

**DESCRIPTION OF SIX NEW SPECIES OF LANTERN-SHARKS
OF THE GENUS *ETMOPTERUS* (SQUALOIDEA: ETMOPTERIDAE)
FROM THE AUSTRALASIAN REGION**

by

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ABSTRACT. - Six new species of squaloid sharks of the genus *Etmopterus* are described from the Arafura and Banda Seas (south-east Indian Ocean), and the Coral Sea (south-west Pacific): *E. fusus* sp. nov. from the slope of northwestern Australia; *E. evansi* sp. nov. from northwestern Australia and eastern Indonesia; *E. dianthus* sp. nov. from the Coral Sea; *E. dislineatus* sp. nov. off tropical eastern Australia; and *E. caudistigmus* sp. nov. and *E. pseudosqualiolus* sp. nov. from the slopes of the Chesterfield Islands, New Caledonia, and the northern part of the Norfolk Ridge. They can be distinguished by their coloration, body shape, teeth morphology, vertebral counts, dermal denticles, the position of their fins, and the size and shape of luminescent markings on the flank, caudal peduncle and caudal fin. A key for the *Etmopterus* species of tropical Australasia is provided.

RÉSUMÉ. - Description de six espèces nouvelles de requins-lanternes du genre *Etmopterus* (Squaloidea: Etmopteridae) de la région australasienne.

Six espèces nouvelles de requins-lanternes du genre *Etmopterus* sont décrites des mers d'Arafura, de Banda (sud-est de l'Océan Indien) et de la mer de Corail (sud-ouest de l'Océan Pacifique): *E. fusus* sp. nov. de la pente continentale du nord-ouest de l'Australie; *E. evansi* sp. nov. du nord-ouest de l'Australie et de l'Indonésie orientale; *E. dislineatus* sp. nov. de l'Australie orientale tropicale; *E. caudistigmus* sp. nov. et *E. pseudosqualiolus* sp. nov. des pentes des Iles Chesterfields, de Nouvelle-Calédonie et de la partie nord de la ride de Norfolk. Les denticules cutanés, la position des nageoires, le pédoncule caudal et les marques colorées sur les flancs et la queue permettent de distinguer ces espèces. Une clef de détermination des espèces du genre *Etmopterus* de la région australasienne est fournie.

Key words. - Squaloidea - Etmopteridae - *Etmopterus* spp. - New species - Australia - Indonesia - New Caledonia.

Over the last two decades, French and Australian research agencies have undertaken several deepwater exploratory trawl surveys to the remote seamounts and continental margins of the tropical western Indian Ocean and southwestern Pacific. The fish faunas of these regions are poorly known and these surveys have revealed several previously undiscovered chondrichthyans, including six new lantern sharks of the widely distributed temperate and tropical genus *Etmopterus*. This group contains some 24 provisionally recognised nominal species: *E. polli* Bigelow, Schroeder & Springer, 1953, *E. spinax* (Linnaeus, 1758) (eastern Atlantic); *E. gracilispinis* Krefft, 1968 (widespread Atlantic); *E. bullisi* Bigelow & Schroeder, 1957, *E. carteri* Springer & Burgess, 1985, *E. hillianus* (Poey, 1861), *E. pernyi* Springer & Burgess, 1985, *E. robinsi* Schofield & Burgess, 1997, *E. schultzi* Bigelow, Schroeder & Springer, 1953 and *E. virens* Bigelow, Schroeder & Springer, 1953 (western Atlantic); *E. princeps* Collett, 1904 (North Atlantic); *E. decacuspидatus* Chan, 1966 (western North Pacific); *E. litvinovi* Kotlyar, 1990, *E. pycnolepis* Kotlyar,

1990 and *E. villosus* Gilbert, 1905 (central Pacific); *E. splendidus* Yano, 1988 (western central Pacific); *E. unicolor* (Englehardt, 1912) (western Pacific); *E. compagnoi* Fricke & Koch, 1990, *E. granulosus* (Günther, 1880) and *E. sentosus* Bass, d'Aubrey & Kistnasamy, 1976 (western Indian Ocean); *E. brachyurus* Smith & Radcliffe, 1912, *E. lucifer* Jordan & Snyder, 1902, *E. pusillus* (Lowe, 1839) and *E. bigelowi* Shirai & Tachikawa, 1993 (widespread).

The group needs to be revised using consistent morphometrics and thorough descriptions of luminescent markings as proposed by Springer and Burgess (1985). There are also questions as to the validity of some species such as *E. baxteri* Garrick, which have been considered as junior synonyms of *E. granulosus* (Tachikawa *et al.*, 1989). Yamakawa *et al.* (1986) have discussed the existence of at least one species complex within the genus, the 'lucifer-group', and Springer and Burgess (1985) and Shirai and Tachikawa (1993) have defined another complex with truncate dermal denticles, the 'pusillus-group'. Similarly, Yano (1988) divided the genus into three subgroups based on the

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shape of the dermal denticles. Other subgroupings exist, which indicate that the genus is likely to be either para- or polyphyletic. These subgroups can be distinguished by a suite of characters (i.e., morphology of the body, teeth, and luminescent markings) rather than denticle structure alone.

Studies in progress suggest that some of the perceived widespread species consist of suites of more restricted sister species. The possible compositions of these species complexes in the Indo-Pacific region is discussed. Additional undescribed Australian species belonging to the '*Etmopterus lucifer* group' (Yamakawa *et al.*, 1984) will be treated by Burgess and Schofield in supplementary papers.

METHODS

Numerical characters were selected to enable comparisons to be made with other *Etmopterus* data. For new taxa, the holotype and 5 paratypes were measured in full (Tabs I, II). A subset of characters appearing to be useful in discriminating species were then taken for the remaining post-juvenile paratypes. In species descriptions, morphometric and meristic values for the holotype are given first followed in parentheses by the ranges of the paratypes.

Measurements of the first and second dorsal-fin heights, exposed portions of the first and second dorsal spines, lower caudal marking, and the anterior and posterior branches, and base of the flank marking follow Yamakawa *et al.* (1986). Other morphometric methods follow Compagno (1984). Several new measurements, of which some were used but not fully-defined in Springer and Burgess (1985), are used herein: pre-first dorsal and pre-second dorsal-fins lengths are direct measurements taken between the tip of the snout and the embedded anterior edge of the respective dorsal spine (just forward of the exposed spine and detectable by pushing into the adjacent muscle tissue); direct preorbital length is taken on a direct line between the anterior orbital slit and the tip of the snout; pre-vent length is taken from the snout tip to the anterior margin of the vent; spiracle width is the width of the non-scaled opening; eye to spiracle is the least distance between the posterior limit of the orbital slit and the non-scaled spiracle; entire lengths of the first and second dorsal fins are measured from the buried anterior edge of the spine to the terminus of the free rear tip of the fin; soft bases of the first and second dorsal fins are measured horizontally from the junction of the rear edge of the spine and the soft part of the fin to the fin's insertion.

Diagrammatic representations and terminology used for the distinctive flank, post-pelvic, and caudal markings of etmopterid sharks follow Yamakawa *et al.* (1986) with improvisations devised by one of us (G. Burgess): flank marking base length is measured across the base at the ventral margin of the specimen when viewed laterally; anterior

extension of the flank marking is measured along the horizontal axis (i.e., from the anterior-most tip of the marking posteriorly to an elevation at the rear margin of its base); anterior branch length is obtained by subtracting the base length from the anterior extension length; posterior branch length is measured along the horizontal axis (i.e., from an elevation at the rear margin of the marking's base to the posterior-most tip of the branch); upper caudal marking length is the direct measurement of the short, terminal, upper caudal marking including any dots or dashes which coalesce serially along this line; central caudal marking length and height are maximum direct measures of the axial length and vertical height respectively of this oblong structure.

Meristics were taken from X-rays of up to ten specimens when available. Counts were obtained separately for trunk (monospondylous), precaudal (monospondylous + diplospondylous to origin of upper lobe of caudal fin) and caudal (centra of the fin) vertebrae. Tooth row counts, which are difficult to obtain from radiographs, were taken directly from specimens.

Type specimens are deposited in the Muséum national d'Histoire naturelle (MNHN), the ichthyological collections of the Commonwealth Scientific and Industrial Research Organisation, Hobart (CSIRO), the Australian Museum (AMS), and the Florida Museum of Natural History, University of Florida (UF); their registration numbers are prefixed with these acronyms.

SYSTEMATIC ACCOUNTS

Family ETMOPTERIDAE

Genus *Etmopterus* Rafinesque, 1810

Type species. - *Etmopterus aculeatus* Rafinesque, 1810 (= *Squalus spinax* Linnaeus, 1758), by monotypy.

***ETMOPTERUS CAUDISTIGMUS* SP. NOV.**

(Figs 1a, 3a, 5a, 7a; Tab. II)

Holotype. - MNHN 1997-3514, female 339 mm TL, R.V. "Alis", HALICAL 1, stn 22, longline, North-West Lifou, New Caledonia, 20°38'S, 166°52'E, 14 Dec. 1994.

Paratypes. - 2 specimens: MNHN 1997-3515, male 291 mm TL; MNHN 1997-3516, male 314 mm TL, R.V. "Alis", HALICAL 1, stn 27, longline, Reef Beautemps-Beaupré, New Caledonia, 20°18'S, 166°15'E, 17 Dec. 1994.

Diagnosis

A small species of *Etmopterus* with the following combination of characters: moderately firm, slightly compressed body; caudal peduncle rather elongate, about 2.2

times greatest horizontal length of first dorsal fin including spine, about a fifth of TL; mouth relatively broad, 1.4 times eye length; upper teeth of mature males large with 5 slender cusps; denticles short, robust, arranged in regular rows; pale naked patch on upper eyelid; posterior branch of flank markings truncate and merging ventrally with post-pelvic marking; anterior portion of caudal base marking very broad, enveloping ventral surface and extending onto flanks; oval central caudal marking well separated from caudal base marking; upper caudal marking straight; dorsal and ventral surfaces both dark, not contrasted; fins dark distally; trunk vertebrae 40.

Description

Fusiform to slightly compressed (bulging somewhat at belly), long head 22.0 (23.3-23.4)% TL and elongate, narrow caudal peduncle 18.2 (21.1-22.5)% TL. Head slightly depressed, length 2.52 (2.15-2.26) in preopercular length; height 1.06 (0.73-0.83) times width. Snout long, narrowly triangular in lateral view, subangular in dorsal view, horizontal length 1.05 (0.95-1.05) in length of eye, 1.40 (1.36-1.56) in interorbital distance. Eye broadly oval, rather large, length 4.25 (4.55-4.63) in head, 2.36 (1.66-1.73) times

height. Spiracle large, greatest diameter 3.30 (2.94-3.50) in eye length, tear-drop shaped, denticles extending into cavity, spiracular fold naked. Gill openings moderate, slightly oblique, subequal in size, height of fifth slit 1.2 (1.0-1.2)% TL. Mouth broad, very strongly arched, its width 1.26 (1.22-1.24) in preoral distance; three series of functional teeth in upper jaw, one series in lower; teeth dissimilar in upper and lower jaws; upper teeth moderate, erect, multi-cuspid; five cusps in males, central cusp very long, slender, much larger than those adjacent; three cusps in females, central cusp relatively larger near symphysis, 2-3 times longer than lateral pair; teeth in lower jaw unicuspid, interlocking, blade-like, cusps low, very oblique, lower distal margin extremely short. Nostrils large, oblique; nasal flaps poorly developed, anterior flap triangular, posterior flap subrectangular. Dermal denticles very small, low, unicuspid, mostly with defined lateral ridges; robust, strongly recurved posteriorly, arranged in regular, longitudinal rows (evident without magnification) on back, upper tail and most of caudal fin; more upright, thorn-like, recurved ventrally over belly, and on pelvic flank and caudal-fin markings; subconical, upright to weakly recurved, blunt, irregularly spaced on interorbit; white, naked, elongate, tear-



Figure 1. - Lateral view of holotypes. **A:** *Etmopterus caudistigmus* (MNHN 1997-3514); **B:** *E. fusus* (CSIRO H 3149-06); **C:** *E. pseudosqualiolus* (MNHN 1997-3510).

Table I. - Morphometric data for the holotypes of *Etmopterus dianthus*, *E. dislineatus* and *E. evansi*, with ranges provided for the paratypes. Measurements expressed as percentage of the total length.

