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NOTES ON THE ANATOMY OF *RANZANIA TRUNCATA*

A PLECTOGNATH FISH

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INTRODUCTION

An opportunity to dissect a specimen of *Mola* (Gregory and Raven, 1934) and later one of *Masturus* (Raven, 1939) naturally led to speculations as to certain points in the anatomy of *Ranzania*, considered the most aberrant member of this extremely specialized family, the Molidae, or ocean sunfishes, and certainly the rarest in Museum collections. *Ranzania* was first described as *Tetrodon truncatus* by Retzius (1785) and placed in the same genus with *Mola* and *Masturus*. Nardo (1839) put *Tetrodon truncatus* in a separate genus, *Ranzania*, which he named for Camillo Ranzani, a naturalist of Bologna. Jenkins (1895) described a specimen of *Ranzania* taken at Honolulu as a second species, which he named *Ranzania makua*, but it appears that this is not a valid species and that the characters it was based on were those of age, changing with the age of the individual; thus McCulloch (1929) placed it in the synonymy of *R. truncata*.

Specimens of *Ranzania* have been taken from the Atlantic, Pacific and Indian Oceans and occasionally from the Mediterranean but its larvae are said to be unknown.

Ranzania is very much smaller than the other molids. The specimen described from Honolulu by Jenkins was 20 inches (50.5 cm.) long. Trois (1884) mentions one 47 cm. long taken near Trieste and another from Venice, 59 cm. (23 1/4 inches); Beauregard (1893) reports on one 65 cm. (26 3/4 in.) long from the west coast of France, which is the maximum length I have seen recorded.

Dr. E. W. Gudger, of the Department of Fishes of The American Museum of Natural History, in an effort to procure a specimen fortunately corresponded with Mr. Ludwig Glauert, Director of the Natural History Museum at Perth, Western Australia, and through his kindness The American Museum of Natural History received a specimen of *Ranzania* that I have been privileged to dissect.

A search of the literature revealed only one paper dealing with the internal structure of *Ranzania*, aside from the skeleton, and none concerned with the morphology and function of its locomotor apparatus, that is, the musculature of its fins. Trois, who wrote on the anatomy of *Ranzania*, treats in Part I of his account: the skin, oral cavity, intestine, liver, spleen, kidneys and urinary bladder, gills, heart, organs of generation, muscular system, nervous system; and in Part II, the skeleton. Trois states that, with regard to the muscular system, he was compelled to preserve the carcass for the collection and was hindered in studying it by the lack of pliability of the integument, and that from a gross and superficial examination the disposition of the muscles did not seem to differ from those of *Mola*. Most of his remarks on the muscular system concerned the color of the flesh.

The present specimen is a small one; one of several stranded on the south coast of Western Australia near Albany. It has been preserved in formalin for some time and much of its natural coloration has disappeared. Its measurements are as follows:

Greatest length	315 mm.
Greatest depth (tip of dorsal to tip of anal)	230 mm.

Greatest depth of body at caudal margin of appressed pectoral fin	123 mm.
Greatest thickness of body	38 mm.
Diameter of eyelids, antero-posterior	18 mm.
Diameter of eyelids, dorso-ventral	15 mm.
Mouth, a vertical slit	13 mm.
Mouth to anterior border of eye	38 mm.
Mouth to gill opening or anterior border of pectoral	111 mm.
Gill opening, dorso-ventral extent	10 mm.
Depth of "caudal" fin	90 mm.
Height of dorsal fin	78 mm.
Height of anal fin	79 mm.
Length of pectoral fin	58 mm.
Number of pectoral fin rays	13
Number of dorsal fin rays	17
Number of anal fin rays	18

The skin of this young *Ranzania truncata* is composed of hexagonal scales less than 2 mm. in diameter, lying edge to edge, making a rather stiff covering even in this half-grown individual except along the flexure lines around the bases of all the fins. Here there are no scales and the skin is smooth and rubbery, due to the underlying collagenous material, which, however, is poorly developed compared with that of *Mola* and *Masturus*, where it encases the entire animal to a thickness of several centimeters even in half-grown individuals.

