

Portuguese Shark, *Centroscymnus coelolepis* from Japan, with Notes on *C. owstoni*

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Abstract The Portuguese shark, *Centroscymnus coelolepis*, was recently taken from depths of 300 ~ 1,200 m in Suruga Bay in central Japan. This species was heretofore reported only from the Atlantic Ocean. *C. owstoni* is redescribed to clarify the classification of the genus *Centroscymnus* from Japan. *C. coelolepis* and *C. owstoni* are distinguished by such characters as the height of the dorsal fin, the presence or absence of the abdominal ridges, the shape of the dermal denticles and the number of spiral valves.

The deep sea shark genus *Centroscymnus* belongs to the family Squalidae. This genus is distinguished from other genera by its concave crown like dermal denticles and broadly rounded inner corner of the pectoral fins. From the seas around Japan, the genus has been represented by only *C. owstoni* Garman, 1906. Recently, specimens of another species, *C. coelolepis* Bocage et Capello, 1864 have been caught in Suruga Bay, located on the Pacific side of central Japan. This species has hitherto been known as an Atlantic species. The characteristics of these specimens agree well with the descriptions of Vaillant (1888), Garman (1913), and Bigelow and Schroeder (1948). In this paper, a description of this species is given along with a morphological comparison between *C. coelolepis* and *C. owstoni* collected from Suruga Bay.

Materials and methods

The specimens reported below were taken by bottom drop lines, bottom longlines, or bottom gill nets, all of which were set at depths between 150 m and 2,000 m.

C. coelolepis: A total of 34 males and 22 females, ranging in total length (TL) from 637 mm to 1,030 mm, and 23 embryos from 72 mm to 86 mm in TL were examined. A part of these samples consisting of 7 males (NSMT-P 21828, NSMT-P 21829, FUMT-P 4368, FUMT-P 4369, TMFE 562, TMFE 586, and TMFE 603) and 7 females (NSMT-P 21826, NSMT-P 21827, FUMT-P 4366, FUMT-P 4367, TMFE 1660, TMFE 1661, and TMFE 1662) has been registered in the National Science Museum, Tokyo

(NSMT), Department of Fisheries, University Museum, University of Tokyo (FUMT) and Elasmobranchii Collection of the Department of Fisheries, Faculty of Marine Science and Technology, Tokai University (TMFE).

C. owstoni: A total of 112 males and 153 females, ranging in TL from 376 mm to 1,168 mm, and 35 embryos from 165 mm to 245 mm in TL were examined. Seven males (NSMT-P 21832, NSMT-P 21833, FUMT-P 4372, FUMT-P 4373, TMFE 464, TMFE 465, and TMFE 589) and 7 females (NSMT-P 21830, NSMT-P 21831, FUMT-P 4370, FUMT-P 4371, TMFE 156, TMFE 548, and TMFE 557) have been registered.

Morphometric measurements were taken as shown in Fig. 1. Dermal denticles were observed under a binocular microscope and photographed with a scanning electron microscope. All spiral valves were counted from the left lateral view of the ileum.

Centroscymnus coelolepis Bocage et Capello, 1864

(New Japanese name: Marubara-yumezame)
(Fig. 2 above)

Description. Snout short, depressed, broadly rounded at end; length of snout in front of mouth less than, or about equal to, distance from posterior end of eye to 1st gill opening. Gill openings small, almost vertical. Mouth broad and slightly arched. Trunk subcylindrical, moderately stout; abdominal region round. Posterior margin of 1st dorsal fin shorter than anterior margin; slope of posterior margin steep.

