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Occurrence and Reproductive Mode of the False Cat Shark, *Pseudotriakis microdon*, in Japan

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The false cat shark is easily distinguished from other sharks in having the 1st dorsal fin longer at base than caudal fin. Two species of the genus *Pseudotriakis* have been recognized; that is, *P. microdon* Brito Capello, 1868 and *P. acrales* Jordan et Snyder, 1904. Garman (1913) emended *acrales* in the original description as *acrages* because the specific name originated in "speechless" in Greek should be spelled as *acrages,* but we here use *acrales* as in the original description. *P. microdon* has been recorded in both sides of the North Atlantic and Indian Ocean while *P. acrales* has been reported from Japanese and Hawaiian waters (Bass et al., 1975). Two specimens of *Pseudotriakis* were captured with deep-sea bottom longline operated by T/V Seisui-maru, Mie University, at depths of 380 and 468 m in the Sea of Kumanonada, Japan. The female specimen carried one embryo in each uterus. According to a key to species of *Pseudotriakis* given by Bigelow and Schroeder (1948: 229), four specimens including the embryos fall into *P. microdon,* although *P. acrales* was described from Japan. We examined a developmental mode of an embryo by dissecting its abdomen. We found both external and internal yolk sacs in the near-term embryo, resulting in denial of a possiblity of oophagy that had previously been suggested by Forster et al. (1970).

Materials and methods

We examined two adult specimens and two embryos: male, 228 cm TL, collected on January 24th, 1982, at a depth of 468 m, Kumanonada; a female, 265 cm TL, on January 23rd, 1981, at a depth of 380 m, Kumanodada; and two male embryos, 112 cm and 113 cm TL. A mounted skin of the male specimen and two embryos are deposited in Toba Aquarium and Faculty of Fisheries, Mie University, respectively. Measurements were made in fresh state. Methods of measurements followed those used by Bigelow and Schroeder (1948). One embryo was dissected after measurements. For light microscopy, the umbilical stalk was fixed with 10% formalin. Tissue was prepared by usual parafin method sectioned to 5 μm and stained with Mayer's hematoxylin and eosin solution.

Results and discussion

Proportional dimensions expressed in percentage of total length are given in Table 1. These measurements nearly coincide with those of *P. microdon* presented by Cadenat and Blache (1981). The key to species by Bigelow and Schroeder (1948) distinguishes *microdon* from *acrales* in the combination of the following characters: caudal only about 1/5 of total length (1/4 in *acrales*); origin of anal considerably posterior to origin of 2nd dorsal (originally Bigelow and Schroeder used 1st dorsal in stead of 2nd dorsal); distance from tip of snout to angle of mouth about 1/2 as long as from snout to 5th gill opening (1/4 in *acrales*); length of snout in front of mouth about 1/2 as great as width of mouth (1/3 in *acrales*). Four specimens show the following characters: caudal fin 19.8, 19.8, 18.9, 18.6% of total length; anal origin posterior to 2nd dorsal origin by 2.9, 2.7, 3.4, 3.6% of total length; distance from tip of snout to angle of mouth 0.49, 0.49, 0.42, 0.51 as long as from snout to 5th gill opening; length of snout 0.58, 0.51, 0.43, 0.59 as great as width of mouth. These figures indicate that our specimens are clearly *P. microdon* according to the key by Bigelow and Schroeder (1948). In addition, pictures of our specimens (Figs. 1, 2) resemble those figured by Brito Capello (1868a, b), Bigelow and Schroeder (1948), and Cadenat and Blache (1981) much more than those of Jordan and Snyder (1904) in the position of 1st dorsal fin and interspace between pelvic and anal fins. For these reasons, we here identify our specimens as *P. microdon.* However, our specimens share distinctive characters of both species given by Jordan and Snyder (1904) who made morphometric comparisons of the type of *P. acrales* with a specimen of *P. microdon* based on the account published by Bean (1884). A specimen under the name *P. acrales* reported from Formosa by Teng (1962) seems to be conspecific with our specimens. *P. acrales* is

Fig. 1. *Pseudotriakis microdon*, a male, 228 cm TL, caught in Kumanonada, Japan.

Table 1. Proportional dimensions expressed as percentage of total length in *P. microdon* caught in Kumanonada.

