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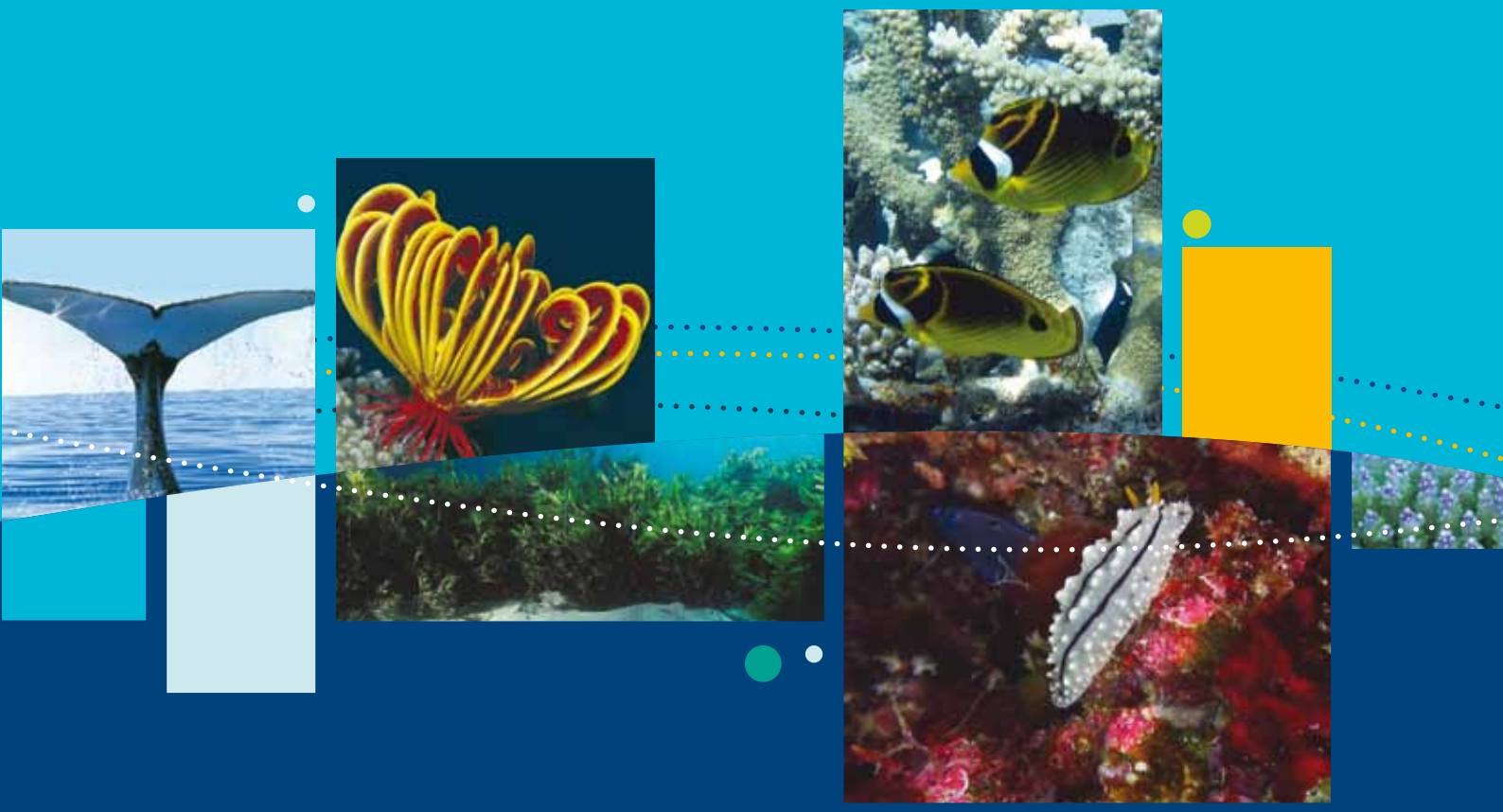