MUSCULATURE

Upon carefully removing the skin in any normal teleostean fish, one encounters a thin aponeurotic sheet adherent to the skin superficially, while its deep surface forms an investment for the lateralis musculature. I have figured elsewhere (Raven, 1939) the condition of this aponeurosis and the inclinator muscles attached to it in *Roccus*, *Hepatus*, *Balistes* and *Diodon*. From this subcutaneous aponeurosis the inclinator muscles of the dorsal and anal fins take their origin. In the first three of the above-mentioned fishes the inclinators form a series of short, closely appressed muscles inserted at the base of each of the rays of the dorsal and anal fins, and have as their function the inclination of the fin rays alternately from side to side serially, to make the characteristic undulatory or wave-like movements commonly seen in these fins. In *Diodon* conditions are quite different. The inclinator muscles are enormously lengthened so that they surround the body and entirely replace the aponeurosis, and furthermore, in *Diodon* and related forms with the puffing habit, the inclinators doubtless serve a double purpose as constrictors of the body and as inclinators of the dorsal and anal fins. A careful examination of subcutaneous areas in *Mola* and *Masturus* revealed nothing in the way of an aponeurosis or inclinator muscles and I therefore conclude that they have entirely disappeared in these forms, though they may be represented by a thin, delicate, glistening membrane which is present on the inner surface of the skin.

In *Ranzania* (Fig. 1), however, the inclinators are present as a broad, very thin and partly aponeurotic sheet of muscle that may be divided into dorsal and ventral divisions separated by the lateral septum. The ventral division, or inclinator analis, arises from the mid-ventral line in the region of the body cavity and from the cleithrum at the caudal border of the gill chamber dorsally to the base of the pectoral fin, and also from the postcleithrum. The fibers pass almost directly caudalward, most of them inserting at the base of the anal fin, but some continue as a thin aponeurosis to the hypaxial portion of the tail.

In plectognath fishes the postcleithrum is well developed and early in their phylogenetic development the most anterior segment of the inclinator analis muscle gained attachment to it. Throughout the subsequent development of the group this muscle relation persists in varying degrees. In *Spheroides* it is especially well developed (Parr, 1927) and I have seen it in vestigial form in both *Masturus* and *Mola*. In the latter it agrees with Rosen's figure (Rosen, 1913), where its attachment to the anal fin has been lost. In *Ranzania*, however, the retractor postclavicularis appears as a distinct, flattened, narrow band, its origin from the postclavicle distinct and its insertion at the base of the anal fin, though aponeurotic, can be clearly followed.

The dorsal division, or inclinator dorsalis, arises in the occipital region and contiguous intermuscular septa. It passes caudalward and inserts mainly at the base of the dorsal fin but a thin sheet continues to the epaxial division of the tail.

