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Redescription of Trichiurid Fish *Tentoriceps cristatus* and Its Occurrence in the South China Sea and the Straits of Malacca

Tetsushi Senta

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Abstract *T. cristatus*, which has not been reported since Klunzinger (1884) first recorded the fish from the Red Sea, commonly occurs in the South China Sea and the Straits of Malacca. A developed cranial crest characterizes the fish. Other taxonomically important characters are: caudal absent, dorsal spines 5, pyloric caeca 11～13, vertebrae on trunk 45～48, pectoral fins short not reaching lateral line, ventral fins situated below 9～12th dorsal ray, anal origin below 47～50th dorsal ray, 2nd infraorbital present. The biological minimum size seems to be around 30 cm in total length. Small fishes constitute a main food category of the species, followed by small-sized crustaceans and squids.

Tentoriceps cristatuts (Klunzinger) has long been a phantasmal fish. Nobody has collected the fish since Klunzinger (1884) reported his *Trichiurus cristatus* from the Red Sea ninety years ago. Whitley (1948) established a new genus *Tentoriceps* for the fish and Tucker (1956) gave a diagnosis of the genus in his revision of the trichiurid fishes, however, nothing new was added to Klunzinger's description on the fish and many taxonomically important characters are left unknown. Unfortunately, Klunzinger's syntypes in his private collection have been missing (Tucker, 1956).

Since January 1970, the research vessel Changi of the Research Department, Southeast Asian Fisheries Development Center, has carried out exploratory trawl fishing in the South China Sea and the Andaman Sea. In the course of R V Changi's surveys, it was found that *T. cristatus* is a common fish in both the seas, although they seldom enter into the cod-end of the trawl net but are caught on legs of the larger mesh of the net sleeves. A detailed description of the fish together with some biological aspects of the fish are given here.

Key to genera of the subfamily Lepidopodinae
(Modified from Tucker, 1956)

a^1 Caudal present.
  b^1 Sagittal crest confined to nape. Interorbital concave ..... *Lepidopus*
  b^2 Sagittal crest continuous from snout tip to dorsal. Interorbital convex.
    c^1 D. 87～93. Body depth 12～13 in length ..... *Evoxymetopon*
    c^2 D. 120. Body depth 20～28 in length ..... *Assurger*
a^2 Caudal absent. Sagittal crest continuous from snout tip to dorsal. Interorbital convex.
  d^1 2nd infraorbital absent. Dorsal spines 3. Pectoral fins long, extending above lateral line. Ventral fins below 15～17th dorsal ray. Anal origin below 42nd dorsal ray or in advance..... ..... *Eupleurogrammus*
  d^2 2nd infraorbital present. Dorsal spines 5. Pectoral fins short, not reaching lateral line. Ventral fins below 9～12th dorsal ray. Anal origin below 47～50th dorsal ray ..... *Tentoriceps*

Tentoriceps cristatuts (Klunzinger)
Kanmuridachi (new Japanese name)
(Figs. 1～4)

Trichiurus cristatus Klunzinger, 1884, Fische Rothen Meeres 1: 120, Taf. 13, Fig. 5a. Eventual disposal of syntypes unknown. Type locality Kosseir, Red Sea coast of Egypt.

Tentoriceps cristatus, Whitley, 1948, Rec. Aust. Mus. 22: 94.

Tentoriceps cristatus, Tucker, 1956, Bull, Brit. Mus. (N. H.) Zool. ser. 4, (3): 110～112, Fig. 17.

? *Trichiurus muticus* (non Gray), Kamohara, Fauna Nipponica, 15: 113～114, Fig. 54. Japan Sea off Yamaguchi Prefecture?

? *Trichiurus muticus* (non Gray), Iwai and Hotta, 1950, Bull. Tokushima Pref. Fish. Exp. Sta. (1950): 23～26, Figs. 1 and 2. The Pacific coast of Shikoku, Japan.

