

# **Intergovernmental Oceanographic Commission**

Workshop Report No. 30



## **International Workshop on Marine Pollution in the South-west Atlantic**

Montevideo, 10-14 November 1980

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<u>No.</u>	<u>Title</u>	<u>Publishing Body</u>	<u>Languages</u>
1	CCOP-IOC, 1974, Metallogenesis, Hydrocarbons and Tectonic Patterns in Eastern Asia /Report of the IDOE Workshop on; Bangkok, Thailand, 24-29 September 1973 UNDP (CCOP), 138 pp.	Office of the Project Manager UNDP/CCOP c/o ESCAP Sala Santitham Bangkok 2, Thailand	English
2	CICAR Ichthyoplankton Workshop, Mexico City, 16-27 July 1974 (Unesco Technical Paper in Marine Sciences, No. 20).	Division of Marine Sciences, Unesco Place de Fontenoy 75700 Paris, France	English Spanish
3	Report of the IOC/GFCM/ICSEM International Workshop on Marine Pollution in the Mediterranean, Monte Carlo, 9-14 September 1974.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English French Spanish
4	Report of the Workshop on the Phenomenon known as "El Niño", Guayaquil, Ecuador, 4-12 December 1974.	FAO Via delle Terme di Caracalla 00100 Rome, Italy	English Spanish
5	IDOE International Workshop on Marine Geology and Geophysics of the Caribbean Region and its Resources, Kingston, Jamaica, 17-22 February 1975.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English Spanish
6	Report of the CCOP/SOPAC-IOC IDOE International Workshop on Geology, Mineral Resources and Geophysics of the South Pacific, Suva, Fiji, 1-6 September 1975.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English
7	Report of the Scientific Workshop to Initiate Planning for a Co-operative Investigation in the North and Central Western Indian Ocean, organized within the IDOE under the sponsorship of IOC/FAO (IOFC)/Unesco/EAC, Nairobi, Kenya, 25 March-2 April 1976.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English (full text) Extract and Recommendations also in:  French Spanish Russian
8	Joint IOC/FAO(IPFC)/UNEP International Workshop on Marine Pollution in East Asian Waters, Penang, 7-13 April 1976.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English

<u>No.</u>	<u>Title</u>	<u>Publishing Body</u>	<u>Languages</u>
9	IOC/CMG/SCOR Second International Workshop on Marine Geoscience, Mauritius, 9-13 August 1976.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English French Spanish Russian
10	IOC/WMO Second Workshop on Marine Pollution (Petroleum) Monitoring, Monaco, 14-18 June 1976.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English French Spanish Russian
11	Report of the IOC/FAO/UNEP International Workshop on Marine Pollution in the Caribbean and Adjacent Regions, Port of Spain, Trinidad, 13-17 December 1976.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English Spanish
11 Suppl.	Collected contributions of invited lecturers and authors to the IOC/FAO/UNEP International workshop on Marine Pollution in the Caribbean and Adjacent Regions, Port of Spain, Trinidad, 13-17 December 1976.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English Spanish
12	Report of the IOC/ARIBE Interdisciplinary Workshop on Scientific Programmes in Support of Fisheries Projects, Fort-de-France, Martinique, 28 November-2 December 1977.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English Spanish
13	Report of the IOC/ARIBE Workshop on Environmental Geology of the Caribbean Coastal Area, 16-18 January 1978.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English Spanish
14	IOC/FAO/WHO/UNEP International Workshop on Marine Pollution in the Gulf of Guinea and Adjacent Areas, Abidjan, Ivory Coast, 2-9 May 1978.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English French
15	CPPS/FAO/IOC/UNEP International Workshop on Marine Pollution in the South-East Pacific, Santiago de Chile, 6-10 November 1978.	IOC, Unesco Place de Fontenoy 75700 Paris, France  CPPS Señor Miguel Bakula Secretario General de la Comisión Permanente del Pacífico Sur Vanderghem 590 Lima 27, Peru	English  Spanish
16	Workshop on the Western Pacific, Tokyo, 19-20 February 1979.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English French Russian

<u>No.</u>	<u>Title</u>	<u>Publishing Body</u>	<u>Languages</u>
17	Joint IOC/WMO Workshop on Oceanographic Products and the IGOS Data Processing and Services System (IDPSS), Moscow, 9-11 April 1979.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English
17 Suppl.	Papers submitted to the Joint IOC/WMO Seminar on Oceanographic Products and the IGOS Data Processing and Services System, Moscow, 2-6 April 1979.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English
18	IOC/Unesco Workshop on Syllabus for Training Marine Technicians, Miami, 22-26 May 1978 (Unesco reports in marine sciences, No. 4)	Division of Marine Sciences, Unesco Place de Fontenoy 75700 Paris, France	English French Spanish Russian
19	IOC Workshop on Marine Science Syllabus for Secondary Schools, Llantwit Major, Wales, U.K., 5-9 June 1978 (Unesco reports in marine sciences, No. 5).	Division of Marine Sciences, Unesco Place de Fontenoy 75700 Paris, France	English French Spanish Russian
20	Second CCOP-IOC Workshop on IDOE Studies of East Asia Tectonics and Resources, Bandung, Indonesia, 17-21 October 1978.	Office of the Project Manager UNDP/CCOP c/o ESCAP Sala Santitham Bangkok 2, Thailand	English
21	Second IDOE Symposium on Turbulence in the Ocean, Liège, Belgium, 7-18 May 1979.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English French Spanish Russian
22	Third IOC/WMO Workshop on Marine Pollution Monitoring, New Delhi, 11-15 February 1980.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English French Spanish Russian
23	WESTPAC Workshop on the Marine Geology and Geophysics of the North-West Pacific, Tokyo, 27-31 March 1980.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English Russian
24	WESTPAC Workshop on Coastal Transport of Pollutants, Tokyo, 27-31 March 1980.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English
25	Workshop on the Intercalibration of Sampling Procedures of the IOC/WMO UNEP Pilot Project on Monitoring Background Levels of Selected Pollutants in Open-Ocean Waters, Bermuda, 11-26 January 1980.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English