Species group report card – dugongs

Supporting the draft marine bioregional plan for the North-west Marine Region

prepared under the *Environment Protection and Biodiversity Conservation Act 1999*

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SPECIES GROUP REPORT CARD – DUGONGS

Supporting the draft marine bioregional plan for the North-west Marine Region prepared under the *Environment Protection and Biodiversity Conservation Act 1999*

Report cards

The primary objective of the report cards is to provide accessible and up-to-date information on the conservation values found in Commonwealth marine regions. This information is maintained by the Department of Sustainability, Environment, Water, Population and Communities and is available online through the department's website (**www.environment.gov.au**).

Reflecting the categories of conservation values, there are three types of report cards:

- species group report cards
- marine environment report cards
- heritage places report cards.

While the focus of these report cards is the Commonwealth marine environment, in some instances pressures and ecological processes occurring in state waters are referred to where there is connectivity between pressures and ecological processes in state and Commonwealth waters.

Species group report cards

Species group report cards are prepared for large taxonomic groups that include species identified as conservation values in a region; that is, species that are listed under Part 13 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and live in the Commonwealth marine area for all or part of their lifecycle. All listed threatened, migratory and marine species and all cetaceans occurring in Commonwealth waters are protected under the EPBC Act and are identified in the relevant marine bioregional plans as conservation values.

Species group report cards focus on species for which the region is important from a conservation perspective; for example, species of which a significant proportion of the population or an important life stage occurs in the region's waters.

For these species, the report cards:

- outline the conservation status of the species and the current state of knowledge about its ecology in the region
- define biologically important areas; that is, areas where aggregations of individuals of a species display biologically important behaviours
- assess the level of concern in relation to different pressures.

1. Dugong of the North-west Marine Region

The dugong (*Dugong dugon*) is the only living member of the family Dugongidae and is one of only four living species of the order Sirenia. A significant proportion of the world's dugong population occurs in coastal waters from Shark Bay in Western Australia to Moreton Bay in Queensland (Marsh et al. 2011). Current dugong distributions are believed to represent relict populations separated by large areas where they are either extinct or close to extinction.

Some of the coastal waters adjacent to the North-west Marine Region support significant populations of dugongs, including Shark Bay, which has an estimated population of around 10 000 individuals. Dugongs also occur in Exmouth Gulf and offshore on the North West Shelf, in and adjacent to Ningaloo Reef, in coastal waters close to Broome and along the Kimberley coast, and on the edge of the continental shelf at Ashmore Reef (DEWHA 2008).

Dugongs inhabit seagrass meadows in coastal waters, estuarine creeks and streams. They are migratory, which is believed to be related to their search for suitable seagrass beds or warmer waters. Seagrass is the preferred food of dugongs, but they are also known to eat algae and macroinvertebrates. Dugongs can live for more than 70 years, have a low reproduction rate and long generation time. Females reach sexual maturity between 6 and 17 years old, have a gestation period of 13 months and usually give birth to one calf.

The dugong is listed as migratory and marine under section 248 of the EPBC Act.

Biologically important areas

Biologically important areas are areas where aggregations of individuals of a species display biologically important behaviours. Based on available information, biologically important areas have been identified where possible for listed threatened species and for listed marine species where the region is considered to support a significant proportion of the population or an important life history stage. Biologically important areas have been identified for dugongs in the North-west Marine Region.

Biologically important areas are included in the North-west Marine Region Conservation Values Atlas (**www.environment.gov.au/coasts/mbp/north-west/index.html**). Maps of biologically important areas for dugong are provided in Attachment 1.

2. Vulnerabilities and pressures

Vulnerabilities

The population biology of dugongs renders them particularly vulnerable to mortality as adults (Marsh et al. 2011). Unexploited dugong populations are characterised by considerable longevity (a lifespan of more than 70 years), long gestation (12–14 months), litter sizes of one, long intervals between births (more than 2.5 years), prolonged periods until sexual maturity (6–17 years), and high and temporally stable adult survival (Marsh et al. 1984). Adult survival is the most important determinant of population growth. The maximum rate of population increase under optimum conditions when natural mortality is low is approximately 5 per cent per annum. The maximum sustainable mortality rate of adult females killed by human activities is around 1–2 per cent (Heinsohn et al. 2004; Marsh et al. 1997; Marsh et al. 2004); lower in areas where, or at times when, food supplies are low (Marsh & Kwan 2008; Marsh et al. 2002).

