Bull. Nat. Sci. Mus. Tokyo, 10 (3), October 20, 1967

A Miocene Alepisauroid Fish of a New Family, Polymerichthyidae, from Japan

By

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(Communicated by Hiroshi OZAKI)

Introduction

Abundant fish fossils of excellent quality have been found and reported from Miocene beds in the area around the Pacific Ocean. The majority of specimens discovered in Japan are also from the Miocene period.

When the author visited the town of Hôraiji, Aichi Prefecture, Japan, in 1965, he found a remarkable Miocene fish in the fossil collection of Mr. Masayasu NAGURA, a maker of suzuri (inkstone). A detailed study of the fossil reveals that it has a combination of several important features which necessitates the establishment of a new family. The closest relatives of this fossil fish are found among bathypelagic alepisauroid fishes of the families Anotopteridae and Alepisauridae of the order Myctophiformes (or Salmoniformes of Greenwood and others, 1966). The fossil has a head similar to that of the Anotopteridae, but its dorsal fin is well developed as in the Alepisauridae. It differs from both families in having a very elongate body with many vertebrae and a much reduced caudal fin like that of the Nemichthyidae and some Trichiuridae. This fossil is described herein and an attempt is made to assess its morphology and systematic position.

Acknowledgements

The author wishes to express his appreciation to Mr. Masayasu NAGURA for the loan of the specimen, which was recently donated to the National Science Museum, Tokyo. I am also grateful to the following persons for their invaluable help and encouragement: Mr. Ienori FUJIYAMA of the National Science Museum, Tokyo, first told me about fossil fishes in the town of Hôraiji; Drs. Kiyomatsu MATSUBARA and Tamotsu IWAI of Kyoto University first suggested that the specimen might be related to *Anotopterus*; Dr. Jinjirô NAKAI of Tôkai University donated a specimen of *Alepisaurus ferox* which was collected at the beach of Shimizu, Shizuoka Prefecture; Dr. Tokiharu ABE of Tôkai Regional Fisheries Laboratory allowed me to examine specimens of *Anotopterus pharao* from the Pacific; Mr. Kiyû KOBAYASHI of Hokkaidô University

provided a radiograph of *A. pharao*; Dr. Hiroshi OZAKI and Mr. Yoshikazu HASEGAWA of the National Science Museum, Tokyo, made necessary arrangements for the loan of the specimen and for the publication of this paper; Mr. HASEGAWA provided me with geological informations of the bed which yielded the fossil specimen.

Thanks are due also to Dr. Carl L. HUBBS of the University of California for his suggestion about the generic name, and to Drs. Robert Rush MILLER of the University of Michigan, William A. GOSLINE of the University of Hawaii, Don E. MCALLISTER of the National Museum of Canada, and Jules M. CRANE, JR. of Cerritos College, California, who kindly read the manuscript and gave important advice in its preparation.

Description

Family **Polymerichthyidae**, new family

Diagnosis: An alepisauroid family with an anguilliform body and a large number (more than 150) of vertebrae. The dorsal fin is well developed with numerous rays. Scales are probably absent. The eye lies on the posterior part of the head. The palatine teeth are enormous, inclined forward, and shaped like a pointed sword with double edges. The maxilla is excluded from the gape. The intermuscular bones are very well developed. The pelvic and adipose fins are apparently absent. The caudal fin is reduced to a tiny brush with few rays.

Polymerichthys, new genus

Type-species: *Polymerichthys nagurai*, new species.

Diagnosis: The dorsal fin has a long base starting immediately behind the head region. The number of dorsal rays is about 300 to 350. The pectoral fins are ventrally situated. The premaxillary and dentary teeth are small and numerous. There are about 186 vertebrae. The neural and haemal spines project from the central part of the centrum.

Etymology: The generic name is from the Greek *poly* plus *meris* and *ichthys* meaning fish with many meristic parts. The gender is masculine.

Polymerichthys nagurai, new species

(Fig. 1–3, Pls. 1–2)

Type specimen: Holotype. National Science Museum, Tokyo, Paleontological Collection no. 6599. An almost complete skeleton on greyish black shale collected by the late Yûzô NAGURA, probably in 1927.