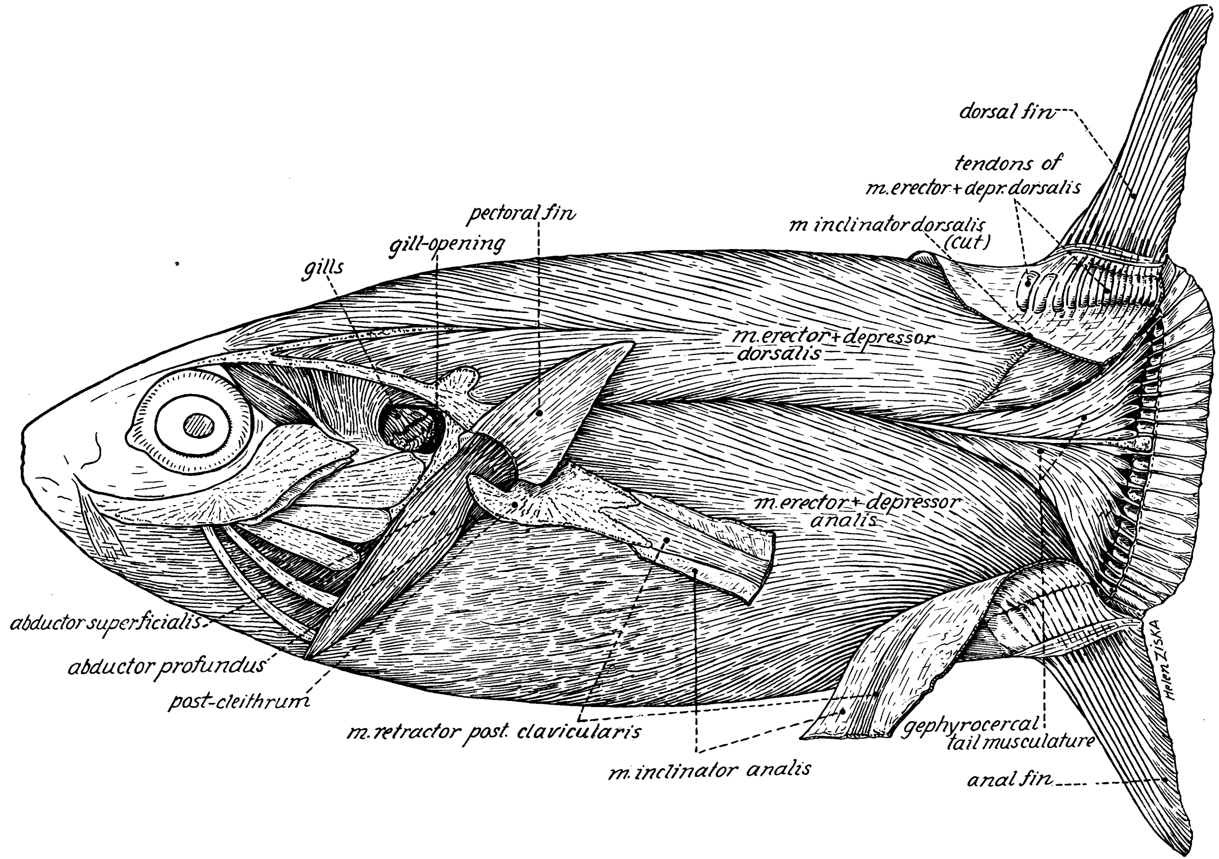

Fig. 1. *Ranzania truncata*, dissection showing musculature.

After removal of the skin and part of the inclinator muscles of the dorsal and anal fins. The erector-depressor muscle masses here reach their greatest development, surpassing that in the other molids, in which they do not extend around the body cavity to enclose the viscera.

In *Ranzania*, as in *Masturus* and *Mola*, all the metameric lateralis mass of musculature as seen in less specialized teleosts has been lost.

The erector and depressor muscles of the dorsal and anal fins, which have been shown to enlarge progressively throughout the plectognath series, reached their greatest development in *Ranzania*. Contrary to the statement of Trois (1884, p. 1300), who wrote [translated]: "I could form only a gross and superficial idea of the disposition of the muscular system, which, however, did not seem to differ from that of the *Orthragoriscus mola*," they decidedly surpassed the development seen in *Masturus* and *Mola*.

Ranzania truncata is sometimes spoken of as the "short sunfish," when, in fact, it is longer than either of the other species, even though this elongation is secondary. This, however, was noted long ago by Beauregard (1893, p. 230). It should be pointed out that the secondary lengthening of *Ranzania* seems to be directly related to the increase in size of the erector and depressor muscles of the dorsal and anal fins to such an extent that in *Ranzania* alone of all known fishes the territory of the metameric musculature, that is, the lateralis mass, is entirely replaced by them.

The relation of the inclinator muscles and aponeurosis to the tail is the same as their relation to the dorsal and anal fins. The attachment of the erector and depressor muscles to dermal rays of the tail is likewise the same as to the dorsal and anal fins. Finally, the nerves to the tail muscles come off immediately behind the nerves to the erector-depressor muscles of the dorsal and anal fins, all indicating that these muscles are serially homologous and not primary caudal muscles secondarily migrated cephalad, but parts of the dorsal and anal fin muscles formed into a gephyrocercal tail.

Skeleton

Figure 2

Both Trois (1884) and Beauregard (1893) have pointed out on the basis of adult specimens that the skeleton of *Ranzania* differs from that of *Mola* in the much more complete ossification of the bones of the former. This is to be seen even in the half-grown specimen at hand. Though many of the bones are hard, others are soft enough to be easily cut with a knife and thus resemble those of *Mola* and *Masturus*. Ossification of the skeleton may be looked upon as a primitive character for the Molidae, which has been retained by *Ranzania*, probably in association with different environmental habits and with its smaller size.

Skull and Shoulder-Girdle

In the arrangement and form of the skull bones, as in so many other characters, *Diodon* and *Mola* act as a key to the conditions seen in *Ranzania*. In *Ranzania* the maxilla is produced medianward more than in *Mola*, so that it reaches the midline beneath the median process of the premaxilla, and thus some of the dental laminae just behind the beak are here borne by the maxilla instead of the premaxilla as is usual. The premaxilla and maxilla are suturally united and the latter articulates with the palatine.

As in *Mola*, the palatine has a large backwardly directed median process, which overlies and abuts against the parasphenoid.