<u>No.</u>	<u>Title</u>	<u>Publishing Body</u>	<u>Languages</u>
26	IOC Workshop on Coastal Area Management in the Caribbean Region, Mexico City, 24 September-5 October 1979.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English Spanish
27	CCOP/SOPAC-IOC Second International Workshop on Geology, Mineral Resources and Geophysics of the South Pacific, Nouméa, New Caledonia, 9-15 October 1980.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English
28	FAO/IOC Workshop on the effects of environmental variation on the survival of larval pelagic fishes Lima, 20 April-5 May 1980.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English
29	WESTPAC Workshop on marine biological methodology	IOC, Unesco Place de Fontenoy 75700 Paris, France	English
30	International Workshop on Marine Pollution in the South-West Atlantic	IOC, Unesco, Place de Fontenoy, 75700, Paris, France	English Spanish

## 1. OPENING OF THE WORKSHOP

In the presence of the Minister of Education and Culture of the Eastern Republic of Uruguay, Dr Daniel Darracq, the workshop was opened by its Honorary President, Rear Admiral Francisco Sangurro, Head of Maritime and River Interests, who welcomed the participants, representatives and observers. The Rear Admiral emphasized the importance that Uruguay attached to the holding of this meeting in Montevideo, recognizing as it did the growing scale of the marine pollution problems confronting it and the need to develop the resources to tackle and solve those problems.

He likewise recognized that the situation of Uruguay, bordering the River Plate estuary and the south-west Atlantic and situated between the fraternal countries of Brazil and Argentina, made close co-operation in these tasks essential.

Mr Gustavo Malek, Director of the Unesco<sup>(1)</sup> Regional Office for Latin America and the Caribbean, thanked Rear Admiral Sangurro on behalf of the Director-General of Unesco for his words of welcome and stressed Unesco's interest - and, in particular, that of the Intergovernmental Oceanographic Commission - in promoting such meetings, which helped to develop co-operation between Member States. Mr Malek outlined the principles on which Unesco's oceanography programmes and those of its Regional Office (formerly the Field Science Office) were based, before going on to summarize the main programmes and services of the Commission and the Organization's Division of Marine Sciences. He stressed the importance of developing regional machinery for co-operation between Member States, particularly with regard to the marine sciences. He suggested that participants should address themselves to that question during the debate, since it would be useful to know whether the needs felt by the Member States in the region in regard to the marine sciences would be met by some form of Sub-Commission drawing on the experience gained from co-operative research projects (such as CICAR, CIM, CSK) and through the IOC Association for the Caribbean and Adjacent Regions (IOCARIBE).

On behalf of the Commission's Secretariat, Mr Ray C. Griffiths, Assistant Secretary of the IOC, thanked the Uruguayan authorities for their generous invitation, and then went on to give a more detailed account of the Global Investigation of Pollution in the Marine Environment (GIPME) and the Marine Pollution Monitoring Programme (MARPOLMON) forming part of the same research project. He outlined the various aspects of marine pollution that might be taken into account during the discussions. He also clarified the workshop's objectives, already referred to by previous speakers. He emphasized that participants were attending the workshop in an individual capacity as scientists and technologists active in the field in question. (A list of participants will be found in Annex III.)

On behalf of the workshop, he likewise thanked the Governments of Spain and France for defraying the participation costs of Dr Antonio Ballester and Professor Michel Leveau respectively, who were attending the workshop as experts from outside the region.

## 2. ORGANIZATION

### 2.1 Election of the Chairman and two Rapporteurs

Mr Hugo Bernardi proposed Captain Mario Rodriguez Luis, the current Chairman of the Uruguayan National Oceanological Commission, for the post of Chairman of the workshop. The nomination was accepted unanimously.

<sup>(1)</sup> A list of abbreviations will be found in Annex IV.

The Chairman for his part proposed two Rapporteurs, Dr Yara Maria Gomide Gouvêa from Brazil and Dr Adan Edgardo Pucci from Argentina. The two candidates were likewise adopted unanimously.

## 2.2 Administrative arrangements

A work plan was outlined by the Secretary, who suggested hours of work and invited the Chairman to consider the possibility of constituting working groups as required.

## 2.3 Documentation

The Secretary also gave a brief description of the documentation and of the way in which the summary report should be presented. The agenda of the workshop will be found in Annex I and the Recommendation which it adopted in Annex II.

## 3. PRESENT STATE OF KNOWLEDGE AND PROGRAMMES

### 3.1 Argentina

Dr Aldo Orlando of the Argentine Naval Hydrography Service described the situation regarding marine pollution on the Argentine continental shelf, identifying the following areas as potential sources of marine pollution:

- (i) The Greater Buenos Aires area. This urban-industrial complex of over 10 million inhabitants generated a large quantity of waste of all kinds, the bulk of which found its way, by various paths, into the River Plate.
- (ii) The Mar del Plata area. The problem of marine pollution in this area arose from the discharge of domestic waste generated by the fluctuating population of the city of Mar del Plata, from the discharge of organic matter by canning, oil and fish meal factories and from port activities.
- (iii) The Bahía Blanca area. The main urban centres, agricultural and stock-raising industries and ports are situated on the north coast of the city of that name. The estuary of the bay, which is approximately 80 kilometres wide and covers an area of 1,300 km<sup>2</sup> at high tide and 400 km<sup>2</sup> at low tide is the final discharge point for the pollutants generated in the urban-industrial area.
- (iv) The Golfo Nuevo area. In addition to the traditional fish processing plants, this new industrial development zone currently includes an aluminium production plant and a textile preparation and dying plant. The potential marine pollution hazard arises from the operation of these two plants and from associated port activities.
- (v) The Golfo de San Jorge area. In this region, the main marine pollution problem stems from the activities of the petroleum industry, particularly from oil tanker traffic.

Dr Orlando went on to list the institutions involved in the study of marine pollution problems, namely the National Institute of Fisheries Research and Development (Instituto Nacional de Investigación y Desarrollo Pesquero, Mar del Plata, Province of Buenos Aires), the Marine Biology Research Centre (Centro de

Investigación de Biología Marina, Buenos Aires), the Patagonian National Centre (Centro Nacional Patagónico, Puerto Madryn, Chubut), the Argentine Antarctic Institute (Instituto Antártico Argentino, Buenos Aires), the Argentine Oceanographic Institute (Instituto Argentino de Oceanografía, Bahía Blanca, Province of Buenos Aires), and the Naval Hydrographic Service (Servicio de Hidrografía Naval, Buenos Aires).

