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A New Middle Miocene Righteye Flatfish, *Microstomus tochigiensis*, from Tochigi, Japan

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Abstract A fossil righteye flatfish was collected from the Middle Miocene Kanomatazawa Formation, Tochigi Prefecture, Japan. It is described as a new species of the genus *Microstomus* in the family Pleuronectidae of the order Pleuronectiformes. This species is characterized by having 11 abdominal vertebrae and three anteriormost plate-like neural spines.

Introduction

A fossil fish specimen was collected by a construction worker at the Shiobara dam site in the rock belonging to the Middle Miocene Kanomatazawa Formation (SAITO, 1963; AKUTSU, 1964) at Kanazawa, Shiobara-cho, Tochigi Prefecture, Japan (Fig. 1). It is reported as a new species of *Microstomus* of the flatfish family Pleuronectidae, being distinct from the other species of the genus in the numbers of abdominal vertebrae and its anteriormost plate-like neural spines.

Systematic Description

Class Osteichthyes

Order Pleuronectiformes

Suborder Pleuronectoidei

Family Pleuronectidae

Subfamily Pleuronectinae (sensu SAKAMOTO, 1984 b)

Genus ***Microstomus*** GOTTSCHE, 1835

Microstomus tochigiensis sp. nov.

(New Japanese name: Tochigi-baba-garei)

Figures 2–5

Holotype: Tochigi Prefectural Museum (TPM) catalogue number 786.

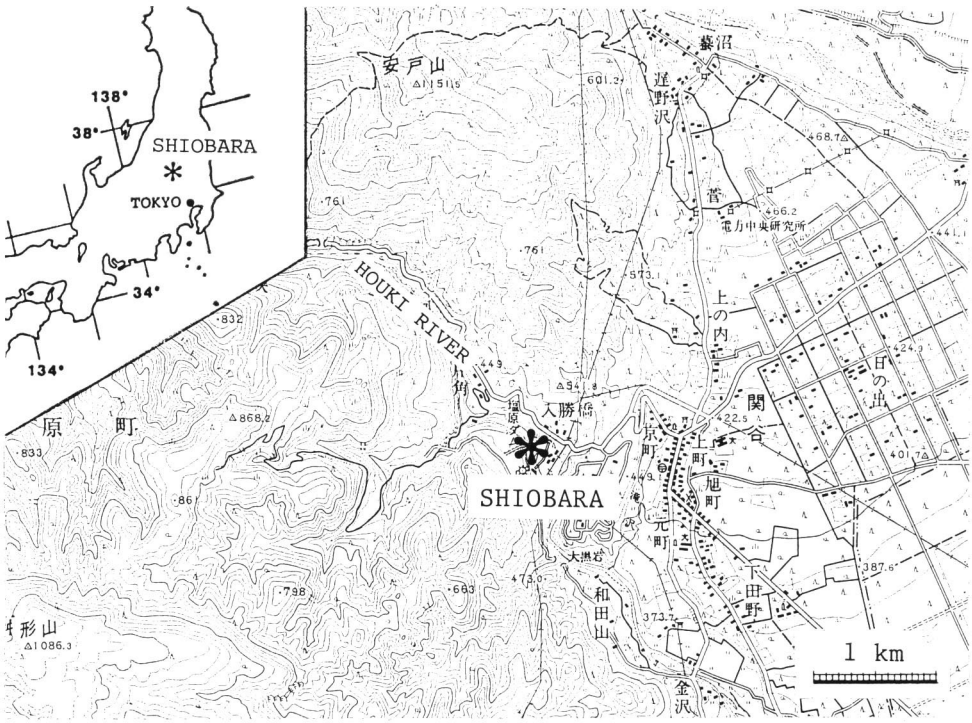

Fig. 1. Map showing the locality of a new Miocene righteye flatfish *Microstomus tochigiensis* sp. nov.

Etymology: The species name, *tochigiensis*, is derived from the name of the Tochigi Prefecture where the specimen was discovered.

