Urogymnus acanthobothrium sp. nov., a new euryhaline whipray (Myliobatiformes: Dasyatidae) from Australia and Papua New Guinea

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Abstract.

The Mumburarr Whipray, *Urogymnus acanthobothrium* sp. nov, is described from a single specimen taken from the Cambridge Gulf, Western Australia, and from images of ten other specimens from northern Australia and Papua New Guinea (all observed but not collected). It is a very large ray that attains at least 161 cm disc width, making it amongst the largest of the whiprays. The ventral tail below the caudal sting has a low, short-based fold. A ventral tail fold (or a dorsal fold) has not been recorded for any other himanturin stingray in the Indo-West Pacific. Molecular data suggest it is most closely related to a similar but more widely distributed cognate, *U. granulatus*. Both of these species share a suboval disc shape, similar squamation patterns, and the tail posterior to the sting is entirely white (at least in small individuals). *U. acanthobothrium* sp. nov. differs from *U. granulatus* in having a longer and more angular snout, longer tail, more posteriorly inserted caudal sting, lacks white flecks on the dorsal surface, and the ventral disc is uniformly white (rather than white with a broad black margin). It co-occurs with two other morphologically distinct *Urogymnus* in the region (*U. asperrimus* and *U. dalyensis*). Like *U. dalyensis* it occurs in both brackish and marine waters. A key is proved to the members of the genus *Urogymnus*.

Key words: *Urogymnus acanthobothrium*; Dasyatidae; giant whipray; new species; Australia; Papua New Guinea

Introduction

The first specimens of this large whipray, a pregnant female and her young, were caught in the Arafura Sea during a field survey of the parasite fauna of northern Australian chondrichthyan fishes. The survey was initiated in 1999 by Janine Caira and Kirsten Jensen as part of a wider study of cestode parasites funded by the American National Science Foundation (NSF; http://tapewormdb.uconn.edu/). For logistical reasons, presumably due to the large size of the female, only tissue and parasite samples were retained. One of us (PL) was approached by the collectors to provide an identification of this ray based on separate images of the female and her offspring. No presently recognised stingray occurring in the Indo-Pacific was known to attain such a large size, elongate oval disc with finely blotched yellowish grey dorsal coloration as an adult and a greyish brown pup. Subsequently, as part of another NSF funded project, a DNA sequence was obtained for the pregnant female specimen which also found it to be distinct from all other regional species (Naylor *et al.*, 2012).

A search to obtain material of this unidentified species was subsequently initiated to enable a formal description of this species. A large research project on northern Australia euryhaline elasmobranchs under the National Environmental Research Program (NERP) resulted in the capture of three unidentified stingrays in tidal rivers within Kakadu National Park in the Northern Territory. Due to permit restrictions, only tissue samples were retained. Molecular sequencing of one of these revealed that it matched the Arafura Sea specimen. Subsequently, an effort was made to collect a whole specimen of this species and during sampling for euryhaline elasmobranchs under the National Environmental Science Program (NESP) in Cambridge Gulf in the Kimberley region of Western Australia, two specimens were caught with one of these retained.

In another project running concurrently, observers from the National Fisheries Authority in Papua New Guinea obtained bycatch data and chondrichthyan samples from the Gulf of Papua prawn trawl fishery as part of a joint Australia/Papua New Guinea project. Three additional specimens of this large ray were observed in the shallow marine waters of the Gulf, but due to their size only images (of 2 specimens) and tissue samples (from all 3 specimens) were obtained.

Morphological and molecular analyses of existing specimens indicate the new ray belongs to the recently redefined genus *Urogymnus* (*sensu* Last *et al.*, 2016). This group now consists of the new species, herein formally described and named, and 5 other valid nominal taxa: *Urogymnus asperrimus* (Bloch & Schneider, 1801), *U. dalyensis* (Last & Manjaji-Matsumoto, 2008), *U. granulatus* (Macleay, 1883), *U. lobistomus* (Manjaji-Matsumoto & Last, 2006) and *U. polylepis* (Bleeker, 1852). A key is provided to this group.

Materials and methods

Morphological methodology follows standards developed for whiprays (Himanturinae) by Manjaji (2004), which are based on modifications from Compagno & Heemstra (1984) and Last & Stevens (1994), as outlined by Last *et al.* (2006), and include some new descriptive features (i.e. morphology of the disc and its attributes, and squamation). Measurements were taken in millimetres (mm) as direct lengths (shortest point-to-point distance). Tooth rows for both upper and lower jaws were counted as diagonal rows across the tooth band beginning at one corner of the mouth (Fischer & Hureau, 1987). A corner of the mouth had to be slit so the tooth rows were fully visible for counting. Meristic data for the unique type (WAM) were obtained from radiographs. Counts follow Compagno & Roberts (1982), with some modifications: an intermediate radial (i.e. those that lie between the propterygium and mesopterygium, or between the mesopterygium and metapterygium) is assigned to the pterygium with the greatest level of overlap of its base to each of the pterygia concerned; the first distal propterygial and metapterygial elements were considered to form part of the main skeleton and were not incorporated into counts; the first enlarged anterior element of the pelvic fin (with 3–4 distal segments fused at their bases) were counted as one. Synarcual centra are not included in vertebral counts as they are obscured by mid-dorsal denticles on radiographs; the notochord of the tail was excluded from vertebral counts. Morphometric data, based on the holotype are presented in Table 1 and expressed as proportions of disc width (DW). Comparative morphometric and meristics are based largely on Manjaji (2004) who focused more generally on taxonomy of the genus *Himantura* (now formerly including several species of *Urogymnus*; *sensu* Last *et al.*, 2016). Whiprays have developmental stages of the dorsal denticles that are extremely useful for distinguishing species (Manjaji, 2004; Last *et al.*, 2006). The sequence of development usually varies between species, and not all species display all possible stages of development. However, only one specimen of the new species was available for study, so while we were able to obtain some details from photographs of released specimens, our knowledge of denticle development in this species remains poor. The holotype was deposited at the Western Australian Museum, Perth (WAM) as a condition of the collection permit.

