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Etmopterus baxteri, a Junior Synonym of *E. granulosus* (Elasmobranchii, Squalidae)

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Abstract The small holotype of *Etmopterus granulosus* is different in morphometrics from the large holotype of *E. baxteri*, but agrees well with small specimens of *E. baxteri*. The dermal denticles of these species show no differences. These facts indicate that *E. baxteri* is a junior synonym of *E. granulosus*.

The purpose of this account is to provide evidence for establishing that *Etmopterus baxteri* GARRICK, 1957, from New Zealand is a junior synoym of *E. granulosus* (GÜNTHER, 1880) from the southwestern coast of South America.

GÜNTHER (1880) described the dermal denticles from the side of the body of *E. granulosus* as being granular. This description of the denticles was accepted by later authors, including BIGELOW and SCHROEDER (1957) when describing *E. bullisi* and GARRICK (1957) when describing *E. baxteri*, as a valid character which could readily separate *granulosus* from their new species. However, more recent studies revealed that the denticles of *E. granulosus* are not granular but instead are rather slender and conical-cusped (KREFFT, 1968; COMPAGNO, 1984), as they are in *E. baxteri*. These findings led us to review the validity of *E. granulosus* and *E. baxteri*, because these two species closely resemble each other.

We examined the holotype of *E. granulosus* (=*Spinax granulosus* GÜNTHER, 1880, p. 19, pl. 2, fig. C) in the British Museum (Natural History) (BMNH) and the holotype of *E. baxteri* in the National Museum of New Zealand (NMNZ). In addition, we also studied many specimens of *Etmopterus baxteri* which were collected from New Zealand waters and preserved in NMNZ and the National Science Museum, Tokyo (NSMT). Identification of *E. baxteri* was made from the holotype and from GARRICK's descriptions (GARRICK, 1957, 1960). As a result of our studies, we here synonymize *E. baxteri* with *E. granulosus*.

Materials and Methods

Specimens examined. *Etmopterus granulosus*: Holotype of *Spinax granulosus*, BMNH 1879.5.14.460, juvenile male, 247 mm in total length (TL), southwestern coast of South America (Chile), 220 m in depth, by voyage of H. M. S. Challenger.

E. baxteri: Holotype, NMNZ–P 1950, adult female, 742 mm TL, south of Kaikoura, New Zealand, 915 m in depth, by Mr. R. Baxter, Nov. 1955. Other specimens: NMNZ–P 1419, one male and four females, 187–290 mm TL, Hikurangi Trench; NMNZ–P 2967, female, 263 mm TL, Cook Strait; NSMT–P 41563, female, 236 mm TL, NSMT–P 41564, male, 239 mm TL, NSMT–P 41565, female, 204 mm TL, NSMT–P 41566, female, 263 mm TL, east of New Zealand (41°29′S, 164°12′W), 923–874 m in depth, by R/V Shinkai-maru, April 4, 1985; NSMT–P 42524, male, 501 mm TL, NSMT–P 42525, male, 336 mm TL, east of New Zealand (44°39′S, 172°53′E), 476–515 m in depth, March 8, 1983; NSMT–P 42824, male, 522 mm TL, NSMT–P 42825, male, 516 mm TL, NSMT–P 42826, female, 672 mm TL, NSMT–P 42827, female, 624 mm TL, NSMT–P 42828, embryos, two males and two females, 178–200 mm TL, south of New Zealand (48°51′S, 167°24′W), 629–633 m in depth, Oct. 23, 1983; NSMT–P 42929, one male and five females, 223–275 mm TL, east of New Zealand (43°59′S, 177°46′E), 779–780 m in depth, Mar. 12, 1983; NSMT–P 43166, male, 373 mm TL, south of New Zealand (48°51′S, 167°22′E), 632–585 m in depth, Apr. 13, 1983.

E. princeps: FUMT (Department of Fisheries, University Museum, University of Tokyo)–P 10842, 4 near-term embryos (three males and one female, collected from a female 730 mm TL), 172–176 mm TL, Western Atlantic Ocean (57°07′N, 19°46′W), 830–915 m in depth, July 3, 1986 (formerly deposited in Institut für Seefischerei, Zoologisches Museum, Universität Hamburg (ISH)).

Proportional measurements follow YAMAKAWA *et al.* (1986) except for overall length of dorsal fins. In this study, overall length was measured from the origin of the exposed dorsal spine to the rear tip of the fin.

