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9.—Studies on Western Australian sharks and rays of the families Scyliorhinidae, Urolophidae and Torpedinidae

by R. J. McKay*

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Abstract

Studies on the Families Scyliorhinidae, Urolophidae and Torpedinidae from Australian waters are given with descriptions of two new species in the genus *Urolophus* and one new species in the genus *Narcine*. Four additions to the fish fauna of Western Australia are included. Keys are provided..

Introduction

With the advent of commercial prawn trawling in the Shark Bay and Exmouth Gulf areas, and with the growing popularity of skin-diving and spearfishing in the local waters of the State, the Western Australian Museum has received numerous collections of fishes. Not unexpectedly, many fishes prove to be new records for Western Australia, and a few are new to science.

This paper is based on material in the Western Australian Museum collection. The works of Fowler (1941) and Bigelow & Schroeder (1948, 1953) were basic to this study. Some additional references not given by the above mentioned authors are included.

Family SCYLIORHINIDAE

Rather small, bottom dwelling sharks characterised by possessing an anal fin; two (rarely only one) dorsal fins, the first dorsal fin with at least half of its base posterior to the origin of the pelvic fins. A distinct spiracle present behind eye; eye without nictitating membrane although a nictitating fold below eye is generally present. Mouth with several series of teeth functional, no distinct groove connecting mouth with nostrils; if shallow groove present, no fleshy barbel on anterior margin of nostril. Labial folds more or less developed. Rather attractively marked, inoffensive little sharks found in temperate and tropical latitudes; well represented in Australia. Mostly inhabiting shallow coastal waters.

* Western Australian Museum, Perth, Western Australia.

Key to Genera of Scyliorhinidae found in Australian seas

(1)	Upper edge of caudal fin with a crest of modified, enlarged denticles, outlined below by a narrow band of naked skin	*GALEUS*
	Caudal fin with uniform denticles, no crest or band of naked skin .	2
(2)	No labial folds on jaws. Mouth broadly distensible. Belly capable of distension	*CEPHALOSCYLLIUM*
	Labial folds present on both jaws and around corners of mouth. Mouth and belly not distensible	3
(3)	Nasal flap reaches and slightly overlaps mouth; no hind nasal flap. A well defined fold below eye. Labial folds very long	*ATELOMYCTERUS*
	Nasal flap not reaching mouth; hind nasal valves present. Fold below eye present. Labial folds very short to moderately long	*HALAELURUS*

Genus *GALEUS* Rafinesque

Galeus Rafinesque 1810 p.13; type species by selection Fowler 1908 p.53. *Galeus metastomus* Rafinesque 1800
Pristiurus Bonaparte 1834; type species *Pristiurus melanostomum* Bonaparte = *Galeus melastomus* Rafinesque 1810.
Figaro Whitley 1928 p.238; type species *Pristiurus (Figaro) boardmani* Whitley 1928.

Diagnosis. Two dorsal fins, the first dorsal fin originates over or behind rear part of pelvic fins. Nostrils separated by a broad isthmus and far from mouth. Mouth large and with labial folds around corners. Anal fin longer than second dorsal fin. Denticles along dorsal margin of anterior part of caudal fin enlarged, forming a well defined crest, outlined below by a narrow band of naked skin. One species in Australia.

Galeus boardmani (Whitley)

Pristiurus (Figaro) boardmani Whitley 1928 p.238. Type locality 10 miles NE. Montague Island, southern New South Wales.
Figaro boardmani, Whitley 1929 p. 354; McCulloch 1929-30 p.8; Whitley 1934 p.198; Whitley 1939 p.230, Bass Strait 100-200 fathoms, Great Australian Bight south and west from Eucla 70-450 fathoms; Whitley 1940 pp.90-91, Figs.78 and 83; Whitley 1964 p.33.
Figaro boardmani socius Whitley 1939 p.230; Whitley 1940 pp.90-91; Whitley 1948 p.8; Whitley 1964 p.33.
Galeus boardmani, Fowler 1941 pp.28 and 29; Munro 1956 p.6; Olsen 1958 p.156; Scott 1962 p.24; Stead 1963 p.22.

Differs from all other species in the genus in having the ventral margin of the caudal peduncle, as well as the anterior dorsal margin of the caudal fin, with a conspicuous crest of enlarged denticles.

Known from New South Wales, Victoria, Tasmania, South Australia and southern Western Australia. Specimens recognised by Whitley as a subspecies *G. boardmani socius* from the Great Australian Bight are reported to be lighter in coloration. Not represented in the W.A. Museum.

Genus *CEPHALOSCYLLIUM* Gill

Cephaloscyllium Gill 1862 p.407; type species *Scyllium laticeps* Duméril 1853.

Diagnosis. Head wide and rather flattened, snout short and narrowing sharply forwards. Mouth wide, arched, distensible, and without well developed labial folds. Eye slit-like. Dermal denticles giving body a rough appearance. Belly capable of inflation. One subspecies in Australia.

Cephaloscyllium isabella laticeps (Duméril)

See Fowler (1941 p.3) for references and description. Known from southern New South Wales. Victoria, South Australia and Tasmania. Not yet recorded from Western Australia and not represented in the W.A. Museum.

Genus *ATELOMYCTERUS* Garman

Atelomycterus Garman 1913 p.100; type species *Scyllium marmoratum* Bennett 1830.

Diagnosis. Mouth with long labial folds on upper and lower jaws. Nasal flap with rounded lobes overlapping mouth. Nictitating fold below eye well developed. Second dorsal fin larger than anal fin. Two species in Australia.

Atelomycterus marmoratus (Bennett)

(Fig. 1 a, b, c, d)

Scyllium marmoratum Bennett 1830 p.693; Günther 1870 p.400; Day 1875-78 p.724 pl.190, Fig.2.
Scyliorhinus marmoratus, Regan 1908 p.462.
Atelomycterus marmoratus, Garman 1913 p.100; White 1937 p.108, pls.1b, 3d, etc; Fowler 1941 pp. 62 to 64, Fig.6. (Synonyms and many references).

Coloration variable; young with transverse bands of brown colour separated by light blotches or white spots, becoming irregularly spotted and blotched with age.

Previous records of this species from northern Australia by McCulloch 1910 p.688; McCulloch 1929-30 p.9; Whitley 1932 p.322, Pl.38, Fig.1 a-c, Port Darwin; Whitley 1934a p.198 all refer to *Atelomycterus macleayi. A. marmoratus* was not included in the recent list of fishes recorded from Australia (Whitley 1964 p.33).

A male (collected by W. and W. Poole from the Onslow area of Western Australia during September 1964, W.A.M.* P 8629, total length 370 mm.) agrees well with Day's (1875-78 p.724, Pl.190, Fig.2) description and figure and with the description given by Fowler (1941 pp.62-64). A juvenile male, W.A.M. P 8811, total length 99 mm, taken by dip-net in Cygnet Bay, King Sound, Western Australia, by C.S.I.R.O., 15 October 1949, has a striking colour pattern of dark brown cross-bars on a pale background (both specimens figured). Biometrics given in Table 1. New record for Australia.

* Numbers preceded by W.A.M. belong to specimens in registered collection of the Western Australian Museum

TABLE 1

Measurements of Atelomycterus marmoratus *(P8629 and P8811)*, Halaelurus labiosus *(P332 and P11749) and* Halaelurus burgeri *(P8807, P8808 and P8809).*

Measurement in mm	P8629	P8811	P332	P11749	P8807	P8808	P8809
Total length	370	99	487	585	285	320	285
Labial furrow Upper	12	3.0	15	20	0.5	0.5	0.5
Labial furrow Lower	13	3.7	17.5	21	3	4.2	4
Snout to : outer nostrils	11	2.5	9	11	7	8 5	8.5
: eye	25	6.5	22	24	15	16	15
: spiracle	37	9.4	35	45	25	25	25
: mouth	20	4.8	13	18	13	14	14
: 1st gill opening	59	16.4	60	75	35	40	38
: 3rd gill opening	69	19.2	73	92	41	46	45
: 5th gill opening	77	21.0	84	107	47	52	51
: pectoral origin	72	19.3	80	101	43	50	49
: 1st dorsal origin	178	45.9	239	290	113	129	116
: 2nd dorsal origin	256	64.2	325	396	178	201	180
: anal fin origin	244	60.3	305	371	160	184	160
: lower caudal origin	306	75.5	380	461	217	246	215
: pelvic insertion	163	40.0	206	252	100	114	103
Distance between exposed nostrils	20	6.3	23	27	5	5	5
Mouth width	26	7.3	31	37	20	22	20
Eye horizontal diameter	11	2.7	12	14	9	9.3	10
Interorbital (mid.)	25	9.0	26	33	18	19	19
First dorsal fin : base	29	6.0	34	44	20	19	17
: last ray	10	2.6	12	16	6.5	7.3	7
: height	20	5.9	25	....	13	14	13
Second dorsal fin : base	30	7.2	36	43	20	21	19
: last ray	9	3.0	11	16	6	6.3	6
: height	19	5.5	24	35	11	11	12
Anal fin : base	24	8.0	45	55	24	24	20
: last ray	7	2.8	9	12 5	6	7	6
: height	11	3.5	14	22	10	10	9
Pectoral fin : base	18	4.0	21	26	15	16	14
: anterior margin	38	12.0	49	70	29	31	29
Pelvic fin : base	20	4.5	29	32	10	12	12
: anterior margin	27	7.0	35	45	17	18	18
Trunk at pectoral origin : height	30	8.1	41	45	25	24	24
: width	36	8.8	49	58	31	37	33

Atelomycterus macleayi Whitley

Scyliorhinus marmoratus (*non* Bennett), McCulloch 1910 p.688.

Atelomycterus marmoratus (*non* Bennett), McCulloch 1929-30 p.9, north Australia; Whitley 1932 p.322, pl.38, Fig.1a-c, Port Darwin; Whitley 1934a p.198, reference only.

Atelomycterus macleayi Whitley 1939 p.230, type locality Port Darwin, Northern Territory; Whitley 1940 pp.92-93, Figs.78, 86 and 87, Darwin and Melville Island; Whitley 1947 p. 148. egg case from Turtle Island; Whitley 1948 p.8, area 5, Western Australia; Munro 1956 p.6; Whitley 1964 p.33; Taylor 1964 p.54.

Very similar to *A. marmoratus* but has coloration "Brownish with darker spots and markings arranged in band-like groups along the back" (Whitley 1940 p.93) and differs in having the egg case without tendrils on anterior end. The egg case of this species has been recorded from Western Australia by Whitley (1947 p. 148) but adults have not been discovered. Not represented in the W.A. Museum.

Genus *HALAELURUS* Gill

Halaelurus Gill 1862 p.407; type species *Scyllium burgeri* Müller and Henle 1841.

Aulohalaelurus Fowler 1934 p.237; type species *Catulus labiosus* Waite 1905.

Asymbolus Whitley 1939 p.229; type species *Scyllium anale* Ogilby 1885.

Juncrus Whitley 1939 p.229; type species *Scyllium vincenti* Zietz 1908.

Diagnosis. Snout short. Mouth large, with labial folds extending around each corner. Nostrils with valves not reaching mouth; no groove between nostrils and mouth. First dorsal fin behind origin of ventral fin.