Urogymnus acanthobothrium **sp. nov.**

Mumburarr Whipray

(Figs 1–6; Table 1)

Himantura sp.: Fyler *et al.*, 2009: 107, figs 58 and 59

Himantura sp. 1: Naylor *et al*., 2012, tissue GN 2103 (specimen NT-96, not retained).

Himantura sp. 5: Last *et al*., 2016, tissues GN 2103, GN 13667, GN 16659, GN 16661, GN 16993, GN 17253, GN 17254 (Fig. 3).

Urogymnus sp. 5: Last *et al*., 2016, tissues GN 13667, GN 17253 (Fig. 5).

Holotype. WAM P. 34488-001, juvenile male 672 mm DW, West Arm of Cambridge Gulf, Western Australia, Australia, 15°33′ S, 127°59′ E, depth 2.2 m, collected by P. Kyne & G. Johnson, 11 Nov 2015.

Other Material. <u>9 specimens (none retained)</u>. Global Cestode Database NT-96 (photographs; tissue accession GN 2103), adult female 1610 mm DW with embryo ~265 mm DW (size estimated from image), east of Wessel Islands, Northern Territory, Australia, 11°18′ S, 137°00′ E, ~60 m depth, collected by J. Caira & K. Jensen, 17 Nov 1999; PNG field accession 130034 (photograph; tissue accession GN 16659), female 1140 mm DW, east of Aibinio Island, Gulf of Papua, Papua New Guinea, 8°42′ S, 144°07′ E, 18–20 m depth, 2 Dec 2014, collected by S. Tova; PNG field accession 230260 (tissue accession GN 16661), male 1000 mm DW, east of Aibinio Island, Gulf of Papua, Papua New Guinea, 8°36′ S, 144°01′ E, 11–15 m depth, 11 Dec 2014, collected by S. Tova; PNG field accession 180028 (photograph; tissue accession GN 16993), late adolescent male 1030 mm DW, south of Deception Bay, Gulf of Papua, Papua New Guinea, 7°58′10′′ S, 144°38′50′′ E, 10–14 m depth, 6 Apr 2015, collected by S. Ohuesaho; PNG (no field accession number), photograph, adult male 1100 mm DW, Gulf of Papua, Papua New Guinea, 8°01′4′′ S, 144°40′2′′ E, 17–23 m depth, 2 Nov 2015, collected by National Fisheries Authority; photograph, female 520 mm DW and juvenile male 580 mm DW (released alive), Wildman River, Northern Territory, Australia, 12°21′30′′ S, 132°08′30′′ E, depth 7.8 m, collected by P. Kyne & P. Feutry, 29 Aug 2013; photograph, juvenile male 390 mm DW (released alive; tissue accession GN 13667), West Alligator River, Northern Territory, Australia, 12°22′48′′ S, 132°15′33′′ E, depth 4.2 m, collected by P. Kyne & M. Grubert, 22 Oct 2013; photograph, juvenile male 600 mm DW (released alive), Ord River, Western Australia, Australia, 15°16′42′′ S, 128°16′41′′ E, depth 8.7 m, collected by P. Kyne & G. Johnson, 7 Nov 2015.

Diagnosis. A species of *Urogymnus* distinguished by a combination of the following characters: disc elongate suboval, snout tip to axis of maximum width 53% DW; anterior disc margin not truncated, almost straight, lateral apices broadly rounded; preorbital snout broadly angular, angle 114°, with a very small apical lobe; preorbit long, length 26% TL, 2.1 times interorbital length; orbits small, protruded slightly; spiracle very large, 8.6% DW, 1.9 in orbit diameter; internasal distance 2.0 in prenasal length, 2.8 times nostril length; preoral snout length 2.6 times mouth width, 2.5 times internarial distance; caudal sting very large, length more than a 30% DW; mid-scapular denticles very small and inconspicuous; secondary denticles very small, rather widely spaced, band delimited but margin not sharply defined, band truncate forward of eye; minute upright tertiary denticles present, barely visible; low and short-based ventral tail fold present; dorsal disc colour variable, plain dark greyish brown to yellowish brown in juveniles, very finely and faintly mottled greyish white to yellowish brown in adults; ventral surface largely white, posterior disc without regular dark margins; tail beyond sting white in young, unknown but possibly paler than anterior tail in adults; propterygial radials 66, 3 times the number of mesopterygial radials; total vertebral segments (excluding synarcual) 151.