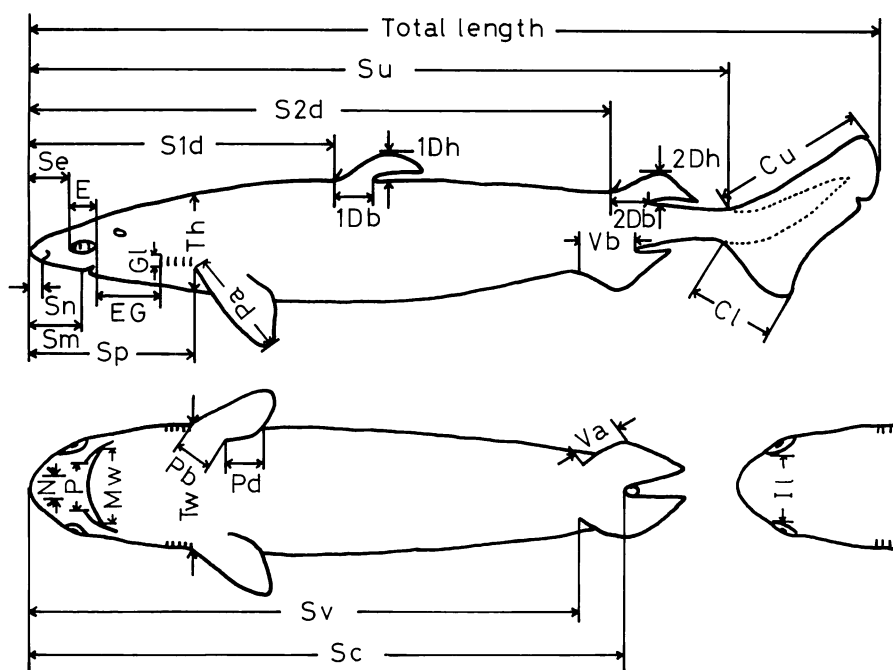


Fig. 1. Measurements taken in the present study. Cl, length of lower caudal lobe; Cu, length of upper caudal lobe; E, horizontal eye diameter; EG, distance between eye and 1st gill opening; Gl, length of gill opening; Il, interorbital length; Mw, mouth width; N, distance between inner corners of nostrils; P, distance between inner ends of preoral clefts; Pa, length of anterior margin of pectoral fin; Pb, length of pectoral fin base; Pd, length of distal margin of pectoral fin; Sc, snout tip to cloaca; Se, snout tip to eye; Sm, snout tip to mouth; Sn, snout tip to outer nostril; Sp, snout tip to pectoral fin origin; Su, snout tip to upper caudal origin; Sv, snout tip to pelvic fin origin; S1d, snout tip to 1st dorsal fin spine; S2d, snout tip to 2nd dorsal fin spine; Th, height of trunk at pectoral fin origin; Tw, width of trunk at pectoral fin origin; Va, length of anterior margin of pelvic fin; Vb, length of pelvic fin base; 1Db, length from emergence of 1st dorsal spine to posterior end of fin base; 1Dh, height of 1st dorsal fin; 2Db, length from emergence of 2nd dorsal spine to posterior end of fin base; 2Dh, height of 2nd dorsal fin.

Both dorsal fin spines more or less exposed at tip. Caudal peduncle without lateral keels or precaudal pits. Outline of caudal fin with a well-marked subterminal notch.

In the following, the mean values of total specimens are followed by ranges in parentheses. The asterisks show no significant differences between the sexes in the body proportions as a result of a significance test for the mean ($Pr(t)=0.01$).

Height of trunk at origin of pectorals 11.7%* (7.9~16.7%) of TL. Length measured from snout to cloaca 67.3%* (63.8~71.2%) of TL. Head length measured from snout tip to 5th gill opening 4.15* (3.68~4.74) in body length from snout tip to upper caudal origin.

Snout length anterior to eye 1.28* (0.90~1.73) in horizontal diameter of eye and 2.31* (1.62~3.57) in interorbital length. Snout tip to mouth 1.24 (1.00~1.42) in mouth width in males and 1.36 (1.07~1.78) in females. Distance between inner corners of nostrils 1.34* (0.95~1.58) in distance between inner ends of preoral clefts.

Snout tip to point of emergence of 1st dorsal fin spine 36.4%* (33.7~38.6%) and to 2nd dorsal fin spine 69.3%* (65.9~73.2%) of TL. Length of 1st dorsal fin base, measured from point of emergence of spine, 0.94 (0.77~1.22) in length of 2nd dorsal base in males, and 0.89 (0.71~1.03) in females. Height of 1st dorsal fin 1.26* (1.00~1.64) in that of 2nd dorsal fin.

