
A review of marine resource use in coastal Papua

John C. Pernetta, Lance Hill

Abstract

This paper provides a review of marine resource utilisation along the South coast of Papua New Guinea. The nature of the available resources and their distribution are reviewed. Traditional techniques involved in the collection of marine species, in hunting dugong and turtle, and in fishing for fin-fish are discussed. Certain techniques are found throughout the area, whereas others are restricted in their distribution and are indicative of local specialisation.

Traditional use of marine resources is discussed; this includes the manufacture of various ornaments and artefacts, for food and for trade. Current and future exploitation is reviewed and it is concluded that the effect of monetisation of subsistence resources will place further strain on species which are already showing signs of over-exploitation.

Résumé

L'auteur examine la nature, la répartition et l'utilisation des ressources marines de la côte sud de la Papouasie Nouvelle-Guinée. Il étudie les techniques employées pour la pêche traditionnelle, la capture des dugongs et des tortues. Certaines techniques sont pratiquées sur toute la côte, d'autres ont une localisation plus restreinte et sont le signe d'une spécialisation locale.

L'auteur analyse les diverses utilisations des ressources marines : consommation, objets d'échange, fabrication de parures et d'outillage. Il examine les conditions actuelles et futures de cette exploitation et l'auteur conclut que l'effet de la monétarisation des ressources de subsistance font peser un risque de disparition des espèces qui commencent déjà à montrer des signes de surexploitation.

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A review of marine resource use in coastal Papua

by

John C. PERNETTA* and Lance HILL*

INTRODUCTION.

This paper aims to provide a basic review of marine resource use in the Western, Gulf and Central Provinces, and the mainland area of the Milne Bay Province of Papua New Guinea. As such it reviews the distribution of resources, their current utilisation, and the known extent of past use.

Whilst it may appear superficially obvious that marine resources including shellfish, fish and larger animals have, and continue to play an important role in the diet of coastal peoples in this area, what are perhaps less obvious, are some of the changes in resource availability and exploitation which have occurred in the recent past. Furthermore the traditional use of marine resources as dietary items has frequently been undervalued by anthropologists and others who suggest that activities such as communal fishing are undertaken for fun and not from necessity; as one example, Moulik (1973), describing fishing in the Milne Bay coastal villages states that fishing is an :

Intermittant food producing task which provides no regular contribution to the diet.

This statement is made despite the author's own data which shows that 3.1 hours/week are spent by men from these villages in fishing, and that this represents 17% of their productive work time. Bayliss-Smith (unpubl.) has shown that in Fiji a similar proportion of time invested in fishing yields 79 to 95% of the total animal protein in the diet, but only between 7 and 13% of the total dietary energy. It is important therefore that any discussion of marine resources for food in subsistence

societies recognises their total nutritional importance, not merely their energy value. For example marine foods are important sources of essential nutrients such as iodine, calcium and fat soluble vitamins. The relationship between dietary energy and protein is discussed more fully elsewhere (Pernetta & Hill, 1981).

In addition to their dietary importance marine resources play an important role in trade, artefact manufacture, the technology and social organisation of the communities concerned.

COASTAL ENVIRONMENTS.

The coastal area of the island of New Guinea under consideration here, lies between 141°-151° East and 8°-11° South, and comprises the southern coast of Papua New Guinea (Fig. 1). Three broad ecological regions can be distinguished in this area : to the West in the Kiwai, Torres Straits area of Western Province, coral reef and lagoon habitats predominate; the mouth of the Fly River and the Gulf Province coastline consist largely of extensive mangrove swamps bordering the Gulf of Papua; further East the Central Province and Milne Bay coastlines are once again dominated by reef and lagoon habitats.

Within each broad ecological region differences are apparent resulting in a mosaic habitat pattern. Thus the reefs of the Western Province consist of numerous large patch reefs with extensive sea grass beds. In the Central Province and Milne Bay areas, fringing reefs are more common whilst the coast

* Department of Biology, University of Papua New Guinea, Waigani, Papua New Guinea.

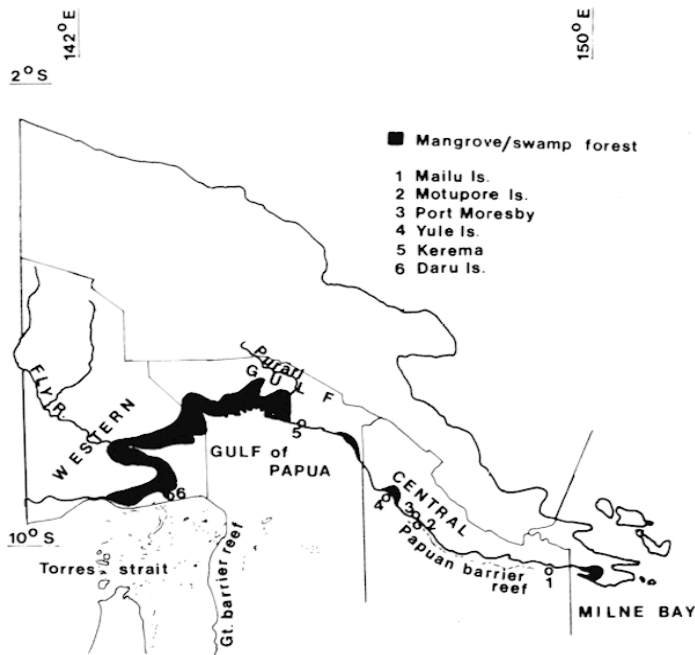


FIGURE 1. — Map of Papua New Guinea showing the ecological regions, Provinces and major centres discussed in the text.

is protected for much of its length by the large off-shore Papuan Barrier reef. In this South Eastern region river mouths and bays are frequently dominated by a thin band of mangroves, with off shore muddy substrates and sea grass beds. In contrast the mangroves of the Gulf Province form an extensive belt, some 12 km thick, of swamp forest fringing the coast.