Results and Discussion

Proportional dimensions. Proportional dimensions in percentage of total length of wide size range of non-type specimens identified by us as *E. baxteri*, plus those of the holotypes of *E. granulosus* and *E. baxteri* are shown in Table 1. These data for non-type specimens agree with those of *E. baxteri* in the descriptions of GARRICK (1957, 1960) provided that changes with growth are taken into account. As noted by GARRICK (1960), the proportions of *E. baxteri* show remarkable changes with growth. For example, lengths from the snout tip to the pelvic fin and to the second dorsal fin, interspace between the first and the second dorsal fins, interspace between the pectoral and the pelvic fins, and overall length of the pelvic fins increase in proportion with growth. On the contrary, proportions of dorsal lobe length of the caudal

Table 1. Proportional dimensions in percentage of total length of the holotypes of *E. granulosus* and *E. baxteri* and those of wide size range of non-type specimens. Figures in parentheses indicate the mean value of the specimens examined.

Cat. No.	Holotype of *E. granulosus* BMNH 1879.5.14.460	non-type specimens (collected from New Zealand waters)				Holotype of *E. baxteri* NMNZ-P 1950
Total length (mm)	247	178–200 (187) (embryos, N=4)	187–373 (261) (N=18)	501–522 (513) (N=3)	624–672 (N=2)	742
Snout tip to:						
outer nostrils	1.5	1.5– 1.9 (1.7)	1.3– 2.2 (1.7)	1.3– 1.5 (1.4)	1.3	1.2
eye	6.0	5.1– 6.1 (5.6)	5.1– 6.6 (5.9)	4.0– 4.6 (4.4)	4.3– 4.4	4.2
spiracle	13.4	13.6–14.5 (14.0)	13.1–14.9 (13.9)	12.6–13.0 (12.8)	12.2–12.4	11.4
mouth	11.1	11.0–11.8 (11.4)	9.7–11.4 (10.9)	9.2–10.1 (9.5)	9.6– 9.8	8.3
1st gill opening	21.4	19.4–20.7 (20.0)	17.1–20.4 (19.4)	18.4–19.4 (18.9)	17.9–18.2	16.1
5th gill opening	23.8	21.9–23.7 (22.9)	21.9–24.1 (23.0)	21.8–22.8 (22.4)	20.7–21.0	20.7
pelvic origin	52.6	52.1–53.1 (52.7)	48.3–55.0 (51.8)	53.5–54.3 (54.0)	57.1–58.0	57.4
1st dorsal origin	35.5	33.0–34.8 (34.0)	31.6–36.0 (34.3)	33.9–34.9 (34.4)	35.7–36.3	34.9
2nd dorsal origin	61.8		58.2–64.0 (61.0)	64.5–64.9 (64.7)	67.8–70.0	68.2
upper caudal origin	77.3	75.0–76.5 (75.7)	72.8–78.0 (75.1)	77.4–77.9 (77.7)	80.8–82.1	81.6
Distance between bases:						
1st and 2nd dorsal	23.1		20.9–24.3 (22.6)	25.2–26.7 (26.2)	28.0–28.5	28.8
2nd dorsal and caudal	10.1	8.5–10.0 (9.4)	8.3–11.4 (9.5)	8.1– 9.4 (8.6)	8.5– 8.6	9.0
pectoral and pelvic	25.0	25.0–28.7 (26.7)	22.4–25.6 (24.0)	27.3–27.7 (27.5)	28.8–29.3	33.2
pelvic and caudal	15.9	13.7–15.4 (14.5)	12.6–15.8 (14.2)	13.8–14.8 (14.3)	13.8–14.0	14.2
Nostrils: distance between inner corners	3.6	2.8– 3.4 (3.1)	2.7– 3.5 (3.3)	2.8– 3.1 (2.9)	2.7– 2.8	3.0
Mouth: width	9.8	8.6– 9.9 (9.1)	8.9–10.6 (9.9)	9.1–10.2 (9.7)	10.4–10.6	9.2
Eye: horizontal diameter	7.2	6.4– 6.8 (6.5)	5.9– 7.4 (6.6)	5.5– 6.1 (5.8)	5.1– 5.2	5.6
1st dorsal fin:						
overall length	9.8	8.4– 9.5 (9.1)	7.6–10.0 (9.2)	9.2–10.1 (9.8)	9.9–10.1	8.2
length of post. margin	5.6	4.7– 5.8 (5.2)	4.4– 5.9 (5.0)	5.2– 5.4 (5.3)	5.0– 5.2	4.2
height	3.5	3.1– 4.5 (3.6)	3.0– 4.2 (3.4)	3.8– 4.1 (3.9)	3.4	2.7
2nd dorsal fin:						
overall length	11.3		9.5–11.5 (10.3)	10.7–11.0 (10.9)	10.3–10.4	9.7
length of post. margin	6.7	4.7– 5.7 (5.0)	4.8– 7.1 (5.6)	5.2– 5.4 (5.3)	5.4– 5.5	4.2
height	4.5	4.3– 5.5 (4.7)	3.2– 5.0 (4.3)	4.4– 4.5 (4.5)	3.8– 3.9	3.6
Pectoral fin:						
length of ant. margin	10.2	8.8– 9.4 (9.2)	8.7–11.6 (10.3)	10.2–10.7 (10.5)	10.3–10.4	9.3
Pelvic fin:						
overall length	11.1	8.7–10.0 (9.6)	9.7–11.1 (10.5)	12.0–12.2 (12.1)	12.7–12.9	10.3
length of base	7.2	5.3– 6.9 (6.1)	6.0– 7.8 (6.7)	6.0– 7.8 (7.0)	8.2– 8.3	8.1
Caudal fin:						
dorsal lobe length	24.4	24.0–25.3 (24.7)	23.5–26.8 (24.9)	23.3–24.4 (23.7)	21.3–22.0	18.6
ventral lobe length	13.0	11.1–12.3 (11.6)	11.7–15.0 (13.0)	12.8–13.6 (13.3)	11.9–12.1	10.0

