

1. INTRODUCTION

1.1 International trade in echinoderms

According to the FAO's annual statistics (1984)¹ and Conand and Sloan (in press), the world echinoderm harvest in 1983 amounted to approximately 80,000 tonnes. Echinids account for roughly two-thirds of the total, sea urchins being considered a delicacy for their genital glands. The biggest market is Japan, an avid consumer of 'uni', where the 26,800 tonne trade consists mainly of species from the family Strongylocentrotidae. Next comes Chile with an 11,800 tonne harvest of the species *Loxechinus albus*, most of which is exported to Japan. The same country is the main destination for the north-eastern Pacific coast catches of *Strongylocentrotus franciscanus*, which totalled 8 590 tonnes in 1983 (Sloan, in press). Trade in other species, such as *Paracentrotus lividus* in France, is not significant.

The other group of economic echinoderms comprises the holothurians, which are gathered either for local consumption, fresh or boiled, as in Japan and Korea (12,688 tonnes in 1983), or to be prepared as bêche-de-mer (or trepang) for export to Asian markets (around 13,000 tonnes).

1.2 History of research on holothurian fisheries

Holothurians, which have a very long history of consumption by the Chinese, are known in the western world as sea slugs or sea cucumbers; the term '*Cucumis marinus*' appeared as early as Pliny. The first scientific studies, in the late sixteenth century, dealt primarily with species taxonomy and anatomy. Knowledge of their distribution was gathered on the great voyages of discovery (Challenger, Albatros, Siboga). By the end of the nineteenth century, papers had been published on holothurian fishing for trepang production in various areas. Semper (1868) and Seale (1911) described this activity in the Philippines, Saville-Kent (1903) on the Australian Great Barrier Reef, Koningsberger (1904) in the Dutch East Indies (Indonesia) and Hornell (1917) in India.

A later work is 'l'Industria del Trepang' by Sella and Sella (1940), who studied the statistics for the main markets, described the fishing grounds of eastern Africa and recorded attempts to produce Italian trepang using Mediterranean species. Such commodities could not compete with the quality products traded on the Asian markets. Panning (1944) described the industry and the species exploited in 'Die Trepang Fischerei', while Choe (1963) carried out a detailed investigation of the main Japanese species of commercial interest, *Stichopus japonicus*. As well as addressing the morphological aspects and the biological and ecological parameters, this author gave an account of attempts to sustain and increase stocks.

In recent times, the worldwide growth of fishing activities has made fisheries management a necessity; this has become possible through the knowledge acquired about population dynamics. Small-scale artisanal fisheries are no exception to the rule, but, as with many tropical species, little is yet known about the biology and ecology of holothurians. In 1974, the South Pacific Commission (SPC), an organisation established in 1947 to promote cooperation

1. FAO data on holothurian catches, not including Japan and Korea, have been multiplied by a factor of ten because these statistics probably relate to the dry product (cf. Chapter 6).

and regional development, and the FAO jointly produced a fishermen's handbook on bêche-de-mer, derived from a report by Sachithanathan. The SPC has since brought out a revised edition, in 1979 and, in conjunction with the Fisheries Division, conducted a survey of stocks in Fiji (Gentle, 1979). Other research has been carried out at universities in Australia and Papua New Guinea. Finally, as part of a programme of research and development focussing on the lagoon and coastal zones of New Caledonia, the "Institut français de Recherche Scientifique pour le Développement en Coopération (ORSTOM) has sponsored studies on species biology and distribution (Conand, 1979, 1981, 1982, 1983, 1985; Conand and Chardy, 1985).

1.3 Background information on the southern tropical Pacific

1.3.1 An introduction to the region

The southern tropical Pacific is a vast area of the Pacific Ocean, extending over 30 million square kilometres and corresponding to the area served by the SPC.² It covers approximately one hundred degrees of longitude between the tropics, from 130° East to 130° West (Figure 1). Excluding Papua New Guinea, which alone accounts for 465,000 km², total land area amounts to 90,000 km², formed by the archipelagoes of Micronesia, Melanesia and Polynesia. Their respective land areas and populations, given in Table 1, demonstrate the very uneven distribution of inhabitant densities.