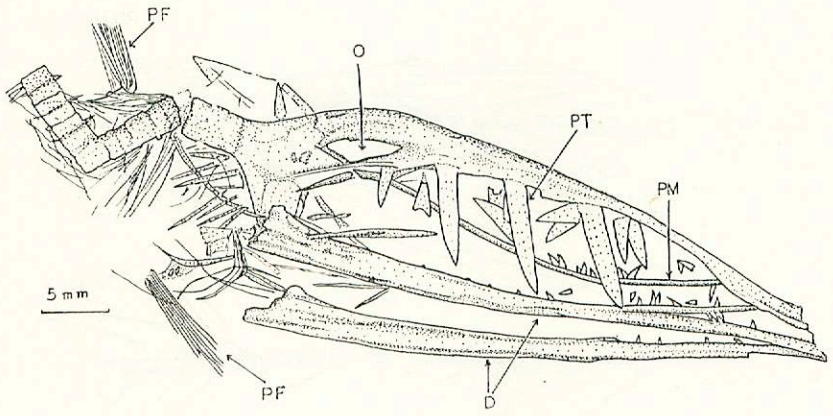

Fig. 1. Head region of *Polymerichthys nagurai* n. gen. & n. sp. D, dentary; O, orbit; PF, pectoral fin; PM, premaxilla; PT, palatine teeth.

Horizon: Tubozawa formation (KATÔ, 1962), Middle Miocene.

Type locality: About 600 meters northeast of Hôraiji Railroad Station (Taguchi Line), Minamishidara-gun, Aichi Prefecture, in lat. 34°58′N. and long. 137°34′E.

Etymology: The specific name is taken from the family name of NAGURA who collected and donated the specimen.

Description: The fossil is almost complete, lacking only a small section of the anterior vertebrae. It has a large skull and a slender, anguilliform body. The standard length is approximately 380 mm. The depth of the body is about 7.0 mm at a point 170 mm from the tip of the snout, 9.0 mm at 260 mm, and about 4.0 mm at 300 mm, and is about 1.0 mm near the base of the caudal fin.

The dorsal fin has a long base starting immediately behind the head region; its posterior end is not clear but almost reaches the base of the caudal fin (the last observable fin ray is near the 166th vertebra). The exact number of dorsal fin rays is uncountable, but in the 10 mm distance between the 84th and the 88th vertebra 12 rays are observed. From this, a rough calculation of the total number of dorsal fin rays is between 300 and 350. The length of the dorsal ray near the 60th and the 110th vertebrae is 8 mm. The anal fin starts near a point 255 mm from the snout (at about the 83rd vertebra), and its posterior end reaches near the caudal base (the last observable fin ray is near the 140th vertebra). The first 28 anal fin rays look like short paired spinelets (Fig. 2C), as in *Nemichthys*. In general appearance, the dorsal and anal fins are similar to those in the Nemichthyidae. The left and right pectoral fins lie just behind the head. From their manner of preservation, it is assumed that they were attached to the body in a ventral rather than a lateral position (Fig. 1). Countable pectoral rays are 8 in the right and 12 to 15 in the left fin. No

