

# natural resources Journal

Published four times a year by The University of New Mexico School of Law

VOL. 10

APRIL 1970

No. 2

## THE ECOSYSTEM AS A CRITERION FOR PUBLIC LAND POLICY\*

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A public lands policy restricted to lands in governmental ownership has been politically expedient but ecologically unrealistic. The natural processes of physical and biological systems that comprise the land do not necessarily accommodate themselves to the artificial boundaries and restrictions that law and political economy impose upon them. The stress of human demands upon the land tends to displace natural processes throughout its ecosystems and to impair the capacity of the natural environment for self renewal. American public land policy is based upon a set of historically derived assumptions—legal, economic, and political—that provide no means for taking the fundamental ecological context of land use into account. It is, of course, necessary to cope with land problems within the conventional context of public attitudes, laws, and economic arrangements, inadequate though they may be to encompass all of the land related needs of contemporary society. But it is also important to know that there is a larger context for policy with which laws and governments must ultimately reckon: it is the condition of the land as the physical base for human welfare and survival. If human demands upon the natural environment continue to mount, it will become necessary as a matter of welfare and survival to abandon present land policy assumptions for a policy of public management of human environment on ecologically valid principles. The proposed National Land Use Policy Act of 1970 (S. 3354, Jackson) specifically indicates ecological factors as criteria for sound land use planning and establishes a national-state-local system for obtaining comprehensive land-use planning and management in which ecologically sound principles are favored.

How would a public land policy based upon ecosystems concepts differ from policies based upon other considerations? Public land

\* This paper is an elaboration and extension of an earlier version, *An Ecosystem Approach to Public Land Policy*, presented at the Tenth Annual Western Resources Conference, Colorado State University, July 1-3, 1968.

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policies here and abroad have traditionally been based on juridic, economic, or demographic concepts.<sup>1</sup> Land planning based on sectoral analysis (essentially on economic and social uses) has been the predominant source of policy in those countries in which the rational allocation of natural resources in land has become an accepted public responsibility. Spatial planning, "which considers man and his natural environment in their geographical and historical associations" is an alternative complementary approach to land policy, but does not necessarily take ecological considerations fully into account.<sup>2</sup> Ecological considerations, although not always by that name, have sometimes influenced land policies. But an ecosystems approach to public land policy has seldom been attempted on national or regional scales. The reason does not lie wholly in the complexity and ambiguity of ecosystems, although these are deterring factors. Failure to apply ecological criteria to land use policies is primarily the consequence of two related causes. The first is the inability of society, because of inadequate knowledge, insufficient wealth, or incompatible institutions, to build ecologically based land policies into a general system of environmental management. The second, and more obvious, is incompatible interests among competing land users.

An ecosystems approach to land policy encounters resistance to the degree that it is inconsistent with the values, assumptions, institutions, and practices that shape the prevailing social arrangement which affect the custody and care of the land. Ecological considerations may, in themselves, be compatible with specific aspects of traditional land use arrangements. For example, specific legal restrictions in Denmark, the Netherlands, and the United Kingdom are designed to protect and perpetuate certain traditional uses of the land for ecological reasons as well as for sentimental and esthetic purposes. Incompatibility among uses derives as often from the structuring of land use arrangements—from the way in which the various institutions influencing the use of land are related—as it does from contradictions among the uses themselves. Thus the factors involved in banking, taxation, insurance, and property law, when woven into a non-ecological matrix of public land policy, afford a very resistant, inadvertent barrier to an ecosystems approach. To establish rapidly a land policy in which ecological principles predominated would require that the conventional matrix be unravelled and rewoven

1. C. Haar, *Land-Use Planning* (1959), *Law and Land: Anglo-American Planning Practice* (1964). See also, C. Berger, *Land Ownership and Use* (1968).

2. E. Ackerman, *A View of Terrestrial Space*, (a review of *L'Organisation de l'espace: Éléments de géographie volontaire* by Jean Labasse, Paris; Hermann, 1966, 157 Science 1031. Labasse's book is a major contribution to the literature of land policy and planning.

questions. It is certain to arouse objections among persons unwilling or unable to consider normative concepts. It may fail to interest persons who believe that the only practical focus of public policy is upon the condition of things as they are. Nevertheless, goals and values are implicit in the concept of "policy." The student concerned with the public interest must examine the relevance of public policies to changes in the condition of society and to future stability and welfare. Not all criteria for the formulation and application of a policy afford equally effective means to its specified ends. Moreover, not all goals or objectives serve equally well the general or long-term interests of society. For example, policies that permitted massive and continuing loss of top soil or encouraged price-escalating land speculation would not be a good *public* land policy under any criteria, however beneficial they might appear to be to the immediate interests of particular land users or owners.

