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Status of the Western Australian Marine Turtle Populations: The Western Australian Marine Turtle Project 1986-1990

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The cover illustration by Samantha Usback shows a mature female green turtle, *Chelonia mydas,* being recorded on its journey to lay eggs on a beach in north Queensland.

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Author’s Note re: Nesting Turtles – Dirk Hartog Island.

Green turtles do not nest at Dirk Hartog Island presently, and seem to have not done so in recent historical time.

The mention re King taking turtles at Dirk Hartog Island in January 1822 included under the heading "The Green Turtle" on p2 of this WA Status report 1994 was based on an assumption that green turtles were the preferred species being sought, and were the species being procured.

Seven summers field work on DHI northern end nesting beaches from the 1993/94 nesting season have shown that these nesting beaches are used by loggerhead turtles alone.

RIT Prince. October 2000.

Addendum – March 2003:

Andrew David (1995). The Voyage of HMS Herald to Australia … under the Command of Captain Henry Mangles Denham. The Miegunyah Press edition.

From Pp. 292-5, *passim*, David notes that Captain Denham conferred the name Turtle Bay in consequence of his crew having taken some 24 loggerhead turtles from the beach there on Dirk Hartog Island from overnight on 6-7 March 1858.

Status of the Western Australian Marine Turtle Populations: The Western Australian Marine Turtle Project 1986-1990

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Abstract
Four species of marine turtles nest at Western Australian rookeries. The green turtle *(Chelonia mydas)* is by far the most abundant, with nesting use of individual major rookeries observed over the past 3 years varying from *c*. 3 000 to 10 000 or more females per season. Information becoming available for the flatback turtle *(Natator depressus)* is suggesting that this turtle may be the next most abundant species, with annual nesting of hundreds to thousands of females. Nesting hawksbill *(Eretmochelys imbricata)* and loggerhead turtles *(Caretta caretta)* appear to be much less abundant than the flatback. The leatherback turtle *(Dermochelys coriacea)* has not been recorded nesting, but appears to be a regular feeding migrant. We have no information on occurrence of the olive ridley turtle *(Lepidochelys olivacea).*

Feeding ground/rookery association data are scarce. The best information we have suggests that feeding grounds for many of the green turtles using the Lacepede Islands rookery are located off the Northern Territory coast.

Current levels of exploitation of the Western Australian marine turtle resources by Aboriginal people are poorly known. However, there are few substantial coastal communities with traditional 'salt-water' ties in northern and north-western Western Australia.

More information is needed on the nature of by-catch of marine turtles in the course of commercial fishing operations in Western Australian waters, and on other sources of incidental mortality.

There is a wide range of State and Commonwealth legislation applicable to conservation and management of marine turtles in the Western Australian region. Application of these statutes to address specific requirements for marine turtle conservation in the region is presently patchy. Major nesting sites for the green turtle have the most comprehensive legal protection as conferred by reservation as National Parks or Nature Reserves. Known hawksbill turtle rookeries are also well covered, but our existing knowledge of flatback and loggerhead turtle nesting distribution suggests a real need to fill gaps in their protection by reservation. There are no comprehensive data sufficient to guide decisions on placement of marine conservation areas to protect particular feeding ground aggregations associated with nominated rookeries within the State, but existing or proposed marine conservation reserves established in the northern parts of Western Australia should be of value to marine turtles. Protection of feeding ground populations of marine turtles is not solely a matter of single State responsibility, however.

Knowledge which is necessary to improve the approach to conservation of Western Australian region dependent marine turtle populations is being sought within the framework of the Western Australian Marine Turtle Project managed by the Western Australian Department of Conservation and Land Management. Work in progress is being guided by our developing knowledge of these turtle populations, and is being greatly assisted by participation of volunteers from the general community, members of Aboriginal communities in the Kimberley region, and by cooperation of staff of other government authorities and organisations.

Introduction

Limpus (1982) provided a summary of current knowledge of Australian sea turtle populations. In that paper he noted that nesting of three species was reported from various locations in northern Western Australia (Figures 1, 4, 5, ibid.), but that detailed knowledge of the populations was not available.

In this paper I provide further information on the status of the Western Australian marine turtle populations.

The more comprehensive data now available have been obtained in course of work undertaken as part of the Western Australian Marine Turtle Project being supported by the Western Australian Department of Conservation and Land Management (CALM), the Australian National Parks and Wildlife Service (ANPWS), West Australian Petroleum Pty Ltd (WAPET), and others.

Species, Presence

Some marine turtles may be found from time to time at almost any place on the Western Australia coast, but these animals are more commonly found

from around the Houtman Abrolhos (c. 29^{O}S) northward. Shark Bay includes the southernmost nesting localities.

Four of the hard-shelled species of marine turtles are recorded as regular breeders in Western Australia. These are the green turtle *(Chelonia mydas)*, the flatback turtle *(Natator depressus)*, the loggerhead turtle *(Caretta caretta)*, and the hawksbill turtle *(Eretmochelys imbricata)*. The olive ridley turtle *(Lepidochelys olivacea)* is known to nest at some Northern Territory (Cogger & Lindner 1969; Guinea, 1990) and Queensland (Limpus 1975, Limpus et al. 1983) locations, but authenticated records of its occurrence in Western Australia are absent. The leatherback turtle *(Dermochelys coriacea)* appears to be a regular non-nesting migrant visitor to Western Australian waters.

The Green Turtle

The green turtle is undoubtedly the most abundant species in Western Australian waters. Small numbers of feeding turtles can be seen along the edge of the reefs fringing the cliffy coast southward of Shark Bay down to the mouth of the Murchison River, and around the reefs of the Houtman Abrolhos (Hatcher et al. 1988, p. 14).

Occasional observations, and strandings of dead or moribund animals, are also reported from the Perth area. However, the First substantial concentrations of the green turtle are found in Shark Bay.

King (1827; Vol 2, pp. 181, 2, 8) remarked on the apparent ease of procuring large turtles and some eggs in January 1822 at the north end of Dirk Hartog Island, Shark Bay. Previously, Baudin (1974, pp. 505, 10, 13) had noted that turtles could be procured in season from the area around Faure Island.