Specimens. Studies on meristic and morphometric characters are made of 21 specimens listed in Table 1. For the studies on feeding habit, fecundity and length-weight relationship, etc., 16 additional specimens, 283～530 mm in total length, caught together with RD No. 7401024 and 15 more specimens, 312～495 mm in total length, caught together with RD No. 7402001 are utilized.

Description D. V, 126～144 followed by 1 or 2 elements without rays. A. i. I, 82～91 elements not piercing the skin. P. 11. V. I. B. 7. G. R. 2～6+7～11. Vertebrae 45～48 +105～117, aggregate 152～164. Pyloric caeca 11～13, mostly 12.

Body ribbon-like, elongated, greatest depth (in region between pectoral and ventral fins) 17.2～24.1 in total length and 6.7～9.1 in preanal length*. Preanal length 2.5～2.9 in total length. Head 8.8～10.6 in total length and 3.3～4.1 in anal length. In head length, diameter of eye 5.1～6.1, snout length 2.5～2.9, length of pectoral fin 4.5～6.4. Relative measurements of bodily parts such as head length, depth of the body and length of pectoral fin change with age (Fig. 3).

Upper profile of head convex, a steep continuous curve from the tip of the snout to

Table 1. Collection records of specimens of *Tentoriceps cristatus*. All by trawl net.

Catalogue no.	Sex	Total length (mm)	Preanal length (mm)	Date	Location		Depth of sea (m)
					Lat. N	Long. E	
RD 7210006	♀	633	236	7.10.72	02°06′	104°45′	55～64
ZUMT 53025	♀	410	149	〃	〃	〃	〃
RD 7309032	♀?	303	114	29. 9.73	02°58′	104°44′	66
RD 7309035	♀	607	225	30. 9.73	02°57′	104°44′	66
RD 7309055	♀	648	237	〃	02°55′	104°43′	64～67
RD 7309056	♂	683	253	〃	〃	〃	〃
RD 7309057	♂	—	240	〃	〃	〃	〃
RD 7309058	♂	369	129	〃	〃	〃	〃
RD 7309059	♀	375	136	〃	〃	〃	〃
RD 7401008	♀	568	227	7. 1.74	05°48′	99°08′	78～86
RD 7401022	♂	621	241	16. 1.74	05°46′	99°03′	62～70
RD 7401024	♀	540	230	〃	05°47′	99°03′	66～76
RD. s. 7401	♂	530	209	〃	〃	〃	〃
RD. s. 7402	♀	462	173	〃	〃	〃	〃
RD 7402001	♂	541	210	18. 2.74	06°47′	98°42′	83～87
NSMT 17851	♂	382	146	〃	〃	〃	〃
ZUMT 53026	♀	435	168	〃	〃	〃	〃
NSMT 17852	♂	372	142	〃	〃	〃	〃
BM 1974.3.5.1	♂	496	189	〃	〃	〃	〃
BM 1974.3.5.2	♀	380	148	〃	〃	〃	〃
BM 1974.3.5.3	♂?	337	125	〃	〃	〃	〃

Note: BM, British Museum (Natural History); NSMT, Dept. Zool. National Sci. Mus. Tokyo; RD, Research Department, Southeast Asian Fisheries Development Center; ZUMT, Dept. Zool., Univ. Mus., Univ. Tokyo.

* Preanal length: distance from tip of lower jaw to anus.

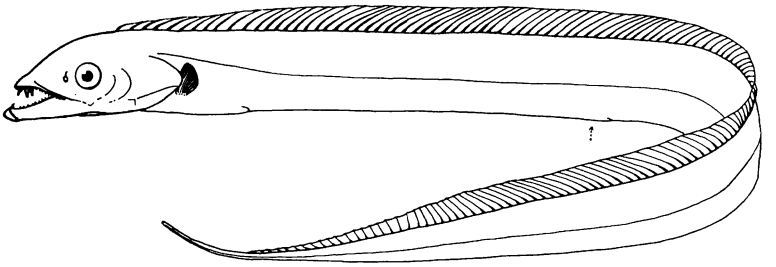

Fig. 1. *Tentoriceps cristatus* (Klunzinger), 540 mm in total length and 230 mm in preanal length.

