

**Intergovernmental Oceanographic Commission**  
Workshop report no. 8

**Report of the IOC/FAO (IPFC)/UNEP  
International Workshop on Marine  
Pollution in East Asian Waters**

Universiti Sains Malaysia, Penang  
7-13 April 1976



Intergovernmental Oceanographic Commission

Report of the International Workshop on Marine Pollution in East Asian Waters sponsored by the Intergovernmental Oceanographic Commission, the Indo-Pacific Fisheries Council of the Food and Agriculture Organization and the United Nations Environment Programme. \*

Universiti Sains Malaysia  
Penang, Malaysia

7 - 13 April 1976



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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), 158 p.	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 Science, 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	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	IOC/FAO(IOFC)/UNESCO/EAC Scientific Workshop to Initiate Planning for a Co-operative Investigation in the North and Central Western Indian Ocean, Nairobi, Kenya, 25 March - 2 April 1976.	IOC, Unesco Place de Fontenoy 75700 Paris, France	English

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Summary Report

1. Introduction

East Asia is probably one of the most complicated areas of the world, with its great diversity of geography, races, societies, economies and environments. It contains the largest part of the world's population. Environmental problems have received inadequate attention. The marine environment is one area in which international co-operation is essential if pollution problems are to be solved, since marine pollutants recognize no national boundaries.

The United Nations Environment Programme (UNEP) thus provided financial support for an International Workshop on Marine Pollution in East Asian Waters organized and convened jointly by the Intergovernmental Oceanographic Commission (IOC) of UNESCO, the Indo-Pacific Fisheries Council, of the FAO, and UNEP. The Government of Malaysia hosted the Workshop which was held at Universiti Sains Malaysia, Penang, from 7 to 13 April 1976.

The main aims of the workshop were to:

- a) define the present problems of marine pollution in the Indo-Pacific region and to identify the main gaps in the present knowledge;
- b) to identify the priority studies required;
- c) to propose possible pilot projects on baseline studies in the region.

2. Opening of the Session

The Minister of Science, Technology and Environment, the Honourable Tan Sri Ong Kee Hui, officially opened the Workshop. Dato Alwi bin Jantan, Chairman of the National Organizing Committee for the Workshop, welcomed the participants, and Mr Raymond C. Griffiths, Assistant Secretary of IOC, welcomed the participants on behalf of the sponsoring agencies (IOC/FAO/UNEP), and thanked the Malaysian authorities for the invitation to hold the Workshop in Penang.

Professor C.P. Ramachandran, Dean of the School of Biological Sciences, Universiti Sains Malaysia, was elected Chairman. Dr A. Soegiarto, Indonesia, was elected as Co-Chairman and Dr Peter Barnett, U.K., as Rapporteur.

A brief telegraphic message was then adopted and dispatched to the Executive Director and the Governing Council of UNEP in the name of the Chairman of the Workshop. It expressed the participants' gratitude to UNEP

for its generous support to the Workshop and their strong hope for UNEP's continued support and encouragement of regional co-operation for the protection of the marine environment in the East Asian region.

The Agenda of the Workshop is given in Annex I, and the List of Participants is given in Annex II.

### 3. Pollutants

#### 3.1 Working Groups

Three working groups were formed to consider various pollution subjects:

Group 1 : Organic and biological pollutants  
(Chairman : Dr B.S. Morton;  
Rapporteur : Dr G.B. Thompson)

Group 2 : Chemical pollutants, particularly pesticides and inorganic  
(Chairman : Dr A. Soegiarto;  
Rapporteur : Dr S.J. Thrower)

Group 3 : Physical and oil pollutants  
(Chairman : Dr A.A. Jothy;  
Rapporteur : Prof. R. Johannes)

Reports from each group were discussed in plenary session before considering proposals for pilot projects.

#### 3.2 Introduction

It was agreed that the term "marine environment" includes water, sediments, coastal and offshore ecosystems and the air and sea interfaces. It also includes estuaries, coastal and open seas.

The region is very complex, ranging from temperate waters in the north to tropical in the south, where marine ecosystems of particularly high diversity occur. The complicated geography of continent and islands of different sizes provides a very wide range of marine environments in the coastal areas.

The marine environment is very important to the nations of the region as a source of food and minerals, as a means of transportation and as a dump for waste materials from industrial and urban complexes. Some undesirable materials resulting from human activities on land find their way into the seas via the rivers. The main human activities and associated pollutants are summarized in Table 1.

All these uses and activities result in considerable pollution of the marine environment and the effects of the pollutants have to be minimized. Already, there are indications that parts of the environment are being damaged (e.g. reduced fisheries and the destruction of coral reefs as a result of siltation).

In a region of such complexity there is great variability in the known distribution of the pollutants. Some pollutants are very widespread although the amounts vary considerably from place to place. Other

Table 1

The main human activities and the main pollutants associated with them in East Asia.

Types of Activity	Type of pollutant or environmental problem
Urbanization	Domestic sewage; earth-moving and land reclamation; dredging of harbours, etc. Industrial wastes.
Agriculture, forestry	Pesticides, particularly chlorinated hydrocarbons, organophosphates, carbamates, fertilizers (hypertrophication); silt.
Oil extraction, refinery and transport, dispersants	Oil and oil dispersants.
Mining (including sea-bed mining)	Metals and metalloids (tin, copper, nickel, arsenic); silt; destruction of corals by silt or direct mining for building materials.
Metallurgy	Metals, especially copper, zinc, nickel, cadmium.
Cellulose	Organochlorine compounds from chlorine bleaching; mercury from production of caustic soda and chlorine, used in cellulose treatment, organic slimicides.
Plastics	By-products from vinyl chloride production, monomers, cadmium and other stabilizers; plastic litter.
Power generation	Heat; radioactive waste.
Desalination	Heat; salt.

pollutants are very localized although in places where they occur they can have significant effects. Much of this is due to the great variation in the distribution and intensity of human activities within the region, although it should be recognized that the occurrence of a pollutant in a particular place does not necessarily mean that it originates locally. Great stress was laid on the need for much more information on the physical factors affecting the dispersal of pollutants by the sea.

It was recognized that there is considerable variation in our knowledge of pollution throughout the region. Some countries have very well developed research programmes whilst others are in the process of developing them. Some countries have only a little information on pollutants. For certain pollutants, this sometimes gives the mistaken impression that countries which have done little research are less polluted than countries for which there is a great deal of data.

The absence of knowledge about the effects of pollutants in many parts of the region caused great concern and there was general agreement that it was essential that more research be undertaken. It was recognized that most countries are beginning to monitor some pollutants but it was thought that other work should be done to improve our knowledge. These included the establishment of data exchange centres (see Section 4), the standardization of techniques for measuring pollutant levels and the need to train the people involved so that they could carry out work (particularly with sophisticated instruments) in parts of the region where poor facilities exist. There is likely to be a need to arrange for facilities for servicing and calibrating instruments regionally, sub-regionally or nationally.

There is great variation in the effects of the various pollutants on the environment whether for reasons of quantity, toxicity or persistence. There is a risk of some toxic compounds building up in various parts of the environment. This should be avoided as far as possible although it is recognized that occasionally it is sometimes necessary to achieve a balance between, for example, DDT levels in the environment and the benefits this insecticide brings in fighting malaria.

Some pollutants are of great importance on a regional basis but it was recognized that most pollution problems are essentially more localized, although where the same problem occurs in different parts it is essential that the results of the different investigations should be compared (see Section 4).

