

INSTANCES OF EXCESSIVE THICKENING OF CERTAIN BONES
IN THE RIBBON FISH, *TRICHIURUS LEPTURUS* LINNAEUS*

By P. S. B. R. JAMES

Central Marine Fisheries Research Station, Mandapam Camp.

INTRODUCTION

WHILE studying the biology and fishery of ribbon fishes of the family Trichiuridae from Indian waters, my attention was drawn by Dr. S. Jones to the occurrence of some swollen bones, popularly called 'stones' in *Trichiurus lepturus*. Although Cuvier (*vide* Gunther, 1860) and Starks (1911) have mentioned such instances in the skull and clavicle of this species, similar cases in respect of other bones have hitherto not been reported. The results of an investigation of the identity, nature and occurrence of these bones are presented in this paper.

MATERIAL AND METHODS

Several samples of *Trichiurus lepturus* (*Trichiurus wt/me/a*(Forsk.) from various places, especially where it forms an important fishery, along the East and West Coasts of India were collected during the period January 1959 to July 1960. 534 specimens of both sexes and of different sizes, varying between 43 to 978 mm. (S.L.) were examined for the extra ossified bones. Besides these, samples of three other species of ribbon fishes occurring in Indian waters namely *Lepturacanthus savala*, *Eupleurogrammus intermedius* and *Eupleurogrammus muticus* (James, 1960) were also examined, to ascertain any such instances of excessive thickening of bones. Alizarin stained specimens of the four species were studied to fix the identity of bones that become stone-like and to study the effect of such extra growths on the adjoining structures. Skeletons of fresh specimens were prepared by cooking in water and the disarticulated parts were scrutinized for additional ossifications. In addition to material from Indian coastal waters, four large specimens of *T. lepturus* from the Andaman Sea were also examined.

OBSERVATIONS

General considerations: Excess ossification, or additional bone formation is confined to the supraoccipital bone and the interneural and interhaemal spines. Table I shows a summary of the material examined and results obtained.

Of the four species of ribbon fishes occurring in Indian waters, thickened bones appear to be present only in *T. lepturus* and its occurrence was found to be fairly

*Published with the permission of the Chief Research Officer, Central Marine Fisheries Research Station, Mandapam Camp.

common. Of those affected, males with such bones are less numerous (36.5%) than the females (63.4%). Thickening of supraoccipital and the interhaemal spines is more common while that of interneurals appears to be comparatively rare. Occasionally all the three types are found in the same individual, or a combination of any two may be present. The thickened interneurals and interhaemals may be successive, alternating or even widely separated by intervening normal spines; The successive bones may or may not unite, but when they unite, they form a single massive 'stone'. The number of such modified bones forming a mass or 'stone' can be made out by counting the number of corresponding neural or haemal spines. The affected neural or haemal spines are slightly short and blunt at their extremities, whereas the normal ones are longer and pointed at their tips. As in the case of normal bones, the enlarged bones are covered by a layer of muscles, and externally by the skin.

The bony enlargements are clearly perceptible externally in the bigger size groups but are not always symmetrical and often are seen prominently bulging on one side. In smaller individuals their presence can be detected by touch. The enlarged bones (Pl. II, Fig. 3) are of various shapes : oblong, oval, triangular, round or even irregular but are usually compressed laterally in conformity with the lateral flattening of body. Sometimes a single 'stone' presents a groove or depression to give it a bilobed appearance and when it is a compound structure involving more than one spine, intervening depressions indicate the number of such spines.

The swollen bones fully occupy the interspaces between the preceding and succeeding bones, often bringing pressure on normal bones to bend or curve round the enlargements (Pl. I, Figs. 3, 4). Longitudinal sections of the three types of enlarged bones Pl. II, Fig. 3) have been examined. The thickened supraoccipital presents a honeycomb-like pattern in a section. The bony substance is soft and alveolar. The thickened interneural or interhaemal is less alveolar and often presents a bigger central cavity, whose bony substance is harder than that of supraoccipital. In all cases, it appears, the bone deposition is more of a superficial, soft, cellular nature than a regular periosteal deposit. The more alveolar bones float, while their normal counterparts sink in water, showing that this modification tends to make the bones buoyant.

In the normal head of a specimen, the posterior confluence of the frontal ridges, and in continuation of it, the low supraoccipital crest are elevated to form a sagittal crest, which is confined to the nape (Pl. I, Fig. 1). When there is an enormous thickening of the supraoccipital bone the whole occipital region of the skull is dorsally concealed by the bony mass, sometimes extending to the first one or two vertebrae, and results in a further elevation and strong convex dorsal curvature at the nape region (Pl. I, Fig. 2). In such specimens the pre-occipital profile of the head steeply dips down. The varying degree of enlargement of supraoccipital fully or partially overlaps the parietals and the temporal ridges on the sides. The supraoccipital enlargement is occasionally asymmetrical at the forked posterior end. It bears a median groove along the posterior half, which indicates the position of the origin of dorsal fin.

