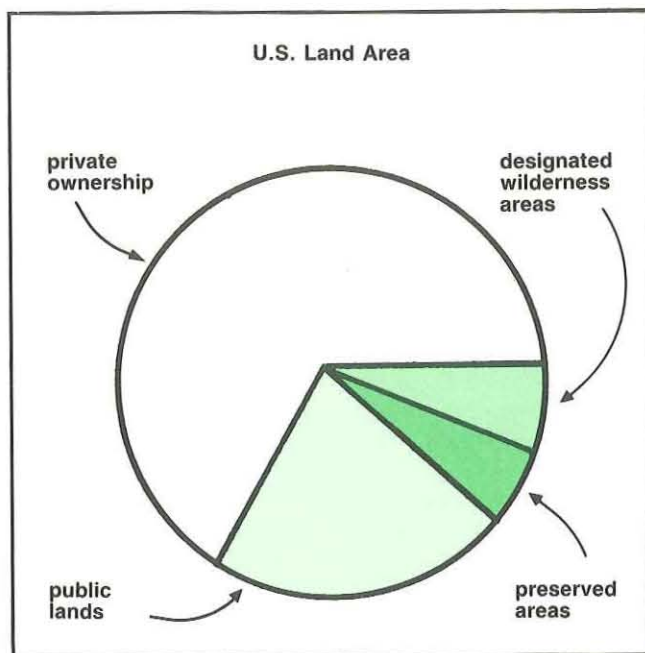
It would be a tragedy if these crucial decisions were made on the basis of short-term economic gains for private corporations or by self-interested defenses of wilderness generated by local environmental groups

bent on forcing the problems accompanying growth to occur elsewhere. Such a tragedy can be avoided only if decisions are made on the basis of rational land use criteria. What concepts, values, and principles underlie such criteria?

Conservation and Preservation

Policies regarding a parcel of land range from radically exploitative to radically preservationist. This continuum is best seen as varying according to the time frame over which the benefits and uses are judged.

Radical exploiters of resources use them in a way that damages or destroys their regenerative capacity. The mathematician/economist Colin Clark has shown that, under fairly common economic assumptions, corporate profits will be maximized by radical over-exploitation.



Economic interest is often served by maximizing short-term profits and reinvesting them in alternative profit-making ventures—in the process destroying the resource exploited.

Conservationists advocate moderate use of resources—the derivation of extractive and consumptive products in a way that does not damage the regenerative processes of the resource. Preservationists advocate removal of the resource from use for consumptive and extractive purposes.

If we assume even a moderate concern for the future, there are obvious advantages in protecting resources that could yield indefinite bounty. This gives us a reason to reject radical exploitation and to advocate vigilance in avoiding destructive use of natural resources. But there remain many controversies among environmental protectionists, which include advocates of moderate use (conservationists) and of removal from use (preservationists).

These controversies cannot be resolved by appeal to the motivations driving the two positions. It is common to suggest that these are diametrically opposed—that conservationists advocate balanced use of nature for human purposes, while true preservationists defend nature for its own sake. This contrast is overdrawn, however. The preservation of unspoiled wilderness can be and has been endorsed for *human* motives, as in the Wilderness Act of 1973, which seeks "to secure for the American people of present and future generations the benefit of an enduring resource of wilderness." When this principle is combined with the factual belief that human beings lack the knowledge to manage complex natural systems adequately, the result is a preservationist stance. On this view, some mature, complex, and relatively large pristine

areas should be set aside from present extractive and exploitative human use, with human management avoided whenever possible.

John McPhee uses an anecdote to illustrate this version of preservationism in his wonderful little book, *Encounters with the Archdruid*. The preservationist David Brower had raised butterflies and

had often watched them emerge from the chrysalis—first a crack in the case, then a feeler, and in an hour a butterfly. He said he had felt that he wanted to help, to speed them through the long and awkward procedure; and he had once tried. The butterflies came out with extended abdomens, and their wings were balled together like miniature clenched fists. Nothing happened. They sat there till they died.

