

ECOLOGICAL AND MORPHOLOGICAL STUDY ON FISH-FAUNA FROM THE WATERS AROUND TAIWAN AND ITS ADJACENT ISLANDS

2. Notes on some rare continental shelf fishes and description of two new species

SHIH-CHIEH SHEN AND WAI-HWA TING

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ABSTRACT

S. C. Shen and W. H. Ting (1972) *Ecological and Morphological Study on Fish-Fauna from the Waters Around Taiwan and its Adjacent Islands*. Bull. Inst. Zool., Academia Sinica 11(1): 13-31. Five rare species, *Deania aciculata* (Garman), *Etmopterus lucifer* Jordan and Snyder, *Ateleopus japonicus* Bleeker, *Gonorhynchus abbreviatus* Temminck & Schlegel, *Xiphasia setifer* Swainson, and two new species, *Dalatias tachiensis* n. sp., *Squatina formosa* n. sp. are described. *D. aciculata*, *E. lucifer*, *A. japonicus* and *S. formosa* distribute in north-eastern (Ta-chi) and south-western (Tung-kong) parts of Taiwan, *G. abbreviatus* distributes in Ta-chi and Peng-hu (Pescadore Islands), *D. tachiensis* and *X. setifer* are found in Ta-chi only. *A. purpureus* Tanaka and *A. tanabensis* are considered as synonyms of *A. japonicus*.

For the purpose of ecological and morphological study on fish-fauna from the waters around Taiwan and its adjacent Islands, the extensive and intensive collections of fishes have been made since 1968, we found five rare deep-water fishes and two new species caught from more than 100 meters deep, by single trawling net in north-eastern (Ta-chi), south-western (Tung-kong) continental shelf and Pescadore Islands. *Etmopterus lucifer* was first recorded in 1959 and described by Teng (1962) and Chen (1963), but all specimens were collected from south-western part only. In the present report, most of specimens were collected from north-eastern part and found that its teeth form of upper jaw, length of head, length of caudal fin vary with

the growth. *Ateleopus purpureus* was reported by Chen (1955, 1969) and collected from south-western part only; at present it is considered as a synonym of *A. japonicus* and also it distributes widely from north-eastern (Ta-chi) to south-western part (Tung-kong). *Deania aciculata* (Garman) was found in north-eastern and south-western parts too. *Gonorhynchus abbreviatus* Temminck & Schlegel was reported only from Pescadore Islands by Chen (1955, 1969), but at present, it shows that their distribution ranges from Ta-chi to Pescadore Islands. *Xiphasia setifer* Swainson is a new record to Taiwan and it distributes in north-eastern part (Ta-chi) only. *Dalatias tachiensis* n. sp. and *Squatina formosa* n. sp. are described as new species.

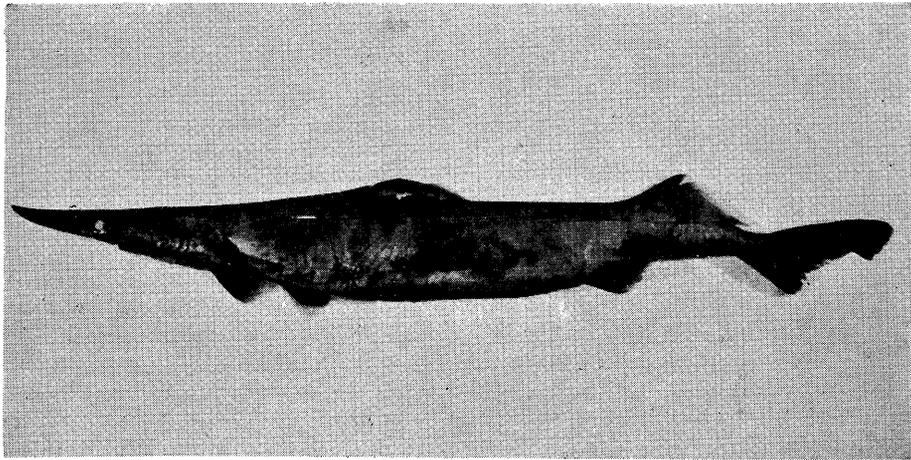
Deania aciculata (Garman)

Fig. 1, A-D.

Acanthidium aciculatum Garman, Bull. Mus. Comp. Zool., 46, p. 207, 1906; Mem. Mus. Comp. Zool., 36, p. 217, 1913. Fowler, Proc. 4th Pacific Sci. Congs. Java., p. 496, 1930.

Centrophorus calceus Regan, Ann. Mag. Nat. Hist. 8 (2), p. 51, 1908.

Deania aciculata Fowler, Bull. U. S. Nat. Mus. 100 (13), p. 239, 1940. Matsubara, Fish. Morph. Hier. 1, p. 124, 1955. Okada, Cat. Vert. Japan, p. 121, 1938; Okada & Matsubara, Key Fish. Fish-like anim. Jap., p. 18, 1938.



(A)

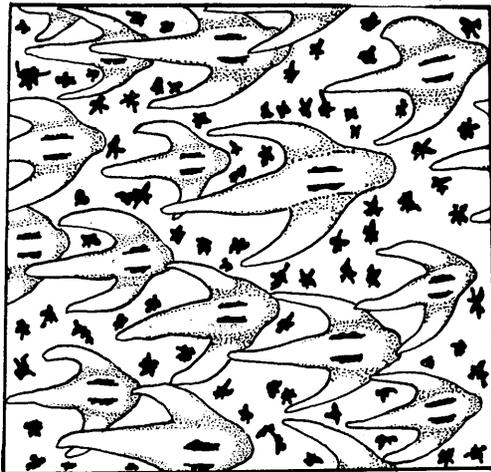
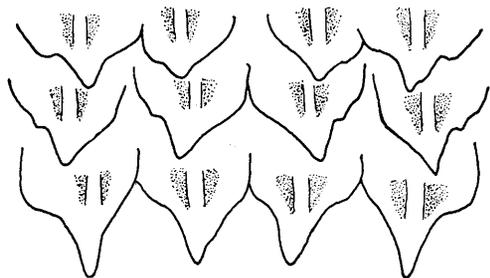
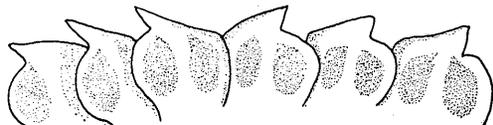
(B) $\times 100$ (C) $\times 12$ (D) $\times 12$

Fig. 1. A. *Deania aciculata* (Garman), 900 mm in TL.
 B. The form of scales under 1st dorsal fin.
 C. Teeth of the upper jaw (medial).
 D. Teeth of medial lower jaw.

DESCRIPTION: The following measurements are expressed in percentages of the total length and in parentheses, the number of times contained in total length. Total length is measured from tip of snout to postermost margin of upper caudal lobe. Head length 18.44 (5.42), as measured from tip of snout to first gill opening; body depth 10.02 (9.98), as measured at the first dorsal spine; distance from tip of snout to the pectoral insertion 22.11 (4.52), to first dorsal origin 28.33 (3.53), to second dorsal origin 28.33 (3.53), to second dorsal origin 68.89 (1.45), to upper caudal origin 83.39 (1.19), to lower caudal origin 80.00 (1.25), to pelvic insertion 64.44 (1.55); length of caudal fin 20.00 (5.00), as measured from lower caudal origin to postermost margin of upper caudal fin; length of upper caudal lobe 16.56 (6.04), length of lower caudal lobe 15.22 (6.57); distance from origin of first dorsal fin to origin of 2nd dorsal fin 39.78 (2.51), origin of 2nd dorsal fin to origin of upper caudal lobe 15.67 (6.38), insertion of pectoral fin to insertion of pelvic fin 42.89 (2.33), insertion of pelvic fin to origin of lower caudal lobe 16.80 (5.96).

The following measurements are expressed in percentages of head length and in parentheses, the number of times contained in head length. Head length is measured from tip of snout to first gill opening. Snout 28.92 (3.46), as measured from tip of snout to anterior margin of eye; distance from tip of snout to anterior margin of outer nostril 28.92 (3.46), to spiracle 80.72 (1.24); distance between inner corners of spiracles 18.07 (5.53); interorbital 28.07 (3.56); length of upper labial furrow 20.96 (4.77); length of first gill-opening 5.78 (17.29), of 2nd 6.51 (15.37), of 3rd 7.23 (13.83), of 4th 7.59 (13.17), of 5th 8.19 (12.21); horizontal diameter of eye 22.89 (4.37), its vertical 9.64 (10.25); distance between spiracles 24.70 (4.05), its horizontal diameter 5.54 (18.04); length of base of 1st dorsal fin 117.5 (0.85), its posterior margin 22.22 (4.51), its height 16.02 (6.24), length of spine 18.43 (5.42); length of base of 2nd dorsal fin 64.10 (1.56), of posterior margin 26.45 (3.92), of height

14.82 (6.75), of spine 19.28 (5.19); length of base of pectoral fin 27.23 (3.67), of anterior margin 38.31 (2.61), of distal margin 27.71 (3.61); length of base of pelvic fin 28.67 (3.49), of anterior margin 26.14 (3.82), of distal margin 26.14 (3.82).