When considering the establishment of priorities in the field of marine pollution, particularly with regard to research and development, the following questions should be kept in mind:

- a) Is there a threat to the ecology of such areas as mangrove swamps, estuaries and coral reefs due to pollution?
- b) Has there been a change in the distribution and abundance of living aquatic organisms due to present or previous pollutants?
- c) Are present pollution levels a threat to the survival of organisms used in aquaculture?

- d) Is there a risk of contaminating cultured or free-living aquatic organisms that would render them unsuitable for human consumption?
- e) What are the main pathways of pollutants to and within the sea and how significant is air pollution?
- f) Can we predict from studies of national development programmes which pollutants are likely to be of future importance, and, if so, can we plan now to negate the impact of such development on the environment?

### 3.3 Pollutants, sources and effects

Although the three working groups deal separately with certain types of pollutants (i.e. organic and biological; chemical, particularly pesticides and inorganic; physical pollutants and oil) the Workshop was conscious of the need to consider all the pollutants discussed in some order of priority. An attempt was made to apportion them to three priority categories (1, 2 and 3, in decreasing order) according to suggestions made and discussed during the Plenary Session (Table 2). No attempt was made to order priorities within each group.

#### 3.3.1 Oil

The Working Group 3 on physical pollutants and oil classified the sources of oil as follows:

- Discharge of bilge water from fishing boats and other maritime vessels.
- Discharge of ballast water.
- Refinery effluents.
- Onshore and offshore production.
- Transport of oil.
- Receiving terminals.

The areas mainly affected are shown in Table 2.

Taking into account the enormous quantities of oil transported through the region, the number of onshore and offshore stations which process or produce petroleum, the claims of nearly all the countries in the area of beach pollution by oil, and the high number of oil spills and their adverse effects on marine organisms, the working group gave oil a high priority as a pollutant. Considerable concern was expressed about the indiscriminate use of dispersants for oil clean-ups and their adverse effects on marine organisms.



Table 2

The main pollutants in an approximate order of priority by groups and the countries having special concern with them or being affected by them.

Pollutant	Priority grouping	Country and/or area having special concern or being affected *
1. Oil		<u>Malacca Straits</u> , <u>South China Seas</u> , <u>Seto Inland Sea</u> , Tokyo Bay, Hong Kong, <u>Singapore</u> , Ulsan (Korea), Manila Bay.
2. DDT, pesticides, organochlorines, etc.		India**, Philippines, Vietnam, Korea, Malaysia, Indonesia, Japan, Thailand, Australia (North).
3. Heavy metals	1	India, Philippines, Japan, Hong Kong, Indonesia, Malaysia.
4. Organic and biological pollutants. Fertilizers.		Singapore, Thailand, Korea, Hong Kong, India, Indonesia, Japan, Malaysia, Philippines, Australia (North; fertilizers).
5. Silt.		<u>Malacca Straits</u> , <u>Marinduque and Cebu (Philippines)</u> , <u>Phuket (Thailand)</u> , India, Hong Kong, Kalimantan and Java (Indonesia). Sarawak and Sabah (Malaysia), Korea, Seto Inland Sea (Japan), Australia (N).
6. Heat	2	<u>East coast of Gulf of Thailand</u> , <u>Bintulu (Sarawak)</u> , <u>Bagac Bay (West coast of Luzon, Philippines)</u> , Straits of Johore, Hong Kong
7. Metalloids		Japan, Indonesia, Malaysia, India, Philippines.
8. Plastics		Hong Kong, Japan.
9. Radioactive wastes.	3	Japan.
10. Salt (desalination)		<u>Hong Kong</u> , Japan, Singapore.

\* Based on available information. Underlined areas were those specifically identified as being high priority areas.

\*\* Only eastern India was considered.

3.3.2 DDT, pesticides, organochlorines, etc.

and

3.3.3 Heavy metals

Working Group 2 emphasized that most of the problems caused by these pollutants were due to pesticides, since East Asia is largely an agricultural area.

The main pollutants causing concern in the region are:

- DDT and similar compounds (chlorinated hydrocarbon pesticides).
- Organophosphates and carbamates.
- Heavy metals, especially cadmium, lead and arsenic. Tin is of special importance to Malaysia and Indonesia. Mercury in sediments is of special interest in Japan.
- Bleaching agents in certain areas, e.g. India and Japan.
- Defoliants have been a special problem in Vietnam, the consequences of which remain since they or their degradation products are persistent.

Unlike the other two working groups, Working Group 2 did not discuss to any extent the effects of the priority pollutants, nor their control or treatment. This did not indicate any lack of concern about the effects of these very widespread pollutants; the Group devoted most of its attention to the consideration of its recommendations.

3.3.4 Organic and biological pollutants

The Working Group 1 defined the sources of pollution and placed them in the following approximate order of decreasing importance:

- Domestic waste waters
- Agricultural wastes (manures and fertilizers)
- Industrial effluents (food processing, textiles, etc.)
- Solid urban waste
- Wastes from land reclamation, spoils and sedimentation
- Red tides
- Reduced freshwater input.

The common effects of organic waste are increased oxygen demand, increased nutrient concentrations, increased turbidity, and a higher input of pathogens, leading to structural changes in the marine ecosystems and to

a considerable hazard to public health (contact with contaminated seawater or consumption of seafood fished in such waters).

Pollution levels usually decrease with increasing distance from the land; there is little evidence of direct contamination offshore but ecological changes may result from coastal enrichment. Indirect effects may be from lethal and sublethal pollution levels threatening adult fish breeding in inshore waters, and their young. A possible source of concern is sewage sludge dumping in deeper waters.

Some cities in the region use primary or secondary sewage treatment for domestic wastes; this treatment is based on established western practices which are too costly to be generally adopted and may be less efficient than locally-derived, low-cost methods such as stabilization and aerated ponds and ditches, especially in Asian tropical climates.

In rural regions (with increasing affluence and contact with urban areas) an increasing demand for waterborne sewage disposal will lead to the loss of traditional methods of disposal direct to the soil.

The health hazards associated with domestic sewage discharge into the sea relate particularly to the collection of shellfish and the use of beaches as recreational areas. This is particularly important with respect to tropical pathogens.

There are no regional (as opposed to national) standards for the discharge of domestic waste waters, but standards derived from temperate regions are probably inappropriate.

Aquaculture is carried out in estuaries exploiting naturally high productivity, and in cages on open coasts, exploiting good water quality. Species being cultured may be unable to withstand reduced oxygen levels.

Undesirable ecological changes in the species composition of a region may adversely affect the natural spat resources upon which the aquaculturist is dependent.

Microbiological contamination of the product may affect the industry directly or indirectly by real or imagined fears in the public mind of pollution.

Coastal fisheries typically exploited locally may suffer a gradual decline in catch as pollution levels increase or may be subjected to periodic fish kills, the cause of which is rarely discovered. Deep water fisheries may be especially affected where inshore breeding species suffer mortality.

Altered sea-water quality, due to organic pollution, may influence the parameters under which power stations, desalinators, and sea-water flushing systems operate. Ecological changes may affect the fouling community.

Agricultural wastes, such as pig and poultry manure, are generally used as a fertilizer in agriculture, aquaculture or horticulture, and only become a problem where insufficient land is available for these purposes.

and the waste enters inland or coastal waters. This is particularly important in Hong Kong and Singapore where effluents from food processing industries, tanneries, textile and other plants are often discharged in an environmentally damaging way.

