

NEW BIOGEOGRAPHICAL INFORMATION ON QUEENSLAND CHONDRICHTHYANS

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New information is presented on chondrichthyan fishes. *Mobula japonica* (Müller & Henle, 1841) is reported for the first time from Australian waters from two specimens, one from Lake Macquarie, New South Wales and one from Fraser Island, Queensland. *Squaliolus aliae* Teng, 1959 and *Asymbolus analis* (Ogilby, 1885) are reported for the first time from waters off Queensland, and aspects of the biology of *A. analis* are discussed. Significant southern range extensions are reported for *Aetomylaeus nichofii* (Schneider, 1801) and *Dasyatis leylandi* Last, 1987. Southern range extensions are also reported for *Carcharhinus amboinensis* (Müller & Henle, 1839) and *Carcharhinus caudatus* (Whitley, 1945) and these species are recorded for the first time from Moreton Bay. Northern range extensions are reported for *Hypnos monopterygius* (Shaw & Nodder, 1795) and *Orectolobus maculatus* (Bonnaterre, 1788). Comments are also made on the distribution of *Dipturus australis* (Macleay, 1884) and *Myliobatis hamlyni* Ogilby, 1911. □ *Biogeography, Chondrichthyes, Queensland waters, Elasmobranchii, Squaliolus, Orectolobus, Asymbolus, Dasyatis, Aetomylaeus, Myliobatis, Mobula.*

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Australian waters support a diverse chondrichthyan fauna, with at least 296 known species (Last & Stevens, 1994), while additional species are still being recorded, for example, *Isurus paucus* Guitart Manday, 1966 (Stevens, 1995) and *Isistius plutodus* Garrick & Springer, 1964 (McGroutner, 2001). Over half of these species have been recorded from Queensland waters or the Australian Exclusive Economic Zone adjacent to Queensland (Last & Stevens, 1994). Despite the diversity of fauna in this state, there exists a paucity of data concerning the basic biology of most Queensland chondrichthyans. Limited published research is available on the life history of tropical elasmobranch species from the Gulf of Carpentaria and other northern regions (e.g. Stevens & McLoughlin, 1991; Salini et al., 1992), inshore species from the Townsville region (e.g. Simpfendorfer, 1998), *Hemiscyllium ocellatum* (Bonnaterre, 1788) from the southern Great Barrier Reef (e.g. Heupel et al., 1999) and *Aptychotrema rostrata* (Shaw & Nodder, 1794) from Moreton Bay (e.g. Kyne & Bennett, 2002). Similarly with life history data, obtaining information on a species' geographical and bathymetric distribution is essential for understanding ecology, for management

purposes, and in defining levels of interactions with fisheries. Information concerning the biogeography of many species in Queensland waters continues to expand and to be refined with the collection and identification of new material.

This paper presents information on new chondrichthyan material deposited in the Queensland Museum, including that taken by Queensland Department of Primary Industries (QDPI) trawl surveys. A number of range extensions are documented as well as a new record for Australia.

MATERIALS AND METHODS

A. analis, *D. australis*, *D. leylandi* and *A. nichofii* were captured by demersal otter trawl as part of a QDPI project on the bycatch of the Queensland East Coast Trawl Fishery. *D. leylandi* and *A. nichofii* were collected by a 13.6m commercial trawler fitted with twin 4-seam Florida Flyer nets; net body mesh size of 5.0cm; codend mesh size of 4.4cm; headrope length was 7.3m. Specimens of *A. analis* and *D. australis* were taken by a 17.1m commercial trawler fitted with three 2-seam Florida Flyer nets; net body mesh size of 5.0cm; codend mesh size of 4.4cm; headrope length was 12.8m or

21.9m (depending on nets fitted at the time). Capture details for specimens collected by other methods are given with the specimen information.

Specimens were identified using Last & Stevens (1994) and Last (1999). Measurements and mass were recorded and maturity assessed (following Bass et al., 1973) in the laboratory. The following abbreviations are used for institutions: AMS, Australian Museum, Sydney; CSIRO, CSIRO Marine Laboratories, Hobart; QM, Queensland Museum, Brisbane. Methods and abbreviations for measurements of sharks follow Compagno (2001). Additional measurements for batoids are DW (disc width) and DL (disc length). Those for *Mobula japonica* follow Notarbartolo-Di-Sciara (1987).