Body elongate, little compressed. Head depressed. Snout produced, longer than the rest of head, blunt. Eyes large, without nictitating membranes. Mouth transverse, behind middle of head, moderately arched, with deep groove more than half of which anterior and labial folds at each angle; lower labial fold more than half length of jaw, upper shorter and hidden by groove; teeth 32 rows above 30 rows below, upper with sharp erect triangular cusps rising from middle of cutting edges, broadening at bases; below group of sharp pointed teeth near symphysis, become slightly oblique toward mouth corners and cusp base much broader than central portion; nostrils small, midway in snout, front valve with short pointed lobe crossing nostril; gill-openings narrow, subequal; spiracle large, valve with laminae-like gills.

First dorsal spine midway between front spiracle edge and ventral origin; second dorsal originate just above the posterior margin of ventral base; caudal equals distance from tip of snout to second gill opening.

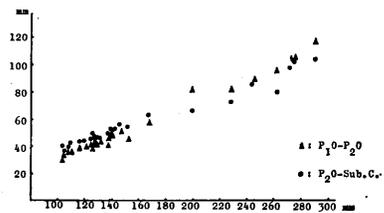
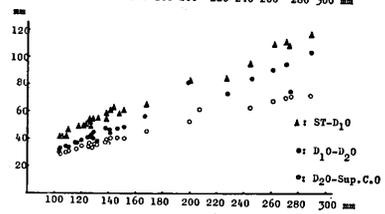
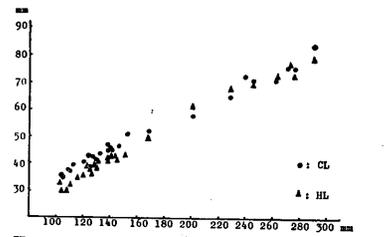
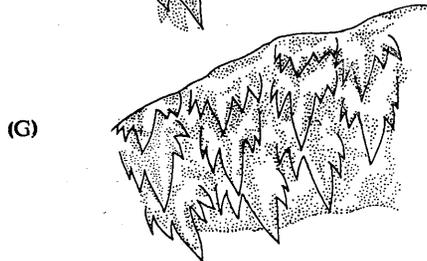
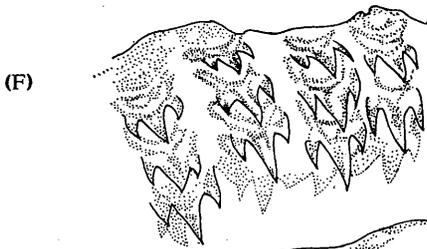
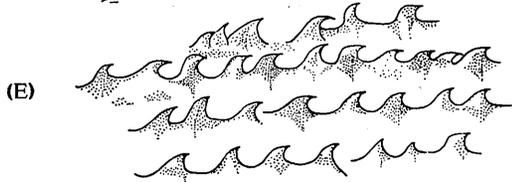
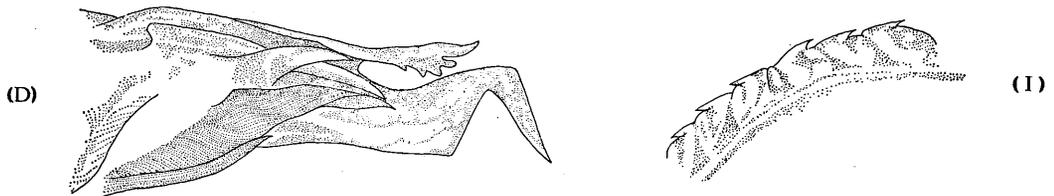
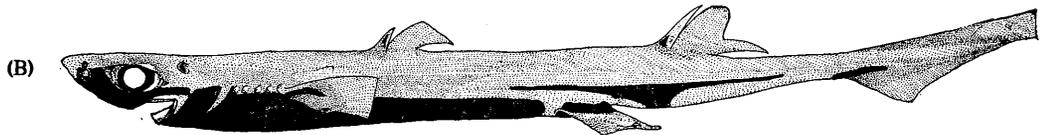
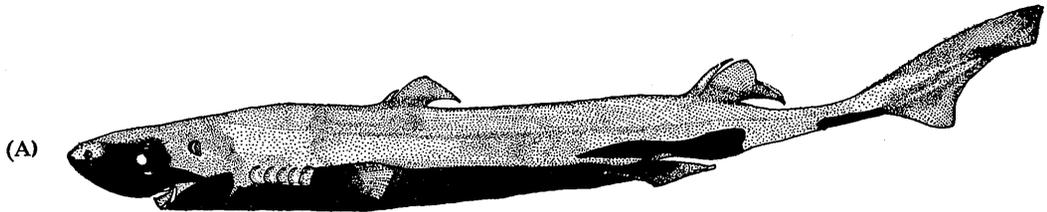
Scales very small, slender, each with 3 sharp slender cusps.

Color in formalin gray, most of fins a little dark. Length 900 mm collected from Tung-kong.

Etmopterus lucifer Jordan and Snyder

Figures 2. A-J. Table 1.

Etmopterus lucifer Jordan & Snyder, Proc. U. S. Nat. Mus. 25, p. 79, 1902; Annot. Zool. Jap. 3 (2 & 3), p. 129, 1901; Jordan & Fowler, Proc. U. S. Nat. Mus. 26, p. 634, 1903; Tanaka, Fish. Jap. 8, p. 133, 1912; Fowler, Bull. U. S. Nat. Mus., 100 (13), p. 246, 1941; Jordan, Tanaka & Snyder, Jour. Coll. Sci. Imp. Univ. Tokyo, 33 (1), p. 20, 1913; Okada, Cat. Vert. Jap., p. 121, 1938; Matsubara, Fish. Morph. Hierar., p. 136, 1955; Okada



Length from tip of snout to subcaudal origin

- Fig. 2. A-B. Both male 258 mm and 297 mm in total length of *Etmopterus lucifer* showing their different color pattern of dark band extends from ventral surface to lateral.
- C-D. Osteological structure and external feature of clasper of the above B.
- E. Showing the arrangements and structure of the scales under the first dorsal fin.
- F-H. Showing the cusps of teeth of the upper jaw.
- I. Teeth of lower jaw.
- J. The correlations between CL, HL, St-D₁O, D₁O-D₂O, D₂O-Sup. C. O, P₁O-P₂O and P₂O-Sub. C. O and length from tip of snout to subcaudal origin of *Etmopterus lucifer*.
- CL: As measured from subcaudal origin to posteromost margin of upper caudal lobe.
- HL: From tip of snout to 5th gill opening.
- ST-D₁O: Tip of snout to 1st dorsal origin.
- D₁O-D₂O: Origin of 1st Dorsal fin to origin of 2nd dorsal origin.
- D₂O-Sup. C. O: 2nd dorsal origin to origin of upper caudal origin.
- P₁O-P₂O: Origin of pectoral fin to origin of pelvic fin.
- P₂O-Sub. C. O: Origin of pelvic fin to origin of lower caudal lobe.

& Matsubara, Key Fish & Fish-like Anim. Jap., p. 18, 1938; Teng, Lab. Fish. Biol. Rept. 5, p. 73, 1959; Teng, Class. Dist. Chondrich. Taiwan, p. 162, 1962; Chen. Ichth. Ser. 1, Tong-hai Univ. p. 84, 1963; Herre, Res. Rept. 20, Fish. Wild. Serv. p. 30, 1953; Smith, Sea Fish. South Africa. p. 1965; Chen, Synop. Vert. Taiwan 1, p. 65, 1969; Chu, Nan-hai Yu Ray Tsu, p. 44, 1962; Tomiyama, Abe & Tokioka, Encyc. Zool. Illus. Color Jap. p. 298, 1965.

Spinax lucifer, Regan, Ann. Mag. Nat. Hist. 8 (2), p. 45, 1908; Weber, Siboga-Exped. 57, Fish. p. 597, 1913.

