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Research article

THE COMPARATIVE OSTEOLOGY OF *DEMISSOLINEA NOVAEGUINEENSIS* BURHANUDDIN AND IWATSUKI, 2003 AND *TRICHIURUS LEPTURUS* LINNAEUS, 1758 (PERCIFOMES: TRICHIURIDAE)

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ABSTRACT: The comparative osteology of hairtail fishes of *Demissolinea novaeguineensis* Burhanuddin & Iwatsuki, 2003 and *Trichiurus lepturus* Linnaeus, 1758 of the family Trichiuridae, which lack a forked caudal fin type, were studied. The characters of osteology, that are neurocranium, supraoccipital, orbital region, anal fin and vertebral column of two genera were analyzed and compared. The results revealed that the characters of osteology are valuable tools to identify the two genera under investigation and could be considered as good taxonomic criteria to differentiate the hairtail fishes without a forked caudal fin. An osteological key to genera is provided.
Key words: Trichiuridae, comparative osteology, hairtail fishes

INTRODUCTION

The trichiurid, commonly known as hairtail fishes or ribbonfishes, are benthopelagic predators inhabiting the continental shelf and slope worldwide. Their habitats in tropical and temperate regions range from estuaries to open water 1500 m in depth [7]. Adults are generally identified by their extremely elongated, laterally compressed bodies and fang-like teeth on premaxillary symphysis [5]. Although not as important commercially as their tuna and billfish relatives, some species of hairtail fishes constitute valuable fisheries in several areas of the world, such as the East China Sea, the North Indian Ocean and the Mediterranean [1, 2].

The hairtail fishes lack a forked caudal fin, caudal peduncle tapers into a hairlike process of the family Trichiuridae comprises four genera: *Eupleurogrammus*, *Lepturacanthus*, *Tentoriceps* and *Trichiurus* [7]. On the other hand, a new genus from New Guinea, *Demissolinea* was recognized by [2]. Accordingly, the family Trichiuridae lacks a forked caudal fin increases the total number of genera to five.

Eupleurogrammus and *Tentoriceps* are clearly distinguishable from *Lepturacanthus*, *Trichiurus* and *Demissolinea* by having small pelvic fins that are "reduced to scale-like processes" [2]. *Demissolinea novaeguineensis* and *Trichiurus lepturus* have been confused taxonomically because of their similar overall body appearance and coloration, resulting in their being considered as "one variable species" by many researchers. Accordingly, *D. novaeguineensis* Burhanuddin and Iwatsuki, 2003 is herein described as different species distincted from *T. lepturus* Linnaeus, 1758.

MATERIALS AND METHODS

The vertebral column, anal fin and neurocranium term followed [5, 1], and [2]. An analysis of the osteology of neurocranium, anal fin and vertebral of caudal peduncle was confirmed using a close-up monitoring system [magnified 30 times; Softex Co., Ltd., Tokyo (model No: CMBW-2)].

Material examined

The five genera of family Trichiuridae lack a forked caudal fin examined are listed below. The range of total lengths in mm, sample sizes and locality are shown in parentheses: *Demissolinea novaeguineensis* (450-475 mm, 2 specimens, New Guinea). *Trichiurus lepturus* (265-1300 mm, 10 specimens, South Carolina, Florida, Atlantic Ocean, U.S.A., Eilot, Red Sea and Venezuela). *Eupleurogrammus muticus* (252-395 mm, 10 specimens, Qingdao, East China Sea), *Lepturacanthus savala* (311-483 mm, 12 specimens, Qingdao, East China Sea and Chennai, India. *Tentoriceps cristatus*: (495- 640mm, 6 specimens, Okinawa, Japan), *T. gangeticus* FAKU S. 1626, 480 mm TL, Mandapan, India; FAKU S. 1874–1875, 300–325 mm TL, Singapore; ZSI F4811/2 (holotype of *T. gangeticus*), 444 mm TL, West Bengal, India.

