WORKSHOP SERIES No. 8

TRADITIONAL KNOWLEDGE OF THE MARINE ENVIRONMENT IN NORTHERN AUSTRALIA

Proceedings of a Workshop held in Townsville, Australia, 29 and 30 July 1985

Sponsored by the Great Barrier Reef Marine Park Authority and
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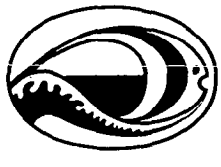

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EXECUTIVE SUMMARY

Aborigines and Torres Strait Islanders hunted dugong and turtles, fished and collected shellfish in the waters of northern Australia for thousands of years during which they accumulated an extensive knowledge of the natural history and behaviour of their prey, and ways to avoid over-exploitation of vulnerable species.

Much of that knowledge has been irretrievably lost since the advent of Europeans, and with the passing of each year more will be lost with the deaths of tribal elders. It is therefore important that surviving traditional knowledge of the marine environment be conserved, not only for the cultural identity of today's Aborigines and Islanders, but also for its possible relevance to the management of the north's marine resources.

A workshop was held in July 1985 to assess the status of traditional knowledge of the marine environment in Northern Australia. It was an unusual gathering, representing a variety of cultures, ways of life and professional interests. The workshop included traditional Aboriginal and Islander dugong and turtle hunters, representatives from Aboriginal communities in Queensland, the Northern Territory and Western Australia, commercial fishermen and their State and Commonwealth management organisations, anthropologists, biological scientists, and resource managers.

The objectives of the workshop were:

(1) to consider the nature and perceptions of traditional knowledge of the marine environment in relation to marine use and management;

(2) to review studies relating to Aboriginal and Islander fishing in Northern Australia, including those addressing traditional, biological and anthropological aspects of knowledge relevant to marine use and management; and

(3) to identify gaps in information and recommend possible areas of investigation relating to traditional fisheries (with special reference to information which may be lost by the deaths of elders).

The project was jointly funded by the Great Barrier Reef Marine Park Authority and the Commonwealth Department of Primary Industry, while travel and accommodation costs for Aborigines and Torres Strait Islanders were met by the Commonwealth Department of Education. The workshop was particularly fortunate in having as chairman Dr Eric Willmot, then Deputy Secretary of the Department of Aboriginal Affairs and a former Director of the Australian Institute of Aboriginal Studies, whose unique skills and experience held together this diverse group for two days.

The formal presentations fell into four subject areas.

Background academic papers on archaeology, anthropology and ethnobiology.

The scene was set by Professor John Campbell's review of recent archaeological research. The oldest evidence of freshwater fishing in Australia is about 35,000 years old, but evidence of marine fishing is lacking because the most recent Pleistocene Ice Age coastline remains hidden beneath the ocean. In North Queensland the oldest freshwater remains are about 18,000 years old, while the oldest marine remains, in Princess Charlotte Bay, are about 5,000 years old. Extensive stone fishtraps are found around Hinchinbrook Island.

The written records of Aboriginal maritime activities are similarly scant. A detailed literature review by Dr Kingsley Palmer identified four sources of information: the early European explorers and settlers; the writers who described Aboriginal society; the maritime anthropologists; and recent land-rights studies of Aboriginal sea tenure.

A history of Aborigines in Western Australia given by Dr Nicholas Green told of exploitation of coastal people by early pearlers, enforced resettlement into communities, and recent attempts to gain land and sea rights. Fishing remains important for the approximately 8,000 Aborigines living in coastal communities. Some are entering commercial fishing and the Bardi have established a trochus fishery. Traditional tenure to the sea was claimed in the unsuccessful Western Australia Land Bill.

The importance of studies of traditional fisheries for economic, political and management reasons, and the necessity to integrate biological and social studies was emphasised by Dr Robert Johannes. Traditional fishermen can be a rich source of information on the target species and their environment, for example, on the behaviour of dugongs and turtles, the spawning of barramundi, and migration of spiny lobsters. It was noted with concern that traditional knowledge is often no longer being transmitted effectively within cultures and is being lost when the holders die, making its recording a priority. Interest in biological/fisheries/social studies of traditional marine management has greatly increased in Asia and the Pacific in recent years.

Presentations by Aborigines and Islanders on the type of traditional knowledge held within their communities,

Established near Cape Direction on Cape York in 1924, the Lockhart River community still fishes on a semi-subsistence basis. Community representative Mr Isaac Hobson said that Cooktown salmon are caught by line, barramundi, stingrays, and a variety of reef fish are speared, crayfish are captured by diving, turtles and dugong are harpooned from dinghies, and various crabs, and shellfish are collected at low tide. The community's move to the new site away from the coast has made fishing and dugong hunting more difficult.

The Hopevale Community was established near Cape Bedford in 1886, but was relocatedduring World War II. The representative, Mr Lester Rosendale, said that mullet, shellfish and turtle supplement the normal diet, while dugong are an important festive food. The old dugong hunters manage the hunt, and instruct', younger members. The Great Barrier Reef Marine Park Authority has closely managed the taking of dugong, imposing a quota of twenty per year in 1985, but this was subsequently lifted as the quota was not met.

The Wujal Wujal community fishes mainly in Cedar Bay.' Mr Jimmy Johnson described how lines, cast nets and'traps are frequently used, and women undertake much of the fishing activity. Although turtles are hunted, dugongs a're not often taken as they are uncommon in the area.

The Yarrabah community near Cai'rns was founded in.1862. Mr Bryce Barlow told of the fishing seasons; shellfish and clams are taken in May and June,, turtle eggs are collected and turtle are-hunted in November and December, and dugong are hunted between December and March.

On Palm Island near Townsville fish and shellfish still form an important part of the diet although the fishing effort has declined, according to Mr Eric Bunn. The elders used to fish' at a semisubsistence level but it is more a recreational activity today. Efforts to establish commercial fisheries have not been successful. There was a general concern on stocks; the fish catch appears to have declined because of competition from the commercial fisheries and turtles and giant clams have 'been depleted by outsiders.

The Torres Strait communities have a more intact culture and rely more heavily on sea food. Mr Ephraim Bani described dugong hunting on Badu and Thursday Islands. The 'professional' (traditional) hunters - of which only a handful survive - possess an extensive knowledge of the behaviour of their prey, can differentiate the sexes, pregnant females, and those with calf. They are discriminating in their hunting, as opposed to the young 'amateurs' who use outboards.

On Murray Island, Mr Eddie Mabo said that turtles, clams, spiny lobsters, rock cod, grouper, mackerel, trevally, sardines and other fish are important food. However the fishing effort has declined since the cash store opened and obesity and diabetes are prevalent.

At Borroloola in the Gulf of Carpentaria, only four or five traditional dugong hunters survive, said Mr Graeme Friday. Dugongs are important in mythology, and the main dreaming sites are situated here. Green turtles are also commonly hunted, and eggs of all species are taken.

The Bardi community in Western Australia still rely on fish, shellfish, and turtles, while dugongs are occasionally taken. Traditionally many marine species were taken and people controlled fishing and hunting in their own territory. Much of the traditional knowledge is being lost, and the communityis willing to assist scientists in its documentation.

Studies on the usage of marine resources by traditional communities.

A biological study of the usage and the status of traditional knowledge of marine resources at Hope Vale was undertaken by Mr Andrew Smith for GBRMPA. About 160 Guugu Yimidhirr names for marine species were recorded and the identity and seasonality of the major types recorded. About one hundred turtles and sixteen dugongs were taken in 1985.

A comprehensive account of the traditional knowledge and use of marine species, and sea tenure of the Yolngu in Arnhem Land was given by Mr Stephen Davis. Traditional economics, rights and boundaries, annual patterns of movements, the calendar, commercial and subsistence exploitation and conflicts, and land and sea rights were described.

The rich and complex traditional knowledge of dugongs and turtles held by the Yanyuwa around Borroloola was outlined by Mr John Bradley. The detailed nomenclature relating to species, age, sex, external and internal anatomy, the migration and general behaviour, the techniques of hunting, rituals in butchering, the spiritual significance, and problems caused by incursions by outsiders were described in detail.

Dr Robert Prince focussed on the management issues raised by traditional marine hunting and fishing in Western Australia, the legislation relating to these activities, and the problems of Aborigines and Islanders fishing and hunting away from the traditional areas.

Studies by Dr Helene Marsh on the status and biology of the dugong indicate that they may live about seventy years, first calf at about 10-15 years, and bear every 3-7 years. They are prone to overfishing; no more than 2.5 per cent of females can be removed from a population each year. Dugongs are extinct or endangered over most of their former range and in Australia they are subject to many sources of man-induced mortality (traditional hunting, accidental netting etc). Torres Strait stocks cannot sustain the recent level of hunting, while the eastern stocks are more secure.

A paper tabled by Claudia Baldwin examined the cultural significance of the dugong in Australia, the need for management, information requirement, and the approach and problems of GBRMPA in their conservation.

The biology of turtles in the Torres Strait region was described by Dr Colin Limpus. Six species (of which the green is the most common) and two major nesting aggregations are present. Their biology is poorly understood but they are known to be very long-lived and nest erratically, at intervals of several years, making them prone to overfishing. About 10,000 are caught in Torres Strait each year. Taqged turtles from eastern Australia have been recovered from Indonesia, Irian Jaya, Papua New Guinea and the Pacific Islands, indicating the necessity for international conservation measures.

In discussion papers tabled at the workshop (1) Dr Carla Catterall examined the biological characteristics '(size at maturity, intertidal burying, subtidal populations, benthic mobility, pelagic larvae) of various species of intertidal shellfish and the patterns of exploitation which might make them prone to overfishing; and (2) Dr Ian Poiner described a study to assess the effects of prawn trawling on the subsistence. fishery in Torres Strait.

Gordon Anderson discussed ways in which the different life cycle' characteristics of three species subject to subsistence hunting (the saltwater crocodile, the green turtle and the dugong) may affect traditional hunters' perceptions of the distribution and. abundance of these species. Management implications were described. ,

Workshop commissions. ,

In the final session the workshop broke into five groups to consider key issue's raised in the presentations and draft appropriate resolutions. These are summarised below.

Marine demography

- It is necessary to collect catch data on traditional and other fisheries, the nature of the fishing effort, and stocks of the major species.
- Turtles, 'dugongs and barramundi require individual species management plans.
- Information on the usage of marine resources should be gathered from the Aboriginal and Islander communities in a short-term, coordinated program using an appropriate range of sampling strategies.
- The'program should be coordinated by appropriate State., Commonwealth and Territorial agencies.

Management principles

- Traditional knowledge is a useful shortcut to information valuable for marine resource management.
- As their importance has been demonstrated elsewhere in the tropics, more studies should be undertaken on'the subject in Australia.
- Traditional marine resource management may provide a useful framework on which to build contemporary management programs.

International action

- Australian stocks, of turtles and dugongs cannot be managed in isolation from neighbouring countries' stocks.
- Australian turtle and dugong stocks are of world significance.
- International cooperation should occur in management of common stocks, trade in products from these, and exchange of information on their management.

Education

A coordinating mechanism should be established to:

- address gaps in knowledge on traditional marine knowledge;
- improve dissemination of this information among Aboriginal and Islander communities, government agencies and the public; and
- prioritise the recording of endangered traditional knowledge.

Communication and planning

- An appropriate forum should have terms of reference to include planning of recommendations resulting from this workshop, and communication among interest groups.
- An expert committee, membership to be decided, should be appointed to plan and communicate future action in relation to a national research program in traditional fisheries. It should report to the sponsoring agencies, and through them to other interested parties.
- The mechanisms previously drafted for this purpose in the Commonwealth Government should be adopted, ie. the appointment of a coordinator, liaison officers from the state with the function of involving traditional communities, and a senior scientist (possibly from within CSIRO) to oversee the quality of the research program.

PART A

BACKGROUND PAPERS IN ARCHAEOLOGY, ANTHROPOLOGY AND ETHNOBIOLOGY

ROLE OF FISHING IN ABORIGINAL SOCIETY BEFORE EUROPEAN ARRIVAL IN AUSTRALIA

John Campbell

The ultimate origins of indigenous Australian fishing technology presumablylie in south-eastern Asia, the normally assumed centre of origin 'for Aboriginal Australians. Whether the various indigenous methods for fishing were further developed in, Australia or influenced by outside developments remains to be determined. Certainly a fair range of Australian Aboriginal fishing technology has probably been developed locally, as it is clear from other lines of evidence that Australia remained comparatively isolated from the outside world throughout most of Aboriginal prehistory.

Further, traditional Aboriginal knowledge of the marine environment in general in northern Australia was presumably actively added to from generation to generation in the early millennia of Aboriginal.adaption to Australia, as many aspects of the environment would have been different in detail from south-eastern Asia, even if many of the broad patterns would have been familiar.

Additional knowledge accumulation would have occurred with further adaptions to changing coastal, littoral and off-shore environments associated with the major changes in sea-level which took place right up to between about 8,000 and 6,000 years ago. In more recent times still other Aboriginal adaptations and what I would term 'techno-ecological' developments occurred, which we' can pick up directly in the archaeological record, such as the development of elaborate tidal fish trap systems.

One can argue that the initial human colonisation of Australia took place before about 40,000 years ago, but it is not at all certain how many subsequent phases of colonisation there might. have been before the arrival of Europeans in Australia. Some would argue that there were perhaps three or more phases of colonisation. Certainly, it is also clear that some sort of contact must have occurred at around about 5,000 to 4,000 years ago when the dingo was apparently first introduced to Australia from south-eastern Asia, perhaps via New Guinea.

Precisely how long Torres Strait has been occupied, or rather the Torres Strait Islands, remains to be determined, but some contact between Aboriginal Australia and Melanesia certainly occurred there within at least the last 1,000 years. Direct evidence for

fishing (both fishing in the usual sense and gathering of shellfish) in Australia, on the other hand, goes back at least 35,000 years at Lake Mungo in New South Wales, for instance.

NORTHERN AUSTRALIA

The role of fishing in Aboriginal economies in the late Pleistocene (or late ice age) in northern Australia is still not fully clear. No truly coastal archaeological sites are known yet for this time period, and any that might still exist would now be many metres under water and in most cases would probably be extemely difficult and expensive to find and excavate.

One promising area to look could be ancient caves or cave entrances at, say, 20 to 30 metres below present sea level in the Great Barrier Reef which itself is a massive limestone formation honeycombed with cave systems. What we do know about fishing in the late Pleistocene in northern Australia comes from inland cave sites which would have been even further inland at the time they were first used.

Two such sites in North Queensland are Colless Creek near Lawn Hill and Walkunder Arch Cave near Chillagoe. At both these ancient cave sites people camped under the rock overhangs and consumed freshwater mussels and fish which they had collected or fished in neighbouring creeks and waterholes about 18,000 to 12,000 years ago, incidentally at a time when much of inland Australia was much drier than it is now. In other words, we do know that people were definitely exploiting aquatic resources, and that they had the appropriate knowledge and technology to exploit littoral resources. In fact a number of southern Australian inland sites actually have marine shellfish remains which must have been carried quite some distance inland.

In the Holocene, or the last 10,000 years, we have an ever increasing number of archaeological sites in northern Australia with clear evidence for the exploitation of marine resources, especially as we come closer to the present. This is perhaps partly a result of the fact that the younger archaeological sites are often the better preserved and partly a result of the fact that sea levels reached their present level about 8,000 years ago and have been fairly stable since about 6,000 years ago.

Most of these archaeological sites with marine evidence are shell middens and mounds. Many of these have been found at, or very close to, the present littoral zone, but some have been found slightly further inland in areas where there has been a fair degree of progradation. These sites include evidence for exploitation of a wide range of fish and shellfish, as well as dugongs, turtles, crustaceans and the like.

The main areas which have been studied so far are in north-western Western Australia, parts of Arnhem Land, the western side of Cape York Peninsula especially around Weipa, the eastern side of Cape York Peninsuia especially round Princess Charlotte Bay, parts of the mainland coast near Innisfail and Ayr, and Hinchinbrook and Magnetic Islands. The northern tip of Cape York

Peninsula and some of the islands, of Torres Strait are now being properly investigated as well. In a brief review of this sort it is not possible to go into great detail on what is now known about all of these various parts of northern Australia. Instead I will concentrate on Princess Charlotte Bay and Hinchinbrook Island, both of which have now been radiocarbon dated.

PRINCESS CHARLOTTE BAY

Shell middens and mounds, occupied rockshelters with shell debris on their floors and dugong burials are all known from Princess Charlotte Bay. The first dated use of the area starts at close to 5,000 years ago and carries onvirtually to the present., Marine. resources there apparently varied in their abundance over time, and this may have helped to determine to one extent or another the size of local Aboriginal populations. Whether Aboriginal use of the area intensified during the last 1,000 years or so is a matter for some debate.

HINCHINBROOK ISLAND

Shell middens and mounds and elaborate stone-built tidal fish-trapsystems are known from Hinchinbrook Island. The first dated use of the area starts at about 2,000 years ago, though as with Princess Charlotte Bay, this age limit will probably be extended as more research is carried out. The fish traps. on 'Hinchinbrook were clearly very productive, and in fact some of these still operate virtually automatically, trapping fish and encouraging development on the spot of shell fish, and edible mangroves. It has been argued that they should be referred to as 'automatic-seafood retrieval systems'. At the time of initial contact with Europeans, Hinchinbrook Island apparently supported an entire Aboriginal tribe and had a number of semi-permanent villages. The case for intensified use of marine resources is perhaps even stronger on Hinchinbrook.

WORKSHOP DISCUSSION

The discussion covered the following points:

The fishtraps located on Hinchinbrook Island still work to some extent. Trapped fish survive from one tide to another.

It is possible that the traps were used all year (rather than broken at the end of the season), as they serviced a permanent population. The funnel traps were probably worked with baskets.

STATUS OF DOCUMENTARY INFORMATION ON ABORIGINAL AND ISLANDER FISHING AND MARINE HUNTING IN NORTHERN AUSTRALIA

Kingsley Palmer

INTRODUCTION

By comparison with the amount of information available on other aspects of Aboriginal society - social organisation, local organisation, material culture and Aboriginal religion for example - our knowledge of Aboriginal use of the sea is indeed poor. In many cases, Aboriginal groups who occupied coastal areas were not exclusively maritime people, since traditionally they moved across fairly large tracts of land that could include coastline, off-shore islands and hinterland. In addition, and particularly in northern Australia, Aborigines exploited marine resources in estuarine and tidal environments - sometimes many kilometres from the sea. Nevertheless, our knowledge of the economic activities of all these people remains limited. In this paper I discuss some of the reasons that lie behind this paucity and examine both the limits and the extent of the information that is available.

The lack of detailed information about Aboriginal people, as constituting a major maritime culture, is all the more surprising since coastal areas of Australia undoubtedly offered some of the richest and best living areas for people on the whole continent. The coastal areas were generally well watered, had abundant supplies of fish and other marine foods and provided routes for easy access along beach ways and the opportunity for transport by sea. Certainly northern coastal parts of Australia were well populated and it has been estimated that there were, on average, two persons per square mile in this region. However, in some southern coastal areas there may have been as many as five to ten persons per square mile (Maddock, 1974). Moreover, early explorers and settlers first encountered, and therefore described Aborigines in the coastal areas, while those inhabitants of the more remote and more arid interior were often not encountered by explorers and settlers until very much later in the history of colonial Australia.

The coastal Aboriginal inhabitants of Australia bore the brunt of the excesses of the settlers as well as suffering more than some of the interior dwellers from contact diseases like chicken pox and influenza. Thus, many of the coastal cultures were among the first to disappear from the face of the newly settled land. However, the absence of interest, in maritime cultures probably reflects a preoccupation of early explorers and later researchers who were more interested in other aspects of Aboriginal society. Research workers, and in particular, anthropologists, were taken up with matters that had to do with Aboriginal myth and religion, material culture and kinship and social organisation. Moreover, the students of the Aborigines were themselves, on the whole, from societies that stressed the importance of the land, and whose economic system was largely based upon the land. In the

absence of any diverse or comprehensive and capital intensive fishing industry or other complex process of marine exploitation, the European mind did not easily comprehend the Aboriginal utilisation of the sea, its economic importance and territorial component in Aboriginal culture.

We do not know for certain the exact date when Aborigines first arrived in Australia. It is, however, generally agreed that this probably occurred sometime about 40,000 years ago. Those early settlers, travelling as they did from the north or the north-west, arrived here by sea. They did therefore belong to a maritime culture and had the capability to traverse considerable distances over the sea in boats that were at least secure enough to offer them a passage that enabled them to colonize the . . continent. Although the sea straits were probably narrower than they are today, the voyages of these early settlers were indeed courageous. Blainey has traced the possible routes that these early voyagers must have taken and. noted that the widest gap that they would need to have traversed would have been at least 70 to 100 miles wide. (Blainey, 1975). Mulvaney (1975) has indicated alternative routes to New Guinea (which was then a part of Australia) - but the sea distances involved were sizeable.

The archaeological record is all too easily ignored when assessing our knowledge of the maritime cultures of Australia. A number of archaeologists have explored remains on offshore islands which indicate that Aboriginal people had lived in these maritime environments in times gone by. In particular Beaton (1978) has discussed the archaeology of the Great Barrier Reef. In Western Australia, Dortch (1984) has examined prehistoric stone artefacts on some of the offshore islands of Western Australia, and concluded that they provide evidence of occupation of the shelf prior to the rising of the sea. Also in Western Australia, Glover (1984) has suggested that the source for stone artefacts, found in the Perth basin, occurred in an area which is now inundated by the sea. In the Pilbara region of Western Australia, Lorblanchet has excavated shell middens and recorded rock art sites revealing details of a maritime culture in excess of 6,000 years old (Lorblanchet and Jones, 1980).

In this discussion of the status of documented knowledge about Aboriginal use of the sea, I divide the relevant data into four major categories. The first includes the comments and observations of the early explorers and settlers about Aborigines and their use of the sea. The second includes those writers who made a study of Aboriginal society in one form or another, but whose work had a particular material culture bias, and generally excluded any sociological or economic analysis. Third, there are those writers who have written on maritime cultures in one form or another and most of whom have been trained anthropologists. Finally, there is a growing body of literature which has emerged in the last eight years or so which concerns Aboriginal rights to the sea and their interests a'nd ownership of it. This literature has resulted from legal and political movements whereby Aboriginal people have sought to gain control and access to the sea and sought support from research workers in stating their claims.

THE EARLY EUROPEAN EXPLORERS

Just as the first Aboriginal settlers and explorers of Australia came by sea, so too did the Europeans. In fact, Australia was known as a continent by mariners long before any Europeans had attempted to settle the place. The first European explorers commented upon the coastal Aborigines they encountered. William Dampier, visiting the coast in January 1688 remarked:

> Their only Food is a small sort of Fish, which they get by making Wares of Stone across little Coves or Branches of the Sea; every Tide bringing in the small Fish, and there leaving them for Prey to these People, who constantly attend there to search for them at Low-water. This small Fry I take to be the top of their Fishery: They have no instruments to catch great Fish, should they come; and such seldom stay to be left behind at Low-water.. . In other places at Low-water they seek for Cockles, Muscles, and Periwinkles: of these shell-fish there are fewer still; so that their chiefest dependence [sic] is upon what the sea leaves in their Wares; which be it much or little they gather up, and march to the Places of their Abode.
> (Dampier, W. in Masefield, 1906)

By the beginning of the nineteenth century, when the pioneering settlement of 1788 had aroused European interest in the continent as a whole, a number of voyages of discovery took place. These consisted largely of attempts to circumnavigate the continent, mapping the topography, charting the seabed, and keeping an eye open for suitable harbours, places for future settlement and resources, and matter of interest to natural historians at the time. One such explorer was Nicolas Baudin who was Commander-in-Chief of the Corvettes Le Geographe and Le Naturaliste. The explorers were not interested in detailed ethnographic description, nor did they generally have the time or the opportunity to do more than navigate their vessels.

> Until then, we had not seen a single one of the natives of the country, but as we landed, we saw one up to this waist in the water, busy spearing fish.
> (Baudin, 1974)

The illustrations that were produced at the time of the Baudin expedition are perhaps more informative - telling us something of the way Aborigines fished using nets as well as spears and had a variety of vessels, including dug-out and outrigger canoes. Baudin also records that the Aborigines were jealous of their land in the face of the encroaching foreigners:

> But as he continued to advance, the natives began to shout violently, signalling us to go back. As his signs were in the direction of the ships, we were in no doubt at all as to what he was saying to us.
> (ibid.)

Later accounts by early settlers also contain many references to the Aborigines in coastal areas. However, most of them give us little more detail than a descriptive account, of the material culture of the Aboriginal people living by the sea, their use of fish traps, and in particular their utilisation of canoes.

THE EARLY ETHNOGRAPHERS: MARITIME MATERIAL CULTURE IN AUSTRALIA

Poor though our information may be in general on Aboriginal use of the sea, the literature on canoes is extensive. Maybe the exotic nature of a dug-out or bark canoe captured the imagination,, of early ethnographers. Whatever the reasons were, we probably know more about this aspect of the coastal Aborigines! material culture than any other facet of their maritime affairs. What we do not know so much about, however, are issues of ownership,, co-operation, trade and prestige associated with canoes, canoe making and canoe owners.

Matthew Flinders, who sailed the northern coasts of Australia between 1801 and 1803, was probably the first to note the use of canoes by Aborigines in Australia,.but it was left to later writers to differentiate their types and use. E.M.. Curr, writing in 1883, noted details of canoe building, as well as their use in hunting and fishing by coastal Aborigines. Curr was probably one of the first enthnographers to document accurately this aspect of material culture (Curr, 1886). Radcliffe-Brown, better known for his studies in social anthropology, wrote of the rafts of Western Australia (Radcliffe-Brown, 1916), while the Frobenius Expedition of 1938-9 documented a variety of watercraft, including dug-out canoes, bark canoes and rafts (cf. Lommel, 1952). Another significant writer on watercraft in Aboriginal Australia was J.R. Love, who described their use amongst the Warora in northern Australia in his classic work Stone Age Bushmen Today (Love, 1936).

Apart from the log rafts of Western Australia, the canoes of northern Australia fall into two types: bark canoes and dug-out canoes. The former were made from a single piece of bark prised from a tree and gathered at the end to form a bow and stern. These canoes were serviceable especially on inland waterways like the Arafura Swamp. The canoes required constant repair and had to be caulked with grass and mud. They were discarded,at the end of the season. Thomson, observing these canoes in Arnhem Land in the 1930's, recorded in detail their manufacture and use for goose egg collection (Thomson, 1983). The people with whom 'he' lived and worked also had access to the dug-out canoe,, which was more seaworthy and allowed access to offshore islands, and permitted their navigators to traverse coastal waters. The dug-out canoes were, however, more complex to build than the bark canoes, involving a greater degree of co-operation and were very heavy, but had the advantage of lasting much longer (Jones and Meehan, 1977).

The Aborigines on Cape York used an outrigger canoe, also constructed from a hollowed out log. The advantage of extra stability made it superior to the dug-out used without an outrigger, and it probably owed its genesis to the influence of the Torres Strait Islanders and Papuans to the north. Some

writers have noted that the dug-out canoes of northern Australia had their origins in the island of Celebes, from whence the Macassans came to exploit the rich shallow trepang beds of the northern Australian coast. The trepang or sea cucumber was a much prized delicacy which Macassan traders exported as far as China. The Macassans left their dug-out canoes with the local Aborigines - in part as payment for what they took. The Aborigines themselves, no doubt, copied the style of the canoes from the Macassans from whom they also learnt about steel knives, steel fish hooks, pottery vessels and alcohol (Macknight, 1976; Thomson, 1949; Warner, 1969).

Other papers and notes of ethnographic interest proliferate. The library at the Australian Institute of Aboriginal Studies in Canberra has literally hundreds of brief references to canoes, fishing techniques, fishing with nets, fish hooks, spears, fish traps, turtle hunting, the collection of turtle eggs, dugong hunting, the making of dugong ropes and so on. Yet despite this quite extensive literature on how Aborigines utilised the seas, we are left largely in the dark as to what social processes were involved, and what were the interactions and exchanges that characterised this economic and social activity.

The overall impression of these earlier writers is then - with very few exceptions - of a descriptive account of Aboriginal uses of the sea with little or no analysis. Not that this work is in itself of no account. It provides a useful insight into the operations of coastal people in Australia. However, it has limitations when compared with the work of anthropologists who tried to link coastal Aboriginal material culture with their lifestyle, attitudes, beliefs and the ways in which their societies were changing.

ANTHROPOLOGICAL RESEARCH IN MORE RECENT TIMES

One of the pioneers of modern anthropological studies in northern coastal areas of Australia was Lloyd Warner, who wrote in 1937 A Black Civilization. This book describes the Murngin (generally called the Yolngu) of north-east Arnhem Land. Although Lloyd Warner studied a group who lived on the coast, his interests were focused on local and social organisation, kinship and totemism, with only a passing interest in economic activity and transport (Warner, 1969). However, Warner did pay detailed attention to matters of social change and the influence of the Macassan traders (ibid.).

Thomson worked in east Arnhem land, particularly 'round Blue Mud Bay in 1935 and 1937 and wrote of the effect the Macassans had on the ceremonial exchange cycle of the region (Thomson, 1949). Thomson had also visited Cape York, where he documented dugong hunters, fishermen and the culture of a coastal people in detail (Thomson, 1934a, 1934b, 1956). F.G. Rose, writing in 1961, discussed the effects of the introduction of the dug-out canoe on the economy of Groote Eylandt, where he worked in the 1950s. Warner, Thomson and Rose stand out from other writers of this period. They were certainly more interested in matters of social change, interaction, social structure and culture rather then simply describing fishing techniques, canoe manufacture and associated technologies of the coastal people.

By the time David Turner visited Groote Eylandt in 1969 'the changes wrought by modernisation on the island were quite apparent. In his book Tradition and Transformation (1974) he notes the way this island culture had altered as mining, mission and modern technology had replaced more traditional institutions. The photograph on the book's cover is'fitting: a dug-out canoe with an outboard motor (Turner, 1974). Despite this, little work has been done on the effect that such thing6 as aluminium dinghies, "Mercury," outboards and modern nets have had on indigenous economic systems, local political control and technology. Moreover, as the years passed and the traditional forms of activities declined, little was written'on the changing pattern of the maritime exploitation and the uses the Aboriginal people made of the sea in the context of their changed social and technological circumstances. The effects of 20th century technologies on dugong, turtle and other populations has received scant attention, but has been addressed in a paper by Chase,, (1979).

Turner was not alone in developing anthropological studies of change in northern Australia. Other workers had developed an interest in Aborigines' conception of the sea, not merely as an economic resource or as a means of transport, but as a spiritual reality which took its place in their belief system. This aspect of Aboriginal religious belief has received less attention than Aboriginal beliefs about the land - a matter that informs the writings about Aborigines and the land from quite early on.

In 1970 R.M. Berndt wrote a monograph titled The Sacred Site: The Western Arnhem Land Example, in which he documented the spiritual beliefs Aborigines held about the sea, the straits, reefs and offshore islands. Although Berndt did not specifically address the issue of maritime cultures per se, he introduced a new ingredient into the study of coastal people that was to have significance later on. Moreover, it was an aspect of Aboriginal religious belief that had remained largely undocumented. In 1976 Berndt published an account in which he documented in detail the ownership of both islands and adjacent seas in north-east Arnhem Land. He demonstrated how it was that the mythological beings of the creative era of the Dreaming traversed both land and sea and so ordained the clan territories and sacred sites of the local Aboriginal people (Berndt, 1976a).

Other work by R.M. Berndt and his wife C.H. Berndt included Man, Land and Myth (1970), a study of the inland Gunwinggu people of western Arnhem Land which also included reference to coastal people with whom they had also worked. Like Warner, the Berndts were interested in social anthropology, but unlike Warner they included a chapter on economic utilisation of the environment; including comments on the economic relationships that the Gunwinggu had with their maritime neighbours. R.M. Berndt's Love songs of Arnhem Land (1976b) includes many songs collected from coastal people, thus extending our knowledge of' the diverse and complex cultures of these people who lived with the sea.

There were other studies undertaken which also helped to contextualise our knowledge about coastal people. For example, J. Altman wrote of the riverine and estuarine Gunwinggu in western Arnhem Land and provided detailed data on marine species. Altman also discussed the significance in economic, social and cultural terms of the exploitation of marine species (Altman, 1982). Jeffrey Heath, a linguist, working in south-east Arnhem Land, has produced a variety of texts in the local language which contain a rich variety of references to the use of the sea. Heath's work shows the complexities of a language evolved by a maritime culture (Heath, 1981).

Other researchers have also contributed to our knowledge of Aboriginal use of the sea in more recent times. In particular Betty Meehan has written a definitive account of the use of shellfish and other marine foods by a group of Aborigines with whom she worked in northern Arnhem Land (Meehan, 1982). Anderson (1982) describes in detail a maritime economic system in north Queensland. Peterson (1973) has studied camp site locations amongst coastal people. There have also been studies of seafood and diet undertaken by O'Dea and Sinclair (1982) carried out on the Kimberley coast in Western Australia. In addition, Crawford (1983) has written on Aboriginal exploitation of marine resources in the Admiralty Gulf area of the Kimberley region. Ohshima (1983a, 1983b) has studied the ecological and cultural diversity in Torres Strait in a comparison of Australia and New Guinea cultures, as well as producing an account of land use and sea surface use amongst maritime people. Other research, largely unpublished, has been carried out by Fisher (1984) on Aboriginal Customary Law, while Kathleen Pope, continuing the tradition of' an interest in material culture, analysed materials collected from Cape York Peninsular from the Roth ethnographic collection at the Australian Museum in Sydney. This included much work on outrigger canoes (Pope, 1967).

Although there has been a number of modern studies relating to coastal Aboriginal people, most of these reflect mainstream trends in Aboriginal anthropological studies, rather than specifically being interested in maritime cultures for their own sake. Thus, writers like Williams (1982), Reid (1983), Keen (1978), Sutton (1978) and von Sturmer (1978), Clunies Ross and Hiatt (1977) have all provided important data on coastal people, but the focus of their research has not been upon a maritime culture.

Other writers have commented upon Aboriginal proprietorial interests in the sea that form a part of their territorial estates. Chase (1980) documents ownership of the seas in eastern Cape York, concluding incidentally that the main Barrier Reef, some thirty kilometres off-shore was unknown before lugger employment (ibid.). Chase and Sutton (1981) also describe Aboriginal ownership of the seas in the region of the Lockhart Community. Davis (1983) presented detailed data concerning territoriality and use of the seas in northern Arnhem Land where he also worked as a school teacher. However, as our knowledge of Aboriginal culture and society has broadened with the increase in anthropological work, particularly during the last twenty years, so too has our understanding of the peoples who have lived

adjacent to the sea. Nevertheless, it is true to say that there is no single work which has focussed on an Aboriginal group as a maritime culture, and attempted to develop understandings about that culture in terms of their relationship to the sea in economic, ritual, social and environmental contexts.

LAND RIGHTS AND SEA RIGHTS:, A NEW DIRECTION FOR ABORIGINAL' RESEARCH

In 1973 Justice Woodward undertook a Commission of Enquiry into the possibility of establishing Aboriginal Land Rights in the Northern Territory of Australia. Woodward took evidence from a variety of people, including a number of Aborigines living on settlements around the Northern Territory and in Arnhem **Land.** While listening to Aboriginal aspirations about their land and indeed about their seas, he came to understand that Aboriginal Land Rights need necessarily include Sea Rights. He wrote:

> I accept that Aborigines make traditional claims to most, and probably all, off-shore islands. Their legends link those islands with the mainland because o,f the passage of mythical beings from one to the other. The effect of this is that the sea between also has significance. Certainly Aborigines generally regard estuaries, bays and waters immediately adjacent to the shoreline as being part of their land.
> (Woodward, 1974)

However, the Federal Land Rights legislation as it was passed in the Northern Territory in 1976 did not provide for ownership of the seas, but it did make provision for reciprocal legislation of the Northern Territory in relation to the making of laws, "regulating or prohibiting the entry of persons onto, or controlling fishing activities in, waters of the sea.....within two kilometres of Aboriginal land". (Aboriginal Land Rights (N.T.) Act 1976, Section 73.1.d). The Northern Territory Aboriginal Land Act 1978 was enacted to fulfil this requirement.

The details of the Northern Territory Aboriginal Land Act and the cases mounted before the Northern Territory Land Commissioner as a response to it are beyond the scope of this review. However, the Act and the resultant "Sea Closures", as they are somewhat misleadingly called, have been significant for two main reasons. First, research was carried out on behalf of Aboriginal people (and the Land Councils representing them) in which the interests of the Aboriginal people were considered first and those of the academic community second. This meant, that there was a change of emphasis and focus on the part of researchers. Moreover, the sea, the littoral zone, off-shore islands, reefs and marine resources became the focus of a detailed investigation. Perhaps for the first time studies were produced examining Aboriginal uses of the seas, their territorial inclinations, reliq'ious beliefs and economic exploitation of a maritime environment as a whole. Second, therefore, there has emerged over the years since the introduction of Land Rights in the Northern Territory a growing body of material (most of it remaining unpublished) which has to do with Aboriginal use of the sea.

Memmott (1977) wrote on the ownership of the seas in north-east Arnhem Land for the Joint Select Committee on Aboriginal Land Rights in the Northern Territory. Also at this time both Keen and Morphy made separate submissions to the Select Committee, and Meehan commented upon the role of seafood in a contemporary Aboriginal society (see Keen, 1977; Morphy, 1977; Meehan, 1977).

The bulk of the material which has emerged from the Aboriginal Land Rights Act in the Northern Territory is available in the form of "Sea Closure Application Books" or "Land Claim Books" lodged with the Northern Territory Land Commissioner. A review of the "Sea Closure" procedures in the Northern Territory was produced by Keen (1985), and an account of Aboriginal ownership of the seas and adjacent land was written by Palmer (1985). Some of the "Land Claim Books" contained material relevant to Aboriginal use of the sea. These included reports by Avery and McLaughlin (1977) and Bern and McLaughlin (1980).

The first Sea Closure under the Aboriginal Land Act was at Milingimbi (Dreyfus and Dhulumburrk, 1979) followed by an adjacent area known as Howard Island and Castlereagh Bay (Davis, 1982). The work of these researchers provided a wealth of detailed data on Aboriginal use of the seas. The Sea Closure process is not without its critical component - both legal and anthropological - and comments on the applications provide valuable additional reading (Keen, 1980, 1983; Aboriginal Land Commissioner, 1981).

There have been three other Sea Closure applications lodged to date; one for Groote Eylandt, one for Croker Island in western Arnhem Land and one for Bathurst and Melville Islands. All three are as yet unheard (Palmer, 1984; Palmer and Brady, 1984). Toohey in his review of the Aboriginal Land Rights (N.T.) Act (Toohey, 1984) briefly considered the Aboriginal Land Act and noted that the powers of the Commissioner should be strengthened under the Act consistent with his powers under the Aboriginal Land Rights Act.

The interest in sea rights in the Northern Territory extended to Western Australia when consideration was being given to Land Rights legislation in that State. Seaman, the Commissioner of the Aboriginal Land Inquiry was asked to consider the extent to which waters adjacent to Aboriginal land should be protected. He noted the considerable evidence he collected from Aboriginal people and their interest in the sea (Seaman, 1984). Al though the Western Australian legislation floundered in the Legislative Council of that State, the process of producing the draft Bill did at least contribute to our knowledge of Aboriginal attitudes to the sea in the northern areas of Western Australia.

CONCLUSION

In this review of the status of our knowledge of Aboriginal use of the sea I have outlined much of the literature, both published and unpublished, available to us. I have also attempted to trace a trend which reflects something of the history of Western intellectual endeavour over the last 200 years or more in Australia. The hallmark of much early commentary was

ethnocentric curiosity made with respect to an alien and at times distant culture. Later observers were intrigued with the curio value of what they saw and observed. However, they generally omitted reference to the social fabric and complex network of relationships and interactions that gave birth to the material culture they described. Indeed, some early observers regarded the Aborigines as a "primitive" race whose material culture they considered to be simplistic and a reflection of the Stone Age. From this limited view, later scientific enquiry made considerable progress towards understanding the structure and composition of Aboriginal society and in characterising it as a functional and complex system. However, this enquiry was still often constrained by the pre-occupdtions of western anthropological tradition - Aboriginal religion, totemism, social organisation, kinship and marriage. With very few exceptions (Meehan, 1982; Berndt, 1970) a broader understanding of Aboriginal relationships (both spiritual and economic.) with a coastal domain were not a matter for detailed consideration by anthropologists.

The paradigm shift that resulted in a radical change in our appreciation and understanding of coastal peoples took place with the development of the need to understand in our own legal as well as social terms, how Aborigines on the northern coasts lived, owned and comprehended the land and sea about them. In this new era data have been collected, presented and analysed from an altogether new perspective that has a history of less than ten years. It is to this new literature that we must turn if we are to become properly informed about the ways in which Aborigines use and understand the sea today. However, this should not be done at the expense of neglecting earlier sources and the work of those researchers who have provided us with detailed accounts of coastal people in the past. Our knowledge should be cumulative and our interests ecumenical - so as to avoid the narrow perspectives that have so limited the understandings of some of our predecessors.,

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ABORIGINAL AFFILIATIONS WITH THE SEA IN WESTERN AUSTRALIA

Nicholas Green

FIRST CONTACT

European exploration of Western Australia was initiated by the need to locate new areas for economic ventures including pearling, whaling and pastoralism.

One of the first areas 'to be explored was the Dampier Archipelago, on the, north-west coast, and it was here in February 1818, that Phillip Parker King intercepted three Aborigines paddling long vessels or 'marine velocipedes' near Goodwyn Island (King, 1969). F.T. Gregory subsequently explored the region which resulted in the first settlement being established in 1863 at Tien Tsin, later to be known as Cossack. Roebourne was established soon after and became the centre of government in the area.

In 1865 Europeans started to exploit the rich pearl shell beds in Nickol Bay and by the 1870s these easily accessible pearl banks were exhausted. The pearling industry focussed its attention on the deeper waters of Flying Foam Passage and as far south as Shark Bay and north to Derby. Local whaling bases, in conjunction with pearling settlements became widespread in the Archipelago. The metropolitan newspapers of the 1870s reflected their profitability. The government representative, R.J. Sholl, wrote in 1873 on a visit to Flying Foam:

> "At the time of my visit there were engaged in the fishing 24 pearl boats and 47 smaller boats,' including dinghies etc. The industrial population consisted of 500 of whom 67 were white men and the remainder natives and Malays. There were, onshore, some 50 natives comprising old men, women and children. "
> (Sholl, 1873).

Pearling fleets were operating from Roebuck Bay and King Sound in the Kimberley at this time. Interactions between Aboriginal people and the European-Asian pearlers often had disastrous consequences in terms of social impact. Aboriginal people we're recruited as labour on the pearling fleets. The Lacepede Islands were used as a depot where Aboriginal people were kept prior to being sold to pearlers further down the coast (Green and Turner, 1984).

By 1868 there were, according to Sholl, 60 natives and'30 whites employed on the pearling'boats in the Dampier Archipelago. By 1869, Aborigines were in great demand as divers, as exemplified by R. Thatcher; "Already hands are scarce and the much depised natives eagerly sought after." (Herald, 25.12.1869)

The methods used to "recruit' Aborigines for pearling often turned sour and consisted of kidnapping and mistreatment, sometimes murder (Runt, 1978.). Perhaps it was this attitude

which led to the murder of a policeman, his assistant and two pearlers by Aborigines in 1868. The end result of this incident was that Aborigines were relentlessly persecuted.and shot by the settlers. D. Carley wrote that:

> "It is very well known about Nickol Bay and the Flying Foam Passage, that on one day there were quite sixty natives, men, women and children shot dead. The natives showed me the skulls of 15 who were shot dead. Three of the skulls were those of children, and two of these small skulls had bullet holes in them." (CS03679/86).

The wrath inflicted upon the Aboriginal inhabitants of the Dampier Archipelago was so severe that there are no accounts of Aborigines living traditionally in the area after 1868.

The development of missions in the Kimberley was aimed at preventing similar situations from occurring. The coastal Worora people were first affected by Europeans with the attempted settlement of the Camden Harbour Pastoral settlement in 1864. In 1912 a Presbyterian mission was established at Port George IV inlet, but by 1916 the mission had shifted to Kunmunya. The principal reason for this move was to remove the Aboriginal people from what the missionaries saw as disastrous liaisons between the Aborigines and the crews of pearling luggers (Green and Turner, 1984). By 1949, with pastoral stations occupying almost all of the Aboriginal land in the north Kimberley, Worora, Wunambal and Ngarinyin people lived in two major mission settlements, Kunmunya and Munja. Some people had travelled to Kalumburu and the Forrest River Mission (Oombulgari) prior to this period. The former people moved eventually to Wotjalum and thence to Derby to be resettled at Mowanjum.

The history of the Dampierland communities is strikingly similar. These coastal dwelling people were exposed to a wide range of effects from Aboriginal-European contact. Pastoralists took control of the well-watered lands to the east, displacing the Aboriginal people who fled to the coast. Interactions between Aboriginal people and the European-Asian pearling crews often had disastrous consequences.

Father Duncan McNab arrived on the western shore of King Sound in 1885 to establish a mission at Disaster Bay. The mission was short-lived, but it introduced Aborigines to missionaries, whose aim was to protect the Aboriginal people from the exploitation of pearlers, pastoralists and miners. Missions were to have a lasting impact on the lives of the Dampierland people, with missions being established at Beagle Bay in 1890, Lombadina in 1892 and Sunday Island in 1899. When the Sunday Island mission closed in 1957 the Bardi were moved to Derby where they stayed until 1967. The time spent in Derby for the Bardi and Djawi people of the Buccaneer Archipelago, was a time of great unhappiness. Living on a town reserve at the edge of the salt flats, many people were for the first time exposed to alcohol and boredom. The lack of fish (the previous dietary staple), the number of sandflies and mosquitoes, inadequate housing and being away from their traditional homeland, promoted their move back to Sunday Island in 1967, and then to One Arm Point in 1972.