Marine substrates may vary from fine mud through silts to sandy beaches or rocky shores, thus the diversity of resources available within the regions as a whole is highly localised. Local availability may result in either a high or low range of species being available for exploitation. For example the range of edible mollusc species available in mangrove swamps is less than that available on a fringing reef with sea grass beds. Poraituk (in press) identified 16 mollusc species in use in the Purari Delta of the Gulf Province compared with the thirty or so which are regularly exploited in reef areas (Swadling, 1977a). Oram (1977) discusses the local variability in available terrestrial resources in the Motu speaking area and highlights some of the differences in resource availability and use in geographically close Motuan villages. Irwin (1977) demonstrates similar differences in marine resource distribution and use between a mainland archaeological site and a contemporaneous one on Mailu Island in the Milne Bay Province,

whilst Swadling (1977a) provides a similar comparison of three coastal sites with differing substrates.

MARINE RESOURCES.

a. Large mammals.

It would appear that although a number of dolphin and whale species are present within the area they have not been extensively utilised, with the possible exception of the Irrawaddy dolphin (*Orcaella brevirostris*) in the Purari delta (Liem, in press). No ethnographic accounts of systematic whale or dolphin hunting in this area exist, in contrast to the opportunistic hunting undertaken both in the past and currently by the communities on the North Coast of New Guinea and Islands (Dawbin, 1966; Dawbin & Hill, unpubl. obs.) and in a concerted manner on Malaita, Solomon Islands (Dawbin, 1966). Current work by one of us (J.C.P.) has demonstrated the presence of *Grampus griseus* in recent archaeological materials from Motupore Island in Bootless Inlet. Whether this represents a stranded specimen or is indicative of more persistent opportunistic hunting of these animals is unknown. Seligman (1910) also records the use of whale bone for lime spatulas in the Massim area of South Eastern New Guinea, although this may have been traded into this area from the islands to the East.

In contrast the dugong, *Dugong dugon* was and still is hunted in the Kiwai areas of Western Province; between Pari and Marshall Lagoon by the Motu people and further East in mainland Milne Bay. In the latter two cases hunting of this species may always have resulted in low returns since Turner (1878) and Gaigo (1977) describe how the capture of a dugong traditionally resulted in special feasts. Recent surveys of dugong populations have shown that in these two areas dugong are at low density and are found in small groups of three to five individuals (Hudson, 1977). In contrast large herds are frequently encountered in the Kiwai, Torres Straits area (Hudson, 1977). Olewale & Sedu (in press) describe in detail the techniques employed in dugong hunting in this area and its use as a trade resource to exchange for sago with villages in the Fly River delta. The importance of this resource in this area is further substantiated by the accounts in Haddon (1912) of

ceremonies associated with dugong hunting and its role in the social organisation of Kiwai people.

b. Reptiles.

Two species of crocodiles occur in the area under consideration although only one, the saltwater species, *Crocodylus porosus* occurs to any large extent in coastal marine areas. Preferring areas of coastal swamp and mangrove forest, this animal is found along the whole southern coast in areas of suitable habitat. The Gulf and Western Provinces were considered to be the major centres of this resource in Papua New Guinea (Behler, 1976) although recent work suggests that these populations are at lower levels than previously thought (Pernetta & Burgin, 1980). As Hope (1977) suggests, populations of this animal have declined only recently, and the geographical and numerical extent of subsistence hunting prior to European contact is unknown. The presence of crocodile remnants in the Motupore midden¹ suggests a continuous but low level of exploitation in prehistoric times. This is further supported by the fact that crocodiles are currently eaten in many coastal and inland villages, a practice which is unlikely to have arisen throughout the area only over the last thirty years, in response to commercial hunting. Chalmers & Gill (1885) also mention the eating of a crocodile at Parimata.

Six of the seven extant species of marine turtle are known from Papua New Guinea waters and although only four are definitely recorded from the area under consideration (Spring, 1978) the others are likely to be present. The most important species from a subsistence viewpoint are; *Chelonia mydas* and *Eretmochelys imbricata*, which are exploited both as eggs and adults. Both species are utilised in the Western, Central and Milne Bay areas in large numbers. In contrast these species appear less important in the Gulf and Fly delta areas than the freshwater and estuarine species *Carrettochelys insculpta* (Liem, in press). The other turtle species are all (7) predominantly freshwater species although *Chelodina novaeguineae*, *Chelodina siebenrocki* and *Elseya novaeguineae*, may also be found in coastal mangrove swamps and are important subsistence food resources (Pernetta, in press).

These smaller species are mainly exploited as adults for food.

In addition to the above the file snake *Acrochordus arafurae* and the various varanid lizards should be mentioned. Although both are more terrestrial than marine resources, like the other reptiles they occur in mangrove swamps and estuarine areas. The skins of both are used for making drums whilst the flesh of the varanid lizards is eaten widely.

c. Fish.

Some 1,096 species of fish are currently recorded from Papua New Guinea (Munro, 1967) although this can by no means be considered the final total. The bulk of these are marine species, with only some 200 known from freshwater of which only 111 breed in such situations. Most of the freshwater and estuarine species are derived from marine families (Haines, in press). The highest diversity of species is associated with reef areas where the families Scaridae, Holocentridae, Apogonidae, Epinephelidae, Lutjanidae, Lethrinidae, Labridae, Coridae, Siganidae, Carangidae and Balistidae are dominant components of the fish fauna. In estuarine and mangrove areas representatives of some of these families may be present but the families Mugilidae, Atherinidae and Hemirhamphidae are more common together with the important migratory species, the barramundi (*Lates calcarifer*). In estuarine and freshwater environs various catfishes dominate the fish community. Pelagic fishes such as tuna, trevally and barracouda are important components of the fisheries along the coast and may be exploited seasonally when they visit spawning grounds close inshore.

The actual species of fish available at any one location will be affected by the nature of the substratum, whether silt, mud or sand, together with the proximity of reefs, sea grass beds and mangrove swamp, the latter forming an important nursery area for many species.

d. Crustaceans.

The most important crab species along the coast is the widespread mud crab, *Scylla serrata* which normally occurs in the vicinity of mangrove swamps and softer substrates. In contrast reef areas may be important sources of crayfish (*Panulirus ornatus*), captured when they migrate to the reefs to spawn. Other

1. Where archaeological materials from Motupore are mentioned in this paper, they refer to current, unpublished work by Dr. L. Groube & Dr. J. C. Pernetta unless otherwise noted.

crab species and some prawn species may be important locally and include a variety of mangrove and terrestrial species. In contrast the deep water crustacean resource of the Gulf of Papua includes a number of prawn species (Gwyther, 1980) which were never exploited by traditional means.

e. *Echinoderms*.

