

First record of the squaloid shark *Scymnodon squamulosus* from the Hawaiian Islands

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The genus *Scymnodon* Bocage & Capello, 1864 belongs to the family Squalidae and is distinguished from other similar genera by the presence of upper teeth that are much longer midway along each side of the jaw than either toward the center of the mouth or its outer corners (Bigelow and Schroeder, 1957). Bigelow and Schroeder (1957) recognized three species of *Scymnodon*: *ringens* Bocage & Capello, 1864, *obscurus* Vaillant, 1888, and *squamulosus* Günther, 1877. They differentiated between *squamulosus* and *obscurus* by the presence of transverse ridges on the dermal denticles of *obscurus* and their absence from *squamulosus*. Yano and Tanaka (1984) discovered that denticles of type specimens of *squamulosus* also had transverse ridges and they considered *obscurus* as a junior synonym of *squamulosus*. Yano and Tanaka (1984) included *S. plunketi* Waite, 1900 in this genus and described a new species, *S. ichiharai*. Taniuchi and Garrick (1986) grouped *ringens*, *plunketi*, *ichiharai*, and *S. macracanthus* Regan, 1906 in the genus *Scymnodon*, and resurrected the genus *Zameus* Jordan & Fowler, 1903, for *squamulosus*. Compagno (1984), Compagno et al. (1989, 1991) and Ebert et al. (1992) have retained the use of *Scymnodon squamulosus*. We follow Compagno (1984) and others in use of the genus *Scymnodon*.

Scymnodon squamulosus, the velvet dogfish, has a fairly wide distribution along continental margins of tropical and temperate waters, with records from both the western Atlantic (Gulf of Mexico, Surinam, and Brazil) and the eastern Atlantic (Iceland to Senegal, and southern

Africa) (Krefft, 1980; Compagno, 1984; Compagno et al., 1991). These sharks were reported from the Indian Ocean off southern Africa and western Australia (Bass et al., 1976; Shcherbachev, 1987; Last and Stevens, 1994). Pacific records include the South China Sea, Australia, New Zealand, Chile and Japan (Chu and Meng, 1982; Paulin et al. 1989; Melendez, 1991; Nakaya and Shirai, 1992). We report the first occurrence of *S. squamulosus* in the central Pacific and compare the morphometrics and reproductive condition of our specimens with those collected elsewhere.

Material and Methods

A female *Scymnodon squamulosus* (786 mm total length [TL]) was captured on tuna longline gear set by the commercial fishing vessel *Miss Jessica*, 168 km north of the island of Kauai, Hawaii (23°29'N, 158°59'W) 15 October, 1995. Depth of capture was estimated at between 27 and 35 m. Surface water temperature was measured at 26.2°C. The shark was frozen and stored for 6 days prior to examination. This specimen was deposited in the Bernice P. Bishop Museum, Honolulu (BPBM #37030). Measurements were taken to the nearest mm following Compagno (1984) and converted to percentage of TL. Denticles from the side of the trunk were examined under a light microscope and photographed. The diameter of eggs in the ovary, uterus width, and ovary weight were used as an index of maturity.

Two additional specimens (of unknown sex

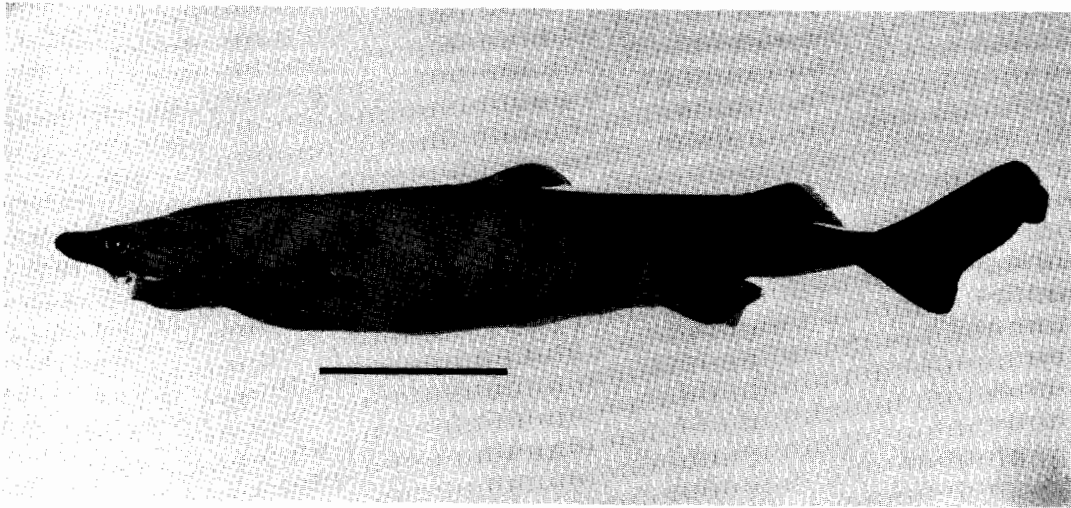


Fig. 1. *Scymnodon squamulosus*, female, 786 mm TL, from Hawaii, BPBM 37030. The bar is 15 cm.

and TL) were captured in the late 1980's by longline vessels fishing in the north of the Hawaiian Islands (M. Seki, pers. comm.), but were not available for examination. For one of these specimens (captured 400 km north of Oahu, 28°24'N, 157°54'W, in August 1987 at a depth of 157 m) the structure of trunk denticles was examined with a scanning electron microscope.

