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INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION

PROGRAMME FOR THE GLOBAL INVESTIGATION OF POLLUTION IN THE MARINE ENVIRONMENT

This document was originally presented by the delegate of the USSR to the first session of the International Co-ordination Group for GIPME (IOC/GIPME-I/INF.7), held in London, 2-6 April 1973.

In accordance with resolution EC-II.9 of the second session of the IOC Executive Council, this text is now being distributed to Member States of the Commission for comment.

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1. Character of the problem

The world's oceans play an exceedingly important part in the vital activities of human society. However, during the past few decades they have been widely used as a garbage dump for wastes of various kinds, in some areas in quantities exceeding the possibilities of self-purification. In certain regions a high level of marine pollution can now be observed. The discharge of wastes leads to harmful consequences, reducing biological productivity and creating a threat to ecological systems.

There is accordingly a need for carrying out on an international scale investigations and studies in regard to the scientific aspects of the problem of fighting pollution in seas and oceans. One of the most important aspects of the work on pollution problems is the creation of a global system for research into the pollution of the world's oceans, and the working out of measures on a global scale for the protection of marine waters from pollution.

This programme has been drawn up taking into account the basic provisions of resolution 2586 (XXIV) of the United Nations General Assembly, concerning the promotion of effective measures directed towards the prevention and control of marine pollution, the recommendations of the Joint IMCO/FAO/UNESCO/WMO/WHO/IAEA/UN Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP) and the FAO Technical Conference on Marine Pollution and its Effects on Living Resources and Fishing, the Long-Term Expanded Programme of Oceanic Research, the plans and programme of the Intergovernmental Oceanographic Commission's Integrated Global Ocean Station System, the report of the first session of the IOC Group of Experts on the Long-Term Scientific Policy and Planning (GELTSPAP) and the recommendations of the United Nations Intergovernmental Working Group on Marine Pollution.

The Global Investigation of Pollution in the Marine Environment, as well as the implementation of a number of preliminary measures, is being arranged on a national basis by means of an international agreement.

2. Tasks and aims

The Global Investigation of Pollution in the Marine Environment entails:

2.1 Organizing and carrying out systematic observations of the state of chemical pollution of marine waters, bottom deposits and marine fauna;

2.2 Identifying and registering sources of pollution which are situated beyond the borders of national jurisdiction, or, in agreement with States which are parties to the present programme, such as are situated on land and within territorial waters.

The above-mentioned investigations are conducted with the following purposes in view:

2.3 To obtain a systematic picture of the level of pollution and of the geographical distribution of the main pollutants;

2.4 To study the transformation of the natural chemical content of marine waters and bottom deposits, disturbances in the ecological system, changes in the sanitary-hygienic condition of the waters and the nutritional qualities of

sea produce, and disturbances in heat- and gas-exchange in the oceans and the atmosphere and in the biological productivity of the marine environment as a result of pollution;

2.5 To work out a forecast of qualitative alterations in the marine environment and bottom deposits which will appear as a consequence of pollution;

2.6 To work out scientifically well-founded recommendations for the United Nations and the States participating in the present programme in regard to international regulation of the discharge of pollutants and protection of the marine environment from pollution.

3. General organizational principles in regard to the Global Investigation of Pollution in the Marine Environment

The Global Investigation comprises three mutually interconnected systems:

3.1 A system of international observations in open regions of oceans and seas outside the sphere of action of intergovernmental regional agreements. This system is organized by the Intergovernmental Oceanographic Commission and is being implemented by States participating in the present programme;

3.2 A system of regional observations, which are carried out in individual sea and ocean regions on the basis of intergovernmental agreements between the States participating in the present programme;

3.3 A system of national observations in territorial waters and on the continental shelf.

Co-ordination of the first two systems with the national observations is arranged by the IOC in agreement with the participating States, in such a way as not to infringe national sovereignty. The measurement and evaluation of pollution levels is done by the participating States in accordance with uniform methods, which entails a certain amount of preliminary work before a start can be made on this programme.

Information on pollution levels and their consequences is accumulated and sorted out and systematized in the World Oceanographic Data Centres A and B.