As dugongs are dependent on seagrass for food, any loss or degradation of seagrass due to anthropogenic activities (e.g. dredging, port construction, oil pollution), could adversely affect this species. The effect of seagrass loss or dieback on dugongs is twofold. Some dugongs remain in the affected area but lose body condition, reduce breeding and suffer increased mortality, while others move hundreds of kilometres with uncertain consequences (Preen & Marsh 1995; Marsh & Kwan 2008). Some animals that move die (Preen & Marsh 1995); others eventually migrate back to the affected area when it recovers (Marsh et al. 2011). Marsh and Kwan (2008) found that seagrass dieback events significantly decrease dugong reproductive rates.

Assessment of pressures

On the basis of current information, pressures have been assessed for dugongs in the North-west Marine Region. A summary of the pressure assessment for dugongs is provided in Table 1. No pressure *of concern* have been identified for dugong and only those pressures identified as *of concern* or *of potential concern* are discussed in further detail below.
A description of the pressure assessment process, including the definition of substantial impact used in this assessment, is provided in the *Overview of marine bioregional plans* at **www.environment.gov.au/coasts/mbp/index.html**.

Table 1: Assessment of the level of concern associated with the effects of pressures on dugong in the North-west Marine Region

Pressure	Source	Rating
Sea level rise	Climate change	
Changes in sea temperature	Climate change	
Ocean acidification	Climate change	
Chemical pollution/contaminants	Shipping	
	Vessels (other)	
	Urban development	
	Agricultural activities	
	On and offshore mining operations and ore-leading at ports	
Nutrient pollution	Urban development	
	Agricultural activities	
Marine debris	Shipping	
	Vessels (other)	
	Fishing boats	
	Land-based activities	
Noise pollution	Seismic exploration	
	Shipping	
	Vessels	
	Onshore and offshore construction	
	Defence activities	
Physical habitat modification due to port and other coastal developments	Dredging	
	Dredge spoil	
	Land-based activities	

Legend of concern; of potential concern; of less concern; not of concern; data deficient/ not assessed

Table 1 continued: Assessment of the level of concern associated with the effects of pressures on dugong in the North-west Marine Region

Pressure	Source	Rating
Physical habitat modification	Fishing gear	
	Storm events	
Human presence at sensitive sites	Tourism	
	Recreation and charter fishing	
	Research	
Extraction of living resources	Indigenous harvest	
Bycatch	Commercial fishing (domestic)	
Oil pollution	Shipping	
	Vessels (other)	
	Oil rigs	
Collision with vessels	Shipping	
	Tourism	
	Fishing	
Disease	Shipping	
	Fishing vessels	
	Other vessels	
Invasive species	Shipping	
	Fishing vessels	
	Other vessels	

Legend of concern; of potential concern; of less concern; not of concern; data deficient/ not assessed

There is little information on the impacts of many of the pressures on dugongs in the North-west Marine Region, although there is information about impacts of pressures on dugongs elsewhere in Australia. In addition, the cumulative impacts of several pressures acting simultaneously is likely to be considerable but is poorly understood. The pressures identified as *of potential concern* are considered in two groups: pressures associated with habitat loss due to climate change and industrial developments; and pressures associated with human-induced mortality of dugongs.

