

Paralichthys yamanai, a New Middle Miocene Lefteye
Flatfish from Tottori, Japan

By

Kazuo SAKAMOTO¹ and Teruya UYENO²

¹Department of Zoology, University Museum, University of Tokyo,
7-3-1 Hongo, Bunkyo-ku, Tokyo, 113

²Department of Geology, National Science Museum,
3-23-1 Hyakunin-cho, Shinjuku-ku, Tokyo, 169

Abstract Fossils of a lefteye flatfish were found in the Middle Miocene Iwami Formation, Tottori Group, Tottori Prefecture, Japan. They are reported as belonging to a new species of the genus *Paralichthys* in the family Paralichthyidae of the order Pleuronectiformes. This species is characterized by having a dwarf body; approximately 60 dorsal and 50 anal fin rays; and 11 abdominal and 25 to 26 caudal vertebrae.

Introduction

Fish fossils were collected by Mr. Iwao YAMANA in the rock belonging to the Middle Miocene Iwami Formation of the Tottori Group (UEMURA *et al.*, 1979) at Miyanoshita, Kokufu-cho, Tottori Prefecture, Japan (Fig. 1). After comparison with species of the Paralichthyidae from Japan and its adjacent regions, we have concluded that this Miocene species is distinct in body size, and numbers of dorsal and anal fin rays, and vertebrae.

Systematic Description

Class Osteichthyes

Order Pleuronectiformes

Suborder Pleuronectoidei

Family Paralichthyidae

Genus *Paralichthys* GIRARD, 1858

Paralichthys yamanai sp. nov.

(New Japanese name: Tottori-birame)

Holotype: Tottori Prefectural Museum (TRPM) catalogue number 664-075B. Standard length is about 32 mm (Figs. 2, 5).

Paratypes: TRPM 664-156, about 19 mm in standard length (Fig. 3); TRPM 664-

058, about 18 mm in standard length (Fig. 4).

Etymology: The species name, *yamanai*, is derived from the name of Mr. Iwao YAMANAI who has collected the present and numerous other fossil specimens from the Miyanoshita locality.

Diagnosis: A species of *Paralichthys* with dwarf body, about 60 dorsal fin rays, about 50 anal fin rays, and 11 abdominal and 25 to 26 caudal vertebrae.

Description of the holotype: The specimen is almost complete, but separated into two parts; the body is rather slender and the depth being greatest at about two fifths length from the anterior tip. Its greatest depth is about 2.8 times included in the standard length and almost equal to the head length.

The head region is fairly well preserved and several bones are identifiable. The mouth is large: the upper jaw length is about 2.7 times included in the head length. The upper jaw extends at least beyond the anterior margin of the lower eye. Elements in both jaws are not observable except for the premaxillary. Among cranial elements, only the main part of the parasphenoid is recognizable. Both eyes with preserved melanophores are located on the left side of the head. The lower eye is located slightly in advance of the upper one.

In the suspensorial and opercular regions, only the ectopterygoid, quadrate and preopercle are identifiable. Fragments of several branchiostegal rays are observable below the opercular bones. The urohyal is located just in front of the cleithra. The angle between the main and sciatic parts is about 45°.

Fifty five dorsal fin rays and 48 proximal pterygiophores are counted (their total numbers can not be estimated). Two proximal pterygiophores are usually inserted between two adjacent neural spines. In the anal fin, 35 rays and 41 proximal pterygiophores are counted (the total numbers can not be estimated). Two proximal pterygiophores are usually located between two adjacent haemal spines, excepting several anterior ones. The anteriormost proximal pterygiophore is elongated and attached to the anterior surface of the first haemal spine. Its anteroventral end curves forwardly.

Of the shoulder girdle, the cleithrum and postcleithrum are well preserved. Both pelvic bones are short-based and situated behind the cleithra.

The centrum of each of the 11 abdominal vertebrae possesses a neural spine. All the spines are nearly straight, and the first spine is directed upward, second to fourth ones slightly backward, and fifth to eleventh ones slightly forward. The caudal vertebrae with well developed neural and haemal spines are 26 in number.

