Occurrence and Conservation of the Dugong (Sirenia: Dugongidae) in New South Wales

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Recent sightings of dugongs well beyond the southern limit of their accepted range (~27°S) on the Australian east coast prompted a review of past records of dugongs and their current conservation status in New South Wales. While archaeological analyses have identified bones of *Dugong dugon* in Aboriginal middens at Botany Bay (~34°S) and colonial records indicate stranded animals as far south as Tathra (~36.5°S), there were no verified sightings of live individuals in NSW waters for some years; however, five separate sightings of individuals and pairs were documented in the austral summer of 2002/03 in estuaries on the NSW central coast (~32-33.5°S). It is suggested that conditions such as warm sea temperatures and low rainfall (promoting seagrass growth) may be facilitating explorative ranging south by dugongs.

The IUCN lists dugongs as 'vulnerable' at a global scale and they are also classified 'vulnerable' under the Threatened Species Conservation Act NSW 1995, yet they are not routinely considered in risk assessments for inshore development in this State. Threatening processes such as shark meshing persist. The importance of considering dugongs in future impact assessments for inshore marine and estuarine developments is emphasized.

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INTRODUCTION

The dugong (*Dugong dugon*), along with all other extant Sirenians, is regarded as a shallow water, tropical and sub-tropical species (Martin and Reeves 2002; Rice 1998). Dugongs are thought to be strictly marine, inhabiting the coasts of some 37 countries and territories (Marsh et al. 2002). Despite their widespread distribution, dugong numbers have declined in most of their known range and they are believed to be represented by fragmented, relic populations in most countries. Likely causes for this decline and continuing threats include: large-scale destruction of seagrass as a result of sedimentation, dredging, mining, trawling, and pollution; incidental take as by-catch in commercial and recreational gill and mesh nets as well as shark nets set for bather protection; direct takes from indigenous hunting, and vessel strikes and disturbance (Marsh et al. 1999, 2002; Hodgson 2003).

Australian waters are the dugong's stronghold, where their distribution is described as extending from Shark Bay in Western Australia (25°S) around northern Australia to Moreton Bay in southern Queensland (27°S) (Marsh et al. 2002). Dugongs are a 'listed marine species' under the Australian *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act). The EPBC Act reflects Australia's commitments under various international conventions including the *Bonn Convention on the Conservation of Migratory Species of Wild Animals*, which lists the dugong on Appendix 2. Dugongs are also considered 'vulnerable' under the *Threatened Species Conservation Act* NSW 1995 and under the *Nature Conservation Act* Qld 1992.

Evidence of a decline in dugong numbers along the urban coast of Queensland (Marsh et al. 2001) led to the establishment of a series of dugong protection areas in some key dugong habitats in Queensland (Marsh et al. 1999; Marsh 2000). No similar protection has been afforded dugongs in NSW, presumably on the assumption that only vagrants of the species range into NSW waters. Dugongs have been considered in some impact assessments for aquaculture developments in NSW (e.g. Anon. 2001a), but not others (e.g. Anon. 2001b). These assessments occurred in the same location, suggesting consideration of dugongs and potential impacts thereon is inconsistent in NSW.

In this paper, we highlight past and present evidence that the dugong's range on the east coast of Australia extends into NSW waters, including estuaries, when environmental conditions are suitable. Given their conservation status under both international conventions and national acts, we suggest that occasional visitation warrants adherence to the legal obligation of considering dugongs and their preferred habitats in future impact assessments.

EARLY RECORDS TO RECENT SIGHTINGS

Dugong bones have been found associated with edge-ground hatchet heads in Aboriginal middens near Sydney, indicating that at least small numbers of dugongs have utilized NSW waters for many centuries (Etheridge et al. 1896). In 1799 Flinders described the catching of dugongs by Aborigines in Moreton Bay, southeast Queensland (Mackaness 1979). Aborigines in NSW also caught dugongs in more recent times, with bones having been found in middens as far south as Botany Bay in the late 18th Century (Troughton 1928).

There are currently two sources of dugong sightings in NSW: the Atlas of NSW Wildlife and records of by-catch from shark meshing supervised by NSW Fisheries. The Atlas of NSW Wildlife yields 83 reports of live, stranded and dead animals for the period 1788 to 2003 (Anon. 2003b; Fig. 1).

A significant portion of these reports (63) occurred in late 1992 and throughout 1993. This influx of animals occurred after the loss of 1,000 km^2 of seagrass from Hervey Bay in southeast Queensland following floods (Preen and Marsh 1995). Two dugongs were caught in NSW shark meshing during this time (Swansea in November 1992 and January 1993). Three earlier captures were also made in shark nets (Bronte in July 1951, Bondi in July 1951, Queenscliff in April 1971) (Krogh and Reid 1996).

