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Original Articles (原著)

Clidoderma chitaensis, A New Fossil Flat Fish, from the Miocene Yamami Formation, Chita Peninsula, Aichi, Central Japan

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Abstract

A fossil flat fish with many tubercles all over the body is found in the tuffaceous sandstone bed of the Miocene Yamami Formation of the Morozaki Group, Aichi Prefecture, central Japan. This is identified as a new fossil species, which has close relation to the living species *Clidoderma asperrimum* (Temminck et Schlegel), Samegarei (Japanese name), in the family Pleuronectidae.

Key words: Miocene, Morozaki Group, flat fish (Pleuronectidae), tuberculous scale.

Introduction

A fossil flat fish was found from a cutting at Kiriyama, Mihama-cho, near the distal end of Chita Peninsula (Fig. 1) by the junior author in June, 1993.

In this paper, *Clidoderma chitaensis*, a new species is described comparing with living species, *Clidoderma asperrimum* and others which inhabit the neighbouring sea around Japan.

Locality and geology

Kiriyama, the fossil locality, Mihama-cho lies 1.5 km, west of Utsumi, Minamichita or 1.3 km, north west of Toyooka I. C., the terminus of Minami Chita central way and is situated at Long. 136°55′25″E and Lat. 34°43′58″N (Fig. 1).

The fossil bed which is composed of some thin

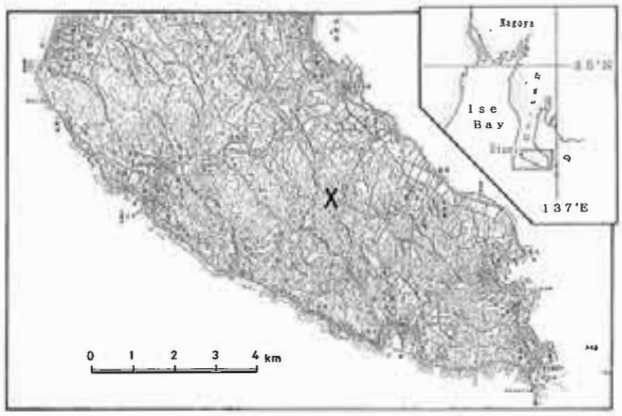


Fig. 1. Locality map (cited from 1/50,000 map sheet 「Morozaki」 of Geographical Survey Institute of Japan).
X……locality.

tuffaceous sandostone layers (5 cm in thickness) with fragments of carbonized plant and many specimens of *Brissopsis* sp. is just below the laminated tuffaceous sandstone (1 meter in thickness, maybe Otsukata

sandstone in Kondo and Kimura, 1987) and is alternating with mud beds. It belongs to the upper part of the Yamami Formation of the Morozaki Group on the basis of the thick sandstone above mentioned.

Fossil assemblage (Hachiya, Yamaoka and Mizuno, 1993): Mollusca: *Saccella miensis*, Ophiuroidea: Ophiuroidea gen. et sp. indet. Echinodermata: *Brissopsis* sp. Fishes: *Aldrovandia affinis*, Gonostomatidae gen. et sp. indet., *Lampanyctus* spp., *Diaphus* spp., *Coelorhynchus* sp., *Scomber* sp., *Howella* sp.

These species are the principal members of the fauna of the Yamami Formation. They indicate the deep sea paleoenvironment (Ohe, 1993).

Systematic description

Family Pleuronectidae (カレイ科)

Genus *Clidoderma* Bleeker, 1862 (サメガレイ属)

Type species: *Clidoderma asperrimum* (Temminck et Schlegel, 1846)

Clidoderma chitaensis sp. nov.

Japanese name, Chita-samegarei, チタサメガレイ

(Pls. 1-3; Fig. 2; Tables, 1, 2)

Holotype: the lower counterpart, embedded in tuffaceous sandstone; MFM27001, deposited in the Mizunami Fossil Museum.

Collector: Motohiro Kawase (junior author), Tokai fossil Society, Nagoya City.

Etymology : *chitaensis* was named after the locality area "Chita".

Compared living specimens: *Clidoderma asperrimum* (Temminck et Schlegel), Samegarei in Japanese, (1) #OPC940512, Total length=41.7 cm, Standard length=35.1 cm, Head length=9.8 cm, Body depth=19.4 cm, Least depth=3.4 cm, Caudal pedancle=2.1 cm, Eye diameter=1.9 cm; offered from Muroran Municipal Aquarium, Hokkaido, 1994; (2) #OPC940611, Standard length=20.95 cm, Head length=5.9 cm, Body depth=12.3 cm, Least depth=1.95 cm, Caudal pedancle=0.75 cm, Eye diameter=1.35 cm, Length of pectoral fin=2.4 cm, offered from Otaru Aquarium, Hokkaido. 1994.

