



A review of the genus *Cephaloscyllium* (Chondrichthyes: Carcharhiniformes: Scyliorhinidae) from Taiwanese waters

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Abstract

Sharks of the genus *Cephaloscyllium* from Taiwan were reviewed. After extensive survey of the specimens deposited in museums, universities and fisheries institutions in Taiwan and Japan, the following four species were recognized as valid in Taiwanese waters: *C. umbratile* Jordan & Fowler, 1903, *C. fasciatum* Chan, 1966, *C. sarawakensis* Yano, Ahmad & Gambang, 2005, and *C. formosanum* Teng, 1962. *Cephaloscyllium formosanum* is resurrected herein. Four species (*C. circulopullum* Yano, Ahmad & Gambang, 2005, *C. parvum* Inoue & Nakaya, 2006, *C. pardelotum* Schaaf-da Silva & Ebert, 2008, *C. maculatum* Schaaf-da Silva & Ebert, 2008) are concluded to be junior synonyms. The four valid species here recognized are fully described, and a key to Taiwanese species is provided. The original description of *C. formosanum* was translated into English from Japanese and is included as an Appendix.

Key words: Carcharhiniformes, Scyliorhinidae, *Cephaloscyllium*, swellsharks, taxonomic revision, Taiwan

Introduction

The sharks of the genus *Cephaloscyllium* Gill, 1862 (family Scyliorhinidae, order Carcharhiniformes) are known only from the Indian and Pacific oceans, and mainly inhabit temperate to tropical continental shelves and slopes. They are called “swell sharks” or “balloon sharks” because they swallow seawater in the stomach and inflate their abdomen like a balloon perhaps to threaten predators and to settle the body among rocks or crevices.

Cephaloscyllium is characterized by having the first dorsal fin located behind pelvic fin origin, supraorbital crest on the cranium, smaller second dorsal fin than first dorsal and anal fins, second dorsal fin base totally above anal fin base, and absence of labial furrows from jaw corners.

Compagno (1984) recognized seven species in the genus: *Cephaloscyllium isabellum* (Bonnaterre, 1788) from New Zealand; *C. laticeps* (Dumeril, 1853) from south Australia; *C. ventriosum* (Garman, 1880) from the Pacific coasts of North and South America; *C. sufflans* (Regan, 1921) from east Africa; *C. nacione* Whitley, 1932 from south Australia; *C. fasciatum* Chan 1966 from Vietnam; and *C. silasi* (Talwar, 1974) from India. However, Compagno (1984) also contained many indeterminate and tentative factors in his account. Since then, many new species have been described: *C. sarawakensis* Yano, Ahmad & Gambang, 2005 and *C. circulopullum* Yano, Ahmad & Gambang, 2005 from Sarawak; *C. parvum* Inoue & Nakaya, 2006 from the South China Sea; *C. pardelotum* Schaaf-da Silva & Ebert, 2008 and *C. maculatum* Schaaf-da Silva & Ebert, 2008 from Taiwan; *C. albipinnum* Last, Motomura & White, 2008 from eastern south Australia; *C. cooki* Last, Seret & White, 2008 from northern Australia; *C. hiscosellum* White & Ebert, 2008 and *C. specuum* Last, Seret & White, 2008 from western north Australia; *C. pictum* Last, Seret & White, 2008 from eastern Indonesia; *C. signorum* Last, Seret & White, 2008 and *C. zebrum* Last & White, 2008 from eastern north Australia; *C. variegatum* Last & White, 2008 from eastern Australia; and *C. stevensi* Randall & Clark, 2011 from Papua New Guinea.

Among *Cephaloscyllium* species, the following eight species have been described from the East and South China seas and Pacific Ocean around Taiwan: *Cephaloscyllium umbratile* Jordan & Fowler, 1903, *C. fasciatum*, *C. sarawakensis*, *C. circulopullum*, *C. parvum*, *C. pardelotum*, *C. maculatum* and *C. formosanum* Teng, 1962.

In a taxonomic revision of Japanese scylliorhinid sharks, Nakaya (1975) considered *Cephaloscyllium umbratile* as a distinct species. But later, Springer (1979) synonymized *C. umbratile* under *C. isabellum*, and also treated *C. formosanum* as a junior synonym of *C. isabellum*. This action was tentatively followed by Compagno (1984, 1988, 1999), but he had mistaken treatment of *C. umbratile* by mixing it with what was later described as *C. sarawakensis*. Compagno *et al.* (2005) considered *C. umbratile* distinct from *C. isabellum*, but their treatment of *C. umbratile* and *C. sarawakensis* is still in confusion. Schaaf-da Silva & Ebert (2008) reviewed the species from the western North Pacific and also considered *C. umbratile* as distinct from *C. isabellum*, but kept *C. formosanum* in the synonymy of *C. umbratile*. Schaaf-da Silva & Ebert (2008) also described two new species *C. pardelotum* and *C. maculatum* from Taiwan, each based on a small juvenile. Despite Schaaf-da Silva & Ebert's (2008) revision, the taxonomy of the Taiwanese *Cephaloscyllium* still remains problematical and is in confusion.

The present study was conducted to review Taiwanese swellsharks of the genus *Cephaloscyllium*, to thoroughly describe them based on many voucher specimens, and to give an effective key to the Taiwanese species.

Materials and methods

Method of measurements and terminology follow Compagno (2002). Sexual maturity follows Nakaya & Stehmann (1998). Vertebral counts were determined by taking radiographs. Institutional acronyms are those in Sabaj Pérez (2012).

Results

Key to the species of *Cephaloscyllium* in Taiwan

- 1a. Body and fins with patterns of dark lines forming open-centered saddles, loops, reticulations and spots. *C. fasciatum*
- 1b. Body with dark blotches, saddles and spots 2
- 2a. Juveniles less than 20 cm TL with many polka-dots and saddle blotches on body. Individuals larger than 20 cm TL with two dark broad saddle blotches before first dorsal fin, first saddle immediately behind eye and second saddle over posterior 1/3 of pectoral fin base and pectoral inner margin; no or faint polka-dots; a dark semi-circular to vertically elliptical blotch evident on lateral side of body between pectoral and pelvic fins *C. sarawakensis*
- 2b. Saddle blotches before first dorsal fin three or four. Polka-dots absent even in juveniles 3
- 3a. Three saddle blotches before first dorsal fin; second saddle over pectoral fin base; third saddle between pectoral and pelvic fins *C. umbratile*
- 3b. Four saddle blotches before first dorsal fin; second saddle over gill openings; third saddle above inner margin of pectoral fin. *C. formosanum*

Cephaloscyllium fasciatum Chan, 1966

English name: Reticulate swellshark

Taiwanese name: Tiao-wen-tou-sa

(Figures 1–3, Table 1)

Cephaloscyllium fasciatum Chan, 1966, pp. 232–236, fig. 6, 7 (a, c), 8, plate (original description); Springer, 1979, pp. 38–39, figs. 20–21; Compagno, 1984, pp. 297–298; Compagno, 1988, p. 113; Compagno *et al.*, 2005, p. 216, pl. 36; Ebert *et al.*, 2013, p. 325, pl. 43.

Cephaloscyllium pardelotum Schaaf-da Silva & Ebert, 2008, p. 3, fig. 1; Ebert *et al.*, 2013, p. 327, pl. 44.

Cephaloscyllium maculatum Schaaf-da Silva & Ebert, 2008, p. 7, fig. 6; Ebert *et al.*, 2013, p. 327, pl. 44.

[non] *C. fasciatum*: Last & Stevens, 1994, p. 197, pl. 23.

Material examined. *Taiwan*: ASIZP 57906, female, 155 mm TL (Dong-gang, Pingtung, 22°47'N, 120°43'E). ASIZP 57928, 1 male, 229 mm TL, 3 females, 206–232 mm TL (Dong-sha Island, South China Sea, 19°85'N,

114°03'E). ASIZP 62203, female, 198 mm TL (Fong-gang, Pingtung, 100 m). ASIZP 62205, male, 189 mm TL (Fong-gang, Pingtung, 300 m). NMMB-P 0434, male, 216 mm TL (Dong-gang, Pingtung). NMMB-P 6105, male, 164 mm TL (Dong-gang, Pingtung). NMMB-P 11091, female, 211 mm TL (Dong-gang, Pingtung). NMMB-P 11092, male, 215 mm TL (Dong-gang, Pingtung). NMMB-P 12652, female, 160 mm TL (no data). NMMB-P 14043, male, 178 mm TL (Dong-gang, Pingtung). NMMB-P 14526, male, 180 mm TL (Dong-gang, 300m). NMMB-P 14561, male, 217 mm TL (Fong-gang, Pingtung, 300 m). NMMB-P 16158, female, 212 mm TL (Dong-gang, Pingtung). NMMB-P 16170, male, 198 mm TL (Dong-gang, Pingtung). NMMB-P 16171, male, 206 mm TL (Dong-gang, Pingtung). NMMB-P 16506, male, 192 mm TL (Dong-gang, Pingtung). NMMB-P 17123, female, 224 mm TL (Dong-gang, Pingtung). NMMB-P 17176, male, 161 mm TL (Dong-gang, Pingtung). NMMB-P 17177, male, 144 mm TL (Dong-gang, Pingtung). NMMB-P 17123, female, 224 mm TL (Dong-gang, Pingtung). HUMZ-P 213792, male, 175 mm TL (Dong-gang, Pingtung). *Other regions*: BMNH 1965.8.11.1 (holotype), female, 422 mm TL (417.5 mm TL when examined by Inoue) (off east-southeast of Cape Bantangan, Vietnam, 15°55.7'N, 109°28.5'E).

Diagnosis. Dorsal sides of body and fins with complex reticulations. Eight open-centered dark brown saddles on body; first saddle immediately behind eye, second saddle above gill openings, third saddle above inner margin of pectoral fin, fourth saddle above middle between pectoral and pelvic fins. Dorsal sides of pectoral and pelvic fins with a loop pattern. Small species maturing at a size less than 422 mm TL (female) and attaining at least 422 mm TL (holotype).

Description. Proportional measurements and meristic counts are in Table 1.

Body slender (Figure 1). Head large and well depressed. Trunk thick, tail slender. Caudal peduncle slender and long; length about two times its height. Caudal fin axis a little elevated.

Snout short, its tip rather pointed, dorsal side flat. Interorbital area flat. Nostrils closer to mouth than to snout tip. Anterior nasal flap well developed, extending as a lobe, without or with shallow notch on its posterior margin; flap not reaching mouth. Posterior nasal flap well developed. Internarial space almost equal to nostril width. Mouth wide and high; width more than two times preoral length (without teeth); lower jaw almost straight along the side with a flat symphysis. Labial furrows mostly absent from both jaws, rarely with a small one on lower jaw. Eye small, slender. Spiracle small, behind and slightly below eye. Gill openings short; fourth and fifth openings on base of pectoral fin.

Pectoral fin moderate in size; its apex and free rear tip moderately rounded; posterior margin slightly concave in adult and linear or slightly convex in young. First dorsal fin origin about center of body; origin above anterior 1/3 to middle of pelvic base; base length shorter than pelvic-anal fin space; apex well rounded and its free rear tip slightly rounded; posterior margin linear in adult and well convex in young. Second dorsal fin considerably smaller than first dorsal fin; origin above anterior 1/3 of anal base; base much shorter than anal fin base; apex well rounded; free rear tip bluntly pointed. Pelvic fin insertion below middle of first dorsal fin base; apex broadly rounded. Anal fin larger than second dorsal fin; origin below posterior 1/3 of interdorsal space; insertion opposite to second dorsal fin insertion; base length longer than anal-lower caudal space; apex well rounded; free rear tip pointed; anterior margin long and convex; posterior margin rounded. Caudal fin slender and small, with a moderately developed lower lobe and a distinct subterminal notch; no enlarged dermal denticles on its dorsal and preentral margin; terminal and subterminal margin linear in adult and well rounded in young.

Teeth: number of teeth on both jaws relatively fewer: upper jaw 58 (holotype), lower jaw 56 (holotype) (Chan, 1966); all teeth with 3 or 5 cusps, principal cusp longest with a few smaller cusps on both sides; teeth near symphysis on both jaws symmetrical; lateral teeth more asymmetrical toward side of jaws.

Dermal denticles: dermal denticles on lateral side of body above pectoral fin thick with 3 cusps; lateral cusps indistinct; a strong medial ridge and numerous weak ridges running from base toward each cusp.

Vertebrae: monospondylous vertebrae 42–47 (holotype 45), precaudal diplospondylous vertebrae 30–35 (holotype 33), precaudal vertebrae 72–81 (holotype 78).

Spiral valves: 9 (holotype).

TABLE1. Proportional measurements and counts of *Cephaloscyllium fasciatum*, *C. pardelotum* and *C. maculatum*.

Species	<i>C. fasciatum</i>							<i>C. pardelotum</i> ²	<i>C. maculatum</i> ²	
	Male (n=11)			Female (n=9)			Holotype (f) ¹	Holotype (f)	Holotype (m)	
Specimens								BM(NH)		
Catalogue number								1965.8.11.1	CAS 224876	CAS 224877
Measurements:	Min	Max	Mean	Min	Max	Mean				
Total length (mm)	TOT	144.0	228.5	186.9	154.8	232.0	199.8	417.5	202.0	188.0
Proportion (%TL)										
Precaudal length	PRC	71.5	74.5	73.4	70.7	75.5	73.6	74.2	72.3	77.7
Prenarial length	PRN	2.3	3.1	2.7	2.0	3.1	2.7	2.5	2.5	1.6
Preoral length (from lip, excl. teeth)	POR lip	3.8	4.8	4.3	3.4	4.7	4.2	3.2	5.0	4.3
Preorbital length	POB	5.7	6.6	6.2	5.1	6.6	5.9	5.1	5.9	6.4
Prespiracle length	PSP	9.2	10.6	10.2	9.2	10.8	10.2	9.3	9.9	9.6
Prebranchial length	PG1	13.2	16.0	14.6	14.0	16.3	14.9	13.8	15.3	16.0
Pre 5th branchial length	PG5	18.8	18.8	18.8	18.7	20.1	19.2	19.2	19.8	22.3
Prepectoral length	PP1	17.1	19.0	18.1	15.2	20.2	17.6	16.5	18.3	19.7
Prepelvic length	PP2	40.4	45.2	42.7	42.1	46.5	43.9	45.8	41.1	43.1
Snout-vent length	???	43.1	47.7	45.1	45.0	48.6	46.5		45.0	46.8
Preanal length	PAL	55.6	59.7	57.9	56.4	61.8	58.8	61.5	57.4	60.1
Pre-first dorsal fin length	PD1	45.3	47.6	46.5	44.1	48.6	46.7	49.7	48.0	48.9
Pre-second dorsal fin length	PD2	58.5	63.0	60.6	59.1	63.2	61.0	63.5	60.4	63.8
Interdorsal space length	IDS	6.8	10.1	8.3	6.3	8.6	7.7	7.0	6.9	9.0
Dorsal-caudal length	DCS	7.9	7.9	7.9	6.5	7.5	6.9	6.6	6.4	7.4
Pectoral-pelvic length	PPS	13.5	20.0	16.3	15.3	21.0	18.3	20.5	14.9	18.6
Pelvic-anal space	PAS	7.9	10.4	9.2	7.0	8.8	8.2	8.6	8.4	11.2
Anal-caudal length	ACS	6.0	8.1	7.0	5.1	7.2	6.1	5.5	5.9	6.4
Eye length	EYL	3.0	4.0	3.6	3.4	4.0	3.7	3.5	3.7	3.2
Interorbital space	INO	7.5	8.9	8.2	7.5	8.9	8.1	8.1	8.2	8.0
Nostril width	NOW	2.6	3.5	3.0	2.5	3.4	2.8	2.7	3.0	2.7
Internarial space	INW	2.8	3.1	2.9	2.2	3.6	2.9	2.9	2.5	4.0 (2.5–3.2) ³
Anterior nasal flap length	ANF								1.2	1.6
Spiracle length	SPL	0.3	0.8	0.6	0.7	0.9	0.7		1.0	0.5
Mouth length	MOL	3.9	5.8	4.7	3.5	5.2	4.3	4.4	4.2	3.7 (3.1–4.0) ³
Mouth width	MOW	9.8	11.3	10.5	8.9	10.6	9.8	10.3	10.4	7.4 (8.1–10.2) ³
First gill height	GS1	1.7	2.1	1.9	1.4	1.9	1.6	1.8	1.7	1.6
Second gill height	GS2	1.7	2.1	1.9	1.4	1.9	1.7		1.7	1.6
Third gill height	GS3	1.7	2.1	1.9	1.4	1.9	1.7		1.7	1.6
Fourth gill height	GS4	1.7	2.1	1.9	1.4	1.9	1.7		1.5	1.6
Fifth gill height	GS5	0.9	1.8	1.4	0.8	1.7	1.3	0.9	1.5	1.1
Head height	HDH	7.0	8.5	7.9	6.3	8.1	7.2	6.6	7.4	10.1
Head width	HDW	14.3	16.3	15.1	13.0	15.6	14.4	15.6	13.9	13.3
Trunk height	TRH				7.1	7.1	7.1	7.7	8.4	12.8