4. Scientific foundations for the Global Investigation of Pollution in the Marine Environment

The degree of pollution and its geographical distribution, which integrally reflect the level of pollution and self-purification processes, are determined by the "pollution balance", which includes the following components:

4.1 On the "plus" side

4.1.1 Influx with river waters.

4.1.2 Influx from coastal outfalls.

4.1.3 Influx caused by intentional or accidental discharges from ships and by the exploitation of bottom deposits.

4.1.4 Influx from the sea bottom under conditions of turbidity.

4.1.5 Influx with currents and hydrobionts from other regions.

4.1.6 Influx from (or into) the deep-lying waters with aeolian (wind), vertical and convective mixing.

4.1.7 Influx caused by the decomposition of complex substances.

4.1.8 Influx with aerosols and windborne particles.

4.2 On the "minus" side

4.2.1 Loss to other regions of the sea caused by currents.

4.2.2 Loss to the deep-lying layers, caused by vertical exchange.

4.2.3 Deposition as sediments (in suspensions, following coagulation or the accretion of dead organisms).

4.2.4 Physical, chemical and microbiological disintegration into the most elementary substances.

4.2.5 Loss to the layer of atmosphere adjoining the water.

4.2.6 Loss through assimilation by marine fauna.

The influx, distribution and dispersion of pollutants are determined by currents, turbulent diffusion, wind disturbances, vertical circulation and the migration of organisms (fauna); all of these are essentially dependent on hydrometeorological conditions - winds, currents, temperature, salinity of water, hydrography of the region (configuration of the shoreline, depth, relief and gradient of the sea bottom).

Typical of delta regions are transfer of pollutants by river currents, reduction in concentration where river and marine waters meet, intense sedimentation in suspensions and sudden drop in current velocity in shallow waters.

Typical of open sea regions are transfer by currents, fall-out into deep-lying layers as a result of vertical circulation and deposition on the sea bottom.

Typical of the polluted terraces of coastal regions are deposition on the sea bottom and secondary pollution resulting from wind waves.

The leading part in the process of self-purification is played by microbiological and biochemical processes. Chemical and microbiological purification are essentially dependent on the temperature of the water, its pH, the degrees to which it is saturated by oxygen, the state of the carbon dioxide balance, the chemical and mechanical composition of suspended matter and the hydrobiological characteristics of the basin.

The pollution balance equation can be briefly expressed as follows:

1. For the sea in its entirety:

$$\Delta C = (C_b + C_m + C_B + C_g + C_a) - (C'_B + C_{px} + C_{pb} + C'_g + C'_a)$$

2. For a particular region of the sea:

$$\Delta C = (C_b + C_m + C_{ad} + C_t + C + C_a) - (C'_a + C_{px} + C_{pb} + C'_g + C'_a)$$

where

ΔC - the increment during an interval of time Δt

b - influx from rivers or coastal outfalls

m - offshore dumping into the sea

b - outflow caused by water exchange

ad - outflow caused by advection

px - chemical disintegration

pb - biochemical disintegration

a - exchange with the atmosphere

g - exchange with the sea bottom

t - turbulent exchange.

In order that discharges should not lead to appreciable disturbance of the natural chemical content, the following conditions must be fulfilled:

$0 \geqslant \Delta C$ and $0 < C < MPC$, where MPC is the maximum permissible concentration.

Determination of the general and distinctive features of the pollution balance and the processes peculiar to each region points, first, to the need for quantitative study of the effect of each of the various factors on the transfer and kinetics of decomposition of pollutants, and, secondly, to the need for experimental and theoretical (model) studies in regard to the processes of their transformation and the effect of pollution on the evolution of the environment, with a view to assessing the permissible load on the seas and oceans as a whole and on their invididual regions in particular.

By "permissible load" is meant pollutants in quantity and composition such that their rate of decomposition and dispersal will exceed the rate of accumulation.

When defining the methodological foundations for the Global Investigation of Pollution, it is essential to bear in mind a number of fundamental points, namely:

4.3 The basic principle in studying the degree of pollution and transformation of the chemical content of the marine environment, or the evolution of the oceans under the influence of pollution, more particularly from a long-term point of view, is the principle of comparison with standard samples, which have to be taken in areas that are not polluted at present.

4.4 Fields of pollution are not homogeneous and are possibly discrete in time and space because:

4.4.1 Sources of pollution are localized in space;

4.4.2 Discharges occur at irregular intervals of time;

4.4.3 The composition and volume of the discharged substances varies;

4.4.4 The pollutants also differ in respect of solubility and cumulative ability;

4.4.5 Depending on its physico-geographical condition the marine environment possesses a varying capacity for self-purification and is marked by varying hydrodynamic and hydrobiological conditions governing the transfer and diffusion of pollutants.

