

complex biological systems—especially ecosystems. Systems analysis has already been demonstrated to be a successful adjunct to conventional field and laboratory methods in ecology.

Systems analysis should be applied in at least three major ways in the IBP:

(1) An early step will involve development of methods to examine existing data on ecosystem processes in a sensitivity analysis aimed to reveal the relative importance of certain factors; this analysis will aid in allocation of resources for research activities in integrated system studies.

(2) Computer techniques are essential for rapid organization and analysis of data derived in total-system studies, especially those phases involving intensive use of electronic recording equipment.

(3) Systems methods will be applied in analysis and integration of results from studies in the United States and elsewhere, designed to test and develop ecological theories.

A major task will be to train ecologists in the use of computers and mathematical methods in systems analysis. When possible, systems analysts should be members of each interdisciplinary team. The program should make available systems analysts to consult with investigators working on single processes or components or synoptic data to insure that data obtained can be utilized in composite analyses.

Information centers

The IBP goal of synthesis in man's understanding of ecosystem relations requires one or more information centers to fill several roles:

(1) To store primary data and derived variables for analyses beyond those to be expected at individual research sites.

(2) To distribute computer programs and primary data to individuals or other centers.

(3) To coordinate basic descriptions and groupings of terrestrial and freshwater systems, extending the coding and formats being tested in the data center of the Conservation Section.

(4) To facilitate comparisons between ecosystems and between parts of the world in a total system context (e.g., summarizing tables expressing rates of transfer of energy, nitrogen, and other elements).

(5) To aid IBP planning and activities by storing current information on the work of scientists as it is gathered by project directors.

Training

Since there is a shortage of biologists capable of undertaking the type of studies proposed, training is a major need. The objectives of the IBP in general, and the study of terrestrial and aquatic environments in particular, cut across traditional academic boundaries. Outstanding ecologists will be encouraged to apply for funds to develop training programs that educate ecologists who are technically well-trained in a specialty but are also able to deal with the larger problems of man and the landscape.

Three phases of training are acknowledged:

(1) the university pre- and post-doctoral programs which require close cooperation between the basic biological and natural resource departments and sound basic training in physical, mathematical, and computer sciences;

(2) special institutes for instruction in modern methods for the practicing ecologists; and

(3) short courses of symposia for biologists desiring familiarity with recent advances.

Administration

For successful development of the center based programs, and for coordination of contributory studies, some stimulation, assistance, and direction is necessary. We suggest this be accomplished with a Program Director, a Program Coordinator, and an Advisory Committee. Appointment of a Program Director and an Advisory Committee will be through the concurrence of the Freshwater and Terrestrial Productivity Subcommittee on suitable candidates. The Advisory Committee may also include representatives selected from the appropriate federal agencies. Liaison member from other IBP subcommittees should collaborate in the planning.

The Program Director will be a reputable ecologist who will be assisted by a full-time Program Coordinator to handle most of the work of coordinating the