T. lajor RMNH 6030 (holotype), 226 mm TL, Manado, Indonesia.*T. lepturus japonicus*: FRLM 19821, 389 mm TL, Nagasaki, Japan; MUFS 18241, 18245, 2 specimens, 970–1040 mm TL, TsushimaIs., Nagasaki, Japan; RMNH D 2040 (holotype), 945 mm TL, Shimabara, Nagasaki, Japan .*T. lepturus* ANSP 142228, 500 mm TL, South Carolina, U.S.A.; CAS 154017, 3 specimens, 360–396 mm TL, Sao Paulo, Brazil; CAS 19317, 990 mm TL, Florida, U.S.A.; CAS 19318, 600 mm TL, South Carolina, U.S.A.; CAS 20478, 3 specimens, 475–520 mm TL, Panama, Eastern Pacific; CAS 138686, 4 specimens, 462–501 mm TL, Texas, U.S.A.; CAS 138687, 2 specimens, 305– 375 mm TL, Texas, U.S.A.; CAS 54805, 5 specimens, 401–440 mm TL, Peru; FAKU S. 1190, Atlantic Ocean, U.S.A.; HUJ 4950, 2 specimens, 415–432 mm TL, Eilat, Red Sea; HUJ 11285, 1300 mm TL, Eilat, Red Sea; MUFS 18430, 770 mm TL, Mangalore, Karnataka, India; MUFS 39043, 982 mm TL, Calcutta, India; MUFS 19096, 810 mm TL, Chennai, India; USMN 188290, 513 mm TL, Florida, U.S.A.; USNM 222892, 265 mm TL, Mouth of Rio, Venezuela; USNM 272932, 3 specimens, 305–520 mm TL, Florida, U.S.A.; USNM 300462, 700 mm TL, Caribbean Sea, Belize, U.S.A .*T. malabaricus* : BMNH 1867.5.30.2 (syntype), 352 mm TL, Cochin, India. *T. margarites*: IOCAS 83-1174 (holotype), 792 mm TL, Sanya, South China Sea.

RESULTS AND DISCUSSION

Diagnostic Features of the Genera:

Body remarkably elongated and compressed, caudal fin absent, body tapering to a hair-like tail; A single naris on each snout; mouth large, with an nonprotrusible upper jaw; lower jaw extending beyond the tip of the upper jaw and bearing a pair of small anterior fangs; a single lateral line; lateral line descending steeply from the head and reaching close to the ventral and parallel with ventral contour of body to end of caudal peduncle; single dorsal fin extending about 90% of total body length; posterior and ventral margins of the opercle, subopercle, and interopercle are strongly splintered or fimbriated; a longer pterotic with the posterior tip terminating beyond the posterior margin of neurocranium; a coracoid with a well-developed plate bearing a convex ventral margin that extend beyond the posterior margin of the fourth actinost [8, 7, 5, 2, 4].

The structure osteology of *Eupleurogrammus* and *Tentoriceps* are not further compare in this study because both clearly distinguishable from *Demissolinea* and *Trichiurus* by having the small pelvic fins reduced to scale-like proses.

Neurocranium

Very elongated, narrow shaped of the skull reflects the highly carnivorous nature of these fishes. In dorsal view, the neurocranium of the trichiurids is triangular, being narrow anteriorly and wider posteriorly (Fig.1). The neurocranium in the *Trichiurus lepturus* and *Demissolinea novaeguineensis* is long and narrow, broadest at the posterior end. The dorsal surface is flat in *T. lepturus* while it is concave in *D. novaeguineensis*. The orbits are large in *T. lepturus* about 1/3 length of neurocranium while they are small in *D. novaeguineensis* measuring less than 1/3 of the neurocranium

