

Trans. Proc. Palaeont. Soc. Japan, N.S., No. 67, pp. 125-128, Sept. 20, 1967

## 526. SOME FOSSIL *Gobi* FROM JAPAN\*

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日本からのハゼ化石：能登半島，中部中新統の東印内層，中部更新統の平床層，多摩丘陵，上部鮮新統の柿生層および三浦半島，中部更新統の大津層から，ハゼ属の耳石化石の産出を報告，能登からの2新種を記載した。

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### Introduction

Our knowledge of fish otoliths, both fossil and Recent, has been very poor in Japan. In 1956 HATAI first described 4 species of Pliocene and Pleistocene otoliths from the Boso Peninsula. Later, he (HATAI & KOTAKA, 1963; HATAI, 1965) described and illustrated various Recent and seven fossil otoliths mostly from northern Japan.

During the selection of foraminiferal fossils from washed sediments in laboratory and the sampling of foraminiferous material in the fields, fossil otoliths can be frequently encountered and in exceptional cases they are even common. In the present situation, however, the author finds it difficult to obtain numerous kinds of Recent otolith specimens, especially those of off-shore and deep sea fishes. Therefore, any reliable determination of the morphological affinity of these fossil species to the Recent ones or their systematic positions cannot be made, and most of the specimens at hand have not been examined taxonomically.

Recently the author found some otolith specimens of *Gobius*, which is easily distinguishable in having a quad-

rate outline with a closed sulcus, in the samples from four formations, namely, (1) the Higashi-innai and (2) the Hiratoko formations, both being developed at the northern end of the Noto Peninsula on the Japan Sea-side of central Japan, (3) the Kakio formation of the Tama Hills and (4) the Owtsu formation of the Miura Peninsula, both on the Pacific-side of central Japan. The first formation was laid down during the early stage of the middle Miocene marine-transgression, at which the warm and shallow waters widely spread around the Japanese Islands. The third one is upper Pliocene in age and yields the characteristic subtropical fossil fauna. The other two formations are interpreted as the deposits of the interglacial transgressive stage of middle Pleistocene. As the occurrence of the originally warm and shallow-brackish water fishes in such sediments is interesting, it is reported here briefly with descriptions of two new species.

### Occurrence

The Miocene Noto specimens from the Higashi-innai formation were collected at a small roadside exposure bordering the primary school at Wasumi, 3.5 km SE of Yanagida, Yanagida-mura, Suzu County, Ishikawa Prefecture. Two speci-

\* Received November 28, 1966; read September 24, 1966, at Akita.

mens of *Gobius* species were found together with several otoliths of other families. One of the two is rather strongly worn out and the both are possibly not indigenous but were drifted by current from some nearby shallower place, because the foraminiferal assemblage indicates a deeper-water facies than the general habitat of *Gobius* species. This fossil species is named *Gobius rusticus*, n. sp.

The Pleistocene Noto specimens were obtained from the basal part of the upper sandstone member of the Hiratoko formation in a road-cut south of Hiratoko, Suzu City, on the prefectural road connecting the town of Showin with Suzumisaki. This fossil locality is considered to be on the opposite side of the road from the type exposure of the so-called Hiratoko shell-bed, which lies unconformably on the upper Miocene diatomaceous mudstone of the Iizuka formation at this locality. Until now, 16 specimens of *Gobius* were obtained. Their morphological features fall well within a reasonable range of variations of one species, and so the specimens are named *Gobius notoensis*, n. sp.

Only one Pliocene otolith specimen of *Gobius* was found in the sample (#1982) collected from the type locality of the Kakio formation at Yamaguchi, 1 km NNE of Kakio station, Tama Hills, NW of Yokohama.

The Miura material came from the Owtsu formation at the following two localities, ca. 1 km apart from each other, in Yokosuka City:

- (1) Roadside cutting at Miharu-machi 5-chome, 600 m SW of Horinouchi station.
- (2) Roadside cutting at Hebinuma, 300 m SE of Shin-Owtsu station.

The formation may be subdivided into the following three lithological units

distinctly and broadly depressed; ventral

- (1) Thick massive siltstone, partly sandy siltstone.
- (2) Pumiceous, coarse- to fine-grained sandstone to sandy mudstone, partly rich in molluscan shells.
- (3) Basal conglomerate, composed dominantly of subangular pebbles of silt derived from the basement Miocene rocks.

Total thickness 20–30 m

One specimen each of *Gobius* was found in five foraminiferous samples from different horizons of the middle member of the formation. The morphological variation ranges cannot be inferred because of the scarcity of specimens, and they are not treated here in any more detail. The obtained specimens seem to comprise at least two or more species.

Receiving a hint from their occurrences, the author examined some selected rock-samples of the middle Pleistocene and the alluvial deposits, which are nearly the same as the Owtsu formation in depositional environments, but failed to obtain *Gobius* specimens.

### Description of New Species

*Gobius rusticus* AOKI, n. sp.

Text-figs. 1–2

Sagitta medium in size, thick, as long as height, quadrate in shape, with narrowly rounded or somewhat irregularly curved four corners, dorsal margin very broadly rounded but slightly indented, ventral margin more straight than dorsal, anterior and posterior sides vertically truncated and concave in the middle; sulcus gobioid in rather broadly depressed central area, horizontal and elongate subpyriform, distinctly marked with rim, somewhat constricted and narrower in the middle; ridge above sulcus rather prominent, longitudinal and short; area from upper to lower:

furrow shallow but distinct, ventral area between sulcus and ventral furrow weakly and flatly raised; outer surface considerably inflated, smooth, very slightly uneven but without noteworthy sculpture.

