

12. All-Media Recommendations

12.1. MONITORING OF SELECTED RADIONUCLIDES

UNSCEAR, in cooperation with WHO, FAO, IAEA, WMO and national laboratories publishes regular reports on ionizing radiation (e.g., UNSCEAR, 1972). In addition, many countries publish national summaries; The Canadian report (e.g., DasGupta, 1972), for example, contains information on gross beta radioactivity in surface air and precipitation at 24 monitoring sites, concentrations of stable elements and selected radionuclides in whole milk samples obtained from 16 cities, as well as other special results.

Inspection of these reports indicates a tendency to publish summarized data (e.g., mean values and monthly extremes) rather than the original values. Presumably there are few requests, if any at all, for the basic data sets.

The UNSCEAR program is commendable and meets its stated objectives. For the purposes of GEMS, a selection from amongst the many radionuclides needs to be made, however. As indicated in list 2 in Section 5, Cesium 137 and Strontium 90 have been chosen, because of their relatively long half-lives, their ubiquity, and their consequent importance as tracers of biogeochemical pathways.

There is a related world program of monitoring isotope concentrations in precipitation. The data are published by IAEA, in cooperation with WMO and participating national laboratories (e.g., IAEA, 1973). The information is valuable to atmospheric modellers, providing clues, for example, on inter-hemispheric transfers. The following recommendation is therefore made.

Recommendation 40: It is recommended that the UNSCEAR cooperative program contribute data on levels of Cesium 137 and Strontium 90 in various media to GEMS Phase I. It is further recommended that the IAEA cooperative program on monitoring isotope concentrations in precipitation also contribute data to GEMS Phase I.

12.2. EPIDEMIOLOGICAL MONITORING

The health of human populations is already "monitored" in many ways, using indices such as infant mortality or general death rates, growth rates in terms of weight and height, and statistics of hospital admissions, sickness-absence or consultation rates with physicians. Variations in these indices with time and place are related to a whole range of medical and socio-economic factors, and it is in general difficult to isolate direct effects of environmental agents. The most clearly defined relationships are seen in the case of acute effects, whenever in a particular locality, a sudden increase in morbidity or mortality follows a sharp

change in some environmental factor. Quite simple indices, such as daily or weekly totals of new cases of a particular disease, may sometimes be sufficient to implicate a local environmental factor, but in general it is necessary to monitor morbidity and mortality in considerable detail for this purpose.

The role of environmental factors in the gradual development of chronic disease is more difficult to determine, and it usually requires special enquiries among carefully defined population groups. Useful indicators of the possible influence of environmental factors can, however, be obtained from routinely collected statistics of morbidity or mortality. Much work has been done relating death rates from selected diseases in different cities, or in different parts of the same city, to the quality of air, water or food, but the populations often differ in many respects other than the quality of their physical environments. The use of occupational groups helps to reduce the variations in general socio-economic factors, but there may then be complications due to selection for fitness for the job. Data on the health of children can be valuable, but again there is a need to control for extraneous variables. Studies of the prevalence of chronic disease and of death rates among migrant groups are of special interest, since they give some idea of the relative importance of environmental conditions and ethnic origins.

An Expert Committee of WHO (WHO, 1971b) has included on a list of desirable properties for an epidemiological index, ready availability of the data (i.e., without the need for special investigations) and completeness of coverage (relating to whole populations rather than small samples); the most widely available statistics are those based on death certificates or hospital admissions. There is international agreement on the classification of causes of death, but the reliability of diagnoses varies widely. To make the maximum use of routinely collected data, there is a need to ensure uniformity in reporting procedures, and it would be helpful in studies of long-term effects, if separate sources of data on individuals could be linked in some way.

The following recommendation is therefore made.

Recommendation 41: It is recommended that the appropriate Specialized Agency examine various simple indices of morbidity and mortality, and of growth rates in terms of weight and height, noting their usefulness in studies of both short- and long-term effects of environmental stresses. Upon selection of a few priority indices, intergovernmental approval should be sought for their universal adoption.

Despite a number of difficulties (the diagnosis may be incomplete or wrong), intergovernmental standardization of reporting procedures would be a major step forward.

The suggestion has been made that selected indoor environments of study groups should be monitored. This may be feasible for selected populations, e.g., miners, but there is the additional problem of obtain-

ing representative measurements of the indoor environment. Air quality in mines, for example, varies with depth and local ventilation rates. Nevertheless, the following recommendation is made.