In the United States, and particularly in the West, ambiguity can easily occur in the use of the expression "public land policy." Does the expression connote a public policy for land generally—all land? Or does it refer only to policies regarding lands in public ownership? Conventional American assumptions and word usage take the latter definition as the more practical and appropriate. Yet eminent domain, land use zoning, and sale of land for tax delinquency, make it clear that public jurisdiction over land is general and not confined to public ownership. An ecosystems approach to public land policy assumes a scope that embraces all land regardless of its ownership or custody under law. The metes and bounds of ecosystems are determined by physical, biological and cultural forces. Men may impose their own arrangements on natural systems, but engineers, surveyors, and lawyers neither amend nor repeal the so-called laws of nature. Ecosystems form a complex unity embracing the entire earth. And although men have never been able to deal with the ultimate unity of the ecosphere, they have been learning more and more about its interrelated workings. As more has been learned, the practicality of introducing ecological concepts into land use policy is enhanced. But the word "practicality" may be given two different interpretations. There is a conventional short-run practicality of socially sanctioned arrangements. There is also a long-run practicality that takes account of ecological trends, assesses the consequences of their continuation into the future, and estimates the effects of modifying forces that may impinge upon them.

Implicit in the ecosystems concept is recognition that maintenance of the ecosystem depends upon the consistency of man-made standards, laws, and boundaries with those that have evolved through

in a new pattern. In a colony on the moon there would be an overwhelming presumption in favor of a predominately ecological approach. The arguments for survival would outweigh all others. On earth, ecological criteria will increasingly modify or replace other indices of value as the constraints of the closed-system environment of Spaceship Earth become increasingly apparent.

The context of land policy changes when the ecosystems concept is introduced. The discourse can no longer be confined realistically to lands in governmental ownership, but must take into account whatever lands are included in particular ecosystems, regardless of who holds title to them. This broadening of the policy context may be opposed by persons committed to the inviolate right of private landownership, or who hold specific interests in land use that they believe might be threatened by public action. Ecological principles are more often and more easily applied to government lands than to private holdings. Pressure for rapid economic return, and the financial or technological inability of the private owner to apply ecological concepts, are the more common explanations. But if the management of whole ecosystems becomes a matter of public policy, then the formulation of public land policy must proceed upon the basis of the proposition that all land is in some degree public.

To conceive an ecosystems approach to public land policy, one must have first arrived at an ecological viewpoint toward the world of man and nature. But this is not the viewpoint from which pioneers, land speculators, farmers, miners, stockmen, lawyers, bankers, or local government officials have commonly seen the land. To institute an ecosystems approach to public land policy, a great many other things besides land must be considered. An ecosystems approach is essentially a total systems approach. It therefore includes in its purview many things omitted in less comprehensive systems. It would impose constraints upon single purpose approaches to the environment and would arouse hostility among individuals whose single purpose pursuits would thereby be constrained.

## I

### IMPLICATIONS OF AN ECOSYSTEMS LAND POLICY

Before examining more closely the ecosystem concept and the opposition to its implied modification of rights of landownership, the implications of the term "public land policy" must be identified, as they are basic to the questions: What approach to land policy is most consistent with the public interest? All things considered, what policy is best? The term "best" arouses a multitude of subsidiary

natural processes. For example, man's structural works or artificial boundaries when forced into or across a natural system may alter, impair, or destroy it. The Southern Pacific Railroad causeway altered the ecology of the Great Salt Lake, and land fills on the Eastern Seaboard estuaries are impairing numerous and valuable marine and salt-marsh ecosystems. Persistent mining of ground water has changed the ecology of soils and land surfaces in many parts of the United States, notably in central Arizona. It is obvious that man-made ecosystems will inevitably affect those of natural origin where civilized society exists. It is not obvious, however, that human changes must always be destructive to natural systems or that, with thoughtful planning, man-made and natural ecosystems could not more often coexist in harmony.

But why this concern with an ecological basis for land policy? By what reasoning is an ecosystems approach to land use more useful or more valid than any other? Are ecological criteria merely the tools or overt expressions of a naturalistic ideology—an ecological mystique—which some nature lovers and a few apprehensive scientists would substitute for the economic common sense of people who know that the practical business of life continues to be the procuring of food, clothing, and shelter? Does an ecosystems concept impute some teleological design to nature? Is man required to seek out nature's purposes and adapt his laws and practices to nature's ends regardless of his own needs and purposes? The ancient Christian, substituting God's purposes for nature's, could have affirmed this proposition. Adherents to natural law concepts might still do so. But in the dominant societies of this technoeconomic age, mastery or manipulation of nature has become a goal that sometimes approaches a secular religion. Nature, if she has purposes, does not reveal them in language that contemporary man has been able to understand. Technological man, however, has defined and developed his own purposes in relation to nature. These purposes basically require the obtaining of food, clothing, and shelter from nature, and to this end man has organized his relationships with his environment on the basis of the uses he makes of particular components of the natural world. These components are the familiar "natural resources."