Maximum diameter of holotype 2.33 mm; thickness ca. 0.65 mm.

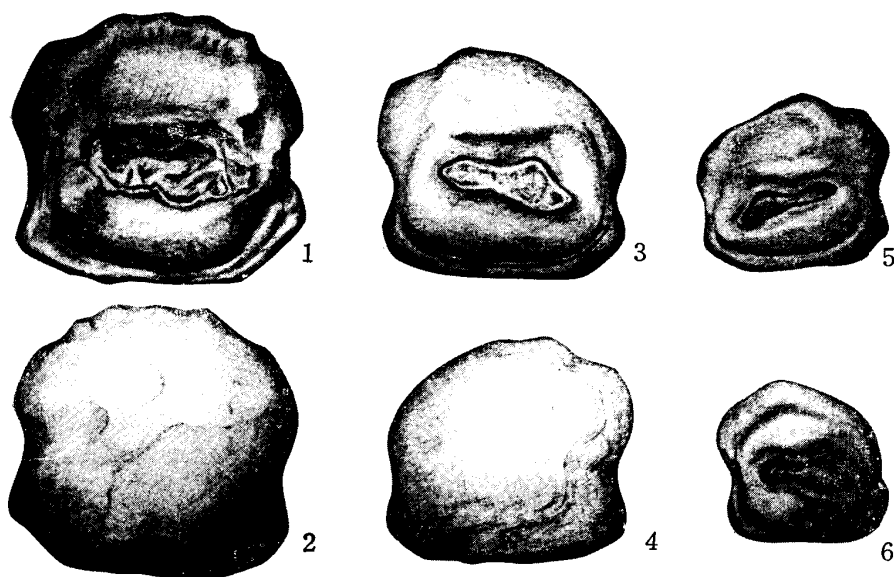
Holotype and paratype from sample #4543, Wasumi, 3.5 km SE of Yanagida, Yanagida-mura, Suzu County, Noto Peninsula; Higashi-innai formation, middle Miocene.

The sagitta of *Gobius rusticus* n. sp. differs from those of the known *Gobius* species in having the thick and stout sagitta with almost quadrate outline, more distinctly raised ridge and depressed dorsal area.

*Gobius notoensis* AOKI, n. sp.

Text-figs. 3-6

Sagitta small in size, stout, moderately thick, plano-convex, roundly quadrate or somewhat pentagonal in outline, with rounded antero-dorsal corner and three sharply rounded ones, slightly longer than height, posterior dorsal corner slightly projecting posteriorly, dorsal margin broadly arched with one or two bluntly rounded projections in the middle or in the somewhat posterior part, ventral margin nearly straight, anterior and posterior borders vertically truncate and distinctly concave in the middle, posterior one more so than anterior;



Text-figs. 1-2. *Gobius rusticus* AOKI, n. sp.

×15. outer and inner views of left sagitta, holotype. Loc. Wasumi, Suzu, Noto Peninsula; middle Miocene, Higashi-innai formation.

Text-figs. 3-6. *Gobius notoensis* AOKI, n. sp.

×15. 3, 4. outer and inner views of left sagitta, holotype; 5. inner view of right sagitta, paratype; 6. inner view of left sagitta, paratype. Loc. Hiratoko, Suzu, Noto Peninsula; middle Pleistocene, Hiratoko formation.

The type specimens are now preserved in the author's private collection at the Institute of Foundation Engineering, Saitama University.

sulcus centrally situated in nearly flat inner face, shallowly but distinctly excavated, typically gobioid, closed at both ends horizontal, short and narrower in the posterior half, usually sloping downward in the anterior half; longitudinal ridge above sulcus usually low and obscure; ventral furrow distinct, narrow and long, running parallel to the ventral margin; area wide and slightly depressed; outer face moderately convex and smooth.

Maximum diameter of holotype 2.06 mm, thickness 0.59 mm. The maximum diameter of paratypes ranges 0.92 mm to 1.91 mm.

Holotype and paratypes from sample #4527, Hiratoko, Suzu City, Noto Peninsula; Hiratoko formation, middle Pleistocene.

The otolith of *Gobius notoensis* n. sp. is characterized by the roughly pentagonal outline with more straight ventral margin, more distinct ventral furrow, and less conspicuous area and ridge above the sulcus. The fundamental morphology of the sagitta of this new species is probably similar to those of *Otolithus (Gobius) orientalis* VORSTMAN (1927, p. 11, pl. 4, f. 12) and *Otolithus (Gobius) tankilensis* VORSTMAN (1927, p. 9,

pl. 4, f. 8) from the Miocene of Java, but differs in having the more quadrate outline, wider area and a different shape of the sulcus.

**Acknowledgements:**—The author is much indebted to Prof. Kazunori TAKAGI of the Tokyo University of Fisheries for his kind determination of Recent fish species, and to Prof. Wataru HASHIMOTO of the Tokyo University of Education for permission to use the laboratory facilities. The collection of the fossils from Noto had been made possible through a grant in aid from the Japan Society for the Promotion of Science.

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Boso	房	総
Hebinuma	蛇	沼
Higashi-innai	東	印
Hiratoko	平	床
Horinouchi	堀	ノ
Iizuka	飯	塚
Ishikawa	石	川
Kakio	柿	生
Miharu	三	春
Miura	三	浦
Noto	能	登

Owtsu	大	津
Shin-Owtsu	新	大
Shōwin	正	院
Suzu	珠	洲
Tama	多	摩
Wasumi	和	住
Yamaguchi	山	口
Yanagida	柳	田
Yokohama	横	浜
Yokosuka	横	須
		賀