

Takeda, Oishi, Fujiyama 1984

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BULLETIN OF THE IWATE PREFECTURAL MUSEUM, No. 2, p. 157-163, August, 1984

**A Record of Pliocene Cancrid Crab, *Cancer minutoserratus*
NAGAO, from the Yushima Formation, Iwate Prefecture,
with a note on Subgeneric Diversity of *Cancer* in Japan**

Masatsune TAKEDA

Department of Zoology, National Science Museum, Tokyo 160,

Masayuki OISHI

Iwate Prefectural Museum, Morioka, Iwate 020-01,

and

Ienori FUJIYAMA

Department of Geology, National Science Museum, Tokyo 160

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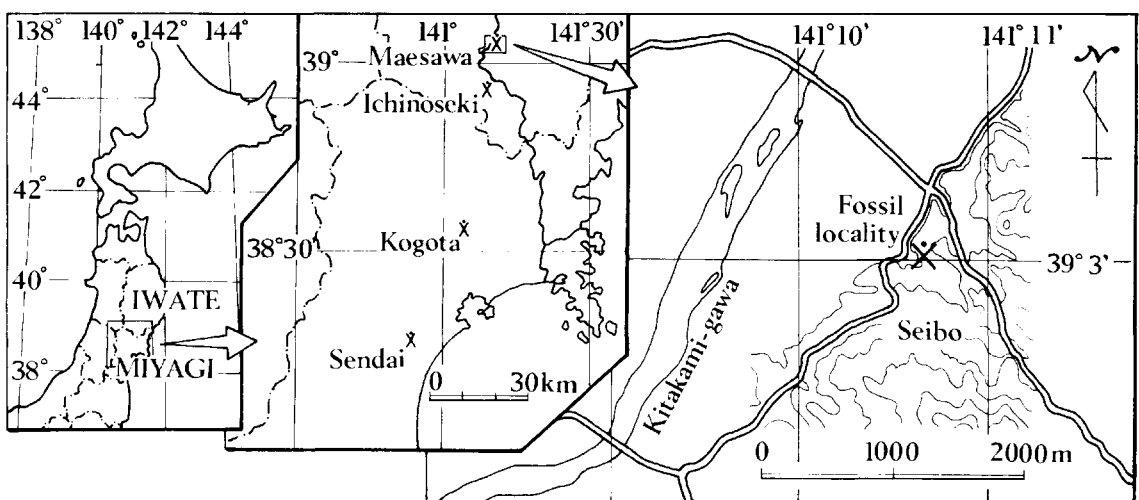
Ienori FUJIYAMA

Department of Geology, National Science Museum, Tokyo 160

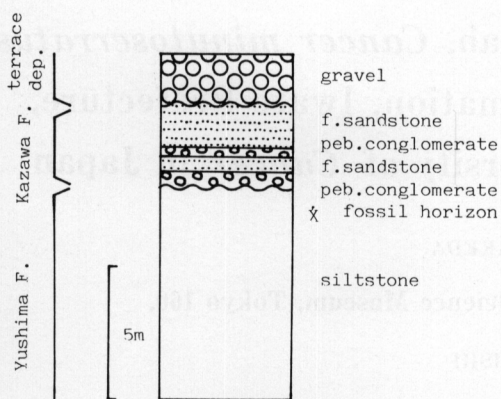
During 9 days from September 27 to October 5, 1982, staff members of the Iwate Prefectural Museum excavated whale bones of good preservation referable to an individual at Maesawa-cho, Iwate Prefecture, Northeast Japan. The results of the excavation with geological consideration and identification of the whale and associated fossils will be published in due time.

Many pieces of crab fossils found along

with the whale bones and other invertebrates were definitely identified as *Cancer minotoserratus* NAGAO of the family Cancridae. This species is, as to be noted in the following lines, known only from the Pliocene formations of Northeast Japan, representing the interesting data for the subgeneric diversity and dispersal of the genus *Cancer*. All the specimens dealt with in the present paper are deposited in the Iwate Prefectural Museum.



Text-fig. 1. Maps showing the known localities of *Cancer minotoserratus* NAGAO, and map of Maesawa-cho to show the fossil locality.