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TABLE 1. (Continued)

Species	<i>C. fasciatum</i>							<i>C. pardelotum</i> ²	<i>C. maculatum</i> ²	
	Male (n=11)			Female (n=9)			Holotype (f) ¹	Holotype (f)	Holotype (m)	
Specimens								BM(NH)		
Catalogue number								1965.8.11.1	CAS 224876	CAS 224877
Measurements:	Min	Max	Mean	Min	Max	Mean				
Trunk width	TRW			11.8	11.8	11.8	12.8	12.4	13.3	
Caudal peduncle height	CPH	3.5	4.3	3.9	3.3	4.1	3.6	3.2	3.7	
Caudal peduncle width	CPW	3.1	3.4	3.3	2.7	3.5	3.1	2.2	3.2	
Pectoral fin length	P1L	13.0	13.9	13.4	12.3	13.8	13.1	13.4	11.7	
Pectoral fin anterior margin	P1A	11.6	13.6	12.7	11.9	12.4	12.1	12.4	11.7	
Pectoral fin base length	P1B	7.7	9.7	8.6	6.4	9.8	8.1	7.6	8.9	
Pectoral fin height	P1H	8.1	9.6	8.8	8.3	9.8	9.0	10.4	8.9	
Pectoral fin inner margin	P1I	3.7	5.7	4.4	3.7	5.2	4.5		5.4	
Pectoral fin posterior margin	P1P	6.7	9.6	7.7	7.1	9.2	8.2	10.1	8.4	
Pelvic fin length	P2L	8.3	10.6	9.6	9.3	10.5	9.8		10.4	
Pelvic fin anterior margin	P2A								5.4	
Pelvic fin base length	P2B	5.7	7.4	6.6	6.2	8.2	7.2	6.7	6.9	
Pelvic fin height	P2H								3.5	
Pelvic fin inner margin	P2I	2.7	3.7	3.1	2.1	2.9	2.5	3.0	3.0	
Pelvic fin posterior margin	P2P								6.9	
Clasper outer length	CLO	1.3	2.0	1.6						
Clasper inner length	CLI	3.6	5.0	4.3						
Clasper base length	CLB									
First dorsal fin length	D1L	9.2	10.1	9.6	8.8	10.0	9.3			
First dorsal fin anterior margin	D1A								8.7	
First dorsal fin base length	D1B	6.2	7.2	6.7	5.5	7.3	6.4	6.9	5.9	
First dorsal fin height	D1H	3.5	4.2	3.9	3.1	4.2	3.8	4.9	3.4	
First dorsal fin inner margin	D1I	2.5	3.7	2.9	2.1	3.0	2.5	2.5	3.0	
First dorsal fin posterior margin	D1P								3.0	
Second dorsal fin length	D2L	6.9	7.7	7.4	7.0	7.3	7.1			
Second dorsal fin anterior margin	D2A								6.9	
Second dorsal fin base length	D2B	3.6	6.0	5.0	3.6	4.8	4.3	4.7	5.0	
Second dorsal fin height	D2H	2.2	2.8	2.5	2.2	2.7	2.4	2.6	2.5	
Second dorsal fin inner margin	D2I	1.7	2.6	2.3	2.3	2.8	2.5	2.8	2.2	
Second dorsal fin posterior margin	D2P								2.0	
Anal fin length	ANL	8.8	10.1	9.6	8.9	10.3	9.7		10.4	
Anal fin anterior margin	ANA								6.9	

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TABLE 1. (Continued)

Species	<i>C. fasciatum</i>							<i>C. pardelotum</i> ²	<i>C. maculatum</i> ²	
	Male (n=11)			Female (n=9)			Holotype (f) ¹	Holotype (f)	Holotype (m)	
Specimens							BM(NH) 1965.8.11.1	CAS 224876	CAS 224877	
Catalogue number										
Measurements:		Min	Max	Mean	Min	Max	Mean			
Anal fin base length	ANB	6.5	7.8	7.2	6.2	8.2	7.1	7.0	7.4	8.0
Anal fin height	ANH	2.8	3.6	3.2	2.4	3.2	2.8	3.1	3.5	3.2
Anal fin inner margin	ANI	2.6	2.9	2.7	2.0	3.1	2.5	2.3	3.0	1.6
Anal fin posterior margin	ANP								5.0	3.7
Caudal dorsal margin	CDM	23.8	29.5	26.8	23.6	27.7	25.7	24.2	26.7	25.5
Caudal preventral margin	CPV	9.8	11.9	10.8	10.0	12.3	11.2		9.4	10.1
Caudal postventral lower margin	CPL	11.5	13.8	12.7	10.8	13.3	12.2			
Caudal subterminal margin	CST	5.1	5.5	5.3	4.2	5.3	4.8		4.5	4.3
Caudal terminal margin	CTR	4.3	5.2	4.8	3.8	4.9	4.4		5.4	5.3
Caudal terminal lobe	CTL								6.9	6.4
First dorsal-fin midpoint pectoral-fin insertion	DPI	22.2	24.5	23.3	22.8	25.3	24.3			
First dorsal-fin midpoint pelvic-fin origin	DPO	7.1	8.7	7.7	6.4	7.8	7.1		11.9	18.1
Pelvic-fin midpoint first dorsal-fin insertion	PDI	5.6	7.6	6.4	4.4	6.5	5.4			
Pelvic-fin midpoint second dorsal-fin origin	PDO	13.5	15.3	14.4	12.2	14.3	13.3			
Second dorsal-fin origin anal-fin origin	DAO	2.1	3.1	2.6	2.6	3.1	2.8		3.5	4.3
Counts:										
monospondyloous vertebrae	MON	40	45	43	42	47	45	45	44	46
precaudal dipospondyloous vertebrae	PDI	30	35	32	30	34	32	33	30	33
precaudal vertebrae	PRC	72	80	78	72	81	77	78	74	79

¹ taken by Inoue

² from Shaarf-da Silva & Ebert (2008),

³ back-calculated from Fig. 7b in Shaarf-da Silva & Ebert (2008).

Color. Holotype (adult, Figure 1): Dorsal and lateral side of body reticulated; dark brown lines forming open-centered dorsal saddle blotches present on light brown ground color; ground color on underside of body, paired fins and anal fin light brownish; numerous small dark brown spots present on dorsal side of body. Eight dorsal saddle blotches on body: first saddle immediately behind eye, second saddle above gill openings, third saddle above inner margin of pectoral fin, fourth saddle above middle between pectoral and pelvic fins, fifth saddle on first dorsal fin, sixth saddle on second dorsal fin, seventh saddle on caudal fin just behind caudal peduncle, and eighth saddle on posterior half of caudal fin.

Additional specimens: Ground body color brownish or light brownish dorsally, whitish ventrally. Ventral side of head slightly dark marginally. Many complex and variable reticulation on body and fins. Eight open-centered dark brown saddle blotches on body, each one greatly variable in shape (below). Position of the saddle blotches are: first saddle blotch immediately behind eye, second one above gill openings, third one above inner margin of pectoral fin, fourth one above middle between pectoral and pelvic fins, fifth one on first dorsal fin, sixth one on second dorsal fin, seventh one on caudal fin just behind caudal peduncle, and eighth saddle blotch on posterior half

of caudal fin. One loop each on dorsal sides of pectoral and pelvic fins. Lateral loops present on snout, below eye, around first and second gill openings, above pectoral fin base, between third and fourth saddles. Many dark brown dots, sometimes white dots, on lateral side of body between saddles and loops. Dorsal side of pectoral fin dotted. Anal fin and lower lobe of caudal fin with lines.

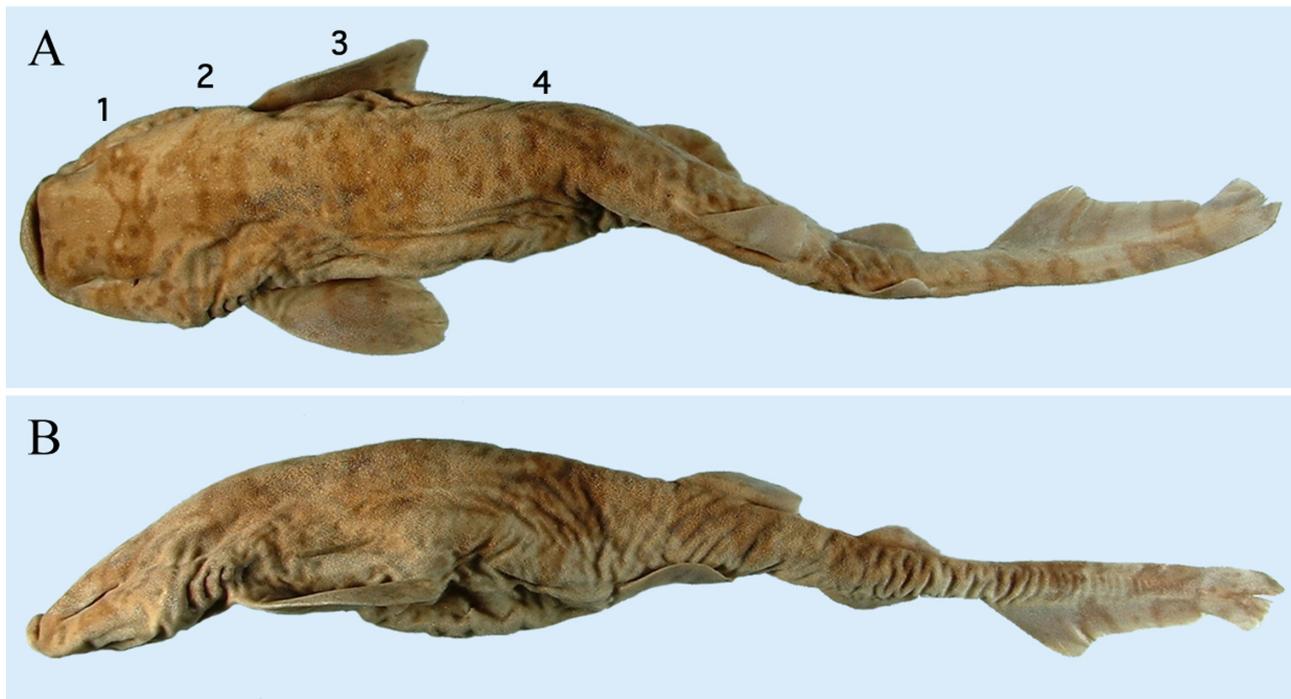


FIGURE 1. Holotype of *Cephaloscyllium fasciatum*, BMNH 1965.8.11.1, female, 417.5 mm TL. A, Dorsal view; B, Lateral view. Arabic numerals show saddle blotches before first dorsal fin.

Variation (Figure 2): Reticulation on body and fins greatly variable, as shown below. Reticulation patterns on right and left sides sometimes different in a same specimen (NMMB-P 17177). Reticulation patterns mostly clear, sometimes obscure and broken into thin or thick lines (NMMB-P 11019). Saddle lines variable in shape, sometimes forming small loops along mid-dorsal line (NMMB-P 6105), elongate to form triangular or elliptic circles on lateral side of body (NMMB-P 16506). Saddles sometimes darker inside (NMMB-P 14043). First saddle completely separate into right and left portions (NMMB-P 14013), or partly separate (NMMB-P 16506). Second saddle sometimes continuous with lateral loops above pectoral base and gill openings (NMMB-P 17177), or with a loop around gill openings (NMMB-P 12652). Third saddle continuous with a lateral loop above pectoral base (NMMB-P 17123). Fourth saddle often continuous with lateral loops between pectoral and pelvic fins (NMMB-P 17176). Lateral loops greatly variable, triangular, quadrangular (NMMB-P 6105), polyangular, circular (NMMB-P 12652), elliptical (NMMB-P 14526) and combination of these in shape. Dark dots absent (NMMB-P 17123) or present (NMMB-P 16506). White spots mostly absent, rarely faintly present (NMMB-P A434).

Size. Largest specimen 422 mm TL (holotype). Size at maturation less than 422 mm TL (female).

Distribution. Western North Pacific Ocean and South China Sea (off South Taiwan, China, Philippines and Vietnam); 112–172 fathoms (Chan, 1966), 200–400 m (Ho, pers. obs.).

Remarks. This species was described based on a maturing holotype and four juvenile paratypes collected from Vietnam, and is strongly characterized by its reticulated color patterns on body and fins. Recently, Schaaf-da Silva & Ebert (2008) reviewed the western North Pacific swellsharks, and described two new species, *Cephaloscyllium pardelotum* and *C. maculatum*, both similar to *C. fasciatum* in possession of reticulated color patterns on body and fins.

Schaaf-da Silva & Ebert (2008) differentiated *Cephaloscyllium pardelotum* from *C. fasciatum* by the condition of saddle borders (variegated, patchy and forming an H-shape in *C. pardelotum*), rosettes (distinctive in *C.*

pardelotum), relative length of anal fin posterior margin (0.07 times in PCL in *C. pardelotum*, vs. 0.03–0.04 in *C. fasciatum*).

They also distinguished *Cephaloscyllium maculatum* from *C. fasciatum* by the color patterns (less variegated in *C. maculatum*), condition of anterior nasal flap (short and triangular in *C. maculatum*), internarial space (4.0% TL in *C. maculatum* vs. 2.7–3.2% TL in the type specimens [4.5% TL in their non-type material] of *C. fasciatum*), mouth width (7.4% TL vs. 10.5–11.8% [10.5%]), and mouth length (3.7% TL vs. 5.5–6.2% [7.0%]).