Diagnosis: A species of *Microstomus* with 11 abdominal vertebrae and three anteriormost plate-like neural spines.

Description: The specimen is incomplete and lacks the posterior part of the caudal region. The head length of the blind side is about 40 mm. The head region is fairly well preserved and several bones are recognizable. The mouth is small: the lower jaw length of the blind side is about 3.4 times included in the head length. In the upper jaw, a long and robust ascending process and a part of the articular process of the premaxillary of the blind side are observable. In the lower jaw, the dentary with 11 incomplete teeth (not pointed at their tips) and articular of the blind side are observable. Although the neurocranium, especially orbital region, is fairly well preserved, it is difficult to identify each element (Fig. 3).

In the suspensorial and opercular regions, only parts of the metapterygoid, hyomandibular and preopercle of the blind side are remained. Fragments of four branchiostegal rays are recognizable. The urohyal in fish-hook shape, which is broken at its posterior portion, is located just anterior to the cleithrum of the ocular side (Fig. 4).

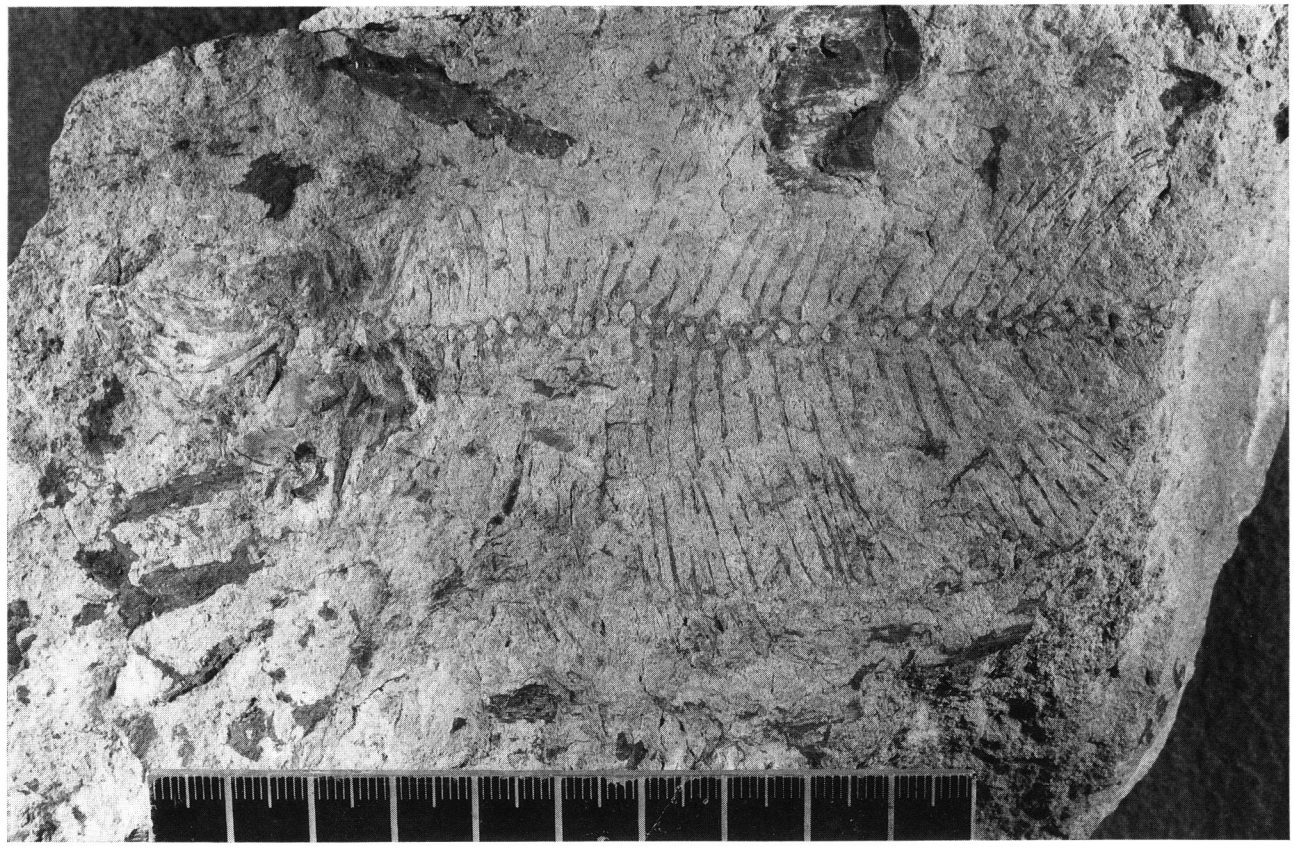

Fig. 2. The holotype of *Microstomus tochigiensis* sp. nov. (TPM 786), from Middle Miocene Kanomatazawa Formation, Tochigi Prefecture, Japan. About 40 mm in head length of blind side.

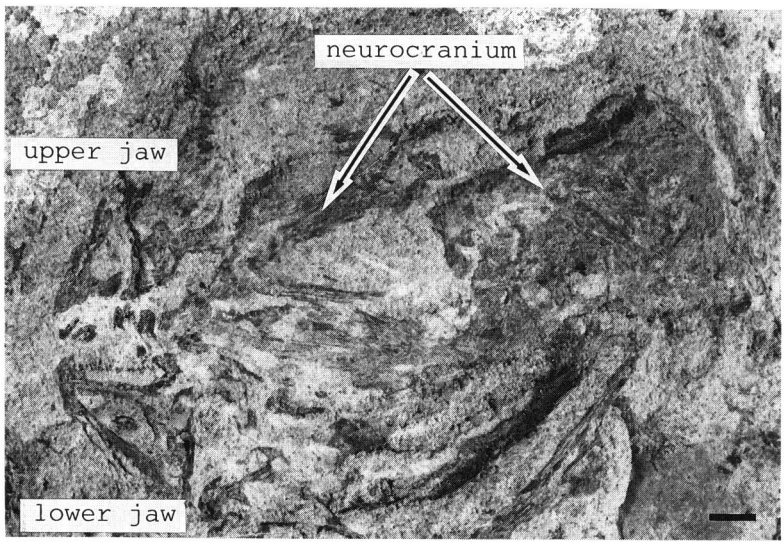

Fig. 3. Head region of *Microstomus tochigiensis* sp. nov., holotype, TPM 786. Scale shows 2 mm.

