

A Fish Fossil of the Family Scombridae from a Miocene Bed in Toyama Prefecture, Japan

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A caudal region of a fossil fish was found in the collection of the College of Liberal Arts, Toyama University. The name of the locality, collector, and the date when it was collected were written on the matrix of the nodule. The locality indicates that the age of the fossil is Middle Miocene. The fossil is well preserved, and the important characters which indicate the systematic position among the family Scombridae are clearly observable.

Detailed comparative studies on caudal regions of almost all genera of the Scombridae revealed that the skeletal structures of the tail in the family are fairly constant at the generic level, and that the fossil has characters which essentially agree with those of the genus *Grammatorcynus*.

In this report, representative types of scombrid tails and the fossil are illustrated and discussed.

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Locality and Horizon

Locality. Sôre, Yamada-mura, Nei-gun, Toyama Prefecture, Japan. 36°35'N 137°6'E.

Horizon. The only possible bed which could have yielded the specimen is Monmyoji sandstone and mudstone alternation members in Kurosedani Formation, Yatsuo

Subgroup of Hokuriku Group, Middle Miocene (FUJII and KIKUKAWA, 1974).

The name of the locality, Sôre, literally means a topography of landslides. Lithologically the locality consists of sandstone and mudstone in alternation. The sandstone is coarse and the mudstone is black shale. The fossil fish was found in a nodule of brownish mudstone. The nodule was probably brought to the surface by a landslide. The lower part of the member of the bed yielded molluscs such as *Vicarya callosa*, *Anadara kakehataensis* and others which indicate tropical habitat. On the other hand the upper part of the member yielded *Operculina complanata*, *Miogipsina kotoi* which now live in a shallow sea environment, together with *Propeamussium tateiwai* in the Yamadanaka tuff, which usually lives in comparatively deepwater habitat.

The species of *Grammatorcynus* is now distributed from Ryukyu Islands south to tropical regions of the Pacific and Indian Oceans and Red sea (MATSUBARA, 1955).

Class OSTEICHTHYES

Order Perciformes

Family Scombridae

Grammatorcynus sp.

(Pl. 1)

Specimen. National Science Museum, Tokyo, Paleontological collection NSMT-PV. 15287. The specimen is a caudal region including 7 vertebrae and some scattered caudal fin rays on brownish nodule of mudstone collected by Bunzo TAKEMORI on March 11, 1951.

Description. Though 7 vertebrae are observable on the matrix, the anteriormost centrum and a detached centrum below the axis are not included here for the description. The former is too large to be the next to the 5th preural vertebra, and there is no evidence that the latter belongs to the same specimen as the rest of vertebrae. The largest centrum was probably deposited there in the course of disintegration of the specimen during fossilization. The detached and scattered caudal fin rays on the matrix suggest that the fish was considerably displaced before fixed as in the matrix. From 2nd to 4th, preural centra appear to be more or less similar in size, becoming slightly smaller toward the posterior end of the fish. The centra are almost square in these vertebrae with a large concavity at the upper portion of the lateral side. Only small sections of neural and haemal spines of the 5th preural vertebra are preserved. The neural and haemal spines of the 2nd, 3rd, and 4th preural vertebrae are thickened, and not depressed to the thin plate-like condition found in *Thunnus*. A piece of the epural is observable on the dorsal side of the hypural plate. The hypural plate has a distinct notch at the posterior end. The haemal spine of the last vertebra (parhypural) is not fused with the hypural plate. There is no suture in the middle of the hypural plate, and the upper and lower part of the plate is completely fused. The hypural plate shows 6 shallow grooves which indicate places of attachment of caudal fin rays. The narrow depression immediately dorsal to the plate appears to indicate the presence of the

unfused last hypural which is missing from its position.

Terminologies of the caudal skeleton used here are based on MONOD (1968), and NYBELIN (1963).