the origin of the dorsal set at about 40° to the longitudinal axis (Fig. 1). Cranial crest formed by elevation of ethmofrontal region through the posterior confluence of the frontal crest to supraoccipital ridge (Fig. 2A and B). One nostril on each side, its dorsoposterior margin hardened. Maxillary entirely sheathed by 1st infraorbital. Posterior end of opercle acutely elliptical, reaching to middle of pectoral base. Free margin of subopercle convex. Pectoral fins short, far from reaching lateral line when stretched upward. Pelvic fins represented by a pair of scale-like structure inserted below 9～12th dorsal ray or about 2 eye-diameters behind the posterior end of pectoral base. Anal fin is externally represented by a scale-like spine which is preceded by a rudimentary spinule and followed by 82～91 elements which are recognizable only with alizarin treated specimens. The scale-like spine situated below 47～50th dorsal ray. Termination of dorsal fin extendidg 4～5 vertebrae beyond the last anal element. Caudal externally absent. Whiptail short, 1/2 head. Leateral line descending gently from the shoulder, distance from lateral line to ventral profile at anus 69～81% of distance from lateral line to dorsal. Lower jaw much prominent, a cartilaginous protuberance at its symphysis. A single series of 10～13 small pointed teeth on each side of lower jaw, anterior 1 or 2 often larger than the others. On each side of upper jaw, 12～20 small pointed teeth in an outer row; near the anterior end, 3 barbless fangs, 1 or 2 of them often missing. Vomer and tongue toothless. Palatine usually smooth, in few specimens several minute teeth near its posterior end. Gill rakers on first arch 2～6+7～11, short and spinous, with enlarged base furnished with villiform spinules under the epidermis. Gill rakers on lower limb of first arch limited on ceratobranchial; rudimentary base arranged between gill rakers and on hypobranchial, but not penetrating the epidermis (Fig. 2F).

Pterotic process well developed, extending far beyond the posterior end of supraoccipital (Fig. 2B). 2nd infraorbital present, small, slightly touching with the anterior end near the postero-ventral corner of 1st infraorbital (Fig. 2C). Branchiostegal rays 7, 4 on ceratohyal and 3 on epihyal, posteriorly increasing in length, the 1st ray short and thin, about 1/4 of the last (Fig. 2D). Foramen piercing scapula slightly oblong, its longitudinal diameter about 1/3 of longitudinal length of scapula. Pelvic girdle rudimentary, represented by a bony rod, both extremities ending in fine points; the anterior half much shorter than the posterior (Fig. 2E). Neural spines of 2nd to 4th or 5th vertebrae compressed and bifurcated, corresponding with pterygiophores for 1st to 3rd or 4th dorsal spines. Pterygiophore for 1st dorsal spine spatulate, much enlarged anteriorly, its anterior margin parallel with the posterior concavity of supraoccipital. Neural spines of 5th or 6th vertebra and onward, except for posterior ones, long and slender, each with its anterior side sticking to corresponding interneural spine. Neural spines for 6～10 posterior vertebrae transformed into irregular quadrangle. The last vertebra, urostyle, elongated conical, often with rudiment of hypural bone on its ventral side. On dorsal and ventral sides of urostyle, but only on dorsal side in some specimens, 6～13 rudimentary caudal rays present but not penetrating the skin (Fig. 2G).