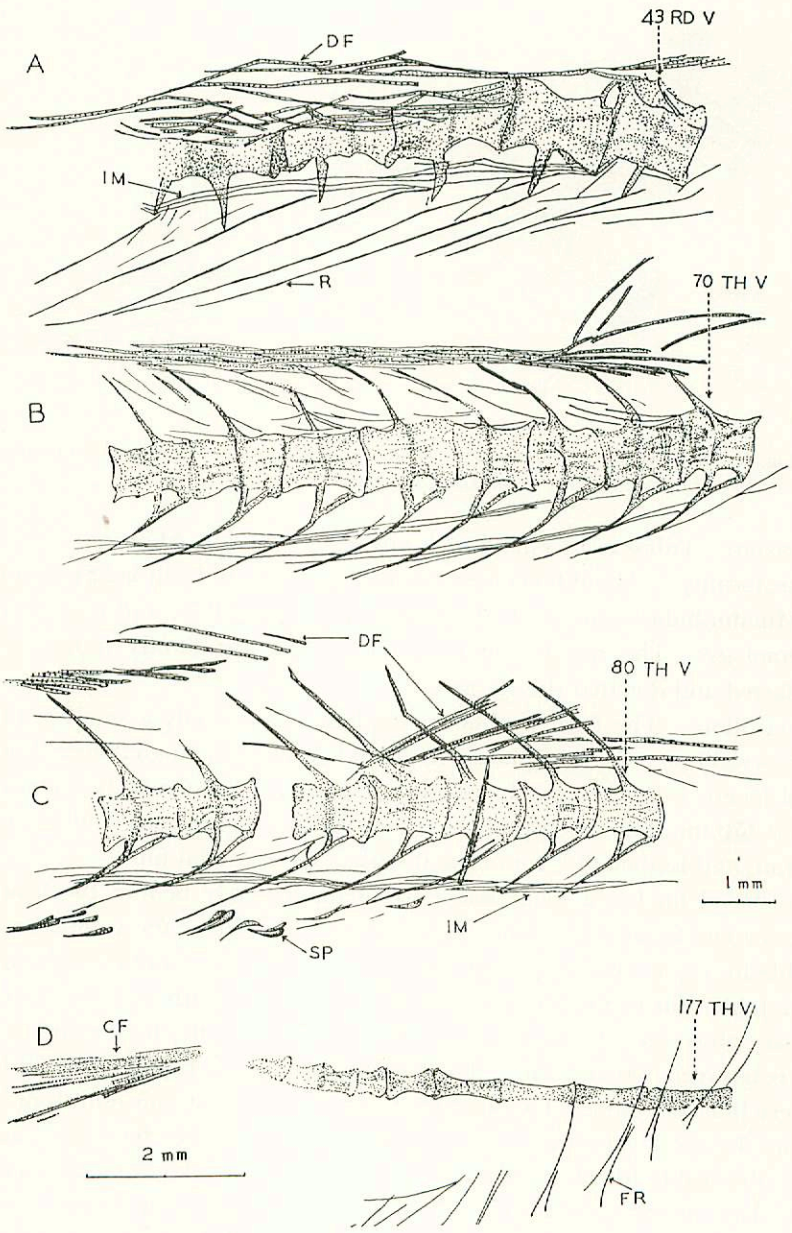

Fig. 2. Vertebrae, intermuscular bones, and fin rays in four parts of the body of *Polymerichthys nagurai* n. gen. & n. sp. CF, caudal fin; FR, fin ray of preceeding vertebrae; DF, dorsal fin ray; IM, intermuscular bone; R,rib; P, spinelets; V, vertebra.

pelvic or adipose fins are observable. The long based dorsal fin suggests that there was no adipose fin. The caudal fin is reduced to a tiny brush-like structure with few rays (Fig. 2D).

Scales are not observable. Squamation was probably extremely reduced or absent as in other alepisauroid fishes.

The length of the skull is 48 mm. The orbit lies far back on the skull. The general shape of the skull closely resembles that of *Anotopterus* (NYBELIN, 1946: Fig. 4). *Polymerichthys* has extremely large teeth, probably on the palatine, as in *Anotopterus* and *Alepisaurus*. Three large immovable teeth and nine depressable teeth of intermediate sizes are present on this bone. The length and width of the largest teeth are 9 mm and 1.3 mm respectively. These teeth are straight, sharply pointed, double edged, and inclined forward (Fig. 1). The premaxilla is very narrow (width 0.5 mm) with many small pointed teeth. The largest one is 1.7 mm long and 0.4 mm wide. The maxilla is not clearly observable but probably is excluded from the gape. This is assumed from the length of the premaxilla. The lower jaw is slender, long, and slightly curved. Its length is 45.5 mm, only slightly shorter than the length of the skull; its width is greatest around the posterior end of the upper edge. The dentary bears only minute teeth. Some scattered bones around the posterior end of the skull suggest a few incomplete parts of the gills and branchiostegals, but their form and number are not clear.

The number of the vertebrae is about 186. Vertebrae become progressively smaller toward the posterior part of the column. The shape of the first and second vertebrae is slightly distorted and not clear. The third one is 2.4 mm in length and 1.5 mm wide at the narrowest part. The length and the thickness (at the narrowest point) of the 7th vertebra are 2.6 mm and 1.6 mm, respectively. The length and width of other vertebrae are measurable from Fig. 2 and Plate 1.