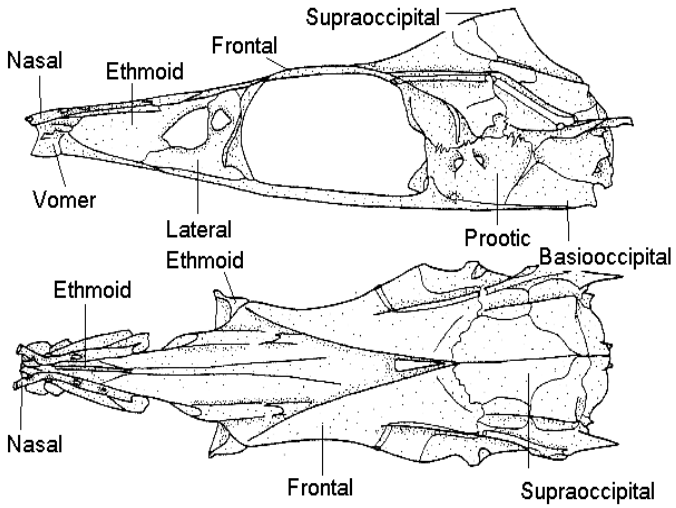

Fig. 1. Lateral and dorsal views (top and bottom, respectively) of the neurocranium of the family trichiuridae (*Trichiurus lepturus*).

Supraoccipital

The supraoccipital is a median bone forming the posterodorsal corner of the neurocranium. It is convex above, broadest in the middle and narrower at either ends (Fig. 2). The posterior end of supraoccipital is blunt in *D. novaeguineensis* but sharp point in *T. lepturus*. [7] Reported that some specimens of *T. lepturus* from waters around India show extreme ossification of supraoccipital bone.

The paired frontals from the largest portion, approximately 2/3 of the dorsal roof of the skull. Anteriorly, the frontal attaches to the nasal, ethmoid, and lateral ethmoid. Posteriorly, it articulates with the pterosphenoid, sphenotic, parietal, and supraoccipital. Medially, the frontals are joined to each other. The posterior confluence of the frontals is elevated in *T. lepturus* to a low crest which is least developed in *D. novaeguineensis*. The parasphenoid is more or less similar shape in *D. novaeguineensis* and *T. lepturus* species.

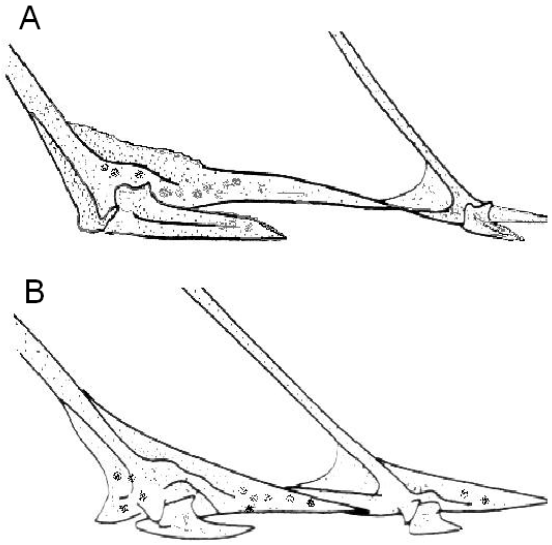

Fig. 2. Morphology of first anal fin spine elements. A, *Demissolinea novaeguineensis* (RMNH 24619, 475 mm TL) and B, *Trichiurus lepturus* (ANSP 142228, 500 mm TL).

Anal fin

The anal fin commences slightly behind the vent and runs midventrally towards the tip of the tail. The first anal spine in *T. lepturus* is spinous in appearance but triangular in cross section, length less than half of dermal eye opening and the base situated below 42nd to 44th dorsal-fin ray base. This spine is much longer in *D. novaeguineensis* than in *T. lepturus* and the first anal fin spine base situated below 37th to 41st dorsal-fin ray base.

