10. Dugong

Dugong surfacing at Ashmore Reef on the edge of the Australian continental shelf, some 840 km west of Darwin and 610 km north of Broome ***Source:*** *Scott D Whiting*

This chapter should be cited as:
Saalfeld, K & Marsh, H (2004). Dugong. In National Oceans Office. Description of Key Species Groups in the Northern Planning Area. National Oceans Office. Hobart, Australia.

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Species group name and description

Dugong dugon: Dugong, Sea Cow

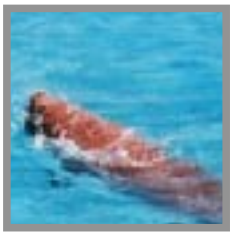
The dugong is a large, herbivorous, exclusively marine mammal and is the only extant (living) member of the family Dugongidae. It is one of only four extant species of the order Sirenia, which are descended from terrestrial mammals that browsed in shallow grassy swamps during the Eocene period. Their closest modern relative is the elephant.

Adult dugongs grow up to about 3 m in length and up to 450 kg (Spain & Heinsohn 1975) and have a rotund body with a horizontal tail and forward pectoral fins. Dugong eyes are set laterally. The auditory (ear) openings are small and set laterally behind the eyes.

Status

International

The dugong is listed as vulnerable to extinction in the International Union for the Conservation of Nature, World Conservation Union's Red Data Book of Threatened Species (IUCN 2000). The dugong is listed on the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) and on Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). The Indigenous dugong fishery in Torres Strait is also listed as an Article 22 fishery in the Torres Strait Treaty between Australia and Papua New Guinea.



Australian Government

The Convention on Biological Diversity, the Convention on the Conservation of Migratory Species, and the Convention on the International Trade of Endangered Species of Wild Fauna and Flora (CITES) all oblige Australia to protect the dugong stocks in northern Australian waters (Stokes and Dobbs 2001). *The Australian Government Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) makes it an offence to take any action that may have a significant impact on a matter of national environmental significance without prior approval from the Minister for the Environment and Heritage. Matters of national significance include listed migratory species.

The dugong is listed both as a migratory species and as a listed marine species under the EPBC Act. Any actions that might significantly impact on a population of the species must be referred to the Minister for the Environment and Heritage for approval. The EPBC Act also makes it an offence to recklessly kill, injure, take, trade, keep or move a member of a listed migratory species in a Commonwealth area, unless the person taking the action holds a permit under the EPBC Act.

However, nothing in the EPBC Act affects the operation of section 211 of the *Native Title Act 1993* which states that Indigenous people with a Native Title right carrying out traditional hunting of dugongs do not need a permit under the EPBC Act authorising them to undertake the activity, nor do they need approval under that Act.

The Commonwealth gives effect to the provisions of the Torres Strait Treaty between Australia and Papua New Guinea through the *Commonwealth Torres Strait Fisheries Act 1984* which recognises the dugong fishery as an Article 22 Fishery.

Queensland

The dugong is protected wildlife in Queensland waters under the *Nature Conservation Act 1992*, under which it is classified as vulnerable. The Act prohibits the taking, interference with, possession, control or movement of protected wildlife, unless authorised to do so under the Act. The Act recognises the rights of Aboriginal and Torres Strait Islander people to take, use or keep protected wildlife under Aboriginal tradition or Island custom subject to any provision of a conservation plan that expressly applies to the taking, using or keeping of protected wildlife under Aboriginal tradition or Island custom. However, this section of the Act has not been proclaimed and so the act is effectively silent on the issue of Indigenous hunting as discussed below. Additionally, the Act does not permit an Aboriginal or Torres Strait Island person to take, use or keep protected wildlife under Aboriginal tradition or Island custom in a protected area unless authorised to do so under the Act.

Queensland gives effect to the provisions of the Torres Strait Treaty between Australia and Papua New Guinea through the *Torres Strait Fisheries Act Qld 1984* which, like the corresponding Commonwealth legislation, recognises the dugong fishery as an Article 22 Fishery.

Northern Territory

In the Northern Territory (NT), dugongs are protected wildlife under the *Territory Parks and Wildlife Conservation Act 2001* (TPWC Act). The Act prohibits the taking, interference with, possession, control or movement of protected wildlife, unless authorised to do so under the Act. The Act recognises the rights of Aboriginal people who have traditionally used an area of land or water to continue to use that area for traditional hunting, food gathering (other than for sale) and for ceremonial or religious purposes. Traditional hunting of dugong by Aboriginal people is covered by section 122 of the Act and Aboriginal people carrying out traditional hunting of dugong do not need a permit under the TPWC Act authorising them to undertake the activity, nor do they need the approval of the Act.

General comment

The different jurisdictions in the Northern Planning Area (NPA) differ in their listing of the dugong for two reasons: (1) it is legitimate to estimate extinction probability differently at different spatial scales and (2) jurisdictions differ in their definitions of the categories of threat. Nonetheless, as outlined above, most Commonwealth, Queensland and NT laws consider dugongs as species to be protected, except from hunting by Indigenous peoples under prescribed circumstances. However, the legislative environment is completely different in the Torres Strait Protected Zone (TSPZ) and adjacent waters, where the dugong is considered as the target species of an Indigenous fishery rather than as a protected species. The concept of 'sustainability' only emerged in Australian law after the 1992 Rio Earth Summit in the National Strategy for Ecologically Sustainable Development (ESD) which became State and Commonwealth policy under the Inter Governmental Agreement on the Environment (IGAE) 1992.

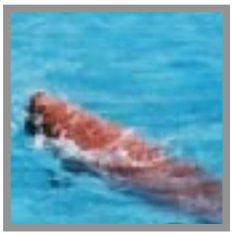
10. Dugong

In 1992, the Australian High Court made the landmark decision to recognise the potential existence of Native Title on land in Australia *(Mabo v The State of Queensland [No 2] (1992) 173 CLR 1)*. This decision provided a new framework for the recognition of Indigenous rights to land, sea and wildlife, and gave Indigenous peoples who are Native Title holders some bargaining power over the management of their traditional lands. The Commonwealth Government's legislative response to this decision was the Commonwealth *Native Title Act 1993*. The Queensland and NT Governments subsequently also passed Native Title legislation. As explained above, Section 211 of the Commonwealth Act negates a Native Titleholder's need to obtain permits for certain activities including hunting, provided hunting is for the purpose of satisfying personal, domestic or non-commercial communal needs and is exercised as part of the hunter's Native Title rights and interests. This right was affirmed in 1999 by the Yanner decision of the High Court of Australia which concluded that Queensland State fauna licensing requirements did not apply to Native Title holders exercising rights for 'personal, domestic or non-commercial needs' by virtue of s211 *Native Title* Act and s109 of the Australian Constitution *(Yanner v Eaton [1999] HCA 53 7 October 1999)*.

The use of s.211 in the sea countries of the Indigenous peoples in the dugong's range in the NPA will ultimately turn on the existence of their Native Title right. Native Title over the customary sea area surrounding Croker Island in the NT was recognised in the Croker Island Native Title judgment *(Mary Yarmirr & Others v The Northern Territory and Others, 1998)* and confirmed by the High Court of Australia in October 2001 *(The Commonwealth of Australia v Yarmirr; Yarmirr v Northern Territory [2001] HCA56 11 October 2001)*. The High Court determined that Native Title over the sea in this case was not exclusive and that interests of importance to Native Title holders specifically include traditional hunting of dugongs. A similar decision was made with respect to the Wellesly Islands in the Gulf of Carpentaria in March 2004. *(The Lardil Peoples v State of Queensland [2004] FCA 298)*.

