UNITED NATIONS ENVIRONMENT PROGRAMME

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Physical ocean environment in the South Pacific Commission Area

UNEP Regional Seas Reports and Studies No. 83

Prepared in co-operation with

SPC

SPEC

ESCAP

UNEP 1986

PREFACE

Fourteen years ago the United Nations Conference on the Human Environment (Stockholm 5-16 June 1972) adopted the Action Plan for the Human Environment, including the General Principles for Assessment and Control of Marine Pollution. In the light of the results of the Stockholm Conference, the United Nations General Assembly decided to establish the United Nations Environment Programme (UNEP) to "serve as a focal point for environmental action and co-ordination within the United Nations system" (General Assembly resolution 2997(XXVII) of 15 December 1972). The organizations of the United Nations system were invited "to adopt the measures that may be required to undertake concerted and co-ordinated programmes with regard to international environmental problems", and the "intergovernmental and non-governmental organizations that have an interest in the field of the environment" were also invited "to lend their full support and collaboration to the United Nations with a view to achieving the largest possible degree of co-operation and co-ordination". Subsequently, the Governing Council of UNEP chose "Oceans" as one of the priority areas in which it would focus efforts to fulfill its catalytic and co-ordinating role.

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 ten 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[2/].

The idea for a regional South Pacific Environment Management Programme came from the South Pacific Commission (SPC) in 1974. Consultations between SPC and UNEP led, in 1975, to the suggestion of organizing a South Pacific Conference on the Human Environment. The South Pacific Bureau for Economic Co-operation (SPEC) and the Economic and Social Commission for Asia and the Pacific (ESCAP) soon joined SPC's initiative and UNEP supported the development of what became known as the South Pacific Regional Environment Programme (SPREP) as part of its Regional Seas Programme.

1/ Mediterranean, Kuwait Action Plan Region, West and Central Africa, Wider Caribbean, East Asian Seas, South-East Pacific, South Pacific, Red Sea and Gulf of Aden, Eastern Africa and South Asian Seas.

2/ UNEP: Achievements and planned development of UNEP's Regional Seas Programme and comparable programmes sponsored by other bodies. UNEP Regional Seas Reports and Studies No. 1. UNEP, 1982.

An Action Plan for the South Pacific Regional Environment Programme (SPREP) was adopted at the Conference on Human Environment in the South Pacific at Rarotonga, 8-11 March 1982, and was endorsed seven months later at the South Pacific Conference and South Pacific Forum[3/].

This document has been prepared by Mr. Bruno Wauthy of ORSTOM (Office de la Recherche Scientifique et Technique Outre-Mer) as a contribution to the South Pacific Regional Environment Programme. The sponsors of the study would like to express their gratitude to the author and ORSTOM.

3/ SPC/SPEC/ESCAP/UNEP: Action Plan for managing the natural resources and environment in the South Pacific Region. UNEP Regional Seas Reports and Studies No. 29. UNEP, 1983.

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GEOGRAPHICAL INTRODUCTION TO THE SPC AREA

Geographical extent

The South Pacific Commission (SPC) Area (Fig. 1B) extends from 130°W to 130°E, on either side of the international dateline, between the two tropics. It is unequally distributed as regards latitude, with two thirds of its area in the Southern Hemisphere and one third in the Northern Hemisphere. Its eastern area corresponds roughly to the central South Pacific, and its western portion to the western Pacific, excluding the areas of the Coral Sea to the South and the Philippine Sea to the North which wash the Australian and Philippines coastlines respectively.

The area covered is approximately 27.5 million km^2 and represents four-tenths of the intertropical Pacific (Fig. 1A) and almost one-fifth of the area of all oceans within the intertropical belt.

The distances involved are considerable, measuring 8,000 km from Guam to Tahiti; 11,000 km from Pitcairn to Palau; 5,500 km from the North of the Marianas to Noumea and 3,600 km from Christmas Island to Rapa. From Papeete (Tahiti), the nearest continental landfalls are Sydney at a distance of 6,000 km; San Francisco at 6,600 km; Terre Adélie at 7,000 km; Vladivostok at 7,500 km; Valparaiso at 7,700 km and Panama at 8,200 km.