In *D. novaeguineensis*, the first anal spine long and dagger-shaped, while in *T. lepturus*, enlarged and short [2]. The anal-soft rays of *Demissolinea* and *T. lepturus* are reduced to spinule-like processes that are not branched or segmented. These spinules are triangular shaped in cross section and resembles the morphology of the first anal spine.

Vertebral column

All the trichiurids with a well-developed caudal skeleton bear an ultimate centrum that has undergone flexion and forms a urostyle. The vertebral column of the hairtail fishes exhibits a remarkable simplicity when compared to many scombroid fishes. The vertebrae are more or less short in the anterior region and progressively long posteriorly to tip of the caudal peduncle. *T. lepturus*, in which the tail is more filamentous and hair-like, when compared to *D. novaeguineensis* (Fig. 3 A and B).

The neural of *D. novaeguineensis* and *T. lepturus* are shorter and smaller than hemal, slender terminating in sharp points, hemal canals are big in the anterior caudal vertebrae, decreasing in size towards the caudal peduncle end. The ribs are very fragile and thin, lining the abdominal cavity or extending the full distance of trunk.

In *D. novaeguineensis*, caudal peduncle vertebrae short and bearing neural spine (except ultimate), the last four penultimate centra bearing one long and two short neural spine on the middle of dorsal zygapophyses while they are absent in *T. lepturus* (Fig. 3 A and B).

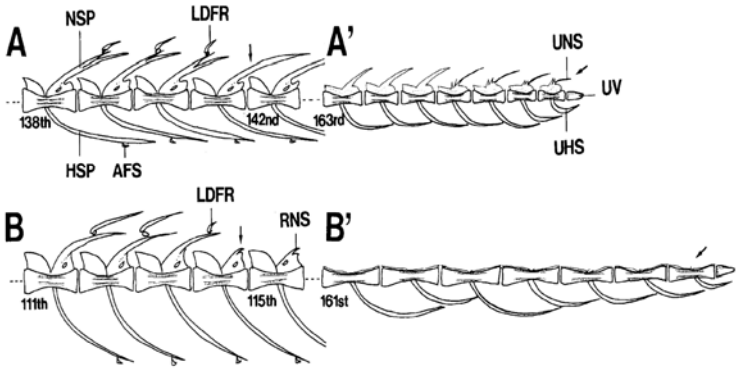

Fig. 3. Vertebrae supporting dorsal fin rays and posterior portion of caudal peduncle. A, A' *Demissolinea novaeguineensis* (RMNH 24619, 475 mm TL) and B, B' *Trichiurus lepturus* (ANSP 142228, 500 mm TL). *NSP*, articulating of neural spine; *LDFR*, last dorsal fin ray; *HSP*, articulating of hemal spine; *AFS*, anal fin spine; *UNS*, ultimate neural spine vertebrae; UV, ultimate vertebrae; *UHS*, ultimate hemal spine vertebrae; *RNS*, reduced neural spine.

Osteological key to genera:

1A. The dorsal surface of neurocranium concave; orbit small, less than 1/3 of the neurocranium; posterior end of supraoccipital is somewhat blunt; first anal spine long and dagger-shaped; caudal peduncle vertebrae short and bearing neural spine (except ultimate), the last four penultimate centra remarkably bearing one long and two short neural spine on the middle of dorsal zygapophyses…… *Demissolinea*.

1B.The dorsal surface of neurocranium flat; orbit large, 1/3 or more of the neurocranium; posterior end of supraoccipital is sharp point; first anal spine enlarged, short, length less than half of dermal eye opening; neural spine on caudal peduncle vertebrae absent……..…*Trichiurus*.

CONCLUSION

The comparative study of the osteology of two hairtail fishes, *Demissolinea novaeguineensis* and *Trichiurus lepturus* is described. The structure of neurocranium, supraoccipital, orbital region, anal fin and vertebral column are comparable and it could be considered as taxonomic criteria are considered to be important distinguishing features between the species.

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