Whilst "bêche de mer" were extensively fished commercially in the Torres Straits at the start of this century this fishery has fallen into disuse and the various species never appear to have been important subsistence foods. In contrast the sea urchin *Tripneustes gratilla* appears to have been widely used for food. This species is common on reef flat areas and in sea grass beds, wherever these occur along the coast.

f. *Molluscs*.

The molluscan resource of the South coast is almost as diverse as the finfish and may in many areas have been as important, if not more important as a source of subsistence food. Again the diversity of the available species is higher in association with coral reefs than with the mangrove lined shoreline of the Gulf Province. In sandy sea grass areas *Strombus luhuanus* is a major subsistence species whilst reef communities are dominated by members of the families Arcidae, Strombidae, Tridacnidae, Trochidae, Turbinidae and Conidae; rocky shores by Neritidae and Cerithidae; mangrove areas by Cerithidae, Neritidae and the bivalve *Geloina coaxans*. In areas of soft silt or muddy substrates the species *Pinctada margaritifera*, and *Chama spp.* are more common; in sandy areas the latter genus is replaced by *Spondylus spp.* Swadling (1977a) contrasts the available molluscs in three ecologically distinct areas; a sheltered mangrove area at Delena, a rocky fringing reef at Pari, and a sandy shore at Obu and shows that the most important species differ in each area with only a few occurring in more than one of the locations.

THE TECHNOLOGY OF MARINE RESOURCE UTILISATION.

In the case of mollusc, crustacean and echinoderm exploitation no specialised technological devices appear to have been employed. The collection or gleaning of such resources appears to have been a predominantly female

activity, whilst fishing for finfish and the hunting of dugong and turtle were undertaken by the men.

The predominant fishing techniques were the use of nets of various types, and trapping, although unbarbed, turtle shell hooks are known from the Torres Straits, Toaripi and Kiwai areas (Chalmers, 1898; Haddon, 1935; Landtman, 1927). Turner (1878) notes that the only fish hook he saw further East was an unbarbed turtleshell one in the possession of an Elema (Gulf) man. Landtman (1927) gives a description of the mode of manufacture of these hooks which involved cutting a strip of turtleshell from the plate which was then heated and bent around a rounded stone. Such hooks were used on a "Tow line" or for angling using a rod of sago palm stalk. Occasionally they were used as set lines on a flexible pole with a dance rattle attached to the pole, giving warning when a fish was hooked (Landtman, 1927). The only other reference to rod fishing in this area involves the use of a fish snare and wood float from Freshwater Bay, in the Papuan Gulf (*sic* Edge-Partington, 1890-98 : 1, p. 325). The manner in which this was used or the species caught with it is not recorded. Edge-Partington (1898 : 3, p. 90) also illustrates a hand fishing line from Mailu. Whether this was used with hook or gorge, or for trolling with a lure is not stated.

Simple thorn hooks used with hand lines are recorded from the Gulf Province and Hall Sound (Anell, 1955). Turtle shell hooks are also known from the Southeastern tip of New Guinea but whether they were regularly made in this area or traded in from the nearby islands of Milne Bay is unknown. What is quite remarkable is the general agreement in the ethnological literature that the Motu of Central Province lacked fish hooks and gorges and relied on net fishing techniques. Anell (1955) remarks that hooks were unknown from the S.E. coast of the mainland.

Gorges appear to have had a limited distribution in this area as fish hooks. (Landtman, 1927) records the men of Kiwai using a rod and gorge to angle for fish close to shore. Gorges were made from a stick pointed at both ends, or by binding two fish spines (*pakuro*, sp indet.) base to base; a single coconut fibre was used to tie the bait on. Gorges appear to have been absent from the rest of the coast although Anell (1955) cites a single unnamed source describing their use in catching crocodiles in the Purari River area.

Spears and bow and arrow were widely em-

ployed in fishing along this coast (Austin, 1946; 1948; Beaver, 1920; Chalmers, 1903; Chalmers & Gill, 1885; Edge-Partington, 1890-1898; Haddon, 1912; Landtman, 1927). Chalmers & Gill (1885) describe men perched on poles in the water (the upright pole having a small cross piece) shooting fish with bows and arrows over a sandy beach in the Motu-Motu area. Night fishing with a spear is described by Haddon (1912), from the Torres Straits, where one man holds a torch, the second the spear; and by Beaver (1920) from the Kiwai area where spear fishing is done at night from a canoe and the spearman also holds the torch. The spears and arrows employed were mainly multiple pronged, having three or four barbed or unbarbed prongs, although Haddon reports single pronged, barbed spears being used for larger fish in the Torres Straits area. Such spears for larger fish may have been more widely used as they were also employed for barramundi in the Hall Sound area (Rau, pers. comm.). Haddon (1912) further describes a number of different sized spears with different names which were employed for different fish or octopus, by women or by men.

Balfour (1925) discusses the distribution of thorn-lined traps which are considered by Anell (1955) to represent an ancient element in the fishing technology of the area. Such traps are widespread along the South Coast of Papua New Guinea. They are known to occur throughout the Fly river drainage from the Ok region in the interior to the Kiwai areas of the coast (Austin, 1948; Beaver, 1920; Chalmers, 1903; Edge-Partington, 1890-98). They are also recorded from the Gulf Province river systems and may have occurred as far along the south coast as Orangerie Bay (Anell, 1955), although this latter record is uncertain. Such traps were made from the stems of *Calamus* (Balfour, 1925) or sago palm mid-ribs (Edge-Partington, 1890-98 : 2, p. 175), bound together in a cone, the thorns pointing towards the apex where the bait was tied. The outside of the trap was covered with leaves to prevent the trap from filling with mud, or the fish reaching the bait through the walls of the trap. Such traps were used in dams across small estuarine creeks in Orokaiva (Beaver, 1914-15), suspended from poles in coastal marine environments (Landtman, 1927) or tied in series on a rope and sunk into small creeks and bays (Anell, 1955).

