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New records of the Japanese devilray *Mobula japonica* (Müller & Henle 1841) for Australian waters

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ABSTRACT

New Australian records of the Japanese devilray *Mobula japonica* (Müller & Henle 1841) are documented from photographs taken at Ribbon Reefs, Fraser Island, off Noosa and off Southport, Qld, and from a specimen beach-washed on North Stradbroke Island, Qld. This specimen, measuring 2224 mm disc width, was located on 02/09/2007 and is the first sexually mature male recorded in Australian waters. Morphometrics for this specimen are generally consistent with previously published accounts. Where differences exist, these are marginal. Within Australian waters, *M. japonica* has thus far only been recorded from the east coast, within the latitudinal range 14°57'–32°59'S. The recent increase in records suggests the species is more common in Australian waters than previously thought. □ *Myliobatoidei, Mobulidae, North Stradbroke Island.*

The Japanese devilray *Mobula japonica* (Müller & Henle 1841) (Rajiformes: Myliobatoidei: Mobulidae) is thought to be circumglobal in warm temperate and tropical waters of the Atlantic, Pacific and Indian Oceans (Last & Stevens 1994). However, its detailed distribution, along with its biology is poorly-known, and it was previously thought to be rare, or at least rarely documented in Australian waters (Kyne et al. 2005).

The family Mobulidae is comprised of two genera: *Manta* Bancroft, 1829 and *Mobula* Rafinesque, 1810, separated by the position of the mouth; at end of snout tip in *Manta*, and ventral on the head and posterior of the snout tip in *Mobula*. There are nine recognised valid species of *Mobula* worldwide (Notarbartolo-di-Sciara 1987). Distinguishing characters of *Mobula japonica* include: elliptical spiracles situated dorsal to the

level of the pectoral fins, white tip to dorsal fin, very long tail (when unbroken) and the presence of a caudal spine (Notarbartolo-di-Sciara 1987; Last & Stevens 1994). This latter character is shared only with *Mobula mobular* (Bonnaterre 1788), which is possibly endemic to the Mediterranean, although the systematics concerning the relationship between *M. japonica* and *M. mobular* remain unresolved (Notarbartolo-di-Sciara 1987).

Four species of mobulids have been confirmed for Australian waters. *Manta birostris* (Donndorff 1798) and *Mobula eregoodootenkee* Garman 1913 are reasonably common in tropical waters, while *Mobula thurstoni* (Lloyd 1908) is known from a single record off Mackay, Qld, and *Mobula japonica* from two previous specimens from the east coast (Last & Stevens 1994; Kyne et al. 2005).

Mobula japanica is a medium to large devilray, attaining a disc width (DW) of at least 3100 mm (Paulin et al. 1982).

The first recorded Australian specimen of *M. japanica* was a 1880 mm DW individual collected by net fisherman, inshore Lake Macquarie, NSW (32°59'S, 151°35'E) on 04/04/1968 (AMSIB.8021). The sex is unknown, as only the head was lodged in the AMS collection, however, from accompanying original photographs it appears to be female (Kyne et al. 2005). The second specimen was a 1088 mm DW immature male found beach-washed on Eurong Beach, Fraser Island, Qld (25°31'S, 153°08'E) on 17/08/2000 (QMI.33855) (Kyne et al. 2005). This paper presents information on a number of new records for Australian waters, in particular a beach-washed specimen from North Stradbroke Island, Qld.

METHODS

All records were identified using Notarbartolo-di-Sciara (1987) and Last & Stevens (1994). The North Stradbroke Island specimen was reportedly alive when first located by a member of the public. Upon collection it was dead but very fresh. Morphometrics and photographs were taken of the fresh specimen on arrival at the Moreton Bay Research Station, Dunwich. Thirty-four morphometrics were recorded, including 29 following the methodology of Notarbartolo-di-Sciara (1987), and additional measurements of the claspers and caudal spine. Morphometrics were compared to previously published results from the E Pacific (Notarbartolo-di-Sciara 1987) and the Fraser Island specimen (Kyne et al. 2005). The following abbreviations are used for institutions: AMS, Australian Museum, Sydney; QM, Queensland Museum, Brisbane.