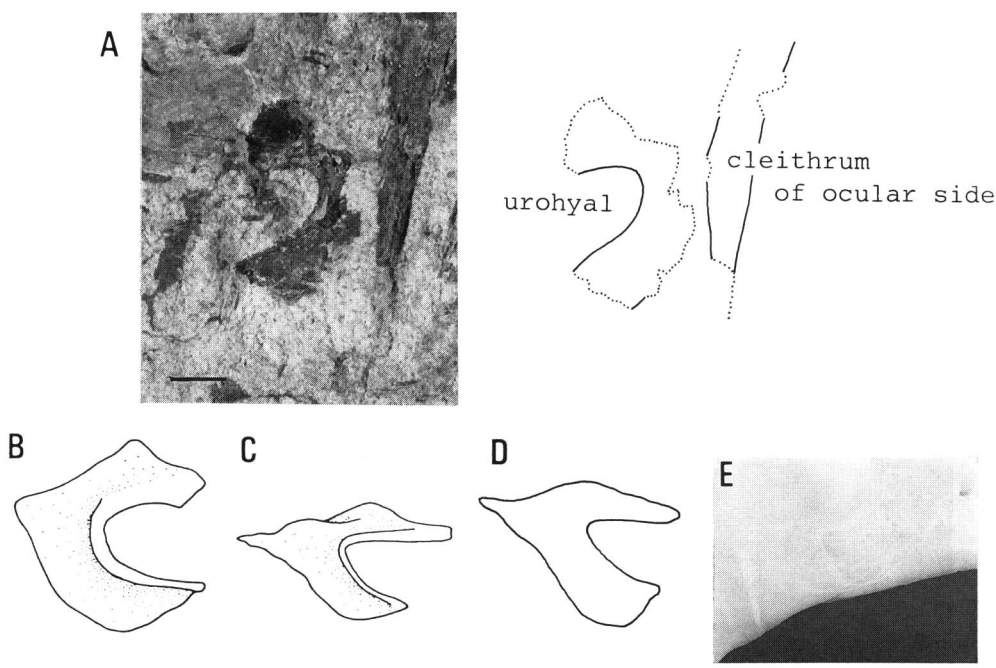

Fig. 4. Urohyals of *Microstomus tochigiensis* sp. nov. and four Recent pleuronectine fishes. A, *Microstomus tochigiensis* sp. nov., holotype, TPM 786; B, *M. achne* from SAKAMOTO (1984 b); C, *Tanakius kitaharai* from SAKAMOTO (1984 b); D, *Glyptocephalus stelleri* redrawn from HIKITA (1934); E, *Errex zachirus*, x-rayed photograph, HUMZ 45014, 297.0 mm SL. A, blind side; B–E, ocular side. Scale shows 2 mm.

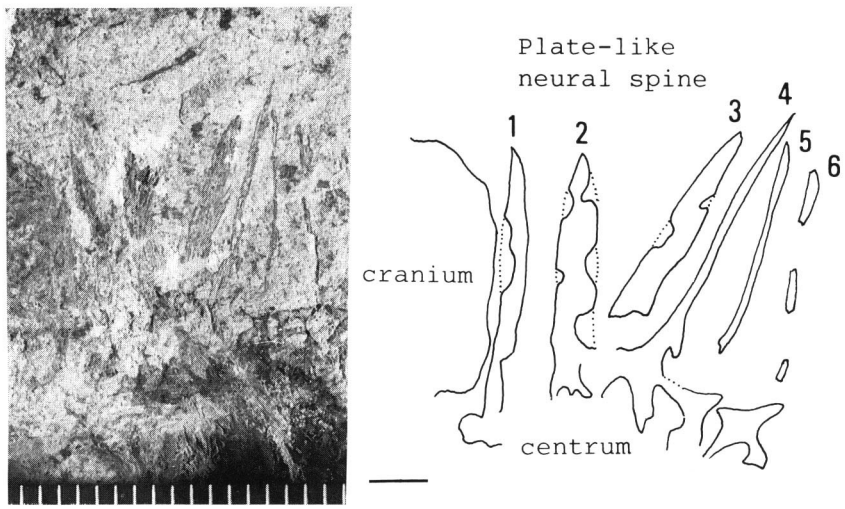

Fig. 5. Anterior portion of the abdominal vertebrae showing three anteriormost plate-like neural spines in *Microstomus tochigiensis* sp. nov., holotype, TPM 786. Scale shows 2 mm.

Dorsal and anal fin rays are poorly preserved. Only fragments of several dorsal fin rays and 12 incomplete proximal pterygiophores are remained. Ten incomplete anal fin rays and 33 proximal pterygiophores are countable. The anteriormost proximal pterygiophore whose middle part is remained is enlarged and robust, and curves anteroventrally. It is located just in front of the first haemal spine.

On the shoulder girdle, only main parts of the cleithra of both sides are observable. A part of the pelvis with a postpelvic process is preserved and anterodorsally inserted into the cleithra.

The centrum of each of 11 abdominal vertebrae possesses a neural spine. First three centra are poorly preserved. The third to sixth neural spines are displaced. The first, second and eleventh spines are nearly straight and directed upward, and seventh to tenth ones slightly curve forward. Three anteriormost neural spines are laterally broad and plate-like, and others are slender (Fig. 5). Parapophyses of the fourth to eleventh vertebrae are observable. Twenty nine caudal vertebrae with well developed neural and haemal spines are countable, but the total number is not estimated.