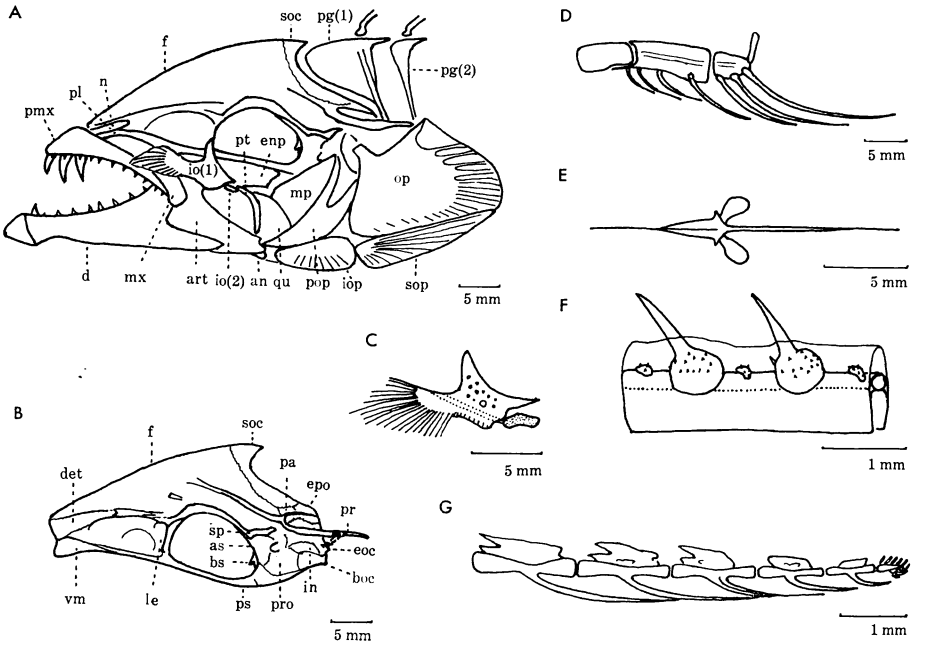

Fig. 2. Skeleton of *T. cristatus*. A, head; B, cranium; C, 1st infraorbital and 2nd (dotted); D, hyoid arch and branchiostegals; E, pelvic girdle and fins, dorsal view; F, a part of ceratobranchial to show gill rakers; G, posterior vertebrae. A～F from a specimen 530 mm in total length and 209 mm in anal length, G from a specimen 462 mm in total length and 173 mm in anal length. an, angular; art, articular; as, alisphenoid; boc, basioccipital; bs, basisphenoid; d, dentary; det, dermoethmoid; eoc, exoccipital; epo, epiotic; f, frontal; in, intercalar; io (1) and (2), 1st and 2nd infraorbitals; iop, interopercle; le, lateral ethmoid; mp, metapterygoid; mx, maxillary; n, nasal; op, opercle; pa, parietal; pg (1) and (2), pterygiophores for 1st and 2nd dorsal rays; pl, palatine; pmx, premaxillary; pop, preopercle; pr, pterotic; pro, prootic; ps, parasphenoid; pt, pterygoid; qu, quadrate; soc, supraoccipital; sop, subopercle; sp, sphenotic; vm, vomer.

In fresh specimens, color of body silvery white. Tips of upper and lower jaws, and dorsal and anal bases dark. Dorsal fin dark with a darker spot at about 18th～22nd rays in large specimens, almost hyaline in small individuals. In formalin, ground color of body silver with dark cloud-like irregular patches on dorsal half in large specimens; in small specimens nearly hyaline. Otherwise same as in fresh specimens.

Distribution The present species was first reported from the Red Sea (Klunzinger, 1884). The specimens utilized in this report were collected in the sea off the east coast of the southern Malay Peninsula where the depth of the sea ranged from 55～70 m and the salinity near bottom was 33.42～33.91‰, and in the northern part of the Straits of Malacca, 55～87 m deep and 33.15～33.91‰ in salinity. The fish has not been found in trawl catches in the northern Andaman Sea off Irrawaddy Estuary where the water depth ranged from 30～50 m and the salinity from 30.01～32.69‰.

Kamohara (1940) gave the description and illustration of *Trichiurus* (=*Eupleurogrammus*) *muticus* based upon the specimens 700～900 mm in total length probably from the Japan Sea off Yamaguchi Prefecture. Iwai and Hotta (1950) also reported the collection of 2 specimens of *T. muticus*, 858 and 863.5 mm in total length, from the Pacific coast of Shikoku, Japan. Neither specimen is *E. muticus*, but *Tentoriceps cristatus*, or a new species closely related to it (Senta, in preparation).