Description. Disc elongate suboval, width 94% of its length in holotype; robust, distinctly raised above mid-scapulocoracoid, maximum thickness 0.12 in disc width (DW); snout broadly angular, with a small but pronounced apical lobe, angle 114°; anterior margins almost straight, oblique to longitudinal axis of disc; lateral apices broadly rounded; posterior margin weakly convex, free rear tip narrowly rounded. Pelvic fins rather short, 21.2% DW; width across base 13.0% DW. Mature male unavailable for examination of adult clasper. Tail rather slender, whip-like, tapering evenly toward sting then becoming subcircular, length 2.18 times DW; base rather narrow, moderately depressed in cross-section, width 1.26 times height; caudal sting greatly enlarged, 30.3% DW, broad and strongly depressed. Ventral tail fold short (see Fig. 5), base length 7.8% DW, 0.14 in length from cloaca to sting, 23.7 times maximum height, preceded and followed by short, low fleshy ridge; maximum fold height 21% tail height at same point.

Snout relatively long, strongly depressed; preoral snout length 2.61 times mouth width, 2.46 times internarial distance, 25.3% DW; direct preorbital snout length 2.06 times interorbital length; snout to maximum disc width 53.0% DW; interorbital space almost flat with slight medial depression; orbits small, slightly protruded, diameter 1.89 in spiracle length; eye length 4.06 in spiracle length, intereye distance 7.68 times eye length. Spiracles very large, subrectangular to suboval; situated dorsolaterally; anterior margin oblique and almost straight, its origin beneath mid-orbit; posterior margin straight and strongly curved. Nostrils rather small, laterally expanded slightly, outer margin almost straight, internasal distance 1.97 in prenasal length, 2.83 times nostril length. Nasal curtain skirt shaped, broad and rather short, width 2.07 times length; lateral margin weakly concave, smooth edged; posterolateral apex nested within broad groove; posterior margin very weakly fringed (fringes indistinct and margin forming an angular ridge), weakly double concave; fully overlapping upper jaw and almost touching lower jaw.

Mouth arched slightly (Fig. 3); oronasal groove shallow, extending posteriorly from posterolateral edge of mouth to chin, posterior extremities slightly exceeding mouth width apart; skin on ventral surface of lower jaw strongly papillate, in a broad strip around lips. Mouth floor with 2 large, fleshy medial papillae, their height ~4 mm, separated by about ~6 mm; a much smaller ridge-like lateral papilla near each corner of mouth, widely separated from inner pair, height ~2.5 mm; medial papilla simple, subtriangular, rounded distally with irregular margin, longitudinally flattened, subequal in size; largest known individual (Global Cestode Database NT-96, 1610 mm DW) reported to have 5 central and 2 lateral oral papillae. Upper jaw mildly double concave with a bulbous synthesis, lower jaw triple concave; lower jaw interlocking with upper jaw internally (upper jaw deeply recessed in head). Teeth small, broadly subtriangular to rhomboidal, in quincunx; similar in size in upper and lower jaws; surfaces of crowns strongly crenulate. Tooth rows in upper jaw ~40, in lower jaw >40, difficult to count without further dissection.

Gill opening margins narrowly S-shaped, smooth edged; length of first gill slit 1.40 times length of fifth, 2.41 in mouth width; distance between first gill slits 2.33 times internasal distance, 0.44 of ventral head length; distance between fifth gill slits 1.71 times internasal distance, 0.32 in ventral head length.

Squamation. <u>In holotype</u>: Denticle band prominent, lateral disc appearing smooth but densely and evenly covered with minute upright subconical denticles (barely visible with naked eye or detectable by touch except margin of secondary band). Suprascapular denticles 3, very small (length of largest 2.6 mm), similar in size, barely larger than adjacent denticles of secondary band; surfaces irregular; upper surface of crown not obviously flattened. Secondary and tertiary denticles easily distinguishable from each other. Secondary denticles very small, rather widely spaced (interspaces almost half denticle width), heart-shaped, similar in size, usually directed posteriorly, not larger across scapular region than elsewhere in band. Secondary denticle band well developed on disc, extending from just forward of orbit across mid disc then tapering gradually and extending onto tail; margin of band somewhat irregular (not sharply demarcated as an edge); truncate forward of eye, continuous over entire interorbital space, narrowest on mid disc beside spiracles, broadest over scapular region; similar band of denticles extending onto entire dorsal and upper lateral surfaces of tail before caudal sting; similar denticles on lateral edge of tail beneath caudal sting; small prickly upright and rather widely spaced denticles present on tail posterior to sting (some similar denticles near sting base on dorsal base). Tertiary denticles minute, barely detectable, partially embedded, possibly increasing in size with ontogeny (needing confirmation). Ventral surface of disc naked.

Meristics. Total pectoral-fin radials 150; propterygium 66, mesopterygium 22, metapterygium 62. Pelvic-fin radials 1 (includes 3–4 distal elements fused at base) + 22. Vertebral centra (excluding synarcual) 151; monospondylous 57; pre-sting diplospondylous 94; post-sting diplospondylous 0.

Colour. In holotype (when fresh): Disc uniformly yellowish brown dorsally (denticle band similar to rest of disc but denticle crowns slightly paler than adjacent skin); skin also with a few small, irregularly spaced, darker speckles; disc margin with narrow white strip around pectoral fin anteriorly, becoming dusky posteriorly; pupil of eye black, spiracle whitish; anterior tail paler yellow, gradually becoming whitish forward of caudal sting base; sting and tail beyond sting uniformly white (strongly contrasted with yellowish disc); no information available for ventral surface. *Holotype* (in preservative): Upper surface uniformly pale brownish with denticle band distinct and paler than surrounding disc; denticle crowns appearing as white specks; spiracle dark greyish interiorly, posterior margin white. Ventral surface of disc largely white, irregular light and dark grey patches centrally and on posterior parts of pelvic fins. Tail largely white above, more yellowish and typically darker ventrally; ventral base greyish with some greyish-brown patches before caudal sting; posterior quarter of ventral tail with a dark brown medial stripe; ventral fold pale brownish and white.