DESCRIPTION: The following measurements are expressed in percentages of the total length and in parentheses, the number of times contained in total length. Total length is measured from tip of snout to origin of subcaudal fin. Head length 21.88-25.19 (3.97-4.57), as measured from tip of snout to first gill opening; body depth 9.55-13.60 (7.30-10.60), as measured at the origin of pectoral fin; distance from tip of snout to origin of first dorsal fin (ST-D₁O) 38.40-42.24 (2.43-3.57); distance between the origin of 1st dorsal fin to the origin of second dorsal fin (D₁O-D₂O) 28.83-39.96 (2.52-3.56), between the origin of 2nd dorsal fin to origin of upper caudal lobe (D₂O-Up. C. O) 25.91-29.01 (3.41-3.82), between the insertion of pectoral fin

and the insertion of pelvic fin (P₁O-P₂O) 28.31-40.78 (2.81-3.12), between the insertion of pelvic fin and the origin of subcaudal fin (P₂O-Sub. C. O) 32.91-38.12 (2.61-3.00); length of caudal fin 28.33-34.41 (2.89-3.81), as measured from the origin of upper caudal fin to its posteromost margin.

The following measurements are expressed in percentages of head length and in parentheses, the number of times contained in head length. Head length is measured from tip of snout to first gill-opening. Snout 31.42-42.81 (2.31-3.22), as measured from tip of snout to anterior margin of eye; to anterior margin of outer nostril 5.01-7.52 (1.31-1.90); to anterior margin of spiracle 70.70-72.11 (1.42-1.64); to medial anterior margin of mouth 48.54-75.61 (1.31-2.11). Width of mouth 40.11-48.81 (2.11-2.50); length of upper labial furrow 18.75-28.81 (3.54-5.31); length of 1st gill-opening 4.51-9.83 (10.22-22.33), of 2nd gill-opening 4.53-9.24 (10.89-22.31), of 3rd gill-opening 4.54-8.91 (11.21-22.34), of 4th gill-opening 4.54-8.91 (11.21-22.34), of 5th gill-opening 6.53-10.61 (9.41-15.32); horizontal diameter of eye 31.92-41.33 (2.32-3.11), vertical 14.91-25.73 (3.91-6.73); length of 1st dorsal base 21.11-25.22 (4.00-4.82), of 2nd dorsal base 30.71-38.73 (2.61-3.33); length of pectoral base 24.11-32.22-4.21, of its anterior margin 41.21-58.90 (1.71-2.40); length of pelvic base 24.44-51.11

Table 1. Frequency distributions of number of dental cusps of *E. lucifer*

Body Length (mm)	Sex	Number of Dental Cusps							Total
		3-cuspid	3 & 5 cuspid mixed	5-cuspid	5 & 7 cuspid mixed	7-cuspid	7 & 9 cuspid mixed	9-cuspid	
101-150	M	4	—	—	—	—	—	—	4
	F	10	1	—	—	—	—	—	11
151-200	M	9	2	—	—	—	—	—	11
	F	20	5	—	—	—	—	—	25
201-250	M	3	1	3	1	—	—	—	8
	F	7	1	1	—	—	—	—	9
251-300	M	—	—	—	1	5	3	1	10
	F	—	1	1	—	—	—	—	2
301-350	M	—	—	—	1	2	—	—	3
	F	—	1	7	1	—	—	—	9
351-400	M	—	—	—	—	—	—	—	—
	F	—	—	1	1	—	—	—	2
Total	M	16	3	3	3	7	3	1	36
	F	37	9	10	2	—	—	—	58

(2.00-4.11), of its anterior margin 26.73-33.62 (3.00-3.71); length of upper caudal lobe 108.91-135.52 (0.71-0.92), of subcaudal lobe 44.71-62.52 (1.62-2.64).

Body moderately elongate, not compressed, longer than tail. Snout produced, blunt, wide. Eyes large, lateral, shielded by pigment, without nictitating membranes. Mouth transverse, moderately arched, long deep groove at each mouth angles. Teeth dissimilar in 2 jaws, upper erect, 28-30 rows, varying from tricuspid to 9-cuspid by size, or mixed with 3-5 cuspid, 5-7 cuspid, 7-9 cuspid (Fig. 2 F-H, Table 1), with median lanceolate cusp, 1-4 graduated inner cusps on each side of the median one; lower with 30-32 rows, cutting edge nearly horizontal, cusp low as compressed terminal denticle to each tooth directed outward (Fig. 2-I); nostrils anterior, sub-lateral and inferior, frontal valve small triangular pointed. Gill-openings about equal in width with spiracles superior and behind the level of the upper part of eye.

Scales are small denticles, pointed and bent backward terminally, arranged in longitudinal close-set rows on body (Fig. 2-E) and in oblique

rows (dorsoventrally) above lateral line on tail.

First dorsal origin about mid way between tip of snout and origin of second dorsal fin. Second dorsal origin above posterior end of ventral base or behind it. Ventral origin mid way between origin of pectoral and origin of subcaudal, or a little near to subcaudal origin. Each clasper bears 4 rather large, slender, terminal antrorse spine and extends beyond ventrals (Fig. 2-C & D).

Color in formalin brownish gray, under surface dark brown; a whitish longitudinal band on lower part of body, which broadens posteriorly and is divided into two by a dark brown band coming from the under surface (Fig. 2-A & B).

Dalatias tachiensis n. sp.

Fig. 3 A-F.

HOLOTYPE.—NTU7234001, a male, 480 mm TL, 3000 meters out off coast of Ta-chi (24°56.5'N, 121°53.0'E), north-eastern of Taiwan, caught by single trawling net from 100-120 fathoms depth.

DESCRIPTION: The following measurements are expressed in percentages of the total

length and in parentheses, the number of times contained in total length. Head length 21.42 (4.67), is measured from tip of snout to fifth gill-opening; to first gill-opening 16.58 (6.03); to third gill-opening 19.42 (5.15); to the origin of first dorsal fin 35.17 (2.84); to the origin of second dorsal fin 61.08 (1.64); to the origin of upper caudal lobe 80.92 (1.24); to the origin of lower caudal lobe 71.17 (1.41); to the insertion of pectoral fin 21.75 (5.60); to the insertion of pelvic fin 51.29 (1.95). Distance between the origin of first and second dorsal fins 25.92 (3.86), between the origin of second dorsal and upper caudal lobe 17.13 (5.84), between the insertion of pectoral and pelvic fins 29.54 (3.39), between the insertion of pelvic and the origin of lower caudal fin 19.88 (5.03). Great depth 11.46 (8.74), as measured at the origin of pectoral fin. Length of base of first dorsal fin 4.21 (23.76) and its vertical height 3.54 (28.24). Length of base of second dorsal fin 5.46 (18.32) and its vertical height 4.42 (22.64). Length of base of pectoral fin 4.38 (22.86), and its length of anterior margin 9.29 (10.76), distal margin 5.92 (16.90), and inner margin 5.67 (17.65). Length of base of pelvic fin 6.83 (14.63), its length of anterior margin 6.67 (15.00), distal margin 6.38 (15.69). Length of caudal fin 25.71 (3.89), its upper lobe 22.79 (4.39), lower lobe 20.92 (4.78).

The following measurements are expressed in percentages of the head length and in parentheses, the number of times contained in head length. Snout 15.95 (6.27), as measured from tip of snout to anterior margin of eye; horizontal diameter of eye 21.01 (4.76), vertical 9.37 (10.28); interorbital 30.35 (3.29); length of spiracle 8.75 (11.42), interspiracle 21.79 (4.59); width of mouth 37.55 (2.66); upper labial furrow 13.13 (7.61), lower 8.37 (11.95), both measured from corner of mouth; length of first gill-opening 9.14 (10.94), second as long as first, third 9.53 (10.49), fourth 11.09 (9.02), fifth 12.06 (8.29).

