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Resource Expertise in Environmental Planning and Impact

The Baseline Study As A Tool In Environmental Impact Assessment—Allan Hirsch,¹ U.S. Fish and Wildlife Service

1-1 *Introduction*

With the advent of the environmental movement, and particularly in response to the National Environmental Policy Act and other legislation, the environmental baseline study has become an accepted element of many federal resource development and environmental protection programs. Currently, baseline studies conducted by various governmental agencies or required by regulations address a wide range of environments, resource developments and potential impacts.

They include:

- a. terrestrial,
- b. freshwater,
- c. and marine ecosystems.

1 • Present address Environmental Protection Agency.

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As part of an accelerated program to develop geothermal resources in the western United States, U.S. Geological Survey regulations require a one-year environmental baseline study prior to initiation of geothermal production from federal leases. Bureau of Land Management lease stipulations governing a prototype oil shale development program in Colorado and Utah require the lessees to conduct two-year environmental baseline and monitoring studies prior to initiation of development. The Department of the Interior has initiated an accelerated program to lease and develop Outer Continental Shelf oil and gas reserves in response to national energy needs. During the last two years, as part of that program, the Department's Bureau of Land Management has funded a wide ranging series of marine environmental baseline studies extending around the coasts of the United States from the Beaufort Sea in Arctic Alaska to the South Atlantic.

1-1.1 Preparations

- a. In anticipation of probable need to prepare an Environmental Impact Statement on a program of deep ocean mining for manganese nodules, the National Oceanic and Atmospheric
- b. Administration is undertaking baseline studies in the central Pacific Ocean.
- c. Environmental baseline studies are being conducted by the electric utility industry in:
 - (1) rivers,
 - (2) estuaries,
 - (3) and coastal areas to meet Environmental

Protection Agency and Nuclear Regulatory Commission requirements relating to power plants development.

An Environmental Protection Agency program to regulate ocean dumping of wastes has generated baseline surveys of various dump sites ranging from locations on the Outer Continental Shelf to a deep water dump site at the edge of the mid-Atlantic Continental Slope at depths extending to almost 3000 meters. The State of Washington is undertaking a program of baseline studies of Puget Sound in advance of trans-shipment of Alaskan oil.

1-1.2 Resources

Major resources are being committed to such investigations. For example, the fiscal year 1977 budget of the Department of the Interior requests \$55 million for the Bureau of Land Management's Outer Continental Shelf study program described above.

1-1.3 The costs of establishing baselines for prototype oil shale development programs have been estimated at between \$12 and \$18 million.

1-1.4 A conservative estimate perhaps \$10 to \$15 million has been spent by the electric utility industry in collecting baseline and related environmental data on the Hudson River Estuary.

Large numbers of scientists in many disciplines are involved in baseline studies. In Alaska the magnitude of federally sponsored marine baseline studies seems to be straining the

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supply of qualified personnel and suitable research vessels. In some areas on the Northern Great Plains, so many scientists are criss-crossing the land in pursuit of baseline data that local ranchers have invoked the Heisenberg Principle, observing that the studies may create more environmental disturbance than the projected coal mining.

In short, the environmental baseline study has assumed major importance. Heavy reliance is being placed upon baseline studies to help decision-makers meet the intent of NEPA and other environmental regulations. These programs are being justified as necessary to prove understandings which can help minimize environmental impact of various developments and reconcile the inherent conflict between environmental protection and economic development that has become a major public policy issue in recent years.

1-1.5 Equipment

In addition, for many of the large ecosystems under study, such as remote marine areas whose investigation requires expensive equipment and logistic support, current support for baseline study programs represents an unprecedented opportunity to develop synoptic, interdisciplinary approaches which can add to our fund of information and understanding. Thus, at a time when usual federal sources of research support are relatively limited, these study efforts are of added importance to ecologists.

At the same time, there is considerable evidence of concern about the utility of the baseline study approach. For example, the Department of the Interior has established an Outer Continental Shelf Environmental Studies Advisory Committee to provide scientific advice concerning its

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environmental studies program. For over two years the scientists on this Committee have continued to debate the rationale of the baseline study approach with seemingly little agreement.² An evaluation of baseline data being collected on the prototype oil shale leases has pointed to the need for more precise data guidelines to assure that a scientifically sound program will emerge for monitoring potential environmental changes (Fish and Wildlife Service 1976) The adequacy and value of extensive baseline studies conducted for evaluation of power plant impact in such coastal systems as Chesapeake Bay and the Hudson River Estuary continues to be questioned.