Non types (not retained and descriptions based on images): Late embryo (Global Cestode Database NT-96, Fig. 2A) similar to juvenile above, uniformly dark greyish brown dorsally, tail similarly greyish brown to caudal sting base; sting and tail beyond sting pale greyish. Juvenile male (tissue accession GN 13667, Fig. 2B) darker than adults, uniformly dark greyish brown dorsally, eye and spiracle darker; tail similarly greyish brown to caudal sting base; sting and tail beyond sting white. Female (PNG field accession 130034, Fig. 2C mottled greyish yellow on outer dorsal disc with denticle band paler yellowish and distinct from rest of disc; spiracles bluish white and prominent; tail white near and beyond caudal sting; ventral surface uniformly white (outer pectoral fins pinkish due to skin damage). Adult male (PNG, no field accession number, Fig. 2D) medium brown on dorsal surface and very finely mottled; clasper pinkish white. Adult female (NT-96, Fig. 2E) very finely and very faintly mottled greyish white on outer dorsal disc with denticle band paler yellowish and distinguishable from rest of disc; spiracles bluish grey and prominent; tail base similar to disc before caudal sting; tail missing beyond sting but possibly paler than anterior tail.

Size. Among the largest of all stingrays; adult female (1610 mm DW, 1740 mm disc length) aborted a late embryo (estimated to be ~265 mm DW) on capture. Juveniles (n=5) measured 390–672 mm DW, 430–720 mm DL. A late adolescent male (1030 mm DW) was captured off Papua New Guinea but not retained.

Distribution. Gulf of Papua, Papua New Guinea, and northern Australia (Fig. 7), in brackish reaches of tidal rivers and estuaries, and marine waters. Juveniles have been recorded from lower reaches of the Wildman and West Alligator Rivers, Northern Territory (NT), and the lower Ord River and West Arm of Cambridge Gulf, Western Australia. Juvenile capture depths were 2.2–8.7 m; salinity 14.6–33.1; turbidity 367–>1000 NTU. An adult female was recorded in marine waters at a depth of 60 m east of the Wessel Islands, NT. Subadult specimens caught in the Gulf of Papua were from depths of 10–20 m. Probably more widespread in remote and under-surveyed areas of northern Australia and Papua New Guinea, particularly within the complex river systems and associated coastal zones.

Etymology. A large female collected during a survey of cestode parasites of northern Australian chondrichthyan fishes yielded 4 species of cestodes of the genus *Acanthobothrium* (*A. oceanharvestae*, *A. popi*, *A. rodmani* and *A. zimmeri*) that are found only in this species (Fyler *et al.*, 2009). Hence, the epithet '*acanthobothrium'* is used as a noun in apposition to recognise the historical significance of the parasite project in the discovery of this whipray. The vernacular name 'Mumburarr Whipray' is used to acknowledge the assistance of Traditional Owners in locating this species, in particular the peoples of the Alligator Rivers region in the Northern Territory. Mumburarr is a local Limilngan language name used by the Minitja people of the West Alligator River region meaning stingray. Coastal, estuarine and riverine stingrays were traditionally hunted for food and the caudal sting was used as a traditional knife.

Conservation considerations. While at present there is insufficient data available to assess the extinction risk status of *Urogymnus acanthobothrium* sp. nov., it should be noted that euryhaline elasmobranchs are generally of conservation concern (Lucifora *et al*., 2015). The limited numbers of existing records suggests that the new species may be naturally rare, and it is likely to possess life history characteristics of large elasmobranchs (i.e. late age at maturity, low fecundity, long lifespan, and low natural mortality) which result in low productivity and a limited ability to recover from population depletion (Musick, 1999).

Juvenile *U. acanthobothrium* in northern Australia receive some refuge in Kakadu National Park where there is no commercial fishing. Juveniles have been recorded in the Wildman and West Alligator Rivers within the Park; access to the latter is completely closed (i.e. no boat access is permitted) providing a unique conservation zone. In the Kimberley region of Western Australia, commercial fishing activities are limited where juveniles have been recorded. The deployment of turtle exclusion devices (TEDs) most likely minimizes their capture in the Australian Northern Prawn Fishery as large rays can be effectively excluded from trawl nets (Brewer *et al*., 2006). This fishery operates across northern Australia, including in the area where the first (adult) specimen was caught. Nevertheless, this species is caught as bycatch of trawling in the Gulf of Papua; that fishery is currently investigating the use of TEDs which would limit future catches of at least the largest specimens.

The sporadic records of *U. acanthobothrium* across northern Australia and the Gulf of Papua suggest a wider distribution than presently known, and an effort should be made to collect more comprehensive data on this species, particularly on its distribution, ecology and interactions with fisheries, to accurately assess its extinction risk status.