Increasing urbanization and affluence will result in a greater demand for water. This may result in a local reduction of freshwater input to the sea. The consequence of this process in the tropical region requires assessment.

The location of recreational beaches is often such that wave action will concentrate pollutants, in all forms, upon them. They may also be degraded from the land by local effluent discharges and reclamation, resulting in a deterioration of water and sand quality with consequent reduced aesthetic appeal. Water catchments may reduce input of sediment to the beach and result in a decrease in the beach area. On these beaches "red tide" is a possible visible indicator of increased pollution.

There is little evidence to suggest that the estuarine environment, particularly the back-of-the-shore mangroves, is affected by river-borne pollutants. However, the back-of-the-shore environment is often considerably degraded by: (1) reclamation; (2) dumping and disposal of agricultural and domestic wastes; (3) water-borne contamination of natural mangrove drainage.

Corals occur away from major estuaries and their centres of population because they are extremely sensitive to reduced salinities and increased turbidities. Corals also inhabit nutrient-deficient oxygen-rich waters and thus any changes in all or some of these parameters by pollution can adversely affect them. Tourist centres and resorts dependent upon coral as a major attraction could be particularly affected.

### 3.3.5 Sedimentation

The Working Group 3 considered that silt (from rivers) and undersea mining and dredging wastes should all be considered together as sedimentation.

The following sources of sediment were identified:

- Land clearing for purposes of agriculture, lumbering, residential and industrial land use, resulting in erosion.
- Terrestrial mining, particularly for tin, copper, nickel etc.
- Seabed mining for sand, corals, tin etc.
- Dredging to deepen harbours and estuarine areas for fishponds, and to provide filling for land reclamation.

Areas mainly affected are listed in Table 2.

In view of the large amounts of sediments which enter the estuaries and inshore waters, the working group inferred from experience in other regions, which are already under investigation, that these sediments may have serious ecological consequences, and the effects on corals and their

ecological systems must be particularly taken into account. It was also agreed that the benthic biota would suffer from the addition of these sediments. In addition to such direct effects the group discussed such indirect effects as the adsorption of metals and pesticides on the eroding soil, and was of the opinion that the total effects of these sediments on living resources of the sea have to be considered.

#### 3.3.6 Heat

Because thermal pollution is mainly a potential problem in the region it was decided to place it in priority grouping 2 (Table 2). Nevertheless, Working Group 3 on physical pollution felt that thermal pollution from power plants should be regarded as a serious problem since most of the countries of the region have already established or are planning power stations with a throughput of large quantities of cooling water. The group felt that because tropical organisms live in water which is normally close to their upper thermal limits, thermal pollution is potentially a very serious problem in the tropics, and that better knowledge of the consequences of thermal addition would be needed for correct selection of power plant sites. Whilst it has been classified under priority grouping 2 (Table 2), it was recognized that thermal pollution was already having significant effects in certain localized areas (e.g. Straits of Johore).

#### 3.3.7 Metalloids

These pollutants, from mining activities, were not recognized as being of serious consequence in the region and were, for the time being, classified under priority grouping 2.

#### 3.3.8 Plastics

Working Group 3, on physical and oil pollution, reported that plastics and other persistent solids introduced into the sea by direct dumping or via rivers were significant polluters in Japanese waters where adverse effects of vinyl sheets and other plastic rubbish have been observed. However, the group decided not to classify this type of physical pollution as a priority problem for the region (Table 2, priority group 3).

#### 3.3.9 Radioactive wastes

A similar decision was made with respect to radioactive materials as pollutants (Table 2, priority group 3).

#### 3.3.10 Salt

Salt from desalination plant effluents was thought to have a low regional priority.

### 3.4 Research priorities and recommendations for various pollutants

#### 3.4.1 Oil

The priority research subjects for oil are:

### Biology

- Effect on community composition (e.g. mangrove, coral and estuarine communities).
- Indicator species of high sensitivity.
- Effects of oils and dispersants on the survival, growth and reproduction of species such as mullet, milk fish, bivalves and shrimp (all larval stages are probably particularly susceptible).
- Survey of oil tainting problems.

### Chemistry

- Chemical fate of oil in the sea.
- Characterization of oil.
- Monitoring: type and quantity in water, sediments, biota.
- Establishment of a voluntary report system by ships, resort owners, fishermen etc.

### Physical oceanography

- Hydrographic studies providing information on the movement and distribution of oil.

#### 3.4.2 DDT, pesticides, organochlorines

and

#### 3.4.3 Heavy metals

The recommendations of Working Group 2 which considered these pollutants were of a universal kind and have been incorporated into the general recommendations on pollutants in section 3.5.

More specifically, the Group pointed to a number of questions concerning these pollutants:

- What are the pathways in each country by which these materials reach the sea?
- Which should have the priority - the extent to which a substance persists in the environment or its potential for doing harm to organisms in the environment?
- Into what compounds do some of these pollutants degrade?
- Is there any synergistic effect which might aggravate the effects of pesticides and inorganic pollutants?

- Is the degradation of pesticides the same in Asian regions as in European waters, and are European priorities valid in this region? For example, degradation of some pesticides is temperature dependent.
- In the light of the previous question, should we try to standardize techniques for monitoring pollutants in this region?

The recommendations for research on these pollutants were as follows:

- Baseline studies to determine existing pollutant levels in the marine environment.
- Studies of toxic effects of pollutants, their degradation and passage through ecosystems, ecological effects and eventual distribution in the environment as well as establishing or predicting future trends.

Recommendations for methods and facilities, manpower training and public awareness have been incorporated into section 3.5.

#### 3.4.4 Organic and biological pollutants

Treatment was discussed in some detail by Working Group 1, for which the following recommendations were made:

- In major cities, low-cost methods of sewage treatment appropriate to, and taking advantage of, local conditions, should be developed and used.
- In rural areas, waterborne sewage disposal systems should be designed so as to return nutrients to the land instead of discharging them into natural waters. Particular attention should be paid to the potential value of domestic and agricultural waste waters as a fertilizer in aquaculture and fisheries.
- The hazards associated with the consumption of shellfish contaminated by microbes should be surveyed in the region. Quality standards or guidelines should be derived, and suitable treatment and control methods proposed.
- The hazards involved in contamination of recreational waters by micro-organisms and particularly by red tides should be investigated and reviewed on a regional basis, with a view to the establishment of guidelines.
- Research is required on the recycling or less damaging disposal of agricultural and industrial organic wastes, particularly fertilizers.
- To reduce pollution by urban run-off, improved garbage collection services and public awareness of the problem are required. The recycling and use of such waste as a resource should also be studied.

Research priorities were identified as follows:

- A regional baseline study of organic nutrients and coastal enrichment in selected coastal areas, and especially estuaries, lagoons, and coral reefs.
- The establishment of a regional source inventory, assessment and data bank of biological and organic pollutants (however, see section 4).
- A study of the impact on mangroves of: (a) seaborne pollutants, and (b) land reclamation.
- A study of the impact of pollutants upon coral reef communities.
- A study of the impact of pollutants upon aquaculture and coastal fisheries.
- A study of the survival time of human pathogens in tropical marine waters, with correlated epidemiological studies.
- A study of red tides in East Asian waters and their possible correlation with pollution. This study may test the feasibility of using these phenomena as indicators of pollution.
- A study to determine the feasibility of using aquatic, possibly sessile, intertidal organisms as biological indicators of pollution.
- The effects of organic pollutants upon fish populations.
- A study to assess the gainful utilization of organic wastes in coastal aquaculture.
- Pilot projects on the development of low-cost sewage and waste treatment systems.