SPECIES RECORDS AND DISCUSSION

Squaliolus aliae Teng, 1959

MATERIAL. QMI32529; ♂, 134mm TL (Fig. 1A) was captured by trawl 30-40 miles N of Cape Moreton, Qld, 26°21-31'S, 153°28'E, at 183-201m depth on 23/04/2000. AMS I43064-001; ♂, 130mm TL was captured by plankton tow in the Coral Sea, 12°44-50'S, 153°52-55'E, at 120-150m depth on 16-17/05/1995.

REMARKS. *Squaliolus aliae* is probably the smallest known living shark species (Last & Stevens, 1994). It was known on the Australian east coast by AMS I20515-001, ♀, 98mm TL, E of Sydney, NSW, 33°44'S, 151°52'E, demersal trawl, 457m, 24/11/1977; and AMSI30411-001, ♀, 213mm TL, E of Kiama, NSW, 34°42'S, 151°16'E, demersal trawl, 474m, 21/11/1978. This species is also reported from NW WA (Last & Stevens, 1994). Regionally, it is reported from Japan, Taiwan and the Philippines (Last & Stevens, 1994).

A close relative, *Squaliolus laticaudus* Smith & Radcliffe, 1912, has a nearly circumtropical distribution, but has not yet been confirmed from Australian waters. *S. laticaudus* has a larger eye (eye length, EYL, 73.4-85.6% of interorbital space, INO, 61.0%-81.7% of preorbital length, POB) than *S. aliae* (EYL 46.3-69.9% INO, 42.6%-66.4% POB) (Sasaki & Uyeno, 1987). QMI32529 has an EYL 58.4% INO and 51.0% POB and AMSI43064-001 an EYL 48.6% and

52.3% POB). Sasaki & Uyeno (1987) provided 2 further characters to separate these species. Firstly, in *S. aliae* the upper margin of the orbit is chevron-shaped, while in *S. laticaudus* it is nearly straight. The chevron-shaped upper margin is clear in QMI32529 and AMS I43064-001. Secondly, a pair of papillae is present on the lip of the upper jaw in *S. aliae* and absent in *S. laticaudus*. Due to damage to the mouth of QMI32529 and the effects of fixation this feature was not useful in identifying these specimens. However, given the size and shape of the upper margin of the eye, both specimens are *S. aliae*, as are the 2 NSW specimens (AMS I20515-001, EYL 63.7% INO; AMS I30411-001, EYL 56.8% INO).

Orectolobus maculatus (Bonnaterre, 1788)

MATERIAL. Collected by demersal trawl by P. Duncan off north Qld: QMI31417, immature ♂, 845mm TL, off Hardline Reefs, 20°46'S, 151°20'E, 218m, 09/08/1999; QMI31438, immature ♂, 445mm TL, off Calder Island, 20°46'S, 151°28'E, 215m, 10/08/1999.

REMARKS. *Orectolobus maculatus* was known from the S coast of Australia between SE Qld and SW WA, excluding Tasmania. Further records from Japan and the South China Sea require confirmation (Last & Stevens, 1994). The records presented here significantly increase the N distribution, recording it for the first time from the Great Barrier Reef region. Furthermore, the known bathymetric range is increased from a depth of 110m to 218m.

Asymbolus analis (Ogilby, 1885)

MATERIAL. Captured by demersal otter trawl from S Qld waters in depths of 85-159m. QMI32876, mature ♂, 458mm TL, 27°02'S, 153°37'E, 137m, 13/03/2001; QMI33353, immature ♀, 329mm TL, mass 110g, 27°10'S, 153°38'E, 135m, 29/07/2002; and QMI33354 (Fig. 1B), immature ♂, 300mm TL, mass 81g, 27°47'S, 153°49'E, 86m, 24/07/2002. 10 specimens were dissected to obtain life history data (see details below). **OTHER MATERIAL.** AMS IB8255, I26023-001, I26023-001, I34747-001, I35418-001, I35423-001, I35423-002, I40476-001.

REMARKS. These specimens are consistent with many of the diagnostic features outlined in Last & Stevens (1994) and Last (1999). They have a greyish background colouration, overlain

FIG. 1. A, *Squaliolus aliae*, QMI32529, 134mm TL, lateral view. B, *Asymbolus analis*, QMI33354, 300mm TL, lateral view. C, *Dasyatis leylandi*, QMI33352, 130mm DW, dorsal view. D, *Aetomylaeus nichofii*, QMI33854, 343mm DW, dorsal view. E, *Mobula japonica*, QMI33855, 1088mm DW, dorsal view. F, *Hypnos monopterygius*, photographed on the south side of Heron Island Reef, Great Barrier Reef, November 1995 (Photo: M. Prekker).



with saddle-like blotches, dark brownish spots and whitish flecks, and densely packed denticles, giving the skin a rough appearance. These specimens may be distinguished from the sympatric *Asymbolus rubiginosus* Last, Gomon & Gledhill, 1999, another dark-spotted *Asymbolus* species, by a shorter caudal fin (range of CDM, the dorsal margin of the caudal fin, of the three specimens 19.0-20.6% TL vs 23.7-26.6% TL in *A. rubiginosus*), and a larger, broadly semicircular, posterior nasal flap.