The rights of Indigenous peoples who are historically associated with the coastal waters in the dugong's range in the NPA are less clear and have changed several times. For example, since the early years of the 20th century, Queensland and NT fauna and/or fisheries legislation generally permitted all Aboriginal peoples to take native marine fauna such as dugongs for subsistence. This is still the case in the NT as well as in Torres Strait. In contrast in other parts of Queensland, the legislation has changed several times. Since 1974 and exemptions for Indigenous peoples have been varied through time. The Queensland *Community Services (Aborigines) Act 1984* exempts members of an Aboriginal community resident on trust areas from fisheries legislation. The legislative regime governing dugong and turtle hunting was eventually changed to the *Queensland Nature Conservation Act 1992*. This legislation allows Indigenous peoples to take, use or keep wildlife taken in accordance with Aboriginal tradition or Islander custom subject to the provisions of a conservation plan, which is required for protected wildlife such as dugongs and turtles. This section of the *Queensland Nature Conservation Act 1992* has never been proclaimed as noted above. Nonetheless, the Queensland *Nature Conservation (Dugong) Conservation Plan 1999* states that the Indigenous hunting of dugongs by Aboriginal people will be managed in a manner consistent with the Commonwealth *Native Title Act 1993*, which confirms the rights of traditional owners but is silent on the rights of traditionally associated peoples.

Since 1999, the EPBC Act regulates activities within Australian jurisdiction likely to have a significant impact on the Commonwealth Marine Area, which is defined in this Act as essentially that area under Commonwealth title and jurisdiction, except for state and NT waters (s23–24a). The EPBC Act explicitly states that it does not affect the operation of s211 of the Commonwealth *Native Title Act 1993*. Nonetheless, where Native Title has survived, it is subject to the important qualification that its exercise has usually to be in accordance with the provisions of other relevant legislation. Presumably this means that any Indigenous person (including traditional owners) practising unsustainable levels of hunting for dugongs in the NPA could be prosecuted under the EPBC Act. It is arguable that these powers could also be applied to other activities in the NPA if they impact on the conservation and management of such species in the Marine Area (Professor Martin Tsamenyi, Centre for Maritime Policy University of Wollongong, pers. comm. 2002). A key management priority then should be to develop and implement a method of ensuring that the Indigenous harvest of dugongs in northern Australia is sustainable. As a key object of the EPBC Act is the need to promote a cooperative approach to the conservation and ecologically sustainable use of Australia's biodiversity, it would be consistent with that Act for this method to be determined cooperatively by Indigenous communities and the relevant managing agencies. Given that dugongs move large distances and that there are no clearly defined stock boundaries, sustainable harvest levels need to be calculated at appropriate spatial scales. This is a considerable challenge given the differences in the laws relevant to species conservation and the hunting rights of Indigenous peoples outlined above.



Habitat and Distribution

Life history and reproductive ecology

Life history models for the dugong (Marsh et al. 1984, Boyd et al. 1999) indicate that they are long-lived animals with a low reproductive rate, long gestation period and high investment in each offspring.

Marsh (1980) estimated the age of dugongs by counting seasonally deposited growth layer groups in the tusks. Their maximum life span is approximately seventy years. Dugongs over 2.5 m are generally mature, while male and female dugongs less than 2.2 m are probably immature (Marsh et al. 1984). The pre-reproductive interval ranges between 6 and 15 years (Marsh et al. 2003 & in press).

Female dugongs usually bear a single calf every 2.5 to 7 years. The gestation period is about 13 months and the calf suckles for about 18 months. At least some calving occurs in the shallow waters of tidal sandbanks (Marsh et al. 1984) and estuaries (Hughes & Oxley-Oxford 1971); possibly a strategy to avoid shark attacks (Anderson 1981). Breeding is diffusely seasonal, with breeding activity more likely to occur in the second half of the year than in the first (Boyd et al. 1999).

Population simulations indicate that even with the most optimistic combinations of life history parameters (eg low natural mortality and no human-induced mortality) a dugong population is unlikely to increase at more than 5% per year (Marsh 1995b, Boyd et al. 1999) with more realistic predictions of increase ranging from 1 to 3% per year (Marsh et al. 2003 & in press).

Diet and habitat

Dugongs feed on seagrasses found in the shallow tidal and subidal coastal marine environment. They were originally believed to feed opportunistically on available seagrasses (Marsh et al. 1982, Lanyon et al. 1989), but Preen (1992) indicates that preferential grazing occurs in at least some areas, apparently based on the nutritional quality of the seagrass. Lanyon (1991) and Aragones (1996) found that the most frequently selected seagrass species are lowest in fibre and highest in available nitrogen and presumed digestibility. In many areas, seagrass species of the genera *Halophila* and *Halodule* are favoured.

Marine algae are also eaten (Spain & Heinsohn 1973, Marsh et al. 1982). Macroinvertebrates are also consumed particularly at the higher latitude limits of the range (Heinsohn & Spain 1974, Anderson 1989 and Preen 1995a). Algal feeding is believed to occur only when seagrass is scarce (Spain & Heinsohn 1973).

When feeding on the preferred seagrasses, dugongs dig up the whole plant including the nutrient-rich rhizomes (Heinsohn & Marsh 1978, Marsh et al. 1982). This produces the distinctive feeding trails that are seen particularly in low biomass seagrass beds. Dugongs consume between 28 and 40 kg of seagrass each day.

Dugongs have also been reported in deeper water further offshore. Large numbers have been sighted in waters more than 10 m deep (Marsh & Saalfeld 1989, 1991) and Marsh and Saalfeld (1989) sighted dugongs up to 58 km from the north Queensland coast in water up to 37 m deep. This distribution reflects that of deeper seagrasses such as *Halophila spinulosa* (Lee Long et al. 1993). Whiting (1999) reported dugongs, including calves, at Ashmore Reef on the edge of the Australian continental shelf, some 840 km west of Darwin and 610 km north of Broome.