	<i>Etmopterus dianthus</i>			<i>Etmopterus dislineatus</i>			<i>Etmopterus evansi</i>		
	Holotype	Paratypes		Holotype	Paratypes		Holotype	Paratypes	
	CSIRO H 1414-02	(n = 5)		CSIRO H 1416-01	(n = 5)		CSIRO H 3141-16	(n = 5)	
	Min	Max	Min	Max	Min	Max	Min	Max	
Total length (mm)	389	317	409	448	333	427	271	247	297
Pre-caudal length	78.1	77.9	80.3	80.4	79.1	80.9	76.8	76.4	78.5
Pre-second dorsal length	61.0	60.0	61.9	57.1	56.0	59.3	57.7	55.7	58.3
Pre-first dorsal length	34.4	32.2	37.0	30.2	29.2	32.9	32.3	29.7	32.9
Head length	19.8	19.6	21.2	20.2	18.6	21.3	19.9	19.2	21.8
Pre-branchial length	15.5	14.6	15.8	15.4	14.6	17.7	15.0	14.3	17.0
Pre-spiracular length	10.6	10.7	11.4	10.6	10.4	12.2	10.8	10.7	12.1
Pre-orbital length (horizontal)	3.8	3.6	4.3	4.4	4.2	5.0	3.6	3.7	5.2
Pre-orbital length (direct)	5.8	5.0	5.8	5.5	5.2	5.9	5.0	5.2	6.1
Pre-narial length	3.3	2.9	3.2	3.0	2.7	3.3	3.2	2.8	3.7
Pre-oral length	9.0	8.4	9.4	8.6	8.4	9.8	8.3	8.1	9.1
Eye length	5.9	5.3	6.8	5.1	5.2	6.3	5.4	5.6	6.0
Eye height	0.9	1.0	1.2	1.9	1.6	2.5	1.8	1.5	1.9
Spiracle length	0.8	0.7	1.2	1.2	1.0	1.5	1.6	1.0	1.8
Eye-spiracle distance	2.6	2.1	2.9	2.3	1.9	2.4	1.7	1.7	2.5
First gill slit height	1.5	1.0	1.9	1.2	0.8	1.0	0.8	0.7	1.3
Fifth gill slit height	1.7	1.4	2.0	1.0	0.7	1.0	1.0	0.7	1.0
Mouth length	1.2	1.3	1.7	0.8	1.0	1.4	1.1	0.9	1.4
Mouth width	6.3	6.0	7.2	5.7	5.0	6.4	6.2	5.4	6.8
Nostril width	2.3	2.0	2.7	1.9	1.6	2.3	2.4	1.9	2.4
Interorbital width	8.2	7.6	8.9	7.0	6.2	7.9	7.8	7.3	8.2
Head width	11.4	10.0	11.1	9.4	9.3	10.7	10.4	8.7	11.8
Head height	9.1	8.1	9.5	6.4	6.6	7.8	8.9	7.6	9.1
Pre-pectoral length	19.6	19.3	20.9	20.0	18.3	20.4	18.3	17.8	21.2
Pre-pelvic length	53.1	52.0	54.8	46.8	45.2	48.5	48.5	48.1	50.5
Snout-vent distance	57.6	56.0	58.1	49.1	48.4	52.0	53.9	52.0	55.2
Pectoral-pelvic distance	29.4	27.8	30.8	22.0	21.2	23.5	24.7	21.5	27.4
Interdorsal distance	20.6	20.0	21.5	24.1	22.5	25.0	20.5	18.9	20.7
Dorsal-caudal distance	10.5	9.8	11.6	16.7	15.0	18.4	12.7	12.5	14.3
Pelvic-caudal distance	14.9	14.3	16.7	26.8	22.8	25.8	18.9	19.1	21.8
Pectoral fin - anterior margin length	6.9	6.6	7.1	8.1	8.1	9.6	9.0	9.3	10.2
Pectoral fin - inner margin length	3.5	2.8	3.9	4.5	4.5	5.5	5.4	4.6	5.6
Pectoral fin - posterior margin length	5.2	5.4	5.8	5.4	5.8	6.2	5.6	5.3	5.8
Pectoral fin - base length	5.1	4.7	5.5	5.2	4.9	5.7	6.6	5.9	6.3
First dorsal fin - maximum length	9.2	8.1	9.2	6.6	6.1	6.8	8.6	8.2	9.2
First dorsal fin - soft base length	3.7	3.1	3.5	2.6	2.2	3.1	3.9	3.5	4.3
First dorsal fin - inner margin length	3.7	3.4	4.1	3.1	2.7	3.5	3.5	2.6	4.1
First dorsal fin - height	2.8	2.3	3.0	2.0	1.7	2.2	2.5	2.1	2.5
First dorsal spine length	1.7	1.3	2.0	-	1.6	2.1	2.6	1.6	2.9
Second dorsal fin - maximum length	10.8	10.0	11.2	10.8	9.7	11.1	12.1	11.3	12.4
Second dorsal fin - soft base length	4.2	3.1	4.4	4.3	3.8	4.3	4.5	4.5	4.9
Pelvic fin - length	10.9	9.2	10.9	9.8	9.7	11.0	10.8	9.9	10.6
Pelvic fin - anterior margin length	5.9	5.4	6.2	4.3	4.8	5.7	5.2	5.4	6.4
Caudal fin - dorsal margin length	21.9	19.7	22.1	18.7	18.5	20.4	22.5	21.6	22.5
Caudal fin - pre-ventral margin length	10.9	9.4	11.0	8.7	8.3	9.1	10.8	9.2	10.7
Caudal fin - subterminal margin length	3.6	3.4	3.8	2.9	2.8	3.8	3.4	2.8	4.2
Flank marking - posterior branch length	2.3	2.2	2.7	14.3	12.0	14.0	10.2	9.7	11.2
Flank marking - anterior extension	12.8	11.1	13.6	10.4	10.2	11.5	10.3	10.7	11.9
Flank marking - base length	2.5	2.2	2.7	0.0	0.5	1.6	0.0	0.0	1.7
Flank marking - anterior branch length	10.3	8.9	10.8	10.4	9.3	10.5	10.3	9.5	11.3
Caudal base marking - length	4.6	3.8	4.3	3.5	4.6	5.5	8.5	9.3	9.9
Upper caudal marking - length	4.1	3.2	5.2	5.2	3.0	5.2	3.4	1.7	3.1
Central caudal marking - axial length	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Central caudal marking - height	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table II. - Morphometric data for the holotypes of *Etmopterus caudistigmus*, *E. fusus* and *E. pseudosqualiolus*, with ranges provided for the paratypes. Measurements expressed as percentage of the total length.

	<i>Etmopterus caudistigmus</i>			<i>Etmopterus fusus</i>			<i>Etmopterus pseudosqualiolus</i>		
	Holotype	Paratypes		Holotype	Paratypes		Holotype	Paratypes	
	MNHN	(n = 2)		MNHN	(n = 5)		MNHN	(n = 4)	
	1997-3514	Min	Max	H 3149-06	Min	Max	1997-3510	Min	Max
Total length (mm)	339	291	314	251	257	293	448	395	453
Pre-caudal length	77.4	75.6	80.3	79.4	77.9	79.9	76.6	75.8	79.8
Pre-second dorsal length	58.3	57.4	60.8	59.6	57.1	61.5	58.5	57.2	59.9
Pre-first dorsal length	28.0	28.9	29.9	29.5	28.7	30.3	33.0	30.9	33.7
Head length	22.0	23.3	23.4	21.9	21.2	23.2	22.5	18.4	23.0
Pre-branchial length	17.0	17.0	18.1	17.5	15.2	17.0	16.7	15.1	17.2
Pre-spiracular length	11.9	11.4	12.5	12.0	11.3	12.1	11.8	9.5	11.0
Pre-orbital length (horizontal)	4.9	4.9	5.3	4.3	4.0	4.3	5.2	4.2	4.7
Pre-orbital length (direct)	5.8	5.8	6.2	5.5	5.3	5.7	5.8	5.1	5.5
Pre-narial length	3.0	2.5	2.5	3.3	3.0	3.2	1.9	1.7	2.3
Pre-oral length	8.9	8.9	9.4	9.3	8.7	9.7	8.2	7.3	8.0
Eye length	5.2	5.1	5.1	5.8	5.6	6.1	4.1	3.7	4.4
Eye height	2.2	2.9	3.1	2.6	2.3	2.7	2.7	2.0	2.8
Spiracle length	1.6	1.5	1.7	1.3	1.2	1.5	1.3	1.2	1.5
Eye-spiracle distance	2.8	2.8	3.1	3.0	2.5	3.2	2.2	2.1	2.6
First gill slit height	1.3	1.1	1.1	1.6	1.7	2.0	1.6	1.5	1.7
Fifth gill slit height	1.2	1.0	1.2	1.3	1.5	1.7	1.5	1.3	1.5
Mouth length	-	-	-	1.4	1.0	1.5	1.6	1.1	1.5
Mouth width	7.1	7.7	7.7	6.8	5.3	6.6	7.2	7.0	7.9
Nostril width	2.3	2.5	2.5	2.9	2.1	2.9	2.2	2.0	2.2
Interorbital width	6.8	7.3	7.6	6.9	6.8	7.4	7.7	7.8	8.0
Head width	8.7	9.6	10.3	8.9	9.2	10.8	9.6	8.2	10.4
Head height	9.3	7.6	7.9	9.9	9.2	10.6	9.3	7.8	9.0
Pre-pectoral length	21.2	22.5	22.6	21.2	21.2	22.8	21.4	20.4	22.8
Pre-pelvic length	50.0	48.5	50.3	50.2	49.2	52.9	54.0	52.1	56.5
Snout-vent distance	55.3	50.3	52.9	52.8	52.5	56.1	58.0	56.7	60.8
Pectoral-pelvic distance	25.7	22.2	24.2	23.2	22.6	27.6	27.2	28.1	30.2
Interdorsal distance	27.5	26.8	28.0	26.3	22.7	26.9	19.3	19.9	24.4
Dorsal-caudal distance	13.6	14.1	14.8	14.5	13.1	15.5	13.1	11.6	13.0
Pelvic-caudal distance	18.2	21.1	22.5	20.9	18.3	22.0	16.1	14.8	16.6
Pectoral fin - anterior margin length	9.4	9.0	9.1	8.7	8.2	10.3	8.6	7.3	8.8
Pectoral fin - inner margin length	5.8	5.1	5.1	4.4	4.8	6.5	3.3	2.6	4.0
Pectoral fin - posterior margin length	5.6	6.7	7.0	5.3	4.7	5.5	5.1	4.3	5.7
Pectoral fin - base length	4.0	4.0	4.4	5.1	4.6	5.6	4.7	4.0	5.4
First dorsal fin - maximum length	8.3	7.9	8.7	8.2	8.3	9.8	9.2	8.6	10.2
First dorsal fin - soft base length	2.8	2.6	3.0	3.7	3.3	4.1	3.5	3.0	3.5
First dorsal fin - inner margin length	4.0	3.8	3.9	3.8	4.0	4.6	4.6	4.3	5.4
First dorsal fin - height	2.8	3.0	3.0	2.5	2.2	2.8	2.8	2.4	2.6
First dorsal spine length	-	-	-	1.3	1.5	2.6	-	1.0	1.8
Second dorsal fin - maximum length	11.9	10.9	13.0	12.4	11.1	12.9	11.6	10.8	13.4
Second dorsal fin - soft base length	4.5	4.7	5.2	5.0	4.2	5.0	5.7	4.7	6.0
Second dorsal fin - inner margin length	5.3	5.2	5.5	6.0	5.2	6.6	4.8	4.6	5.5
Second dorsal fin - height	3.8	4.6	4.6	4.3	3.6	4.4	4.0	3.7	4.8
Second dorsal spine length	-	5.0	5.0	4.3	3.8	5.8	-	3.1	4.1
Pelvic fin - length	10.1	9.5	10.1	11.5	9.7	11.1	10.6	9.4	10.4
Pelvic fin - anterior margin length	5.6	5.0	5.1	5.9	5.0	6.2	5.9	6.0	6.5
Caudal fin - dorsal margin length	20.1	19.1	22.0	19.4	19.6	22.2	21.4	19.1	20.0
Caudal fin - pre-ventral margin length	10.4	9.4	9.5	10.8	10.1	11.5	11.5	10.8	11.0
Caudal fin - subterminal margin length	3.5	3.0	5.4	3.4	3.7	4.4	3.7	3.3	4.6
Flank marking - posterior branch length	0.7	0.6	0.7	0.9	0.1	1.0	0.2	0.0	0.4
Flank marking - anterior extension	18.5	18.5	18.8	18.7	16.1	18.9	14.8	13.2	16.0
Flank marking - base length	7.6	8.2	12.3	7.8	6.8	8.2	4.3	4.5	5.4
Flank marking - anterior branch length	10.9	6.2	10.7	10.9	8.3	11.2	10.5	8.5	11.4
Caudal base marking - length	2.6	2.2	2.8	2.3	2.3	3.7	11.2	8.4	11.4
Upper caudal marking - length	2.5	2.4	3.4	1.9	1.9	3.4	2.4	2.0	3.8
Central caudal marking - axial length	3.9	3.7	3.9	4.1	4.1	5.6	7.2	5.3	8.3
Central caudal marking - height	0.9	1.1	1.1	1.4	0.8	1.2	0.0	0.0	0.0

shaped patch on posterior half of upper eyelid (possibly luminescent tissue). First dorsal fin almost entirely covered with closely spaced denticles, basal half of second dorsal fin similarly covered, distal half with sparse coverage; denticles present over gill membranes. Distal margins of fins largely covered with skin; narrow fringes of ceratotrichia along posterior margins of dorsal fins, mostly weak on other fins. First dorsal fin low, rounded; fin-spine origin well forward of pectoral-fin rear tip; insertion of base well forward of pelvic-fin origin; smaller than second, length from snout to first dorsal spine 1.76 (1.62-1.68) in length from spine origin to upper caudal-fin origin; length of 1st dorsal fin 1.43 (1.38-1.48) in 2nd dorsal fin; height of 1st dorsal fin 1.38 (1.55) in 2nd dorsal fin; first dorsal spine damaged. Second dorsal fin of moderate size, upright, very deeply concave posterior margin, long free rear tip, spine length (0.91) in height of 2nd dorsal fin; fin-spine origin just behind insertion of pelvic fin; interdorsal space 0.77 (0.81-0.84) in length from snout tip to pectoral-fin origin; interdorsal space marginally shorter, 1.02 (1.07-1.08) in predorsal distance. First dorsal spine small, less than half length of second dorsal spine. Pectoral fin moderate, inner margin 5.8 (5.1)% TL, apex acute, pigmented distally, posterior margin deep and truncate; base very short, 2.32 (2.07-2.24) in length of anterior margin. Caudal peduncle long, uniformly slender, 1.41 (1.02-1.07) in distance between pectoral and pelvic fins, 1.16 (1.00-1.07) in prepectoral distance; second dorsal to caudal fin interspace 2.02 (1.81-1.98) in interdorsal distance. Caudal fin short, less than head length; subterminal notch well-defined; length of lower caudal lobe 1.93 (2.03-2.32) in upper lobe length. Vertebral centra 87? (86) in 2 specimens, monospondylous 40 (40), precaudal 61 (61) and caudal 26? (25). Teeth in upper jaw 31 (35), lower jaw 39 (37).