Only two records of dead and stranded individuals have been reported to the NSW National

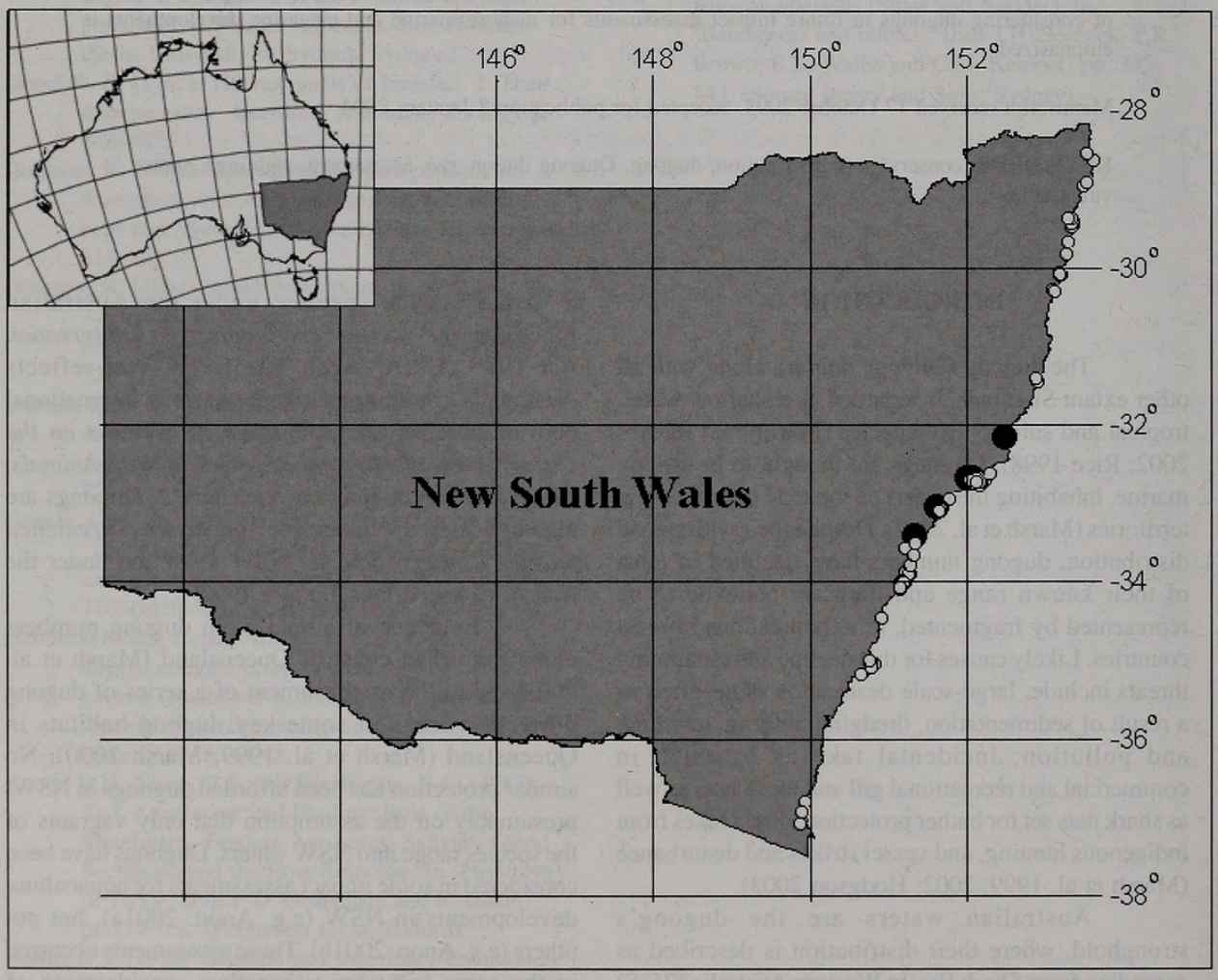

Figure 1. Past records of dugongs on the NSW coast from 1788 to 2003 (open circles; Anon. 2003b) and dugong sightings in central NSW estuaries during summer 2002/03 (filled circles).

Estuary	Date	Lat./Long.	Description	Source
Wallis Lake	Late Oct. 2002	32°11.0′ 152°30.2′	Kayak tour operator reports dugong/s over seagrass beds within Wallis Lake	S. Smith, pers. comm.
Port Stephens	10th Jan. 2003	32°42.8′ 152°06.7′	Dolphin watch operators report two adult dugongs near Manton Bank	D. Aldritch, pers. comm.
Lake Macquarie	24th Jan. 2003	33°20.5′ 150°29.8′	Recreational fishers report cow-calf pair travelling seaward out Swansea Channel	B. Roche, pers. comm.
Port Stephens	1st Feb. 2003	32°41.8′ 152°03.2′	Dolphin watch operator report dugong/s in upper estuary west of Soldiers Point	D. Aldritch, pers. comm.
Brisbane Water	3rd Feb. 2003	33°30.1′ 152°20.3′	Resident reports dugong/s off Orange Grove beach	Anon. 2003b

Table 1. Dugong sightings in central NSW estuaries in the austral summer of 2002/2003.