As long as man's numbers were few, his technology simple, and his demands upon the natural world limited, it was feasible to deal with the land and its products as if they were no more than discrete resources. Man was unable simultaneously to make both rapid and far-reaching changes in natural ecosystems. Major ecological changes, such as deforestation or the spread of cultivation over the grasslands required time, measured in Europe and Asia by centuries.

Some of these changes, as in the brittle, sub-arid ecosystems of the Middle East were cumulatively destructive. Other changes, as in the clearing of forests for agriculture in Western Europe, largely substituted one ecological system for another of comparable stability and productivity. But modern science and technology have permitted man to upset longstanding ecological balances. His numbers have multiplied without restraint. His technology has become powerful and complex with unpredictable side-effects, and his demands upon his environment have grown inordinate. Competition for resources has rapidly increased and conflicts among resource users have become a major phenomenon of politics.

If the categorizing of the products of nature into "natural resources" had been based upon a comprehending, selective utilization of the ecosystem, the implications of this "development process" for the integrity and survival of the ecosystem would have been available as a source for principles by which conflicts over resource uses might have been mediated. But ecosystems integrity as a criterion for policy choices has followed, not preceded, the natural resources concept of man-environment relationships. As a consequence, public land policy has shared in the contentiousness associated with the politics of natural resources, and the ecosystem concept has had as yet little mediating effect upon land-use conflicts. Neither in politics nor in administration has there been a generally accepted body of knowledge or doctrine by which conflicts over resource uses could be readily resolved. In the absence of an "ordering" or organizing concept, efforts to coordinate natural resources policies have been largely ineffectual or have been used as covers to impose or prevent one use over others. Prior to the recent intensification of the water pollution issue, the major impetus toward coordinative efforts in water policy may be seen as efforts to restrain the autonomous and arbitrary exercise of power by the Corps of Engineers, or it may be seen as efforts to reconcile differences between the Corps and competing agencies, most frequently the Bureau of Reclamation.

Public policy for land use, as for resources use generally, has been decided chiefly through trial by political combat. "Conservation" as a concept has been helpful principally as an intermediary proposition, midway between unrestricted competition among resource users and an ecologically based view of public responsibility for the self-renewing capabilities of the ecosystem. Aphorisms such as "conservation means wise use" are of little help in the absence of objective criteria for wisdom. An ecosystems approach to public land policy implies the possibility of public decisions based upon empirical principles of

public interest in environmental quality and in the self-renewing capabilities of natural systems.

Availability of an objectively rational basis for land policy decisions (if such a basis is actually possible) does not imply, as a matter of course, that this basis will be accepted or acted upon. Human beings may be expected to act more often on a subjective level of rationality than upon more objective and enduring principles. But, until the ecosystems concept has been articulated and its amenability to practical application demonstrated, it is unavailable as a basis for policy. Yet, although the ecosystems approach to land policy remains largely on the theoretical level, it is nevertheless available for practical application at such time as it is perceived as a means of coping with the ecological predicament into which man has blundered.

To understand the ecological predicament of modern man is to begin to understand why an ecosystems approach may ultimately become necessary to human well-being and even to survival. Unfortunately, an understanding of the circumstances, now often described as the "ecological crisis," carries no automatic insight in how to correct or prevent conditions that are almost universally conceded to be harmful. If, as we shall presently contend, application of the ecosystems concept implies a wholly new way of organizing man's relations with the natural world, an ecosystems approach to public land policy implies fundamental changes in the rights and responsibilities of individuals and corporations in the possession and use of land.

It may not be too much to say that ecologically-based public policies imply a thorough-going transformation of some major sectors of the nation's political economy. The nature and scope of a public land policy based on ecological principles would be comprehensive and coordinative. The individual land-owner would lose certain rights and gain certain protections. Controversies over land use would be more often settled by administrative than by judicial means, and the criteria for settlement more often ecological fact than statutory law. Substantial changes could be expected to take place in the practical economics of land use. Application of ecological concepts would find a major obstacle in the treatment of land as a commodity. Private possession of land under ecological ground-rules could be made consistent with an ecosystems approach to land policy. But the freedom to buy, sell, or transfer land without regard to the ecological consequences of the intended or resulting action would not be consistent with an ecosystems approach. *Laissez faire* land economics, although deeply rooted in American folkways, is becoming increasingly inconsistent with the interests of the vast majority

of citizens—a majority of citizens who live in great cities, own no land, and for whom the needs and amenities of life are becoming increasingly costly and difficult of access. All the same, the transition to an ecological approach will be painful, for as John Ise once remarked, “. . . Americans are land value animals. For three hundred years they have been moving westward seeking titles to land they hoped would rise in value; for three hundred years they have been following the lure of unearned increment, the beacon light of ‘something for nothing’. . . .”<sup>8</sup>