On the preservationist view, butterflies, like the other complex processes of nature, work best when left alone. Human interference does not, in such cases, lead to an improvement.

Thus, while preservationism *could* be justified by a belief that nature is intrinsically valuable and should be protected from human use for its own sake, this difficult-to-understand and even more difficult-to-support position is not essential to preservationism. The preservationist attitude can be fully sustained on a humanistic basis, given a concern for the very long run and a skepticism about human abilities to manage ecosystems over such long periods of time.

The conservationist and preservationist positions *are* distinguished, however, by different underlying concepts of ecosystem health and stability. Moreover, an examination of these concepts assists in making a choice between the two positions, since ecological theory favors the preservationist over the conservationist concept of ecosystem stability. Thus ecological theory provides strong support for the view that the best way to secure human benefits from nature over the long run may be to remove significant tracts of land from current human use.

Two Conceptions of Stability

Both conceptions of environmental protection embody an idea of what it is for an ecosystem to function normally. The core of this idea is the belief that a system is healthy only if it is in some sense stable. But the concept of stability is notoriously ambiguous, and conservationists and preservationists implicitly use two different conceptions of stability to inform their view of protectionism.

Conservationists tend to interpret the stability of a system statically, in terms of concepts such as constancy or resilience. A system is constant if it does not change through time; a system is resilient if it undergoes change, but demonstrates an ability to return to its normal (i.e., predisturbance) state after a disturbance. This cluster of stability concepts treats change as in one way or another abnormal.

The static view of stability comes naturally to conservationists because of their dominant concern to increase the output of some small number of products

that contribute to human well-being. Since humans find only a few natural products useful for their purposes, human needs dictate a limited definition of natural productivity. Furthermore, since it is difficult to project human demand for products beyond a generation or so, the conservationists' concern for constant production of consumptive products encourages a focus on short- and medium-term productivity. Major structural changes in an ecosystem are likely to decrease rather than increase production of these goods, because as the system becomes more diverse, energy inputs will be distributed more widely. Thus, when productive systems begin to change, whether as a result of natural or artificial forces, conservationists propose further management of the system, with the goal of maintaining the system's constancy or at least resilience, so that it will continue to yield the desired products.

concentration on the autonomy of systems shifts attention away from particular products of human interest and so away from short- and medium-term goals to a concern for the very long run.

Ecological theory lends strong support to dynamic concepts of ecosystem stability. Constancy hardly ever occurs in nature. Even when a system appears constant, it is usually because compensatory changes return the system to equilibrium. Ecosystems are normally resilient, provided that perturbations do not exceed a certain threshold of severity. But if that threshold is exceeded, then the system may collapse or a new equilibrium may be established.

Systems change, both in response to internal developments and to external pressures. Systems pass into new developmental phases or, in response to heavy exploitation, restabilize at lower levels of complexity. Systems change through ecological time as a

Photo credit Bureau of Land Management



The Aravaipa Canyon Wilderness Area, Arizona

Preservationists, on the other hand, view stability dynamically. On this view, a system is stable even through profound changes in structure and function, provided those changes result from patterns that emerge from the present internal states of the system. For example, if a pine forest ecosystem passes naturally into a mixed hardwood forest in the absence of a major disturbance, this system can be considered stable in the sense that its alterations are predictable on the basis of causes inherent in the system.

Since preservationists view natural systems as autonomous, highly integrated, and dynamic, they doubt that the knowledge and ability of humans is sufficient to manage a system totally and see each intentional modification by human manipulation as one more chance for natural functioning to be disrupted. Their

result of successional development, and they change through evolutionary time as a result of natural selection. Thus the conservationist's concept of stability does not encompass the entire range of ecosystem functioning.