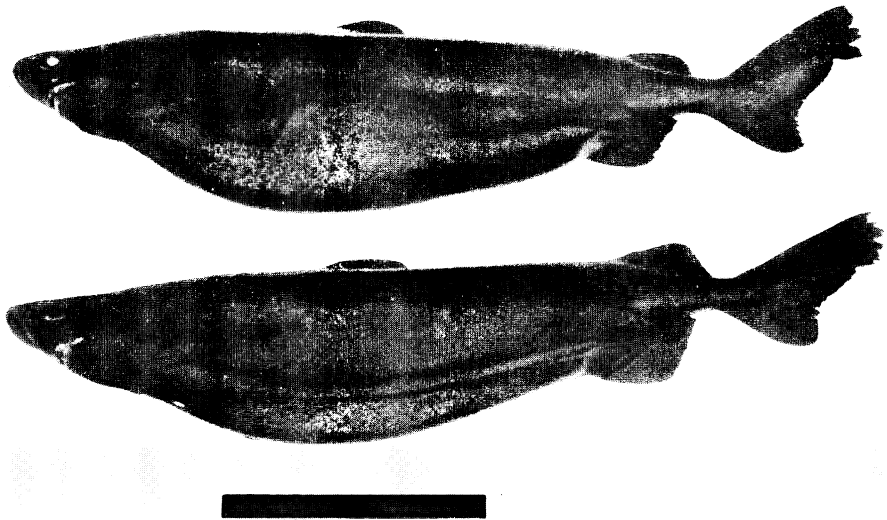


Fig. 2. *Centroscyrmus coelolepis*, female 1,027 mm TL (above). *C. owstoni*, female 1,021 mm TL (below). Scale indicates 300 mm

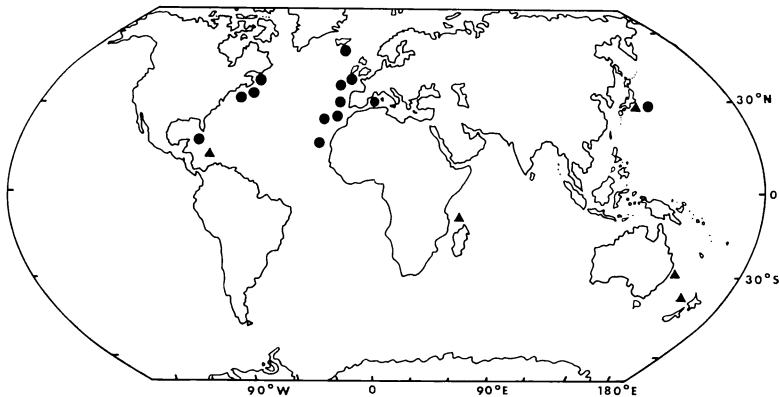


Fig. 3. Distributional records for *Centroscyrmus coelolepis* (●) and *C. owstoni* (▲).

Length of anterior margin of pectoral fin 13.4%* (10.1~15.7%) of TL.

Upper and lower teeth dissimilar; upper ones awl-shaped and loosely spaced. One or two teeth in center sector of mouth nearly as long as those next to them. Lower teeth smoothed and quadrate; outer margin deeply notched, single cusp strongly oblique; without symmetrical median tooth. Dental formula: $\frac{(22 \sim 35) - (0 \sim 2) - (21 \sim 31)}{(15 \sim 21) - 0 - (14 \sim 20)}$; number of teeth on right and left sides of each jaw equal.

Dermal denticles on side of body resemble scales, with rounded margins and concave

crowns; dermal denticles on head similar in shape to those on trunk. Mean number of spiral valves 18 (16~21). Total vertebral number 108 (102~114), monospondylous 60 (56~64), precaudal 77 (68~84).

Color: Uniformly dark brown.