Parks and Wildlife Service (NPWS) in the last decade, with no live sightings occurring until late 2002/03. Between late October 2002 and early February 2003, five separate sightings of individuals and pairs within (or swimming out of) central coastal estuaries were reported to NPWS and/or the authors (Table 1; Fig. 1). These occurred along a c. 200km stretch of coastline and we do not know if these sightings include repeat sightings of the same individual(s).

SEAGRASS DISTRIBUTION AND WATER TEMPERATURES

All the estuaries in which dugongs were sighted are known to support seagrass meadows (Table 2). Dugongs have been recorded eating the seagrasses listed in Table 2, with the exception of *Ruppia* spp. (Anderson 1986, Marsh et al. 1982, Lanyon et al. 1989). Species of the genus *Halophila* are preferred. The distribution of dugongs has been reported as being constrained to water temperatures >~18°C (Anderson 1986, 1994; Marsh et al. 1994; Preen et al. 1997). However, the water temperatures at the sites in Table 2 were above this thermal threshold in summer 2002/03.

DISCUSSION

The low abundance of dugongs in NSW waters may be the result of a number of factors including limited availability of seagrass in the region, relatively low water temperatures during winter months and in open coastal waters between estuary and bay habitats, and/or human pressures. The entire NSW coast supports only 155 km^2 of seagrass (West et al. 1989), the major portion of which would be *Posidonia australis* and species of the Zosteraceae family, which are not favoured by dugongs. In relative terms, the amount of seagrass in NSW is much less than the total area of seagrass in Moreton Bay alone (250 km^2: Abal et al. 1998) and would contain correspondingly small cover of *Halophila* spp. Troughton (1928) interpreted historical records as suggesting that dugongs may have occurred in greater numbers in NSW prior to European settlement. It has also been suggested (MacMillan 1955) that dugong populations on the tropical east coast were again beginning to expand into the northern rivers region of NSW. Any expansion of the dugong's range into NSW waters further south than this region may have been inhibited by the loss of seagrass beds in areas such as Port Macquarie and Botany Bay to anthropogenic influences (Pointer and Peterkin 1996).

The dugong observations in 2002/03 (Table 1) were in areas of NSW which have some of the largest seagrass beds, at least two of which include *Halophila* species – part of the preferred diet of dugongs (Marsh et al. 1982; Table 2). The increasing evidence that individual dugongs embark on movements over many hundreds of kilometres within tropical waters (N. Gales pers. comm; Marsh and Lawler 2001, 2002; Marsh

Estuary (latitude)	Seagrass species and approximate area coverage	Water temp. (°C)
Wallis Lake (~32.2°S)	Zosteraceae, *Posidonia australis*, *Ruppia* and *Halophila* spp. ~30.785km^2	October mean: 18.9 October 2002: 21.0
Port Stephens (~32.7°S)	Zosteraceae, *Posidonia australis* and *Halophila* spp. ~7.453km^2	January mean: 24.1 February mean: 24.6
Lake Macquarie (~33.1°S)	Zosteraceae, *Posidonia australis*, *Ruppia* and *Halophila* spp. ~13.391km^2	January mean: 21.6
Brisbane Water (~33.4°S)	Zosteraceae, *Posidonia australis* and *Halophila* spp. ~5.490km^2	February mean: 22.1

Table 2. Extent of seagrass meadows and water temperatures at sighting ocations. Sources for seagrass coverage and water temperature data: West et al. (1985) and Anon. (2003a) respectively. Water temperatures are means from 1987-2002, unless otherwise stated.

and Rathbun 1990; Marsh et al. 2002) suggests it is possible that dugongs explore and utilize these southern seagrass beds. Warm water temperatures during the summer months of 2002/03 may have encouraged this behaviour.

Although only five dugongs have been reported drowned in shark nets in NSW over the last c. 50 years (Krogh and Reid 1996), such deaths are not inconsequential since few dugongs are commonly found south of Moreton Bay. Two of these mortalities coincided with a seagrass dieback event (Preen and Marsh 1995) and further impact on Queensland seagrass beds or increase in water temperature in NSW may see an increase in shark net capture of dugongs off NSW beaches. Such events will highlight negative effects on populations of non-target species, and the efficacy of shark control programs for bather protection in NSW and Queensland will again be called into question (Anon. 2002).

The dugong is classified as 'vulnerable' at a global scale on the IUCN Red List of Threatened Species. As the only extant species in the family Dugongidae, the extinction of the dugong will result in biodiversity loss at the family and generic levels as well as at the species level. In the light of inconsistencies evident in risk assessments for inshore development in NSW, we re-iterate that dugongs should be considered occasional visitors to NSW coastal waters. Their limited numbers warrant the dugongs' consideration in future impact assessments for estuarine and inshore marine developments. The estuarine nature of recent sightings suggests that explorative ranging by dugongs is not necessarily limited to strictly marine environments, rather to areas where seagrass beds occur. This also adds weight to the importance of assessing potential impacts on seagrass habitats.

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