Neural spines are not visible on at least the first seven vertebrae. After the 11th vertebra, about 15 vertebrae are missing. The next observable vertebra is probably the 27th (it is on this assumption that the following vertebrae are numbered). The length of the 28th vertebra is 2.4 mm. Long ribs are attached to the 31st to 60th vertebrae (Fig. 2A). The vertebrae between the 39th and the 70th possess haemapophysis-like structure which projects from the middle part of the centrum (Fig. 2A). Vertebrae posterior to the 71st possess both posteriorly inclined, long and slender neural and haemal spines (Fig. 2, B and C). These spines project from the middle of the centrum and are supported by ossification from the anterior zygapophysis (Fig. 2).

Intermuscular bones are well developed and their pattern is similar to that of *Anotopterus* (ROFEN, 1966; Figs. 177–179). They are long and horizontal to the body axis. Most of the origins of the intermuscular bones are not clear, but those at the

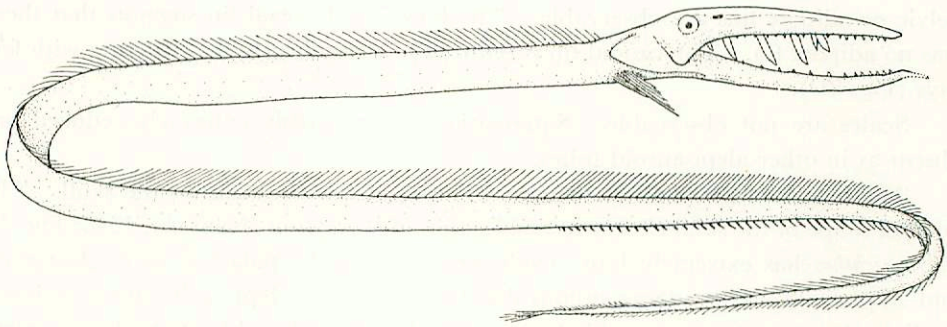

Fig. 3. Restoration of *Polymerichthys nagurai* n. gen. & n. sp.

dorsal part around the 8th vertebra originate near the proximal part of a neural spine and run backward crossing at least 4 posterior successive neural spines, so that more than 4 intermuscular bones usually extend between two adjacent neural spines.

Relationship

The characters described above suggest that *Polymerichthys nagurai* is a predatory bathypelagic fish which probably lived in the midwater part of the deep oceans, as do other alepisauroid fishes. The following features agree with the definition of alepisauroid inioms (GOSLINE, MARSHALL, & MEAD, 1966:9) and place the Polymerichthyidae in the suborder Alepisauroidei: (1) exclusion of the maxilla from the gape by the premaxilla; (2) a single row of numerous small teeth on each premaxilla; (3) a row of teeth on each palatine; (4) a row of teeth on each dentary; (5) pectoral fins in the ventral position; (6) a mouth which is able to take a large meal at one gulp; (7) reduced squamation; (8) well developed intermuscular bones in both the epaxial and hypaxial parts of the myotomes; (9) a very elongate body. The number of anal fin rays in the fossil is greater than that given in the definition.

In his studies of alepisauroid fishes, MARSHALL (1955: 331–332) stated that the predominant evolutionary trend in this group has been toward adaptations for dealing with nektonic prey, extraordinary elasticity of the tissue of the stomach and body wall being associated with a loss or marked reduction in the scaling. He further stated that the Alepisauridae, Anotopteridae, Omosudidae, and Paralepididae show a definite trend toward the development of elongate to very elongate body forms. When the characters of *Polymerichthys* are compared with those of these alepisauroid families, it is evident that this fossil attained the extreme of the trends described above in every respect. The huge palatine teeth of the fossil are an adaptation for dealing with nektonic prey, and their comparative size in relation to that of the head is the greatest among known alepisauroids. The elasticity of the tissue

of the stomach is demonstrated by the very long ribs in the abdominal region of the fossil. Reduction of squamation probably reached the most extreme condition. In the trend of body elongation, *Polymerichthys* also well surpassed the known alepisauroids. The number of vertebrae is about 50 in *Alepisaurus ferox* (HOTTA, 1961: 25), about 80 in *Anotopterus pharao*, and about 186 in *Polymerichthys nagurai*.