Distribution. In addition to the records from Japan, this species is known from the North Atlantic between depths of 700 m and 2,020 m (Garman, 1913; Bigelow and Schroeder, 1948; Forster, 1964, 1968; Krefft, 1967; Clarke and Merrett, 1972; Compagno, 1977), and the western Mediterranean between depths of 330 m and

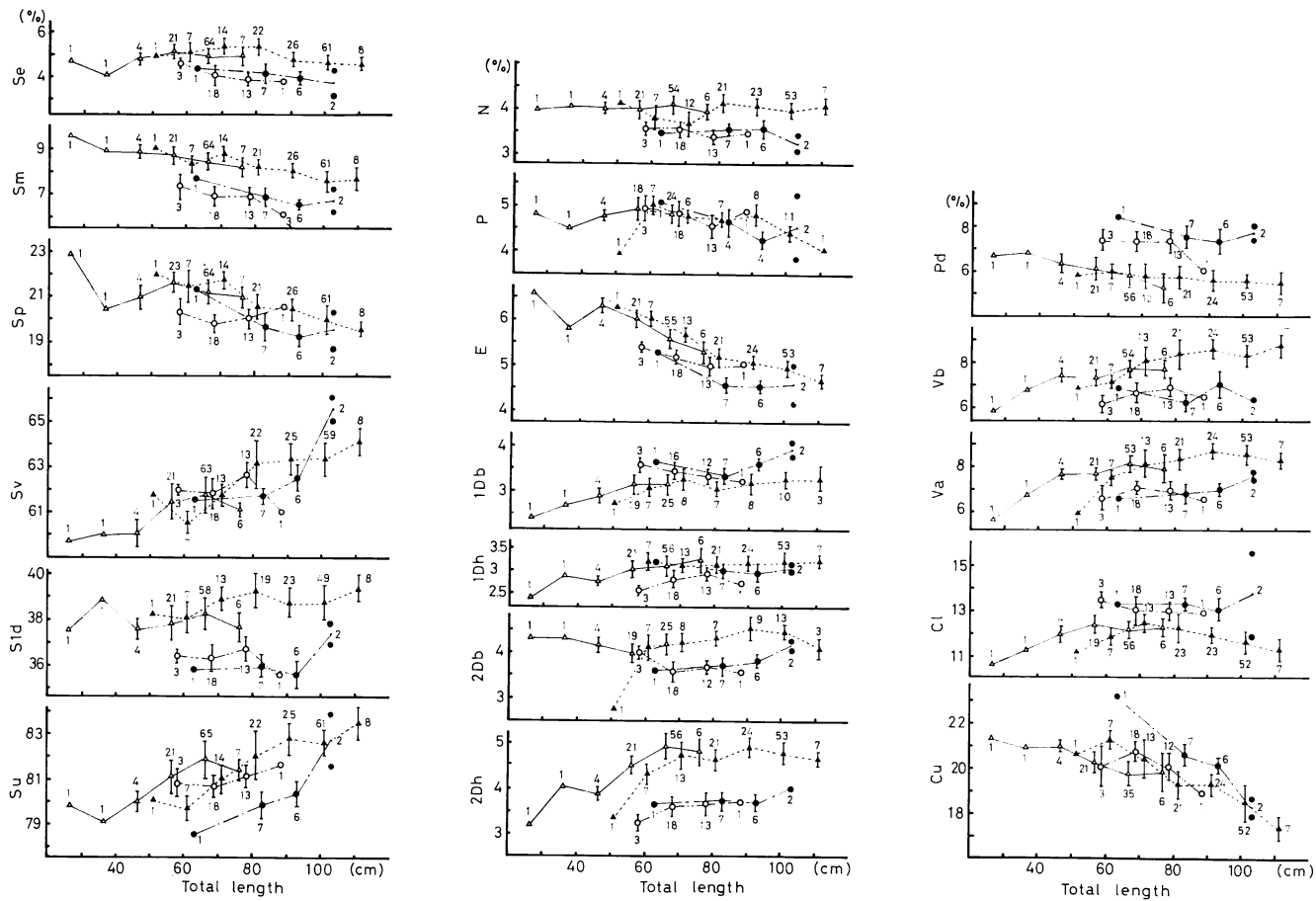


Fig. 4. Proportional body dimensions as percentages of total length. ○, *Centroscyllium coelolepis* male; ●, *C. coelolepis* female; △, *C. owstoni* male; ▲, *C. owstoni* female. Short vertical lines indicate standard deviation. Abbreviations same as in Fig. 1. Numbers in each figure indicate the number of individuals measured.