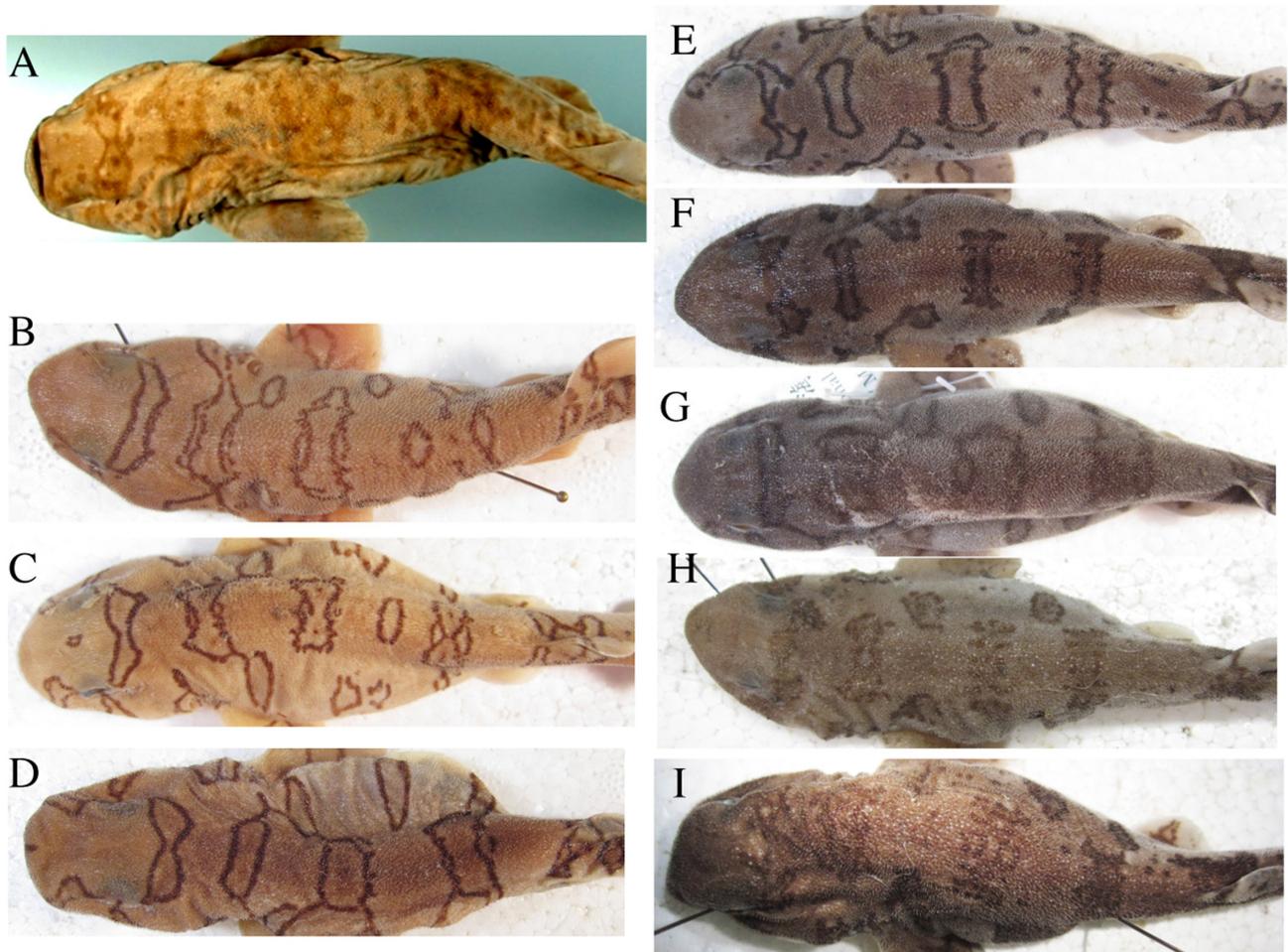


FIGURE 2. Color variation of *Cephaloscyllium fasciatum*. A, Holotype, BMNH 1965.8.11.1, female, 417.5 mm TL; B, NMMB-P 12652, female, 160 mm TL; C, NMMB-P 6105, male, 164 mm TL; D, NMMB-P 14526, male, 180 mm TL; E, NMMB-P 16506, male, 192 mm TL; F, NMMB-P 14043, male, 178 mm TL; G, NMMB-P 17123, female, 224 mm TL; H, ASIZP 62205, male, 189 mm TL; I, ASIZP 62203, female, 198 mm TL, male, 175 mm TL.

As mentioned in the above description, *Cephaloscyllium fasciatum* has a highly variable color patterns. The reticulation and lines are very clear in some specimens, but thick, thin, obscure, variegated or broken in other specimens. Saddle blotches are also quite variable, i.e. narrow, wide, subdivided into some smaller parts, connected with other saddles, and/or looped. The lateral blotches (loops) vary between angular, rectangular, round or elliptical in form, and are broken into some loops, separate or connected each other, or continuous with the saddle blotches. The saddle and lateral blotches (loops) are clear inside in many of the specimens, but dark in the others. The color patterns were often different between right and left sides even in a same individual (Figure 3). Schaaf-da Silva & Ebert (2008) used the color patterns to distinguish their two new species from *C. fasciatum*, but the colorations of *C. pardelotum* and *C. maculatum* are within the variations present in *C. fasciatum*.

Schaaf-da Silva & Ebert (2008) used relative length of anal fin posterior margin (0.07 vs. 0.03–0.04 times in PCL in *Cephaloscyllium pardelotum* and *C. fasciatum*, respectively) to distinguish them. However, the relative length of anal fin posterior margin is 0.075 in PCL in their comparative material of *C. fasciatum* (SU 34041), widening the range to 0.03–0.075 for *C. fasciatum*. Therefore, *C. pardelotum* is included within this range and is indistinguishable from *C. fasciatum*.



FIGURE 3. Color variation in a same specimen, HUMZ 213792, male, 175 mm TL. A, Left side of body; B, Right side of body (right and left are reversed for easier comparison).

Schaaf-da Silva & Ebert (2008) gave a graph of internarial space (their fig. 8, p. 12), suggesting a specific-level difference of *Cephaloscyllium maculatum* from *C. pardelotum* and *C. fasciatum*. They also gave figures of ventral side of head of these species (their figs. 7a–c, p. 11). Their figure 7b (*C. maculatum*) indicates that the internarial space and nostril width are almost same in this species, but the proportional measurements given in Table 1 are much different, or 4.0% TL for internarial space and 2.7% TL for nostril width. Their figure 7a shows *C. pardelotum*, and the measurements and figure of this species correspond well. So the three discriminating characters given in the original description were back-calculated from their figure 7b, based on preoral length and nostril width (See Table 1, column *C. maculatum*). Results of back-calculation are that the internarial space is 2.5–3.2% TL (instead of 4.0% TL in the original description), mouth width 8.1–10.2% (7.4%), and mouth length 3.1–4.0% (3.7%), and indicate these measurements are within or almost within the ranges of *C. fasciatum*.

Short and triangular (not lobate) anterior nasal flap is another diagnostic character of *Cephaloscyllium maculatum*. The type specimen (417.5 mm TL) of *C. fasciatum* has a distinct lobate anterior nasal flap. Although the anterior nasal flaps are weakly lobate in most of the specimens, its shape is easily changeable, because the anterior nasal flap is very small and soft especially in smaller specimens. The right and left nasal flaps are different in shape in some specimens. For these reasons, it was often difficult to judge whether the anterior nasal flap of the specimens is short triangular or lobate, especially in smaller specimens.

Conclusively, *Cephaloscyllium pardelotum* and *C. maculatum* are considered junior synonyms of *C. fasciatum*.

***Cephaloscyllium sarawakensis* Yano, Ahmad & Gambang, 2005**

English name: Sarawak pygmy swellshark

Taiwanese name: Sa-lao-yue-tou-sa

(Figures 4–6, Table 2)

Cephaloscyllium sarawakensis Yano, Ahmad & Gambang, 2005, p. 147, pls. 92–101; Ebert *et al.*, 2013, p. 328, pl. 44.

Cephaloscyllium umbratile: Teng, 1962, p. 45, fig. 10; Chen, 1963, p. 29, fig. 9; Chan, 1966, p. 229, fig. 5, 7, pl. 2; Bessednov, 1969, p. 27, figs. 9, 10; Chen *et al.*, 1997, p. 2, fig. 5.

Cephaloscyllium sufflans: Fourmanoir & Nhu-Nhung, 1965, p. 13, fig. 1.

Cephaloscyllium formosanum: Shen, 1984, p. 2, pl. 2 (4-4 a, b).

Cephaloscyllium isabellum (in part as pseudo-*umbratile*): Compagno, 1984, p. 298.

Cephaloscyllium sp. (in part): Compagno, 1988, p. 115; Compagno *et al.*, 2005: p. 222, pl. 36.

Cephaloscyllium circulopullum Yano, Ahmad & Gambang, 2005, p. 159, pls. 102–105.

Cephaloscyllium parvum Inoue & Nakaya, 2006, p. 77, figs. 1–3.

Material examined. *Taiwan*: ASIZP 53881, male, 325 mm TL (Dong-gang). HUMZ 114179, male, 142 mm TL; HUMZ 114180, male, 164 mm TL; HUMZ 114181, male, 218 mm TL; HUMZ 170770 (paratype of *C. parvum*), male, 166 mm TL (Kaohsiung). NMMB-P6104, a female, 143 mm TL, 5 males, 151–197 mm TL (Taiwan). NMMB-P 6597 (formerly THUP 616), female, 278 mm TL (Kaohsiung). NMMB-P 6604 (formerly THUP 1666), male, 334 mm TL (Dong-gang, Pingtung). NMMB-P 6608 (formerly THUP 2537-8), 1 male, 200 mm TL, 1 female, 212 mm TL (Dong-gang, Pingtung). NMMB-P 6617 (formerly THUP 2211), female, 173 mm TL (Dong-gang, Pingtung). NMMB-P 17476, female, 162 mm TL (Ke-tzu-liao, Kaohsiung). NMMB-P 17134, male, 159 mm TL (Ke-tzu-liao, Kaohsiung, Da-xi). NMMB-P 17136, female, 246 mm TL (Ke-tzu-liao, Kaohsiung, Da-xi). NMMB-P 17138, male, 155 mm TL (Ke-tzu-liao, Kaohsiung, Da-xi). NMMB-P 17139, male, 156 mm TL (Ke-tzu-liao, Kaohsiung, Da-xi). NMMB-P 17141, male, 212 mm TL (Ke-tzu-liao, Kaohsiung, Da-xi). NMMB-P 17182, female, 192 mm TL (Ke-tzu-liao, Kaohsiung, Da-xi). NMMB-P uncat. (HO-375), female, 263 mm TL (Ke-tzu-liao, Kaohsiung). TFRI 3080, female, 395 mm TL (Taiwan). TFRI 3359, female, 441 mm TL (Taiwan). *Other regions*: HUMZ 109126 (holotype of *C. parvum*), male, 397 mm TL; HUMZ 109124 (paratype of *C. parvum*), female, 406 mm TL; HUMZ 109125 (paratype of *C. parvum*), female, 377 mm TL; HUMZ 109127 (paratype of *C. parvum*), male, 349 mm TL (off Sarawak, Borneo Island, Malaysia). FAKU 100088, female, 378 mm TL (Gulf of Tongking, southern China). NMMB-P 13578, female, 375 mm TL (Nha Trang, Vietnam). NMMB-P 13579, male, 182 mm TL (Nha Trang, Vietnam).

Diagnosis. Two distinct and wide dark brown saddle blotches before first dorsal fin in adults. Juveniles with three saddle blotches before first dorsal fin. First saddle immediately behind eye, second saddle over posterior 1/3 of base and inner margin of pectoral fin, and third saddle a little before first dorsal fin, which fades with growth. Dark lateral circular to oblong blotches present above gill openings and on lateral side of trunk. Young individuals with many polka dots on body and fins. Anterior nasal flap triangular without an elongate flap. Small species maturing at about 35 cm TL and attaining at least 44 cm TL.

Description. Proportional measurements and meristic counts are given in Table 2.

Body thick and stout (Figure 4). Head large and rather rounded. Trunk and tail rather thick. Caudal peduncle short and thick; length almost equal to its height. Caudal fin axis a little elevated.

Snout long, its tip rounded, dorsal side rather convex. Interorbital area flat slightly convex. Nostrils closer to mouth than to snout tip. Anterior nasal flap triangular without notch on its posterior margin, not extending as a definite lobe; flap not reaching mouth. Posterior nasal flap well developed. Internarial space narrow; its length shorter than nostril width. Mouth narrow and low; width less than two times preoral length (without teeth); lower jaw arched with evenly rounded symphysis. Labial furrows completely absent from both jaws. Eye small, slender. Spiracle small, behind and slightly below eye. Gill openings short; fourth and fifth openings on base of pectoral fin.

Pectoral fin moderate in size; its apex and free rear tip moderately rounded; its posterior margin linear in adult, and convex in young. First dorsal fin origin located before or at about center of body; its origin above anterior 1/3 of pelvic base; base length about equal to pelvic-anal fin space; apex and free rear tip rounded; posterior margin linear or slightly concave in adult and well convex in young. Second dorsal fin considerably smaller than first dorsal fin; its origin above anterior 1/3 of anal base; base shorter than anal fin base; apex broadly rounded; free rear

tip slightly pointed. Pelvic fin insertion below posterior 1/3 of first dorsal base; apex broadly rounded. Anal fin larger than second dorsal fin; its origin below posterior 1/3 of interdorsal space; insertion opposite to second dorsal fin insertion; base length longer than anal-lower caudal space; apex broadly rounded; free rear tip pointed; posterior margin linear or slightly concave in adult and well rounded in young. Caudal fin wide and relatively large, with a developed lower lobe and a distinct subterminal notch; no enlarged dermal denticles on its dorsal and preentral margin; terminal and subterminal margin linear or slightly convex in adult and well rounded in young.

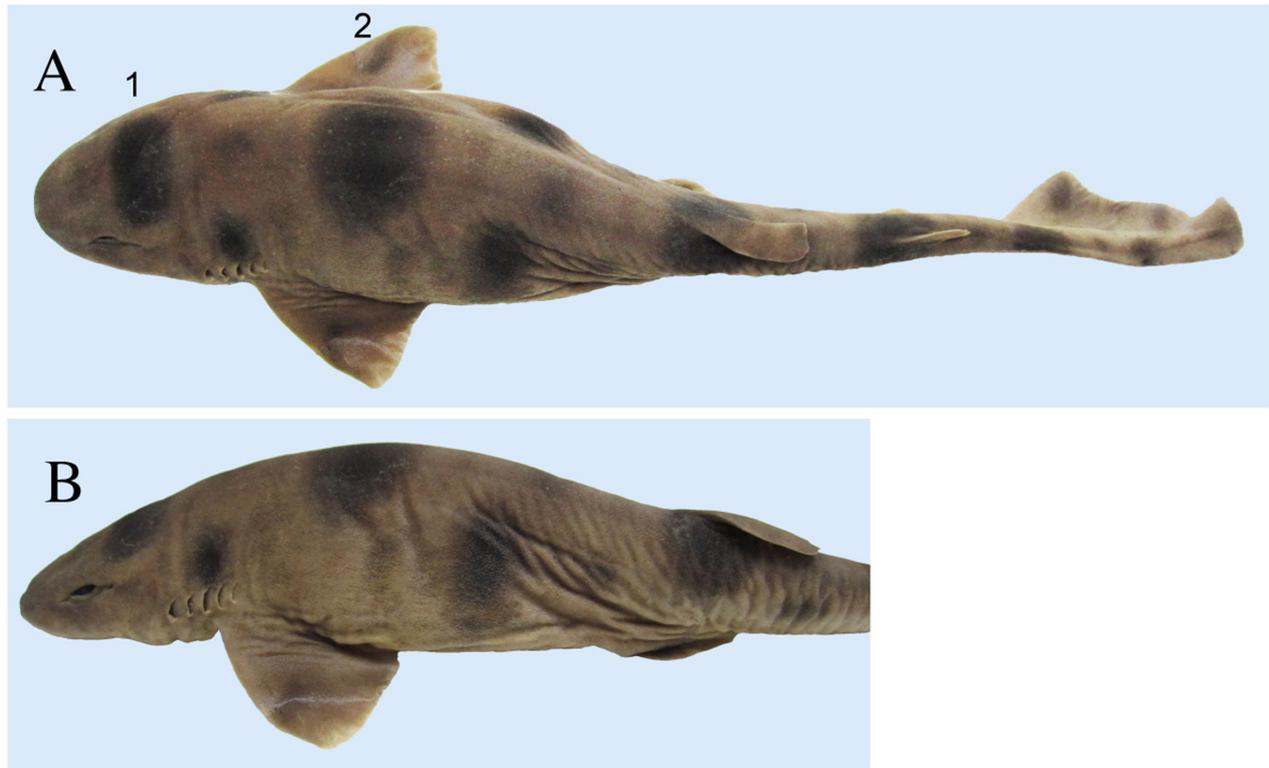


FIGURE 4. *Cephaloscyllium sarawakensis*, NMMB-P 13578, female, 375 mm TL. A, Dorsal view; B, Lateral view. Arabic numerals show saddle blotches before first dorsal fin.

Teeth: number of teeth on both jaws relatively fewer; upper jaw 54-68, lower jaw 60-63; teeth with 3 (infrequently 4) cusps, principal cusp largest and longest with a few smaller cusps on both sides; teeth near symphysis on both jaws symmetrical; lateral teeth more asymmetrical toward side of jaws.

Dermal denticles: dermal denticles on lateral side of body above pectoral fin thick and leaf-like, with one cusp (infrequently one cusp with indistinct lateral cusps) and with 3–5 strong ridges running from base toward apex of each cusp.