Platichthys stellatus (Pallas), Numagarei in Japanese. #OPC95034-1, Total length=24.5 cm, Standard length=20.0 cm, HL=5.7 cm, Body depth=10.2 cm, Least depth=2.1 cm, Top-Anus=6.6 cm; Locality, off Sanriku, Miyagi Pref.

Kareius bicoloratus (Basilewsky), Ishigarei in Japanese, #OPC950429, Total length=27.6 cm, Head length=6.8 cm, Body depth=10.5 cm; Locality, Ise Bay, 1995.

#OPC: Specimen-number in Ohe's private collection.

Diagnosis: Oval in body shape. Eyes on the right side. The dorsal fin begins from above the center of left eye. The first inter neural spine is bow-shaped, rather straight and moderately expanded. Each fin ray is soft and unbranched. The total number of anal fin ray is 58; Dorsal fin rays, 86; Caudal fin rays, 19. Also pectoral fin rays, 9. Abdominal cavity is moderately large and is equal to head length. Mouth is comparatively large and oblique.

The body is covered with many tubercles which are close together, rather roughly on ocular side and the large one is conical, triangular with 7-8 ridges or spines on the posterior margin. There are three longitudinal lines which are formed by remarkably larger tubercles along the margin of the body and each distal end in haemal spine.

Total number of vertebrae including urostyle is 43, which is comparatively large number (abdominal vertebrae, 15; caudal vertebrae, 28). Caudal pedancle is short in length.

Description: The most part of the body is well preserved, but some of the marginal parts such as jaws, throat and ventral margins, a part of anal fin, and ventral fin are missing.

The body appears to have eyes on the left side (Pl. 1, Fig. 1; Fig. 2), but it is evident that this species has eyes on the right side, judging from the facts that the inferior part of frontal bone in the skull is buried in a tuffaceous sandstone and there are some pores of tubercle on the hypural bones of caudal skeleton. The left half of head skeleton is well preserved with other side buried in the tuffaceous sandstone. The construction of the head is simple, rough and is composed of the characteristic bones such as long skull with high