Recent accounts of the abundance of nesting green turtles at Dirk Hartog Island, for comparison with King's observation, are not available, but some nesting by green turtles does occur in Shark Bay. The green turtle population present includes both adult and sub-adult animals (personal observation). More comprehensive population data are required for this area.

Northward from Shark Bay, the green turtle is a common member of the marine fauna.

Important major nesting areas of the Gascoyne and Pilbara include the sandy mainland beaches of the Ningaloo Marine Park - North West Cape area (see also Johannes & Rimmer 1984), the Muiron Islands, Serrurier (Long) Island, the western coastal parts of Barrow Island, some islands of the Monte Bello group (principally Trimouille and North West islands), and some of the Dampier Archipelago islands (see Morris 1990, pp. 30 & 33, Appendix VI; principally Rosemary, Legendre and Delambre islands). Some other islands in this region support a lesser effort. Major field studies are in progress at the Ningaloo Marine Park - North West Cape and Barrow Island rookeries. We are also attempting to obtain more detailed information on usage of the other areas.

The major green turtle rookery of the Kimberley region is the Lacepede Islands group. Most intensive use is focussed on West Island, where major field work is continuing. Lesser Kimberley region rookeries include Browse Island, Cassini Island, and Scott Reef (Sandy Island). Further afield, Cartier Islet appears to be consistently used, and the Ashmore Reef islands appear to sustain consistent low intensity effort.

Marine turtles also nest at various points along the Eighty Mile Beach coast of the southern Kimberley region. Probably green turtles are included, but adequate site-specific data are not yet available. We do have some evidence that flatback turtles nest in this area.

Locations of the presently known important green turtle rookeries in the Western Australian region are shown in Figure I.
Quantitative data on actual abundance of green turtles in Western Australian waters at present are sketchy, and need to be refined. However, observations on rookery use by green turtles over the four seasons 1986/7 through 1989/90 provide some pointers.

Peak intensity of use of the Lacepede Islands rookery was observed over the 1989/90 season. Mid-December 1989, approximately 6-800 female green turtles were coming ashore nightly to attempt nesting. By mid-February 1990, numbers beaching had dropped to around 4-600 per night, and substantial turnover of the nesting turtles seemed to have occurred. Dry-sand conditions made nest construction difficult during this season, and approximately 20-25 % of turtles returned to the beach on consecutive nights during field work in December 1989. A 1989/90 seasonal total estimate of perhaps 8-10 thousand nesting visitors is not unrealistic, and could be conservative.

Nesting intensity at the Lacepede Islands in the 1987/88 season approached that observed in 1989/90; 1988/89 use was slightly lower than for 1987/88, while numbers visiting for the 1986/87

season were much less - perhaps only 20-25 % of the 1989/90 peak.

In contrast with the Lacepede Islands 1989/90 observations, the lowest intensity of use of the Barrow Island rookery so far observed occurred during the 1989/90 season. Nightly visitors to the beach monitoring site being worked varied between 15 and 60 individuals, depending on tide state. A total west coastal aerial track count (including the monitoring site) conducted early am on 19 December 1989 produced an estimate of 335 crawls. Even at this seasonal low intensity, it is quite possible that 3-5 thousand nesting turtles were using Barrow Island during 1989/90. In peak years, considerably larger numbers of nesting green turtles use Barrow Island.

Detailed observations have only been made over the 1988/89 and 1989/90 seasons for the Ningaloo Marine Park - North West Cape mainland beach rookery sites. Very low intensity use was the norm for the 1989/90 season, consistent with the Barrow Island picture. Possibly as few as 2-3 thousand nesting green turtles were involved. Much greater numbers visited during the 1988/89 season.

Other Western Australian green turtle rookeries mentioned above have not yet been studied on site at the same intensity as the three major field study areas discussed above. However, Morris (1990; and unpublished data) showed by aerial monitoring of tracks made by beaching turtles that several islands within the Dampier Archipelago (Rosemary, Legendre and Delambre islands in particular), were visited by fair numbers of nesting turtles, including many greens. The Monte Bello Islands group has not been subject to similar sustained surveillance, but both Trimouille and North West islands are certainly visited by many nesting green turtles (personal observation). Patterns of use and numbers of turtles involved in this case are believed to be similar to nearby Barrow Island. Likewise, the Muiron Islands and Serrurier (Long) Island with respect to the Ningaloo Marine Park - North West Cape beaches.

Aerial inspection of the more remote Kimberley island rookeries has suggested that usage of these sites also varies similarly to the pattern observed at the Lacepede Islands, but much smaller numbers of turtles appear to be involved. Regular reports of continuing current low intensity use of Browse Island are received. Detailed current data for Cassini Island, Sandy Island on Scott Reef, and Cartier Islet are not available. ANPWS has data for Ashmore Reef.

In total, the new data now available update the summary of Limpus (1982) and suggest a substantial, regionally important nesting population of green turtles dependent on Western Australian rookeries. Some of the preliminary data from our project have now been incorporated in the recent review prepared by Groombridge and Luxmoore (1989) for IUCN, but additional data are now to hand. An approximate 4 to 5 fold variation in seasonal nesting intensity has been observed to date. Much greater variation might still occur in the longer term.

Flatback Turtle

Limpus (1982) was unable to provide specific information on the flatback turtle in Western Australia. Data becoming available from our project work (Prince, this workshop) now suggest that the flatback turtle might well be the next most abundant species after the green turtle in northern Western Australian coastal waters, although the distribution of the flatback may be more restricted than that of the green and other species. We have no confirmed records of the flatback being found in Exmouth Gulf or further southwards. Detailed comprehensive data on the occurrence of the flatback away from nesting beaches would also be desirable.

Nesting of the flatback turtle in Western Australia does appear to be typified by fairly widespread use by small numbers of turtles of isolated mainland beaches, the occurrence of some more intensively used island and mainland rookeries, and limited use of some other beaches shared with the green turtle, and other species.

To date, two important rookeries used exclusively by flatback turtles have been identified in the Pilbara region. These are on the eastern coast of Barrow Island (being used by an average of c. 25-30 turtles per night mid-summer 1989/90), and on the mainland coast near Cape Thouin (peak nightly usage estimated at 15-25 turtles per night for the 1989/90 season [Oliver, unpubl. data]). Similar site usage by flatback turtles is believed likely for a number of places along the Eighty Mile Beach, as mentioned previously, but confirmation in detail is needed.