Dr Orlando gave a brief summary of the research programmes being carried out in these institutes, highlighting in particular the study into pollution in the River Plate and the adjacent coastal area being carried out jointly by the Naval Hydrographic Service of Argentina and the Hydrographic and Meteorological Service of the Uruguayan Navy. Dr Orlando added that the Naval Hydrographic Service of Argentina was actively participating in such international IOC projects as the Marine Pollution (Petroleum) Monitoring Pilot Project and the Marine Pollution Monitoring Programme (MARPOLMON). Argentina was also participating in the Bathy-Tesac Project which was part of the Integrated Global Ocean Station System (IGOSS) co-sponsored by IOC and WMO.

With regard to legislation to combat marine pollution in Argentina, Dr Orlando reported that national laws and ministerial regulations were in force in that area, adding that such legislation was aimed particularly at combating marine pollution from ships.

### 3.2 Brazil

Dr Luis Roberto Tommasi of the Oceanographic Institute of the University of São Paulo and the Environmental Technology and Sanitation Company (Compania de Tecnología y Saneamiento Ambiental - CETESB), described the marine pollution situation in Brazil.

Dr Tommasi said that the main urban-industrial centres in Brazil were situated away from its extensive coastline and added that, although there was pollution in some coastal areas, large stretches of the coastline remained in good ecological condition. The main problem affecting certain of the coastal zones were linked to urban-industrial seaboard development, oil tanker terminals, mineral exploitation activities and port zones in general.

Some of the activities mentioned had contributed to the deterioration of coastal systems, particularly in the state of Rio de Janeiro and in the southern part of the state of São Paulo. Among the areas that had been the specific subject of many studies, Dr Tommasi mentioned the Baía de Guanabara and the Baía de Todos los Santos, describing the activities of the various institutions involved in those studies. He reported that the Special Secretariat of the Environment (SEMA) was sponsoring studies in co-operation with other national institutions to evaluate the levels of heavy metals in waters, sediments and organisms at numerous points along the Brazilian coast. In addition, the Environmental Technology and Sanitation Company (CETSB) was studying the ecological effects of the underwater outfall system in the Baía de Santos and its impact on the recreational zones on the São Paulo coast. The National Foundation for Environmental Engineering (FEEMA) was sponsoring studies into pollution in the Baía de Guanabara, in particular the effect of the underwater outfall system on the ecology of the bay and the impact on adjoining beaches of pollutants dumped in recreational zones. The Health and Environment Secretariat was conducting studies through the Department of the Environment into pollution in the Laguna de los Patos and the Tramandí region and into water quality on the beaches of the state of Rio Grande do Sul.

Drawing on the results of the above-mentioned studies, Dr Tommasi offered some preliminary information on the levels of heavy metals in marine organisms in the zones concerned. With regard to oil pollution, he said that, following the accident involving the oil tanker Tarik Ibn Ziyad in 1976, the authorities concerned had drawn up a programme to monitor the operation of oil tankers as an addition to existing programmes designed to preserve the quality of coastal ecosystems.

Dr Tommasi drew attention to the work done by the Oceanographic Institute of the University of São Paulo in training specialists in marine pollution study and control. The Institute was engaged on projects to assess the impact of pollutants on marine organisms of the benthos and on necton in regions already affected by human activity. Finally, he drew attention to the importance of the seminars on marine pollution organized by CETESB in co-operation with institutions in France, the United States of America, Canada and the Scandinavian countries.

As an addition to Dr Tommasi's report, Dr Yara Maria Gomide Gouvêa briefly summarized the legal situation concerning marine pollution in Brazil. Dr Gomide Gouvêa spoke of the need for a review of current legislation in the light of the growing incidence of marine pollution, particularly that stemming from the routine operations of oil tankers. She said that the responsibility for enforcing existing legislation lay with the Director of Ports and Coasts of the Brazilian Ministry of Maritime Affairs, adding that legal machinery for the protection of the marine environment was also available in the form of sea-borne trade regulations and the fishing code. With regard to international conventions, Dr Gomide Gouvêa reported that Brazil had ratified the 1969 International Convention on Civil Liability for Oil Pollution Damage, the 1971 International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage and the 1973 International Convention for the Prevention of Pollution from Ships.

### 3.3 Uruguay

In his report on the marine pollution situation in Uruguay, Dr Heber Nion stated that studies in this field were for the most part in their early stages. He said that a number of institutions in the country were carrying out research into the pollution of national water resources and added that these studies were at varied stages of development. There was as yet no coherent overall programme to monitor river and ocean pollution. On the legal aspects of marine pollution, Dr Nion observed that Uruguay had acceded to various international conventions and had concluded bilateral treaties with other countries in the region. At the national level, he reported that statutory and regulatory provision had been made to control river and marine pollution. Dr Nion referred to the need to step up the training of scientific and technical personnel so that working groups able to obtain and interpret information could be set up to evaluate the current state of marine pollution in Uruguay.

### Discussion

Each report gave rise to a series of questions and explanations, enabling the experts concerned to describe the various programmes being carried out in their respective institutions and the efforts being made to evaluate the impact of pollution in estuaries and coastal regions. The importance of these zones as receptors and concentrators of pollutants was stressed, attention being drawn to the importance of the River Plate estuary in that respect.

The regional and the invited experts were agreed on the need to make use of the information provided by basic studies in order to understand the present condition and cleansing capacity of the coastal zones of the region and thus to improve

the planning of future development in those areas. They also recognized the inherent difficulty of interpreting these basic studies in such a way as to arrive at conclusive results.

#### 4. PROBLEMS OF MARINE POLLUTION IN THE SOUTH-WEST ATLANTIC

The unofficial national reports revealed a relative shortage of information on the level of pollutants from land-based, river or atmospheric sources and on their impact on the coastal zones of the region.

With a view to the future planning of basic research on marine pollution in the area, a number of special papers were given on themes relating to the main aspects of pollution in coastal and estuary zones.