Other forms of trap were undoubtedly employed in this area. Beaver (1920) shows a photograph of a large fishing pot (5-6 feet long)

from the Aird Delta of the Gulf Province, although the use and mode of operation of this trap is unexplained. Rau (pers. comm.) states that a trap made in the form of a plunge basket was employed in the Roro speaking areas, the open end of the conical basket having a smaller cone with open ends inserted inside. Such traps were used in dams across small tidal creeks and fish were driven into the trap or traps by a line of women working downstream stirring up a mass of mud from the bottom. Austin (1946), Beaver (1920) and Landtman (1927) also mention conical basket traps in Western Province without providing details of their use or construction, which may well be similar to that described above. Beaver (1920) also describes coconut leaf baskets being used in tidal creeks as traps. They were suspended in such a way that fish sheltering in them were trapped by the tide. It is not clear from his description what form this trap takes although it may well be of the form illustrated by Edge-Partington (1890-98 : 1, p. 307) from elsewhere in New Guinea.

The plunge basket, an open-ended cone of cane, appears to be another ancient technological element widely used by women in mangrove and estuarine areas. It is still in common use in the Gulf Province (Cragg, in press). Fish are stalked, the basket plunged into the water over the fish which are then removed by hand through the opening at the top. Landtman (1927) described the Kiwai version of the plunge basket which is closed at the apex and could be closed at the other wider end onto a trapped fish using the feet. It appears to be unrecorded from the Eastern Motu area where it may have been functionally replaced by a variety of small framed hand nets.

Small framed hand nets are known from the Gulf Province (Edge-Partington, 1890-98 : 2, p. 169) and the Motu areas (Edge-Partington, 1890-98 : 2, p. 169). Although such hand nets were in use along the coast in the Mimika region of Irian Jaya (Rawlings, 1927) and in the Fly river itself, the Kiwai coastal people used no such nets (Landtman, 1927) nor did the Torres Straits islanders. Haddon (1912) describes fishing for small schooling fish (*Haerengula kunzei* sic = *H. ovalis*?) using a *werir*, a six foot pole with a bundle of banana leaves tied on one end, and a *weres*, a conical basket similar to the plunge basket but made from split bamboo with a closed end. Two men would 'herd' the fish into shallow water using the *werir* where they would be scooped up by a third man using the basket *weres*.

Another form of framed net is still widely in use in the Gulf Province; this consists of two long poles some eight to ten feet in length, arranged in the form of a V with the net attached between. Two lines of women work together using these nets, pushing them in front of themselves and towards the other line. As the two lines of women approach each other the nets are raised simultaneously with the fish trapped in the folds of the net (Cragg, pers. comm.). Similar nets are also in use in the Trobriand islands (pers. obs.) and thus it is questionable whether this net type is autochthonous to the area under consideration.

The literature concerning nets and their use appears less detailed and reliable than for many other techniques. Despite giving details of other fishing techniques Beaver (1920) makes no reference to nets anywhere in the Western and Gulf Provinces. Edge-Partington (1890-98 : 2, p. 190) figures a "peg for fastening down nets in river fishing" whose provenance is given as the "Mouth of the Fly", and on page 187 of the same volume he figures a wooden net float from S.E. Papua. On page 169 is illustrated a stake net for fishing again with no provenance given. The net is thirty nine inches in height at the ends which are attached to poles 4 feet in length, the height in the middle is given as 20 inches and the length as 114 inches. An interesting feature of this net is the variation in mesh size between the three panels of the net. The middle one is illustrated with a mesh size of half the diameter of the two outer panels. This net is figured on the same page as hand nets from the Papuan Gulf and Motu areas. Square nets supported by poles at the ends, with shell weights along the bottom, and described as seines appear to have been distributed throughout this area.

Gaigo (1977) describes past and present net fishing practices amongst the Motu of the Port Moresby area. Nets were made from 'bark' fibre and used for mullet schools in mangrove areas, for mackerel tuna in open water, as tidal traps on reef flats, and as encirclement traps in deeper water outside the reef. Schools of fish would be encircled using several large nets and fish removed by spearing or the use of smaller nets inside the main ones. Pulsford (1976) in his account of ceremonial tuna fishing by Pari villagers describes how nets are tied to permanently established poles, forming a funnel trap on the migratory pathways of tuna. Two canoes, stationed at the

entrance to the trap, would close the mouth behind a school of fish using another net; as fish became entangled in the nets they were removed by divers who entered the water with the school of fish. The permanent establishment of the poles which are renewed as they rot, argues for a detailed knowledge on the part of the local people concerning the habits and behaviour of the species fished.

Permanent, stone built traps for fish in reef areas are only recorded from the Torres Straits, where Haddon (1912) points out that they had already fallen into disuse at the time of his visit. Analogous in function to such stone traps, which catch fish on the reef flat as the tide falls, is the modern use of long nets over the reef flat areas of the Central and Milne Bay Provinces; such practices were doubtless also employed in the past.

The use of modern gill nets has resulted in smaller groups co-operating in net fishing than was probably normal in the past. Belshaw (1952) describes how several canoes would combine for fishing trips to the reefs in the vicinity of Port Moresby and would remain on the reefs for several nights. The short length of most traditional nets would probably have been the cause of such co-operative fishing, since a number of nets combined would increase the size of a tidal trap which could be constructed, or would improve the chances of encircling large schools of fish. Such traditional nets in the Motu areas are described as seine rather than gill nets (Belshaw, 1952) although it seems likely that most substrata in reef areas would be unsuitable for operating true seine nets. The small nets fastened to poles, such as the one described above, might well have been used as seines with a man holding each pole and walking along a tidal channel or creek in mangrove areas. The materials used in netting appear to vary according to the function of the net but the following sources of fibre are mentioned in various sources; banana fibre, coconut roots, inner bark of hibiscus, and paper mulberry bark.

Fish poisons were also widely used in the past and again most authors have neglected to mention the species concerned. Landtman (1927) for instance states that three types are employed by the Kiwai, but fails to state which the species are. Derris root is perhaps the most common together with the bark of mangrove, although which species was used is nowhere specified.

The hunting of dugong and turtle involved perhaps the most specialised techniques in

marine resource exploitation in this area. In both the Torres Straits and Kiwai areas these animals were harpooned using a 10-15 foot harpoon with a detachable head to which forty feet of vine rope was attached. Haddon (1912) and Landtman (1927) both give detailed descriptions of the harpoon haft and head, the line and the modes of capture. Beaver (1920) notes that turtle were mainly hunted at night during the breeding season when the animals were to be found on the surface and appeared to be more easily approached than at other times. Dugong were hunted mainly at periods of the new and full moon and the harpooner stood on a specially constructed platform over the sea grass beds where an animal was known to have fed the previous night. On striking an animal the harpooner would jump from the platform calling out to the canoe which would stand off some distance away. This practice was not without risk to the harpooner who might become entangled in the line and drown (Haddon, 1935).