Eighteen caudal fin rays are countable. Shapes of epural, parhypural and hypurals are recognized from their traces. Of hypurals, the first and second, and the third and fourth ones are fused with each other respectively. The fifth one is separated (Fig. 5).

Description of the paratypes: The specimen (TRPM 664-156) with rather slender body is almost complete. The body depth is greatest at about two fifths length from the anterior tip, and about 2.4 times included in the standard length and about 0.8 times in the head length.

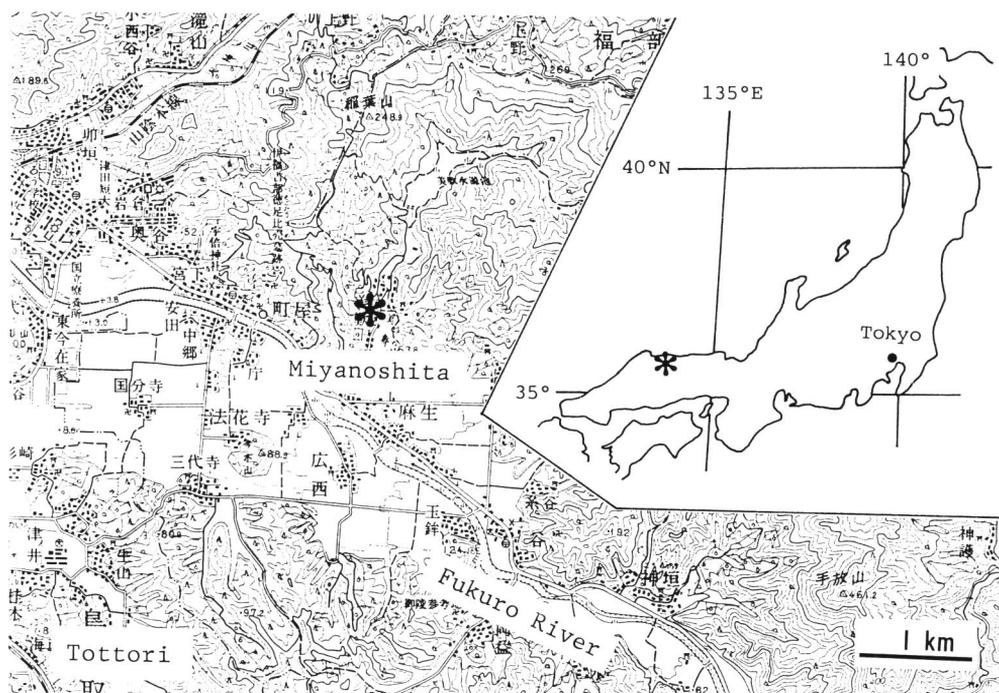


Fig. 1. Map showing the fossil locality of a new Miocene lefteye flatfish *Paralichthys yamanai* sp. nov.

The head region is fairly well preserved and several bones are identifiable. The mouth is large: the upper jaw length is about 2.7 times included in the head length. The upper jaw is at least beyond the anterior margin of the lower eye. Elements of both jaws are not identifiable. In the cranial region, only the parasphenoid is recognizable. Both eyes with preserved melanophores are located on the right side of the head. However, a portion of the melanophores of the lower eye is situated under the parasphenoid. This indicates that the present specimen is lefteyed. The lower eye is slightly before the upper one.

Only the ectopterygoid and preopercle are observable in the suspensorial and opercular regions. Seven branchiostegal rays are observed below the opercular region. The urohyal is located just anterior to the cleithra, and the angle between the main and sciatic parts is about 40° .

In the dorsal fin, there are about 60 rays. Fifty proximal pterygiophores are countable (the total number can not be estimated). In the anal fin, about 50 rays are recognizable, and 43 proximal pterygiophores are counted, but the total can not be estimated. The features in dorsal and anal rays and their pterygiophores are the same as those in the holotype.

In the shoulder girdle, the cleithrum and postcleithrum are observable. The



Fig. 2. The holotype of *Paralicthys yamanai* sp. nov. (TRPM 664-075B), from Middle Miocene Iwami Formation, Tottori Prefecture, Japan. About 32 mm in standard length. Scale shows 2 mm.

pelvic bone with six rays is located behind the cleithra.