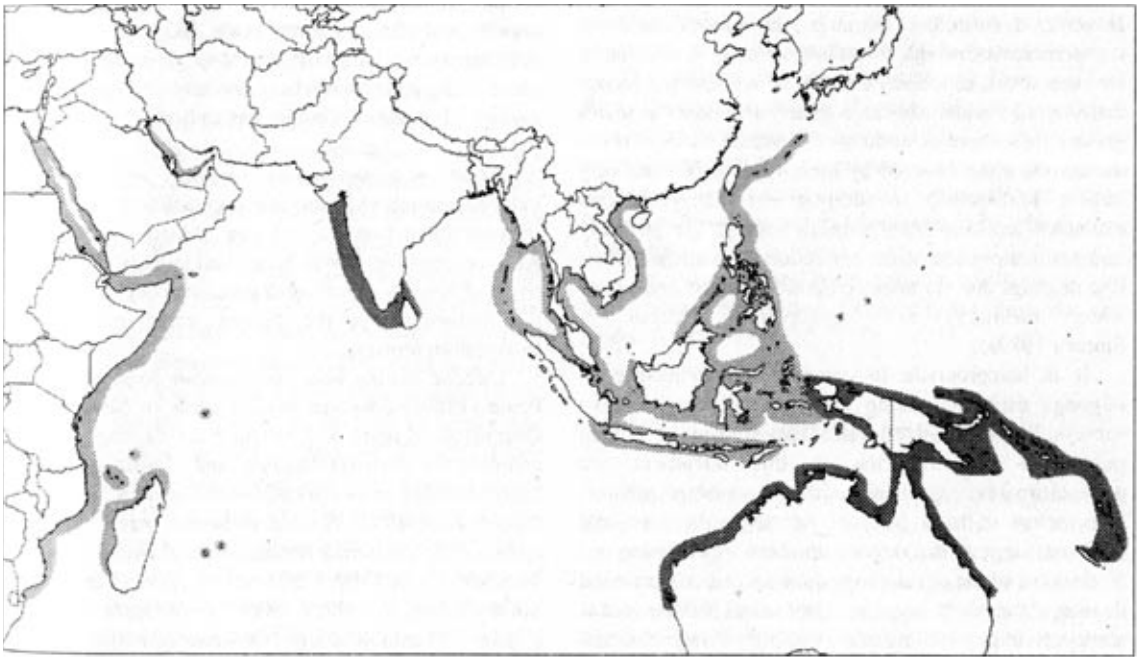
Movements

Dugong movements have been tracked in several studies using VHF and satellite transmitters. Movements appear to be individualistic. Most animals restrict their movements to tens of kilometres within the vicinity of seagrass beds (Marsh & Rathbun 1990, Preen 1993, 1995b, 1999 & 2001, de Longh et al. 1998). A number of animals have been observed to travel large distances – up to 600 km in a few days (Marsh & Rathbun 1990, Preen 1995b, 1999 & 2001). These observations indicate that dugongs have the capacity to undertake long-distance movements, a factor which must be taken into account in their management and significantly affecting habitat management. The results of repeated surveys of the same regions provide strong evidence for large-scale movements of dugongs in response to seagrass dieback as outlined below.

Distribution and abundance

The range of the dugong (Figure 10.1) spans 37 countries throughout the tropical and subtropical coastal and island waters of the Indo-West Pacific from east Africa to the Solomon Islands and between about 26° and 27° north and south of the equator (Marsh et al. 2002). Over much of this range the dugong is believed to be represented by relict populations separated by large areas where they are close to extinction or extinct.

Figure 10.1: *The known range of the dugong*



The different shadings illustrate different dugong populations, although a genetic basis for these populations has generally not yet been confirmed. Australian dugongs are genetically distinct from those in South-east Asia (from Marsh et al. 2002).

Marsh et al. (2002) reports that, while dugong numbers have declined over much of their range, they are higher than previously supposed in many areas. However, most of the knowledge of dugong distribution and abundance over much of their range is derived from incidental sightings, accidental drownings, and the anecdotal reports of fishers (Marsh et al. 2002). More detailed information is available for several countries based on spatially and temporally limited surveys generally conducted parallel to the shoreline and providing minimum counts only (Marsh et al. 2002). Only in northern Australia, the Arabian Gulf region and New Caledonia have extensive quantitative aerial surveys incorporating corrections for visibility biases been conducted, providing comprehensive knowledge of dugong distribution and abundance in the coastal waters of most of the dugong's range in these areas (Marsh et al. 2002 and Garrigue pers. comm.).

A significant proportion of the world's dugong stocks is found in northern Australian waters between Shark Bay in Western Australia and Moreton Bay in Queensland (Marsh & Lefebvre 1994). It is generally accepted that Australia is the stronghold for the species, with the dugong being the most abundant marine mammal in inshore waters (Marsh unpublished data). Most recent estimates put the Australian population at more than 80 000 dugongs (Marsh et al. 2002). This is likely to be an underestimate as some areas of suitable habitat have not been surveyed.

Table 10.1 summarises available knowledge of dugong numbers in the NPA derived from aerial surveys. Figures 10.2, 10.3, 10.4 and 10.5 show the distribution of dugong in the coastal waters of the NPA based on the most recent aerial surveys.

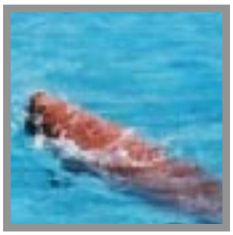


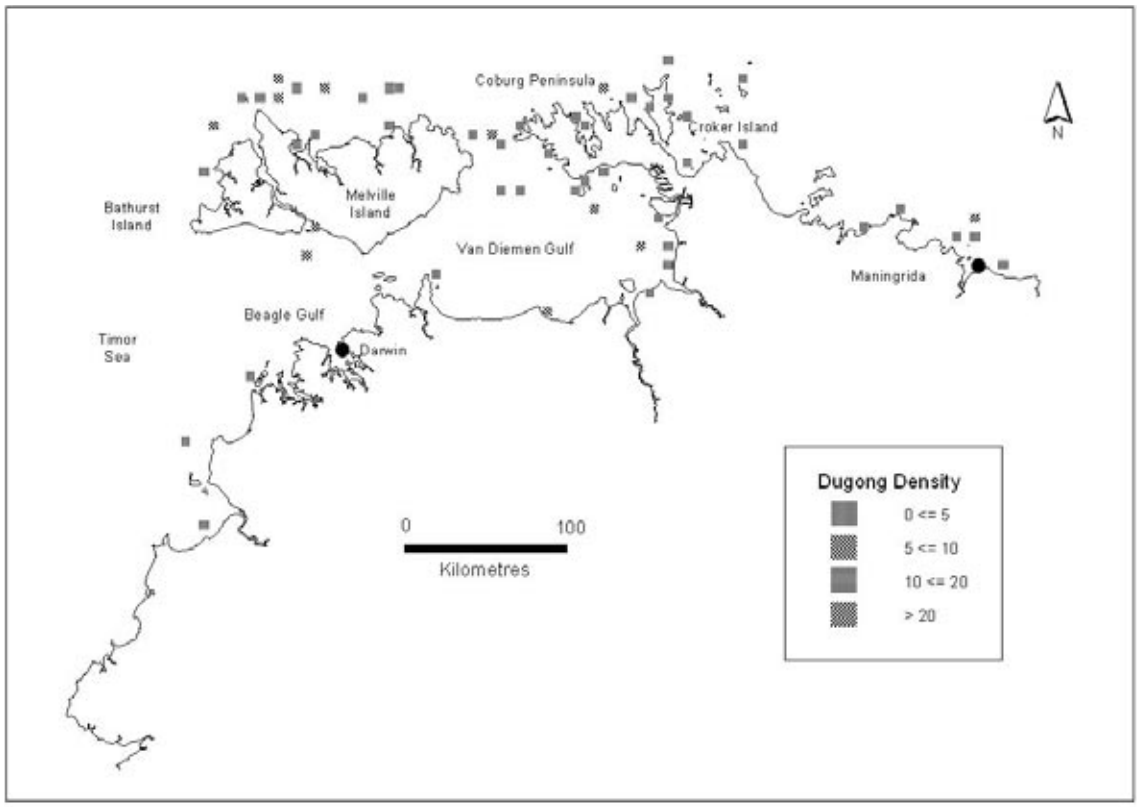
Table 10.1: *Numbers and density (± standard errors) of dugong in the Northern Planning Area The variation in the population estimate for Torres Strait results from dugongs moving in and out of the survey area as explained below.*

Location	Date	Area (km²)	Number ± S.E.
Northern Arnhem Land (Goulburn Islands to Milingimbi)	December 1995[1]	9096	1763 ± 956
Gulf of Carpentaria coast of the Northern Territory	February 1985[2]	27 216	16 846 ± 3259
	November 1994[1]	24 770	23 336 ± 3040
Gulf of Carpentaria Coast of Queensland	December 1997[3]	33 026	4,266 ± 657
Torres Strait[4]	November 1987	30 560	13 319 ± 2136[5]
	November, December 1991		24 225 ± 3276[5]
	November 1996		27 881 ± 4720[5]
	November 2001		14,106 ± 2314[5]
	November 2001		14 029 ± 2342[6]
Total[7]		97 452	36 981 ± 4162

[1] Saalfeld (2000).
[2] Bayliss & Freeland (1989).
[3] Marsh et al. (1998).
[4] Marsh et al. (2003 & in press).
[5] estimated using methodology of Marsh and Sinclair (1989a).
[6] estimated using methodology of Pollock et al. (2003 & in review).
[7] sum of population estimates of most recent surveys and for area of surveys only (Saalfeld 2000 data not used as unreviewed, see Preen 1995b).