The SPC Area is thus primarily a vast ocean expanse covering the major portion of the area known to geographers as Oceania.

Emerged land

The emerged land takes the form of a multitude (poly) of small (micro) islands (nesos) scattered over a vast expanse of ocean and mostly grouped in archipelagos which form Micronesia in the North-west and Polynesia in the East. They contrast with the larger islands of Melanesia, which extend from Fiji to New Guinea and form part of the structural mass of the Australian continent.

Table I shows:

The areas of islands or archipelagos (taken from Le Million, Vol. XV, OCEANIE, ed. Grange Batelière, Paris) in Micronesia, Polynesia and Melanesia, excluding, in the last case, Papua-New Guinea, in view of its clearly continental character;

The areas of ocean occupied by these major provinces, estimated on the basis of the geographical distribution of the archipelagos;

Ratings on an "insularity index" expressed as percentages and calculated on the basis of the ratio of emerged land areas to ocean area.

The insularity characteristic is extreme in Micronesia where the islands represent only an infinitesimal fraction of the ocean area; it is very pronounced in Polynesia where the remoteness from continents accentuates the impression of isolation, but is less marked in island Melanesia, where there is almost 100 times as much land area as in Micronesia.

Nevertheless, throughout the SPC Area, insularity remains the predominant characteristic, since only 2 per cent of the area consists of emerged land, whereas water represents 98 per cent. Figure 1A, which could be regarded as an "artist's view of Earth from space directly over Jarvis Island", illustrates this clearly.

While the presence of the small islands has only a marginal influence on the characteristics of the ocean environment, the large islands of Melanesia, some of which are very high (chains with

peaks of over 4,000 metres in New Guinea) are important in that their heavy rainfall produces considerable erosion, leaching large quantities of soluble minerals (nutrient salts and trace elements) throughout the year, thereby increasing the fertility of the waters of the adjacent ocean. The highest rates of chemical leaching from the rocks are in fact seen in the humid equatorial zone where temperatures are high and rainfall abundant (Strakhov, 1960).

The ocean floor (Fig. 2)

The relief of the ocean floor is very uneven in the western part of the area where the continental margins are found.

The continental shelf down to the 200 m isobath demarcates the continent proper and illustrates clearly that New Guinea is directly linked to Australia. Most of the Arafura Sea is less than 100 metres in depth, and the Torres Strait less than 20 metres.

The margin area extends from the continent to the island arcs in the East which form an almost continuous chain of islands or shallows stretching from New Zealand, through Tonga, the Solomon Islands, the Bismarck Archipelago, Palau and the Marianas to Japan. This is the area of such adjacent seas as the Tasman Sea, the Coral Sea, the Solomon Sea and the Philippine Sea. Inside the margin area seamounts support archipelagos such as Fiji, Vanuatu, New Caledonia and the Loyalty Islands, while ridges more than 2,000 metres deep (Lord How Rise, Norfolk Island Ridge and Lau Ridge) isolate plateaux where the depth exceeds 2,000 metres (Northern Fiji and Chesterfield) and even 4,000 metres (New Guinea Basin, Solomons Basin, New Hebrides Basin, Fiji Basin and Coral Sea Basin).

The island arcs are bounded on the East by deep trenches, the most distinctive of which are the Marianas Trench (10,915 metres), the Palau Trench (8,050 metres), the Bougainville Trench (9,103 metres), the New Hebrides Trench (9,165 metres), the Tonga Trench (10,882 metres) and the Kermadec Trench (10,047 metres); in many cases the walls of these trenches are in the form of steps.

To the East of the island arcs, the relief is less accentuated. Average depth is greater than 4,000 metres; seamounts in the form of ocean ridges stretch over considerable distances. Their width varies from 200 km to 500 km; they are more or less parallel, running in a NW-SE direction, and they sometimes form basements of atolls (Carolines, Marshalls, Kiribaki and Tuvalu, Tokelau-Cook, Line Islands and Tuamotu-Gambier). In conjunction with a number of East-west transverse plateaux, they demarcate basins of various sizes (Carolines Basin, Marshalls Basin, South-west Pacific Basin, Central Basin, North-west Basin) and a number of deep trenches. Other less extensive relief features created by volcanic activity form the basements of more isolated island groups (Society Islands, Samoa, Marquesas, Hawaii).