In the west Kimberley region, rookeries used exclusively by flatbacks have been identified within King Sound (northern-most of the Helpman Islands) and at the Slate Islands. In the north Kimberley, what appears to be possibly the most important Western Australian flatback turtle rookery on current knowledge has been identified on the mainland around Cape Domett, at the eastern head of Cambridge Gulf. The nearby Lacrosse Island is included here. Estimates of 30-50 turtles per night beaching to nest at Cape

Domett mid-year during the northern dry season have been reported (Osborn, pers. comm., 1987). Further detailed information on use of this rookery is presently being sought.

Apart from the exclusive flatback turtle nesting sites mentioned above, regular low frequency nesting by flatback turtles alongside greens has been recorded at both Barrow Island and the Lacepede Islands. Flatback turtles also nest in mixed-species groups at the Lowendal Islands, and among islands of the Dampier Archipelago (Morris 1990; and unpublished data).

The main flatback turtle rookeries identified to date are shown in Figure 2.

In total, whereas green turtles nest annually in thousands, or even tens of thousands at Western Australian rookeries, our current data on nesting of flatback turtles suggest that only hundreds, or perhaps thousands, of animals are nesting on an annual basis in Western Australian waters.

Hawksbill Turtle

Hawksbill turtles have occasionally stranded on beaches in the Perth area. and the species seems to regularly frequent areas from Shark Bay northwards. However, nesting occurrences have been hard to detect. In part, this appears to be due to an extended seasonally diffuse nesting pattern, in contrast with the seasonally peaked pattern of the green turtle, but the hawksbill turtle also does not appear to be particularly abundant as a nesting species in Western Australia.

Important hawksbill nesting sites have been confirmed at Varanus Island in the Lowendal Islands group, and at Rosemary Island in the Dampier Archipelago. The Varanus Island population is subject to continuing study (Morris & Robinson, and Robinson, unpubl. data). The hawksbill turtle is also recorded in the Pilbara as nesting at the Monte Bello Islands group (Oliver, pers. comm.; author, unpubl. data for Trimouille, North West, and Ah Chong islands; Robinson, pers. comm., for South East 1), and on other islands of the Lowendals group (Robinson, pers. comm.) and within the Dampier Archipelago (Morris 1990).

Confirmed northern Gascoyne region nesting locations for the hawksbill turtle now include the Muiron Islands and some of the Ningaloo Marine Park - North West Cape beaches. Presently, very few turtles appear to be involved here. We have no confirmed records of nesting of hawksbills from more southerly locations.

Emergence of hatchlings from a single nest seen at the Lacepede Islands during the 1989/90 fieldwork represents the sole recorded observation so far of hawksbill turtle nesting there. Phillip McCarthy (pers. comm.) has only recently reported the discovery of a probable hawksbill turtle nest near One Arm Point in King Sound. These two observations represent the total information we have on hawksbill turtle nesting in the Kimberley region. Small hawksbill turtles do appear to be reasonably common on reefs near One Arm Point, however.

Hawksbill turtles have also been reported nesting at Ashmore Reef.

On our present knowledge, the annual nesting effort of hawksbill turtles in the Western Australian region appears to involve tens to hundreds of turtles, rather than thousands.

Loggerhead Turtle

Proper assessment of the status of the loggerhead turtle in Western Australia on present knowledge is enigmatic. The adult loggerhead turtle is one of the more visible turtles on the west coast, and is the commonest victim of stranding on beaches in the south-west of Western Australia (including the Perth metropolitan area). Loggerhead young-of-the-year are also occasionally washed ashore in numbers around the south and lower western coasts of Western Australia after storms in the winter-spring period, and are the commonest marine turtle specimens in the Western Australian Museum herpetological collections (Smith, pers. comm.). The source of these young turtles could be nesting areas we have located in the Shark Bay and North West Cape region, but Hughes (in litt., 1990) has also suggested that some could come from South African rookeries. This is a most interesting possibility.

In contrast with the other hard-shelled species of marine turtles nesting in Western Australia, the known nesting distribution of the loggerhead turtle appears to have a slightly more southerly focus. Regular nesting has only been confirmed for the lower Pilbara and the Gascoyne regions, with nesting on both insular and mainland beaches having been documented. In common with the hawksbill, the nesting pattern for the loggerhead also appears to be extended and seasonally diffuse. Laying has been reported for Shark Bay in July (Woldendorp, pers. comm.), when beach temperatures may be below 20^{o}C.

Regular, low intensity nesting by loggerhead turtles on some Ningaloo Marine Park - North West Cape beaches, and at the Muiron Islands

nearby, has also been recorded. Apart from this, isolated instances only of loggerheads beaching to attempt nesting elsewhere have been reported (e.g. one confirmed in four seasons at Varanus Island in the Lowendals [Robinson, pers. comm.]; one unconfirmed report of a loggerhead beaching at Browse Island), although it is thought that Delambre Island in the Dampier Archipelago might attract greater use (Morris 1990, pp. 30 & 33, Appendix VI). Very small numbers of adult female turtles appear to be involved in each case. Indeed, our present data suggest that the loggerhead may be the least abundant nesting species of marine turtle in Western Australia, much scarcer even than the hawksbill turtle.

Feeding Area Associations, Migrations

Documentation of specific rookery/feeding area associations for Western Australian marine turtle populations is presently fragmentary.

The most specific information available is for the green turtle, and is based on reported recoveries of tagged turtles (Prince, Morris & Williams, unpubl. data). Female green turtles tagged at the Lacepede Islands include animals that appear to disperse to Northern Territory north coast feeding areas. Two tagged females have also been recovered from the Cult of Carpentaria; one near Mornington Island, and the other near Numbulwar, SW of Groote Eylandt. The tagged green turtles recovered from Northern Territory and Gulf locations include animals from both the 1986/87 and 1987/88 nesting groups at the Lacepede Islands. We have not yet had any reports of recoveries of 1988/89 season or 1989/90 season animals from these areas.