Perhaps the most striking modification of the skull bones is to be seen in the hyomandibular, which is produced backward as a long flange overlying the dorsal part of the gill chamber. This backwardly directed flange is doubtless homologous with a very definite crest to be seen at the caudal border of the hyomandibular in both *Diodon* and *Mola*. It appears that the flange on the hyomandibular of *Ranzania*, braced as it is, prevents the collapse of the branchial chamber, an office usually performed by the opercular, which in *Ranzania* is vestigial while the subopercular is absent. The symplectic is also absent.

The branchiostegal rays are five in number, one less than in *Mola*. The first arises from the lateral border of the epihyal, the second from both epi- and ceratohyals and the joint between them; the third from the lateral surface of the ceratohyal, while the fourth and fifth arise from the posterior border of the ceratohyal.

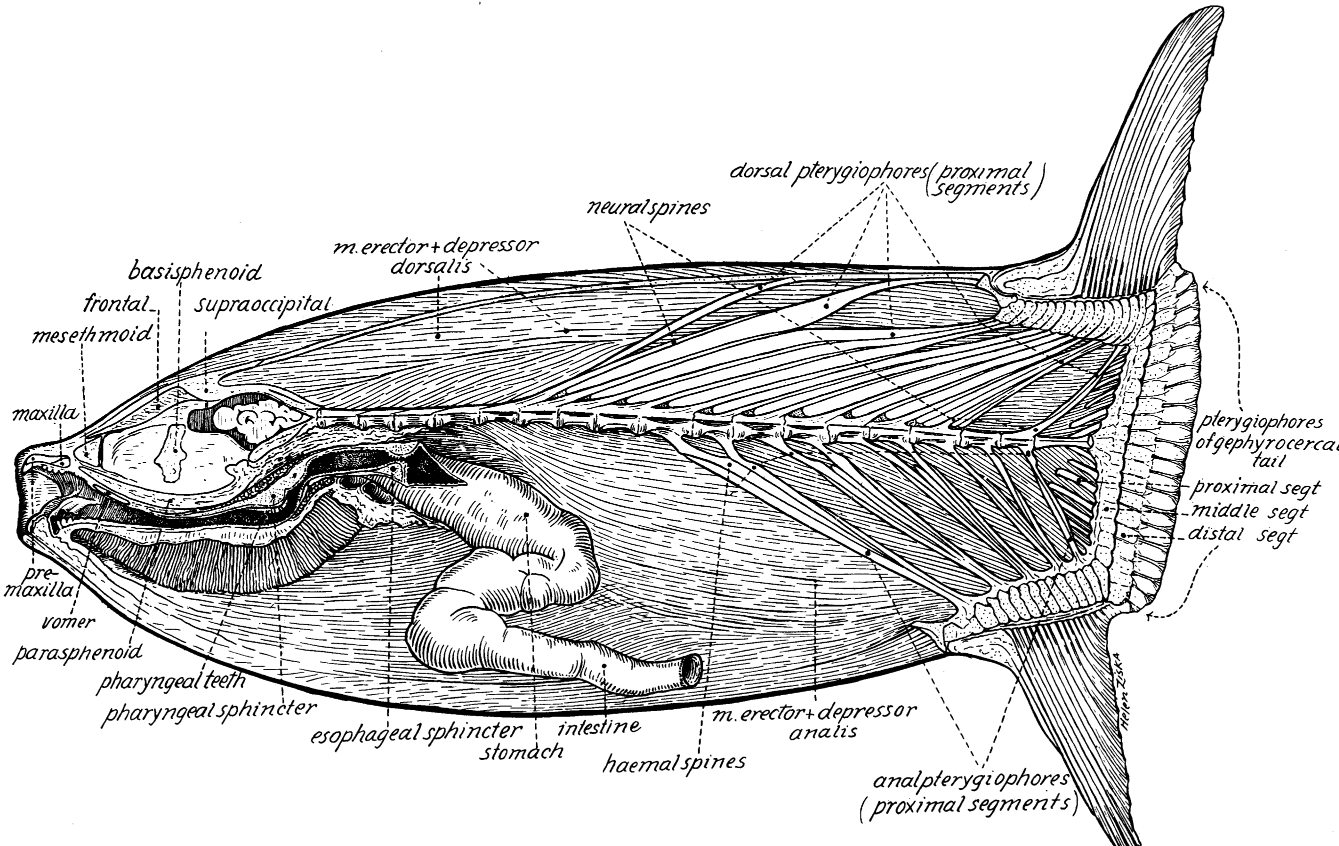

Fig. 2. *Ranzania truncata*, skeleton. Showing especially the extreme backward slope of the neural and haemal spines and the interlocking arrangement of the pterygiophores.