Vertebrae: monospondylous vertebrae 37–42, precaudal diplospondylous vertebrae 26–33, precaudal vertebrae 63–72.

Spiral valves: 7–8.

Color. (1) Specimens less than ca. 17 cm TL (Figures 5a–d). Ground body color brownish dorsally, pale to slightly grayish ventrally. Ventral side of head usually uniform, slightly dark marginally with some spots, sometimes heavily spotted on ventral sides of head, body and fins (NMMB P-17139). Seven dark brown and wide saddle blotches on body; first saddle immediately behind eye, second saddle over posterior 1/3 of pectoral fin base and inner margin, third saddle a little before first dorsal fin, fourth saddle on first dorsal fin, fifth saddle on second dorsal fin, sixth saddle on caudal fin just behind caudal peduncle, and seventh saddle on posterior half of caudal fin. Each saddle with a blackish area surrounded by a white line; first and second saddles with a blackish transverse band surrounded by a thin white line; third saddle with a blackish circular spot; fourth and fifth saddles with a pair of black circular spots on both sides of the fins. A dark and large lateral blotch between pectoral and pelvic fins. A distinct blackish circular blotch above gill opening region. Many smaller dark circular spots in polka-dot pattern present on dorsal sides of head, body, dorsal sides of pectoral and pelvic fins, dorsal fins and caudal fin.



FIGURE 5. Dorsal views of *Cephaloscyllium sarawakensis*, showing color pattern changes with growth. A, NMMB-P 17133, female, 145 mm TL; B, NMMB-P 17138, male, 155 mm TL; C, NMMB-P 17139, male, 156 mm TL; D, NMMB-P 17134, male, 159 mm TL; E, NMMB-P 17183, female, 184 mm TL; F, NMMB-P 17141, male, 212 mm TL; G, NMMB-P 17137, female, 213 mm TL; H, NMMB-P 17136, female, 246 mm TL.

TABLE 2. Proportional measurements and counts of *Cephaloscyllium sarawakensis*, *C. parvum* and *C. circulopullum*.

Species		<i>C. sarawakensis</i>						<i>C. parvum</i> ²			<i>C. circulopullum</i> ¹	
		Taiwan specimens (n=16)			Type specimens (n=6) ¹			Type specimens (n=5)			holotype	paratype
		Min	Max	Mean	Min	Max	Mean	Min	Max	Mean		
Total length (mm)	TOT (mm)	155.0	441.0	257.9	263.0	408.0	353.9	165.7	406.0	323.7	377.0	378.0
Proportion (%TL)												
Precaudal length (%)	PRC (%TL)	69.4	76.4	73.7	73.8	78.8	75.9	71.2	78.0	75.7	74.0	73.5
Precaudal length to lower origin (%)	PRC lower	68.4	76.2	72.5	71.8	77.6	74.7	68.0	76.5	73.6	73.5	72.8
Prenarial length	PRN	2.6	3.5	3.1	2.7	3.8	3.3	3.1	3.7	3.4	4.0	4.2
Preoral length	POR	4.4	7.2	5.3	4.8	5.3	5.0	4.7	5.7	5.2	6.4	6.1
Preorbital length	POB	5.0	7.6	6.1	5.5	7.6	6.2	5.6	6.2	5.9	7.2	7.1
Prespiracle length	PSP	6.6	10.8	9.5	8.7	10.9	10.0	8.3	10.7	9.5	12.5	12.7
Prebranchial length	PG1	12.9	16.1	14.5	15.0	16.2	15.6	14.0	16.5	15.1	17.0	16.4
Pre 5th branchial length	PG5	17.6	21.5	19.7	20.2	21.0	20.5	19.6	21.3	20.5	23.1	22.2
Prepectoral length	PP1	16.1	20.3	18.1	18.3	19.4	18.8	16.6	21.3	19.1	21.5	20.6
Prepelvic length	PP2	38.0	45.2	42.4	43.6	49.8	46.5	40.9	45.1	43.2	43.8	45.0
Snout-vent length	SVL	44.5	46.6	45.5	44.7	57.2	49.7				45.9	46.0
Preanal length	PAL	52.0	62.9	58.1	59.3	64.1	61.8	55.5	63.2	60.3	60.2	60.3
Pre-first dorsal fin length	PD1	41.3	50.7	45.6	44.1	47.8	46.0	43.1	49.5	46.6	49.1	49.2
Pre-second dorsal fin length	PD2	56.5	65.9	61.3	60.1	64.7	63.2	57.9	65.8	63.2	62.1	62.4
Interdorsal space length	IDS	7.6	10.2	8.6	8.7	10.9	9.7	8.6	9.7	9.2	8.8	10.1
Dorsal-caudal length	DCS	4.9	9.8	6.5	4.9	8.2	7.0	4.9	10.7	7.6	6.4	6.9
Pectoral-pelvic length	PPS	12.7	19.3	16.0	17.8	24.9	21.3	13.3	21.7	18.3	14.9	17.7
Pelvic-anal space	PAS	7.7	11.1	8.9	7.6	11.2	9.3	8.1	12.5	10.0	10.6	10.3
Anal-caudal length	ACS	3.8	5.8	4.9	5.4	7.6	6.3	4.2	7.0	5.7	5.8	6.1
Eye length	EYL	2.8	3.5	3.2	4.1	4.8	4.4	3.1	3.8	3.4	4.8	4.5
Eye height	EYH	0.8	0.9	0.9	1.0	1.7	1.3				1.1	1.3
Interorbital space	INO	7.2	8.6	8.0	6.7	9.0	7.7	7.4	8.1	7.8	8.0	7.7
Nostril width	NOW	2.7	3.7	3.2	2.5	3.7	3.2	2.7	3.3	3.1	3.4	2.9
Internarial space	INW	1.4	2.4	1.8	1.9	2.3	2.1	2.0	2.3	2.1	2.1	2.4
Spiracle length	SPL	0.5	0.7	0.6	0.4	1.4	0.8				0.5	0.5
Mouth length	MOL	2.3	4.1	2.9	2.3	4.2	3.2	2.5	3.1	2.9	4.5	3.4
Mouth width	MOW	7.3	9.4	8.7	8.5	10.3	9.4	8.5	9.6	9.0	8.8	8.5
First gill height	GS1	1.0	2.1	1.6	1.1	2.3	1.6	1.4	1.7	1.6	1.1	1.3
Second gill height	GS2	1.5	2.1	1.8	1.1	2.3	1.7				1.1	1.6
Third gill height	GS3	1.5	2.1	1.8	1.4	2.3	1.9				1.3	1.9
Fourth gill height	GS4	1.5	2.1	1.8	1.1	2.5	1.9				1.3	1.1
Fifth gill height	GS5	0.8	1.9	1.3	1.1	1.8	1.5	1.1	1.4	1.2	0.8	0.8
Head height	HDH	6.3	10.3	8.9				5.6	10.3	8.4		
Head width	HDW	12.6	16.5	14.5				13.2	15.7	14.5		

..... continued on the next page

TABLE 2. (Continued)

Species		<i>C. sarawakensis</i>						<i>C. parvum</i> ²			<i>C. cir culopullum</i> ¹	
		Taiwan specimens (n=16)			Type specimens (n=6) ¹			Type specimens (n=5)			holotype	paratype
		Min	Max	Mean	Min	Max	Mean	Min	Max	Mean		
Trunk height	TRH	9.2	16.1	12.6				11.3	11.3	11.3		
Trunk width	TRW	12.7	17.7	14.3				15.2	15.2	15.2		
Pectoral fin base length	P1B	7.9	10.3	9.0	6.9	10.0	8.3	7.8	9.5	8.8	8.0	8.2
Pectoral fin height	P1H	6.2	10.4	8.3				7.1	9.5	8.5		
Pectoral fin inner margin	P1I	3.9	5.0	4.6	3.9	6.4	4.8	3.2	4.3	3.7	3.7	3.7
Pectoral fin posterior margin	P1P	4.6	9.6	6.8	7.6	9.8	8.9	8.0	8.7	8.4	7.7	6.9
Pelvic fin length	P2L	8.7	10.4	9.8	9.1	11.9	11.0				9.8	9.8
Pelvic fin base length	P2B	5.6	9.4	7.6	4.9	9.0	7.4	6.6	8.5	7.4	6.1	6.3
Pelvic fin inner margin	P2I	2.4	5.1	3.5	2.5	4.5	3.5	3.1	4.7	3.6	2.7	4.0
Clasper outer length	CLO	0.8	2.7	1.6	7.6	7.6	7.6	1.3	6.8	4.5	6.6	6.7
Clasper inner length	CLI	3.4	5.8	4.7				4.2	11.5	8.5		
First dorsal fin length	D1L	10.4	10.7	10.5	8.7	11.9	10.4				8.8	10.1
First dorsal fin base length	D1B	6.7	9.3	7.7	7.5	9.3	8.2	7.1	8.3	7.6	6.6	8.7
First dorsal fin height	D1H	4.1	5.6	4.9	4.6	5.4	5.0	4.5	5.4	4.8	4.2	3.7
First dorsal fin inner margin	D1I	2.3	3.9	3.1				2.2	2.4	2.3		
Second dorsal fin length	D2L	8.3	9.8	9.2	7.3	8.4	7.7				6.6	8.2
Second dorsal fin base length	D2B	5.2	6.7	5.8	4.5	5.4	4.9	4.7	6.4	5.5	4.8	5.3
Second dorsal fin height	D2H	2.8	4.0	3.3	2.5	3.2	2.9	2.4	3.5	2.9	2.7	3.2
Second dorsal fin inner margin	D2I	2.6	3.7	3.0				2.0	3.0	2.5		
Anal fin length	ANL	11.5	12.6	12.0	9.0	10.0	9.5				9.3	10.8
Anal fin base length	ANB	7.7	9.9	8.8	5.1	6.8	6.2	7.2	9.4	8.0	6.9	8.2
Anal fin height	ANH	3.2	4.3	3.8	3.4	4.0	3.6	3.2	3.7	3.5	2.9	2.9
Anal fin inner margin	ANI	2.2	4.0	3.1				2.2	3.2	2.6		
Caudal dorsal margin	CDM	22.8	27.3	25.7	22.0	25.9	24.1	22.4	26.0	23.6	23.1	25.9
Caudal preentral margin	CPV	9.6	12.3	10.9	9.5	11.9	11.0				9.8	9.3
Caudal subterminal margin	CST	3.3	5.1	4.1	4.0	5.3	4.6	3.9	4.8	4.3	4.2	3.7
Caudal terminal margin	CTR	3.3	6.4	5.0				5.2	5.6	5.4		
Counts:												
Monospondylous vertebrae	MON	37	42	39.4	36		36	37	41	39.1	37	
Precaudal diplospondylous vertebrae	PDI	25	32	28.6	32		32	27	33	30.7	29	
Precaudal vertebrae	PRX	63	72	68.0	68		68	68	71	70.0	66	

¹from Yano *et al.* (2005), ² from Inoue & Nakaya (2006)

(2) Specimens between ca. 17–30 cm TL (Figures 5e–h, Figure 6). Color patterns become obscure with growth. Polka-dot color pattern fainter with growth. Third and seventh saddle blotches getting fainter with growth. A semi-circular to vertically elliptical dark lateral blotch between pectoral and pelvic fins, and a dark blotch above gill openings present (Figure 6). White lines surrounding spots and bands fainter with growth.

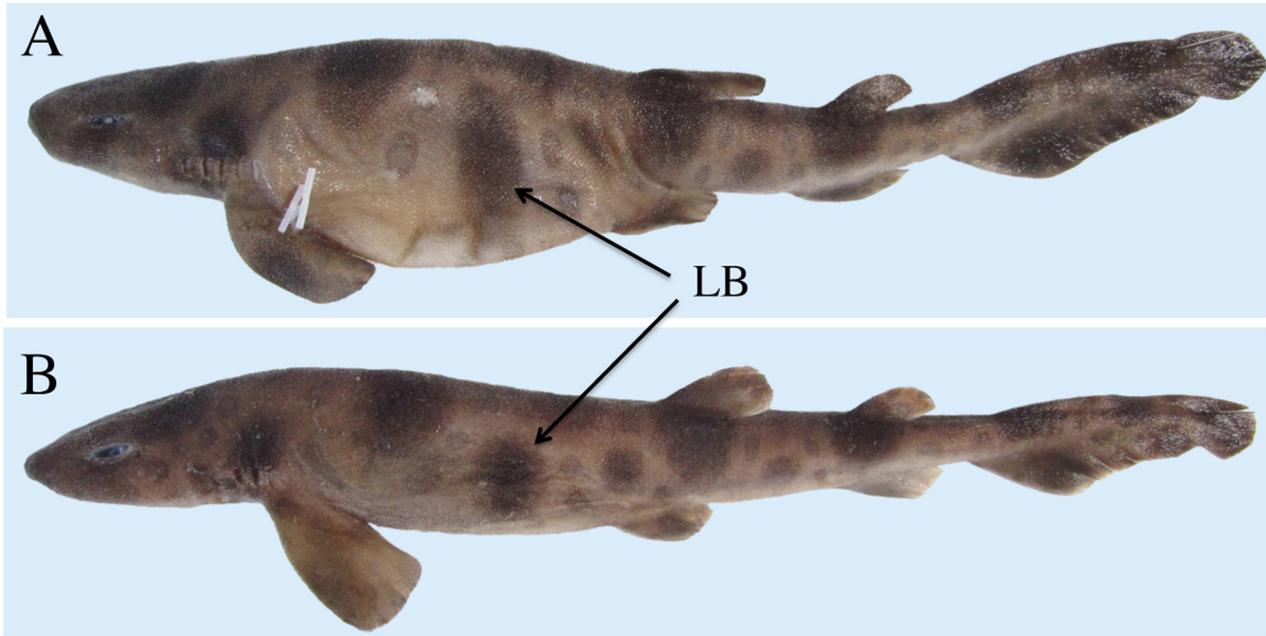


FIGURE 6. Lateral views of *Cephaloscyllium sarawakensis*, showing variation of lateral blotch (LB). A, NMMB-P 17137, female, 210 mm TL; B, NMMB-P uncat. (HO-375), female, 263 mm TL.

(3) Specimens larger than ca. 30 cm TL (Figure 4). Polka-dot color pattern completely lost. Only five wide saddle blotches present on body, i.e. first and second saddles before first dorsal fin, third saddle obscure, fourth to sixth saddles on dorsal fins and caudal fin, and seventh saddle faint and small. A large semi-circular to vertically elliptical dark lateral blotch present between pectoral and pelvic fins. A smaller dark blotch above gill openings. White lines surrounding spots and bands completely lost.

Size. Size at maturation less than 325 mm TL in male, less than 354 mm TL in female (Yano *et al.*, 2005). Maximum size at least 397 mm TL in male, 441 mm TL in female (Inoue & Nakaya, 2006).

Distribution. South China Sea (western South Taiwan, Hong Kong, Gulf of Tongking, Vietnam, Malaysia); 118–165 m (Yano *et al.*, 2005), 45–91 fathoms (Chan, 1966), 100–200 m (Ho, pers. obs.).

Remarks. *Cephaloscyllium sarawakensis* and *C. circulopullum* were described by Yano *et al.* (2005), based on specimens collected from Sarawak, in a book of limited distribution. Inoue & Nakaya (2006) described *C. parvum* based on specimens collected from Sarawak, Taiwan and China. Later, Schaaf-da Silva & Ebert (2008) treated *C. parvum* as a junior synonym of *C. sarawakensis*, with which we agree.

Yano *et al.* (2005, p. 153) gave four characters for distinguishing *Cephaloscyllium circulopullum* from *C. sarawakensis*: position of the first dorsal fin origin, length from snout tip to pectoral origin, mouth width, and shape of dark blotch on center of body side between pectoral and pelvic fins.