Discussion

Judging from the general shape of the orbital region of the neurocranium (Fig. 3), it is apparent that the present species is a member of the righteyed flatfishes: righteyed members of Psettodidae and Citharidae, Pleuronectidae, and Soleidae (see NORMAN, 1934; CHABANAUD, 1936; OCHIAI, 1966; AMAOKA, 1969, 1972; SAKAMOTO, 1984 b; CHAPLEAU, 1988; CHAPLEAU & KEAST, 1988). Whithin these flatfishes, the new species belongs to the family Pleuronectidae sensu NORMAN (1934) with modification by

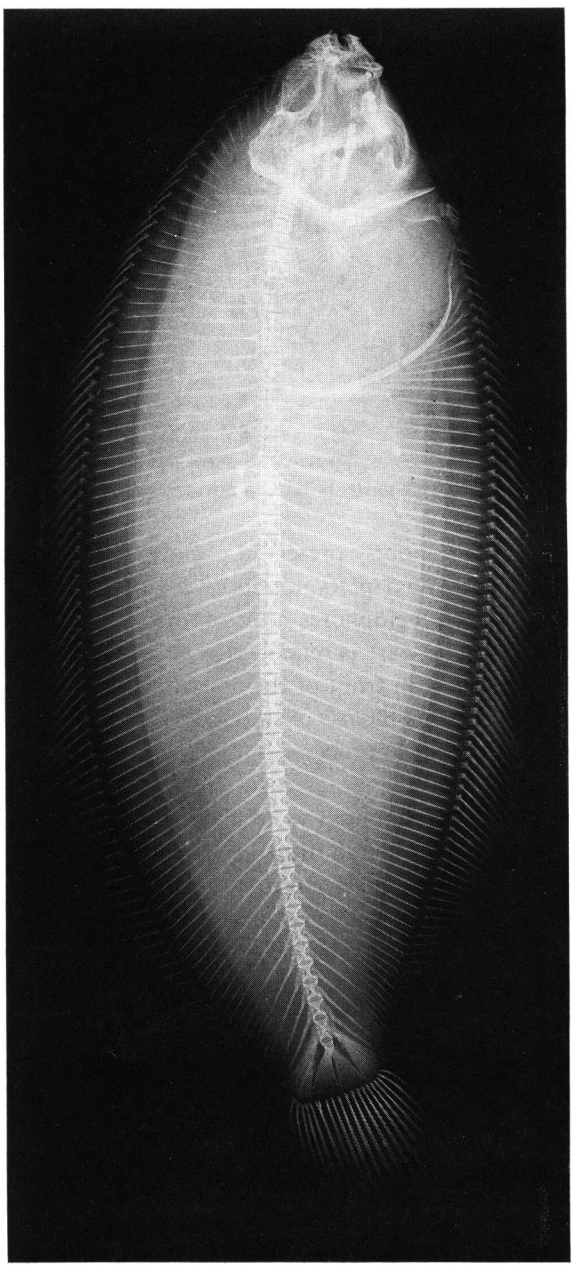

Fig. 6. X-rayed photograph of *Microstomus achne*, HUMZ 57209, 188.5 mm SL, Onahama Fish Market, Fukushima Prefecture, Pacific coast of Japan.

Table 1. Abdominal and total vertebrae and number of anteriormost plate-like neural spines in five *Microstomus* species. Data for the living species are obtained from the following comparative materials: *Microstomus kitt*, 12 specimens, 196.2–305.0 mm SL, HUMZ 86783–86792, 87223, 87224; *M. achne*, 35 specimens, 142.6–327.5 mm SL, HUMZ 19443, 33244, 35248, 45559, 45560, 48304, 52038, 52883–52885, 56733, 57133–57138, 57140, 57199–57202, 57204, 57205, 57207, 57209–57212, 57214, 59321, 75747, 90915, 100281; *M. pacificus*, 23 specimens, 237.5–360.2 mm SL, HUMZ 30943, 33789, 44992, 45001, 45002, 45015, 45016, 67108–67110, 67112–67114, 67116, 67233, 67846, 67848, 67909, 68404, 76428, 77310, 84901, 89398; *M. shuntovi*, 25 specimens, 157.8–245.2 mm SL, HUMZ 56710, 57222, 57614–57634, 68829, 68835.