Recommendation 42: It is recommended that the appropriate Specialized Agency appoint an expert committee to consider the usefulness and feasibility of monitoring selected indoor environments in order to obtain quantitative data on cause-effect relations with pollutants.

The possibility of remote, intermediate and impact epidemiological monitoring is attractive. Prior (1971), for example, has examined the health of selected groups in New Zealand, Rarotonga in the Cook Islands (representative of a transition zone between a simple existence and a European-style life) and Pukapuka and the Tokelan Islands, where life, work and dietary habits have changed little in the past century. This approach is recommended as a model for further studies.

Recommendation 43: It is recommended that the appropriate Specialized Agency develop pilot epidemiological studies for remote, intermediate and impact situations.

The question of epidemic forecasting should also be mentioned. WHO already has some programs in this field (WHO, 1972a) but the reporting of outbreaks by Member States is on a purely voluntary basis. With the recent increase in international travel, and with the current interest in monitoring, this seems an appropriate time to review existing programs and procedures.

Recommendation 44: It is recommended that an expert committee be appointed to review existing programs and procedures for epidemic forecasting.

The recommendations listed above should be undertaken in parallel with basic studies on the toxicities of various substances. A recent survey of environmental health effects is given in the WHO publication, "Health Hazards of the Human Environment" (WHO, 1972b).

12.3. MONITORING OF ANIMALS AND BIRDS

12.3.1. Introduction

Many pilot studies have been made of wild animal and bird populations, migratory behaviours and trace-substance uptakes. A number of regional networks manned by amateur observers also exist. In this connection, the sampling uncertainties associated with monitoring the numbers of endangered species are not always recognized. This is the classical "extreme-value" problem in statistics, for which the random

sampling errors are likely to be large and the statistical confidence limits very wide.

An example of a well-formulated pilot study is that described by Holden (1970), a cooperative examination of organochlorine pesticide residues in terrestrial and aquatic wildlife. Laboratories in the following countries participated: Canada, Finland, Ireland, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, the United Kingdom and the United States. In the first part of the program, an intercalibration of analytical methods was undertaken, through exchange of samples of cod liver oil, chicken egg, sprat homogenate and a solution of standard chemicals. In the second stage, starling, pike, marine mussel and dogfish were caught in areas believed to be free of local pesticide usage, and analyzed. It was found that the range of variation of residues among individuals of a natural population was much larger than that due to analytical errors or to differences between laboratories.

No Phase I GEMS component can be proposed. However, two important recommendations are made, one dealing with the *chemical* analysis of animal and bird specimens, the other dealing with the *effects* of environmental stresses on species and mixed populations.

12.3.2. Chemical Analysis of Wildlife Specimens

A number of pilot studies have already indicated the feasibility of monitoring for specific residues in wildlife. The following recommendation is therefore made.

Recommendation 45: It is recommended that the appropriate Specialized Agencies develop and seek intergovernmental agreement on a program for monitoring for some of the relevant priority pollutants in a few designated species of birds and animals, in remote, intermediate and impact areas. It is further recommended that an operational program be proposed in 1976 for GEMS Phase II.

During the period 1974-76, Member States are encouraged to undertake additional pilot studies, with emphasis on residues of mercury, lead, cadmium, DDT and PCB's.

12.3.3. Monitoring of Effects

When multi-species populations of birds or animals are placed under environmental stress, they respond in various complex ways. Partly because the interactions are not yet well understood in many cases, simple indices are often used to measure biological effects:

- (a) Indices of species diversity or of equitability
(a measure of relative abundance),
- (b) Age structures of populations,
- (c) Reproductive rates,
- (d) Presence or absence of sensitive indicator species.

(e) Thickness of bird eggshells (believed to be related to pesticide concentrations).

A number of individual and regional pilot studies have been undertaken. (See Jenkins, 1971, for a review, and for some recommendations concerning monitoring programs.) These pilot studies should be encouraged and expanded. In addition, there is need for national and international workshops to achieve a consensus within the scientific community on monitoring methodologies. The following recommendation is therefore made.

Recommendation 46: It is recommended that SCOPE-IUCN be invited to organize workshops on methodologies for monitoring communities of animals and birds, including endangered species, and that recommendations be made to the appropriate Specialized Agencies in 1976.

During the period 1974-76, Member States are of course encouraged to organize workshops and related pilot studies.