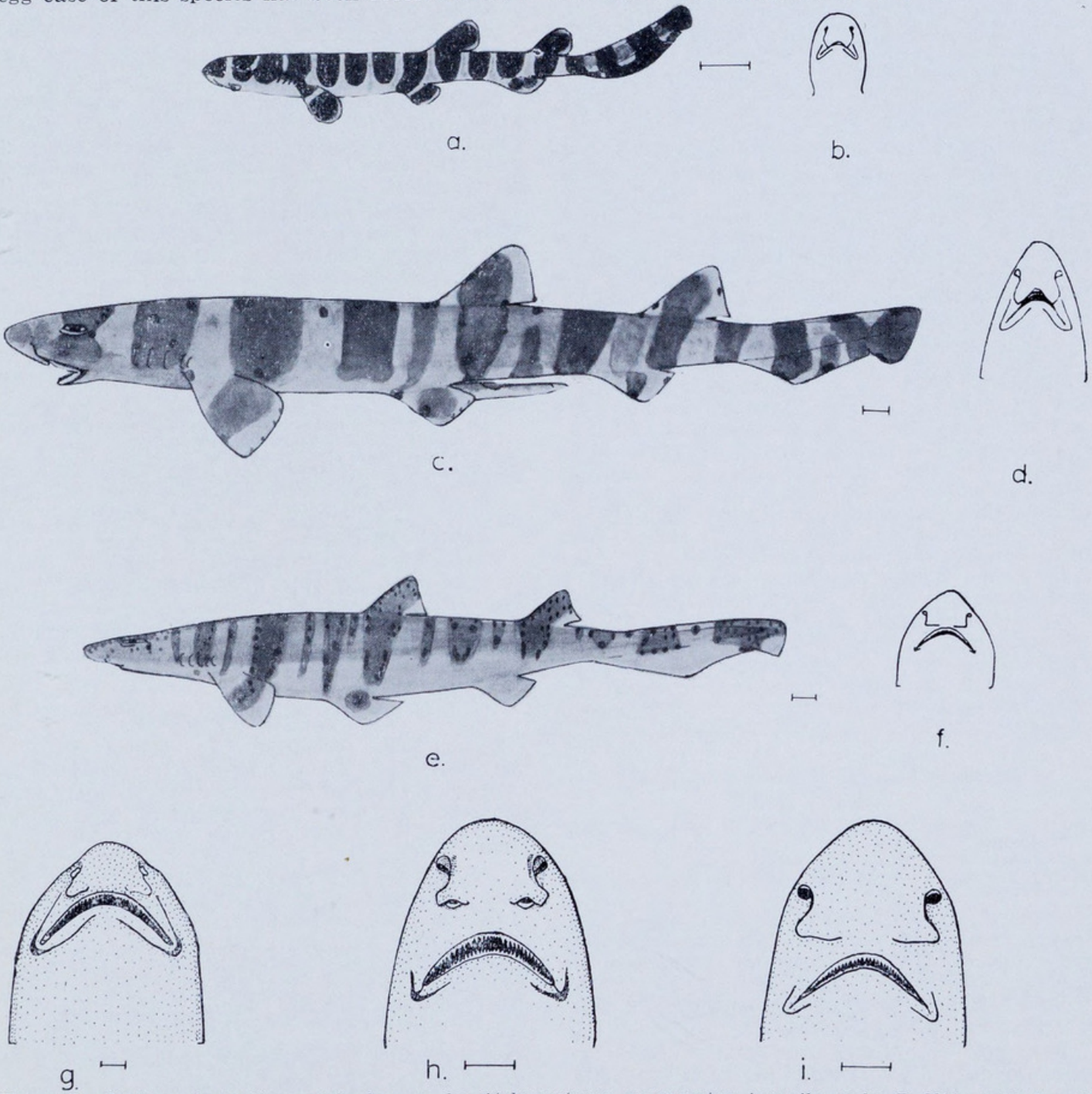


Figure 1.—Western Australian catsharks. a, b: *Atelomycterus marmoratus* juvenile male, P 8811, total length 99 mm. a. lateral view, b. ventral surface of head; c, d: *Atelomycterus marmoratus* male, P 8629, total length 370 mm. c. lateral view, d. ventral surface of head; e, f: *Halaelurus bugeri* female, P 8807, total length 285 mm. e. lateral view, f. ventral surface of head; g: *Halaelurus labiosus*, ventral surface of head; h: *Halaelurus analis*, ventral surface of head; i: *Halaelurus vincenti*, ventral surface of head.

Key to species of Halaelurus in Australian seas

(1) Labial folds greatly developed on upper and lower jaws .... *labiosus*
Labial folds moderate, lower fold not extending halfway to symphysis of lower jaw 2

(2) Upper labial folds very short and rather inconspicuous .... *burgeri*
Upper labial folds well developed 3

(3) Body light with scattered dark brown spots on body and fins .... *analis*
Body dark with ill-defined darker cross-bars and blotches; hinder part of head, body and fins, with creamy white spots .... *vincenti*

Halaelurus labiosus (Waite)

(Fig. 1g)

Catulus labiosus Waite 1905 p.57, Fig.23, type locality Fremantle, Western Australia.
Halaelurus labiosus, Garman 1913 p.88; Ogilby 1916 pp.77-78; Fowler 1941 p.51; Munro 1966 p.6; Stead 1963 p.23; Taylor 1964 p.54.
Scyliorhinus labiosus. McCulloch 1929-30 p.8.
Aulohalaelurus labiosus, Whitley 1934b p.153, Fig.1; Whitley 1940 p.89, Figs.78 and 80; Whitley 1948 p.8; Whitley 1964 p.33.

Nasal valves not overlapping mouth. Labial folds extending nearly to symphysis of lower jaw. Colour dark above, paler below. Head, body and fins with scattered large black spots. Body with some scattered small white spots on sides. Type in Western Australian Museum. Distribution. Appears to be restricted to Western Australia, actual records are: W.A.M. P 332, male 487 mm, t.l., Cottesloe; P 1955, male 542 mm t.l., Fremantle; P 4151, male 480 mm t.l., Rottnest Island; P 5690, female 673 mm t.l., Cottesloe; P 5919, female 645 mm t.l., Yallingup; P 5920, female 514 mm t.l., Point Peron, Fremantle area; P 7070, female 461 mm t.l., Albany; P 8657, male 626 mm t.l., Albany; P 11749, male 585mm t.l., Rat Island anchorage, Abrolhos Islands. Not recorded east of Albany or north of Abrolhos Islands. Records of this species from Queensland, Northern Territory and northern Western Australia are evidently erroneous as Whitley (1940 p. 89) suggests. I also agree with Taylor (1964 p. 54) that these records are probably referable to *Atelomycterus macleayi* (or *A. marmoratus*). Stead (1963 p. 23) is in error in stating that *H. labiosus* "appears to be fairly widespread around the northern parts of Australia . . . ." Biometrics of specimens P 332 and P 11749 given in Table 1.

Halaelurus burgeri (Müller and Henle)

(Fig. 1 e.f)

Scyllium burgeri Müller and Henle 1841 p.8, pl.2; Günther 1870 p.404.
Scyliorhinus buergeri, Regan 1908 p.461.
Halaelurus burgeri, White 1937 p.107, pls 2e, 3a; Fowler 1941 pp.44-45.

Upper labial folds very short. Nine or ten brown cross-bars outlined with small blackish spots, alternating with narrow cross-bars or lines of dark spots, on a light brown background. Head, dorsal fins, pectoral, and ventral fins, with small dark spots.

This new record for Australia is based on three examples all trawled in 21-29 fathoms, Shark Bay, Western Australia, collected by Mr. E. Barker on F.R.V. "Peron": a male, W.A.M. P 8809, total length 285 mm, 21 September, 1964; a male, W.A.M. P 8808, total length 320 mm, 14 November, 1964; a female, W.A.M. P 8807, total length 285 mm, 15 November, 1964. Biometrics given in Table 1.

Distribution. India, East Indies, Philippines, China, Formosa, Japan (Fowler 1941) and now Western Australia.

Halaelurus analis (Ogilby)

(Fig. 1 h)

Scyllium anale Ogilby 1885 pp.445 and 464; type locality Middle Harbour, Port Jackson; Regan 1908 p.460.
Catulus analis, Waite 1899 p.31, pl.2, Fig.1, New South Wales; Waite 1906 p.228, pl.40, Fig.38, egg cases.
Scyliorhinus analis, McCulloch 1911 p.3, Bass Strait and New South Wales, 14-45 fathoms; McCulloch 1929-30 p.8.
Halaelurus analis, Garman 1913 p.85; Waite 1921 p.18, Fig. 21; Waite 1923 p.36; Fowler 1941 p.48, New South Wales, Victoria, Tasmania, South Australia; Munro 1956 p.6; Olsen 1958 p.156; Scott 1962 p.25; Stead 1964 pp.22-23.
Asymbolis analis, Whitley 1940 p.89; Whitley 1948 p.8; Whitley 1964 p.33.

Nasal lobes not reaching mouth, their width about equal to interspace. Brownish above with about 8 diffuse slightly darker blotches on back; head, body, and fins with scattered brown spots.

Distribution. Southern New South Wales, Victoria, Tasmania, South Australia and southern Western Australia. (W.A.M. P711, Bald Island, east of Albany).

Halaelurus vincenti (Zeitz)

(Fig. 1 i)

Scyllium vincenti Zeitz 1908 p.287, type locality Kangaroo Island, South Australia.
Scyliorhinus vincenti, McCulloch 1911 p.4, pl.2, Figs.1 and 3; McCulloch 1929-30 p.8, Investigator Strait and Kangaroo Island, South Australia.
Scylliorhinus vincenti, Waite 1921 p.17.
Halaelurus vincenti, Waite 1923 p.35; Fowler 1941 p.50; Munro 1956 p.6; Olsen 1958 p.156; Scott 1962 p.25; Stead 1963 p.23.
Juncrus vincenti, Whitley 1940 p.90; Whitley 1948 p.8; Whitley 1964 p.33.

Brown above with ill-defined cross-bars, some dark blotches on sides. Head, body, tail and fins with many white spots.

Distribution. Victoria, South Australia, southern Western Australia (W.A.M. P3777, Esperance), and Tasmania.

Family **UROLOPHIDAE**

Snout little produced. Tail short, with a well developed caudal fin. One or occasionally two stout serrated spines on tail. Small rays not exceeding three feet in length. One genus in Australia, represented by ten species.

Genus *UROLOPHUS* Müller and Henle

Urolophus Müller and Henle 1837 p.17; type species *Raja cruciata* Lacepede 1804.

Diagnosis. Small rays having a well developed caudal fin preceded by a strong saw-edged spine (or spines). Tail shorter than body in some species. A small dorsal fin may be present.