The physical environment may be divided into four main structural types:

- high continental islands, of sedimentary or metamorphic origin, with varied reliefs and soils;
- high volcanic islands, where the degree of soil development depends on the age of the volcanic activity;
- elevated platform reefs;
- low islands or atolls close to sea level, composed of coral sand and debris.

Table 1 - Land area and population distributions in the South Pacific
(Source - ORSTOM, 1981).

	LAND AREA		POPULATION		DENSITY per Km ²
	Km ²	%	1978 Estimates No.	%	
Melanesia (archipelagoes)	78 200	87	1 060 500	59	13.6
Polynesia	8 742	10	461 800	25	52.8
Micronesia	3 115	3	286 000	16	91.8

2. Data relating to research in Australia (Queensland) on holothurians of commercial importance have been included in this document. The history of the trade in that country is linked with other countries in the region and the same species are sometimes exploited there in similar environments.

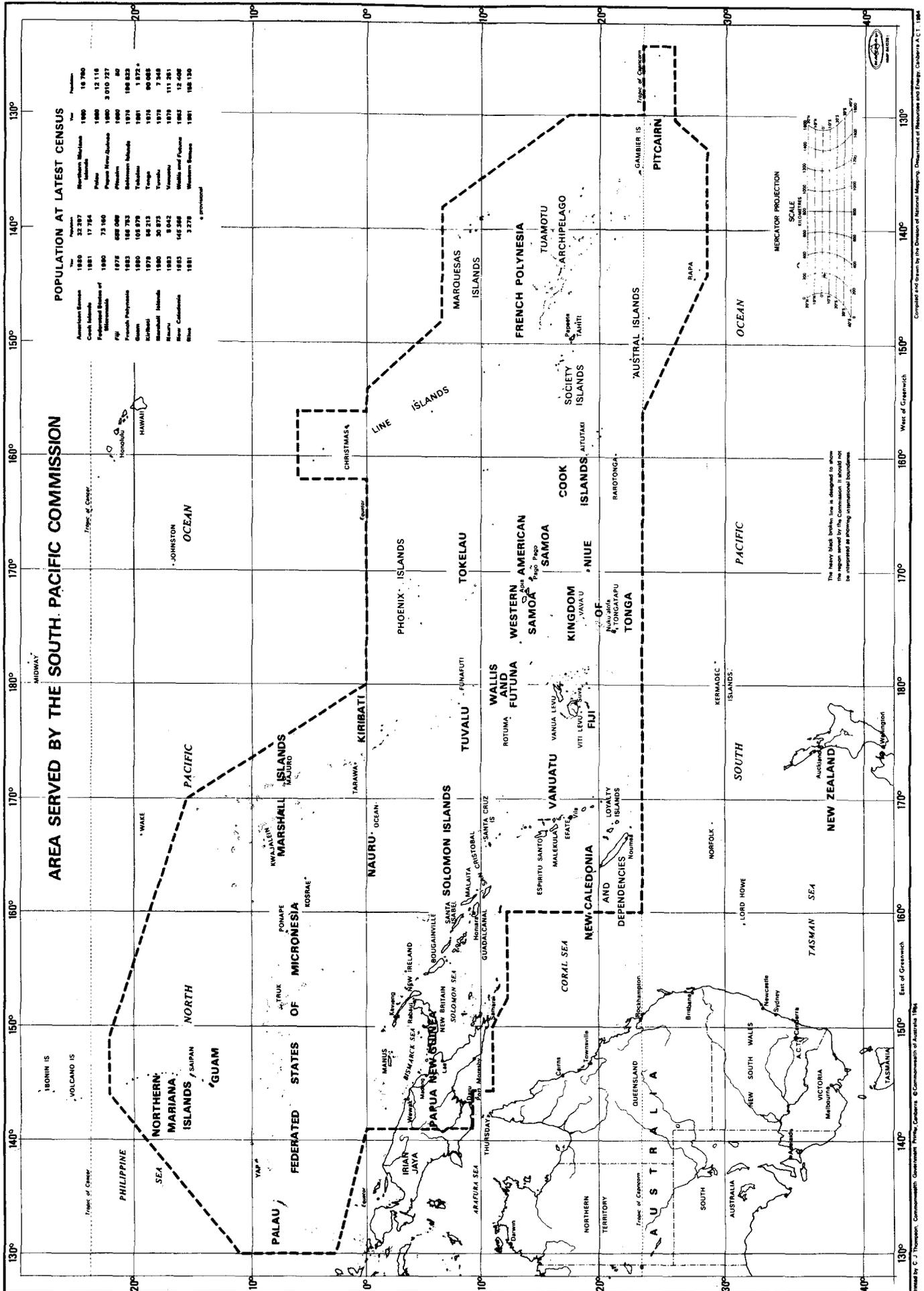


Figure 1 - Southern tropical Pacific; area served by the SPC (Source: SPC, 1984)

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1.3.2 Countries and territories

This brief description of states and their populations is drawn from the Pacific Islands Yearbook (1978) and the Atlas of New Caledonia published by ORSTOM (1981).

Papua New Guinea: An independent state, comprising the eastern half of the island of New Guinea, a very complex continental island, and outlying island groups, (Bismarck, Bougainville, etc.) including continental, volcanic and low islands. The essentially Melanesian population of around 3 million is composed of many different ethnic groups. Approximately seven hundred distinct languages are spoken.

Solomon Islands: This extensive archipelago, covering 29,000 km², is an independent country consisting of six main high islands, as well as elevated reefs and atolls. The population of around 200,000 is Melanesian.

Vanuatu: Independent since 1980, this island group is formed of some sixty mainly volcanic islands (11,900 km²). Melanesians account for almost the entire population of approximately 100,000.