The interneural thickenings are much larger than the interhaemal. This is probably a direct result of the greater height of the interneurals. The interhaemal thickenings appear never to exceed the height of the body between the lateral line (running along lower one-third of body) and the ventral margin of the body.

Y*BLE t

Summary of the data

(Expressed in percentages)

Total number of specimens examined	Sort igfg O n u	IS &B			.31 8 1 1 1 1 1		.8*3 P i		Interhaemal, Interneura together	IP
		g-s-a	f i l l e S 13	«	w	w				
534	56*	10.4	26.9	28.5	1.6	44.6	12.5	10.7	7.1	
Males	19	36.5	14.2	25.0	100	40.0	42.8	50.0	50.0	
Females	33	63.4	85.8	75.0	Nil	60.0	57.2	50.0	50.0	

* 4 Specimens, sex unknown, not included in calculation of percentage sexwise.

Analysis of frequency of occurrence.—From Table I, and other data presented in the text, the following observations are made :—

The supraoccipital thickening (PL II, Figs. 1 and 2) was found to be present in both sexes. Its occurrence was first noticed in a specimen measuring 422 mm., from Vizhingam (Trivandrum) on the West Coast. The biggest specimen showing this enlargement was 707 mm. from Idinthakarai (Tinnevely) on the Gulf of Mannar. However, a 978 mm. (male) was found with a normal supraoccipital bone. The supraoccipital thickening occurs either exclusively or in combination with enlargements of interhaemal or interneural or both. Of 56 specimens showing different combinations of the three types, supraoccipital enlargement is present in 41 specimens as under :—(i) supraoccipital alone—14 (2 males, 12 females, ranging in size between 424-790 mm.); (ii) in combination with interneural enlargements—6 ; (iii) with interhaemal enlargements—21 ; (iv) with both interhaemal and interneural—4. Sexwise, it is distributed in the ratio of 13 males to 24 females (+4 of sex unknown).

Interhaemal enlargement (PL I, Fig. 3) was first noticed in a specimen of 422 mm. and the biggest specimen measures 728 mm., both from Vizhingam (Trivandrum). It was found in 39 individuals as follows :—(i) exclusively—12 ; (ii) with supraoccipital—25 ; (iii) with interneural—6. The sex ratio for the occurrence of enlarged interhaemal is 15 males to 20 females (+4 of sex unknown).

The interneural enlargement (PL I, Fig. 4) was first noticed in a specimen of 523 mm. and the biggest specimen in which it occurs, measures 978 mm., both from Vizhingam (Trivandrum). Its occurrence in 10 individuals is as follows :—(i) exclusively in 1 ; (ii) with supraoccipital—7 ; (iii) with interhaemal—6. Sexwise, it is present in 5 males and 4 females (+1 of sex unknown).

It will be seen that interhaemal enlargements are more common than those of the interneurals. The location of the thickened bones is variable. The anterior-most interhaemal enlargement was found to be that against the 56th vertebra and the posteriormost against the 112th vertebra from anterior end, inclusive of atlas vertebra. In the case of interneural thickenings the anteriormost was found against

vertebra 15, and the posteriormost against vertebra 88. This indicates that any interneural or interhaemal bone is equally susceptible to enlargement, although in the material examined, they fall within the limits mentioned above.

The fusion of the thickened bones is common on the haemal side, and except for one instance, it is absent on the neural side. The maximum number of 'stones' found in a single individual at a time is 5. The biggest 'stone', a compound interneural condition involving 3 spines, measures 23.5 mm. in height and 22.5 mm. in width.

DISCUSSION AND CONCLUSIONS

Excess ossification of bones is not uncommon in fishes, and many earlier workers have drawn attention to this phenomenon, in the different groups. Barnard (1948) refers to such thickened bones in *Chrysoblephus gibbiceps* and *Caranx equula* and terms the condition as 'hyperostosis.' Ebina (1936) mentions extraordinary bone formation in the supraoccipital bone of *Evynnis cardinalis*. Gopinath (1951) described the secondary ossification of supraoccipital crest in certain Carangids, and suggested such bone formation helps the fishes to maintain equilibrium. Gregory (1933) mentioned the swelling of the supraoccipital in *Chaetodipterus faber* and Gunther (1860) mentioned the development of outgrowths from certain of the interneurals and neurals of *Lepidopus caudatus* which is known to be a teratological condition. Kestevan (1928) and Littken (1880) as cited by Gopinath (*I.e.*) have described an occipital knob in the crest of *Pagrosomus auratus* and the large occipital crest which brings in a change in the head profile of *Coryphaena hippurus*, respectively.