Some female green turtles dispersing northward from the Lacepede Islands rookery also appear to occupy feeding grounds within King Sound. Other feeding grounds may be located off the north-west Kimberley coast of Western Australia, but low levels of appropriate human activity and paucity of population in this area suggest that chance recovery of any tagged turtles resident in this area is most unlikely. Resources available have not yet permitted any dedicated search of any of these possible feeding grounds to try and detect the presence of tagged turtles.

Recovery of Western Australian tagged turtles by Indonesian fishermen operating off the Kimberley coast has also been anticipated, but no reports have been made to date. However, one Indonesian tagged green turtle has been recovered from King Sound (September 1989). This turtle showed no sign of recent or impending egg production, but was reputedly below peak 'fatness' (information from the hunters). We have not yet been able to determine the source rookery.

Other data of Limpus (Limpus & Parmenter 1986, Figure 2(a); Limpus, in litt., 1986) also show that exchange of Australian and Indonesian nesting green turtles does occur. More detailed information on this matter is obviously needed in the context of management of green turtle populations in the Western Australian region. However, turtles have not been found on board Indonesian fishing vessels currently being apprehended on the west and north-west Kimberley coast for breaches of Australian Fishing Zone (AFZ) access agreements (Australian Customs & AFZ Officers, pers. comms., September 1990). Conversely, there is no doubt that Indonesian fishermen have previously taken turtles from the Ashmore Reef area. Kitchener (pers. comm.) has also suggested on the basis of enquiries he has now made in the region that major depletion of marine turtle resources in the vicinity of Timor and Roti may have occurred in recent times.

Green turtles tagged at the two major Pilbara - Gascoyne area rookeries being worked (Barrow Island, and Ningaloo Marine Park - North West Cape and the Muiron Islands group), have produced only two recovery reports to date. The first turtle reported, from the group nesting at Barrow Island during the 1987/88 season, was recovered on the west Kimberley coast mid-198 8. The second turtle was captured and then released near One Arm Point on 4 November 1990. This turtle was tagged on North West Cape on 2 January 1990. Probable northward dispersal of green turtles nesting at the southern Western Australian rookeries was initially expected. Absence of any further recovery reports for Pilbara and Gascoyne tagged turtles suggests an additional current need for dedicated search for feeding ground locations.

Green turtle tag recovery data noted above are summarized in Figure 3.

Distant recovery of only one other Western Australian tagged turtle has been reported to date. This animal was a loggerhead, which nested at South Muiron Island late February 1988, and was taken at Maningrida, N.T., in late May 1989. Apart from further confirming the capacity of loggerhead turtles for long distance dispersal, this observation is difficult to interpret further because of the paucity of observations of nesting loggerheads at Western Australian locations. Cogger and Lindner (1969) do suggest that the loggerhead does not nest in the Northern Territory.

No recoveries from among the small numbers of hawksbill and flatback turtles tagged at Western Australian sites have been reported so far.

The fact that leatherback turtles appear to be regular visitors to the Western Australian coastal waters, but have not been reported as a nesting species, suggests that major feeding grounds for this species include Western Australian locations. One tagged leatherback turtle, believed to have come from an Indonesian rookery (possibly Sukamade Beach, Meru Betiri National Park, East Java; Limpus, in litt., 1986), was seen and released in King Sound during October 1986.

Exploitation and Other Incidental Mortality

Good statistical data on current levels of exploitation of Western Australian marine turtle populations are not readily obtained. However, northern Australian Aboriginal people are legally permitted to take marine turtles and their eggs for food. All the tagged turtle recovery reports that we have received have come from Aboriginal people.

Green Turtle

Indicated mortality rates arising from hunting of tagged adult green turtles are of the order of 1-2% per annum, or thereabouts. Under-reporting of captures of tagged turtles has been detected, and is an important complication. This is an extremely difficult problem to address satisfactorily without substantial commitment of effort to direct liaison. During recent work in the King Sound area, the information I obtained suggested that at least three cases of non-reporting had occurred in parallel with reporting of capture of 12 other turtles.

Collection of more accurate information on turtle harvest by Aboriginal people requires cooperation of the people involved, and is possibly a practical proposition only within a community. We have not yet been able to establish any such detailed program in association with our current project work, but are attempting to do so.

Capelle (1979; reported in Kowarsky 1982) has suggested that Aboriginal people in Western Australia take very few turtles. Approximately half of the tagged Western Australian Lacepede Islands nesting green turtles reported taken to date by Aboriginal people have indeed been taken in Northern Territory locations.

Contemporary validity of Capelle's Western Australian harvest estimate has not yet been fully assessed, but recent observations I have made in the west Kimberley, along with information offered by hunters, suggest a much greater current local harvest. A total annual Aboriginal green turtle harvest of somewhere between Capelle's (1979) estimate of 100+ for all Western Australian locations, and say half of Kowarsky's (1982) estimate of perhaps 2 000 being taken by Northern Territory communities (where feeding ground green turtle groups can include animals from both Lacepede Islands and northern Great Barrier Reef nesting populations; see also, Limpus & Parmenter 1986) appears to be a much more reasonable current assessment of the green turtle exploitation dependent on the Lacepede Islands breeding group. Much better information is desirable.

The major Western Australian coastal green turtle rookeries are generally free of egg harvest at present.

Expatriate Torres Strait Islanders now living in the Dampier-Karratha area are known to be hunters of green turtles (and dugongs). Their activities have yet to be assessed.

Flatback Turtle

Oliver (unpubl. data) has information suggesting that Aboriginal exploitation at known flatback turtle nesting areas in the Port Hedland district is a regular practice during the nesting season, and may account for several dozen adults and perhaps twice as many clutches of eggs. In the west Kimberley, and along other parts of the Kimberley coast, the emergent picture we have clearly suggests that the flatback turtle, being the common coastal nesting species, was the most important source of eggs. Adults were generally not taken.

Overall, the picture now suggested for the flatback is of a previous low to moderate level of sustainable egg harvest by Aboriginal people, particularly at coastal sites. Any increase in this activity, combined with a shift to increased harvest of adults, as noted above, appears to have potential for significant local impact in special circumstances.