The Queensland specimens, however, differ from some characters outlined in Last (1999). The range of the head length (HDL) of the 3 QM specimens (17.3-18.0% TL) falls within the range of HDL given for *A. rubiginosus* (16.7-18.0% TL) and outside that for *A. analis* (18.1-19.0% TL). Furthermore, the interdorsal space (IDS) (12.1-13.1% TL) falls within the ranges given for both *A. rubiginosus* (IDS 12.9-15.1% TL) and *A. analis* (IDS 10.7-12.5% TL). Interdorsal space for *A. analis* in Last (1999) is given as 'much less than 1.5 times total length of first dorsal fin'. Relative proportions of this feature are used to separate *A. analis* from *Asymbolus pallidus* Last, Gomon & Gledhill, 1999 and *Asymbolus occiduus* Last, Gomon & Gledhill, 1999, 2 other dark-spotted *Asymbolus* species. However, the IDS of the QM specimens range from 1.46-1.71 times D1L. It appears that interdorsal space and head length proportions are more variable than previously thought, and may not be useful for *Asymbolus* species identification. Additional AMS material examined (n=8) supported this suggestion, with the range of IDS 1.36-1.66 D1L and the range of HDL 16.7-19.6% TL for specimens from NSW.

Asymbolus analis is endemic to the east coast of Australia, and was previously thought to be confined to NSW and Vic. waters from Port Macquarie S to Lakes Entrance. These records provide the first account of *A. analis* from Queensland waters, and examination of additional NSW material extends its bathymetric distribution from 79m reported in Last & Stevens (1994) to 199m. *Asymbolus* includes eight species restricted to Australian waters (Last, 1999) and an undescribed species from New Caledonia (Séret, 1994).

Last & Stevens (1994) reported that ♂ *A. analis* mature at 520mm TL, but provide no information on ♀ size at maturity. Of the 3 ♂ QM specimens, one was immature at 300mm TL and the others were mature at 458 and 460mm TL, lowering the previous maturity estimate by at

TABLE 1. Maximum ovum diameter (MOD) and number of yellow-yolked ova \geq 5mm diameter for five mature ♀ *Asymbolus analis*.

Capture date	TL (mm)	MOD (mm)	Ova number
15/03/2001	455	19	12
14/09/2001	460	17	8
16/09/2001	470	24	7
13/10/2001	460	20	7
14/10/2001	470	23	15

least 60mm. Five ♀ of 278-329mm TL were all immature; while 5 ♀ of 455-470mm TL were all mature.

Mature females had a single functional ovary. None of the 5 mature females were carrying eggcases in their oviducts, but all had a number of ripe ovarian ova with maximum ovum diameters ranging from 17-24mm (Table 1). Oviducal glands were well-developed and expanded in all mature females with an average diameter of 27.3mm (range 25-29mm). The large ripe ova during the 3 months in which mature female *A. analis* were captured (March, September and October) suggests that the species may not have a well-defined reproductive season, similar to the situation reported for some other scyliorhinid sharks (e.g. Horie & Tanaka, 2000).

Carcharhinus amboinensis (Müller & Henle, 1839)

MATERIAL. QM I33857; ♀, 1195mm TL, 940mm FL, 840mm PCL, mass 13.3kg was captured by handline by R. Pillans 800m off Shorncliffe Jetty, Moreton Bay, 27°19'S, 153°05'E, at 4m depth on 27/12/2002. It is most likely to be immature, as females are known to mature at about 215cm TL (Last & Stevens, 1994).

REMARKS. *Carcharhinus amboinensis* has been reported from the E North Atlantic and the Indo-West Pacific and locally in tropical and subtropical waters from Carnarvon, WA to Bundaberg, Qld (24°45'S, 152°24'E) (Last & Stevens, 1994). This provides the first record of *C. amboinensis* S of Bundaberg and the first record from Moreton Bay, not having been previously reported by Johnson (1999). This species is reasonably common within Moreton Bay (R. Pillans, pers. comm.), although not well represented in the QM collection. It is similar to the bull shark *C. leucas* (Valenciennes, in Müller & Henle, 1839), possibly leading to confusion in the field with this more abundant species.