Yano *et al.* (2005, p. 153) described the first dorsal fin origin in *Cephaloscyllium circulopullum* as located above “half of pelvic fin base”, but that it is located “about opposite pelvic fin origin or in front of it” in *C. sarawakensis*. All the specimens used in this study (32 specimens in total), including type specimens of *C. parvum*, which is now a junior synonym of *C. sarawakensis*, have first dorsal fin origin above anterior 1/3 (holotype of *C. parvum*) or almost at level of middle pelvic fin base, never opposite or before pelvic fin origin. The origins of the first dorsal fins shown in the original figures (pls. 92, 93, 95 and 96) are also apparently behind pelvic fin origins, or above pelvic fin bases, just like those of *C. circulopullum*. Therefore, the relative position of the first dorsal fin origin and pelvic fin base can not be a distinguishing character of *C. circulopullum* and *C. sarawakensis*.

Length from snout tip to pectoral origin (20.6% TL and 21.5% TL in *Cephaloscyllium circulopullum* vs. 17.2–19.4% TL in *C. sarawakensis* in the original descriptions) also can not be a distinguishing character, because the

range is widened (16.1–21.3% TL) for *C. sarawakensis* by inclusion of specimens from Taiwan, as well as the type and additional specimens of *C. parvum*.

The mouth widths of *Cephaloscyllium circulopullum* (8.5% TL and 8.8% TL) are completely included within the range of *C. sarawakensis* (8.2–10.3% TL) in the original description.

The shape of dark blotch on lateral side of body between pectoral and pelvic fins was described as “almost circle” for *Cephaloscyllium circulopullum* and “vertical elongate” for *C. sarawakensis*. As shown in the discussion of *C. fasciatum*, it is almost impossible to describe a new species for the genus *Cephaloscyllium* without taking vast intraspecific color variation into consideration. For example, the lateral loops on body side are greatly variable in *C. fasciatum*, i.e. triangular, quadrangular, polyangular, circular, elliptical and combination of these. Actually, semi-circular to vertically elongate blotches were found in the specimens examined (Figure 6). Therefore, we consider that the characters “almost circle” and “vertical elongate” simply represent color variations within *C. sarawakensis*.

Accordingly, the distinguishing characters used in the original descriptions are invalid, and as no other characters are available for the species distinction, *C. circulopullum* is considered as a junior synonym of *C. sarawakensis*.

***Cephaloscyllium umbratile* Jordan & Fowler, 1903**

English name: Japanese swellshark

Taiwanese name: Tou-sa

Japanese name: Nanukazame

(Figures 7–8, Table 3)

Cephaloscyllium umbratile Jordan & Fowler, 1903, pp. 602–603, fig. 1; Fowler, 1941, pp. 32–33; Nakaya, 1975, pp. 9–14, figs. 1–3; Nakaya in Okamura *et al.*, 1984, pp. 38–39; Shen, 1984, p. 2, pl. 2 (4–3); Yamada *et al.*, 1986, p. 8; Amaoka *et al.*, 1995, p. 16; Nakaya, 1997, pp. 41–42; Compagno *et al.*, 2005, p. 218; Schaaf-da Silva & Ebert, 2008, pp. 15–21; Shen & Wu, 2012, p. 64; Ebert *et al.*, 2013, p. 331, pl. 43.

Cephaloscyllium isabellum: Chen & Joung in Shen *et al.*, 1993, p. 54, pls. 5–8.

Cephaloscyllium sp.: Compagno *et al.*, 2005, p. 222.

Galeus eastmani: Shen, 1984, p. 2, plate 2 (4–2).

[non] *Cephaloscyllium umbratile*: Teng, 1962, p. 45, fig. 10; Chen, 1963, p. 29, fig. 9; Chan, 1966, p. 229, figs. 5, 7, pl. 2; Bessednov, 1969, p. 27, figs. 9, 10; Chen *et al.*, 1997, p. 2, fig. 5.

Material examined. *Taiwan*: NMMB-P10849, male 593 mm TL (Nan-fang-ao, Yilan). NMMB P-15466, 2 males, 325–425 mm TL (Da-xi, Yilan). NMMB-P16168, male, 195 mm TL (Da-xi, Yilan). NMMB-P 16199, female, 230 mm TL; NMMB-P 16201, female, 203 mm TL; NMMB-P16462, 2 females, 210–260 mm TL; NMMB P-16618, 1 male, 321 mm TL, 2 females, 313–317 mm TL (Nan-fang-ao, Yilan). NMMB P-17180, female, 217 mm TL; NMMB-P 17183, female, 193 mm TL (Ke-tzu-liao, Kaohsiung). NMMB-P 17184, female, 215 mm TL; NMMB P-17185, female, 217 mm TL (Da-xi, Yilan). HUMZ 170361, female, 412 mm TL; HUMZ 170370, female, 214 mm TL; HUMZ 170372, female, 254 mm TL; HUMZ 170373, male, 398 mm TL; HUMZ 170374, female, 186 mm TL; HUMZ 170375, female, 218 mm TL; HUMZ 170376, male, 192 mm TL; HUMZ 170384, female, 332 mm TL; HUMZ 170471, female, 348 mm TL; HUMZ 170472, male, 315 mm TL; HUMZ 170473, female, 303 mm TL; HUMZ 170474, female, 265 mm TL; HUMZ 170475, female, 215 mm TL; HUMZ, 170476, male, 186 mm TL; HUMZ 170477, male, 193 mm TL; HUMZ 170478, female; HUMZ 170479, male, 240 mm TL; HUMZ 170480, female, 194 mm TL; HUMZ 170481, male, 318 mm TL; HUMZ 170966, male, 253 mm TL; HUMZ 170967, female, 436 mm TL; HUMZ 170968, male, 351 mm TL; HUMZ 171371, male, 181 mm TL; HUMZ 213790, male, 798 mm TL; HUMZ 213791, male, 813 mm TL (Da-xi, Yilan). *Other regions*: HUMZ 35478, male, 298 mm TL; HUMZ 80127, male, 306 mm TL; HUMZ 58698, female, 279 mm TL; HUMZ 39370, male, 430 mm TL; HUMZ 39371, male, 307 mm TL; HUMZ 49478, male, 240 mm TL; HUMZ 80496, female, 268 mm TL; HUMZ 80497, male, 293 mm TL; HUMZ 110107, male, 346 mm TL; HUMZ 121953, male, 444 mm TL; HUMZ 35074, male, 266 mm TL (Kochi, Japan). HUMZ 65593, female, 249 mm TL; HUMZ 65992, female, 236 mm TL; HUMZ 65993, male, 244 mm TL; HUMZ 66180, male, 702 mm TL; HUMZ 66181, female, 417 mm TL; HUMZ 66227, male, 237 mm TL (Ishikawa Pref., Japan). HUMZ 50000, male, 564 mm TL (off Usujiri, Hokkaido Pref., Japan). HUMZ 39379, female, 377 mm TL; HUMZ 39439, female, 371 mm TL (Kii Strait, Japan). HUMZ 39434,

female, 331 mm TL (Kagoshima Pref., Japan). HUMZ 95268, female, 896 mm TL; HUMZ 95269, male, 948 mm TL (27°57.7'N, 127°59.7'E). HUMZ 117826, male, 845 mm TL (Wakayama Pref., Japan). HUMZ 138270, male, 296 mm TL; HUMZ 138597, female, 259 mm TL (Yamagata Pref., Japan). HUMZ 178907, female, 948 mm TL; HUMZ 178908, male, 962 mm TL; HUMZ 178909, male, 938 mm TL; HUMZ 178910, male, 980 mm TL; HUMZ 178911, female, 889 mm TL; HUMZ 178912, female, 1011 mm TL (Shimane Pref., Japan). HUMZ 39471, female, 243 mm TL; HUMZ 121950, male, 294 mm TL; HUMZ 122689, female, 487 mm TL (locality unknown). FAKU 1012, female, 225 mm TL; FAKU 23818, male, 302 mm TL; FAKU K1261, female, 245 mm TL (Mie Pref., Japan). FAKU 58914, male, 550 mm TL (Kyoto Pref., Japan). TMFE 12776, male, 216 mm TL; TMFE 12786, female, 204 mm TL; TMFE 12789, female, 232 mm TL; TMFE 12791, female, 246 mm TL; TMFE 12797, female, 261 mm TL; TMFE 12860, female, 286 mm TL; TMFE 12890, male, 213 mm TL; TMFE 12921, female, 270 mm TL; TMFE 13324, female, 451 mm TL; TMFE 13592, female, 375 mm TL; TMFE 13606, male, 218 mm TL; TMFE 13607, male, 187 mm TL; TMFE 14024, male, 376 mm TL; TMFE 14027, male, 401 mm TL; TMFE 14052, female, 300 mm TL; TMFE 14053, male, 228 mm TL; TMFE 14065, female, 293 mm TL (Shizuoka Pref., Japan).

Diagnosis. Three broad dark saddle blotches before first dorsal fin; first saddle on posterior half of interorbital region and immediately behind eye, second saddle over pectoral fin base, third saddle at middle between pectoral and pelvic fin bases. Adults with dark and irregular spots and sometimes with white spots between the saddles. Large species maturing at about 950 mm TL and attaining 1145 mm TL.

Description. Body slender in young, stout in adults (Figure 7). Head large, broad and well depressed. Trunk robust, tail slender. Caudal peduncle rather slender; length about 1.5 times its height. Caudal fin axis a little elevated.

Snout short, its tip slightly pointed, dorsal side flat. Interorbital area flat, shallowly concave in larger specimens. Nostrils closer to mouth than to snout tip. Anterior nasal flap well developed, extending as a definite lobe, with a distinct notch on its posterior margin; flap not reaching mouth. Posterior nasal flap developed. Internarial space wide, its length greater than nostril width. Mouth very wide and high; width nearly three times preoral length (without teeth); lower jaw almost straight along the side with a flat symphysis. Labial furrows completely absent from both jaws. Eye small, slender. Spiracle small, behind and slightly below eye. Gill openings short; fourth and fifth openings on base of pectoral fin.

Pectoral fin moderate in size; apex and free rear tip moderately rounded; posterior margin about linear in adult and well convex in young. First dorsal fin origin before center of body in young, behind it in adult; origin above anterior 1/3 to middle of pelvic base; base length shorter than pelvic-anal fin space; apex well rounded and free rear tip slightly rounded; anterior and posterior margin linear in adult and well convex in young. Second dorsal fin considerably smaller than first dorsal fin; origin above anterior 1/4 of anal fin base; base much shorter than anal fin base; apex well rounded; free rear tip bluntly pointed; its anterior margin slightly convex; posterior margin linear or slightly concave. Pelvic fin insertion below middle of first dorsal fin base; apex broadly rounded. Anal fin larger than second dorsal fin; its origin below posterior 1/3 of interdorsal space; insertion opposite to second dorsal fin insertion; base longer than anal-lower caudal space; apex well rounded; its free rear tip pointed; anterior margin long and convex; posterior margin linear or slightly concave. Caudal fin slender, with a moderately developed lower lobe and a distinct subterminal notch; no enlarged dermal denticles on its dorsal and preventral margin; terminal and subterminal margin linear in adult and well rounded in young.

Teeth: number of teeth on both jaws high; upper jaw 77–110, lower jaw 71–102; teeth with 3–5 cusps, principal cusp longest with a few smaller cusps on both sides; teeth near symphysis on both jaws large and symmetrical; lateral teeth smaller and more asymmetrical toward side of jaws.

Dermal denticles: dermal denticles on lateral side of body above pectoral fin thick with 1–3 cusps; lateral cusps small, indistinct; three strong ridges running from base toward each cusp.

Vertebrae: monospondylous vertebrae 47–54, precaudal diplospondylous vertebrae 30–40, precaudal vertebrae 79–91.

Spiral valves: 9–12.

TABLE 3. Proportional measurements and counts of *Cephaloscyllium umbratile*.

Specimens		Male (n=41)			Female (n=45)		
		Min	Max	Mean	Min	Max	Mean
Total length (mm)	TOT	192.2	979.5	421.5	185.8	1011.1	355.8
Proportion (%TL)							
Precaudal length (%)	PRC	70.9	79.8	74.7	68.8	79.7	74.0
Precaudal length to lower origin (%)	PRC lower	69.5	78.7	73.4	68.0	78.3	72.5
Prenarial length	PRN	2.2	3.3	2.8	2.2	3.7	2.9
Prenarial length from inner nostrils	PRN inner	3.4	3.6	3.5	3.5	4.5	3.8
Preoral length	POR	2.6	5.2	4.1	3.2	5.3	4.3
Preorbital length	POB	4.5	7.1	5.6	4.8	7.6	5.7
Prespiracle length	PSP	8.6	11.7	9.7	8.3	11.6	9.9
Prebranchial length	PG1	14.0	17.4	15.4	14.1	16.9	15.6
Pre 5th branchial length	PG5	16.9	22.8	19.8	17.8	21.7	19.8
Prepectoral length	PP1	16.2	20.2	18.4	16.2	20.5	18.4
Prepelvic length	PP2	37.9	50.9	43.9	38.1	50.7	43.5
Snout-vent length	???	48.7	50.6	49.5	45.6	48.3	47.2
Vent-caudal length	???	49.7	51.4	50.6	49.8	53.0	51.8
Preanal length	PAL	55.5	67.6	60.7	52.0	67.1	59.5
Pre-first dorsal fin length	PD1	42.6	54.8	48.4	43.1	54.0	47.5
Pre-second dorsal fin length	PD2	57.9	69.8	63.2	57.3	69.1	62.5
Interdorsal space length	IDS	6.5	8.8	7.8	6.6	9.3	7.9
Dorsal-caudal length	DCS	5.2	8.7	6.8	5.1	9.1	7.0
Pectoral-pelvic length	PPS	13.5	23.5	18.2	13.9	23.8	17.9
Pelvic-anal space	PAS	8.5	11.6	10.3	7.5	10.2	9.0
Anal-caudal length	ACS	4.4	7.5	5.8	4.8	7.3	5.9
Eye length	EYL	2.7	3.9	3.1	2.7	4.0	3.2
Eye height	EYH				0.4	0.9	0.6
Interorbital space	INO	7.1	8.6	7.7	7.2	8.5	7.8
Nostril width	NOW	2.1	3.2	2.6	2.2	3.5	2.7
Internarial space	INW	2.3	3.5	2.8	2.4	3.7	2.9
Spiracle length	SPL	0.5	0.8	0.6	0.4	0.8	0.6
Mouth length	MOL	3.3	6.3	4.2	3.2	5.7	4.1
Mouth width	MOW	7.3	12.4	9.9	7.3	12.7	9.7
First gill height	GS1	1.1	2.4	1.8	1.2	2.6	1.8
Second gill height	GS2	1.7	2.3	2.0	1.3	2.0	1.6
Third gill height	GS3	1.7	2.3	2.0	1.3	2.0	1.6
Fourth gill height	GS4	1.7	2.3	2.0	1.3	2.0	1.6
Fifth gill height	GS5	0.8	2.0	1.2	0.5	1.8	1.1
Head height	HDH	5.7	10.5	7.8	5.4	14.2	7.7
Head width	HDW	10.9	18.3	14.3	11.4	19.0	14.2
Trunk height	TRH	7.5	14.4	10.0	6.3	11.3	9.1
Trunk width	TRW	9.4	18.6	12.8	8.8	18.2	12.6
Caudal peduncle height	CPH	3.0	3.5	3.2	3.2	3.7	3.5
Caudal peduncle width	CPW	2.8	3.3	3.1	2.7	3.1	2.9

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TABLE 3 (continued)