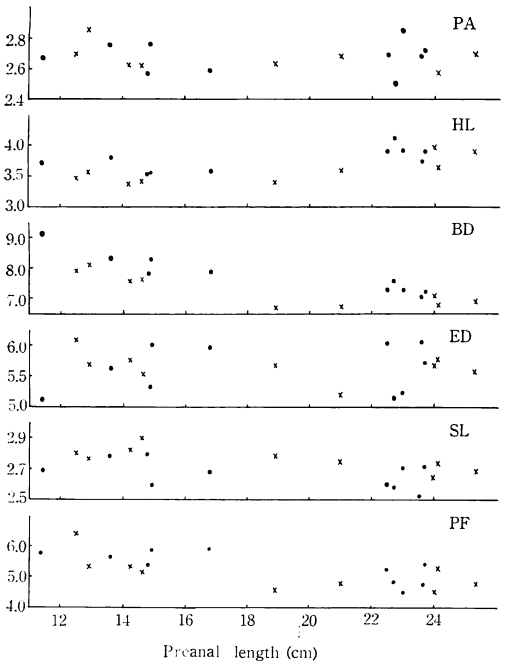

Fig. 3. Proportional measurements of body parts of male (dots) and female (crosses) *T. cristatus* of various sizes. PA, preanal length in total length; HL, and BD, head length and depth of body in preanal length; ED, SL and PF, diameter of eye, snout length and length of pectoral fin in head.

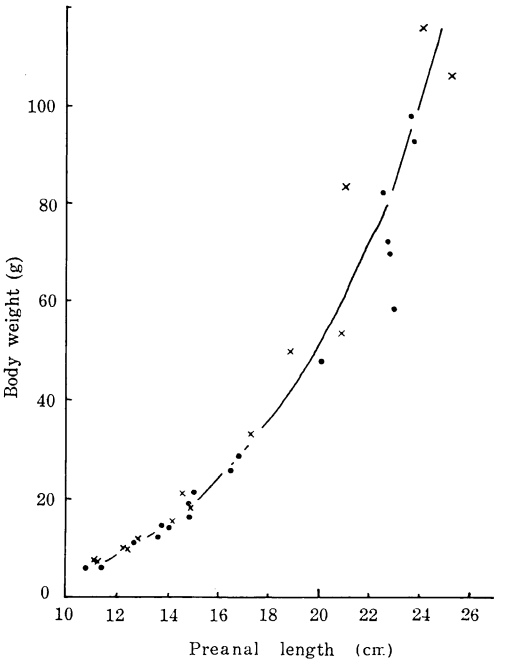

Fig. 4. Length-weight relationship of male (dots) and female (crosses) *T. cristatus*.

Notes on Biology Length-weight relationship. The specimens obtained so far ranged from 283 to 683 mm in total length and from 107 to 253 mm in preanal length. The relationship between preanal length (PA in centimeter) and body weight (W in gram) is illustrated in Fig. 4, and expressed by the formula given below.

$$W=7.201\cdot PA^{2.875}\cdot 10^{-3}\ .$$

Reproduction. Of 52 specimens examined, 28 (or 53.8%) were female and 24 (46.2%) were male. The right and left ovaries are wrapped by a single sack, although they are internally separated by a septum. Well-developed ovaries occupy the posterior half to two-thirds of the abdominal cavity, weighing 3~11% of body weight. The maximum observed value of gonad index* was 62.5. Ovarian eggs were usually separable into 2 or 3 size groups (Table 2). The 2nd and 3rd groups were observed in ovaries exceeding 20 in gonad index. Table 2 gives some examples of the count of ovarian eggs. The individual shown at the bottom of the table was the smallest specimen, only 9.1 g in body weight, which had a developed ovaries, suggesting that the biological minimum size of the fish may be around 300 mm in total length. Eggs of the third size group possessed oil globules, which were usually separated into many small ones. Only in one egg out of 71 eggs observed the oil globules had aggregated to form a single large oil globule, 0.4 mm in diameter.