The survey data suggest that distribution of dugong along the Arnhem Land coast of the NPA is patchy, with a single aggregation offshore from Maningrida being the largest detected (Figure 10.2).

Figure 10.2: *Distribution of dugong density (dugong/km²) along the northern coast of the Northern Territory from the December 1995 survey Sightings near Maningrida are within the NPA.*



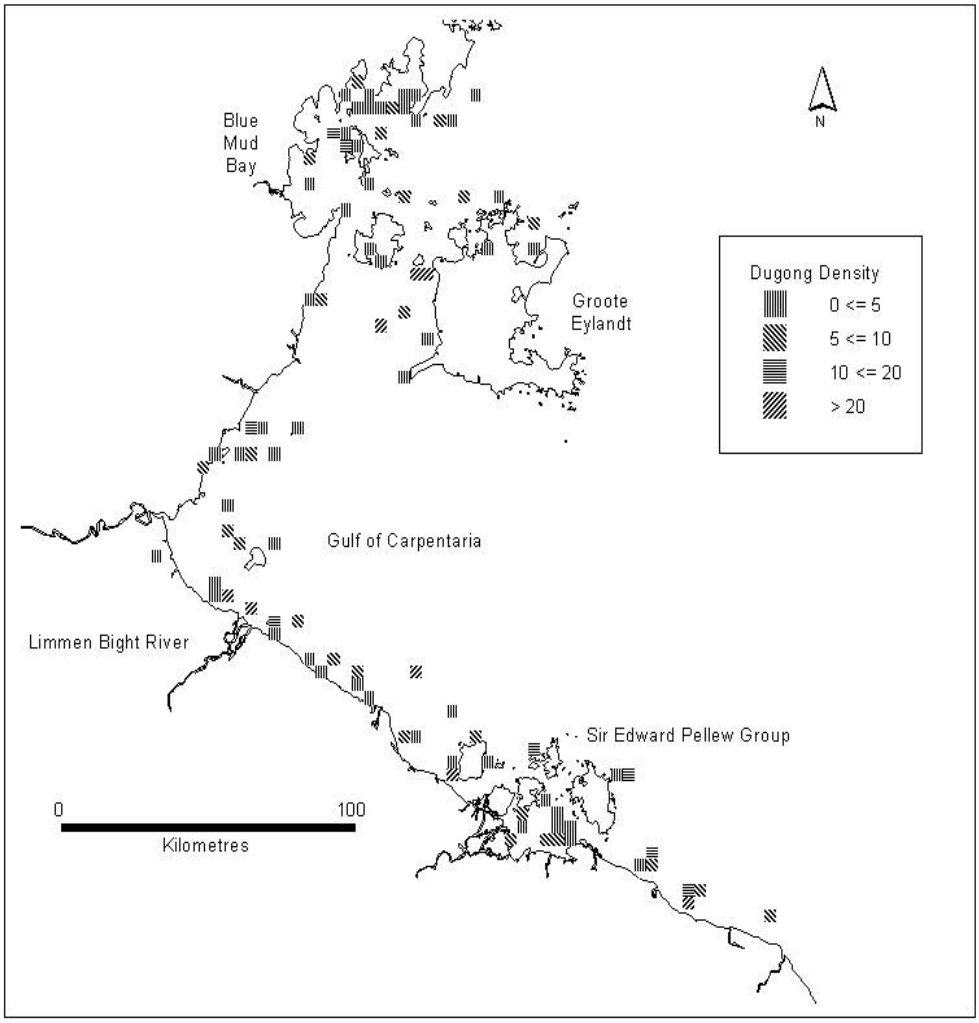
The surveys suggest that the distribution of dugongs along the western Gulf of Carpentaria (GoC) coastline is much more uniform (Figure 10.3), with dugongs occurring along almost the entire length of coastline at medium to high densities. Within this relatively uniform distribution three areas are significant: the top half of Blue Mud Bay, the mouth of the Limmen Bight River and the Sir Edward Pellew Group of islands. The coastal strip from the mouth of the Limmen Bight River to east of the Sir Edward Pellew Group has the largest population of dugongs in the NT and ranks in the top four dugong areas in Australia. Saalfeld (2000) estimates that some 8000 dugongs occur along this strip of coast and within the island group. Blue Mud Bay was estimated to have some 4200 dugongs, giving it the fourth largest population of dugongs in the NT (Saalfeld 2000) and also ranking in the top eight dugong areas in Australia.

Preen (1995b) surveyed the Sir Edward Pellew Group to mouth of the Limmen Bight in the dry season of 1994 and wet season of 1995. Initial analysis indicates a marked difference to the results of the November 1994 survey of Saalfeld (2000). Both of Preen's estimates are 60% lower than that of Saalfeld. This difference is difficult to reconcile given that Preen's surveys were conducted both before and after those of Saalfeld. The area needs to be resurveyed as part of a comprehensive survey of the GoC to derive current baseline abundance estimates.

Almost all sightings of dugongs in the western GoC occurred within the shallow coastal territorial waters of the NT. Few sightings occurred within Commonwealth waters.

Marsh et al. (1998) surveyed the Queensland coast of the GoC, including the Wellesley Islands in December 1997. Of the estimated 4000+ dugong along this coastline more than 60% occurred in the Wellesley Islands area. Most of the remainder was sighted on the northern half of Cape York Peninsula (Figure 10.4).

Figure 3: *Distribution of dugong density (dugong/km²) along the Gulf of Carpentaria coast of the Northern Territory from the November 1994 survey*