The abdominal vertebrae are distorted anteriorly and 11 in number. Fragments of three ribs are observed. The caudal vertebrae with well developed neural and haemal spines are 25 in number.

In the caudal fin, there are 18 fin rays. The parhypural and hypurals are observable. The features in the hypurals are the same as those in the holotype.

The specimen (TRPM 664-058) is incomplete and lacks the anterior portion of

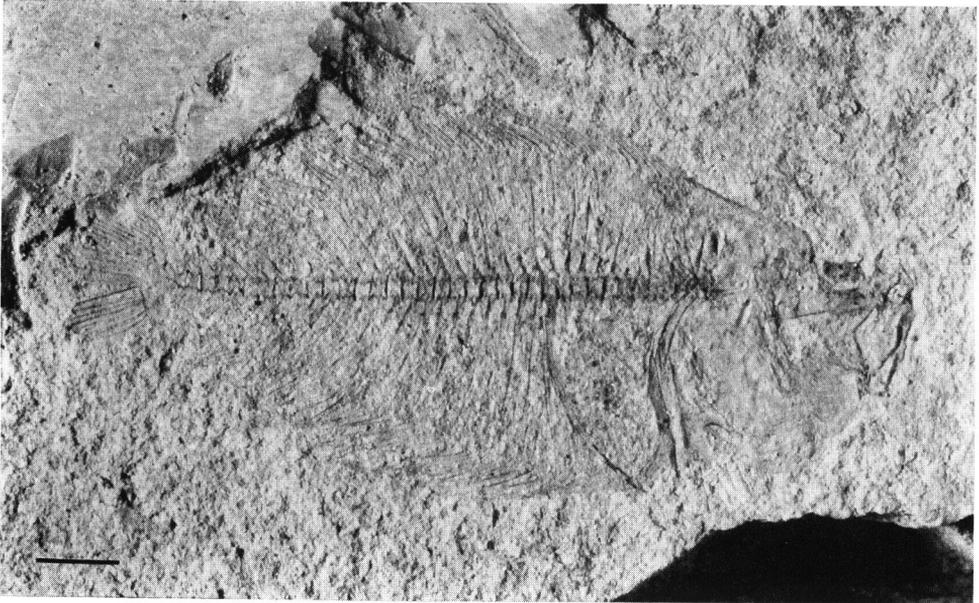


Fig. 3. The paratype of *Paralichthys yamanai* sp. nov. (TRPM 664-156), from the same locality as the holotype. About 19 mm in standard length. Scale shows 2 mm.