	Embryo		Adult	
Sex	male	male	female	male
Total length	112 cm	113 cm	265 cm	228 cm
Body weight	6.1 kg	6.9 kg	98.0 kg	39.5 kg
Snout tip to:				
outer nostril	3.9	3.4	4.2	3.9
eye	7.0	7.1	6.0	5.7
spiracle	11.1	10.8	10.0	9.3
mouth	5.2	5.0	4.4	4.8
1st gill opening	17.1	15.9	15.5	14.8
5th gill opening	20.9	19.6	20.8	19.1
pectoral origin	21.1	19.8	20.8	18.4
pelvic origin	56.3	54.9	56.6	54.7
1st dorsal origin	35.7	37.2	32.1	34.6
2nd dorsal origin	63.4	63.7	64.2	65.3
anal fin origin	66.3	66.4	67.6	68.9
upper caudal origin	81.3	80.5	80.0	81.4
Nostril:				
distance between inner corners	4.9	5.3	4.4	4.2
Mouth:				
width	8.9	9.9	10.2	8.1
length	5.2	4.6	4.5	5.0
Gill opening:				
1st	2.7	2.7	1.9	—
3rd	2.7	2.7	—	—
5th	1.8	1.9	1.5	—
Eye:				
horizontal diameter	3.4	3.5	2.3	2.3
1st dorsal fin:				
length of base	20.5	18.1	22.6	20.2
height	3.4	3.3	3.8	2.2
2nd dorsal fin:				
length of base	13.8	14.2	12.8	—
height	6.4	6.7	7.9	—
Anal fin:				
length of base	9.0	8.9	—	—
height	3.5	4.0	—	—
Caudal fin:				
length of upper caudal	19.8	19.8	18.9	18.6
length of lower caudal	8.9	9.6	8.3	7.7

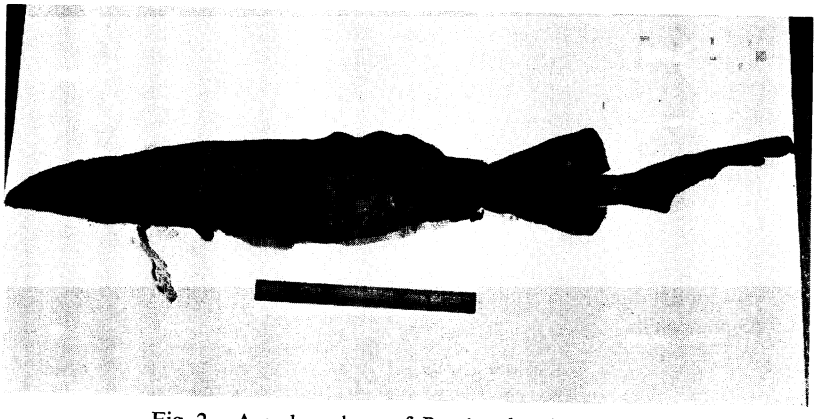

Fig. 2. A male embryo of *P. microdon*, 112 cm TL.

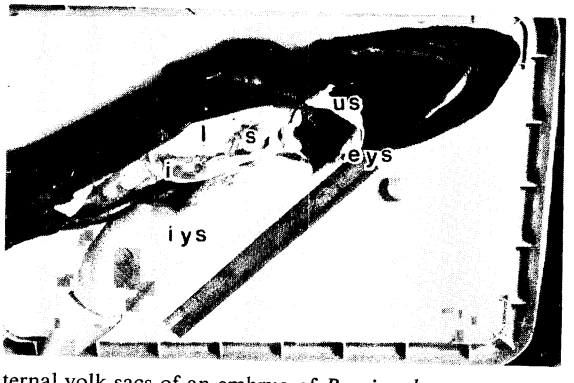

Fig. 3. External and internal yolk sacs of an embryo of *P. microdon*. eys, external yolk sac; iys, internal yolk sac; i, intestine; l, liver; s, stomach; us, umbilical stalk.

