

ments, both those relatively little disturbed by man and those that have been appreciably modified by his activities. These environments provide natural laboratories for the long-term study of ecosystems and their inherent biological productivity. Preserved areas, if available for long-term scientific use, serve as yardsticks for policy decisions on use, protection, and management of comparable areas of land or water. They furnish basic guides to national resource management and land capability evaluations. Relatively undisturbed areas are sources of valuable animals for use in experimental medicine, and they serve as reservoirs of genetic plant material of potential economic value in agriculture and medicine.

There is as yet no fully effective scheme for definition, delimitation, and designation of major ecosystems, but a registry for U.S. and contiguous areas is urgently needed. As for existing reserves, it is safe to say that despite the efforts of the Department of the Interior, the Department of Agriculture, the Nature Conservancy, and other groups, much more information is essential. For example, supplementary data are needed on who owns the areas in question, what use is permitted, and whether there have been earlier studies of a scientific nature.

New reserves are surely needed if the system is to include adequate samples of each major ecosystem, and a system of priorities must be set up for the establishment of these new reserves.

Because natural areas are established for a variety of purposes, techniques adopted for management of a particular unit will depend upon the objectives for which it was set aside. Clearly, an area established to perpetuate a particular ecosystem or special biological entity would require one kind of management and an area intended for research involving manipulation of the components of the system would require another. Again, an area designated for preservation or restoration of a selected successional stage would require one kind of management and an area where natural processes are allowed to continue without hindrance would require another. In most cases, data are presently inadequate to insure that the objectives sought can be successfully attained. It would be most shortsighted to concentrate only on setting aside natural areas and then neglect the studies needed to insure attainment of the established goals.

LIMITATIONS OF PRIMARY PRODUCTION

A major goal is to assess the precise extent of the chief impediments to production processes. It is not precisely known why a rain forest may contain islands of drought or why a desert may contain islands of arable land. Appraising the hemispheric extent of these areas requires comparable maps of rainfall, radiation, soils, and frost. The maps should show the probabilities or frequencies of those quantities needed to insure dependable production. The efforts of organizations, such as the World Meteorological Organization, that are capable of organizing fundamental surveys would be of benefit.

Another goal is to find ways of raising the upper limits of photosynthesis. The assemblage of nationalities, disciplines, and agricultural ecosystems that will exist under the IBP may reveal new ways of removing such limitations as drought, soil fertility, and cold. The prospects of discovery would be enhanced if a number of scientists could be brought together for study of one or more ecosystems unlike the well-known ones characteristic of Temperate Zone agriculture.

There is urgent need for better understanding of drought tolerance of basic crops in the Western Hemisphere. Almost all established crop areas at times receive suboptimal amounts of precipitation. Study of the physiology of plants under water stress is a prerequisite to an understanding of water economy and drought tolerance.

Also needed in the Western Hemisphere is a thorough study of the effects of temperature on the physiology of plants.

A problem particularly relevant to plants growing on soils of the tropical areas of the Western Hemisphere relates to restricted rooting volume due to low base status, soil acidity, and aluminum toxicity. Basic physiological studies of root growth-root rhizosphere interaction are needed.

Nitrogen is often the element limiting primary production, yet the atmosphere contains a vast reservoir of this element. To improve understanding of nitrogen fixation, it is important to—

Assess quantitatively the availability of nitrogen on both a regional and a worldwide basis.

The studies should give attention to great world soil groups and climates and to the Tropics, the Arctic zone, and the hydrosphere.