Hawksbill and Loggerhead Turtles

We have no current information on any possible Aboriginal exploitation of hawksbill and loggerhead turtles in Western Australia. However, north Kimberley Aboriginal people have referred to 'poison turtle' in past discussions. This reference is believed to be to the hawksbill turtle, as in other reports (eg. Bustard 1972, p. 90). Eggs only may have been exploited for food when found in this region. Some minor attempts at illegal trade in hawksbill turtle shells have been detected in the past. There is no evidence of any organized or substantial trade having originated from this source.

Other Mortality
There is some circumstantial evidence suggesting reduction of the turtle populations frequenting the Ashmore Reef area over the past 10-15 years (AFZ officers, and others, pers. comms.). If this is the case, it could be attributable to the known Indonesian region turtle fishery (Greenpeace International, 1989). This matter needs further attention.

In addition to the legal exploitation of turtles and turtle eggs by Australian coastal Aboriginal communities, and the apparent impact of presumed Indonesian harvest of mainly green turtle populations frequenting Australian territorial waters in the Western Australian region, incidental harvest of some turtles is a by-product of some commercial fisheries.

Poiner et al. (1990) have shown that the Australian Northern Prawn Fishery does catch a relatively large number of marine turtles, but that only a small percentage of these appears to be killed. Comparable data for Western Australian based trawl fisheries are lacking.

On face value, information on these particular Western Australian fisheries suggests that some turtles are taken, with some being killed, but that current impact would probably be much less than that ascribed to the Northern Prawn Fishery, particularly because of the apparently marked effect trawl duration has on survival of trapped turtles (Poiner et al., ibid.). Average trawl times in the Shark Bay and Exmouth Gulf prawn fisheries are around 2 hours maximum (Andrews, pers. comm.). Nevertheless, the estimated annual turtle by-catch and kill attributable to the Northern Prawn Fishery is equivalent to estimated levels of harvest of marine turtles by a moderately large Aboriginal community, although the species comprising the catch in each instance would generally be dissimilar.

The bias in catchability of different species of marine turtles taken by prawn and other trawls might however be of local significance for conservation, say, where small nesting populations of loggerhead turtles are involved, e.g. Western Australian loggerheads in the Shark Bay area. This possibility requires careful investigation.

AFZ observers also noticed that Taiwanese fishery operations located off the north-west Australian coast during the 1980s period did catch and kill some marine turtles (Read, pers. comm.).
Quantitatively, the numbers of adult green turtles taken were relatively small, but it is not known from which particular rookery population(s) these may have come.

In addition to the by-catch of hard-shelled species of marine turtles discussed above, adult or sub-adult leatherback turtles are also consistently trapped in small numbers by entanglement in commercial lobster-pot lines, and occasionally other fishing gear, off the lower Western Australian coast. This occurrence at once provides an opportunity to collect and examine specimens of this turtle where entanglement leads to death, but is also a potential source of regional concern for conservation. We presently have insufficient information available to properly interpret these observations, but do believe that the matter requires continuing close attention.

Circumstances outlined above suggest that it would be prudent to obtain much better information on the current fisheries by-catch of marine turtles taken in Western Australia waters, but that precipitate action is not necessary. This strategy is part of the Western Australian Marine Turtle Project plan. A watching brief is also kept on possible effects of other industrial, commercial and recreational developments that may impact on marine turtle populations.

Legal Status of the Western Australian Region Marine Turtles
The legal status of marine turtles in the Western Australian region is affected by State and Commonwealth legislation, depending on location. The following represents a brief overview.

The simplest case is presented in respect of land-based sites. Practically all of these are subject to State territorial control. Rookeries may be reserved in accordance with provisions of the Land Act 1933 (as amended) as National Parks or Nature Reserves, and vested in the National Parks and Nature Conservation Authority (NPNCA), a statutory body set up by the Conservation and Land Management Act 1984 (as amended; the CALM Act). This action provides added security of tenure and purpose. The seaward boundaries of a reserve may extend as far as low water (LWM), but are often limited to high water (HWM). The former is of course the more appropriate boundary for protection of land-based areas of importance to marine turtles. Management of National Parks and Nature Reserves is the responsibility of the Department of Conservation and Land Management (CALM), as provided for in the CALM Act 1984 (as amended).

The general provisions for the protection of wildlife statewide as prescribed under the Wildlife Conservation Act 1950 (as amended) remain in force on National Parks and Nature Reserves.

Areas reserved for the retention of wildlife conservation values may however be subject to further use for mining or petroleum extraction as provided for in the Mining Act 1978 (as amended) and/or the Petroleum Act 1967 (as amended), subject to initial review and mediation in accordance with provisions of the Environmental Protection Act 1971 (as amended), and final Government decision.

Areas below the HWM within State jurisdiction may be reserved for conservation purposes also. This action is effected pursuant to Section 13 of the CALM Act, but management measures that may be applied within these reserved areas are subject to explicit requirement for CALM to reach agreement with the Fisheries Department in accord with that Department's responsibilities for administration of the Fisheries Act 1905 (as amended). Other legislative provisions mentioned above, or their equivalent, are also effective in State territorial waters.

Outside the three nautical mile State territorial limits, but within Australian national territorial waters, Commonwealth legislation generally applies, and is administered by Commonwealth authorities unless particular agreements for other administrative arrangements have been made (Offshore Constitutional Settlement [OCS] agreements, such as affect offshore petroleum exploration and exploitation). Marine reserved areas complementary to State reservations can be established under the National Parks and Wildlife Conservation Act 1975 (as amended), as in the case of Ningaloo Marine Park (see May et al. 1989), and thus potentially provide for greater security of marine habitat important for marine wildlife such as turtles at sea.

I believe that the Australian National Parks and Wildlife Conservation Act 1975 (as amended), the Wildlife Protection (Regulation of Exports and Imports) Act 1982 (as amended), and the Fisheries Act 1952 (as amended) are generally relevant to the matter of conservation and management of marine turtle populations in the wider Western Australian region, but make no claim to particular knowledge in this regard. There may well be other significant Commonwealth legislation affecting these matters too (e.g. measures to control dumping of wastes and oil at sea; see also May et al. 1989, Section 4, for some more comprehensive discussion of some of these).

Conservation Measures for Marine Turtles in the Western Australian Region

General

Specific habitat protection measures assisting marine turtle conservation in Western Australia are presently focussed on terrestrial sites, with the exception of the joint Commonwealth/State declared Ningaloo Marine Park. With this particular exception, protected sites that exist currently include rookeries, but clearly exclude the marine habitats where the turtles spend most of their lives. Some of these areas are of course outside Western Australian territorial control, and some may also be outside Australian national control.