#### 3.4.5 Sedimentation

For sedimentation Working Group 3 recommended the following priority research subjects:

##### Geology

- Bottom surveys
- Monitoring sediment load and distribution

##### Chemistry

- Pollutant analysis of suspended sediments
- Adsorption of pollutants on sediment particles

##### Biology

- Impact on primary productivity
- Impact on community structure



- Identification of indicator species showing greatest sensitivity (e.g. corals)
- Impact on the survival, growth, migratory and spawning habits of marine organisms
- Impact on fisheries

#### Physical oceanography

- Hydrography and effect of water movements on sediment distribution
- Effect of suspended particles on water transparency and primary production

#### 3.4.6 Heat

For thermal pollution the Working Group 3 identified the priority research areas as follows:

##### Biology

- Lethal effects of elevated temperatures, especially in tropical areas with high ambient temperatures
- Sublethal effects on fish and invertebrates and their eggs and larvae, and on the growth, spawning, migratory behaviour and other aspects of the biology of the adults
- The impact of heated water on the fouling community that will develop within and around power stations
- Synergistic effects with organic pollutants and other toxic substances

##### Physical oceanography

- Hydrographic studies relevant to an understanding of the dispersal and mixing of heated effluents

##### Planning

- Careful site planning, with the aid of biologists and hydrographers, for the establishment of thermal plants at locations where the environmental impact will be minimized.

#### 3.4.7 Metalloids

#### 3.4.8 Plastics

#### 3.4.9 Radioactive wastes

#### 3.4.10 Salt

There were no specific recommendations for any of these four types of pollutant from the working groups which considered them.

#### 3.5 General conclusions and recommendations on pollutants

The preceding discussions identified the main gaps in our present knowledge of marine pollution in the Indo-Pacific region. By identifying the types of priority study required they provided the basis for the discussions on pilot projects in Section 5. In addition, the following important and more general recommendations emerged from the discussions about pollutants as a whole:

- a) A need for more baseline studies of the marine environment, with emphasis on marine ecosystems (e.g. coral reefs and mangroves). By 'baseline' is understood the determination of present levels and distributions of pollutants in the various environmental media (e.g. water, sediments, organisms and sea-surface air). A review of any baseline studies carried out so far is required. Identification of suitable indicator organisms for baseline studies was regarded as vital. After critical evaluation of the results of baseline studies, monitoring of significant pollutants may be undertaken.
- b) A much greater understanding of the physical processes in the coastal waters of the region, particularly water circulation, as mechanisms for the distribution of pollutants are fundamental to marine pollution studies.
- c) Continuous investigations of the physical and chemical parameters of the environment to provide information on the long-term accumulation of pollutants and a basis for understanding the pathways by which pollutants are distributed.
- d) Research should be carried out on problems different from baseline studies and monitoring. Such problems are toxic effects (dose/response relationship), pollutant degradation and transfer between the various media, and ecological effects.
- e) Standardization of analytical and other required methods for marine pollution studies should be examined, with a particular view to the adoption of modern methods. All studies should be preceded by suitable intercalibration exercises. At the same time the standardization of technical terms and units of measurement is essential.
- f) There is an urgent need to train scientists and technicians in the principles and techniques of marine pollution research. This training should be particularly directed towards ecological and analytical methods, including maintenance and calibration of equipment.
- g) Mechanisms for the exchange of data, information (see Section 4), specimens and samples should be developed.

h) Efforts should be made to elicit public support, to generate governmental and non-governmental commitment, and to increase public awareness of environment pollution and its significance.

#### 4. Arrangements for data exchange

In any scientific investigation, exchange of information is essential if results are to be considered within the general framework of scientific knowledge and understanding. In scientific investigations involving the international co-operation of several countries the exchange of information is not only essential but also urgent for the satisfactory progress and completion of a project.

In considering projects for the Indo-Pacific region it will be necessary to ensure that adequate data exchange takes place for all regional and sub-regional projects proposed by the Workshop. A short plenary session reviewed the data exchange possibilities for the region. Existing exchange systems used by the United Nations organizations were discussed. One system is the Aquatic Science and Fisheries Information System (ASFIS) operated by FAO with the collaboration of the IOC and the International Referral System (IRS) of UNEP. Another is the inventory of data on contaminants in aquatic organisms compiled by the Fishery Data Centre of FAO as part of a co-operative project of UNEP, the first edition (February 1976) of which contains data from about 150 institutions. The IOC Working Committee for International Oceanographic Data Exchange (IODE) has developed some standard information reporting procedures and has prepared some marine data inventories. It has also formed a sub-group on marine pollution data. These various systems, except the IRS, deal with specific marine organisms and with specific marine pollutants and could provide methods of data exchange, but they do not provide for the storage of data. The IRS provides information on data sources. It was pointed out that countries which receive agency funding in support of national programmes are under an obligation to send their data to the World Data Centres and relevant regional data centres.

Within the countries of the region there is considerable variation in the methods of data exchange at the national level. Some nations have sophisticated exchange arrangements. For example, the Indian National Oceanographic Data Exchange System deals not only with data from its coastal waters but also from the Indian Ocean as a whole. Similar arrangements exist in Japan, USSR and Australia. A number of nations are either beginning to set up exchange centres (e.g. Thailand, Philippines and Indonesia) or are planning to do so (e.g. Malaysia). There are no such plans for Hong Kong but information can be obtained from the Secretary for the Environment, The Hong Kong Government. A directory of all people working on environmental pollution has been compiled by the Australian Commonwealth Department of the Environment in Canberra, and can be supplied on request. From this a worker can write directly to a scientist with a particular pollution interest.

The Indonesian Petroleum Institute's Study Group on Pollution (P.O. Box 89JKT, Jakarta) is making studies to evaluate environmental pollution data, particularly for oil.

The continuing project on the survey of institutional capabilities for the Indian Ocean and East Asian region, as part of UNEP's marine environmental monitoring and marine living resources programme, was described. The project is carried out by the National Institute of Oceanography, Goa, India. The

primary aim is to prepare a catalogue of institutions with marine science capabilities with special reference to their facilities, personnel and capabilities for work on marine pollution research and monitoring and/or living resources management. The survey will be completed by UNEP in co-operation with FAO and IOC, and its results will be used when the implementation of the projects proposed under Section 5 will be considered.

The general opinion was that it would be desirable to have a data exchange centre for the region, preferably with facilities for publishing scientific papers about tropical studies. However, it is premature to recommend its establishment in the near future because greater effort is needed first of all to establish national centres in all or most of the countries involved. The importance of standardizing procedures was also stressed.

Meanwhile, the possibilities are that existing world or national agency facilities might be used, and some positive suggestions to this effect were made by Japanese, Indian and Soviet participants.

There were two final proposals on data exchange from the plenary:

- a) To recommend the establishment of national oceanographic data centres in the region, where they do not already exist.
- b) To recommend that, in the interim before a regional data exchange centre is proposed, an existing national system be used for regional references.

## 5. Proposals for Pilot Projects

These were considered at the regional and sub-regional levels. There was an initial plenary session on regional projects, in which a great deal of vigorous discussion took place as to which projects should be considered on a regional basis. In view of the different opinions expressed it was decided that discussions at the sub-regional level should take place before deciding on regional priorities. There was general agreement, as there had been in Section 3, that for both types of study the adequate training of personnel and the intercalibration of instrumentation was of great importance.