Scymnodon squamulosus (Günther, 1877)
(Fig. 1)

Centrophorus squamulosus Günther, 1877: 433 (type locality: Japan). *Centroscymnus obscurus* Vaillant, 1888: 67, pl. 2, fig. 2 (Soudan); Bass et al., 1986: 53, fig. 5.7 (Durban).

Zameus squamulosus Jordan & Fowler, 1903: 633 (Japan); Taniuchi and Garrick, 1986: 129, fig. 3 (New Zealand, Japan); Last and Stevens, 1994: 102, fig. 8.40 (Australia).

Scymnodon squamulosus Regan, 1908: 48; Garman, 1913: 209; Fowler, 1930: 496; Schmidt, 1931: 7; Yano and Tanaka, 1984: 352, fig. 8 (Japan); Compagno et al., 1989: 32 (southern Africa); Melendez, 1991: 89 (Chile).

Scymnodon obscurus Bigelow & Schroeder, 1957: 101; Krefft, 1980: 3, fig. 1 (Atlantic); Nakaya, 1982: 47, pl. 9 (Japan); Chu and Meng, 1982: 86 (South China Sea).

Description. Proportional body measurements, expressed as percentages of TL for the *S. squamulosus* from Hawaii and specimens from other locations, are shown in Table 1. The 786 mm female from Hawaii conforms to the de-

scription of Yano and Tanaka (1984) and with few exceptions, proportional measurements fall within the ranges reported in other studies. Innerspace between the first and second dorsal spines in our specimen was slightly greater than in other studies (25.5%TL, versus 16.9–24.9%TL). Distance between inner corners of preoral clefts, horizontal eye diameter, inner orbital width, trunk height, trunk width, and the depth of the caudal fin notch for the Hawaii shark were all shorter than in previous studies, possibly due to freezing (Table 1).

Tooth counts in both upper and lower jaws of our specimen (30–29/19–19) did not differ from those reported by other investigators (Bass et al., 1976; Yano and Tanaka, 1984; Taniuchi and Garrick, 1986). The characteristic transverse ridges on dermal denticles were obvious with inspection using a light microscope on denticles from the 786 mm female, and from one of the other sharks from north of the Hawaiian Islands with SEM (Fig. 2).

Biological observations. The stomach of the Hawaii shark was empty except for bait. The shark weighed 2900 g and was mature. The ovaries weighed 100 g, and contained large, light yellow colored eggs that ranged from 32.1 to 37.0 mm in diameter. The right ovary contained five eggs and the left contained three eggs. The uterus was 18.5 mm in width.

Table 1. Total length and proportional dimensions (in percent total length) of *Scymnodon squamulosus* from Hawaii and specimens from other locations