EARLY OBSERVATIONS OF COASTAL ABORIGINES UTILISING MARITIME RESOURCES

There are widespread records of Aboriginal people utilising maritime resources in Western Australia. I will briefly mention some instances here to 'provide a general overview.

In the south-west'of,Western Australia, Aboriginal people tended to utilise the lower reaches of estuaries for collecting fish. These people had no form of water transport and confined their actitivies to the sheltered embayments and rivers. 'It appears that certain, restrictions were placed on the procurement of particular fish species. Whales, however, 'were exploited by Aborigines.taking full advantage of 'strandings by Sperm and False Killer Whales, whereby people would gorge themselves on the meat. Seals were dealt with in a similar way. Meagher and Ride suggest that the absence of seal colonies on the south-western mainland coast today and their presence on the offshore islands may be linked to the former predation by the Aborigines (Meagher and Ride, 1980).

Early accounts of the Marduthunera, Ngarluma and now the extinct Yaburara people in the Dampier Archipelago, reveal the preparation of mangrove seeds by boiling them in conch shells prior to removing their toxic properties by leaching (Harper, 1886; Hall, 1971; Bates, no date). Descriptions are given of spearing turtles by using short stabbing sticks (Stow, 1981). The use of nets appeared to be widespread among these coastal, people. A net from Nickol Bay exhibited in Perth in the 1880s measured 27 by 3 feet (Inquirer 23.2.1887). These nets were made from spinifex and there were different types utilised for different purposes. One described by Ridley in 1863 was funnel-shaped, and others resembled small stake nets made up of a two-stranded twine (Ridley, 1863). The use of drag nets from rafts offshore was also common.

People gathering for ceremonial purposes on islands, or to exploit resurces such as turtle eggs in the breeding season, necessitated inter-island voyaging. There were several accounts of the log rafts used in the Dampier Archipelago by the Aborignal inhabitants. King described in detail rafts comprised of two or three short mangrove logs tied together and being propelled by paddling with the hands (King, 1969). There are also inferences of the use of inflated turtles tied together as one man rafts (von Brandenstein, pers.comm., 1981).

The Wumambal and Gambre people in Admiralty Gulf exploited the islands and the reefs to the north and took particular, delight in boating skills and in the harvest of the sea (Crawford, 1983). The coastal Worora were in a similar situation, although the larger islands were permanently inhabited, as were the Montgomery Islands and the Sunday Island group (Crawford, 1983).

In discussing the Bardi people of One Arm Point and Lombadina, it is pertinent to note that the traditions and views observed earlier this century by people such as Elkin (1932) and Worms (1952), still hold true. today. The Bardi and Djawi travelled along the coast and.island-hoppe'd on mangrove wood double rafts.

The wood for the rafts being located only in restricted localities, special journeys of great distances were made in order to harvest suitable wood. Family groups often travelled on the one raft and groups of families travelled together from one locality to another.

Baler shells were used to carry water on these long voyages. Neap tides were the optimum tides used to island-hop, with people planning their voyages around their comprehensive knowledge of the currents and winds.

The Bardi and Djawi believe that ancestral beings travelled the seas and created the islands, reefs, sandbanks and marine species found within the sea. The adventures of these ancestral beings are recalled in song and story. The beings named all the features in the environment includng particular places on the seabed where certain ritual activities occured which, in some cases, resulted in rituaf paraphernalia being left behind metamorphosing into particular marine features. Rituals were carried out by these ancestral beings from the north through the islands where certain named ritual sites were located. These rituals passed through the Dampierland Peninsula and travelled south along the coast to Broome, La Grange and south-east into the interior.

CONTEMPORARY USE OF THE SEA AND ITS RESOURCES

Aboriginal people resident in coastal communities tend to utilise marine resources of one form or another. Large regional centres such as Geraldton and Carnarvon have a high number of resident Aboriginal people, most of whom tend to be immigrants from inland areas. Some of these people fish for purely social reasons as well as economic ones. Onslow, Roebourne and La Grange are similar in the marine exploitation patterns. The methods used tend to be localised and on a small scale, supplementing people's meat-based diets.

Other centres, such as Broome, tend to be made up of coastal Aboriginal people. These people rely heavily on sea resources as these make up their traditional and preferred diet. People in Broome often spend a great deal of time netting and catching fish. In this area, fishing plays an important role in strengthening ties to the sea as well as providing an emotional outlet. There are approximately 8,000 Aboriginal people living in coastal communities in the central and north-west division, according to the 1981 government census. A large proportion of these people, especially those residing at Broome, Beagle Bay, Lombadina, One Arm Point, Kalumburu and Oombulgari, spend time exploiting marine resources.

The Bardi community at One Arm Point is the community that I would like to concentrate on for the remainder of this discussion. People in the community, which numbers approximately 140 adults divided into seven clan-based residential groups, spend a great deal of work and leisure time exploiting their rich coastal environment. I have already mentioned that the Bardi traditionally used the sea including the islands, bays, estuaries, tidal mudflats and reefs for a range of food gathering and ritual activities.

Fish, dugong and turtle are preferred dietary staples, with beef playing a 'lesser role in the Bardi diet. Older Bardi people reveal an acute awareness of environmental factors which may affect the procurement of marine species. There is an understanding of the tides, the times of resource availability and the characteristics of the species being hunted. One example of Bardi environmental awareness is reflected in how they divide up their seasons, which relate closely to prime times for exploiting particular marine resources, for example:

Barlgana albubur: March-April when the south-east wind starts and marks the beginning of the dry season.
Niyarda barlgana: May-August, the 'middle of the south-east wind when strong winds occur and the Dugong season starts in Mangala (July).
Djalalay: August-September, the south-east wind finishes and the westerlies start, the dugong season ends.
Lalin: October-December; westerly winds become strong. the weather becomes hot, married turtle. time and ceremonies start.
Djandjala Balburgin: December, rain clouds come from the north.
Ungulgul: December-February, north-west wind blows, rainy season, married turtle season ends in January.

The knowledge of the seasons reflects the type of resources available for exploitation. The case of the green turtle, the main species hunted at One Arm Point is one example concerning this knowledge. The most productive period for hunting kulkil (turtle) is at low tide, at the beginning of Lalin, or at married turtle time. This is the time when turtles are mating and are found floating on the surface of the water and they tend to be quiet and not easily disturbed. They are also referred to as being 'fat' at this time, although turtles are generally hunted all year round.

Only men hunt turtles due to the ritual connotations associated with the procurement of this marine reptile; women and children often catch small turtles at low tide on the exposed reefs, in the tidal channels and lagoons (Green and Turner, 1984). Once a turtle has been harpooned, there are rites concerned with the butchering and distribution of the meat. Each anatomical feature of the turtle has a specific name, and some of these names also have ritual connotations. 'Fat' turtles are highly prized and are commonly hunted in specific locations offshore. Ritual places on the land are used both as viewing platforms to observe turtles prior to hunting, and also as increase centres where rituals are performed to ensure an adequate supply. Despite the abundance, of turtles in the area, people generally take only enough to satisfy their immediate family requirements.

Different locations provide different marine resources. For example, Wanburura is a stand of mangroves on the east side of Ring Sound. This is one location where the Bardi people collect wood for rafts. The nearby island Djanuwan is used for constructing the rafts as it is a good camp and also provides turtle eggs in season. Mayunlambuli is a dugong hunting area.

Biyana is a shelling ground for alngay (trochus), while Milbugaran is a campsite and is also a place for observing married turtle, as is Mirlimirl. Ungalgun is a reef for gathering alngay. Muruldullum is a nesting ground fo'r sea birds, and eggs.

are collected there in season. Raluralu has married turtle, a good camping area and fresh water, etc. Thus the Bardi view of their world reflects these prime locations for exploiting marine resources located in each estate or Buru.

Cultural restrictions also apply to the hunting of dugongs. It is believed that dugongs were once human and ritual songs and stories corroborate this belief. Before a dugong was butchered the hunter would draw lines upon the carcass in charcoal accordng to traditinal patterns. Ritual songs were sung as the dugong was butchered. The portions of meat were then distributed to persons in various kin relationships to the hunter. This practice has ceased, much to the dismay of the older Bardi men at One Arm Point. They see a need to keep these traditional practices alive in their community. The south-east wind brings the dugong into the waters surrounding Dampierland where they apparently stay for three months before returning to areas in the north-east.

People in One Arm Point have travelled up to sixty kilometres to hunt dugong in seas which do not traditionally belong to them (Green and Turner, 1984).

Marine species are named and additional names may be given to fish species at specific times in their life cycles. These names also have, in some cases, ritual connotations. As with turtle and dugong, a complex system of taboos applies to the catching, distribution and consumption of certain species of fish. Some marine species have mythological connotations and are linked to celestial features.

Today there are several examples of commercial exploitation by the Bardi people of their marine resources. Some of these ventures have been successful whilst others have not. The Bardi community has been issued an experimental fishing licence. It is not possible for the community to hold a commercial fishing licence since the boats in the community do not meet with survey requirements and none of the Aboriginal men have gained the necessary certification to hold marine licences. The community keeps monthly records of all people taking fish for sale, recording the species and weight of fish caught. At present fish can only be sold locally; however, it is the intention of the community to sell fish to regional centres in the Kimberley. The main fish caught include bream, Spanish flag, barramundi, snapper, cod, blue bone and queenfish. The numbers caught each month depend largely on the motivation of the fishermen.

The Bardi attempted to enter professional fishing by utilising large boats. They bought two boats, both of which came to an untimely end. The situation reported by Owen Stanley, with regard to the Tiwi's attempts to establish a fish trading company in 1970 reflects the Bardi's attempts, As in the case of the Tiwi, operations by the Bardi based on a more simple technology such as the use of dinghies and outboard motors, and the need to catch fish only when they want to, is proving to be more successful in the long term. The Beagle Bay community is establishing a fishing based tourist enterprise whereby community members take tourists fishing and camping along the coast. The success of this venture has not yet been ascertained.

The Bardi have also established a moderately successful industry for the collection of trochus shell. They clean and sell the dry shell in Broome where it is sent to the United Kingdom and made into jewellery. A bag weighing eighty kilograms has a market value of eighty dollars, five dollars of which returns to the community. Strict size regulations are enforced with only shell which measures between sixty five 'and one hundred millimetres in length being, taken.

The trochus industry is operated at an' individual rather than a community level. Collectors must hold a licence issued by the Fisheries Department and the community. A committee has been established at One Arm Point, with members from each of the seven resident clan groups, meeting to discuss measures to prevent over-exploitation. Potentially large quantities of shell can be collected from the rich reefs. One person can collect 180 to 190 kilograms of shell per day. Men usually shell in pairs, using a 14 foot dinghy'. Each boat with its crew has the potential to carry up to four hundred and eighty kilograms of shell to their pr'oces'sing plant each day.

The Bardi people are acutely aware of the damage caused by the Indonesians who fish and collect shell from the reefs. Whole populations of trochus were decimated by Indonesians on Sunday Island and the Roe Islands.

The Bardi have considered establishing their own trochus hatchery, to repopulate areas of reef which are continually exploited. Research and infrastructure costs remain prohibitively expensive at the present time. Plans for the sale of the dried trochus meat were under way but the Japanese buyer was not making the processing of the meat a viable proposition to the Bardi people. Recent plans to make jewellery and to carve shell in the community are being considered in order to create more long term local employment.

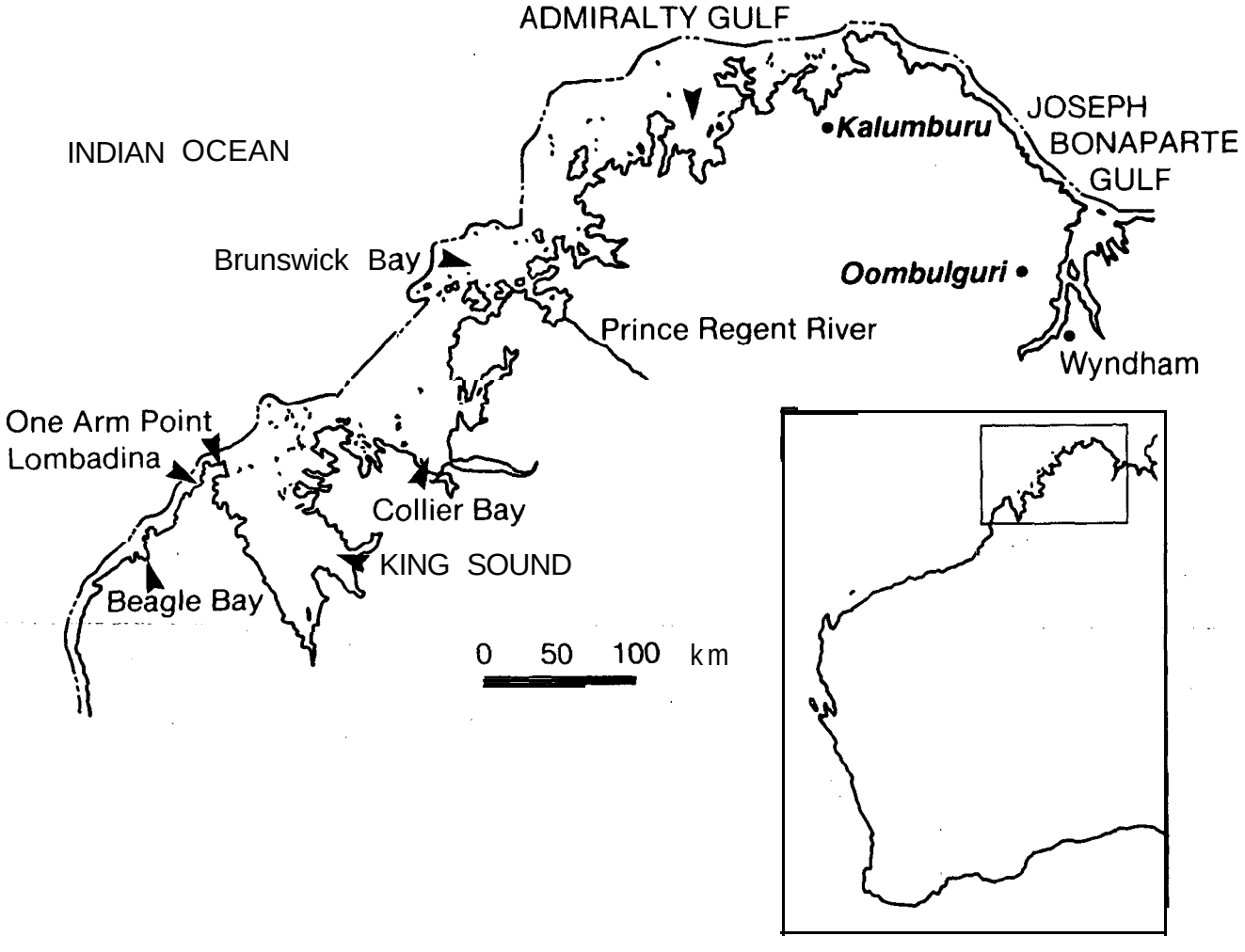
On the whole the Bardi economy is heavily dependent on the local marine resources. Bardi people are looking towards the future with a view to self-management of their local environment on a scale which will ensure increased local employment. Unfortunately, government initiatives in these matters are slow and have offered little return for the Bardi to date.

At this stage I feel it is pertinent to discuss what the Dampierland community hoped was to be their first attempt at acquiring marine management through the efforts of the Aboriginal Land Inquiry and the proposed Land Rights Bill.

THE ABORIGINAL LAND INQUIRY

1983 saw the beginning of an attempt by the West Australian Government to address the issue of Aboriginal Land Rights. One of the terms of reference was as follows; "The Inquiry will consider the extent to which waters adjacent to granted lands should be protected for the use of Aboriginal people."

Figure 1. Map of the Kimberley coast showing the extent of State jurisdiction.



In order to answer this term; of reference, the Aboriginal people of Beagle Bay; Lombadina and One Arm Point united in the common goal to have their traditional rights to sea recogni'sed'by the Government with a view to &elf-management.

The communities argued the case that their members had interests in the land and sea, that people exploited certain marine resources, and that they had an intimate knowledge of their environment. Substantial evidence was given as to the existence of ritual and mythological sites in the sea. Davis and Prescott (1985) substantiated their claims with supporting evidence from the Northern Territory. The communities felt that areas of sea should be closed for their use, in order to protect the economic, ritual and mythological sites, within them.,. They felt that European professional fishermen should not be able to fish in these closed areas and they said that existing pearling leases ,.should be controlled by the communities. The concept of Aboriginal rangers patrolling the seas to ensure that no illegal fishing occurred and to ensure that the shell beds and fishing areas were properly monitored was suggested.

The Commissioner, Paul Seaman QC, recognised that these people did have strong claims to protect.the sea for their' use., He recommended that water should be protected for Aboriginal people for uses which were still a part of traditionallife. Traditional life was defined to include access to traditional activities connected with significant areas in, or associated with, the sea, or customary modes of foraging or fishing in or near the sea (Seaman, 1984). Seaman accepted that these Aboriginal people had due claim on a traditional basis to areas of seas in and around the Dampierland Peninsula and he recognised that people who today hunted dugong and turtles with dinghies and outboard motors were still hunting in a traditional mode.

Substantial evidence was submitted by the communities in order to convince the Inquiry of their claims to the sea. These claims were accepted by the Commissioner. Unfortunately, neither the Aboriginal communities nor, I suspect, the Commissioner,. realised the depth of the anti-Land Rights feeling in the wider'community and that the issue had become politically expedient..The failure of the Land Bill to be passed in the Lower House of Parliament reflected this concern.

The lack of Land Rights and tenure to the sea means that these Aboriginal people will have to seek alternative means to protect and manage their marine environment.

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WORKSHOP DISCUSSION

The discussion covered the following points:

Research on traditional uses of marine resources in Western Australia is only recent in response to Land Commission information requirements; there is currently little research underway and there is a danger of knowledge being lost.

Remoteness of the area limits research.

The extent of current use of the sea in traditional ways differs amongst communities, and varies according to degree of access to the sea.

All communities considered as fishing to some extent traditionally are located in the tropics.

People will hunt dugongs where available, but this plays a small part in their diet in comparison to fish and turtles.

The Bardi people have stories about Brew Reef which lies about 50 km offshore. It was noted by a participant that changes in technology may have affected the perceived extent of territory.

RESEARCH ON TRADITIONAL TROPICAL FISHERIES: SOME IMPLICATIONS FOR TORRES STRAIT AND AUSTRALIAN ABORIGINAL FISHERIES

R. E. Johannes

The past decade has witnessed an almost explosive growth of research on traditional fisheries in the tropics. In Australia, however, the subject has only very recently begun to attract the attention of more than a tiny group of policy makers and researchers. This delayed entry into the field provides Australia with the opportunity to learn from the findings - and benefit from the mistakes - of those who started earlier. Here I briefly outline some of the general conclusions arising from this research and discuss their relevance to traditional fisheries in northern Australia.

Although the catch-per-unit-effort of traditional fishermen is very low, their numbers are very high - eight to ten million throughout the tropics - and their total catch amounts to almost one-half of the world's food fish. Only about one-eighth as much fossil fuel is expended in these fisheries as on catching the remainder by higher technology fishing (Thompson, 1980).

Despite the high employment, low energy costs and high total yields afforded by traditional fisheries, they were little studied until the 1970s. This is because traditional fishermen are typically cash poor, are scattered widely in small, remote communities, and are out of touch with central government authorities. Thus they lack a strong political voice with which to draw attention to their problems and articulate the often impressive economic and nutritional significance of their activities.

The need for expanded research in this area became apparent in part because of the failure of countless foreign aid projects designed to assist traditional fisheries. Typically, these projects were based on the reflex introduction of training and new technology on the tacit assumption that what has proven useful to western high technology fishermen will ipso facto be useful to all fishermen. But classical fisheries theory is based on temperate zone species and high technology fisheries in capitalist economies and neither traditional fishermen nor tropical fishers behave according to such theory.

So it has become increasingly apparent that tropical marine resource managers must develop a much better understanding of both the biological and the socio-economic features of these fisheries if they are to formulate realistic objectives and achieve useful results. Accordingly, research on traditional fisheries has been given elevated priority by FAO, UNESCO, ICLARM, the Agency for International Development, the world Bank, the South Pacific Commission and a number of other multinational or international organisations.

Traditional fisheries involve, per unit of catch, far more fishermen, boats, methods, habitats fished, species caught, landing sites and distribution channels than do higher technology fisheries. Within Australia, traditional fisheries in the Torres Strait Islands provide an example. Here, in a population of about 5,000, people fish in ones and twos, on foot or from small boats, out of villages and tiny outlying settlements on seventeen different islands,, and in several quite different types of marine environments spread over an area of 30,000 square kilometres. They use harpoons, poisons, spears, spearguns, various 'types of nets, reef gleaning, and trolling and droplines, in order to catch a host of reef, mangrove and pelagic fishes, as well, as rock lobsters, crabs, perhaps two dozen species of molluscs, and dugong and turtles. There. is no central market. Landing, ta'kes place at dozens of sites and at all times of day and night. Some of the catch is sold locally. Some is iced or frozen'for export. Much is given away'according to complex traditional systems of distribution;

Because of various environmental, geographic and cultural differences within the Strait, no one island fishery is representative of any other. Thus research on no single island or selected group of islands will provide information that adequately represents the islands as a whole.

The costs of gaining the information necessary for conventional fisheries management of all these sub-fisheries would greatly exceed the economic benefits. The costs of effective conventional enforcement of the resulting fisheries regulations would also be greatly disproportionate to the benefits. Why, then, do researchers not simply "write off" such fisheries?

ECONOMIC JUSTIFICATION

Research on most species harvested in these fisheries is not warranted on purely economic grounds. But there are often'sound economic reasons for studying the segments of the fishery that involve certain high-value species important to traditional fishermen, or to higher technology fishermen exploiting the same stock.

In Australia a case in point is the barramundi, a valuable source of food for many coastal Aboriginal communities and certain Torres Strait communities, as well as a prized commercial and recreational species - one that has been subjected to excessive fishing pressure over wide areas.

Research on traditional fisheries for trochus, rock lobsters, mud crabs, beche-de-mer and mackerel are, or have been, justified on purely economic grounds for similar reasons. At present ,, research on traditional fisheries for most other invertebrates and fin-fishes, sea turtles and dugong is not. This may change in the case of fin-fishes if adequate markets can be found for what is presently an under-utilised resource in much of northern Australia.

POLITICAL JUSTIFICATION

Political reasons for supporting research on traditional fisheries elsewhere in the tropics are varied., but many fall under the general headings of resolving boundary disputes and allocating resources. Such considerations are relevant to the traditional fisheries of both Aborigines and Torres Strait Islanders.

For example, the Torres Strait Treaty between Papua New Guinea and Australia, ratified in February 1985, arose from negotiations between the two countries relating to sovereignty and maritime boundaries in the Strait. One of the main objectives of the Treaty is, "to acknowledge and protect the traditional way of life and livelihood of the traditional inhabitants including their traditional fishing."

Because little information about the traditional fishery was available (other than that gleaned from anthropological studies carried out at the turn of the century) the governments of Australia and Papua New Guinea acknowledged the need for a broadly based research program. Accordingly the Commonwealth Department of Primary Industry requested the CSIRO Division of Fisheries to carry out studies on aspects of the traditional fishery that appear to relate to island welfare, the implementation of the Torres Strait Treaty, and the formulation of policy alternatives for securing sustained yield exploitation of those marine stocks which constitute important components of the fishery . . . . .

Another political issue that has emerged recently in Australia is giving strong additional impetus to traditional fisheries research: traditional fishing rights. Although historical accounts reveal the existence of traditional fishing rights among Aboriginal people and Torres Strait Islanders, fisheries administrators in Australia were, until recently, largely unaware of these rights. Here I would like to discuss traditional fishing rights within the context of traditional marine resource management.

TRADITIONAL MARINE RESOURCE MANAGEMENT

Traditional fishermen in some tropical areas have been keenly aware that there are limits on how much they can harvest without depleting their stocks. For centuries, fishermen in Polynesia and Micronesia, for example, have practised all the basic marine fisheries conservation measures that westerners began to employ only around the turn of the century (Johannes, 1978).

Growing awareness of the existence and value of traditional resource management systems has led both UNESCO and the International Union for the Conservation of Nature and Natural Resources to establish formal working groups of social scientists and biologists to investigate these systems. A common theme of these groups is that modern natural resource management in traditional societies will achieve greater acceptance and thus be more effective if it incorporates, or is compatible with, traditional management concepts and cultural practices.

A subject that is receiving, much, attention from these groups and associated researchers is traditional use rights in fisheries (TURFs). TURFs provide a means of maintaining or improving the welfare of small fishing communities by facilitating sound marine resource manasement (for example, Cordell, 1974; Johannes, 1977; Christy, 1982; and many others).. Where TURFs exist, it is usually in the best interest of those who possess them not to overfish. The penalty for doing so - reduced future catches - accrues directly to the owners. Self-interest thus dictates conservation.

Where such resources are available to everyone, in contrast, it is in the best interest of fishermen to catch all they can. Since they cannot control the activities of other fishermen, the fish they refrain from catching will most likely be caught by someone else. In a fishery open to all, self-interest dictates overfishing. TURFs constitute a type of,what the fisheries biologist refers to as limited entry, some form of which is essential for 'sound fisheries management.

Another group of researchers have emerged recently with contrasting views. They argue that TURFs are not always maintained by the owners with conservation in mind. Furthermore,, TURFs can impede fisheries management and development because traditional owners may lock up coastal marine resources, excluding the outside capital and expertise needed for their effective exploitation (Haines, 1982; Polunin, 1984).

These contrasting views are based much less on 'differing interpretations of the facts than on different sets of facts. Systems of traditional marine tenure are very diverse. Some, accordingly, are more useful in the context of resource management than others.

Collectively, studies on TURFs appear to support the hypothesis that they function better as mechanisms for marine resource management in areas where marine resources are limited relative to the needs of the users and recognized as such by the users.

In Australia we need to find out just how consistent traditional marine tenure systems are with contemporary marine resource management. We need to establish for each TURF whether it contributes - or has the potential to contribute - to the effective conservation, the equitable' allocation and/or the. sound economic management of the resource. These questions raise a host of subsidiary ones. For example, should our main economic goal be to maximise profit, yield or employment? It is rarely, if ever, possible to maximise for even two of these simultaneously. In the case of allocation, who decides what is equitable?

As for conservation, do we have, or can we reasonably expect to get, enough biological data to answer the question confidently? The cost-benefit ratio of biological research on small but typically very complex tropical fisheries is, as already mentioned, 'very **high.**

Another conservation issue characterises many traditional fisheries, including those of Australian Aboriginal fishermen. It concerns the many taboos and other restrictions on catching or consuming certain species. Some researchers have assumed that such practices automatically serve a conservation function. Undoubtedly some do. But when the use of one species is proscribed, it puts additional pressure on other species. Only when a restriction directs demand away from a limited resource to a more plentiful one can it be said to result in useful conservation. Some restrictions may actually shift demand in the opposite direction.

TRADITIONAL KNOWLEDGE

Biologists have come to realise that traditional fishermen can be a rich source of information on the species they catch and the environments in which they fish.

In the Pacific islands, for example, it has been stated that "the native fisherman is possessed of a store of precise knowledge that may be truly characterized as a natural science" (Handy, 1932). Marine biologists, Ottino and Plessis (1972) comment that such fishermen possess a knowledge of fish behaviour "of a stupefying richness and at times of such precision that the poverty of our own conceptions makes inquiry very difficult."

Traditional fishermen can often provide information essential to management on aspects of the biology of species in their waters - information on such subjects as the timing and routes taken by migrating fishes, spawning seasons and localities, behaviour in relation to fishing gear (Johannes, 1981 for instance). Do such findings pertain to traditional fishing in northern Australia?

It is becoming increasingly clear that both Torres Strait Islanders and Aborigines possess knowledge of the behaviour of marine animals that is valuable to researchers. Some of their knowledge of dugong and turtle behaviour has been documented by Anderson and Heinsohn (1978) and Nietschmann and Nietschmann (1981). Aboriginal fishermen in northern Arnhem Land also possess valuable knowledge about such things as seasonal variations in feeding, migration and reproduction of many coastal marine species (Davis, 1984a), including barramundi.

For many years biologists argued heatedly over the question of whether barramundi spawn in rivers or in shallow coastal waters. The answer is fundamentally important to the management of this species. But the circumstantial evidence was ambiguous, and persistent but unsubstantiated reports were in conflict. Light could have been thrown on the issue long ago if biologists had sought the knowledge of native fishermen.

The question appeared to have been resolved when Moore (1982) demonstrated that barramundi in the Fly River system of Papua New Guinea migrated downstream into Torres Strait and 100 kilometres or more along the coast before spawning. But Aboriginal fishermen in northern Arnhem Land had always maintained that barramundi commonly spawned well upstream in local rivers (S. Davis, pers. comm.). When informed that a biologist had proved

otherwise in the Torres, Strait area, these fishermen were firm in, their insistence that in their waters barramundi spawned in rivers.

This apparent conflict between fishermen and biologists was resolved when T. Davis (1985) demonstrated that barramundi did indeed spawn well upstream in rivers in northern Arnhem Land. The characteristic common to spawning locations in both Torres Strait and northern Arnhem Land turned out to be not a particular type of geographic space, but salinity.

Barramundi spawn in waters more saline than fresh water but somewhat less saline than ocean water. Salinities in this range are found along the coast in northern Torres Strait. But the appropriate salinities in northern Arnhem Land have been found as much as several tens of kilometers upstream in rivers. Here the much gentler incline of the rivers and the much greater tidal amplitude result in the transport of high salinity waters far upstream.

Another intriguing example of potentially valuable traditional knowledge concerns rock lobsters. Aboriginal fishermen report seeing rock lobsters moving eastward, single file, head to tail, across shallow open sandy areas along certain portions of the coast of the Northern Territory during the dry season. These movements are strikingly similar to the migrations of a Caribbean species of rock lobster described by Herrnkind et al. (1973). (It is worth noting that the phenomenon was, well known to Caribbean fishermen long before marine biologists learned about it). Both migrations are described as:

being in single file;

involving head to tail contact;

occurring during a season of decreasing temperatures;

having a clear longshore component, and;

occurring over open, sandy areas where lobsters are rarely seen at other times.

Caribbean fishermen catch many more lobsters than usual during such migrations. In Australia, rock lobsters are a lucrative export; in 1985 the price to fishermen was around $15 per kilogram. Could the migrations described by Aboriginal fishermen form the basis of a local industry? If they do, it will be because Aboriginal fishermen brought to the attention of biologists observations made in waters about which the latter have very little knowledge.

Many traditional fishing peoples in the tropics relish fat-laden, fish, invertebrates, dugong and sea turtles. In consequence, traditional Aboriginal fishermen, among others, are keenly aware of the predictable seasonal variations and unpredictable year to year variations in the fatness of these species. Torres Strait Islanders commonly associate a marked and anomalous decline in the fattiness of turtles and dugong (and a decline in abundance of some fishes) with an unusual and extensive dieoff of seagrass that they report to have occurred in the 1970s.

Biologists know that in certain species (studied mainly in temperate waters) variations in fat content sometimes relate to seasonal spawning and migration cycles. They may also relate to variations in food quality and quantity associated with variations in rainfall. But biologists have not availed themselves of traditional fishermen's knowledge of fatness cycles of a great many tropical species, knowledge that should aid in exploring the causes and consequences in more detail. The fat content of marine animals influences their flavour, shelf-life and smoking qualities.

Until recently, biologists working in the tropics tended to work in splendid isolation from the cultures that were supposed to benefit from their research. The realisation is spreading, however, that native peoples and biologists have convergent interests as well as complementary sets of knowledge and skills. Brownrigg (1982) states, for example, that for natural resource managers:

> "the benefits of working with native peoples include gaining an additional constituency, recruiting personnel with profound knowledge of local areas and learning about long-term resource strategies which have proven their adaptability for thousands of years. For native peoples, the benefits include legal recognition of ecologically sound traditional land-use practices, appropriate employment of their traditional lands, and new advocates at-a. national level."
> (Brownrigg, 1982)

But there are not nearly enough biologists interested in, or in a position to record, all the important traditional practices of native peoples and their knowledge of natural resources they use.

Moreover, individuals who reveal their traditional knowledge to outsiders are relinquishing a certain amount of status or power. Naturally they will sometimes be reluctant, especially if they can see no benefits arising from disclosure of this knowledge.

Traditional knowledge is often no longer being transmitted effectively even within cultures; it is being lost as its owners die. Young members of the educated elite whose formal education is often obtained far from their own communities are among the people in these cultures who know least about such knowledge. Ironically it is these very people who will be most responsible for influencing patterns of natural resource and conservation in their communities in future years. Their technical and political sophistication cannot possibly be put to best use without the knowledge of their natural resources possessed by their elders. Educational institutions have a responsibility to retain such knowledge. Its absence from their curricula amounts to the damning assertion that it is no longer worth learning.

I have suggested in various forums that a course on traditional knowledge and management of natural resources be part of the curricula in native schools, But the transmission of such information cannot be achieved entirely in a typical classroom setting, As one of the course requirements, students might

therefore be asked to do reports describing some aspects of traditional management or knowledge of natural resources, obtained by interviewing their elders and observing their practices. Copies of such reports could be kept on permanent file in the schools where,' collectively, they would grow to become a unique and valuable source of traditional knowledge. As an incentive, where appropriate, national 'and local prizes might be'offered for the best projects.

Responses to this notion outside Australia have been encouraging. For-example, organizers of Canada's Man in the Biosphere Program have adopted the idea and are sponsoring prizes for student essays on traditionalnative American knowledge and practices' relating to natural resources (Freeman, personal communication). A teacher of fisheries science in Papua New Guinea set his students'the task of reporting on traditional fishing in their respective villages. The reports were recently published as a book (Quinn et al, 1984) and the projects are continuing.

COLLABORATION OF BIOLOGISTS AND SOCIAL SCIENTISTS

Emmerson (1980) examined in detail the roles of economics, law, anthropology and biology in artisanal fisheries development. He concluded that

> as points of departure for inshore fisheries development in low-income countries, other things being equal, anthropological and biological questions should prove more useful than economic or legal ones. Biology is basic. Depending on whether the resource is physically' under or over-fished radically different implications for development result.
>
> The advantage of anthropology, on the other hand, lies in understanding the behaviour of fishermen and their families as members of rural communities that may need assistance not for the sake of their resources but in their own right.

The importance of social science research to fisheries management is now widely recognised outside Australia. Increasingly in the United States, for example, fisheries management plans are incorporating formal social impact assessments. A recently formed Fisheries Social Science Network, organized by the U.S. National Marine Fisheries Service, has a membership of well over 300 individuals in the U.S. and Canada. A wide range of disciplines is represented, with anthropologists and fisheries management specialists (usually biologists) predominating.

In Australia, the recognition of the close ties between technological and social issues is stated to be an integral part of government policy (Tegart, 1984). But sadly, some biologists still scorn the social sciences as being non-quantitative and therefore not truly scientific. They thereby demonstrate not only a complete ignorance of modern social science, but also a fundamental misunderstanding of what constitutes legitimate science. In their quest for better quantification in research

areas where it is essential, they have somehow convinced themselves that only quantitative research is legitimate research.

Many millions of dollars of resource development aid have been wasted in the past because of inadequate attention to the qualitative social dimensions of the problem. Often project managers have been completely unaware, for example, that social relations governing traditional subsistence activities are frequently inconsistent with capitalistic behaviour and have attributed their project failures simply to "laziness" on the part of the aid recipients. Halapua (1982) provides an excellent discussion of the subject as it pertains to traditional fisheries.

Social science helps reveal ways of introducing developments that are more likely to succeed. (But it also teaches the biologist to think about the ethical dilemma of promoting development projects that may transform traditional societies profoundly).

For anthropologists the benefits of bringing biology into their studies have long been obvious. Ethnobiology is one example. In the field of maritime anthropology the recent realisation that traditional fishermen, unlike most high technology fishermen, widely practice limited entry and that this has important implications for resource management has been described as "a startling discovery" (Cordell, 1984).

This realisation has been helped along by fisheries biologists; until they pointed out the significance of TURFs in the context of marine resource management, studies of traditional marine tenure systems were rare. Where they were studied at all, they were generally accorded only a few paragraphs as an afterthought in treatises on land tenure.

Within the past year, however, two books of collected papers on the subject have been published (Ruddle and Akimichi, 1984; Ruddle and Johannes, 1985) and a third is in press (Cordell). All three exemplify close collaboration among social and biological researchers and fishermen. They should prove useful in helping to analyze the issues raised by the existence of traditional marine tenure in Australia.

The resolution of this issue and other problems relating to traditional fisheries will not progress satisfactorily in Australia without fishermen, biologists and social scientists understanding each other's knowledge, customs and perceptions. This workshop provides an excellent beginning.

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WORKSHOP DISCUSSION

The discussion covered the following points:

Aid programs have not worked well in relation to traditional fisheries, one reason being a lack of social science input. An example is given in the publication 'The Fishermen of Tonga'.

The question of costs and benefits of biological research of tropical fisheries is sensitive because the number of species and complex distribution makes research expensive.

The greatest problem in studying traditional fisheries is data collection, and interviews may provide. a 'useful short cut in biological research.

It is important both to interview fishermen and to cross-check biological information.

Local knowledge of traditional 'fishermen can modify generalisations from biologists who have worked only in limited areas.

Rock lobsters migrating in single file over sandy areas (as in the Caribbean) have been reported by an Aboriginal community in the Northern Territory.

There is a need for education and training in schools regarding traditional fishing, particularly along the lines of the work done by Norman Quinn in Papua New Guinea.

Information collection in schools'should be acknowledged as a valuable research tool.

PART B

TRADITIONAL KNOWLEDGE WITHIN THE COMMUNITIES*

GREAT BARRIER REEF COMMUNITIES

Lockhart River - Mr Isaac Hobson

The first settlement in the area was a Church of England mission, south of Cape Direction in 1924. In 1967 the Church of England handed the mission over to the Queensland government and a new settlement was established at Lockhart River.

With a population of 400, the community is serviced three times a week by a DC3 on an old World War II airstrip, and also by a barge bringing cargo from Cairns. All families have access to social service benefits and purchase food from the Lockhart River store. These facilities have led to changes in hunting and fishing practices, especially by young people who no longer hunt and fish as frequently as the older members of the community.

The community has not commercialised its fishing practices because it is believed that professional fishermen in the area have control of the market to the south. Marine animals 'that are still sought on a subsistence basis include:

salmon, caught by handline in February and July;

barramundi, caught in the Cooktown River and some coastal creeks, usually by spear;

reef fish speared from some of the few boats in the community;

crayfish, caught by diving from dinghies;

turtle, caught by harpooning and bulldogging;

dugong, caught by harpooning;

stingray, speared in shallow water; and,

crabs, oysters and shellfish.

Traditionally, spearfishing is carried out from canoes of more than about fifteen feet, with outriggers.

Lockhart River residents worked on pearling luggers some forty years ago, and were sought by commercial fishermen as trochus and trepang divers. Today, when searching for crayfish, they dive to a depth of up to ten feet, sometimes using goggles, and obtain crayfish from under bommies and rocks with a small handspear.

* Editors' Note: Compiled by editors from oral presentations and discussions.

Turtles (both qreen and hawksbill) are seen in the area, and are plentiful at Lockhart River. Turtles are caught in the stretches of shallow water at the old mission site, but the prevailing south-east wind causes problems at the new site.

Turtles may be hunted at any time of year. The community favours green turtles, and hawksbill are rarely eaten because some believe they are poisonous. Loggerhead turtles are not hunted because they are too stringy to eat. Turtles are more easily caught than dugongs, and the latter tend to be caught mainly for festivals and feasts, when a specific effort is made.

The move to the new mission site has made hunting difficult, especially for dugongs, because of reduced accessibility to good hunting areas. There used to be plenty of dugongs, at the old mission site, but nowadays hunting in this location calls for a two person expedition which entails camping out even in good weather. Therefore Lockhart River residents now catch dugongs near the seven mile long Cape Direction sandbar, although few have been seen in this area of late, possibly because of a shortage of feed.

Nowadays dugongs are cut up immediately after catching, on the nearest sandbar. Previously, however, hunters making a catch at night would leave it until the following day; or, if making a catch in the morning, would leave it until the afternoon, as the meat is easier to cut if the carcass has been left for a few hours.

Crabs and shellfish are plentiful, and may be collected close to the current community site. Crabs are caught at any time, but are considered easier to catch at full moon. Oysters are also plentiful, and are collected at Kid Point.

Land-based hunting and gathering includes pig hunting and digging turkey eggs.

Hopevale - Mr Lester Rosendale

Hopevale was settled on the northern side of Cape Bedford in 1886 by a German missionary. Until World War II the community lived in three missions at Cape Bedford, MacIvor River and Ayling. During World War II these communities were evacuated to Woorabinda, and after the War they were moved to a new site forty-two kilometres north of Cooktown. Administered by the Lutheran Church, the present community is made up of people from as far afield as Bamaga and Bowen. The community's diet varies between dugongs, turtles and beef, as well as fish and shellfish. The store at Hopevale is supplied with fish from Cooktown.

At the first mission sites the community used to fish.,from Cape Bedford to the Starcke River using lines, nets and spearfishing techniques to catch blue-tailed mullet in September,' October and November. Dugongs were also hunted, and, in the 1920s and 1930s, beche-de-mer or trepang.

Activities have changed. Clinker-built boats have given way to high-powered outboard motorboats so that expeditions which used to take a day from the Starcke River, to Cape Bedford can now be completed in about 4.5 hours.

Boats are used to catch turtles, dugongs and fish. Details of fishing are covered in Andrew Smith's paper (this volume). The community tends to fish between new moon and second quarter, because it is believed that this is the best time to find fish. Another custom involves a successful mullet fisherman giving up to the whole of his catch to relatives or to those who claim some relationship.

It is generally the women who fish and collect shellfish, as they are considered more able in this field than the men, who hunt dugongs and turtles. Shellfish are generally collected from mainland shores.

Different fisheries are exploited at different times of year, depending on which fish are 'fat' at the time. The community follows the same fishing patterns as they have always followed, although younger people tend to fish for sport rather than for subsistence. Almost annually the community catches a large groper swimming along the shore near the MacIvor River.

Dugongs are hunted at Christmas when the community goes to the coast. This seems to be the only time when community members come together at the coast, and it is possible to organise hunting parties of three or four.

The old hunters these days 'manage' a hunt, giving instructions to the younger members of the community, and most younger hunters acquire expertise from going out on expeditions with older members. There is no record of successful past hunting trips because of counting methods: 'one', 'two', 'three', then 'big mob'. Information on hunting has been handed down only to those who are interested. However, a series of strokes cut into the sandstone of the rocks near Cape Flattery provide a record of the number of dugongs caught by older community residents. The community still hunts for dugongs along most of the coastline between the Starcke River and Cape Bedford and the islands and reefs near the coast. The catch does not exceed consumption by the community, which remains undecided about the extent of restrictions entailed by the policy of allowing it to take 20 dugongs per year by permit. (Note: the quota was lifted in 1986 after the 1985 quota was not met. (eds.))

Wujal Wujal - Mr Jimmy Johnson

Much of what has been said about fisheries traditions 'at Lockhart River and Hopevale also applies at Wujal Wujal. As at Hopevale the women are considered to be better at fishing than the men. The community fishes mainly at Cedar Bay, two hours by boat from Wujal Wujal. In rough weather, however, the Rattlesnake Island area becomes difficult to negotiate. Until recently, when outboard motors were introduced, the journey was made by paddling or sailing outrigger canoes carrying three or four people, two of whom would paddle at a time.

Three to four turtles may be caught per trip, and line fishing from boats is practised, as well as net fishing. Cast nets have been employed more recently, but fish traps have never been used. Fish caught include trevally, grunter, black bream, mangrove jack and salmon.

A few people at Wujal Wujal may have dugong catching knowledge, but dugongs are not hunted because there are so few in the area. The community would not hunt in the Hopevale area without permission from the Hopevale community.

Other seasonal activities include pig-hunting and digging for turkey eggs.

Fishing by the Lockhart River, Hopevale and Wujal Wujal communities is practised on a subsistence rather, than a commercial basis.- as the communities are remote and mar'kets therefore inaccessible.

The seasonal, nature of hunting and fishing was emphasised by the' representatives of the three communities. Catching of turtles and fish depends on whether they are 'fat'. Hunters assess the condition of a turtle by feeling the animal's 'armpit', under"; the front flipper.

Yar rabah - Mr **Bryce** Barlow

Yarrabah is a community of about 1,500 people founded in 1862 by. the Reverend Gribble, who then founded a number of other communities, such as those of Mitchell and Edwards Rivers, before returning to Yarrabah. The community used to consist of eleven' farms, but these have been amalgamated into one.

Dugongs, turtles, turtle eggs, clams and other shells and' shellfish are taken by the community. People used also to collect seabirds' eggs in spring. Both dugout canoes with outriggers and sailing boats are used.

Shellfish and clams are collected in May and June. Shellfish used to be prolific on the mainland reefs near Yarrabah, but now only oysters can be found there. The community considers that women should not eat shellfish while pregnant or until three months after childbirth.