Prior to the implementation of the pilot projects, regional or sub-regional, UNEP will inform the governments in the region of the results of the Workshop, ask for their comments on the proposed pilot projects and for their agreement to participate in them. The pilot projects will be carried out by national research institutions nominated by their governments. Detailed operational plans for the projects will be elaborated by a relevant specialized agency or a regional body at consultations with scientists from the interested institutions participating. These plans will define the modalities, such as common methods, analytical procedures, areas of investigation or monitoring, parameters to be studied and ways of reporting and co-ordination, and will be used as a basis for providing technical assistance (training and equipment) and the mechanism for the early implementation of the projects, including the organization of networks of collaborating institutions. For each of the approved projects one of the participating institutions will be given the role of a regional activity centre.

The Workshop pointed out that proposals for regional and sub-regional projects would be valuable contributions to the IOC's Global Investigation of Pollution in the Marine Environment.

#### 5.1 Regional co-operation

It was thought that regional pilot projects should satisfy three criteria:

- a) They should provide as integrated a view as possible of the general level of pollution in the region.
- b) They should not duplicate existing programmes to any great extent.
- c) They should allow most of the countries to participate.

It was suggested that regional projects should be small pilot studies probably designed to determine marine pollution baselines. They would indicate which pollutants were the most critical, which would provide a sound basis for a system of monitoring and which could be expanded to gradually cover the whole area.

The point was made that because of the lack of environmental legislation, at both international and national levels, it was essential that basic scientific information be obtained on which future legislation could be based.

The UNEP representative mentioned that an international workshop on environmental law was being proposed by a group of lawyers in the region with special emphasis on the legal problems involved in the protection of the marine environment; it would thus be possible in the near future to maintain a close dialogue between scientific and legal experts so that they might together be able to tackle the problems of marine environment protection in an interdisciplinary manner. The participants at the Workshop welcomed this information, although they did not discuss this topic in detail.

Satellite observations were considered to be potentially very useful for certain aspects of some regional projects. Although cloud cover could create problems it was noted that South East Asia was probably a good region in this respect since most of the cloud cover was significantly restricted to the land mass.

It was felt that throughout the region sewage, metals and pesticides were the commonest pollutants. There were suggestions that these would make good subjects for a regional project. However, it was agreed that a suitable detailed regional investigation would be too costly. At the same time it was recognized that sub-regional programmes on some of these pollutants were already being carried out by the USSR and Japan.

Since there was a requirement for regional studies which were relatively small pilot projects the following four projects were proposed for regional co-operation. The list does not indicate any order of priority.

## Regional Project 1

### 1. Title of the project

Mangrove ecosystems as sewage and sediment buffer zones.

### 2. Justification and background

- a) Mangroves constitute a diverse resource in the region that centre on the expanding aquaculture industry. Their potential is largely unassessed, and because of their fragility they are being destroyed on a big scale.
- b) Mangrove forests are important spawning grounds, nurseries and feeding grounds for economically significant aquatic species.
- c) Mangrove forests act as buffers for sediment and hence prevent damage to sensitive communities like coral reefs.

### 3. Objectives

#### 3.1 Long-range objectives

- a) To provide a scientific basis for the optimum exploitation of mangrove communities.
- b) To assess existing fisheries productivity and its possible improvement and/or preservation.

#### 3.2 Immediate objectives

- a) To assess the present status and impact of pollution (especially physical) upon mangrove ecosystems by the analysis of national aerial surveys and satellite mapping. Results from this should be correlated with field observations and reports to assess damage both to the more aquatic pioneer community and to the back-of-the-shore flora and fauna.
- b) To investigate the relevant hydrography, chemistry and transport of sediments as well as the microbiology and aquatic productivity of the unique mangrove ecosystems in the region.

## Regional Project 2

### 1. Title of the project

Comparative study of metals using oysters as indicators.

### 2. Justification and background

Oysters occur naturally throughout the East Asian region and are being cultured on a commercial scale in several parts of the region. The oyster has already been established as a reliable indicator of pollution through the accumulation of toxic heavy metals and through harbouring pathogens of significance to human health.

### 3. Objectives

#### 3.1 Long-range objectives

A study of regional baseline pollution levels in the oyster and other bivalves based on:

- a) Toxic metal contamination (e.g. zinc, cadmium, etc.)
- b) Coliforms and selected pathogens.

From these data it might be possible to establish regional contamination levels and propose guidelines for hygiene standards.

#### 3.2 Immediate objectives

Each participating country or laboratory would initiate a study of heavy metal contamination utilizing atomic absorption spectrophotometry. The analytical procedures will be standardized and the participants in the project will intercalibrate their methods. Microbiological contaminants would also be studied following standard procedures as yet to be determined.

### Regional Project 3

1. Title of the project

Studies of red tides in East Asian waters.

2. Justification and background

Red tides are a global natural phenomenon. There is a general feeling, however, that their incidence in the Asian region is increasing, possibly as a consequence of pollution.

3. Objectives

3.1 Long-range objectives

To determine:

- a) the species creating red tide;
- b) the size and concentration of the tides;
- c) the toxicity of the tide to the main marine organisms, especially those consumed by man; and
- d) assemble other data relevant to weather, hydrography and possible increased pollution levels, particularly of nutrients.

3.2 Immediate objectives

To arrange for a network of national laboratories to study the phenomenon. These would make observations, undertake analyses and report data on red tides. One of them would act as a referral centre. Participants would be issued with simple identification and data recording sheets.

An initial approach could be made to the Centre for Short-Lived Phenomena (formerly connected with the Smithsonian Institution) for past records, and a scientific literature review could be made.



## Regional Project 4

### 1. Title of the project

A study of physical dispersal processes in coastal waters.

### 2. Justification and background

The sea outfalls from large cities or industrial belts, or even from an isolated industry, discharge effluents and domestic sewage into the coastal and nearshore waters. The dispersal, mixing and eventual transport of these pollutants to any zone away from the outfalls depend on the dynamic characteristics of the coastal water.

In trying to predict the ultimate fate of any effluent that has been or is being discharged into the coastal waters, the factors that determine the dynamic characteristics of the waters receiving the effluent and its neighbourhood should be known for any given time of the year - since these vary in time and space, and can be expected to show considerable variations in areas influenced by the monsoons. This knowledge could be gained by conducting regular physical oceanographic surveys of the area concerned to define safe limits of disposal of wastes with a view to avoiding pollution.

### 3. Objectives

#### 3.1 Long-range objectives

To determine the ways in which the physical transport processes of coastal waters account for the dispersion of pollutants throughout the region with a view to predicting future trends.

#### 3.2 Immediate objectives

To study coastal circulation (advection, turbulent mixing, eddy and other diffusion processes, tides, wave action), silting and sedimentation as they affect the distribution of the major pollutants, by carrying out surveys in nearshore/coastal waters using, as far as practicable, modern instrumentation and techniques. These surveys, when carried out over a few seasonal cycles, or at least over a year, would give an insight into the physical and dynamic properties of the concerned marine region. When such surveys are completed each participating country would be in a position to prepare maps or charts indicating monthly/seasonal characteristics of its coastal and nearshore water bodies. It would thus be possible to lay out guidelines for controlling and monitoring marine pollution for stretches of coastal areas of any given participating country.