New Caledonia: This French overseas territory consists mainly of 'Grande Terre', a long narrow continental island, and the Loyalty Islands, which are elevated reefs, 19,100 km² in all. New Caledonia has a multiracial population of approximately 140,000, in which Melanesians and Europeans predominate.

Fiji: This independent archipelago of 320 islands consists of high volcanic islands, the largest of which are Viti Levu and Vanua Levu, elevated reefs and atolls (10,400 km²). The population, originally Melanesian, has undergone strong Polynesian influence; the descendants of Indian indentured labourers brought in to tend the sugar-cane crop outnumber native Fijians.

Tuvalu: A small independent state (26 km²). Its Polynesian population, 7,300 strong, lives on atolls.

Wallis and Futuna: A French overseas territory (210 km²). These are volcanic islands. The 10,000 inhabitants are Polynesian.

Western Samoa: An independent nation consisting of two main volcanic islands and a number of small islands (2,900 km²). The 153,000 population is of Polynesian stock.

American Samoa: A United States territory (197 km²) comprising, in addition to Tutuila, the main volcanic island, other small islands and atolls. The 31,000 population includes Polynesians, Europeans from America and Asians who are mainly employed in the tuna fishing industry.

Kingdom of Tonga: Tonga is made up of three main groups of numerous volcanic islands and elevated reefs (740 km²), scattered over 560 km from north to south. The 93,000 inhabitants are Polynesian.

Tokelau: A territory administered by New Zealand, this territory consists of three atolls (10 km²) populated by 1,600 inhabitants.

Cook Islands: This self-governing country associated with New Zealand consists of fifteen volcanic or raised islands, the biggest of which is Rarotonga (240 km²). Polynesians account for the great majority of the 18,500 population.

Niue: Similar in status to the Cook Islands, Niue is an elevated reef (259 km²). It sustains 3,700 Polynesian inhabitants.