Key to species of Urolophus in Australian seas

(1) Tail short. Tail length less than than distance between mouth and centre of cloaca 2
Tail long. Tail length greater than distance between mouth and centre of cloaca 4

(2) Disc spotted; length of eye half spiracle length .... *gigas*
Disc not spotted, back uniform or with longitudinal stripe and sometimes transverse markings; length of eye greater than half spiracle length 3

(3) Back with dark longitudinal stripe and dark transverse markings .... *cruciatus*
Back with indefinite brown longitudinal stripe or back uniform yellowish. No transverse markings .... *sufflavus*

(4) Internasal flap with a broad fringe on its posterior margin. Nostrils with broad lobes posteriorly. Tail without lateral folds 5
Internasal flap with a narrow fringe or with lobules on its posterior margin. Nostrils without broad posterior lobes. Tail with lateral fold or keel on each side 6

(5) Angular margin of spiracle projecting .... *testaceus*
Angular margin of spiracle not projecting .... *mucosus*

(6) Papillae behind lower jaw numerous and close together 8
Papillae behind lower jaw few and sparse 7

(7) Disc slightly broader than long. Back uniform light green, sometimes with a broad blackish bar across interorbital space and extending outward on either side eye .... *viridis*
Disc much broader than long. Back not green 9

(8) Eye about 2 in interorbital space. Outline of disc somewhat rhomboidal. Disc sandy brown above, speckled with closely set white dots .... *bucculentus*
Eye about equal to interorbital space. Outline of disc almost circular. Disc sandy brown above, spotted with black dots and blotches with 12 or more conspicuous blue centred, large brown spots *circularis*

(9) Outer margin of nostril with a conspicuous tentacle; anterior of nasal flap with well developed lobes laterally. Back uniform light brown .... *lobatus*
Outer margin of nostril without a conspicuous tentacle; anterior of nasal flap without lateral lobes. Back grey, with two faint Plumbeous cross bars on hinder part of head .... *expansus*

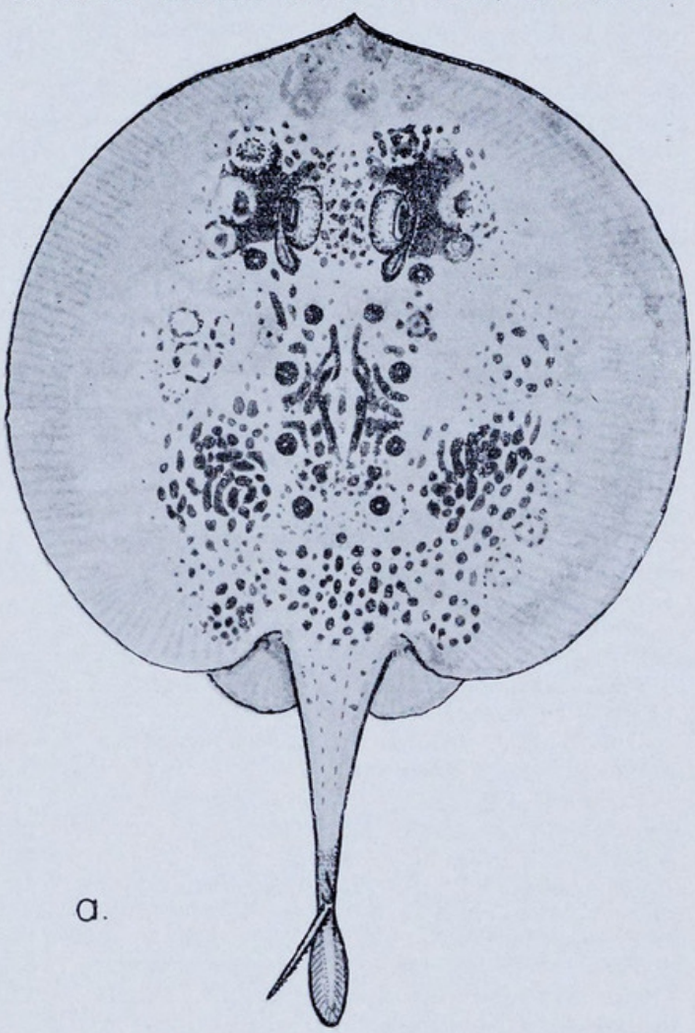
Urolophus circularis species nova

(Fig. 2. a, b)

Material. Holotype: Female, total length 478 mm, Western Australian Museum reg. No. P 8191, collected by E. A. Robinson and R. J. McKay, in 5 fathoms near Seaward Reef, 3 miles west of Carnac Island, Fremantle area, Western Australia, 10 December, 1961.

Description. Disc slightly broader than long; somewhat broadly circular in general outline, anterior margin broadly rounded with a small projecting snout; margins of disc in preorbital region with recurved radials forming a rounded, thickened edge; lateral margins rounded, posterior corner moderately rounded, inner margins weakly concave. Tail, from centre of cloaca, longer than the distance between mouth and centre of cloaca. Tail tapering gently, moderately flattened dorso-ventrally, rounded slightly beneath; a well developed dorsal fin present, followed immediately by a stout spine bearing 35-44 sharp recurved lateral teeth. Caudal fin rounded at tip, with weakly convex upper and lower margins, depth of caudal fin about equal to length of dorsal fin base. Tail bearing a well developed dermal ridge laterally.

Snout in front of orbits about 3.5 times in distance between snout tip and centre of cloaca. Snout tip to mouth about 3.7 in snout to cloaca centre. Orbit about as long as interorbital space. Spiracles with outer margin extending to about anterior third of orbit, the interior



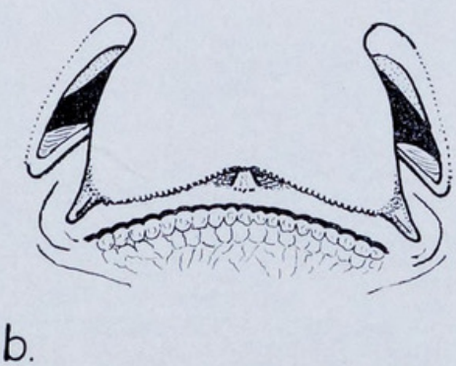


Figure 2.—Stingaree. *Urolophus circularis* sp. nov. *Holotype* P 8191, total length 478 mm. a: dorsal view; b: mouth and nasal curtain.

opening extending to about posterior third of orbit. Spiracles can be completely closed by a cutaneous curtain or flap present on the upper spiracular margin below eye. Distance between spiracles about twice horizontal diameter of orbit.

Nasal curtain thickened laterally, corner produced forming lobes; hind margin of curtain weakly fringed. Nostrils transverse, anterior margins with a thin cutaneous flap which covers half of exposed nostril; hinder margin with outer half expanded into a fleshy lobe that projects inwards. Lateral margins of nostril thickened but not produced into broad lobes.

Mouth slightly arched, lower jaw with numerous closely set papillae. Teeth pavement-like, close together, in about 24 diagonal rows in upper jaw and in 26 rows in lower jaw; both jaws with about 15 series of teeth in the mid-line, only 6 series in upper jaw and about 7 series in the lower jaw are functional. Immediately behind both bands of teeth, inside mouth, are transverse curtains; the curtain on the roof of the mouth is distinctly fringed, and is followed by a less well-developed, non-fringed, curtain; the curtain on the floor of the mouth is less fringed than the curtain on roof of mouth, and is followed by a transverse row of 10 simple, slender papillae.

Gill-openings widely separated anteriorly, the distance between the last gill-openings about 1.5 in distance between first gill-openings.

Skin on disc and tail naked above and below. Minute pores on disc, more numerous in preorbital area and towards lateral margins Some minute pores on dorsal surface

Pelvic fins broadly rounded, their posterior margin gently recurved to merge with the tail.

Colour. Dorsal surface of disc a light sandy grey, with a mauve tinge throughout, covered with spots and blotches of dark brown. Some spots, especially in the mid-line, merged together; suborbital regions with extensive brown mottling and isolated diffuse brown spots enclosing a dark edged light blue centre; each brown spot surrounded by a light area. Light mauve-grey below. Tail light dusky brown above and below, a slightly darker area surrounds dorsal fin.

Dimensions expressed as per cent. of total length. Snout tip to tip of caudal fin (total length) 478 mm. Disc: extreme breadth 60.9.

Disc:	length (not including pelvics 59.0
	length to inner pectoral margin 53.4
Snout tip to:	orbits 15.7
	mouth 15.1
	Cloaca centre 55.4
	dorsal fin origin 75.1.
Orbits:	horizontal diameter 5.2
	distance between 5.7
Spiracle:	length 5.2
	distance between 10.7
Mouth:	breadth 7.7
Nostrils:	distance between exposed inner margins 6.1
Nasal flap:	posterior breadth 9.4
Gill openings:	length of 1st 2.1
	3rd 2.3
	5th 1.3
Dorsal fin:	vertical height 1.9
	length of base 4.0
Tail spine:	length from base 13.6
Caudal fin:	length from ventral origin 16.7
	depth 4.2
Tail keel:	length 10.9

Urolophus gigas Scott

Urolophus gigas Scott 1954 p. 105; Munro 1956 p.19; Scott 1962 p.44; Whitley 1964 p.34.

Distribution. Only known from South Australia (St. Vincent and Spencer Gulfs).

Urolophus cruciatus (Lacépède)

Raja cruciata Lacépède 1804 pp.201, 210.

Urolophus cruciatus, Günther 1870 p.485, Port Arthur; Macleay 1881 p.314; Waite 1899 p.43; McCulloch 1911 p.14; Waite and McCulloch 1915 p.460, Great Australian Bight; McCulloch 1916 p.171; Waite 1921 p.32 Fig.45; McCulloch 1929-30 p.27; Whitley 1940 p.216 Fig.246; Fowler 1941 p.442; Whitley 1948 p.10; Munro 1956 p.18; Scott 1962 p.43; Stead 1963 p.172; Whitley 1964 p.34.

Urolophus ephippiatus Richardson 1846 p.35, pl.24.

Not represented in the Western Australian Museum.

Distribution. Victoria, Tasmania, South Australia and southern Western Australia.

Urolophus sufflavus Whitley

Urolophus cruciatus (non Lacépède), Waite 1899 p.43; Waite 1904 p.10.

Urolophus aurantiacus (non Müller and Henle) McCulloch 1916 p.172, pl.49; McCulloch 1927 p.12 pl.3, Fig.39a; Stead 1963 pp.170-172.

Urolophus sufflavus Whitley 1929, based on McCulloch 1916; McCulloch 1929-30 p.27; Whitley 1940 p.215, Fig. 244; Fowler 1941 pp.441-442; Munro 1956 p.18; Whitley 1964 p.34.

Fowler (1941 p.442) remarks . . . "Apparently differs from the Japanese *Urolophus aurantiacus* in the dark median dorsal stripe."

Distribution. Only known from southern New South Wales. Not represented in the Western Australian Museum.

Urolophus testaceus (Müller and Henle)

Trygonoptera testacea Müller and Henle 1841 p.174; Waite 1899 p.44; Garman 1913 p.410.

Trygon testacea, Zeitz 1908 p.292.

Urolophus testaceus, Günther 1870 p.486, Sydney, Cape Upstart, Australia; Macleay 1881 p.315; Waite 1899 p.44; McCulloch 1916 p.174, pl.50; Ogilby 1916 p.86; Jumpin Pin, Cape Moreton, South Hill, Low Bluff, Double Island Point; Waite 1921 p.32, Fig.46; McCulloch 1929-30 p.27, Queensland, New South Wales, Victoria, South Australia; Whitley 1940 p.218, Figs.191, 226 and 248; Fowler 1941 p.447; Munro 1956 p.18; Scott 1962 p.42; Stead 1963 p.175; Marshall 1964 p.41; Whitley 1964 p.34.

First record for Western Australia based on 7 examples: W.A.M. P 3743, Fremantle, trawled 3 September 1954, total length 305 mm; W.A.M. P 7691, King George Sound, Albany, trawled by L.F.B. "Bluefin", 1959, total length 207 mm; W.A.M. P 8192-8195, Cottesloe Bank, trawled by F.R.V. "Peron", 17 April 1960, total lengths 407 mm, 360 mm, 328 mm, 180 mm; W.A.M. P 8206, Garden Island, January 1960, total length 434 mm.

Distribution. Southern Queensland, New South Wales, Victoria, South Australia and now Western Australia.

Urolophus mucosus Whitley

Urolophus (Trygonoptera) mucosus Whitley 1939 p.257, type locality King George Sound, Western Australia; Whitley 1940 p.219, Fig.249; Whitley 1948 p.10; Munro 1956 p.19; Whitley 1964 p.34.

Closely allied to *U. testaceus* but the snout is rounded and the inner margin of the spiracle lacks a projecting tip. Two specimens in the Western Australian Museum agree well with Whitley's description and figure. W.A.M.