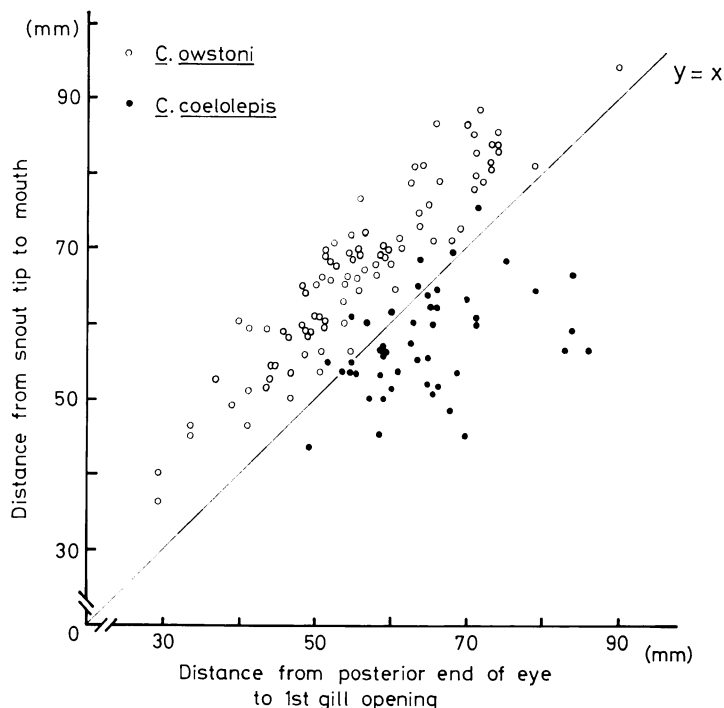


Fig. 5. Relationship between the distance from posterior end of eye to 1st gill opening and the distance from snout tip to mouth.

2,718 m (Gray, 1956) (Fig. 3).

***Centroscymnus owstoni* Garman, 1906**

(Japanese name: Yumezame)

(Fig. 2 below)

Description. Head depressed, broadly rounded at end, length of snout in front of mouth more than distance from posterior end of eye to 1st gill opening. Gill opening small, almost vertical. Trunk subcylindrical; abdominal region square with noticeable abdominal ridges, particularly in males. Posterior margin of 1st dorsal fin shorter than anterior margin; slope of posterior margin steep. Both dorsal fin spines more or less exposed at tip. Caudal peduncle without lateral keels or precaudal pits. Outline of caudal fin with a well-marked subterminal notch.

Height of trunk at origin of pectorals 10.1% (6.5~14.1%) of TL in males, and 11.4% (6.8~15.2%) in females. Length measured from snout to cloaca 67.2% (58.8~71.5%) of TL in males, and 68.5% (65.2~79.6%) in females. Head length 3.89 (3.52~4.28) in body length in males, and 4.09 (3.58~4.63) in females.

Snout length 1.21 (0.78~1.62) in horizontal diameter of eye in males, and 1.10 (0.73~1.63) in females. Snout length 2.04* (1.42~3.09) in interorbital length. Snout tip to mouth 0.96 (0.70~1.18) in mouth width in males, and 1.05 (0.68~1.50) in females. Distance between inner corners of nostrils 1.24* (1.00~1.67) in distance between inner ends of preoral clefts.

Snout tip to 1st dorsal spine 38.1% (32.8~41.1%) and 2nd dorsal spine 70.4% (63.5~73.6%) of TL in males, and 38.8% (35.4~47.7%) and 71.5% (68.2~75.2%), respectively, in females. Length of 1st dorsal fin base 0.75* (0.55~1.04) in that of 2nd dorsal base. Height of 1st dorsal fin 1.53* (1.21~2.13) in that of 2nd dorsal fin. Length of anterior margin of pectoral fin 12.3% (10.1~13.9%) of TL in males, and 12.5% (10.3~14.9%) in females.