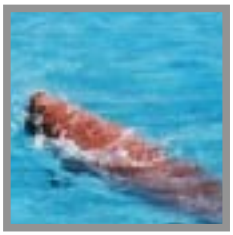
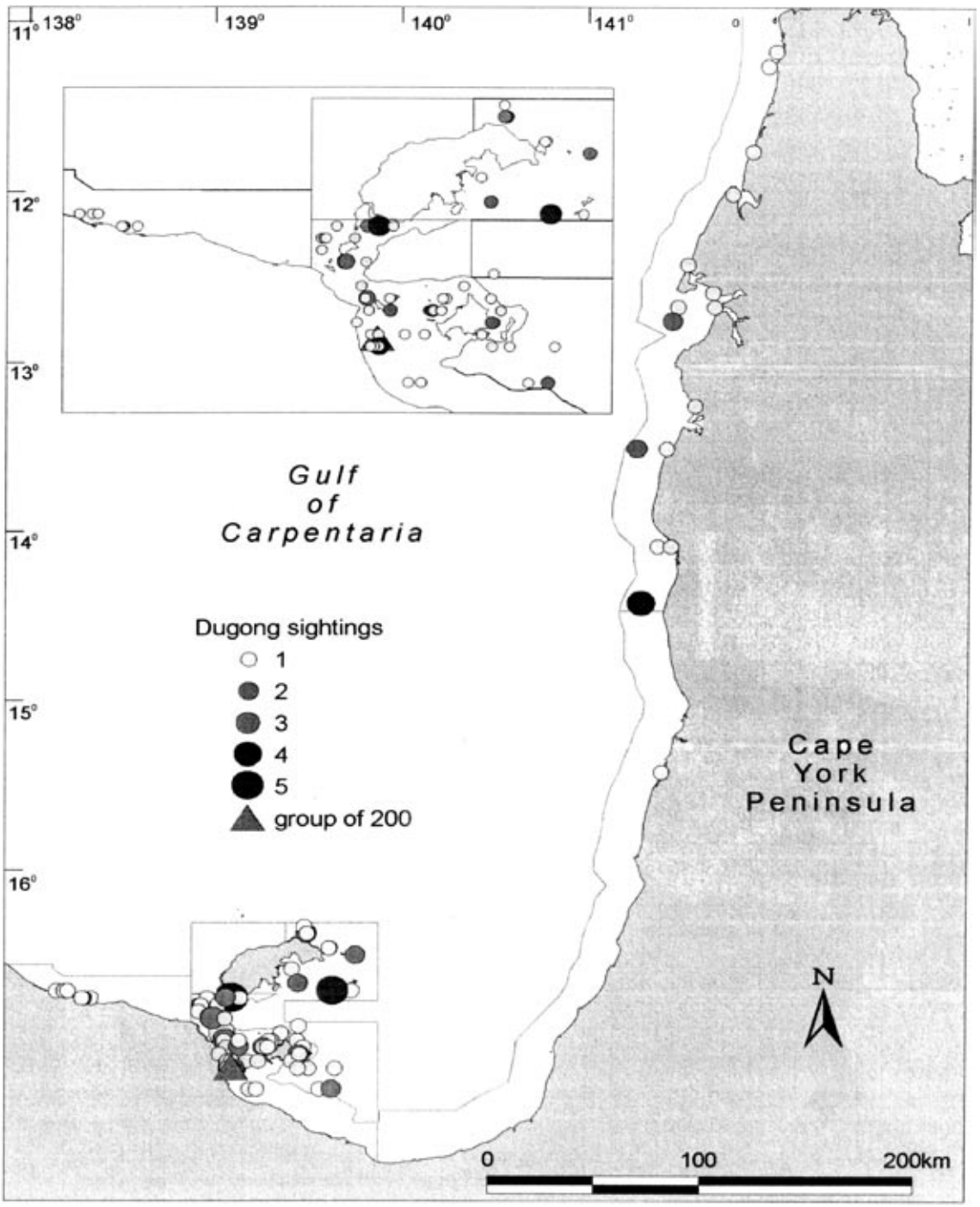


Figure 10.4: *Distribution of dugong sightings along the Gulf of Carpentaria coast of Queensland from the November 1997 survey (from Marsh et al. 1998)*

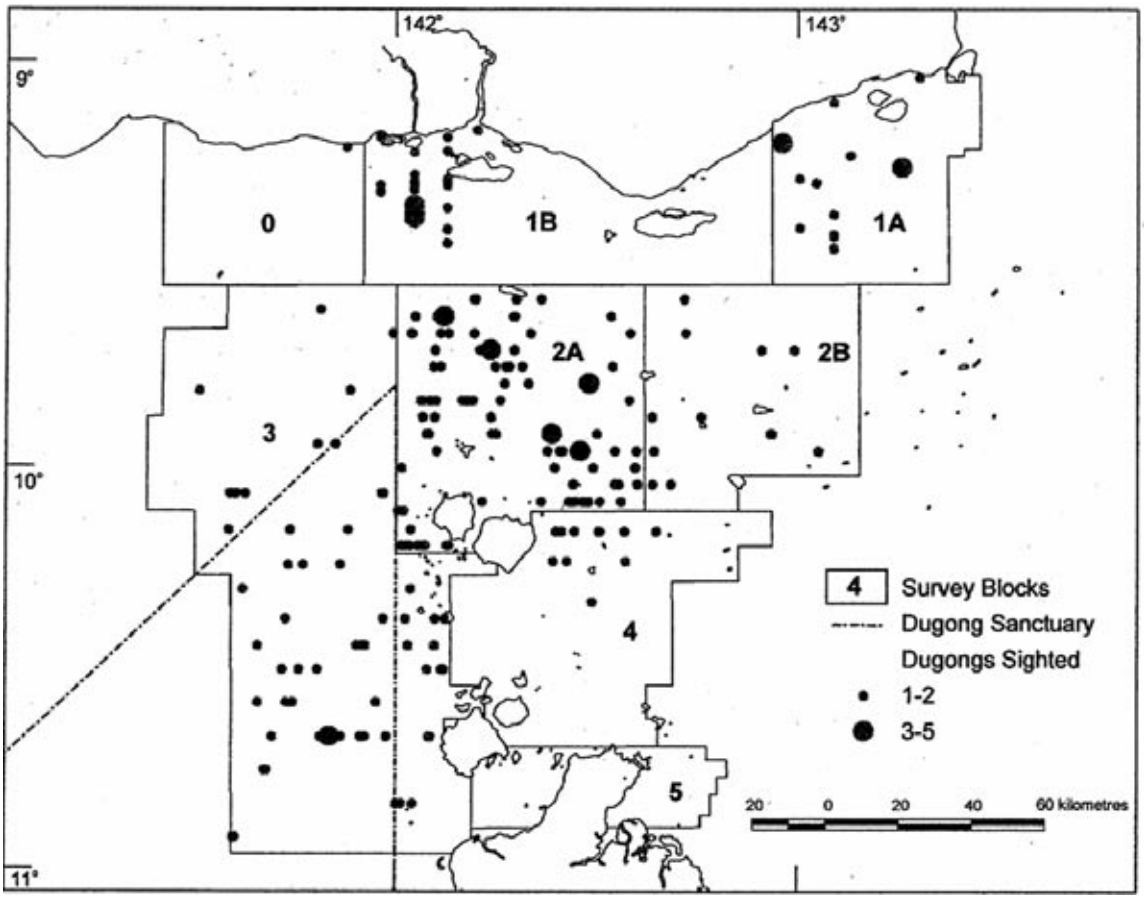


Of the estimated 27 602 (± 3110) dugongs in the GoC, only 15% occurred in the waters of the Queensland coast, reflecting the much greater area of seagrass along the NT coast. Poiner et al. (1987) estimate the area of seagrass along the NT coast of the GoC at 751 km² compared with just 155 km² (17%) for the Queensland coast[1].

Torres Strait has been identified as probably the most important dugong habitat in the world (Marsh et al. 2003) and the Torres Strait dugong population is globally significant. Torres Strait is the most intensively surveyed dugong habitat within the NPA, with four broad-scale surveys of the area between 1987 and 2001. Table 10.1 gives population estimates for the Torres Strait based on these surveys, with population estimates ranging between 13 000 and 27 000 during the 14-year period. Figure 10.5 shows the distribution of dugong sightings from the November 2001 survey of Torres Strait.

[1]For further information on seagrasses in the Northern Planning Area see chapter 2 (Seagrasses).

Figure 10.5: *Distribution of dugong sightings in the Torres Strait from the November 2001 survey (from Marsh et al. 2003).*



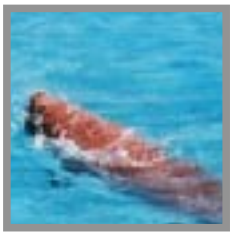
There were significant differences in the four population estimates obtained for the Torres Strait over the past 14 years (Marsh et al. 2003 & in press). Marsh and her group propose that these differences are due to large-scale movements of dugong in and out of the Torres Strait area. Anecdotal evidence supporting large-scale movements is available (Marsh et al. 2003 & in press) and supports the hypothesis that variation in population estimates is due to large-scale movements associated with seagrass dieback in the Torres Strait region.