P 4207, Perth Waters (off Fremantle) 26 January 1958, total length 464 mm; W.A.M. P 8196, Cottesloe Bank, trawled by F.R.V. "Peron", 17 April 1960, total length 284 mm. The Western Australian Museum has a number of specimens that show much variation in body proportions and coloration, and a large series may prove *U. mucosus* to be within the limits of a very variable *U. testaceus*. Although all authors have described *U. testaceus* as having the disc uniformly coloured above, I have specimens (that I refer to this species for want of comparative material) with dark brown areas around the eyes and spiracles, and on the disc. The shape of the disc of the uniformly coloured examples differs somewhat from all specimens possessing dark markings. A comparison between specimens from New South Wales and a large series of Western Australian material is clearly needed. Previously known from southern Western Australia, *U. mucosus* is now recorded from the west coast.

Urolophus viridis McCulloch

Urolophus viridis McCulloch 1916 p. 176, Babel Island, Bass Strait; Green Cape, Newcastle, Jervis Bay, Botany Bay, Port Jackson, Sandon Bluffs, New South Wales; Tasmania. McCulloch 1929-30 p.28; Whitley 1940 pp.219-220, Fig.250; Fowler 1941 p.445; Munro 1956 p.18; Stead 1963 p.174; Whitley 1964 p.34.

First record for Western Australia based on 7 males and 5 females, W.A.M. P 14108 to P 14119, 145 mm t.l. to 300 mm t.l., trawled in 17 to 18 fathoms, north-east of Rottnest Island, Western Australia, by L.F.B. "Bluefin", September 18, 1965, collected by the author and Mr. C. Disley. This species could be easily distinguished from all other rays in the trawl catch, as the dorsal surface of the disc was a light moss-green in fresh specimens.

Distribution. New South Wales, Victoria, Tasmania, and now Western Australia.

Urolophus lobatus species nova

Material. Holotype: Female, total length 205 mm, Western Australian Museum regd. No. P 14133, collected in 18 fathoms north-east of Rottnest Island, Western Australia, 18 September 1965. Paratypes: 12 males and 6 females trawled in 17-18 fathoms, north-east of Rottnest Island, Western Australia, collected by the author on board L.B.F. "Bluefin," 18 September 1965. W.A.M. P 14120, 206 mm t.l.; P 14121, 201 mm t.l.; P 14122, 260 mm t.l.; P 14123, 225 mm t.l.; P 14124, 251 mm t.l.; P 14125, 188 mm t.l.; P. 14126, 260 mm t.l.; P 14127, 202 mm t.l. ; P 14129, 204 mm t.l.; P 14130, 250 mm t.l.; P 14131, 212 mm t.l.; P 14134, 223 mm t.l.; P 14135, 208 mm t.l.; P 14136, 197 mm t.l.; P 14137, 288 mm t.l.; P 14138, 239 mm t.l.; P 14140, 198 mm t.l.

Description. Disc much broader than long, greatest breadth 64.9% (paratypes 59.9% to 68.6%) in total length. Greatest length of disc 53.7% (51.4% to 56.9%) in total length.

Tail, from the centre of the cloaca, longer than distance between the mouth and the centre of the cloaca. The tail tapers gently, rather flattened above and below, and bears a well developed dermal ridge laterally. Caudal fin long and narrow, with a slightly pointed tip (some paratypes have a rounded tip to the caudal fin). Tail 50.2% (tail becomes proportionately shorter with an increase in total length, from 53.3% of total length at 210 mm t.l., to 46.6% at 260 mm t.l.) of total length.

Snout with a very short pointed tip, its length in front of the orbits 24.5% (24.0% to 27.3%) in distance between tip of snout and centre of cloaca. Tip of snout to posterior margin of nasal flap 27.0% (24.8% to 28.0%) in distance between tip of snout and centre of cloaca.

Orbits of eyes about equal to interorbital space, and 44.8% (36.8% to 45.8%) in distance before orbits.

Spiracles small, their outer margin extends to below the anterior third of the orbit, and their posterior rim extends to less than half the orbital length behind the eye.

Nasal curtain with well developed lobe like expansions on the anterior lateral margins. The lobes are slightly concave on outer surface, convex on inner surface, and completely close the nostrils when pressed flat. The outer margin of the nasal opening has a short (but conspicuous) tentacle on the post-lateral extremity, and a flat, rounded lobe, almost covering the nostril, internally. The posterior margin of the nasal flap, or curtain, is very weakly fimbriate.

Mouth transverse, its width is a little less than the greatest width of the nasal curtain. Very few papillae behind lower jaw. Teeth pavement like, bearing a low transverse ridge; about 20 rows of teeth in the upper jaw, and about 21 rows in the lower jaw. Behind the teeth in the upper jaw is a fringed, transverse, fleshy curtain, and behind the teeth in the lower jaw are 9 to 10 raised papillae.

Pelvic fins broadly rounded at all angles; the origin of the pelvic fins is situated before the vent, and the distance between the pelvic fin origin and the tip of the snout is 46.3% (45.6% to 48.5%) of the total length. Colour. Uniform pale brown above, pale grey to white below. Tip of the caudal fin darker than remainder of fin. The dorsal spine is a bright lemon-yellow. No markings on disc.

Dimensions of the holotype in millimetres:

Snout tip to the tip of the caudal fin (total length) 205 mm.

Disc:	extreme breadth 133.
	length (not including pelvics) 110.
	length to inner pectoral margin 101.
Snout tip to:	orbits of eyes 25.
	mouth 28.
	Origin of pelvic fins 95.
	centre of cloaca 102.
	origin of caudal spine 149.
Orbits:	horizontal diameter 11.
	distance between 10.
Spiracle:	length 11.
	distance between 18.
Mouth:	breadth 11.
Nasal flap:	anterior least width 7.
	posterior maximum width 13.
	length 6.
Pelvic fin:	base 21.
	distance between origins 31.
Caudal fin:	length from ventral origin 49.
	depth 8.
Tail keel:	length 57.

The lobate nasal curtain and the form of the nostrils clearly distinguish this species from all other previously described urolophids. The only species with a wide disc other than *Urolophus*

expansus is *Urolophus kaianus* Günther (original description copied in part by Fowler (1941 p. 445). The description given by Günther 1870 is inadequate and no illustration is supplied.

Mr. P. J. Whitehead, of the British Museum of Natural History, kindly forwarded an excellent drawing of the nostrils and nasal flap of the largest of the two syntypes of *U. kaianus* (235 mm in total length); this drawing shows the nasal flap to be relatively simple, without lobate anterior lateral margins, and the outer margin of the nostril lacks the tentacle found on all specimens of *U. lobatus*.

Urolophus expansus McCulloch

Urolophus expansus McCulloch 1916 p.178, Fig.2, type locality Great Australian Bight in 80-120 fathoms; Waite 1921 p.33, Fig. 47; McCulloch 1929-30 p.27; Whitley 1940 p.218, Fig.247; Fowler 1941 p.446; Munro 1956 p.18; Scott 1961 p.43, Great Australian Bight South Australia; Whitley 1964 p.34.

Distribution. Trawled in 80-120 fathoms in the Great Australian Bight, South Australia, not yet recorded from Western Australia.

Urolophus bucculentus Macleay

Urolophus bucculentes Macleay 1884 p.172, type locality outside Port Jackson in 40-60 fathoms; McCulloch 1916 p.177, Bass Strait, in 70-100 fathoms; McCulloch 1921 p.466, pl.41, Figs.1-3; McCulloch 1929-30 p.27, New South Wales, Tasmania; Whitley 1940 p.216, Fig.245; Fowler 1941 pp.443-444; Munro 1956 p.18, southern New South Wales, Victoria, and Tasmania; Stead 1963 p.173; Whitley 1964 p.34.

Trygonoptera bucculenta Waite 1899 p.44, pl.5, text Fig.3, Garman 1913 p.410.

Distribution. Southern New South Wales, Victoria and Tasmania. Not recorded from Western Australia, although Stead (1963 p. 173) suggests that this species may be present in Western Australian waters.

Family **TORPEDINIDAE**

Sluggish fishes, remaining on the bottom partially buried in sand, these rays are well known for their capability of delivering a powerful electric shock if handled or trodden upon by an unwary swimmer. The electric organs consist of large numbers of vertical columnar structures arranged more or less regularly in a honeycomb fashion on each side of the disc. The columns are divided by transverse electric discs or plates of jelly-like consistency. The whole organ occupies the entire thickness of the disc, and may often be discerned through the thin overlying skin on the ventral surface.

Outline of the disc is almost circular in some species, rather elongate in others; skin naked above and below. Tail short, sometimes rudimentary, bearing two dorsal fins and a well developed caudal fin. No spines on tail.

Eyes developed and functional in some species, almost obsolete in others. Spiracles close behind eyes, with or without fringes or papillae.

Three genera in Australia.

Key to genera of Torpedinidae found in Australian seas

(1)	Tail shorter than disc	2
	Tail longer than disc	*NARCINE*
(2)	Pelvic fins united into a smaller disc. Teeth with two or three cusps	*HYPNOS*
	Pelvic fins not united. Teeth with only one cusp	*TORPEDO*

Genus *HYPNOS* Duméril

Hypnos Duméril 1852 p.277; type species *Hypnos subnigrum* Duméril 1852 = *Lophius monopterygius* Shaw and Nodder 1795.

Hypnarce Waite 1902 p.180; type species *Hypnos subnigrum* Duméril 1852.

Diagnosis. Disc broader than long, flattened. Tail short and rudimentary, bearing two small dorsal fins situated close together. Mouth not protractile. Teeth numerous and with three cusps. Spiracle close behind eye, with margin of spiracle fringed. Eyes small, about half diameter of spiracle. Pelvic fins united into a smaller disc.

One species, endemic to Australia.

Hypnos monopterygium (Shaw and Nodder)

Lophius monopterygius Shaw and Nodder 1795 pls.202 and 203.

Hypnos subnigrum Duméril 1852 p.279; Günther 1870 p.453, West Australia; Macleay 1880 p.310, Port Jackson and West Australia; Haswell 1884 p.104, pl.11, Figs.6-9; Howes 1890 p.669, pl.57; Waite 1899 p.42; Zeitz 1908 p.292; McCulloch 1921 pl.38, Figs.3-4; Fowler 1941 p.340.

Hyprarce Subnigrum, Garman 1913 p.304; McCulloch 1921 p.467, New South Wales; Great Australian Bight; Port Jackson and Clarence River estuary; Rottnest Island, Western Australia; Waite 1921 p.28, Fig.41.

Hypnarce subnigra, Waite 1902 p.180; McCulloch 1929-30 p.25; Marshall 1964 p.34, pl.13.

Hypnarce monopterygium, Whitley 1940 p.165, Figs.11, 187, and 188; Whitley 1948 p.9.

Hypnos monopterygium, Munro 1956 p.20; Scott 1962 pp.50-51; Stead 1963 pp.146-148, Fig.47; Whitley 1964 p.34.

This strangely shaped electric ray is not uncommon in Western Australian waters, and has been taken on the southern and lower western coastline northwards to Shark Bay where it is frequently trawled.

Material examined in Western Australian Museum: 4 males, total length 240mm-400mm, 9 females, total length 192mm-548mm from: Emu Point (Albany), Flinders Bay (near Augusta), Yallingup, Bunker Bay (near Cape Naturaliste), Safety Bay. Naval Base, Woodmans Point, Rottnest Island, Fremantle, Lancelin Island, Beagle Island, and Shark Bay. I have recorded specimens from Cottesloe, City Beach, Wallabi Islands (Houtman Abrolhos), Shark Bay (many localities within Shark Bay in 7-11 fathoms, smallest example was a male of 155 mm, largest specimen a female of 510 mm total length).

Distribution. Southern Queensland, New South Wales, South Australia and Western Australia.

Genus *TORPEDO* Houttuyn

Torpedo Houttuyn 1764 p.453; type species *Raja torpedo* Linnaeus 1758.

For generic synonyms see Bigelow and Schroeder (1953 p.90).

One species in Australia.