4.5 On the "plus" side of the pollution balance, the most important rôle is at present played by the influx with river waters and that from coastal outfalls, from ships and from the atmosphere. As far as method is concerned, the investigations must therefore be based on the following all-important principles:

4.6 The organization of multidisciplinary observations, comprising meteorological, hydrological, hydrochemical and hydrobiological observations and covering water, marine fauna, sea bottom deposits and the adjacent layer of the atmosphere.

4.7 The organization of systematic observations in No. 1 Baseline Regions, which are not polluted and in which the standard samples must be taken. These regions must be defined in the process of carrying out the necessary preliminary surveys in all oceans and at various geographical latitudes.

4.8 The organization of systematic observations in No. 2 Baseline Regions, which lie in the most polluted regions of the oceans near large river deltas, large populated and industrial areas, regions of sub-marine exploitation of mineral deposits, and on the main navigational routes.

4.9 The organization of periodic observations in areas tied to the Baseline Regions, with increasing distances between the stations as one moves from No. 2 regions to No. 1 regions. Governments must be advised to observe the same principles when organizing regional investigations of pollution - since these are considered to be a component part of the global investigation.

5. Necessary preliminary measures

5.1 Surveying the open seas in order to determine the levels and spatial distribution of the main categories of pollutants, with a view to the preparation of a detailed plan for carrying out long-term observations of pollution.

5.2 The unification and standardization of methods of chemical, microbiological and bacteriological analysis, measurements of physical characteristics and methods of sample selection. The intercalibration of observation methods and means is carried out within the framework of regional observations (e.g. for the North and Baltic Seas).

5.3 The elaboration and standardization of unified forms for registration, transmission and processing of observational data.

5.4 Training specialists, from developing countries in particular, in modern methods of organizing and carrying out observations and methods of analysis.

The results of these preliminary measures should be discussed by the Group of Experts on Scientific Aspects of Marine Pollution (GESAMP), whose task it is to work out recommendations on international standard methods of analysis and means of observation and to draft a plan for long-term observations of pollution.

It is intended that these preliminary measures will be implemented in 1972-1973.

N.B. The scope and nature of the preliminary measures was discussed and accepted in principle at the third session of the Group of Experts on Scientific Aspects of Marine Pollution (Rome, 1971).

6. Geographical scope of regional and international observations in open sea regions

6.1 As a result of the investigations into pollution in various sea and ocean regions carried out in recent years by many States, we now know a number of basins where it is essential to arrange for the regional monitoring of pollution. They include: North, Baltic and Mediterranean Seas, various regions of the Pacific Ocean off the shores of Japan, Canada and the U.S.A.

The first session of the United Nations Intergovernmental Working Group on Marine Pollution (London, 1971) expressed satisfaction at the willingness of the coastal States to organize regional systems for observing pollution in the above-mentioned regions.

6.2 Due to the fact that data on pollution in open sea regions is not complete and rather "casual", it is only possible, at present, to define tentatively the regions to which priority must be given in the investigation of pollution and its consequences. These include:

6.2.1 Regions of the Atlantic Ocean: The Gulf of Mexico, the Bay of Biscay, regions of Newfoundland and Labrador, the North Atlantic current, the south-west of Africa, Gibraltar, the Gulf of Guinea.

6.2.2 Regions of the Pacific Ocean: Panama Canal, Gulf of Alaska, Great Barrier Reef, Kuro-Shio.

6.2.3 Regions of the Indian Ocean: Red Sea, Persian Gulf.

7. Scope of the observations (data to be covered)

In accordance with the findings of the third session of the Group of Experts on Scientific Aspects of Marine Pollution (GESAMP), the basic categories of marine pollution include:

household wastes, pesticides, inorganic substances, radioactive wastes, oil and oil products, organic substances, war industry wastes, detergents.

On the basis of this list and the recommendations of the third session of GESAMP concerning the establishment of regional monitoring systems in Puget Sound and in the North and Baltic Seas, the following chemical pollutants must be given priority when undertaking the necessary preliminary surveys and organizing the global investigations:

oil and oil products, organo-chlorine- and organo-phosphorous substances, lead, mercury, copper, organic phosphorus and nitrogen, carbon, BOC_5.*

As well as these it is necessary to observe the indicators of environmental conditions: salinity, pH, oxygen, oxidation, phosphates, nitrites and ammonium.

