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State of the marine environment in the East Asian Seas Region

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PREFACE

The better understanding of the changing problems facing the marine environment is a continuing goal of UNEP's ocean programme, as it provides the necessary scientific background for shaping UNEP's policy towards the protection of the oceans.

The main sources of factual information used in the assessment of the state of the marine environment are data published in open scientific literature, data available in various reports published as "grey literature" and data generated through numerous research and monitoring programmes sponsored by UNEP and other organizations.

Several procedures are used to evaluate critically the large amount of available data and to prepare consolidated site-specific or contaminant-specific reviews.

GESAMP, the IMO/FAO/Unesco/WMO/WHO/IAEA/UN/UNEP Joint Group of Experts on Scientific Aspects of Marine Pollution, is charged by its sponsoring bodies with preparation of global reviews. Reviews dealing with several contaminants have been already published by GESAMP and others are being prepared for publication. The first global review on the state of the marine environment was also published by GESAMP in 1982, and the second global review was published in 1990 [1/].

In parallel with the preparation of global assessments, the preparation of a series of regional assessments, following the general format of the second global review by GESAMP, was initiated by UNEP in 1986, with co-operation of the Food and Agriculture Organization of the United Nations (FAO) and the Intergovernmental Oceanographic Commission of Unesco (IOC). Fifteen task teams of scientists were set up, involving primarily experts from the relevant regions, to prepare the regional reports under the joint overall co-ordination of UNEP, FAO and IOC, and with the collaboration of a number of other organizations.

The present document is the product of the Task Team for the East Asian Seas Region. The final text of the report was prepared by E.D. Gomez, as Rapporteur of the Task Team for the East Asian Seas Region, with collaboration of E. Deocadiz, M. Hungspreugs, A. A. Jothy, Kuan Kwee Jee, A. Soegiarto, and R.S.S. Wu, whose contributions are gratefully acknowledged.

The report was edited and prepared for publication by Philip Tortell of Environmental Management Limited, New Zealand.

1/ Publications of GESAMP are available from the organizations sponsoring GESAMP.

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1. INTRODUCTION

1.1 Aims of the report

This is a first attempt to provide a perspective of the state of the marine environment in the East Asian Seas region. It is the initial review in a series that will be conducted periodically. Through such an exercise, it is hoped to document the trends in marine contamination in the region as well as general marine ecosystem health. It will be recognized that factors other than pollution may have significant impacts on the well-being or condition of natural habitats. While amelioration of deteriorating trends is welcome and sometimes seen, more often than not it is cost prohibitive.

This report and subsequent ones should therefore be helpful to decision-makers at all levels, national, regional, and international, to provide the database for the management of the marine environment. It is envisaged that the report will also guide potential sponsors from the private sector and the international community to subsidize activities in the region that are apt to contribute to the understanding and betterment of the marine environment.

This report is intended to serve as a reference document to the global review of the state of the marine environment referred to below.

1.2 Geographic coverage of the report

The region covered by this report is Southeast Asia (Fig. 1). It is bounded on the north by the South China Sea and the Philippine Sea; on the west by the Andaman Sea, the Straits of Malacca and the Eastern Indian Ocean; through to the Timor Sea and the Arafura Sea on the south; and the Pacific Ocean on the east. Other significant marine areas include the Gulf of Thailand, the Java Sea, the Sulu Sea, the Sulawesi Sea, the Straits of Macassar, the Flores Sea, and the Banda Sea. The Asian mainland is on the northwest sector while the Australian subcontinent is on the southeast sector. In between these two land masses are the two large archipelagoes of Indonesia and the Philippines with more than 20,000 islands of a wide range of sizes.

1.3 About the report

It is acknowledged that the data used in this report are not comprehensive. While this is partly due to the limitations of the task team members in not being able to access all available data, it is more a reflection of the state of knowledge of the status of the marine environment in the region. As explained in subsequent sections, much data have been discarded due to lack of quality assurance. Even more basic is the fact that the number of studies of any specific contaminant or ecosystem have been few and far between. Hence, the overall picture is far from complete but the image is forming. It is hoped that with each succeeding review, the mosaic will become more complete.