The relationship of the Polymerichthyidae to other families of alepisauroids is an interesting problem. In the forwardly inclined palatine teeth, position of eyes, and general structure and shape of the head region, *Polymerichthys* is remarkably similar to *Anotopterus* (NYBELIN, 1946). These features, and comparison with characters of *Anotopterus* listed by HUBBS, MEAD, and WILLIMOVSKY (1953), suggest that the closest relative of this new family is the Anotopteridae. On the other hand, *Polymerichthys* possesses a long, well-developed dorsal fin—a structure absent in the Anotopteridae. The other closely related family, the Alepisauridae, has a large dorsal fin, but its palatine teeth are inclined backward, and it has large teeth on the dentary.

As a result of morphological comparison, MAUL (1964: 59) concluded that the only obvious difference between the Alepisauridae and the Anotopteridae is in the presence or absence of the dorsal fin; otherwise these two families are so similar in many features that there is insufficient reason to separate them. If MAUL's opinion is correct, it is a reasonable procedure to place *Polymerichthys* together with *Alepisaurus* and *Anotopterus* in a single family. However, HARRY (1953) stated that the Anotopteridae is most closely related to the Paralepididae, and the Alepisauridae to the Omosudidae. If we accept this opinion, then the Anotopteridae and Alepisauridae should not be

Table 1.

	Polymerichthyidae	Anotopteridae	Alepisauridae
Body	Very elongate and anguilliform	Elongate but not anguilliform	Elongate but not anguilliform
Number of vertebrae	More than 150	About 80	About 50
Dorsal fin	Long-based and short-rayed with 300 to 350 rays	Absent	Long but high with only 36 to 50 rays
Anal fin	Long-based and short-rayed, with some spinelets	Short-based and long-rayed, without spinelets	Short-based and long-rayed, without spinelets
Pelvic fin	Apparently absent	Present	Present
Adipose fin	Apparently absent	Present	Present
Caudal fin	Almost vestigial	Moderate	Moderate
Palatine teeth	Inclined forward	Inclined forward	Inclined backward
Dentary teeth	Only very small ones	Only very small ones	Some are large, and moderate and small ones are also present

combined into a single family without including the Paralepididae and Omosudidae. This action would make a cumbersome family with a wide range of variation, and would practically reduce the suborder Alepisauroidei to a family. Such action, therefore, would present an unbalanced situation in the order Myctophiformes.

Considering all these factors, the author reached the decision to establish a new family, the Polymerichthyidae, for the fossil species, and to place it systematically closest to the family Anotopteridae. Morphological differences found among the Polymerichthyidae, Anotopteridae, and Alepisauridae are listed in Table 1.

Discussion

Since most lower teleostean families appeared before the Eocene period, the Polymerichthyidae could not be ancestral to any Recent families. Therefore, this new family is now extinct, or may still have surviving members which are unknown to science yet. CRANE (1966) recently reported on fossils of deep sea fishes from a Miocene bed in California, and concluded that they have not changed much since the Middle Miocene.

Fossil alepisauroid fishes was briefly summarized by HARRY (1953: 244). The only known fossil species which is closely related to *Polymerichthys* is *Alepisaurus paronai* described by D'ERASMO (1924). Judging from the original description and figures, this species seems to have good generic characters of *Alepisaurus*.

Though the Polymerichthyidae was described here based upon fossil material, recent active search for deep sea fishes might someday reveal a Recent member of this new family.

Summary

A new species and genus of bathypelagic alepisauroid fish was discovered from a Middle Miocene bed in Aichi Prefecture. It has a head similar to that of the Anotopteridae with enormous, forwardly inclined, palatine teeth. But, unlike the Anotopteridae, the fossil has a well-developed dorsal fin and a much reduced, almost vestigial caudal fin. Comparative study of this fossil with other alepisauroids convinced the author of the need to establish a new family, the Polymerichthyidae, for it. In this report, the fossil fish *Polymerichthys nagurai* n. gen. & n. sp. is described in detail, and an assessment of its systematic position is presented.

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Explanation of Plates 1-2

Plate 1

Polymerichthys nagurai n. gen. & n. sp.

Plate 2

Head region of *Polymerichthys nagurai* n. gen. & n. sp.