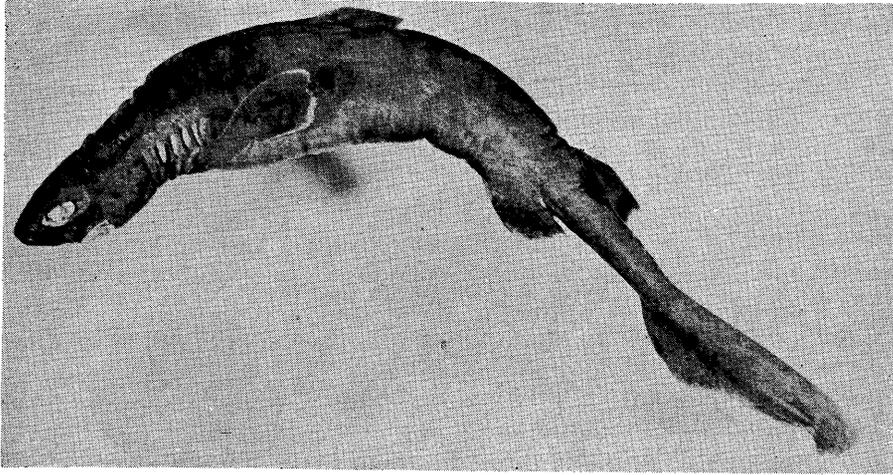
Body fusiform, moderately elongate, snout short, subconic end obtusely rounded. Height at origin of pectoral fin as greatest depth about 1/7 (14.16) its length to origin of upper caudal lobe.

Tail sector 2.62 times of its body sector to cloaca. Caudal peduncle without lateral ridges or pre-caudal pits. Dermal denticles, over trunk as a whole, small, loose-spaced, nail-like scale, their blades close to the skin, thick anteriorly, needle-like medial posteriorly, with 3 weak ridges, medial short uniting at base of the needle, lateral two long uniting at the needle point; pedicels thicker and shorter. Denticles on lower side of snout or behind mouth, small, loose-space-triangular, scale-like, usually with 3 weakly marked longitudinal ridges.

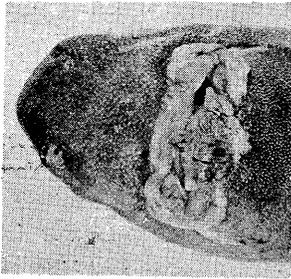
Head about equal of length of caudal fin, slightly convex above. Snout thick, broadly rounded or slightly ovate anteriorly, very short. Eye oblong, its horizontal diameter $\frac{1}{2}$ as long as snout in front of mouth. Spiracle on latero-dorsal side of head a little above level of eye, transverse about equal to vertical diameter of eye. Gill-openings small, first and second the smallest and fourth and fifth the longest, the longest a little longer than vertical diameter of eye, the fifth close in front of pectoral. Nostril close to anterior margin of snout, oblique, its anterior margin with a low, triangular lobe, rounded at the tip. Mouth only very slightly arched, its breadth a little greater than length of snout in front of mouth. Lips noticeably thick and fleshy, but without special cartilaginous supports near corner of mouth, the lower lip free, with numerous shallow groove on thick fleshy lip. Upper labial fold extending about more than $\frac{1}{3}$ of distance toward symphysis, but lower less than $\frac{1}{2}$ that far.

Teeth $\frac{9-9}{9-9}$, apparently unlike in the two jaws, upper teeth arranged in 3 series, the outer most smallest, thorn-like, on broad bases, curved rearward; lower teeth in one series blade-like, with quadrate bases and broad triangular cusps, the later with regularly serrate edges, the median teeth the largest, oblique and decreasing in size toward corners.

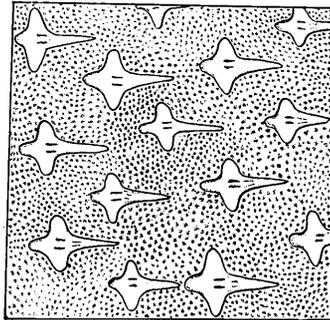
First dorsal about 1/5 as long at base as head, brush-shaped with broadly rounded apex, its posterior margin straight and nearly perpen-



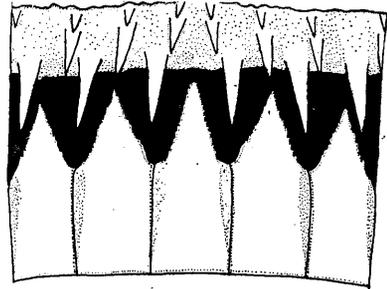
(A)



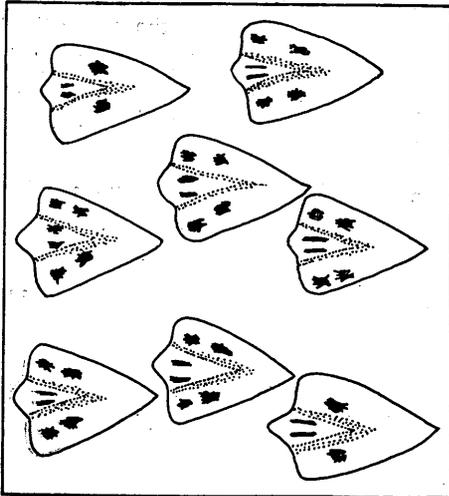
(B)



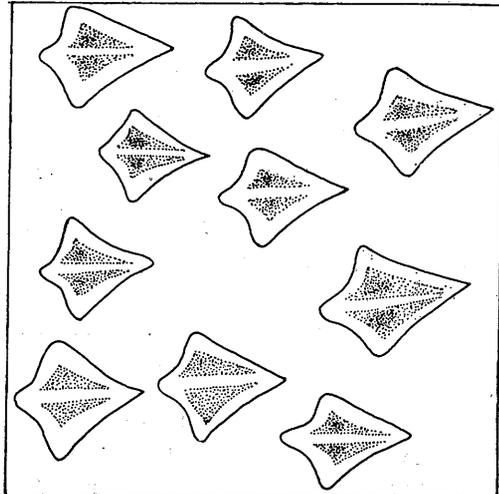
(C)



(D)



(E)



(F)

- Fig. 3. A. Holotype 480 mm TL, female, of *Dalatias tachiensis* n. sp.
 B. Showing the thick lip of lower jaw.
 C. Showing the structure and arrangements of scales under first dorsal fin.
 D. Showing the structure and arrangements of teeth in both jaws.
 E. Showing the forms and arrangements of scales of the ventral surface before mouth.
 F. Showing the forms and arrangements of scales of the ventral surface behind mouth.

dicular, its free lower margin a little longer than its base, its origin just behind the tips of pectorals. Second dorsal a little larger than 1st, its origin about over last 1/3 of bases of pelvics, its distal margin about equal to its base, concave and rear corner acute, its free lower margin a little shorter than its base. Caudal with upper and subterminally rounded apex, its lower margin deeply incised, its upper posterior margin convex. Pelvics about $1\frac{1}{4}$ times as long at base as second dorsal, with nearly straight anterior margin, broadly rounded apices and tapering deeply incised, its upper posterior margin rear corners. Pectorals 2.31 in head, with broadly rounded tip and convex anterior and distal margins.

Color in fresh black, after preservation dark above and gray below. Fins with whitish margins except caudal.

DIAGNOSIS: The present species is quite closely related to *Dalatias licha* (Bonnaterre), but it is different from that in having more thick, muscular, lower lip; more loose-spaced slender dermal denticles on body, loose-spaced, triangular dermal scale on lower surface before mouth, and roughly quadrate dermal scale on ventral surface of lower jaw; and different teeth form of lower jaw and teeth decreasing in size towards anteriorly on upper jaw.

Squatina formosa n. sp.

Fig. 4 A-D.

HOLOTYPE:—NTT7213130, a female, 337 mm Tung-kong (20°28.0'N, 120°26.3'E), south-western part of Taiwan, caught by single trawling net from depth 100 fathoms, 31 January, 1972.

PARATYPE:—NTU7222433, a female, 377 mm TL; NTU7041631, a female, 377 mm TL; NTU7041632, a female, 457 mm TL; 3000

meters out off coast of Ta-chi (24°56.5'N, 121°53.0'E), north-eastern of Taiwan, caught by single trawling net from 100-120 fathoms depth.