Specimens		Male (n=41)			Female (n=45)		
		Min	Max	Mean	Min	Max	Mean
Pectoral fin length	P1L	12.8	14.4	13.5	11.8	13.9	12.8
Pectoral fin anterior margin	P1A	13.0	13.3	13.1	10.8	13.9	12.4
Pectoral fin base length	P1B	6.5	9.5	8.0	6.8	9.8	8.0
Pectoral fin height	P1H	7.4	13.1	9.6	7.2	13.0	9.1
Pectoral fin inner margin	P1I	3.5	5.7	4.6	3.3	5.9	4.4
Pectoral fin posterior margin	P1P	7.8	13.4	9.8	6.6	12.5	8.9
Pelvic fin length	P2L	10.3	11.1	10.8	9.4	10.4	9.9
Pelvic fin base length	P2B	5.6	8.0	6.5	5.6	8.9	7.4
Pelvic fin inner margin	P2I	2.6	5.3	4.0	1.6	3.5	2.3
Clasper outer length	CLO	1.4	8.8	2.8	1.7	1.7	1.7
Clasper inner length	CLI	3.8	12.7	5.8	5.1	5.1	5.1
Clasper base length	CLB	0.7	0.9	0.8	0.6	0.6	0.6
First dorsal fin length	D1L	10.5	10.6	10.6	9.7	11.2	10.5
First dorsal fin anterior margin	D1A	9.7	10.6	10.2			
First dorsal fin base length	D1B	6.5	8.5	7.4	6.2	8.7	7.3
First dorsal fin height	D1H	3.9	7.5	5.2	3.7	6.8	5.0
First dorsal fin inner margin	D1I	2.1	3.4	2.7	1.9	3.5	2.6
First dorsal fin posterior margin	D1P	4.2	5.5	4.8			
Second dorsal fin length	D2L	7.7	8.4	8.0	6.7	7.9	7.4
Second dorsal fin anterior margin	D2A	5.6	6.4	6.0			
Second dorsal fin base length	D2B	4.4	8.8	5.4	4.4	6.1	5.3
Second dorsal fin height	D2H	2.1	3.4	2.7	2.1	3.6	2.7
Second dorsal fin inner margin	D2I	1.3	3.1	2.4	1.5	3.1	2.3
Second dorsal fin posterior margin	D2P	2.9	3.0	3.0			
Anal fin length	ANL	9.8	10.9	10.4	9.4	10.3	9.9
Anal fin anterior margin	ANA	8.0	8.0	8.0			
Anal fin base length	ANB	6.3	8.5	7.4	6.5	8.9	7.7
Anal fin height	ANH	2.7	4.6	3.4	2.8	4.4	3.3
Anal fin inner margin	ANI	1.7	3.0	2.3	1.8	2.9	2.3
Anal fin posterior margin	ANP	4.5	4.5	4.5			
Caudal dorsal margin	CDM	20.3	27.7	24.5	19.4	29.3	25.2
Caudal preventral margin	CPV	9.2	10.6	10.0	4.1	10.4	8.3
Caudal postventral lower margin	CPL	10.6	11.3	10.9	9.8	12.1	11.0
Caudal subterminal margin	CST	3.2	6.5	4.4	3.4	5.4	4.3
Caudal terminal margin	CTR	4.9	6.8	5.9	4.4	6.6	5.8
First dorsal-fin midpoint pectoral-fin insertion	DPI	25.0	28.3	26.5	24.2	26.4	25.3
First dorsal-fin midpoint pelvic-fin origin	DPO	6.8	7.8	7.4	6.5	8.6	7.4
Pelvic-fin midpoint first dorsal-fin insertion	PDI	4.6	7.8	6.1	5.3	6.4	5.9
Pelvic-fin midpoint second dorsal-fin origin	PDO	14.1	14.6	14.3	12.9	15.5	14.2
Second dorsal-fin origin anal-fin origin	DAO	1.2	2.2	1.8	1.5	3.4	2.5
Counts:							
Monospondyloous vertebrae		48	54	50.6	47	53	50.1
Caudal diplospondyloous vertebrae		30	40	34.9	30	38	34.7
Precaudal vertebrae		79	91	85.5	79	90	84.8

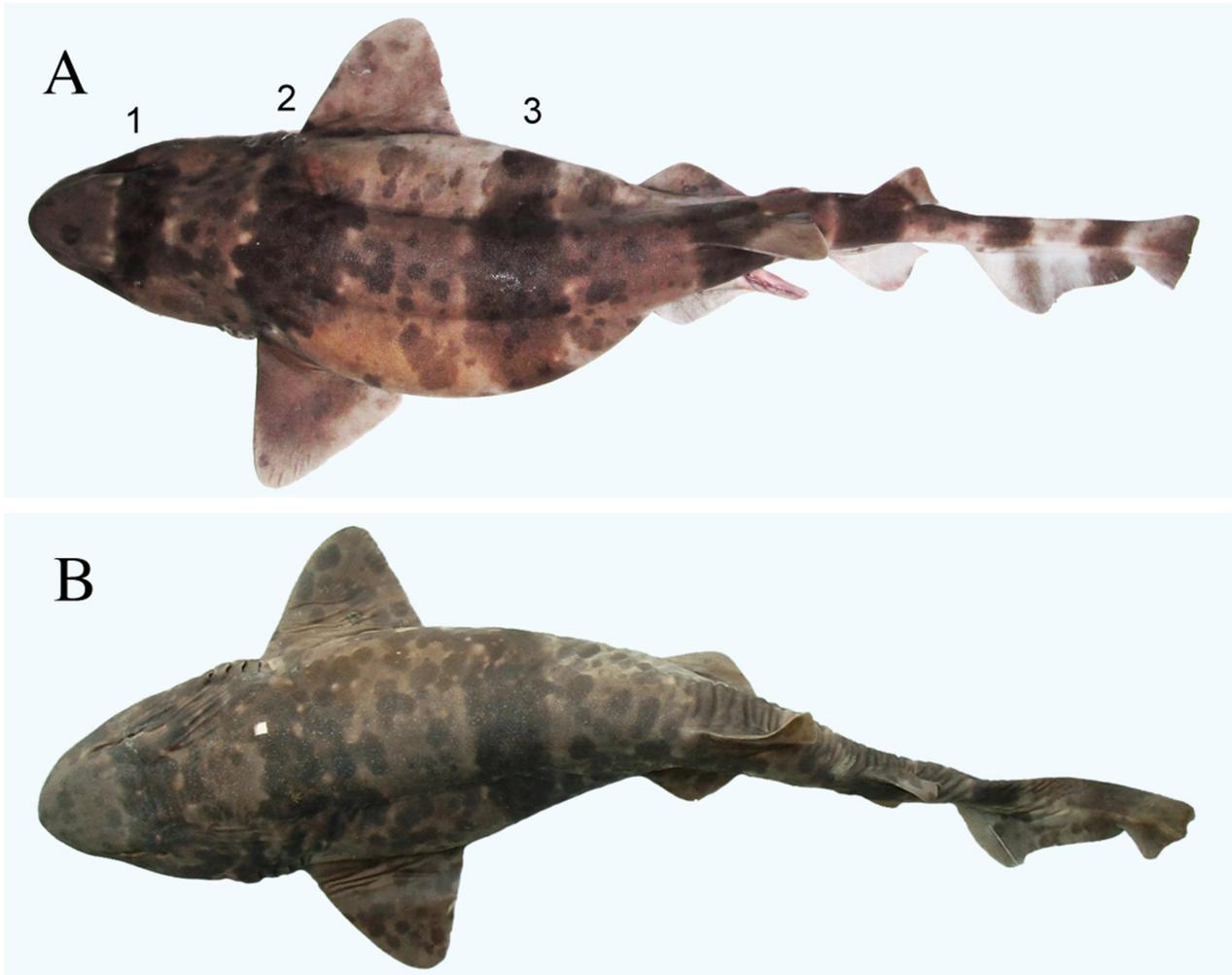


FIGURE 7. *Cephaloscyllium umbratile* from Taiwan (A) and Japan (B). A, HUMZ 213790, male, 798 mm TL collected at Daxi, Taiwan; B, HUMZ 117826, male, 845 mm TL, collected at Wakayama, Japan. Arabic numerals show saddle blotches before first dorsal fin.

Color. Ground body color brownish dorsally, pale ventrally. Seven dark brown and wide saddle blotches on body; first saddle on posterior half of interorbital region and immediately behind eye, second saddle over pectoral fin base, third saddle at middle between pectoral and pelvic fin bases, fourth saddle on first dorsal fin, fifth saddle on second dorsal fin, sixth saddle on caudal fin just behind caudal peduncle, and seventh saddle on posterior half of caudal fin. Saddles sometimes surrounded by whitish lines. Dorsal sides of pectoral and pelvic fins uniformly light brownish. Specimens larger than about 350 mm TL (Figures 7, 8f–g) with many dark irregular spots and some white spots on dorsal side of body, dorsal fins and caudal fin, with dark grayish stains and blotches on ventral side of body.

Size. Size at maturation 961–960 mm TL (male), 921–1040 mm TL (female) (Taniuchi, 1988). Maximum size 1140 mm TL (male), 1145 mm TL (female) (Taniuchi, 1988).

Distribution. Western North Pacific Ocean, including Japan Sea, East China Sea (Japan, Korea, China and Taiwan); 90–200 m (Taniuchi, 1988), 200–500 m (Ho, pers. obs.).

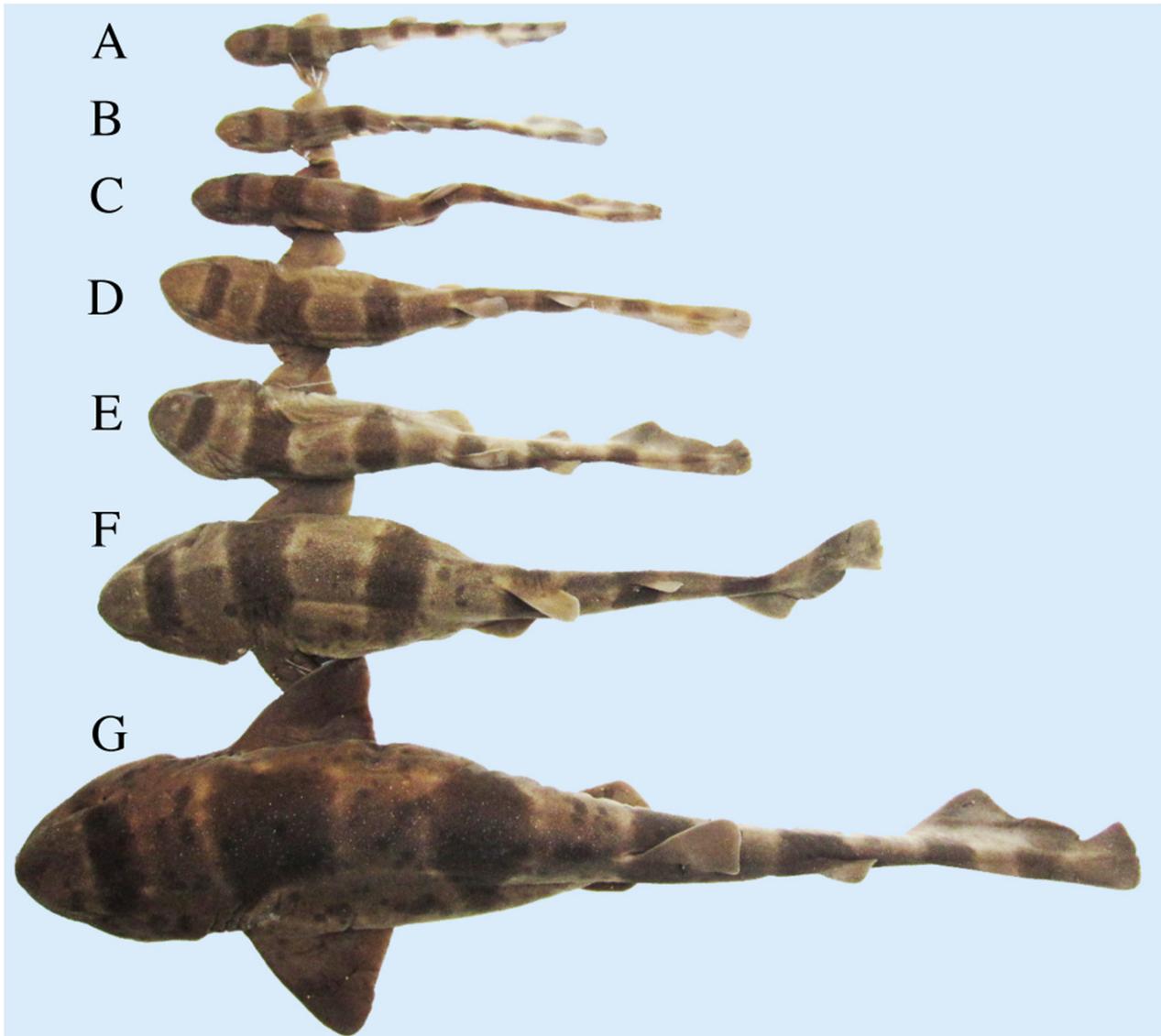


FIGURE 8. Dorsal views of *Cephaloscyllium umbratile*, showing color pattern changes with growth. A, NMMB-P 17185, female, 185 mm TL; B, NMMB-P 17184, female, 210 mm TL; C, NMMB-P 16462, female, 255 mm TL; D, NMMB-P 15618, male, 315 mm TL; E, NMMB-P 15466, male, 325 mm TL; F, NMMB-P 15466, male, 425 mm TL; G, NMMB-P 10849, male, 593 mm TL.

Remarks. *Cephaloscyllium umbratile* was described based on a specimen collected at Nagasaki, Japan, and was recognized as a distinct species by Nakaya (1975). Later, Springer (1979) treated *C. umbratile* as a junior synonym of *C. isabellum*. Compagno (1984, 1988) followed Springer (1979) with a question mark. However, all the recent workers such as Compagno (1999), Compagno *et al.* (2005), and Schaaf-da Silva & Ebert (2008) treat *C. umbratile* as a distinct species, with which we agree.

The measurements and meristic counts do not work well as distinguishing characters in many cases, but the body coloration can be a good diagnostic character of the species in this genus. Figures 7 and 8 show ontogenetic color changes of *Cephaloscyllium umbratile* in specimens between 185 mm TL to 845 mm TL. One of the consistent diagnostic characters for *C. umbratile* is the number and position of dorsal saddle blotches. As shown above, seven dark brown and broad saddle blotches are present on body. First saddle blotch is located on posterior half of interorbital region and immediately behind eye, second saddle is positioned over pectoral fin base, third saddle at middle between pectoral and pelvic fin bases, fourth saddle on first dorsal fin, fifth saddle on second dorsal fin, and sixth and seventh saddles are located on posterior half of caudal fin. These characters are very

consistent throughout life in *C. umbratile*. Dark stains appear on dorsal side of body and fins with growth. Blunt whitish lines tend to encircle dark saddle blotches, and to be broken into paler dots, or disappear, with growth.

Cephaloscyllium umbratile is clearly characterized and can be distinguished from other species in western North Pacific species by presence of three dark broad saddle blotches before first dorsal fin, and the position of second and third saddle blotches. For more information about consistency of saddle blotches, see discussions of other species and general discussion.

***Cephaloscyllium formosanum* Teng, 1962**

English name: Formosa swellshark

Taiwanese name: Tai-wan-tou-sa

Japanese name: Hoshi nanukazame

(Figure 9, Table 4)

Cephaloscyllium formosanum Teng, 1962: pp. 48–51, fig. 11.

Material examined. Holotype: TFRI 4339, female, 655 mm TL (off Tungkang [Dong-gang], western South Taiwan, 22°25'N, 120°25'E). The holotype was examined by Inoue in 2002 at TFRI, but it was missing (maybe lost) when KN and HH visited TFRI in October, 2012.

Diagnosis. Four broad dark saddle blotches before first dorsal fin; first saddle just behind eye, second saddle over gill openings, third saddle above inner margin of pectoral fin and fourth above pelvic fin origin. A narrow dark band between third and fourth saddle blotches. Numerous small white spots on all body. Margins of egg case indented. Medium-sized species getting mature at size less than 65 cm TL.

Description. Proportional measurements and meristic counts are given in Table 4.

Body slender (Figure 9). Head large and well depressed. Trunk height at pectoral insertion higher than height of head. Tail slightly compressed. Caudal peduncle without pit and keel. Caudal axis a little elevated. Snout comparatively long, tip rounded, length greater than 1st dorsal and anal fin bases. Nostrils near mouth. Anterior nasal flap well developed, sub-triangular with a small notch on its posterior margin; flap not reaching mouth. Posterior nasal flaps developed. Internarial space comparatively wide, almost equal to nostril width. Mouth very wide, its length longer than eye length; anterior part of lower jaw rounded. Labial furrows completely absent from both jaws. Eye small, length less than preoral length. Spiracle small, behind and slightly below eye. Gill openings short; first opening longest, smaller toward fifth opening; fourth and fifth openings on base of pectoral fin.