Comparisons

Urogymnus acanthobothrium sp. nov., which attains at least 161 cm DW, is amongst the largest whiprays. No other himanturin ray in the Indo-West Pacific has a ventral tail fold (present but very narrow in *U. acanthobothrium*); a well-developed fold is present in the Atlantic whipray genus, *Fontitrygon*. Of species of *Urogymnus*, *U. granulatus* is also unusual in that it has a uniformly white tail, and appears to be closest to this species based on NADH2 data (see Figs 3 & 5; Last *et al.*, 2016). Based on the holotype and data provided by Manjaji (2004) for *U. granulatus*, *U. acanthobothrium* has a longer (length ~2.5 vs 1.5-2.1 times combined orbit and spiracle length) and more angular snout (angle 114° vs 122-123°), longer tail (length 2.3-2.4 vs 1.3-2.1 times DW), more posteriorly positioned caudal sting (horizontal length from disc insertion to sting origin ~3.3 vs ~2 times interspiraclar width), more oval tail base (otherwise subcircular), lacks white flecks on the dorsal surface, and the ventral disc is uniformly white (rather than white with a broad black margin). Other members of the genus have a much more angular snout (*U. lobistomus*) or the snout is much more obtuse (almost truncate) anteriorly (*U. dalyensis* and *U. polylepis*). The type of the genus, *U. asperrimus*, also known as the Porcupine Ray, which has an extremely thorny dorsal surface unique within whiprays and lacks a caudal sting, is probably highly derived.

Initially, an enormous ray photographed by Mark Erdmann while diving near Raja Ampat (Papua) was thought to be conspecific with this species, but after subsequent examination of his photographs, it is more likely a very large *Urogymnus polylepis* (Bleeker, 1852). *Urogymnus polylepis* also reaches a huge size and specimens from the Chao Phraya River (Thailand) measured 192 cm DW and at least 242 kg. A close relative from tropical Australia and probably New Guinea, *Urogymnus dalyensis*, is a much smaller ray (reported at 124 cm DW) that co-occurs with *U. acanthobothrium* in parts of this region. It remains a mystery how such a large coastal animal can escape detection for so long. However, the superficial similarity of these *Urogymnus* species in the region, and the paucity of comparative specimens in ichthyological collections because of their large size, are likely reasons.

Key to the genus *Urogymnus*

1. Upper disc very prickly, sparsely covered in long spiny thorns; no caudal sting …………***Urogymnus asperrimus*** (Indo–West Pacific, and possibly eastern Atlantic)

Upper disc rather smooth or covered with small denticles; caudal sting present (if damaged, groove housing sting usually evident) ………………**2**

2. Snout very elongate and narrowly pointed; denticle band extending almost to snout tip in adults …………………………***Urogymnus lobistomus*** (Indo–Malay Archipelago)

Snout not elongate, broadly pointed or obtuse with small apical lobe; denticle band not or just extending past snout tip ……………………………………….**3**

3. Disc broadly pointed, apical lobe small or indistinct; length of snout <2.6 times combined orbit and spiracle length; tail white beyond caudal sting ………. **4**

Disc obtuse anteriorly with prominent apical lobe; length of snout >2.6 times combined orbit and spiracle length; tail dark beyond caudal sting ………. **5**

4. Short ventral fold on tail; tail very elongate, length 2.3-2.4 times DW; dorsal surface plain coloured, ventral surface of disc lacking prominent dark posterior margin …………………………… ***Urogymnus acanthobothrium*** (northern Australia & Papua New Guinea)…

No ventral fold on tail; tail elongate, length 1.3-2.1 times DW; dorsal surface covered with white flecks (often obscured by dark mucous), ventral surface of disc with prominent dark margin …………***Urogymnus granulatus*** (Indo–West Pacific)

5. Preoral snout length 3.8–4.3 times mouth width, 2.8–3.2 times internarial distance; preorbital snout length 2.3–2.9 times interorbital length, orbit diameter 49–61% of spiracle length …………………...***Urogymnus polylepis*** (Indo–West Pacific)

Preoral snout length 3.3–3.4 times mouth width, 2.4–2.6 times internarial distance; preorbital snout length 2.1–2.2 times interorbital length, orbit diameter 62–75% of spiracle length …………………….***Urogymnus dalyensis*** (northern Australia & probably New Guinea)

Comparative material.

Urogymnus dalyensis: 9 specimens. CSIRO H 2503–01 (holotype), juvenile male 620 mm DW, Pentecost River (Bindoola Creek junction), Western Australia, 15°42′ S, 127°51′ E, Sep 1990; CSIRO H 2524–01 (paratype), female 450 mm DW, Gilbert River (crossing of the Burke Development Road), Queensland, Australia, 17°11′ S, 141°45′ E, 0.3 m, Aug 1989; CSIRO H 6657–01 (paratype), juvenile male 517 mm DW, Fitzroy River (Telegraph Pool), Western Australia, 17°38′ S, 123°34′ E, 1.1 m, 13 Oct 2002; FUMT–P10863 (paratype), female 474 mm DW, Daly River, Northern Territory, Australia, 18 Aug 1989; NTM S 14745–001 (paratype), adolescent male 880 mm DW, Daly River (upstream from crossing), Northern Territory, Australia, 13°46′ S, 130°43′ E, 18 Nov 1998; NTM S 15183–001 (paratype), juvenile male 380 mm DW, Daly River crossing, Northern Territory, Australia, 13°46′ S, 130°42′ E, Jul 1999; NTM S 15184–001 (paratype), juvenile male 415 mm DW, Daly River crossing, Northern Territory, Australia, 13°46′ S, 130°42′ E, Aug 1999; NTM S 16248–001 (paratype), juvenile male 415 mm DW, Daly River (below Oolloo crossing), Northern Territory, Australia, 14°00′ S, 131°14′ E, 9 Jul 2006; WAM P 32955–001 (paratype), juvenile male 464 mm DW, Ord River, Western Australia, 15°34′ S, 128°37′ E, 3.5 m, 19 Nov 2002.