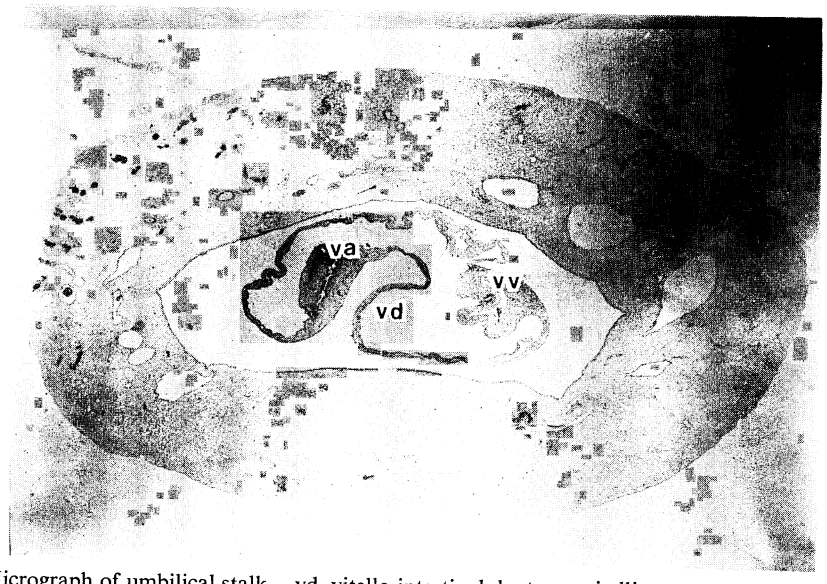

Fig. 4. Micrograph of umbilical stalk. vd, vitello-intestinal duct; va, vitelline artery; vv, vitelline vein.

probably a junior synonym of *P. microdon* as suggested by Cadenat and Blache (1981) because there are great variations in proportional measurements within *P. microdon*.

We also examined a developmental mode of an embryo. As seen in Figs. 2 and 3, an external yolk sac of 50 mm in diameter was apparently observed. It connected with the abdomen of the embryo by an umbilical stalk, which was 75 mm in length and 16 mm in diameter, arising at the thoracic region. The umbilical stalk included a vitello-intestinal duct and two chief blood vessels in the central portion; vitelline artery and vein (Fig. 4). A wide space occurred between the inner and outer coasts as reported in *Squalus acanthias* (see TeWinkel, 1943) and *Etmopterus lucifer* (see Iwai, 1957). When the abdominal portion was dissected, the external yolk sac was found to connect with an internal yolk sac entering the anterior bend of the duodenum. No contents were observed in its stomach.

The mode of reproduction in *P. microdon* is said to be aplacental viviparity (Cadenat and Blache, 1981). According to Wourms (1977), there are three types of aplacental viviparity; dependent solely on yolk reserves, oophagy, and placental analogues. Forster et al. (1970) demonstrated a possibility of oophagy in *P. microdon* on the basis of the examination of three mature females caught in the Indian Ocean. They observed numerous oocytes measuring 9 mm in mean ovum diameter. In addition, they reported that one embryo measuring 79 mm TL in each oviduct of the 2,565 mm specimen was found to have a yolk sac of approximately 50 mm in diameter. These facts imply, according to Forster et al. (1970), that *P. microdon* is oophagous because their observation appeared to be consistent with the form of embryo development in *Carcharias taurus* described by Springer (1948). However, embryos of oophagous species have a stomach full of egg yolk material (Lohberger, 1910; Shann, 1923; Springer, 1948; Otake and Mizue, 1981; Fujita, 1981). Furthermore, near-term embryos of oophagous sharks have neither internal nor external yolk sacs since yolk reserves are absorbed in the early stage of development. These features of oophagy are not consistent with our observations on the embryo of *P. microdon*. Therefore, it is concluded that *P. microdon* is not oophagous but a type of placental analogues among aplacental viviparity. There is a possibility that size at birth is variable from place to place, judging from a report on the presence of a 96 cm free-swimming shark.

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熊野灘に出現したオシザメ属の1種 *Pseudotriakis microdon* とその生殖様式

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熊野灘でオシザメ属の雄と雌それぞれ一尾を採集した．雌には左右の子宮に一尾ずつの雄の胎仔がみられた．この4尾の標本は，Bigelow と Schroeder (1948) のオシザメ属の検索に従えば，*Pseudotriakis microdon* と同定された．胎仔を解剖した結果，外卵黄のうとつながる内卵黄のうが存在し，また胃袋は空であったので，Forster ら (1970) が指摘した食卵性の可能性は否定され，placental analogues 型の非胎盤型胎生であることが分った．

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