



UNITED NATIONS ENVIRONMENT PROGRAMME

*Pollution and the marine environment
in the Indian Ocean*

UNEP Regional Seas Reports and Studies No. 13

PREFACE

The Regional Seas Programme was initiated by UNEP in 1974. Since then, the Governing Council of UNEP has repeatedly endorsed a regional approach to the control of marine pollution and the management of marine and coastal resources and has requested the development of regional action plans.

The Regional Seas Programme at present includes eleven regions ^{1/} and has over 120 coastal States participating in it. It is conceived as an action-oriented programme having concern not only for the consequences but also for the causes of environmental degradation and encompassing a comprehensive approach to combating environmental problems through the management of marine and coastal areas. Each regional action plan is formulated according to the needs of the region as perceived by the Governments concerned. It is designed to link assessment of the quality of the marine environment and the causes of its deterioration with activities for the management and development of the marine and coastal environment. The action plans promote the parallel development of regional legal agreements and of action-oriented programme activities.

Five of the regions in the UNEP programme include in their geographic scope coastal waters of the Indian Ocean or of the seas on its periphery. These are the East Africa, East Asian Seas, Kuwait Action Plan Region, South Asian Seas, and Red Sea and Gulf of Aden.

The present report was prepared with the aim of assessing the present level of pollution in the Indian Ocean and the extent of information available on the marine environment and pollution in the area. In addition to the States of the East African Region (Comoros, Kenya, Madagascar, Mauritius, Mozambique, Seychelles, Somalia and the United Republic of Tanzania), the study covers Bangladesh, Burma, India, Pakistan and Sri Lanka. In its preparation, information was obtained from most of the marine institutes of the States mentioned above. In addition, many useful documents were made available by the Library of the Oceanographic Museum at Monaco and the Library of the Marine Biological Association of the United Kingdom in Plymouth. The assistance and co-operation received from these institutes as well as from Governments and University sources is gratefully acknowledged.

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PART I

THE MARINE ENVIRONMENT

1.0 INTRODUCTION

This report attempts to provide a general idea of the sources, levels and effects of marine pollutants in the Indian Ocean as well as the existence and extent of marine pollution monitoring systems at present available in the area. It is intended to serve as a source document for eventual programmes relating to pollution monitoring and its combatting in the Indian Ocean Area.

This paper has been divided into two parts. Part one deals with the introduction and description of the area. It provides information on the physiography of the region which covers the physical aspects of the ocean such as current systems and water-mass movements; the geological features of the ocean bed; and the meteorology related to the area. Marine chemistry, marine biology and fisheries of the area are also included.