Pressures associated with habitat loss

Dugong habitat loss is likely to increase in the North-west Marine Region due to the large-scale industrial development occurring in the region and the impacts of climate change. The implications of climate change on seagrass distribution in the region are uncertain but could result in a decline in the extent and/or health of seagrass meadows. Thus pressures associated with both industrial development and climate change (and their cumulative impacts) are *of potential concern* for dugongs in the North-west Marine Region because they are likely to lead to the loss of dugong habitat and, consequently, population decline. Local seagrass loss can be very important for two reasons: there is some evidence that dugongs are faithful to specific areas learned from their mothers and are slow to recolonise other areas (Marsh et al. 2011), and the distribution of the dugong is typically fragmented. There is anecdotal evidence that some local areas may be staging posts between key habitats.

Loss of dugong habitat associated with climate change

Sea level rise

Sea level has been rising at approximately 7.1 millimetres per year in the North-west Marine Region since the 1990s, the largest increase in Australia (National Tidal Centre 2010). Global sea levels have risen by 20 cm between 1870 and 2004 and predictions estimate a further rise of 5–15 cm by 2030, relative to 1990 levels (Church et al. 2009). Longer term predictions estimate increases of 0.5 m to 1.0 m by 2100, relative to 2000 levels (Climate Commission 2011). The main concern with sea level rise is the potential consequences when sea level rise is combined with increasing cyclone frequency (Climate Commission 2011; DCC 2009). Predictions for the North-west Marine Region in 2100 are for a hundred-fold increase in extreme sea level events in the Pilbara and up to a thousand-fold increase in the Kimberley (DCC 2009).

The likelihood of seagrass impacts due to climate change–induced sea level rise is linked to the location-specific interaction between climate, geomorphology and hydrology. The meso-tidal Pilbara Region may be more vulnerable to this pressure than the macro-tidal Kimberley (Semeniuk 1994; Woodroffe 1995), but this hypothesis remains untested. The resultant decrease in available light for seagrass meadows may lead to a reduction in growth and productivity of seagrass and the loss of seagrass in deeper waters. Sea level rise is also likely to lead to erosion of coastlines, which will increase the turbidity of coastal waters and affect survival of seagrasses. Although it is possible that new seagrass habitats may develop as low-lying coastal areas become intertidal, the overall effect of sea level rise on dugong habitats in the North-west Marine Region is uncertain and thus *of potential concern*.

Changes in sea temperature

The likely increase in sea temperature associated with climate change is *of potential concern* for dugongs in the North-west Marine Region. Waycott et al. (2007) argue that elevated temperature will result in the greatest climate change impact on seagrasses, particularly in shallow habitats. Sea temperatures have warmed by 0.7 ºC between 1910–1929 and 1989–2008, and current projections estimate ocean temperatures will be 1 ºC warmer by 2030 (Lough 2009). Campbell et al. (2006) conducted temperature experiments on tropical seagrass species, including species eaten by dugongs, and demonstrated that the photosynthetic condition of all seagrass species tested was likely to suffer irreparable effects from short-term or episodic changes in seawater temperature (with temperatures reaching 40–45 ºC). These acute stress responses of seagrasses to elevated seawater temperature are consistent with observed reductions in above-ground biomass during a recent El Niño event. In the Gulf of Carpentaria in 2002 seagrass loss and subsequent reports of 'water fat' (starving) dugongs were associated with elevated seawater temperature, although data are lacking to prove a causal link between these phenomena (Kwan & Bell 2003).

Physical habitat modification—storm events

The likely increase in the intensity of storm events associated with climate change is *of potential concern* for dugongs and their habitats in the North-west Marine Region. Modelling predicts that climate change will result in increased intensity of storms and storm surges (Connolly 2009; Hyder Consulting 2008). Present indications are that modest to moderate increases (0–20 per cent) in average and maximum cyclone intensities are expected by the end of the century in some regions (Walsh & Ryan 2000). Evidence from various parts of northern Australia outside the North-west Marine Region points to episodic losses of hundreds of square kilometres of seagrass associated with extreme weather events such as cyclones and floods (Poiner & Peterkin 1996; Preen & Marsh 1995; Preen et al. 1995). Light availability for seagrass is typically significantly reduced after extreme weather events and deposited sediments can physically smother seagrass surfaces (Cabaço et al. 2008). In addition, storm surges can lead to dugongs being stranded above the high tide level (Marsh 1989).