Within Torres Strait, Block 2A (Figure 10.5) (Orman Reefs region) had the highest dugong population in the 1987, 1991 and 1996 surveys of the Torres Strait (between 36 and 48% of total population) and second highest estimate in 2001 (25%). The second ranked area in Torres Strait is the western region (Block 3, Marsh et al. 2003) with between 21 and 39% of the total population across the four surveys. In 2001, when the Orman Reef area ranked second in population estimate the western region ranked highest and in the years when Orman Reef area ranked highest the western area ranked second.

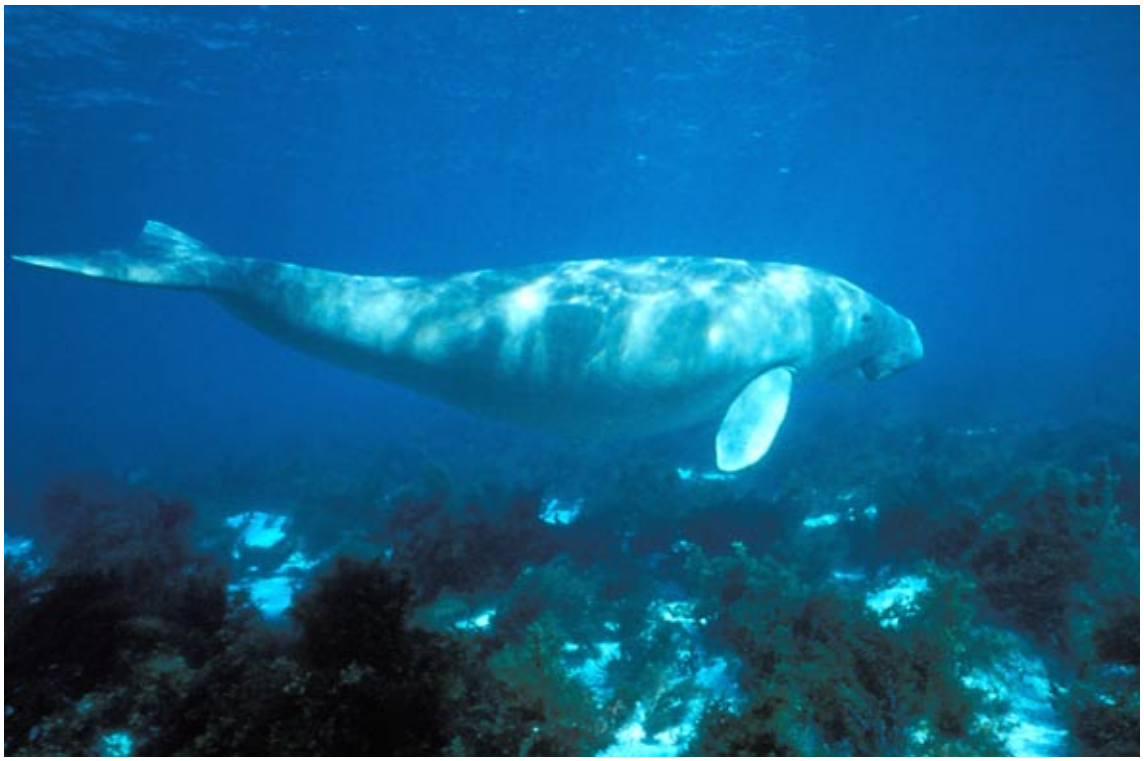
Significance of the species group in the Northern Planning Area

The dugong has significant cultural and dietary value for many Indigenous peoples in the NPA and for many coastal peoples is the most highly valued food. This significance stems from the high status of dugong hunting and hunters in their communities, the essential role of dugong in Aboriginal traditional culture and religion, the quality of dugong meat and the medicinal value of dugong oil.

Dugongs occur all along the NT coast of the NPA in reasonable numbers and are hunted by almost all coastal Aboriginal communities along this coastline. Along the Queensland coast of the NPA, Aboriginal hunting is of greatest significance in the Wellesley Islands area and the Torres Strait region, which includes the Papua New Guinea and Northern Peninsula area. Hunting is less important along the western coast of Cape York Peninsula although dugongs will be hunted when available (see below).



Dugong off the east coast of Australia **Source:** *Great Barrier Reef Marine Park Authority*



Seagrass beds have been mapped in Torres Strait and the Queensland coast of the GoC including the Wellesley Island Group, the mouth of the Limmen Bight River to and including the Sir Edward Pellew Group of islands and Blue Mud Bay. However, many of these maps are dated and as seagrass communities tend to be dynamic, may be of limited value for marine planning.

Impacts/threats

Habitat loss and degradation

Habitat loss has been identified as a potential source of localised declines in dugong populations (Thorogood et al. 1990, Johannes & MacFarlane 1991, Preen et al. 1993, Preen & Marsh 1995). Natural events such as cyclones and floods can cause extensive damage to seagrass communities through severe wave action, shifting sand, adverse salinity changes and light reduction (Heinsohn & Spain 1974, Kenyon & Poiner 1987, Thorogood et al. 1990, Preen et al. 1993).

The only confirmed record of habitat loss or degradation along the NT coast of the NPA is in the area of the mouth of the Limmen Bight River to and including the Sir Edward Pellew Group of islands. The seagrass beds of this area were severely damaged by Cyclone Sandy in 1985 (Thorogood et al. 1990). Anecdotal reports (Felicity Chapman pers. comm., Steve Johnson pers. comm.) suggest that extensive damage to seagrass beds in the Sir Edward Pellew area also occurred in 1996 associated with Tropical Cyclones Jacob and Ethel. Dugong hunters from the area have reported that dugong numbers in the area declined following these cyclones.

Given the lack of coastal development along the NT coast of the NPA it is unlikely that anthropogenic inputs into the area will occur or have any impact on important dugong habitat, except around ports. For example, an ore spillage at the McArthur River Mine harbour facility could result in heavy metal pollution of dugong habitat in the Limmen Bight/Sir Edward Pellew Group region. This possibility is of great concern to local Aboriginal people.

Limited coastal development along the Queensland coast of the NPA is also expected to result in little or no anthropogenic impact on dugong habitat, except in the immediate region of ports such as Karumba and Weipa. Loss of seagrass in the Karumba area (Marsh et al. 2002) could affect the ability of dugongs to move between feeding grounds in the south-east GoC.

Anthropogenic impacts on dugong habitat in the Torres Strait area are also expected to be slight (Marsh et al. 2002) unless changes in landuse, such as forestry and mining along the southern Papua coast, affect seagrass

beds through terrestrial runoff (Marsh et al. 2002). Marsh et al. (2002) identified possible outcomes from a re-evaluation of the Mining Moratorium for Torres Strait as a potential threat to both dugong habitat and populations. If the moratorium is not renewed and mining and hydrocarbon exploration and production are allowed, the management of any exploration and production activities must take into account possible direct and indirect impacts on dugongs and their habitats. Marsh et al. (2002) notes that there has been little relevant research on the acoustic impacts of mining exploration on dugongs in shallow tropical waters. The likely extent of such impacts is unknown but they are of great concern to Islanders. These activities can also occur in other waters of the NPA where dugongs are found, though there has been little activity to date.