Turtles are hunted in October, November and December, and dugongs in April, May and June. Between December and March dugongs stay out at the reefs, following the colder water, and return to the coast only when the coastal water cools. Dugong hunting takes place at night, and hunters locate the animals by listening for their cough. Aluminium boats are considered'too noisy for hunting dugongs.

Palm Island - Mr Eric Bunn

Fishing by the Palm Island community is no longer truly traditional, and' is becoming largely a pleasure activity. Many of the old people for whom fishing was a subsistence activity have now died and their. knowledge has not been passed on.

Palm Islanders believe that commercial fisheries have depleted marine populations in their fishing grounds. While in earlier days the women, rowing out in wooden 'flatties to catch reef fish, could expect'to fill a sugar bag in 1.5 hours, it is possible now to fish all day virtually without success.:

In the depression years the reef provided mullet, turtles and dugongs over and above government rations, although the community fished only during daylight hours because of the curfew.

The clam population has been devastated in Pompey Bay and at Fantome Island, the dugongs around the Palm Islands have now disappeared, and turtles have decreased significantly.

There used to be three feeding areas for the green and loggerhead turtles which are seen in the Palm Islands area: at Havannah Island, North East Bay and Pompey Bay. The community believes that pleasure boating is disturbing the turtle population.

At the time of the workshop it is the trochus collecting season. The trochus come up with the cold water on to the reef flat and the community collects the shells at low tide.

Fish and shellfish form an important and valued part of the Palm Islanders' diet, partly because the community believes in their medicinal properties - for example, the green fat of the turtle.

Attempts at commercial fishing by the Palm Island community have failed largely as a result of bad management, inexperience, and people being employed on wages rather than on contract. Currently the community is looking at the possibility of farming giant clams.

TORRES STRAIT COMMUNITIES

Badu and Thursday Islands - Mr Ephraim **Bani**

While traditional fishing still occurs in Torres Strait, many people have left the Torres Strait Islands and have gone to the mainland, leaving behind traditional knowledge and creating a gap between them and their cultural environment. Modern technology cannot replace traditional knowledge in the field of dugong hunting.

There are now two types of dugong hunters in Torres Strait communities: the 'professional' and the 'amateur'. The professional has a great deal of cultural knowledge and plans his hunt, whereas the amateur tends to use a high-powered outboard, thus depending on speed rather than knowledge of dugong behaviour to hunt successfully. The professional possesses the knowledge to be selective when hunting, and decides whether a dugong is 'fat' and good to eat. Thus the community traditionally esteems him as a champion hunter and good provider, and he is always the first to obtain the favour of a female. Nowadays, however, men no longer hunt specifically to attract those of the opposite sex.

Selection techniques for hunting dugongs include differentiation between the sexes and recognition of preqnant females and herd leaders. Professional hunters differentiate between male and female dugongs by the length of their faces; the face of a male is longer. In addition, the first in a line of swimming dugongs will be a female and the second a male. A pregnant dugong is distinguished by the tail thrown high when diving into the water.

During darkness the sexes are distinguished by the sounds they make,. The male makes a loud sound and the female a softer sound, like a whisper. These two sounds made in succession signify a male and female dugong swimming together, where the male is the fully-grown calf. Two sounds made simultaneously signify a mother and a young calf. Herd leaders make a whistling sound. An aid to the aural tracking methods employed at night is provided by the 'luminous trail' which issues from the mouth of feeding dugongs. The Torres Strait Islanders have given this a name similarto that for the Milky Way.

Feeding trails usually take the form of lines across the seagrass patch, their direction depending partly on its size and shape. The hunter can estimate the position of a dugong by assessing the effect of the tide, wind and currents, on the feeding trail. Thus it is essential that he understand the movement of the stars and the different oceanographic and weather conditions. The hunter watches the surface and pattern of the trail to predict the dugong's movements, but does not pick up the harpoon until the animal is within range. Having harpooned the dugong, he drowns it.

A professional might instruct an amateur in hunting techniques but would not actually accompany him on an expedition. There may be only three or four professional hunters remaining in the Torres Strait and it is important that their knowledge be recorded for both Torres Strait culture and marine biologists.

In the early 1970s young amateur hunters were killing herd leaders, contrary to custom. This factor, together with the dugong's sensitivity to noise, may have led to its declining numbers in the area.

Torres Strait Islanders used dugong oil as a castor oil substitute, and still apply it externally to bruises. The importance of the dugong for them also extends into the mythological dimension, as they believe that dugongs spread from an ancestral reef to the Torres Strait islands, Borgu, Thursday Island and Cape York. Today there are relatively few sightings in these areas, although individual dugongs are recognised to return to specific areas over long periods.

Murray Island - Mr Eddie Mabo

I lived in Torres Strait for my first twenty years, and now return regularly to visit. My paper is based on information learned from adults while living in Torres' Strait.

Me'r (Murray) Island is the largest of the three islands comprising the Murray Group which lies at the eastern end of Torres Strait. Unlike the western Torres Strait Islands the eastern islands are volcanic. Mer Island has lush vegetation and thick rainforest. There used to be about 2.000 people living on the island on a subsistence basis. My ancestors made Mer their home many generations "B.C." (before Cook),.

I believe that my ancestors were capitalists and that their consequent recognition of boundaries of clan ownership on land and sea led to conservation of resources. However, this practice. was established to ensure survival of individual clans rather

than as a philosophical priority of conservational management in the community.

In recent years since the cash store opened and canned food became available almost fifty-five per cent of the island population suffers from obesity or diabetes. A reduction of manual labour undertaken has also contributed to this problem. Yet although some behaviour similar to that of urban blacks manifests itself, traditional laws are still practised in some measure, and these ways are near to the hearts of the Murray Islanders.

Torres Strait Islanders are believed to be among the oldest inhabitants of Australia, and are expert horticulturalists and fishermen. There is a plentiful supply of fish from the waters around the islands, including grouper, mackerel, trevally, rock cod, sardines and sharks. Spears and handlines are used to catch trevally and mackerel, and the community tends to fish in the early morning and late afternoon before the sardines retreat to the reef at dusk.

Mackerel remain in these waters all year, and may be caught with live bait, whereas the maiu (yellow and black spotted trevally) is caught in May to July. The maiu feeds on the base sections of seagrass and on 'tick' (which resembles paua shell). Trevally are caught by men, women and children, using a handline with roasted or decomposed sardines for bait. On the whole, however, men do not participate in fishing as they feel it to be below their dignity.

Stone fish traps near the beach were built by ancestors of the community. The construction of the traps was a major effort made during periods of tide when the boulders were underwater and could be lifted more easily. The traps are reactivated between January and March each year and provide their owners with a constant supply of fish for the following nine months.

Trap owners must be approached for permission to harvest fish from their traps. If a trap owner cannot be found he must be given payment for harvesting the fish. This procedure applies also to clam shell collecting and the harvesting of other marine resources. The clan leader has the right to decide who may or may not take clams.

In July and August the women's task is to fish for rock cod on the far edge of the stone fish traps and on the boulders of the reef. It is thought that the rock cod come in to spawn because the fish caught are full of eggs.

In September to December and April to June, Mer Reef is invaded by rock lobsters and octopus, which are regarded as delicacies. They are hunted at night by both men and women, using palm leaf flares and pressure lamps.

Mer is a known breeding area for green turtles; other sites include Bramble Cay and Darnley Islands. A large number of turtles come up to lay eggs in the mating season. One night in 1985, 120 tracks led down to the beach after one tide. Such large numbers led Murray Islanders to question the restrictions on turtle hunting.

Out of the breeding season turtles are rarely hunted, but turtle oil is stored and roasted with mashed banana or yams to keep up the fat content in the community's diet. Nowadays bottles are used instead of coconut shells to store fat.

Discussion

In relation to the closing comment of Mr Bani's presentation, it was noted that the persistence of individual dugongs in a particular area for long periods of time has also been reported in Western Australia at Lombadina, near Broome. It is believed that this behavioural pattern may encourage similar patterns in other dugongs. Additionally, 'whistlers' (herd leaders) are also recognis,ed in W.A. as large older males in the community.

Other unrelated comments made include the following:

stonefish are dangerous to feeding dugongs;

dugongs can prevent shark bites by making their body hard;

baby dugongs shed tears when caught and killed;

dugongs have been reported to live in captivity for up to eleven years. Currently there are dugongs in captivity in Indonesia and Japan.

GULF OF CARPENTARIA AND NORTH-WESTERN AUSTRALIAN COMMUNITIES

Borroloola - Mr **Graeme Friday** and Mr Johnson Timothy

Borroloola lies in the south-west corner of the Gulf of Carpentaria. The community has many mythological associations with the dugong, including its main Gulf dreaming sites.

There are not many traditional fishermen in the community,now, and only four or five people have traditional hunting knowledge. Within the community hunting is of variable importance, as many individuals have lived on the mainland.

The community catches fish using aluminium boats, lines and spears. Stingrays are caught by the tail and the sting removed. Oysters and mud crabs are also collected by both men and women. Turtle eggs are sought in September, October and December. The community also hunts dugongs and turtle. Only men may catch dugongs, although a woman may take the helm of a boat used to hunt.

If dugongs cannot be caught during the day the community catches them at night, but in the latter instance the animal is not butchered until the, following day. There are clear and definite rules for the treatment of captured dugongs. The animal'must face seaward when being brought ashore, and a specific.method of butchering must be used. All parts of the dugong's anatomy have specific names. The community has seventeen different names for dugongs which refer to their behaviour in their habitat., occasionally many dugongs are observed. One hundred and thirty were washed up during Cyclone Kathy.

Flat-back, hawksbill and green turtles occur in the area, but the community eats only green turtles. Hawksbill is considered poisonous. Turtles are caught using a harpoon and two ropes. All turtle eggs are eaten. Species may be determined by the relative size of their eggs: loggerhead eggs are the biggest; green turtle eggs are smaller, and hawksbill eggs smaller still, though this last species is considered the most palatable.

Bardi Community, One Arm Point - Mr Joe Davey

One Arm Point is about 240 kilometres north-east of Broome by road. The area known to the **Bardi** extends from the settlement of Beagle Bay across King Sound to Montgomery Islands. King Sound has a tidal range of about eleven metres and a tide flow of six to seven knots.

Ordinary fish are the most important sea food now taken. Turtles are also very important. Few dugongs are now caught but they are prized highly.

Fish are caught mostly with hand lines. Some fish are speared, but nets are rarely used. Turtles and dugongs are taken from boats using spears. Fish are taken close to the community centre at One Arm Point at any time of the year. In bad weather when fish are needed a net may be used. Generally all people go fishing. Turtles are taken locally by men who own boats and they may be caught at any time of the year. Dugongs are caught in season from about April to August; Most are caught near One Arm Point, but people may travel away at some times in search of dugong.

Trochus shell is fished for sale, but the meat is not eaten. Nor does the community eat trepang as some species are believed to be toxic. All fish, green turtles and dugongs are eaten by the community. Hawksbill is considered unpalatable. Sharing of the catch is now restricted to within family groups.

In early times all sorts of reef shellfish (clams, mussels, trochus, etc.) were important food. Some reef fish were speared and the community continues to catch them in fish traps. Other fish were caught in traps or were hunted in rock pools. The community used also to poison fish. Groups of people also caught turtles and dugongs on reefs by hand. Traditional spears were also used in daytime hunting. Modern fishing lines, aluminium boats with outboard motors and metal tipped spears are now used because these implements facilitate hunting and fishing.

Dugongs are most readily seen and caught during the hunting season. It is thought that these dugong move away from the community outside this season, but it is understood that they can be found in some of the other areas throughout the year. The seagrass eaten by dugongs and turtles grows on the small island reefs of the Buccaneer Archipelago. Sharks can catch turtles and possibly dugongs. Dugongs breed in August and September or perhaps later, and dugongs may be born in shallow waters, such as those around the Montgomery Islands. Green and flatback turtles nest inside King Sound.

Traditional knowledge is being lost. Some that has' been recorded has not come back to the community. In early times this knowledge was passed from father to son (and from mother to 'daughter), and from groups of old people to the young. Special stories and the like were the responsibility of particular people.

People controlled fishing and hunting in their own country. Some people who were more skilled always took the lead in catching animals like dugongs and turtles. Rules for eating seafoods by different members of families are still followed in community groups. Wishes of the owners of particular country are'also respected. The community remains unconvinced that it is over-,' hunting, but is nevertheless worried about'the dugong population. If dugongs or other endangered species inhabited local waters constantly, rules for their conservation would have to be devised.

The community believes that it does know quite a lot about the various marine species that it eats; as well as some.others which are not used as food. This information can be recorded by appropriate people, but the community would like to see the results afterwards and have the information available for educating its young people.

The community is willing to help scientists with their work, but would like to understand what these people are doing.

'GENERAL DISCUSSION

It was suggested that resources may never have been sufficiently limited in Torres Strait to have necessitated any type of conservation effort by the indigenous population. Mabo said that, on the whole, Torres Strait Islanders stop exploiting a marine resource that they perceive to be decreasing, in order to let the population regenerate. During World War II, while men were away, the clam populations increased from their pre-War levels. After the war they were decimated. One clan leader prohibited clam. collection to allow clam spawning for regeneration. Other instances of conservation awareness in the Torres Strait Islands were related to the practice of turtle farming. Bags and bags of sardines were. being collected to feed these turtles, sardine schools were decreasing, and the Murray Island community protested that they might become extinct., The turtles have since been released and sardine numbers have increased.

It was pointed out that in the instance of the sardines the Islanders might be concerned not because the schools were becoming smaller, but because non-Islanders might be exploiting the resource without due recognition to the Murray Island community.

Mabo has seen crown of thorns starfish in the Torres Strait Islands, but has no knowledge of infestations. The people knew not to touch the starfish because it would cause a stinging reaction.

There was some discussion concerning the reaction of the communities to the possible loss of dugongs. Barlow (Yarrabah) said that his community would hunt only turtles and that the loss of dugongs as a resource would not be too serious. Bani (Badu and Thursday Islands) thought that the loss of dugongs would have significant cultural ramifications, particularly for the older people of the community, but that the younger people would not be so affected. Davey (One Arm Point) said that the loss of dugongs would not affect his community much, as they caught few, and these only in season. At Borroloola the loss of dugongs would mean loss of food supply and ceremonial practices and could therefore lead to a social crisis. In the Northern Territory dugongs form a very important part of some rituals and secret ceremonies.

There was general agreement that, with the dugong's slow breeding, increased hunting could result in its extinction.

On the question as to whether the loss of an animal would lead to the loss of rituals, Palmer referred to desert mythology, which features many ritual animals no longer in existence.

There was considerable discussion concerning conservation management by indigenous communities, and whether such procedures were practised in a conscious effort to conserve marine life. Certainly all groups exploit living resources in seasonal cycles, with harvest periods depending on the 'fatness' and availability of the various species.

In obtaining traditional knowledge of the various mar-ine resources in Arnhem Land, it has been found that different clans must be interviewed at different times of the year in relation to the various organisms. Thirty or forty clan estates have been found in Arnhem Land, but no one clan covers the whole range of organisms. For example, while a large number of species of shellfish may be recognised in the wet season by one community, the same group of people may recognise only ten species at other times of year. Additionally, communities specialise in different activities, thus making acquisition of information very complex.

Palmer emphasised that notions of conservation will prejudice the answers of white management with regard to traditional fishing and there is a need to distinguish between resource management and taking what *is* available in various seasons.

Table 1. Marine resources exploited by the Bardi Community.

	HOW CAUGHT	TINE OF YEAR	WHERE CAUGHT	TIDES	MOON	OBLIGATIONS	FISHED ON A REGULAR BASIS	ECONOMIC
DUGOHG	boat/spear	April-August	Lombardia to Dugony Bay (Talbot Bay)	any	moonlight nights now best	now share in family groups	depends on the seasons and on opportunity.	food only
TURTLES	as above	all year	local	as above	moonlight is good, but can catch in daylight	as above	yes	as above
OTAER FISH	lines mostly some nets and spears	as above	as above	as above	any	as above	yes	as above
REEF FISH	spear, line	all year, but different species	local	low tide	moonlight	as above	no	as above
CRABS	hand	all year	local	as above	any	family	no	as above
TROCHUS SHELL	hand	depends on the weather	local	as above	as above	commercial	yes	$1,000/t
REEF SHELLS (OYSTERS, CLAMS, ETC.1	hand	as above	local	as above	as above	family	no	food only

PART C

STUDIES ON THE USAGE OF MARINE RESOURCES BY TRADITIONAL COMWUNITIES

THE USAGE OF MARINE RESOURCES BY THE PEOPLE OF THE HOPEVALE ABORIGINAL COMMUNITY ON THE EAST COAST OF CAPE YORK PENINSULA: PRELIMINARY RESULTS.

Andrew Smith

INTRODUCTION

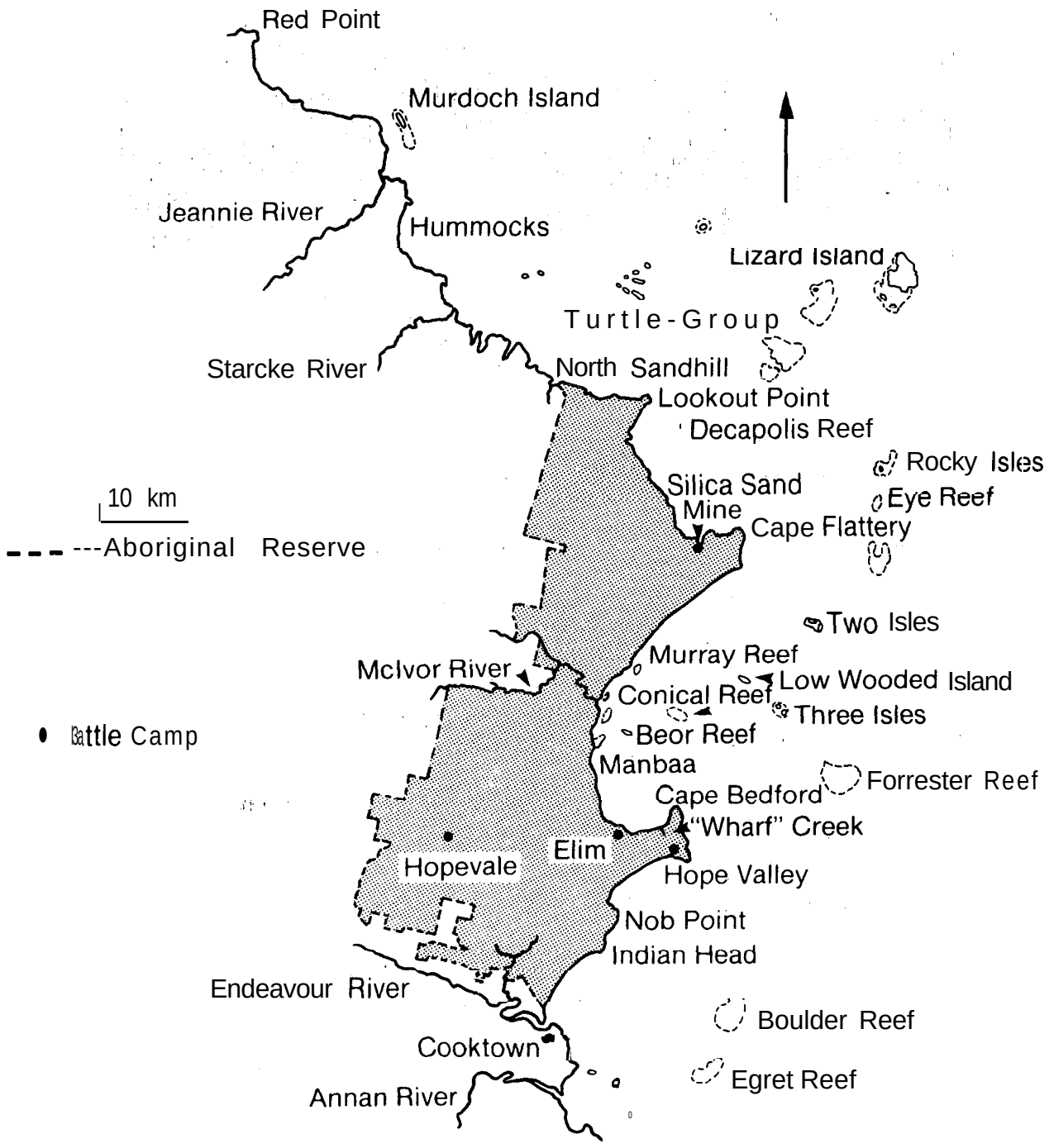
Marine resource management and conservation agencies in the tropics have, until recently, ignored the relevance of traditional knowledge. The inclusion of ethnobiological studies is now becoming accepted as important in developing management programs for regions where artisanal/subsistence fishermen comprise one of the major users (Hankes, 1984). As resource management involves regulating the behaviour of those groups whose activities affect the resource, local needs, aspirations and cultural values must be recognised and incorporated. If management schemes are to be successfully employed in indigenous communities, legislation should-be pa-tterned after local traditions to gain greater public support and thus easier enforcement (Johnannes, 1984; Robinson, 1985). An essential step in this process is the recognition and documentation of indigenous knowledge.

Three Aboriginal communities (Yarrabah, Wujal Wujal and Hopevale) occur adjacent to the Cairns Section of the Great Barrier Reef Marine Park; and one, Lockhart River, is next to the Far Northern Section of the park. All these communities utilise the marine resources in their areas.

Despite having been resettled in missions and communities, the coastal Aborigines of Cape York Peninsula still retain and use their considerable knowledge of marine resources, even if on a part-time basis (Chase, 1978). This knowledge is relevant to the management of the Marine Park.

In particular, dugongs (Dugong dugon) and green turtles (Chelonia mydas) form an important part of the diet and culture of coastal Abori'gines in many parts of northern Australia. Dugongs are listed as vulnerable to extinction in the IUCN Red Data Book (1982). Aerial surveys conducted from 1976 to 1984 established that the Starcke River area is probably one of the most important regions in the world yet identified for dugongs (Heinsohn and Marsh, 1981; Marsh, 1985). For this reason, the area between Lookout Point and Jeannie River has been designated as a Scientific Research Zone by the Great Barrier Reef Marine Park Authority (GBRMPA). Recreational activities, fishing (other than permitted traditional fishing and hunting) and collecting are excluded from this area.

Figure 1. Map of the **Hopevale** region.



The resources of this Scientific Research Zone, especially dugongs and turtles, have historically been exploited by residents of the Hopevale community. An effective fishing and management plan which considers and incorporates Aboriginal fishing and marine hunting in this area will need to be developed over several years. Accordingly GBRMPA financed this study to document marine resource usage.

This paper will discuss the objectives of the study and the methodology used, and outline the preliminary results of the first of two stages and their implications.

OBJECTIVES

The objectives of the first stage of the study were:

to document the marine hunting and fishing practices of the Hopevale Aboriginal community;

to acquire indigenous knowledge of the biology and behaviour of tropical marine food resources of the Great Barrier Reef Marine Park;

to use the above information to:
evaluate the factors that act to limit or encourage marine resource usage by the Hopevale community;

to assess the possible need for, and methods of, management of marine hunting and fishing practices, and the implications for the species involved;

to assess the need for further investigation of possible impact on the Hopevale community due to marine resource management;

to provide the GBRMPA with recommendations that could be used in the development of a management program for usage of the marine resources of the Marine Park adjacent to Aboriginal communities.

METHODOLOGY

The fieldwork occurred between January 1984 and March 1985. My research time at Hopevale was divided fairly evenly between the community itself and the beach camps. Time at the beach camps was determined by the movements of Hopevale residents. Most weekends and all public and school holidays were spent at the beach camps or other fishing locations. I spent considerable time with the few permanent residents at the Elim and Manbaa beach camps (Figure 1).

The initial period of the fieldwork was used to establish a rapport with members of the community. I obtained information through both formal and informal interviews, and participant observation. The general informant pool consisted of approximately forty-eight men and five women; the key informant pool comprised ten men. There is therefore a bias towards male orientated information and activities.

The formal interviews were based on the development research sequence outlined by Spradley (1979, 1980), whereby a series of descriptive, structural and contrast (verification) questions are asked over an extended period of time. Informant.reliability was tested by asking two series of questions on fishing or on the biology of fish or other animals:

questions to which the answers were already known, and

'plausible questions to which the informant could not possibly know the answers:(Johannes, 1981).

The'types of ethnobiological information which were collected on dugongs, turtles, fish and invertebrate marine resources included:

the indigenous taxonomies for such species and the total number of terminal categories known and recognised, the names and numbers of categories in successively more inclusive groups. These were compared with scientific designations for the same localities;

the structure of classifications and types of cognitive devices employed;

the uses of such species, for example, food, non-food economic uses, medicinal (dugong oil), social and religious;

knowledge of the biology and ecology of different species, for example, life histories and behaviour;

knowledge and techniques of marine resource appropriation;

knowledge and techniques of management and manipulation of the physical marine environment.

Data were obtained on the dugongs and turtles, fish, and marine invertebrates caught or collected. These data included; species, size, sex and reproductive status, location and time of catching, quantity of catch, method of catch, and identity and motive of hunter.

The ethnobiological information and interview transcripts have been incorporated into a database management system for easier handling, assessing and comparison.

All dugong specimens collected were forwarded to Dr H. Marsh (JCUNQ) for processing and analysis. The stomach contents were, analysed by Ms J. Lanyon using the technique outlined in Channells and Morrissey (1981). The remaining specimens were analysed by Dr Marsh using the techniques outlined in Marsh et al. (1984b) and Marsh et al. (1984c).

All turtle specimens were forwarded to Dr C. J. Limpus (Q.NPWS) for processing and analysis.

RESULTS AND DISCUSSION

Guugu Yimidhirr People and the Hopevale Community

Prior to European invasion, the Guugu Yimidhirr speaking people inhabited a territory extending from the Annan River north to the mouth of the Jeannie River, and west to the Normanby River area, called Battle Camp (Figure 1) (Haviland, 1979a). They also laid claim to many reefs and islands (including Lizard Island) off the coast (Haviland, 1979a; Terwiel-Powell, 1976). This territory consisted of thirty-two named locales (Haviland, 197933).

The first recorded contact with the Guugu Yimidhirr people was in June 1770, during Captain Cook's forced stay at the Endeavour River (Beaglehole, 1955). Both Cook and Banks recorded information on Aboriginal usage of marine resources (Beaglehole, 1955, 1962).

The discovery of gold at the Palmer River in 1872 resulted in Cooktown being established as the port to serve the goldfields in 1873. This resulted in an influx of miners and settlers into the Guugu Yimidhirr region. An area of 50,000 acres of agriculturally worthless land between the Endeavour and McIvor Rivers was gazetted in 1881 as an Aboriginal reserve (Haviland, 1980; Terwiel-Powell, 1976).

The Cape Bedford Mission was established in 1886 by a Lutheran missionary (Haviland, 1980). The whole community was evacuated, with disastrous results to their health, to Woorabinda (Central Queensland) in 1942 for 'security' reasons (28 people died within a month and a further 35 died during their stay) (Terwiel-Powell, 1976). The people were returned to the new mission site at Hopevale in 1949. In recent years a number of beach camps have been established from Manbaa to Nob Point. These are used extensively during weekends and school holidays.

Fishing, Marine Hunting and Collecting Techniques

Captain Cook's and Joseph Banks' journals (Beaglehole, 1955, 1962) show that some of the 'pre-contact' marine resource appropriation techniques used were the collecting of shellfish, the spearing (using a spear-thrower) of fish and crabs, line fishing using shell hooks, and harpooning of turtles (and probably dugongs). Banks specifically noted how dependent the people of the area were on marine foodstuffs.

All of these practices were still in use at the time of the establishment of the Cape Bedford mission. However, they had been modified with the adoption of modern materials such as metal harpoon heads and spear tips (Roth, 1901). All four of the methods described by Cook and Banks are currently in use. The technology and techniques of capture in some cases have changed remarkably little. For example, the womera (spear-thrower) described by Banks (Beaglehole, 1962) closely resembles those currently used for fishing. Cook noted a harpoon head in one of the turtles caught by his men, however he could not believe that the apparently frail canoes were being used to capture turtles (Beaglehole, 1955). The later discovery by his crew of numerous turtle carapaces on the islands near Lizard Island proved his beliefs incorrect (Beaglehole, 1955, 1962). Harpooning techniques are essentially the same; however harpooning now

occurs from aluminium or fibreglass dinghies (3.6 to 4.9m) with outboard motors (10 to 70hp, but mostly 25 to 40hp).

Adaptation'to, and employment of, introduced materials has broadened the mix of technologies used to exploit marine resources from four to seven,, apparently without supplanting any. This is surprising considering the loss of'marine knowledge that resulted from the combined effects of the earlier Queensland, Government policy of displacement, the'mission policy of separating children from their parents, plus the devastating effects of the removal of the whole community to Woorabinda during World War II (Haviland, 1980; Terwiel-Powell, 1976).

The collecting of sea urchins (Stomopneustes variolaris) and various mollusc species for food still occurs.

Spears, used in conjunction with a womera, remain a popular' method of capturing, fish, stingrays, crabs and crayfish. They are used either from the bow of small boats in rivers and creeks; for example, when hunting blue-tailed mullet (Valamugil seheli), or from the beaches, the fishermen often wading chest-deep into water (after stingrays).

At least two of the post-contact fishing technologies have been in use for a long time. The purchase of a fishing net was first. authorised for mission use by the Queensland government in 1898. Men were introduced to diving in the late 1800s when they laboured on the boats fishing for trochus and beche-de-mer. Diving is now limited to the younger males using spearguns for crayfish, reef fish and, more rarely, for collecting a speciesof sea urchin.

Marine Resources Used

At present 161 Guugu Yimidhirr language names and 166 recognised categories of marine animals have been recorded for the Hopevale community. Seventy-seven are currently used for food, and a further forty-one for bait. Only ten were recorded as having any other significance. These include dugongs, two species of turtle (green and hawksbill), crocodiles, one species of shark, and five species of molluscs. The species/categories recognised by Hopevale people, their uses/means of capture, relative abundance and general habitat where they were caught are summarised in Smith (1985).

The previous disruptions to community life caused by the mission and the war-time evacuation have had an effect on the amount of marine knowledge currently retained by the community. For example, although approximately seven language categories for dugongs are known by Hopevale hunters, very few people can remember all seven. These categories of dugong refer to sex, size (age), degree of fatness and the quality of the meat. Only one name is in common use at present. In contrast, John Bradley has recorded fourteen categories into which the Yanyuwa people of Borroloola still classify dugong (Bradley, this volume).

With the exception of the crocodile,, all of the large vertebrates (mammals and reptiles) previously taken are still currently being caught. In contrast, the number of types of fin-fish caught appears to have increased remarkably. This result is presumably

partly due to the greater use of fishing nets and a wider range of line fishing equipment. The lack of detailed historical information would have also biased this result.

The number of species/categories of molluscs and.echinoderms utilised has decreased, whereas the number of crustaceans collected has diversified, for instance, prawns are now caught with bait nets.

The fruits of one species of marine plant, the seagrass Enhalus acoroides, are eaten opportunistically.

Dugongs

For the last two years, dugong hunting by members of the Hopevale community has been controlled by the Great Barrier Reef Marine Park Authority and Queensland National Parks and Wildlife Service via a system of twenty individual permits. Each permit allows the holder or his nominee to catch one dugong during a four week period in December to January each year.

During the 1983/84 dugong hunting season thirteen dugongs were recorded caught by ten hunting groups. Nine were caught in the area near Murdoch Island, three near the "Hummocks" and one south of the Starcke River (Figure 1). At least one dugong was caught on eight of the expeditions, although not all boat crews were successful. Two trips were unsuccessful. On one the hunter lost a dugong after harpooning it and could not continue because of a shortage of fuel. The other failed due to engine trouble.

In the 1984/85 hunting season, sixteen dugongs were taken in the Starcke River area, and two between Lookout Point and Cape Flattery. A total of twenty dugong hunting trips were made, three being unsuccessful.

Analysis of the data and specimens obtained from these animals, indicate that dugongs of all ages, including reproductively active females, were hunted. A newly-pregnant female was caught in the 1983/84 season. In the 1984/85 season the catch included at least two lactating females, one of which had recently given birth, and three females in oestrus. The reproductive data, with respect to the age of sexual maturity and calving season, were consistent with information from other parts of north Queensland (Marsh et al, 1984d).

The hunters gave no appearance of hunting selectively for either sex. The sex ratio for the 1983/84 season was 10 males to 3 females. These were caught over slightly more diverse areas than those in the following season. However, in the 1984/85 season, 15 of the 19 dugongs caught were female. Assuming a 1:1 sex ratio, as indicated by most large samples of dugongs (Marsh et al, 1984b, 1984c; Hudson, in press), the probablity of this happening was 0.007. If the animals caught in the Starcke River area are considered separately, the sex ratio is even more striking: 14 of the 16 animals caught being female (pt0.002). This suggests that female dugongs may on occasions concentrate in the rich feeding grounds near the Starcke River, an area favoured by the hunters.

There are suggestions of a similar pattern in a very similar area near the mouth of the MacAuthur River in the Northern Territory.

The dugongs stranded by the storm surge accompanying Cyclone Kathy when it passed through this area in March 1984 were predominantly females and young calves (Marsh et al, 1984a).

During an aerial survey in November 1984, Marsh (1985) found sixty per cent of the observed dugongs (Cape Bedford to Cape Melville) were more than twenty kilometres from the coast, the largest group being eight animals. However, 'a Coastal Surveillance flight about ten days later reported a large aggregation of dugongs sheltering behind Murdoch Island during rough weather. If dugongs (especially females) do concentrate in certain areas, this has important consequences for management. Any aggregations of dugongs in areas used for hunting.can facilitate their capture, providing an opportunity for excessive exploitation. These management problems are discussed further in Smith (1985).

Turtles

During the twelve months of fieldwork'at least ninety-six green turtles (Chelonia mydas) were taken (35 female; 7 male; 54. of undetermined sex) and at least one hawksbill turtle (Eretmochelys imbricata). It was possible that another ten to fifteen turtles may have been taken which went unrecorded.

Turtles were taken mainly (depending on the time of year and weather conditions) at the Starcke River region, Forrester Reef!, Boulder Reef, Conical Rock, and the McIvor River mouth.

Reproductive data were collected from twenty-four of the green turtles caught (20 females; 4 male). The age classes for the male turtles were one juvenile, two sub-adults and one adult; and for the female turtles, two juveniles, seven sub-adults and eleven adults. All the adult females taken prior to September 1984 were preparing to breed in the 1984/85 season. None of those sampled after September were preparing to breed that season.

This indicates that the Starcke region is a feeding area, from which breeding females migrate out prior to mid-September. Courtship and mating were observed to commence in August. Those preparing to breed that coming season would have begun migrating around that time, the females mating with a succession of males, (which tend to remain in a fixed area) on the way (Limpus pers. comm.). Two turtle tag returns from the Hopevale region suggests that at least some of the population nest at North West Island (Capricorn Bunker Group).

Observations and interview data suggest that selection does occur with turtle- hunting, based primarily on the tail length and fatness of the turtle (determined by external examination of the quality and quantity of the flesh at the base of the neck). By selecting for short-tailed turtles, the hunters tend to take predominantly females, but there is also a chance of immature adult male turtles being taken. The sex of male turtles cannot be determined on the basis of tail length until they become sexually mature. The sex ratio of green turtles caught indicated that either very few adult males were in the area, or the hunters were selective. The sex ratio of the green turtles stranded at

MacAuthur River (N.T.) by Cyclone Kathy in 1984, was exceptionally biased towards females (Marsh, et al, 1984a). The Starcke River region is a very similar habitat and therefore the population sex ratio may also be naturally biased towards females.

Fish (Teleosts and Elasmobrachs)

All edible fish were kept, even quite small ones (these were often used in "soups"), by the men and women fishing. The most commonly sought fish was barramundi (Lates calcarifer). Most barramundi were caught in nets. The rest were speared or caught on lines.

From September to early December, the blue-tailed mullet (Valamugil seheli) were sought during their breeding migration. They were nearly always speared either up the Endeavour or McIvor Rivers, or when they ran in schools along the beaches either side of Cape Bedford. Numbers caught per boat (2 to 4 people) per trip (about 3 to 4 hours) varied considerably. With good conditions and accurate spearing, thirty or more could be taken in a couple of hours. Usually, however, the number was less than ten per trip. The majority of those taken in the second week of December had spent gonads. This tends to indicate that spawning may have occurred around the full moon in early December, although no Hopevale fishermen had seen or heard of spawning aggregations at any time.

After the first thunderstorm of the wet season, various species of stingrays were considered to be in season. The actual time varies for different species, but is indicated by the fullness and pinkish-white colour of the liver. The favoured species were: long-tailed ray (Himantura uarnak); mangrove ray (H. granulata); cowtail ray (Dasyatis sephen); and the thorny ray (Urogymnus asperrimus). Other species were also taken occasionally. During the 1984/85 Christmas holiday period, at least eighteen stingrays were taken, probably more.

Invertebrates

The most commonly used crustaceans were the mud crab (Scylla serrata) and the sand crab (Portunus pelagicus). These were taken at low tide on the intertidal flats or on rising tides amongst the mangroves. All sizes of both sexes were taken by spearing (especially by young boys practising spearing).

Hermit crab species occupying Telescopium telescopium and Terebralia spp shells were collected, often by the sack-full, from the mangroves at low tide for use as bait.

Locations

Although hunting trips to catch dugongs usually involved a 50-nautical mile voyage up to the Starcke River area, most of the other fishing activities occurred closer to the beach camps.

Netting for fish occurred mainly in the areas adjacent to the beach camps from Elim to the McIvor River, and occasionally in the creeks in the Starcke River area.

Line fishing occurred along the whole coast, especially the inshore reefs, and the creeks and rivers.

Spearing occurred in the Endeavour, McIvor and Starcke Rivers, and all the tidal creeks. The mouth of the McIvor River was a popular place for stingrays., With the right weather conditions, spearing of fish (such as mullet and trevally) occurred off the beaches.

The areas of heaviest use were the McIvor River (fish), the Starcke River region (turtles, dugongs), the 'Wharf' creek at Cape Bedford (fish), the Endeavour River (blue-tailed mullet), and the beaches from Elim to the McIvor River (nets). However,, the hunting and fishing activities of Hopevale people can occur along approximately 200 kilometres of coastline from the Annan River north to Red Point (Figure 1).

The preferred weather and tidal conditions for fishing depended largely on the type of fishing and which species were being sought.

In general, the spring tide periods (especially the full moon) were preferred for netting, line fishing, and turtle and dugong hunting. Within these periods however, the timing of the high and low tides was important for different activities.

The spring tides were preferred for beach netting and dugong hunting over the broad intertidal flats, due to the relatively brief period the water covered the area. The fishermen and hunters believe a greater number of fish and dugong rush into these areas because of the short time available to feed relative to neap tide periods.

The south-easterly winds which predominate from about April to October severely restricted fishing and hunting activities as they cause rough seas.

Fishing activities were influenced to a great extent by outside factors such as school/work holiday periods, the GBRMPA restrictions on dugong hunting, and road and sea conditions. A variable number of retired or unemployed people spent considerable time engaged in fishing activities.

Seasonality

This is an important determinant of which marine resources were used. The seasonal availability of some of the more commonly used marine resources are shown in Figure 2. There was a strong preference for 'fat' animals. Stingray species, for example, were only speared during the wet season when their livers were 'full'.

Figure 2. Seasonal availability and exploitation of some of the marine resources by the **Hopevale** community. (Note: (XXXXX) heavy, (xxxx) medium, and (....) light levels of exploitation - relative only.)

RESOURCE	J	F	M	A	M	J	J	A	S	O	N	D
DUGONG*	xxx											x
GREEN TURTLE	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx											
BLUE-TAIL MULLET								..xxxxxxxxxxxx...				
STINGRAYS	xxxxxxxxx.....								.	..xxxxxxxxx		
GUULUU (SEA URCHIN)						....xxxxxxxxxxxxx....						
FISH (GENERAL)	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx											
FRESHWATER FISH	xxxxxxxxxxxx.....xxxx											

* now regulated by GBRMPA permits.

The sea urchin (Stomopenustes variolaris) was only taken from July to about September when their gonads were developed.

The blue-tailed mullet were only taken during their breeding migrations, September to early December. Their roe and fatty flesh were very popular.

Sand and mud crabs were taken all year round, but were considered fattest in the winter months, especially around full moon.

Occasionally, floral indicators were used to indicate the more common seasons. For example, Grevillea pteridiifolia flowering indicates the season for the sea urchin; Oscillatoria blooms are indicators of oysters being 'fatter'; the flowering of an Acacia sp. indicates the blue-tailed mullet season.

CONCLUSION

Although this study is still incomplete, the preliminary results obtained show that there is considerable knowledge and information to be acquired from working with fishermen and hunters from Aboriginal communities.

These interim results have been used to provide GBRMPA with recommendations that could be used in the development of a management programme for usage of the marine resources by Aboriginal communities adjacent to the Marine Park on the east coast of Cape York Peninsula (Smith, 1985).

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WORKSHOP DISCUSSION

The discussioncovered the following points:

In the Hopevale community stingrays with a 'fat' liver are claimed to be more palatable, but it is not known,, whether they are more nutritious in this condition.

The women in Hopevale' and other communities have the main responsibility for collecting.

Dugong and turtle hunting is predominantly a male activity for the Hopevale community.

ABORIGINAL TENURE OF THE SEA IN NORTHERN ARNHEM LAND

Stephen Davis

INDRODUCTION

In 1931 Arnhem Land was legislatively reserved for the use of Aboriginal people who had traditionally occupied the area. Within this area the coastal Aboriginal people of north-eastern Arnhem Land may be considered an homogenous group both culturally and in terms of their exploitation of marine resources. They refer to themselves as Yolngu (a vernacular term meaning Aboriginal man) and are variously referred to in the literature as 'Murngin' (Warner, 1937), 'Wulamba cultural bloc' (Berndt, 1951) and currently as the Yolngu bloc.

The Yolngu world is divided into two patrilineal moieties, **Dhuwa** and **Yirritja.** Each person is born into a patrilineal group (clan) within one of the moieties which afford them, among other things, economic use of particular tracts of land and/or sea (commonly referred to as estates), and confer attendant ritual responsibilities. Yolngu also obtain varied rights to other tracts through their matrilineal affiliation.

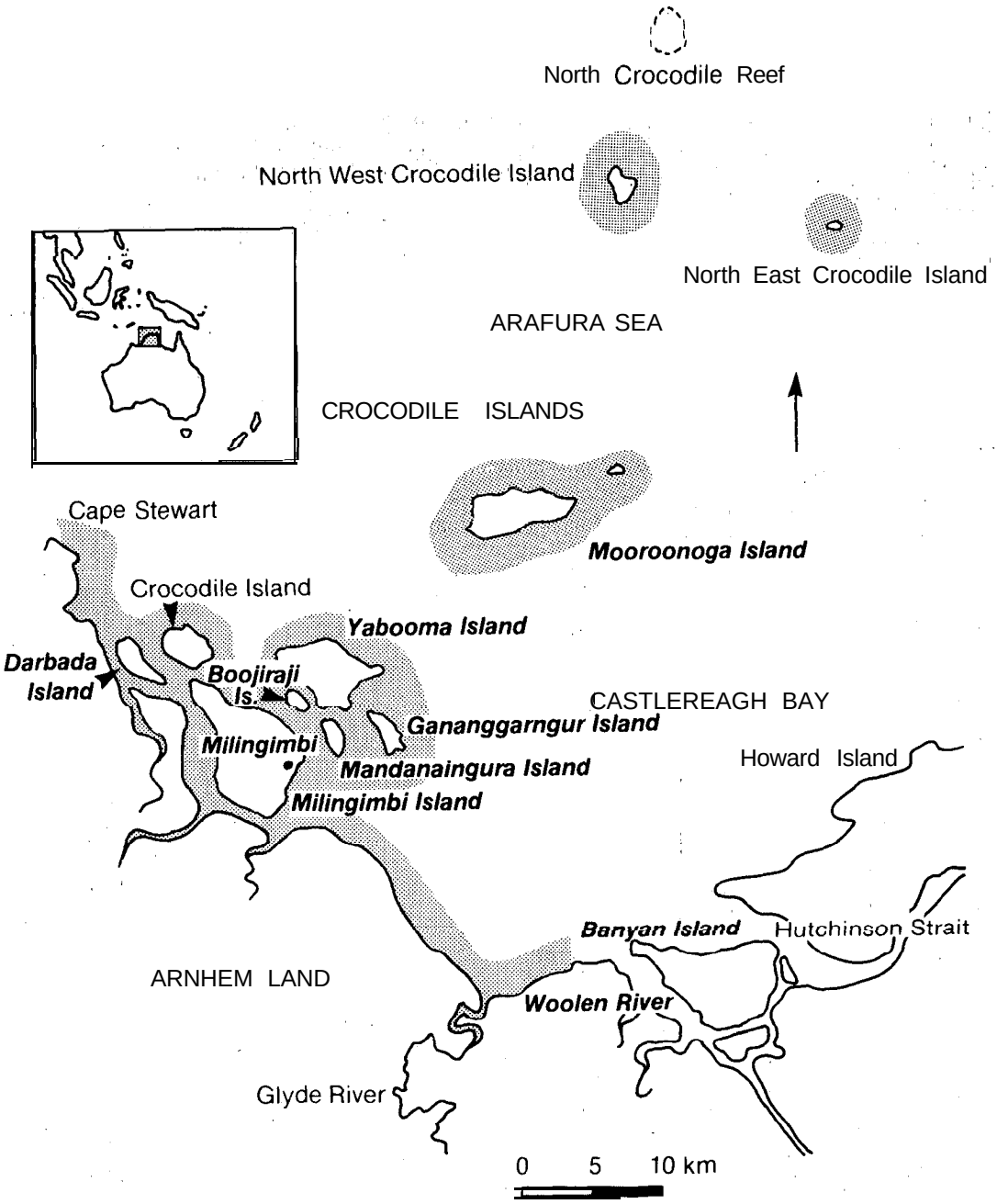
The Crocodile Islands and Castlereagh Bay area of north-eastern Arnhem Land renresents seventeen clan estates, each ranging from the mainland and inshore estuarine localities to offshore islands, reefs and sand-bars up to eighty kilometres from the mainland (Figure 1). The marine component of each estate averages approximately 320 square kilometres. I conducted my initial research among the Yolngu with whom I lived for three years from 1979. The Northern Territory Fishing Industry Research and Development Trust fund then afforded an opportun ity for a continued research programme specifically to examine tenure of the sea among the Yolngu in view of present legislation affecting the use of seas and future management programmes. The research programme included documenting the boundaries of clan estates, economic zones, sites and paths of ancestral activity, the location of residential and hunting camps and the knowledge and use of the sea and foreshore throughout the yearly cycle.