DESCRIPTION: The following measurements are expressed in percentages of the total length and in parentheses, the number of times contained in total length. The first value refers to the holotype and is followed in sequence the average and range of three paratypes. Head length 18.28 (5.47), 17.83 (17.51-18.14), is measured from tip of snout to fifth gill-opening; to first gill-opening 16.20 (6.17), 15.49 (14.97-16.02); to third gill-opening 17.09 (5.80), 16.63 (16.41-16.85); to the insertion of pectoral fin 20.77 (4.81), 21.75 (21.22-22.28); to the origin of first dorsal fin 60.24 (1.66), 59.25 (58.67-59.82); to the origin of second dorsal fin 71.45 (1.40), 70.59 (69.92-71.25); to the origin of upper caudal lobe 84.55 (1.18), 83.04 (81.96-84.11); to the origin of lower caudal lobe 82.20 (1.22), 81.30 (79.90-82.70); to the insertion of pelvic fin 39.41 (2.54), 40.22 (38.30-42.14). Greatest width of head 25.22 (3.96), 25.47 (24.35-26.59), as measured at the posterior of the spiracle. Height of head 9.50 (10.53), 8.09 (7.27-8.90), as measured at the same region of its width. Body width 10.98 (9.11), 10.41 (9.27-11.10), its height 31.87 (3.14), 33.71 (31.30-36.11), both as measured at the origin of pectoral fin. Distance between the origin of first dorsal fin and second dorsal fin 11.34 (8.82), 11.41 (10.56-12.25); between second dorsal fin and the origin of upper caudal lobe 13.12 (7.62), 12.61 (12.04-13.18); between the insertion of pectoral fin and pelvic fin 19.17 (5.22), 19.27 (18.30-20.24); between the insertion of pelvic fin and the origin of the lower caudal lobe 45.99 (2.17), 44.30 (42.84-45.76). Length of base 4.69

(21.33), 4.19 (3.98-4.40), and vertical height of first dorsal fin 4.99 (20.06), 5.20 (4.88-5.52). Length of base 4.15 (24.07), 3.87 (3.80-3.94), and vertical height of second dorsal fin 4.33 (23.08), 4.54 (4.08-4.99). Greatest width of pectoral fin 41.54 (2.41), 42.42 (40.32-44.51), length of base 9.48 (10.66), 9.77 (9.15-10.39), length of inner margin 9.85 (10.15), 10.55 (9.81-11.29), length of outer margin 23.74 (4.21), 25.02 (24.30-25.73), length of distal margin 13.18 (7.59), 13.26 (11.94-14.57). Greatest width of pelvic fin 28.43 (3.52), 29.07 (26.63-31.51), length of base 13.06 (7.66), 13.47 (12.82-14.12), length of outer margin 10.39 (9.63), 10.56 (10.24-10.88), length of distal margin 15.67 (6.38), 14.86 (14.16-15.56). Length of caudal fin as equal to its lower lobe 16.02 (6.24), 15.32 (14.91-15.73), of upper caudal lobe 13.38 (7.47), 13.63 (13.21-14.05).

The following measurements are expressed percentage of head length and in parentheses, the number of times contained in head length. The first value refers to the holotype and is followed in sequence the average and range of three paratypes. Tip of snout to anterior margin of eye 21.75 (4.60), 22.35 (19.01-25.69); to anterior margin of spiracle 42.53 (2.35), 46.87 (43.86-49.88). Horizontal diameter of eye 15.26 (6.55), 14.86 (14.46-15.25) and vertical of it 8.12 (12.32), 9.09 (8.19-9.98). Interorbital 44.81 (2.23), 47.87 (45.91-49.83). Length of spiracle 14.94 (6.70), 13.12 (11.99-14.24), interspiracle 37.99 (2.63), 44.52 (41.23-47.80). Distance between eyes and spiracles 8.12 (12.32), 11.50 (10.53-12.47). Width of mouth 69.16 (1.45), 73.91 (70.76-77.06). Length of gill-openings, first 47.73 (2.10), 42.80 (37.13-48.47), second 45.45 (2.20), 42.35 (36.55-48.14), third 43.83 (2.28), 42.33 (36.84-47.80), fourth 43.83 (2.28), 43.18 (38.89-47.46), fifth 43.18 (2.32), 42.83 (38.81-46.78). Height of caudal peduncle 11.69 (8.56), 12.14 (11.40-12.88), and width of it 19.48 (5.13), 17.73 (15.79-19.66).

Body skate-like, much flattened dorsoventrally and expanded laterally anterior to cloaca, but tapering thence rearward. Head broadly rounded, with wing-like lateral expansions; snout very

broad and short; eye dorsal, without nictitating membranes, horizontal diameter a little longer than spiracle; interorbital a little concave with dermal denticles, a little wider than interspiracle; nostrils terminal, entirely separate from mouth by deep furrow, their inner anterior margin with two barbels, the outer barbel triangular with broad base, slightly fringed edge and tapering toward tip, the inner barbel narrow membrane, broader basally, rolling inward, rod-like, tapering tip and rising from the base of the outer without an intervening lobe; their outer anterior margin of nostril expanded as a slight fringed edge, subtriangular membrane, rolling ventrally, the posterior margin of nostril smooth. Fold at front of head only slightly expanded in obtusely rounded contours out side and behind corners of mouth. Distance from eye to nostril a little longer than from eye to spiracle. Mouth terminal, broad, slightly arched, with lower labial furrow extending toward center of the mouth, but no upper furrow.

Teeth $\frac{10-12-10-12}{9-9}$, examined by using

X-ray photograph, in three rows, with erect, conical cusp on broadly expanded base, the outermost teeth slightly the smallest, a broad gap at symphysis in each jaw.

Dermal denticles on dorsal surface loosely spaced but generally distributed, conical, the spinous portion weakly recurved, mostly with 4 longitudinal ridges; bases broad; larger denticles in clusters of 6 or 7 beside inner anterior and of 12 or 13 beside inner posterior of eye, with two or three rows extending from near inner side of nostril towards eye; specimens with 3 rows of more large denticles along mid-line of back from opposite anterior ends of bases of ventrals to origin of first dorsal and many rows of larger denticles along mid-dorsal from that bases of ventrals to the opposite anterior ends of bases of pectorals; denticles on body of back, pectoral and pelvic fins smaller and weak, but larger along anterior and outer margins of paired fins and all of unpaired fins; denticles on lower surface with flat ovoid blades on very short

pedicels, close-spaced on outer parts of paired fins and on lower surface of tail, but abdomen and inner parts of paired fins naked.

Dorsals similar in form, brush-shaped, with

broadly rounded apex. First dorsal about $\frac{1}{4}$ as long at base as head, its vertical height a little greater than length of base, its origin above $\frac{1}{10}$ posterior end of pelvic fins. Interspace between