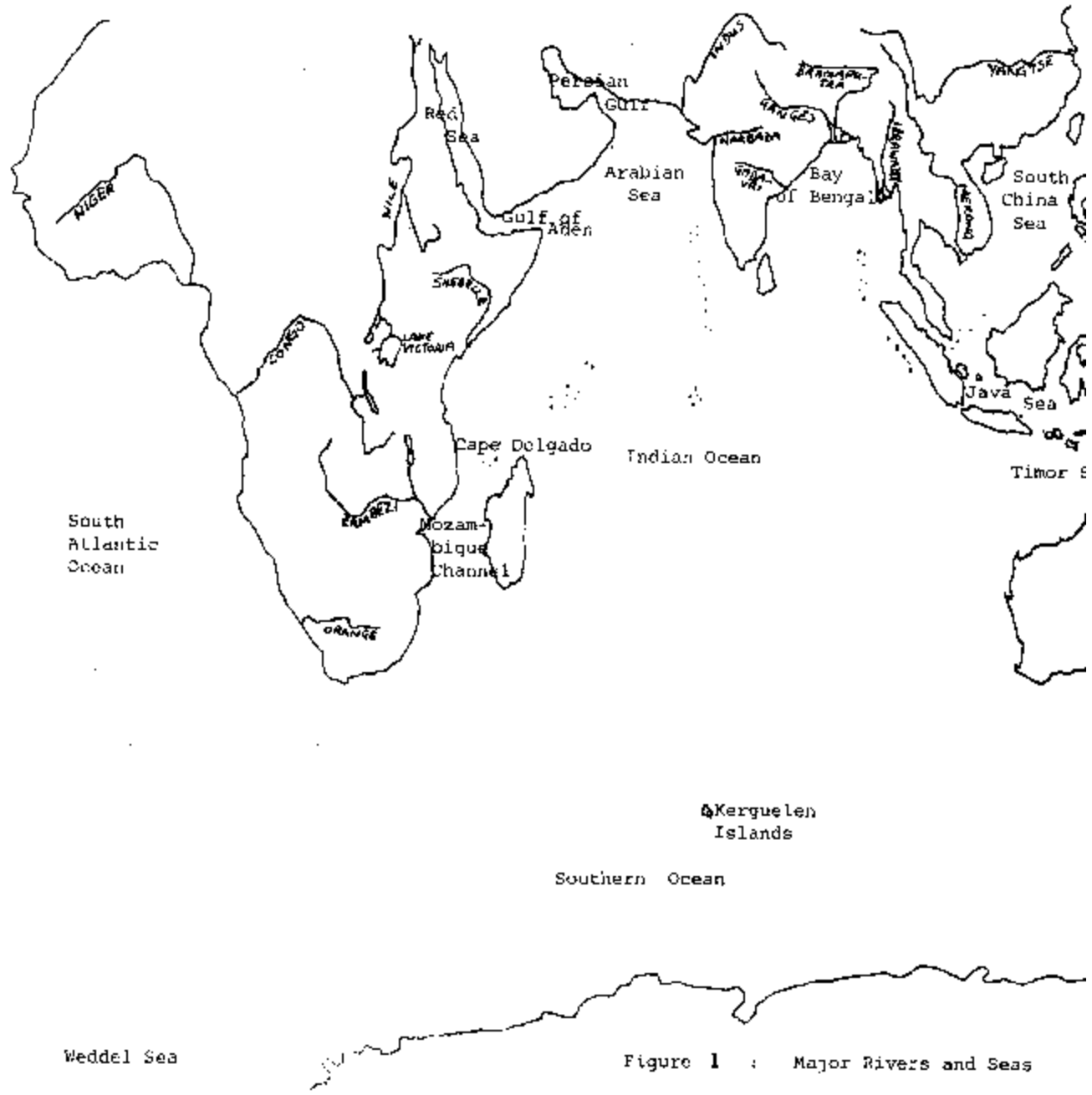
Part two deals with the pollution problems of the area and covers industrial pollution, pollution from municipal and domestic sources, oil contamination, radioactive pollution and pollution related to agricultural activities.

The information in this overview has been obtained from papers and documents provided from several research centres located in the countries bordering the Indian Ocean as well as from the references listed in the bibliography.

2.0 DEFINITION OF THE REGION

For the purpose of this report, the Indian Ocean has been defined as follows: Western Boundary, 77°E and to the southern border of Mozambique; Eastern Boundary, 112°E (to the western coast of Australia); Southern Boundary, 30°S, from Durban on the South African Coast to Green Horn on the West Australian Coast. The two major basins included within these limits are the Bay of Bengal and the Arabian Sea. The area covered by these boundaries is of the order of 70 million square kilometres and the average depth of the ocean is 3000 metres. Seas opening into and forming a part of the Ocean but not treated specifically are, the Persian Gulf, the Red Sea, the Gulf of Oman, the Gulf of Aden, the Timor Sea and the Malacca Straits (see fig. 1).

Countries having borders on the area under survey are Mozambique, Tanzania, Kenya, Somalia, Pakistan, India, Bangladesh and Burma. Islands within the area are Madagascar, Sri Lanka, the Seychelles, Mauritius, the Comoro Islands and the Maldives as well as the territorial islands (see fig. 2). Despite the aforementioned boundaries, the oceanography studied will cover the whole area of the Indian Ocean so as to facilitate the presentation of features such as currents and water mass movement and hence the southern boundary will extend to Antarctica.