As this report was being completed, two publications of relevance were about to be published but were not available to the task team. The reader is referred to the special issue of Ambio, Journal of the Human Environment, on the East Asian Seas region for recent papers on the marine environment of the area (Vol. 17 No. 3, 1988). And, for a more comprehensive reference on oil pollution in the region, the Proceedings of a Meeting of Experts on the Control of Oil Pollution in the East Asian Seas Region have just been issued as No. 96 of the UNEP Regional Seas Reports and Studies series (Yap et al, 1988).

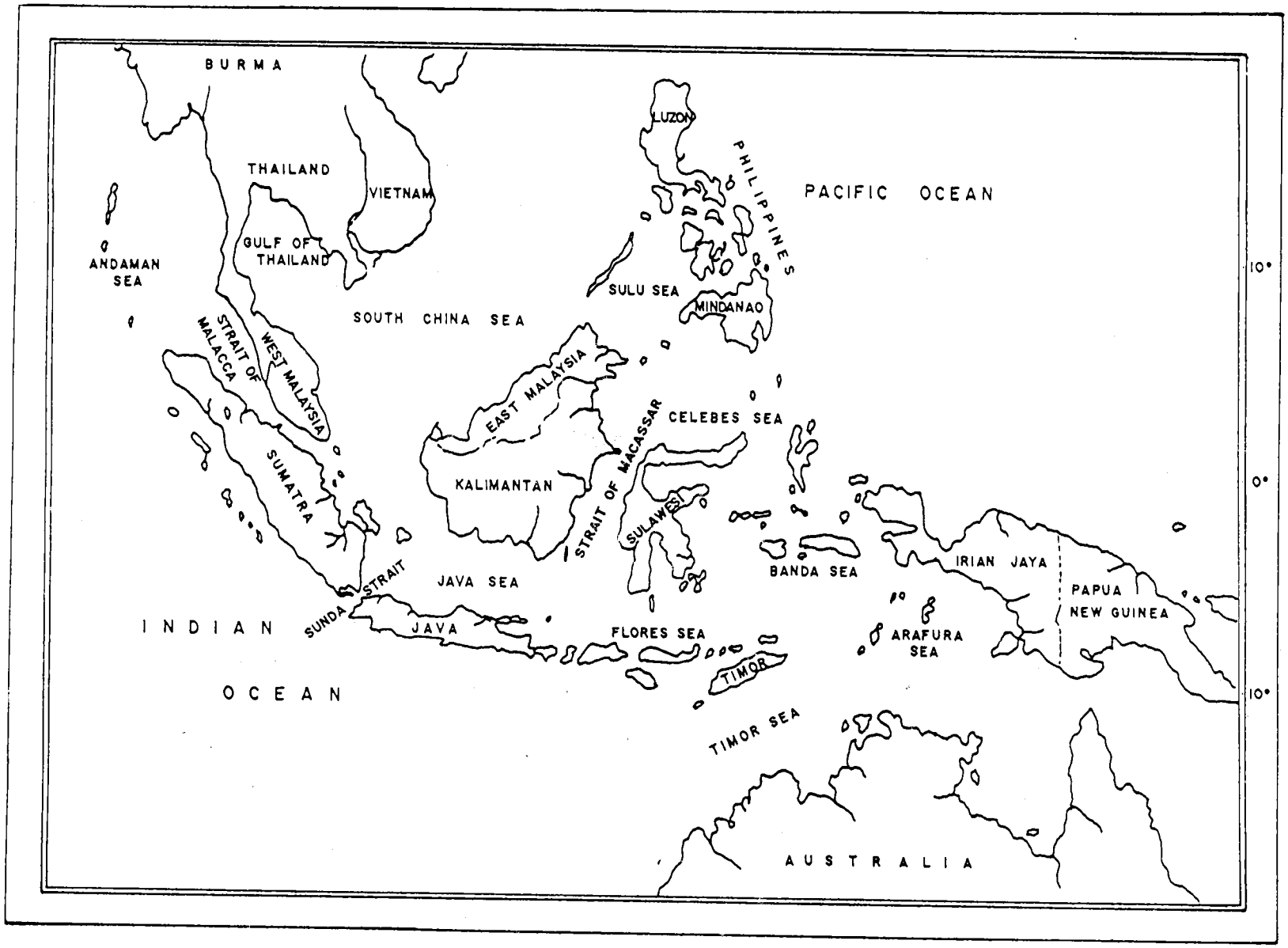

Fig. 1. Map of the Southeast Asian Seas

2. CHARACTERISTICS OF THE REGION

Southeast Asian waters comprise the Andaman Sea, the Straits of Malacca, the Straits of Singapore, the South China Sea, the Java Sea, the Flores Sea, the Banda Sea, the Arafura Sea, the Timor Sea, the Celebes Sea, the Sulu Sea, and the Philippine Sea. The whole body of water covers 8.94 million square kilometers in area, which represents about 2.5 per cent of the world's ocean surface. The southeast Asian marine realm includes shallow continental shelves, deep sea basins, troughs, trenches, continental slopes and volcanic and coral islands. The numerous large and small islands divide the waters into different seas connected by many channels, passages and straits.

Located between the Asian and the Australian continents, the southeast Asian region is strongly influenced by monsoons. The north monsoon in southeast Asia lasts from December to February and the south monsoon from June to August. The rest of the year represents the transition from the north to the south monsoons (March to May) and from the south to the north monsoons (September to November).

The oceanographic characteristics below are drawn from Soegiarto (1985). The water mass of the Southeast Asian region originates from the Pacific Ocean. This is clearly indicated by surface current patterns in the region. The North Equatorial Current flows westwards and upon reaching the Philippine islands, splits into 2 main branches. The northward branch becomes the Kuroshio, and the southward branch, the Mindanao Current. The Kuroshio begins east of northern Luzon as a swift and narrow segment of the western boundary current and flows to the east coast of Taiwan, the East China Sea and the Japan Sea. During the north monsoon, the Kuroshio is deflected into the China Sea. The Mindanao Current flows southeast with a speed of 1 or 2 knots along the coast of Mindanao Island with its main part entering the Celebes Sea through the straits between Mindanao, Sangir and Talaut Islands.