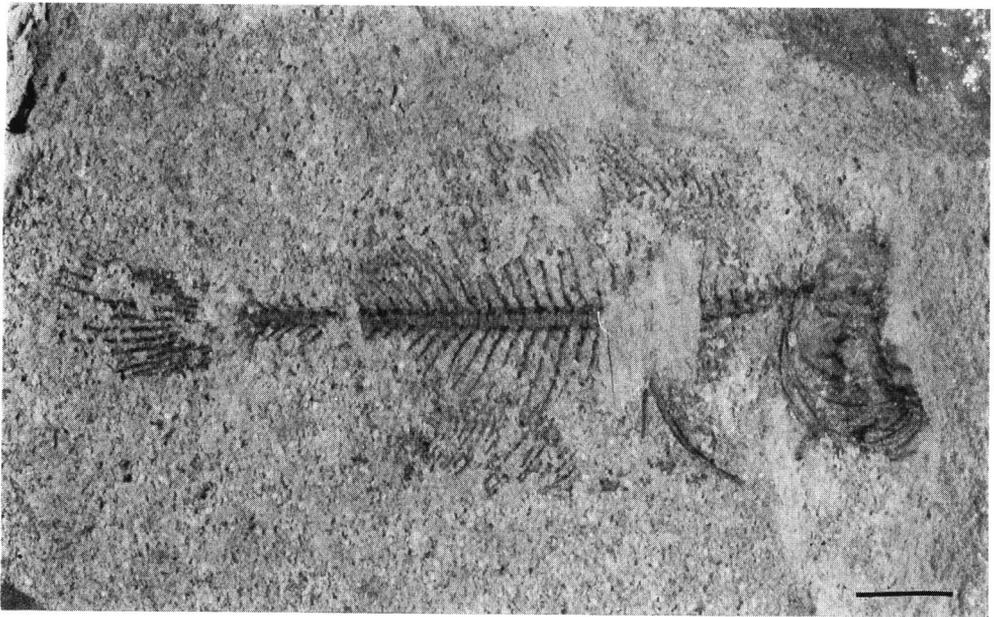


Fig. 4. The paratype of *Paralichthys yamanai* sp. nov. (TRPM 664-058), from the same locality as the holotype. About 18 mm in standard length. Scale shows 2 mm.

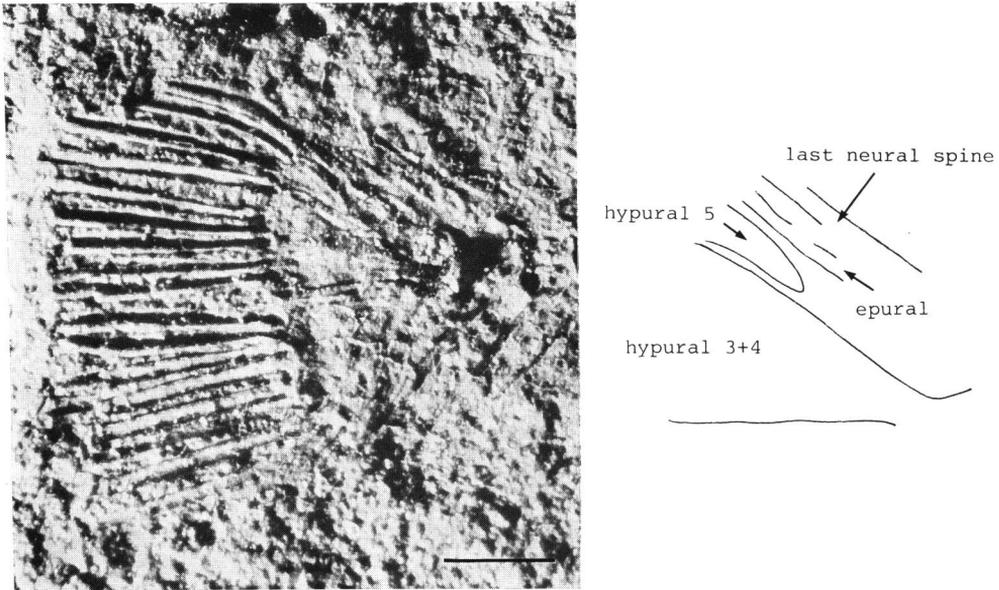


Fig. 5. A part of the caudal skeleton in the holotype, TRPM 664-075B. Scale shows 1 mm.

the head. In the head region, only several branchiostegal rays are observable.

In the dorsal fin, about 42 rays and several proximal pterygiophores are countable (their total numbers are not estimated). In the anal fin, about 17 rays are countable, but the total can not be estimated. The first proximal pterygiophore is incomplete, and similar to that of the holotype.