Species	Abdominal vertebrae				Total vertebrae									Plate-like neural spines		Specimens examined
	11	12	13	14	46	47	48	49	50	51	52	53	54	3	4	
M. tochigiensis sp. nov.	1													1		1
M. kitt	1	11				8	4								12	12
M. achne		5	29	1	1		11	13	9	1					35	35
M. pacificus		21	2							1	10	10	2		23	23
M. shuntovi		22	3		2	14	7	2							25	25

Abbreviation: HUMZ, Laboratory of Marine Zoology, Hokkaido University; SL, standard length

HUBBS (1945), because it has a fish-hook-like urohyal, and an enlarged and robust first proximal pterygiophore of the anal fin (OCHIAI, 1966; AMAOKA, 1969, 1972; HENSELY and AHLSTROM, 1984; SAKAMOTO, 1984 b; CHAPLEAU, 1988; CHAPLEAU and KEAST, 1988). Also, this species is included in the subfamily Pleuronectinae (sensu SAKAMOTO, 1984 b) by having the first neural spine (SAKAMOTO, 1984 b).

The pleuronectine fishes are divided into two groups in relation to the size of the mouth: large and small mouth groups (SAKAMOTO & UYENO, 1989). The present species is within the small mouth group comprising 12 genera (SAKAMOTO, 1984 b). The classification of this group have been made using mainly external characters by many investigators (e.g. NORMAN, 1934; HIKITA, 1934; UENO, 1955; MATSUBARA, 1955; SAKAMOTO, 1984 a). Since almost all the discriminative characters used for Recent species are not observable in the fossil, we used the relation between the urohyal and cleithra examined by SAKAMOTO (1984 b) as a character for the assignment of the present species. As shown in Fig. 4, it is highly probable that the urohyal in this fossil is attached to or inserted into the cleithra, though its posterior portion is missing. Such a situation is found in members of *Microstomus*, *Tanakius*, *Glyptocephalus* and *Errex* within the small mouth pleuronectines (SAKAMOTO, 1984 b). Moreover, it is evident that the general shape of the urohyal is more similar to that of *Microstomus* than to those of other three genera (Fig. 4). In addition to these comparisons, since no characters are available to establish a new genus, we concluded that it is reasonable to classify the present species into the genus *Microstomus*.

Microstomus consists of three species in the North Pacific and one species in the

North Atlantic: *M. kitt* (from North Atlantic), *M. achne* (from western North Pacific: Suruga Bay northward and from East China Sea to southern Kuril Islands) (Fig. 6), *M. pacificus* (from eastern North Pacific: from northern Baja California to Bering Sea), and *M. shuntovi* (from Emperor Seamounts). They have been distinguished from one another by such characters as the number of scales in the longitudinal row and the degree of the distribution of scales in the snout (NORMAN, 1934; BORETS, 1983). Since these characters are not observable in the fossil, we used the following characters into consideration to compare the fossil species with four Recent species: numbers of anteriormost plate-like neural spines, and abdominal vertebrae. This species is distinguishable from all Recent *Microstomus* species in both characters: 3 in the fossil species vs. 4 in other species in the number of anteriormost plate-like neural spines, and 11 vs. mostly 12–13 in the number of abdominal vertebrae (Table 1 and Fig. 6). As far as we are aware, no other fossil species of the genus *Microstomus* was previously described.

On the basis of the zoogeographical distribution of both Recent and fossil species mentioned in the present study, the origin of the genus *Microstomus* is considered to be in the western North Pacific prior to Middle Miocene age. In *Microstomus*, the number of abdominal vertebrae and anteriormost plate-like neural spines had increased in Recent species (Table 1).

Acknowledgments

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