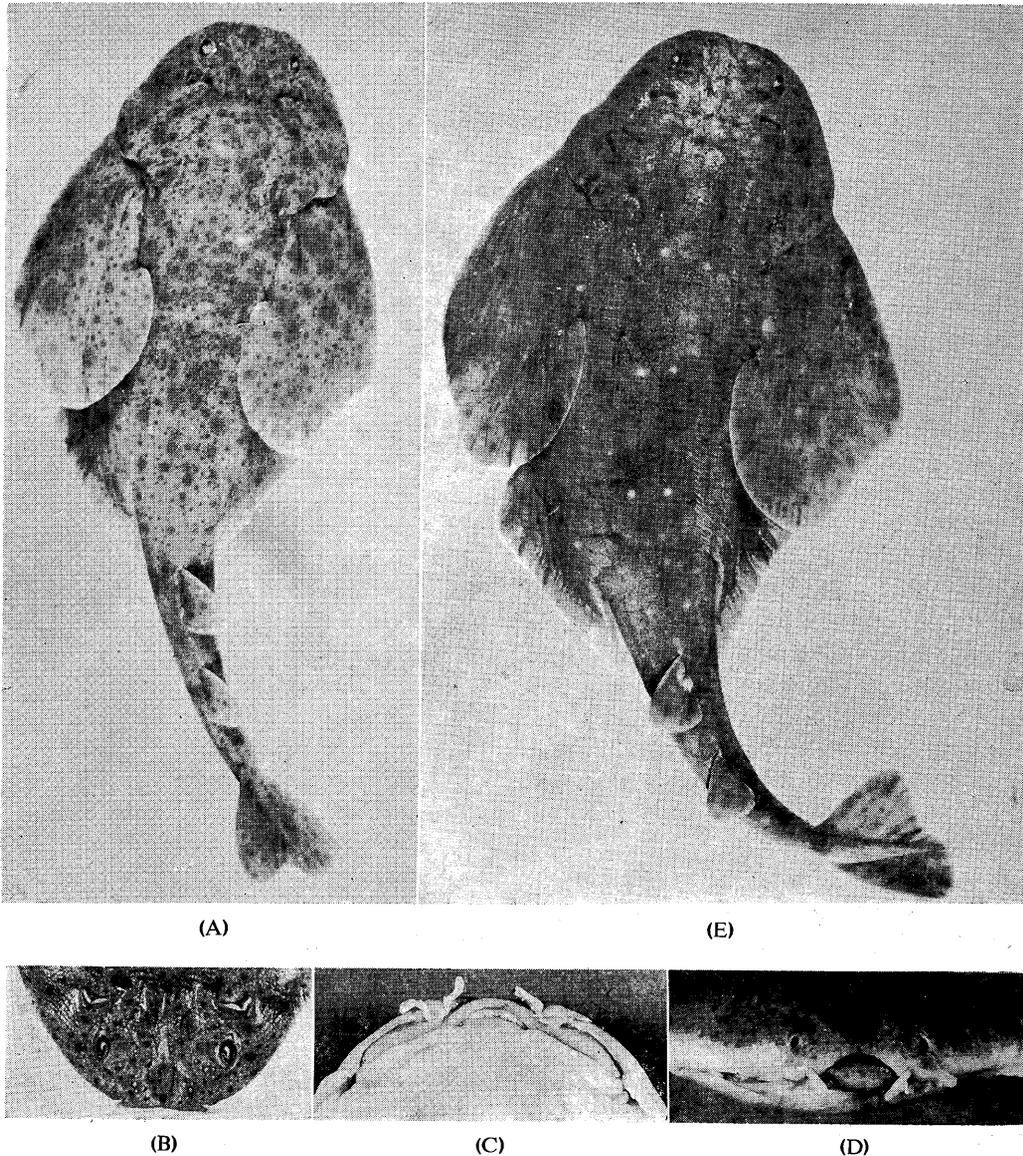


Fig. 4. A-C. *Squatina formosa* n. sp. Holotype 337 mm TL.
 D-E. Paratype, a female, 337 mm TL, NTU7041631, showing the more clear white spots paired on mid-dorsal than the holotype.

first and second dorsals about two times as horizontal diameter of eye. Second dorsal a little smaller than first. Interspace between second dorsal and caudal about $1\frac{1}{2}$ times as between first and second second dorsals. Caudal as long as length from tip of snout to first gill-opening, its upper margin only about $\frac{3}{4}$ as long as its lower margin, both its corners rounded but the lower more broadly, the posterior margin moderately concave with a shallow obscure notch above the termination of caudal axis. Pelvics smaller than pectorals, the anterior margins weakly convex, distal margins nearly straight, their outer corners broadly rounded, their posterior corners tapering with blunt tip. Transition from distal margin to inner margin of pectoral smoothly by a rounded corner, its rounded outer corner approximately in 120° angle, its outer margin slightly arched, distal margin slightly concave, inner anterior margin moderately rounded and definitely notched at axil; anterior margin slightly concave and expanded anteriorly tapering with blunt tip.

COLOR: Fresh specimens are yellowish-gray with dark-brown spots and blotches on dorsal surface including both sides unpaired fins, a large dark brown semi-triangular spot on each side of tail just below first dorsal fin; a narrow vertical band (dark brown) on each side of tail just below second dorsal fin; four pairs small, round, white spots appear on mid-dorsal between posterior of head and first dorsal fin in preserved specimens.

DIAGNOSIS: The present species is closely related to *S. nebulosa* Regan and *S. japonica* Bleeker, but it is quite different from these two species, in their color pattern, in having fold at front of head with only one slightly expanded in obtusely rounded contours out side and behind corners of mouth, distal margin of pectoral fin slightly concave and distance from eye to spiracle shorter than horizontal diameter of eye.

Ateleopus japonicus Bleeker

Figure 5. A-B. Table 2.

Ateleopus japonicus, Bleeker, 1854, p. 19; Gün-

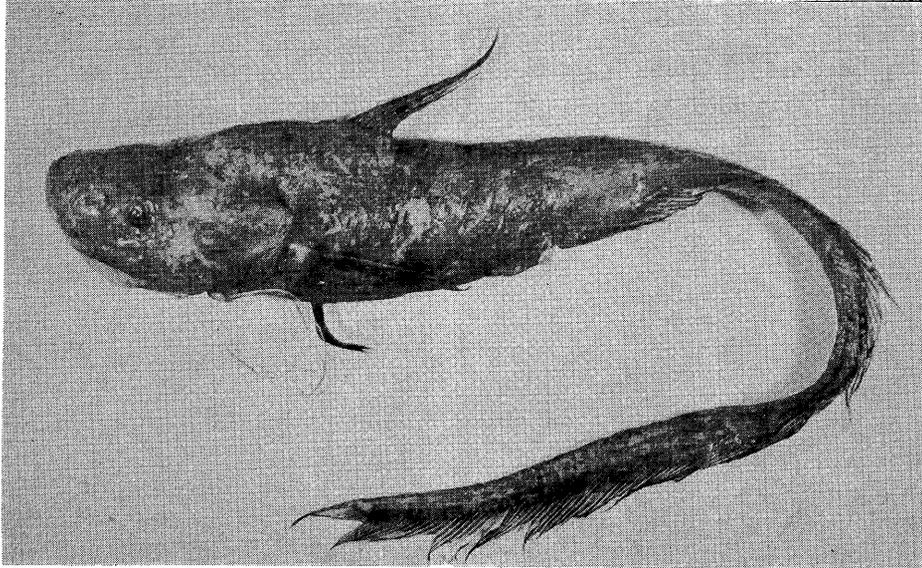
ther, 1887, p. 159; Goode & Bean, 1895, p. 348; Jordan, Tanaka & Snyder, 1913, p. 57; Sauter, 1905, p. 234; Smith, 1949, p. 116; Jordan & Snyder, 1901, p. 115; Matsubara, 1955, p. 273; Matsubara, 1965, p. 275; Lindberg & Legeza, 1965, p. 151; Okada, 1938, p. 137; Okada & Matsubara, 1938, p. 62.

Ateleopus purpureus Tanaka 1915, p. 565; Matsubara, 1955, p. 273; Chen, 1955, p. 153; Chu, 1962, p. 156; Chu, 1963, p. 138; Okada, 1938, p. 137; Chen, 1969, p. 153; Okada & Matsubara, 1938, p. 62.

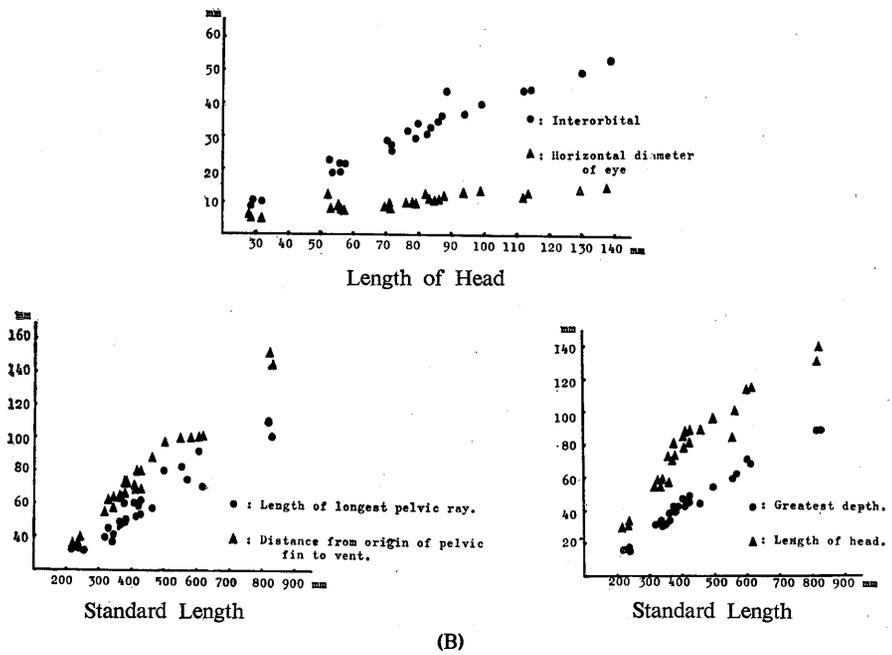
Ateleopus tanabensis Tanaka, 1918, p. 223; Matsubara, 1955, p. 273; Okada, 1938, p. 137; Okada & Matsubara, 1938, p. 62.

DESCRIPTION: Dorsal fin rays 9-10; anal fin rays 100-122; pectoral fin rays 13; pelvic fin rays 6 (first and 4th-6th are not visible externally); segmented caudal fin rays 5-7; lateral line scales 46 (loose-spaced, embedded in the skin not visible externally); gill-rakers 8-10 (lower limb of the first gill arch); vertebrae 29-31 + 100-101 = 129-132; branchiostegal rays 7-8.