ACKNOWLEDGEMENT OF ABORIGINAL RIGHTS

From earliest contacts, Aboriginal people on the, northern Australian coast have asserted rights over seas adjoining the coast. Many accounts of contact give evidence of, or acknowledge, Aboriginal rights over the sea. Prior to European contact with Aboriginal people in Arnhem Land there were at least three sources of non-Aboriginal contact (Berndt and Berndt, 1954).

Aboriginal people speak of the **Baydjini** people who came from the north-west beyond the Arafura and Timor Seas, travelling on the monsoons in praus and bringing with them women and cloth. They stayed long enough to cultivate the land and build permanent stone dwellings. Berndt and Berndt (1954) record stories from older Aboriginal people which suggest the **Baydjini** originated from the East Indies.

Figure 1. Locality map of the Crocodile Islands, Castlereagh Bay, Northern Territory, delineating closure of seas in the, Milingimbi and Glyde River areas.



Contact with another group of people known by Aborigines as the **Badu** is recorded in a cycle of songs which deals with pre-European contact (Berndt and Berndt, 1954). The **Badu** people came from the north-east, an area which is mythologically associated with the spirits of dead Aboriginal people. The third and major pre-European contact with Aboriginal people in Arnhem Land came from the Macassans of Celebes. These contacts, which began perhaps as early as the sixteenth century, were much more frequent and continued well into this century, as recently as forty years ago (Berndt and Berndt, 1977; MacKnight 1969a, 1976).

The Macassans attempted to develop a good relationship with Aboriginal people, whom they often needed to supplement their labour force to fish for trepang. The Macassans also traded for rights to set up camps and for access to fresh water. These same rights were acknowledged in a letter carried by Captain James Cook in 1768 on his voyage to the southern continent in the Endeavour. The letter, from the President of the Royal Society as co-sponsor of the voyage, gave Cook the following advice in relation to indigenous persons:

> They are the natural, and in the strictest sense of the word, the legal possessors of the several regions they inhabit. No European nation has a right to occupy any part of their country, or settle among them without their voluntary consent.
> (Beaglehole, 1955)

From earliest known contacts, then, various acknowledgements have been made of Aboriginal rights over territorial seas and the economic resources therein, whether by payment, recompense or otherwise.

TRADITIONAL ECONOMIC RIGHTS

Each clan group among the Yolngu acknowledges the rights of other clan groups over particular areas or estates encompassing the sea and foreshore. These estates are not always continuous and may be composed of a number of areas encompassing different habitats. This distribution allows exploitation of resources in differing areas at various and appropriate times of the year. A common spread of such areas shows a marked break-up of localities consistent with seasonal differences in the availability of fish, shellfish, turtles, dugongs and other sea resources such as turtle eggs. The boundaries are rigid and rarely, if ever, subject to dispute among Aboriginal people.

Aboriginal people consider their estates as encompassing all parts of their territorial seas which extend from the land to the seaward horizon, as viewed from the shore, with that area beyond the horizon being "for government".

It is a mark of the responsibility of a man for his estate that he should hunt and fish on it and occupy it. Yolngu regard hunting, fishing and foraging as responsible management.

The management of naturalresources is an integral part of 'owning' land and sea in the Aboriginal sense of ownership. This is not so much a 'matter of 'owning' as it is a matter of fulfilling obligatory responsibilities. One might say that it is not a state of having or possessing land and sea in such a way as to be able to legally effect disposal or sale, but that of being an inseparable part of the estate.

The act of ownership requires physical management such as systematic burning in order to "clean up" land, 'harvesting from land and sea, maintaining ritual song cycles in the performance of ceremonies, and other similar activities, which are obligatory and fulfil spiritual responsibilities. Such management is the responsibility, and prerogative of particular senior men. To not perform such acts leaves one open to. accusations of gross neglect by other custodians who may also have specified rights to 'those same areas of land and sea.

POPULATION MOVEMENT PATTERNS

The Crocodile Islands and Castlereagh Bay area are daily traversed by members of the residential clan groups for the purposes of hunting, travel to adjoining clan areas for ceremonies and travel to central communities such as Milingimbi, Nangala and Galiwin'ku.

This movement of people is a daily occurrence much as might occur in any local population area.

However, in terms of seasonal movement there is a high positive correlation between the changing emphasis on different kinds of marine food resources and the movement of Yolngu through the Crocodile Islands and Castlereagh Bay area during the yearly cycle.

Yolngu knowledge of seasonal fish movements would lead one to positively correlate such movements with Yolngu population movements. However, Western marine biology has little knowledge of such seasonal fish movements. In view of the lack. of such base data no reliable evaluation of Yolngu knowledge may be concluded with reference outside its own system. One must then take such knowledge at face value and evaluate it within the system in which it operates. This assumption suggests that Yolngu population movements display a high positive correlation with the movement of fish within the Crocodile Islands and Castlereagh Bay area.

Similarly the 'fat' cycle is a phenomenon about which little is known by western biologists. The emphasis on the condition of the food source being in prime condition (djukurrmirr: fat-possessing) again shows a high positive correlation with the seasonal movement of Yolngu populations. This fat-possessing quality extends to fish, crustaceans, molluscs, birds, mammals and reptiles.

The seasonal movement pattern from a sedentary wet season existence through to the highly mobile hunting groups of the dry season is underpinned with considerations of potential product value and prestige in visiting particular economic and camp sites. Consideration of rights of access to estates punctuate planned hunting expeditions while asserting rights in succession to estates may often be the motive for dry season occupation of sites on mother's or mother's mother's estates.

The seasonal Yolngu population movement pattern, then, is the product of interplay between the political, social and economic spheres of Yolngu life.

The following account of the Yolngu calendar illustrating Aboriginal seasonal activities and knowledge of the littoral zone is based on my fieldwork from 1979 to 1981 supplemented with regular field trips from 1982 to 1984 with intensive regular fieldtrips at the height of each season as sponsored by the Northern Territory Fishing Industry Research and Development Trust Fund.

TRADITIONAL KNOWLEDGE AND SEASONAL USE OF THE LITTORAL ZONE

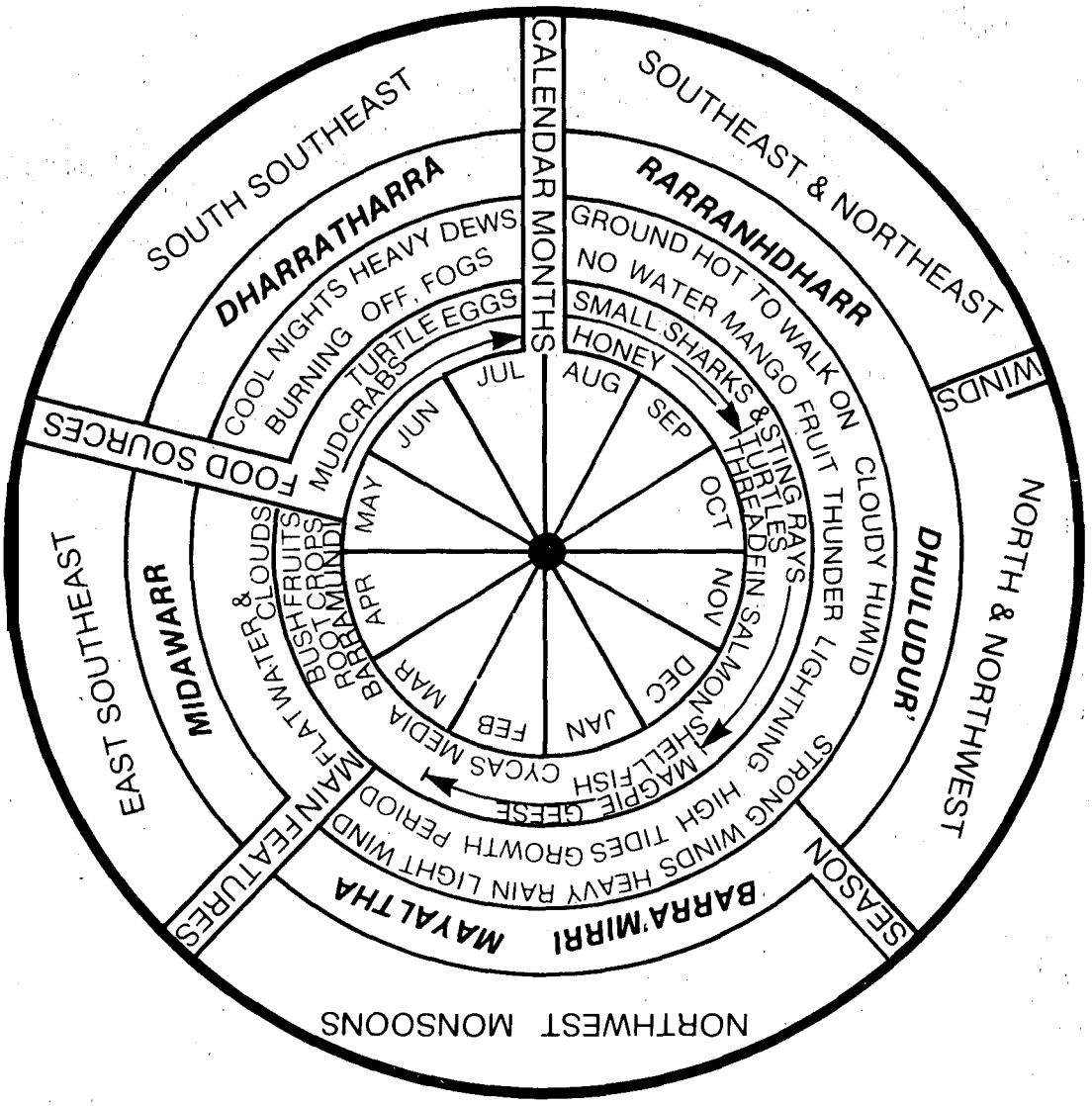
Seasonal calendar

Yolngu generally recognise six major seasons in the yearly cycle of natural events. Each season is heralded by distinct changes in faunal, floral and climatic conditions. Aboriginal people view the natural environ a-s. a total, integrated. system of which they are a part.

The main seasons which they recognise correspond roughly with our seasonal calendar as follows:

Dhuludur': The pre-wet season (October to November)
Barramirri: The growth season (December to January)
Mayaltha: The flowering season (February to March)
Midawarr: The fruiting season (March to April) including Ngathangamakulingamirri: (harvest season of about two weeks) (April)
Dharratharramirri: Early dry season (May to July) including Burrugumirri: (birth of'sharks and stingray, about three weeks) (July to August)
Rarrandharr: Main dry season (August to October)

Figure 2. Yolngu seasonal calendar. The months of the year have been included in the calendar only for oridntation purposes.



Pre-wet season

During the late dry season and pre-wet season, daily hunting activities extend to the most seaward regions of Yolngu marine estates. The calmness of the sea makes this the safest season to travel. The clear sky assists Yolngu sea voyages which at times rely upon celestial navigation, especially for longer voyages. Such voyages occur less frequently now with the ready **access** to charter aircraft and relatively abundant supply of money for such charter.

Traditionally, long voyages and hunting trips extending over many days involved hunting parties requiring access to several estates and thus the party included members of a number of clans.

During the pre-wet season tidal amplitude is large and the floodplains are covered with water for the first time since the fruiting season in the last wet season. The sea is flat and the water is clear. The weather is still cool during the night, as it was in the main dry season, with mists settling in the stillness of the night and rising early in the morning after the light north-west wind has started blowing. Just before dawn it is cold and the stars shine brightly through clear skies. The winds are mixed, with the south-west, the south-east, north-east and north-west winds, each blowing at different times, often within the same day.

Yolngu believe that the 'male' thunder that comes early in the pre-wet season shrinks the water holes. When the sky is covered by heavy cloud most of the day, the 'female' thunder brings the rain.

Along the shoreline, the incoming tide often brings floating pornupan mangrove (Sonneratia alba) flowers.

The green turtle (Chelonia mydas), flatback turtle (Chelonia depressa) and hawksbill turtle (Eretmochelys imbricata) are the most commonly hunted turtles at this time of year. Before the storms of the wet season the calm seas allow extensive trips to the furthest turtle hunting grounds.

With the extreme low tides of the pre-wet season, false trumpet shells (Syrinx aranus) and yellow bailer shells (Melo amphora) are found in abundance on the exposed sand bars, especially those surrounding reefs. Cooperative hunting trips of men from various clans are arranged to exploit these shellfish. On the reefs themselves and the rocky shorelines of the outer islands, black lipped oysters are 'fat' and are constantly harvested by women throughout the pre-wet season. The occurrence of the largest of such oyster beds is on the seaward islands of the Crocodile Islands, including Murrungga and Gurriba Islands.

Close into shore Pinctada and Pinctada maxima are the main shellfish collected. At the edge of the mangroves, oysters (Saccostrea tuberculata) are found attached to the aerial roots of the small-stilted mangrove (Rhyzophora stylosa). This shellfish is also found in abundance on the mangrove roots overhanging the water of small tidal creeks.

The lined nerite (Nerita lineata) is yet another shellfish which is found on mangrove trees. Unlike the oyster it does not attach itself to the roots. Rather, it crawls on the roots and the trunk of the tree. Oysters are always cooked in hot ashes whereas the lined nerites may be either cooked in hot ashes or boiled.

The shellfish Geloina coaxans is collected from the mud further into the mangroves. Shells which have been broken open are often found strewn around the mud. The thick shell has been crushed by mud crabs (Scylla serrata) which come with the rising tide to look for food. During the pre-wet the mud crabs are no longer fat'. There is considerably less emphasis on inshore shellfish resources during the pre-wet.

The barramundi (Lates calcarifer) move back to the mouth of the creeks and around the mangroves before they swim up the creeks to breed during the heavy rains.' Yolngu men often idle their boats close to the banks in the quiet waters of the tidal creeks in search of the barramundi. Such fish are taken by a single hunter with his spear poised in the bow of the boat. As in turtle hunting, the spearman in the bow gives discrete direction and speed signals with his fingers. The men most often engaged'in such inshore hunting are from clans with estates fringing estuarine areas or from distant estates but now living in central communities. Inshore hunting from boats is generally an ad hoc activity in that it most often takes place close to the central community. The hunt only actively engages one hunter. Such hunting thus often take's place en route to another destination or while waiting for someone at the predetermined 'landing' or meeting place, which consists of a clearing in the mangroves fringing the mainland.

During the pre-wet season the threadfin divide into two groups. Sheridan's threadfin (Polydactylus' sheridani) move to the creek mouths with the barramundi, while giant threadfin (Eleutheronema tetradactylum) swim out to join other fish around the reefs. Skinnyfish (Scomberoides lysan), spotted trevally (Caranx melampygus) and queenfish (Scomberoides tala) move out into the deeper water' around the reefs. Yolngu with estates encompassing the offshore islands fish the shallow reef water on the incoming neap tides. Birds which flock to dive at the young great trevally (Caranx nobili,s) which live in the shallow waters surrounding the reefs, are used by Yolngu to indicate the presence of fish. In this same locality threadfin swim in the,, pre-wet season. Barracuda (Agrioposphyraena barracuda) have moved out past the reefs into the deepest water and will return later in the wet season.

Towards the end of the pre-wet season the rain is brought only by the north-west wind. It rains,almost every evening. This is the start of the next season which is signified by heavy rain and an abundance of plant growth.

The season of heavy rain and plant growth

The abundance of water which fosters the growth in plants also brings new populations of mosquitoes which infest the mangroves. However, mangrove worms are, considered so deliciously fat, that even the mosquitoes, are tolerated in order to gather them.

Although mud crabs, which also live in the mangroves are frequently encountered, they are not 'fat' until early in the dry season and so are not hunted by Yolngu.

The black-lipped oyster will not be 'fat' again until the north-east wind returns in the dry season. With the change in weather conditions other shellfish are not fat. These include the turban shell (Subinella anguis), the giant gem chiton (Acanthopleura gemmata), P. hiantina, Anadara granosa, the telescope mud creeper (Telescopium telescopium) and the lined nerite.

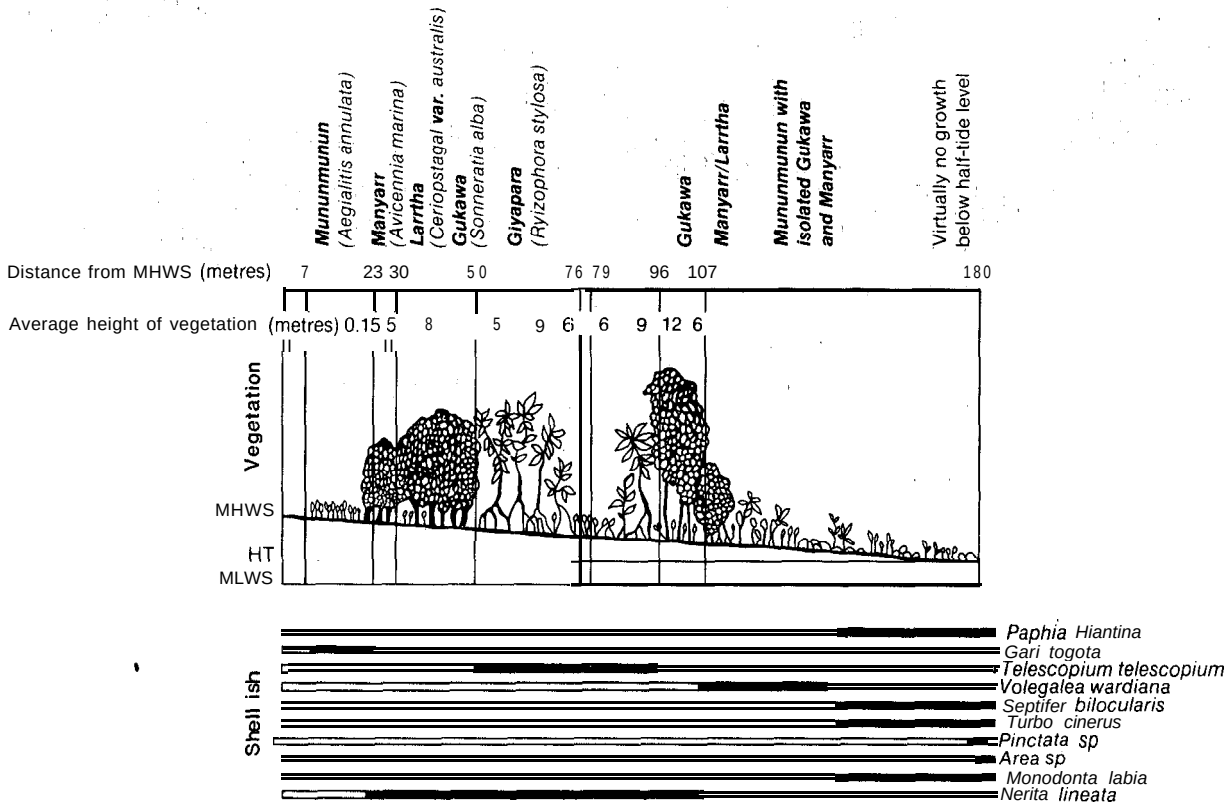
Along the beaches young tamarind trees (Tamarindus indicus) sprout from the seeds which had ripened in the dry season. The large tamarind trees are bright green with all their new growth.

Further down on the beach there are often large swarms of dragonflies (Notoneura sp.). They swarm on the north-west wind and hover around the water's edge and often a little further inland past the beach. When this swarming occurs regularly, the sea mullet (Mugil cephalus) and the diamond-scaled mullet (Liza raigienis) are considered to be fat and can be caught as soon as the seas are calm. Such fishing is limited to sheltered inshore areas. Barramundi can be found swimming lazily along in the quiet water under the overhanging mangrove trees in the creeks. Soon they will be found in large schools moving around past rocky areas and beaches as they begin to populate tidal creeks and mangroves in search of food. When barramundi are searching for food like this, they lose the black on their backs which developed when they were feeding near-t-he--fresh water. Sheridan's threadfin has left the giant threadfin and is living with the barramundi. They will stay together until later in the dry season. Salmon catfish (Netuma thalassina) and blue catfish (Neoarius australis) are also moving from the creek mouths to the mangroves and are fat. Turrum are living around the rocks and small reefs close in to the islands. Skinnyfish are living with the turrum, but also move along the edge of the beaches when there are very high tides. At this time of year the tides start to become higher than normal. A few days after the full moon the highest tides occur. These are the spring tides. Soon, the soil is soaked with rain and most of the later rainwater lies on top of the soil.

Yolngu withdraw from hunting camps on the outer islands. Fishing and turtle hunting activities are quickly curtailed. Yolngu move to more permanent campsites which generally afford access to extensive shellfish beds and mangroves which are gleaned daily. Shellfish gleaned by Yolngu women from such systems often yield in excess of sixty per cent of the daily diet. Women forage as the receding tide exposes successive shellfish beds.

Yolngu delineate zones in the mangrove system by the distribution of the dominant species of mangrove flora. These zones are labelled by Yolngu, as in Western scientific taxonomies, by the dominant floral species. Each zone has particular species of shellfish associated with it (Figure 3).

Figure 3. Mangrove vegetation and shellfish habitats at Top Camp (Ngamuyani).



The high spring tides rise up the creeks and meet with the rain water flowing out of the bush. All the water joins together and floods the saltpans and grassy floodplains. These areas stay full of water until the end of the wet season. This is the time when the barramundi swim up across the floodplains and are easily speared in the grass.

The barracuda move back from the deep water and can be caught close into the rocky shore of the islands. They appear to frequent localities where the water runs deep and fast. Black-finned long-toms (Tylosurus melanotus) leap up and fish-tail across the top of the water, often for long distances. Yolngu consider them good to eat during the heavy rains. Often young long-toms can be seen swimming in the sheltered waters of the creeks while larger ones are found almost anywhere in the open water. They are caught by opportunistic hunters using spears from the bow of an idling dinghy.

As the north-west wind brings storms daily, the sea is dirty and rough so most fishing is done close to shore and around the creeks. Purple tusk fish (Choerodon cephalotes) and other reef fish are 'fat' but Yolngu often believe weather conditions to be too dangerous for people to travel out to reefs and other islands. Violent rain squalls quickly spring up and small dinghies may not be able to outrun them. There are still plenty of stringrays inshore, but the water is usually too dirty or too rough to be able to see them before the presence of the hunter frightens them and they escape.

Sharks such as the black-tipped shark (Carcharhinus spallanzani) and the lemon shark (Carcharhinus amblyrthynchoides), which were born in the middle of the dry season, are now living around the mouths of the creeks and along the edges of the mangroves. Later in the wet, they will move further out into deep water, with the black-tipped shark subsequently frequenting the reefs.

Sometimes there may be a calm day when turtles can be seen, but mostly it is too rough to hunt turtles. There are no turtle eggs to be collected until the dry season.

Soon the bush passionfruit (Passiflora foetida) flowers. Many other plants flower, and the rain becomes infrequent and sometimes stops for several weeks. These are indications that the season of heavy rain and growth is drawing to a close and the season of flowering plants is starting.

The flowering season

The flowering season is a season of short duration. It marks a distinction between the main wet season, being the season of heavy growth, and the fruiting season.

The sandflies appear when the sandy soil dries out, and they stay until the next rain. Mosquitoes appear in large numbers after every rain. This signals to Yolngu the change of seasons which brings the time for plants to flower. During the flowering season the trunks of many trees are covered by lush green vines but there is very little bush food.

The flowering season is so called because of the abundance of plants that flower at this time. Among the grasslands and throughout the bush, small plants flower wherever growth is possible; Generally these small plants are like grasses and are only significant in that they confirm to Yolngu that the present season is the flowering season.

Shellfish continue to be gleaned from beds adjacent to the wet season camps but fishing activities are infrequent, 'as in the previous season. Food sources have changed little since the previous season.

The fruiting season

The wind changes from north-west to the north-east, bringing rough seas and heavy waves which crash onto the shore; 'Early in the fruiting season the storms still bring heavy rain daily, often with thunder and lightning., The deep sea is heavy and rolls with large waves. Travel across the sea at this time is considered very dangerous.

By the middle of the fruiting season the wind has changed to the east and the heavy storms are less frequent. Light easterly winds blow throughout most of the day bringing cooler weather.

When the mango trees shoot new leaves, which are, red, the first south-east wind blows gently in the early morning before sunrise. Shortly after sunrise the east wind blows and continues for the rest of the day. The seas are very flat at this time and it is often hard to see where the sea ends and the sky starts, because the horizon is lost in the reflection of the sky on the sea. Th'is is the time for turtle hunting.

Turtles begin to lay their eggs again, but serious hunting for their eggs will not occur until the dry season. Turtle hunting is a daily occurrence during the fruiting season with flatback, green, loggerhead (Caretta caretta) and' hawksbill turtles being common: Dugongs (Dugong dugon) may be hunted at night during the fruiting season. Yo ngu state that dugong sleep on the surface and are carried by the sea currents. On moonlit nights dugongs can be found floating in the channels. It is easy to follow the channels because white foam marks the middle of the channel where the dugong sleeps. Hunters quietly follow the white foam line in the moonlight until they see a sleeping dugong and spear it with harpoons.

The first turtle spearing is generally around the time of the last wet season storm. This turtle forms the focus of a turtle hunting ceremony in which all people in the local community participate. The turtle is decapitated. The head is given to the captain of the boat. The internal organs are removed th'rough the neck opening created by the decapitation. A large fire is then built and a layer of stones, each of approximately ten centimetre diameter, is placed on the firewood. The turtle carcass is then placed on the layer of stones and the fire lit. When the wood has burnt down to coals the turtle is removed and the hot stones placed inside the carcass through the neck opening

and the carcass is then replaced on the hot coals. When the turtle is cooked the lower epidermal shell is removed to allow access to the meat. This part of the shell is taken and stood vertically in the sand in an area of the beach immediately adjacent to the fire. A mock turtle hunt then takes place. The women dance in a large circle, surrounding the performance. A man with acknowledged senior ritual status dances as the spearman with harpoon and rope in hand. Several men hold the turtle rope in line as the spearman advances on the lower epidermal of the turtle shell which has been stood vertically in the sand to represent the turtle in the hunt. Each advance and retreat matches another verse in the song cycle which is sung to accompany the dance. This ceremony signals the 'opening' of the turtle hunting season.

With the growth of so many plants providing food sources in the bush during the fruiting season, there is not as much emphasis on shellfish. Only a handful of shellfish species are eaten during the fruiting season. Tapes hiantina accounts for most of the shellfish collected during this season, while the balance is made up of Modialis proslivis, Gafrarium tumidum, Pinctada chemnitzii, P. maxima, P. sugillate, Gari togota, and Ward's volema (Volegalea wardiana). All of these species are fat during this season. As the next season (the early dry season) approaches, the black-lipped oyster will become fat and can be found on the rocky shoreline and reefs of outer islands where the water is clear. The lined nerite will be collected in great numbers in the mangroves by people hunting for mud crabs.

The heavy rain and high spring tides early in the fruiting season bring flooding along the grass-covered floodplains and the saltpans. The barramundi may again be found in this shallow water where they are easily speared. Otherwise, barramundi are usually found in the mangroves, or around the rocky areas close to the mangroves.

Hunting fish across the floodplains is undertaken by individuals with spears. Sometimes men sit in trees above gutters leading to the main watercourses waiting for fish to pass on the ebb and flood tide.

Thomson (1937) documented many cooperative fishing parties across the inundated floodplains. Such cooperative efforts involved the construction of large fish traps and weirs which redirected the fish to catching baskets: Thomson also noted the use of fish fences in much the same way as commercial fishermen use nets for barramundi. On Gurriba, Murrungga, Mararrtharayngur and Yurriwi Islands the rock base for the fish fences remain in place. These were often used in the wet season when sea travel was at a minimum and in island locations where there was little access to appropriate wet season shellfish beds such as mudflats and mangroves. Such fish fences were also used on inshore islands, but more particularly in the late wet and early dry season, due to the reliance on shellfish during the wet season.

During the fruiting season, Sheridan's threadfin live closely with barramundi and skinnyfish which have come in from the outer islands and reefs.

Giant threadf in which were commonly found with skinnyfish early in the wet, have moved out to the shallow offshore reefs to live with great trevally. Turrum move further out from the mainland and join the large barracuda which are returni'ng from deeper water. Towards the end of the wet, the sea becomes calmer, with the 'east wind blowing gently. This is, the time when purple tusk fish, pikey break (Acanthopagus berda), black-spot tusk fish (Choerodon schoenleinii) and most reef fish are becoming fat.

The changing weather conditions and increased availability of fish and shellfish on offshore islands leads to a general feeling of expectation among Yolngu who start to plan hunting expeditions. Older men often sit under tamarind trees on the beaches discussing the weather conditions and the likely abundance of fish and turtle eggs at various offshore locations.

There is considerable prestige attached to the first offshore hunting t'rip of the dry season. The success of such a trip must be ensured, for an unsuccessful trip may'be an outstanding embarrassment and temporarily diminish a man's power to co-opt: people into joint ventures through his accumulated obligations and alliances. Therefore, with mutual understanding to the potential prestige of a successful hunt, senior men discuss possible hunting grounds and the composition of hunting parties which will ensure access to such sites.

Towards the end of the fruiting season, the days are becoming much more like the dry seson. But, in the small harvest time, when most plant food is ready in the bush, the weather often builds up to threaten a storm. Then, when the grass, Heteropogon contortus, has dried out and is bending with the weight of seed, one last storm of the wet season comes and flattens it. This storm is brought on the strong south-east wind, which is the main dry season wind. Sometimes, isolated fires have already been lit, but the real burning off is held back until early in the dry season, the next season.

The early dry season

After the first storm in the early dry season the winds vary in direction. Heavy dews come with the light east-south-east to south-east wind that blows every night. The nights are cool with mist early on some mornings. When well into the ea'rly dry season, 'the south-east kind swings further south and becomes south-east to south-south-east and is stronger. The salt pans dry out and the plant Arthrocnemum leiostachyum turns red.

The lined nerite and Gelonia coaxans are the only shellfish which are significant in the mangroves during this season. Not all shellfish which were eaten earlier in the year taste good during the dry season. With changes in the weather conditions the taste of some shellfish change. Shellfish which Yolngu eat at this time of the year are: the faded sunset shell (Asaphis deflorata), Tellina linguafolis, Tapes variegata, the turban shell, Gari togata, Anadara granosa, Septifer bilocularis, Lopha folium, Gafrarium tumidum, Latona cuneata, Modialis proslivis, Nerita polita and Nerita ambicilla.

Crustaceans which are common in this season include: immature and mature mud crabs, sand crabs (Portunus pelagicus), horn-eyed ghost crabs (Ocypode ceratophthalama) and fiddler crabs (Uca sp).

Preparations are completed for the first of the dry season hunting expeditions to offshore islands such as Gurriba and other coastal localities such as Ngandwa (Cape Stewart) which are still not accessible by land because of flooding. The shafts of turtle harpoons have often been renewed. Similarly new ropes have been acquired and fitted to the harpoon tips which have been ground to a fine point.

If the north-west monsoons persist into early May then it is very likely that the first major hunting expedition will coincide with the nesting of the crested tern (Sterna bergii). The crested tern lays a single egg on the sanaimmediately adjacent to the beach above the high water mark. Approximately one week later a second egg is laid. The eggs are much sought after by Yolngu. Turtle eggs are invariably found in close proximity to the crested tern colonies. There is considerable social pressure to time the expedition such that both an abundance of turtle eggs and crested tern eggs are collected.

However, to arrive at the tern colony before the first egg is laid or later when embryos have formed in the eggs thus making them unsuitable for consumption is a considerable embarrassment to the hunters and one which will not quickly be forgotton by other senior men.

The product of the hunt, then, is seen by Yolngu to be a concrete validation of one's knowledge of the marine environment. Knowledge is power and thus the diminished product of an expedition caused by any one of a number of circumstances such as inappropriate timing of the hunt, inexperienced boat handlers or unreliable equipment may compromise the social and political status of the senior organisers of the hunt.

Early in the dry season the sea is the most significant place for food. Barramundi, Sheridan's threadfin and the giant threadfin are the most important fish because of the large amount of fat they have. Other fish which are a common food source during this time are; skinnyfish, salmon catfish, diamond-scaled mullet, pikey bream, mangrove jacks (Lutjanus arrgentimaculatus), purple tusk fish, estuary rock cod (Epinephelus tauvina) and sea mullet.

Yolngu start fishing in earnest and often set up hunting camps of single day or overnight duration in the early dry season. For an overnight hunt the catch on the first day is cooked with the hunters consuming their fill. The catch on the second day and the cooked remainder of the first day's catch are returned to the main camp at the conclusion of the hunt. For long trips only the fish catch from the final two days are returned to the main camp or settlement. Turtles are kept live for the return journey. The location of turtle nests are noted with excavation often being left until the final days of the hunt so as to minimise cartage and ensure the freshness of the eggs.

When the south-east wind blows stronger in the latter half of the season, most fish that live near the reefs move away to sheltered water near the shore. Skinnyfish can often be found near the barramundi, which come in to feed on the small mangrove plant Aegialitis annulata around the rocky areas of mangroves. Where A. annulata grows in the mud, Yolngu say that Sheridan's fhreadfin and giant threadfin come in and use their long whiskers to find food in the muddy water.

Although most of 'the five common marine' turtles can be found at some time in the early dry Season, the green and the flatback turtle are the most commonly hunted.

"When Pandanus yirrkalaensis fruit starts to change from green to red, then the early dry season is nearly finished. As soon as, the first fruit drops to the ground, the flatback turtle starts to lay its eggs. At the same time the red flowering Kurrajong (Brachychiton paradoxis) has lost all its leaves and begins to flower. This indicates to Yolngu that sharks are giving birth to their young and the early dry season is over. The next season, the, main dry season, does not start immediately.

The north-east, south-west and south-east winds vary for a few weeks. These are signs that the early dry season has finished.

Morinda citrifolia produces fruit, Grevillea pteridiifolia flowers produce nectar and Eucalyptus confertifolia is flowering, from which honey is produced. Acacia torulosa is also flowering, indicating that sweetlip (Lethrinus chrysostomus) are good to eat and may be found around reefs. Acacia auriculiformis flowers, and this is associated with turtles having a lot of fat. When the winds settle down the main dry season will start.

It is a very short season which lasts only for a few weeks. Stingrays, such as the brown stingray (Dasyatis fluviorum), the rat-tailed ray (Gymnura australis) and the cowtail ray (Dasyatis sephen) are fat. When Buchanania dbovata flowers, this indicates the stingrays are fat.

During this intermediate season, small sharks and stingrays are cooked in a special way. First the liver is cut out and washed in clean water. Then the rest of the body is cooked on hot ashes. The soft backbone, head and tail are removed after cooking. The meat is then kneaded and washed with fresh water, The liver is lightly cooked on the hot ashes for a few moments, cut up and kneaded through the meat. This makes it sweet.

The main dry season

The wariner south-east wind starts to blow and the fruit of the pandanus, which turned red when sharks gave birth, begins to fall to the ground. This indicates that there will soon be lots of turtle eggs on the islands further out to sea and the turtles, themselves will be full of fat. This is the start of the main dry season. During this season all five species of turtles are fat. Each turtle has several different types of fat. Unlaid yellow eggs are fat, green fat is attached to the inside of the shell, yellow fat is sometimes found inside the stomach, round fat is found near the back legs of the turtle and the round

pieces of meat around the shoulders contain a lot of fat. The long piece of meat in the shoulders also contains a lot of fat.

Turtles' eggs are usually found high on the beach. The large ones are from the flatback turtle which lay up to fifty eggs, while the smaller eggs are from the Pacific ridley (Lepidochelys olivacea), green and hawksbill turtles, which lay around one hundred eggs. Yolngu say that the loggerhead turtle eggs are never found because they lay their, eggs out on the sandbars in the water.

On some beaches, Gould's goanna (Varanus gouldiij comes down early in the morning and digs up the turtle nest. It eats as much as it can, often returning later to eat any eggs that remain.

The mangrove monitor (Varanus indicus) is also fat at this time of year and is often hunted when a group of people are hunting for mud crabs in mangroves.

When the light breezes are blowing offshore the sea is very flat and the water is clear. The mangrove tree Sonneratia alba, which flowers early in the main dry season, indicates that the diamond-scaled mullet are fat, while sea mullet are losing their fat because they are laying their eggs.

Barramundi are moving down out of the creeks to join the Sheridan's threadfin around the edge of the mangroves. Barramundi have a black back showing they still possess the fat derived when they-we-re---b-r-eed-ing in the fresh water at the-head of the creeks. Giant threadfin have moved out to the reefs with the skinnyfish and coral cod (Cerphalopholis minatus) are losing their fat.

Most fish which have fat during the main dry season live around the reefs. They are:

black-spot tusk fish (Choerodon schoenleinii);
sweetlip (Lethrinus chrysostomos);
red emperor (Lutjanus sebae);
diamond fish (Monodactylus argenteus);
yellow emperor (Diploprion bifasciatum);
white trevally (Caranx sexfasciatus).

On the outer islands where most reef fish live, the large black-lipped oysters, which are found during the main dry season are fat. Other oysters, such as Saccostrea tuberculata and Lopha folium, are found in similar habitats, providing an ample food source. The lined nerite and Gelonia coaxans are shellfish which are still collected from the mangroves as is the mangrove worm, which is found in several species of mangrove trees. Large land snails (Xanthomelon pachystylum, X. spheroiderum) are still collected and eaten during the main dry season.

The young saltwater crocodiles (Crocodylus porosus) which were born in the wet season, can now be seen sleeping on their mothers' backs.

When Guettarda speciosa flowers, the reef fish, such as the black-spot and purple tusk fish, are fat.

When the first white-breasted wood swallows, (Artamus leucorphynchus) arrive, the next season - the pre-wet 'season - is about to begin. The weather changes and the thunder begins.

TRADITIONS AND CHANGE

The work of Warner (1928-1929) and Thomson (1935-1936) confirms that the patterns of, estates and seasonal activities presently' evidenced in the Crocodile Islands applied with equal significance fifty years ago to all clan groups among the Yolngu. The continuity of estates and activities suggests that few significant changes have taken place'even further into the past.

Today, while the significance of rights in estates retains its importance and the knowledge about the location of boundaries is maintained, there is less reliance on subsistence activities, amongst some members of the community. Predominantly it is those clans who live in central communities a considerable distance from their estates who'evidence least reliance on subsistence activities. The receipt of pensions and social security payments has given such clans an ability to buy foods and goods to the extent of negating their need for hunting and gathering activities, apart from recreational purposes. Clans who are estate owners in the vicinity of the central community tend to' expend their pensions and social security payments on capital goods such as aluminium dinghies and outboard motors which are used in the conduct of subsistence activities.

Both individuals and families of the community have emigrated to Darwin, living in town camps and government housing. Such people rely most commonly on government welfare payments, while a few individuals have entered state politics or taken up public, service positions and have not time to engage in subsistence activities.

There are, however some events which might'serve to reduce the importance of territory within the Aboriginal community, or create difficulties for those Aboriginals who seek to retain the traditional close relationship with the land and sea.

ABORIGINAL COMMERCIAL ACTIVITIES

The only commercial activity in which Yolngu have significantly engaged is fishing. Yolngu traditionally fish for subsistence" purposes only. There have been numerous attempts to institute commercial fishing programms in each of the major Aboriginal, communities along the Northern Territory coast. Without exception, each attempt ultimately failed, with the Aboriginal men returning to subsistence fishing after the withdrawal of non-Aboriginal advisers.

Commercial fishing operations were initially instituted by church mission staff in an effort to make the new communities self-' sufficient and as a means of teaching Aboriginal people to be more productive rather than pursuing a hunter-gather type life. Most operations flourished initially but all eventually degenerated and ultimately 'ceased.

Marine resources themselves were extensive and the ultimate demise of the operations was not due to lack of capital equipment. The collapse of commercial operations is due, at least in part, to the fact that, without an outside agent to act as their medium of operation, Yolngu cannot circumvent their kinship system and social structure in such a way as to dispose of their catch for financial gain or otherwise outside their community.

Within the social and political structure to which each Yolngu is subject, there is a culturally prescribed mechanism for the distribution of all of the catch resulting from turtle hunting, fishing, dugong hunting, and all other activities which harvest the environment. Where the catch is clearly more than will meet the needs of the immediate family, claims on the remainder may be made in line with established cultural rules.

Thus, there is no surplus. There is no sale, no capital return on the product. But such distribution patterns are vital to the building of reciprocal obligations. For example, accrual of such obligations is an important part of wife bestowal and calling on allies for dispute resolution. Indeed, the day to day functioning of life in a Yolngu community is underpinned with a network of reciprocal obligations helping to maintain social control.

However, the presence of a non-Aboriginal who operates as the catalyst for a commercial operation, particularly if he is seen as a government agent, allows for the Yolngu rules of product distribution to be by-passed. Although this may then result in an inflow of cash or goods, the Yolngu social structure will again intervene by not allowing any Yolngu person to acquire that which will elevate him beyond his position in Yolngu society as determined by traditional rules.

This may be effected by socially ostracising the person acquiring excess goods or money. Such will be the social discrimination against that person and his family that his impetus to maintain the commercial enterprise will be lost. Conversely, the Yolngu system of product distribution may operate so effectively that the Aboriginal fisherman engaged in commercial activities may be left with little of the catch after kinship obligations have been resolved.

However, this will not mean endless obligations on behalf of all those to whom the product has been distributed. The system will maintain an equilibrium such that the fisherman will still lose his fish but relatives will only be required to meet a reasonable level of obligation. Hence in such cases the return from the produce does little to meet the energy expended or the inherent social problems. Subsequently one should not be surprised to learn that Yolngu may avoid commercial operations such as fishing.

NON-ABORIGINAL COMMERCIAL ACTIVITIES

Exploration and mining have not occurred in the Howard Island and Castlereagh Bay area. However, offshore oil drilling did recently create a need for onshore bases and radar beacon positions from which drilling rigs could obtain a position fix to drill a well. Yolngu rejected the proposal for a shore base on Gurriba or Murrungga Islands largely on the advice of non-Aboriginals. Further consultation with Yolngu resulted in permission being obtained for the erection of the radar beacons. At present the Yolngu on Howard Island are considering an exploration proposal over their estates. Those wishing to accede to the proposal generally are not the owners of the estates but claim affiliation through various other links. The matter is yet to be resolved and seems to be the first of many such proposals waiting to be considered.

However, commercial fishing has been occurring for some time and is creating difficulties. Barramundi fishing represents the largest sector of commercial fishing operations in the Northern Territory. It is an activity which directly contributes two million dollars each year to the Northern Territory fishing industry and yields a further eight million dollars annually throughout the Northern Territory economy in terms of activities such as tourism and boat sales. Barramundi and associated threadfin salmon fishing are conducted largely in close proximity to estuarine areas. The continued objections by, Aboriginals to such usage of estuarine areas and river mouths has led many commercial fishermen to see themselves in commercial competition with Aboriginal people for the resources of such areas. However, such localities are rarely, if ever, fished by Yolngu.

Yolngu generally regard estuarine areas as being sites which are the focus of the activities of ancestral beings and therefore subject to severe restrictions on access. Some areas are subject to total prohibitions on entry, while access to other areas may be permitted only in the presence of senior ritual leaders. There is a range of conditions of entry applying to areas of restricted access. The outstanding feature of estuarine sites is that it was through the river system that ancestral beings who travelled from the sea impregnated the land, giving it form and meaning. The entry, then, of commercial fishermen into these areas is a matter of considerable concern to Yolngu in terms of their spiritual well-being.

Yolngu attribute the deaths of several senior Aboriginal men to supernatural punishment in consequence of not having been able to prevent the violation of their marine estates and sites by non-Aboriginal commercial fishermen.

Yolngu knowledge of the movement of fish indicates that apart from daily feeding patterns, the majority of barramundi move through the estuarine areas twice a year. Yolngu state that barramundi inhabit the mangroves and adjacent shallow foreshores throughout the dry season until spawning,. after which they move up the river during the wet season to feed across the floodplains which are inundated by the spring tides and the wet season storms. After gorging themselves with food, the majority of barramundi move downstream to the sea. Yolngu state that the majority of barramundi then funnel through the river mouth into,

the adjacent mangrove communities of the open coast. Some remain in the river system, moving in and out of small gutters and around the river mouth with the ebb and flow of the tide.

Yolngu therefore see commercial fishermen who set their nets at the river mouth as seriously interrupting the natural movement of the species and diminishing the barramundi population in the mangroves and adjacent foreshore, as well as putting both themselves and Aboriginal custodians at risk in terms of reprisal from ancestral beings for the violation of restricted sites. It is in the channels which penetrate the mangroves that Yolngu fish in the dry season. They rarely fish in the mouths of major river systems due to dangers associated with the activities of ancestral beings and limitations in traditional fishing technology appropriate to such areas.