Loss of dugong habitat associated with industrial development

Physical habitat modification—dredging

The huge expansion in the offshore oil and gas and land-based mining industries in the North-west Marine Region and associated port and coastal development have the potential to impact dugong habitats because dredging and related activities, including spoil dumping, may degrade seagrass beds due to smothering and lack of light. There is little evidence of current substantial impact in the region but there is an established link between smothering, absence of light and seagrass decline (Cabaço et al. 2008).

Oil pollution—oil rigs

Australia has a strong system for regulating industry activity that is the potential source of oil spills and this system is being strengthened further in response to the Montara oil spill. While oil spills are unpredictable events and their likelihood is low based on past experience, their consequences, especially for threatened species at important areas, could be severe. The coincidence of dugong habitats and extensive oil and gas exploration and production in the North-west Marine Region has the potential to adversely affect dugongs should a spill occur. Oil pollution may result in seagrass loss, although there is little evidence of a substantial impact on dugongs or their seagrass habitats from oil pollution from within the North-west Marine Region as yet. In addition, the dramatic effects of oil spills on seagrasses may not persist for long periods (Kenworthy et al. 1993).

Invasive species

Asian bag or date mussel (*Musculista senhousia*) is a medium priority marine pest; that is, it has a reasonably high impact and/or invasion potential (Hayes et al. 2005). A review by Aquenal (2008) suggests that the potential for this species to become established in the North-west Marine Region is high. *Musculista* is transported in ballast water and as biofouling on vessel hulls. It tolerates low salinity and a wide range of temperatures and is present in parts of temperate southern Australia. It is present in the Leeuwin–Naturaliste coast of south-west Western Australia, including in Fremantle Harbour. *Musculista* invasion in the northern hemisphere has been linked with fragmentation of seagrass beds (Aquenal 2008). Shipping between the ports of Freemantle, north-western Australia and Asia is likely to increase in the future, thus increasing the potential for the mussel to be introduced into the North-west Marine Region (DEWHA 2008). There are reasonable grounds to predict that, if the pest is introduced, it has the potential to impact on seagrass habitats on which dugongs depend.

Pressures associated with human-induced mortality of dugongs

Because of their life history characteristics and vulnerabilities, pressures that cause dugong mortality are *of potential concern* if such pressures occur over a wide geographic area, even if the magnitude of the pressures is uncertain.

Marine debris

Debris harmful to marine wildlife includes plastics washed or blown from land into the sea, fishing gear abandoned by recreational and commercial fishers (ghost nets), and solid non-biodegradable floating materials (such as plastics) disposed of by ships at sea. The North-west Marine Region has increasing population, increasing shipping activity, fishing activities (commercial; recreational; traditional Indonesian; and illegal, unregulated and

unreported) and currents that bring debris from the populous Indonesian archipelago. All these factors increase the potential for marine debris to enter the region. Large amounts of fishing net are discarded or lost from the fisheries of the Arafura Sea (Limpus 2009). The amounts, characteristics and impacts of debris disposed of or lost overboard in the Arafura Sea are largely unknown (Kiessling 2003) and it is not known what proportion of such debris enters the North-west Marine Region. The established depositor beaches are mainly in the Northern Territory and the Gulf of Carpentaria coast, Queensland. This pressure is *of potential concern* because it is likely to cause injury or death to individual dugongs and there is inconclusive evidence about the adequacy of management measures to minimise the impact of marine debris on dugongs.

Extraction of living resources—Indigenous harvest

Indigenous communities and individuals with a native title right (determined or common law) to hunt dugongs may do so for their personal, domestic or non-commercial communal needs without a permit or licence. Indigenous harvest occurs in many communities adjacent to the North-west Marine Region. However, the level of harvest, and thus its sustainability, is unknown. Any impact is likely to be spatially variable. Dugongs are vulnerable to this pressure despite the recent investment in community ranger groups that are assuming responsibility for hunting management, and the Dugong and Marine Turtle Project coordinated by the North Australian Indigenous Land and Sea Management Alliance (NAILSMA 2010).