The tides of southeast Asian waters are affected by both the Pacific and the Indian Oceans. Diurnal tides predominate in the South China and Java Seas, whereas mixed tides prevail in the eastern Indonesian archipelago, Philippine waters, the Andaman Sea, Straits of Malacca, and the shelf areas northeast of Australia.

Since the Southeast Asian region straddles the equator, the surface water is characterized by high temperature. This property combined with the influence of low salinity reduces the density of the surface water rather markedly. The large excess of rainfall over evaporation causes an average salinity of less than 34 parts per thousand within a region enclosed by a line running from Sri Lanka, off the islands of Sumatra, Java, Celebes and Philippines to Taiwan.

One of the features of tropical waters is that the surface layer is warm and the annual temperature variation is small. During the north monsoon, generally high surface temperatures of 28-30°C prevail on the west coast of Sumatra and the eastern Indonesian archipelago waters. However, because of the inflow of water masses from higher latitudes, colder water (26-27°C) is found in the South China Sea. Temperatures of 26-27°C also prevail in the Arafura Sea and the south coast of Java. In other waters, temperatures range between 27°C and 29°C.

The average annual range of sea surface temperature in the equatorial region is less than 2°C but is slightly higher, 3°C to 4°C, in the Banda Sea, the Arafura Sea and Timor Sea as well as in the waters south of Java.

The salinity in southeast Asian waters is extremely variable. The effects of high rainfall, run-off of many large rivers, and geographical subdivisions of the seas are responsible for this characteristic. The distribution of discharges from land, presence of large bays and channels with little water exchange contribute to the general lowering of the salinity. The monsoons cause rainy and dry seasons which then also affect the annual variation of salinity.