Carcharhinus cautus (Whitley, 1945)

MATERIAL. QMI32158; ♀, 670mm TL, 535mm FL, 490mm PCL) was collected from the shoreline adjacent to Toondah Harbour, Cleveland, Moreton Bay, 27°32'S, 153°17'E, on 24/05/2000. The shark was found dead, but showed no signs of hook or net capture; QMI33856; ♀, 1260mm TL, 1060mm FL, 950mm PCL, mass 12.5kg) was captured by handline by R. Pillans off Green Island, Moreton Bay, 27°26'S, 153°14'E, at 5m depth on 06/03/2002. Given its size, and the fresh mating scars, this specimen was most likely mature, as both sexes are reported to mature at 800-850mm TL (Last & Stevens, 1994).

REMARKS. Known only from S New Guinea, the Solomon Islands and tropical Australia between Carnarvon, WA and Bundaberg, Qld (24°45'S) (Last & Stevens, 1994). These are the first records of *C. cautus* south of Bundaberg and the first records from Moreton Bay, not having been previously reported by Johnson (1999).

Dipturus australis (Macleay, 1884)

MATERIAL. QMI33853; ♀, 358mm TL, 258mm DW, 212mm DL, mass 320g) was captured by demersal otter trawl off Moreton Island, 27°13'S, 153°39'E at 135m depth on 28/07/2002. Other specimens are QMI11903, from 26°40'S, 153°15'E and I11904 from 27°44'S, 153°27'E.

REMARKS. This species is reported to be 'the most common skate on the continental shelf of central eastern Australia' (Last & Stevens, 1994), being recorded from off Moreton Bay S to Jervis Bay, NSW. Last & Stevens (1994: 347) stated that 'records of this species from prawn trawl catches from southern Queensland require validation.' This specimen, taken by a commercial prawn trawler, confirms that the Queensland trawl fishery interacts with this species. Despite its apparent common occurrence off NSW, this species appears to be uncommon in Queensland waters.

Hypnos monopterygius (Shaw & Nodder, 1795)

MATERIAL. An individual (Fig. 1F) was observed by MBB off the reef edge on the S side of Heron Island, Great Barrier Reef (23°27'S, 151°55'E) in November 1995. It was initially buried in coral/sand substrate at 4m depth but was disturbed by a boat anchor. It proceeded to swim and settle again amongst *Acropora* coral.

REMARKS. This species is endemic to tropical and warm temperate Australia, from Broome, WA to St Vincents Gulf, SA and from Eden, NSW to Caloundra, S Qld. The species is absent from the immediate area between SA and NSW (Last

& Stevens, 1994). This observation extends the N distribution of the species on the E coast and provides the first record from the Great Barrier Reef.

Dasyatis leylandi Last, 1987

MATERIAL. QMI33352, immature ♂, 225mm TL, 130mm DW, 108mm DL, mass 70g, and, immature ♂, 315mm TL, 173mm DW, 146mm DL, mass 160g) (Fig. 1C) were captured by demersal otter trawl in Hervey Bay, 25°07'S, 152°39'E, at 11m depth on 14/06/2002.

REMARKS. *Dasyatis leylandi* had previously been recorded from N Australia between Monte Bello Islands, WA and Townsville, Qld (19°15'S, 146°49'E), as well as New Guinea (Last & Stevens, 1994). These records represent a significant range extension for the species on the E coast (~1,200km). The species appears to be relatively common on scallop trawling grounds between Hervey Bay and Gladstone (Peter Kyne, unpubl. data).

Aetomylaeus nichofii (Schneider, 1801)

MATERIAL. QMI33854; ♀, 343mm DW, 530mm TL, mass 450g) (Fig. 1D) was captured by demersal otter trawl in Hervey Bay, 25°13'S, 152°43'E, at 8m depth on 11/06/2002. QM I12534, immature ♂, 245mm DW, 514mm TL, off Brampton Island, 20°48'S, 149°16'E, 22m, 13/08/1957; AMS I34389-027, immature ♂, 350mm DW, 690mm TL, off Shoalwater Bay, 22°21'S, 150°45'E, 43m, 25/10/1993.