Discussion

In order to determine the systematic position of the fossil, we examined and figured osteological structures of tail regions of almost all genera of the family Scombridae (Fig. 1). The genera compared are listed in the following section. As the result of the investigation, it was found that the structural features of the caudal skeletons among scombrids are fairly constant within genera. Six osteological characters were selected

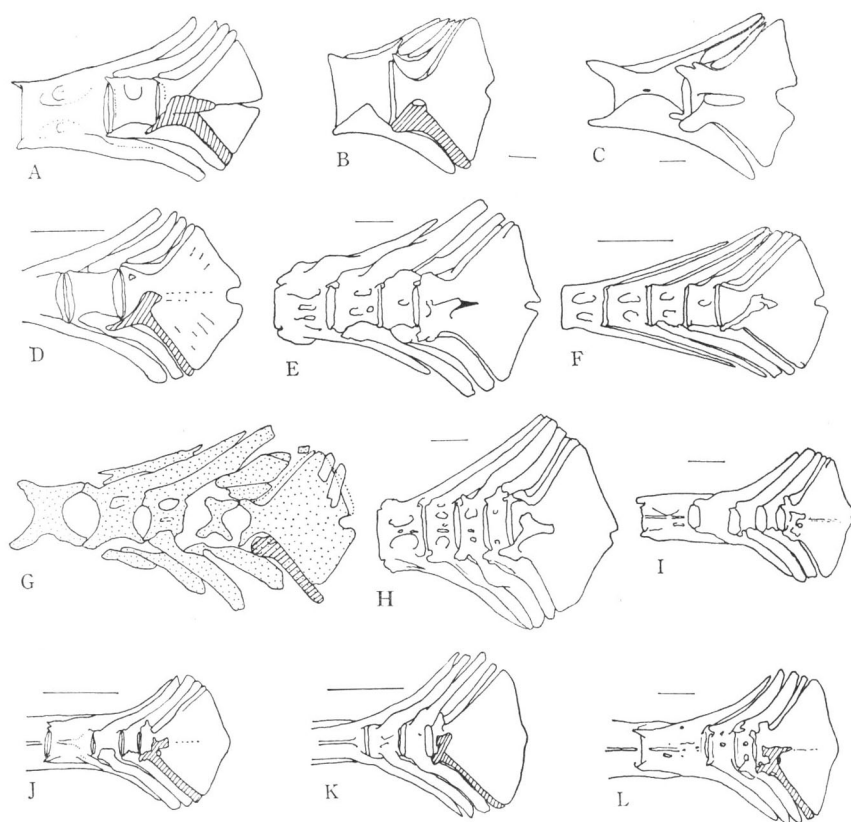


Fig. 1. Caudal skeletons of scombrid fishes.

A, *Scomber japonicus*; B, *Xiphias*; C, *Istiophorus*; D, *Grammatocygnus*; E, *Gasterochisma melampus*; F, *Scomberomorus niphonius*; G, fossil specimen; H, *Acanthocybium solandri*; I, *Gymnosarda unicolor*; J, *Sarda orientalis*; K, *Euthynus affinis*; L, *Thunnus albacares*.

Shaded area indicates the unfused parhypural which is the haemal spine of the first preural vertebra.

Table 1. Distribution of primitive characters of the caudal skeleton among scombroid fishes and the fossil. Species with more "+" retains more primitive characters.

Scientific names	Characters of primitive state				
	Upper and lower parts of hypural plate unfused	Notch at posterior end of hypural plate	Last hypural unfused	Unshortened 2nd and 3rd preural vertebra	Unfused parhypural which is the last hemal spine
The fossil specimen	—	+	+	+	+
<i>Scomber japonicus</i>	+	+	+	+	+
<i>Rastrelliger kanagurta</i>	+	+	+	+	+
<i>Grammatocynus bicarinatus</i>	—	+	+	+	+
<i>Scomberomorus niphonius</i>	—	+	+	+	—
<i>Acanthocybium solandri</i>	—	+	+	+	—
<i>Gasterochisma melampus</i>	—	+	—	+	—
<i>Sarda orientalis</i>	—	—	—	—	+
<i>Gymnosarda unicolor</i>	—	+	—	—	—
<i>Euthynnus affinis</i>	—	—	—	—	+
<i>Katsuwonus pelamis</i>	—	—	—	—	+
<i>Auxis thazard</i>	—	—	—	—	+
<i>Allothunnus fallai</i>	—	—	—	—	+
<i>Thunnus albacares</i>	—	—	—	—	+
<i>Thunnus obesus</i>	—	—	—	—	+
<i>Xiphias gladius</i>	—	+	—	+	+
<i>Istiophorus albicans</i>	—	+	—	+	—

for comparison and the result were summarized in Table 1.