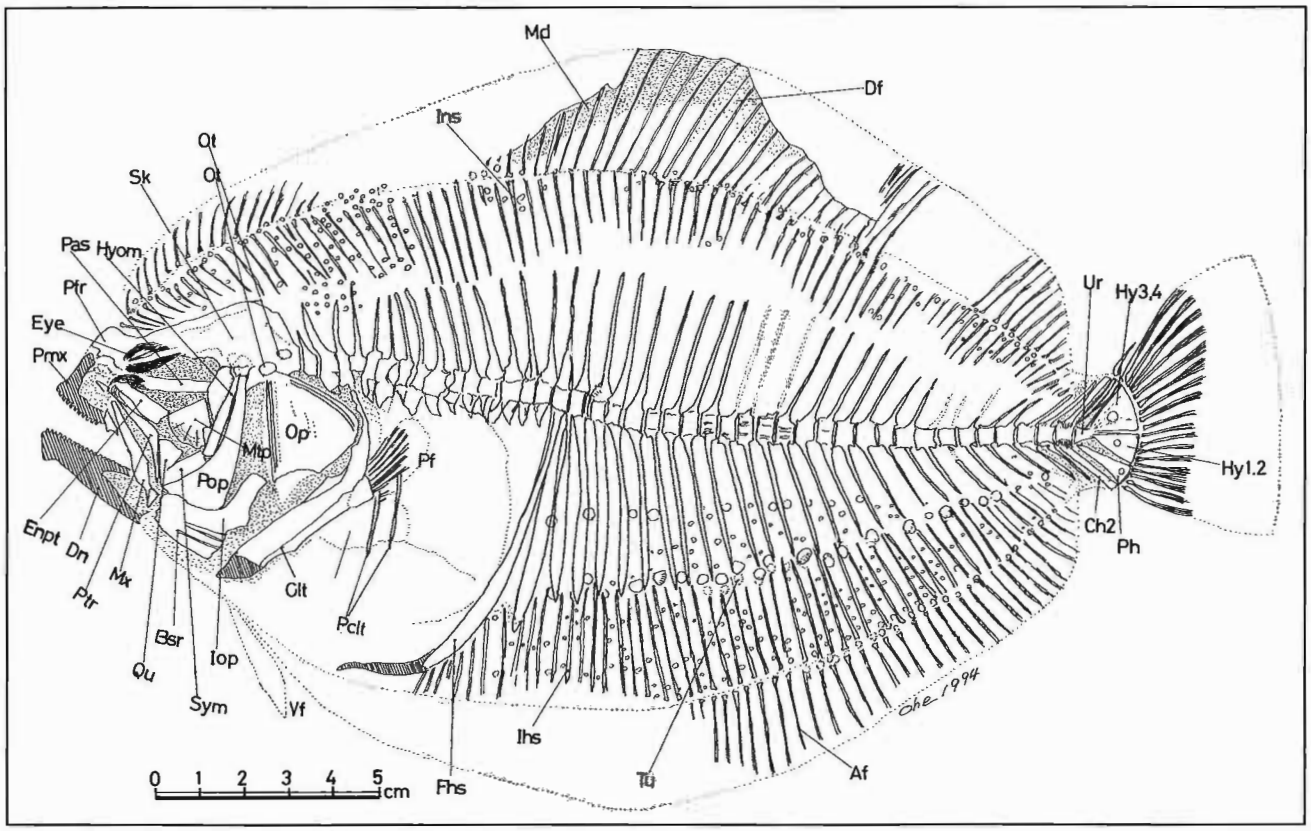


Fig. 2. The whole picture of *Clidoderma chitaensis* sp. nov.
Abbreviations-Af: anal fin; Bsr: brachiostegal ray; Eye: eye; Ch: caudal haemal spine; Clt: cleithrum; Df: dorsal fin; Dn: dentary; Enpt: entopterygoid; Fhs: the first interhaemal spine; Hy1-5; hypural: Hyom; hyomandibular; Ihs: interhaemal spine; Ins: interneural spine; Iop: interopercular; Md: membrane of dorsal fin; Mtp: metapterygoid; Mx: maxillary; Op: opercular; Ot: otolith; Pas: parasphenoid; Pclt: post cleithrum; Pf: pectoral fin; Pfr: prefrontal; Ph: prehypural; Pmx: premaxillary; Pop: preopercular; Ptr: pterygoid; Qu: quadrate; Sk: skull; Sym: symplectic; Tu: tubercle; Ur: urostyle; Vf: ventral fin. Line pattern is lost part.

epiotic and thick frontal in the left side, preopercular with expanded distal part, triangular opercular with convex surface, large inner opercular, straight cleithrum of the right side, small triangular quadrate, fan-shaped metapterygoid, small bow-shaped pterygoid and hyomandibular with slim rod.

Two circular sagittae are also recognized in prootic bone area of the skull.

The traces of the membrane between dorsal fin rays are well preserved in black colour.

The main rod of the first interhaemal spine is bow-shaped, rather straight, moderately wide with lost distal end. Not only the first haemal spine but also the second and third interhaemal spines are flat, long and wide. There are many small, circular hollows all over the surface of the flat body. These are traces of rough bony tubercles on the ocular side of the body. Most of hollows are filled with white clayey substance. The largest one is conical, triangular in shape, with 7—8 ridges or spines on the posterior margin and 3.5 mm in diameter. Comparatively large hollows are lined along each distal end of haemal spine. In addition, each tubercle along the margin of the body is situated between two neighbouring fin rays. There are three rows of tubercles on the surface in all, but the other rows are almost invisible. Both interhaemal and interspinous bones (=inter neural spines) are needle-shaped and equal to the pairing haemal and neural spines in length. All the neural spines of abdominal vertebra tilt toward the skull.

Measurements: Length of each part is as follows. Though the posterior margin of the caudal fin and the

tip of the head are lost, the total length is estimated at about 27 centimeters.

Table 1. Length of each part of *Clidoderma chitaensis* sp. nov.

Total length	24.7cm+ ?
Standard length	23.6cm
Body depth	12.0cm
Head length	6.0cm
Snout length	0.6cm
Length of skull	5.2cm
Least depth	2.3cm
Caudal pedancle	1.4cm
Eye diameter (horizontal)	1.2cm
Length of pectoral fin	1.3cm+ ?
Maximum length in dorsal fin rays	3.0cm
Maximum length in anal fin rays	2.5cm
The first haemal spine	5.0cm
The second haemal spine	4.5cm
The third haemal spine	4.3cm

Comparison with living species: This new species is very close to some living species in ratios as shown in the Table 2. In the ratio of the caudal pedancle to the body depth, the value of the new species is slightly smaller than those of two specimens of living species.

Tubercles are different from those of living species in structure and size.

Table 2. Comparison with ratios of length of each part among fossil species and two living species *Clidoderma asperrimum* (Temminck et Schlegel).

Ratios in each length	fossil	#OPC 940512	#OPC 940611
Standard length/Body depth	1.97	1.81	1.70
Standard length/Head length	3.93	3.58	3.55
Standard length/Caudal pedancle	16.86	16.71	16.76
Body depth/Head length	2.0	1.98	2.08
Body depth/Least depth	5.22	5.71	6.31
Body depth/Caudal pedancle	8.57	9.24	9.84
Head length/Eye diameter	5.0	5.16	4.37
Least depth/Caudal pedancle	1.64	1.62	1.56

#OPC: Specimen-number in Ohe's Private Collection

Discussion

In Japan, two fossil species of the genus *Clidoderma* were reported from the Miocene Toyohama Formation, Aichi Prefecture (Ohe, 1984) and the Pliocene Tatsunokuchi Formation, Fukushima Prefecture (Sakamoto and Uyeno, 1988).