Luminescent markings

Markings not well defined, barely detectable on head. Belly marking upper margin poorly defined, extending from beneath pectoral fin to pelvic base, disjunct immediately after pectoral-fin base but continuous to pelvic fin (reaching fin above origin); no obvious dark fingers on ventral base of pelvic fin. Pelvic flank marking poorly defined; anterior branch of flank marking broad and long, extending well forward of pelvic-fin origin; posterior branch truncated distally, massive (greatest height at truncation subequal to half body depth through the same vertical axis) terminating just posterior of second dorsal-fin insertion, about twelfth length of anterior branch. Post-pelvic marking continuous with flank markings, extending posteriorly to level of rear edge of posterior branch of flank marking. Caudal base marking very broad, forming a broad saddle anteriorly (covering entire ventral surface of posterior caudal peduncle and extending dorsally to a level almost half of caudal peduncle

height), posteriorly tapering to point about a spiracle length behind origin of lower caudal-fin lobe, finger 2.6 (2.2-2.8)% TL. Central caudal marking narrow ovoid, distinctly shorter than eye length, well apart from caudal base marking (separated by more than half length of caudal marking). Upper caudal marking a narrow bar, more than half length of central caudal marking, 2.5 (2.4-3.4)% TL.

Colour

Very darkly pigmented, dark greyish to black, with weak distinction between dorsum, lateral surfaces, and ventrum. Belly and flank markings mostly indistinct but evident through increased density of large melanophores under magnification; dark areas somewhat more pronounced on base and extension of caudal fin; vertical extension of caudal base marking sharply defined dorsally, and posteriorly on base of upper caudal lobe; sharply demarcated central caudal marking on the basal third of upper caudal lobe; upper caudal black, most contrasted of markings. Fins almost uniformly dark, sometimes greyish near edges but not pale or translucent. Whitish patch distinct on upper eyelid. Inside of mouth grey.

Size

Reaches at least 339 mm TL (female); male 314 mm TL mature.

Distribution

Known from continental slope off New Caledonia in 638-793 m.

Etymology

Combination of the Latin 'cauda' and Greek 'stigma' in allusion to the presence of an oval-shaped, caudal-fin marking.

Remarks

Belongs to a subgroup of *Etmopterus* that includes *E. splendidus* Yano and another new species described herein, *E. fusus*. In addition to possessing at least one unique feature, the presence of a central caudal-fin marking, these species share several characters: a firm, almost subcylindrical body; a broadly oval to subcircular eye; short conical denticles with prominent lateral ridges; a truncate posterior flank marking; caudal base marking very broad and forming a saddle anteriorly; and the pale naked area on the hind half of each upper eyelid possibly containing a light organ. This subgroup may prove to be generically distinct within the family.

Yano's (1988) type series of *E. splendidus* consisted of two specimens from Japan and three specimens from Indonesia (BMNH 1986.11.27: 86-88). The illustration of

the holotype (NSMT-P 50273) of *E. splendidus*, collected from near Shimo-Koshiki Island off Japan, depicts an *Etmopterus* species with a relatively short snout and short caudal peduncle. From this figure, *E. splendidus* has a much shorter caudal peduncle (length about 15% TL) than both new species described herein, *E. caudistigmus* and *E. fusus* (18.2-22.5% TL), but this measurement varied considerably across his type series (16.6-19.1% TL).

Yano (pers comm.) was unable to compare the Japanese and Indonesian types directly so he did not detect differences in morphology between regions. However, he kindly re-examined his morphometric data at our request and discovered two regional morphotypes. Both Japanese specimens were found to have a short caudal peduncle (16.6-16.8% TL) and the Indonesian types were consistent with the two Indo-Australasian species (18.7-19.1% TL). We suggest that two species exist within the type series of *E. splendidus* and, given its locality and morphological similarity, the Indonesian form is probably conspecific with *E. fusus*.

In addition to having a longer caudal peduncle, *E. caudistigmus* differs from *E. splendidus* in having a longer interdorsal space (26.8-28.0 versus 20.7-24.2% TL) and has simpler teeth in the upper jaw (3 cusps in females rather than 5), more vertebrae (61 rather than 56-58 precaudal centra), and possibly a longer snout. It differs from *E. fusus* in having more trunk vertebrae (40 versus 36-38 centra), a longer snout (horizontal length 4.9-5.3 rather than 4.0-4.3% TL), fewer cusps (3 in females and 5 in males rather than 5 and 7 cusps respectively) in the upper jaw teeth, darker edged fins, and a larger mouth.

***ETMOPTERUS DIANTHUS* SP. NOV.**

(Figs 2a, 4a, 6a, 8a; Tab. I)

Etmopterus sp. D. - Last and Stevens, 1994: p. 76 (Plate 8, fig. 8.18).

Holotype. - CSIRO H 1414-02, female 389 mm TL, F.R.V. "Soela", So 6/85, stn 78, lobster trawl, 880 m, West of Lihou Reefs, Queensland Plateau, 16°55'S, 151°31'E, 6 Dec. 1985.

Paratypes. - 23 specimens: CSIRO H 609-06, embryo 95 mm TL; CSIRO H 1414-01, female 408 mm TL; CSIRO H 1414-03, mature male 409 mm TL; CSIRO H 1414-04, female 405 mm TL; CSIRO H 1414-05, female 392 mm TL; CSIRO H 1414-06, immature male 317 mm TL; CSIRO H 1414-07, adolescent male 338 mm TL; CSIRO H 1414-08, immature male 267 mm TL, collected with the holotype; CSIRO H 716-02, 4 females: 155-186 mm TL; CSIRO H 1415-01, female 269 mm TL; CSIRO H 1415-02, female 268 mm TL; AMS I 41108-001, female 225 mm TL, UF 119621, female 258 mm TL, F.R.V.

"Soela", So 6/85, stn 79, lobster trawl, 792-802 m, West of Lihou Reefs, Queensland Plateau, 17°00'S, 151°18'E, 6 Dec. 1985. MNHN 1997-3517, male 296 mm TL; MNHN 1997-3518, female 305 mm TL; MNHN 1997-3519, female 266 mm TL; MNHN 1997-3520, female 257 mm TL; MNHN 1997-3521, female 392 mm TL; MNHN 1997-3522, male 379 mm TL; MNHN 1997-3523, male 313 mm TL, R.V. "Alis", HALIPRO 1, stn CH 874, bottom trawl, 708-830 m, New Caledonia, 23°06'S, 166°53'E, 30 Mar. 1994.

Diagnosis

A medium-sized *Etmopterus* with the following combination of characters: soft fusiform, stout, subcylindrical body; head relatively short (usually less than 21% TL); mouth broad, subequal to eye length; narrow eyes and no pale naked patch on upper eyelid; first dorsal fin well behind rear tip of pectoral fin; short caudal peduncle, about 1.6-2 times greatest horizontal length of first dorsal fin including spine, less than a sixth of TL; pectoral fin small (length of anterior margin less than the twelfth of TL); upper teeth of mature males with 5 cusps; denticles minute, bristle-like, mostly arranged randomly; posterior branch of flank marking truncate; anterior portion of caudal base marking not extended anteriorly; no central caudal marking; dorsal and ventral coloration moderately contrasted, upper surface pinkish before preservation; monospondylous centra 40-43.

Description

Fusiform, subcylindrical trunk, relatively short head (19.8-21.2% TL) and short, tapering caudal peduncle, 14.9 (14.3-16.7)% TL. Head subconical, 2.92 (2.66-2.95) in pre-cloacal length; height 1.25 (1.06-1.29) in width. Snout moderately long, subconical in lateral view, subtriangular with broadly rounded tip in dorsal view, horizontal length 1.54 (1.34-1.79) in eye length, 2.16 (1.76-2.32) in interorbital distance. Eye narrowly oval, large, length 3.36 (3.09-3.73) in head, 6.28 (4.61-6.56) times height. Spiracle medium, semi-circular, greatest diameter 7.37 (5.07-7.46) in eye length; denticles just falling short of spiracular opening, anterior margin and fold naked. Gill openings rather large, upright, subequal in size, fifth 1.7 (1.4-2.0)% TL; denticles concentrated on central portion, remainder of membranes naked; pronounced greyish white. Mouth well arched, its width 1.43 (1.22-1.42) in pre-oral distance; 3 to 4 series of functional teeth in upper jaw, one series in lower; teeth dissimilar in upper and lower jaws; upper teeth small, erect, multicuspid; 5 cusps (mostly 5 cusps in female paratypes), central cusp distinctly long, broad spear-shaped; cusps becoming smaller laterally, second about half length of central cusp, third cusp about a third length of second cusp; teeth of lower jaw unicuspid, interlocking, blade-like,

oblique, lower margin moderately long. Nostrils relatively small, oblique, nasal flaps moderately developed and subtriangular in shape. Dermal denticles minute, bristle-like, strongly recurved distally, sharp, very dense on trunk, mostly randomly arranged (but occasionally in irregular, diagonal or longitudinal rows); interorbital denticles slender, sharp, upright to tilted, dense, needle-like; denticles of belly irregular, directed more ventrally than posteriorly; denticles of flank marking directed somewhat more ventrad than those of adjacent trunk, caudal markings as those of trunk, not arranged in distinct rows; dorsal-fin bases with denticles. Most of fins covered with skin and denticles; narrow fringes of ceratotrichia along their posterior margins. First dorsal fin small, somewhat erected, subtriangular; second dorsal fin distinctly taller, slightly recurved, apex somewhat subangular, weak concave posterior margin, rather short inner margin. First dorsal-fin spine well behind free rear tip of pectoral fin; smaller than second, length from snout to

first dorsal spine 1.27 (1.17-1.43) in length from spine origin to upper caudal-fin origin; length of 1st dorsal fin 1.18 (1.12-1.29) of 2nd dorsal-fin length; height of 1st dorsal fin 1.36 (1.28-1.68) of 2nd dorsal-fin height; first dorsal spine very short, length 1.65 (1.38-2.16) in height of 1st dorsal fin. Second dorsal-fin spine origin slightly behind insertion of pelvic fin; spine rather large, exposed length 1.34 (0.96-1.31) in height of 2nd dorsal fin; interdorsal space 0.95 (0.9-1.0) in length from snout tip to pectoral-fin origin, 1.67 (1.50-1.85) in predorsal distance. Pectoral fin very small, inner margin 3.5 (2.8-3.9)% TL, narrowly rounded; base small, 1.37 (1.28-1.50) in length of anterior margin. Caudal peduncle short, 1.98 (1.69-2.08) in distance between pectoral-fin insertion and pelvic-fin origin, length much less, 1.32 (1.24-1.35) than prepectoral distance; second dorsal-caudal fin interspace 1.97 (1.72-2.17) in interdorsal distance. Caudal fin rather long, exceeding length of caudal peduncle; subterminal notch well defined; length of lower

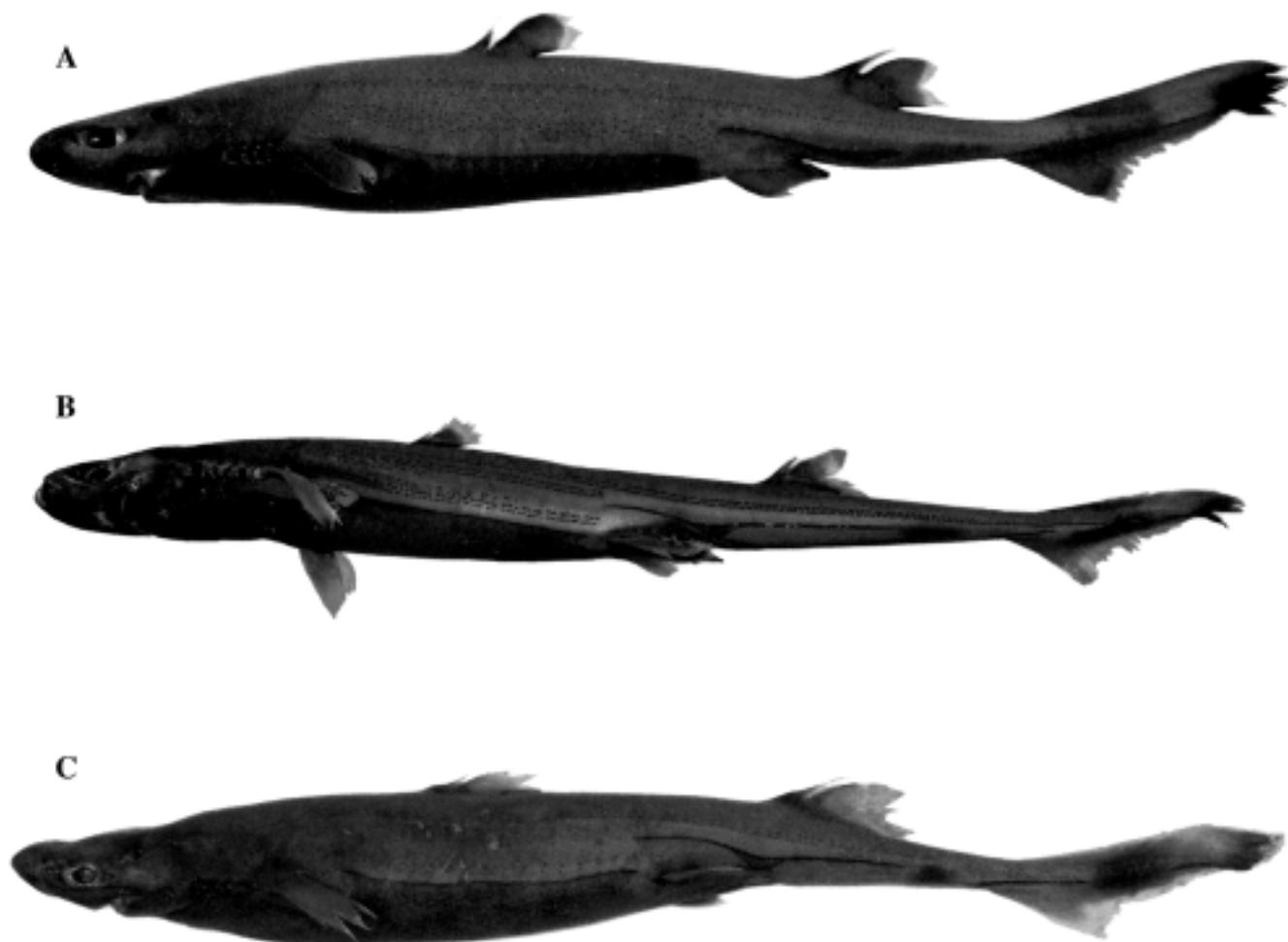


Figure 2. - Lateral view of: **A:** *Etmopterus dianthus* paratype (CSIRO H 1414-06); **B:** *E. dislineatus* paratype (CSIRO H 1415-10); **C:** *E. evansi* holotype (CSIRO H 3141-16).

caudal lobe 2.01 (2.0-2.29) in upper lobe length; terminal lobe weakly diverging, posterior margin slightly convex. Vertebral centra 81 (79-85, mainly 80-81) in 17 specimens, monospondylous 41 (40-43, rarely 43), precaudal 59 (56-60, mainly 58-60), and caudal 22 (22-26, mainly 22-24).