Torpedo macneilli (Whitley)

Torpedo fairchildi (non Hutton), McCulloch 1919 pp.171-172, pl.25, 49 fathoms off Green Cape, New South Wales (description); Stead 1963 pp.145, 148 and 149.

Narcobatus fairchildi (non Hutton), Waite 1921 p.28, Fig. 40, South Australia; McCulloch 1926 p.159, Bass Strait; Great Australian Bight, south of Eucla on the border between South and Western Australia, 80-320 fathoms; McCulloch 1927 p.10, pl.3, Fig.32a.

Notastrape macneilli Whitley 1932 p.327; Whitley 1940 p.162, Fig.181; Fowler 1941 pp.345-346 (as synonym of *T. fairchildi* Hutton); Whitley 1948 p.9, area 1, Western Australia; Whitley 1964 p.34.

Torpedo macneilli, Bigelow & Schroeder 1953 pp.93, 95; Munro 1956 p.20; Scott p.51.

Doubtfully distinct from *Torpedo fairchildi* Hutton, found in New Zealand. Whitley (1940 p.162) states . . . "It may be only a subspecies of the New Zealand *fairchildi*". Fowler (1941 p.345) unites *T. macneilli* with *T. fairchildi*, but Bigelow & Schroeder (1953), while doubting the validity of *T. macneilli* (p 90) state (footnote No. 63, p.95) . . . "the rear end of the base of its (*T. macneilli*) first dorsal is considerably posterior to the rear ends of the pelvic fin bases, not in a line with the latter, as appears to be the case in the New Zealand *T. fairchildi* . . . ." Bigelow & Schroeder retain *T. macneilli* as a separate species in their key to species of the genus *Torpedo* (pp.94-96). Stead (1963 p.149) regards *T. macneilli* as conspecific with *T. fairchildi* Hutton.

The characters separating *T. macneilli* from the New Zealand *T. fairchildi* appear to be:

(1) Spiracles closer to orbits.
(2) Disc not as circular.
(3) Rear end of the base of the first dorsal fin considerably posterior to the rear ends of the pelvic fin bases.

Distribution. New South Wales, Victoria, South Australia and southern Western Australia. Not represented in the Western Australian Museum.

Genus *NARCINE* Henle

Narcine Henle 1834 p.2; type species *Torpedo brasiliensis* Olfers 1831.
Syrraxis Jourdan 1841; type species *Narcine indica* Henle 1834.
Cyclonarce Gill 1862 p.387; type species *Narcine timlei* Henle = *Raja timlei* Bloch & Schneider 1801.
Gonionarce Gill 1862 p.387; type species *Narcine indica* Henle 1834.
Heteronarce Regan 1921 p.414; type species *Heteronarce garmani* Regan 1921.
Narcinops Whitley 1940 p.164; type species *Narcine tasmaniensis* Richardson 1840.

Diagnosis. Disc rounded, shorter or slightly longer than tail. Tail moderate, with well developed lateral cutaneous folds. Caudal fin ovate or truncate. Two dorsal fins, the first originating over or slightly behind ends of pelvic fin bases. Pelvic fins distinct, their outer margins broadly rounded or concave, posterior margins not joined across base of tail. Snout produced, rostral cartilage broad and shovel-shaped, somewhat flexible near tip, with or without a transverse foramen in proximal portion. Mouth narrow, transverse, protractile as a short tube; upper and lower jaw cartilages bound together by two triangular labial cartilages which limit gape of mouth. Teeth in narrow bands only loosely attached to jaw cartilages, and extending well out on to upper and lower lips. Nostrils not divided by a cross-bridge, almost roofed over by a joint nasal curtain which extends to or almost to mouth. Nasal curtain almost as broad as deep in some species, much broader than deep in others. Eyes developed, smaller than spiracles in some species, larger than spiracles in others. Spiracles contiguous to eyes or only slightly separate; margins smooth, corrugated, or bearing papillae.

The following species are recognised by the author.

- *Narcine timlei* (Bloch & Schneider) 1801.
- *Narcine brasiliensis* (Olfers) 1831.
- *Narcine indica* Henle 1834.
- *Narcine tasmaniensis* Richardson 1840.
- *Narcine lingula* Richardson 1846.
- *Narcine mollis* Lloyd 1907.
- *Nacine brunnea* Annandale 1909.
- *Narcine garmani* (Regan) 1921.
- *Narcine vermiculatus* Breder 1928.
- *Narcine schmitti* Hildebrand 1948.
- *Narcine westraliensis* sp. nov.

Comments. In their recent revision of the Torpedinidae, Bigelow and Schroeder (1963 pp.87-132) consider *Syrraxis, Cyclonarce, Gonionarce,* and *Narcinops,* synonms of *Narcine,* and remarked (p.89 footnote) . . . "*Heteronarce* is so close to *Narcine* that its generic validity is doubtful . . . " In keys to the Torpedinidae given by Fowler (1941 p.332), and Bigelow and Schroeder (1953 pp.87-90), *N. westraliensis* sp. nov. would key down to *Heteronarce.*

The key character recognised by previous authors for *Heteronarce* is the relatively narrow nasal flap. *N. westraliensis* has this narrow nasal flap but in most other features resembles species belonging to *Narcine,* particularly *N. tasmaniensis. Heteronarce* is here synonymised with *Narcine,* the concept of which has been broadened.

Narcine westraliensis species nova

(Figs. 3, 4, 5, 6)

The description is based on the holotype, a male of 212 mm total length, W.A.M. P 6963, collected by author October 5, 1960, 8 miles N.W. of Cape Peron, Shark Bay, Western Australia. The range given within the parenthesis is the percentage of the total length of 43 paratypes listed below.

Description. Disc subcircular, anterior margin evenly rounded. Length of disc slightly less than breadth (equal to or slightly greater than breadth in most paratypes) 40.6% of total length, (38.7-41.6 in males, 36.9-44.1 in females). Posterior contour of pectorals rounded and recurved, merging with sides of tail. Tail moderately rounded above, slightly flattened below, tapering to caudal fin, length from centre of cloaca 55.7% of total length (52.3-58.3), and greater than distance between snout tip and centre of cloaca. Tail with a narrow, low cutaneous fold originating below first dorsal fin, and continuing 25.9% of total length (20.1-29.0).

Length of snout in front of orbits 8.9% (7.1-10.4) of total length. Orbits prominent and elevated, larger than spiracles; longitudinal diameter of orbit 47.4% of snout length (38.8-58.8 in males, 38.9-50.0 in females) and 81.8% of interorbital space (53.8-90.0 in males, 57.1-72.7 in females). Width of orbits 54.5% of interorbital space (35.7-70.0 in males, 35.3-59.1 in females).

Spiracles contiguous to eyes; margins smooth, only slightly raised, without papillae. Length of spiracle from posterior of orbit 42.9% (28.6-46.1 in males, 26.7-50.0 in females) of distance between spiracles.

Snout tip to anterior margins of nostrils 8.5% (7.7-9.6) of total length. Nostrils small, almost transverse interiorly, rounded exteriorly. *Nasal flap or curtain narrow with rounded corners, straight behind without projections or lobes, free edge entire, without fringes.* Depth of nasal curtain 85.0% of its least width (65.0-92.9 in males, 68.8-100.0 in females. Nostrils without outer flaps or lobes.

Mouth transverse, straight, somewhat protractile; extreme breadth 7.6% (6.0-8.5) of total length. Lips fleshy and wrinkled.

Teeth somewhat rhomboidal in shape, inner ones with posterior angle produced to form an acuminate cusp. (Tooth rows increasing with growth, from 6/6 in embryo of 63 mm t.l., to 22/21 in female of 266 mm t.l., see Fig.4). Tooth bands extend outside mouth (see Fig.5a). Behind teeth of both jaws, a raised fimbriate fleshy ridge is present, followed by transverse, raised, cutaneous ridges lacking projections in the midline.

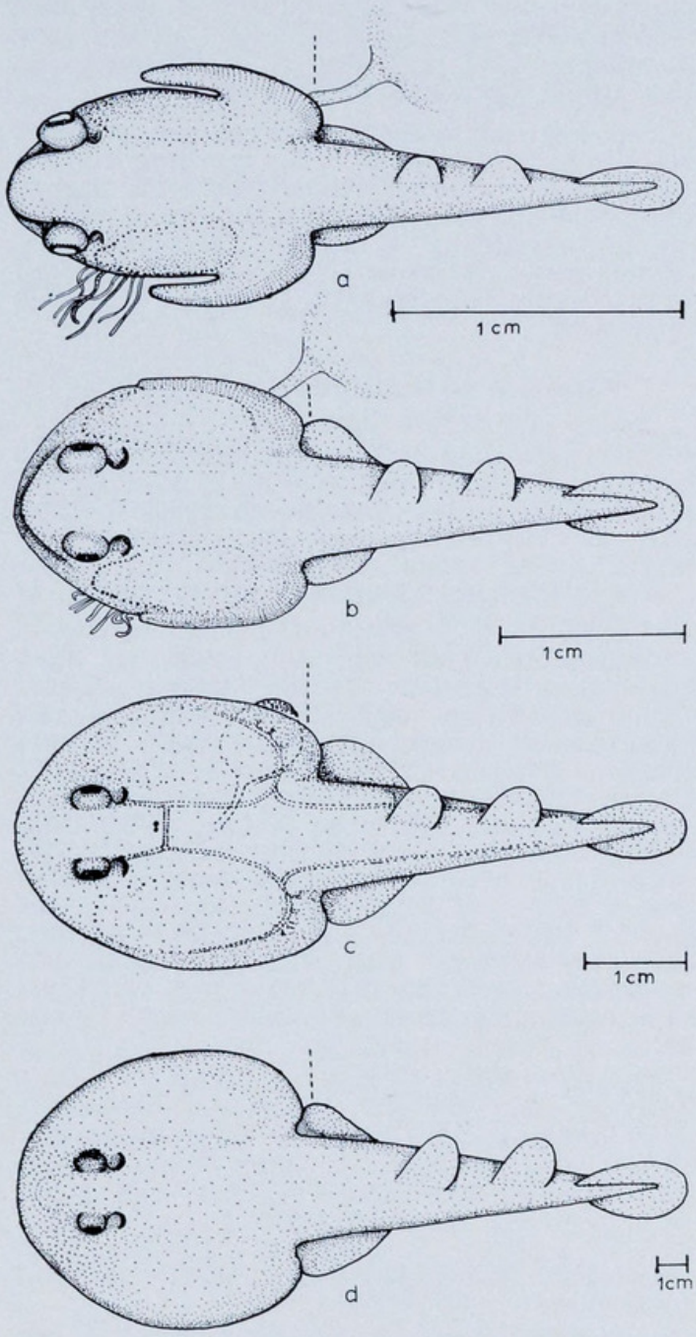


Figure 3.—*Narcine westraliensis* sp. nov. selected specimens showing changes in body proportions with increase in size. All are drawn to same size for comparison. a: embryo P 7721, total length 23.2 mm; b: embryo P 7726, total length 38.6 mm; c: embyro P 7734, total length 66.5 mm; d: adult male, total length 212 mm.

Snout tip to origin of first dorsal fin 55.7% of total length (52.1-57.1 in males, 50.5-57.9 in females). Snout tip to origin of second dorsal fin 70.3% of total length (66.8-71.8 in males, 65.3-74.1 in females). Dorsal fins, similar in shape, apex rounded, little change with growth. Origin of first dorsal fin over posterior end of pelvic base. First dorsal fin vertical height 8.5% of total length (7.2-10.0 in males, 6.0-9.6 in females); second dorsal fin vertical height 8.0% of total length (7.5-10.2 in males, 6.3-9.8 in females). First dorsal fin base 7.6% of total length (6.9-9.0 in males, 6.9-8.3 in females); second dorsal fin base 8.5% of total length (7.8-9.6 in males, 8.0-9.2 in females) Interdorsal space 5.2% of total length (5.1-8.3 in males, 5.0-7.2 in females).