## 5.2 Sub-regional pilot projects

Six sub-regional working groups were set up as follows:

1. Bay of Bengal.
2. Straits of Malacca.
3. Gulf of Thailand.
4. South China Sea.
5. Sea of Japan, Yellow Sea and East China Sea.
6. Seas of the Eastern Archipelago.

It was emphasised that in making these groupings there was no intention of excluding any countries. Participants were assured that they could take part in any of the group discussions.

The reports of the six groups suggested sub-regional projects which tended to fall into two categories; those that specified the type of pollutant and those that described general pollutant effects on ecosystems.

Of the projects which specified the type of pollutant, it is interesting to note that although oil was regarded as a widespread cause of marine pollution in the region it was given priority in only three sub-regions. However, the Workshop was informed of the IGOSS Marine Pollution (Petroleum) Monitoring Pilot Project, and it was explained that countries in the region may participate in that project, which is jointly sponsored by IOC and WMO.

Certain sub-regional projects were similar to some regional projects; this is because the subject (e.g. mangrove ecology, siltation) has special sub-regional characteristics. Such sub-regional projects would contribute to the regional project but were expected to go into the problem at much greater depth in the sub-regional context.

During the discussions on sub-regional projects the Soviet and Japanese experts expressed their mutual interest in studies of marine pollution of the Kuroshio region and suggested that their studies should be an important sub-regional project for the East Asian region.

The sub-regional projects approved were as follows:

Sub-region 1 : Bay of Bengal

Priority No.1

1. Title of the project

Assessment of the levels of DDT and heavy metals (especially cadmium) and arsenic in sediments and estuarine organisms (especially molluscs).

2. Justification and background

Baseline studies have not been carried out so far on these pollutants. The prolific use of pesticides and the increase of industries on river banks contribute to heavy inputs of pesticides and metals in river waters. These have caused problems in estuarine waters and are more likely to become severe. The above appears to be common to all littoral states bordering the Bay of Bengal.

3. Objectives

3.1 Long-range objectives

To determine the effect of these pollutants on marine resources utilized by man and plan effective measures to prevent, substitute or control such pollutants reaching estuarine waters, and to establish a monitoring system.

3.2 Immediate objectives

To initiate baseline studies to assess the present status in selected areas.

Priority No.2

1. Title of the project

Sewage disposal and possible health hazards as assessed by studies on coliform counts, BOD and essential nutrients.

2. Justification and background

In all the littoral states around the Bay of Bengal sewage and domestic wastes are mostly disposed untreated. These discharges are liable to cause health hazards to peoples in the affected areas, affect fishery resources and reduce the aesthetic value of beaches.

3. Objectives

3.1 Long-range objectives

On the basis of studies conducted suitable measures will be proposed for the pretreatment, the establishment of disposal sites and other

appropriate control measures, and a monitoring system will be established.

### 3.2 Immediate objectives

Neither the quantity of sewage disposed nor the quality of water around sewage discharge outlets have been assessed in the region. The main immediate objectives are to initiate baseline studies to:

- a) identify the different sources of pollution (namely sewage, sullage and other domestic discharges);
- b) quantify coliforms, BOD and essential nutrients and the extent of pollution.

## Priority No.3

### 1. Title of the project

Pollution problems in the coastal areas of the Bay of Bengal due to siltation and its effect on fishes of commercial importance.

### 2. Justification and background

In almost all the littoral states bordering the Bay of Bengal the rivers carry very large amounts of silt (by erosion, human settlement etc.) to the estuarine zones. This siltation has affected the fishery resources in certain areas. The problem has been further aggravated by dredging, mining and filling operations. No substantive data are available to assess the effect of siltation on fisheries and seaweeds of commercial importance.

### 3. Objectives

#### 3.1 Long-range objectives

To preserve marine resources at optimum levels of productivity in the region, especially those of great economic importance, by regular monitoring of the level and rate of siltation.

#### 3.2 Immediate objectives

To monitor sediment loads and distribution and their impact on primary productivity and community structure of selected commercially important species.

Sub-region 2 : Malacca Straits

Priority No.1

1. Title of the project

Assessment of oil pollution and its impact on living resources.

2. Justification and background

The Straits of Malacca are subject to extremely heavy navigation. About 3 billion tons of goods per annum, including more than 300 million tons (1973) of crude oil and its derivatives, are transported through the Straits by an estimated 4,300 loaded tankers. The release of oil from normal shipping operations is considerable. Accidents are becoming more frequent with ever-expanding transport and there are indications that in several places the edible marine resources are being severely damaged.

3. Objectives

3.1 Long-range objectives

- a) To establish a permanent monitoring network to determine the extent of pollution by oil in the Straits of Malacca.
- b) To assess the effect of oil pollution on littoral communities and fisheries.
- c) To investigate the biodegradation of oil in tropical waters.
- d) To develop contingency plans for dealing with large-scale, accidental oil spills, including arrangements for emergency actions.

3.2 Immediate objectives

- a) To establish baseline data on the extent of pollution by oil in the waters of the Straits of Malacca.
- b) To investigate the effect of oil pollution on fisheries and mangrove vegetation in selected areas.

Priority No.2

1. Title of the project

Assessment of sedimentation levels and their effect on the environment.

2. Justification and background

The Straits of Malacca serve as a sink for river discharges, particularly silt, from the Indonesian island of Sumatra and from peninsular Malaysia. The sediment load in the Straits has been increasing over the years, primarily due to such human activities as sea-bed and terrestrial mining for tin, land clearance for purposes of agriculture, lumbering and urbanization, and dredging to deepen harbours and estuaries. The semi-enclosed nature of the Straits prevents the sediment load from being carried into open waters, owing to the lack of strong coastal currents or wave action.

3. Objectives

3.1 Long-range objectives

- a) To study the physical transport of suspended material.
- b) To study concurring pollution (e.g. by metals).
- c) To study the effects of siltation on community structure (e.g. corals), bottom fauna and primary productivity.
- d) To study the effects on fishery resources and aquaculture.
- e) To evaluate physical interference with local fishing techniques.
- f) To evaluate silting effects on harbours and estuaries.
- g) To evaluate effects of dumping of dredged material with the purpose of recommending suitable dumping sites.
- h) To establish a monitoring programme of sedimentation and transport of suspended material.

3.2 Immediate objectives

- a) To establish the extent of sedimentation.
- b) To identify the contributing sources, both natural and man-made.

Priority No.3

1. Title of the project

Monitoring of selected metals.

2. Justification and background

The countries surrounding the Straits of Malacca produce about three quarters of the world's tin. Much of the tailings from tin mining eventually find their way into the sea. At the mouth of the Straits (around Phuket, Thailand) off-shore tin mining is prevalent. Such operations are likely to spread into the Straits.

Very little is known of the levels of the metal in seawater, sediments and marine organisms. There is the possibility of tin being present in significant levels in both metallic and methylated forms. It is most important that studies be carried out on this metal in this particular sub-region.

Apart from tin, arsenic and lead, in particular, should be studied. Vast amounts of organo-arsenic are used as herbicides and arsenic is also associated with the tin mining and smelting industries. Preliminary surveys have also indicated the presence of high levels of lead in this sub-region.

3. Objectives

3.1 Long-range objectives

- a) To identify the forms in which the metals occur in the organisms.
- b) To identify biochemical cycles including possible biotransformation of the compounds.
- c) To compare levels from the baseline studies with existing food standards.

3.2 Immediate objectives

- a) To identify suitable pollutant-accumulating species as indicator organisms.
- b) To collect baseline data on the levels of tin, arsenic and lead in indicator organisms.