Following fresh examination, the specimen was transported to the QM. Space restrictions precluded fixation and storage of the whole animal, however, a fibreglass cast of the fresh whole specimen was made for public display at

the QM. The head (including cephalic fins) and region posterior from the dorsal fin (including dorsal fin, pelvic fins, claspers, tail and caudal spine) were dissected from the whole specimen and lodged in the QM Ichthyological Collection. Some sections of gill arches were also preserved, as well as liver and muscle tissue samples in alcohol for possible future DNA analysis.

Photographs were obtained of individuals from a number of locations along the east coast of Qld: Fraser Island (beach-washed specimen; individual not retained), off Southport (live sightings), Ribbon Reefs (live sighting) and off Noosa (fisheries bycatch; specimens not retained).

RESULTS AND DISCUSSION

A 2224 mm DW mature male *M. japanica* (QMI.38137) (Fig. 1A-D) was beach-washed on Flinders Beach, North Stradbroke Island, Qld, Australia (27°24'59"S, 153°29'12"E) on 02/09/2007. Table 1 presents morphometrics for the specimen. For comparison, those from the second Australian specimen (Fraser Island, Qld; QMI.33855; Kyne et al. 2005) and the range of values for the 29 measurements given in Notarbartolo-di-Sciara (1987) for specimens from the E Pacific are also included.

The measured size of the specimen (2224 mm DW) is within the reported maximum for the species, which is at least 3100 mm DW (Paulin et al. 1982; Last & Stevens 1994). White et al. (2006) estimated size at maturity for male *M. japanica* from eastern Indonesian waters (DW₅₀ with confidence intervals) as 2016 mm (1984–2050 mm) DW. The North Stradbroke specimen represents the only known mature male of the Australian records.

Over one third of the 29 morphometric measurements were outside of the range reported by Notarbartolo-di-Sciara (1987) for specimens from the E Pacific (Table 1). Nine of the 11 of these were above the previously published range, while

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TABLE 1. Proportional dimensions as thousandths of disc width for *Mobula japonica* from North Stradbroke (QMI.38137) and Fraser Islands (QMI.33855; Kyne et al. 2005), Qld, Australia, and those given by Notarbartolo-di-Sciara (1987). * denotes proportional measurements which fall outside the previously reported range.

Location	QMI.38137	QMI.33855	Notarbartolo-di-Sciara (1987) Range
	North Stradbroke Is., Qld	Fraser Is., Qld	Eastern Pacific
1. Disc width (mm)	2224	1088	1316-2259
2. Disc length	544*	445	448-531
3. Anterior projection	354	310	321-379
4. Rostrum to pelvic fin	560	453	457-561
5. Predorsal length	461*	373	373-441
6. Dorsal fin base	42	42	39-55
7. Dorsal fin height	45	34	35-47
8. Precloacal distance	441*	388	367-430
9. Tail length	517*	1245	641-1075
10. 1st gill opening length	56	50	47-57
11. 2nd gill opening length	60	51	51-62
12. 3rd gill opening length	61	53	49-61
13. 4th gill opening length	58	48	44-58
14. 5th gill opening length	44	36	34-44
15. 1st interbranchial distance	122*	90	108-119
16. 5th interbranchial distance	56	41	46-69
17. Rostrum to 1st gill openings	122*	105	103-121
18. Rostrum to 5th gill openings	225*	190	193-221
19. Pelvic fin length	123	86	108-131
20. Cephalic fin length	128*	107	117-127
21. Cephalic fin width	34*	49	52-68
22. Eyeball diameter	21	23	21-26
23. Cranial width	188*	161	148-169
24. Preoral length	58*	38	38-43
25. Head length	153	138	132-163
26. Mouth width	124	103	110-126
27. Internarial distance	108	98	99-110
28. Upper toothband length	90	80	83-94
29. Lower toothband length	90	77	81-96
Clasper length inner	110	38	-
Clasper length outer	41	13	-
Clasper width	22	6	-
Dorsal spine length	36	48	-
Ventral spine length	10	17	-

two were below (tail length and cephalic fin width). The tail was damaged, explaining the lower range for that value. Kyne et al. (2005) noted the unreliability of this as a diagnostic feature due to its susceptibility to damage. The following measurements associated with the head were all above the previously published range: cranial width, preoral length and cephalic fin length, as were disc length and the predorsal length (Table 1). However, with the exception of tail length, all differences were marginal (0.1 to 2.0% of DW), and may be related to either measuring technique (although the present study followed Notarbartolo-di-Sciara (1987) very closely), or a limited number of replicates from the original study (n=19; Notarbartolo-di-Sciara, 1987). Alternatively, some differences may reflect regional or population-level variability. Genetic analysis may be able to shed some light on the latter possibility.