Habitat loss or degradation associated with catastrophic events such as cyclones or 'big' wet seasons, resulting in the loss of seagrass beds through increased siltation, mechanical damage and freshwater influx, is likely to be a greater threat, and is not amenable to management intervention. Such losses have been implicated in the large-scale movement of dugong populations (Preen et al. 1993 & 1995, Preen & Marsh 1995, Marsh et al. 2003 & in press). Seagrass dieback in the Torres Strait region is considered to be the major contributor to variation in estimates of dugong abundance in the region over the period 1987 to 2001 (and earlier) due to emigration and immigration associated with seagrass dieback and recovery. Differentiation of these movement effects on population abundance from changes in population size *per se* and other anthropogenic effects is difficult at best and, without detailed information on the other sources of anthropogenic impact (see below), probably impossible. The Population Viability Analysis of Heinsohn et al. (in press) demonstrates that, when harvesting is high in some areas, mobility of dugongs between populations increases the probability of quasi-extinction for the meta-population.

Trawling on seagrass beds has proven to be damaging and as a consequence the Northern Prawn Fishery has closed specific areas to trawling, to protect seagrass beds because of their importance as prawn nursery areas (Marsh et al. 2002).

Incidental Catch

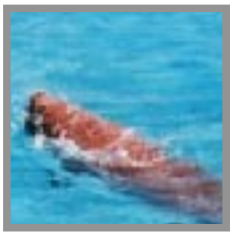
Entanglement in large mesh (150 mm and greater) fishing nets is a documented source of dugong mortality. However, the data necessary to determine the magnitude of the impact of incidental catch on dugong populations in NT and Queensland waters of the GoC and the Torres Strait are not available and are likely to be very difficult (or impossible) to collect as the catch rates are likely to be sporadic, and making observers compulsory is a logistical and financial challenge in remote areas in this fishery.

Fishing activities which could potentially affect dugong populations are commercial barramundi fishing using set nets, inshore shark fishing using pelagic nets, bait fishing using nets to catch bait for mud-crabbing and staked coastal nets used by coastal net fishery.

No data exist concerning the impact of commercial net fisheries along the north Arnhem Land coast of the NPA. Very limited data on the impact of commercial net fisheries along the NT GoC coast of the NPA is available. Coates (2002) reported for the Borroloola region that, during the course of a 15-month study, a minimum of 40 dugongs died as a result of non-Indigenous mortality. This represented some 42% of the total mortality reported for the region (Coates 2002). Of this minimum, some 15% (six animals) could be directly attributable to commercial barramundi fishing; this proportion is likely to be underestimated (Coates 2002).

An inshore commercial finfish fishery occurs along all tidal waters in the GoC and adjoining waterways between the 25 nautical mile line and the shore (Marsh et al. 2002). Marsh et al. (2002) reports: 'anecdotal evidence suggests that incidental captures were not uncommon in the late 1970s and early 1980s when the number of meshnetters operating along the Queensland coast of the GoC (R Garrett pers. comm. 1998), and the fishing effort (Magro et al. 1996) were much higher than today'. Several initiatives have been introduced which have the potential to reduce the bycatch of dugongs in this fishery (*Fisheries (Gulf of Carpentaria Inshore Finfish) Management Plan 1999*):

- the barramundi mesh net fishery is closed between early October and the end of January
- several spatial closures to netting have been introduced
- changes to net fishing regulations in the Wellesley Island Protected Wildlife Area, the most important dugong area along the Queensland Gulf Coast
- the ban on setting nets across waterways or channels within 100 m of another net
- the encouragement of commercial fishers to undergo an Endangered Species Awareness Course as part of their code of conduct



Pingers/acoustic alarms are being trialled as deterrents to marine mammals in the gill net fishery. However, this initiative is unlikely to have a significant effect on dugong mortality. The behaviour of wild dugongs was not altered by similar alarms in experimental trials (Amanda Hodgson pers. comm. 2003).

In 2002, there were reports of dugongs being caught in the GoC in gill nets in areas where they have not been seen for many years (B Kehoe pers. comm. 2002). It is likely that dugongs had moved into these areas as a result of seagrass dieback in Torres Strait. The movement of dugongs to new areas as a result of dieback events means that dugong management must have the flexibility and coordination to respond in a timely manner. This is very difficult in remote areas.

The impacts of commercial net fisheries on dugong populations in the Torres Strait are considered to be low except along the Papua New Guinea coast. However, there is anecdotal evidence of dugong mortality due to Indonesian and Taiwanese vessels operating illegally in the region (Marsh et al. 2002) and reports of incidental or deliberate catches of dugongs in nets in waters in the Papua New Guinea sector of the Protected Zone and Boigu and Saibai Islands (Marsh et al. 2002).

Although the extent of the threat posed by commercial net fisheries to dugong populations along the coast of the NPA is unquantified, sufficient information is available to identify it as a threat that needs to be addressed in a coordinated manner by management across the region. It is a very important issue for traditional owners in the region and should be formally addressed in traditional use marine resource agreements.

Indigenous use and hunting

Few data exist on the extent of traditional hunting in the NPA outside Torres Strait. Bertram and Bertram (1973) reported that an average of 62 dugongs were harvested per year at Numbulwar during the 1960s. Bayliss and Freeland (1989) reported that this had reduced to approximately 10 per year in the 1980s. Local hunters attributed the decrease to a decline in dugong abundance. However, no data were available to determine whether this perceived decline was due to an actual decline, change in dugong behaviour, change in hunting effort, or a combination of all of these. Catches of between eight and 16 dugongs per year between 1980 and 1993 have been reported for Borroloola (Marsh et al. 1994). Coates (2002) has reported an annual harvest of 45 dugongs per year for the Borroloola region (the Limmen River to Weayran River including the Sir Edward Pellew Islands group), representing in excess of 50% of the reported mortality for the region Coates (2002). Bradley (1997) has reported a gradual decline in dugong hunting in the region, particularly from pre-1960 (Coates 2002).

Extrapolation of available information results in an estimate of an Indigenous harvest of 190 dugongs per year for the NT coast of the NPA (derived Henry & Lyle 2003). However, there is no measure of uncertainty associated with this estimate. As it is based on a low sampling effort in a survey that was not designed to estimate the extent of the dugong harvest, its reliability is uncertain. Nonetheless, the entire NT coast of the NPA appears to be significant in relation to Indigenous hunting.

Marsh et al. (2002) provides Indigenous harvest levels of dugongs in the Wellesley Islands area (21–50 and 51–100 dugong per annum) and at Mornington Island (40 dugong per annum) for the mid to late 1970s. No data on current Indigenous harvest levels for this area are available (Marsh et al. 2002) as the data in Henry and Lyle (2003) are aggregated at a state level. However, within the Queensland coast area of the NPA, the Wellesley Islands region appears to be particularly significant in relation to Indigenous hunting.

The Indigenous harvest of dugongs along the western coast of Cape York Peninsula is generally lower than in the remainder of the NPA, presumably reflecting the relatively low dugong abundance (Marsh et al. 2002; Figure 10.4). However, opportunistic hunting occurs when dugongs are sighted. For example, in early 2002 there were numerous reports of herds of dugongs in unusual locations including off Weipa in the GoC (Michael Rasheed, QDPI, pers. comm. 2002), and reports of 30–60 dugongs killed off Weipa, particularly by residents of the Naparum community (David Donald & Ian Little pers. comm. 2002).

Within the Torres Strait region the Indigenous dugong harvest is a legal fishery as explained above. The sustainability of this fishery has been of concern since the early 1980s (Marsh et al. 1997, 2002, Marsh et al. 2003 & in press, Heinsohn et al. in press). Marsh et al. (2003) compiled Indigenous harvest data for Torres Strait covering the period 1973 to 2001, with coverage ranging from individual islands to most of the Torres Strait (see Marsh et al. 2003 for sources). These data indicate an Indigenous harvest over the entire Torres Strait approaching or exceeding 1000 animals per annum. This estimate does not include the Northern Peninsula area or the Papua New Guinea coast.