Urogymnus granulatus: 5 specimens: CSIRO H 2751-01, juvenile male (475 mm total length), Groote Eylandt, Northern Territory, Australia, 13°49′ S, 136°30′ E, 1 m depth, 2 Sep 1990; CSIRO H 4426-32, adult male (claspers only), Muara Angke fish market, Jakarta, Indonesia, 17 Oct 1995; CSIRO CA 1255, juvenile male, north of Anson Bay, Western Australia, 12°05′ S, 130°00′ E, 54 m depth, 3 Jul 1980; CSIRO H 3864-01, juvenile male 235 mm DW, North Channel, east of Cape York Peninsula, Queensland, Australia, 11°43′ S, 143°28′ E, 20 m depth, 9 Apr 1994; CSIRO H 4417-01, juvenile 330 mm DW, northeast of Shelburne Bay, Queensland, Australia, 11°31.8′ S, 143°28.5′ E, 19 m depth, 3 Dec 1995.

Urogymnus lobistomus: 7 specimens: SMEC 369 (holotype), mature male 492 mm DW, Bintulu, Sarawak, Malaysia, 3°10′ N, 113°01′ E, 15 Jun 2002; SMEC 370 (paratype), juvenile male 280 mm DW, Mukah, Sarawak, Malaysia, 2°54′ N, 112°06′ E, 13 Jun 2002; SMEC 371 (paratype), female, 327 mm DW, Mukah, Sarawak, Malaysia, 2°54′ N, 112°06′ E, 2 Jun 2002; IPMB 38.32.02 (paratype) mature male 600 mm DW, Mukah, Sarawak, Malaysia, 2°54′ N, 112°06′ E, 2 Jun 2002; CSIRO H 5472-01, female 343 mm DW, Kuching fish market, Sarawak, Malaysia, 1°25′ N, 110°20′ E, 29 Jan 1999; CSIRO H 5485-01, female, 516 mm DW, Kuching fish market, Sarawak, Malaysia, 1°25′ N, 110°20′ E, 2 May 1999; CSIRO H 6214-03, prenatal male pup, 184 mm DW, Mukah, Sarawak, Malaysia, 2°54′ N, 112°06′E, 29 Apr 2004.

Urogymnus polylepis: 14 specimens: RMNH T 7452, juvenile male (holotype), 301 mm DW, Java, Indonesia; CSIRO H 5283–01 juvenile male 372 mm DW, SMEC KTG2–23397, juvenile male, 524 mm DW, SMEC KTG3–20497, female 545 mm DW, SMEC KTG7–21096, neonatal male 363 mm DW, IPMB MMKG1, juvenile male 515 mm DW, Kinabatangan River, Sabah, Malaysia; MTUF 30233, female 494 mm DW, Rajmehar, India; MTUF 30203, juvenile male 450 mm DW, Bhagalpur, India; MTUF 30204, juvenile male 460 mm DW, MTUF 30205 and MTUF 30206, female 466 mm DW and juvenile male 480 mm DW, Chao Phraya River, Thailand; RMNH 3365 (photo only), unspecified locality; SMEC BFT1–697, female 605 mm TL, Padas River, Sabah, Malaysia; SMEC SKN10–15697, adolescent male, 1210 mm DW, Sandakan, Sabah, Malaysia.

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Figure legends

FIGURE 1. *Urogymnus acanthobothrium* sp. nov., juvenile male holotype (WAM P.34488-001, 672 mm DW): A, dorsal surface, fresh; B, ventral surface, preserved.

FIGURE 2. Dorsal surfaces of fresh non-types of *Urogymnus acanthobothrium* sp. nov.: A, embryo ~265 mm DW, east of Wessel Islands, Northern Territory, Australia (photo: K. Jensen); B, juvenile male 390 mm DW, West Alligator River, Northern Territory, Australia (photo: P. Kyne); C, female 1140 mm DW, Gulf of Papua, Papua New Guinea (photo: S. Tova); D, adult male 1100 mm DW, Gulf of Papua, Papua New Guinea (photo: National Fisheries Authority); E, adult female 1610 mm DW, east of Wessel Islands, Northern Territory, Australia (Photo: K. Jensen).

FIGURE 3. Oronasal region of *Urogymnus acanthobothrium* sp. nov., juvenile male holotype (WAM P.34488-001, 672 mm DW, preserved).

FIGURE 4. Scapular denticles of *Urogymnus acanthobothrium* sp. nov., juvenile male holotype (WAM P.34488-001, 672 mm DW, fresh).

FIGURE 5. Denticle band at the tail base of *Urogymnus acanthobothrium* sp. nov., juvenile male holotype (WAM P.34488-001, 672 mm DW, preserved).

FIGURE 6. Tail below caudal sting of *Urogymnus acanthobothrium* sp. nov., juvenile male holotype (WAM P.34488-001, 672 mm DW, fresh): A, lateral view; B, ventral view. Note the low ventral skin fold below the caudal sting.

FIGURE 7. Posterior tail of *Urogymnus acanthobothrium* sp. nov., juvenile male holotype (WAM P.34488-001, 672 mm DW, fresh): A, dorsal view; B, lateral view; C, ventral view.

FIGURE 8. Distributional range of *Urogymnus acanthobothrium* sp. nov.