COMMERCIAL'AND SUBSISTENCE CONFLICT

Gross misunderstandings between commercial fishermen and Aboriginal people located in close proximity to prime commercial fishing grounds have led in some cases to confrontation and threats of shooting and spearing. Commercial fishermen claim the fish as a resource for all Australians, which any person should be able to harvest. Several species of fish such as large specimens of barramundi and salmon catfish which are taken by commercial fishermen are of a totemic significance to Yolngu, and within Aboriginal law, the Yolngu are charged with ensuring the continued well-being of such species within their clan estate and its surrounds. The-use of the-Aboriginal Sacred Sites Act 1978, in such cases has, in practice i--totally restricted access to. such areas under any and all circumstances.- However, it is possible to specify circumstances of access in consultation with Aboriginal custodians. Where a particular species of fish may be nominated as being of particular significance to Aboriginal groups, then alternative legislation may be appropriate.

In accordance with Section 57 of the Regulations under the Northern Territory Fish and Fisheries Act 1980,

"The Administrator may, by notice in the Gazette, declare that an area is reserved -

(a) for the purpose of protecting or re-establishing a marine environment or an aquatic environment; or

(b) for the purpose of protecting or re-establishing fish or fish breeding grounds."

Within the terms of section 57, fish species of a particular totemic significance for specific Aboriginal groups may be protected. Of course the detriment to other persons and the extent of the distribution of the totemic influence of the species are critical considerations.

There has not been any case to date whereby the above legislation has been used to protect species of fish of totemic significance to Aboriginal persons but it may yet prove to be a viable interpretation of the legislation.

Issues surrounding the conflict between commercial fishermen and Aboriginal people have become so emotionally charged that the participants have failed to look analytically at each other's operations in terms of the species sought, the time of the year such species are sought by each group, or the area over which each group conducts its fishing activities.

Barramundi, as 'the main inshore fish resource sought by, commercial fishermen, is the primary target of conflict., The methods employed and areas fished at times of operations of each opposing group are quite disparate. There is sufficient information from commercial fishermen's monthly fishing returns and records of the daily aerial coastal surveillance to assess their methods, areas fished and times of:operations. Research on the subject of Aboriginal fishing methods, areas fished and the seasonality orotherwise of such fishing activities is being supported by the Northern Territory Fishing Industry Research and Development Trust Fund. This programme should provide criticial information on areas of apparent conflict and Aboriginal tenure of the sea in general.

Yolngu perceive the presence of a commercial fishing vessel in their area as positive intent to violate their traditional rights and put Aboriginal lives under threat through desecration of sites. However, it is crucial to realise that Yolngu do not perceive the taking of fish in the economic sphere as the most threatening aspect. The ability of a non-Aboriginal to enter a Yolngu clan estate without permission from the Yolngu custodians, to remain on the area and then to proceed to move freely in that area and take resources from that estate are acts which, if committed by an Aboriginal person but a few years ago, would, probably have resulted in the death of the intruder. Today such an offence in Aboriginal law would certainly incur a penalty of open social redress and compensation.

In an effort to alleviate potential conflict between Aboriginal fishermen and commercial fishing regulations the Northern Territory Government has introduced a new regulation, namely 7B: Conditions for Aboriginal Licence for Non-commercial Fishing under the Fish and Fisheries Act 1980, which allows the Director of Fisheries to license a member of an Aboriginal community whereby the licensee shall not:

(a) use gill-netting exceeding 200 metres in length;

(b) use gill-netting in waters closed to gill-netting; or

(c) supply fish or dispose of fish except to an Aboriginal community.

This new regulation then, recognises the traditional use of fish fences and nets, the mesh size of such fences and nets as approximately that of commercial fishing nets, the distribution of such fishing practices and the means of distribution of the product. The distribution of the product may prove to be a more reasonable criterion of assessing the commercial status or otherwise of fishing rather than the equipment employed. In the Northern Territory regulations., the supply or disposal of fish in the local Aboriginal community ensures a negligible effect on the commercial fishing market.

LEGISLATIVE PROTECTION

The traditional boundaries of clan estates, sites, and economic zones established in Aboriginal law are generally unrecognised by government and commercial fishermen. To fail to recognise them is a threat within Aboriginal law, to usurp the position, power and identity of the people of that estate and those upon whom they may call for allegiance.

Hence, Aboriginal people have sometimes used European law in an effort to curtail such violations of their clan estates. Such recourse was for several years couched only in terms of apprehending and prosecuting, under the Northern Territory Fish and Fisheries Act 1980, commercial fishermen acting illegally. For a number of reasons most prosecutions either failed to be secured or resulted in insignificant fines.

The Aboriginal Sacred Sites Act 1978 has provided a number of Aboriqinal clans with opportunities to restrict access to *sites* of considerable significance in both marine and terrestrial areas. A number of marine sites have been registered under the act including sites up to 80 km from the mainland of Australia. The marine sites registered to date range in size from a few square kilometres up to 600 sq km, as in the case of a marine site north-west of Murrungga Island. Of the total 4,140 sq km of marine habitat in the Crocodile Islands and Castlereagh Bay area, 25.39 percent of the total area has been registered as "sacred sites'! under the Aboriginal Sacred Sites Act 1978. The total registered area of 1 051 sq km includes all seven river mouths and estuarine system; entering Castlereagh Bay. In the case of marine sites the legislation has been directed primarily at restricting access by commercial fishermen who, apart from Aboriginal people, are the main users of such areas.

The Commercial Fishermen's Association has had moderate success in discussions with Aboriginal custodians, but the process of communication with senior Aboriginal persons involves communication techniques uncharacteristic of European communication. Aboriginal custodians of sites in the area have been dissatisfied with the policing of registered marine site violations by the Aboriginal Sacred Sites Authority and have consequently sought relief in the Aboriginal Land Act 1978 in an effort to close seas adjacent to Aboriginal land.

CLOSURE OF SEAS

The Aboriginal Land Rights (Northern Territory) Act 1976 Section 73(1) empowers the Legislative Assembly of the Northern Territory to make laws:

> "... regulating or prohibiting the entry of persons into, or controlling fishing or other activities in, waters of the seas, including waters of the territorial sea of Australia, adjoining, and within two kilometres of, Aboriginal land, but so that any such laws shall provide for the right of Aboriginals to enter, and use the resources of, those waters in accordance with Aboriginal tradition."

In exercise of that authority, the Assembly enacted Part III of the Aboriginal Land Act 1978 - "Control of Entry Onto Seas Adjoining Aboriginal Land".

Section 12(1) of the Act empowers the Administrator of the Northern Territory of Australia, by notice in the Gazette, to close the seas adjoining and within two kilometres of Aboriginal land:

> "... to any persons or classes of person, or for any purpose other than to Aboriginals who are entitled by Aboriginal tradition to enter and use those seas and who enter and use those seas in accordance with Aboriginal tradition."

Section 12(2) provides that the notice in the Gazette shall specify:

"(a) the area closed by the notice by description of the boundaries and by a diagram showing the approximate position of the boundaries:

(b) the persons or classes of persons to whom the area is closed; and

(c) the purpose for which the area of the sea is closed."

The Administrator of the Northern Territory may, before deciding to close a part of the seas, refer the matter of closure to the Aboriginal Land Commissioner, according to Section 12(3), for report and inquiry. In the event of the Administrator not being prepared to close an area within 56 days of the matter being referred to him, he is obliged to refer it to the Aboriginal Land Commissioner.

Section 12(3) lists for inquiry:

"(a) whether, in accordance with Aboriginal tradition,, strangers were restricted in their right to enter those seas;

(b) whether the use of those seas by strangers is interfering with or may interfere with the use of those seas in accordance with Aboriginal tradition by the Aboriginals who have traditionally used those seas;

(c) whether the use of those seas by strangers is interfering with or may interfere with the use of adjoining Aboriginal lands by the traditional Aboriginal owners;,

(d) whether any person would be disadvantaged if the seas were closed to him;

(e) the commercial, environmental and recreational interests of the public; and

(f) such other matters as the Aboriginal Land Commissioner considers relevant to closure to those seas.'!

Several Aboriginal groups have made application to the Administrator to close seas adjacent to Aboriginal land. In practice, however, all such applications have subsequently been referred to the Aboriginal Land Commissioner at the expiry of the statutory 56 days in accordance with Section 12(3). This has resulted in the hearing of two of the applications. Both applications were in the Crocodile Islands and Castlereagh Bay area.

The Aboriginal Land Commissioner is not required, under the Aboriginal Land Act, to make recommendations. His function is to enquire into and report to the Administrator on those matters mentioned specifically in Section 12(3) of the Act and on such other matters as he considers relevant to the closure of the seas.

Two years after the Commissioner's report of the first cast, Closure of Seas: Milingimbi, Crocodile Islands and Glyde River Area, which was forwarded to the Administrator on 28 August 1981, the Northern Territory Government directed the Administrator of the Northern Territory to close the seas in the Milingimbi, Crocodile Islands and Glyde River area as specified in The Northern Territory Government Gazette No. G30, 29 July 1983 in pursuance of Section 12(1) and (2) of the Aboriginal Land Act. The areas of the seas specified were closed:

(i) to provide for the quiet enjoyment of those seas by Aboriginals who are entitled by Aboriginal tradition to enter and use those seas; and

(ii) for the protection of sacred sites important to the Aboriginals referred to in sub-paragraph (i).

The location of "sacred sites" was not specified, but assumed to lie within the gazetted area. This, however, was not the case with all sites. The basic document for the closure of seas application, prepared on behalf of the Aboriginal applicants and known as a claim book, was prepared in this case by a legal officer of the Northern Land Council. There was no reference to expertise in traditional coastal resource management and little data on Aboriginal knowledge of the littoral zone included in the claim book. Such omissions became apparent just days before the court hearing. Local knowledge then became the cornerstone of the case with most evidence being introduced orally during the hearing. As in Aboriginal claims to land previously heard under the Aboriginal Land Act 1978, the Commissioner made an on-site inspection of the seas under application. Evidence was taken in open court on-site as well as in closed sessions restricted to Aboriginal men only. In such closed sessions evidence was generally given as to the ritual significance of.marine areas and details of related mythology.

The second closure of seas application Closure of Seas: Howard Island and Castlereaah Hay to be heard before the Aboriginal Land Commissioner made considerable use of indigenous knowledge of coastal marine resources. The claim book was prepared by consultants engaged directly by the applicants in view of their experience with Aboriginal marine knowledge and familiarity with the Aboriginal applicants.

The third application is the Groote Eylandt claim which has had its preliminary hearing before the Aboriginal Land Commissioner.

A draft copy of the Bathurst and.Melville Islands Sea Closure Application was completed in November, 1983. The maps in the report delineated the location of marine economic zones and specified marine 'food' sources used by the Tiwi people of Bathurst and Melville Islands. Specific clan boundaries, hunting camps, ceremonial sites, marine areas of significance due to the activities of ancestral beings and named localities were detailed on the maps. Such data in this case has facilitated discussions between the Tiwi Aboriginal people of Bathurst and Melville Islands and other prospective users of the marine area, being" commercial and amateur fishermen in particular.

Due to its close proximity to Darwin'the seas adjacent to the 1,100 km in Bathurst and Melville Islands coastline represents an outstanding marine resource. If the case can be resolved through negotiation, then considerable advances will have been made in communicating to non-Aboriginal Australians detailed Aboriginal knowledge of marine resources and the indigenous significance of marine areas.

LAND RIGHTS AND SEA RIGHTS

Non-Aboriginal Australians generally espouse a freedom of the seas and regard marine fauna, such as fish, as a common resource. Aboriginal people in north Australia perceive a continuity between the land and the sea such that there is a natural extension of the system of tenure of the sea to that of,the land.

Sea rights legislation preserves anchorages and rights of transit for all vessels. Equivalent provisions are not made in land claims, however.

Whereas the right of veto on the extraction of minerals is maintained in land claims, it is not as significant a consideration in sea claims. In the Howard Island and Castlereagh Bay Sea Closure Application mineral extraction was a consideration only to the extent of agreeing to permit right of passage for possible future land-based exploration on adjacent Aboriginal land.

PROBLEMS WITH PRESENT LEGISLATIVE PROTECTION

Most applications for closure of seas, if proceeded in the manner of applications in the Northern Territory, could be expected to cost between half and one million dollars each. The size of the marine area under consideration makes little difference to the total cost of the application.

court proceedings are an adversary situation and as such inevitably bring Aboriginal applicants into confrontation with objectors to sea closures. Such situations are difficult in that it is most often old senior Aboriginal men who are custodians of the areas under application. They invariably seek to avoid such confrontations which lead to degeneration of race relations. Furthermore, such senior men are also the custodians of restricted ritual information. They often feel obliged to reveal

such information in the course of the court proceedings. This causes them considerable stress as, they believe, 'any possible abuse of the information may be viewed by ancestral beings as tantamount to mismanagement of ancestral activity sites with fatal consequences for Aboriginal custodians.

There is, then, a considerable amount of anxiety and stress for senior Aboriginal custodians inherent in the court proceedings which are the vehicle of an application to close the seas under the present Northern Territory legislation.

The successful Milingimbi and Glyde River Sea Closure Application resulted in little change for the protection of marine areas for the Aboriginal applicants. The final report on the application found that existing holders of barramundi commercial fishing licences could continue to enter and fish in the closure area. This situation does not apply to licences that are transferred upon the sale of the boat and/or licence. Naval vessels, Commonwealth Government personnel and vessels supplying goods to coastal communities appear to be exempt from closure restrictions. Ultimately, then, it is only the rare touring yacht that may be subject to restrictions applying to areas of closed seas and yet Aboriginal people have often shown considerable hospitality to such yachts.

With no determination of the term "low water" in the Arnhem Land Grant, the base from which to measure the two kilometres closure is obscure, hence negating the usefulness of the gazetted map.

--The closure o-f the seas is operative from the low- water mark of the adjoining Aboriginal land. However there is no indication in the Arnhem Land Land Grant (1933) as to which low water mark was intended (low water indian spring, low water neap, mean low water, lowest astronomic tide). In areas of large tidal amplitude and low gradient coastline such as are dominant along the coast of north Australia, small variations in vertical height as may be evident between alternative interpretations of "low water mark" may result in large horizontal shifts in the seaward extent of the closure zone. In the Milingimbi region, for example, from the high water indian spring tide mark there is approximately a 13 km seaward exposure of substrate from the site known as Malwanhatharra on the foreshore of the Milidjingi clan estate on a 0.1 m tide which approximates to lowest astronomic tide. The lateral shift in the 2 km wide closure zone declared under Northern Territory legislation in this area consequent to various interpretations of the term "low-water mark" could conceivably be of such magnitude that the closure zones from lowest astronomic tide and low water mean tide respectively were entirely disparate. In such a situation, with the closure operating from mean low water mark, there would be occasions such as extremely low tides approaching 0.1 m when the zone of sea closure would be entirely exposed . . . a sea closure with no sea!

Policing closed areas of sea has proved to be a problem. Areas subject to closure applications are most often remote with little or no police presence. The government-sponsored daily aerial coastal surveillance documents and photographs each vessel encountered in the vicinity of closed seas. However, not only

are coastal surveillance authorities reluctant to be party to possible resultant prosecutions but there seems to be no mechanism for ensuring the passage of data relating to official sightings of intrusions through to policing authorities.

It is therefore left to local Aboriginal people in the vicinity of the closure area to perform police functions.' Within Aboriginal tradition such functions, were clear-cut; but Aboriginal people do not feel the same confidence in applying legislation which they perceive as distinct from Aboriginal law.

For Yolngu and other Aboriginal groups in north Australia, Australian law does not have the immutable quality of Aboriginal law and inevitably results in confrontation:. Hence Aboriginal people prefer to avoid active 'involvement in' the administration of Australian law.

The administration of Aboriginal 'sacred sites legislation similarly suffers from the problems of policing marine areas registered or declared as sacred sites along the Northern Territory coastline.

FUTURE OF ABORIGINAL SEA RIGHTS

The Groote Eylandt sea closure application is presently before the Aboriginal Land Commissioner. Draft claim books presenting the cases of the Aboriginal applicants have also been prepared on the Croker Island and Daly River areas of the Northern Territory coast. The Daly River case is expected to draw significant objections from mineral exploration companies as well as commercial fishing interests.

All three cases will receive objections on behalf of the recreational interests of the Northern Territory public. The Groote Eylandt case, however, is the first sea case to evidence considerable economic detriment to present users of the area under application for closure.'

Commercial fishing interests claim that at least 2,000 persons are dependent on commercial fishing in the Groote Eylandt area under application. Furthermore, half the northern prawn fleet, representing an investment of approximately $111 million, conducted fishing activities in the area during 1982-1983 (the most recent figures available) and the catch value from that area in the last few years has amounted to several million dollars. To be weighed against this and other evidence from objectors to the proposed sea closure is the traditional and contemporary significance of the area to Aboriginal people., The presentation of a case on behalf of the Aboriginal applicants such as to outweigh the detriment alleged in the submissions by commercial fishing interests is a formidable task. Yet the claim book states that it was prepared with only three weeks of fieldwork by a person with no previous experience either with that Aboriginal group or in tenure of the sea and with no recourse to any discipline other than anthropology.

The case to close seas adjacent to Aboriginal land is presented by a lawyer on behalf of the Aboriginal applicants. The case is based on data gathered and interpreted by an anthropologist. But

can any one discipline reasonably contend to adequately interpret the spectrum of information necessary to produce a cohesive and coherent representation of the entire system of tenure of the sea as it relates to a specified physical area and the attendant social group's spiritual and economic reliance on that system?

The system of tenure relies on information from social anthropologists interpreted against a background of geographic data such as tidal amplitude and flow, coastal sedimentation and river formation. Similarly, biological data such as the movement and habits of marine species is critical in its potential correlation with human population movements through the biosphere.

By far the most desirable resolution of claims is one of mutual agreement reached by all parties, thus either negating the necessity for a pitched battle in court or requiring legal ratification of an agreement between parties. This has been the situation among the Tiwi Aboriginal people of Bathurst and Melville Islands. Documentation on tenure of the sea was produced over a two year period by a research team. The resulting data was used as the basis for negotiations between Tiwi and other users of the seas adjacent to Tiwi Aboriginal Land.

The negotiations have produced amicable relations between all parties through a mutual understanding of each group's interests and concerns. Non-Aboriginal fishermen have been considerably impressed by Tiwi knowledge of fish species and the sea in general. Soon the Tiwi hope to have the results of such negotiations formally recognised by the government of the Northern Territory.

The drafting of legislation on Aboriginal claims to seas is presently being conducted and was recently considered in the Aboriginal Land Inquiry in Western Australia on a national basis. The system of tenure of the sea is similar throughout the coastal Aboriginal groups of northern Australia where spiritual affiliation and economic usage along traditional lines remains strong. The Northern Territory is unique in that its entire coastline falls within the bounds of such usage patterns. Queensland and Western Australia both evidence considerably diminished economic usage of marine areas of Aboriginal people in their southern latitudes, How then will their legislation and the national legislation adequately reflect the breadth of Aboriginal claims?

CONCLUSION

Yolngu acquire a considerable knowledge of the marine environment primarily by experience in the company of older men. Their knowledge of the habits of individual species is framed within a seasonal knowledge of a complete system of tenure of the littoral zone. At the same time it is circumscribed by social, political and economic factors. Such factors are used, through co-operating hunting expeditions, to build social and political alliances.

The daily and seasonal movement of the Yolngu population is closely tied to the shifting emphasis on various natural species throughout the marine enviroment necessitating access to the resource of estimates other than one's patriclan estate. Marine estates and sites are strictly delineated, not so much as to preclude access, 'as to ensure acknowledgement'of rights across boundaries.. Thisprinciple underpins cooperative hunting expeditions.

Future research on Aboriginal tenure of the sea would be. considerably advanced if it proceeded on a cooperative' multidisciplinary basis. There is no doubt that the results of such research should be made available to legislators in order that legislation reasonably reflect the reality of the daily life situation., If this is not done then the implementation of the legislation may prove to be frustrating and costly. Therefore such multidisciplinary research should proceed with considerable support at the earliest opportunity.

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WORKSHOP DISCUSSION

The discussion covered the following points:

Many people recognise that traditional fishermen have a large amount of knowledge of the marine resource but the form of such knowledge (paintings, stories, etc.) may not be well understood or recognised by Western culture.

The transmission of traditional knowledge is being undertaken in selected schools in the Northern Territory.

THE CONCURRENCE OF KNOWLEDGE AND TRADITION IN THE HUNTING OF DUGONGS AND SEA TURTLES IN THE SIR EDWARD PELLEW ISLANDS

John J. Bradley

The Yanyuwa group of Aboriginal people who live in and,around Borroloola in the south-western Gulf of Carpentaria pride themselves on being hunters of dugongs and sea turtles. This pride is based on both an historical association and the continuing management and spirtual identification with these two marin'e animals.

In Yanyuwa society, certain people are regarded as being maramaranja, which can be translated as "a dugong and sea turtle hunter of excellence". It is a title of which individuals and their associated families can be proud.

The Yanyuwa'hunt the dugong and sea turtle in the shallow waters which are found around the Sir Edward Pellew Islands, the mouth of the Carrington Channel and the mouths of the McArthur, Crooked and Wearyan Rivers.

It is in these shallow waters that various species of seagrass can be found. Both the dugong and sea turtle feed on seagrass. The Yanyuwa classify the seagrass into that which is eaten by the dugong and that which is eaten by the turtle. In actual fact both animals feed on a large number of different species which exist in the Gulf. The Yanyuwa classify the seagrass as follows:

> **maraman/ma-lhanngu:-** Halodule univervis and Halophila ovalis; eaten by the dugong.
>
> **na-wirrilbirril/na-julangal:-** Enhalus acoroides which is eaten by the sea turtle. A general term for all sea-grass beds is Ki-maramanda.

The knowledge the Yanyuwa hunters possess in relation to the dugong and turtle is rich and complex. Thisknowledge concerns both the factual details concerning the sea turtle and dugong, and the deep spiritual significance which deals with how the Yanyuwa must act towards these animals. The Yanyuwa classify the dugong and sea turtle into a number of different categories. These are given below:

GENERAL

Walya - general term for both dugong and sea turtle

waliki/nhabal - general term for all dugong

wudanyuka - general term for all sea turtle

li-waliki/a-waliki - a herd of dugong

FEMALE DUGONG

a-banthamu - old cow with small tusks visible

a-bayawiji - mature cow, capable of breeding (no tusks)

a-ngayiwunyarra/a-kulhakulhawiji - pregnant cow

a-lhumurrawiji - pregnant cow with a calf still following her

a-miramba - non-lactating cow, but with a large calf still following her

a-ngarninybala - cow with her calf riding on her back

a-wuduwu - young female dugong

li-milkamilarra - small group of cows with calves

nyankardu - dugong foetus

MALE DUGONG

bungkurl - very fat, small male dugong

jiyamirama/jiwarnarrila - male dugong which travels away from her during times of threat

mayili - bull dugong with small tusks

rangkarraku/rangkarrangu - bull dugong travelling by itself

wiriji - large old bull with a mottled hide, considered to be the offspring of the Rainbow Serpent

wirumantharra - bull dugong whistling, often said to be the leader of the herd

ngumba - very young dugong

SEA TURTLE

There are three species of turtle in the area of the Pellew Islands. The most commonly hunted is the Green Turtle.

MALURRBA - green turtle

warrikuliyangu/ngululurru - male green turtle

rra-tharra/lhathanka - female green turtle

wandangumara - very large female green turtle

bankiba - very large male green turtle

ngajilingajili - green turtle with a light coloured shell and a lot of yellow colouring on the underside

lijalijangulyanda - young green turtle not considered big enough to eat

limarrwurrirri - green turtle which is considered to have a big head

a-wathawayawiji - female green turtle containing unlaid eggs

yabalarla - green turtle hatchling

ngarrangarra - green turtle 'which lacks a, lot of'body fat

wunakathangu - green turtle 'found with ulcerations' in the stomach (is not eaten)

WIRNDIWIRNDI - flat-backed turtle

jadawangarni - male flat-backed turtle

a-karninja - female flat-backed turtle

Note: This species of sea turtle is occasionally captured by Yanyuwa hunters.

'KARRUBU - hawksbill turtle

yibarriwuna - male hawksbill turtle

a-ngurrin - female hawksbill turtle

Note: This species is not captured by the Yanyuwa as it is considered poisonous.

General Terms relating to turtles:-

ribankuja - mating turtles

rujurru - turtle hatchling

ngangkurrurru - female on the beach laying eggs

The hunters of dugongs and turtles know that it is the tides which primarily affect the movement of their prey. Both animals feed on the coastal sea-,grass beds at high tide (ngakan) and move out onto the off shore beds at low tide **(mangkuru).**

A turning tide **(jalababa)** is often considered a good time to hunt dugongs especially if the tide'is on the inward turn, as the dugongs will be travelling in towards the sea-grass beds. If the. sea is calm both dugongs and turtles can occasionally be seen feeding on the sea-grass beds along the more exposed coastal and ree.,f areas.

The Yanyuwa men who are familiar with the dugong say that it is a migratory animal. Its migratory path seems. to range from just south of the Limmen River mouth, down through the Pellew Islands and continuing eastward to the region of the Robinson River mouth.

The' Yanyuwa classify the dugong into two groupings; there, are those that are continually moving and those which.tend to more remain in particular localities. In Yanyuwa the migration of the dugong is known as **muyu,** and those dugong which remain in one area are called **jibiya baji** or "countrymen belong 'to' that place".

In the area of the Sir Edward Pellew Islands the dugong migration path would seem to run south of West Island, to the north of South West Island and then into the small strait between South West Island and Centre island and eastward past the mouths of the McArthur and Wearyan Rivers.

Both the dugong and the turtle frequent areas of sea-grass beds. The Yanyuwa do not view the turtle as a migratory animal, though research has shown that the green turtle does migrate large distances to nest (Limpus, 1985, pers. comm.).

The localities at which dugong and sea turtle are known to frequent, and often stay, are the south-west and central west coast of West Island (Mamadathamburu), the area in the vicinity of the central west coast of South West Island (Mangurrungurru) the McArthur River mouth and Dugong Creek (Wuthanda), an area around the mouth of the Crooked River mouth (Liwujujuluwa), and area to the north-east of Sharkers Point called Lidambuwa and an area to the north of the Wearyan River called Bulubuluwiji.

At most times of the year dugongs and turtles can be found at any one of these localities in varying numbers (Figure 1).

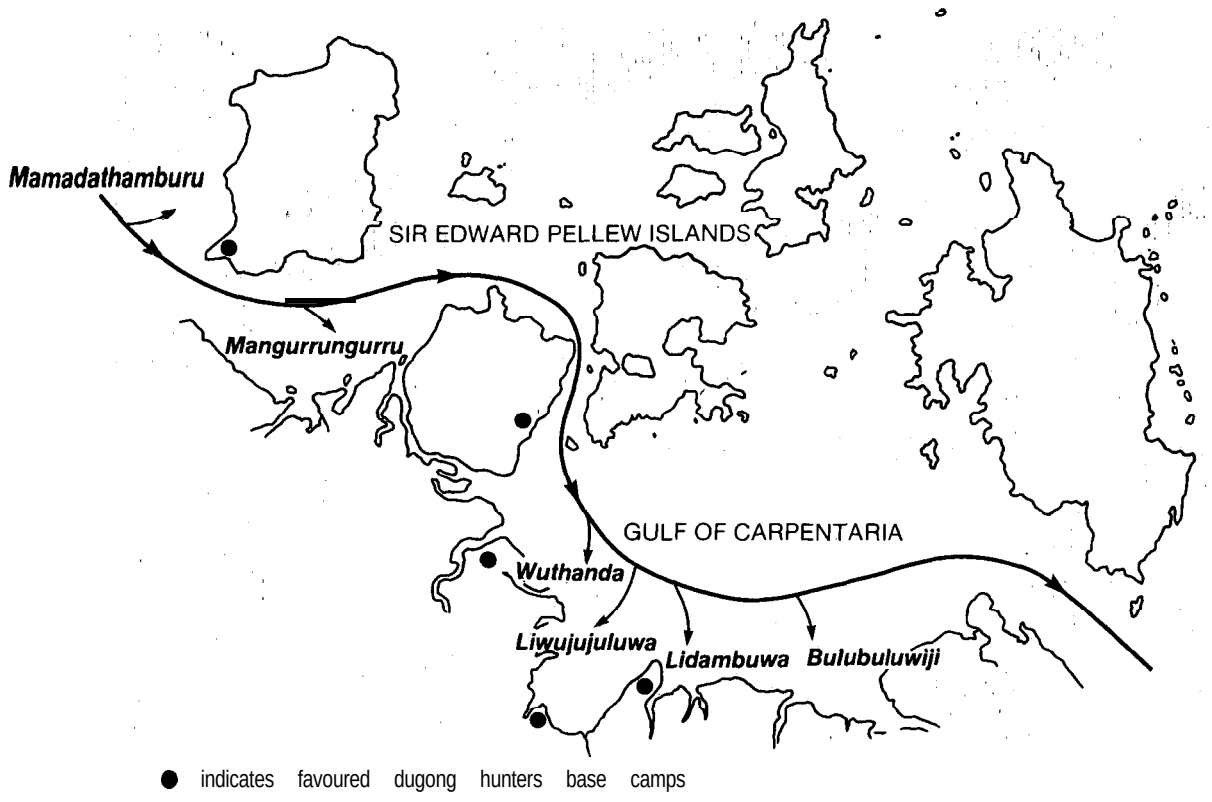
The largest numbers of dugong are found in the vicinity of the Pellew Islands in the mid dry season, usually around June, July and August. It is during this time that the Yanyuwa do the greater part of their dugong and turtle hunting, though people will hunt at other times of the year. During the mid dry season however, the sea is usually calm and the strong south-easterly winds (rra-mardu) have ceased to blow.

The Yanyuwa still hunt dugongs and turtles with a harpoon which has a detachable head to which is attached a long rope and float. Most senior Yanyuwa men possess at least one harpoon which is called either na-ridiridi, yirlakungka or ratharr. They are usually made out of young 'messmate' trees (Eucalyptus tetrodonta) and are from 3 to 5 m in length. The harpoons are usually well cared for, being rubbed with the sap of certain trees, red ochre and sugar-bee wax to help preserve them.

Into the larger end of the harpoon is carved a hole in which the harpoon point rests. This hole is called the na-wuthula or **na-balalarra.** More commonly however it is called na-mulu or 'its mouth'.

The harpoon points are called na-malbi or na-wulukayangu and are today made of metal, usually a piece of steel rod approximately 15 cm in length and 1 cm in diameter. In past times these points were made out of an unidentified hardwood species which in Yanyuwa is called na-wubulu. These wooden points were warmed slowly in the hot white ashes of a fire to temper them. In past times the wooden points used for hunting turtles were barbed because the hunters had to spear the turtle in the neck or flippers, as the wooden points could not penetrate the shell. These barbed wooden points were called **na-ngalhinbiji.**

Figure 1. Map showing dugong migratory path and favoured dugong hunters base camps.



The top of the harpoon point is wrapped in cloth or paperbark and then tightly bound with string; this ensures that the harpoon points rests firmly in the harpoon.

The harpoon point is attached to the harpoon ropes called ma-ngarduku or ma-yinymathu. In past times these ropes were made out of the shredded bark of the kurrajong or banyan tree. Today commercially made nylon or hemp rope is used.

At times the kurrajong ropes are still made for sale to Aboriginal art and craft organisations.

Two ropes are required, each about 20 metres in length. The harpoon point is attached to the rope by way of the nungawa, which is a small loop made in the end of the rope through which the harpoon point is passed. The bound end of the harpoon point is pushed firmly against the loop and then both are tied together with string.

The other end of the ropes are attached to a wooden float called mawarl. This float is made from a light piece of wood and is usually about 60 to 70 centimetres in length and about 20 centimetres in diameter. The float is thrown out when a dugong or turtle is harpooned, to mark the course the harpooned animal takes and to tire it out. This float was of more importance in the days of bark and dugout canoes when men had to paddle to catch their prey but with the advent of the motor boat the hunters can usually keep up with the turtle or dugong and the float is only rarely required. However, it is always carried and kept attached to the ropes. The float is still useful if the engine fails, the rope becomes tangled, if the hunter falls overboard when he spears the dugong, or loses the harpoon.

It is the law of the Yanyuwa that the dugong and turtle be harpooned twice. The first harpoon point into the dugong is called na-walangkarramba or na-walangkarrangu, and the second harpoon point is called na-nyirriwa or na-nyirriwangu.

Most of the equipment mentioned above is prepared or repaired by the Yanyuwa hunters whilst still at camp or while travelling on the river on the way to the sea.

Yanyuwa dugong hunters must follow strict rules before leaving the land to go hunting. Hunters try to keep their noise level to a minimum; they will not break sticks, burn string or sugar bag wax or handle greasy food. The reasons for these restrictions are not known but the restriction on making noise is said to be because the dugong is keen of hearing. In Yanyuwa the dugong is said to be lingi, a term usually reserved for a person of high intelligence or keen hearing. It is believed if too much noise is made the dugongs will hear and travel to deep water where they cannot be hunted. The above rules are only followed for dugong; there are no such rules associated with the hunting of turtle.

However, the rules are followed the majority of times as the hunters do not know which of the two animals they are going to get unless they have a specific intention in mind.

Men will not handle greasy food.before hunting as the'y believe, if it gets onto the harpoon points it will make them smooth and they will come out of the harpooned dugong or turtle.

Any person who disregards these restrictions and others concerning the law of the dugong have the following phrase directed at them; Wardiwiji angkawangu or "You are filled with badness you are a mainland dweller". Needless to say this is a very insulting remark to people who class themselves 'as sea people and the hunters of dugongs and turtles.

When hunters reach the -area in which they wish to hunt, they scan the water for dugong and sea turtle surfacing to breathe, muddy water which has been caused. by these animals feeding, broken pieces of floating sea grass and excreta. It is these signs which make visible and meaningful tracks to the hunter.

When an animal is found, the skill of the driver (wuliyi) is crucial. He has to follow hand signals given by the,harpooner and get him in range to spear the animal. He quite often has to keep up with the dugong which can swim at speeds up to 12 knots for short periods. Turtles are also capable of short bursts of speed. The driver has to watch and follow hand signals as to where the dugong or turtle goes. In shallow water, a dugong can be tracked by the wake which is caused by the upward and downward movement of the tail which causes a series of flat circles on the surface of the water (Marsh, 1981). Turtles are always tracked through the water by sight.

When a dugong has been speared once it usually tires quickly, and can be brought into range once more and speared again,. The hunter usually tries to place one harpoon in the region of the neck and another in the lower back or tail region.

After it has been speared twice, the dugong is pulled alongside the boat. In Yanyuwa this action is called lhungkayarra. The dugong is then grabbed by the tail and a noose is placed around it, just below the flukes. The dugong is then turned around so its stomach is facing outwards, the tail is braced against the gunwhale. This causes the head to hang down under water and in so doing, drowns the dugong.

In past times when the Yanyuwa hunted dugongs from bark canoes, the dugong was not drowned alongside the canoe for fear that the struggling animal would damage the frail craft. Instead, the dugong was brought within a short distance of the canoe and then the hunter swam out to the dugong and plugged the dugong's nostrils with paperbark or even his own fingers, and he stayed with the dugong until it drowned.

From the moment a dugong is speared until it is drowned, no talking takes place. It is believed that to talk while the dugong is dying is a sign of great disrespectand if someone does talk while the dugong is being pulled alongside the boat the spirits who guard the dugong will come and remove the harpoon points.

The hunters usually try to spear young male dugongs and occasionally a cow, as long as it has not got a calf or does not appear to be pregnant. The Yanyuwa dugong hunters say that they can tell the difference between a male dugong and a pregnant cow by the way in which it dives after surfacing; a pregnant cow is said to dive quicker and at a sharper angle.

Large old bull dugongs are avoided because they are said to be the offspring of the Rainbow Serpent and are therefore to be feared. They can be killed, but only with the assistance of special power songs which are said to weaken the animal and break its back. Quite often, however, if one of these dugongs is harpooned the rope is cut. There is a lot of sense in this act. These large dugongs are powerful, and trying to kill one by drowning would be much more hazardous than it usually *is.*

When the dugong is drowned it is tied alongside the boat. A rope is tied around the tail which is then fixed to the back of the boat, a harpoon point is passed through the dugong's nostrils and to this a rope is attached. This rope is tied to the front of the boat. The dugong is then taken back to land for butchering.

During times when groups of Yanyuwa people are camped on the islands they will often hunt dugong at night. The animal is located by listening for the sounds of it surfacing to breathe. Dugongs are followed through the water by their phosphorescent wake known to the Yanyuwa as balirrka. This type of hunting is seen to be much more dangerous, so there is very careful preparation of the hunting equipment before going out onto the sea.

Sea turtles are hunted in a similar fashion to dugongs. However turtles can at times prove more difficult to catch due to the length of time they can stay submerged. Quite often a harpooned turtle will swim under the boat which makes it very difficult for the driver of the boat to place the harpooner in an ideal position to harpoon it for the second time.

When the turtle has been harpooned twice it is pulled up alongside the boat, and taken hold of by the front flippers. If the turtle is relatively small it is tied by its front flippers to the side of the boat, so that it hangs vertically in the water with its head above the water line. This is to ensure that it does not drown. The Yanyuwa believe that if they let a turtle drown they will have great difficulty in finding and hunting turtle when they go hunting again.

With the turtle secured either in or alongside the boat it is taken back to land for killing, cooking and butchering. The turtle is killed by hitting it hard on the head with a stone or an axe to break the hard protective' covering plates. A long sharp stick is then thrust into this hole to 'mangle the brains'. This act must be performed by a person who stands in the position a ritual guardian of the sea turtle.

When dead, the turtle must be laid on its back and the first cut is made to begin the butchering. This cut is made in front of the lower frontal shell (na-ngundawa). The act of making this cut is called ngunduwamantharra,

The person butchering the turtle then reaches into the turtle through this cut and removes a number of organs. The organs removed and their order of removal is listed below.

ugundurrngundurr - section: of the bronchial tube .

na-widiri - liver '[eaten].

rra-ngawa - bladder.

ma-mulka - stomach [eaten] Occasionally severe ulcerations are found in the stomach of old turtles; these are known as wunakathangu.

wunakakd - "large intestine's [eaten] .

ma-karriyalu - small intestine [eaten].

After the turtle has been gutted, paperbark is folded into. small rolls and pushed into the bronchii remaining inside the'turtle. The reasongiven for this practice is so that the turtle in the sea will not become ngarrangarra or without fat.

The heart of the turtle is removed with the bronchial tubes and is also called ngundurrngundurr.

The liver of the turtle is also called na-manyi.

The stomach of the turtle is also called yalajala.

The turtle is cooked whole, in its shell, before it is butchered. 'Laid in a shallow pit containing hot coals, the turtle is covered over with wood which is set alight.

It is then left for two to three hours. As the turtle cooks it is watched to make sure that the fire does not burn through the shell, resulting in the loss of the mathulmathul. This is a rich "soup" which is composed of meat and fat particles, meat juices, and blood. It is much sought after by older people who believe, that it has medicinal value. After the turtle has cooled 'down it is butchered.

na-buyurru - upper shell

ma-yajbarla - main portion of the hips

ma-rawurr - central hip portion

na-manda - flippers

na-wirlibirli/na-milimili - lower and frontal shells

na-ngabala - skin, meat and fat

na-yalarri - shoulder and chest muscles

na-lakalaka - meat in the ventral area sacred to the se& turtle

na-wuthula - meat and fat

na-lhundu - fat

wurrunthulburrunthul - tail piece, fat and meat

na-narrngu - main tail piece, fat and meat

wulaya - head

na-mulngu - neck

na-yinjii - lungs and bronchii

na-rurru - green fat lining the shell

lhuwayngul - yellow fat

wundumutha - green fat and meat

When a dugong is brought back to the land for butchering its head must be faced back in the direction of the sea. This is so the spirit of the dugong can return to the sea. This is an act of great importance to the Yanyuwa people and is called **ki-maramanngku,** which can be literally translated as "returning the one belonging to the sea grass".

There are two methods which can be used to butcher a dugong. One method, which is called yingkurra (Figure 2), is used for large dugong. The other is called munbul. This method is used for smaller dugong or if the hunters are in a hurry for some reason. The only internal organ of the dugong which is eaten is the small intestine (mura ju ju). It is cut into short lengths of about twenty centimetres. The murajuju is then washed in saltwater and boiled or cooked in a ground oven.

Other organs and body parts removed are:

rra-mayngul - white fat

ngundurrngundurr - heart

na-yinji - lungs

na-widiri - liver

murajuju -small intestine

wilawila - stomach

rimi/rirrkukilwalkarru - large intestine

ma-minji - skin and meat; it also contains the genital organs of the dugong

nawalkirrirri - uterus

rra-wumumu - kidneys

lubala - part of backborie without ribs

a-mardanbangu - short ribs

kurruru - backbone

a-lardurr – ribs

Dugong meat is cooked in a ground oven. 'The ground oven (rabarr) is approximately 1 metre deep, 1 to 2 metres in width and 2 metres in length. The ground oven is filled with wood which is set alight. While the'wood, is burning stones are thrown into the fire to get hot.

When the wood has burnt down to hot coals the heated stones are removed. Green mangrove branches are laid on the bed of leaves and the hot stones placed on top of the meat., The oven is then covered with dirt to seal in the heat. The meat is left to cook for several hours.

During certain ritual occasions parts of the dugong and turtle are kept exclusively for the senior men. This meat is cooked separately and within the confines of a restricted sacred area called a na-manda. The ground oven is placed within the confines of this area.

After the meat has been eaten, all the scraps and bones are thrown back into the ground oven and burnt. The belief is that failure to dispose of the bones correctly will result in a cessation of successful hunting. The rib-cage sections, head, and flippers of the dugong, and the hip and back flipper section of the turtle, are considered sacred. These are the sections which are placed into the ground oven.

When the head of a dugong is removed from the ground oven the flesh is removed, and the jaw is'separated from the skull. The jaw,' skull and flesh is cooked once more. The skull of a dugong is usually thrown back into the sea or river. This is why few dugong skulls are ever found at camp sites; the head of a human or animal is deemed sacred by the Yanyuwa.

If a female dugong is killed and found to be pregnant, the foetus is'taken with the rest of the meat and cooked. It can only be eaten by senior men who fall into either of the following categories; those men who have the dugong as their Dreaming, or those people who by Dreaming relationship call the dugong mother.

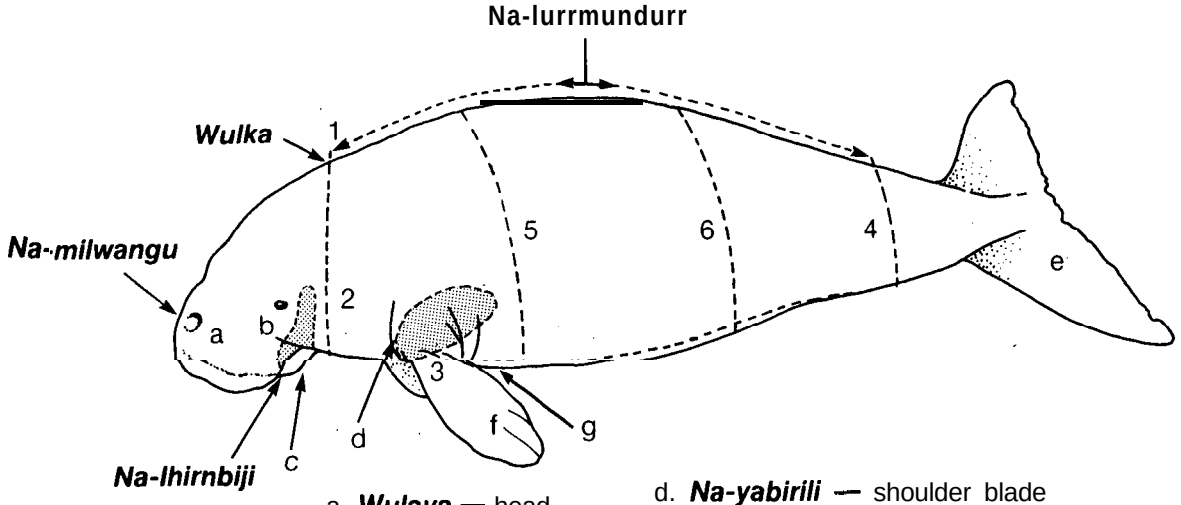
The act of distributing the meat from the dugong and sea-turtle is governed by Yanyuwa law. What each person receives is usually based on his relationship to the hunters and at times by his relationship to the creatures by Dreaming.

The division of turtle and dugong meat is called by the Yanyuwa wangkamantharra, and Yanyuwa law, in terms of song and ceremony, says that the meat from these two animals must be shared. It is not viewed favourably if a hunter does not distribute the meat. In past times such an action was enough to incite heated arguments and even physical violence. This can still be the case today.