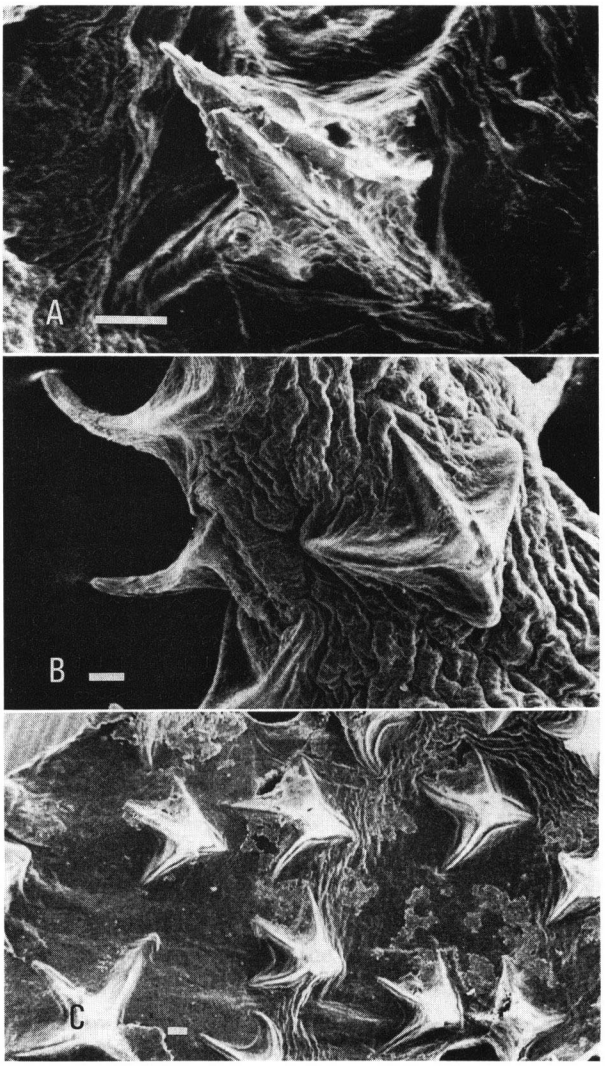

Fig. 1. Dermal denticles of the trunk below 1st dorsal fin of *Etmopterus granulosus*. A: NSMT–P 43166, male, 373 mm TL. B: NSMT–P 42525, male, 336 mm TL. C: NSMT–P 42826, female, 672 mm TL. Each scale bar indicates 100 μm.

fin and horizontal diameter of the eyes decrease with growth. Data for the holotype of *E. granulosus* (247 mm TL) generally fall within the range of values for comparable size of *E. baxteri* (187–373 mm TL), and the few exceptions to this are minor. The holotype of *E. baxteri* is larger than any of our specimens, and hence it is not surprising that many of its proportions are slightly different from those of our non-type specimens, but again those differences are generally in accord with growth change