Weddel Sea

Figure 1 : Major Rivers and Seas

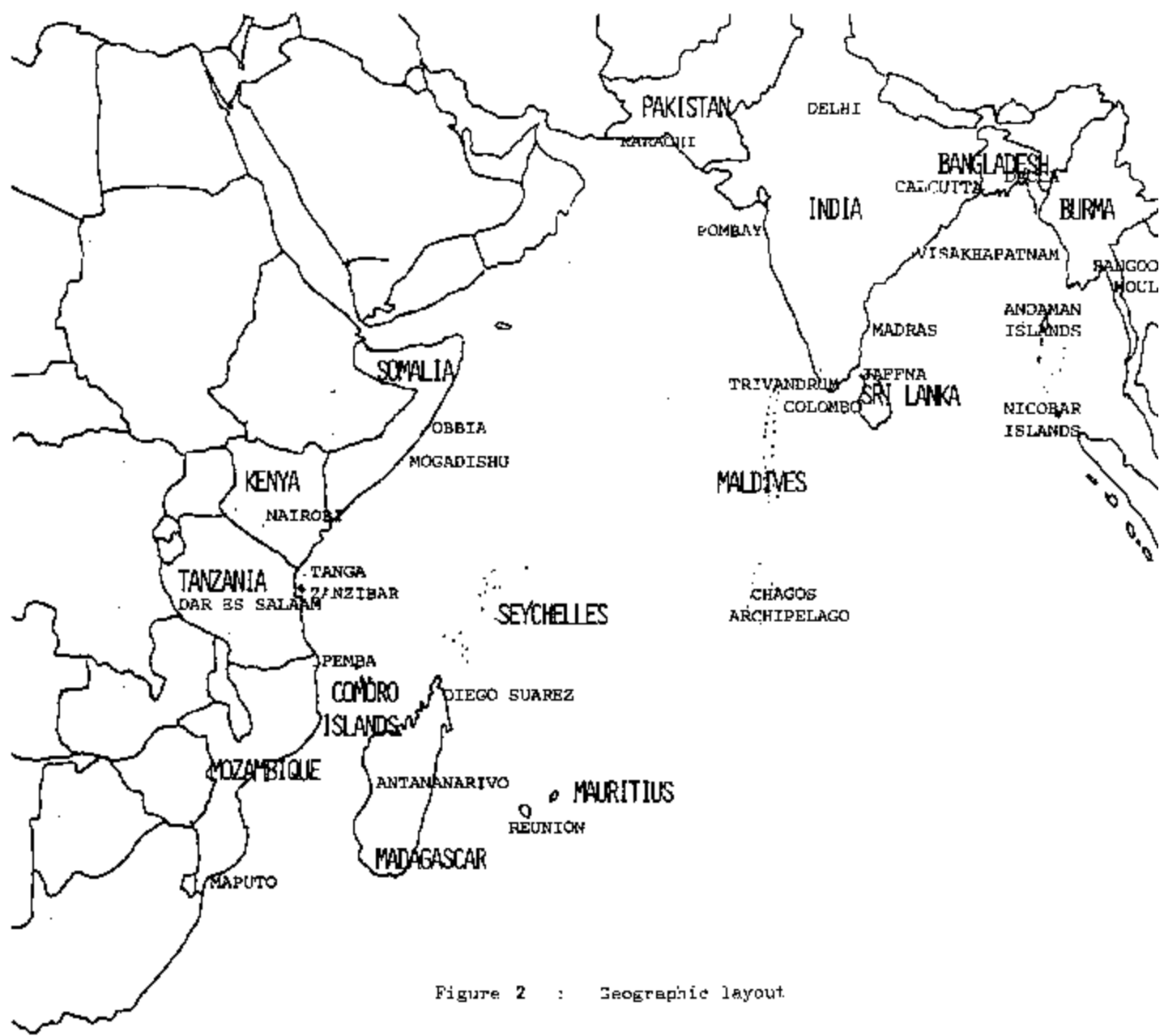


Figure 2 : Geographic layout

3.0 PHYSGOGRAPHY OF THE INDIAN OCEAN BASIN

3.0 Introduction

The Indian Ocean is the smallest of the three major oceans. It has unique features in it's dynamic oceanography, meteorology and geology. There is an overall negative water balance in the Indian Ocean. The Bay of Bengal, on its own, has a positive water balance due to the input by precipitation and run-off exceeding evaporation. The dynamic oceanography is influenced to a great extent by the meteorology especially in the Northern Hemisphere. These inter-related effects give rise to the seasonal monsoons and monsoonal currents.

3.2 The Current Systems

3.2.1 Surface Currents

The current system in the Southern Hemisphere of the Indian Ocean does not change much from season to season and is dominated by the South Equatorial Current and Westwind Drift (see fig. 3). There is a large anticyclonic gyre, the southern-most part of which is the Westwind Drift lying between 30°S and 50°S with a width of 200-240 nautical miles. It can reach a speed of 20-30 NM per day near the Kerguelen Islands, is normally dependent on the wind and is seasonally and regionally variable. In winter it turns north before Australia and joins the current coming from the Pacific via Southern Australia. In summer it joins the south-bound current west of Australia and flows to the Pacific via the southern ocean.

The West Australia Current reaches 10-15 NM per day north of Equatorial Current at 23°S due to the effect of the Southeast Trade winds. In the southern summer the flow becomes eastward and shifts southeast. The current is reinforced in the winter by a flow from the Pacific via the Arafura Sea and reaches up to 8 knot velocity. It divides into three branches before Madagascar; one branch flows northward around the Island at 50-60 NM per day and then turns east, the second branch runs north and the third turns south and becomes the Mozambique

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