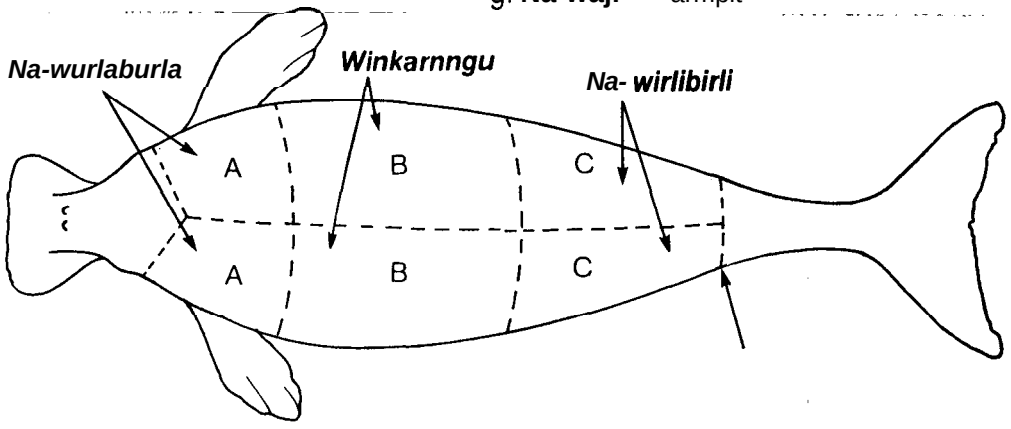
In the division of dugong meat the hunter receives some of the belly meat and the head, and if the dugong has no ritual use (in terms of na-manda cooking), he takes a small portion of the ribs and some of the intestines. The driver of the boat receives the tail, some shoulder meat and ribs.

Figure 2. Method of butchering dugong known as YINGKURRA.

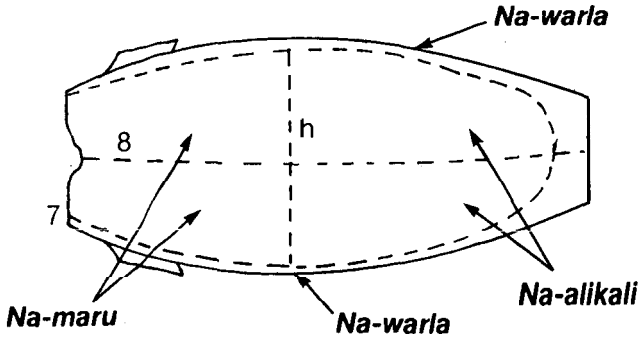
numbers refer to the order in which the cuts are made



a. ***Wulaya*** — head
b. **Na-*rawulurr*** — jaw
c. Na-jamuka — chin
d. ***Na-yabirili*** — shoulder blade
e. Na-yirrimbi — tail
f. ***Na-manda*** — flipper
g. **Na-waji** — armpit



The slabs of meat A, B and ***C*** are called ***Wungal***
The hide of the dugong is called ***Yanjurr***



The belly section, when cut in half, is called ***Na-yalari***
h. ***Na-wurdu*** — belly section

If a woman's brother or sons participated in the hunt, she may not eat meat from the spine or ribs, so she is given a large portion of the intestines. The hunter's sisters, sons and daughters are not allowed to eat any of the tail portions. The hunter also makes a presentation of meat to his mother-in-law. This is done through a second person because of the strong avoidance taboo which exists between son-in-law and mother-in-law. This presentation is seen as an on-going payment in return for the man being allowed to have his wife.

The driver of a boat in a turtle hunt receives some meat 'and associated green and yellow fat from the hip section of the turtle. He also receives some of the chest meat, 'intestines and green fat which lines the shell.

The head and neck of the turtle goes to the senior ritual, guardian for the animal. The hunter's mother and sisters are not allowed to eat the intestines of the turtle so the stomach is saved exclusively for them. As with the dugong,, the best meat is given to the hunter's mother-in-law.

The oil (na-ngilili) which the Yanyuwa obtain from the hide and meat of the dugong during the cooking process is said to have medicinal qualities and is rubbed onto the body and hair. The Yanyuwa say that it makes their hair grow strong and when rubbed on their bodies it keeps them warm and free, from pain.

Both the dugong and the turtle are important mythological beings for the Yanyuwa people and neighbouring groups to the north. The Mara people, whose country lies to the north-west of the Yanyuwa, have a very important Dugong Dreaming centre. The site is known as Wunubarryi (Mt. Young) and lies some seven kilometres south-east from the mouth of the Limmen River. The Yanyuwa people also recognise the importance of this site and they share in the control and use of the Dugong Dreaming power which is centred there.

Just to the east of the hill which comprises wunubarryi can be found a number of quartzite outcrops. These rocks are viewed by the Mara and Yanyuwa to be metamorphosed dugongs and a single dolphin which were stranded on dry land by a receeding king tide (bambiliwa) during the Dreamtime. It is interesting to note that there was a similar occurrence in 1984 during Cyclone Kathy; a number of dugong and sea-turtle were stranded after a storm surge carried them up to eight kilometres inland in the vicinity of the McArthur River delta area.

The Dugong Dreaming is in fact seen to be a herd of dugongs. Two of the rocks are seen to represent male dugongs, while the others are seen to repesent females. It is one these female dugongs that the Yanyuwa and Mara custodians for this site use to carry out dugong increase rituals. When men wish to perform these rituals they approach the Dugong Dreaming herd and brush down the' 'female dugong' they have selected for use in the ritual.

Surrounding the 'female dugongs' are a number of hammerstones. One of these hammerstones is taken and the 'female dugong' is struck and at the same time the names of dugong hunting localities along the coast and in the area of the Pellew islands are called out. A translated example of this calling out is as follows:

> YOU dugongs, listen to me, you will come out from here and you will travel to Wuthanda [McArthur River mouth], Liwujujuluwa [Crooked River mouth], Lidambuwa [Sharkers Point] and Bulubuluwiji [Wearyan River mouth]. Listen to these words that I am telling you!

Some of the 'female dugongs' have deep grooves and depressions in them indicating that the rites of increase are of some antiquity.

In 1976 this Dugong Dreaming site at Wunubarryi was desecrated. The owners of the Nathan River Station, where Wunubarryi is located, dug out two of the 'female dugongs' while constructing a four wheel drive track through the area. The Yanyuwa and Mara people were extremely upset over this incident and they believe that because of this desecration the dugong population in the area of the Sir Edward Pellew Islands has suffered.

The Yanyuwa people have a Dreaming site for the Lone Male Dugong (jiyamirama) at Wungunda on the southern bank of the mouth of the Crooked River, and at Wirdiwirdila, a small island in the Wearyan River, is a Dreaming site associated with the rib-bones of the Lone Male Dugong.

During the singing of their ceremonial song cycles the Yanyuwa also sing of the dugong. Some of these verses are given below. The following songs are associated with the dugong hunting locality of Bulubuluwiji at the mouth of the Wearyan River. These song cycle verses belong to the Yanyuwa Rrumburriya semi-moiety.

Wabarrkuramba jirrimbi ramba	"The tail of the dugong strikes the water"
Yarakiyara lhungkarrmi lhungka	"The cows are gathering, they travel with their calves"
Narnawirijarra yumbarrimajarra	"The bull dugong thrashes, it tires" [It has been harpooned]

The song of the Lone Male Dugong is sung in the song cycle of the Yanyuwa Wuyaliya semi-moiety.

Jiyamirama wukuwarrima	"The back of the Lone Male Dugong is clearly showing".

The turtie is associated with a number of areas over the Sir Edward Pellew Islands. The west coast of West Island and the coastal margins of Bing Bong Station are associated with the Dreaming path of the flat backed turtle (wirndiwirndi). This turtle completed its travels on a reef called Liwintha, which lies just to the south of West Island.

Watson Island and the northern section of North Island are,, associated with the path of the Green Turtle Dreaming (malurrba). Various rock formations.along the Dreaming path of this turtle represent the shell, internal organs and segmentsof meat which the hunters of turtle find important.

There are a number of song cycle verses relating to the turtle but they cannot be reproduced as they belong to secret and sacred rituals.

The Yanyuwa people still class the dugong and turtle as a very important part of their economy, and cannot conceive of a time when they would not be able to have dugong and sea turtle as a part of their diet. There is still distinction given to those men who in Yanyuwa society are called maramaranja or "a dugong and turtle "hunter of excellence".

Within the region of the Sir Edward Peilew islands the turtle always has been, and continues to be, present in large numbers, but the Yanyuwa have in recent times begun to fear for the, safety of the dugong.

With the increased use of the Sir Edward Pellew Islands as a fishing and tourist area, signs are becoming more and more evident that the dugong, and perhaps the turtle, population will" be more threatened as development increases.

In November of 1983 two dugongs were found dead on the mud flats at the mouth of the Carrington Channel. Both dugongs showed signs of having been shot by high powered rifles. On arriving at a beach on the north-west coast of South West Island another two dugong were found; again they showed signs of having suffered death from the use of firearms.

Continuing around the island on the following day another dugong was found on a beach on the east coast of South West Island. Yet another was found on the same weekend on Sharkers Point; it also showed signs of being shot.

It should be noted that the number of dugongs found (six), represents approximately half the number the Yanyuwa men kill per year using traditional methods.

Yanyuwa men and women are continually finding more dugong which have suffered at the hands of visitors to the islands. Dead dugong have been found with their heads cut off or showing signs of being slashed with sharp objects. Other.dugong are found showing severe abrasions and cuts which have been caused by fishing nets.

In April of 1984 a group of Yanyuwa men travelled to South West Island, and while there they found the dismembered carcass of a dugong. Attempts ha'd been made to cover the butchered remains with stones.' The method employed to butcher the dugong and the amount of waste meat found did not correlate with the traditional methods employed by the Yanyuwa. It is reasonable to 'infer,, therefore, that this dugong, toowas a victim of white Australian hunters.

In 1984 the Northern Territory Government announced that it would be subdividing Camp Beach on Centre Island (in the Sir Edward) Pellew Group) into eleven allotments suitable for the building of 'fishermen's huts'. In July of 1985 it was announced that these blocks would be auctioned. Both green and flat-back turtles have been observed nesting on camp beach. Any human occupation on the fore-dune system can only have detrimental effects on the breeding success of the turtles. Turtles are considered to be an endangered species, and as such every effort should be made to protect their habitat and nesting grounds.

An increase in the use of motor boats through the area of the Sir Edward Pellew Islands can only lead to the damage of the extensive sea-grass beds which are to be found along the coastal margins on this part of the Gulf of Carpentaria. Once it has been removed from an effect on the resident populations of both dugongs and turtles.

The continuing episodes of damage to the dugong and turtle populations upsets the Yanyuwa people. The dugong and turtle are Dreamings for certain individuals and groups of people. The continuing episodes of dugong slaughter, damage to important areas for turtle and the desecration of important ritual centres causes unrest in terms of the functioning of a traditionally based society.

There is sadness and sometimes sickness and death caused to those people who stand in a Dreaming relationship to the dugong and turtle. There is also concern that those people who stand in a 'mother' guardian relationship to the dugong and turtle are not fulfilling their duties and obligations towards the species, an offence which is punishable under the dictates of traditional law.

It becomes clear, then, that to the Yanyuwa people the problem does not concern only conservation of the dugong and sea-turtle. There is also a serious difficulty concerning the need to maintain the integrity of their own traditional law system.

The Yanyuwa people are justifiably proud of their dugong and turtle hunting heritage. In terms of their oral history, certain men are mentioned over and over again as being 'dugong and sea turtle hunters of excellence'. Younger men will say with pride that they were 'trained' by these skillful men. Certain old men amongst the Yanyuwa who were once skilled hunters, but can no longer hunt, are spoken of in high regard and their advice is still sought in terms of traditional law and practical knowledge concerning the dugong and turtle.

The dugong and turtle are still of great importance to the Yanyuwa in terms of spiritual attachment and economy. In a world where values are changing quickly, the continuation of the hunting of these two marine animals remains one way in which the Yanyuwa people can continue to identify themselves as "Saltwater People", a title of which they are proud.

But with incursions into the marine environment from outside and uncontrolled sources, the Yanyuwa do indeed wonder for how much longer the dugong and turtle will be of continuing economic importance and for how much longer their rituals will have any relevance in terms of these animals' physical survival.

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TRADITIONAL KNOWLEDGE OF THE MARINE ENVIRONHENT, FISHERIES, AND CONSERVATION OF MARINE WILDLIFE - WESTERN AUSTRALIAN PERSPECTIVE

Robert I.T. Prince

Knowledge of marine wildlife and fisheries resources is important for those bodies presently charged with responsibility for conservation and management of these living natural resources. Similar, but not necessarily completely overlapping, knowledge of these resources is also important for those people who exploit the marine environment.

Conservation and fisheries management authorities and fishermen all desire the continued existence of particular species, groups of species, or other components of natural ecosystems. There is therefore common ground for discussion of problems of changing abundance of different 'resources', and scope for beneficial cooperative study of different species and circumstances of mutual interest that can lead to better understanding of biology and of problems of concern to the various groups involved. These points have already been touched on in the previous papers.

Where management intervention might be required because of changes that have affected a particular situation where traditional exploitation is involved, cooperative investigation of the perceived or possible problem is -the --only- sen-s-ible approach. In Western Australia, both the conservation and fisheries management authorities are aware of the interests of traditional users of marine resources and actively seek consultation with these users. In common with similar authorities elsewhere in Australia, however, these State authorities and their Ministers must also take notice of the concerns of many other people who ask that statutory responsiblities, as they see them, be properly discharged.

Current interest in problems of marine wildlife conservation and management in Western Australia is focussed on dugongs in the West Kimberley, but does not end with this species, nor indeed this situation.

Work now in progress is extending current knowledge of the dugong in Western Australia that has been progressively built up since 1977. Unlike the situations in Shark Bay and Exmouth Gulf and along much of the Pilbara coast however, the West Kimberley area, particularly around the Dampier Land coast, is a focal point for continuing exploitation of dugong and turtles and other marine life by the local Aboriginal people. Conservationist interests believe there is a possible management problem that needs further attention here; some of the Aboriginal people with knowledge of dugong hunting in the area in the past are also worried about the apparent changes in availability of dugongs they have witnessed in the past ten to fifteen years or so (Davis, this volume).

Rather than describe the present field program in detail, I will focus on specifics for which the statutory management authorities must, of necessity, eventually seek a satisfactory resolution.

Helene Marsh haspointed out the worldwide significance of Australian dugong populations in context of conservation of the species (Marsh,.this volume). The Western Australian populations are an important part of the Australian stocks, and for the most part are practically unexploited. The existence of such populations of dugongs 'is of great importance for conservation. This fortuitous occurrence does not, however, have firm legal standing in Western Australia at present.

As. in the other Australian States, Western Australian legislation in the area of wildlife conservation and fisheries management has always permitted Aboriginal people to continue, exploiting their traditional natural resources, be they fish, wildlife, or plant.

To 'date, wildlife-related State legislation'has generally not dealt with questions of acceptability of meth'ods to be used by Aboriginal hunters in procuring, such wildlife. The Fisheries Act, on the other hand,, has. Prior to 1979) Aboriginal use "of any'weir or hedge" was specifically barred (Section 56, Fisheries Act, 1905). Legal constraint on use of fish traps, a most traditional fishing method, still applies due to pr'ovisions of the present Sections 23 and 56 of that Act. Aboriginal fishermen who were formerly allowed to take fish "in their accustomed manner", apart from the exception noted, are now also bound by other provisions of the Act that may be applied to all other fishermen (Sections 9, 10, 23A and 26). Both the wildlife and fisheries statutes have always been clear that permissible exploitation should be limited to food for direct use only.

It is obvious from discussion at this meeting, and elsewhere, that there is continuing debate, both within the Aboriginal and Islander communities and outside, concerning the type of trading in fish and wildlife products that should be permitted, and on the acceptability of different hunting and fishing practices now in use. Direct sale or equivalent trade in products obtained is still legally proscribed.

The concept that natural resources exploited in traditional hunting and fishing might become depleted to the point where constraints to protect the exploited species' stocks could become necessary.is a relatively recent addition to the statutes. The Wildlife Conservation Act also embraces the concept of rarity and vulnerability to extinction (Section 14(2)).

Wildlife and fisheries managers are well aware of the extent of debate on fishing and hunting practices in current use in 'traditional' exploitation, and may well have to move in this regard at some time in futu're where the action seen as necessary is within their power.

The most vexing question at present in regard to conservation of the dugong in Western Australia, and the continuing rights of access to this 'traditional fishery', stems from the fact 'that there are no specific guidelines in regard 'to either limitations on the extent of any 'traditional' fishery or hunt, or in respect of which 'Aboriginal' people might rightly participate in any' particular hunt or fishery, The conservation problem posed 'in Western Australia by these omissions is not yet acute in regard to dugongs or other similar marine resources such as turtles, so there is time to think through a sound and equitable solution.

As far as I am aware, traditional Aboriginal society found no difficulty in accommodating the concepts of custodianship of particular resources by limited groups of people, and of restricted use of these resources by those people generally entitled or otherwise permitted to use them. The same concepts are also embodied in everyday management of exploited fish and wildlife species. The objective in each case is seen to be the same; that is, sustaining a socially desirable and productive activity that is dependent on persistence and continued productivity of the resource bases. Both Aboriginal and white Western Australians have an interest here. Where the question of existence of a 'traditional fishery' is involved, the views of those people having most direct knowledge of such situations is perhaps the most valuable.

Dugong stocks of world significance are to be found off several parts of Western Australia. Although these are not substantially exploited by Aboriginal people at this time, and probably nor were they in the past, the stocks may become vulnerable in the future as Aboriginals become more mobile and knowledge of dugong hunting is gained.

Industrial development on the Pilbara coast has also led to migration of Torres Strait Islanders to places such as Dampier and Karratha. The newly established Island community here has continued to hunt dugong and turtle as they were previously accustomed to do on their home ground (many of these are 'amateurs' as defined by Ephraim Bani). Aboriginal people with whom I discussed the Islander problem feel that it would be no different if I should begin hunting dugong myself.

Issues affecting management of exploitation where an established 'traditional fishery' exists, but, where adverse changes in the stock abundance/exploitation equation appear to have occurred, are best handled by direct study and cooperative consultation. My present Dampier Land study is of this type, but it would be premature to discuss progress to date at this meeting.

Apart from the need to address specific management problems, wildlife conservation authorities in Australia, and in Western Australia in particular, are still in need of much basic knowledge of the flora and fauna for which they have been given responsibility for conservation. It is a matter of shame that the European biologists who carried out the first inventory-type biological surveys in Australia generally ignored the wealth of knowledge of natural history possessed by Aboriginal people. It is also true that many Aboriginal people now recognize the loss of knowledge of their environment that has occurred because of a failure to record information.

Some attempts to redress this continuing loss of information are now being made in Western Australia. Colleagues at the Western Australian Wildlife Research Centre have, over the past several years, been contacting Aboriqinal groups throughout the Western Desert area to seek further insight into the composition of the desert mammal fauna and the processes of decline, and even extinction, o,f some species that have apparently proceeded over the past one hundred years or so. Aboriginal names for different species are being associated with specimens of animals in

discussion with knowledgeable people, These names, with details of ecology and life habits of the animals concerned and their, general economic importance to the people, are being recorded where possible.

We have no comparable work in hand dealing with the marine environment, but anticipate the possibility of some valuable cooperative work on marine turtles in the future. Moya Smith from the Western Australian Museum Human Studies group is also conducting a cultural resource study at Lombadina and around One Arm Point. Information on marine and other biological resources is being collected where possible and could provide a firm basis for some more detailed work in future.

WORKSHOP DISCUSSION

The discussion covered the following points:

Most fisheries departments are concerned with economically important species of fish which may not include all species important to traditional fishermen.

In Western Australia generally, fish are the most important element in terms of volume of total marine products taken by traditional fishermen. Different fish species are favoured at different times of the year.

Local communities could assist in documentation of fishing/species knowledge.

It was noted that much of the discussion at the workshop so far had focused on dugongs and turtles, and that there was a need to talk of aspects of transmission of knowledge of other species.

PART D

STUDIES ON THE BIOLOGY OF TRADITIONAL MARINE RESOURCES

THE DUGONG PROBLEM

Helene Marsh

TRADITIONAL SIGNIFICANCE OF THE DUGONG

I doubt whether any person of European cultural background, including myself, can truly understand the significance of the dugong to many indigenous people from the coastal areas of northern Australia. However, some insight can be gained from the following statement issued by the Aborigines and Islanders who attended the Dugong Workshop held at James Cook University in 1979:

> "...the dugong is of great significance in Aboriginal and Islander ceremony, religion, economy and culture and has an important co-ordinating role in these societies. Any local rarity or extinction in areas in which the hunting of dugongs has occurred traditionally would be likely to cause disruption and such communities have a very real and historic interest in the conservation of the species".

STATUS OF STOCKS

The dugong is listed as vulnerable to extinction by the International Union of the Conservation of Nature (Thornback and Jenkins, 1982). Uncontrolled, deliberate and accidental exploitation is believed to have seriously reduced populations throughout much of the dugong's range which encompasses coastal waters from East Africa to Vanuatu between the latitudes of 26° north and south (Nishiwaki and Marsh, 1985). Although the range includes the waters of some forty countries, Australia is the only developed country with a resident dugong population, and one of the few areas where dedicated aerial surveys to determine dugong distribution and abundance have been carried out.

Extensive aerial surveys have established that sizeable numbers of dugongs still occur in the shallow seas around northern Australia between Shark Bay in Western Australia and Moreton Bay in Queensland (Heinsohn et al., 1976, 1978; Elliott, 1981; Prince et al., 1981; Anderson, 1982; Marsh, 1985a, in press (a); Bayliss, in press). It is likely that this region supports a substantial proportion of the world's dugongs.

The status of the dugong in Australian waters is unknown. As discussed below, there is prima facie evidence to suggest a recent decline in the Torres Strait area (Marsh, in press (a)). Many of the Aborigines and Islanders at this meeting also

expressed concern at what they perceive as a decline in numbers in various areas.

Despite current efforts to estimate dugong numbers in parts of Western, Australia, the Northern Territory and Queensland (Marsh, 1985a and in press (a); and Bayliss, in press), I estimate that it could be a decade or more before the status of the dugong in Australian waters can be confirmed.

This time-lag is due to the combined effects of the dugong's patchy distribution (which makes it difficult to obtain a precise index of dugong density) and low recruitment rate. 'Meanwhile, management regimes incorporating the principle of conservation need to be developed.

LEGAL SITUATION

In Australia, dugongs are protected by State and Federal legislation. Only indigenous people are allowed to hunt dugongs, and trade in dugong products is illegal. Apart from these restrictions, the situation differs somewhat in different areas. In Queensland, only Aborigines and Islanders living on reserves and in certain shires are automatically allowed to hunt under State law. Indigenous people living on reserves adjacent to the Great Barrier Reef Marine Park also require a permit from the Great Barrier Reef Marine Park Authority to hunt within the zoned areas of the Park. Indigenous people living off reserves in Queensland may apply to the Queensland Fish Management Authority to hunt dugongs under permit; such permission is now rarely granted. In the Northern Territory, all Aborigines can hunt provided they do so in "traditional hunting areas", whereas in Western Australia the only restriction on dugong hunting by indigenous people is a ban on hunting in Shark Bay and Exmouth Gulf (Prince, this volume).

In Queensland, hunters are 'not allowed to use "noxious substances" or "explosive devices" (including guns). These restrictions do not apply in the Northern Territory or Western Australia.

Most dugong habitat areas in Australia are so remote that even these laws have been impossible to police effectively.,,

LIFE HISTORY

Almost all information has been obtained from the study of over 600 dugong carcasses. Specimens were obtained from animals accidentally drowned in shark nets in the Townsville area or killed for food by indigenous hunters at various communities in northern Australia and Papua New Guinea (Marsh, 1980, 1985b, in press (a); Marsh et al., 1984 a, b, c). Age has been estimated from tusk dentinal growth layer group counts, the deposition rate being deduced from the seasonal pattern of growth layer deposition. The maximum longevity observed is 73 years. Females have their first calf at a minimum age of 9 to 10 years, and sometimes not until the age of 15 to 17 years. A single calf is usually born and suckles for up to at least 18 months. Calving interval estimates based on apparent pregnancy rates, placental 'scar counts, or calf counts range from three to seven years for various Australian/Torres Strait populations (Marsh, 1985b, in

press (a); Marsh et al., 1984c). Even though there are no reliable data on age-specific fecundity or mortality, there is no evidence of a marked decline in fecundity with age in females (Marsh, 1985b). However, some males may become post-reproductive (Marsh et al., 1984b).

Population simulations indicate that, even with the most optimistic combination of life history parameters, a low schedule of natural mortality and no man-induced mortality, a dugong population is unlikely to increase at more than about five percent per year (Marsh, in press (a)). This means that there needs to be at least 200 dugongs in a population to harvest five females per year without causing the population to decline.

PRESSURES ON AUSTRALIA'S DUGONG STOCK

Are there enough dugongs in Australian waters to sustain the current level of man-induced mortality? In the absence of data on the status of our dugong stock, it is impossible to give an unequivocal answer to this question. However, perceptions of local declines in sightings and/or catches suggest that the answer is no in some areas. One thing is certain. The situation is currently very complex and varies greatly from region to region as discussed further in this paper.

Table 1 summarises my perceptions of the differences between the pressures on Australia's dugong stock at the time of European contact (when there was apparently no problem in harvesting dugongs at a sustainable level) , and the situation now. Several conclusions can be drawn about current circumstances:

1. In many areas, the dugong is now subject to multiple sources of man-induced mortality and habitat damage.

2. Even if the present level of legal protection could be policed effectively, it would not protect the dugong from all these sources of man-induced mortality.

3. It is possible for a dugong population to decline even if the level of indigenous hunting remains constant or decreases.

4. A local situation can change rapidly for a variety of reasons; for example, the availability of new technology, the opening of a new fishery (even for another target species), the loss of traditional knowledge, changing economic circumstances, or a natural event such as a cyclone or storm surge.

5. As pointed out by Johannes (1978), traditional fishermen (in the Pacific Islands) developed better gear primarily to reduce the effort needed to acquire the catch, rather than to increase the catch per se. Thus, the availability of better gear to traditional hunters in the form of Western technology does not necessarily mean that the catch will be increased. Conversely, banning the use of Western technology for hunting dugongs will not guarantee that the catch will be kept at a level consistent with population maintenance, particularly if a population is subject to other impacts.

THE DIFFERING NATURE OF THE DUGONG PROBLEM

Three case studies are outlined to illustrate the regional variation in the pressures on dugongs in Australian waters.

Tortes Strait

The following account of the status of the dugong in Torres Strait is based on Barker-Hudson and Marsh (both in press).

Although it has been illegal to sell dugong meat in Australia since the 1960s and in most of Papua New Guinea since 1976, the people of Daru on the Papua-New Guinean side of Torres Strait received a special dispensation which enabled them to continue selling dugongs in the market,' (Hudson, 1981).

The capacity to sell dugongs during a period of rapid technological change and development of a cash economy led to a marked increase in the dugong catch passing through the Daru market in the late 1970s coincident with the expansion of the barramundi and crayfishing industries. Papua New Guinea Division of Wildlife records indicate that most hunting occurred on Wednesdays and Thursdays for markets which coincided with the distribution of pay to community members. During the same period, substantial numbers of dugongs were also caught by the people of the Australian islands (Nietschmann, 1984), although in the absence of a long-term data, it is impossible to view the Australian catch levels in an historical perspective.

Available records suggest that of the order of 500 to 1,000. dugongs were being caught annually in Torres Strait at this time. The Papua New Guinea Division of.Wildlife monitored the catch passing through the Daru market between 1978 and 1981. During this period more than 500 dugongs were sold, including 218 in 1979 alone. Nietschmann (1984) documented the catch of a total of 504 dugongs at three communities in the Western Islands during several periods between 1975 and 1979, and estimated that the annual dugong catch in Torres Strait was probably of the order of 750 animals. (It is not clear whether this estimate included the Daru catch.)

Population simulations indicate that, assuming the life history information outlined in Section 4 above is correct, at least 22,000 dugongs would need to occur in Torres Strait to sustain an unselective harvest of 500 dugongs, 44,000 to sustain a harvest of 1000 animals. If there was an effective hunting bias in favour of pregnant females as some huntersclaimed (Olewale and Sedu, 1980), these figures are underestimates.

In November 1983, the Torres Strait area was surveyed from the air for dugongs using a technique derived from that developed for censussing kangaroos. Results were generally disappointing. The largest group seen was six in contrast to the large groups seen on some other aerial surveys in Northern Australia in recent years. The survey indicates that there were of the order of 1500 dugongs in the region. This figure is an underestimate, probably a gross underestimate of the number of dugongs in Torres Strait. However, the discrepancy between this figure and the number,. needed to sustain the harvest levels of the late 1970s is so great that there is cause for concern, particularly as catch levels have declined.

The number of dugongs passing through the Daru market plummeted from the high of 218 in 1979, to 70 in 1981, and 18 in the first eight months of 1982. No records have been kept since then, but verbal reports indicate that very few were caught between mid 1982 and early 1984 when the sale of dugong meat in the market was banned. The decline occurred despite a sustained hunting effort (the number of turtles in the market actually increased), and despite the increased availability of motorised craft which enabled the hunters to extend their hunting grounds.

Catches in the Western Islands also appear to have declined. The catch statistics collected by the CSIRO traditional fisheries project in 1983-84 were substantially lower than those recorded by Nietschmann in the late 1970s (R.E. Johannes and Wallace MacFarlane pers. comm.). Again the turtle catch has been maintained suggesting that the effort has not declined.

Although the Torres Strait dugong situation is not typical, it provides an example of how a traditional fishery under the influence of Westernization can overexploit a stock that was previously harvested at a sustainable level.

Borroloola

Despite the usage of Western technology, dugong hunting by the Yanyuwa people who live in the Borroloola area is still comparatively traditional and maintained at a low level of eleven animals or less per year (Bradley, this volume). The people of this area are very concerned at what they perceive as a decline in dugong numbers. They attribute this decline to the activities of white fishermen who apparently kill more dugongs than the traditional hunters. In 1985, for example, ten dugongs drowned in a fishing net at the mouth of the McArthur River in one night, and dugongs with bullet wounds were not uncommonly found floating or washed up dead (Bradley, this volume).

This dugong population has also been subject to high natural mortality recently. A storm surge associated with Cyclone Kathy in March 1984 stranded at least 27 dugongs, up to nine kilometres inland. Although 23 of these animals were returned to the sea, many were young calves which probably failed to survive.

The combined effect of these impacts has resulted in a perceived decline in dugong numbers in the Borroloola area, even though there is no evidence of an increase in the level of traditional hunting in this area.

A fuller account of the status of the dugong in the Borroloola area is given by Marsh et al. (1984 e), Harvey (1985), and Bradley (this volume).

Townsville

Although dugongs are no longer exploited traditionally in the Townsville area (with the exception of a very occasional animal taken by members of the community on Palm Island), they have been subjected to significant incidental mortality over the last twenty years or so. Shark nets, introduced for bather protection in 1964, caught 249 dugongs between August 1964 and July 1983 (Paterson, 1979, and personal communication 1984). Eighty-one animals were caught in the first year of netting. Forty-one

animals wer-e drowned in 1972, the year after Cyclone Althea: severely damaged seagrass beds in the area (Heinsohn and Spain, 1974). Since then, the number of dugongs caught in the nets has dropped to an average of about five per year. The cause of this decline has not been determined. Each year, members of the general public voluntarily report dugong carcasses which wash up on populated beaches in the Townsville area. Eight such cases were reported in 1985. Many of these animals are too decomposed to determine the cause of death, but othersbear scars suggesting that they have tangled in a gill-net and drowned. Thus the Townsville dugong population is subject to a significant level of man-induced mortality both from government shark-nets an'd commercial gill-nets, even in the absence of traditional hunting.

SUGGESTIONS FOR MANAGEMENT

In Australian waters, the range of the dugong extends along some 15,000 km of coastline and includes seas variously controlled by the federal government and three different state governments and their assorted departments and authorities.

Both conservation and development are necessary in this region and must be made compatible with each other. This will require sophisticated resource-use planning and management involving cooperation between different governments in some areas. I believe the management of Australia's dugong stocks should not be considered in isolation but within the context of the overall management of the coastal seas of the various parts of northern Australia.

Effective management of Australia's dugong population will require an assessment of the impact of various human activities on dugong numbers. Activities which are incompatible with dugong population maintenance will need to be excluded from at least some of the areas which support large numbers of animals. The areas set aside will need to be large enough to protect the full range of necessary habitats including dugong feeding, calving and resting areas. As our knowledge of dugong habitat requirements' is inadequate, zoning plans will need provision for updating to take account of new information. Although management areas which will protect dugong stocks are being developed along these lines in the Great Barrier Reef Marine Park (see Great Barrier Reef Marine Park Authority 1983 and 1985), this approach has not.yet been used on a large scale in other parts of northern Australia.

In areas where marine resources are harvested traditionally. effective management regimes will need to recognise the cultural and dietary needs of the indigenous inhabitants of the area. Caughley (1985) has pointed out "that all management decisions, are underpinned by an amalgam of facts and values, and that values are the most influential". As discussed above, it is difficult if not impossible for people of one cultural background to appreciate the values of another. Successful management of resources subject to traditional harvest will require the involvement of indigenous hunters and fishermen in all stages of the planning and management process.

An example of this approach has been detailed by Barker-Hudson (in press). Indigenous hunters were directly involved in the management of dugong hunting in the Maza Wildlife Management Area based at Daru in Torres Strait between 1978 and 1981. User involvement was reinforced by a vigorous programme of community education which was simultaneously developed by the Papua New Guinea Division of Wildlife.

The management regime was developed by a committee which included two representatives from each hunting community, The committee responded to the evidence of over-harvesting by successfully banning the hunting of small dugongs and the use of nets to catch dugongs in 1980, and had discussed returning to fully "traditional" hunting from non-powered sailing canoes by the time the programme was unexpectedly discontinued due to lack of funds in late 1981.

This abrupt termination of the programme meant that there was no time to assist the committee in the transition to being fully self-supporting and it virtually lapsed. However, the programme left a legacy of awareness about the potential for over-harvesting dugongs and the government ban on the sale of dugong meat introduced in 1984 has been respected. In contrast, many of the dugong hunters I have spoken to in the Australian parts of Torres Strait (who have not been exposed to such a programme) remain unconvinced that the perceived decline in dugong numbers could be due to over-harvest.

Baldwin (this volume) has outlined the need for user involvement in an integrated programme of research, management and education to conserve dugongs in the Great Barrier Reef Marine Park. After spending thirteen months living at Hopevale Aboriginal Community, Smith (1985) also advocated a community-based regime to control local dugong hunting, despite the fact that this approach had been rejected by the Hopevale Council when first proposed by Great Barrier Reef Marine Park Authority Staff.

The experience at Daru has shown that it takes at least several years for a successful community-based management programme to evolve even when it is accompanied by vigorous public education initiatives, and I consider that this approach should not be disbanded in Australia because it was initially rejected at Hopevale.

Although community-based management programmes will take time to establish, the hunting rights of indigenous people can be quickly and formally acknowledged by the declaration of appropriate "Traditional Hunting Areas" when zoning plans for a region are drawn up or revised. The Scientific Research Zone which straddles the boundary between the Cairns and Far-North Sections of the Great Barrier Reef Marine Park partially functions as an unofficial "Traditional Hunting Area" for the Hopevale people. However, because this function has not been publicly acknowledged, the hunters do not appreciate the fact that the dugongs they harvest have been protected from incidental mortality from commercial fishing in this area. (This fact has not escaped the commercial fishermen, however.)

Despite the 'different management problems that exist in different' areas, I consider that the effectiveness of marine parks and other management areas in conserving Australia's dugongs will be enhanced if an integrated management programme is developed for the whole region. Monitoring programmes are expensive and once optimised should be standardised to facilitate comparisons between areas. The development of public education programmes is also expensive, and although such programmes should be customised for different localities., it is desirable for each to benefit from the experience of others.

Within Queensland, the Queensland Fish Management Authority took a commendable lead in this direction in 1984 by establishing an interdepartmental committee with both State and Federal Governme'nt representatives which is considering the overall problem of dugong management. It is to be hoped that this committee is the forerunner' of a more broadly-based body which will include indigenous hunters and which will co-ordinate dugong. management throughout northern Australia.

Managing dugongs in Australian waters should be relatively simple compared with most of the rest of the range where human population density is higher, and the conflicting demands, on coastal resources much greater and more complex. As an affluent nation whose waters support a significant proportion'of world dugongs, Australia should be prepared to take a leading role in developing programmes to conserve these animals - or to take most of the blame if they become extinct.

If effective management programmes are not developed and dugongs become rare or extinct in northern Australia, coastal Aborigines. and Islanders will lose not only a major part of their diet, but a major part of their traditional lives.

ACKNOWLEDGEMENTS

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WORKSHOP DISCUSSION

The discussion covered the following points;

A formal method of coordinated dugong management in northern Australia must be devised..

There is a perceived problem with respect to trawlers destroying dugong habitat. The likelihood of this was disputed by a participant on the basis that trawlers do not work directly on seagrass beds.

Table 1. A contrast between the pressures on dugongs in Australia? waters at the tire of European contact and in the 1980's. It should be noted that there is considerable temporal and spatial variation in present-day techniques and that those listed are not necessarily in widespread use.

		PRECONTACT	1980'S
		HUNTING	
WHERE:	overall	Many areas in the range which extends from Shark Ray WA to Moreton Bay QLD.	Restricted to relatively few communities e.g. there is no legal hunting south of Palm Island in QLD.
	single communities	Individual forays restricted by range of craft and the rules of sea-tenure (see Chase, 1978 and Barker-Hudson, in press)	Hunters able to traverse large areas e.g. Hopevale people travel more than 90km to their main dugong hunting ground (Smith, this volume).
HOW:	equipment	harpoon (see Haddon, 1912, Thomson, 1934)	harpoon (see Marsh et al., 1981; Nietschmann and Nietschmann, 19811; gun (Marsh et al., 1984d) motorized boat (Marsh et al., 1981; Nietschmann and Nietschmann, 1981)
	platform	canoe (Thomson, 1934) raft (Smart, 1951) hunting platform (Haddon, 1912)	
	knowledge	extensive traditional knowledge (see Nietschmann, 1984)	some knowledge may be lost due to community disruption (see Smith, this volume)
	ancillaries		CB radio
WHEN:		weather/tides permitting	Better craft have extended the range of suitable weather conditions, however, boat usage is often curtailed by fuel costs, mechanical repairs, and job commitments (see Marsh et al., 19811.
WHY:	for whom	sharing with tribal members	sharing with tribal members, sale (see Marsh, in press b)
	consumption	immediate use	immediate use, freezing, salting (Marsh et al., 1981; 1984d)
		NETTING	
WHERE:	deliberate	a few areas e.g. hand-held nets Mornington Island area (Roughsey, 1971)	
	incidental		commercial gill net fisheries e.g. for barramundi Mary River north in Qld (Hundlde, 1985) (see Marsh, in press b); shark-netting programmes for bather protection at several Queensland localities (see Paterson, 1979)

		OTHER DIRECT MORTALITY	
HOW:		occasional mass-strandings due to tidal surges e.g. Marsh *et al.*, 1984e) natural predators e.g. killer whales (Anderson and Prince, 1985), sharks (Anderson, 1981)	presumably unchanged occasional drownings in trawls (H. Marsh, unpublished data, 1985)
		HABITAT DAMAGE	
HOW:	natural	occasional cyclonic damage to seagrass beds e.g. Birch and Birch 1984), seagrass diebacks like that which occurred in parts of Torres Strait in the 1970'5 *. (Yamashita, in press)	unchanged
	man-induced		potential for local damage to seagrass beds from dredging, trawling, pollution etc (see Larkum and West, 1982); little evidence of such damage to date. Many Aborigines and Islanders claim that dugong habitat is rendered unsuitable by motor noise; these claims have not been proved.

*Yamashita (in press) attributed this die-back to the "Oceanic Grandeur" oil spill, however, this has not been proved and the available evidence suggests otherwise.

MANAGEMENT OF DUGONG: AN ENDANGERED MARINE FOOD SPECIES OF TRADITIONAL SIGNIFICANCE

The need for user involvement in an integrated program of research, management and education.*

Claudia Baldwin

THE PROBLEM

Endangered species: The dugong

The dugong (*Dugong dugon*), the only strictly herbivorous marine animal, is one of only four existing members of the order Sirenia (sea cow), all of which are listed in the IUCN Red Data Book as species which are vulnerable to, or in danger of extinction.

Life history studies of dugongs indicate that the dugong has a lifespan of up to 70 years, a minimum pre-reproductive period of 9 to 10 years, with the female bearing one calf at a time at intervals of 3 to 7 years. According to Marsh (1984 and this volume), low juvenile and adult mortality rates are required to maintain a dugong population.

> Even the most optimistic schedule of reproduction and juvenile mortality demands an adult survivorship of about 90 per cent per ye-ar for-population maintenance. (Marsh, 1984).

Dugong dugon have historically ranged throughout the sub-tropical and tropical coastal and island waters of the Indo-West Pacific Region and have generally been hunted to very low levels throughout the range. A major proportion of the world's remaining dugongs occurs in northern Australia. Aerial surveys completed between 1974 and 1979 established that sizeable herds of dugongs inhabit the shallow coastal waters of eastern Queensland and southern Papua New Guinea.

Exploitation

Dugongs from this area along the coast appear to be under pressure from indigenous hunting which is made more efficient by modern technology; by illegal killing and by incidental captures in gill nets and shark nets (Marsh and Heinsohn, 1982).

Cultural significance

For some coastal Australian Aborigines and Torres Strait Islanders, dugongs have traditionally been a highly-prized source of meat and they are still exploited for this purpose. Because dugong hunting requires a fair degree of skill, success in this field brings important social status to the hunter (Nietschmann, 1982).

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* Editors' note: Reprinted from Great Barrier Reef Marine Park Authority Technical Report (GBRMPA-TR-1)

Dugongs are featured in the creation story of many of the indigenous people across the north of Australia.

Chase (1980) discussed the dugong as a "prestige good",' and the role of "conspicuous giving" and distribution of dugong meat among the sandbeach people of Cape York Peninsula.

> "Resource exploitationby indigenous peoples represents more than securing just the resource. It is part of socialization, moral education, the teaching of 'social and economic responsibilities, an expression of skill and ability" (Nietschmann, 1982).

With dugongs functioning in an important co-ordinating role in the culture of these societies (Anon, 1981), any regional scarcity or extinction of dugong populations in areas where dugong hunting occurs traditionally, would be likely to contribute to community disruption as well as to constitute a significant reduction in world dugong numbers.

NEED FOR MANAGEMENT

Need for a management program incorporating conservation and reasonable use of the resource

The vulnerability of the'dugong.population and the significant cultural role of dugongs in some indigenous societies illustrate the need for, and the challenge to, conserving the dugong population while enabling reasonable use of the resource. The, need for an integrated program of research, management and education in relation to dugongs on the north-east coast of Queensland is addressed in this paper.

Responsibility

The extensive range of dugongs and relative isolation of those taking the resource makes enforcement of regulations difficult. The co-operation of the 'users' is thus necessary for any management scheme to be successful. Responsibility for management, then, lies not only with government organisations that have jurisdiction and interest in the resource, but also with the individuals and communities which are involved in the taking of dugongs. An integrated program of research, management and education must be developed.with participation of all involved parties. A similar approach was developed and applied with some success in Papua New Guinea from 1974-1980 (Hudson, 1981).

INFORMATION NEEDS

Some guidance on information needed to develop policy and an integrated program may be drawn from the International Whaling Commission (IWC) experience (1982) in development of the Bowhead Whale by Alaskan Eskimos. A dugong protection program which allows possible harvesting on the basis of sustainable yield will initially hinge on research in the areas of wildlife science and cultural anthropology. Basic requirements outlined below are adapted from the IWC experience (1982):

the estimated present population size for a given area and any trends in population size (population dynamics);

estimates of net recruitment rates (involving life history studies) and relationship of the recruitment rate to population size (population dynamics);

the number of annual removals from this population and by whom;

location of habitats; documentation of human activity which has resulted in, or may result in, habitat degradation, alteration, or destruction and the trend for the dugong population as a result;

the relationship between marine animals taken: hunting for dugongs is often done coincidentally with turtle hunting;

new harvest regimes that might be considered for the target species.

Many of these aspects have already been studied to some extent. There are, however, identifiable gaps in the information accumulated to date in the developing field of dugong management.

EXAMPLES OF INFORMATION GAPS - WILDLIFE SCIENCE

Population dynamics

Though aerial surveys conducted since 1974 confirm that sizeable populations of dugongs occur around northern Australia, the information gained from these surveys should be considered qualitative rather than quantitative. Recently, more rigorous survey methods, including a systematic sampling regime, were applied by Marsh et al (1984) in Torres Strait aerial surveys. According to Marsh, methodology for dugong aerial surveys needs to be improved further by experimental development.

The information to date also gives little indication of population trends.

> "It is not known whether dugong numbers are increasing, decreasing or stationary at any of the major dugong habitat areas that have been identified" (Marsh, 1984)

Precise techniques for monitoring the status of various populations over time need to be developed.

The need for commitment to continuity of research has been identified by UNEP (Marsh et al., 1983) and the area of population dynamics is an obvious example of this need.

Recruitment rates in relation to' population dynamics

Recent experimentation in construction of population models to determine the annual rate of increase of stable dugong populations (Marsh et al., 1984) has introduced a valuable component to determining the' trends in dugong populations. Refinement of such, models will depend on further research on life history, particularly mortality schedules and breeding cycles.

Annual removals

Dugongs are protected by legislation in Queensland except for subsistence hunting by indigenous people on reserves.

In addition, as of November 1984, within the Cairns Section of the Great Barrier Reef Marine 'Park, 'traditional inhabitants' were required to apply for permits from the Great Barrier Reef Marine Park Authority for traditional hunting of dugong.

The permit system was used to monitor dugong catch for the first time by Hope Vale community during Christmas school vacation period 1983-84. A number of conditions were attached to the required permit. In conjunction with Queensland National Parks and Wildlife Service, day-to-day managers for the Marine Park, the conditions were discussed and accepted by the Hope Vale 'Council as well as by dugong hunters. Two of the conditions attached to the hunting permit are relevant to documentation of annual removals from the population:

> One dugong to be taken per hunter; total quota for the whole community to be 20 dugong.
>
> Catch data sheets to be completed for each dugong taken, for collection by Great Barrier Reef Marine Park Authority.