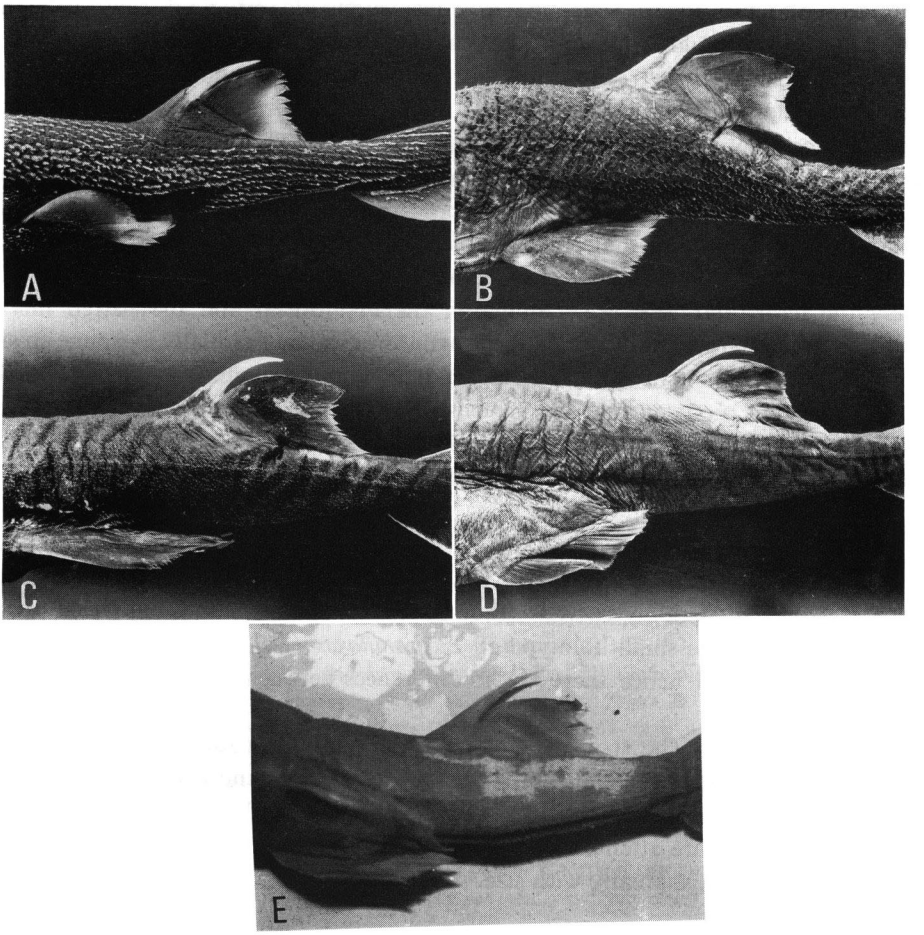

Fig. 2. Flank marking and 2nd dorsal fin spine of *Etmopterus granulosus*. A: NSMT–P 42828, male embryo, 178 mm TL. B: NSMT–P 42929, female, 275 mm TL. C: NSMT–P 42524, male, 501 mm TL. D: Holotype of *E. baxteri*., NMNZ–P 1950, female, 742 mm TL. E: Holotype of *E. granulosus*, BMNH 1879.5.14.460, male, 247 mm TL.

trends. The greatest difference is a considerably larger pectoral-pelvic interspace, about 4% TL larger than in our largest specimen (female, 672 mm TL), but this may be a reflection not only of the trend for this to increase relatively with growth but also of the fact that the holotype was a gravid female and that the abdomen is longer in large females.

Dermal denticles. In all specimens examined, we could not find any dermal denticles lacking conical cusps or truncated. All denticles of *E. granulosus* and *E. baxteri* have more or less slender conical cusps. In *E. baxteri*, the cusps of smaller specimens are more slender than those of larger ones (Fig. 1). In small specimens.

there are about 5 to 10 wide-spaced, conspicuous, longitudinal rows of dermal denticles on the caudal fin and the caudal peduncle (Fig. 2). On the dorsal side of the trunk, these regular rows become gradually random anteriorly, and on the dorsal side of the head the denticles are arranged randomly. They are also arranged randomly on the ventral side of the trunk. These patterns do not differ greatly with increasing size of the specimens, although the density of the denticles increases with growth and the regular arrangement becomes less obvious. In large embryos, denticles are absent from the ventral side of the snout, from the second dorsal fin, around the axilla of the pectoral fins, around the dorsal fin bases, and where the flank markings are. Similarly, the first dorsal and the paired fins are almost naked in large embryos. With growth, these areas gradually become covered with denticles, so that in specimens larger than about 500 mm TL, the only naked areas are on the snout around the nostrils and the lips, in the axilla of the pectoral fins, and on the dorsal fin bases. Dermal denticles of the holotype of *E. granulosus* are of the same size and shape, and distributed and arranged in the same way, as in *E. baxteri* of about the same body size.