In contrast to the harpooning of dugong in the Western Province the Motu constructed special large and strong nets for the catching of these animals. The nets are described by Turner (1878) as being similar to the wallaby nets and were made of fine rope using paper mulberry. In most areas other than the Western Province the catching of turtle involved a man leaping from the canoe onto the back of a basking turtle, with a rope tied around his upper arm. The men in the canoe would then drag the man holding the turtle by the front and back of the carapace, back to the canoe. Landtman (1927), Haddon (1912) and Beaver (1920) all describe a further specialised method of catching turtles, employed by the Kiwai and Torres Straits Islanders. This involved the catching of remoras which were released with a line attached to their tail on sighting a turtle. The remora would attach to the turtle which could then be captured more easily by either harpooning or jumping onto its back in the water.

One further specialised technique of marine resource utilisation appears to have been employed in the Torres Straits area, namely the under-water snaring of terns. A snare would be attached to an upright pole set in the reef flat. The bait consisted of a small fish attached below the snare, and as the tern dived it was caught in the snare and drowned.

The final area of technology involved in marine resource exploitation is the mode of

water transport. Haddon & Hornell (1937) provide detailed descriptions of the canoes from the south coast area. The single outrigger canoe, made from a hollowed log with a small platform built across the boom, is widespread throughout the area and used by both men and women for inshore fishing and general transport. Paddles, or from one to four sails made from strips of pandan leaf sewn together were used by the Kiwais. Canoes without outriggers were relatively uncommon and were only used for travel on creeks and rivers in the Western & Gulf Provinces. In Western Province the Kiwai used the larger double outrigger canoe called *moto moto* (Landtman, 1933; Olewale & Sedu, in press) this being particularly important in dugong and turtle hunting and the associated trading voyages from the offshore hunting grounds to the islands in the Fly River mouth. The single outrigger canoe also occurs through the Papuan Gulf, but in Kerema Bay double hulled canoes are employed instead (Haddon & Hornell, 1937; Williams, 1932/33). Haddon & Hornell (*op. cit.*) also mention a small outrigger called *Kaua* used for shark fishing with a larger one being used for communal fishing with a seine net in Kerema Bay. This appears to be the only reference to shark fishing along the whole of the South coast.

Large double hulled canoes (*haruka*) were used for eastern trading voyages by the Oro-kolo, who carried bows and arrows and tobacco which they exchanged for shell ornaments. Originally propelled by paddles with mats as temporary sails, post contact changes included the addition of rowlocks and oars (apparently copied from mission whaleboats) and later again the development of regular masts and sails, nipa palm bulwarks and deck house for the crew and storage of sago and other commodities (Williams, 1932/33). A further development in this area was the construction of multiple hulled sailing canoes, modelled on the Motu *lakatoi*, called *bevaia*. In central Province as in the Gulf the small canoe with a single outrigger and the double hulled canoe were both widespread. Single outrigger canoes were often rigged with a rectangular matwork sail constructed from a rush.

The characteristic Motuan *lakatoi* was built from three or more logs, with bulwarks, deck house with *kunai* roof and characteristic 'crab-claw' sails. Such canoes were used for the famous Hiri trade between the Motuan villages and the Gulf Province (Barton, 1910).

TABLE 1. — MATERIALS USED IN ARTEFACT MANUFACTURE.

Species	Artefact	Locality	Reference
Molluscs			
<u>Anadara</u> spp.	net weights	Nebira	Bulmer, 1979
<u>Chama pacifica</u>	discs (beads)	Central Prov.	Seligman, 1910
<u>Cassis</u>	tubercles cut & included in a Koita charm	Central Prov.	Seligman, 1910
Conch	trumpet	?	Edge-Partington, 1890-98
"	trumpet	Western Prov.	Austin, 1948
"	trumpet	Kiwai, W. Prov.	Chalmers, 1903
<u>Conus</u> <u>millipunctatus</u>	arm shells	Motu, Central.	Seligman, 1910
<u>Conus</u> spp	arm shells	Yule Island	Vanderwal, 1973
"	arm shells	Nebira	Allen, 1972
"	arm shells	Mailu	Irwin, 1977
"	adzes	Mailu	Irwin, 1977
"	adze	Motupore	Groube/Pernetta
"	tablet	Yule Island	Vanderwal, 1973
"	ornament 'ring'	Yule Island	Vanderwal, 1973
"	ornament 'ring'	Motupore	Groube/Pernetta
"	ornament 'ring'	Torres Strait	Edge-Partington, 1890-98
"	Top discs	Taurama	Bulmer, 1979
"	Top discs	Torres Strait	Edge-Partington, 1890-98
<u>Cymbium</u> (=Melo)	hoe blade	Torres Strait	Edge-Partington, 1890-98
"	'kettle'	Torres Strait	Edge-Partington, 1890-98
"	'saucepan'	Torres Strait	Haddon, 1935
"	'groin shield'	Torres Strait	Haddon, 1935
"	'groin shield'	Kiwai W. Prov.	Landtman, 1933
<u>Cypraea</u> spp.	beads	Taurama	Bulmer, 1979
"	scrapers	Taurama	Bulmer, 1979
<u>Nassa callospira</u>	discs (beads)	Central Prov.	Seligman, 1910
<u>Nautilus</u>	groin shield	Torres Strait	Edge-Partington, 1890-98