Modelling using both the Potential Biological Removal method (Marsh et al. 2003 & in press) and Population Viability Analysis (Heinsohn et al. in press) suggest that the present harvest is an order of magnitude too high. The region can probably sustain a sustainable harvest of about 100 dugongs per year, a number exceeded by the Mabuiag community alone in 1997 and 1998 (Kwan 2002).

In our opinion, supporting the Indigenous communities of the Torres Strait region to manage their harvest sustainably (including the Northern Peninsula Area and the Papuan coast) is the most urgent management action required for dugongs in the NPA.

Other threats/impacts

Several other threats to dugong populations have been identified (see Marsh et al. 2002 for details). These include mortality associated with boat strikes, illegal harvest and natural causes such as disease, and mortality associated with catastrophic events such as cyclones and 'big' wet seasons.

Coates (2002) reported that traditional owners from the Borroloola region were particularly concerned about the impacts of these 'other threats' on the dugong population and habitat in the region. Of particular concern was the perceived impact of increased boat traffic leading to significant changes in dugong behaviour and distribution, through the fragmentation of herds and restriction of their use of inshore seagrass beds. Increased boat traffic was also associated with direct mortality due to boat strike and damage to seagrass beds (Coates 2002). Experimental work by Amanda Hodgson (pers. comm. 2004) in Moreton Bay near Brisbane indicates that direct mortality from vessel strike is a much greater threat to dugongs than displacement due to vessel activity. However, it is likely that traditional owners will disagree with this assessment.

Stranding events due to tidal surges associated with tropical storms have been reported (Marsh 1989). The extent of mortality associated with these events can be high in a localised area. Marsh (1989) reported the stranding of at least 27 dugongs by a tropical cyclone. Twenty-three animals were returned to the sea in a rescue operation; however, the potential existed for all the animals to have perished due to injuries sustained during the stranding.

All these threats are of great concern to the Indigenous peoples of the area and will need to be addressed as part of an overall dugong management strategy for the region.

Information gaps

There are significant information gaps in the NPA with respect to dugongs and their habitats.

Accurate and up-to-date data on dugong distribution and abundance

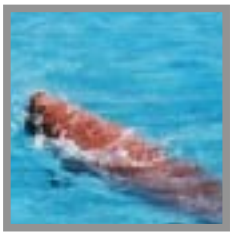
Information on dugong distribution and absolute abundance is required to provide:

- estimates of sustainable levels of anthropogenic mortality from all causes using the Potential Biological Removal Method, which is mandatory to use in similar circumstances in the United States
- a basis of large-scale regional marine planning – the present data are inadequate with respect to: (1) dugong use of potential 'deep-water' seagrass areas of the NT coast; (2) the Limmen Bight/Sir Edward Pellews region where previous surveys have produced anomalous results; (3) a large section of coast between Milingimbi to Blue Mud Bay which has not been surveyed for 19 years
- regional scale trends of dugong abundance over long periods (decades)
- information for Population Viability Analysis of the status of the dugong population in the region – at present, this information is available only for the Torres Strait region (Heinsohn et al. in press).

Aerial surveys are the only means of obtaining this information at the required spatial scales. The capacity of regional scale surveys to provide the information will be greatly enhanced if the surveys are coordinated across the NPA because of the propensity of dugongs to undertake large-scale movements in response to habitat loss associated with extreme weather events.

Recommendation 1:

That the National Oceans Office undertake a coordination role to ensure that broad-scale aerial surveys for dugongs in the coastal waters of the entire NPA are conducted in a regular and coordinated fashion. The program must include training for Indigenous observers to enable them to participate effectively in survey teams.



Accurate data on anthropogenic mortality from all causes

Such data are required to compare with estimates of sustainable levels of anthropogenic mortality from all causes obtained from the aerial survey data and Potential Biological Removal Modelling to determine if the present levels of anthropogenic mortality are sustainable. Given the sporadic incidence of dugong catches in most communities, continuous community-based monitoring is likely to be more effective than a sampling program although some scientific validation of monitoring will be important.

Recommendation 2:

That a community-based traditional harvest monitoring program with appropriate scientific validation be developed and implemented for the NPA with high priority. Minimum data to be collected within constraints imposed by Indigenous traditional culture and law: a) number of animals caught; b) date of catch; c) sex of catch; d) details of hunting method, hunting party, hunting location and hunting effort. The area of highest priority is the Torres Strait region including the Northern Peninsula Area and the Papuan coast.

Recommendation 3:

That the National Oceans Office work with the Queensland and NT governments to develop a coordinated incidental protected species catch monitoring program for fisheries in the region. Minimum data to be collected include: a) number, species identification and fate of animals caught; b) date and circumstance of catch. As these data will be very difficult to collect in such a remote area, the program should concentrate on areas of highest risk - localities which: (1) support significant numbers of dugongs and a high mesh-netting effort, (2) where incidental catch is of particular concern to traditional owners, and (3) where anecdotal reports indicate that the probability of incidental capture is high (eg Borroloola region).

Information about the customary laws limiting dugong harvest

Customary Indigenous laws impose restrictions on traditional hunting of dugongs in some regions such as the northern minor bays of Blue Mud Bay during calving (unidentified traditional owners pers. comm.). Such laws have the potential to provide an effective basis for developing contemporary controls of dugong harvest in areas where that harvest is shown to be unsustainable.

Recommendation 4:

That with the cooperation of traditional owners, customary laws regarding dugong harvest be recorded as a basis for the management of dugong harvest in areas where traditional owners and/or the aerial surveys and catch monitoring indicate it is sustainable .

Maps of seagrass, biomass and community structure

Recommendation 5:

That the National Oceans Office coordinate a comprehensive program of seagrass mapping in the NPA with emphasis on: (1) areas which have not previously been mapped; (2) areas identified as critical dugong habitats and which have not been mapped for many years; (3) areas where there is concern about changes in seagrass distribution as a result of extreme weather events or anthropogenic impacts.

The extent and range of dugong movements and habitat use within the NPA

Recommendation 6:

1. Within the constraints of traditional culture and law and if Traditional Owners wish, Indigenous knowledge of dugong habitat use and local movements be recorded and incorporated into planning and management initiatives.
2. A coordinated program of satellite tracking of dugongs be developed with the cooperation of traditional owners.

Key references and current research

Dugong research is being carried out as part of the Co-operative Research Centre (CRC) Torres Strait program. This program commenced in July 2003 and includes the following task relevant to dugong research:

- an information base for a sustainable traditional fishery of green turtles and dugongs in the Northern Peninsula Area and Inner Islands of Torres Strait (Jillian Grayson)

Data locations

Primary 'scientific' data locations for dugong and their habitats within the NPA:

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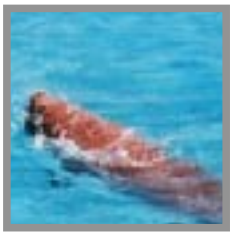

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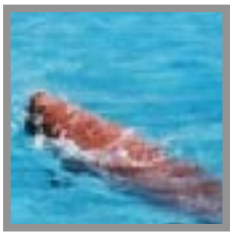

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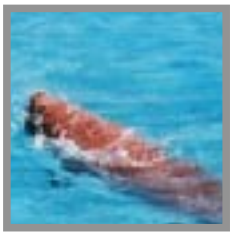

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1 For further information on seagrasses in the Northern Planning Area see chapter 2 (Seagrasses).