## II

### THE SUBSTANCE OF AN ECOSYSTEMS APPROACH

The ecosystems approach has been advanced as a new way of defining public land policy. It would clearly be different from policies now dominant in the United States and to a large extent in other countries also. But the specific ways in which ecosystems relationships could be used as criteria for public policy for land must be defined before their operational feasibility can be assessed. The following summary of the salient properties of ecosystems criteria suggests some of the practical advantages to be gained from their application to land policies.

The first and essential characteristic of the ecosystems approach is its wholistic emphasis. In a pluralistic political-economy that has generally eschewed wholistic thinking, this comprehensive outlook and analysis is a salutary corrective to the tendencies of society to attack problems on a linear or single purpose basis. The novelty of wholistic analysis is now greatly reduced by the growth of systems thinking in government and industry. Indeed, ecosystems criteria may be taken as an application of systems thinking to relationships among natural and artificial environments. Ecosystems criteria, for example, are absolutely essential to the construction of life-support systems for the exploration of the moon and outer space.

Secondly, ecosystems criteria are based on scientific knowledge, although science does not yet have adequate answers to all ecological problems. Public land policies are not notably based on scientific considerations. To enlist science in determining the *goals* of domestic policy is a departure from tradition, although science has often been invoked on behalf of policies adopted by other than scientific rea-

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3. Ise, *Too Much and Too Poor*, in *The American Way* 103 (1955) (published by members of the Faculty Department of Economics, School of Business, University of Kansas). John Ise was for many years a stimulating and productive professor of economics at the University of Kansas and wrote extensively in the field of public policy for natural resources.



soning. For example, the Bureau of Land Management applies many scientific concepts in its administration of federal public lands, but there is much less science in the laws under which the total public land system operates. Obviously, science does not contain the answers to all policy questions, but in the present state of confusion and contradiction that characterizes land law, at least in the United States, scientific criteria might afford an objective basis for mediating otherwise irreconcilable disputes.<sup>4</sup>

Thirdly, an ecosystems approach uses administrative means in preference to adjudication. This becomes possible to the extent that laws, policies, and actions are based on scientifically ascertainable facts rather than on political or technological fiat. Questions of fact become more important than questions of law (at least in a technical sense). Numerous issues, once litigated in the courts, cease to be issues when certain rights, practices or beliefs associated with land ownership are confirmed, modified, or extinguished by demonstrable evidence.

The substance of an ecosystems approach appears simple, although ecosystems are themselves infinitely complex. The approach begins with an assumption derived from scientific inquiry. The natural world is a composite of interrelating life-systems subsisting in a highly improbable terrestrial environment. This environment—the ecosphere—is finite. Some of the components are naturally renewable, others are not. Of its renewable components (or resources) some are capable of restoration within a time dimension meaningful to man. But others, fossil fuels, for example, are incapable of renewal, although for some resources substitutes may be found.

The ultimate necessity of an ecosystems approach to environmental policy, including land, follows from the finite amount of land, water, air and other substances upon which the human economy depends, and the infinite character of human demands upon the environment. The heavier the stress of human demands upon the environment, the greater the degree to which those demands must be coordinated and policed in order that the economy continue to function. In an economy of scarce essentials and pressing demands, either the strong preempt resources and deprive the weak, or, where democratic collectivism prevails, socialization, rationing, licensing, and summary police action are instituted to insure fair shares. Polit-

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4. The need for more adequate criteria for policy to remedy the present confusion and contradiction in the laws governing public (government) land has been outlined by Irving Senzel, Assistant Director, Bureau of Land Management, U.S. Department of the Interior in a paper, *Public Land Laws and Effective Management*, in *Proceedings of the 10th Annual Western Resources Conference*, Fort Collins, Colorado, July 1-3, 1968.

ical *laissez faire* in relation to the environment is feasible only when the demands that man makes upon it are relatively light and when natural ecological processes are permitted to operate, continually renewing the ecosystem so that what man uses today is replaced for his use tomorrow. The argument for ecological sophistication in public policies for land and the environment is no longer primarily the threat of shortages of food, energy or raw materials for industry that troubled the "classic conservationists." The more fundamental danger is to the quality of life and to human freedom—especially personal freedom—that will follow from a course of action that presses society to extremities in the maximum utilization of resources and space. Total resource utilization may well require total social control and the loss of choice and variety in life as the price of continuing subsistence.