The former, *Clidoderma* sp. is a large specimen without the main caudal and head parts. However, this is dubious as to the systematic position. The latter without the head part was already identified as the same as the living species because of having the clear traces of many tubercles covering all the body. The present specimen is under almost perfect preservation and is remarkably different from the Pliocene species above mentioned and living species in having smaller tubercles with some ridges or spines on the posterior margin and in having high density of tubercles.

The number of vertebra upon which the first haemal spine occurs in this new species is 15th and is larger than those of the other species. The total number of vertebrae is also 43. Those numbers of this species are close to those of the large number group such as *Reinhardtius hippoglossoides* (HS, 18-19; vert, 61-63) or *Hippoglossus hippoglossus* (HS, 16; vert, 49-50) and don't fit any other species except *Clidoderma asperrimum* (Ohe and Hamaguchi, 1975; Ohe and others, 1979).

Namely, the present species suggests that most of the characteristics of living species, as an extant species, have been inherited since the Middle Miocene. This suggestion might be supported by surveying the following habitats.

Clidoderma is a monotypic genus and the living species is a habitant in mud bottom of rather deep and cold waters, in Hokkaido, 180-500 meters in depth, northern Japan and the adjacent waters such as Sakhalin, the Kuiril Islnds, the Korean Peninsula, the northern Pacific to the southern waters like the Yellow Sea, the Gulf of Po-Hai, East China Sea, and southern British Columbia (Kuronuma, 1940; Eschmeyer *et al.*, 1983; Matsubara, 1964, Sakamoto, 1984

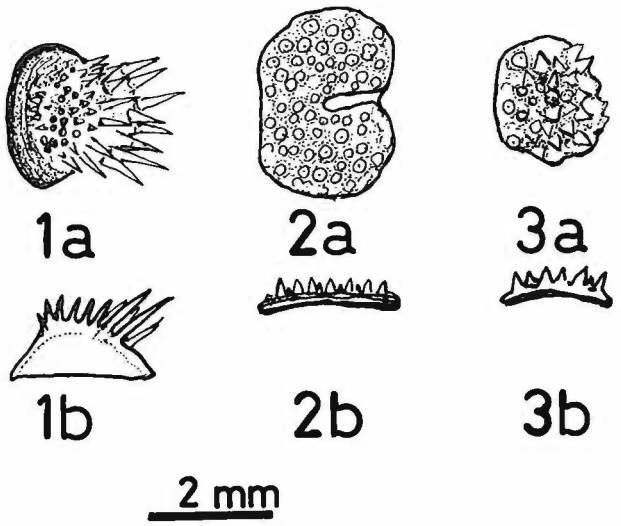


Fig. 3. Tubercles of three living species.
1, *Clidoderma asperrimum* (#OPC940611);
2, *Kareus bicoloratus* (#OPC950429);
3, *Platichthys stellatus* (#OPC95034-1).
a, each dorsal aspect; b, each lateral aspect.

b).

In Japan, there are three species of flat fish with tubercles.

The place and arrangement of tubercles of *Platichthys stellatus* resembles those of *Clidoderma asperrimum*, but the shape and structures of tubercles of these two are basically different as shown in Fig. 3. From the structural view point, *Platichthys stellatus* rather resembles *Kareus bicoloratus* in having many small denticles on its platic dorsal surface.

According to Matsubara (1964) and Eschmeyer, Herald and Hammann (1983), *Platichthys stellatus* and *Kareus bicoloratus*, these two spesies can be hybridized each other under natural circumstances. Also these two species are basically different from the present fossil species not only in the shape of tubercle but also in other features (Table 3).

In Table 3, the number of dorsal fin rays of this fossil species is smaller than other species and the number of anal fin rays is larger. From the above view points, this species may well be considered as a new species.

Taphonomy: Both fins, dorsal and anal were discovered open. The whole osteological structure and organization of the body had not been entirely disinte-

Table. 3. The differences in the characters among four species.

Characters	*Clidoderma chitaensis*	*Clidoderma asperrimum*	*Platichthys stellatus*	*Kareius bicoloratus*
Dorsal fin rays	58	79-94	52-68	62-75
Anal fin rays	86	63-75	36-51	45-55
VN	43	44	36	38
HS	15	15	12	12
HA	15	15	12	12
Distribution of tubercle	Head, all over the body, maybe fin ray.	Head all over the body, fin ray.	Head, linearity on the center, along the margin and pectoral area.	Dorsal and anal parts of the body, along lateral line.
Standing of tubercle	Stand close together.	Stand close together.	Scattered in abdomen area.	Partially isolated.
Shape of tubercle	Conical scale, with spines on the posterior surface.	Conical scale, with spines on the posterior surface.	Small denticles on thick plate, with the concave base.	Small denticles on thick plate, with the flat base.