Table 2 summaries the 13 known records of *M. japonica* for Australia. In addition to the North Stradbroke Island specimen detailed above, a number of photographs of *M. japonica* were obtained from Qld waters. Ian Banks filmed an

individual at 6 m depth off Main Beach, Gold Coast (27°58'S, 153°25'E) on 13/02/2006 and later filmed two individuals nearby (27°56'S, 153°25'E) on 11/05/2008 (still photographs were provided from the video footage). On 03/10/2007, Julie Meles photographed a beach-washed individual 1 km north of McLaughlan Rocks on Fraser Island (25°19'S, 153°13'E). The sex of the specimen was not noted, but it was estimated to measure 3100 mm DW (information provided by Jeff Johnson, QM and Ivan Thrash, QNPWS). Chris Witty photographed an individual on a reef between Ribbon Reef #9 and #10 on the Great Barrier Reef (14°57'S, 145°40'E) at ~10–15 m depth on 01/01/2008 (a total of four devilrays were sighted, but only one individual could be identified as *M. japonica*) (information provided by Qamar Schuyler, Undersea Explorer). A professional fisher caught five specimens from 670 to 1060 mm DW by gill net at 7–12 m depth on ~20/05/2008 just north of the Noosa River mouth (26°23'S, 153°05'E). All were released and sex was not recorded (information provided by Jeff Johnson, QM and S. McCulloch, QDPI & F).

TABLE 2. Summary of Australian records of *Mobula japonica*.

Record & specimen no. (if applicable)	Date of record	Location	Co-ordinates	Collection method	Reference/source
1. AMSIB.8021	04 Apr 1968	Lake Macquarie, NSW	32°59'S, 151°35'E	Estuarine net bycatch	Kyne et al. (2005)
2. QMI.33855	17 Aug 2000	Fraser Island, QLD	25°31'S, 153°08'E	Beach-washed	Kyne et al. (2005)
3.	13 Feb 2006	Off Main Beach, Gold Coast, QLD	27°58'S, 153°25'E	Live sighting (photographs)	I. Banks
4. QMI.38137	02 Sep 2007	North Stradbroke Island, QLD	27°25'S, 153°29'E	Beach-washed	Present study
5.	03 Oct 2007	Fraser Island, QLD	25°19'S, 153°13'E	Beach-washed (photographs)	J. Meles & I. Thrash
6.	01 Jan 2008	Ribbon Reefs, Great Barrier Reef, QLD	14°57'S, 145°40'E	Live sighting (photographs)	C. Witty & Q. Schuyler (Undersea Explorer)
7–8.	11 May 2008	Gold Coast Seaway, QLD	27°56'S, 153°25'E	Live sighting (photographs)	I. Banks
9–13.	~20 May 2008	Off Noosa, Sunshine Coast, QLD	26°23'S, 153°05'E	Gillnet bycatch (photographs)	S. McCulloch (QDPI&F)