Green Turtle Rookeries

Proven major green turtle rookeries are generally included in declared National Parks or Nature Reserves, but some minor rookeries of probable regional significance are not (e.g. Browse Island and Cassini Island). "The Monte Bello Islands currently remain under Commonwealth control, but these islands should be passed over to control of the Western Australian State Government in the near future and then be declared a Marine Park/Nature Reserve (see AIRAC 1979 for mention).

Flatback Turtle Rookeries

Some important flatback turtle rookery sites that have now been identified are not presently secured by reservation, and may urgently need management control. They are attracting increased passive and consumptive use. These include the major Kimberley rookery identified in the Cape Domett area, and the Pilbara mainland rookery near Cape Thouin. Other important rookeries have been identified within existing conservation reserves (e.g. Barrow Island - east coast, Lowendal Islands, some Dampier Archipelago islands). Information on flatback nesting areas currently available is however incomplete.

Hawksbill Turtle Rookeries

Known major hawksbill rookeries are generally within conservation reserves, or likely to be reserved in the case of the sites at the Monte Bello Islands. However, the difficulties previously noted in assessing and documenting nesting of the hawksbill turtle suggest that the information presently available is deficient.

Loggerhead Turtle Rookeries

Regularly used loggerhead turtle nesting sites are most probably not included entirely within existing or proposed conservation reserves. In this respect, the reservation noted in regard to the deficiency of hawksbill turtle rookery data is even more relevant to proper assessment.

Other Conservation Measures
Needs for further reservation of marine conservation areas within Western Australia are presently under review by CALM. Recommendations likely to flow from this review will include proposals for reservation of undoubtedly important areas of marine turtle habitat. The information on which these recommendations will be made does not however include specific knowledge of the importance of particular areas for regional marine turtle populations. Simply, this information is not yet available, being the subject of continuing research within the framework of the Western Australian Marine Turtle Project (below).

Possible needs for complementary action in areas subject to control by other Governments have yet to find an appropriate forum for discussion, but may do so at this workshop.

Management, Research and Education Programs
A formal approach to management of marine turtles in Western Australia is being developed by CALM. Where site-based management problems at nesting areas are being identified, appropriate practical management action is being implemented where possible. Initiation of such action of course requires identification of sites and their attendant problems. This matter is being pursued as part of the Western Australian Marine Turtle Project.

Our Marine Turtle Project has now been running for nearly four years. It is based on an integrated approach to research and management. The objectives are:- i) to acquire better understanding of the Western Australian region marine turtle populations, including aspects of their natural history, population dynamics, and interrelationships between different population units that may be present, so that conservation status can be properly assessed and monitored, and ii) to plan and implement appropriate conservation measures, having regard to both local and regional perspectives.

Project leadership is provided from within the Marine Conservation Research Program, Research Division, CALM. Management officers from within Operations Division, CALM, participate at different levels, depending on circumstances. This ranges from carriage of a specific investigation, assistance with management of project work on conservation areas, salvage of marine turtle specimens, and ad hoc participation on particular jobs when available.

In addition to CALM personnel, assistance with particular tasks has been obtained from AFZ officers. Customs and Coastwatch personnel. State Fisheries officers, and Western Australian Museum staff. The field work program has also been helped along in the Pilbara and Gascoyne regions by participation of numerous volunteers, and, in the West Kimberley, by provision of support for continuing commitment to participation by local Aboriginal people (latterly via the Contract Employment Program for Aboriginals in Natural and Cultural Resource Management [CEPANCRM] scheme administered by ANPWS).

Direct participation offers a first-hand learning experience, as well as a means of advancing the conservation objectives of the project.

Leaflets advertising the project have been circulated since inception of field work in late 1986. An Indonesian language version has now been produced, and is being distributed to fishermen operating within the AFZ, and among coastal communities on some Indonesian islands. A special newsletter summarizing progress of project work has also been prepared and distributed during the past two seasons.

Development of further specific interpretive material is planned by CALM as site-specific data become available. Opportunities for wider media coverage are also sought and encouraged where appropriate.

Problems and Future Directions
All marine turtle research programs are constrained to some extent by the need for labour intensive, long-term effort, particularly where adequate understanding of population dynamics is sought. The Western Australian project is no different in this respect.

Volunteer labour can be obtained. Increased security of basic operational funding in the longer-term would ensure continuity of the work in progress.

The majority of effort so far has been directed to work on major green turtle rookeries closest to the Western Australian coast, with largely incidental attention to other species encountered. Results flowing from dispersal of tagged female green turtles from rookeries post-nesting have pointed to the specific needs for feeding ground surveys. These needs include focussed investigation of identified feeding ground populations in Northern Territory coastal waters, and dedicated search of other probable feeding areas which clearly are not

currently sampled by any means which might detect the presence of tagged adult turtles.

Information linking feeding ground and rookery locations is essential for adequate conservation planning.

Most of the search areas targeted for direct investigation are in remote locations. Access to and operation in these areas will need appropriate additional support. Where there is direct association with Aboriginal cultural and resource use interests, it is also vitally important to ensure the ability of Aboriginal people to fully participate in these investigations.

Aspects of recruitment of juvenile turtles to breeding populations have not yet been addressed. Some areas where numerous juvenile turtles are found have been suggested to us. It is proposed that these sites be properly documented, and that relationships between these young turtles and established breeding populations be defined. We do not intend tackling problems of recruitment from hatchling stage at this point.

The need to obtain better information on exploitation and incidental mortality of marine turtles in the Western Australian region has been highlighted. These topics are of direct relevance to Aboriginal resource management, and management of other natural resource based industries such as fisheries, as well as for conservation of marine turtles.

Other specific aspects of turtle biology are capable of attracting more academic interest. It is considered that a well-founded continuing project will attract this interest. It is our intention to encourage such participation wherever possible. Some work of this sort is now underway.

Acknowledgements
The information summarized above includes the contributions of very many people. Their individual efforts are gratefully acknowledged.