VN: the vertebral count the urostyle included as 1 vertebra.
HS: the number of vertebra upon which the first haemal spine occurs.
HA: the number of vertebra upon which the first haemal arch occurs.

grated and carried somewhere else.

The state of preservation like this means that at that time, this fish should have met with an untimely death by some accidents from the deficiency of oxygen and rapidly had been burried.

Acknowledgements

We express our sincere thanks to Mr. Kenji Kagoshima of the Otaru Aquarium, Hokkaido and Mr. Toshitaka Nakamura of the Muroran Municipal Aquarium who offered the living specimens of *Clidoderma asperrimum* of Hokkaido. We are also very grateful to Dr. Kazuo Sakamoto in the Zoology section of the University Museum of Tokyo for his useful guidances concerning systematic study and Prof. Hajime Hanamura of the Department of anatomy, School of Dentistry, of Aichigakuin University for his assistance on the X-ray photographs in course of the study.

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愛知県知多半島中新統山海累層から得られたいぼ状鱗をもつサメガレイ属新種 *Clidoderma chitaensis* sp. nov.

大江文雄・川瀬基弘

要　　旨

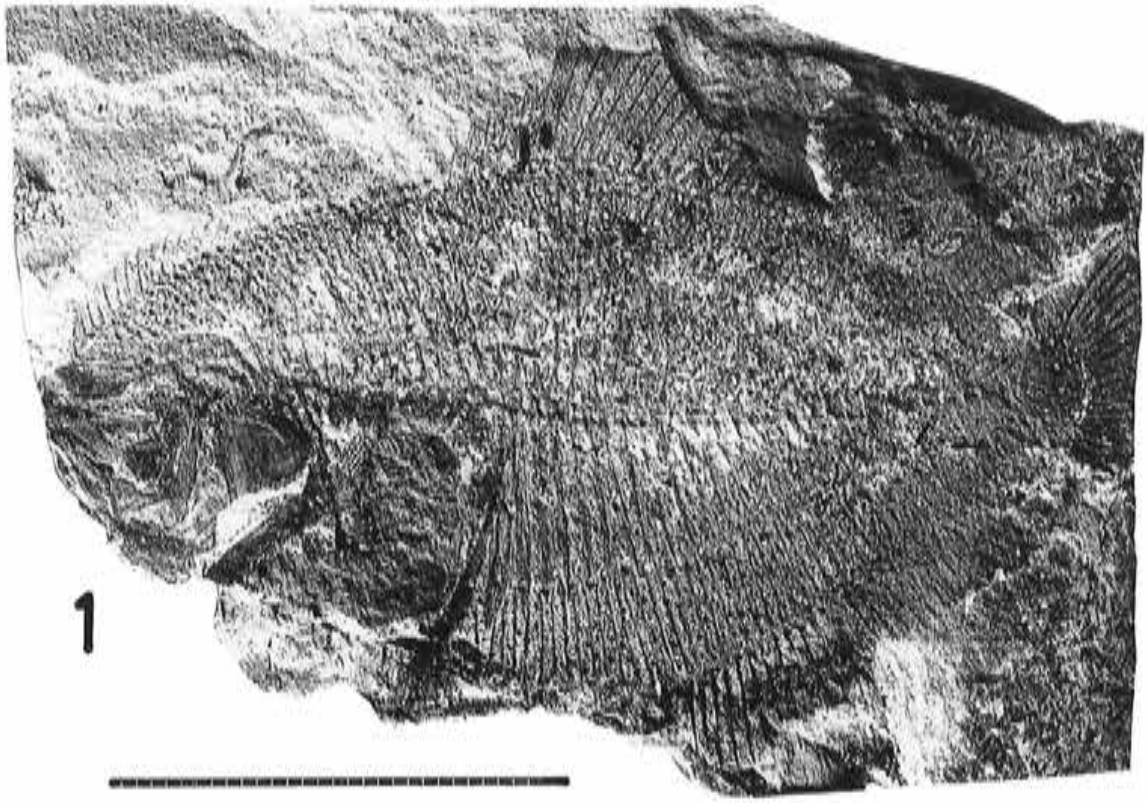
愛知県知多郡美浜町切山の農業用造成地に見られる中新統師崎層群山海累層の凝灰岩質砂岩層から得られたカレイ科魚類化石は現生種との骨格的な比較を行った結果，日本近海，特に北海道より以北の海域に分布するサメガレイ *Clidoderma asperrimum* (Temminck et Schlegel) に基本的に一致することが判明した．しかし，本種の特徴であるいぼ状鱗(Tuberculous scale)の形状，大きさ並びにその配列に，また，背鰭，尻鰭の鰭条数等が異なることを認めたので，ここに本種を新種と位置づけた．