Species	Artefact	Locality	Reference
Ostreidae	'tablet'	Mailu	Irwin, 1977
Olives	drilled as bead	Torres Strait	Edge-Partington, 1890-98
"	head band	Port Moresby	Edge-Partington 1890-98
<u>Ovula ovum</u>	whole on arm/ leg bands	Yule Island	Edge-Partington 1890-98
" "	charm on mast of Hiri canoe	Central Prov.	Seligman, 1910
<u>Pinctada</u>	scrapers	Taurama	Bulmer, 1979
"	'tablet'	Yule Island	Vanderwal, 1973
"	pendant crescent	Motu areas	Seligman, 1910
"	pendant crescent	S.E. Papua	Edge-Partington, 1890-98
"	neck-ornament	Torres Strait	Edge-Partington, 1890-98
<u>Spondylus</u>	discs (beads)	Nebira	Allen, 1972
<u>Tridacna</u>	axe	Torres Strait	Haddon, 1935
"	scraper (adze ?)	Yule Island	Vanderwal, 1973
"	arm shell	Yule Island	Vanderwal, 1973
"	nose stick	Torres Strait	Edge-Partington, 1890-98
"	nose stick	Massim	Seligman, 1910
"	vessel	?	Edge-Partington, 1890-98
"	ear-ring pendant	S.E. Papua	Edge-Partington, 1890-98
"	breast-ornament (ring)	S.E. Papua	Edge-Partington, 1890-98
"	neck ornament	S.E. Papua	Edge-Partington, 1890-98
"	concheilin mass + pearls	Koita charm	Seligman, 1910
" (?)	discs (beads)	Taurama	Bulmer, 1979
<u>Trochus</u>	arm shells	Yule Island	Vanderwal, 1973
"	arm shells	Motupore	Groube/Pernetta
"	arm shells	Taurama	Bulmer, 1979
"	'unit'	Yule Island	Vanderwal, 1973

Species	Artefact	Locality	Reference
<u>Trochus</u>	Pendant in shape of 2 pig tusks	Torres Strait	Edge-Partington, 1890-98
Unident. Molluscs	Net sinkers	Nebira	Allen, 1972
"	surgical instrument	Taoripi	Chalmers, 1898
"	platform for spinning tops	Torres Strait	Edge-Partington, 1890-98
"	discs (beads)	Torres Strait	Edge-Partington, 1890-98
"	discs (beads) on ear-ring	S.E. Papua	Edge-Partington, 1890-98
"	discs	Nebira	Allen, 1972
"	discs	Tatana	Seligman, 1910
Echinoderms.			
<u>Heterocentrotus mammillatus</u>	spines in a Koita charm	Central Prov.	Seligman, 1910
Fish			
<u>Pakuro</u> (sp. indet)	spines bound back to back for fish gorge	Kiwai, W. Prov.	Landtman, 1927
shark	toothed club	S. Tip Papua	Edge-Partington, 1890-98
shark	toothed club	Torres Strait	Haddon, 1912
Sawfish	club	?	Edge-Partington, 1890-98
fish (sp. indet.)	spines for piercing ears	Kiwai, W. Prov.	Landtman, 1912
Reptiles			
<u>Acrochordus arafuræ</u>	skins for drum heads	Fly River area	Turner, 1878

Species	Artefact	Locality	Reference
<i>Varanus</i> spp	skin for drum heads	widespread throughout area	pers. obs.
Crocodile	teeth in Koita hunting charm	Central Prov.	Seligman, 1910
Crocodile	house ornament (skull)	Aroma	Edge-Partington, 1890-98
Turtle shell	ear-rings	Discovery Bay	Seligman, 1910
"	hooks	Torres Straits	Edge-Partington, 1890-98
"	hook	Elema (Gulf)	Turner, 1878
"	pins	Torres Strait	Edge-Partington, 1890-98
"	finger-ring with shell discs	S.E. Papua	Edge-Partington 1890-98
"	ear ring	S.E. Papua	Edge-Partington, 1890-98
"	scraper	Torres Strait	Edge-Partington, 1890-98
"	pendant	Torres Strait	Edge-Partington, 1890-98
"	mask	Torres Strait	Edge-Partington, 1890-98
"	comb	Torres Strait	Edge-Partington, 1890-98
Marine mammals			
whale (sp. indet.)	lime spatula	Massim	Seligman, 1910
dugong	lime spatula	Yule Island	Vanderwal, 1973

They were reconstructed in the host Gulf villages, returning with as many as 10 to 12 logs incorporated into the hull. The logs were obtained in exchange for *Conus* shell arm bracelets (*toea*). Mailu forms the easterly limit of the double hulled canoes where they are known as *orou*.

Apart from the various forms of canoes briefly outlined above, rafts, constructed from five logs held together and braced, were used for the transport of building materials in the Orokolo and Kui areas (Haddon & Hornell, 1937).

MARINE RESOURCE UTILISATION.

It would appear that the primary use for all marine resources was traditionally as food, few items being collected that were not actually eaten, even when the non-edible fraction was used for some other purpose. In all accounts available it would appear that the hunting of larger marine animals and fishing practices involving the capture of most finfish were almost exclusively the pursuits of men. Some fishing

practices, including those involving the use of individual traps or hand nets, and the collection of reef molluscs, crabs and smaller items seem to have been the work of women and children. In general this division of labour is continued in most traditional societies to the present.

Apart from the direct use of marine resources as protein foods, they were frequently traded with inland groups for alternative foods, primarily energy sources. Thus Olewale & Sedu (in press) record the exchange of dugong for sago, and Allen (1977a; 1977b) discusses the Motu, Koita, Koiari exchange involving various items including fish for wallabies and vegetables. The exchange of marine protein for vegetable energy would appear to have occurred predominantly in those areas where sago was unavailable or where good gardening land was away from the coast and under the control of other peoples. In the Gulf and some parts of the Western Province the close proximity of sago and marine resources would have lessened the need to engage in such trade.

Apart from their use directly and indirectly as food, marine resources were widely used for the manufacture of artefacts, ornaments and other products. *Geloina coaxans* for instance was, and still, is widely favoured for making lime used in the chewing of betel nut. The shells are burnt and the lime used as a powder with betel. Turner (1878) records that the Koiari visited the coast to collect the shells (and also salt water in bamboo tubes for cooking) and carried them 20 miles inland before making lime which they then traded back to the Motu coastal villages.

A wide variety of mollusc shells is used for many different purposes some of which are listed in Table 1. As can be seen, certain species tend to dominate the usage patterns: *Conus sp.* for example are used in the manufacture of ornaments; armshells, rings and discs; and as adzes. Although *Trochus* appear to have been used for armshells and pendants it appears not to have been used in the manufacture of fish hooks as occurred elsewhere in Melanesia. Some artefacts, such as *Pinctada* vegetable peelers are still in wide use at the present time while others are no longer made. It is interesting to note that *Trochus* and *Conus* are both reef genera which must have been traded into the Gulf area. Indeed *Conus* of the size necessary to make arm shells which could actually be worn must have been traded from the island Massim area into south eastern

Papua New Guinea since they are not found in the Moresby region and could not be considered common anywhere along the mainland coast. Similar trade links involved the movement of *Conus* arm shells of a different type from the Torres Straits into the Kiwai and inland areas of Western Province.