The following measurements are expressed in percentages of the standard length and in parentheses, the number of times contained in standard length. Head length, from tip of snout to postermost margin of opercle, 11.9-20.8 (4.8-8.4). Body depth, taken at origin of the dorsal fin, 5.8-11.5 (8.7-17.3); height of head, taken at origin of the pelvic fin, 4.9-11.4 (8.1-20.0); distance from tip of snout to origin of dorsal fin 14.2-21.8 (4.6-7.1), to origin of anal fin 26.6-37.4 (2.8-3.8), to origin of pectoral fin 23.8-36.7 (2.7-4.2), to insertion of pelvic fin 8.8-5.7 (6.4-11.3), to posterior end of pelvic fin 21.5-30.0 (3.3-4.6); longest dorsal ray 10.5-16.7 (6.0-9.5); longest anal ray 4.7-7.0 (14.3-21.2); longest pelvic ray 9.8-15.6 (6.4-10.2); length of dorsal base 3.2-4.8 (22.3-31.3); length of anal fin base 64.3-73.4 (1.4-1.6); longest pectoral fin ray 9.7-15.2 (6.6-9.5).



(A)



(B)

Fig. 5. A. *Ateleopus japonicus* Bleeker, 756.5 mm TL.
 B. The correlations between interorbital, horizontal diameter of eye and Length of head; and length of longest pelvic ray, distance from origin of pelvic fin to vent, greatest depth, length of head and standard length of *Ateleopus japonicus*.

Table 2. Morphometric Measurements of *Ateleopus japonicus* Bleeker

Characters	Range		Mean		No. of Individ.
	Prop.	Per.	Prop.	Per.	
Total length	233-860 mm		459.4		25
Standard length	220-830.5 mm		435.9		25
Dorsal fin	9-10		9.2		25
Anal fin	100-122		111		25
Caudal fin	5-7		5.4		25
Pectoral fin	13		13		25
Ventral fin	6		6		25
Branchiostegal ray	7-9		7.2		25
In standard length:					
Head length	4.8-8.4	11.9-20.8	5.8	17.5	25
Greatest depth	8.7-17.3	5.8-11.5	10.6	9.7	25
Heigh of head	8.1-20.4	4.9-11.4	11.0	9.5	25
Dist. from tip of snout to:					
Dorsal origin	4.6-7.1	14.2-21.8	5.4	18.8	25
Anal origin	2.8-3.8	26.6-37.4	3.1	32.7	25
Pectoral origin	5.1-9.4	12.2-19.6	6.3	16.4	25
Posterior end of pectoral fin	2.7-4.2	23.8-36.7	3.3	30.8	25
Ventral origin	6.4-11.3	8.8-15.7	8.4	12.1	25
Posterior end of ventral fin	3.3-4.6	21.5-30.0	3.6	25.7	25
Longest dorsal ray	6.0-9.5	10.5-16.7	7.0	14.5	25
Longest anal ray	14.3-21.2	4.7-7.0	16.5	6.0	25
Longest ventral ray	6.4-10.2	9.8-15.6	7.9	12.9	25
Dorsal base	22.3-31.3	3.2-4.8	25.4	4.0	25
Anal base	1.4-1.6	64.3-73.4	1.5	67.3	25
Longest pectoral ray	6.6-9.5	9.7-15.2	7.8	13.1	25
In head length:					
Snout	2.3-4.7	21.3-43.0	2.8	36.2	25
Maxillary length	2.8-4.5	22.3-34.7	3.1	32.2	25
Interorbital	2.0-3.3	35.0-49.4	2.6	37.2	25
Diameter of eye:					
Horizontal	4.3-9.9	10.1-23.4	7.7	13.4	25
Vertical	4.4-10.2	9.8-22.8	8.3	12.4	25
Postorbital	1.7-2.2	46.0-57.9	2.0	50.5	25

The following measurements are expressed in percentages of the length of head and in parentheses, the number of times contained in length of head. Length of snout 21.3-43.0 (2.3-4.7); length of maxillary 22.3-34.7 (2.8-4.5); diameter of eye (horizontal) 10.1-23.4 (4.3-9.9), vertical 9.8-22.8 (4.4-10.2); interorbital width 35.0-49.4 (2.3-3.3).

Body very elongate, slightly compressed, compression increasing posteriorly. Head blunt, fairly large; trunk short; tail long, compressed and tapering posteriorly. Skin naked, soft on body, gelatinous on anterior part of head especially on snout. Lateral line is not apparent as a line-like tube, pores set far apart, well separated pored cycloid scales on lateral line embedded in deep skin, not visible externally, of which scale round in shape with dorsal and ventral pores on trunk, and elongate in shape with a medial pore rolling up dorsoventrally on tail. Mouth inferior. Premaxillaries strong form the upper jaw of the mouth opening, protractile downwards. Maxillaries are closely joint, each with a supramaxillary. Teeth are small pointed on anterior half of premaxillaries and biseries on each anterior tip. Two nasal opening in an oval shaped nasal capsule lying in front of eye on each side, anterior one opens forward with a short side dermal flap, posterior one opens backward. Dentary, maxillary, palatine and vomer are toothless. Interorbital space wide and convex. Dorsal fin with short base, without spiny rays, situated a little behind origin of pectorals. Anal fin long and united with caudal fin. Pectorals well developed. Ventrals situated on throat, flexible, simple, each of two attached rays having appearance of a single filament, first ray hidden in skin and forth to sixth are vestige. Gill-openings wide; gill membranes separate and free of isthmus. Opercles concealed by skin; subopercle displaces opercle from margin of gill opening.

COLOR: Color in formalin is grayish or dusky, dorsal and pectoral fins blackish, pelvic fins whitish.

Gonorhynchus abbreviatus Temminck & Schlegel.

Fig. 6.

Gonorhynchus abbreviatus Temminck & Schlegel, 1846, p. 217; Jordan & Snyder, 1904, p. 236; Jordan & Herre, 1906, p. 643; Chu, 1962, p. 146; Chu, 1963, p. 122; Okada & Matsubara, 1938, p. 43; Okada, 1938, p. 129; Matsubara, 1955, p. 201; Tomiyama, Abe & Tokioka, 1969, p. 281; Chen, 1969, p. 151; Lindberg & Legeza, 1965, p. 121; Fowler, 1941, p. 729.

DESCRIPTION: Dorsal fin rays 9; anal fin rays 6-8; pectoral fin rays 9; pelvic fin rays 8; segmented caudal fin rays 18; lateral line scales 167-168, above lateral line to dorsal origin 19, below lateral line to anal origin 18-19; vertebrae 54-56=40-42+13-14.

The following measurements are expressed in percentages of the standard length and in parentheses, the number of times contained in standard length. Head length, from tip of snout to postermost margin of opercle, 22.5-23.8 (4.2-4.4). Body depth, taken at origin of dorsal fin, 10.4-10.8 (9.3-9.6). Height of head, taken at the posterior margin of eye, 8.3-8.7 (11.6-12.0). Distance from tip of snout to origin of dorsal fin, 70.5-71.5 (1.3-1.4); to origin of anal fin 84.8-85.0 (1.2); to origin of pelvic fin 68.0-69.2 (1.4-1.5).

The following measurements are expressed in percentages of the length of head and in parentheses, the number of times contained in length of head. Length of snout 36.1-38.9 (2.6-2.8); diameter of eye (horizontal) 23.0-23.6 (4.2-4.3), vertical 15.4-16.4 (6.1-6.5); interorbital width 21.1-28.9 (3.5-4.7); length of barbel 10.9-12.0 (8.3-9.2); least depth of caudal peduncle 40.7-47.7 (2.1-2.5); base of dorsal fin 33.1-35.0 (2.9-3.0); longest dorsal ray (2nd) 48.2-52.3 (1.9-2.1); base of anal fin 21.1-25.7 (4.3-4.7); longest anal ray (2nd) 37.0-37.4 (2.7); longest pectoral ray (3rd) 74.3-74.5 (1.3-1.4); longest pelvic ray (3rd) 41.5-42.6 (2.4-2.5).