Plate 1

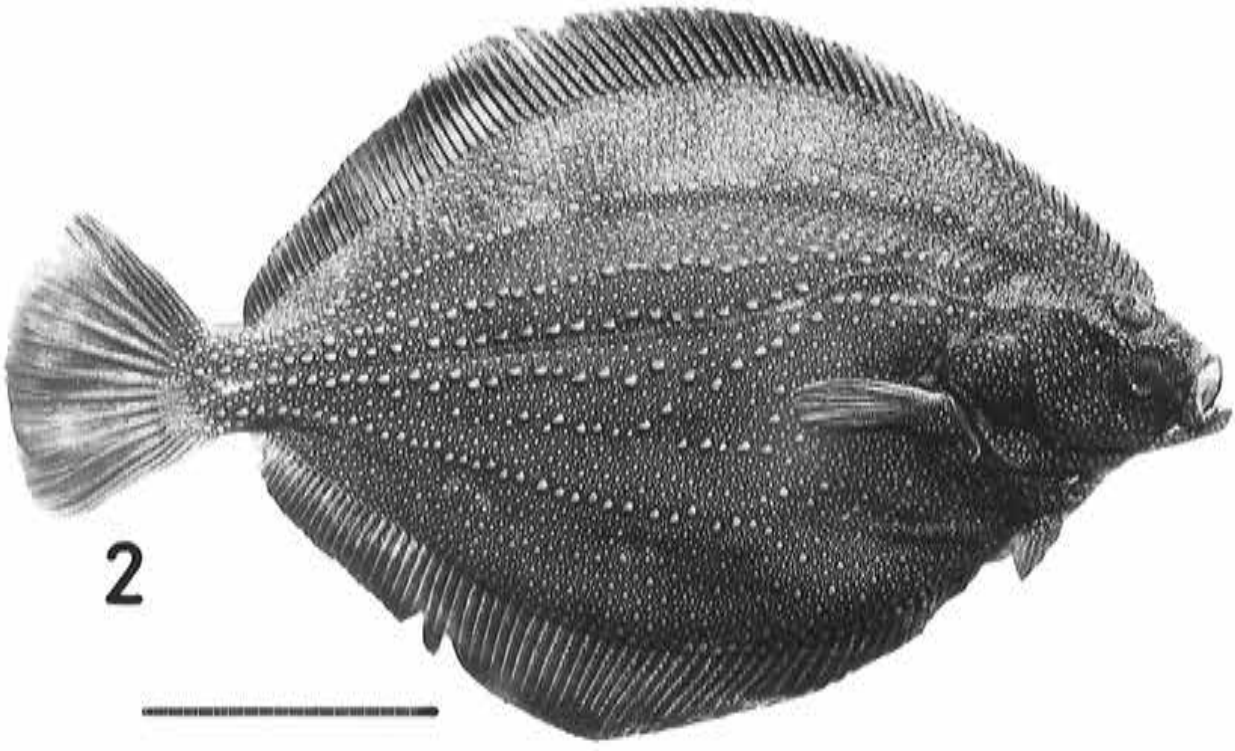
Fig. 1. Holotype, the whole features of *Clidoderma chitaensis* sp. nov.

Fig. 2. Living species, *Clidoderma asperrimum* (Temminck et Schlegel), Samegarei in Japanese, #OPC940512, Total length=41.7 cm; Standard length=35.1 cm; Head length=9.8 cm; Body depth=19.4 cm; Locality: Muroran Municipal Aquarium, Hokkaido.

Each scale bar=10 cm.