Oil pollution—oil rigs

Australia has a strong system for regulating industry activity that is the potential source of oil spills and this system is being strengthened further in response to the Montara oil spill. While oil spills are unpredictable events and their likelihood is low based on past experience, their consequences, especially for threatened species at important areas, could be severe. In the North-west Marine Region, large dugong populations coincide with oil and gas exploration and production activities. Oil pollution arising from these activities has the potential to result in dugong mortality. About 150 dugongs were estimated to have died in the Arabian Gulf during the Nowruz oil spill in 1983–1984 when more than one million barrels of oil flowed from seven wells damaged during the Iran–Iraq war (Preen et al. in press). There is little evidence of a substantial impact on dugongs in the North-west Marine Region to date. However, the species is vulnerable to oil pollution, the industry is expanding and there is potential for accidents to occur in areas used by dugong.

Collisions with vessels

The North-west Marine Region is experiencing significant growth in shipping and vessel traffic associated with increases in industrial development due to the resources boom. As a result, an increase in the human population with one of the highest levels of boat ownership per capita in Australia is occurring (Marsh et al. 2002). The Region and adjacent waters has a high level of shore-based tourist boat activity, including in the vicinity of seagrass beds in Ningaloo Marine Park, Shark Bay and Exmouth Gulf. All these changes have the potential to increase the risk to dugong of vessel strikes. Dugongs are killed accidentally when struck by boats and propellers when feeding in shallow inshore waters, particularly in areas where fast boats are used (Marsh et al. 2002). The relative contribution of vessels of different types to dugong mortality is not known and is likely to be area specific. The greatest danger appears to be in narrow channels used by boats and dugongs at low tide (Groom et al. 2004). Dugongs can become habituated to boat traffic, especially traffic concentrated around large seagrass meadows on which they feed. They have been known to continue to use an area even if they are continually disturbed by vessel traffic. There are anecdotal reports of dugongs being killed by vessel strike in the North-west Marine Region but evidence of impacts in the region is limited. The pressure is *of potential concern* because the dugong is vulnerable to the pressure, the pressure is increasing, and there is inadequate evidence of the effectiveness of management measures.

3. Current protection measures

Australia is a signatory to several international agreements to protect dugongs. Dugongs are protected as a migratory and marine species under the EPBC Act and as a protected species under Western Australian legislation.

Alongside the EPBC Act, a broad range of sector-specific management measures to address environmental issues and mitigate impacts apply to activities that take place in Commonwealth marine areas. These measures give effect to regulatory and administrative requirements under Commonwealth and state legislation for activities such as commercial and recreational fishing, oil and gas exploration and production, ports activities and maritime transport. In some instances, as in the case of shipping, these measures also fulfil Australia's obligations under a number of international conventions for the protection of the marine environment from pollution and environmental harm.

In particular, to protect dugongs Australia has implemented a number of measures including spatial and seasonal commercial fisheries closures (aimed at reducing the bycatch of dugongs in gill nets and the physical damage of trawling on seagrass beds), and Indigenous management strategies for the protection of dugong habitat and populations. Evidence of the effectiveness of these management measures however, has not been documented.

International agreements

- Convention on International Trade in Endangered Species (CITES)—**www.cites.org**
- The Bonn Convention: Conservation of Migratory Species (CMS)—**www.cms.int**
- CMS Memorandum of Understanding on the Conservation and Management of Dugongs and their Habitats throughout their Range—**www.cms.int/species/dugong/index.htm**.

For more information on conservation listings under the EPBC Act and related management objectives and protection measures, visit the following sites:

www.environment.gov.au/epbc/protect/migratory.html (listed migratory species)
www.environment.gov.au/coasts/species/marine-species-list.html.

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Attachment 1: Biologically important areas for dugongs in and adjacent to the North-west Marine Region