Fig. 1A

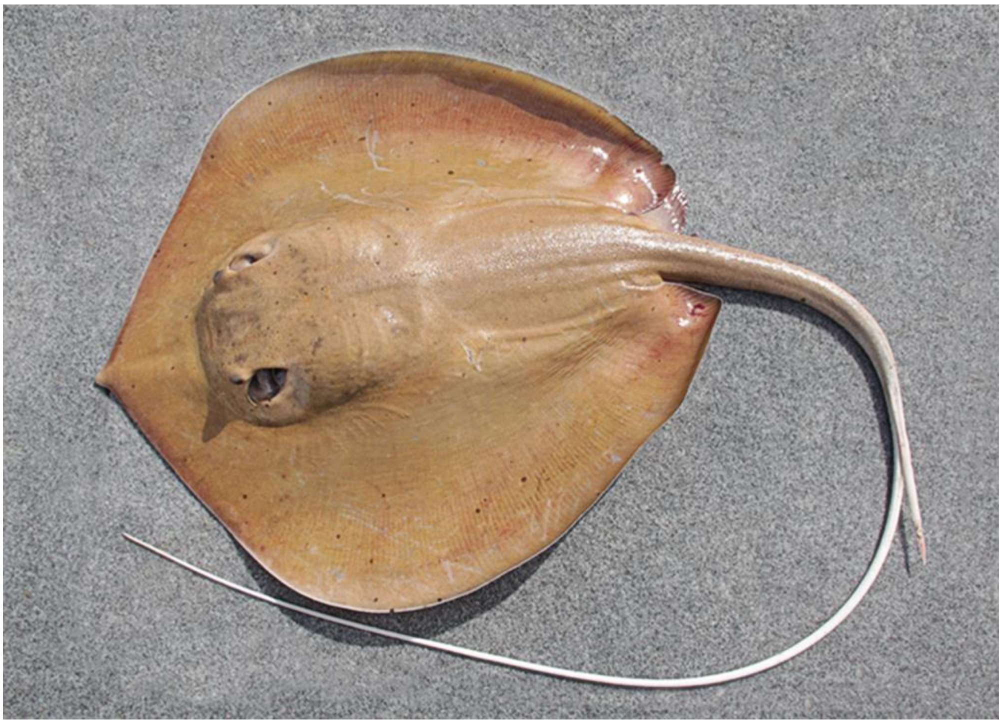

Fig. 1B

Fig. 2A

Fig. 2B

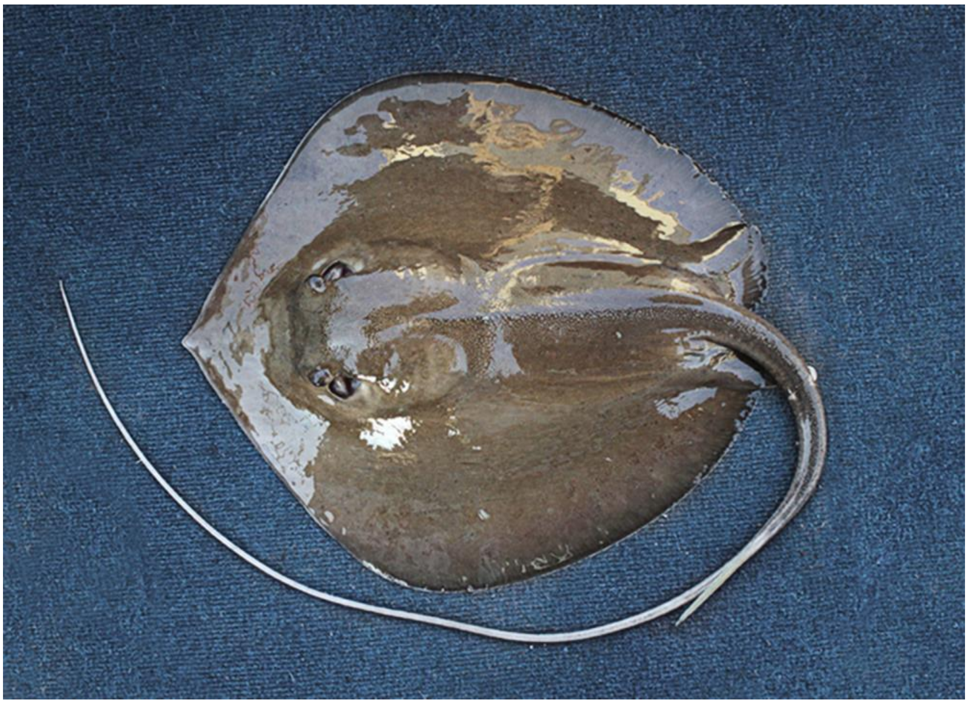

Fig. 2C

Fig. 2D

Fig. 2E