12.4. EMISSION MONITORING

In order to undertake a mass budget of pollutants, information on source strengths (e.g., emission rates of various industrial pollutants from chimneys and water pipes) is required. In some cases, regional source strengths can be inferred from economic data but the latter information is not always in a suitable or readily available form. Based on a SCOPE study, a consultancy report has been prepared by A. Hollaender on a proposed international registry of potentially toxic chemicals, for the UN Advisory Committee on the Application of Science and Technology to Development. There will be a number of difficulties in implementing such a scheme. In addition, there is a genuine need within the scientific community for better estimates of the strengths of the *natural* sources of the priority pollutants, as well as for man-made heat releases. The following recommendation is therefore made.

Recommendation 47: It is recommended that over the next two years, the appropriate Specialized Agencies examine the feasibility of monitoring source strengths on the regional scale. It is also recommended that SCOPE be invited to explore in greater detail than presently available, the scientific requirements for source-strength data, both man-made and natural, and for both point and diffuse area sources.

12.5. SOCIOLOGICAL AND ECONOMIC MONITORING

The health of the environment depends to a certain extent on sociological and economic factors. In the interpretation of epidemiological data, for example, information is required on the following variables: diet, education, working conditions, housing, transportation, employment, clothing, recreation and social insurance coverage (WHO,

1971b). Nevertheless, there has not yet been inter-disciplinary consensus on the most relevant sociological and economic indicators for international environmental monitoring. The following recommendation is therefore made.

Recommendation 48: It is recommended that UNEP stimulate research programs into the development of sociological and economic indicators of the state of the environment.

12.6. REMOTE SENSING

COSPAR W/G VI has prepared a report on remote sensing of climatic indicators (COSPAR W/G VI, 1972) while NASA published an earlier document on remote sensing of pollution (NASA, 1971). The most exciting remote-sensing applications for air pollution monitoring will probably not come until the 1980's, when it may be possible to obtain precise estimates of the total atmospheric burden of various trace gases.

In the immediate future, remote sensing will be most useful in determining surface properties (see Recommendation 4, Section 6.1.4.), including the presence of oil slicks and chlorophyll (an indicator of phytoplankton activity), and thermal pollution of water bodies. The following recommendation is therefore made.

Recommendation 49: It is recommended that COSPAR convene a meeting of specialists to determine the present state of the art in remote sensing, to recommend a GEMS Phase II component, and to prepare long-term proposals for research programs and pilot studies.

12.7. RARE EVENTS

The need for supplementary short-term monitoring has already been mentioned in Recommendations 15 and 43, which dealt with marine oil spills and epidemics. Other examples could be cited, e.g., massive bird kills due to inadvertent releases of toxic substances into the environment. It is noted here that the Smithsonian Institution has had considerable experience in reporting rare environmental events. The following general recommendation is therefore made.

Recommendation 50: It is recommended that UNEP appoint an Expert Committee, with representation from the Smithsonian Institution, to examine the question of emergency monitoring and to make recommendations.

12.8. PRESERVATION OF SAMPLES

Substances and processes of most concern today may be replaced by others in fifty years. Not only will knowledge of cause-effect relations

increase but also the ability to measure will improve. The conceptual framework for understanding the environment is always based on what can be perceived at a particular moment in time. There is merit, therefore, in considering the storage of samples for analysis in the distant future. Appropriate material might include human teeth and hair.

WHO already has a program for storing human serum at its Serum Reference Bank in Tokyo (WHO, 1970). WHO has emphasized that in order to ensure adequate supplies for posterity, procedures for withdrawal of samples from such Banks must be established at the outset. In addition, the storage techniques must be examined carefully. There is, of course, the related problem of short-term storage and shipment of samples from GEMS remote stations to central laboratories. Robertson (1968), for example, has commented that many of the discrepancies in the reported concentrations of trace elements in the oceans are due to contamination of the samples, either during collection and storage or subsequent analysis. The following recommendation is therefore made.

Recommendation 51: It is recommended that SCOPE be invited to convene a group of experts to examine the desirability and feasibility of long-term storage of samples of physical and biological material. It is also recommended that SCOPE include in its study, the problem of short-term storage and shipment of samples obtained from remote stations and transported to central laboratories. Finally, it is recommended that the Inter-Agency W/G on Monitoring examine the SCOPE report and make appropriate recommendations to UNEP in 1976.

12.9. HISTORICAL MONITORING

SCOPE (1971) recommended in 1971 that efforts be made to extend environmental time series backward in time, e.g., by using museum specimens, varves and glaciers. Even if the information were fragmentary, it would be of value provided that the measurements were reliable. The following recommendation is therefore made.

Recommendation 52: It is recommended that a group of experts be convened to explore the general area of historical monitoring, and to prepare guidelines for deciding whether various types of historical data should be included in the GEMS system.