As noted in the text, significant new information generated to date by the persons nominated generally awaits more formal publication. The major contributors in this regard deserving special thanks for making their information available for summary in this report are my CALM colleagues Keith Morris, Andy Williams, and Greg Oliver, and Tanny Robinson, a volunteer based at the Lowendal Islands. Andy Williams has also provided the Figures.

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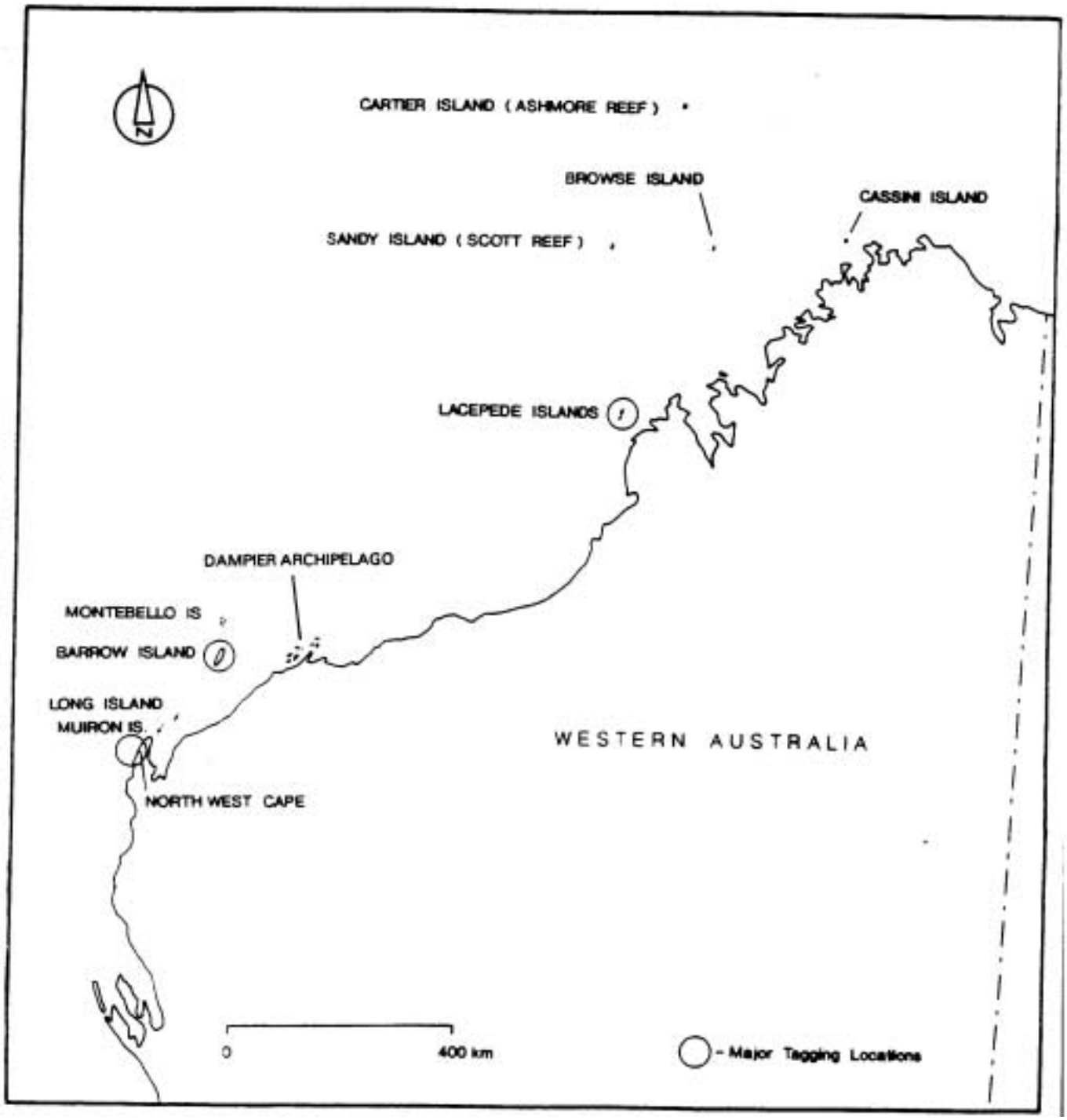
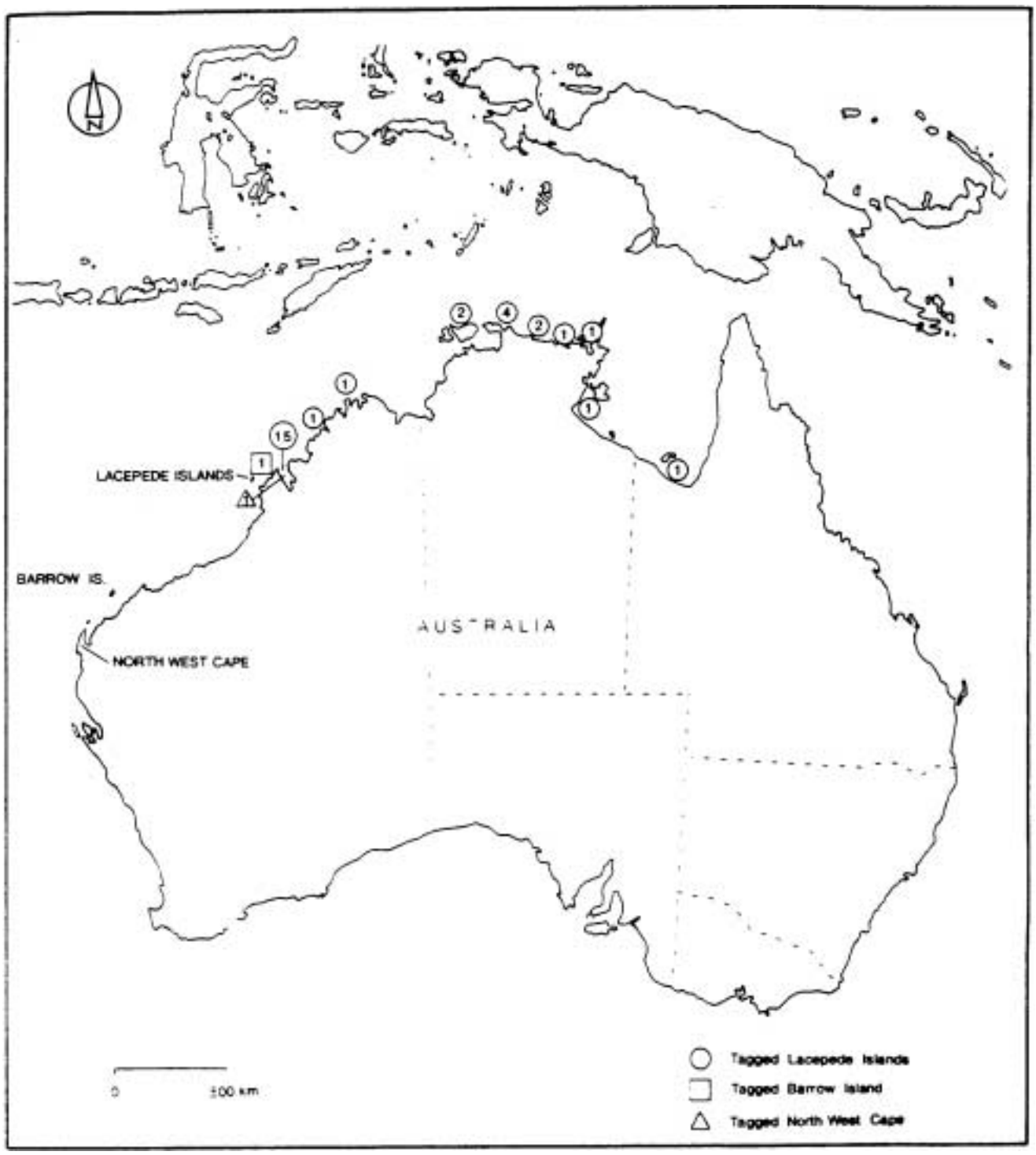
Figure 1. Green Turtle Rookeries in Western Australia.