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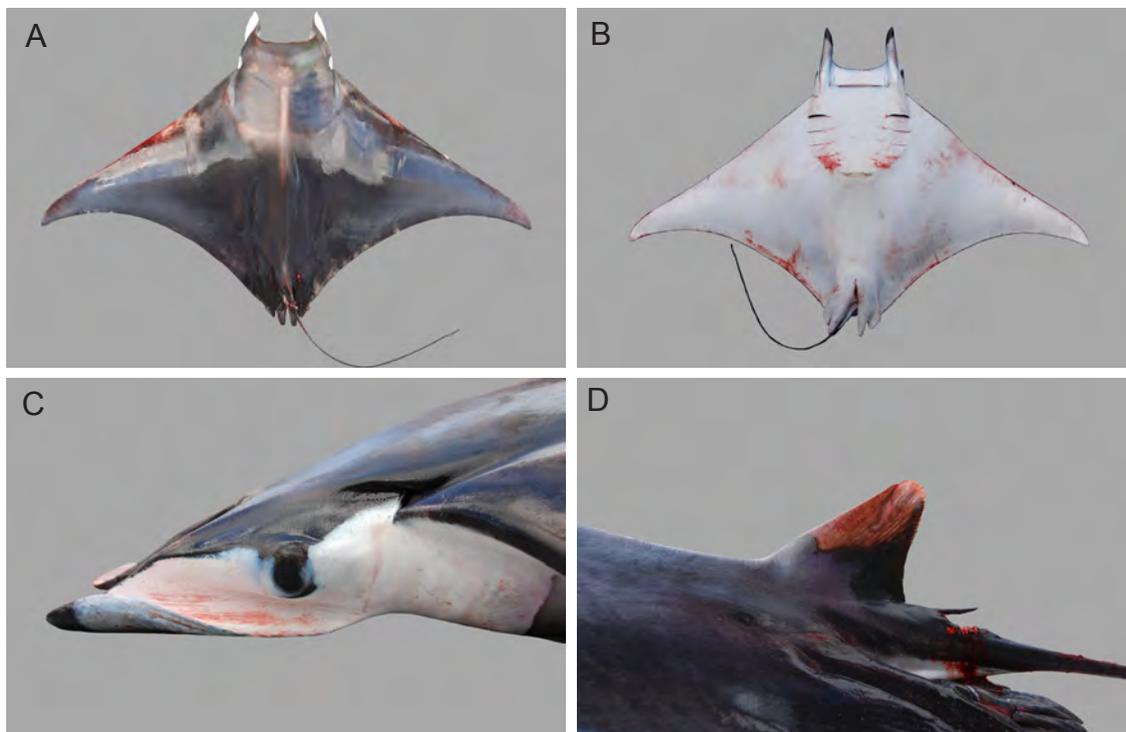


FIG. 1. *Mobula japonica*, QML.38137, 2224 mm DW. A, Whole animal, dorsal view. B, Whole animal, ventral view. C, Head, lateral view. D, Dorsal fin, caudal spine and tail base, lateral view. (Photos: P. Fugelli).

Mobula japonica is the only devilray species found within the Indo-Pacific which possesses a caudal spine. However, Notarbartolo-di-Sciara (1987) noted that the caudal spine can occasionally be missing in the species (2.5% of specimens examined). Furthermore, for *M. japonica* specimens from New Zealand waters, Paulin et al. (1982) noted that in many of the individuals examined, the caudal spine was very small or broken. As such, when identifying specimens in the field, the absence of a caudal spine does not necessarily discount *M. japonica*. Diagnostic characters specified in Notarbartolo-di-Sciara (1987) and Last & Stevens (1994) should be used in combination to ensure the correct identification of Indo-Pacific mobulids.

Very little is known about the stock structure of *M. japonica*, despite its wide distribution. Although thought to be circumtropical, the presently known distribution is disjunct. The connectivity of regional populations or stocks, for example, where the species occurs in the E Pacific and the W Pacific, is unknown. Even locally within Australia and SE Asia it is unknown whether there is one interbreeding stock, or several distinct populations. The latter would have implications for mobulid fisheries where they occur regionally in Indonesia and the Philippines, with the risk of stock depletion greatly increased.

In Australia, *M. japonica* has only been recorded along the east coast, with present records within

the latitudinal range 14°57'–32°59'S. The closest records appear to be from New Zealand where the species is relatively common in waters off the North Island during the summer months to at least 38°22'S (Paulin et al. 1982; Duffy & Abbott 2003). Since the Japanese devilray is commonly caught in Indonesian waters (White et al. 2006), it is expected that it will be recorded more widely from northern and western Australian waters in the future. The number of recent beach-washed records, together with live sightings and fisheries bycatch, suggests a more common occurrence off eastern Australia than previously thought.

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access to photographs and information on additional records.

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