Caudal fin ovoid, upper and lower margins continuously rounded, without definite lower corner. Length of caudal fin from origin of lower margin 17.7% of total length (17.7-19.5 in males, 16.7-20.3 in females).

Pectoral fins overlapping origin of pelvic fins. Outer margin of pelvic fins almost straight (weakly concave to weakly convex). Inner margins of pelvics anterior to rear tips, free from sides of tail for a short distance.

Height of body 9.4% of total length (8.0-11.1 in males, 7.5-13.5 in females). Gill openings small, increasing slightly in length from first to fourth; fifth gill slit smallest.

Body light buff or sandy with rather ornate, variable brown markings on disc. (Pattern frequently in the form of transverse bars or bands of varying width, or vague chain-like markings). Tail with transverse bars in all specimens including embryos. Colour never uniform brown above. Undersurface light, almost white. Eyes black.

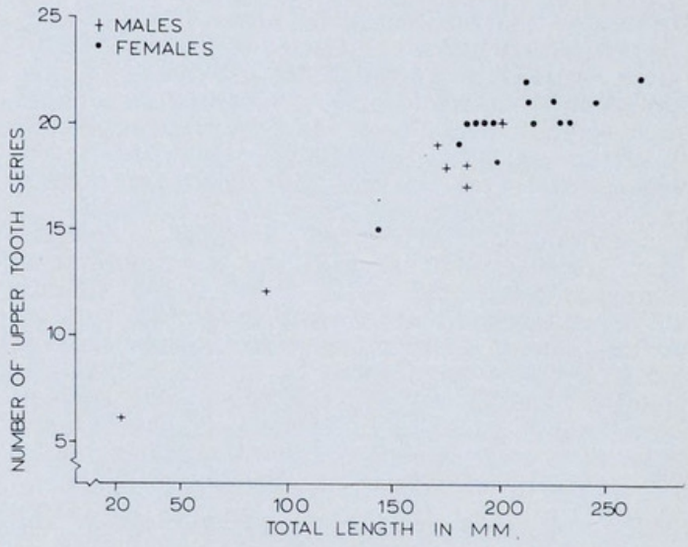


Figure 4.—Scatter diagram showing increase in number of upper tooth series with increase in body size for male and female *Narcine westraliensis*.

Comparison of N. westraliensis with other species

Registered material examined in Western Australian, Australian, and Bombay Museums is prefixed W.A.M., A.M., and B.M. respectively.

Narcine westraliensis

Paratypes. 21 males and 22 females trawled inside Shark Bay by State Fisheries Research Vessel *Peron* during years 1960 and 1962: W.A.M.

P 6946 ♂ 209 mm t.l., P 6947 ♂ 176 mm t.l.,
P 6948 ♀ 212 mm t.l., P 6949 ♀ 190 mm t.l.,
P 6950 ♀ 268 mm t.l., P 6951 ♂ 203 mm t.l.,
P 6952 ♀ 189 mm t.l., P 6953 ♀ 184 mm t.l.,
P 6954 ♂ 186 mm t.l., P 6955 ♂ 174 mm t.l.,
P 6956 ♂ 187 mm t.l., P 6957 ♂ 180 mm t.l.,
P 6958 ♂ 195 mm t.l., P 6959 ♂ 200 mm t.l.,
P 6960 ♀ 110 mm t.l., P 6961 ♂ 182 mm t.l.,
P 6962 ♂ 201 mm t.l., P 6964 ♀ 207 mm t.l.,
P 6965 ♀ 160 mm t.l., P 6966 ♂ 195 mm t.l.,
P 6967 ♂ 184 mm t.l., P 6968 ♀ 193 mm t.l.,
P 6969 ♂ 157 mm t.l., P 6970 ♂ 202 mm t.l.,
P 6971 ♂ 204 mm t.l., P 6972 ♀ 180 mm t.l.,
P 6973 ♂ 117 mm t.l., P 6974 ♀ 195 mm t.l.,
P 6975 ♂ 193 mm t.l., P 6996 ♀ 182 mm t.l.,
P 6997 ♂ 197 mm t.l., P 6998 ♀ 190 mm t.l.,
P 6999 ♀ 188 mm t.l., P 7003 ♀ 196 mm t.l.,
P 7004 ♀ 189 mm t.l., P 7005 ♂ 190 mm t.l.,
P 7009 ♀ 198 mm t.l., P 7016 ♀ 222 mm t.l.,
P 7018 ♀ 238 mm t.l., P 7031 ♀ 220 mm t.l.,
P 7033 ♀ 195 mm t.l., P 7035 ♂ 194 mm t.l.,
P 5027 ♀ 200 mm t.l.

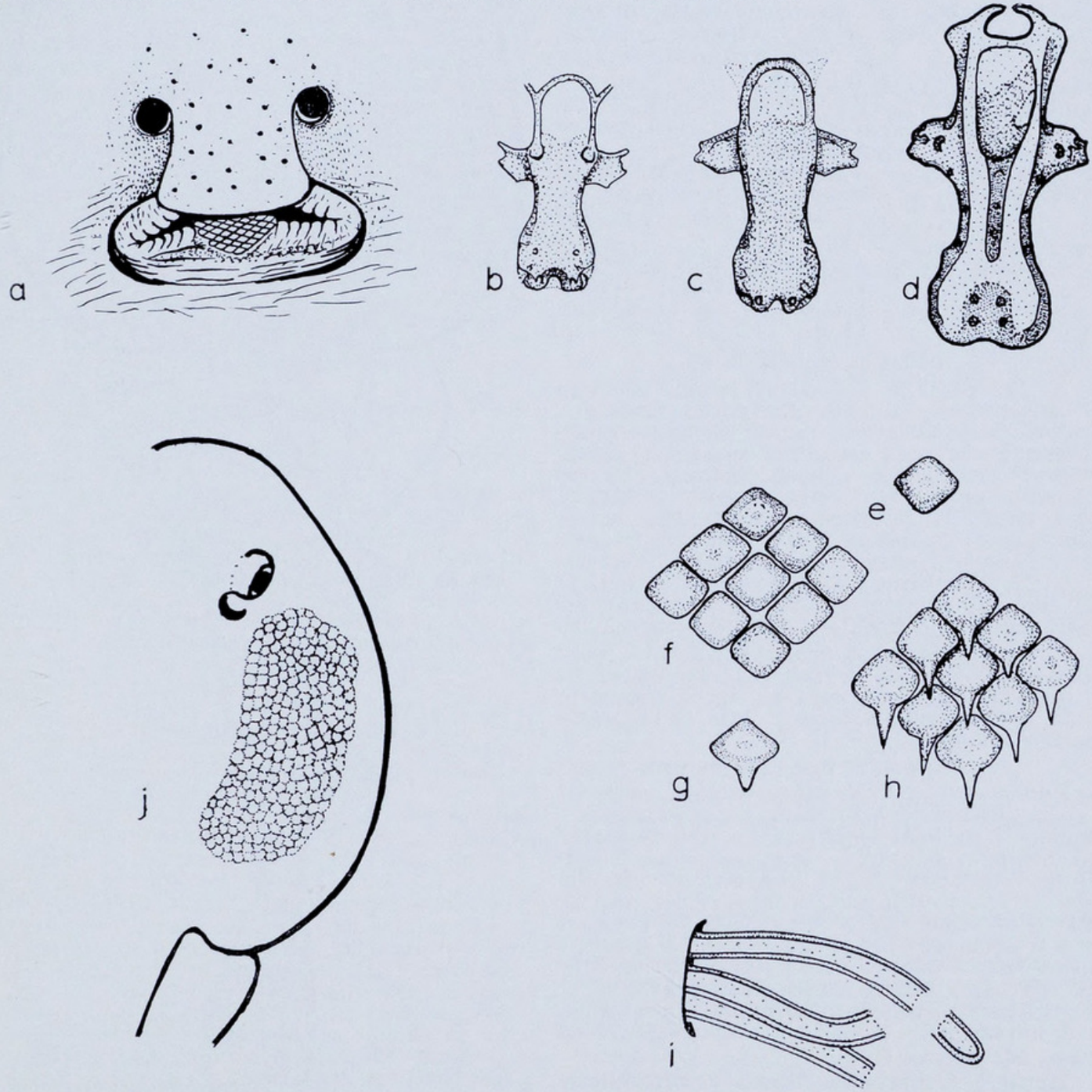


Figure 5.—a: *Narcine westraliensis* mouth and nasal curtain; b: *Narcine westraliensis* skull (from radiograph); c: *Narcine tasmaniensis* skull (from radiograph); d: *Narcine brasiliensis* skull (after Henle); e: External teeth of *Narcine tasmaniensis;* f: External teeth of *Narcine tasmaniensis;* g: Inner-most teeth of *Narcine tasmaniensis;* h: Inner-most teeth of *Narcine westraliensis;* i: Filamentous gills of *Narcine westraliensis* embryos; j: *Narcine westraliensis* showing position of electric organ on one side of disc.

W.A.M. P 6978-P 6993, 16 specimens, some dissected. 21 embryos W.A.M. P 7720 ♀ 36.0 mm t.l., P 7721 sex ? 23.2 mm t.l., P 7722 sex ? 23.3 mm t.l., P 7723 ♀ 36.8 mm t.l., P 7724 ♀ 38.1 mm t.l., P 7725 ♀ 38.5 mm t.l., P 7726 ♂ 38.6 mm t.l., P 7728 ♂ 55.0 mm t.l., P 7729 ♀ 63.6 mm t.l., P 7730 ♀ 61.0 mm t.l., P 7732 sex? 25.7 mm t.l., P 7733 ♀ 59.0 mm t.l., P 7734 ♀ 66.5 mm t.l., P 7797 ♂ 60.0 mm t.l., P 7798 ♀ 53.5 mm t.l., P 7799 ♀ 63.0 mm t.l., P 7800 ♂ 40.0 mm t.l., P 7801 ♀ 64.0 mm t.l., P 7810 ♂ 60.0 mm t.l., P 7851 ♀ 46.0 mm t.l., P 7853 ♀ 47.0 mm t.l.

Embryos in Table 1

Group A. = 3 specimens W.A.M. P 7721, P 7722, P 7732, 23.2 mm t.l. to 25.7 mm t.l.

Group B. = 5 specimens W.A.M. P 7720, P 7723, P 7724, P 7725, P 7726, 36.0 mm t.l. to 38.6 mm t.l.

Group C. = 3 specimens W.A.M. P 7800, P 7851, P 7853, 40.0 mm to 47.0 mm t.l.

Group D. = 5 specimens W.A.M. P 7798, P 7733, P 7728, P 7810, P 7797, 53.5 mm to 60.0 mm t.l.

Group E. = 5 specimens W.A.M. P 7801, P 7799, P 7734, P 7729, P 7730, 61.0 mm to 66.5 mm t.l.

Other Narcine *species*

N. tasmaniensis A.M. IB 4751 male 254 mm t.l., collected Miss J. Campbell, Bermagui, N.S.Wales, 14.viii.1960. A.M. IB 4752 female 224 mm t.l., data as above specimen. A.M. IB 4330 female 110 mm t.l., collected by Dr. A. A. Racek, N.E. Broken Bay, N.S.Wales 19.vi.1959, 137 fathoms. A.M. I 9982 female 225 mm t.l., collected F.R.V. "Endeavour" east of Flinders Island, Bass Strait, vi.1909. A.M. IA 2968 three foetal specimens 75 mm to 92 mm t.l., all females, collected A. Ward, off Port Hacking, N.S.Wales, 40-50 fathoms, x.1926.