All the above authors, except Gunther's reference to *Lepidopus*, have referred to excess ossification of the supraoccipital or its crest in a variety of fishes, while other bones appear evidently not to be involved. The present observations on *Trichiurus lepturus* draw attention to an additional ossification not only of the supraoccipital bone, but also the interneural and interhaemal spines and their combinations. Cuvier was the first to notice a thick mass of bone formed by the fusion of supraoccipital and parietals in the skull of *T. lepturus* and considers it as a peculiarity of the species. Gunther (*I.e.*) while describing the skull of the same species remarks that such a condition was not noticed by him. According to him, it could possibly be a disease of bones similar to that he noticed in *Lepidopus caudatus*.

Starks (*I.e.*) refers to thickening of bones in the skull and clavicle of two specimens of *T. lepturus* from the Atlantic. In addition, he found the lower part of the clavicle swollen, which evidently is a rare condition, in one specimen from China, labeled *Trachlurus japonicus* in the collection of Stanford University. He, however, stated that there are no swollen interneurals, in his account of the general osteological characters of the genus *Trichiurus*.

The present observations show that enlargement of supra-occipital bone, and the interneural and interhaemal spines is quite common in *T. lepturus*, from different localities along the Indian Coast. Individuals over 422 mm. only show the supra-occipital bone and interhaemal spine thickening, whereas the interneural thickening seems to be present only in specimens above 523 mm. Although the analysis of the sample shows a greater percentage of females with these enlarged bones, statistical analysis of data applying the test of significance at 5 % level has shown that sex is independent of the condition. It may, therefore, be concluded that the three

types of thickened bones occur in individuals quite at random, and irrespective of age (above the size limits given), sex and locality.

While enlargement of these bones is common in *T. Upturns*, it is significant that not a single instance of this is revealed in an examination of several specimens of allied species of the family Trichiuridae from Indian waters, all of which have almost similar habits, external form and general osteological characters. Cuvier's description that this thickening and union of bones is a peculiarity of the species is not inconceivable from the present observations, while provision is also made to Gunther's contention that it could be a disease of bones*. It may safely be stated, whatever be the cause of excess ossification in this species, its occurrence is confined only to *T. lepturus*, and not noticed in 600 specimens of *L. savala*, 3038 specimens of *E. intermedins* and 450 specimens of *E. muticus*, examined for this purpose.

It is interesting to note, in this connection, bone thickening in *T. lepturus* has been reported from Atlantic and China (Starks, *I.e.*) and attention is drawn to its occurrence in the same species now, from Indian waters and Andaman sea, thus throwing more light on the homogeneity of the species *Trichiurus lepturus* both in the Atlantic and Indo-Pacific.

SUMMARY

Excess ossification of the supraoccipital bone, interhaemal and interneural spines of *Trichiurus lepturus* is described.

Of the four species of ribbon fishes from Indian waters, it appears to occur only in this species, in both sexes and from all localities.

The theory of homogeneity of the species, *T. lepturus* in Atlantic and Indo-Pacific is supported by the present observations.

ACKNOWLEDGEMENTS

I wish to express my thanks to Dr. S. Jones, Dr. R. Raghu Prasad and to Dr. E. G. Silas for looking through the manuscript and offering valuable suggestions. My thanks are also due to Shri K. G. Nambiar for the photographs and to the collection party of the Central Marine Fisheries Research Station for the specimens from the Andaman Sea.

REFERENCES

- BERNARD, K. H. 1948. Further notes on South African Marine Fishes. *Ann. S. African Mus.*, 36: 403-406.
- EBINA, K. 1936. On the growth of *Evynnis cardinatis* (Lacep.). *Imp. Fish. Inst. Tokyo.*, 31: 69-78.
- GOPINATH, K. 1951. On the peculiar bone formation in the supraoccipital crest of some Carangid fishes. *J. zool. Soc. India*, 3: 267-276.

* In a recent study Bhatt and Murthi (*J. Univ. Bombay*, 28 (5): 84-89, 1960) have referred to this condition as a case of osteoma—a neoplastic disease.

- GREGORY, W. K. 1933. Fish Skulls : A study of the evolution of natural mechanisms. *Trans. Amer. phil. Soc*, 23: 75-481.
- GUNTHER, A. 1860. *Catalogue of the Acanthopterygian Fishes in the collection of the British Museum*, 2 : 1-548. London.
- JAMES, P. S. B. R. 1960. *Eupleurogratnmus intermedius* (Gray) (Trichiuridae : Pisces), a new record from Indian waters. *J. Mar. biol. Ass. India*, 1: 139-142.
- STARKS, E. C. 1911. Osteology of certain Scombroid fishes. The Osteological Characters of the Scombroid fishes of the Families Gempylidae, Lepidopidae, and Trichiuridae. *Stanford Univ. Publ.*, No. 5 : 17-26.

N

X *

'pi

