

10. Vegetation and Forests

10.1. INTRODUCTION

Vegetation and forests are useful integrators of the state of the environment. They are also important renewable sources, providing food and shelter, as well as having substantial economic impacts. Vegetation monitoring is not an easy task. A central problem is the variability in space and time. At an atmospheric or oceanic remote station, a sample of air or of seawater is likely to be representative of a reasonably large volume, if proper precautions are taken. Vegetation, on the other hand, is likely to show important microscale variations, due to differences in shade, soil characteristics, and the differing responses of different species to the same environmental stimuli. To overcome this problem in some community air pollution studies in the United States, sensitive plants are grown indoors in uniform exposures and in similar soils that are regularly fertilized and watered according to pre-arranged schedules. Species are chosen which yield symptoms characteristic of specific pollutants, and in some cases laboratory bioassays are subsequently performed.

A question that is difficult to answer is what are the indicators of the productivity and the health of a vegetated plot. Likely parameters include species populations and diversities, net photosynthetic rates, dry-weight productivity, pollution uptake rates, visible leaf damage, and evaporation rates. To understand the effects of air and soil pollution on these indicators, measurements must be made at remote, intermediate and impact locations or areas. The question then arises as to whether the other environmental factors should be kept as constant as possible—by using special plantations with identical soils (initially), or whether it would be preferable only to monitor at sites not under cultivation or forest management. These are questions to be investigated by UNESCO-MAB and the scientific community. At the present time there are as yet no internationally agreed methodologies. Furthermore, although there may now be a consensus that individual biome studies are relevant on the global scale, there is certainly no universal acceptance of the principle. This latter point of view overlooks the fact that the biosphere was spatially coherent prior to human intervention. The main vegetation and forest belts of the world were well defined, having become adapted to local and regional climatic and soil conditions, and having in fact modified these conditions to optimize their own survival rates. Human activities have disturbed these natural processes, and it is important to quantify both the baseline and disturbed states.

As a supplementary reason for monitoring the net photosynthesis of vegetation, the atmospheric global models of CO_2 and CO require estimates of uptake rates by vegetation. At present, there is little infor-

mation on the magnitudes of these rates, as related to season, latitude and vegetation type.

Finally, the point should be made that vegetative covers (even under baseline conditions) are vital living entities, never quite in equilibrium with their environments over decades. The process of *succession* is often supposed to lead slowly to a steady-state *climax* condition, but this overlooks the effects of long-term climatic trends. Lakes too have a life history, man's influence being merely to accelerate the process of eutrophication. The long-term data obtained from baseline biome stations must be interpreted in this light.

In summary, there are two important reasons for monitoring vegetation and forests:

- a) to obtain information on productivity,
- b) to obtain information on the health of the biosphere. A poor site, for example, may support a slow-growing crop which remains healthy.

10.2. EXISTING BIOLOGICAL PILOT STUDIES

A number of biome pilot studies are in progress, many of them initiated through IBP. A subarctic environmental monitoring station has already been established in Finland, for example. Laamanen (1972) has expressed the view that the program should be coordinated as much as possible with those at other similar stations around the world. The initial monitoring at the Finnish site is limited to sampling for a few chemical substances in air, soil and an adjacent lake.

The IBP has sponsored a number of international biome studies. The tundra program, for example, links field investigations in the USSR, Austria, Canada, Finland, Ireland, Norway, Sweden, UK, and the USA (Welgolaski and Rosswall, 1972). The grassland theme includes field sites in many countries, the Matador site in the Canadian prairies being a typical example. In North and Latin America, the Institute of Ecology (TIE) has organized a network of field stations under a consortium of Canadian, U.S. and Latin American universities and institutions.

The main purpose of most existing terrestrial biome studies is to establish the inter-relations existing in plant communities under baseline conditions, with special attention being paid to productivity and stability of various species. This type of investigation is an essential preprogramming activity for GEMS Phase II and should be encouraged.

10.3. MONITORING PROGRAMS

Only a very modest Phase I GEMS program of monitoring can be proposed. However, a number of pre-programming activities for Phase II are recommended. Here, UNESCO-MAB has an important role to play.

Recommendation 31: It is recommended that the appropriate Specialized Agencies develop operation manuals for annual collection (where present) of samples of suitable species of lichen, mosses, edible nuts, berries and grasses at WMO baseline and other designated remote stations, and for subsequent analysis for mercury, lead, cadmium, sulphur, DDT and PCB's. When intergovernmental agreement is reached, the program can provide data for GEMS Phase I.

The justification for this recommendation are three-fold: (a) many of these plants are in the food chains for Eskimos and other native peoples; (b), some of the plants are accumulators of pollution and are useful indicators of global pollution trends; (c), lichens in particular are very sensitive to certain types of air pollution, providing early warning of harmful biological effects.

Recommendation 32: It is recommended that the appropriate Specialized Agencies, with the assistance of SCOPE, be encouraged to develop methodologies and siting criteria for remote, intermediate and impact biological monitoring stations or areas, noting the siting criteria already established for hydrologic basins and atmospheric chemistry stations. It is also recommended that a proposal for an operational program for monitoring be prepared in 1976 by the appropriate Specialized Agencies.

Recommendation 33: It is recommended that during the period 1974-76, local supplementary Research and Development monitoring programs be encouraged at existing biome stations, to include monitoring of the relevant priority pollutants given in List 2, Section 5, in appropriate biological samples.

Finally, the FAO World Forest Inventory program should be supported.

Recommendation 34: It is recommended that the FAO World Forest Inventory program be encouraged, noting the need to develop more quantitative indicators of forest cover.

10. 4. COMPLEMENTARY MONITORING ACTIVITIES

Meteorological and precipitation chemistry measurements should of course be taken at all pilot stations or areas for biome studies. In some cases, detailed micro-meteorological observations within and above the canopies will be required.