Ecological theory also suggests that the conservationist faith in the prospects for human management of complex ecosystems is misplaced. If the goal of our wilderness policy is to protect biological diversity over the long run, manipulation of systems for productive outputs is counterproductive. It is well known that human management of a large area over time results in less diversity. Agriculture and forestry deliberately limit diversity and channel productivity into a small number of outputs. The preservationist, accepting some managed land use as necessary, insists that some

other lands be set aside to compensate for this loss of diversity in the heavily managed lands. Only by setting land aside in this way can anything like the full range of species and ecosystems be perpetuated for future generations, in the face of increased use for the fulfillment of human needs.

Finally, research on island biogeography has shown that species diversity is directly correlated with island size. Since land preserves are analogous to islands, this provides an argument that larger preserves are preferable to smaller ones.

Conclusions

The conflict between conservationists and preservationists is not a purely scientific one—public policy debates never are. It cannot be resolved by empirical means alone. If, however, we begin with the assumption that our society is committed to the goal of protecting biological diversity for the benefit of future

generations of Americans, there seems to be scientific evidence that only a preservationist approach can succeed. It is an important point in the preservationists' favor that the full range of data is better comprehended using their concept of predictability than the conservationists' favored indicator of resilience. The dynamic features of fragile ecosystems cannot be protected by management initiatives designed to maintain a static concept of stability. The preservationist approach deserves serious attention as we continue our national debate over the use of our remaining unspoiled lands.

This article is drawn from "Conservation, Preservation, and Controversies About the Use of Public Lands," a talk given by Bryan G. Norton, Research Associate at the Center for Philosophy and Public Policy, at the May Third Thursday Briefing, sponsored by the Center for Philosophy and Public Policy. Third Thursday Briefings, held on Capitol Hill from February to June, bring together academic theorists and policymakers to discuss the ethical or conceptual foundations of central policy decisions.

Brave New Office

A century ago the typewriter revolutionized American offices—and in the process transformed clerical work from a high-status male profession to a low-status female job. The gentleman's secretary became "just a secretary," with pay and career opportunities curtailed accordingly. Today the computer promises to bring far more sweeping changes, as the explosion in microprocessing begins to reverberate in the typing pool. Already the word processor has replaced 10 percent of the typewriters in the nation's 500 largest industrial companies, and with the cost of labor rising and the price of electronics dropping, few doubt that the automated, computerized, electronic "office of the future" is on its way.

A first fear is that office automation will boost clerical unemployment; optimists counter that the computer will create new jobs as it destroys old ones. But what will these jobs be like? How will they affect the workers—predominantly women and predominantly un-unionized—who have to do them? The "office of the future" raises important and troubling questions about the rights of workers and the nature and meaning of work.

Computers: Hazardous to Your Health

One danger of the electronic office lies in the deleterious health effects on the now more than 10 million workers who stare at video display terminals (VDTs) during their working day. A 1979-80 study by the National Institute of Occupational Safety and Health found high levels of both physical and mental stress among terminal operators, ranging from back-

aches, headaches, and eyestrain to depression and fatigue. Operators report that work on the terminals, however more efficient, is far more exhausting than work on old-fashioned typewriters.

The Occupational Safety and Health Act of 1970 takes as its stated purpose "to assure so far as possible every working man and woman in the nation safe and healthful working conditions." The right to a safe and healthful workplace is already guaranteed by law (although enforcement is lax and spotty), so office workers whose health is jeopardized by the stampede to computerization should face no new legal or moral battles.

Computer-age health problems seem amenable to commonsense remedies. Terminals can be redesigned to reduce glare and to achieve better contrast between text and screen; detachable keyboards and adjustable tables and chairs considerably improve worker comfort. These simple and relatively inexpensive design features have not been widely adopted, however. A more direct and effective solution is to limit the hours workers spend in front of the terminal. In Norway and Sweden, for example, workers cannot be required to do steady VDT work for more than four hours a day, scheduled in a two-hours-on/two-hours-off rotation. Even in this country, Newspaper Guild contracts negotiated for four newspapers in Minneapolis and St. Paul grant terminal operators extra rest breaks of up to 30 minutes a day.

These health problems are exacerbated, however, by other deeper problems posed by office automation. Computers can be used to increase the pace and