Measurement	Hawaii	Yano & Tanaka (1984)	Taniuchi & Garrick (1986)	Krefft (1980)	Melendez (1991)
<i>n</i>	1	13	4	3	4
Total length (mm)	786	262–634	256–667	316–493	290–551
Snout tip to					
outer nostrils	2.3	1.2–2.8	1.6–2.1	1.3–1.4	
eye	5.6	4.1–6.4	4.6–6.6		5.1–5.4
spiracle	11.1	10.0–12.8	10.8–13.9		
mouth	7.5	7.0–10.7	7.2–9.6	7.8–9.0	8.2–10.7
1st gill opening	16.7	15.2–19.9	16.9–20.5		17.1–20.0
5th gill opening	20.8	20.1–23.7	20.5–24.4		22.9–24.8
pectoral origin	21.1	20.8–24.1	20.7–24.8	22.6–23.7	
pelvic origin	60.6	55.7–61.0	53.8–58.6	57.6–58.3	57.2–59.3
cloaca	65	59.9–65.9			
1st dorsal spine origin	41.4	39.5–43.5	33.1–40.4	40.8–42.9	34.1–41.6
2nd dorsal spine origin	68.3	64.8–69.7	58.6–63.6	65.2–66.8	58.9–64.9
upper caudal origin	81.9	77.1–83.1	75.0–81.3	78.5–80.7	77.3–79.1
lower caudal origin	79.1	75.4–80.4	73.8–79.0		
Innerspace between					
1st & 2nd dorsal spines	25.5	18.1–24.9		19.4–22.4	16.9–19.8
2nd dorsal & caudal	8.7	6.4–9.1		9.7–10.0	
pelvic & caudal	12.4	10.5–14.3		10.7–12.9	
Distance between origins of pectoral & pelvic fins	34.8	31.7–39.5		32.2–34.6	
Distance between inner corners of nostrils	3.7	3.3–4.8	3.0–5.5	4.3–4.6	2.8–5.1
Distance between inner corner of preoral clefts	3.9	4.1–6.1			
Mouth width	7.1	7.3–9.9	7.0–8.8	7.7–7.8	5.9–7.8
Length of 1st gill opening	1.7	0.9–2.1	1.3–1.8	1.3–1.7	
Length of 5th gill opening	1.8	1.1–2.1	1.5–2.1	1.7–2.0	
Horizontal eye diameter	3.7	4.2–6.1	4.0–5.9	5.0–5.7	4.6–5.5
Interorbital width	6.8	8.2–11.1			8.1–10.3
1st dorsal fin length					
base from spine	4.1	3.3–4.4	5.8–8.4	2.9–3.9	5.6–7.6
posterior margin	3.7	2.8–4.7	4.1–5.3		
spine	0.7	0.3–1.1		0.2–0.4	
1st dorsal fin height	2.9	2.0–3.5	2.2–2.9	2.1–2.2	
2nd dorsal fin length					
base from spine	5.9	4.6–7.6	7.5–9.1	5.0–5.3	6.6–8.8
posterior margin	6.6	5.3–7.9	4.4–5.5		
spine	0.5	0.2–1.1		0.3–0.4	
2nd dorsal fin height	3.7	3.0–3.8	2.8–3.5	3.0–3.6	
Pectoral fin length					
anterior margin	10.4	9.5–12.5	10.5–12.2		
distal margin	5.2	4.3–6.3			

Table 1. (Continued)

Measurement	Hawaii	Yano & Tanaka (1984)	Taniuchi & Garrick (1986)	Kreffft (1980)	Melendez (1991)
Length of pelvic fin					
anterior margin	6.1	4.5–8.2	5.8–8.3		
Pelvic fin depth	3.1	2.8–4.1			
Caudal fin length					
upper lobe	17.6	17.3–23.2	19.6–24.2	20.1–20.5	
lower lobe	11.2	10.2–13.5	12.2–13.5	12.7–12.8	
Depth of caudal fin notch	2.2	2.7–4.3			
Trunk at pectoral origin					
width	10.4	11.0–15.3	11.3–12.5	11.4–12.6	
height	7.6	8.8–13.4	8.6–10.2	10.6–11.2	



Fig. 2. Dermal denticles from the trunk region of *Scymnodon squamulosus* (sex and TL unknown) captured north of the Hawaiian Islands, 2 August 1987.

Discussion

Denticles of the two Hawaii specimens examined both possessed the distinctive transverse ridges described by others (Chu et al., 1982; Yano and Tanaka, 1984; Taniuchi and Garrick, 1986) and confirms the identification of these sharks. Size reported for *Scymnodon squamulosus* ranges from 246 to 840 mm TL (Cadenat and Blache, 1981; Yano and Tanaka, 1984). Males are thought to mature at between 450 and 490 mm TL, and females at about 750 mm TL (Kreffft, 1980; Yano and Tanaka, 1984). The 786 mm TL shark captured in Hawaii contained ovaries and ova similar in size and number to those described by Yano and Tanaka (1984).

They found that ovaries of mature females weighed between 15 and 110 g, and contained between three and ten developing ova that were between ten and 40 mm in diameter. The uterus width of our specimen (18.5 mm) was also similar to the uterus width (20 mm) measured by Yano and Tanaka (1984) for a 770 mm TL mature female.

Maximum depth of capture for *S. squamulosus* was reported as between 1500 and 2000 m (Compagno et al., 1989; Last and Stevens, 1994), with highest catch rates recorded between 400 and 900 m depth (Compagno et al., 1989; Yano and Kugai, 1993). This species has often been caught near the bottom in deep water trawls (Last and Stevens, 1984; Wetherbee, pers. obs.), and has a large, oil-rich liver, typical of deep-sea squaloid sharks that are closely associated with the sea floor (Higashi et al., 1954; Kobayashi, 1986). However, catches in midwater trawls (Kreffft, 1980; Cadenat and Blache, 1981) and on pelagic longlines (Taniuchi, 1990; Last and Stevens, 1994) have also been recorded. The capture of specimens very close to the surface in Hawaii is also indicative of a pelagic component of behavior for this species. The observation that these sharks are not restricted to the bottom may explain their wide distribution and presence in an area as isolated as the Hawaiian Islands, which are 4000 km from the nearest continent.

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