Luminescent markings

Reasonably well defined. Head markings extending around lower half of head below mid-eye level; minor discontinuity with belly marking just forward of gill slits. Belly marking extending dorsally to top of gill openings and extending onto lower base of pectoral fin and upper base as a broad finger; upper margin well defined, extending from pectoral to pelvic bases but disjunct immediately after pectoral fin and before pelvic fin; covering entire interpelvic area. Flank marking insertion about a spiracle length forward of second dorsal-fin insertion; anterior branch short, barely reaching origin of pelvic fin; posterior branch variable in shape, semi-truncated, extremely broad, ends below or slightly forward of second dorsal-fin insertion (greatest depth slightly less than half height of tail at the same point), 4.42 (3.58-4.64) in length of anterior branch. Post-pelvic ventral marking long, covering more than half flattened ventral surface of caudal peduncle (extending posteriorly as four narrow fingers on holotype). Precaudal marking quite broad anteriorly, not extending well forward onto caudal peduncle as a saddle; short, length subequal to horizontal snout length, 4.6 (3.8-4.3)% TL; indistinct as ventral caudal marking, not obviously connected to pelvic flank marking. Central caudal marking absent. Upper caudal marking a narrow stripe, distinct, about gill slit length or longer, length 4.1 (3.2-5.2)% TL.

Colour

In life, body light pink to greyish brown on back and upper sides, punctuated laterally with irregular rows of extremely fine, widely spaced, black dash-like markings and dorsally by small, sparsely spaced spots; more uniform darker dusky to greyish black ventrally on head and abdomen (rather sharply bounded from upper coloration sometimes just below eye, through pectoral-fin base to pelvic-fin origin). Flank markings dusky indistinct (less distinct in preserved material), precaudal and caudal markings generally more distinct than flank markings; naked membranes of first four gill openings varying from pronounced greyish white to black, fifth opening sometimes darker greyish brown. Buccal region dark greyish brown, dusky in adolescent paratypes; lips and spiracular membranes greyish brown; teeth white; fine black margin along anterior margin of posterior nare. Caudal fin with broad dusky margin of outer lobe; fins and remainder of caudal fin similar to upper body with pale to translucent posterior margins; dorsal-fin spines pigmented basally, almost transparent distal-

ly; ventral edges of dorsal-fin free rear tips often dark edged.

Size

Reaches at least 409 mm TL (mature male); largest female 408 mm TL; male of 338 mm TL was adolescent.

Distribution

Known from continental slope of the central Queensland Plateau in 108-880 m and off New Caledonia.

Etymology

From the Latin '*dianthus*' meaning pink, with reference to the pinkish upper body coloration in life.

Remarks

Probably belongs within the 'unicolor' group which includes those species having: a relatively deep, flabby body and short caudal peduncle; relatively narrow eyes and no pale patch on upper eyelid; first dorsal fin behind pectoral-fin tip; long, non-serial bristle-like denticles; a short pelvic flank marking; a weak caudal base marking; and no central caudal marking. It can be distinguished from *Etmopterus* sp. B (*sensu* Last and Stevens) and an unresolved taxon *E. unicolor* by its pinkish to greyish coloration (rather than dark brownish to black), prominent pelvic flank and belly markings (usually barely distinguishable), shorter prepectoral length (usually more than 21% TL in Australian *Etmopterus* sp. B), and smaller adult size. *E. dianthus* possibly has a longer caudal peduncle with the second dorsal fin more posteriorly placed relative to the pelvic fin than other members of the complex, and has a lower monospondylous vertebral count than *Etmopterus* sp. B (usually 42 or less rather than 43-46 centra). All southwestern Pacific forms have been considered as synonyms of *E. unicolor* (Yano, 1997) but some of these may prove to be valid species.

***ETMOPTERUS DISLINEATUS* SP. NOV.**

(Figs 2b, 4b, 6b, 8b; Tab. I)

Etmopterus sp. F. - Last and Stevens, 1994: p. 78 (Plate 7, fig. 8.20).

Holotype. - CSIRO H 1416-01, mature male 448 mm TL, F.R.V. "Soela", So 6/85, stn 80, lobster trawl, 696 m, Queensland Plateau, 17°00'S, 151°02'E, 6 Dec. 1985.

Paratypes. - 17 specimens: CSIRO H 947-01, female 347 mm TL; CSIRO H 947-02, female 309 mm TL; CSIRO H 947-03, mature male 389 mm TL; CSIRO H 947-04, adolescent male 330 mm TL; MNHN 2002-0084 - ex. CSIRO H 947-05, mature male 364 mm TL; CSIRO H



Figure 3. - Lateral view of head of holotypes. **A:** *Etmopterus caud-istigmus* (MNHN 1997-3514); **B:** *E. fusus* (CSIRO H 3149-06); **C:** *E. pseudosqualiolus* (MNHN 1997-3510).

947-06, female 382 mm TL; CSIRO H 947-07, female 373 mm TL; CSIRO H 947-08, mature male 355 mm TL; CSIRO H 947-11, female 403 mm TL; CSIRO H 947-15, female 282 mm TL; CSIRO H 1412-01, female 374 mm TL; CSIRO H 1412-02, mature male 373 mm TL; CSIRO H 1412-03, female 333 mm TL; CSIRO H 1412-04, female 394 mm TL; UF 119622, mature male 388 mm TL, F.R.V. "Soela", So 6/85, stn 8, lobster trawl, 590-606 m, South of Saumarez Reef, Saumarez Plateau, 22°57'S, 154°22'E, 17 Nov. 1985. CSIRO H 1415-10, mature male 410 mm TL, F.R.V. "Soela", So 6/85, stn 79, lobster trawl, 792-802 m depth, West of Lihou Reefs, Queensland Plateau, 17°00'S, 151°18'E, 6 Dec. 1985. CSIRO H 1416-02, mature male 427 mm TL, collected with the holotype.

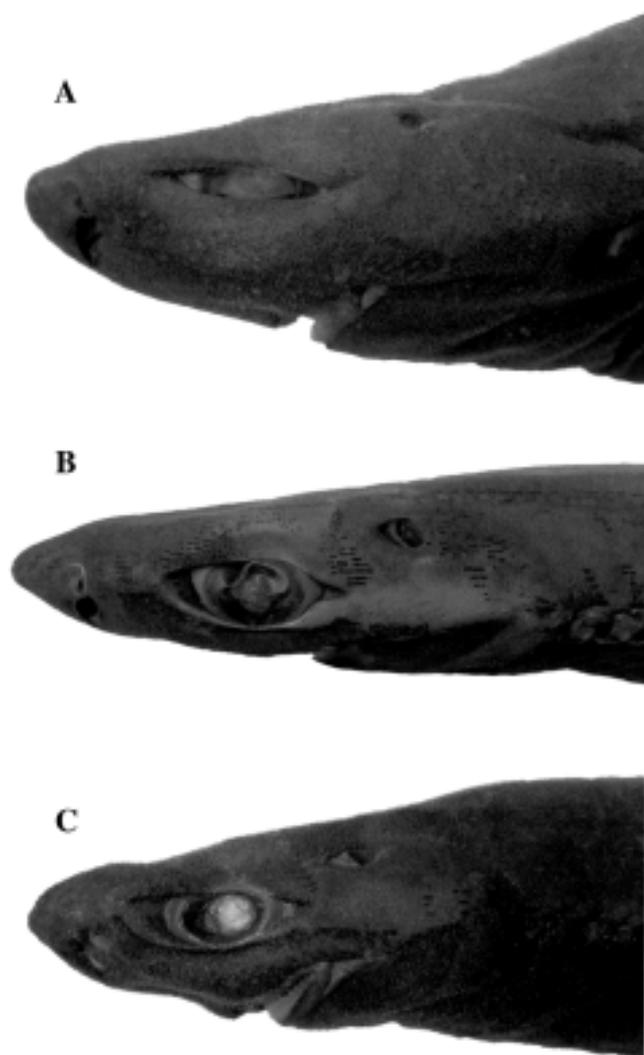


Figure 4. - Lateral view of head of holotypes. **A:** *Etmopterus dianthus* (CSIRO H 1414-02), **B:** *E. dislineatus* (CSIRO H 1416-01); **C:** *E. evansi* (CSIRO H 3141.16).

Diagnosis

A medium-sized species of *Etmopterus* with the following combination of characters: body extremely slender (head height 6.4-7.8% TL); head relatively short (usually less than 21% TL); caudal peduncle very elongate (usually exceeding 23% TL); rather narrow eyes and pale naked patch on upper eyelid; denticles extremely dense, bristle-like, not arranged in clearly defined rows; flank-marking base forward of second dorsal-fin spine, its posterior branch longer than anterior branch and extending beyond free rear tip of second dorsal fin; no central caudal marking; dorsal and ventral coloration strongly contrasted; fine dark horizontal lines forming series of fine dots and dashes on upper half of body; and dark ventral saddle near middle of caudal peduncle; monospondylous centra 41-45.

Description

Elongated, semi-depressed, subcylindrical trunk, short head 20.2 (18.6-21.3% TL) and very long caudal peduncle 26.8 (22.8-25.8% TL). Head rather short, depressed, 2.43 (2.34-2.60) in precloacal length; height 1.46 (1.19-1.56) in width. Snout moderately long, strongly depressed in lateral view, angular in dorsal view, horizontal length 1.16 (1.18-1.46) in eye length, 1.61 (1.23-1.78) in interorbital distance. Eye rather large, length 3.96 (3.01-3.71) in head. Spiracle large, semi-circular, greatest diameter 4.26 (3.46-6.07) in eye length; denticles extending to the periphery of the spiracle, anterior margin naked, spiracular fold entirely naked. Gill openings small, upright, subequal in size, fifth 1.0 (0.7-1.0)% TL; membranes sparsely covered with denticles. Mouth moderately arched, its width 1.52 (1.32-1.74) in preoral distance; three series of functional teeth in upper jaw, one series in lower; teeth dissimilar in upper and lower jaws; upper teeth small, erect, multicuspid; mostly 3 cusps in females (rarely 5), central cusp broad, a third longer than lateral cusps; lateral cusps not particularly longer toward corner of mouth; 7-9 cusps in males, pair of cusps inserted adjacent central cusps smaller than both cusps adjacent in teeth with 9 cusps, otherwise normally descending in height from central cusp; teeth in lower jaw unicuspid, interlocking, blade-like, cusps low, very oblique, lower distal margin extremely short. Nostrils relatively small, oblique; nasal flaps poorly developed, anterior flaps triangular, posterior flaps rectangular in shape. Dermal denticles minute, delicate, bristle-like, pointed, strongly recurved posteriorly on lateral and dorsal surfaces from the level of the pectoral fin back to the tail and caudal fin; dense, not arranged in regular longitudinal rows; denticles on dorsum of head slightly less elongated than those of trunk and more erect; denticles of belly and trunk margins needle-like, extremely small, semi-erect (or directed slightly posteriorly); base of flank marking with sparser and more erect denticles; anterior and posterior branches of flank and caudal base markings naked; denticles of central caudal peduncle and ventral portion of caudal base markings similar to those of upper trunk; lower two-thirds of dorsal-fin densely scaled as are bases. Distal margins of fins largely covered with skin; narrow fringes of ceratotrichia along posterior margins of dorsal and pectoral fins, weak on other fins. First dorsal fin small, low, semi-circular; second dorsal fin tall compared to first, subangular distally, erected, posterior margin slightly concave, long free rear tip. First dorsal-fin spine origin well behind pectoral fin; length from snout to first dorsal spine 1.66 (1.42-1.76) in length from spine origin to upper caudal-fin origin; length of 1st dorsal fin 1.65 (1.50-1.78) in that of 2nd dorsal fin; height of 1st dorsal fin 2.02 (1.99-2.45) in that of 2nd dorsal fin. Second dorsal-fin spine origin well behind insertion of pelvic fin; interdorsal space 0.83 (0.74-0.89) in length from snout tip to pectoral-fin origin, 1.25

(1.17-1.45) in predorsal distance. First dorsal spine small, length (0.85-1.39) in height of 1st dorsal fin, (1.95-2.97) in length of second dorsal spine; second dorsal spine large, length 0.91 (0.93-1.06) in height of 2nd dorsal fin. Pectoral fin rather small, length of inner margin 4.5 (4.5-5.5)% TL; narrowly rounded distally; base broad, 1.56 (1.54-1.7) in length of anterior margin. Caudal peduncle very long, 0.82 (0.86-1.03) in distance between pectoral and pelvic fins, 0.74 (0.72-0.89) in prepectoral distance; second dorsal-caudal fin interspace 1.44 (1.36-1.63) in interdorsal distance. Caudal fin short, subequal to head length but distinctly shorter than caudal peduncle; with well defined subterminal notch; length of lower caudal lobe 2.15 (2.07-2.34) in upper lobe length; caudal terminal lobe diverging, posterior margin truncate. Vertebral centra 92 (89-97, mainly 89-92) in 12 specimens, monospondylous 44 (41-45, mainly 44-45), pre-caudal 68 (64-72, mainly 66-69) and caudal 24 (21-26, mainly 22-25).