Upper and lower teeth dissimilar; upper ones awl-shaped and loosely spaced. An upper tooth in center section of mouth nearly as long as those next to it. Lower teeth smooth-edged and quadrate, outer margin deeply notched, single cusp strongly oblique, without symmetrical

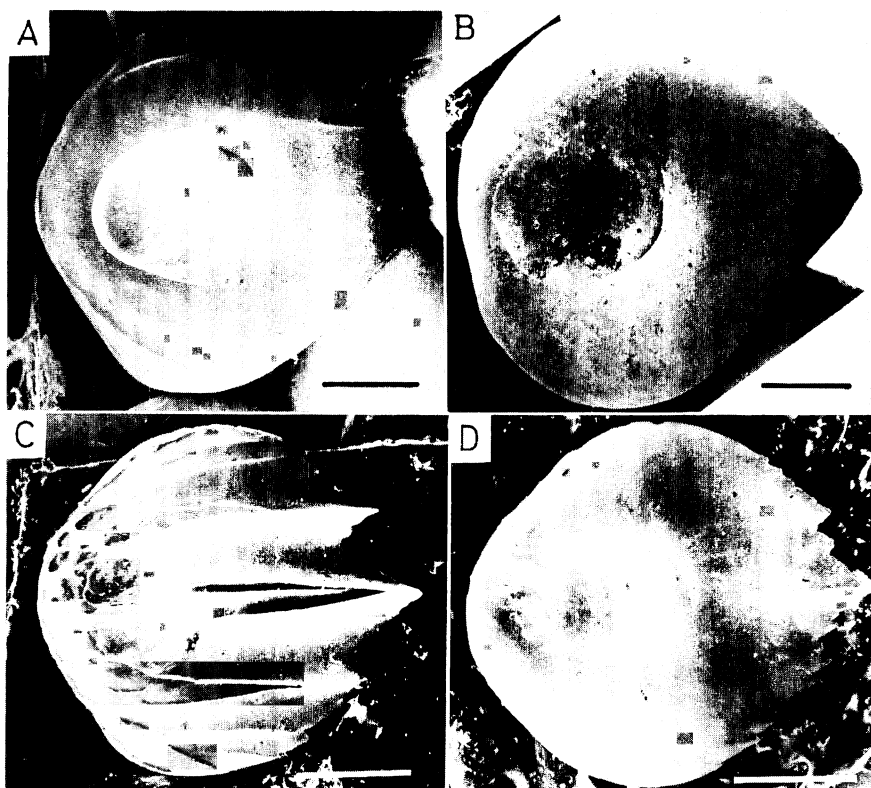


Fig. 6. Dermal denticles of the adult sharks, *Centroscymmus coelolepis* (A, B, female 1027 mm TL) and *C. owstoni* (C, D, female 1,021 mm TL). A, head region above the 1st gill opening; B, trunk side below 1st dorsal fin; C, head region above the 1st gill opening; D, trunk side below 1st dorsal fin. Each scale indicates 500 μ m.

median tooth. Dental formula is as follow:
 $\frac{(18 \sim 38) - (0 \sim 1) - (18 \sim 38)}{(16 \sim 21) - 0 - (16 \sim 19)}$; number of teeth on right and left sides of each jaw equal.

Dermal denticles on side of body with slightly serrated margins and concave crowns; dermal denticles on head with tridentate margins and three or five longitudinal keels.

Mean number of spiral valves 14 (11 ~ 15).

Total vertebral number 103 (96 ~ 108), monospondylous 58 (54 ~ 60); precaudal 75 (71 ~ 79).

Color: Uniformly black.

Distribution. This species is known from Suruga Bay and Sagami Bay, Japan (Garman, 1906), from 1,080 m (600 fathoms) off Kaikoura, New Zealand (Garrick, 1959), off Madagascar between depths of 500 m and 1,000 m (Forster et al., 1970), from the western central Atlantic (Compagno, 1977), and from 823 m off New South Wales, Australia (Bass, 1979) (Fig. 3).

Comparison between *C. coelolepis* and *C. owstoni*

The proportional dimensions, in percentage of total length, are shown in Fig. 4. We made a significance test for the means ($Pr(t) = 0.01$) of the two species at intervals of 10 cm for total lengths ranging from 60 cm to 90 cm.