Dr Enrique Mandelli presented the first paper on the theme of "Metals in the Marine Environment". Dr Mandelli outlined the state of the metals present in natural waters, saying that transitional metals tended to be reactive and therefore to accumulate in sediments and organisms.

The breakdown of continental material and vulcanism are the main natural phenomena responsible for transporting continental metals to the oceans. The erosion of arable land due to its intensive exploitation by man and the discharge or dumping of urban and industrial wastes are the principal artificial sources. The latter represent approximately one tenth of the movements due to natural processes.

He stated that rivers constituted the major pathway of potentially toxic metals to the marine environment and pointed out that it was difficult to make accurate measurements of the concentration of metals in watercourses because of marked regional and seasonal variations and the considerable displacement of these elements due to human activities. He described at least five mechanisms by which metals are transported by rivers, such mechanisms having been detected in rivers as different as the Amazon and the Yukon.

With regard to the atmospheric transport of metals, Dr Mandelli said that the principal mechanism was the aerosol of either marine or continental origin. The production of aerosols containing metals was associated with high-temperature processes such as vulcanism, coal and petroleum combustion, metallurgical processes and cement production. All these processes resulted in the discharge of metals into the atmosphere in the form of gases or very fine particles. The precipitation of these particles by gravity or in association with rain or snow returned such materials to the seas and continents.

Direct inputs of metals due to the discharge of waste in the coastal zones and on the offshore continental shelf was considerable in the coastal regions, which were the most populated of their kind in the world. Dr Mandelli described in detail the ultimate fate of these metals in the marine environment with reference to their chemical composition. He said that processes such as absorption, precipitation, colloidal flocculation and biological fixation tended to transfer metals from the water to the sediments. He added, however, that there was also a tendency for metals to concentrate on the surface of the sea.

The accumulation of metals by marine organisms was selective and reversible. He pointed out, furthermore, that the bulk of the metals accumulated by organisms was concentrated in the granular matter on which the organisms fed. He also referred to processes whereby these metals are transformed by enzyme reactions in micro- and macro-organisms, which constitute detoxification agents.

Dr Mandelli concluded his paper by referring to the pollutant effect of metals on the marine biota, describing their primary effects (modification of behaviour) and secondary effects (changes in the ecosystem). He also alluded to the effects of the presence of metals in the marine environment on fish and human health.

Dr Antonio Ballester presented the second paper of the workshop entitled "Preliminary Considerations concerning a Projected Study of Marine Pollution in the South-West Atlantic". Dr Ballester explained that marine pollution research programmes must have due regard to the level of oceanographic knowledge about the system concerned. If such knowledge was lacking or there were serious gaps in it, one had to consider the need to make good such shortcomings.

A crucial element was knowledge of the dynamics (at the micro-structural level) of the waters under study. An initial system of automatic current meters could be used to supply data for mathematical models which, once constructed, could be maintained relatively easily. Since the dynamics of coastal waters were complex, the treatment to be given to any study would generally be of proportionate complexity.

The marking of waters with colouring agents (such as fluorescein or rhodamine B) or highly soluble radioactive elements (tritium, for example), the use of drift cards and satellite or aircraft observations were some of the fairly rapid, low-cost methods of determining the surface current system in a given region. Data obtained in this way constituted a fairly accessible additional input that was a more or less vital element in basic studies on coastal zone pollution.

It was also desirable to select the pollutants to be studied in the light of the recommendations of the competent international organizations, such as IOC and UNEP, and, above all, having regard to the special features and particular interests of the countries involved in the project. A review of the measuring systems and agencies through which observations would be made was vital and should be carried out with reference to local technological capacity and the availability of those measuring agencies.

Dr Ballester provided a great deal of detailed information on the work of his team in the Catalanian area of the Mediterranean, particularly his work on the accumulation of heavy metals in marine organisms.

### Discussion

The debate that followed the first two papers revealed the participants' interest in coastal pollution by metals, particularly mercury.

Clarifications were sought concerning the presence and dynamics of mercury in the marine environment. It was pointed out in this connection that the accumulation of mercury on the sea bed was influenced by the physicochemical condition of the sediments. It was emphasized that this condition was of crucial importance in polluted zones, even when the mercury being dumped was in low concentrations. Reference was made to the detoxification process that occurred in marine organisms in which this element had accumulated a possible antagonism between mercury and the element selenium was also discussed. Dr Mandelli explained that, once the pollutant had been eliminated from the environment, the detoxification process operated with greater or lesser efficiency according to the degree of physiological damage caused during the accumulation of the metals in the organism. The question of the importance of ethylated lead compounds in the marine environment as a factor in the formation of highly toxic organic compounds of mercury was raised. This was said to be unlikely since the ethylated lead compounds used in petrol were transformed by combustion into inorganic lead compounds.

Information was requested on the possible effect of heavy metals on the coliform organisms present in sewage discharged into the marine environment. The workshop was told that no studies had been carried out in this field and that the only evidence available, experimental in origin, concerned the effect on coliform organisms of salinity levels in sea-water.

With regard to permissible levels of mercury in fish products, Dr Ballester said that the accepted level in Spain was 0.5 ppm of the wet weight and added that routine measurements were taken in Spain of mercury levels in the hair of members of fishing communities. Dr Ballester was asked whether tunny coming from other regions could account for the presence in the Mediterranean of tunny with a relatively low mercury content. Dr Ballester replied that this possibility, mentioned in his work, should be treated as no more than a hypothesis.

It was pointed out finally that there was a need to carry out integrated studies into the presence of heavy metals in the marine environment, that is to say their presence in sea-water, sediments and organisms.

Dr Heber Nion submitted a paper entitled "The Present State of Marine Vertebrates with Reference to Pollution of the Uruguayan Seaboard", a work prepared in conjunction with Dr C. Ríos.

Dr Nion briefly summarized the available information on the mortality rates for fish, marine birds and marine mammals as related to the problems of marine pollution. Where fish were concerned, he said that all the cases of mass mortality observed on the Uruguayan seaboard were due to exceptional natural factors in no way associated with pollution. In the case of marine birds, he said that increases in mortality in all species were all caused by impregnation of their plumage by oil. In the special case of marine mammals, he stated that, while there had been reports of one or two cases of animals being affected externally by oil slicks, such cases were rare since such animals avoided oil patches.