Luminescent markings

All markings very well defined. Head markings extending around lower half of head below mid-eye level; discontinuous with belly marking just forward of gill slits. Belly marking broadly connected to head marking about an nostril length behind mouth, extending dorsally to bottom of gill openings and onto lower base of pectoral fin and upper base as a curved finger; upper margin very sharply defined, extending from pectoral to pelvic bases but disjunct immediately after pectoral fin and before pelvic fin; dark subtriangular extension along anterior ventral base of pelvic fin. Flank-marking base insertion slightly forward of second dorsal-fin origin, anterior branch long and slender extending forward of pelvic-fin origin; posterior branch very long and uniformly slender, extending beyond second dorsal-fin free rear tip, 0.73 (0.67-0.82) in length of anterior branch. Post-pelvic marking very broad anteriorly (width more than a third of caudal peduncle height), truncated posteriorly at level of rear tip of posterior extension of lateral flank marking and coalescing with a well-defined, dark ventral saddle; caudal base marking coalescing anteriorly with ventral saddle and extending nearly to but not touching origin of lower caudal lobe; lower caudal marking moderate, its length less than 1/5th length of upper caudal lobe, finger length 3.5 (4.6-5.5)% TL. Upper caudal marking a narrow bar, rather short, width always less than 1 mm, length 5.2 (3.0-5.2)% TL.

Colour

In life, dorsum and upper sides silvery brown, punctuated laterally by numerous longitudinal rows of small darkly pigmented dashes and dots resulting in a pattern of broken lines; uniformly dark brown to black ventrally on snout, head below upper insertions of gill openings, and on

abdomen below pectoral and pelvic fins; in preservation, contrast between light greyish upper body and dark lower body is pronounced, a mid dorsal light streak with central dashed and dotted dark line occurs from about level of spiracles back to upper caudal base; gill membranes greyish white. Several vertical aggregations of horizontal dashes surround dorsal and lateral margins of eye and above each gill slit; distinctly shaped dark markings found laterally above and posterior to pelvic fins, at base of upper lobe of caudal fin, near posterior margin of upper caudal lobe, and on ventral surface of caudal peduncle posterior to pelvic fins and anterior to lower caudal base; a dusky saddle covers space between post-pelvic marking and ventral portion of caudal base marking, and extends dorsally onto lower flanks; upper caudal-fin notch dusky; a dusky blotch covers middle upper caudal lobe. Dorsal fins dusky, ventral border of free rear tips jet black.

Size

Reaches at least 448 mm TL (mature male); largest female 403 mm TL; smallest mature male 355 mm TL (adolescent at 330 mm).

Distribution

Known from the central Coral Sea, off the Saumarez and Queensland Plateaus, in 590-800 m.

Etymology

From the Latin combination of 'dis' meaning 'apart or broken' and 'lineatus' meaning 'of a line', with reference to the dark broken lines resembling dots and dashes extending horizontally along the body.

Remarks

Possibly close to a subgroup of *Etmopterus* known as the 'lucifer' group and includes another new species described herein, *E. evansi*. Like members of the 'lucifer' group, these species have: depressed heads; somewhat narrowly oval eyes; long tapering flank markings; no central caudal marking; the caudal base marking does not form a saddle anteriorly; and there is a pale naked area on the hind half of each upper eyelid. However, unlike the 'lucifer' group, they have: dense, bristle-like denticles that are arranged irregularly or in poorly defined rows; the caudal base marking has greatly elongated fingers, there is a prominent black ventral saddle on the caudal peduncle just behind the level of the rear tip of the second dorsal fin; and two prominent bands on the caudal fin (through the mid upper lobe and on the terminal lobe). Figures of *E. sentosus* (Bass *et al.*, 1976; Compagno, 1984) show a similar dark saddle on the mid caudal peduncle, however, its denticle structure and pelvic flank morphology suggest that, while distinct, it may be more closely aligned to the 'splendidus'

group.

E. dislineatus from the Coral Sea differs from its eastern Indian Ocean relative, *E. evansi*, in having a more slender body (head height 6.4-7.8 *versus* 7.6-9.1% TL), longer caudal peduncle (22.8-26.8 *versus* 18.9-21.8% TL), the presence of rows of prominent black dashes along its upper half, and more trunk vertebrae (monospondylous centra 41-45 *versus* 37-38). Of the other *Etmopterus* species, *E. decacuspoidatus* from the South China Sea has similarly shaped flank markings, very slender denticles not arranged in regular rows, and teeth in the upper jaw with nine cusps having the pair adjacent the central cusp much smaller than those adjacent. However, *E. decacuspoidatus* has a much shorter interdorsal distance (about as long as distance from snout tip to third gill slit rather than noticeably longer than head length to fifth gill slit), more widely spaced denticles, second dorsal-fin spine originating over the inner margin of the pelvic fin (rather than behind its rear tip), and is probably smaller (adult male holotype mature at 29 cm, males of *E. dislineatus* reach at least 45 cm and a paratype was adolescent at 33 cm).

***ETMOPTERUS EVANSI* SP. NOV.**

(Figs 2c, 4c, 6c, 8c; Tab. I)

Etmopterus sp. E. - Last and Stevens, 1994: p. 7 (Plate 7, fig. 8.19).

Etmopterus brachyurus. - Séret, 1994: Listed in "Chondrichthyan fishes of the KARUBAR deep-sea expedition in Indonesian waters". Abstracts of the 4th Indo-Pacific Fish Conference, Bangkok, 1994.

Holotype. - CSIRO H 3141-16, female 271 mm TL, F.V. "Surefire", stn 2, prawn trawl, 545 m, off Rowley Shoals, northwestern Australia, 17°52'S, 118°16'E, 29 Feb. 1992.

Paratypes. - 11 specimens: CSIRO H 1209-01, immature male 219 mm TL, prawn trawl, 443 m, Scott Reefs, Ashmore Terrace, Timor Sea, 13°56'S, 122°06'E, Jan. 1988. CSIRO H 1207-04, female 293 mm TL, prawn trawl, 430 m, North-West of Port Hedland, 18°20'S, 117°0'E, Oct. 1987. CSIRO H 3147-01, female 240 mm TL, F.V. "Surefire", stn 2, prawn trawl, 460 m, North-West of Port Hedland, northwestern Australia, 18°34'S, 117°22'E, 9 Mar. 1992. CSIRO H 3149-02, female 277 mm TL, F.V. "Surefire", stn 3, prawn trawl, 500 m, North of Dampier Archipelago, 18°50'S, 116°20'E, 10 Mar. 1992. CSIRO H 3143-02, mature male 262 mm TL, F.V. "Surefire", stn 4, prawn trawl, 550 m, North of Dampier Archipelago, 18°49'S, 116°09'E, 10 Mar. 1992. MNHN 2002-0085 - ex. CSIRO H 3158-16, female 247 mm TL; CSIRO H 3158-17, female

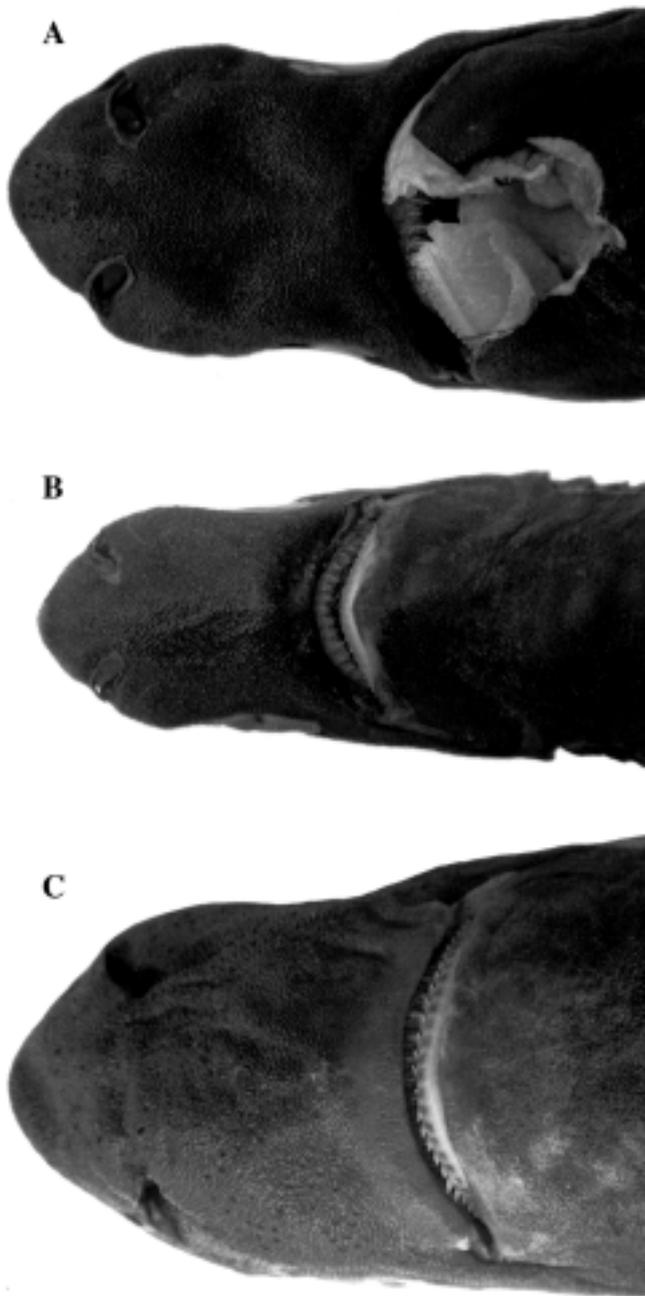


Figure 5. - Ventral view of head of holotypes. **A:** *Etmopterus caudistigmus* (MNHN 1997-3514); **B:** *E. fusus* (CSIRO H 3149-06); **C:** *E. pseudosqualiolus* (MNHN 1997-3510).

297 mm TL, F.V. “Surefire”, stn 2, prawn trawl, 550 m, North-West of Dampier Archipelago, 18°52’S, 116°00’E, 14 Mar. 1992. MNHN 2001-2814, female 270 mm TL; MNHN 2002-0086, male 223 mm TL; MNHN 2001-2816, male 256 mm TL; MNHN 2001-2815, male 275 mm TL, R.V. “Baruna Jaya 1”, KARUBAR, stn CC56, shrimp trawl, 549-552 m, Tanimbar Island, Arafura Sea, 8°16’S, 131°59’E, 31 Oct. 1991.

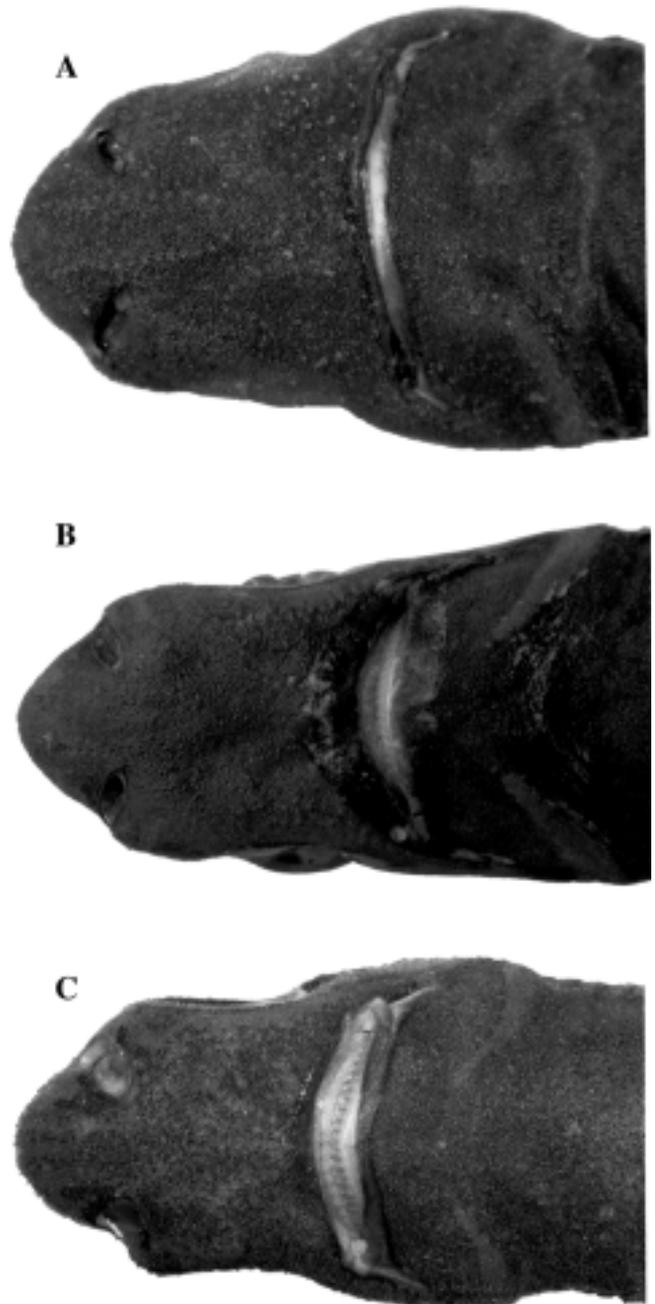


Figure 6. - Ventral view of head of holotypes. **A:** *Etmopterus dianthus* (CSIRO H 1414-02); **B:** *E. dislineatus* (CSIRO H 1416-01); **C:** *E. evansi* (CSIRO H 3141-16).