Twenty-seven morphometric measurements were taken from specimens of the two species, and their percentages to total length were calculated. Among them, the results for 18 body parts are shown in Fig. 4. Some of the results show significant differences between the two species (e.g., Sm, S1d, 2Dh, Pd, Vb, and Va) (Fig. 4). There is a tendency for Sv and Su to increase with growth of individuals in both species and both sexes (Fig. 4). On the contrary, there is a tendency for Sp, except in males, E and Cu to decrease with growth (Fig. 4). There were no significant differences between the two

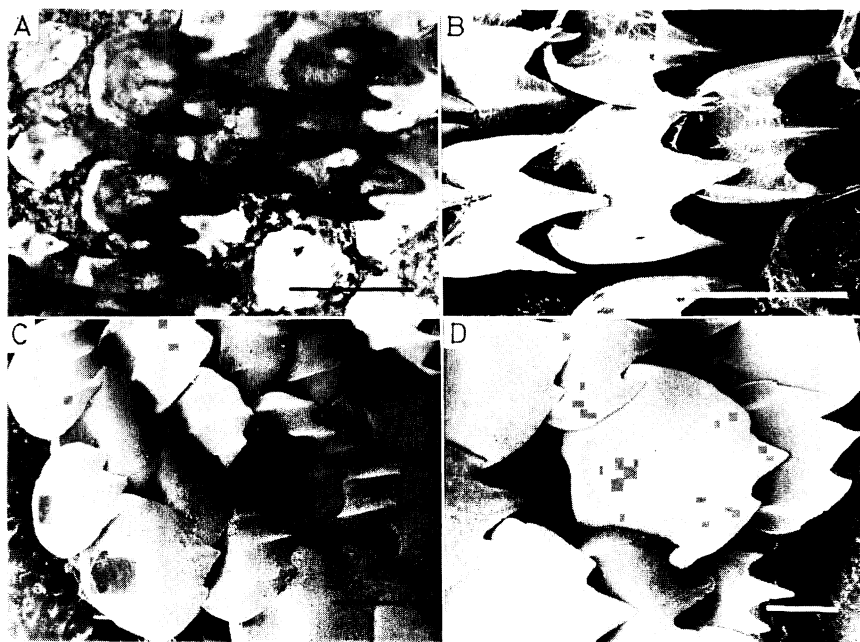


Fig. 7. Dermal denticles of younger sharks. A, *Centroscyrmus owstoni* embryo male 240 mm TL, trunk side below 1st dorsal fin; B, *C. owstoni* juvenile male 376 mm TL, trunk side below 1st dorsal fin; C, *C. owstoni* young male 623 mm TL, trunk side below 1st dorsal fin; D, *C. coelolepis* young male 637 mm TL, trunk side below 1st dorsal fin. Each scale indicates 500 μ m.

species in three body proportions of males (Sc, P, and Pb), as well as in nine proportions of females (Sv, G1 (1st and 5th), P, EG, 2Dh, Pb, Tw, and Th).

The relationship between snout tip to mouth and distance from posterior end of eye to 1st gill opening is shown in Fig. 5. This figure shows that the relative distance from snout tip to mouth is clearly longer in *C. owstoni* than in *C. coelolepis*. This relationship was used by Garman (1913) and Bigelow and Schroeder (1948) to distinguish the two species. However, the relationship obtained from our measurements of a large number of specimens shows some overlap between the two species.

The cross section of the abdominal region of *C. owstoni* was more or less square, with noticeable ridges, particularly in males (Fig. 2). The two species can thus be clearly distinguished from each other by this feature.

The dermal denticles on the side of the body of *C. owstoni* are characterized by slightly serrated margins and concave crowns, but the denticles on the head had tridentate margins and three or five longitudinal keels (Fig. 6). The dermal

denticles were not observable on the body of the embryos (72~86 mm TL) of *C. coelolepis*. However, on the body of the embryos (165~245 mm TL) and juvenile (376 mm TL) of *C. owstoni*, the dermal denticles were seen to have tridentate margins and three or five keels, and were quite different from the denticles on the adult body. The embryos of the two species were covered with mucus. The denticles on the trunk of *C. coelolepis* young (637 mm TL) and *C. owstoni* of similar size had tridentate margins. The denticles of the fishes of this size are not uniform in shape or size; some have longitudinal keels, some are concave, crown-like, and some are small (Fig. 7). We have observed that some specimens of *C. coelolepis* and *C. owstoni* were studded with discolored denticles that were easily shed when the surface of the body was rubbed by hand. New denticles formed after such shedding. These observations agree with the findings by Bigelow and Schroeder (1954) on *C. coelolepis* and by Garrick (1959) on *C. owstoni*.