Food habit. The present species feeds mainly on fishes. Of 35 individuals examined, 6 had empty stomachs. Out of remaining 29, 28 contained small fishes, which were almost exclusively slender in shape. Crustaceans occurred in 18 stomachs. They consisted of euphausid, small shrimp (*Acetes*), alima larva of squilla, and isopod. Five stomachs had juvenile squid.

Remarks Although many important characters of *T. cristatus* were not given in the

* Gonad index: Gonad weight (g)/Preanal length $(cm)^3\cdot 10^5$.

Table 2. Examples of countings of ovarian eggs by size of eggs.

Total length mm	Preanal length mm	Gonad index	Number of eggs 0.1~0.6 mm	0.7~1.0 mm	1.5~1.7 mm	Max. dia. mm	Month of collection
648	237	21.0	21260	5760	23	1.70	September
633	236	42.7	46400	9340	48	1.65	October
303	117	62.5	4650	1470	0	0.95	February

Eggs smaller than 0.1 mm were not counted.

original description (Klunzinger 1884), the present specimens agree quite well with his syntypes so far as the characters given in his paper are concerned. While Klunzinger indicated the uncertainty of the dorsal fin ray count ("D. c. 120 (?)"), the present specimens were found to have 131~149 rays, including spines.

The depth of the body of Klunzinger's 3 specimens were "20~24 (letzteres bei Aelteren)" in total length, but in the present specimens the body tends to be more elongated in the smaller specimens than in the larger ones as demonstrated in Fig. 3. From the figure, however, it may also be seen that due to individual variation a larger specimen may sometimes be more elongated than a smaller one.

According to Klunzinger's figure which illustrates only the head and pectoral fin, a deep notch of the skin exists just before the anterior end of lacrymal, and the dorsal profile is depressed in the occipital region. These, together with some confusion in the representation of the nostrils (at least 2 nostrils are represented) which was pointed out by Tucker (1956), may show that his specimens were not in a good condition and probably stuffed ones. Comparison of fig. 16 (an illustration of *Assurger anzac* (Alexander)) and plate 10 (a picture of a stuffed specimen of the same species) in Tucker's revision well demonstrates the extent and nature of distortion caused by stuffing.

To conclude, it may be reasonable to identify the present specimens as *Tentoriceps cristatus* (Klunzinger). The present species occurred commonly in R V Changi's trawl catches. However, they have not been reported, in spite of the increase in fisheries resources surveys in the region for the past decade. No *T. cristatus* was reported from the catch in the joint Thai-Malaysian-German trawling survey (Bangkok Marine Fisheries Laboratory and Malaysian Fisheries Research Institute, 1967; Wongratana, 1968), although frequent hauls were made in the area where the present specimens were collected.

A possible reason why *T. cristatus* has been missed by ichthyologists may lie in the fact that the species seldom enters the cod-end of the trawl net but is caught on legs of the mesh of the net sleeves. As they are not as big as other trichiurids, fishermen may not collect them to land in the market. Another possibility is the misidentification of the species as *Eupleurogrammus muticus* (Gray). If the key to Indo-Australian species of *Trichiurus* by Beaufort and Chapman (1951) is followed, the present species may be identified as *T. muticus* by ignoring the difference in the origin of anal (about 10 dorsal rays).

The most characteristic in the osteology of the present species is the structure of the cranial crest formed by a continuous elevation from the ethmofrontal region to the supraoccipital ridge. The same structure of the cranial crest may be expected in only 2 other trichiurid species, *Evoximetopon taeniatus* Poey and *Assurger anzac*, which have the similar dorsal profile of head as the present species, although no osteological study of them has been published. James (1961) studied comparatively the osteology of 4 trichiurid fishes, *Trichiurus lepturus*, *Leputracanthus savala* (Cuvier), *Eupleurogrammus intermedius* (Gray) and *E. muticus*. Among them only the last named had an ethmofrontal elevation, which was limited to the middle part of the ethmofrontal region, having concavities in the dorsal profile before and behind the elevation. According to the same author, the suborbital