Throughout nearly all human history man appears to have enjoyed a generally favorable ecological equilibrium. There were, of course, exceptional circumstances in which natural disasters or human errors disrupted a particular localized part of the ecosystem. Earthquakes, floods, droughts, epidemics and famines have disturbed the equilibrium, but the ecosphere as a whole has maintained its stability over thousands of years even though suffering and death have resulted from its localized oscillations. Technology and science have enabled man to cope more effectively with natural disasters, and in some measure to prevent them. But the very success of the human enterprise has created its greatest danger. Technoscience has now given man free rein to increase his numbers and his demands. The result has been a runaway increase in human populations and unremitting pressure on all resources, including land.

This rapid inflation of people and their demands has already impaired the quality of the human environment over large areas of the earth and threatens more serious damage in the years ahead. But at the present stage of human affairs, contemplation of the almost certain consequences of ecological folly is less painful than undergoing the changes that would be required to bring man-environment relationships into ecological balance. There may yet be time to preserve a margin of personal freedom, of environmental variety, and of unforecasted opportunities that would be comparable to what man has experienced in the past. But the prospect of these conditions surviving into the next century is lessened every day. Science fiction, which often assumes a role of prophecy, presents the bleakest of prospects for human freedom and variety. The triumphs of science and technology do not seem to include the timely mastery by man of the cybernetics of his ecosystems. To accomplish this, he would

first have to bring his impulses under control and to exercise a collective self-restraint that has not yet become one of man's strong characteristics.

The idea of instituting lesser controls *now* to protect basic values and to avoid more drastic measures later has little contemporary appeal. It is the American way, and indeed the human way, to react to crises rather than to forestall them. For who can be sure that the threatened crisis will actually materialize? There is no end to conventional wisdom on behalf of procrastination. What candidate for elective public office would advocate action in the face of dangers that were neither clear nor present in the perception of his constituents? How many politicians would commit themselves to the prevention of dangers that, if real, could only be prevented by an inconvenient rearranging of present institutions and relationships, and would cost prospective voters the happy prospect of something-for-nothing gains?

*human welfare*  
Contrary to allegations sometimes made by persons who see it threatening their particular interests, ecosystems policy is not anti-people. Human welfare, now and in the future, is its objective. But the welfare of the individual is ultimately dependent upon the viability of the life-supporting ecosystem. Impoverishment of an ecosystem means impoverishment of all society dependent upon it. For example, to preserve wetlands and estuaries from being drained or filled for dry land uses is not to prefer ducks and muskrats to people. It is rather to prefer the interests of the whole of society in a viable ecosystem to those self-centered interests that would jeopardize the ecosystem for immediate and personal monetary gain.

The substance of an ecosystems approach to land policy is to identify, to protect, and in the interest of human welfare, to manage the natural ecosystems upon whose continuing viability human welfare depends.<sup>5</sup> So far as feasible, an ecosystems approach allows natural processes to carry on the work of self-renewal unassisted by human effort. To the extent that man can rely upon nature to renew the ecosystem, human effort that might otherwise be required for the management of nature is freed for other purposes. The pressure of human needs has forced man under certain conditions into the substitution of artificial for natural ecosystems. Elaborate systems of irrigation, drainage, and flood control are examples of artificial environments that are safe and productive only at the price of un-

5. For a specific example of ecosystems criteria for policy and management see a recently published Masters thesis by B. McClelland, *The Ecosystem—A Unifying Concept for the Management of Natural Areas in the Natural Park System*, Colorado State University, 1968.

remitting attention to maintenance of their systems. The great city is, of course, the most artificial and vulnerable environment of all and exacts from its inhabitants a heavy toll for systems maintenance.

To describe these systems as artificial is not to condemn them or to suggest that they are intrinsically inferior to natural systems. Civilization requires the construction of artificial ecosystems. The ecosystems approach to their management is not to return them to nature, but rather to benefit to the fullest extent from the operation of natural processes. The ecosystems approach implies an understanding of and respect for the potentialities of natural systems. To substitute wherever possible the economy of nature for human effort is the essence of economic as well as ecological good sense. Obviously, it is often necessary to channelize and direct natural forces in order to benefit from them. The extent to which human intervention in natural systems is economically or ecologically justifiable cannot be determined in the absence of demonstrable evidence. A particular high level dam, for example, may or may not be justifiable under an ecosystems approach and in comparison with optional ways of achieving its objectives. It is, however, safe to surmise that a blanket injunction to put *all* rivers under engineering management, or to ignore them altogether, would be very dubious ecological or economic wisdom.