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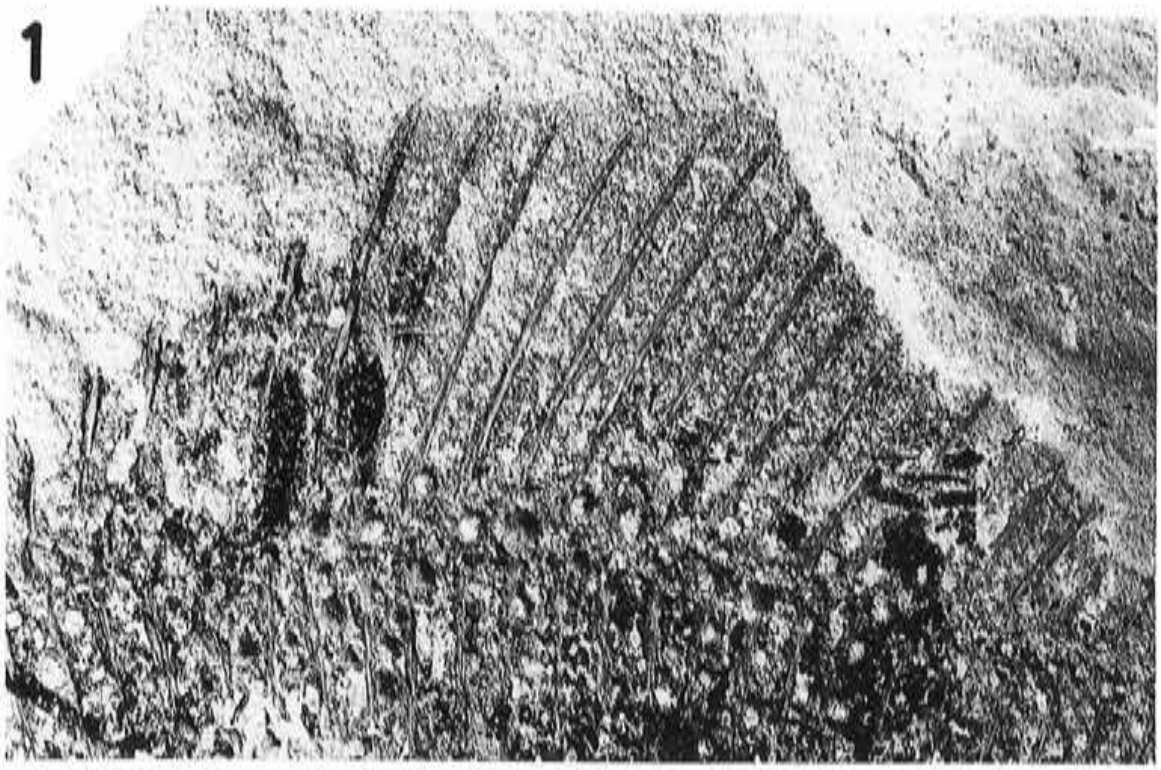
Plate 2

Fig. 1. The part of the dorsal fin rays and membranes of *Clidoderma chitaensis* sp. nov.

Fig. 2. The large tubercles with a row and small tubercles in the abdominal area of *Clidoderma chitaensis* sp. nov.

Each scale bar=2 cm.