Diagnosis

A small species of *Etmopterus* with the following combination of characters: body slender (head height 7.6-9.1% TL); caudal peduncle moderate (about fifth of TL); caudal peduncle elongate (18.9-21.8% TL); rather narrow eyes and pale naked patch on upper eyelid; denticles extremely dense, very thin, delicate, arranged in poorly defined longitudinal rows; flank marking base under or slightly forward

of second dorsal spine, its posterior branch barely reaching free rear tip of second dorsal fin; no central caudal marking; finger of caudal-base marking very long, more than 7% TL; dorsal and ventral coloration strongly contrasted; no series of fine dark dots and dashes on upper half; dark ventral saddle on posterior third of caudal peduncle; prominent dark bands at tip and through mid caudal fin; monospondylous centra 37-38.

Description

Fusiform, subcylindrical, soft-bodied trunk, relatively short head 19.9 (19.2-21.8% TL) and moderate caudal peduncle 18.9 (19.1-21.8% TL). Head subconical, 2.71 (2.42-2.88) in preloacal length; height 1.16 (0.96-1.52) in width. Snout rather short, subconical in lateral view, subangular in dorsal view, horizontal length 1.51 (1.14-1.51) in eye length, 2.17 (1.59-2.09) in interorbital distance. Eye rather large, length 3.66 (3.43-3.70) in head. Spiracle moderate, subcircular, greatest diameter 3.35 (3.21-5.41) in eye length; denticles extending to membranous margin of fold; spiracular fold naked. Gill openings small, upright, subequal in size, fifth slit 1.0 (0.7-1.0)% TL. Mouth moderately arched, its width 1.34 (1.33-1.53) in preoral distance; three series of functional teeth in upper jaw, one series in lower; teeth dissimilar in upper and lower jaws; upper teeth small, erect, multicuspid; usually with 5 cusps in both sexes (occasionally with 3 cusps in symphysis); outer cusps sometimes obscure; middle and outer cusps slightly oblique to central cusp; central cusp and middle pair similar in shape, rather broad based, middle pair about half height of central cusps, about three times length of lateral pair; lower teeth unicuspid, interlocking, blade-like, extremely oblique lower margin very short. Nostrils relatively small, oblique, nasal flaps moderately developed, anterior flap slender, pointed, posterior flap subrectangular. Dermal denticles forming dense coverage, slender, hirsute, delicate, recurved distally, arranged in longitudinal rows (just evident without magnification) dorsally and laterally (except on flank marking); interorbital denticles bristle-like, upright to slightly recurved, sharp, in weak rows; denticles on belly minute, needle-like and villiform, erect (or directed slightly posteroventrally); denticles present but patchy on gill membranes; dorsal-fin bases and fins (apart from hind margins) fully covered in denticles; pale, crescentic naked patch on hind half of upper eyelid poorly developed; pronounced naked areas on lips, behind pectoral and pelvic fins. First dorsal fin low, sub-semicircular. Second dorsal fin taller than first, strongly recurved, with broadly rounded apex, posterior margin weakly concave, moderate free rear tip. Distal margins of fins largely covered with skin; narrow fringes of ceratotrichia along posterior margins of all fins, weak on other fins. First dorsal-fin spine origin well posterior to pectoral-

fin tip (over in some smaller specimens); first dorsal origin slightly forward of half way between pectoral and pelvic origins; length from snout to first dorsal spine 1.37 (1.38-1.64) in length from spine origin to upper caudal-fin origin; length 1st dorsal fin 1.41 (1.31-1.5.0) in that of 2nd dorsal fin; height of 1st dorsal fin 1.47 (1.59-1.77) in that of 2nd dorsal fin. Second dorsal-fin spine origin preceding rear tips of (over to slightly behind insertion of) pelvic fins; second dorsal fin large; interdorsal space 0.89 (0.87-1.08) in length from snout tip to pectoral-fin origin, 1.58 (1.45-1.69) in pre-dorsal distance. First dorsal spine moderately long, its length 0.97 (0.86-1.32) in first dorsal fin height; second dorsal spine larger, 2.10 (1.99-3.14) times length of first, 0.68 (0.73-0.89) in second dorsal fin height. Pectoral fin small, length of inner margin 5.4 (4.6-5.6)% TL; narrowly rounded distally; base broad, 1.37 (1.48-1.72) in length of anterior margin. Caudal peduncle almost flat along ventral surface, moderate, 1.31 (0.99-1.43) in distance between pectoral and pelvic fins; distance from pelvic-fin insertion to lower lobe of caudal fin subequal, 0.97 (0.93-1.09), in prepectoral distance; second dorsal-caudal fin interspace 1.61 (1.33-1.63) in interdorsal distance. Caudal fin rather long, marginally longer than head and caudal peduncle; with weak subterminal notch; length of lower caudal lobe 2.08 (2.01-2.43) in upper lobe length; terminal lobe narrow, subrectangular, with broadly rounded posterior margin. Vertebral centra 79 (76-81) in 6 specimens, monospondylous 38 (37-38), precaudal 55 (55-59, mainly 55-56), and caudal 24 (21-23).

Luminescent markings

Sharply defined in holotype and smallest paratypes (less pronounced in largest individuals). Head markings extending around lower half of head below mid-eye level; discontinuous with belly marking just forward of gill slits. Belly marking broadly connected to head marking about a nostril length behind mouth, dorsally to gill openings and extending onto lower base of pectoral fin and upper base as a finger; upper margin sharply defined, extending from pectoral to pelvic bases but disjunct immediately after pectoral fin and before pelvic fin; dark fingers extending along anterior and posterior ventral bases of pelvic fin. Flank marking insertion over or slightly forward of exposed second dorsal-fin origin, base narrow, anterior branch long and slender, reaching to or just forward of pelvic-fin origin; posterior branch equally slender, (many times narrower than spiracle) reaching to or just falling short of second dorsal free rear tip, subequal, 1.02 (0.89-1.06) in length of anterior branch. Post-pelvic ventral marking long, covering more than half flattened ventral surface of caudal peduncle (extending posteriorly as four narrow fingers on holotype). Ventral caudal marking short, extending forward of caudal lower lobe ori-

gin by about a spiracle length, not extending onto side of caudal peduncle as saddle; posterior finger narrow, very long, length 8.5 (9.3-9.9)% TL. No central caudal marking. Upper caudal marking stripe-like, short, curved slightly, usually slightly longer than spiracle, length 3.4 (1.7-3.1)% TL.

Colour

In life, pale greyish brown dorsally, appreciably darker ventrally; border between these two areas accentuated by fine black lines; head and body markings well defined with enlarged melanophores. In addition to luminescent markings, dark blotches present on tail and caudal fin (these blotches best defined in small specimens); blackish crescentic saddle present on the posterior caudal peduncle just in advance of ventral caudal marking; central portion of upper caudal lobe with a large (about length of eye) blotch that reaches just short of upper and lower margins of caudal fin; entire terminal lobe of caudal fin darkly pigmented; bases of both dorsal fins darkly pigmented, ventral edges of their free rear tips black; inner part of gill membranes dusky, margins black.

Size

Reaches at least 297 mm TL (female); male of 262 mm mature.

Distribution

Known from the continental slope off Western Australia in 430-550 m and from the Arafura Sea (Indonesia) in about 550 m.

Etymology

Named in honour of Australian fishery scientist, David Evans, who over the last decade has meticulously selected and donated valuable taxonomic specimens (including several excellent *Etmopterus* specimens of which two have been designated as holotypes) collected by commercial trawlers from the tropical deepwater of Western Australia.

Remarks

Belongs to a subgroup of *Etmopterus* close to but distinct from the '*lucifer*' group and includes another new species described herein, *E. dislineatus*. These species have: dense, bristle-like denticles that are arranged irregularly or in poorly defined rows; the caudal base marking has greatly elongated fingers, there is a prominent black ventral saddle on the caudal peduncle just behind the level of the rear tip of the second dorsal fin; and two prominent bands on the caudal fin (through the mid upper lobe and on the terminal lobe).

E. evansi differs from *E. dislineatus* in having a less slender body (head height 7.6-9.1 versus 6.4-7.8% TL),

shorter caudal peduncle (18.9-21.8 versus 22.8-26.8% TL), no rows of prominent black dashes along its upper half, and fewer trunk vertebrae (monospondylous centra 37-38 versus 41-45). *E. decacuspoidatus* is related but has many more cusps in the teeth of the upper jaw (9-11 versus 3-5) and the first inner pair are greatly reduced, being dwarfed by those adjacent.

ETMOPTERUS FUSUS SP. NOV.

(Figs 1b, 3b, 5b, 7b; Tab. II)

Etmopterus sp. C. - Last and Stevens, 1994: p. 75 (Plate 8, fig. 8.17).

Holotype. - CSIRO H 3149-06, adult male 251 mm TL, F.V. "Surefire", stn 3, prawn trawl, 500 m, North of Dampier Archipelago, northwestern Australia, 18°50'S, 116°20'E, 10 Mar. 1992.

Paratypes. - 6 specimens: CSIRO H 1621-01, mature male 255 mm TL; CSIRO H 1621-02, mature male 258 mm TL, F.V. "Surefire", stn 2, prawn trawl, Rowley Shoals, 430 m, 18°36'S, 117°19'E, 7 Sep. 1988. CSIRO H 3149-05, female 272 mm TL; CSIRO H 3149-07, female 288 mm TL, northwestern Australia, collected with holotype. MNHN 2002-0086 - ex. CSIRO H 3158-14, female 257 mm TL; CSIRO H 3158-15, female 293 mm TL, F.V. "Surefire", stn 2, prawn trawl, 550 m, North-West of Dampier Archipelago, 18°52'S, 116°00'E, 14 Mar. 1992.

Diagnosis

A small species of *Etmopterus* with the following combination of characters: firm fusiform, almost cylindrical body; relatively long (more than 21% TL) head; mouth moderate, subequal to eye length; pale naked patch present on upper eyelid; caudal peduncle rather elongate, about 2-2.6 times greatest horizontal length of first dorsal fin including spine, about a fifth of TL; upper teeth of mature males with 7 cusps; denticles short, robust, arranged in regular rows; posterior branch of flank marking truncate and merging ventrally with post-pelvic marking; anterior portion of caudal base marking very broad, enveloping ventral surface and extending onto flanks; oval central caudal marking present; upper caudal marking comma-shaped; dorsal and ventral surfaces both dark, not contrasted; pectoral fin pale distally; trunk vertebrae 36-38.

Description

Fusiform, subcylindrical trunk, long head 21.9 (21.2-23.2)% TL and elongate, tapering caudal peduncle 20.9 (18.3-22.0)% TL. Head subconical, 2.41 (2.30-2.64) in pre-cloacal length; height 0.90 (0.96-1.13) subequal to width.

Snout moderately long, subconical in lateral view, subangular in dorsal view, horizontal length 1.35 (1.36-1.51) in length of eye, 1.60 (1.65-1.76) in interorbital distance. Eye broadly oval, rather large, length 3.75 (3.69-3.97) in head, 2.26 (2.13-2.48) times height. Spiracle large, greatest diameter 4.36 (3.80-5.01) in length of eye, tear-drop shaped, denticles extending into cavity, spiracular fold naked. Gill openings rather large, slightly oblique, subequal in size, height of fifth slit 1.3 (1.5-1.7)% TL. Mouth relatively narrow, strongly arched, its width 1.37 (1.38-1.83) in preoral distance; three series of functional teeth in upper jaw, one series in lower; teeth dissimilar in upper and lower jaws; upper teeth small, erect, multicuspid; seven cusps in males, central cusp very long, slender, next adjacent middle pairs two-thirds length of central cusp, lateral pair about half length of middle pair; five cusps in females, middle pair about two-thirds length of central cusp, lateral pair about half length of middle pair, lateral cusps relatively longer toward corner of mouth; teeth in lower jaw unicuspid, interlocking, blade-like, cusps low, very oblique, lower distal margin extremely short. Nostrils large, oblique; nasal flaps poorly developed, anterior flap triangular, posterior flap rectangular. Dermal denticles very small, low, unicuspid, mostly with defined ridges; robust, strongly recurved posteriorly, shorter and blunter on dorsum, most of tail and caudal fin, arranged in regular, longitudinal rows (evident without magnification); subconical, upright to weakly recurved ventrally, blunt on belly and over flank markings; irregularly arranged, much smaller and erect to semi-erect, thorn-like on lateral flank, ventral caudal base and post-pelvic markings; irregularly spaced on interorbit; smaller and ventrally directed on caudal-base extension and mid-caudal markings; white, naked, elongate, tear-shaped patch on posterior half of upper eyelid (possibly luminescent tissue). Dorsal-fin bases with denticles only sparse denticles on lower third of each dorsal fin; denticles present over most of gill membranes. Distal margins of fins largely covered with skin; narrow fringes of ceratotrichia along posterior margins of dorsal fins, mostly weak on other fins. First dorsal fin low, rounded; fin-spine origin over rear tip of pectoral fin; insertion of base well forward of pelvic-fin origin; length from snout to first dorsal spine 1.69 (1.62-1.78) in length from spine origin to upper caudal-fin origin; smaller than second, length of 1st dorsal fin 1.50 (1.32-1.49) in that of 2nd dorsal fin, height 1.72 (1.57-1.88) in that of 2nd dorsal fin; length of first dorsal spine 1.90 (0.99-1.92) in height of 1st dorsal fin. Second dorsal fin of moderate size, posterior margin deeply concave, free rear tip long; fin-spine origin over or just behind insertion of pelvic fin, spine length 1.01 (0.72-0.94) in height of 2nd dorsal fin; interdorsal space 0.81 (0.79-0.98) in length from snout tip to pectoral-fin origin, 1.12 (1.08-1.31) in predorsal distance. First dorsal spine small, usually less than half length of second dorsal spine.