Among fishes examined, *Scomber* seems to retain the most primitive condition with the least degree of fusion of bones. The most specialized condition was found among members of the genus *Thunnus* with the greatest degree of fusion.

The suture between upper and lower hypural plates are present in *Scomber japonicus* and *Rastrelliger kanagurta*, but absent in all other specimens. The notch at the posterior end of the hypural plate is present in the genera *Scomber*, *Rastrelliger*, *Gasterochisma*, *Scomberomorus*, *Grammatocynus*, and *Acanthocybium*. *Gymnosarda unicolor* had a small rudimentary hypural notch. The presence of the notch appears to be a primitive state. The last hypural bone is not fused with the hypural plate in *Scomber*, *Rastrelliger*, *Scomberomorus*, *Acanthocybium*, and *Grammatocynus*, but in the rest it is fused with the plate at least in part. The 2nd and 3rd preural vertebrae are much shortened in *Thunnus* and its relatives. The last haemal spine is fused with the hypural plate in *Gasterochisma*, *Gymnosarda*, and *Istiophorus*, and partly or almost fused in *Scomberomorus* and *Acanthocybium*.

The fossil scombrid from a Middle Miocene bed in Toyama Prefecture, has a similar caudal structure as in the genus *Grammatocynus*, having a notch at the hypural plate, no shortened vertebrae, distinctly unfused last haemal spine, and unfused last

hypural. These structural condition indicate that *Grammatorcynus* belongs to a primitive group among scombrid fishes, and slightly advanced than the most primitive genus *Scomber*.

The species of *Grammatorcynus* is now distributed from Ryukyu Islands south, to tropical regions of the Pacific and Indian Oceans, and Red Sea (MATSUBARA, 1955). This indicate that the climate around the fossil locality was much warmer than today, and it was probably tropical or subtropical.

This fossil represents the first fossil record of the genus *Grammatorcynus* from Japan, and probably the second one in the world.

Recent Species Examined

Following specimens were examined for comparison with the fossil. Abbreviations used for institutions are: FSFRL, Far Seas Fisheries Research Laboratory; TUC, UYENO Collection; ZIUT, Zoological Institute, Faculty of Science, the University of Tokyo. FL means the fork length. TUC specimens without locality informations are all purchased at fish markets in Tokyo.

Scomber japonicus HOUTTUYN (TUC 680814) Pacific coast of Japan; *Rastrelliger kanagurta* (CUVIER) (ZIUT 51430) East China Sea; *Grammatorcynus bicarinatus* (QUOY et GAIMARD), (ZIUT 523801) Ryukyu Islands; *Scomberomorus niphonius* (CUVIER et VALENCIENNES), (TUC 670205); *Acanthocybium solandri* (CUVIER et VALENCIENNES), (TUC 670106) in the area between 09°59'7N 34°58'1W and 05°07'3N 34°54'0W, FL 143.5 cm; *Gasterochisma melampus* RICHARDSON, (FSFRL) locality at 40°09'2S 109°37'5W, FL 105.2 cm; *Sarda orientalis* (TEMMINCK et SCHLEGEL), (ZIUT 13057) Miyako Bay, Japan; *Gymnosarda unicolor* (RÜPPELL), (FSFRL) locality at 08°52'0N 148°53'0E FL 71 cm; *Euthynnus affinis* (CANTOR); ZIUT 17102) Ryukyu Islands; *Katsuwonus pelamis* (LINNÉ), (TUC 680824); *Auxis thazard* (LACEPÈDE), (TUC 680828); *Allothunnus fallai* SERVENTY, (ZIUT 52315) 45°30'S, 149°E, FL 82 cm; *Thunnus albacares* (BONNATERRE), (TUC 670301); *Thunnus obesus* (LOWE), (TUC 670301). Figures of *Xiphias* and *Istiophorus albicans* were redrawn after NAKAMURA, IWAI, and MATSUBARA (1968).

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Explanation of Plate 1

The fossil of the caudal region of *Grammatocygnus* sp., from a Miocene bed in Toyama Prefecture, Japan.