In the shoulder-girdle the number and form of the bones are approximately as in *Mola*. The postcleithrum is proportionately wider and thinner but forks around the pectoral fin in the same manner as in *Mola*. The scapula is reduced even more than in *Mola* and likewise functions as a fourth pterygial.

The present specimen of *Ranzania* has eight precaudal and ten caudal vertebrae. The zygopophyses and neural spines of the first four vertebrae are depressed to form a flat roof for the column as far back as the posterior border of the fifth centrum. The neural spine of the fifth vertebra is 65 mm. long, which is just 6.5 times as long as its centrum, and projects dorso-caudally at an angle of 29° from the column. Unless a careful examination were made, one would suppose this neural spine belonged to the sixth vertebra, for it does not rise above the level of the more anterior depressed neural spines until it reaches a point over the sixth centrum. The neural spine of the fifth vertebra is intercalated between the first two dorsal pterygiophores. The neural spines of most of the vertebrae behind the fifth slope caudalward slightly more than does the fifth, though the most caudal ones have about the same inclination, for they all converge in the direction of the base of the dorsal fin. All the neural spines taper evenly to thread-like points and are braced against pterygiophores.

The antepenultimate vertebra (16th) lacks a neural spine, though one is present on the vertebra immediately before and the one behind it. The last vertebra consists only of a slender centrum.

The first caudal is the ninth vertebra. Its haemal spine is inclined ventro-caudally at about the same angle from the column as are the neural spines. The arrangement of the haemal spines in *Ranzania* differs from that of the other molids in that they are grouped two by two with the exception of the last, which is single, and the anal pterygiophores are likewise grouped with haemal spines.

The pterygiophores are proportionately longer than in the other molids. The first of the dorsal series, which, as already stated, lies just in front of the neural spine of the fifth vertebra, is not connected directly with the base of the dorsal fin but is attached to the long slender ligament—all that remains of the tendon of the m. protractor dorsalis of more primitive fishes.

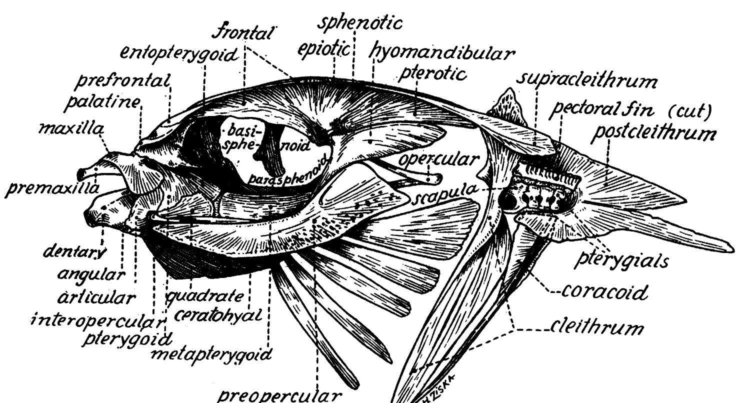

Fig. 3. *Ranzania truncata*. Lateral view of the bones of the skull and shoulder-girdle.

Of the fourteen dorsal pterygiophores, the anterior seven have more or less expanded shafts and all reach down to the column. The anal pterygiophores are stouter than those of the dorsal but are not expanded. The pterygiophores of the "tail," pseudocaudal, number seven dorsal and eight anal. They are slender and unossified and abut, respectively, against the last neural and the last haemal spines.

The caudal inclination of the neural and haemal spines, interlocking with the very long pterygiophores, preclude any lateral body movement and deliver the thrust from the dorsal and anal fins to the vertebral column.

SUMMARY

Ranzania represents the most specialized of all the molids in body-form and, with the exception noted above, in musculature. The elongation of the body, as compared with other molids, is undoubtedly secondary. The persistence of the inclinator muscles of the dorsal and anal fins is the sole primitive feature noted. The former presence of the puffing apparatus is indicated by the retention of the m. retractor postclavicularis, which originated as a slip of the m. inclinator analis in some early balistoid.

The most remarkable feature of the skeleton is the caudal inclination of the haemal and neural spines, indicating the posterior displacement of the dorsal and anal fins. This, in conjunction with the great development of the dorsal and anal fin musculature and the narrow high fins, suggests that *Ranzania*, contrary to earlier opinions, is a fast-swimming form.

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