Evidence from the recent Torres Strait survey suggests that the Torres Strait dugong population cannot sustain the present rate of take (Marsh et al., 1984).

On the whole, though, present information on the number of dugongs taken per year by subsistence hunting, incidental catch and illegal exploitation on the northeast coast of Queensland is sketchy and mainly anecdotal. The appropriate management authorities need to devise a scheme for recording more accurate take of dugongs by all means.

Habitat

Dugongs occur in warm, shallow (to 15 metres, depth), sheltered, inshore and reefal areas where they can feed on extensive beds of seagrasses.

The Great Barrier Reef Marine Park Authority has acknowledged the importance of conservation of the seagrass habitat by introducing restrictive zoning of important habitat areas in both the Cairns and Far Northern Sections of 'the Marine Park.,

To date, there has been no consistent mapping of seagrass beds in northern Australia. However, Dr Ian Poiner (CSIRO) is presently involved in a program aimed at achieving this.

D. Claasen (GBRMPA) and Dr D. Jupp (CSIRO) have been experimenting with use of satellite imagery in identification of seagrass in the Great Barrier Reef Region. Further identification of habitat is required for appropriate application of management measures.

The effects of chemical pollution and siltation due to dredging on the dugong habitat needs to be examined. Pesticides have been found in dugong tissue from dugongs taken off Townsville (Marsh, pers. comm., 1983). Results of further study may provide information on the impact on reproduction of the species, as well as implications for the health of those taking dugongs for food.

Relationship between marine animals taken

Trips undertaken by indigenous people are usually considered successful if either a dugong or turtle is taken, though a dugong is more prestigious. Therefore as dugong numbers decrease or control of harvest increases, more pressure will be placed on the turtle population, also an endangered species.

Recent information on take of turtles in the Torres Strait suggests that turtles are already under fairly severe pressure (Marsh, et al., 1984). The opportunistic nature of this multi-species fishery is important. The nature and impact of this relationship on both numbers and harvest rates of dugongs and turtles needs to be investigated further.

New harvest regimes

Study of conservation measures that have been employed traditionally can provide assistance in devising effective new harvest regimes. Johannes (1978) illustrated that almost every basic resource conservation measure devised in the West was in use in the tropical Pacific centuries ago: closure of fishing areas, closed seasons during spawning, size restrictions, holding excess catch in enclosures until needed, restrictions on taking turtles and birds and their eggs, and limited access to a fishery. Though a few recent examples are knowm, gear restrictions, probably the oldest form of fisheries regulation in the West, seem to be,the rarest form of conservation practised in Oceania.

Historically, one of the most widespread regimes in Oceania was that of reef and lagoon tenure. The right to fish in a particular area was controlled by a clan, chief, or family, who thus regulated the exploitation of their own marine resources. Fishing rights were maintained from the beach to the seaward edge of the outer reefs (Johannes, 1978).

Tenure systems have also been recorded from Arnhem Land, Northern Territory, Australia (S. Davis pers. comm. 1983) to Daru, Papua New Guinea (Hudson, 1983), and to east Cape York.

Recent research by Johannes and MacFarlane (in press, 1984), has, led to documentation of traditional sea rights in the Torres Strait Islands, with emphasis on Murray Island.

Chase (1978) discussed clan territories in the Princess Charlotte Bay area and Nesbit area to the north with clearly defined boundaries extending beyond land,' across marine environments and including offshore islands, sandbars and reefs.

The Great Barrier Reef Marine Park Authority is presently providing funds for A. Smith to document current and traditional hunting and fishing practices at Hope Vale community and other communities on the east coast of Cape York. Aborigines' preference'for 'fat' 'animals can be indicative of breeding,; periods and the state of food sources.: Factors affecting resource usage and implications for management are being investigated.

Prior to the introduction of modern technology, the adaption of the cultural system., and a larger external human population affecting the resource, these traditional management measures appeared to work. The acceptability in the present day needs. to be explored further. The study of traditional harvest regimes falls with the disciplines of both wildlife science and cultural anthropology.

CULTURAL ANTHROPOLOGY REQUIREMENTS

Policies for management of dugong populations are, in reality, oriented to managing the human interactions with the endangered species.

> "Understanding a conservation system means understanding not only the nature of what is being conserved, but also the viewpoint of the conserver. Knowledge of this second element is essential if we are to comprehend a system of resource management employed by a people whose perception of their environment differs from our own." (Johannes, 1978).

Guidelines-used by the I.W.C. technical committee, and a critique of these guidelines by Mitchell and Reeves (1980), form the basis for the following suggestions for a possible 'cultural anthropology' approach to dugong management. It involves study of the role of the dugong harvest (past and present) in cultural activities and in the cultural identity of the Aboriginal and Islander people and of the relationship of this harvest to their well-being. This should provide insight into the relationship between the cultural survival of the indigenous community and the biological survival of the dugong. Information gained in the following areas would significantly aid the development of policies and appropriate management schemes.

Suggestions for research in cultural anthropology:

basic definitions of terms such as 'Aboriginal', 'Islander', 'traditional', 'subsistence';

geographic distribution of the resource 'users' and geographic relationship with the resource;

technology used for hunt : pre-contact, transition and present;

degree to which it is used for subsistence; extent of participation in cash economies;

the role in diet and health regime;

the place of dugong in:

myth, ritual (pre-contact and transition);

material culture;

status and role definitions, within the group and between the group and outsiders;

socialisation of children to the group's social and cultural norms; and

maintenance of identity and quality of self-perception of members of the group;

level and nature of acculturation of the group to other cultures, norms and life-styles in general;

potential impacts from:

change in number of dugongs harvested and in level of effort required-or allowed in terms of gear, hunting time and location;

shift in hunt from dugongs to turtles or other marine resources;

increase in level of technology for hunting;

entry of more individuals from the group into hunting;

extent to which communities or possibly even clan or family groups may have to be considered on an individual basis; differences in degree to which individual communities or families maintain link with past.

INFORMATION GAPS - CULTURAL ANTHROPOLOGY

Definition of 'traditional'

The term 'traditional' has 'been used to define in law those who may participate in the fishery.,, Most definitions of 'traditional' are circular in nature, using the term in describing the definition. For example, in the Cairns Section Zoning Plan (1983), traditional hunting is defined as "the, taking, otherwise than for purposes of sale or trade, in an area by a traditional,inhabitant or a group of traditional inhabitants of animals other than fish, ... in accordance with Aboriginal tradition or Islander tradition, as the case may be, governing the entry and use of that area by that traditional inhabitant or group of traditional inhabitants" (sec.2.1).

Later on in the Zoning Plan (sec.4) it is specified that the means of hunting, the numbers of animals to be taken, and the need for conservation of endangered species shall be given regard when considering an application for a permit of traditional hunting in the Marine Park. Though this definition of 'traditional' allows for flexibility, it does not give much guidance when considering permit conditions and in that context remains open to interpretation.

In Parks Canada National Marine Parks Draft Policy it is proposed that traditional uses of renewable marine resources by local residents will be permitted provided such activities do not destroy natural values and meet one or more of the following conditions:

> activity is a traditional/subsistence resource use by local people;
>
> activity is of cultural value in illustrating traditional man/sea relationships to visitors;
>
> activity is a treaty right or native claims settlement (2.2.9).

However, it is also proposed.in the Draft Policy that no take of endangered species be permitted in National Marine Parks.

It can be argued that the term 'traditional' should allow for the evolving nature of tradition. For instance, due to European settlement and contact, not only did the method of access to the catch change with the introduction of power boats, but associated hunting techniques also changed. These adapted methods and techniques of hunting should be considered 'traditional', as traditions evolve. Pursuing the argument, then, traditional areas of use could be expanded to include those areas used post-European settlement. Likewise certain economic activities, such as trochus collecting in the Great Barrier Reef Region (or the fur trade in Canada) could be considered as traditional.

Mitchell and Reeves (1980) 'offered definitions of subsistence: in review of the Bowhead whale situation.,

The definition of 'tradition' in legislation varies from State to State across Australia. Fisher (1984) suggests that the purpose or underlying method rather than the technology used should be the decisive criterion. She states that defining 'tradition' in terms of residential requirements is undesirable:

> "Where policies of dispersal or displacement have made such demonstrated attachment impossible or extremely difficult to demonstrate (for example in parts of Queensland), then such a limitation may be too stringent" (Fisher, 1984).

She adds, though, that in certain circumstances, it may be necessary to restrict hunting and fishing to traditional methods or technologies and uses the case of dugongs in the Great Barrier Reef Marine Park as an example.

For the purposes of resource management, there is a need to establish a hierarchy of possible restrictions based on the term 'traditional'. In discussion with Aborigines and Islanders the appropriate level of restriction for hunting should be determined and this should be described explicitly.

General review of literature

A brief review of literature relating to cultural anthropology of Aboriginal/Islander communities adjacent to the north-east coast of Queensland has revealed that some relevant and valuable work has been completed. However, not enough information on each community has been provided to complete the picture on the prime cultural anthropological components of this issue. For example, Anderson (1979, 1980) discussed traditional subsistence patterns and multiple enterprise economy in the Bloomfield River area (Wujal Wujal). Chase discussed the role of the dugong in the culture, the cultural continuity of knowledge (1980) and clan territory extending into the marine environment (1978) in Lockhart River and Princess Charlotte Bay areas. Sutton and Rigsby (1982) presented information on control of land and resources and succession to rights in land, languages, totems, and so on among the Aboriginal people of Cape York Peninsula. Nietschmann (1982) discussed the role of resource exploitation among Torres Strait Islanders. A. Smith (1984) has been collecting ethnobiological information on marine resources utilized by Hope Vale residents including indigenous taxonomies for marine species and techniques of marine resource appropriation and management.

THEORY OF PARTICIPATION

With use of wildlife biological and cultural anthropological information, a prime challenge is to develop management programs which can be applied consistently from community to community while taking into account regional dugong population dynamics and individual community needs.

To be successful, any management scheme should be acceptable to all parties.

> "Resource management schemes are of little value if they are not culturally palatable to those they are meant to benefit" (Johannes, 1981a).

At a workshop on dugongs held in 1981, Aboriginal and Islander participants recommended that "all plans for protected areas or reserves for the conservation and protection of the dugong be discussed with those communities likely to be affected to ensure that the greatest possible agreement is achieved" (Anon, 1981).

An integrated research program and management scheme must continue to be developed in order to adequately include the 'users' and have the desired effect of allowing harvesting on a, sustainable basis.

> "Cultures are dynamic and resilient, 'changing in response to the prevailing conditions, but the way in which the changes are introduced affects the final outcome. A natural change in the environment produces a very different reaction to a mandated change imposed from outside. It is therefore very important that the people concerned must be involved in any research and management activities. The exact dimensions of 'change in a culture caused by policy decisions cannot be predicted in advance of the event" (I.W.C. 1982).

PARTICIPATION IN AN INTEGRATED PROGRAM OF RESEARCH, MANAGEMENT AND EDUCATION

Many opportunities exist for involving the 'users' or 'interactors' - Aborigines and Islanders, as well as commercial fishermen - in development of a scheme. A few examples of related research, management, and educational activities are listed below.

Involvement of the 'users' in development of the scheme will provide opportunity for additions to the list and prioritization.

Research and monitoring

Harvest data
: research catch data - biologist accompanying hunters or fishermen in the field to familiarize these people with data needs.

Analysis of specimen material
: collecting and preserving specimen material (training).

Traditional knowledge
: recording local knowledge of those with appropriate experience regarding marine resources, encouraging experienced hunters to pass on the knowledge.

Role of dugong in diet
: school children keeping records of diet.

Role of dugong in culture
: recording myths, ceremonies, collecting evidence of material culture.

Monitoring dugong population dynamics
training indigenous people in monitoring techniques.

Management

Zoning Plan or Management Plan formulation
input from key groups on usage and catch, characteristics of dugong biology and behaviour, location of dugong habitat, and community needs.

Complementary management
input from key groups such as 'dugong hunters when developing policy regarding dugong catch, quotas or permits with conditions.

Education/Interpretation

Interpretation
training indigenous people as marine park officers and fisheries officers with speciality in interpretation.

Education
input from key groups in development of pamphlets, posters, or videos illustrating dugong life history or concern for dugong as endangered species.

Interchange
dialogue between dugong hunters and administrators as educational experience for both.

The focus in this paper has been primarily on the development of management schemes to allow for indigenous use of dugongs in north-east Queensland. However, most of the proposals regarding research, management, and education are applicable to other "user" groups and to much broader geographic areas. Aerial surveys to determine dugong population trends and mapping of seagrass habitat need to be completed for the entire northern coast of Australia. The take of dugong by both indigenous people and others likewise needs to be monitored. The impact of gill-netting on dugong populations needs to be clarified. The disciplines of economics, social anthropology, and wildlife science can be usefully applied to the fishing industry relationship with dugongs. Educational programs can be applied to a wide range of interest groups.

In relation to this broader scope, two components remain the same. First, 'user' (or interactor) involvement is essential to development of a successful integrated program. Secondly, the responsibility for continued development of the integrated program lies with the responsible government agencies working together with 'user' qroups.

RESPOIVSIBILITY FOR DEVELOPMENT OF AN INTEGRATED MANAGEMENT PROGRAM

Government agencies with jurisdiction regarding taking of endangered species along the north-east Queensland coast are the Commonwealth agency, Great Barrier Reef Marine Park Authority and

Queensland agencies which are responsible foradministering the Queensland Fisheries Act.

Much of the east coast dugong habitat is within the Great Barrier Reef Marine Park.' The opportunity for management of this resource is provided through the Great Barrier Reef Marine Park Act 1975 which requires that Zoning Plans for the Marine Park consider conservation as well as reasonable use of the Region's resources. A public participation program is an integral part of the zoning process. Apart from developing Zoning Plans and specific management plans for Sections of the Marine Park, the Great Barrier Reef Marine Park Authority has a commitment to a substantial information/education program and research and investigation relevant to its management responsibilities (Great Barrier Reef Marine Park Authority, 1981). The Authority is also committed to "complementary management" in conjunction with Queensland Government agencies responsible for day-to-day management within and adjacent to the Marine Park.

The Queensland Fish Management Authority has indicated its concern by coordinating an Intergovernmental Committee on Take of Endangered Species to make recommendations for policy and management of dugongs and turtles. It has actively encouraged discussions between groups of north-east coast Aborigines and Islanders. Recommendations are expected from this Committee by the end of 1984.

Both the Great Barrier Reef Marine Park Authority and the responsible Queensland Government agencies can provide support to Australia's international obligation to the 1972 Convention concerning the Protection of the world Cultural and Natural Heritage in relation to the terms underwhich, the Great Barrier Reef was included on the 'World Heritage List".

The government agencies, then, have the responsibility to ensure that development of an integrated management scheme is initiated and that essential research be continued and expanded. Most importantly, these agencies have the responsibility to ensure the participation of those individuals and communities that interact with the resource in ongoing development of the management scheme. The mechanisms for involvement are already in place. It is those communities which will be the prime tangible beneficiaries if a management. scheme is successful.

CONCLUSION

Based on its inherent value as a food item, the dugong has a significant role in the life' style of north-east coast Queensland indigenous people. Because the dugong is vulnerable to extinction there is a need to develop a program to manage the threats to its existence. Most of the north-east coast habitat is within the Great Barrier Reef Marine Park. Relevant Queensland government agencies have indicated their concern about the dugong. The Great Barrier Reef Marine Park Authority has indicated its commitment to conservation of endangered species, where conservation means "wise use in perpetuity". A successful dugong management program must be based on continuity of sound, research. It must be developed in conjunction with relevant

government agencies and 'user' groups. It must be interpreted by means of effective education programs. Only by 'user' involvement in the development of an integrated research, management, and education program will the dugong population of north-east Queensland be able to be used on a sustainable basis.

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THE SEA TURTLE RESOURCES OF THE TORRES STRAIT REGION*

Colin J. **Limpus** and C.J. Parmenter

INTRODUCTION

Six species of sea turtle occur within Torres Strait. Accounts of their biology within Torres Strait can be found in the internal reports of C.J. Parmenter and D. Carter to Applied Ecology P/L. These can be accessed through the Australian National Parks and Wild'life Service. Recent publishe'd accounts of the species within Torres Strait are listed below.

Family: CHELONIIDAE

Green turtle, Chelonia mydas: Kowarsky (1978, 1982), Parmenter (1977, 1978, 1980a, 1980c), Limpus (1980a), Nietschmann (1979), Spring (1982), Garnett et al. (1985).

Flat-back turtle, Chelonia depressa: Bustard (1972), Limpus et al. (1983a), Spring (1979, 1982).

Loggerhead turtle, Caretta caretta: Nil.

Hawksbill turtle, Eretmochelys imbricata: Bustard (1974, 1979), Carr and Main (1973), Carr and Stancyk (1975), Kowarsky (1978), Limpus (1980), Limpus et al. (1983b), Parmenter (1983), Pritchard (1979), Spring (1979, 1982).

Olive ridley turtle, Lepidochelys olivacea: Limpus et al. (1983b).

Family: DERMOCHELYIDAE

Leatherback turtle, Dermochelys coriacea: Limpus and McLachlan (1979).

The following report summarises the above along with additional unpublished records of the authors. For the purposes of this study, Torres Strait is defined as the area bounded by 'latitudes 9° and 11° south and longitudes 141° and 145° east. For brevity, the species will be considered collectively by the principal life history phases as they occur in Torres Strait. Two species, Dermochelys coriacea and Lepidochelys olivacea, occur only rarely within Torres Strait and will not be discussed further. The standard size measurement used is midline curved carapace length (CCL).

*Editors' note: This paper'was initially presented at the Torres Strait Fisheries Seminar, Port Moresby, 11-14 Feb 1985 (Haines, Williams and Coates (eds.). Australian Government Publishing Service, Canberra. 1986).

NESTING

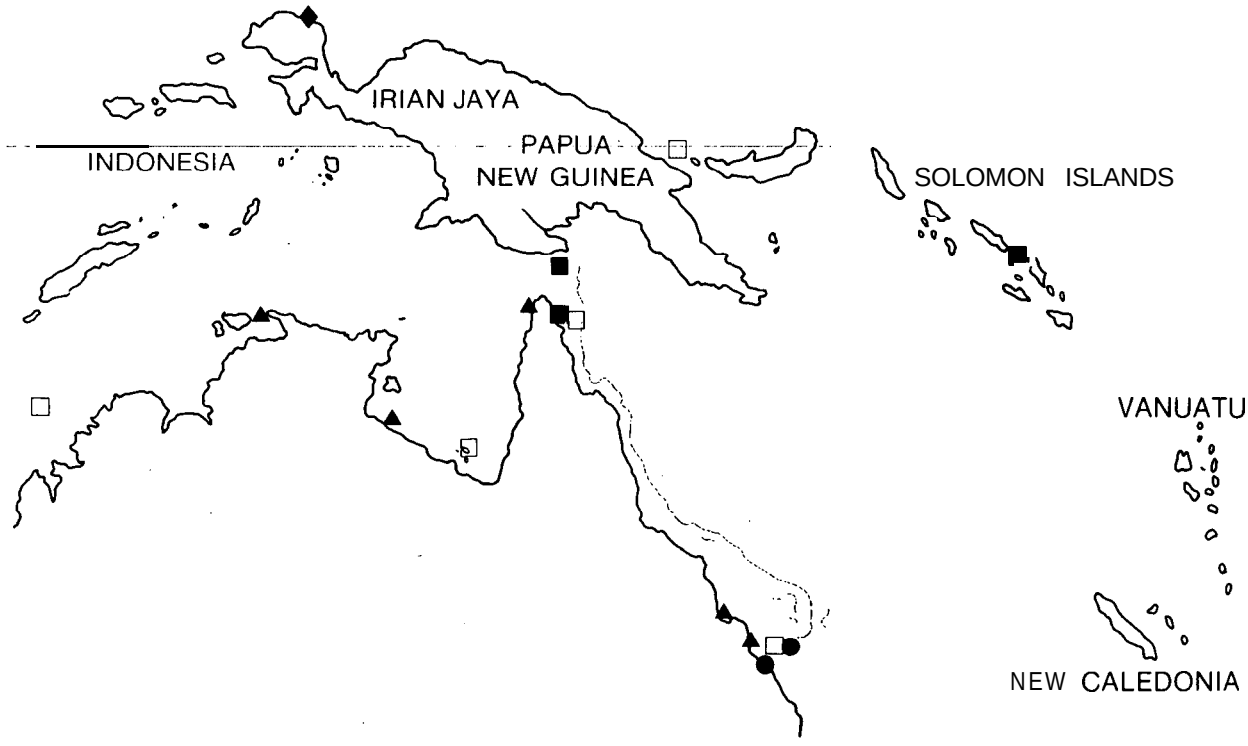
There are two nesting aggregations of sea turtles of international significance within Torres Strait (Parmenter, 1980b; Limpus, 1982; Spring, 1982) (Figure 1)

E. imbricata rookeries in central and eastern Torres Strait (especially on Long Aukane, Mimi and Kabbikane Islands).

C. depressa rookery at Crab Island near Bamaga.

In addition, sporadic to annual low density turtle, nesting occurs on almost every small island and beach.

Figure 1. Major sea turtle rookeries of northern and eastern Australia and adjacent nations. Open square = Chelonia mydas; triangle = Chelonia depressa; circle = Caretta caretta; square = Eretmochelys imbricata; diamond = Dermochelys coriacea.



Chelonia mydas

No major green turtle rookery occurs within Torres Strait. Bramble Cay (9°9'south, 143°52'east) supports the largest for Torres Strait but it is a minor rookery by Queensland standards, supporting up to several hundred nesting females annually in mid summer. Verbal reports of fishermen indicate that Bramble Cay was a much more significant rookery some thirty years ago. The decline was largely the result of harvesting of nesting adults and eggs by crews of Papuan coastal shipping in addition to low level harvests by Australian Torres Strait Islanders. The natural erosion of a major part of the island with the onset of the north-westerly winds each' summer with the associated loss of up to forty-four per cent of a season's egg: production may also' be contributing to a decline,in nesting numbers. Descriptions of past nesting densities suggest that Bramble Cay once supported a nesting density at least an order of magnitude greater than at present, perhaps approaching that of Raine Island.

Turu Cay, Deliverance and Kerr Islands in north-west Torres Strait are rookeries of undetermined importance. Meek (1913) reported Tara (Turu) Cay as "one great nest for turtles!' and captured several green turtles ashore nesting in May 1910. Kowarsky (1978), although he could not differentiate between tracks of C. mydas and C. depressa, flew over these western cays on 9 December 1975 and recorded the best C. mydas nesting for Torres Strait in what was a year of record low level nesting on the eastern Australian C. mydas rookeries (Limpus, 1982). However Torres Strait Islanders in verbal reports have separately identified both C. mydas and C. depressa nesting at Turu, Deliverance and Kerr Islands. The species composition and population sizes of turtles nesting on these three islands need to be determined.

Sporadic to low density C. mydas nesting occurs on most islands of Torres Strait, but especially in eastern Torres Strait: Recaptures of tagged turtles show that some C. mydas nesting at islands such as Don Cay, Darnley Is. and Dowar Is. are part of the Bramble Cay population. A small proportion of the nesting females interchange between adjacent rookeries within and probably between breeding seasons. However, because the majority of the C. mydas nesting is at a very low density in Torres Strait, the species does not nest on Bramble Cay ,as well. In any one season the combined total of this dispersed nesting population is smaller than the Bramble Cay population.

Eretmochelys imbricata

Given that low density nesting by this species' is a feature of almost every island in Torres Strait and that there are a few substantial rookeries for the species there as well, Torres Strait is one of the few remaining major breeding grounds for this species in the world. The species nests year round, peaking in February. The largest nesting density ever recorded for the species has been recorded from Long Island (Bustard in Pritchard, 1979). However the size of the E. imbricata population for the region has never been accurately assessed. In addition, almost every egg laid on the inhabited islands is harvested, as are many eggs on the uninhabited rookeries of eastern Torres Strait. In

western Torres Strait, some rookeries suffer from near total egg predation by varanid lizards. There is a distinct probability that there is no longer sufficient hatchling productivity on a regional basis to maintain a future substantial E. imbricata nesting population in Torres Strait.

Chelonia depressa

Crab Island is the largest rookery for this species which is endemic to the Australian continental shelf. Crab Island supports several thousand nesting females annually. All year round nesting occurs at this rookery, peaking in August. C. depressa also nests at almost inconsequential low density on the continental islands of south western Torres Strait. In central and eastern Torres Strait it is known as a nesting species by the locals. Eggs from Crab Island particularly are harvested at an undetermined rate as, at times, are the nesting females. These are eaten locally and traded at Thursday Island.

C. depressa also nests at low density along the mainland coast of western Cape York Peninsula. Almost all eggs laid on these mainland beaches are destroyed by feral pigs. If the mainland nesting turtles are part of the Crab Island population then at the regional level the species is probably under a substantial combined predator and harvest pressure.

Caretta caretta

There is no recorded nesting by this species in Torres Strait.

COURTSHIP

While reports of C. mydas mating (turtle fast) in the months (September-November) prior to the summer nesting season are common from throughout Torres Strait, courtship has been reported most frequently from eastern Torres Strait (Warrior Reef to south of the Murray Islands) and from western Torres Strait (Badu, Moa, Mabuiag area). Females are harvested selectively from courting groups in both areas. Because turtles do not usually court in their home feeding ground and because the numbers of mating turtles usually far exceeds the local nesting population, it is assumed that these mating aggregations are of migrating turtles enroute to their respective rookeries. A tagging programme will be needed to identify the rookeries associated with the various mating aggregations.

No courtship aggregations of C. depressa or E. imbricata have been reported from the region:

POST HATCHLING PLANKTONIC PHASE

The dispersal patterns of hatchling turtles from the north Queensland rookeries are totally unknown. As is typical of shallow water habitats, turtles in the size range between hatchlings (CCL about 4 cm) and immatures with a carapace length of about 35 cm are extremely rare in Torres Strait.

FEEDING GROUND RESIDENT POPULATIONS

Turtlesoccur in a diversity of habitats throughout Torres Strait but the population levels are unquantified. In the deeper inter-reef habitats, Caretta caretta, Chelonia mydas and C. depressa have been captured in prawn trawls. C. mydas has been recorded from the extensive shallow sea grass beds of north western Torres Strait. Only in the shallow coral reef habitats of eastern Torres Strait has a systematic study of the turtle community been made (CJP, unpublished data). Results o'f this non-selective sampling study of turtles inhabiting the coral reefs are summarised as follows (Table 1):

Chelonia mydas comprised 87.0 per cent of all turtles examined from coral reef habitats in eastern Torres Strait. They ranged in size from small immatures ("waru kasi" with CCL of about 40 cm) to large adult males and females. Most (74.6 per cent) were immatures since they were less than 91 cm CCL (the minimum breeding size for the species in eastern Australia).

Eretmochelys imbricata made up 10.8 per cent of turtles captured from the same habitats. The size range of the resident E. imbricata was mostly that of adults. The smaller immature turtles were noticeably scarce on the reefs of eastern Torres Strait in contrast to their abundance in coral reef habitats within the Great Barrier Reef.

Caretta caretta was present in only low density on the eastern Torres Strait reefs, representing 2.2 per cent of turtles examined. They were all large immature or adult turtles. C. caretta of similar size were reported by turtle fishermen at Daru to be present on the Warrior Reefs in similar low density.

Table 1. Species composition of resident sea turtle populations on coral reef habitats in north-eastern Torres Strait, February 1977–April 1979. Most turtles were caught selectively by the turtle rodeo capture technique (Limpus, 1978). This data was reported on in part by Parmenter (1980a).

Species	Number of turtles caught (number)	(per cent)
Chelonia mydas	201	87.0
Eretmochelys imbricata	25	10.8
Caretta caretta		2.2

The principal turtle harvested from feeding grounds throughout Torres Strait is C. mydas. It is a traditional food item for the region. In the late 1970s we estimated that about 10,000

C. mydas were being harvested annually within the Torres Strait region. Kowarsky (1982) estimated the C. mydas harvest from Cape York and Queensland Torres Strait communities to be in the range 2,500 - 5,000 a year. Isolated records of C. caretta being caught and eaten were also obtained. Although E. imbricata are also caught and eaten on rare occasions, they are generally regarded as poisonous to eat. Only some of the old people were supposed to still know how to cut out the poisonous parts. They are more frequently used as a source of tortoise shell and polished carapaces. These are used locally or traded, as are the polished carapaces of some C. mydas caught for food. No estimate of the size of the E. imbricata harvest has been made.

Studies of the turtles harvested in western Torres Strait (Nietschmann, 1979), Yorke Island (Kowarsky, 1978) and Daru (Prescott, in press) describe the turtle catch but do not describe the resource from which the catch was taken. Parmenter (1980a) demonstrated that the Yorke Islanders were selecting principally for large female mydas when they hunted and this would seem to apply generally throughout the region. Turtles of any size class are scarce on reefs immediately adjacent to settlements such as Yorke Is., Thursday Is. and Daru and is assumed to be the result of localised overfishing for turtle. The same probably applies to all reefs adjacent to settlements. The few turtles captured on Yorke Is. reef were usually at the lower end of the size range for the area are presumed to have been newly recruited to this reef.

FEEDING GROUND AND ROOKERY INTERRELATIONSHIPS

Sea turtles do not normally live adjacent to their rookeries. Rather the adults migrate from their respective, and often widely scattered, feeding grounds to their breeding grounds. The rookeries supplying turtles to the Torres Strait feeding grounds can be identified from the results of our extensive tagging programs on sea turtle populations throughout eastern Australia.

Feeding ground recoveries of turtles tagged on nesting beaches cannot be used directly to quantify dispersal patterns or harvest rates due to variations in the reportage of tag recoveries, tag loss and unequal census at all localities. However the following general conclusions can be drawn from the data.

Tag recoveries have identified at least some of the rookeries used by three species of turtles inhabiting Torres Strait feeding grounds. In summary:

Chelonia mydas: Torres Strait residents breed at widely scattered rookeries including

north-east Torres strait (Bramble Cay, Campbell Is.)
northern Great Barrier Reef (Raine Island, Pandora Cay) (Figure 2)
southern Great Barrier Reef (Capricorn-Bunker Group) (Figure 2)

These migrations covered distances between feeding ground and rookery with a range of 53 to 1734 km.

Eretmochelys **imbricata:** Torres strait residents breed at least as far afield as Solomon Islands, more than 1650 km distant (Parmenter, 1983).

Caretta caretta: Torres Strait residents breed almost exclusively in south Queensland

southern Great Barrier Reef (Capricorn-Bunker Groups)
mainland coast (Bundaberg to Round Hill Head)

These migrations range between 1741 and 1957 km.

Females do not necessarily breed at the rookery closest to their feeding ground. Nor do those living in the same area all breed at the same rookery.

While tagged C. mydas have been recovered from throughout Torres Strait, 59 per cent came from the Warrior Reefs, Daru, Parama area (Table 2). This suggests that over half of the total Torres Strait C. mydas harvest is concentrated in the relatively small area of the Warrior Reefs. These turtles are being taken by PNG fishermen from Daru and adjacent communities. At this time we have no reason to suspect non-compliance with the underlying assumptions of this extrapolation (viz. equal mixing and equal reportage of tagged turtles within the region).

Until there have been adequate tagging programs, the importance of the following rookeries in supplying turtles to the Torres Strait feeding grounds is conjectural: Turu Cay, Deliverance and Kerr Islands and Rocky Islands (south east Gulf of Carpentaria, C. mydas); Coral Sea cays (C. mydas); inner shelf cays of the northern Great Barrier Reef (E. imbricata).

There would appear to be little movement of C. mydas between Torres Strait feeding grounds and the rookeries on the north coast of PNG (Spring, 1983; V. Baker, pers. comm.).

MIGRATORY PATHWAY

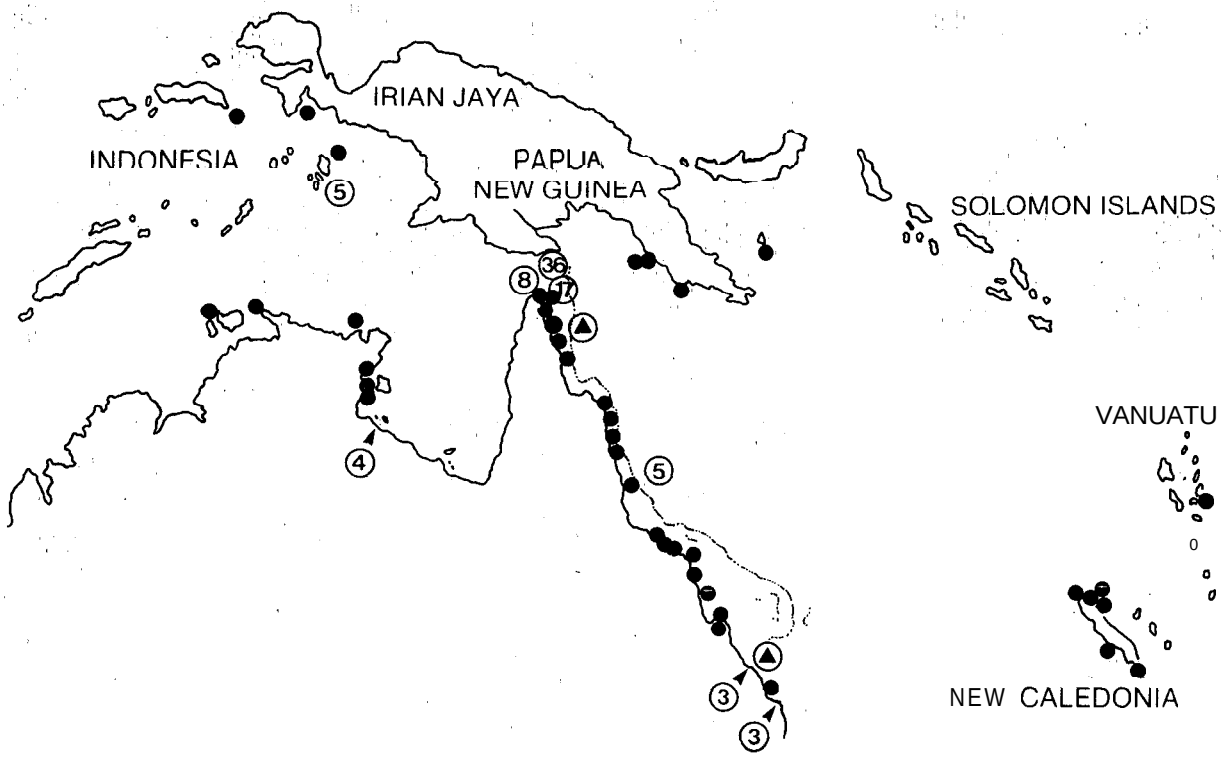
Examination of Figure 2 shows that C. mydas from the Gulf of Carpentaria, Arnhemland, eastern Indonesian Archipelago and Irian Jaya must pass through Torres Strait twice each summer when migrating to and from their rookeries within the Great Barrier Reef. Similarly Caretta caretta migrating between the Gulf of Carpentaria and the southern Great Barrier Reef rookeries must also pass through Torres Strait. Thus Torres Strait acts as a bottleneck to turtles migrating from the most westerly feeding grounds and the Great Barrier Reef rookeries. It appears that many of the C. mydas engage in courtship as they pass through the shallow area of the strait. Thus, Torres Strait is of vital strategic importance to the migration of turtles living to the west, which breed in the Great Barrier Reef.

Table 2. Recaptures of migrant green turtles, Chelonia mydas, originally tagged while breeding at eastern Australian rookeries.

FEEDING GROUND RECAPTURES	Raine Is. Pandora Cay	Bramble Cay	Campbell Island	Capricorn Bunker Gp. male	Capricorn Bunker Gp. female	TOTAL
Indonesia*	6	2				8
Irian Jaya*	2					2
PNG						
- non-Torres Strait	4	3				7
- Torres Strait	36	10	1			47
Australia						79
- Torres Strait	25	4		3		32
- Northern Territory	10					10
- Eastern Queensland	6			27	3	36
Vanuatu	1					1
New Caledonia				6	1	7
TOTALS	90	19	1	36	4	150

* Note: Caution is necessary in use of these figures. Local reports indicate that the majority of recovered tags remain unreported in these regions.

Figure 2. Major breeding grounds **and** recapture points **in the northern** Australia **region.** Chelonia mydas: Dot = single capture; circled number = multiple catch; circled triangle = rookeries.



A SHARED INTERNATIONAL RESOURCE

The eastern Australian C. mydas rookeries of the Great Barrier Reef are the most significant breeding grounds for the species in the south-west Pacific. The same applies to Caretta caretta and E. imbricata. Turtles migrate to breed at these rookeries from eastern Indonesia and Irian Jaya, Papua New Guinea, Solomon Islands, Vanuatu and New Caledonia as well as Northern Territory, Gulf of Carpentaria, Torres Strait, Great Barrier Reef, and inshore south Queensland waters within Australia. These turtles are a shared international resource with the feeding grounds and migratory pathways of some individuals spanning the territorial waters of three nations.

The combined extensive harvest of C. mydas that occurs in eastern Indonesia, Irian Jaya, southern Papua New Guinea, Torres Strait, Northern Territory, eastern Queensland, Solomon Islands, Vanuatu and New Caledonia probably involves a harvest of tens of thousands of turtles annually. A large proportion of this harvest is of turtles from the Raine Island population. We believe that over-harvesting probably is already occurring for this and the other Australian C. mydas nesting populations.

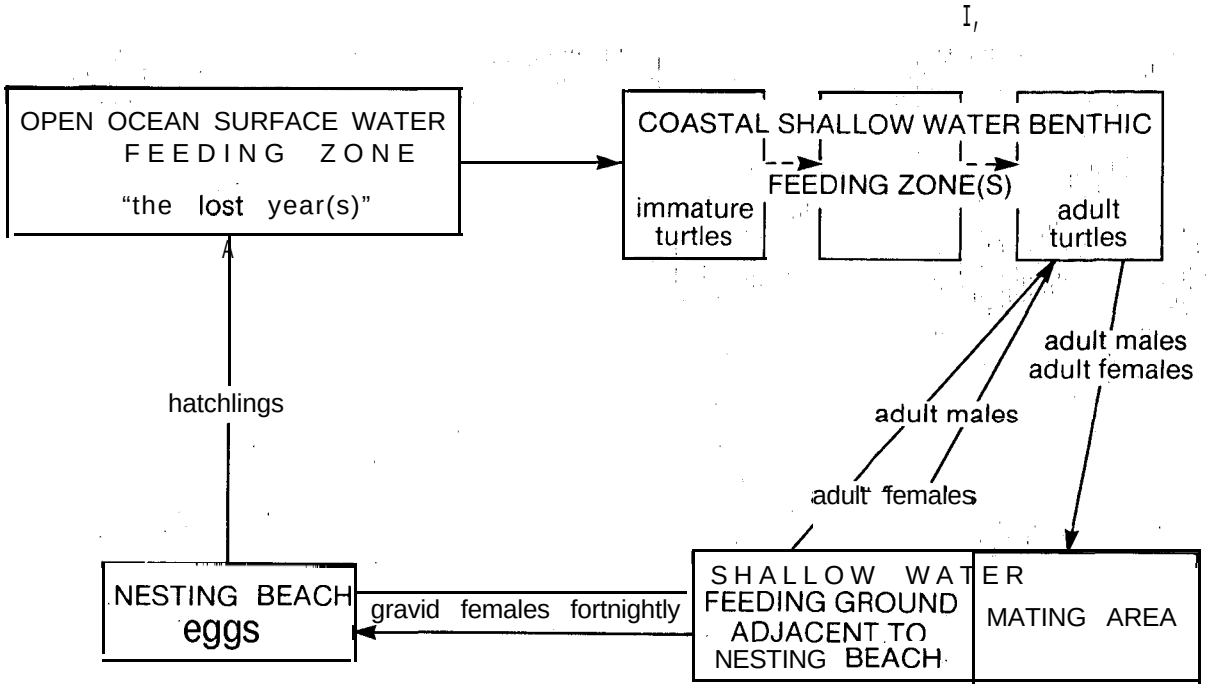
International cooperation in management of these shared turtle resources is essential if they are to be available to future generations.

CONSERVATION--RECOMMENDATIONS

Sea turtles are particularly difficult to manage on a sustained yield basis because their biology is poorly understood. They are migratory. The post hatchling dispersal phase has never been adequately investigated. The relationship between rookeries and feeding grounds is poorly known. They are long lived to maturity (perhaps 50 years or more). Recruitment rates to the adult population are probably very low with an associated low adult natural mortality rate. The individual adult females do not breed annually. The relationship between the nesting numbers and the actual population is unknown. Sex of sea turtles is determined during incubation by the temperature of the nest and can not be assumed to be 1:1. Sex ratio may be variable between populations and indeed between different segments of the same population if different size classes and/or maturity status turtles segregate into different feeding grounds during their developmental migration.

Thus a complex situation exists for Torres Strait. Some of the people of the region rely heavily on sea turtles and/or their eggs for food. There is a high probability that the existing utilization represents over-harvest for these populations. The biology of the species is so poorly understood that no meaningful sustained yield harvest regime can be devised. Peoples in other regions and nations are exploiting heavily the same turtle populations. There are obviously many turtles still available in the feeding grounds and rookeries, leading people from these areas to erroneously believe the general population is secure.

Figure 3. Postulated sea turtle life cycle.



Turtle conservation must be planned for decades into the future because of the time scale of the turtle life cycle. Experience in other countries indicates that when a turtle population crashes recovery will be slow, if at all, and the local communities may have to go without turtles for half a century or more. Therefore if harvestable, or even secure, populations are to be maintained:

the gaps in biological knowledge and understanding that iimit available strategies for sea turtle conservation generally (and in Torres Strait in particular) must be addressed urgently. However, it will take decades to provide workable solutions to the existing pressing problems. Therefore as an interim measure we recommend that:

steps be taken to initiate international cooperation in the conservation and management of the shared turtle resources of the south-west Pacific and Arafura Sea regions;

the proportion of adult female turtles being harvested be reduced;

total protection of the nesting and courting females be introduced;

total harvest rates be reduced in feeding grounds; (This could be -achieved by introducing a quota system, by reverting to less efficient traditional capture techniques, by closing significant parts of the feeding grounds to turtle hunting, or by a combination of these. Unless these types of actions are introduced, communities such as Daru could run out of turtles within the current generation of hunters.)

egg harvests be regulated such that most clutches laid in a region produce hatchlings to the sea; (It seems from studies in south Queensland that about 65 to 70 per cent of the regional clutch production may need to produce hatchlings for population stability. Therefore when eggs are harvested it may be necessary to augment natural hatching success by management actions including protection of nests from predators and nest relocation to escape erosion and flooding.)

the E. imbricata egg harvest of central and eastern Torres Strait cease or be greatly reduced. (This more vigorous action is warranted because of the species' very depleted status globally. If it was considered important not to exclude turtle eggs from the diet of these people, an alternative but limited source of eggs is available locally. A management plan could be instituted for the Bramble Cay C. mydas rookery such that the doomed eggs (Parmenter, 1980a,b) were collected at laying. Those necessary for maintenance

of the rookery could be relocated within the stable portion of the island and the excess could be made available to those communities who have traditionally utilised eggs from this rookery and to those who have had their access to E. imbricata eggs removed.

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WORKSHOP DISCUSSION

The discussion covered the following points:

The survival of baby turtles is very low (probably two to three per 10,000 hatchlings). Therefore there should be less emphasis on taking big female turtles.

There is a long period (possibly six years) between each breeding by female green turtles.

Up to 90 per cent of the green turtle breeding' in the Great Barrier Reef Region occurs on Raine Island and in the Capricorn-Bunker group of islands; therefore the major rookeries are important sites for green turtles.'

Scattered rookeries exist in the Northern Territory. These are probably important to the loggerhead population but not so important for green turtles.,

No one has followed individual green turtles on migration. Radio/satellite tracking may become more feasible as a method is now available (laparoscopy) to, determine whether a female in a feeding ground is likely to migrate to breed.

The figure of 10,000 turtles caught per annum in Torres Strait is only an estimate and is based on observations by a number of researchers in different areas of the Strait.

Intervention at the hatchling stage to protect young turtles (by removal from hatching locality), thereby giving them a head start on growth, -may interfere with imprinting regarding breeding sites.

The critical time for survival of turtles caught in trawling nets may be forty-five minutes to one, hour, after which time they may drown.

EXPLOITATION TECHNIQUES VERSUS CHARACTERISTICS OF EXPLOITED SPECIES: WHICH PARAMETERS DEFINE THE IMPACT OF TRADITIONAL GATHERING ON INTERTIDAL SHELLFISH

Carla P. Catterall and Ian R. Poiner

INTRODUCTION

Many marine molluscs are gathered by humans for food or ornament, and the archaeological record indicates that traditional shell-gathering played an important role in small scale coastal societies around the world. However, few scientific investigations of the subject have been made, perhaps because shell-gathering is usually done by women whereas anthropological studies often focus on hunting by men (Meehan, 1982).

Shell-middens provide a valuable historical record of the use of shellfish by coastal societies, and of the impact of human exploitation on the shellfish populations (Shawcross, 1967; Swadling, 1976). However, the usefulness of this record is limited by a lack of information on either the gathering strategies and techniques of the human societies concerned or the biology and population ecology of the exploited species.

The impact of traditional use patterns on animal populations generally is poorly documented and poorly understood. Some reports have recently stressed that traditional Pacific societies may practise voluntary restraint and sound long-term management to ensure a sustained supply of essential resources. This could occur if the society was characterized by both a conservation ethic and an accumulated understanding of local natural history (Johannes, 1978).

