
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 highlight the 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 list the Australian population of C. porosus on Appendix I, 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 larger 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 from outboard 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 unattended 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 assumption being 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 activities have 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 dugong, 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 of 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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REFERENCES

- ~~Be-r-tram, G.C.L.: 1981. Dugong numbers in retrospect and prospect.~~
in H. Marsh (Ed.) The Dugong: Proceedings of a Seminar
Workshop held at James Cook University. James Cook
University of North Queensland: Townsville.
- Chase, A. 1981. Dugongs and Australian Cultural Systems: Some
Introductory Remarks. in H. Marsh (Ed.) The Dugong:
Proceedings of a Seminar Workshop held at James Cook
University. James Cook University of North Queensland:
Townsville.
- FAO 1979 Report on Sirenians. Annex B, Appendix VII. in:
Working Party on Marine Mammals 1979 Advisory Committee on
Marine Resources Research. FAO Fish. Ser., Vol 2:139-151.
- Heinsohn, G.E.; Spain, A.V. and Anderson, P.K. 1976. Populations
of Dugongs (Mammalia, Sirenia): Aerial survey over the
inshore waters of tropical Australia. Biol. Conserv., 9: 21-
23.
- IUCN 1979(a). Estuarine or saltwater crocodile. in: R.E.
Honegger (Ed.) IUCN Red Data Book Vol. 3: Amphibia and
Reptilia. IUCN 1110 Morges, Switzerland.
- IUCN 1979(b). Green turtle Chelonia mydas (Linnaeus 1758). in
R.E. Honegger (Ed.) IUCN Red Data Book Vol. 3: Amphibia and
Reptilia. IUCN 1110 Morges, Switzerland.

- International Whaling Commission 1982. Aboriginal/Subsistence' Whaling (with **special** reference to the Alaska and Greenland **fisheries**). Rep. Int. Whal. Comm. Special Issue 14.
- International Whaling Commission 1983. Chairman's report of the 34th Meeting of the IWC, Appendix 3, Resolution **Concerning** Aboriginal Subsistence Whaling. Rep. Int. Whal. Comm. 33.
- Limpus, C.J. 1979. Queensland Sea Turtle Project. Unpublished report from Queensland National Parks and Wildlife Service to Australian National Parks and Wildlife Service, May 1979.
- Marsh, H.; Barker-Hudson, B.; **Heinsohn, G.E.** and **Kinbag, F.** 1984. Status of the Dugong 'in the Torres Strait area: results of an aerial survey **in** the perspective of **information on** dugong life history and current catch levels. Unpublished report to Australian National Parks and Wildlife Service, Canberra', Australia.
- Marsh, H.; Heinshon, G.E. and Marsh, L.M. 1984. Breeding cycle, life history and population dynamics of the dugong, Du on **dugon** (Sirenia: Dugongidae). Aust. J. Zool. 32: 7677 . & J ?
- Neitschmann, B. 1977. Torres Strait Islanders and Environment. Unpublished work-in-progress report, Department of Human Geography, Research School of Pacific Studies, Australian National University, 18pp.
- Olewale, E. and Sedu, D. 1981. Moromor (the Dugong) in the Western Province. in L. Moruata, J. Pernetta, and W. Heany (Eds.). **Traditional Conservation** in Papua New Guinea: Implications for Today. Institute for Applied Science and Economic Research Monograph 16, Boroko, PNG.
- Paddy Roe, Broome, personal communication Feb 1984.
- Prince,, R.I.T. 1984. Dugong in Northern waters of western Australia 1984. Unpublished report, Western Australian Wildlife Research Centre, Wanneroo to the Australian National Parks and Wildlife Service, Canberra 30pp.
- Webb, G.; Manilis, S.; Whitehead, P. and Letts, G. 1984. A proposal for the transfer of Crocodylus porosus Schneider (1801) from Appendix 1 to Appendix II of C.I.T.E.S. **v+73pp.** Conservation Commission of the Northern Territory. Australia.