Pectoral fin moderate, inner margin 4.4 (4.8-6.5)% TL, apex narrowly rounded, posterior margin truncate, unpigmented distally; base small, 1.70 (1.60-2.16) in length of anterior margin. Caudal peduncle moderately long, tapering, 1.11 (1.03-1.49) in distance between pectoral and pelvic fins, subequal 1.01 (1.03-1.16) to prepectoral distance; second dorsal-caudal fin interspace 1.82 (1.59-2.05) in interdorsal distance. Caudal fin marginally shorter than head length; subterminal notch well-defined; length of lower caudal-fin lobe 1.81 (1.75-2.00) in upper lobe length. Vertebral centra 78? (77-81) in 6 specimens, monospondylous 37 (36-38), precaudal 56 (55-58), and caudal 22 (22-23).

Luminescent markings

Well defined on tail but sometimes more obscure on head. Head markings extending around lower half of head below mid-eye level; upper margin barely discontinuous with belly marking. Belly marking extending dorsally to gill openings and onto most of pectoral-fin base; upper margin well defined, disjunct immediately after pectoral fin but continuous to pelvic fin, extending horizontally along abdomen then plunging sharply above pelvic-fin origin; covering pelvic-fin interspace. Pelvic flank markings often indistinct; anterior branch of flank marking rather broad and long, extending well forward of pelvic-fin origin; posterior branch truncated distally, massive (greatest height at truncation subequal to half body depth through the same vertical axis), terminating just posterior of second dorsal-fin insertion, 11.7 (more than 8) in length of anterior branch. Caudal base marking very broad, forming a broad saddle anteriorly (covering entire ventral surface of posterior caudal peduncle and extending dorsally to a level more than third of caudal peduncle height), posteriorly tapering to point about a spiracle length behind origin of lower caudal lobe, finger 2.3 (2.3-3.7)% TL. Post-pelvic marking not continuous with belly markings, extending posteriorly to level of rear edge of posterior branch of flank marking. Central caudal marking narrow ovoid, subequal to eye length. Upper caudal marking a narrow bar, somewhat comma-shaped, about half length central caudal marking 1.9 (1.9-3.4)% TL.

Colour

Very darkly pigmented, dark grey to black, dorsal and ventral surfaces both dark; junction between dark ventral markings and upper surfaces still sharply defined; ventral marking suffused with enlarged widely spaced melanophores, upper surfaces with denser coverage of smaller melanophores. Dark ventral markings over under-surface of head, belly, caudal peduncle and caudal fin; flank marking extending laterally forward, above and posterior to pelvic fins, its base extending ventrally to form a wide saddle directly behind pelvic fins; second saddle over caudal peduncle anterior to the lower caudal-fin origin, extending

dorsally onto mid-flank and posteriorly onto upper caudal-fin base; central caudal marking well defined, situated close (less than half its length) from apex of finger of caudal-base marking; upper caudal marking sharply defined, black. Narrow white patch on hind half of upper eyelid; mouth greyish; gill membranes greyish or black, darkest over naked patches. Caudal-fin lobes mostly more lightly pigmented than body, except for flank markings and broad black tip to the upper caudal-fin notch. Pectoral and pelvic-fin bases darkly pigmented, fins pale or translucent except for dusky inner edge. Dorsal-fin bases and anterior fin margins dusky, outer portions pale or translucent; anterior margins usually with fine black edge.

Size

Reaches at least 293 mm TL (female); males 251-258 mm TL all mature.

Distribution

Known from continental slope off northern Western Australia in 430-550 m. Possibly also off Java, Indonesia,

in 120-200 m.

Etymology

Derived from the Latin '*fuscus*' in allusion to its fusiform body shape resembling a naval torpedo.

Remarks

Along with other members of the *splendidus*-complex (ie *Etmopterus caudistigmus* and *E. splendidus*), it shares the following characters: presence of a central caudal-fin marking; a firm, almost subcylindrical body; a broadly oval to subcircular eye; short conical denticles with prominent lateral ridges; a truncate posterior flank marking; a very broad caudal-base marking forming a saddle anteriorly; and a pale naked area on the hind half of each upper eyelid.

Yano's (1988) type series of *E. splendidus* appears to contain specimens of two similar species (see remarks under *E. caudistigmus*). An Indonesian paratype of *E. splendidus* was remeasured using our methodology and compared directly with types of *E. fuscus*. This specimen appears to be conspecific with *E. fuscus*. It only differs slightly in a

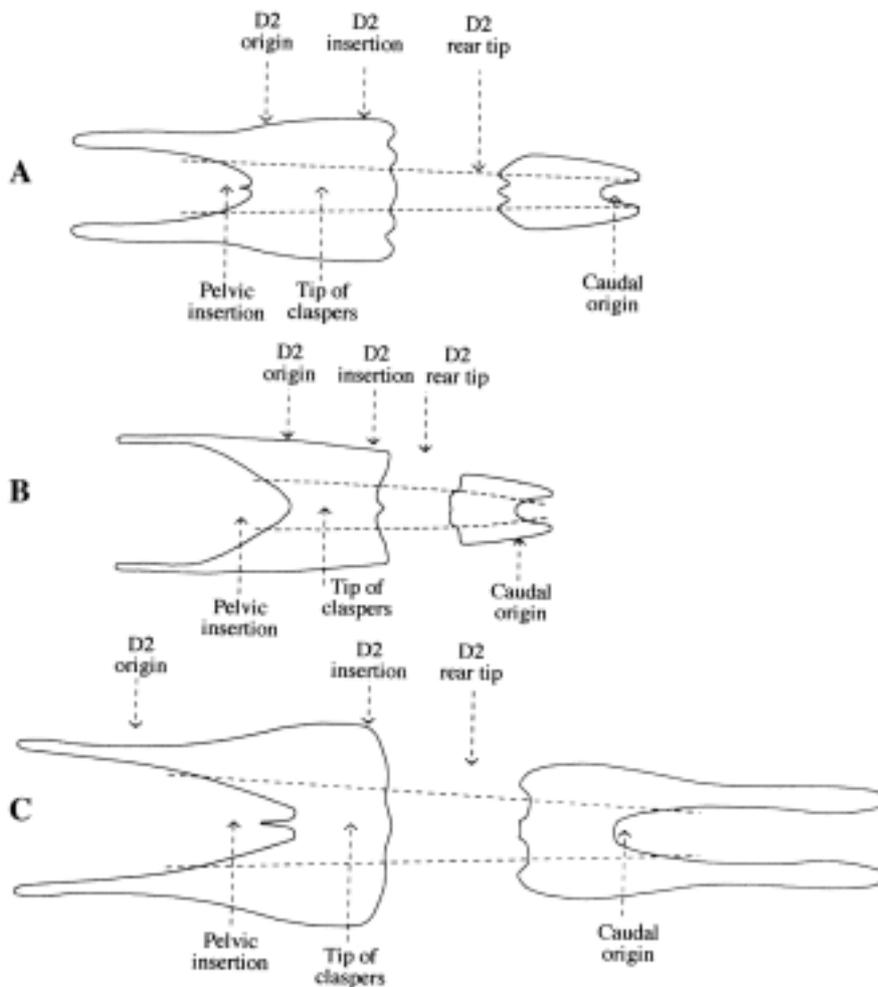


Figure 7. - Diagrammatic representation of luminescent markings of holotypes. **A:** *Etmopterus caudistigmus* (MNHN 1997-3514); **B:** *E. fuscus* (CSIRO H 3149-06); **C:** *E. pseudosqualiolus* (MNHN 1997-3510).

few morphometric characters: relatively slightly longer prepiracular, preorbital, interorbital, and caudal-base marking lengths and eye height; and slightly shorter prenarial and second dorsal-fin inner margin lengths.

Etmopterus splendidus is now known only from the western North Pacific. Apart from its more slender caudal peduncle, *E. fusus* differs from *E. splendidus* (based on a comparison of our data with Yano's) in having a shorter preloacal length (52.5-56.1 versus 57.1-57.4% TL) and prefirst dorsal-fin length (28.7-30.3 versus 32.6-33.4% TL), a narrower head (width 8.9-10.8 versus 11.4-13.4% TL), and possibly a narrower mouth (width 5.3-6.8 versus 7.2-7.7% TL). *E. fusus* differs from *E. caudistigmus* in having fewer trunk centra (36-38 rather than 40), a shorter snout (horizontal length 4.0-4.3 rather than 4.9-5.3% TL), more cusps (females 5 rather than 3, males 7 rather than 5 cusps) in the upper jaw teeth, pale-edged fins (rather than dark), and a smaller mouth.

***ETMOPTERUS PSEUDOSQUALIOLUS* SP. NOV.**

(Figs 1c, 3c, 5c, 7c; Tab. II)

Etmopterus sp. n. - Séret in Grandperrin *et al.*, 1997, listed.

Holotype. - MNHN 1997-3510, male 448 mm TL, R.V. 'Tangaroa', HALIPRO 2, stn BT73, bottom trawl, 1043-1102 m, Norfolk Ridge, 24°52'S, 167°31'E, 20 Nov. 1996.

Paratypes. - 4 specimens: MNHN 1997-3507, female 414 mm TL, R.V. "Alis", HALIPRO 1, stn CH876, bottom trawl, 870-1000 m, Norfolk Ridge, New Caledonia, 23°06'S, 166°47'E, 31 Mar. 1994. MNHN 1997-3508, male 395 mm TL, R.V. "Tangaroa", HALIPRO 2, stn BT40, bottom trawl, 1068-1170 m, Norfolk Ridge, 25°42'S, 167°15'E, 14 Nov. 1996. CSIRO H 5695-01 - ex. MNHN 1997-3509, male 442 mm TL, R.V. "Tangaroa", HALIPRO 2, stn BT52, bottom trawl, 668-870 m, Norfolk Ridge, 25°23'S, 168°18'E, 16 Nov. 1996. MNHN 1997-3511, male 453 mm TL, R.V. Tangaroa, HALIPRO 2, stn BT96, bottom trawl, 1034-1056 m, Lord Howe Ridge, 23°56'S, 161°53'E, 24 Nov. 1996.

Diagnosis

A medium-sized species of *Etmopterus* with the following combination of characters: body cigar-shaped, deep head conical with a short bulbous snout, preoral length 7.3-8.2% TL; eye almost round with a small opalescent lunate patch on upper eyelid margin; pectoral fins small, their rear tips about a cornea diameter in front of second dorsal-fin origin; caudal peduncle short, 14.8-16.6% TL; upper teeth of mature males mostly with 7 cusps, some with 9-11 cusps, in separated rows; central cusps greatly expanded, about 2

times longer than those adjacent; denticles small, with a single erected, slightly curved cusp, arranged in irregular rows; anterior branch of pelvic marking long and slender, posterior branch truncated; precaudal marking with very long finger-like extensions reaching to central caudal fin; dorsal and ventral surfaces both dark, not contrasted; white pineal blotch small, conspicuous, triangular. Trunk vertebrae 46-47.

Description

Elongated, cigar-shaped body, with short, bulbous head 22.5 (18.4-23.0)% TL and short caudal peduncle 16.1 (14.8-16.6)% TL. Head sub-conical, depressed, and short, length 2.57 (2.64-3.09) in preloacal length; height 0.96 (0.75-1.10) in width; horizontal preorbital length 5.2 (4.2-4.7)% TL; prepiracular length about 1.81 (1.97-2.09) in prepectoral length. Snout short, subconical in lateral view (strongly convex ventrally) and broadly blunt in dorsal view, prenasal length 1.9 (1.7-2.3)% TL, preorbital length 0.79 (0.77-1.03) in horizontal diameter of eye, 1.47 (1.68-1.87) in interorbital distance. Eye large, high oval, almost round, horizontal diameter 5.46 (4.19-5.78) in head length, 1.50 (1.46-2.17) times in eye height. Spiracle semi-circular, greatest diameter 3.14 (2.37-3.69) in eye length; denticles extending into spiracular opening, spiracular fold naked, 11 (7-12) pseudobranchial lamellae. Gill openings small, subequal in height, interspaces between them broadest anteriorly, fifth opening partly over pectoral-fin base origin.

Mouth broad, slightly arched, its width about equal to preoral distance; four series of functional teeth in upper jaw, one series in lower; teeth dissimilar in upper and lower jaws; upper teeth moderate, erect, multicuspid; with up to 11 (9-11) cusps in males, central cusps very long, slender, much more massive and about twice as long as those adjacent; lateral cusps parallel to the central cusp; 3 cusps in female MNHN 1997-3507, central cusps relatively larger near symphysis, 2-3 times longer than lateral pair; teeth in lower jaw unicuspid, interlocking, blade-like, cusps low, very oblique, lower distal margin very short. Nostrils large, oblique; nasal flaps poorly developed, anterior flap triangular, posterior flap subrectangular. Dermal denticles below first dorsal fin small, with a single erected, slightly curved cusp, mostly with defined ridges; arranged in irregular longitudinal rows; cusps of denticles of flank markings oriented downward; first and second dorsal fin almost entirely covered with closely spaced denticles, in regular rows; denticles present on gill membranes; origin of pectoral-fin base (inside of fifth opening) naked; pineal white blotch with sparse denticles; a small opalescent, naked, lunate patch on posterior half of upper eyelid (possibly luminescent tissue). Distal margins of fins largely covered with skin; posterior margins with exposed ceratotrichia. First dorsal fin low, flag-shaped with rounded apex; fin-spine origin behind of

pectoral-fin rear tip by about a cornea diameter; insertion of base well forward of pelvic-fin origin; smaller than second dorsal fin, length from snout to 1st dorsal spine 1.32 (1.28-1.58) in length from spine origin to upper caudal-fin origin; length of 1st dorsal fin 1.25 (1.25-1.32) in 2nd dorsal fin; height of 1st dorsal fin 1.44 (1.42-1.98) in 2nd dorsal fin; length of first dorsal spine (1.32-2.34) in height of 1st dorsal fin. Second dorsal fin relatively low, elongate with broadly rounded apex and concave posterior margin, long free rear tip, spine length (1.01-1.28) in height of 2nd dorsal fin; fin-spine origin at the level of pelvic-fin insertion; interdorsal space subequal, 1.11 (0.85-1.14) in length from snout tip to pectoral-fin origin, 1.71 (1.29-1.68) in predorsal distance. First dorsal spine small, less than half length of second dorsal spine. Pectoral fin small, inner margin 3.3 (2.6-4.0)% TL, subrectangular in shape, posterior margin deep and truncated; base broad, 1.85 (1.54-1.95) times in length of anterior margin. Caudal peduncle short, uniformly slender, 1.69 (1.70-1.98) in distance between pectoral and pelvic fins, 1.33 (1.23-1.53) in prepectoral distance; second dorsal to caudal-fin interspace 1.48 (1.58-1.96) in interdorsal

distance. Caudal fin long, about equal to head length; subterminal notch well-defined; length of lower caudal lobe 1.86 (1.59-1.78) times in upper lobe length.