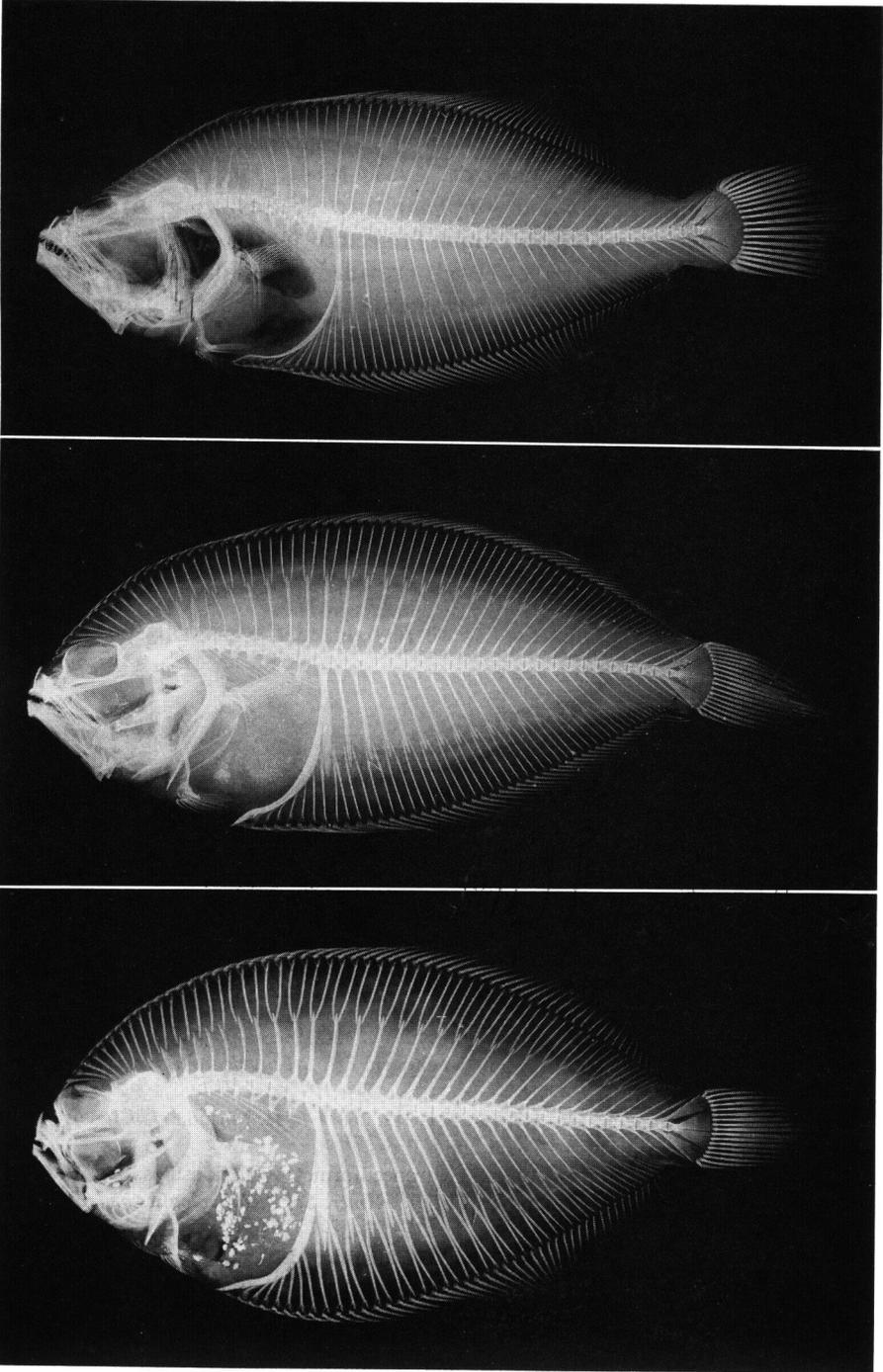
In the shoulder girdle, the cleithrum and postcleithrum are remained.

The abdominal vertebrae are distorted anteriorly and counted as 8 (the total number can be estimated as 11). The caudal vertebrae with well developed neural and haemal spines are counted as 23 (the total is estimated as 26).

Discussion

From the characters described above, it is evident that the present species is a member of the family Paralichthyidae sensu AMAOKA (1969) of the suborder Pleuronectoidei, the order Pleuronectiformes. It has following characters: 1) both eyes are completely lateral and on the left side of the body, 2) the postcleithrum is present, 3) the first proximal pterygiophore of the anal fin is enlarged, 4) ribs are present, 5)

Fig. 6. X-rayed photographs of three Japanese lefteye flatfishes. Top, *Paralichthys olivaceus*, NSMT-P 1266 (National Science Museum, Tokyo), 176.5 mm SL; middle, *Pseudorhombus pentophthalmus*, NSMT-P 19746, 113.0 mm SL; bottom, *Tarphops oligolepis*, ZUMT 59780 (Department of Zoology, University Museum, University of Tokyo), 66.5 mm SL. SL, standard length.



pelvic fins are short-based, and 6) the first and second hypurals, and the third and fourth ones are fused with each other respectively (NORMAN, 1934; HUBBS, 1945; OCHIAI, 1966; AMAOKA, 1969, 1972; HENSLEY and AHLSTROM, 1984).