When society works itself into an ecological straight-jacket, the ecosystem itself may be destroyed in efforts to break out of self-induced but unintended deprivations and constraints. Ecologically overstressed societies are impelled to further intensification of pressure on their environments in an effort to survive. Political leaders of over-populated, ecologically impoverished nations are seldom apt pupils in the school of resources conservation.<sup>6</sup> Survival for them often means getting from the environment whatever can be gotten today, regardless of the consequences for tomorrow. An ecosystems approach to land policy thus also implies a policy of population control. Unless population pressure is manageable, no other aspect of the ecosystem can be freely managed indefinitely. Ultimately the pressure of sheer numbers and the attendant demands upon the ecosystem would force all environmental policies into serving the one overpowering objective of maintaining a minimal existence for the human masses.

There are alternatives to such a course of constrained futility.

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6. Impressive documented evidence to this effect has been assembled by the Conference on the Ecological Aspects of International Development, Warrenton, Virginia, December 8-11, 1968. A published volume containing the papers and proceedings of this conference is being edited by John P. Milton of the Conservation Foundation and M. Faghi Farvar of the Center for the Biology of Natural Systems, Washington University.

Among these might be one classed under the heading of unthinkable thoughts. This course would be for a tough-minded and ecologically sophisticated elite to impose ecological order on their less perceptive or self-disciplined brethren. How this might be done, however, is not clear. Unfortunately, political astuteness and charisma seem more often to be found among the ecologically illiterate members of society. Compulsory population control through biomedical science if possible, or Malthusian control if all other means fail, could very well be the outcome of the present unwillingness of human societies to assess their ecological predicament realistically. Land is a substantially inelastic resource and this means that as human population multiplies, land policy is increasingly determined by population policy. The inseparable connections between land use, population and the public interest have been identified with exceptional clarity by Garrett Hardin in his essay, *The Tragedy of the Commons*.<sup>7</sup>

Among the conflicts in our future-oriented technoscientific society is its fragmented and contradictory treatment of time. The relativity of time has become commonplace, and for certain purposes as in space flight, atomic technology, and medicine, very refined concepts of time are employed. With respect to the dynamics of the ecosystem, however, the time perceptions of modern man are perhaps less developed than those that characterized his agrarian ancestors.

Modern man has not learned to perceive the world as a complex of dynamic interrelated systems. His behavior suggests that he believes the world to be an infinitely open system. Within this open system, time and change have a different meaning than they have when the system is closed. When closed, there is no escape from mistakes, and the consequences of a chain-reaction once started in time cannot be avoided by inter-planetary flight. Space exploration has reinforced the illusion that the infinity of the cosmos offers a way out for earth-bound man. The reality for society in the ascertainable future is that the earth must be considered a closed system, even though it is in continual interaction with the galaxy.<sup>8</sup>

Within this essentially closed system, change is continuous. Man's future is inextricably involved with changes in the air, water, and land which are the gross elements of the ecosphere. He has himself become a principal change agent. His numbers and technologies have the effect of accelerating changes in time, of wearing down land forms, of in-

7. 162 Science 1243. The population versus land issue has also been forcefully stated by P. Sears, *The Inexorable Problem of Space*, 127 Science 9, and by G. Macinko, *Saturation: A Problem Evaded in Planning Land Use*, 149 Science 516.

8. The impact of the closed system on politics and economics was most clearly enunciated by K. Boulding, *The Economics of the Coming Spaceship Earth*, in *Environmental Quality in a Growing Economy* (H. Jarrett ed. 1966). The implications of

creasing the salinity of the sea, and of altering the chemistry of the atmosphere. Only the most comprehensive surveillance of the side effects of technology, and the most carefully evaluated application of science and technology to the ecosystem can prevent inadvertent damage to its self-regenerating capabilities. To be effective, management of the ecosystem must conform to the appropriate time table of nature, not merely to the convenience of man. To illustrate, a dollar crisis or a Far Eastern war may offer politically defensible but ecologically invalid arguments for delaying efforts to save the Great Lakes from death by pollution. Today there may be higher political priorities, but, ecologically, tomorrow may be too late.

### III

#### IN DEFENSE OF AN ECOSYSTEMS LAND POLICY

The intention in this article is not to describe the content of an actual ecosystems land policy. To attempt this without reference to specific places, times, and circumstances would be to contradict the very thesis that has been developed. It is the ecosystems *approach* to policy that has been introduced. It was conceded at the outset that no such comprehensive approach to land policy exists in the United States. If such a policy based on ecological concepts were to be adopted, some major changes in the laws, expectations, and governmental arrangements in American society would also have to occur. These changes are not of the kinds that have been of primary concern to the Public Land Law Review Commission nor have they been the responsibility of the Division of Lands and Natural Resources of the United States Department of Justice. But if they are not the practical problems of the present, they may well be the compelling problems of the future. If the implications of this article are correct, American society and indeed mankind generally will eventually be forced into something like an ecosystems policy for land.