Priority No.4

1. Title of the project

Assessment of health and ecological effects of pollution by degradable organic compounds, such as sewage and agro-industrial waste.

2. Justification and background

The degradable organic substances enter the waters of the Straits of Malacca from the land with practically no treatment. Major sources of these substances are sewage, agricultural waste (fertilisers) and industrial wastes. The impact of this waste is considerable in the vicinity of its entry into the coastal waters, particularly on public health (exposure to contaminated waters, food containing pathogens) and marine communities (oxygen depletion, hypertrophication).

3. Objectives

3.1 Long-range objectives

- a) To assess the effect of degradable organic compounds on human health and marine ecosystems.
- b) To provide guidelines for criteria on environmental quality standards.
- c) To improve waste disposal and waste management practices.

3.2 Immediate objectives

- a) To determine the extent of pollution by degradable organic compounds.
- b) To establish baseline data on the contamination of edible molluscs with coliforms and selected pathogens.
- c) To establish baseline data on oxygen depletion and nutrient enrichment in selected areas.



Sub-region 3 : Gulf of Thailand

Priority No.1

1. Title of the project

Thermal effect studies on some marine organisms of the Gulf of Thailand.

2. Justification and background

A number of nuclear power plants are planned for some countries in this sub-region. These will create thermal pollution problems in the future if the criteria for waste heat discharge have not yet been established. The information on thermal effects in this area is still limited.

The Gulf of Thailand is an area in which the ambient sea-surface temperatures of the coastal waters are very high. They vary between 25°C and 30°C. These waters will be used to provide cooling water for electricity power plants capable of generating up to 600 MW. They will discharge heated cooling water at a temperature of 9° to 20°C above ambient. The second International Workshop on Thermal Pollution, Maryland, USA, 1968, came to the general conclusion that tropical organisms have less adaptability to temperature increases than their counterparts from higher latitudes. Therefore it is thought necessary to develop a long-term research programme on the effects of thermal effluents on marine organisms of this region.

3. Objectives

3.1 Long-range objectives

The results of the investigation will be used for the establishment of criteria for waste heat discharges from industrial plants.

3.2 Immediate objectives

The research should determine:

- a) Lethal, preferred, and avoidance temperatures of some marine organisms.
- b) Effect of temperature changes on the productivity and species composition of marine phytoplankton.

- c) Effect of temperature changes on enzyme reactions, reproduction, growth, and behaviour of some marine organisms.
- d) Effect of temperature changes on the contagion rate of marine disease.
- e) Effects on larvae and eggs of passage through the cooling systems.
- f) Synergistic effects with organic pollutants and other toxic substances.

Priority No.2

1. Title of the project

Effects of some agro-industrial wastes on the coastal ecosystem.

2. Justification and background

Presently, most countries in South East Asia depend on agro-industries and this pattern of economic development will be more pronounced in future. Palm-oil, rubber, and tapioca-starch industries are three main industries in Malaysia and Thailand. The waste waters from these industries have been known to cause extensive damage to the river systems but little is known of the short- and long-term effects of the extra organic load on the coastal ecosystem in Malaysia and Thailand. This study aims at gaining an insight into these particular pollution effects.

3. Objectives

3.1 Long-range objectives

- a) To develop guidelines for the treatment and marine disposal of specific agro-industrial wastes.
- b) To develop an agro-industry development plan along the coastal areas in conjunction with the water quality control plan for the Gulf of Thailand.

3.2 Immediate objectives

- a) To characterize the waste waters and make a laboratory assessment of their potential pollution effects on aquatic life.
- b) To conduct field surveys of the existing pollution effects along the tidal and coastal waters in the region in order to compile baseline data.
- c) To make a detailed ecological study of some particular ecosystem, such as the mangrove swamp, to assess the effects of pollution on its productivity.

Priority No.3

1. Title of the project

Study of the waste assimilation capacity of the Gulf of Thailand.

2. Justification and background

In a systematic approach to any water quality control problem it is necessary to have knowledge of the waste assimilation capacity of the water body concerned so that appropriate water quality criteria can be derived and guidelines for pollution control can be established. For the Gulf of Thailand there is no information on the waste assimilation capacity. This proposed study therefore aims at obtaining such information.

3. Objectives

3.1 Long-range objectives

To integrate water quality control planning in the Gulf of Thailand with economic development planning in the countries concerned.

3.2 Immediate objectives

- a) Hydrographic study of the Gulf of Thailand to determine the magnitude and variation of tides and current in relation to dispersion; for example, the rate of water exchange between the inner bay and the outer bay; and possible seasonal variation.
- b) Study the rate of degradation of organic pollutants and the fate of some non-biodegradable pollutants.
- c) Study the oxygen sources.
- d) Assess the amount of various kinds of pollutants discharged into the Gulf.

Sub-region 4 : South China Sea

Priority No.1

1. Title of the project

The impact of pollution on the mangrove ecosystem and its productivity.

2. Justification and background

The mangrove community is a major resource vital to aquaculture and inshore fishing industries in the South China Sea and it is being threatened by pollution. There is a need to determine what pollutants threaten the integrity and productivity of this ecosystem and to assess their present and future impacts upon it.

3. Objectives

3.1 Long-range objectives

- a) To monitor the different pollutants with regard to their inputs, routes and distribution, effects and trends.
- b) To provide for a rational utilization of the nutrient-rich mangrove and similar areas in order to maintain their integrity and productivity.

3.2 Immediate objectives

- a) To establish baseline data on the nature and level of pollution of the different components of the mangrove ecosystem with regard to the following major pollutants (arranged in approximate order of priority\*):
    - i) Organochlorines
    - ii) Domestic and agricultural wastes
    - iii) Sedimentation/reclamation
    - iv) Oil
    - v) Heavy metals
- \* These priorities may vary from country to country.
- b) To determine the critical pollutants threatening the mangrove ecosystem as a whole or any of its components.
  - c) To assess the toxicity of specific pollutants to the different living resources of the mangrove community.

Priority No.2

1. Title of the project

Levels of toxic metals in the living resources of the South China Sea.

2. Justification and background

There is growing concern about the increasing levels of toxic metals in the waters and natural communities of the South China Sea. There is a need to assess the present trends in the levels of toxic metals such as mercury and other heavy metals in the various marine biota, particularly commercial fish species, to determine which may be particularly endangered.

3. Objectives

3.1 Long-range objectives

- a) To gather data upon which criteria can be established for the control of toxic elements as pollutants.
- b) To determine what commercial species of fish and other marine resources are endangered by contamination by these pollutants.

3.2 Immediate objectives

- a) To determine the nature and levels of toxic metals, particularly mercury and cadmium, present in significant amounts in the living resources of the South China Sea.
- b) To identify sources of input of toxic pollutants into the various waters and natural communities of the South China Sea and to establish their rates, routes and trends.

Priority No.3

1. Title of the project

The effect of siltation on the biota of estuaries and marine coastal areas.

2. Justification and background

Sedimentation and siltation are major environmental pollution problems common to almost all countries in East Asia. Their adverse effects, particularly on the living resources of estuaries and coastal waters, must be determined and understood to protect these fishery resources.

3. Objectives

3.1 Long-range objectives

- a) To gather data on the effects of siltation and sedimentation on the living resources present in estuaries and coastal areas.
- b) To determine the impact of siltation on the productivity of fishery resources in estuaries and coastal marine areas affected by siltation.