With reference to the accumulation of pollutants in marine vertebrates, Dr Nion reported that some data existed on mercury concentrations in various species of fish - all within acceptable limits with the exception of the levels detected in tunny. Dr Nion concluded his report by pointing out that the number of such measurements made in the area was small and by stressing that most of the limited number of incidents recorded were associated with oil spills.

Mr Jorge Rivero Devoto submitted a paper entitled "Environmental pollution caused by the fishing industry".

Mr Rivero Devoto dealt in his paper with the problem of waste generated by the fishing industry, at both the catch and the processing stages. He presented a detailed account of the processes involved in the fishing industry. He went on to describe the pollution to which these processes gave rise, discussed the possibility of recuperating some of the waste matter now dumped, and examined the analytical data concerning the various types of effluents generated by the industry.

He also stated that national and municipal regulations in Uruguay governed the maximum levels of pollutants that the fishing industry was permitted to dump.

Mr Rivero Devoto concluded his paper by pointing out that Uruguay's Fisheries Development Plan covered the question of pollution arising from wastes generated by the fishing industry.

Dr Bernhard Griesinger addressed the workshop on the subject of "Environmental Protection Systems on the Brazilian Seaboard". He said that the Government of Brazil wished to rationalize the exploitation of the country's coastal resources as part of its programme of reducing to a minimum the pollution caused by the urban-industrial development of the coastal zone. He added that the activities associated with this programme were being co-ordinated by the Seaboard Protection Committee (CODEL), a body composed of five federal and five state entities. He went on to describe the objectives of CODEL, which aimed to establish a general picture of the seaboard region, making use of the various sources of scientific and socio-economic information. He added that there also existed emergency plans, involving the Pollution Control Emergency Action Group (GAEP), to deal with spillages of oil and chemical products in the coastal zone.

Among the programmes being sponsored by CODEL, he made special mention of the studies being carried out into the effect of underwater outfalls for the discharge of sewage and river water, the description of marine pollution from industrial sources and the monitoring of water quality in the coastal recreational areas. Dr Griesinger said that one of the regions where many studies had been carried out was the Baía de Santos, considered to be one of the most contaminated stretches of water on the Brazilian seaboard.

Dr Victor Moreno then presented a paper entitled "The Identification of Sources of Hydrocarbons in Argentine Waters".

Dr Moreno drew attention to the importance for biologists, ecologists and conservationists of being able to differentiate, in the marine environment, between natural events and events related to human activities. In the case of marine pollution by petroleum hydrocarbons, Dr Moreno thought that it would not be difficult to recognize the presence of this pollutant in marine organisms if one knew the structure of hydrocarbons naturally present in those organisms. With the help of such information, Dr Moreno said that it would be possible to assess the changes brought about by the presence of petroleum hydrocarbons in marine organisms. With reference to the studies being carried out in Argentine waters, he said that they were designed to detect such changes and to relate them to the phenomena of adaptation, disturbance and, in the case of one or two species, disappearance. In that connection, Dr Moreno offered some speculations on the possible impact of petroleum hydrocarbons on the eggs of the anchoveta, having regard to the depletion of stocks of this species in Argentine waters.

Dr Adan Pucci submitted a paper entitled "Evaluation of Pollution in the Waters and Sediments of the Bahía Blanca".

Dr Pucci began his talk by describing the extent of industrial development in the area of the bay, the oceanographic behaviour of which was very complex and little understood. He went on to identify the various pollution sources, such as the dumping of urban and industrial waste, petroleum hydrocarbons due to tanker activities, and dredging in the channels leading to the port of Bahía Blanca. He also noted that future industrial development in the area would involve the dumping of additional pollutants, as well as thermal pollution due to the construction of a thermal power station. He added that studies already carried out suggested that any further appreciable increase in pollutants would cause damage to the bay area. He concluded his paper by emphasizing the need to adapt current industrial development projects so as to minimize the environmental impact of future coastal development.

## Discussion

The discussion on the papers submitted at the afternoon session of 11 November focused mainly on the impact of pollutants, particularly oil, on the various species of fish of commercial importance in the region. Information was requested concerning the spawning of the anchoveta, the floating of its eggs on the surface of the sea and the possible impact of petroleum hydrocarbons on these eggs. The workshop was told that the eggs of the anchoveta remain on the surface of the sea for a period of 48 hours and that the species spawns throughout the year. With regard to the impact of petroleum on the eggs of the anchoveta, it was suggested that the result might be to affect the larval development of the species. The view was also put that the effect of petroleum on the eggs of the anchoveta might well be minimal compared with the natural factors governing their survival and that the same could be said in connection with the disappearance of the mackerel from the waters of the region.

It was pointed out that, since the impact on the fishing resources of the various regions of the growing quantities of petroleum hydrocarbons in the marine environment was not really known, there was a need to continue to investigate ways of discovering how much of this kind of pollution there was in relation to natural fluctuations. Stress was likewise placed on the need to consider the impact of other pollutants on fisheries and to ensure that waste disposal remained within the limits of tolerance of the environment.

The meeting held on 12 November began with a talk by Dr Enrique Mandelli entitled "Basic Studies on the Distribution of Pollutants in the Gulf of Mexico Region".

Dr Mandelli opened with a reference to the importance of studying regional seas along the lines laid down in the programmes of UNEP. In that connection, he noted the importance of the Gulf of Mexico and the Caribbean sea, a zone regarded as the American Mediterranean. He indicated those areas in the region where basic studies of marine pollution were being carried out. He made special mention of the studies being carried out in the Gulf of Mexico, particularly the Mexican part of the Gulf.

In that connection, he drew attention to the work carried out, in conjunction with the Mexican National Council for Science and Technology (Consejo Nacional de Ciencia y Tecnología de México - CONACYT), under UNDP-Unesco projects Mex/74/004 and Mex/77/010, involving the training of research workers and technicians in the study of coastal pollution problems in Mexico.