The tooth shape of *C. owstoni* was similar to that of *C. coelolepis*. The dental formulas were very similar in the two species. The number of

upper teeth tended to increase with growth in both species. The dental formula of *C. coelolepis* was reported to be $\frac{70}{40}$ in a 1,118 mm specimen, $\frac{58}{40}$ in a 1,080 mm specimen (Garman, 1906; Bigelow and Schroeder, 1948). For *C. owstoni* dental formulas were $\frac{72}{30}$ in a 794 mm specimen, $\frac{72}{30}$ in a 781 mm specimen, $\frac{19-18}{18-19}$ in a 584 mm specimen and $\frac{37}{17-1-17}$ in a 975 mm specimen (Garman, 1906, 1913; Garrick, 1959; Bass 1979). Variation in the number of upper teeth seems due to differences in the size of specimens.

Spiral valves in *C. owstoni* are fewer than in *C. coelolepis* (Table 1). The mean number for *C. owstoni* was 14, while that of *C. coelolepis* was 18. This difference may be another useful character in differentiating the two species.

The total vertebral number in *C. owstoni* was 103 (96~108), monospondylous 58 (54~60) and precaudal 75 (71~79), while that of *C. coelolepis* was 108 (102~114), monospondylous 60 (56~64), and precaudal 77 (68~84) (Table 2). The vertebral counts reported by Springer and Garrick (1964) for these species fall within our measurement range.

Key to species of *Centroscymnus* from Japan

- 1a. Distance from snout tip to mouth less than or about equal to distance from posterior end of eye to 1st gill opening; 1st and 2nd dorsal fins about the same in size and in height; abdomen round, no abdominal ridges; dermal denticles on the head of adults with rounded margins like those on the trunk; number of spiral valves 16~21

(average 18).....*C. coelolepis*

- 1b. Distance from snout tip to mouth more than distance from posterior end of eye to 1st gill opening; 2nd dorsal fin higher than 1st dorsal fin; abdomen square, noticeable abdominal ridges; dermal denticles on the head of adults have tridentate margins and three or five longitudinal keels; number of spiral valves 11~15 (average 14)
.....*C. owstoni*

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Table 1. Number of spiral valves in *Centroscymnus coelolepis* and *C. owstoni*.

	11	12	13	14	15	16	17	18	19	20	21
<i>C. coelolepis</i>						5	9	15	5	3	1
<i>C. owstoni</i>	5	19	39	30	6						

Table 2. Number of total vertebrae in *Centroscymnus coelolepis* and *C. owstoni*.

	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114
<i>C. coelolepis</i>							2	2	1	2	4	8	10	5	5	1	1	1	1
<i>C. owstoni</i>	1			2	7	3	11	22	19	16	9	1	1						

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- (Department of Fisheries, Faculty of Marine Science and Technology, Tokai University, 3-20-1, Orido, Shimizu 424, Japan)
- 駿河湾から得られた日本初記録のマルバラユメザメ (新称) とユメザメの再記載
矢野和成・田中 彰
- 駿河湾における深海性サメ類の生態学的研究を行ない、今まで大西洋でのみ報告されていたマルバラユメザメ (新称) *Centroscymnus coelolepis* が水深 300 m から 1,200 m の間で初めて採集された。本報では、従来日本から報告されているユメザメ *C. owstoni* とマルバラユメザメの形態学的比較を行なった。マルバラユメザメは腹部に隆起を持たない点、成体の鱗が頭部と軀幹部で同形である点、腸螺旋弁数が 16~21 でユメザメの 11~15 と異なっている点等で区別できる。
- (424 清水市折戸 3-20-1 東海大学海洋学部水産学科)