N. timlei A.M. I 135 female 167 mm t.l., purchased Mr. F. Day, ii.1886, Madras A.M. I 49 female 203 mm t.l., data as above specimen. B.M. 88.11.67, male 300 mm t.l. B.M. 88.11.6.87.89, female 288 mm t.l.

N. indica B.M. 1367 male 280 mm t.l.

Narcine westraliensis differs from *N. garmani* (originally *Heteronarce*) in having head approximately 7 in total length (5⅓ in (*N. garmani*) in having snout 7.2 - 10.4% of total length instead of about 11.7%, the diameter of the eye in *N. westraliensis* ranges from 38.8%-58.8% of snout length, whereas in *N. garmani* eye is about 20% of snout length. *N. westraliensis* has a shorter snout; the posterior edge of the nasal flap is regular, outer margins of pelvics not convex, and the caudal fin is ovoid, not fan-shaped. Colour not uniform above as in *N. garmani*.

From N. *mollis* (the other species formerly placed in *Heteronarce*) *N. westraliensis* differs in having disc less than half total length; smaller spiracles without a raised ridge on margin; nasal curtain with rounded corners and no projection in mid-line; nostrils transverse, without a surrounding flap of tissue as shown by Lloyd (1909 pl.XLVI Fig.1a). The caudal fin is ovoid and not fan-shaped as in *N. mollis*. Colour not uniform above.

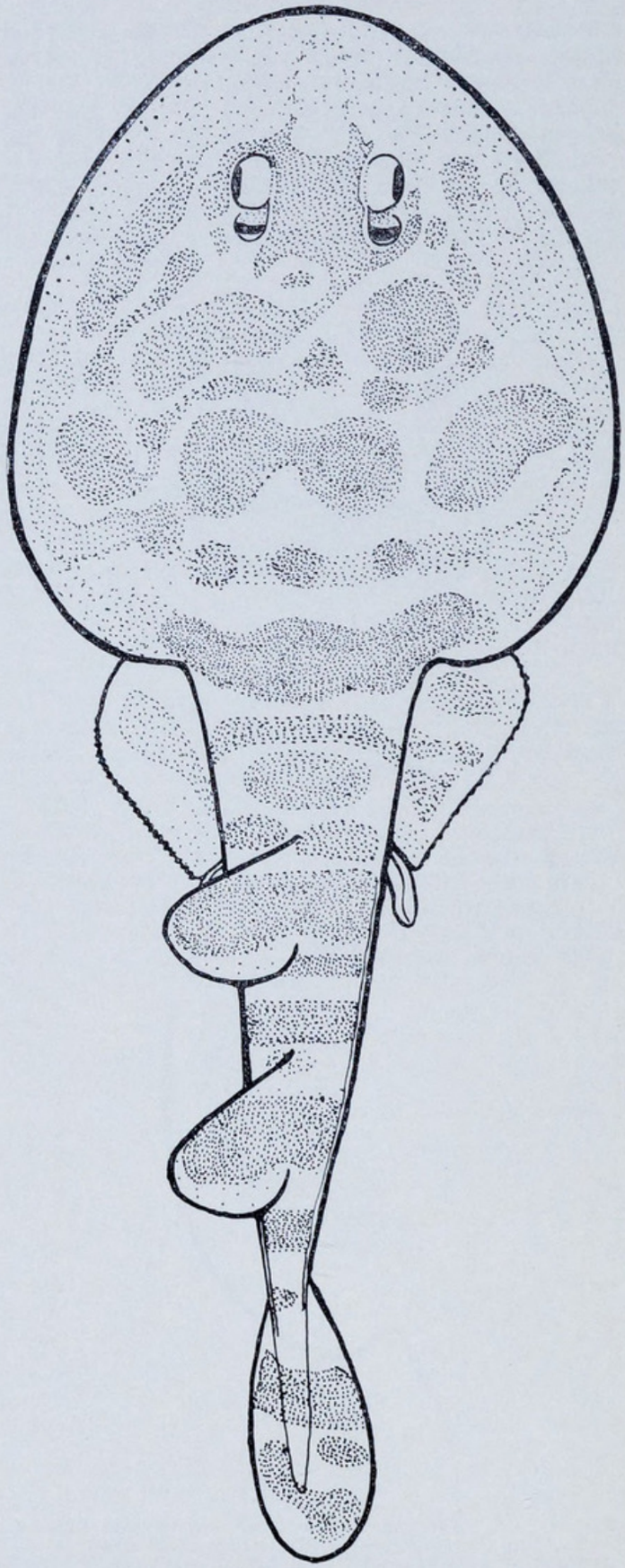


Figure 6.—*Narcine westraliensis*. Holotype P 6963, total length 212 mm.

From other species of the genus *Narcine*, *N. westraliensis* can be distinguished by its colour pattern, and narrower nasal curtain, but apart from these characters it differs from *N. brasiliensis* in having tail ovoid instead of fan-shaped, less numerous teeth series, spiracles with smooth margins, fewer columns in electric organs, and appears to be smaller; from *N. vermiculatus* in having ovoid caudal fin, eyes larger than spiracles, having a slightly smaller snout than figured by Breder (1928 Fig.3, Fig.4), and having dorsal fins more separated; from *N. lingula* in having ovoid caudal fin, eyes larger than spiracles, having a slightly smaller snout than figured by Breder (1928 Fig.3, Fig.4), and having dorsal fins more separated; from *N. lingula* in having ovoid caudal fin, eyes larger than spiracles, fewer teeth series, entirely smooth spiracles, disc longer than wide, and dorsals not rather pointed; from *N. schmitti* in having ovoid caudal fin, smaller disc, and much shorter snout; from *N. indica* in possessing smaller spiracles, shorter dorsal fins, and greater interdorsal space; from *N. timlei* in having smaller disc, much smaller snout, larger eyes, smaller spiracles and in having posterior tips of pelvics free from tail for a short distance; and from *N. brunnea* in those features listed for *N. timlei* and having nasal curtain without a projection in the mid-line.

In comparison with *N. tasmaniensis*, *N. westraliensis* shows the following differences:

(1) The nostrils are closer together, thus resulting in a much narrower nasal curtain.

(2) Coloration is never a uniform brown above.

(3) The second dorsal fin is slightly closer to the origin of the caudal fin.

(4) The spiracles are quite contiguous in all examples, whereas in *N. tasmaniensis* some large examples appear to have the spiracles slightly separate from the eyes. Richardson's (1849 Pl.XI Fig.2) figure of *N. tasmaniensis* shows eyes quite remote from spiracles, and he gives distance between spiracles and eyes as exceeding "the quarter of the space between the eyes."

Whitley (1940, Figs. 180 and 186) show spiracles contiguous with eyes, and this is confirmed for most specimens examined by me, particularly smaller examples.

(5) The nasal curtain of *N. westraliensis* has significantly more pores studding its surface (about 15) than does *N. tasmaniensis* (about 2 or 3).

Regan (1921 p.414), when proposing the genus *Heteronarce*, used the occurrence of numerous pores on the nasal flap of *N. garmani* as a generic character. Lloyd 1909 pl.XLVI, Fig.1a) shows the nasal flap of *N. mollis* with numerous pores. Fowler (1925 p.198), in describing *Narcine natalensis* (= *N. garmani*) made no mention of nasal flap pores, and von Bonde and Swart (1923 p.15) in describing *Heteronarce regani* (= *N. garmani*) state that their specimen "agrees in all features with the generic characters of *Heteronarce* Regan, except that the naso-frontal lobe is not studded with pores."

The occurrence of numerous nasal-flap pores in other species is yet to be determined, as they are inconspicuous and can easily be overlooked.

Internal anatomical observations. Whitley (1940 p.164) proposed the genus *Narcinops* on the basis that *N. tasmaniensis* differed from the typical *Narcine* (*N. brasiliensis*) "in form of body, margin of nasal valves, in having a wider skull and different cartilages, as discovered by Richardson" (1849 p.140).

I agree with Richardson that the skull in *N. tasmaniensis* is proportionately wider than Henle's (1834 Pl.IV Fig.1) figure of the skull of *N. brasiliensis*, that the small intermediate cartilages between antorbital and rostral cartilages are lacking, and that the foramen in the anterior part of the rostral cartilage is absent; but I do not agree with Whitley that these are of generic importance.

All examples of *N. westraliensis* radiographed are without a foramen in the anterior portion of the rostral cartilage, lack the small intermediate cartilage between antorbital and rostral carilages and possess a proportionately wider skull than that figured for *N. brasiliensis* (see Figs. 5 b, c, d).

Richardson (1849 p.180), recorded 118 vertebrae for *N. tasmaniensis*, and for that species (A.M. IB 4751) I count 122. Vertebral counts for specimens of *N. westraliensis* were: W.A.M. P 6952, 107; W.A.M. P 6970, 100; W.A.M. P 6971, 103: W.A.M. P 6972, 102; W.A.M. P 6973, 109; W.A.M. P 6974, 103; W.A.M. 6975, 107.

All radiographed specimens have the first 13 or 14 vertebrae with quite short transverse processes, the next 6 or 7 have transverse processes very long and slender. Specimens W.A.M. P 6952, P 6970 and P 6971 have 5 on one side, 6 on the other. Specimens W.A.M. P 6972, P 6974 and P 6975 have 6 plus 7. In *N. tasmaniensis* A.M. IB 4751 I count 7 plus 7.

Both *N. westraliensis* and *N. tasmaniensis* have short conical spines near posterior internal margins of spiracles, these number from 3 to 7 on each side, individual counts for *N. westraliensis* were ♂ 171 mm t.l., 3 + 3, ♂ 175 mm t.l., 3 + 4, ♂ 181 mm t.l., 4 + 4, ♀ 194 mm t.l., 4 + 4, ♀ 196 mm t.l., 7 + 5, ♀ 248 mm t.l., and ♀ 266 mm t.l., 6 + 6. *N. tasmaniensis* ♂ 254 mm t.l. had 4 + 4.

The pelvic fins in *N. tasmaniensis* (A.M. IB 4751) have 19 cartilaginous rays (including clasper) whereas Richardson (1849 p.181) gives 21. In *N. westraliensis* specimens I find 17 to 19.

Teeth. Figure 4 shows the increase of tooth rows in the upper jaw with growth of *N. westraliensis* specimens. Counts of tooth rows in upper and lower jaws are generally the same but some specimens possess one or two more in upper jaw.

The shape of the innermost and outermost teeth differs markedly as shown by Figs. 5 f, h, the innermost teeth possessing an elongate sharply pointed cusp on lower angle. Since the shape of the teeth is similar in late stage embryos, differences are not due to wear.

Biometrical observations. Table 2 gives the biometrics of *N. westraliensis* adults and embryos and the adults of *N. tasmaniensis*. The values are given as arithmetic means expressed in thousandths of the total length unless stated otherwise.

Regression equations and correlation coefficients for three important dimensions are given separately for 22 adult male and 22 adult female *N. westraliensis*. The statistics and symbols of Simpson, Roe and Lewontin (1960) have been adopted. Males: size range 117 mm t.l. to 212 mm t.l.

The regression of the dimension snout tip to cloaca centre (Y) on the total length (X) is given by the equation $Y = 0.434X + 1.41$, the confidence limits at the 95% level being ± 0.046 and ± 0.91 for Byx and Ay. Confidence limits at any level can be obtained for the mean and individual predicted value of Y using the values Syx = 2.055, $Sx^2 = 414.95$, $\bar{x} = 188$. The correlation of Y and X is very high, r = 0.975, z = 2.185.

The regression of the dimension snout tip to origin of the first dorsal fin (Y) on the total length (X) is given by the equation $Y = 0.528X + 3.72$, the confidence limits at the 95% level being ± 0.058 and ± 1.15. Syx = 2.588. The corection of Y and X is r = 0.972, z = 2.078.