Dr Mandelli added that basic studies of pollutants in coastal areas and lagoons had made it possible to evaluate the short-term effect of the spillage from the oil-rig IXTOC I. He also presented the results of the research carried out in Mexico since 1974 on concentrations of heavy metals, chlorinated hydrocarbons and petroleum hydrocarbons in organisms and sediments of the Mexican coastal zone in the Gulf of Mexico.

He ended by impressing upon the experts of the region the need for co-operation and exchanges in the area of personnel training, the establishment of workshops and the planning of studies on coastal zone pollution in the region.

The workshop continued with a talk by Dr Michel Leveau entitled "The Integrated Study of the Impact of Urban Effluents on Coastal Marine Ecosystems", a paper prepared in collaboration with Dr J.M. Péres.

Dr Leveau began by saying that the studies in question had been carried out by three multidisciplinary research teams over a period of five years in the context of a more general investigation into the state of health of the Mediterranean. The area studied was the coastal zone affected by the underwater outfall from the town of Marseilles, particular emphasis being placed on the impact on pelagic and benthic ecosystems.

Dr Leveau reported on the load and nature of the pollutants discharged from the outfall and on studies of physical, chemical, biological and bacteriological parameters. He also discussed the impact of such discharges on planktonic and benthic elements at the various levels. Summing up the results of such studies, he drew attention to the modification of the ecosystems in the zones affected by the discharge system as compared with other zones. From the health point of view, he pointed out that pathogenic organisms carried by what he termed "nits" of water discharged from the outfall could affect adjacent areas regarded as pollution free.

Mr Walter Castagnino spoke on the subject of "Models of Pollutants in Bays and Coastal Areas". Mr Castagnino referred to the numerous studies of pollution in bays, estuaries and coastal areas in Latin America, mentioning in particular those carried out in the Bahía de Guanabara, the estuary of the River Guaíba in Brazil and the estuaries of the River Guayas and the River Estero Salado in Ecuador. He said that the studies concerned offered guidelines on methods, procedures and ways of calculating and interpreting results. He added that this work had resulted in investment savings and in a reduction in the cost of operations and maintenance essential to the achievement of the desired objectives.

Mr Castagnino spoke of the application of quality models to the waters of bays, estuaries and coastal zones and of their reliability in predicting future conditions. He said that such models were essentially predictive mechanisms and were specific to each case. He concluded by saying that such information was essential to modern society given the limitations of water resources and the need to safeguard the legitimate legacy of future generations.

There was no discussion at this meeting.

The afternoon meeting began with a paper by Dr Atilio François Schusselin on "The Study of Ammonia, Urea and Nitrate-Nitrite Proportions as a Method of Zoning and Studying the Impact of a Sewage Outfall System on the Phytoplankton in the Discharge Area".

Dr François Schusselin referred to the studies carried out in the area affected by the large underwater outfall system of the town of Marseilles in France. These studies were based on the fact that the water discharged from underwater outfalls causes a change or loss of structure in the mass of water concerned. On the basis of a study of urea, ammonia and nitrate-nitrite levels in the area affected by the outfall, proportional diagrams of these nitrogenous substances were constructed, which were then compared with the development of phytoplankton in the various zones.

Dr François Schusselin concluded his paper by pointing out that it was not possible to generalize on the basis of his own findings, and that only the application of this approach to the study of discharges from other underwater outfall systems could confirm the usefulness of the method.

Miss Mary Lopretti presented a paper on "Pollution, pH and Photosynthetic Activity", prepared in association with Mr Josef Balcar.

Miss Lopretti reported that the purpose of the study of the seaweed Salvinia natans, carried out in the laboratory, was to determine the effect of various pollutants - detergents, urea, insecticides and other natural organic materials - on the seaweed in question, having regard to pH fluctuations in the environment. She concluded her talk by observing that the reduction of photosynthetic activity observed in the study coincided with pH values higher than 8. With pH values below 8 the results were erratic. She concluded that in such cases, photosynthetic activity depended more on the presence of pollutants than on pH levels.

Mr Ricardo Ayup Zouain submitted a paper on the theme "Studies to be Planned to Deal with the Effects of Oil Dumping".

Mr Ayup Zouain began by summarizing the impact of oil spillages on pelagic ecosystems, fishing resources, coastal systems and tourist development in the light of experience in other parts of the world. He said that such information was virtually non-existent where the coasts of Uruguay were concerned, and reported that they had accordingly begun to take samples from the coastal zones that seemed most likely to be affected by oil spillage. The studies mentioned included physical, chemical, biological and bacteriological determinations. He ended his paper with a series of recommendations on measures to be taken in the event of major oil spillages in Uruguay's coastal regions.

The final paper of the meeting, entitled "Environmental pollution", was presented by Mr Amilcar Pittamiglio.

Mr Pittamiglio said that the object of his paper was not to draw conclusions or suggest forms of action but rather to offer some thoughts of a general nature. He made the point that, in co-ordinating environmental programmes, the authorities concerned should pay due attention to human health and should make adequate legislative provision in that regard. This called for the establishment of priorities, which should vary according to the particular circumstances. Such plans should also take into account the need to train skilled personnel at all levels, the availability of data and the analysis of information. Mr Pittamiglio ended by stressing the need for co-operation between the various countries in formulating criteria and standards and in carrying out monitoring and other activities required to achieve and maintain an acceptable level in the quality of the coastal zone, i.e. an environment satisfactory to all and vital to the health and well-being of the community.

There was no discussion at this meeting.

The opening paper at the meeting of 13 November was delivered by Dr Oscar Guillen, of the Marine Institute of Peru (Instituto del Mar del Peru), on the theme "Marine Pollution in the Southeast Pacific". The aim of this multinational project was to plan and carry out systematic baseline observations on the concentrations of certain pollutants in the sea-water, sediments and organisms of the coastal zones of Chile, Peru, Ecuador, Colombia and Panama. The project was also designed to develop the capacity to predict the effects of pollutants on the coastal zone. To achieve these objectives, Dr Guillen said that continuous determinations had been made of the pollutants present in the coastal zone and also of their origin. On the basis of the findings, basic standards would be laid down for the protection of human health and that of the living elements in the marine environment. He said that the programme would facilitate the co-ordination of regional research, thereby making for a more efficient joint effort. Dr Guillen went on to describe the general plan, which was in two stages. The first, which was of five years' duration, involved carrying out baseline studies, calculating the relative levels of pollutants and establishing danger levels. The planning of the second

stage, Dr Guillen said, would depend on what was achieved in the first stage. He went on to refer to the programme co-ordination machinery and the activities of the working groups involved. He mentioned a Working Committee made up of representatives from each of the participating countries. He added that this Working Committee would be in contact with such international agencies as IOC, UNEP, FAO and OAS. Dr Guillen ended his paper by detailing the costs of the project and its funding sources.