On the other hand, there is evidence that pre-Western societies in the Pacific in some cases over-exploited their prey to the point of extinction, as in the case of the flightless birds of New Zealand (Diamond and Veitch, 1981). Thus, much of the apparent balance between traditional societies and their resources may be a result of all vulnerable species having gone extinct soon after a particular human group colonised an area, with the remaining prey species persisting by virtue of some biological properties which make it difficult for people using the technology and methods of that particular culture to deplete them. For example, Poiner, Catterall and Swadling (MS) found that the habits and wide depth distribution of Strombus species made them resilient to traditional gathering in Pacific and Caribbean coral reefs, but the introduction of diving and boat technology together with marketing have recently led to overfishing of the Caribbean s. gigas (Brownell and Stevely, 1981).

Thus, the effect of traditional gathering must be assessed and analysed with reference to two sets of information:

a set of the most important (ethnographic) parameters which define the exploitation techniques; and

a set of the most important (biological) parameters of the exploited species or population.

In this paper we will define these parameters as far as possible, and use these to examine the effect of traditional gathering on some tropical Pacific shellfish. We will then suggest a number of specific points for which information should be gathered and formally documented with respect to both traditional, gathering methods and'research into shellfish biology.

PARAMETERS OF TRADITIONAL EXPLOITATION

When using the term 'traditional gathering' with reference to shellfish we mean gathering techniques such as those described by Meehan (1982) and Poiner et al.(MS), for north Australian and New Guinea peoples respectively. -This normally consists of small parties of people, picking shells from intertidal sand, mud or reef flats and the sub-littoral fringe. This type of traditional gathering can be formally charhcterised by the following set of elements (following Catterall and Poiner, 1987),

Shellfish are gathered by people walking in the intertidal zone. The limit is the upper sub-littoral, which can only be reached at spring tides.

Shellfish are individually extracted from the surface, or, from within the sediment, either by hand or with the aid of small hand-held digging tools. Dredges or sieves are not normally used.

Individual shellfish below a certain size are likely to be rejected, but above this threshold the sizes collected reflect the available distribution rather than strong size selectiveness. This is probably to maximise gathering efficiency rather than a deliberate conservation effort, since many studies of foraging in simple nonhuman animals have shown a similar pattern (Pyke, 1984). Several studies (Hancock, 1970; Swadling, 1976; Meehan, 1982) have presented data which suggest that the minimum shellfish size collected by gatherers from intertidal flats is 20 to 30 mm (maximum dimension).

The catch is accumulated in bags, and is then transported to base by hand or boat.

Most shellfish are gathered for immediate consumption: Marketing opporturiities are limited, although some trading may occur.

PARAMETERS OF EXPLOITED POPULATION

To identify the biological attributes which are most important in determining the consequences of traditional gathering to shellfish, it is first helpful to consider the major features in the life history of a generalized gastropod and bivalve. We consider three aspects of the life-history: maturation, movement, and burying.

Maturation

Reproduction in most species is followed by the production of many eggs, from each of which hatches a swimming larva. A few species hatch a shelled juvenile directly from the egg. Immature stages grow until sexual maturity is reached. At this time growth ceases in some species; other keep growing throughout life.

Movement

The benthic shelled individuals may crawl relatively short distances (possibly, up to 1 km per lifetime for most species). Some species are totally immobile when benthic. However , pelagic larvae may potentially be carried much longer distances (hundreds of kilometres) by ocean currents. This permits recruitment from subtidal areas or distant populations. The extent of this depends on the duration of the larval stage and its behaviour, as well as on oceanographic factors.

Burying

Vertical movement shifts individuals between burial and exposure on the surface. Some species are permanently in one or other state. In others, the propensity to bury may vary with size or age (Catterall and Poiner, 1987).

POTENTIAL EFFECTS OF EXPLOITATION

These life-history factors interact in the following way with the human-gather ing strategy to determine whether a given individual shellfish is collected.

First, the size of the individual is important, since the probability of being gathered will usually be negligible up to about 20 mm, but few individuals over 30 mm would be rejected. Thus if the size at maturity is less than about 20 mm, a gathered population will always contain individuals capable of reproducing. If the size at maturity is greater than about 30 mm, then there is a risk that all or most reproductively active individuals will be removed from the local population, potentially reducing recruitment.

Second, buried individuals are less likely to be gathered then individuals on the surface, irrespective of size, since they are difficult to detect visually and only worthwhile extracting with digging tools in areas of extremely high density (for example, Meehan, 1982).

Third, subtidal individuals are less accessible than intertidal individuals. The mean low water level of spring tides is typically exposed for only a few days in some fortnights of the year. Below this level, individuals are inaccessible unless diving or dredging techniques are used. If there are subtidal populations near to qathered intertidal areas, and if the benthic stages of the life-history are moderately mobile, then local replenishment of gathered areas may occur by migration. Otherwise, the local gathered population is at risk of extinction.

Fourth, there may be more distant populations which are not exploited for some reason (for instance, inaccessibility to those walking or in small boats). Depending or-i the duration of the pelagic larval stage, larvae may recruit from these populations to the gathered intertidal populations various distances away.

Thus, the combination of the properties of size, at maturity, intertidal burying, existence of subtidal populations, mobility of benthic stages, and duration of pelagic larval stage should strongly influence a local population's persistence in the face of gathering.

A species with large size at maturity, no burying, restricted to the intertidal zone, and with pelagic larva of short duration' or lack-ing would be likely to go extinct in areas close to human,, settlements. Fortunately, (or perhaps logically) most species do not possess this, combination of attributes. Conversely, species which, reach maturity at.a large size, bury, are distributed down into the subtidal, and which have mobile benthic stages and long-duration pelagic larvae should have a high resilience to gathering.

IMPACTS ON SELECTED TROPICAL SPECIES

In Table 1, the biological and ecological attributes discussed above are presented for six tropical Australian molluscs (three bivalves and three gastropods): Anadara sp. or blood cockle, Tapes sp. or cockle, Saccostrea (Crassostrea) sp. or oyster, Trochus sp. (niloticus) or top shell, Strombus sp. and Melo sp. (amphora) or baler shell. The information in Table 1 was obtained from a variety of sources, including Brownell (1977), Yapp (1977), Nash (1984), references and data in Catterall and Poiner (1987), and unpublished data. In some cases the necessary information was difficult to obtain, and informed extrapolations were made from information on congeneric species. Even for apparently important species such as the commercially cultured rock oyster Saccostrea commercialis details of the life-history have not been published.

All shellfish considered in Table 1 mature at more than 30 mm, so all are potentially at risk on the basis of this property. For each of the remaining four properties, some of the species are at risk,. The shellfish fall into two groups: one in which the risk of local population depletion due to traditonal gathering is relatively low (few asterisks in the Table: Andara, Tapes, Strombus, Melo), and one in which the risk is high (many asterisks: Saccostrea, Trochus).

Table 1. Biological attributes important to the effects of traditional gathering, and their values for six tropical Australian shellfish species. An asterisk indicates that a particular attribute puts local populations at risk of depletion if heavily collected by traditional methods.

ATTRIBUTES	MOLLUSC SPECIES					
	Anadara	Tapes	Saccostrea	Trochus	Strombus	Melo
SIZE (mm) AT MATURITY	* 50-60	* 20-30	* 50-60 (females)	* >>30	* 40-60	* >>30
INTERTIDAL BURYING	often	often	* rare	* rare	often	often
SUBTIDAL POPULATIONS	yes	yes	* little	* little	yes	yes
BENTHIC MOBILITY	* poor	* poor	* poor	moderate	moderate	high
PELAGIC LARVAE	probably * weeks	3-4 weeks	3-4 weeks	* 3-4 days	3-4 weeks	* none
PREDICTED GATHERING IMPACT	low	low	high	high	low	low

Good data with which to test these predictions do not exist. However both Meehan (1982) and Poraituk and Ulijasvek (1981), while commenting on traditional use of a wide range of shellfish including Anadara, Tapes, Melo, mention that oysters Saccostrea in particular have apparently been collected out close to settlements, and are gathered as soon as they become available. Additionally Nash (1984) reviewed evidence that Trochus populations have been heavily overfished in almost all parts of the Pacific where they have been commercially exploited (although this is not strictly traditional gathering, the methods used were not generally technologically advanced). Therefore the predictions of Table 1 are generally supported by the available evidence.

Changes in gathering practices will alter the predicted effects of harvesting. A future task is to identify which changes to gathering practices place previously resilient populations at risk. Changes in technology which give access to buried and subtidal individuals may do this, as will technology which permits access to distant, previously inaccessible populations. Marketing will lead to increases in predation pressure, increasing the risk of overfishing.

'The shift from resilience to overfishing of Strombus gigas in the Caribbean following marketing and better technology was mentioned previously. Recent information from the Philippines (Montano, pers. comm.), suggests the Strombus luhuanus stocks there are becoming depleted following increased use for shell jewellery. Overfi-shing appears to have.driven to extinction several well-established introduced populations of Tapes philippinarum in Hawaii (Yap, 1977).

NEW INFORMATION PRIORITIES

We have already referred to the lack of good data concerning the, important parameters of traditional shell gathering (Meehan, 1982), as well as the important biological and life-history attributes of tropical and subtropical shellfish (even commercially important ones).

Below, we suggest some priorities for the collection of data relating to both sets of attributes. Unless such data are gathered it will be impossible either to predict the effects of various styles of gathering on tropical shellfish, or to assess whether traditional gathering practices could potentially deplete natural populations of shellfish. It will also be impossible to resolve the question of whether the apparent'lack of over-exploitation by traditional groups is due to a cultural conservation ethos or to the interaction of shellfish life history with gathering technology and economics.

Ethnographic Information

Collecting unit
- usual sizes of gathering groups
- sex and age composition
- number of people fed from gathering expedition

Collecting technique'
- collecting method (walk, sit, swim, etc.)
- use of diving or swimming aids
- use of tools for, extraction
- preference for surface versus buried shellfish
- specialisation of gathering trips (mainly for one species at a time? several' species?
- how is the catch carried? how far? what are limitations on distance?

Size selectiveness
- are certain sizes preferred or avoided?

Collecting areas and times
- when do gathering trips occur and what influences this?
- how are collecting localities chosen?
- how regularly is a particular locality visited?
- what is the maximum water depth during gathering?
- relationships of gathering trips with tidal cycle?
- relationships of collecting locations with distance
- method of travel

Economics
does trading occur? how often, and over what distance?

Natural history knowledge (for each species gathered)
spatial and tidal distribution
burying
sex difference, time of reproduction and recruitment
growth rate at maturity
movement capacities
miscellaneous (eg whether venomous)

Biological Information

Life history
growth rate of benthic stages
age and size at maturity
sex differences
longevity and factors affecting it
duration of pelagic larval stage

Movement
mobility of benthic stages
habits of pelagic larvae
oceanographic: current movements

Burying or other refuges
proportion buried and its relationship with size, age-, season---
proportion in other refuges such as inaccessible crevices

Distribution
depth ranqe
habitat specificity
spatial dispersion

Reproduction
duration of breeding deason
regularity of recruitment
density dependence of recruitment

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THE EFFECTS OF TRAWLING ON THE TRADITIONAL MARINE RESOURCES OF THE TORRES STRAIT.

Ian R. Poiner and Aubrey Harris

INTRODUCTION

In northern Australia, otter trawls are normally employed by offshore vessels fishing for penaeid prawns (shrimps). Since such trawls are dragged along the bottom at speeds of around three knots they necessarily catch fish plus a number of other benthic animals as well as prawns. The ratio of fish to prawns averages about 6:1.

Most of the fish so caught are small, non-commercial species, but in some areas commercially important species, including those below legal size, are included. Nearly all of these fish are dead or dying due to suffocation in the cod-end of the trawl when brought on board.

In Australian waters, unless the trawler is operating close to major population centers where marketable fish above legal minimum size may be retained, they are dumped over the side after the prawns have been sorted out. Thus, in heavily fished prawn grounds, a considerable quantity of fish is destroyed during the fishing season.

Ever since prawn trawling started in Australia there have been allegations that the abundance of important fish species has been seriously affected, but reliable data are lacking, not only for Australia, but for other parts of the world. The limited information available concerns changes in the species composition and/or abundance with increasing fishing pressure in some southeast Asian and Australian demersal trawl fisheries (Tiews et al., 1967; Pauly, 1979; Pope, 1979; Poiner and Harris, 1985). At the same time, it is likely that prawn trawling has a marked effect on the ecology of trawl grounds, and research into this topic is long overdue.

In the Torres Strait, there has been a growing number of complaints by the Islander communities that trawling activities are depleting the traditional and artisanal fish catch. In particular, concern has been expressed about mackerel, lobsters and a general decline in reefal species.

More recently, the Torres Strait cultured pearl industry has complained that trawling is having a detrimental effect on the pearl shell habitats in the area. Current available information prevents an unbiased assessment of the complaints.

Potentially, prawn trawling could negatively impact the traditional/artisanal sea based fishing effort of the Torres in several ways:

ECOLOGICAL

Direct

Trawling is targeting on the same species either consciously, (eg. lobsters) or unconsciously, (eg. juvenile reefal finfishes in the trawler bycatch). (Note that current legislation now prevents the taking of lobsters by trawlers in the Torres Strait).

Indirect

Trawling is negatively affecting traditional target species either via trophic interactions, for instance mackerel food fishes', or by significantly altering bottom habitats;

POLITICAL

The presence of the commercial fishery precludes or constrains future traditional/artisanal fisheries development potential. There is no evidence of this in the Torres Strait.

PHYSICAL

The trawl and traditional fisheries are targeting different species but utilizing the same grounds and the commercial methods impinge on the traditional activities (eg. the leiognathid fishery in the Gulf of Thailand). There is no evidence of this type of interaction in the Torres Strait.

The CSIRO Division of Fisheries Research, Effects of Trawling Programme is primarily concerned with assessing the significance of the direct and some of the indirect effects of commercial prawn trawling on the traditional/artisanal fisheries of the Torres Strait. The primary aim of the programme is to ascertain whether prawn trawling has a significant effect on the, fish populations of the Torres Strait, particularly as it affects those species which are used as food by Torres Strait Islanders.

RESEARCH PROGRAMME

The programme was designed in three segments. Initially the research strategy was to compare the fish communities of an area currently being fished with those of the same area prior to the advent of commercial fishing. The lack of a pre-trawling database prevented the application of this segment of the project to the Torres Strait.

The Mornington Island portion of the Gulf of Carpentaria was chosen as the initial study area for the following reasons:

there are comprehensive CSIRO data on the fish communities of this area prior to the advent of trawling; and,

the area has supported a regular tiger prawn fishery for over ten years and therefore has some similarities with Torres Strait.

The Mornington Island segment of the programme has generated both qualitative and quantitative data on the effects of trawling on fish communities. Poiner and Harris (1985) reported a significant decrease in the total number of individuals and a significant increase in the number of fish species per hectare when comparing pre-trawling fish communities with the 1984 situation (twenty years after the commencement of commercial trawling).

They suggested the decreases in total numbers of individuals per hectare were caused by trawling but further studies were needed to clarify the cause(s) of the increase in the total number of species per hectare. Poiner and Harris (MS) report that there have also been significant changes in the relative abundance of species which is also probably due to trawling. For example, there have been significant decreases in the relative abundance of the Leiognathidae, Triacanthidae, and Nemipteridae.

The second and third segments of the programme are centred in the Torres Strait. In the second, catch statistics (traditional and artisanal) are being collected from the island community (Yorke Island) centred in the trawl grounds. This work began in November 1983 and will continue for at least two years. It is proceeding satisfactorily and is providing quantitative data on the fish species important as food for the Torres Strait Islanders.

In the third segment of the programme, eight trawling cruises (spread evenly over twenty-four months) are being undertaken in the Torres Strait using a CSIRO chartered prawn trawler. The design of the sampling is to control for proximity to islands and reefs both in areas open and closed to commercial prawn trawling. It is providing a description (spatial and temporal) of the demersal fish communities of the area as well as allowing an assessment of the level of trawling impact by comparing the results with the Mornington Island data. The trawl results are also being compared with the Yorke Island catch statistics to measure the level of overlap between the traditional and commercial trawl fishery.

The following preliminary. results from a cursory analysis of the first six months of Torres Strait data (two cruises February and June and catch statistics from forty-four days) can be reported:

Turtles

In a total of 114 thirty-minute trawls, two flatbacks and one green turtle were captured, (all were returned alive).

Mackerel

Mackerel generally occur more often in trawls in the Mornington area than in Torres Strait. in the Torres Strait trawis (114) there was a total catch of four Scomberomorus queenslandicus (total weight = 1.3 kg). No adult or juvenile S. commerson have been caught. To date we have no information on mackerel prey species in the bycatch.

Reefal fish

These generally comprised a relatively small portion of the bycatch although more abundant in March than in June. catch rates increase whentrawling on hard bottoms or close to reefs but the results to date would, suggest catch rates are too low to affect traditional activities.

FUTURE RESEARCH

I have already referred to the virtual nonexistence of'data on the effects of prawn'trawling on the ecology of the trawling grounds. In a mixed prawn fishery for tiger and endeavour prawns, similar to that in the Torre's Strait, the trawling strategy is to maximize both the time the nets are on the bottom and the area' covered during'a trawl. The long-term effects of such fishing are unknown and'should be of concern to both the traditional.:'. inhabitants of the area and to the fishermen themselves. A, high. priority should 'be placed on gathering information on the spatial and temporal interaction(s) between trawling effort and benthic organisms (infauna, epifauna and flora) in a variety of bottom habitats.

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PERCEPTIONS OF PLENTY: APPROACHES TO THE MANAGEMENT OF MIGRATORY AND NON-MIGRATORY SPECIES SUBJECT TO TRADITIONAL SUBSISTENCE HUNTING

Gordon R.V. Anderson

INTRODUCTION

In the context of international conventions relating to trade in wildlife, endangered or vulnerable species are those which, because of a severe reduction in range or abundance or an extremely limited geographic distribution, are considered in danger of, or vulnerable to, extinction through continued uncontrolled exploitation. National legislation may prohibit trade in such species, permitting only exchanges for scientific purposes, or trade subject to stringent controls, with provision for trade in products of, for example, captive-reared animals.

In this paper I will deal with three species - the salt-water crocodile (Crocodylus porosus), the dugong (Dugong dugon) and marine turtles, exemplified by the green turtle (Chelonia mydas).

For each species I will deal briefly with the present status of the Australian population (so far as it is documented), known traditional hunting, any past commercial exploitation and other sources of present mortality. I will highligh-t--t-he- -ways in which the different life cycle characteristics of the species may affect traditional hunters' perceptions of the distribution and abundance of the species then examine briefly some approaches to management.

SALTWATER OR ESTUARINE CROCODILE, CROCODYLUS POROSUS

Present Status

The salt water, or estuarine, crocodile is widely distributed across the coastal riverine and marshy areas of northern Australia. This represents the southernmost extent of its range. The species is considered to be very much reduced over other parts of its range and is listed as vulnerable (IUCN, 1979a). In Australia it is considered to be increasing in abundance after a period of nearly thirty years' intensive commercial hunting until protection was implemented (Western Australia 1969; Northern Territory 1971; Queensland 1974).

There is no documentation of the level of the crocodile population before commercial hunting began, but it is now common in the Northern Territory (estimated at half the pre-hunting numbers), with smaller numbers along the coasts of Queensland and Western Australia (Webb et al., 1984). In May 1975 a submission was successfully lodged by Australia to iist the Austraiian population of C. porosus on Appendix I of CITES, with populations other than that in PNG, had been listed in Appendix 1. The change will permit trade in products from captive bred and ranched animals.

Traditional hunting

Eggs of the saltwater crocodile are reported to be a traditional food source for some coastal Aboriginal groups, with smaller sub-adults taken for meat. There may have been traditional hunting of larger animals in some areas, but in others, crocodiles had totemic significance and were not harmed. The advent of firearms may have resulted in the hunting of larger individuals for food in some areas. The present level of subsistence hunting is not well documented, but is estimated to be in the region of 150 animals per annum in the Northern Territory alone (Webb et al., 1984).

Other known sources of mortality

Predation by lar'ger individuals on young crocodiles appears 'to be an important'component in the population dynamics of the' species (Webb et al, 1984). The largest individuals are relatively immune to predation. Accidental entrapment in gill, and trammel nets in rivers, estuaries and inshore areas is known to occur but it is not well documented. Although accidental entrapment is hard to quantify, it is suspected of constituting a significant, proportion of total removals in some areas. To prevent damage to nets and injury to the operator, larger individuals are shot before being freed from the nets.

There is some controlled removal of eggs and older animals for ranching purposes. The total, captive population is about 4,600 animals (Webb et al., 1984). Removals of nuisance animals from areas in which they are considered to pose a threat to humans total about 500, many of which have been relocated or transferred to ranching operations.

Major features of the life cycle

Females become reproductively active at about 220 cm TL, and about 6 to 10 years of age. They produce about 100 eggs of between 300 g and 400 g which are incubated in a mound of vegetation within the breeding territory of a dominant male and guarded by the female. Females may produce more than one clutch of eggs in a twelve month period, but the usual cycle for reproductively active females appears to be an annual clutch. After about eighty days of incubation, hatchlings are released from the mound by the female and are then creched for up to two, months. During this time they feed on small invertebrates close to the nest site. At six months of age when they are about 40 cm long and.500 g in weight, the juveniles begin to disperse slowly, with more dispersal occurring during the wet season. Mature males are polygamous, with an exclusive breeding territory that is strongly maintained during the breeding season. Outside that period, sub-adult males may be tolerated, but will disperse with the onset of breeding activity at the start of the wet season. Animals of about 200 cm are not sexually mature and may weigh about 25 kg. A mature male about 5 m to 5.5 m long and in good condition may weigh up to 700 kg.

Past commercial hunting

The post World War II market for luxury leather items produced from crocodile skin led to the rapid development of commercial hunting of crocodiles in Australia. Intensive hunting occurred from 1945 to 1972, when an estimated 270,000 to 330,000 animals were killed for trade. The commercial hunt involved both white and Aboriginal shooters. Total value of exports of all crocodile skins, including a high proportion of freshwater crocodiles later in the period, peaked at $955,488 in 1961/62, with a total value for the period 1945-73 of $6,035,979, including minor amounts of other game products (Webb et al., 1984).

There was a substantial decline in the abundance of crocodiles over almost all of their range across northern Australia until measures for protection were implemented in the Northern Territory and the two states where the species occurred. A period of intensive research that followed in the early 1970s has led to a greater level of understanding of the natural history and recovery potential of the saltwater crocodile populations under Australian jurisdiction. The subsequent development of experimental rearing and ranching programs in Queensland and more recently in the Northern Territory has opened a new and more hopeful chapter in the commercial utilisation of C. porosus.

THE DUGONG, DUGONG **DUGON**

Present status

Dugong populations have been seriously reduced by hunting over most of their formerly extensive range in the tropical Indo-Pacific. Some local populations are known to have become extinct in the recent past and the waters of the Australian-Papua New Guinea region contain some of the last remaining larger aggregations and possibly the major proportion of the total global stocks of the species (IUCN, 1979b; Bertram, 1981). There is concern that in some areas in the Australian region, legal and illegal hunting and accidental entrapment in fishing nets may have seriously reduced local populations of dugong within the last decade (Heinsohn et al., 1976; Marsh, Barker-Hudson et al., 1984). The species occurs in the tropical inshore waters of Queensland from Moreton Bay north to the Northern Territory and along the coast of Western Australia as far south as Shark Bay. It is locally common in some areas and recorded only as isolated individuals in others.

Traditional hunting

Dugong and dugong hunting are important traditional dietary and cultural components in communities in the Torres Strait and some coastal Aboriginal communities in Queensland, the Northern Territory and Western Australia. Traditional methods of hunting are known to have varied from region to region. Spearing from platforms or small boats is common in some areas (Olewale and Sedu, 1981; Neitschmann, 1977), with capture and drowning of individual animals in isolated tidal channels reported to have been replaced by spearing (introduced after white contact) in others (Paddy Roe, pers. comm.; Prince, 1984).

Ceremonies and other activities associated with dugong and dugong hunting also varied considerably, as did the totemic or other cultural significance attached to the animal and the hunt itself. Coastal communities were more likely to have a wide range of alternative food sources that were periodically exploited than were communities on smaller islands (Chase, 1981). While some hunting is wholly opportunistic, in other areas, pregnant females are reported to be selected (Olewale and Sedu, FAO ACMRR, 1979). Inshore and offshore forms are recognised.

Other known sources of mortality

Natural mortality from pathogens or unknown causative agents associated with periods of unusually heavy rain have been reported for dugong in some areas. Documented predators other than man include sharks and killer whales, with crocodiles also suggested. Illegal hunting for meat that is either used for local consumption, or is reported to be sold in more distant population centres where there is a demand occurs.

Accidental capture in shark meshing operations may have had a significant local effect in some areas since the introduction of the nets in 1964. Of increasing concern is the accidental capture of numbers of dugong in inshore barramundi and threadfin bream nets and a small accidental take in trawl nets. Estimates of total removals are hard to verify.

Severe injury resulting fromoutboard motor impact has been recorded (Marsh, pers. comm.; Prince, pers. comm.), but it appears to be less prevalent than in manatee populations. Disturbance from boat traffic is reported to have resulted in movement of dugong away from areas previously frequented.

Major features of the life cycle

While the knowledge of the biology, distribution and abundance of dugong has become increasingly well documented since the early 1970s, there is still remarkably little direct observation of important aspects of reproductive activities such as,mating and calving and other social interactions. There is little available information on patterns of local, regional or larger-scale movement, although there are records of large aggregations of dugong in areas normally occupied by smaller, isolated groups. Cyclic movement of smaller groups over a feeding range determined by food abundance is considered likely but is not documented. Aggregations of animals apparently using major topographic features in sheltering from prolonged bad weather have been reported (Marsh, pers comm; ACMRR, 1979).

Dugong are long-lived, with a documented estimated maximum age of about 70 years. Females may produce a first calf after a variable period that appears to be 9 or 10 years at a minimum. Gestation is about 12 months with suckling for at least 18 months, during which time the growing calf begins to graze. Estimates of mean calving interval range from 3 to 7 years for various populations (Marsh, pers comm; ACMRR, 1979). There is little information on growth rates, but weights of sub-adults and adults range from 90 kg (1.8 m female) to 262 kg (2.5 m male) (Marsh, Heinsohn and Marsh, 1984).

Commercial exploitation

Large-scale commercial exploitation of dugong occurred on the east coast of Australia for meat and oil that was considered to have medicinal properties, uses which have continued on a much smaller scale elsewhere on the coast. There is no documentation of the scale or extent of the early commercial operations, although it is considered (Marsh, Heinsohn and Marsh, 1984) to have been well underway by the 1890s. It is likely that the rapid development of coastal trading and the trepang, trochus and pearl industries along the east coast, in the Torres Strait and in areas such as that around Broome and Derby would have led to,a local demand for fresh meat from both turtle and dugong. Many of the smaller vessels or tenders would have hunted opportunistically, either for consumption by the crews or for sale (Paddy Roe, pers comm; Prince, pers comm; Marsh et al., 1984). Similar illegal activity is reported to continue in some areas where traditional hunting is not possible to meet a demand for dugong meat.

GREEN TURTLE, CHELONIA MYDAS

Present status

Widely distributed in the Indian and Pacific Oceans, the green turtle has been drastically reduced in many parts of its former range and has been eliminated from some areas by over-exploitation. In other parts of its, range, including Australia, populations appear to be considerable, although reduced in abundance (IUCN, 1979b; Limpus, 1979). The species is considered endangered, although not uncommon in Australian tropical and sub-tropical waters where it nests extensively. Rookeries that may be the largest remaining in the world continue in areas less accessible from centres of human population.

Traditional hunting

As in many other parts of its range, the green turtle has been an important part of the diet of coastal Aboriginal peoples and Torres Strait Islanders. Sub-adult and adult green turtles on feeding grounds are hunted opportunistically and eggs and mature females are taken during seasonal nesting aggregations. Mature females ready to lay and in peak condition are preferred in some areas, with eggs and hatchlings also taken. Hunting of adults may be seasonal in some areas.

Other known sources of mortality

Natural mortality of eggs and hatchlings from disturbance by subsequent nest preparation, climatic effects and disease occurs on the nesting beaches. High mortality of hatchlings from seabird, crab and fish predators may occur adjacent to the nesting beaches with subsequent attrition from larger predators as the animals mature. Adults are subject to predation from larger sharks. There is little known of the effects of parasites and pathogens in Australian populations.

The migratory pathways of green turtles are poorly understood, but it is clear from tag returns that turtles nesting on Australian beaches may move extremely long distances and be killed on distant feeding grounds. In Australian waters, accidental capture in gill, trammel and trawl nets occurs and may be locally important, especially adjacent to nesting beaches. While a proportion of accidentally captured green and other turtles may be released alive, nets that are left unatt'ended for considerable periods will result in a higher. mortality rate. Illegal hunting for meat may also occur.

Major features of the life cycle

From a land-based perspective, the dominant feature of the life cycle of the green turtle is the marked seasonal aggregations of mature animals. These'are associated with mating and occur adjacent to scattered nesting grounds that are used by many hundreds or even thousands of individuals.

Mature females come onto the nesting beaches and excavate a nest in which about 100 eggs, each about 50 g, are deposited and then buried. The female returns to the sea and may then return to land to produce 4 or 5 clutches of eggs at about two week intervals. Up to 10 clutches from a single female have been reported. After about 12 weeks, hatchlings, weighing about 25 g 'to 30 g emerge through the sand and head for the sea. In the GBR region, the nesting season peaks about December, and extends from October to March. Elsewhere it appears to be less marked.

There is little information about the next phase in the green turtle life cycle, until animals of about 30 cm carapace length and about 5 kg total weight return to reef feeding areas. Mature females of about 90 cm carapace length weigh 80 to 100 kg. Mature males and females may migrate long distances and congregate off nesting beaches. Estimates of the age at which egg-laying takes place range from 8 to 30 years, but certainly involves a considerable lag, an assumptionbeing that a high proportion of breeding animals return to the beach on which they hatched.

Commercial exploitation

Commercial exploitation of turtles occurred on the east coast up to the 1930s, with local and export markets for meat, turtleshell and curios. Turtles have long provided a source of fresh meat for coastal and other sea traffic and considerable numbers are likely to have been taken off the Australian coast by steamship traffic in the past. The commercial harvesting of turtles ceased in Queensland in the 1960s with the protection of the species. Widespread attempts at rearing turtles in the Torres Strait area between 1974 and 1980 were later reduced to about twelve larger experimental sites where research on husbandry and wild turtles took place. The program is no longer in operation.

DISCUSSION

Coastal and island peoples of the north of Australia have had a long and close traditional dependence on the marine resources of the area in which they live. A wide range of animals have been used as food, with the three air-breathing large vertebrates (dugong, turtle and crocodile) forming a windfall of meat unmatched by other marine animals (Chase, 1981), with capture of an individual animal carrying considerable importance. All three species would not have been used by all communities, and each has assumed a different importance in the communities in which they have formed a traditional dietary item. In some areas, alternative major sources of protein would have been available more readily than in others, especially after the spread of introduced large terrestrial mammals such as pigs, cattle and water buffalo. Under traditional conditions, a number of restrictions on the manner of hunting and the use and distribution of the products of the hunt amongst the members of the community, together with a lack of long-term storage for meat and other perishable products (for later use or wider distribution), would have limited consumption.

All three species have gone through three major phases of exploitation in the past 200 years - an unknown but possible relatively low and stable take by coastal and island communities that in many areas would have continued relatively unchanged until the mid 1880s; a period of post-contact in which increasing coastal traffic and activity would have resulted in an increased harvest followed by directed commercial exploitation for both local consumption and export of meat and other products. This commercial phase may have involved some traditional communities or individuals directly in production until the mid 1900s when protection in Australia restricted hunting to that for traditional purposes, the present phase. For two of the species there has been development of experimental and commercial-scale farming or ranching to produce meat for local consumption or for high-value export items.

In all three cases, populations of the species elsewhere in the world have been seriously reduced or even locally extinct. All are subject to increasing direct and indirect pressures as patterns of coastal development, usage and fisheries change and coastal human populations expand. The Australian crocodile, dugong and turtle populations are considered to be major proportions of the remaining stocks and are consequently of primary international significance in the conservation of the species. As a consequence, wildlife conservation authorities within Australia bear a much wider responsibility.

To coastal and island communities who have hunted the species traditionally, in a climate of accelerated change and external influence, continued access to the hunt and the resource may assume an importance well beyond the nutritional value or dietary input from the animals taken. Patterns of use will also change and develop as the communities themselves undergo changes. Because of this; the assessment of traditional community and individual requirements and needs is, to a degree, a continuing process.

To what extent, then, are the very different life history characteristics of the three species likely to affect the traditional users' perceptions of the effects their hunting activitieshave on the resources?

The more sedentary and visible a species throughout its life cycle, the more vulnerable it may be to localised depletion from even relatively low levels of hunting. Conversely; such species, especially where the individual animals are 'large and have well-defined areas within which they are found, will be better'known to hunters familiar with an area and who will be better able to assess the abundance of the resource. In such circumstances, hunters will be familiar with much of the area in which the entire life of an individual prey species may be passed. They will be better acquainted, as individuals, with the number of young produced and the potential of the species to withstand harvesting. The disposition of mature and immature animals may also be known from visible signs on river margins, or other patterns of seasonal movement may have been observed through long and close association with the environment in which the animals are living. The hunters are also likely to be aware of other occurrences that could have a local impact on the species. For example, even though there is a considerable lag between hatchling crocodiles and the production of the first clutch, the more sedentary and seasonally territorial nature of at least part of the population may make the effects of local over-exploitation quickly apparent.

Turtles, however, may spend a great proportion of their life span resident on feeding grounds distant from the areas in which they may be hunted or where eggs may be taken. Seasonal aggregations for breeding and nesting, together with the extraordinary concentrations of turtles that are known from some rookeries and the large numbers of eggs produced by each female, may give rise to perceptions of plenty - even in the face of a marked long-term decline in abundance or declines in local abundance of resident adults and sub-adults.

The marked fluctuations between years and long-term cycles of abundance at nesting areas may also mask declines. In these circumstances, even a succession of poor years can be seen simply as a natural phenomenon rather than as a consequence of excessive hunting of adults and young, or gathering of eggs. In addition, there may be a number of direct impacts on the population being hunted that occur well beyond the area of which the hunter has direct experience and which therefore cannot be taken into account in local traditional hunting practices. In the past these have included large-scale commercial exploitation and at present, they include a growing incidence of turtle mortality through net fishing operations.

While little is documented about the <regional movements of dugon'g , it is apparent that they may regularly move more than 100 km in some areas. Especially in turbid waters and with the increasing use of faster powered vessels in hunting, there is far less chance of direct observation of the animal than in the case of the other two species, where a proportion of the life-span is spent on the surface or out of water.

Local perceptions of abundance will thus depend on less direct assessments, such as an increase in effort required for a successful hunt, fewer feeding scars observed in seagrass beds or fewer sightings in areas previously frequented. Local declines in abundance may also be considered as the result of movement of the animals away from increased boat traffic rather than as a decrease in numbers. Seasonal or other aggregations in preferred feeding areas, or while sheltering, may also give rise to perceptions that the level of traditional subsistence hunting is not a major cause of any observed change in numbers of dugong in the area.

Approaches to management

Exploitation of marine mammals elsewhere in the world provides some useful parallels for the approaches that can be taken to traditional hunting of the larger air-breathing vertebrates in Australian waters. Commercial exploitation, under ideal circumstances of species that have not been reduced, should provide for the long-term removal of the maximum number of animals consistent with the maintenance of the population, so maximising the long-term production from the population. In practice, commercial constraints on the efficiency of an operation may favour higher levels of exploitation than can be sustained, to maximise profit in the short-term. Traditional subsistence hunting of abundant species that are considered able to sustain the level of harvest may require little direct management.

Traditional hunting of species that are considered to be severely reduced or endangered, however, has given rise to a great deal of international concern. Intensive national monitoring may be required, as well as sensitive management which takes into account the cultural and nutritional needs of the communities concerned, other possible impacts on the animals being hunted and recovery of the species. The present dilemma is complicated by the fact that, in many cases, declines in the abundance of the traditionally important species may have been the result of activities beyond the control of the local communities - even though they may have been directly or indirectly involved, within living memory, in commercial exploitation.

An approach that has been adopted where a species of importance in a traditional fishery is subject to international controls, has been to establish a distinctly different approach to management. Aboriginal subsistence hunting of some large cetaceans that are considered to be very much reduced in abundance has involved a major effort by national authorities and the communities involved. Studies of the biology of the species being hunted and the establishment of the levels of need in the communities concerned from nutritional, subsistence and cultural perspectives have been undertaken (IWC, 1982, 1983). More recent considerations have included the degree to which methods employed in Aboriginal subsistence whaling are able to meet broader community perceptions of the need for humane killing methods while still fulfilling traditional functions within the hunting community.

Nutritional needs'are defined on the basis of the role of the products of the hunt of the particular species in the diet of the community and their importance in the traditional diet of the community. Consideration has been given to the role of such products in maintaining and improving nutritional balance, per capita consumption together with the availability and acceptability of possible alternative food sources (including non-native foods),

Subsistence needs have been examined in relation to the level of the human population in the communities involved in the hunting and the direct or indirect dependence on such activities. Opportunities for other activities have been included. Assessment of subsistence needs has also involved analysis of historic and more recent levels of catch and assessment of the efficiency of the hunting operation in terms of successful captures and attempts likely to result in death of animals not captured.

Cultural needs have been examined in terms of the level o'f participation by the community in the preparation for the hunt, the hunt itself and in processing the products of the hunt. It has included assessments of the degree to which the products of the hunt are used, food preferences,the role of the products of the hunt in ceremonies and feasts and other traditional activities and religious significance. Cultural needs have also been examined in terms of the role that the hunt may play in developing or maintaining family and community ties and the integrative effects of the hunt and associated distribution of products in the society more generally. It has also involved assessments of the possible disruptive effects of imposed restrictions on community identity.

With the involvement and understanding of the communities concerned, such needs can then be balanced against the best available estimates of the ability of the populations that are being hunted to withstand both the direct takes and any other known removals, whether deliberate or accidental, while still providing for an overall increase in abundance. It is clear, however , that communities will be reluctant to accept constraints on traditional activities unless convinced that there is a real problem and that other impacts on the hunted population of which they are aware are also being tackled by those responsible for management.

CONCLUSION

The three species considered in this paper provide a spectrum of life history patterns. The saltwater crocodile, whose numbers in Australia were severely reduced.by a period of intensive commercial exploitation, appears to be recovering in some areas and have a high potential rate of increase under appropriate protective regimes. The past 'traditional and commercial exploitation of green turtles is not well documented 'and the status of populations in Australian waters is not clear. However, the species, in which large numbers of eggs are produced by each female, 'appears to have the potential for relatively rapid

increases in abundance under appropriate protection. Past commercial and traditional hunting of dugong is also poorly documented at present, though it appears to have increased in the past decade in some areas of particular concern.

What is known of the life history characteristics of the species indicates that replenishment of depleted populations will be slow and will require very careful monitoring and control of both deliberate and accidental removals from the populations as well as direct and indirect effects of human activities on important breeding and feeding areas. Management approaches for all three species, however, because of the isolated nature of many areas in which hunting activity occurs, will require the understanding, acceptance and support of the communities directly affected, Their involvement will facilitate better understanding of the basic biology, patterns of local movement and abundance of the species. As well, their assessment of community nutritional, subsistence and cultural needs and the development of an understanding of the wider implications of local actions will be an important part of the process of successful long-term conservation and the maintenance of traditional activities.

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PART E

COMHISSIONS

The workshop broke into five commissions to consider topics given to them by the workshop Chairman. The commissions were to regard traditional fishing as a special Australian resource in which is embedded a series of interests. These interests are commercial, traditional and academic.

The specific subjects for consideration were to be considered in this context. The commissions are listed below with chairman and rapporteurs. The commissions reported back to the main group and there was minimal discussion of the reports.

COMMISSION	CHAIRMAN/RAPPORTEUR
1. Marine Demography	Chairman: Dr Leon Zann Rapporteur: Dr Helene Marsh
2. Management Principles	Chairman: Dr Bob Johannes Rapporteur: Ms Sally Driml
3. International Action	Chairman: Mr Peter Hunnam Rapporteur: Mr Bob Speirs
4. Education	Chairman: Mr Perry Rendell Rapporteur: Mr Kirk Peterson
5. Communication/Planning Forum	Chairman: Mr Graeme Kelleher Rapporteur: Ms Claudia Baldwin

Summary of Commissions' Recommendations

Commission 1: Rarine Demography

The group noted the following:

- The necessity to collect data on:
  - catch from traditional fisheries and other sources;
  - nature of fishing effort;
  - stock size and identification of major target species used by traditional communities.
- Turtles, dugongs and barramundi are most affected by traditional hunting and fishing and require individual management plans.

- Short term, coordinated studies of the marine resource usage of a large number of communities using a range of sampling strategies are required.

- The program should be coordinated by the appropriate State, Commonwealth and Territorial agencies.

Commission 2: Management Principles

The group noted that the following were the major issues:

- Traditional knowledge is a useful shortcut to information that is valuable for marine resource management.

- This knowledge, as well as traditional marine resource management methods, deserve considerably more study than they have been accorded so far in Australia;, their importance has been demonstrated widely elsewhere throughout the tropics.

- Traditional marine resource management sometimes (but not always) provides a useful framework on which to build contemporary marine resource management programs.

Commission 3: International Action

The group noted the following:

- The Australian populations of turtles and dugongs used by traditional inhabitants cannot be managed in isolation from neighbouring countries.

- Several of these populations are of world-wide importance.

- It would be desirable that cooperation occur between countries concerned, particularly in relation to:

  - exploitation of common stock;
  - trade;
  - exchange of information;

Commission 4: Education

The commission on public education recommended that a coordinating mechanism or committee be established with a view to taking educational initiatives to:

- Address the gaps in the state of traditional fishing/hunting knowledge in Aboriginal and Torres Strait Island communities in Northern Australia;

improve the dissemination of traditional fishing/hunting knowledge amongst Aboriginal and Islander communities, government agencies and the public at large;

prioritise the recording of traditional fishing/hunting knowledge held by Aboriginal and Islander peoples in Northern Australia before it is lost.

Commission 5: Communication/Planning Forum

The group noted the following:

That an appropriate forum should have terms of reference which include:

- planning'action arising from this workshop;
- communicating with and involving all interest groups.

An expert committee should be appointed to plan and communicate future action in relation to a national research program in traditional fisheries.

Membership of the committee to be decided in the future.

The expert committee should report to the sponsoring agencies and through them, to other interested parties.

The mechanisms previously drafted for this purpose in the Commonwealth government be adopted, namely:

- the appointment of a national coordinator;
- the appointment of three liaison officers, one from each of Queensland, Northern Territory and Western Australia, with the function of involving traditional communities.

The appointment of a senior scientist to oversee the quality of the research program.

SUMMARY OF FINDINGS/ISSUES/CONCLUSIONS REACHED BY THE WORKSHOP

Traditional Knowledge and Integration of that Knowledge

A considerable amount of traditional knowledge exists in the Northern Territory, Western Australia and Queensland Aboriginal and Islander communities related to marine biology, marine use and management.

The extent and form of the knowledge differs between areas.

There are major gaps in the collection of that knowledge in Western Australia, Queensland Gulf of Carpentaria communities and some Queensland East Coast communities.

Any new studies to collect traditional knowledge from Aborigines and Islanders should:

- build on previous programs;
- be multi-disciplinary;
- involve community participation to the maximum extent;
- be undertaken in the near future because the, knowledge is dying out.

While communication between individuals appears to be satisfactory, there appears to be a need for another forum for exchange of ideas, for instance, group communication. Traditional communities need to decide what information should be given away and what information should be retained to enable the communities to retain their integrity. Such a forum is also needed to enable communities to find information they may want from management agencies. There is a need for a forum for an exchange of ideas and development of positions and views.

There appears to have been some loss of contact with traditions in some communities and it is necessary for these communities to determine whether they wish to regain some of the traditional knowledge.

It is not always clear whether the "traditional management' of resources has been conscious conservation or whether it has been management by default. Indications of "worry" about declining or over-use of resources and subsequent reductions in exploitation of those resources suggests that such management may not always be management by default.

Existing traditional use and management of marine resources has changed, because of changing technology, culture and community social requirements. Existing traditional management needs to be related to what is required to ensure availability and sustainability of stocks. There needs to be assessment of what is needed from management agencies to close the gap between current traditional management and currently desirable, management.

There needs to be some consideration of the Australian position vis a vis the world regarding resource availability with respect to target species, such as turtles, as the ranges of individual species extend beyond the area of Australian jurisdiction.

Main Conclusions with Respect to Target Species

There is a pressing need for information on population numbers and population dynamics, particularly for turtles and dugong.

There is a great need for information on catches of target species involved in traditional fisheries by other than traditional communities.

There needs to be consideration of other problems in relation to the target species in addition to adult harvest, for example foxes and pigs digging up turtle eggs.

There needs to be consideration of international harvests and management of target species. This is particularly true where commercial markets are involved.

There appears to be significant traditional knowledge of dugong in Western Australia and Torres Strait, green turtle populations particularly in Western Australia, rock lobster especially in the Northern Territory, trochus in Northern Territory and Western Australia, reef fish generally, seabirds and other fisheries.

The issue of establishment of commercial fisheries for Aboriginal communities needs to be addressed, including evaluation of the economic biology of large species, for example turtles, trochus and clams.

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