1-1.6 Clark and Brownell (1973) for example, state that large sums of money have been wasted on power plant baseline studies. A recent editorial in Science (Schindler 1976), while not referring specifically to baseline studies, decries the ineffective design and execution of many environmental impact studies, citing an emphasis on indigestible descriptive data.

a. Several key issues underlie these debated and

- 2 • **Many of these discussions are documented in the minutes of the Department of the Interior's OSC Environmental Studies Advisory Committee and its predecessor organization, the OCS Research Management Advisory Board. An ad hoc committee of this group has also attempted to grapple with the issue of baseline study design, and the report of that effort has provided useful input to this paper (1976).**

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criticisms. They are:

- b. What role should baseline studies play in the evaluation of environmental impact?
- c. What are some important considerations governing the design of baseline studies? and
- d. How should baseline studies relate to some of the other approaches to evaluation of environmental impact?

1-2 *Role Of Baseline Studies*

The 1970 Study of Critical Environmental Problems (SCEP) was a pioneering effort to focus interdisciplinary attention on problems of measuring wide-scale environmental change. The Conference's Work Group on Monitoring discussed baselines as follows: "... our report is concerned not only with monitoring in its sense of providing warnings of critical changes but also with measurements of the present state of the system (the 'baseline')..." The report stated, "We recommend early implementation of a set of ecological baseline stations in remote areas that would provide both specific monitoring of the effects of known problems and warnings of unsuspected effects."

1-2.1 **Ocean Basline Sampling Program**

In describing the components of a proposed ocean baseline sampling program as a precursor of a monitoring program to detect long-term oceanic changes the report stated,

"... both one time and continuing surveys are needed: these surveys will help us establish a baseline for analysis."

Subsequently, the need or establishment of environmental

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baselines has received attention at the 1972 United Nations Conference on the Human Environment and follow-up efforts to implement a Global Environmental Monitoring System (NAS 1976).

This concept of baseline studies has also been incorporated in various federal documents and requirements. The Coast Guard's 1975 "Guide to Preparation of Environmental Analyses for Deepwater Ports," for example, refers to "...comprehensive information on the basic human and natural conditions which constitute the area's 'pre-deepwater port' environment. Baseline environmental information must be provided for the area which may be affected by the deepwater port project to establish existing background levels and conditions so that future changes can be ascertained."

The Bureau of Land Management's Oil Shale Lease (1974) states:

"The lessee shall compile data to determine the conditions existing prior to any development operations under the lease and shall, except as provided below, conduct a monitoring program before, during and subsequent to development operations. The Lessee shall conduct the monitoring program to provide a record of changes form conditions existing prior to development operations, as established by the collection of baseline data..."

Proposed revisions to Environmental Protection Agency Ocean Dumping Regulations and Criteria (1976) currently undergoing review describe baseline surveys of ocean disposal sites as follows:

"The purpose of a baseline or trend assessment survey is to

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determine the physical, chemical, geological, and biological structure of a proposed or existing disposal site at the time of the survey. A baseline or trend assessment survey is to be regarded as a comprehensive synoptic and representative picture of existing conditions; each such survey is to be planned as part of a continual monitoring program through which changes in conditions at a disposal site can be documented and assessed.”

I have been unable to find a relevant dictionary definition of the word “baseline.” However, a reasonable definition of the baseline concept as used by the highly qualified SCEP scientist and as reflected in a number of federal guidelines would be, “A description of conditions existing at a point in time against which subsequent changes can be detected through monitoring.” If this definition is accepted, it delimits to large extent the role of baseline studies in environmental impact evaluation. Under this definition, the baseline study is not a predictive tool; its principle use is for post hoc detection of change. As such, a baseline study would be of limited utility in meeting the requirements of an Environmental Impact Statement, which are basically predictive in nature.

1-2.2 Discussion

Yet there is considerable evidence to suggest this sharp definition of baseline studies is not universally accepted, and that the rationale and expectations for baseline studies are less clear-cut.

1-2.3 For example, in a memorandum on improving Environmental Impact Statements, the Chairman of the Council on Environmental Quality

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stated, “Specific baseline inventories and environmental research will often be needed initially to determine if there are environmental problems that should be analyze in an impact statement” (Peterson 1976).

- 1-2.4 A critique of an Environmental Impact Statement in the report of the Institute of Ecology’s Environmental Impact Assessment Project states, “The EIS does not provide either enough relevant baseline information or enough project-specific discussion of the possible impacts of the proposed alternatives, including ‘no action’ to allow informed independent judgments to be made by agency decision-makers or the public.” (Winder and Allen 1975).**

Statements such as these suggest that in actual practice the term “baseline” is used quite loosely to cover a range of information required for purposed of environmental impact assessment.