Vertebral centra 92 (85-91), monospondylous 46 (46-47), precaudal 67 (63-64), and caudal 25 (21-22). Tooth counts upper jaw (29-34), lower jaw 31 (32-34).

Luminescent markings

Not well defined. Head and belly markings barely distinguishable (only obvious under magnification). Pelvic flank markings more evident; anterior branch long and moderately slender, extending forward of pelvic-fin origin; posterior branch truncated distally, massive, paddle-shaped (greatest height at truncation greater than half body depth through the same vertical axis) terminating just posterior of second dorsal-fin insertion; base of pelvic marking very broad, forming a saddle blotch on the caudal peduncle, its insertion behind level of the second dorsal fin insertion, its origin about at level of the middle of the second dorsal-fin base, well behind pelvic insertion. Precaudal marking saddle-like on the ventral caudal peduncle, originating just

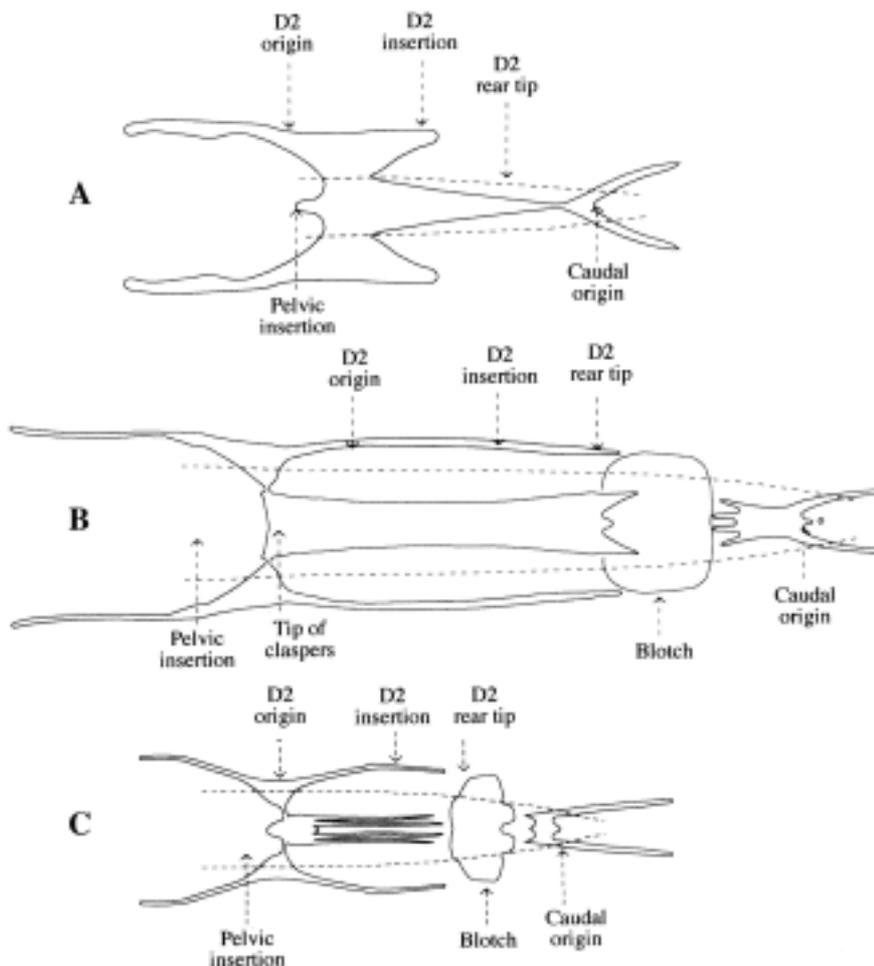


Figure 8. - Diagrammatic representation of luminescent markings of holotypes. A: *Etmopterus dianthus* (CSIRO H 1414-02); B: *E. dislineatus* (CSIRO H 1416-01); C: *E. evansi* (CSIRO H 3141-16).

behind level of second dorsal-fin free rear tip, maximum depth just less than caudal peduncle depth at same point, with very long, broad posterior finger-like extension running on to central caudal fin; finger 10.5 (8.5-11.4)% TL, with an obvious constriction at 33 (27-39)% of its length from its base. Upper caudal marking pronounced, pencil-thin, short, straight, about as long as the distance separating it from the precaudal finger extension, length 2.4 (2.0-3.8)% TL.

Colour

Body dark brown to black, tail somewhat paler, contrasting with the dark flank markings. Fins dark, distally pale, except the caudal terminal lobe which is dark; ventral margin of dorsal-fin free rear tips dark edged, paler hind margin of dorsal-fin distinctly broader on first dorsal than second dorsal; dorsal fin spines translucent distally. A small conspicuous triangular white pineal blotch. Mouth lining and lips brownish. Teeth white. Gill membranes brownish, dark edged distally; inner part pale brownish to whitish.

Size

Reaches at least 453 mm TL (male); largest female 414 mm TL; smallest mature male 395 mm TL.

Distribution

Known from the seamounts of the Norfolk Ridge off southern New Caledonia in 668-1170 m and those of the Lord Howe Ridge off northwestern New Caledonia in 1034-1056 m.

Etymology

A combination of the Greek '*pseudo*' meaning false, with '*squaliolus*', a genus of small squaloid sharks in allusion to the similarity of their general body shapes.

Remarks

Etmopterus pseudosqualiolus is set apart from the other *Etmopterus* species by a cigar-shaped body (resembling that of another squalid genus *Squaliolus*), a very short, deep snout (reminiscent of *Trigonognathus*), small pectoral fin, rounded eye, relatively high number of cusps in the upper teeth of males, and a very long posterior extension of the caudal-base marking. The appearance of this etmopterid is so distinctive that it could possibly be assigned to a new supraspecific group. A dwarf, western central Atlantic species, *E. carteri*, also has a bulbous, almost conical, head but has needle-shaped denticles, no prominent luminous markings, and fewer vertebrae (34-37 monospondylous centra versus 46-47).

KEY TO *ETMOPTERUS* SPECIES OF TROPICAL AUSTRALASIA

1. Denticles low, flat-topped, fixed and immovable (minute, never in distinct rows, barely distinguishable to the naked eye)..... 2
 - Denticles slender, upright, movable (small but distinguishable to the naked eye, sometimes in distinct rows) 3
2. First dorsal fin less than an eye diameter behind free rear tip of pectoral fin; head length to first gill slit longer than distance from first gill slit to first dorsal-fin origin.....
 - *Etmopterus bigelowi* (temperate and tropical oceans)
 - First dorsal fin more than an eye diameter behind free rear tip of pectoral fin; head length to first gill slit shorter than distance from first gill slit to first dorsal-fin origin.....
 - *Etmopterus pusillus* (temperate and tropical oceans)
3. Posterior branch of pelvic flank marking short, thick, posterior edge truncate, barely extending beyond insertion of second dorsal fin4
 - Posterior branch of pelvic flank marking long, slender, extending well past insertion of second dorsal fin (often to rear tip of fin or beyond)9
4. Denticles long, bristle-like; eye narrow, almost slit-like; caudal-base marking short (falling well short of centre of upper caudal lobe); no central caudal marking5
 - Denticles short, rather robust; eye broadly oval to sub-circular; either oval-shaped, central caudal marking present or with a long caudal-base marking that extends to about centre of upper caudal lobe6
5. Upper surface pale, sharply demarcated from dark belly; pelvic flank and caudal markings distinct; monospondylous centra usually 42 or fewer; smaller than 45 cm TL *Etmopterus dianthus* (SW Pacific)
 - Uniformly dark; pelvic flank and caudal markings absent or barely visible; monospondylous centra usually 44 or more; reaches about 70 cm TL
 -*Etmopterus* sp. cf. *unicolor* (Australasia)
6. First dorsal-fin origin behind rear tip of pectoral fin; upper jaw teeth with 7-11 cusps; no central caudal marking; caudal-base marking extending to about centre of upper caudal lobe.....*Etmopterus pseudosqualiolus* (SW Pacific)
 - First dorsal-fin origin over pectoral fin; upper jaw teeth with 3-7 cusps; central caudal marking present; caudal-base marking short7
7. Caudal peduncle less than 17.5% TL
 -**Etmopterus splendidus* (NW Pacific)
 - Caudal peduncle more than 17.5% TL..... 8

8. Snout relatively short, horizontal length less than 4.5% TL; upper jaw teeth with 5 cusps in females, 7 in males; monospondylous centra 36-38.....

.....*Etmopterus fusus* (NW Australia)

Snout relatively long, horizontal length more than 4.5% TL; upper jaw teeth with 3 cusps in females, 5 in males; monospondylous centra 40.....

.....*Etmopterus caudistigmus* (SW Pacific)

9. Flank denticles not arranged in clearly defined lines; dark ventral saddle on caudal peduncle immediately before caudal ventral marking; dark bands across middle and tip of upper caudal-fin lobe..... 10

Flank denticles mostly arranged in regular lines; no dark ventral saddle on caudal peduncle; no dark bands across both middle and tip of upper caudal-fin lobe..... 11

10. Distance from pelvic-fin insertion to lower lobe of caudal fin subequal to distance from snout tip to pectoral-fin origin; flanks lacking rows of prominent, dark dashes.....

.....*Etmopterus evansi* (SE Indian Ocean)

Distance from pelvic-fin insertion to lower lobe of caudal fin almost equal to distance from snout tip to pectoral-fin insertion; flanks with prominent rows of dark dashes.....*Etmopterus dislineatus* (SW Pacific)

11. Base of pelvic flank marking situated posteriorly, under exposed base of second dorsal-fin spine; anterior branch of flank marking usually longer than posterior branch.....

.....*Etmopterus lucifer* (NW Pacific and possibly temperate Southern Hemisphere)

Base of pelvic flank marking situated anteriorly, ahead of base of second dorsal-fin spine; anterior branch of flank marking shorter than posterior branch..... 12

12 Precaudal marking longer than caudal marking.....

.....*Etmopterus brachyurus* (Indo-West Pacific)

Precaudal marking shorter than caudal marking.....

.....*Etmopterus molleri* (SW Pacific)

* *E. splendidus* is included in this key because it was originally described as from Japan and eastern Indonesia, however the type specimens from Indonesia represent another species that is possibly conspecific with *E. fusus*.

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REFERENCES

- BASS A.J., D'AUBREY J.D. & N. KISTNASAMY, 1976. - Sharks of the east coast of southern Africa. VI. The families Oxynotidae, Squalidae, Dalatiidae and Echinorhinidae. *Invest. Rep. Oceanogr. Res. Inst., Durban*, 45: 1-103.
- COMPAGNO L.J.V., 1984. - FAO species catalogue. Vol. 4. Sharks of the world. An annotated and illustrated catalogue of shark species known to date. Part 1. Hexanchiformes to Lamniformes. *FAO Fish. Synop.*, (125) Vol. 4(1): 249 p.
- GRANDPERRIN R., FARMAN R., LORANCE P., JOMESSY T., HAMEL P., LABOUYTE P., LABROSSE P., RICHER DE FORGES B., SÉRET B. & S. VIRLY, 1997. - Campagne HALIPRO 2 de chalutages exploratoires profonds dans le Sud de la zone économique de la Nouvelle-Calédonie (R.V. "Tangaroa" - 4-28 novembre 1996), 150 p.
- LAST P.R. & J.D. STEVENS, 1994. - Sharks and Rays of Australia. 513 p. Australia: CSIRO.
- SÉRET B., 1994. - Chondrichthyan Fishes of New Caledonia. *Chondros*, 5(3): 6-9.
- SHIRAI S. & H. TACHIKAWA, 1993. - Taxonomic resolution of the *Etmopterus pusillus* species group (Elasmobranchii, Etmopteridae), with a description of *E. bigelowi*, n. sp. *Copeia*, 1993(2): 483-495.
- SPRINGER S. & G.H. BURGESS, 1985. - Two new dwarf dogsharks (*Etmopterus*, Squalidae), found off the Caribbean coast of Colombia. *Copeia*, 1985(3): 584-591.
- TACHIKAWA H., TANIUCHI T. & R. ARAI, 1989. - *Etmopterus baxteri*, a junior synonym of *E. granulosus* (Elasmobranchii, Squalidae). *Bull. Natn. Sci. Mus., Tokyo*, Ser. A, 15: 235-241.
- YAMAKAWA T., TANIUCHI T. & Y. NOSE, 1986. - Review of the *Etmopterus lucifer* Group (Squalidae) in Japan. In: Indo-Pacific Fish Biology: Proc. 2nd Intern. Conf. on Indo-Pacific Fishes. (Uyeno T. et al., eds), pp. 197-207. Tokyo: Ichthyological Society of Japan.
- YANO K., 1988. - A new lanternshark *Etmopterus splendidus* from the East China Sea and Java Sea. *Jpn. J. Ichthyol.*, 34: 421-425.
- YANO K., 1997. - First record of the brown lanternshark, *Etmopterus unicolor*, from the waters around New Zealand, and comparison with the southern lanternshark, *E. granulosus*. *Ichthyol. Res.*, 44(1): 61-72.

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