The regression of the dimension snout tip to pectoral axilla (Y) on the total length (X) is given by the equation $Y = 0.394X + 1.66$, the confidence limits at the 95% level being ± 0.047 and ± 0.94. Syx = 2.123. The correlation of Y and X is r = 0.968, z = 2.060.
Females: size range 110 mm t.l. to 268 mm t.l.

The regression of the dimension snout tip to cloaca centre (Y) on the total length (X) is given by the equation $Y = 0.454X - 2.18$, the confidence limits at the 95% level being ± 0.037 and ± 1.08 for Byx and Ay. Confidence limits at any level can be obtained for the mean and individual predicted value of Y using the values Syx = 2.434, $Sx^2 = 863.23$, $\bar{x} = 196$. The correlation of Y and X is very high, r = 0.984, z = 2.410.

The regression of the dimension snout tip to the origin of the first dorsal fin (Y) on the total length (X) is given by the equation $Y = 0.568X - 2.42$, the confidence limits at the 95% level being ± 0.036 and ± 1.06. Syx = 2.372. The correlation of Y and X is r = 0.991, z = 2.700.

The regression of the dimension snout tip to pectoral axilla (Y) on the total length (X) is given by the equation $Y = 0.395X + 2.00$, the confidence limits at the 95% level being ± 0.055 and ± 1.58. Syx = 3.561. The correlation of Y and X is r = 0.960, z = 1.946.

TABLE 2

Biometrical measurement of Narcine westraliensis *and* Narcine tasmaniensis.

	N. westraliensis Embryo's Group A	*N. westraliensis* Embryo's Group B	*N. westraliensis* Embryo's Group C	*N. westraliensis* Embryo's Group D	*N. westraliensis* Embryo's Group E	*N. westraliensis* Adult males	*N. westraliensis* Adult females	*N. tasmaniensis* Adult male	*N. tasmaniensis* Adult females
NUMBER OF SPECIMENS MEASURED	3	5	3	5	5	22	22	1	3
Snout tip to pectoral axilla	446	414	424	444	439	402	402	386	399
Greatest width of disc	358	397	400	411	441	386	379	394	423
Snout tip to line before orbits	59	72*	82	87	91	89	89	91	94
Snout tip to anterior of nostrils	99	93	86	97	91	87	84	75	87
Snout tip to origin of 1st dorsal fin	571	549	538	549	548	550	550	531	549
Snout tip to origin of 2nd dorsal fin	617	670	655	681	674	693	697	677	689
Interorbital space	105	91	78	72	70	58	60	55	60
Distance between spiracles	127	110	94	90	87	69	69	63	67
Greatest width of mouth	69	68	59	61	63	72	72	63	61
Vertical height of 1st dorsal fin	43	59	60	67	65	84	79	75	72
Vertical height of 2nd dorsal fin	46	65*	59	66	64	84	80	67	75
Basal length of 1st dorsal fin	71	70	66	73	71	79	78	71	73
Basal length of 2nd dorsal fin	78	83	77	79	74	87	85	71	75
Distance between dorsal fins	57	52	50	66	58	65	62	87	78
Snout tip to cloaca centre	451**	457	443	438	439	414	441	433	443
Height of body	124	127	114	114	119	96	99	71	85
Length of tail keel	245*	....	....	....	....	239	243	280	300
Caudal fin length	....	....	193	191	185	185†	178†	177	....

All above measurements expressed as thousandths of total length.

Diameter of orbit in interorbital	787	729	753	784	822	722	645*	714	692
Width of orbit in interorbital	614*	546	591	586	582	510	498*	571	538
Length of spiracles in interspiracular	219	229	273	284	315	372	362	438	400
Width of spiracles in interspiracular	165	225	265	291	298	341	320	438	377
Orbit of eye in snout (before orbits)	1349	926	722	638	631	473	436	435	420
Length of nasal flap in its width	467	659	697	856	921	767	851	357	360**
Mouth width in snout length	1157	896	731	697	727	827	820	696	....

All above proportions expressed as thousandths.

* = 1 specimen less. ** = 2 specimens less. † = 12 specimens less.

TABLE 3

Narcine westraliensis
Number of columns in electric organ

Total length	Sex	Left side	Right side
164 mm.	♀	....	208
169 mm.	♀	196	....
180 mm.	♂♀	207	202
181 mm.	♀	198	....
184 mm.	♂♀	214	216
185 mm.	♀	....	197
193 mm.	♂♀	....	198
195 mm.	♂♀	212	220
206 mm.	♀	204	....

Electric organs and capabilities. The development of the electric organs occurs at a very early stage; the columns are readily observable in specimens of 20 mm t.l., and are almost fully developed well before birth. Figure 5j shows position of these organs. Nine specimens were dissected and counts of the number of columns per organ were made; these counts are given in Table 3.

Attempts to induce late stage embryos to discharge were unsuccessful. Cox and Breder (1943 p.48) had difficulty in making adult *Narcine brasiliensis* discharge, and I noticed that *N. westraliensis* was similarly reluctant, and allowed other fishes such as flounder (*Pseudorhombus* sp.) and flying gurnards (*Dactyloptena orientalis* Cuvier and Valenciennes) to settle on them. Adult *Narcine* could be gently handled underwater without receiving electric shocks, but the fish often discharged when first removed from the water. Only occasionally did a large *Narcine* produce a shock sufficiently powerful to discourage handling. As these fish were exhausted after 3 or 4 discharges it was not surprising to find *Narcine* incapable of producing shocks when removed from amongst the catch of the trawl net (the fish had probably exhausted its powers on contact with the trawl net when first captured).

General developments. Figure 3 shows the development of *N. westraliensis,* (a) an embryo, P 7721, 23.2 mm in total length, (b) an embryo, P 7726, 38.6 mm in total length, (c) an embryo, P 7734, 66.5 mm in total length, (d) an adult male 212 mm in total length. Drawn to same scale for comparison.

The smallest embryos obtained measured 19 mm in t.l., and at this size differ considerably from the late stage embryos in having the pectoral fins quite separate from the body; the mouth is rather poorly developed; eyes are relatively much larger; snout is a raised prominence; spiracles are small and covered over by semi-transparent tissue; the nasal openings are almost completely covered by a flap; the tail keel is absent; electric organs are just developed; the dorsal fins, although present have not assumed adult shape; the gills are external, three filaments arise from each gill opening, and extend well past cloaca, the filaments are shown in Figure 5 i.

At 20-22 mm t.l., the tail keel commences to form, and the pectoral fins are closer to the body. Figure 3 a shows specimen W.A.M. P 7721 (23.2 mm t.l.); the tail keel is almost developed at this stage; the pectoral and pelvic rays are unbranched at their extremities; no trace of nuchal pores are present, and colour pattern has not emerged.

Embryo W.A.M. P 7805 (25 mm t.l.) has the nuchal pores just present and shows early development of the mucous canal system.

Embryo W.A.M. P 7849 (a female of 35 mm t.l.) has the beginnings of the characteristic colour pattern; the pectoral and pelvic radials show recent branching at their tips, and fusion of the pectorals is well advanced.

Figure 3 b shows embryo P 7726 (a male of 38.6 mm t.l.), only a slight notch remains on side of disc; the spiracle has almost lost the sealing flap of tissue; the snout is not as prominent; the colour pattern is visible and dorsal fins have developed further. The yolk sac measures about 16 mm in diameter.

The spiracles are fully open in embryos of 40-42 mm, the mouth shows much development, and colour pattern is almost established. External gills are still in evidence until the embryo measures 54 mm in t.l. (W.A.M. P 7856), and the yolk sac persists until a length of 63.5 (W.A.M. P 7081) to 66 mm is reached.

The teeth originate in embryos between 60 and 65 mm total length. Size at birth is approximately 75 mm t.l. Bigelow and Schroeder (1953 p.118) give average length at birth for *N. brasiliensis* as about 110-120 mm.

Female *N. westraliensis* mature at about 180 mm t.l.; one female of 155 mm t.l. was exceptional in having enlarged ovarian follicles. Gravid females were taken throughout the year, but the main breeding season extends from May to November, with peak activity during September and October. Many gravid females were collected and examined, and from one to eight embryos were recorded. Embryos within the one female were sometimes found to be in various stages of development, and some females had late stage embryos positioned for birth whilst very early stage embryos were to be found higher in the oviduct. This observation may partly explain the rather extended breeding season.

It was noticed that gravid females would often have male embryos only in one oviduct, and female embryos in the other. Breder and Springer (1940) noted that in *N. brasiliensis,* small females produced proportionally more female offspring and large females produced proportionally more male offspring; this was not observed in *N. westraliensis.*

Stead (1963 p.149) believed that the electric organs of female electric rays would be inactive during parturition. At birth (75 mm), the embryos of *N. westraliensis* have well developed electric organs, and it is just as likely that any electric stimulation given to an embryo at parturition would not be harmful to it and the embryo would not be given a "lively time" as Stead suggests. Although no gravid females of *N. westraliensis* were actually tested for shocks during parturition, females containing developing embryos certainly did produce shocks.

The inner walls of the uterus in a gravid female *N. indica* have been illustrated by Prashad (1920 pl.vii Fig.4). He reports the entire inner surface to be covered with spatulate villi-like trophonemata, and remarks (p.104) "the covering of trophonemata is so thick that no part of the uterine wall is to be seen between them. In a square inch of wall of the preserved uterus 198 villi were counted." Prashad also mentioned "that the uterus was full of a yellowish milk-like secretion in which the embryos were enclosed."

In all the gravid female *N. westraliensis* examined, the inner walls of the uterus are entirely without a covering of villi, being quite thin, membranous, almost transparent, with an occasional vein across the surface. The embryos within could be easily discerned through the uterine wall.

The uterus contained a clear fluid, quite unlike that described by Prashad for *N. indica*, although this fluid became yellowish and milk-like when the contents of the easily ruptured embryonic yolk sac were set free.

The young appear to be born tail first, and late-stage embryos are often in this position within the uterus. Prematurely born embryos of 60-73 mm t.l. were occasionally found amongst trawl contents on the trawling vessels.

The largest *N. westraliensis* measured by the author was a female of 293 mm t.l.

Habits. As with other electric rays, *N. westraliensis* is a somewhat sluggish, bottom-dwelling fish. It swims away if forcefully disturbed, but often remains stationary, even permitting gentle handling without attempting to escape.

Four adults were sent to Perth by air, and held alive in a marine aquarium for a period of three months. For the following observation I am indebted to Mrs. Munday of Cottesloe, W.A.

"The *Narcine* were often seen to be covering themselves with sand, only the eyes and spiracles remained visible. They could bury themselves rapidly by moving sideways and agitating their bodies, and normally remained covered by sand for most of the day, swimming around in search of food during dusk and early morning. Scraps of fish flesh and crushed terrestrial snails were eaten." The gut contents of 9 adult *N. westraliensis* taken from the trawl contents were examined and contained annelid worms.

Distribution and ecology. Narcine westraliensis was often taken by trawl net inside Shark Bay. It was common on commercial prawn (*Penaeus* sp.) trawling grounds, and especially abundant in areas where the bay scallop *Amusium balloti* Bernardi occurred. In spite of extensive trawling in the Exmouth Gulf area by research vessels "Lancelin" and "Peron" no *Narcine* were taken. *N. westraliensis* appears to be restricted to Shark Bay. The depths at which this little numbfish was found ranged from 6 fathoms to 17 fathoms. Areas outside the depth range given above were rarely trawled.

Although preferring a salinity of about 38.80‰ *N. westraliensis* was found to be present in waters varying in salinity from 36.13‰ to 44.00‰ Bottom temperatures ranged from 17.8°C to 22.8°C.

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