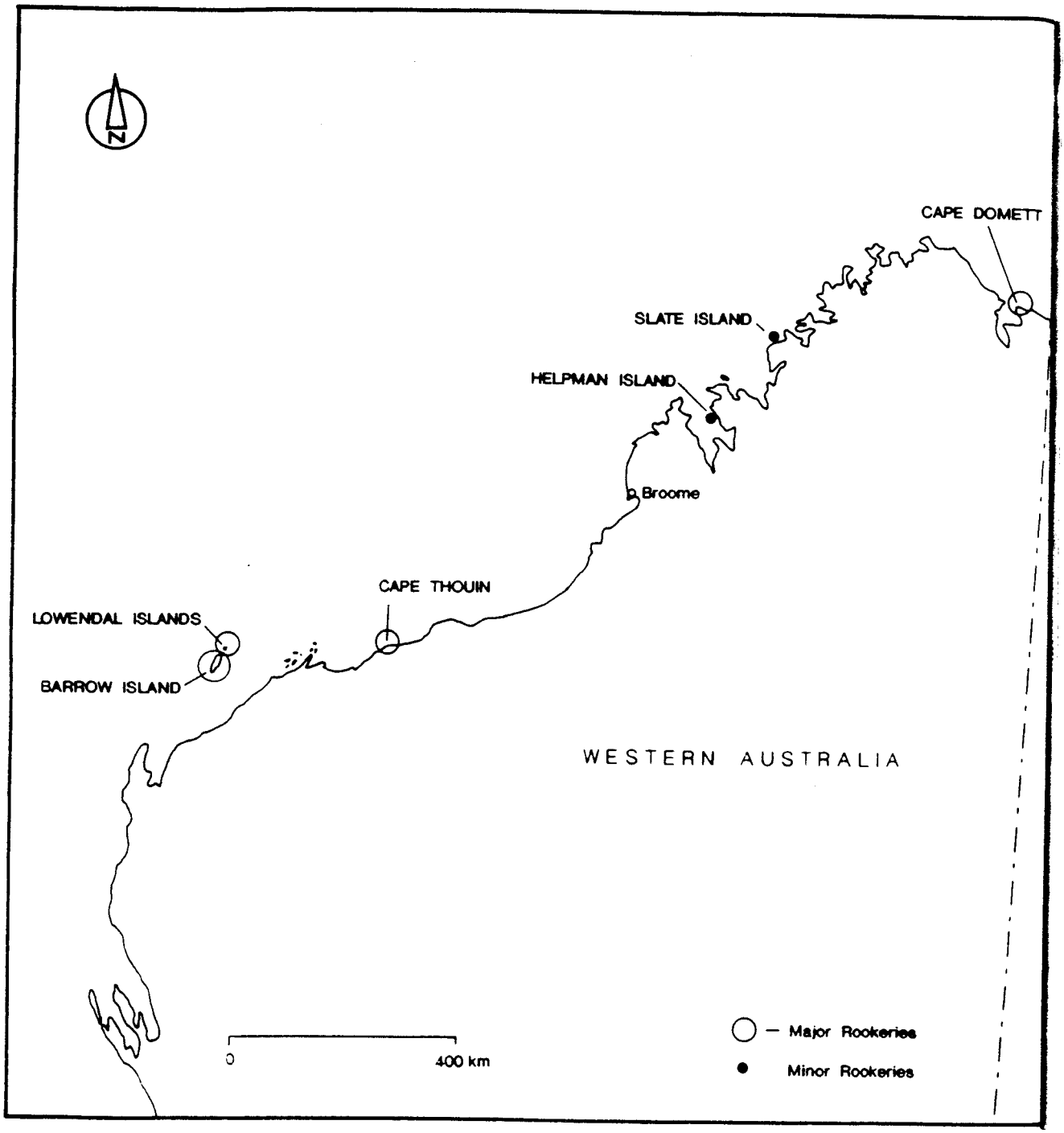
GREEN TURTLE ROOKERIES IN WESTERN AUSTRALIA

Figure 2. Green Turtle Recoveries from Western Australian Rookeries.



GREEN TURTLE RECOVERIES FROM WESTERN AUSTRALIAN ROOKERIES

Figure 3. Flatback Turtle Rookeries in Western Australia.



FLATBACK TURTLE ROOKERIES IN WESTERN AUSTRALIA