We compared it with the modern and fossil paralichthyid species from Japan. Concerning the Recent species, three genera and 10 species have been reported from Japan and its adjacent waters (AMAOKA, 1969, 1984): *Paralichthys* (one species), *Pseudorhombus* (seven species) and *Tarphops* (two species) (Fig. 6). Also, *Pseudorhombus sonei* was reported from Akita Prefecture in the Miocene (SONE, 1944; SHIKAMA, 1964). Although AMAOKA (1969) provided many diagnostic characters for the three genera through his extensive anatomical study on the Japanese sinistral flounders, all these characters can not be observed in the fossils, excepting 18 caudal fin rays and the possession of a free epural. These two characters seen in the fossil species are important diagnoses for *Paralichthys*. In addition to this, since no other characters are available to be considered adequate to establish a new genus, it is most reasonable to classify the present species into the genus *Paralichthys*.

The present species is easily distinguishable from *P. olivaceus*, the only species of *Paralichthys* found around Japan, in having different numbers of dorsal fin rays (about 60 vs. 77-81 in *P. olivaceus*), anal fin rays (about 50 vs. 59-61), and caudal vertebrae (25-26 vs. 27) (data for *P. olivaceus* from AMAOKA, 1984).

On the basis of these comparisons, we recognized the present species as a new species in the genus *Paralichthys*.

Acknowledgments

We are grateful to Mr. Iwao YAMANA and Professor Saburo AKAGI of Tottori University who gave us the opportunity to study the fossil specimens, and the staff of Tottori Prefectural Museum for their assistance.

References

- AMAOKA, K., 1969. Studies on the sinistral flounders found in the waters around Japan—Taxonomy, anatomy and phylogeny. *J. Shimonoseki Univ. Fish.*, **18**(2): 65–340.
- , 1972. Osteology and relationships of the citharid fish *Brachypleura novaezeelandiae*. *Japan. J. Ichthyol.*, **19**(4): 263–273.
- , 1984. Paralichthyidae, p. 346–347, pls. 311–312, 368. In H. Masuda *et al.* (eds): The Fishes of Japanese Archipelago. Tokyo, Tokai Univ. Press.
- HENSLEY, D. A. & E. H. AHLSTROM, 1984. Pleuronectiformes: Relationships. In H. G. MOSER *et al.* (eds): Ontogeny and Systematics in Fishes. *Amer. Soc. Ichthyologists and Herpetologists, Spec. Publ.*, (1): 670–687.
- HUBBS, C. L., 1945. Phylogenetic position of the Citharidae, a family of flatfishes. *Misc. Publ. Mus. Zool., Univ. Michigan*, (63): 1–33.
- NORMAN, J. R., 1934. A systematic monograph of the flatfishes (Heterosomata). 1. Psettodidae, Bothidae, Pleuronectidae. 1–459 pp. London, Brit. Mus.
- OCHIAI, A., 1966. Studies on the comparative morphology and ecology of the Japanese soles. *Mi-*

- saki Mar. Biol. Inst., Kyoto Univ., Spec. Rep.*, (3): 1-97, pls. 1-2. (In Japanese.)
- SHIKAMA, T., 1964. Index Fossils of Japan. 1-287 pp., 1-80 pls. Tokyo, Asakura-shoten. (In Japanese.)
- SONE, H., 1944. (Fish fossils from Oguni-mura, Mogami-gun, Yamagata Prefecture and Yokotecho, Hiraka-gun, Akita Prefecture). *Jour. Geol. Soc. Japan*, 51: 71-72. (In Japanese.)
- UEMURA, F., T. SAKAMOTO & N. YAMADA, 1979. Geology of the Wakasa District. Quadrangle series, Okayama (12) no. 22. 1-91 pp., 1-8 pls., 1 map. Geological Survey of Japan. (In Japanese with English summary.)