In general, the surface dissolved oxygen (DO) does not show a strong seasonal variation. DO concentrations for the eastern Indonesian archipelago are 4.0 to 4.5 ml/l at the surface and 2.5 and 3.0 ml/l at depth; for the Sunda Shelf, 3.5 and 4.0 ml/l; for the area of Mindanao current, 4.5 ml/l; for the south coast of Java, 2.5 to 3.0 ml/l at the coastal area and over 4.0 ml/l towards the open sea; and for the South China Sea, 2.5 and 3.0 ml/l.

Several factors influence the water tranparency, e.g., silt content, plankton and other particulate matter in the water. Low water transparency (less than 10 meters deep) is found in the areas of river mouths and in coastal waters around Sumatra, Borneo, and the Gulf of Thailand. In general, the transparency is higher in the deep water (between 10 and 20 meters) and in the open seas (20 to 30 meters).

Turning to the land, the population of the six ASEAN countries and Hong Kong is in the order of a little under one third of a billion people. The region is considered developing and predominantly agricultural, with industries concentrated around a limited number of cities which characteristically have high population densities (2 to 8 million).

Under the circumstances, the marine environment has been influenced more and more by human activities with the degree of contamination being most pronounced near coastal population centres. The concern of individual governments to safeguard the marine environment from further degradation was translated into a regional effort with the development of an action plan initially for the member states of the Association of Southeast Asian Nations (ASEAN). The East Asian Seas Action Plan was adopted in 1981 and since that time, more than half a dozen regional projects have been implemented by national institutions in five countries.

The succeeding chapters present a summary of the available data on marine contamination in the region, specifically from Hong Kong, Indonesia, Malaysia, the Philippines, Singapore and Thailand.

3. MARINE CONTAMINANTS

3.1 Concentrations (levels and distribution) in water, sediments and biota

Data on the concentration of contaminants in sea water and sediment have been very sparsely reported in the EAS region, a region which is still in its infancy in the context of marine pollution monitoring. Laboratories are often faced with the problems of inadequacies in facilities, qualified personnel and funds to carry out this task. Besides, the measurement of heavy metals and chlorinated hydrocarbons in sea water, in particular, requires greater accuracy and sophistication in methodology, owing to their levels being generally a few magnitudes below those in biota.

Concentration in water

Trace metals

This is perhaps the most difficult analysis among the three media considered as the levels of trace metals in sea water are very low compared with the concentration of major elements. Contamination can be easily introduced in all stages - sampling, storage, analysis and concentration measurements.

Hong Kong, Malaysia and the Philippines did not report data of heavy metals in sea water. Singapore reported a trend, decreases in Cd and Pb, but a slight increase in Cu from 1980 to 1985, using atomic absorption spectrophotometry. In 1985, mean Cu concentration varied from 2.0 to 2.9 µg/l.

Thailand reported the following figures for 15 stations in the Upper Gulf of Thailand (Hungspreugs, 1985), in µg/l.

		November 1984 (flood season)	**March 1985** (dry season)
Cd	mean	0.04	0.07
	range	0.01 - 0.09	0.02 - 0.19
Cu	mean	0.97	0.39
	range	0.01 - 3.40	0.01 - 1.30
Pb	mean	0.01	0.02
	range	n.d. - 0.02	0.01 - 0.06
Zn	mean	5.61	4.72
	range	4.29 - 7.59	1.63 - 9.24

N.B. Detection limits are: Cd - 0.005, Cu - 0.01, Pb - 0.005, Zn - 0.5, using the co-precipitation method with $CoCl_2$ - APDC (Huizenga, 1981), then flameless AAS for Cd, Cu and Pb, and flame AAS for Zn. All preparations were performed under laminar flow cabinet or 'clean bench Class 100'.

The concentration of heavy metals in some localized coastal waters of Indonesia has been reported to be very high. Among these are the coastal waters of Jakarta Bay, Surabaya and the Straits of Malacca. Studies by Razak et al. (1984) indicated the severity of heavy metal pollution in Jakarta Bay - Cu, Hg, Pb and Cd levels (0.16, 0.013, 0.31 and 0.19 mg/l, respectively) were found to be higher than the standard set by the Indonesian government: Cu, 0.06 mg/l; Hg, 0.006 mg/l; Pb, 0.075 mg/l; and Cd, 0.01 mg/l.

Petroleum hydrocarbons