Pectoral fin moderate in size; its apex and free rear tip moderately rounded; its posterior margin somewhat linear. First dorsal fin origin above center of pelvic fin base; base length shorter than interdorsal space; its height 1.1 in its base length; its apex well rounded and its free rear tip bluntly pointed; its anterior margin long and slightly convex; its posterior margin linear. Second dorsal fin considerably smaller than first dorsal fin; its origin above anterior 1/3 of anal fin base; base length 1.4 in anal fin base length; its height 1.6 in its base length; apex well rounded and its free rear tip well pointed; its anterior margin long and slightly convex; its posterior margin slightly concave. Pelvic fin about as large as first dorsal fin in area; its origin located just at center of body; its insertion below middle of first dorsal fin base; its base length 0.8 in first dorsal fin base length; its apex broadly rounded; its free rear tip bluntly pointed; its inner margin linear. Anal fin larger than second dorsal fin; its origin below posterior 1/3 of interdorsal space; its insertion opposite to second dorsal fin insertion; its base length slightly shorter than interdorsal space; its height 1.7 in its base length; its apex well rounded and its free rear tip well pointed; its anterior margin long and convex; its posterior margin concave; its inner margin linear. Caudal fin with a moderately developed lower lobe and a distinct subterminal notch; no enlarged dermal denticles on its dorsal and preentral margin; ventral and posterior tip rounded; terminal and subterminal margin linear.

Teeth: number of upper jaw teeth 68, lower jaw teeth 78 (Teng, 1962). All teeth same, with 3 (infrequently 5) cusps, principal cusp large and long; no symphyseal tooth on upper jaw, but three small teeth on lower jaw symphysis (Teng, 1962).

TABLE 4. Proportional measurements and counts of *Cephaloscyllium formosanum* and *C. umbratile*.

Species		<i>C. formosanum</i>		<i>C. umbratile</i>	
Specimen		holotype (TFRI 4339) ¹		n=41	
Sex		female		male	
Sex		female		female	
Total length (mm)	TOT	655	192.2 – 979.5	185.8 – 1011.1	
Proportional measurements (%TL):					
Precaudal length	PRC	81.0	70.9 – 79.8	68.8 – 79.7	
Precaudal length to lower origin (%)	PRC lower	78.3	69.5 – 78.7	68.0 – 78.3	
Prenarial length	PRN	2.6	2.2 – 3.3	2.2 – 3.7	
Preoral length	POR	3.8	2.6 – 5.2	3.2 – 5.3	
Preorbital length	POB	6.7	4.5 – 7.1	4.8 – 7.6	
Prespiracle length	PSP	10.3	8.6 – 11.7	8.3 – 11.6	
Prebranchial length	PG1	17.0	14.0 – 17.4	14.1 – 16.9	
Pre 5th branchial length	PG5	21.7	16.9 – 22.8	17.8 – 21.7	
Prepectoral length	PP1	21.1	16.2 – 20.2	16.2 – 20.5	
Prepelvic length	PP2	50.0	37.9 – 50.9	38.1 – 50.7	
Preanal length	PAL	66.5	55.5 – 67.6	52.0 – 67.1	
Pre-first dorsal fin length	PD1	57.2	42.6 – 54.8	43.1 – 54.0	
Pre-second dorsal fin length	PD2	70.0	57.9 – 69.8	57.3 – 69.1	
Interdorsal space length	IDS	7.6	6.5 – 8.8	6.6 – 9.3	
Dorsal-caudal length	DCS	6.4	5.2 – 8.7	5.1 – 9.1	
Pelvic-anal space	PAS	8.2	8.5 – 11.6	7.5 – 10.2	
Anal-caudal length	ACS	5.7	4.4 – 7.5	4.8 – 7.3	
Eye length	EYL	3.2	2.7 – 3.9	2.7 – 4.0	
Interorbital space	INO	7.6	7.1 – 8.6	7.2 – 8.5	
Nostril width	NOW	2.6	2.1 – 3.2	2.2 – 3.5	
Internarial space	INW	2.8	2.3 – 3.5	2.4 – 3.7	
Mouth length	MOL	4.9	3.3 – 6.3	3.2 – 5.7	
Mouth width	MOW	10.0	7.3 – 12.4	7.3 – 12.7	
First gill height	GS1	2.8	1.1 – 2.4	1.2 – 2.6	
Fifth gill height	GS5	1.6	0.8 – 2.0	0.5 – 1.8	
Head height	HDH	10.7	5.7 – 10.5	5.4 – 14.2	
Head width	HDW	14.9	10.9 – 18.3	11.4 – 19.0	
Pectoral fin base length	P1B	7.5	6.5 – 9.5	6.8 – 9.8	
Pectoral fin height	P1H	11.3	7.4 – 13.1	7.2 – 13.0	
Pectoral fin inner margin	P1I	4.6	3.5 – 5.7	3.3 – 5.9	
Pectoral fin posterior margin	P1P	10.8	7.8 – 13.4	6.6 – 12.5	
Pelvic fin base length	P2B	8.0	5.6 – 8.0	5.6 – 8.9	
Pelvic fin inner margin	P2I	2.4	2.6 – 5.3	1.6 – 3.5	
First dorsal fin base length	D1B	6.4	6.5 – 8.5	6.2 – 8.7	
First dorsal fin height	D1H	5.6	3.9 – 7.5	3.7 – 6.8	

..... continued on the next page

TABLE 4. (Continued)

Species		<i>C. formosanum</i>		<i>C. umbratile</i>		
		holotype (TFRI 4339) ¹		n=41	n=45	
Specimen				male	female	
Sex		female				female
First dorsal fin inner margin	D1I	2.9	2.1 – 3.4	1.9 – 3.5		
Second dorsal fin base length	D2B	4.2	4.4 – 8.8	4.4 – 6.1		
Second dorsal fin height	D2H	2.5	2.1 – 3.4	2.1 – 3.6		
Second dorsal fin inner margin	D2I	2.9	1.3 – 3.1	1.5 – 3.1		
Anal fin base length	ANB	6.0	6.3 – 8.5	6.5 – 8.9		
Anal fin height	ANH	3.6	2.7 – 4.6	2.8 – 4.4		
Anal fin inner margin	ANI	2.8	1.7 – 3.0	1.8 – 2.9		
Caudal dorsal margin	CDM	21.7	20.3 – 27.7	19.4 – 29.3		
Caudal subterminal margin	CST	4.3	3.2 – 6.5	3.4 – 5.4		
Caudal terminal margin	CTR	5.5	4.9 – 6.8	4.4 – 6.6		
Counts:						
Monospondylous vertebrae		45	48 – 54	47 – 53		
Precaudal diplospondylous vertebrae		34	30 – 40	30 – 38		
Precaudal vertebrae		79	79 – 91	79 – 90		

¹ taken by Inoue.

Dermal denticles: dermal denticles on lateral side of body above pectoral fin thick with three cusps; principal cusp longest, lateral cusps indistinct; three strong ridges running from base toward each cusp; some weak ridges running among strong ridges.

Vertebrae: monospondylous vertebrae 45, precaudal diplospondylous vertebrae 34 (precaudal vertebrae 79).

Spiral valves: unknown

Egg cases: two egg shells present; shape rectangular, with long tendrils on four corners; anterior projections widely separate; posterior ends curving closer each other; surface of shell smooth; lateral margins with remarkable wavy ridges on lateral margins at middle half, and anterior and posterior parts (from Teng, 1962).

Color. Teng (1962) described that about ten dark brownish transverse bands are present on dorsal and lateral sides of body, but these bands had already faded away from the holotype, when the second author Inoue examined the holotype in 2002. However, Teng's original figure clearly indicates four broad and distinct saddle blotches before first dorsal fin, i.e. first saddle blotch at posterior part of eye and postorbital region, second saddle over gill opening region, third one above inner margin of pectoral fin, and fourth one above origin of pelvic fin. The figure also shows wide saddle blotches, one on first dorsal fin, one on second dorsal fin, and two saddles on caudal fin. In addition, a narrow saddle band is seen between third and fourth saddle blotches and one on caudal peduncle. Numerous small white spots and a few small dark spots were recognized in 2002, as indicated in the original figure.

Size. Size at maturation less than 655 mm TL (female). Maximum size at least 655 mm TL (female).

Distribution. Off Dong-gang, western South Taiwan; about 200 fathoms (Teng, 1962).

Remarks. *Cephaloscyllium formosanum* and *C. umbratile* were synonymized under *C. isabellum* (Bonnaterre, 1788) without any reason by Springer (1979). Compagno (1984, 1988) followed Springer's opinion. Compagno (1988) also mentioned that *C. umbratile* and *C. formosanum* are probably the same species, but Compagno (1999) considered *C. isabellum* and *C. umbratile* to be different species. Recently Schaaf-da Silva & Ebert (2008)

reviewed the western North Pacific swellsharks, and they also considered *C. umbratile* as distinct from *C. isabellum*, and treated *C. formosanum* as a junior synonym of *C. umbratile*, following previous workers.

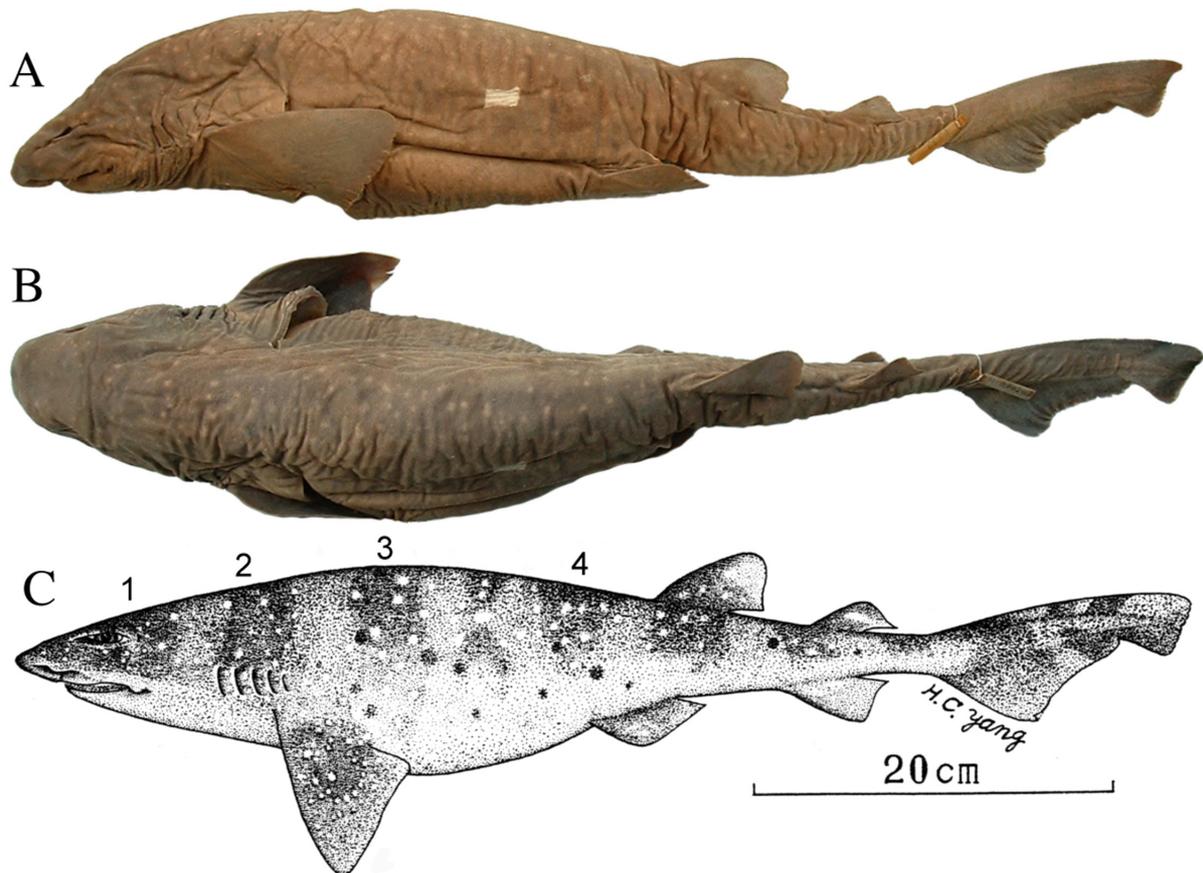


FIGURE 9. Holotype (A, B) and original drawing (C) of *Cephaloscyllium formosanum*, TFR1 4339, female, 655 mm TL. Arabic numerals show saddle blotches before first dorsal fin.

As shown above, *Cephaloscyllium formosanum* is currently considered as a junior synonym of *C. umbratile*, but the validity of *C. formosanum* has never been studied before. Here we discuss its validity, based on comparisons of the holotypes of *C. formosanum* and *C. umbratile*, and many specimens of *C. umbratile*.

The holotype of *Cephaloscyllium formosanum* was examined by Inoue in 2002, and the measurements and other morphological information were taken from the holotype. A part of the morphological information of the holotype of *C. umbratile* was taken from Schaaf-da Silva & Ebert (2008), though their morphometric data were not used, because the holotype is a stuffed dried specimen (SU 12693).

Morphometric data of these two species are almost overlapping in the holotype of *Cephaloscyllium formosanum* and specimens of *C. umbratile* (Table 4). The vertebral counts are also overlapping in precaudal diplospondylous vertebrae (34 in *C. formosanum*, 30–40 in *C. umbratile*), but are somewhat different in monospondylous vertebrae (45, 47–54).

The coloration can be diagnostic in this genus, and the number and position of the broad saddle blotches before first dorsal fin are consistent and species specific in the genus *Cephaloscyllium*. The broad saddle blotches before first dorsal fin are four in *C. formosanum*, but three in *C. umbratile* (Figures 7 and 8). The position of second saddle blotch is over gill opening region in *C. formosanum*, but it is always over pectoral fin base in *C. umbratile*. The third saddle blotch is located above inner margin of pectoral fin in *C. formosanum*, but it is at middle of pectoral and pelvic fins in *C. umbratile*. The fourth saddle blotch is positioned above pelvic fin origin in *C. formosanum*, but it is on first dorsal fin in *C. umbratile*.

The holotype of *Cephaloscyllium formosanum* (655 mm TL) has egg cases, and this species is already mature at a length of 66 cm TL. However, the females of *C. umbratile* are still immature at this size, and get mature at

921–1040 mm TL (Taniuchi, 1988). Therefore, *C. formosanum* is rather a smaller species than *C. umbratile*. In addition, the margins of the egg case are remarkably wavy in *C. formosanum* (Teng, 1962), but the margins of the egg cases are smooth in *C. umbratile*.

These facts indicate that *Cephaloscyllium formosanum* is apparently distinct from *C. umbratile*, and therefore *C. formosanum* Teng, 1962 is resurrected here.

Discussion

Body coloration is an important discriminating character in the taxonomic account of the genus *Cephaloscyllium*. Actually the color patterns are used as main diagnostic characters of the species in the recent new species descriptions (Last *et al.*, 2008a; Last *et al.*, 2008b; Last & White, 2008; Schaaf-da Silva & Ebert, 2008; White & Ebert, 2008; Clark & Randall, 2011).

The color patterns of each species are quite variable, as shown above in the species accounts of Taiwanese swellsharks. Therefore, the color patterns should be carefully utilized in recognizing species in the genus *Cephaloscyllium*. The variations discussed in this paper include extensive individual and ontogenetic variations, i.e. presence or absence, and shapes of white or dark blotches, spots and lines. Western North Pacific species of the genus *Cephaloscyllium* have 7–10 saddle blotches on body and caudal fin, but the number and position of saddle blotches before first dorsal fin are quite stable and species specific. *C. umbratile* has always three broad distinct saddle blotches before first dorsal fin throughout life, with first saddle at posterior part of eyes, second saddle over pectoral fin base, and third saddle at middle of interspace between pectoral and pelvic bases. *C. formosanum* has four broad saddle blotches before first dorsal fin; first saddle at posterior part of eyes, second saddle over gill openings, third saddle above inner margin of pectoral fin, and fourth saddle above pelvic fin origin. *C. fasciatum* has also four saddle blotches before first dorsal fin, and the positions of the saddles are same as those of *C. formosanum*, but the saddles in *C. fasciatum* are composed of complex patterns marked by dark or dotted lines. *C. sarawakensis* has only two broad saddle blotches before first dorsal fin in adults, with first saddle at posterior part of eyes and second saddle above posterior part of the base and inner margin of pectoral fin. Although the young and adolescent individuals of *C. sarawakensis* have small third saddle blotch before first dorsal fin, it will disappear with growth.