French Polynesia: A French overseas territory comprising various archipelagoes (Society, Tuamotu, Gambier, Marquesas, Austral) of volcanic islands, raised reefs and atolls, representing a total land area of 4,000 km², scattered over four million km² of ocean. The population of 140,000 is essentially Polynesian or part-Polynesian and concentrated largely in Papeete.

Kiribati: An independent country comprising the many atolls of the Gilbert, Phoenix and Line islands (720 km²). The 56,000 population is Micronesian.

Nauru: An independent micro-state consisting of an elevated reef (22 km²). Phosphate mining has given the 7,500 inhabitants a high standard of living.

Northern Marianas: A chain of sixteen volcanic islands 480 km in length from north to south, with a land area of 471 km². Six islands are inhabited. Two-thirds of the 15,000-strong population are Chamorros, descendants of the indigenous population, while the remaining third are the offspring of immigrants from the Carolines.

Guam: A United States territory situated at the southern end of the Marianas, Guam is an old volcanic island, 549 km² in area. The population of around 100,000 has been influenced by Spanish colonisation. The economy relies on the military base and tourism.

Palau: This group of islands in the western Carolines is formed of more than 200 islands, some of which are volcanic and others elevated reefs (460 km²). Eight of these islands are populated by a total of 14,000 Micronesians.

Federated States of Micronesia: Stretching from west to east of the Caroline Islands, the FSM comprise Yap, with its four high islands and atolls (121 km²), Truk, made up of volcanic islands and atolls (118 km²) enclosed by a broad reef and a lagoon, Ponape and Kosrae. The Micronesian population totals approximately 70,000.

Marshall Islands: The easternmost part of the former U.S. Trust Territory of the Pacific Islands. The 34 islands include 29 atolls (180 km²) scattered over almost 970,000 km² of ocean. The Micronesian population is 29,000 in number.

The diversity of the physical environment and the peoples is matched by the great differences in political status, often a legacy of the last war. The problems of economic development are manifold, and often intractable because of the sheer smallness of the territories, their low population densities and their remoteness from world markets. Difficulties due to climatic hazards, cyclones and drought also have to be contended with.

1.3.3 Coastal zones and resources

The very vastness of the ocean leaves scope for planning greater utilisation of fisheries resources. The traditional importance of this activity has been reinforced by the establishment of two hundred nautical mile exclusive economic zones. The pelagic resources, mainly consisting of tuna, are capable of sustaining more intensive exploitation.

The coastal environments are highly diverse, as a result of various historical, climatic, physical and biological factors. The principal types of substrate are:

- coral formations developing on coasts not subject to major alluvial deposits or cold water currents;
- other rock or sedimentary substrates of beaches, estuaries and lagoons.

Historical factors such as fluctuations in sea level caused by glaciation or tectonic accidents, during the Quaternary period in particular, have influenced coastal morphology and reef building. The major reef types - fringing reefs, islet reefs, barrier reefs and atolls - feature zonation in groupings or parallel formations, as determined by the gradients of the relevant environmental factors.

The physical structure of an island has a direct impact on the composition of its substrate. Continental type islands, with varied soils and subject to orographic rain, show the greatest degree of diversity. The structure of volcanic islands and elevated platform reefs varies according to the age of the volcanic activity or the elevation. Atolls are the least diversified islands and the extent of inflow from and outflow to the ocean determines the degree of confinement of their lagoons.

Coastal resources are also very varied; they have been utilised on a small scale as a source of food since time immemorial but also as ornaments and trade items. The harvest is very varied: certain algae, molluscs (trochus, collectors' shells, giant clams, pearl-shells, oysters, cephalopods, etc.) and shellfish (prawns, crabs, spiny lobsters) being the most commonly gathered invertebrates, but corals, sponges and echinoderms are also consumed. Among vertebrates, besides an untold number of fish species, turtles and dugongs are also exploited.