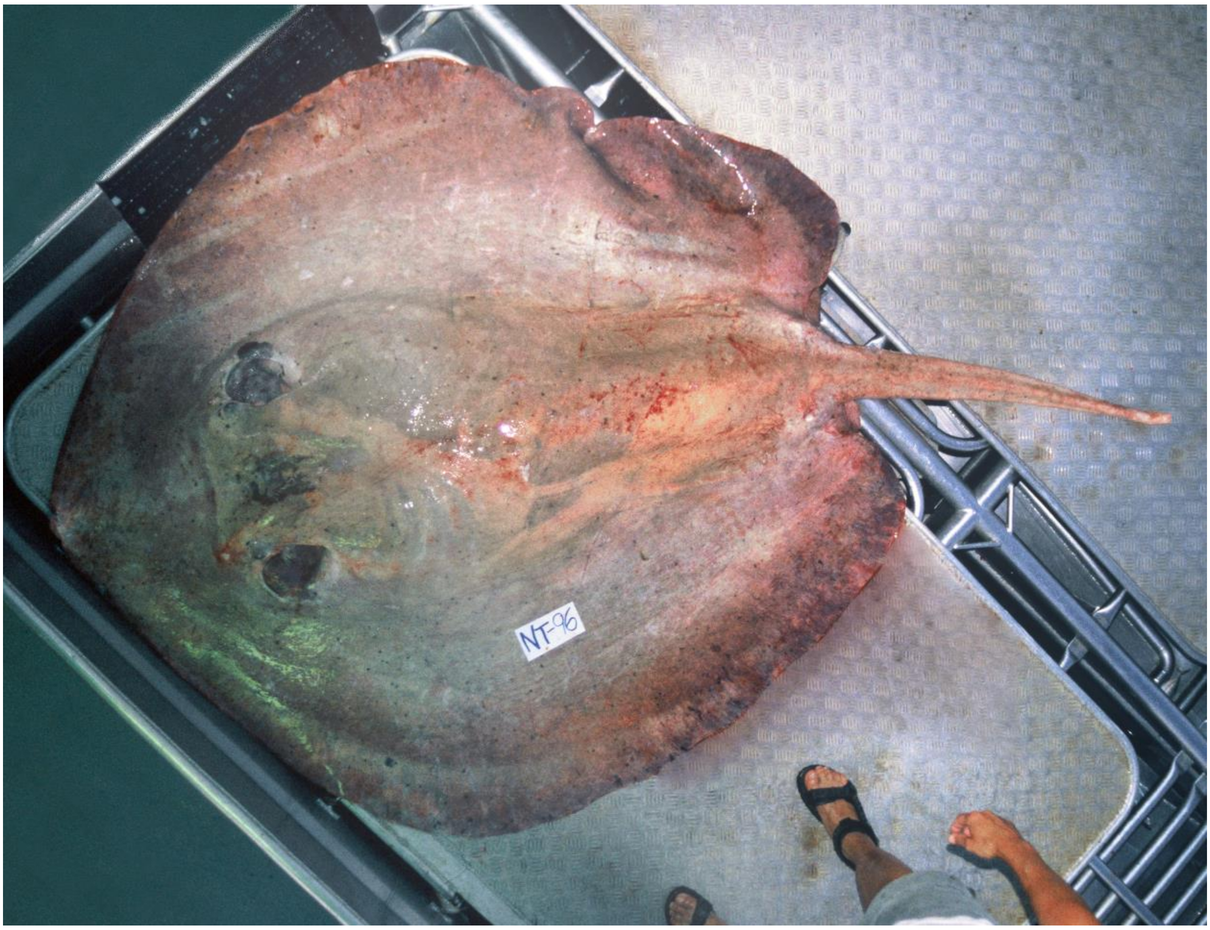

Fig. 3

Fig. 4

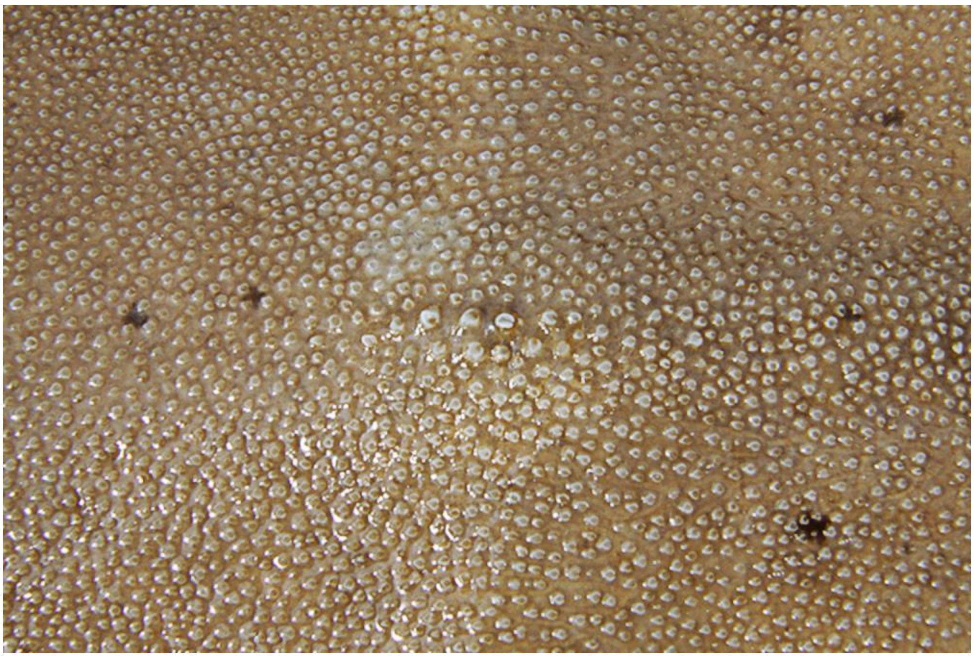

Fig. 5

Fig. 6A

Fig. 6B

Fig. 7A

Fig. 7B

Fig. 7C

Fig. 8