The physical characteristics include: temperature of water and air, velocity and direction of wind and currents, turbidity.

The data to be covered in regional observations are determined taking into account the above recommendations, and on the basis of the actual types of pollutant encountered.

In deciding what microbiological and hydrobiological observations must be carried out it is necessary to take into account the following basic aims:

1. Study of the interaction between marine fauna (and communities of such fauna) and the pollution entering the marine environment, and, in the first place, a study of the effect of toxic substances on organisms (communities) and of the part played by organisms in the process of self-purification;

2. Study of changes in ecological systems under the influence of pollution.

N.B. Only chemical components and physical characteristics are referred to here in detail. This section needs to be completed by additional information on microbiological and hydrobiological observations.

8. Preliminary surveys

The draft plan for preliminary surveys by the technical services of the States participating in the present programme must be drawn up before the middle of 1973, responsibility for this being entrusted to the Group of Experts on Scientific Aspects of Marine Pollution (GESAMP).

In planning the preliminary surveys it is necessary to make full use of the international and national oceanographic expeditions that are operating in various open sea regions, recommending that observations be made not only in the expeditions' areas of operation, but also on the routes to such areas. By this means a considerable part of the oceans will be covered.

In order to obtain data on the varying character of pollution in space and time, fairly frequent observations are essential. To define the optimum frequency of observations it is necessary to take the following factors into account:

8.1 The laws governing the formation of physical and hydrochemical fields (as known from observations and analytical studies), the position of frontal zones, the density transition layer, the main systems of currents, etc., taking into account that the largest part of soluble pollution is in a fixed relationship with certain physico-chemical characteristics, for example with salinity especially in those regions where its distribution is largely determined by hydrodynamic factors.

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*Translator's foot-note: Biological oxygen consumption (5), taken to be equivalent to biological oxygen demand (5) in technical English.

8.2 The fact that the basic mass of dissolved pollutants is transferred and dispersed in the upper layer of the ocean.

8.3 The peculiarities of dissolution, coagulation, deposition and disintegration of pollutants. For example, there is considerable evidence to show that the salts of heavy metals coagulate and deposit comparatively rapidly, therefore their concentration decreases rapidly with increasing distance from the source of discharge. Or again, the rate of deposition of lignin in sea water is in direct proportion to the salinity. Therefore, in regions of fresh-water influx the sea bottom is comparatively less polluted by lignin, the degree of pollution of the bottom increasing as one removes from the points of entry.

Taking this into account, we can make the following recommendations:

8.4 Only at some stations (in the deep stream current, in the stagnant zone, above a trough, No. 1 and No. 2 Baseline Regions are samples collected from the whole depth, e.g., from the following horizons - surface, 50 m., 100 m., above and below density transition layer, bottom). In some stations sampling can be confined to the top 100 m. layer of water - e.g. on the Kola peninsular meridian which crosses the stream of the North Atlantic current, two or three deep-water stations will suffice.

8.5 For the preliminary surveys carried out at deep-water stations, samples are taken for analysis of all the above-mentioned pollutants. At other stations, samples are taken for analysis of the most wide-spread pollutants (oil products and pesticides).

8.6 The preliminary surveys should be carried out at least twice (during the warm and cold seasons) for the purpose of studying the influence of changes in natural physico-chemical conditions on the processes of self-purification, transfer and diffusion of pollutants.

9. Indicative stages in organizing and carrying out the Global Investigation of Pollution in the Marine Environment

9.1 First stage

9.1.1 The carrying out of preliminary surveys.

9.1.2 Elaboration and standardization of unified international forms for registration, transmission and processing of observational data.

9.2 Second stage

9.2.1 The preparation of recommendations on unified international standard methods of analysis and means of observation.

9.2.2 The preparation of a draft plan for a system of international observations in open ocean and sea regions, outside the sphere of intergovernmental regional agreements, and of a detailed programme for a global system of pollution monitoring.

9.2.3 Preparation of a forecast as to how the marine environment will evolve under the influence of pollution.

9.2.4 The formulation of criteria for international regulations governing the discharge of pollutants into seas and oceans and for protection of the marine environment from pollution.

9.2.5 The preparation of a preliminary plan for further long-term and international investigations of the problem.