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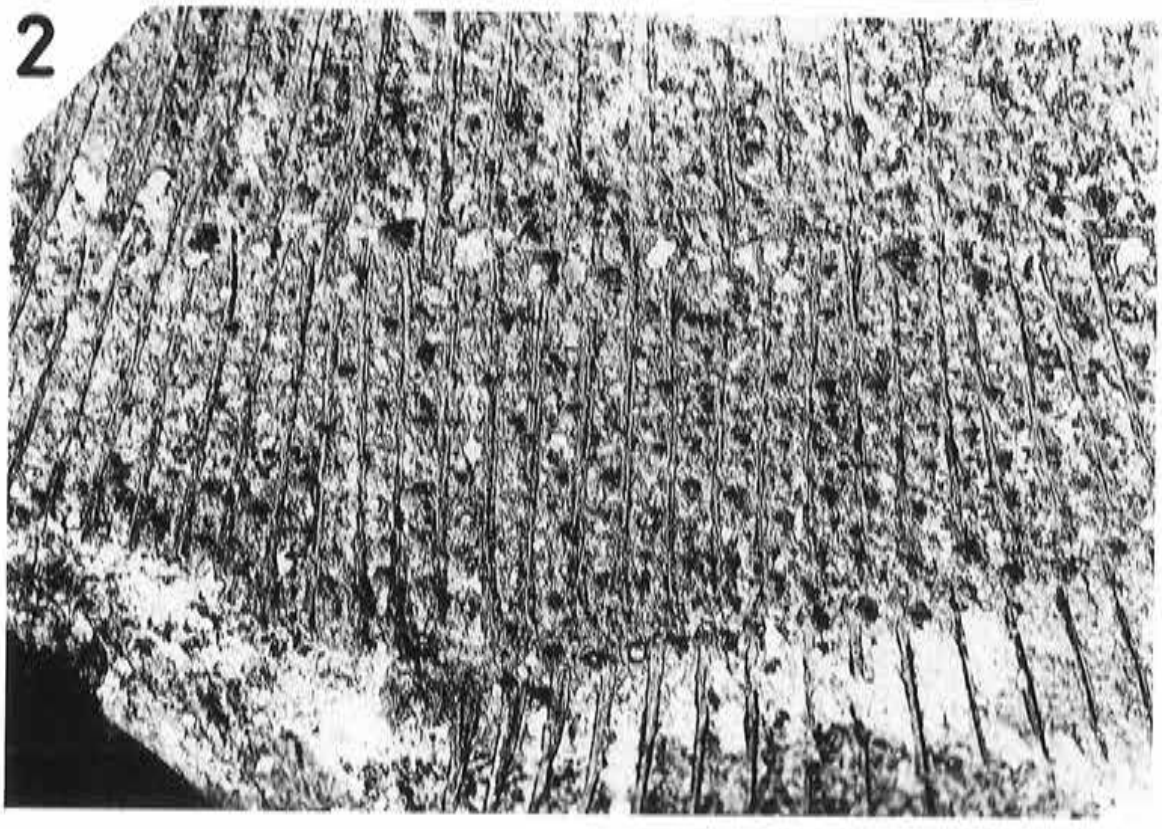
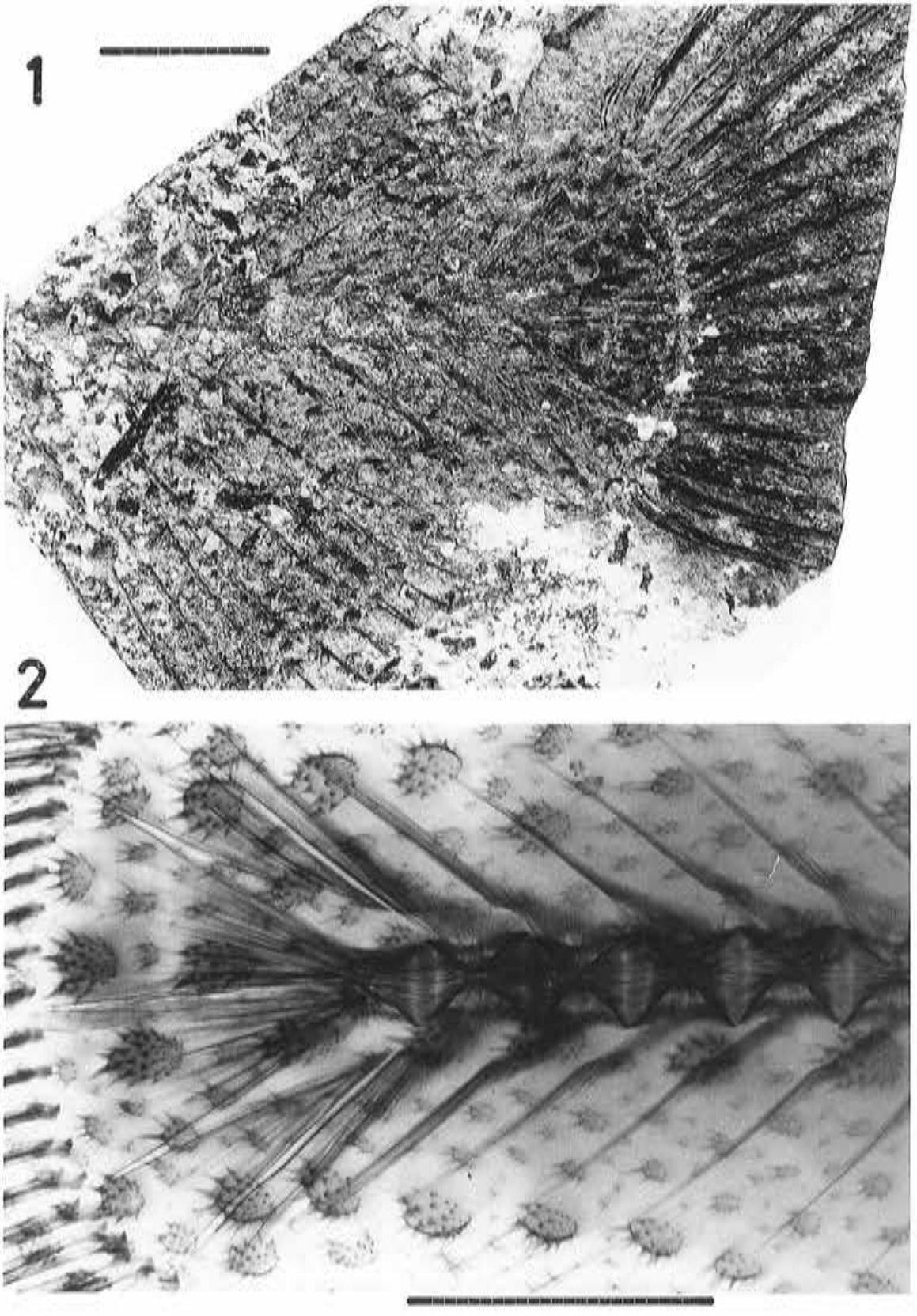


Plate 3

Fig. 1. The caudal skeleton of *Clidoderma chitaensis* sp. nov.

Fig. 2. The X-ray photograph of the caudal skeleton and tubercles of *Clidoderma asperrimum* (Temminck et Schlegel), #OPC940611, Standard length=20.95 cm; Least depth=1.95 cm.
Locality: Otaru Aquarium, Hokkaido. 1994.

Each scale bar=1 cm.


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