Second dorsal fin spine. The second dorsal fin spine is very long, stout, and strongly curved in large specimens of *E. baxteri*, but in smaller specimens and embryos it is only moderately curved although still fairly long and stout. The second dorsal fin spine in the small holotype of *E. granulosus* (247 mm TL) is like that of small *E. baxteri* and hence there are no differences between these species in that respect (Fig. 2).

Flank marking. The specimens of *E. baxteri* possess a long anterior branch of the flank marking which extends above the pelvic fin base, and a very short posterior branch which is nearly triangular in shape. Although the flank marking appears at first sight to be more attenuated in some specimens, its shape is relatively constant and it does not change greatly with size. The shape is almost identical with that of *E. granulosus* (Fig. 2).

Distribution. Present study reveals that *E. granulosus* is distributed off Chile and off New Zealand. COMPAGNO (1984) mentioned that *E. granulosus* is distributed in Falkland/Malvinas Islands, southern Argentine, Straits of Magellan, southern Chile, and Cape of Good Hope, South Africa. GOLVAN and PAKHORUKOV (1986) reported the occurrence of *E. baxteri* on the submarine ridge of Sierra-Leone (6°50′N, 22°00′W) at a depth of 1350 m. Therefore, *E. granulosus* is thought to show a wide range of distribution chiefly in deep waters of the southern hemisphere.

Remarks. Another species of the genus, *E. princeps*, which is distributed in the Atlantic Ocean, also resembles *E. baxteri* in its proportional dimensions. GARRICK (1960) discussed the differences between these two species. Although he retained them as separate species, he noted that further examination and comparison of both species are needed. We examined some specimens of *E. princeps* collected from the Atlantic Ocean and deposited in FUMT, and found that these specimens lack the

distinct flank marking which exists in the specimens of *E. granulosus* and *E. baxteri*. So, we agree with GARRICK (1960)'s conclusion that *E. princeps* is not conspecific with *E. granulosus*.

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References

BIGELOW, H. B., & W. C. SCHROEDER, 1957. A study of the sharks of the suborder Squaloidea. *Bull. Mus. comp. Zool.*, **117**: 1–150, pls. 1–4.

COMPAGNO, L. J. V., 1984. FAO species catalogue. Vol. 4. Sharks of the world. An annotated and illustrated catalogue of shark species known to date. Part 1. Hexanchiformes to Lamniformes. *FAO Fish. Synop.*, (125), **4**: 1–249.

GARRICK, J. A. F., 1957. Studies on New Zealand Elasmobranchii. Part VI. Two new species of *Etmopterus* from New Zealand. *Bull. Mus. comp. Zool.*, **116**: 171–190.

——— 1960. Studies on New Zealand Elasmobranchii. Part XI. Squaloids of the genera *Deania*, *Etmopterus*, *Oxynotus* and *Dalatias* in New Zealand waters. *Trans. R. Soc. N. Z.*, **88**: 489–517.

GOLVAN, G. A., & N. P. PAKHORUKOV, 1986. New records of rare species of cartilaginous fishes. *J. Ichthyol. USSR*, **26**(2): 117–120.

GÜNTHER, A., 1880. Report on the shore fishes procured during the voyage of H.M.S. Challenger in the years 1873–1876. *Rep. Sci. Res. Voy. H. M. S. Challenger, Zoology*, **1**(6): 1–82, pls. 1–32.

KREFFT, G., 1968. Neue und erstmalig nachgewiesene Knorpelfische aus dem Archibenthal des Südwestatlantiks, einschließlich einer Diskussion einiger *Etmopterus*-Arten südlicher Meere. *Arch. Fischereiwiss.*, **19**: 1–42.

YAMAKAWA, T., T. TANIUCHI & Y. NOSE, 1986. Review of the *Etmopterus lucifer* group in Japan. *In* UYENO, T., R. ARAI, T. TANIUCHI and K. MATSUURA (eds.), *Indo-Pacific Fish Biology: Proceedings of the Second International Conference on Indo-Pacific Fishes*, pp. 197–207. Ichthyological Society of Japan, Tokyo.