3.2 Immediate objectives

- a) To determine the effect of sedimentation on the species composition, number and diversity.
- b) To assess the effect of turbidity and reduced sunlight on the biotic community in general and the aquatic flora and coral community in particular.

Priority No.4

1. Title of the project

The effect of oil on the marine biota of the South China Sea with particular emphasis on coastal resources.

2. Justification and background

The South China Sea is a major route for oil tankers. Offshore exploration for oil is particularly intense in this area. The need for baseline data on both the present oil pollution levels and the toxic effects of oil upon the different living marine resources and communities is apparent.

3. Objectives

3.1 Long-range objectives

To assess the effect of crude oil, its components and degradation products upon the tropical marine biota, particularly:

- a) The shore
- b) Benthic resources
- c) Pelagic resources

3.2 Immediate objectives

- a) To establish baseline data on the present levels of oil pollution in the South China Sea.
- b) To monitor input of oil into the sea from the various sources.
- c) Basic studies of the toxic effects of oil and dispersants on selected species and communities.



Sub-region 5 : Sea of Japan, Yellow Sea, East China Sea

Priority No.1

1. title of the project

Distribution of heavy metals and organochlorines in marine organisms, sediments and waters.

2. Justification and background

Surveys on the distribution of heavy metals and organochlorines in marine organisms, sediments and waters have been largely from samples taken in coastal areas. It is urgent to expand the survey to open seas, such as the East China Sea. Surveys of biological material, plankton and especially food fish are of significance with regard to food hygiene.

3. Objectives

3.1 Long-range objectives

To ensure contamination-free seafoods and to monitor the contamination of the ocean ecosystem by toxic metals and organochlorines.

3.2 Immediate objectives

To co-ordinate existing national research programmes, including the standardization and/or intercalibration of methods. To identify areas where further research is required, and to co-operate in sample collection from the open oceans. To provide for the prompt exchange of data and information between countries.

Priority No.2

1. Title of the project

Tracing pollution trends in certain coastal areas, particularly Seto Inland Sea, Ulsan Bay, the west coast of the island of Taiwan and the Kuroshio region.

2. Justification and background

To predict the future trend of pollution, the monitoring of pollutant levels in sea water, sediment and living organisms should be undertaken on a long-term scale. Its necessity has been emphasized in the paper of Working Group 2. The region, however, covers a wide and varied area. Therefore, surveys should be carried out in a limited area rather than in the open sea, where sufficient background data are already available. Seto Inland Sea, Ulsan Bay, the west coast of the island of Taiwan and the Kuroshio area may be feasible for this purpose.

3. Objectives

Establishment of standard methods for analyses which can be used in the long term. Software, especially for processing of ecological data, should be developed.

Priority No.3

1. Title of the project

Studies on the uptake of pollutants and self-purification by shellfish.

2. Justification and background

Shellfish contaminated with various pollutants may be hazards to human consumption and public health. Their accumulation rates are different from those of the environment. Therefore, the rate of uptake of pollutants and self-purification should be determined under different environmental conditions. Shellfish produced in estuaries or near shorelines have been contaminated with pathogenic organisms to some extent in some areas of the region.

3. Objectives

3.1 Long-range objectives

- a) To determine the accumulation of heavy metals and pesticides by shellfish, and their depuration.
- b) Survey of pathogenic viruses.

3.2 Immediate objectives

Survey of sanitary indicator micro-organisms such as total coliform, faecal coliform and other related micro-organisms in shellfish meat and their environment.

Priority No.4

1. Title of the project

Eutrophication by nitrogen and phosphorus with particular reference to red tides.

2. Justification and background

In the Seto Inland Sea, Japan, eutrophication by nitrogen and phosphorus often causes red tides, leading to mass mortality of fish. In Korea, red tides have caused fish kills. In Hong Kong, red tides are becoming more frequent and enrichment by nitrogen and phosphorus is increasing.

3. Objectives

3.1 Long-range objectives

These are to understand the general principles and processes regulating plankton growth and abundance, insofar as these are related to nutrient enrichment and with special reference to the development and occurrence of red tides. The ultimate objective is the accurate prediction of the consequences of nutrient enrichment.

3.2 Immediate objectives

Existing and proposed research projects on plankton population dynamics in the sub-region should be co-ordinated, and methods used to determine zooplankton and phytoplankton abundance and nutrient concentrations should be standardized and/or intercalibrated. Particular attention should be paid to optimum frequency of sampling. Arrangements should be made for the prompt exchange of information on red tides or other algal blooms, and standard observational and reporting procedures introduced.

Sub-region 6 : Eastern Archipelago

Priority No.1

1. Title of the project

Mangrove ecosystems as sewage buffer zones.

2. Justification and background

a) Because of the high population density in South East Asia, sewage disposal is and will be a major problem in this area. It is likely that it will be harmful to fragile tropical aquatic ecosystems.

b) Studies suggest that mangrove communities may be used in the future as low-cost sewage disposal areas.

3. Objectives

3.1 Long-range objectives

To provide a possible low-cost method for the reduction of harmful effects of sewage in tropical areas where mangrove communities exist.

3.2 Immediate objectives

To investigate the relevant hydrography, chemistry and transport of sediments. To study the microbiology and aquatic productivity of two selected mangrove ecosystems one of which is under pressure and the other of which will come under pressure from sewage discharges. This should provide the necessary information for the acceptance or rejection of this method of sewage disposal. In the case of acceptance, optimum levels of sewage discharge could be worked out.

Priority No.2

1. Title of the project

Impact of sedimentation and coral exploitation on reef and adjacent communities and the shoreline.

2. Justification and background

- a) Coral reefs contribute to marine productivity by providing spawning grounds, nurseries, shelter and feeding grounds for important tropical marine species.
- b) Recreational resources of coral reef areas are well appreciated and any damage can adversely affect the tourist industry.
- c) Coral reefs serve as sources of beach sand and protect existing beaches from erosion.
- d) Coral reefs are threatened by coral mining and coral harvesting; while siltation is a major threat to coral life.

3. Objectives

3.1 Long-range objectives

To provide a scientific background for the protection of existing coral reef communities to assure their continued productivity and their utilization together with adjacent beaches, for recreational purposes.

3.2 Immediate objectives

- a) To study the hydrography and sediment transport in coral reefs and adjacent areas.
- b) To survey the distribution of, and the adverse impacts of, siltation on coral reef communities.

6. Adoption of the Report

The report of the Workshop was adopted by the participants.

7. Closure of the Workshop

After expressions of thanks to the host government and the host institution by the Co-chairman, Dr Aprilani Soegiarto, on behalf of the participants and by Mr Raymond C. Griffiths, on behalf of the sponsoring UN organizations, the Workshop was formally closed by the Honourable Chief Minister of Penang, Yang Amat Berhormat Dr Lim Chong Eu.

ACKNOWLEDGEMENT

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The sponsoring organizations also wish to thank the members of the Malaysian national and local organizing committees for their considerable help in the preparations for the Workshop.

AGENDA

1. Opening of Workshop
2. Election of Rapporteur
3. Pollutants
  - 3.1 Physical pollution
  - 3.2 Organic and biological pollution
  - 3.3 Pesticides and inorganic pollution
  - 3.4 Oil
4. Arrangements for Data Exchange
5. Proposals for Pilot Projects
  - 5.1 Regional co-operation
  - 5.2 Sub-regional co-operation
6. Adoption of the Report
7. Closure of the Workshop



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