Body elongate, almost cylindrical, slightly compressed at caudal part. Head conical, snout slightly elongate and pointed. Small thin ctenoid

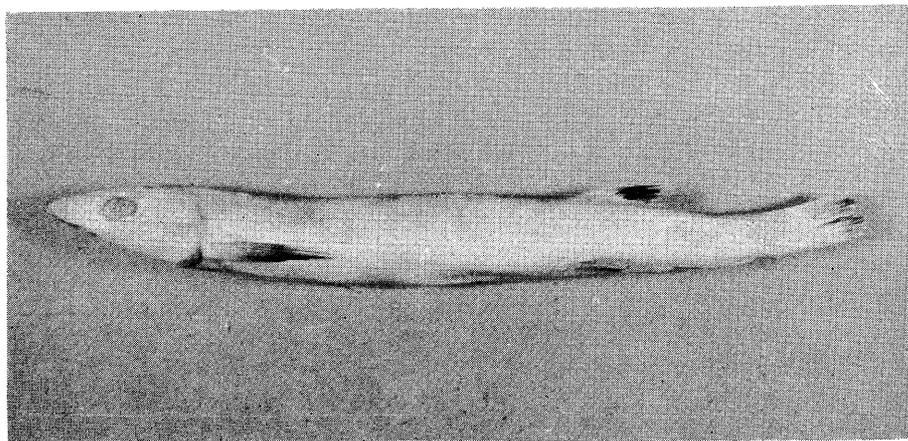


Fig. 6. *Gonorhynchus abbreviatus* Temminck & Schlegel, 240 mm TL, 185 mm SL.

scales converging head as well as body. Mouth small, inferior; lips fleshy, upper fimbriated, lower membrane-like and rolling outside covered on chin and united with upper lip at both corners. Jaws toothless. Two nasal openings in a small round nasal cavity at both sides near snout tip, anterior one opens horizontally or obliquely, and posterior one opens vertically. Gill membrane widely connected to isthmus and its openings narrow. Lateral line present but expressed by dermal tube not by pored scales. All fins short based. Dorsal fin lying in posterior of body above ventrals. Anal fin far behind end of dorsal and smaller than dorsal. Paired fins with long, free fleshy pointed scaly flaps. Dorsal and anal fins with short fleshy pointed scaly flaps which united with bases of their anterior rays. Bases of dorsal, anal, pelvic and caudal fins covered with scales.

Color in formalin dark brown on back and paler or yellowish below; dorsal and caudal black at tip, paler basally; paired fins black; anal fin paler; opercle margin blackish.

Xiphasia setifer Swainson

Figure 7.

Xiphasia setifer Swainson, 1839, p. 259; Day, 1876, p. 337; Day, 1889, p. 327; Beaufort & Chapman, 1951, p. 381; Tanaka, 1908,

p. 49; Herre, 1926, p. 224; Herre, 1939, p. 368; Okada, 1938, p. 258; Okada & Matsubara, 1938, p. 404; Matsubara, 1955, p. 742; Chu, 1962, p. 711; Tomiyama, Abe & Tokioka, 1969, p. 116; Smith, 1965, p. 346.

Xiphogadus setifer Günther 1862, p. 374.

DESCRIPTION: Dorsal fin elements XIV 106-118; anal fin elements II 108-117; pectoral fin rays 13; pelvic fin elements I 2; caudal fin rays 10-12. Vertebrae 15+115=131.

The following measurements are expressed in percentages of the standard length and in parentheses, the number of times contained in standard length. Head length, from tip of snout to upper most of gill opening, 5.8-7.8 (12.8-17.6); body depth, taken at the origin of pectoral fin, 2.3-3.0 (33.3-43.3); distance from tip of snout to dorsal origin 1.1-2.2 (46.3-89.6), to anal origin 11.9-15.7 (6.4-8.4), to ventral origin 4.9-6.4 (15.7-20.3); length of dorsal base 98.4-99.1 (1.01-1.04); length of anal base 83.8-88.0 (1.1-1.2).

The following measurements are expressed in percentages of the head length and in parentheses, the number of times contained in head length. Snout length 23.1-28.0 (3.6-4.3); inter-orbital 12.6-15.6 (6.4-7.9); horizontal diameter of eye 22.8-30.4 (3.3-4.4), vertical of it 20.5-

25.3 (4.0-4.9); longest dorsal ray 58.0 85.1 (1.2-1.7); longest anal ray 59.6-81.0 (1.2-1.7); longest pectoral ray 46.4-53.7 (1.9-2.2); longest ventral ray 50.0-76.9 (1.3-2.0).

Body is naked, very elongate, slender, eel-like, slightly compressed, compression increasing posteriorly, especially on tail, becoming ribbon-like. Head somewhat blunt, predorsal profile boldly convex anteriorly, about equal to trunk, height slightly wider than body. Mouth slants up then curved downward and back, with slender, curved, tip pointed anteriorly, flattened laterally, movable teeth closely compacted in one row on each jaw, posteriorly to the row of teeth in lower jaw is a pair of long, sharp, strong, backward-curved canines which fit into large cavities running upward and backward before the eyes; behind these cavities is a pair of much smaller downward-projecting canines. Snout longer than eye. Interorbital space narrow, slightly convex. Gill opening very small, about $\frac{1}{2}$ of diameter of eye, lower end opposite to upper base of pectoral fin. Dorsal fin long, originates above or a little before to the level of anterior margin of orbit, spines and rays become gradually decreasing to the tail; anal fin origin below level of 15th or 16th ray of

dorsal fin, height is similar to dorsal fin, both fins confluent with caudal fin. Caudal fin has four medial rays elongated, and the central two rays greatly extend into hair-like, more than 10 times in the length of unelongated ones. Pectoral fin originates just behind the lower end of the gill-opening, rather broad but short. Pelvic fin originates before the level of the gill opening, very narrow, composed one spine and two rays, the medial one extends into filament, more longer than pectoral fin.

Color in fresh specimens is bright yellow with 28 broad dark brown vertical band on the dorsal and body, the first behind head; the dorsal yellow at its origin and with a ovate black spot on the upper membrane between 4th to 6th spines, both dorsal and anal fins with a broad marginal blackish band; the caudal filaments blackish; the head dusky yellowish, the pelvic and pectoral fins yellow.

Color in formalin specimens, the yellow has faded to pale and the dorsal blackish terminal and pale basally; the pectoral and pelvic fins pale; the fading caused the dark bands to appear as fourteen grayish wide cross-bands, each with a medial cross pale bar.

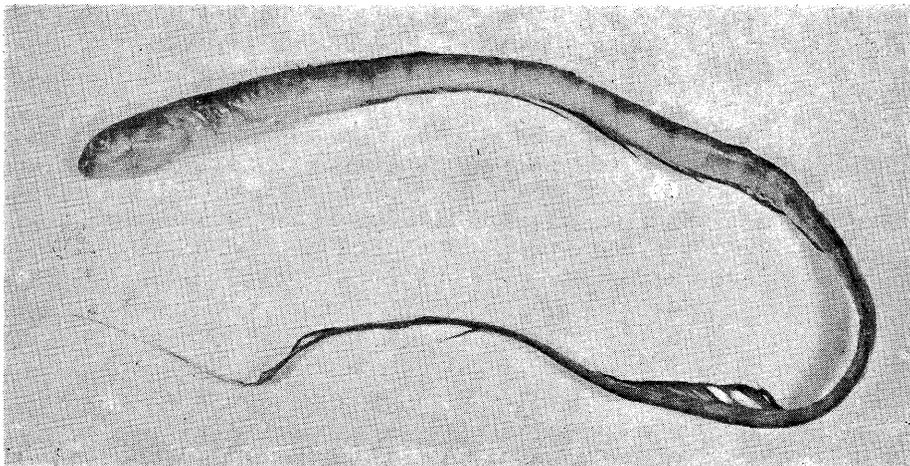


Fig. 7. *Xiphasia setifer* Swainson, 589.3 mm TL, 519.5 SL.

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臺灣近海產魚類生態及形態的研究

II. 幾種罕見的深海魚及兩種新種

沈世傑 丁蔚華

臺灣產的五種罕見的大陸棚魚，小棘鮫 *Deania aciculata* (Garman)，烏鯊或燈籠棘鮫 *Etmopterus lucifer* Jordan & Snyder，瓣魚或日本軟腕魚 *Ateleopus japonicus* Bleeker，鼠鱧魚 *Gonorhynchus abbreviatus* Temminck & Schlegel，帶鰓（毛尾鰓魚）*Xiphasia setifer* Swainson 及二種新種大溪黑鯊 *Dalatias tachiensis* n. sp. 臺灣扁鯊（臺灣琵琶鮫）*Squatina formosa* n. sp.。前三種及最後一種新種，皆出現於大溪（臺灣之東北部，即蘇澳以北）及東港近海（臺灣西南部）鼠鱧魚則出現於大溪及澎湖，而帶鰓魚首次發現於臺灣，及大溪，烏鯊新種雖到目前為止僅發現於大溪。但根據既往魚類採集調查之所得及魚種之分佈情形來看，該一地區一由臺灣東北部，蘇澳以北北上至東海南經臺灣海峽之臺灣西南部東港近海向西南延伸以至南中國海，其間必有一連串的共同性，又臺灣以往所報告的紫軟腕魚 *Ateleopus purpureus* Tanaka 僅出現於東港而今亦相繼發現於大溪，今將其列入日本軟腕魚 *Ateleopus japonicus* Bleeker 之同物異名。