In a number of archaeological sites evidence for the manufacture of shell 'beads' or discs is known, although in some instances the species of mollusc used is in doubt (Allen, 1972; Bulmer, 1979).

Although turtle shell was apparently used in the manufacture of fish hooks only in the Torres Strait area, it was used there and elsewhere for personal jewelry, in the form of finger-rings, ear-rings, or as an inlay on shell discs worn as a pendant, or as lime spatulas. Dugong skin was apparently used for waist bands and drum skins in the Central Province (Hudson, 1977) the teeth were worn as charms whilst the tusks may have been used as lime spatulas or, as in one example from Motupore, as a dagger (Allen, pers. comm.). In Milne Bay they are used as betel nut crushers (Hudson, 1977). Vanderwal (1973) mentions the use of dugong bone for a lime spatulas although this appears to be the only known instance of worked dugong bone on the south coast. In island Milne Bay Hudson (1977) cites their use in the manufacture of needles for basket weaving.

The use of fish spines for the manufacture of fishing gorges by the Kiwai has already been recounted above, and again this appears to be the only recorded instance of the use of fish bone for artefact manufacture. Almost all bone awls and nose bones recovered during the present excavations at Motupore have been made from wallaby or other terrestrial mammal or bird bone. The use of fish spines for piercing ears is described by Landtman (1927) for the Kiwai Papuans, a use which may well have been more widespread since the practice of piercing ears and nasal septa was widespread amongst many coastal people. Although the practice of tattooing was widespread in the region, the authors were unable to locate any account of the instrument used, which might well have included fish bone points.

It is of interest to note that archaeological excavations which have centred round Port Moresby in the Central district, Yule Island towards the Gulf and Mailu Island in the south-east show a similar range of artefacts to those recorded ethnographically at the turn of

the century. Thus the history of such items would appear to be reasonably continuous throughout the area. With the paucity of current data only one major trend can be discerned, namely the replacement of *Trochus* shell arm bands by *Conus* shell in the later periods of the Yule Island investigations. Changing resource use in artefact manufacture during the prehistoric period remains an area of endeavour which has been little explored to date and which might be fruitful to future workers. Swadling (1977b) suggests that the same range of molluscan species have been utilised in the vicinity of Pari for the past 2,000 years. Unfortunately sufficient data are not available to state what changes have taken place in the species composition or abundance during that time.

CURRENT UTILISATION AND POTENTIAL DEVELOPMENTS.

The strong dependence of coastal populations on the utilisation of marine resources for food, exchange and other purposes continues today. However the realisation that some of these resources have economic potential has led to an increasing commercialisation of many traditional resources.

The lack of adequate surveys and the considerable problems of reporting subsistence fisheries catches makes any attempt at quantification hazardous. Highly variable estimates of annual landings have been made : 3,700 tonnes (Schuster, 1951); 30,000 tonnes (Filewood, 1972); 18,000 tonnes (Anon, 1972) and 10-15,000 tonnes (West, 1977). Kearney (1977) claimed annual village based harvesting yields 13,600 tonnes of reef fish with lesser amounts of river and estuarine fish, crayfish, molluscs and other species. All these figures represent total artisanal production for the country as a whole. Haines (1978/79) in a short term study of the subsistence fish catches of three villages in different habitat zones of the Purari River Delta estimated that 292 tonnes of fish, 146 tonnes of crabs and a comparable quantity of prawns were landed annually in the Baimuru Sub-District. Current rates of dugong and turtle utilisation have not been reported.

Traditional methods of obtaining these resources continue to be employed in most areas, supplemented by introduced items such as synthetic nets and lines, metal hooks, diving goggles, rubber powered spears and spearguns, underwater lights, pressure lanterns for night

fishing, poisons, outboard motors and small diesel powered dories.

The process of development along western style lines has resulted in a shift from reciprocal sharing and exchange which characterised the pre-contact situation to a gradual commercialisation of inshore marine resources. The effect of this has been to intensify the utilisation of some species such as mud crabs, lobsters, crocodiles, dugong, and turtles, some almost to the point of over-exploitation.

Commercial developments within the area can be considered in two separate sections, the inshore artisanal and the offshore commercial fisheries of the Gulf. The first development is characterised only by improved technological items of the kind discussed above and relies on direct sale of fresh produce or simple processing. The offshore fishery involves larger vessels, using sophisticated gear and processing, with the products directed to external markets. Production figures for the whole of Papua New Guinea are given in Table 2.

The important subsistence barramundi fishery has been extensively commercialised

TABLE 2. — FISHERIES PRODUCTION FIGURES FOR PAPUA NEW GUINEA. (Data from : Summary of statistics 1976/77, Bureau of Statistics, 1979).

	Year ended 31st December			
	1974	1975	1976	1977
Crustacea				
Prawns	668	417	872	900
Crayfish	340	174	290	233
Crabs	150	450	450	440
Fresh water crustacea	100	103	112	100
Fish				
Barramundi	400	89	222	210
Anchovies	1,000	750	980	1,801
Tuna				
Skipjack	40,630	28,891	24,471	20,220
Yellowfin	1,420	1,743	3,563	4,009 a
Miscellaneous				
Marine	5,000	15,000	15,000	15,000 b
Freshwater	10,000	11,000	12,000	12,000 b

Note: all figures are in tonnes.

a) includes minor tuna species

b) estimated.

through the major part of its range; the middle Fly, Daru coastal area and Gulf delta, this change coming since the introduction of floating gill nets in 1961. It is currently operating at close to its maximum sustained yield with an annual harvest between 200-250 tonnes (Anon, 1976). A major part of the catch is exported as frozen fillets, the remainder supplying the urban based internal market.

The major urban centres; Port Moresby, Kerema and Daru and minor administrative centres support markets for the sale of a diversity of marine resources. Filewood (1972) estimated that between 150-200 tonnes of marine produce pass through Port Moresby's Koki market with slightly lesser amounts passing through the other outlets in the town. Dugong and turtle are important market items at Daru, but depletion of stocks has occurred in Central Province (Moore, 1977; Hudson, 1977).