Dr Luis Roberto Tommasi presented the second paper of the day, on the theme of "Marine Pollution in Brazil". Dr Tomassi began his paper with some general considerations on pollution processes in the coastal zone, pollution input sources and pollution transformation and accumulation processes in the marine environment. He went on to refer specifically to pollution problems in the coastal area of Brazil. He identified the zones most affected and described the main pollutants detected in those zones. On the question of contamination by heavy metals, he presented data relating to the Baía de Guanabara, the Baía de Todos los Santos and the Baía de Santos, noting the high levels of lead and cadmium in organisms in those areas. Dr Tommasi also spoke of the effect of oil pollution, particularly on the northern coast of the state of São Paulo, and of the high concentration of faecal organisms in the Baía de Rio de Janeiro, the Baía de Puerto de Recife and the Baía de Santos. He considered this latter bay to be the most oxygen-depleted in all Brazil due to the discharge of sewage and effluents from the fertilizer industry. He pointed out that the indiscriminate discharge of solid wastes into coastal waters represented a great environmental hazard that had not yet been treated with proper urgency. Dr Tommasi ended his paper by describing the pollution monitoring programmes currently in operation in Brazil, and the national and state institutions responsible for combating coastal zone pollution.

The final paper of the meeting was submitted by Mr Luis Salvatore on the theme: "Anti-Pollution Plans in Puerto de la Paloma, Uruguay".

Mr Salvatore began his talk by referring to Uruguay's Fisheries Development Plan, which was being carried out by the National Fisheries Institute of Uruguay (Instituto Nacional de Pesca del Uruguay - INAPE). This plan envisaged the decentralization of the fishing industry, currently centred on Montevideo Bay, and its development in other parts of the country. He referred to the plan to develop the industry in Puerto de la Paloma, situated on the Atlantic 240 kilometres to the east of Montevideo. Mr Salvatore said that it was planned to establish four complete fish processing plants in the port, and that in the operation of these plants, thought was being given to the possibility of controlling the discharge of effluents so as to preserve the coastal zone. To that end, the Ministry of Transport and Public Works had laid down waste water quality standards for the fishing industry. Mr Salvatore said that all the fish processing plants would discharge their wastes into a common sewage system, although it had not yet been decided how finally to dispose of the effluents generated. Two proposals had been made. The first involved constructing an underwater outfall to discharge the effluents directly into the sea and the second envisaged running the outfall to a waste stabilization reservoir. After a suitable period in the reservoir, the wastes could be discharged directly into the sea. Mr Salvatore concluded his paper by emphasizing that the aim of the authorities was to make the Puerto de la Paloma zone into a model fisheries terminal.

There was no discussion at this meeting.

## 5. STUDY PROJECTS

The Chairman of the Workshop invited the participating experts to examine the marine pollution problems of the region closely, observing where possible the guidelines laid down in the annotated agenda. He recommended that they should keep in mind two major aspects - pollution in the region as a whole and cases of specific zones common to all the countries of the region.

In accordance with the priorities and criteria formulated in the course of the workshop, it was decided to deal in plenary session with recommendations concerning a limited number of projects so as to focus on the principal marine pollution problems in the region. It was pointed out that such projects must come within the sphere of competence of the institutions of the region, as prescribed in the Comprehensive Plan for Global Investigation of Pollution in the Marine Environment (IOC Technical Series, No. 14).

The regional experts (Annex III) agreed that, in view of the multi-institutional nature of marine pollution studies, it was essential to standardize the methods employed in the implementation of both national and regional programmes. In that connection, there was an urgent need to establish an intercalibration programme to work out common methods for the collection, preservation and analysis of samples. It was also agreed that there was a need to promote close technological and scientific co-operation between the institutions of the region, including training and mutual assistance programmes. To this end, it was proposed that a Regional Intercalibration Centre should be set up with its headquarters in Montevideo. Its first task, it was suggested, could be to undertake an intercalibration project based on the experience of the Bermuda exercise in January 1980 (Workshop on Intercalibration of Sampling Procedures of the IOC/WMO/UNEP Pilot Project on Monitoring Background Levels of Selected Pollutants in Open-Ocean Waters).

## 6. TRAINING AND MUTUAL ASSISTANCE

In formulating the above proposals, the participants recognized that teaching, training and mutual assistance were essential elements in the proper development of future regional programmes. There was repeated reference in the debate to the need to step up higher education in the marine sciences. The point was made that teaching and training should take place as far as possible within the region itself so that future research workers and technicians would be familiar with local problems and needs. It was stressed that this training should concentrate on specific problems and viable projects. It was also mentioned that, in evaluating the special needs of the region, particular attention should be paid to the experience of other regions. Following a general examination of the problems confronting the institutions of the region, reference was made to the urgent need to consolidate existing institutions and strengthen their library and general information services in areas relating to the pollution of coastal and ocean ecosystems.

## 7. INSTITUTIONAL MACHINERY

The workshop recognized the existence in the region of university centres, marine research institutes, government laboratories and other centres pursuing marine pollution programmes. These centres, which varied in their objectives and in the extent to which they were involved in carrying out pollution programmes, had been identified in the papers submitted by the regional experts. However, it was pointed out that, if the basic research programmes necessary for an understanding

of the problems of the region were to be carried out, special provision might need to be made with regard to the co-ordination of specific programmes at both national and regional levels.

In that connection, the participants supported the creation of a Regional Marine Sciences Review of the kind proposed at the Workshop on the Benthic Ecology of the South-West Atlantic. It was also suggested that an editorial board should be chosen and that practical arrangements for setting up such a review should be made. The value of the International Marine Science Newsletter was also recognized - in which connection congratulations were offered to Unesco and, in particular, its Regional Office for Science and Technology for Latin America and the Caribbean (ROSTLAC).