In essence this article asserts that man's predicament is that of passengers on a spaceship whose destination is unknown, whose numbers and appetites are increasing, and who have been long accustomed to quarrelsome and improvident conduct. The passengers assume that the builders of the spaceship endowed it with self-renewing mechanisms so that they need take little thought of its maintenance. Moreover, because the ship is very large, they act as though it were infinite, although they are quite capable of calculating its

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the closed system for resources policy and human society have been explained by M. Kelso in a paper, *Man, Natural Resources and the Quality of Life*, prepared for a seminar at Montana State University, December, 1967.

carrying capacity for given levels of safety and convenience. They know that there may come a day when its resources will be taxed beyond capacity. But they are also possessed by the optimistic thought that before the day of disaster arrives, they will land on some habitable planet. And so there is doubt among them as to the practical necessity for restraint.

This is the paradigm of Spaceship Earth whose passengers are only now beginning to realize where they are. Only the ecologically informed among them are aware of the growing precariousness of their condition. Unfortunately, the practical men who are the leaders and managers of the enterprise, although well-informed in many important ways, are generally uninformed or misinformed in this important respect. Their attention is on the lesser mechanics of the enterprise and on the mediation of quarrels among the passengers that might destroy the ship prematurely. Is it then to be conceded that the outcome of the voyage is hopeless, that the passengers cannot be taught, and that the officers and crew are unwilling to learn? No incontrovertible evidence compels this conclusion. It is equally plausible to assume, because human civilization is in itself a highly improbable phenomenon, that the limits of its improbability have not yet been reached. Unlikely as it may be, it is possible that American society, if not mankind generally, may reassess its circumstances with sufficient realism and insight to avoid ecological foreclosure. It is conceivable that people may voluntarily adopt ways of organizing their economy and of behaving in relation to the natural environment so as to bring the economy and the ecosystem into a dynamic, self-sustaining equilibrium.

It is hardly to be expected that the ecosystems policy can be made attractive to persons who would suffer real economic or psychological loss through its implementation. These persons, however, constitute a relatively small, although disproportionately influential, force in society. A greater number of Americans appear to have been wedded to certain fundamental concepts and institutions that do not serve them well. This incongruity between real needs and postulated values has been especially strong in matters of land use regulation and environmental management. Urban apartment dwellers appear in large numbers to subscribe to environmental policies appropriate only to the life and times of Daniel Boone. A more adequate understanding of the values, attitudes and understandings of urban Americans in relation to natural systems is greatly needed.

If present demographic projections are valid, the America of the 21st Century, and even before, will be politically dominated by the residents of great cities. Their beliefs and wishes could reshape pub-

lic policies toward land. Few of the millions of urban residents will be owners of land; few will have a personal stake in returns from its rental, sale, or exploitation. But all would be in some measure dependent on it for the realization of other values. The great mass of urban dwellers are therefore not likely to be hostile to ecosystems concepts. They are likely to be totally unfamiliar with it, and to be unable to appraise its significance or its meaning for their lives. Defense of the concept among landless urbanites is thus largely a matter of including an understanding of ecology, and its implications for human welfare and public policy. Under present circumstances this would be a difficult task but it is even now being undertaken. For example, the Wave Hill Environmental Science Center in New York City works in close cooperation with the New York City public schools to bring a better understanding of the relationship between man and his environment to the children of the city. A similar effort is under way at High Rock Park Conservation Center on Staten Island.

A practical objection to the plausibility of an ecologically oriented public policy is the complexity of the ecosystems themselves. Taking as their target for criticism an exaggerated interpretation of ecology, critics say that because ecologists insist that everything relating to an ecosystem must be taken into account, nothing can be taken into account. This, they say, is because ecology provides no method for assessing priorities among the properties of ecosystems in relation to human values. The conclusion follows that the findings of ecological science are largely inapplicable (although not necessarily irrelevant) to the economics and politics of land policy. This criticism would have validity if an ecosystems approach to public land policy did in fact imply an extension of ecological concepts to everything having to do with land tenure and management, or required every aspect of an ecosystem to be examined in relation to every land use decision. But this totalitarian interpretation is neither necessary nor feasible. The fact is that ecologists are sometimes able to present alternative sets of policies for public consideration, together with their probable consequences. These may be reviewed by the public or by its representatives who may then establish priorities in public law policy.