Therefore, the species distributing western North Pacific can be phenetically categorized into three distinct species groups by number of saddle blotches before first dorsal fin, i.e. the two-saddle group (*Cephaloscyllium sarawakensis*), three-saddle group (*C. umbratile*), and four-saddle group (*C. formosanum* and *C. fasciatum*). We have not yet directly examined any specimens of other species from Australia and other areas, but relatively many species (at least *C. isabellum*, *C. cooki*, *C. pictum*, *C. speccum* and *C. hiscosellum*) seem to be members of four-saddle group. Other species may have four, five or more saddle blotches, which should be verified based on many specimens.

References

- Amaoka, K., Nakaya, K. & Yabe, M. (2011) *Fishes of Hokkaido*. Hokkaido Shinbun, Sapporo, Japan, 482 pp.
- Bessednov, L.N. (1969) The fishes of the Gulf of Tonkin. Part 1. Elasmobranchs. *Transactions of Pacific Research Institute of Fisheries and Oceanography*, 66, 1–138. [in Russian]
- Chan, W.L. (1966) New sharks from the South China Sea. *Journal of Zoology*, 148, 218–237.
<http://dx.doi.org/10.1111/j.1469-7998.1966.tb02949.x>
- Chen, C.T. & Joung, S.-J. (1993) Chondrichthyes. In: Shen, S.-C., Lee, S.-C., Shao, K.-T., Mok, H.-K., Chen, C.-T. & Chen, C.-H. (Eds.), *Fishes of Taiwan*. Department of Zoology, National Taiwan University, Taipei, pp. 29–91. [in Chinese]
- Chen, J.T.F. (1963) A review of the sharks of Taiwan. *Biological Bulletin of Department of Biology, College of Science, Tunghai University, Ichthyology Series*, 1, 1–102.
- Chen, Q.C., Cai, Y.Z. & Ma, X.M. (1997) *Fishes from Nansha Islands to South China Coastal waters 1*. Science Press, Beijing, 202 pp.
- Clark, E. & Randall, J.E. (2011) *Cephaloscyllium stevensi*: a new species of swell shark (Carcharhiniformes: Scyliorhinidae) from Papua New Guinea. *Aqua International Journal of Ichthyology*, 17 (1), 23–34.
<http://dx.doi.org/10.1111/jai.2001.17.issue-1>
- Compagno, L.J.V. (1984) FAO species catalogue. Sharks of the world. An annotated and illustrated catalogue of shark species known to date. Part 2. Carcharhiniformes. *FAO Fisheries Synopsis*, 4, 251–655.

- Compagno, L.J.V. (1988) *Sharks of the order Carcharhiniformes*. Princeton University Press, New Jersey, 486 pp.
- Compagno, L.J.V. (1999) Checklist of living elasmobranchs. In: Hamlett, W.C. (Ed.), *Sharks, skates, and rays: the biology of elasmobranch fishes*. The Johns Hopkins University Press, Baltimore, pp. 481–498.
- Compagno, L.J.V. (2002) *Sharks of the world. An annotated and illustrated catalogue of shark species known to date. Volume 2. Bullhead, mackerel and carpet sharks (Heterodontiformes, Lamniformes and Orectolobiformes)*. FAO Species Catalogue for Fishery Purposes, No.1, 2, 1–269.
- Compagno, L.J.V., Dando, M. & Fowler, S. (2005) *Sharks of the world*. Princeton University Press, Princeton, 368 pp.
- Ebert, D.A., Fowler, S. & Compagno, L.J.V. (2013) *Sharks of the world*. Wild Nature Press, Plymouth, UK, 528 pp.
- Fourmanoir, P. & Nhu-Nhung, D.-T. (1965) Liste complémentaire des poissons marins de Nha-Trang. *Cahiers d'ORSTOM (Séries Océanographie)* July, 1–114.
- Fowler, H.W. (1941) Contributions to the biology of the Philippine archipelago and adjacent regions. The fishes of the groups Elasmobranchii, Holocephali, Isospondyli, and Ostarophysii obtained by the U.S. Bureau of Fisheries steamer “Albatross” in 1907 to 1910, chiefly in the Philippine Islands and adjacent seas. *Bulletin United States National Museum*, 100, 1–879, figs. 1–30.
- Inoue, S. & Nakaya, K. (2006) *Cephaloscyllium parvum* (Chondrochthyes: Carcharhiniformes: Scyliorhinidae), a new swell shark from the South China Sea. *Species Diversity*, 11, 77–92.
- Jordan, D.S. & Fowler, H.W. (1903) A review of the elasmobranchiate fishes of Japan. *Proceedings of U. S. National Museum*, 26, 593–674.
<http://dx.doi.org/10.5479/si.00963801.26-1324.593>
- Last, P.R. & Stevens, J.D. (1994) *Sharks and rays of Australia*. CSIRO, Australia, 513 pp.
- Last, P.R., Séret, B. & White, W.T. (2008) New swellsharks (*Cephaloscyllium*: Scyliorhinidae) from the Indo–Australian region. In: Last, P.R., White, W.T. & Pogonoski, J.J. (Eds.), *Descriptions of new Australian chondrichthyans*. CSIRO Marine & Atmospheric Research Paper 022, pp. 129–146.
- Last, P.R., Motomura, H. & White, W.T. (2008) *Cephaloscyllium albipinnum* sp. nov., a new swellshark (Carcharhiniformes: Scyliorhinidae) from southeastern Australia. In: Last, P.R., White, W.T. & Pogonoski, J.J. (Eds.), *Descriptions of new Australian chondrichthyans*. CSIRO Marine & Atmospheric Research Paper 022, pp. 147–157.
- Last, P.R. & White, W.T. (2008) Two new saddled swellsharks (*Cephaloscyllium*: Scyliorhinidae) from eastern Australia. In: Last, P.R., White, W.T. & Pogonoski, J.J. (Eds.), *Descriptions of new Australian chondrichthyans*. CSIRO Marine & Atmospheric Research Paper 022, pp. 159–170.
- Nakaya, K. (1975) Taxonomy, comparative anatomy and phylogeny of Japanese catsharks, Scyliorhinidae. *Memoirs of the Faculty of Fisheries, Hokkaido University*, 23, 1–94.
- Nakaya, K. (1984) *Cephaloscyllium umbratile*. In: Okamura, O. & Kitajima, T. (Eds.), *Fishes of the Okinawa trough and the adjacent waters*. Japan Fisheries Resource Conservation Association, Tokyo, pp. 38–39.
- Nakaya, K. (1997) *Sea fishes of Japan*. Yamato Keikoku Sha, Tokyo, 783 pp. [in Japanese]
- Nakaya, K. & Stehmann, M. (1998) A new species of deepwater catshark, *Apristurus aphyodes* n. sp., from the eastern North Atlantic (Chondrichthyes: Elasmobranchii: Scyliorhinidae). *Archive of Fishery and Marine Research*, 46, 77–90.
- Sabaj Pérez, M.H. (Ed.) (2012) Standard symbolic codes for institutional resource collections in herpetology and ichthyology: an online reference. Version 3.0. American Society of Ichthyologists and Herpetologists, Washington, DC. Available from: <http://www.asih.org/> (23 February 2012)
- Schaaf-da Silva, J.A. & Ebert, D.A. (2008) A revision of the western North Pacific swellsharks, genus *Cephaloscyllium* Gill 1862 (Chondrichthyes: Carcharhiniformes: Scyliorhinidae), including descriptions of two new species. *Zootaxa*, 1872, 1–28.
- Shen, S.C. (1984) *Coastal Fishes of Taiwan*. National Taiwan University, Taipei, 190 pp., 152 pls. [in Chinese]
- Shen, S.C. & Wu, K.Y. (2012) *Fishes of Taiwan*. National Museum of Marine Biology & Aquarium, Pingtung, 896 pp. [in Chinese]
- Springer, S. (1979) A revision of the catsharks, family Scyliorhinidae. *NOAA Technical Report, Circular*, 422, 1–152.
- Taniuchi, T. (1988) Aspects of reproduction and food habits of the Japanese swellshark *Cephaloscyllium umbratile* from Choshi. *Japan Nippon Suisan Gakkaishi*, 54, 627–633.
<http://dx.doi.org/10.2331/suisan.54.627>
- Teng, H.T. (1962) *Classification and distribution of the Chondrichthyes of Taiwan*. Ogawa Press, Maizuru, Kyoto, 304 pp. [in Japanese]
- White, W.T. & Ebert, D.A. (2008) *Cephaloscyllium hiscosellum* sp. nov., a new swellshark (Carcharhiniformes: Scyliorhinidae) from northwestern Australia. In: Last, P.R., White, W.T. & Pogonoski, J.J. (Eds.), *Descriptions of new Australian chondrichthyans*. CSIRO Marine & Atmospheric Research Paper 022, pp. 171–178.
- Yamada, U., Tagawa, M., Kishida, S. & Honjo, K. (1986) *Fishes of the East China Sea and the Yellow Sea*. West Regional Fisheries Laboratory, Nagasaki, Japan, 501 pp. [in Japanese]
- Yano, K., Ahmad, A., Gambang, A.C., Hamid, I.A., Razak, S.A. & Zainal, A. (2005) *Sharks and rays of Malaysia and Brunei Darussalam*. Kuala Terengganu, SEAFDEC-MFRDMD, 530 pp.

Appendix

Original description of *Cephaloscyllium formosanum* Teng, 1962

[Translation by Kazuhiro Nakaya]

Cephaloscyllium formosanum was described by Teng (1962) in Japanese in a publication entitled "Classification and Distribution of the Chondrichthyes in Taiwan" (published from Ogawa Press, Maizuru, Japan, 304 pp.). Below is the translation of the original description of *Cephaloscyllium formosanum* n. sp. (pp. 48–51, fig. 11 in Teng, 1962). The original Figure 11 is reproduced as Figure 10 in the present paper.

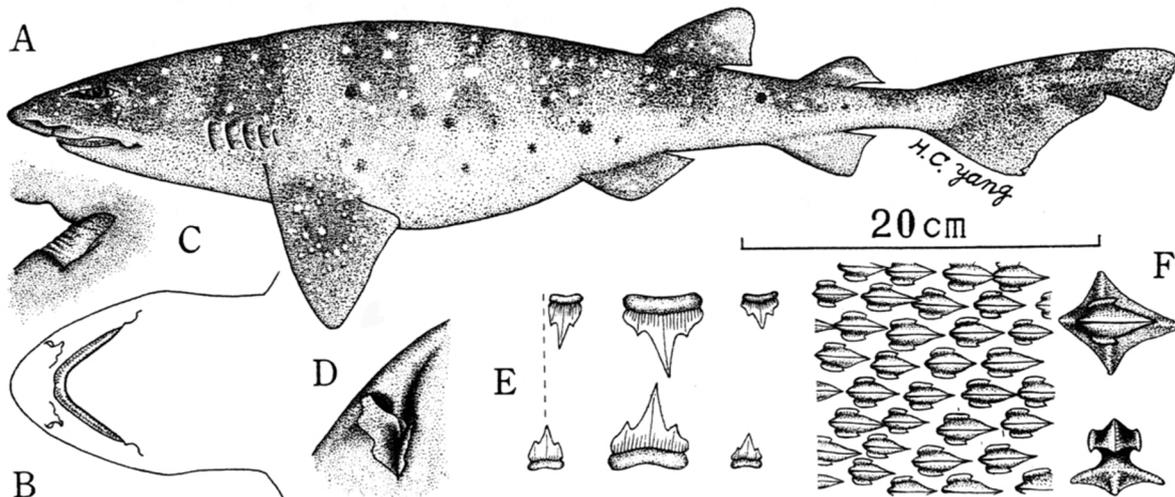


FIGURE 10. Original figure of *Cephaloscyllium formosanum* in Teng (1962). Figure legend in Teng's original paper is as follows. "Fig. 11. *Cephaloscyllium formosanum*, n. sp., holotype, female, 655 mm in total length, from off Tungkang, Pintung Pref., Formosa (Taiwan Fish. Res. Inst. No. 4339). A, lateral aspect; B, ventral aspect of head; C, mouth cleft of left side; D, nostril; E, median and lateral teeth of left side of both upper (1st, 16th and 31st) and lower (median, 10th and 32nd) jaws; F, dorsal and apical aspect (right), and arrangement (left) of dermal denticles."

"Type specimen: female, 655 mm in total length (Taiwan Fish. Res. Inst. No. 4339), off Tungkang [Dong-gang], southwest coast of Taiwan (Formosa), Lat. 22°25'N, Long. 120°25'E; about 200 fathoms; March 7, 1961.

Measurements: Measurements of the holotype.

Trunk at origin of pectoral: height 117.

Snout length in front of: eye 40; mouth 24.

Eye: horizontal diameter 21; distance between 53.

Mouth: breadth 68.

Nostrils: distance between inner ends 19.

Gill opening lengths: first 17; fourth 14; fifth 10.

First dorsal fin: length of base 43.

Second dorsal fin: length of base 30.

Anal fin: length of base 44.

Pelvic fin: length of base 50.

Distance from snout tip to: first dorsal 360; second dorsal 443; lower caudal 506; pectoral 146; pelvics 320; anal 425; fifth gill opening 150.

Interspace between: first and second dorsals 45; second dorsal and caudal 34; anal and lower caudal 37.

Description: Total length 4.37 times head length. Body length (snout tip to lower caudal origin) 4.32 times body height, 3.37 times head length. Head length 3 times snout length, 7.1 times eye length. Snout length 2.43 times eye length.

Body robust, wide, compressed; abdomen greatly swollen. Head large, wide; snout short and rounded. Nostril large; right and left nostrils greatly separated, closer to snout tip than to mouth corner. Anterior nasal valve wide; posterior margin separate into two lobes; outer angle projecting and separate from mouth, but reaching behind level of anterior margin of mouth. Posterior nasal valve small. Mouth considerably large; lower labial furrow rudimentary covered by labial valve of mouth corner on upper jaw. Spiracle small behind eye. Eye slender antero-posteriorly, closer to snout tip than to first gill slit; lower eye lid covered with upper eye lid when closed. Gill slits small, smaller backward;

last two slits above pectoral fin base. Dental formula $34+0+34/34+3+33=68/70$; teeth same in shape on both jaws; 3 cusped (rarely 5 cusped); central cusp largest; all teeth with many ridges on outside of base; no central teeth on upper jaw; 3 small teeth at lower jaw symphysis; 3 rows functional.

First dorsal fin much smaller than pectoral fin, a little larger than anal fin; base length slightly less than interdorsal space; origin above posterior 1/4 of pelvic fin base; outer corner rounded; inner corner pointed. Second dorsal fin much smaller than first dorsal fin; origin above anterior 1/3 of anal fin base; outer corner blunt; inner corner pointed reaching slightly behind anal fin tip. Caudal fin equal to head in length, shorter than 1/4 of total length; lower lobe developed; a subterminal notch present. Anal fin smaller than first dorsal fin, much larger than second dorsal fin; base 1.18 times caudal peduncle length; origin before second dorsal fin origin. Pelvic fin smaller than first dorsal fin; base slightly longer than interdorsal space, less than pelvic and anal fin space. Pectoral fin rather large; length 1.5 times width; posterior margin truncate.

Body grayish red brown, with about 10 dark brownish vertical bands on dorsal side of body; many white spots on body and some dark spots on abdomen and tail region; abdomen grayish white.

Dermal denticles small, pointed, with a large and long central cups; lateral cusps short; stalk short; basal plate rhomboid with four ridges.

Two egg cases present; shape rectangular, with long tendrils on four corners; anterior projections widely separate; posterior ends curving closer each other; surfaces of the egg cases smooth; lateral margins with remarkable wavy ridges on lateral margins at middle half, and anterior and posterior parts."