#### 8. ADOPTION OF THE FINAL REPORT AND RECOMMENDATIONS

The participants in the workshop approved the report of their discussions and expressed the hope that the workshop technical report would be published at an early date. It was agreed that the possibility should be examined of bringing the technical papers out as a supplement, which could be published following the distribution of the main report. The participants went on to approve the recommendations made by the workshop (Annex II).

#### 9. CLOSURE OF THE WORKSHOP

Bringing the workshop to a close, the Honorary President, Rear Admiral Francisco Sangurro, congratulated the IOC Secretariat, the Unesco Regional Office and the participants on the excellent way in which the workshop had been prepared and conducted. He expressed the hope that the proposals which it had made would be favourably considered by the authorities of the countries in the region so that they could be implemented without delay.

The Secretary of the Workshop, Mr Ray C. Griffiths, thanked the Honorary President on behalf of the IOC Secretariat for his words of praise and renewed his thanks to the Government of Uruguay for its invaluable help in organizing the workshop. His thanks also went to Unesco's Regional Office in Montevideo for all that it had done to prepare the workshop, and to the regional experts and invited experts for their first-rate contributions. He said that the conclusions and recommendations formulated would help to advance research into the problems posed by marine pollution in the region.

The workshop was declared closed at 4 p.m. on 14 November 1980.

ANNEX I

AGENDA

1. Opening of the workshop
2. Organization
  - 2.1 Election of the Chairman and two Rapporteurs
  - 2.2 Administrative arrangements
  - 2.3 Documentation
3. Present state of knowledge and programmes
  - 3.1 Argentina
  - 3.2 Brazil
  - 3.3 Uruguay
4. Problems of marine pollution in the South-West Atlantic
5. Study projects
6. Training and mutual assistance
7. Institutional machinery
8. Adoption of the final report and recommendations
9. Closure of the workshop

ANNEX II

RECOMMENDATIONS

The International Workshop on Marine Pollution in the South-West Atlantic,

Considering that:

- (1) while marine pollution in the South-West Atlantic does not yet constitute a widespread problem, continuing population growth, industrial development and increasing maritime traffic undoubtedly represent a potential danger, areas of pollution of various kinds having already been detected,
- (2) exchanges of information have shown that the countries concerned do not at present possess sufficient numbers of specialized scientists or adequate technical and financial resources and that institutions involved in marine pollution studies are at present not employing standard methods in the sampling, preservation and analysis of sea-water, sediments and marine organisms,
- (3) although research is being carried out in all the countries concerned, the nature and scale of the problem call for co-ordinated action in the region,

Recommends that the Intergovernmental Oceanographic Commission:

- (a) propose to Member States that they should formulate institutional plans or projects in such a way as to centralize them in a National Plan for the Prevention and Study of Marine Pollution;
- (b) propose to the Member States of the region that a Standing Committee - consisting of one recognized expert in this field from each country and one representative of IOC - be set up to provide co-ordinating machinery for the harmonizing of national plans in accordance with the "Comprehensive Plan for the Global Investigation of Pollution in the Marine Environment and Baseline Study Guidelines" (IOC Technical Series, No. 14) and that these plans be updated;
- (c) sponsor the creation of a Regional Intercalibration Centre, with its headquarters at Montevideo, which it is suggested could begin its work with an intercalibration exercise based on the recommendations of the Workshop on Intercalibration of Sampling Procedures of the IOC/WMO/UNEP Pilot Project on Monitoring Background Levels of Selected Pollutants in Open-Ocean Waters, held in Bermuda in January 1980, and on the relevant recommendations of the IOC subsidiary organs involved in this field, such as the Working Group on Global Investigations of Pollution in the Marine Environment and its Group of Experts on Methods, Standards and Intercalibration, having regard to the fact that this and similar exercises will require the collaboration of institutions of international standing;
- (d) prepare an updated summary of the available technical information, together with a comprehensive inventory of existing institutions, research workers and resources in the region;
- (e) request Member States to assess their future requirements regarding human and technical resources and infrastructure so as to enable the Commission to provide the necessary support to ensure the fullest participation of countries in the Regional Programme through the Training, Education and Mutual Assistance Programme;

- (f) urge Member States in the region to extend and strengthen baseline studies leading to knowledge of current levels of pollution and its effects on coastal ecosystems;
- (g) promote biennial workshops on marine pollution to evaluate the progress made in both national and regional research;
- (h) place on record, through the Secretary of the Commission, the gratitude of the participants to the Governments of Spain and France for having helped Dr Antonio Ballester and Dr Michel Leveau, respectively, to attend the workshop.

ANNEX III

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ANNEX IV

LIST OF ABBREVIATIONS

BATHY-TESAC	Bathythermograph report, temperature, salinity and currents
CETESB	Compania de tecnologia y saneamiento ambiental (Environmental Technology and Sanitation Company)
CICAR	Co-operative Investigations of the Caribbean and Adjacent Regions
CIM	Co-operative Investigations in the Mediterranean
CONACYT	Consejo Nacional de Ciencia y Tecnología - Mexico (National Council for Science and Technology)
CODEL	Seaboard Protection Committee (Brazil)
IOC	Intergovernmental Oceanographic Commission
CSK	Co-operative Study of the Kuroshio and Adjacent Regions
DMA	Department of the Environment (Brazil)
FAO	Food and Agriculture Organization of the United Nations
FEEMA	State Foundation for Environmental Engineering (Brazil)
GIPME	Global Investigation of Pollution in the Marine Environment
INADE	Instituto Nacional de Pesca - Uruguay (National Fisheries Institute)
IOCARIBE	IOC Association of the Caribbean and Adjacent Regions
MAPMOPP	Joint IOC/WMO Subgroup of Experts on the Marine Pollution (Petroleum) Monitoring Pilot Project
MARPOLMON	IOC/WMO Marine Pollution Monitoring Programme
OAS	Organization of American States
ROSTLAC	Regional Office of Science and Technology for Latin America and the Caribbean
SEMA	Special Secretariat of the Environment (Brazil)
UNEP	United Nations Environment Programme
Unesco	United Nations Educational, Scientific and Cultural Organization