It is doubtful that a public land policy designed to preserve and protect ecosystems would necessarily be more complex than the mass of laws, policies, and regulations affecting the ownership and use of land today. The effectiveness of an ecosystems land policy does not depend upon its mirroring the complexities of ecosystems. On the contrary, an ecosystems approach might simplify and clarify public land policy. A policy for the protection and ecologically intelligent



management of ecosystems could, by the establishment of standards and guidelines, reduce the confusion, conflict, and uncertainty that characterizes land use policy throughout the United States. It may be unrealistic to believe that the American people will adopt an ecosystems approach to land policy on its merits, but an ecological approach would almost certainly be more realistic in its treatment of the real problems of land than are some of the present policies. For the truth is that a great part of public policy for land is only tangentially concerned with the land as a major element in the human life support system. Land policies are not necessarily framed with reference to the land itself, but are often consequent to decisions made in banks, bars, and bedrooms. In any case, land use policy has been and will continue to be instrumental to broader social objectives. The nature of these objectives and their relevance to the continuing maintenance of the land as an element in the ecosphere must therefore be taken into account in any serious effort to understand or to modify land use policy and practices.

Public land policy does not begin with the land, but with man's dependencies upon it. Measured by ultimate human welfare, the most important of these dependencies is the basic function of land in the ecosystems through which life on earth is sustained. But these ecological functions are not the ones accorded the higher priorities in our society. Matters of land economics, of law, of land use technologies, and of public relations are in the forefront of our attention. Our concepts of public law and private property split our thought and action so that we tend to think of public land policy *only* as policy for publicly-owned lands. The idea of a public land policy for all lands regardless of formal title would be consistent with ecological realities. From a legal viewpoint, however, a public land policy for "private" lands might appear to be a contradiction in terms. The immediate and practical problems of land policy under the prevailing laws and assumptions require attention, and most students of public land policy will examine them in this context.<sup>9</sup> Yet the larger view is also needed. Our preoccupation with immediate and practical problems should not prevent our questioning whether we are indeed addressing ourselves to the right questions, at the right time, and in the right way. Public land policy is amenable to treatment at several levels of discourse. This article has sought a broad and theoretical level of treatment on the premise that unless the context of public

9. Nevertheless the National Forest Products Association, representative of large interests in land use under both public and private ownership, has urged (at its 1968 annual meeting on September 5, in Washington, D.C.) that the need for a national policy for land use generally should be examined.

land policy is consistent with ecological realities, specific land policies will ultimately prove to be ineffectual or harmful. The argument of this article has been that the socio-political context of land use policy in America has been ecologically unwise, unrealistic, and uneconomic. The conclusion follows that a fundamental change of public attitude will be required if the broad range of needs and interests of the American people are to be served from the limited amount of land whose future use has not already been determined by law or events.

Fortunately, although the time for remedial measures is already very late, action is now being taken in the Congress to obtain, through federal-state-local cooperation, a national policy for land. The National Land Use Policy Act of 1970, introduced in the Senate by Henry M. Jackson on January 29 would establish a ". . . comprehensive system of national and statewide land use planning and decision-making."<sup>10</sup> In the language of the bill, the Congress finds that ". . . failure to conduct competent ecologically sound land use planning has required public and private enterprise to delay, litigate and cancel proposed public utility and industrial and commercial development because of unresolved land use questions," and that ". . . land use decisions of the Federal government often have a tremendous impact upon the ecology, the environment and the patterns of development in local communities." For these and other reasons specified in its text, the bill declares it a ". . . continuing responsibility of the Federal Government, consistent with the responsibility of State and local government for land-use planning and management, to undertake the development of a national policy—which shall incorporate ecological, environmental, esthetic, economic, social and other appropriate factors—as a guide in making specific decisions at the national level—and shall provide a framework for development of interstate, State, and local land use policy." The bill declares that national land-use policy should ". . . favor patterns of land use planning, management and development which are in accord with sound ecological principles."

The bill provides for grants to the States for land use planning and administration. It specifies guidelines and requirements for state action and would progressively reduce allotments in other grant programs (affecting land use, *e.g.*, highways, airports, housing) to States failing to comply with its provisions. The jurisdiction of the Water Resources Planning Council and the River Basin Commissions created by the Water Resources Planning Act (79 Stat. 244) would be en-

10. *Congressional Record*, Jan. 29, 1970, S. 836; quoted passages are from the text of the bill beginning on page S. 838.

larged and a Federal Planning Information Center would be created.

If enacted, S. 3354 would move the ecosystem from a theoretical criterion for land use policy to a very practical consideration. The Act specifically requires that ecological factors be considered in land use planning and favors policies and practices, "in accord with sound ecological principles." But not only would public land policy and land use economics be altered by this Act. The applied phase of the science of ecology would also be pressed to provide substance for policy—to provide demonstrable evidence of the ecological soundness of principles—to translate concepts of ecosystem boundaries and interrelationships into politically meaningful terms. The challenge of this task adds urgency to efforts now in progress to strengthen and extend the research capabilities of the nation to deal with problems of man-environment relationships.