The lobster, *Panulirus ornatus*, is taken on the shallow reefs around Daru, Torres Straits and Yule Island, either by diving or snorkeling and spearing, with surround nets or at night using pressure lamps. The Daru fishery yielded 60 tonnes in 1975 and the Yule Island fishery 25 tonnes (Anon, 1976). The widespread mangrove crab *Scylla serrata*, has recently been made the basis of a small scale pilot venture based at Baimuru in the Purari delta (Stevens, 1980). During 1978 11 tonnes were hand caught for marketing in Port Moresby and the highlands (Opnai, 1980).

A village based crocodile farming programme, based on both species was instigated in the early 1970's following the rapid decline of the resource as a result of indiscriminate hunting. Of variable success, the history and status of the project is discussed in detail by Burgin (1980). Pearl farming at both Port Moresby and Samarai have been ongoing ventures, but production costs and possible pollution problems caused the closure of the Port Moresby farm in 1975.

In contrast to the above fisheries which are based on the monetisation of a traditional resource, the prawn and lobster trawling in the Gulf of Papua, which commenced in 1969, is based on a resource which was not traditionally exploited. It currently forms the basis of the second most import export fishery in the country yielding 750 tonnes of prawns (primarily the banana prawn, *Pennaeus merguensis*) and 526 tonnes of lobster (Wilson & Tatamasi, 1977). Incidental catches of squid, longtail tuna, mackerel tuna and miscel-

laneous trawl fish are also marketed internally.

A range of additional traditional resources with perceived commercial potential have been noted (Anon, 1976; Moore, 1977). These include the freshwater crayfish, *Cherax albertisii* in the extensive coastal swamp systems of the Western Province; the giant freshwater prawn, *Macrobrachium rosenbergii* which is widespread in fresh and brackish waters of the area; and the extensive mixed fish resource of the Purari-Kikori delta (Haines, 1979). However problems of the diversity of species and the concomittant issue of market acceptance, remoteness and the high cost of transport, maintenance of equipment and the complex issues of traditional fishing rights and ownership patterns must be given serious consideration before development can occur (Kearney, 1977).

DISCUSSION.

It is apparent from the foregoing that marine resources have and continue to play an important role in the lives and economy of the peoples living in this area. The range of techniques developed to exploit these resources, whilst it displays elements of commonality throughout the area, such as the wide distribution of plunge baskets and hand nets, also displays local specialisation and adaptation. For example the Motu developed strong nets for catching dugong while the Kiwai use a harpoon for the same species. Perhaps the most surprising feature of the technology associated with fishing in this area is the absence of the fish hook in the Motu and southeastern areas.

One might suggest that the fishing technology possessed by the Motu is one primarily adapted from estuarine and river fishing where nets form the dominant technique. The absence of all fish hooks, gorges and lures strongly suggests that the Motu are unlikely to have been derived from any island group to the East, or if they were then their departure from such an area predates the appearance of the fish hook technology which is widespread throughout the Massim and island Melanesia to the East. Allen (1977b) suggests that the Motu derived from the East some 2,000 years ago and arrived into this area as a specialised sea-faring people, bringing with them pottery and a predisposition to trade. The unique design of the Motu *Lakatoi* however, argues for an independent deve-

lopment of this craft at a later date than their initial arrival in the area. Certainly the technology associated with marine resource exploitation possessed by the Motu is a shallow water one which is far less well adapted for the reef and lagoon-environments in which these people are presently located than for example, is the Kiwai/Torres Strait's technology to the West, or the Trobriand islander's technology to the East.

Unfortunately many of these interesting questions are likely to remain unanswered since it will be apparent from this review that with the exception perhaps of the Kiwai/Torres Strait islanders, the technology and traditional knowledge of coastal people in this area has not been well recorded to date. Much of this knowledge is already disappearing in the face of western style education and development : thus the extent to which one group of people was, or was not adapted to the ecology of their area may well be unknowable in the near future.

An accelerating factor in this process of the attrition of traditional knowledge and practice concerning marine resources stems from the monetisation of subsistence species. This effect on fisheries resources has been extensively discussed by Haines (in press) and Johannes (in press) who suggest that the traditional systems controlling exploitation of marine resources, such as limited entry and the influence of village elders, tend to break down when resources are converted to cash rather than gathered for village consumption.

The influence of the Christian church must also not be overlooked; see for example the influence of the church on the decline of ceremonial tuna fishing at Pari village (Pulsford, 1975).

Population growth has also had, and will continue to have an increasing effect on marine resources use in this area. Changes in demographic patterns have resulted in the depletion of marine shellfish resources in some areas (Swadling, 1977a; 1977b) whilst the increasing demand for protein in the densely populated areas of the highlands Provinces of Papua New Guinea places further demands upon resources which are already showing signs of over-exploitation.

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SUMMARY

This paper provides a review of marine resource utilisation along the South coast of Papua New Guinea. The nature of the available resources and their distribution are reviewed. Traditional techniques involved in the collection of marine species, in hunting dugong and turtle, and in fishing for fin-fish are discussed. Certain techniques are found throughout the area, whereas others are restricted in their distribution and are indicative of local specialisation.

Traditional use of marine resources is discussed;

this includes the manufacture of various ornaments and artefacts, for food and for trade. Current and future exploitation is reviewed and it is concluded that the effect of monetisation of subsistence resources will place further strain on species which are already showing signs of over-exploitation.

RÉSUMÉ

L'auteur examine la nature, la répartition et l'utilisation des ressources marines de la côte sud de la Papouasie Nouvelle-Guinée. Il étudie les techniques employées pour la pêche traditionnelle, la capture des dugongs et des tortues. Certaines techniques sont pratiquées sur toute la côte, d'autres ont une localisation plus restreinte et sont le signe d'une spécialisation locale.

L'auteur analyse les diverses utilisations des ressources marines : consommation, objets d'échange, fabrication de parures et d'outillage. Il examine les conditions actuelles et futures de cette exploitation et l'auteur conclut que l'effet de la monétarisation des ressources de subsistance font peser un risque de disparition des espèces qui commencent déjà à montrer des signes de surexploitation.