REMARKS. Last & Stevens (1994) report that *A. nichofii* has an Indo-West Pacific distribution from S Japan to Australia and W to India. In Australia it occurs in tropical waters from Bonaparte Archipelago, WA to Cairns, Qld (16°54'S, 145°47'E). The above specimens significantly expand its southern range (by ~1,600km).

Myliobatis hamlyni Ogilby, 1911

MATERIAL. QMI33318; ♀, 440mm DW, 945mm TL) was collected by demersal trawl by P. Duncan off Swain Reefs, 20°40'S, 151°20'E at 210-220m depth on 07/08/1999.

REMARKS. Previously known only from the holotype (QMI1567) caught off Cape Moreton, Qld (approximately 27°02'S, 153°28'E) in January 1911 (no other collection details are available), and CSIRO H2578-01 from E of Swansea, NSW (33°05'S, 151°58'E) collected at 117-121m on 09/11/1994. CSIRO H3860-01 from SW of Shark Bay, WA (26°47'S, 112°35'E) at 346-347m on 03/01/1991 is closely related to



FIG. 2. *Mobula japonica*, AMSIB8021, whole specimen before head was removed. Note diagnostic characters of species, white tip to dorsal fin, short cephalic lobes, long tail and spiracles situated above insertion of pectoral fins (Photo: Athel D'Ombrain, courtesy of the Australian Museum, Sydney).

M. hamlyni. This western form was identified as *M. hamlyni* in Last & Stevens (1994) but now appears to be distinct from that species (Peter Last, pers. comm.). *Myliobatis hamlyni* therefore appears to be restricted to E Australia.

Last & Stevens (1994) and Compagno & Last (1999) reported that *M. hamlyni* is doubtfully distinct from the W Indian Ocean *Myliobatis aquila* (Linnaeus, 1758) or the W Pacific *M. tobijeji* Bleeker, 1854. The relationship between the 3 species needs further assessment, as does the relationship between the east and west coast forms.

Mobula japonica (Müller & Henle, 1841)

MATERIAL. AMSIB8021 is the head of a specimen collected inshore by net fishermen from Lake Macquarie, NSW (32°59'S, 151°35'E) on 04/04/1968. QMI33855; immature ♂, 1088mm DW) (Fig. 1E) was found beach-washed on Eurong Beach, Fraser Island (25°31'S, 153°08'E) on 17/08/2000.

REMARKS. A series of photographs and measurements of the complete NSW animal,

together with the head, were sent to the AMS by Athel D'Ombrain. The identification of the specimen has been verified from the head and original photographs (Fig. 2), showing a short head and cephalic lobes, a very long wire-like tail, a white dorsal fin tip, elliptical spiracles situated above the level of the pectoral fins, and a statement in the original correspondences from Mr D'Ombrain, 'A spine was cut from base of tail'. Within *Mobula*, only *M. japonica* and *M. mobular* possess a caudal stinging spine. *M. mobular* is closely related and morphologically similar to *M. japonica*, however, the former appears to be endemic to the Mediterranean Sea (Notarbartolo-Di-Sciara, 1987; Hemida et al., 2002).

The sex of the individual was not reported, but from the photographs appears to be female. The collector reported a 'width of disc' of 74 inches (1880mm), a 'length overall' of 114 inches (2896mm), a 'total length without tail' of 41.5 inches (1054mm) and a 'tail' of 72.5 inches (1842mm).

Collection of the first Qld specimen was reported by Hobson (2001) who also provided photographs of the fresh specimen. Full morphometric details are available from JWJ. Many of the proportional dimensions differ slightly from those presented in Notarbartolo-Di-Sciara (1987), with numerous measurements falling outside the lower end of the ranges given for material examined. The Queensland specimen has a greater relative disc width, and the tail far exceeds the maximum relative length given by Notarbartolo-Di-Sciara (1987). *Mobula japonica* has a long tail relative to other *Mobula* species, however this is a less reliable diagnostic feature, given the tail's susceptibility to damage.

Mobula japonica, which has a circumtropical distribution in warm temperate and tropical seas, is known from the Atlantic, Pacific and Indian Oceans. Regionally, it has been recorded from New Zealand, but reports from Australia needed confirmation (Last & Stevens, 1994). These records confirm that 4 species of mobulid rays occur in Australian waters: *Manta birostris* (Donndorff, 1798) and *Mobula eregoodootenkee* Garman, 1913 appear to be reasonably common in Qld waters; *Mobula thurstoni* (Lloyd, 1908) is known from a single record off Mackay, Qld (Last & Stevens, 1994). All species are rarely caught and are not well represented in museum collections.

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