The bathymetry illustrated in Figure 2 shows the Coral and Solomon Seas to be relatively isolated:

To the West by the continental land mass of Australia and New Guinea which form a virtually continuous barrier; to the East and North by the island arcs of the New Hebrides, the Santa Cruz, the Solomons and New Britain; to the South by shoals between New Caledonia, the Chesterfield Plateau and the Great Barrier Reef which render virtually impossible any exchange with the Tasman Sea at depths greater than 3,000 metres.

Table 1: AREAS AND DEGREE OF "INSULARITY" IN THE SPC AREA

	LAND (km^2)	OCEAN ($10^6 km^2$)	INSULARITY
Marianas	404		
Marshall	181		
Palau	478		
Ponape	334		
Carolines			
Yap	216		
Truk	104		
Guam	549		
Nauru	21		
Kiribati	931		
MICRONESIA	3 218	8,8	0,036%
Tuvalu	26		
Wallis and Futuna	255		
Western Samoa	2 842		
American Samoa	197		
Tonga	699		
Tokelau	10		
Cook	455		
Niue	259		
Society	1 647		
Marquesas	1 274		
Tubuais	164		
Tuamotu-Gambier	915		
POLYNESIA	8 733	13,2	0,066%
New Britain	36 519		
New Ireland	8 651		
Manus-Admiralty	2 072		
Bougainville-Buka	10 500		
Solomons	28 446		
Fiji	18 272		
Vanuatu	14 763		
New Caledonia	19 058		
MELANESIA	138 281	5,5	2,51 %
Papua New Guinea	403 950		
Total MELANESIA	542 231	5,5	9,85 %
TOTAL SPC AREA	554 182	27,5	2,01 %

METEOROLOGY

Atmospheric circulation

Atmospheric pressure at ground level and low-level wind regime

Pressure distribution at sea level (Figure 3 - Queeney, 1974) is determined by the different reactions of the continents and oceans to the seasonal thermal factor of solar radiation.

In the Southern Hemisphere, the dominant influence is that of latitude. Isobars are approximately zonal; the sub-tropical high pressure belts are practically continuous, although there is some increase in pressure over Australia during the southern winter, while in summer, the North of the continent is invaded by the Indonesian equatorial low pressure zones.

In the Northern Hemisphere, the dominant influence in the extreme seasons is the continental effect. In the northern summer, the Indo-Asiatic continental thermal depression deepens, while the whole of the northern Pacific is covered by an anticyclone. In winter, on the other hand, a vast and powerful anticyclone forms over Asia, centred over the Himalaya massif, while the vast Aleutian depression zone pushes back the sub-tropical ocean anticyclone to the eastern part of the northern Pacific.

This pressure field determines the low level wind patterns. In the Central Pacific, the constancy of the sub-tropical high pressure belts (Hawaii anticyclone, Easter Island anticyclone) sustains a year-round regime of trade winds which blow steadily in the direction of the near equatorial low-pressure zone.

In the western Pacific, the influence of Asia results in a seasonal pattern of monsoons which blow from the high-pressure zones in the winter hemisphere towards the continental low-pressure zones in the summer hemisphere. In the Philippines, New Guinea and northern Australia, for example, there is an alternation of winds in the North to North-west sector during the northern winter, and of winds in the South to South-east sector during the southern winter.

Throughout a "normal year", the equatorial zone including Indonesia is covered by troughs of relatively low pressure, with the result that there is usually a decrease in the pressure gradient along the equator between the eastern and western Pacific, resulting in a zonal circulation known as the "Walker cell", consisting of a lower branch in the form of the trade winds, a rising branch over Indonesia and an upper return branch feeding subsident air into a descending branch over the eastern Pacific.