The need to sharply define the purpose of baseline studies and the role and inherent limitations of the baseline approach is more than an effort to establish a semantic strawman. At least some of the problems concerning adequacy of baseline study design and utility of the findings seem to stem form imprecision concerning the basic purpose.

1-3 *Predictive Versus Post Hoc Studies*

Both predictive and post hoc environmental impact assessments are required. Predictive capability is needed to guide those decisions that can be taken to avoid or minimize environmental damage in advance. However, since our ability to predict is quite unreliable and will never be completely adequate, a post-development monitoring program is needed to support a feedback loop by measuring actual impacts. This information can be used to take remedial action where technology permits and where the damage is not irreversible.

The post hoc assessment, or retrospective study, will also improve our capability to predict similar circumstances in the future. In this regard, we need to improve our ability to transfer findings gained from impact studies in one ecosystem to other similar systems, thus enabling us to make meaningful management generalizations concerning impact. Ecological classification systems, such as the one described at this Symposium by Montanari and Townsend (1976) in their paper on the National Wetlands Inventory can facilitate this by providing means of aggregating information and extrapolating research results and management experience among systems with similar properties.

Descriptive information is required for both predictive and post hoc assessments, but the attributes of the information needed for each purpose are somewhat different. I believe that many descriptive studies of large scale ecosystems conducted under the broad aegis of “baseline” address neither set of attributes well. Therefore, it may be useful to distinguish between two interrelated but distinct study approaches conducted for the purpose of describing

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ecosystems subject of impact: (1) ecological characterization, and (2) baseline and monitoring studies.

1-4 *Ecological Characterization*

Clearly, as an early step in the environmental impact assessment process, efforts must be made to understand the most salient features of the ecosystem involved. This includes such features as the biological resources important to man (e.g., fish, bird and mammal populations, endangered species) and particularly important components of their habitat (e.g., breeding, spawning and migratory areas). It includes identification of key biological processes such as climatic conditions and transport mechanisms. Environmental hazards such as storms, floods or earthquakes should also be assessed.

This kind of information will provide at least an initial basis for predicting some of the anticipated impacts of development. For example, in its Outer Continental Shelf Oil and Gas Leasing Program, the Department of the Interior is currently using information on distribution of important biota; prevailing wind and current patterns; and probability of storms, earthquakes or other spill-inducing hazards in risk analyses which can be used to exclude particularly hazardous tracts from development.

1-4.1 The need for good reconnaissance information of this type is well-recognized. However, descriptive information on large-scale ecosystems could prove more meaningful if structured to accomplish what I will term “ecological characterization.” An

ecological characterization is a description of the important components and processes comprising an ecosystem and an understanding of their functional relationships.

1-4.2 The characterization should address such major elements as:

- a. physiography and geology;
- b. climate;
- c. physical transport mechanisms such as hydrology, sediment flux, physical oceanography (in the case of marine systems), and
- d. atmospheric transport.

1-4.3 It should describe:

- (1) the important species, and
- (2) communities and populations in the study area, with particular emphasis on those organisms perceived as being of importance to man or critical to the functioning of the ecosystem.
- (3) Population estimates can be approximate but they should attempt to address the extent and cause of natural variability.

1-4.4 The characterization should describe:

- a. ecological processes, such as trophic relationships, food chains, and energy flows, particularly those considered to be or known to be controlling.
- b. It should describe social and economic features of the area (e.g., population distribution, land use,

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industrial development), and address significant man-induced or natural influences on the ecosystem such as successional processes, existing man-made modifications and extent of pollution.

The characterization should also address transboundary effects—that is the relationship of influences outside the ecosystem on the system itself. Ecological classification systems based on hierarchical concepts, combined with conceptual ecosystem modeling, should help provide a more structured approach to the definition of reasonable study boundaries.

Some of the follow-up studies required after the initial characterization may be straightforward inventories, needed to fill gaps in descriptive information. Frequently, more dynamic study approaches will be indicated. For example, this may involve development and verification of functional predictive models for specific system interactions or controlled ecosystems experiments.³ As studies such as these are completed, the initial characterization can be upgraded and refined.

3 • **Barrett, et al. (1976) in a recent paper outline guidelines for testing and evaluating perturbations on total ecosystems, many of which have direct application to the issues being discussed here.**