ring of *T. lepturus* and *L. savala* consists of 3 elements, the 1st, and 2nd infraorbitals and dermosphenotic while in *E. intermedius* and *E. muticus* the 2nd infraorbital and dermosphenotic are absent. The 2nd infraorbital of both *T. lepturus* and *L. savala* is a long, delicate bent bone (something like a boomerang), situated immediately behind the 1st infraorbital, and the dermosphenotic is a crescent-shaped small bone freely suspended at the posterior margin of the orbit. Having a short tiny 2nd infraorbital and lacking the dermosphenotic, *T. cristatus* lies between the species of Trichiurinae (*T. elpturus* and *L. savala*) and the *Eupleurogrammus* species.

James (1961) also mentioned a bizarre appearance of the last vertebra due to extra growths on all sides seen in all the species studied. However, it is not mentioned and is not clear from the photomicrographs of alizarin stained posterior vertebrae of the 4 species whether any rudimentary caudal rays are present as in *T. cristatus*. Uchida (1941, 1964) reported a temporary development of caudal rays in early stages of life history of *E. muticus*, which was not observed in *T. lepturus*. At 58 mm in total length when the development of caudal rays was at its maximum, the longest rays (2 median rays) were about 6.0 mm long. Thereafter, the caudal rays degenerated, and only rudimentary hypural bones were observed in a specimen of 153 mm in total length.

The number of the abdorminal vertebrae of the present species, 45～48, is greater than that of any other ecaudate species of Trichiuridae, 32～41 as given by Tucker (1956). This, together with the fact that the present species has 5 dorsal spines, may serve for identifying the larval form of the species after a certain developmental stage, although it is known that during the development the number of trunk myotomes increases by a backward movement of the anus in trichiurid larvae (Delsman, 1926).

Delsman (1926) found 6 different kinds of trichiurid eggs from the Java Sea. The diameter of eggs of the largest kind ranged from 2.4～2.45 mm, and that of the smallest 1.55～1.65 mm. All the eggs had a single large oil globule, 0.40～0.65 mm in diameter. Judging from the most developed ovarian eggs, *T. cristatus* is considered to spawn eggs similar to those of other trichiurids.

Silas and James (1960) and James (1967) reported the occurrence of 5 Indian trichiurid species, *Trichiurus lepturus*, *Leputracanthus savala*, *L. gangetics* (Gupta), *Eupleurogrammus intermedius* and *E. muticus*, in the Gangetic Estuary, while no *Tentoriceps cristatus* is known in the estuaries and coastal waters of India nor occurred in R V Changi's catch in the water off Irrawaddy Estuary. This may show that *T. cristatus* is a more oceanic species living in more saline waters than the other ecaudate trichiurids.

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(Note. Titles in parentheses are originally given only in Japanese and put into English by the present author.)

(Research Department, Southeast Asian Fisheries Development Center, Changi, Singapore)

南支那海およびマラッカ海峡より得たカンムリダチ *Tentoriceps cristatus*

千田　哲資

カンムリダチ (新称) は Klunzinger (1884) が紅海からの3尾の標本に基いて記載して以来どこからも報告されていない．実際にはこの魚は表記の海域では底曳網で普通に採集される．オシロイダチと似て尾鰭を欠き，腹鰭は1対の鱗状片よりなり，臀鰭は鱗状の1棘のみが明らかで他の鰭条は痕跡的に皮下に埋没している．カンムリダチを近似種から分つ特徴は以下のとおりである．頭部背郭の隆起縁は吻端から背鰭起部まで連続して丸く外方にふくらむ，背鰭棘5，幽門垂11～13，軀幹部の脊椎骨45～48，胸鰭は短かく側線に達しない，腹鰭は第9～12背鰭条下にある，臀鰭起部は第47～50背鰭条下にある，第二眼下骨が存在する．全長30 cmで生物学的最小形に達する．主として魚食性であるが，小型甲殻類・イカなども食する．タチウオやオシロイダチと比べ沖合性・高鹹性のようで，陸水の影響の強い水域では得られない．

(シンガポール，チャンギ，東南アジア漁業開発センター調査部局)