Text-fig. 2. Columnar section of the fossil locality.

| | | |
|----------|-------------------|------|
| Pleist. | Takizawa F. | 40m |
| Pliocene | Mataki F. | 50m |
| | Kazawa F. | 80m |
| | Yushima F. | 50m |
| | Ariga F. | 40m |
| Miocene | Genbi F. | |
| | Itsukushi wld.tf. | 100m |
| | | 150m |
| | Tsukumo ss. | 100m |
| | Shimokurosawa F. | 200m |
| | Junijin ss. | 80m |
| | Jikyozan Andesite | 300m |

Text-fig. 3. Stratigraphic sequence of the southern part of Ichinoseki region (after KITAMURA, 1981).



Text-fig. 4. Carapace of *Cancer minutoserratus* NAGAO exposed by the side of whale bones in the field.

Occurrence and Geology

The fossils were collected from the bluish gray massive siltstone of the Yushima Formation (HAYAKAWA *et al.*, 1954), exposed at road-

side cutting, at Seibo, Maesawa-cho, the western margin of the Kitakami Mountains, Northeast Japan (text-fig. 1). The formation is unconformably overlain by the Kazawa Formation (HAYAKAWA *et al.*, *op. cit.*), composed of con-

glomerate and sandstone at the locality (text-fig. 2). A number of fossil crabs were found associated with various kinds of fossils such as whale bones, molluscan shells, seastars and plant fragments, etc. The carapaces and chelipeds were buried in positions parallel with the horizontal laminae poorly developed in the siltstone.

The Yushima Formation in this area had previously been named as the Koromogawa shell beds by SHIMAKURA and TSUCHIDA (1939), whereas HAYAKAWA *et al.* (1954) later included it in the Yushima Formation extensively distributed in the southern part of Ichinoseki region (text-fig. 3). The formation is paleontologically and stratigraphically correlated with the early Pliocene Tatsunokuchi Formation (HANZAWA *et al.*, 1953), distributed in the environs of Sendai City, Miyagi Prefecture (ONODERA, 1957; KITAMURA, 1981; and others).

Description

Family Cancridae

Genus *Cancer* LINNAEUS, 1758

Cancer minutoserratus NAGAO, 1940

(text-figs. 4-6)

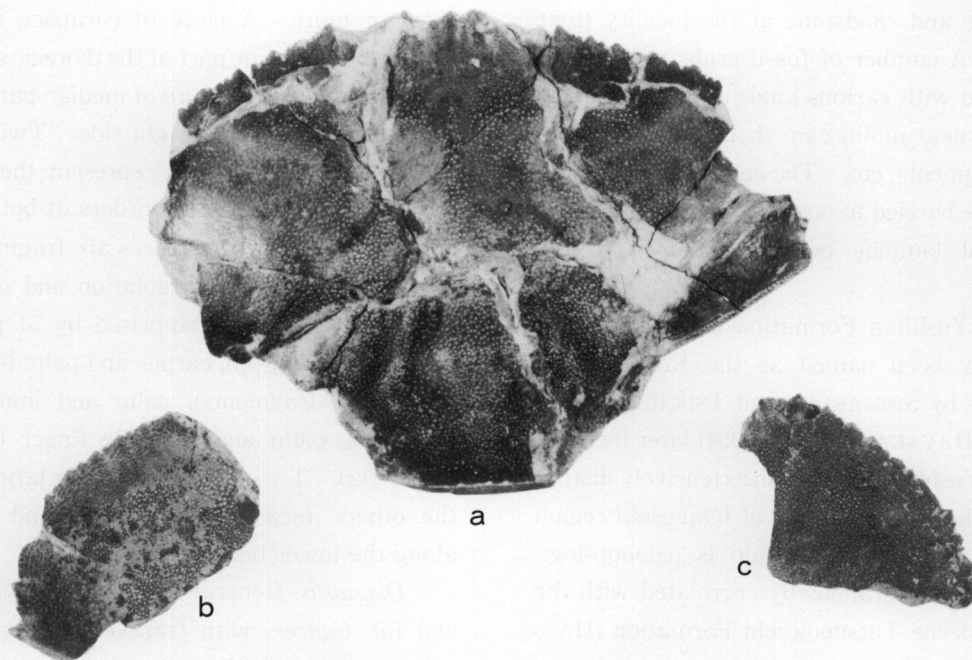
NAGAO, 1940: 69-72, pl. 23 (Hyojogawara, Sendai, Miyagi Pref.).—IMAZUMI, 1962: 243 (Tatsunokuchigorge, Sendai; Kogota, Miyagi Pref.; Ichinoseki, Iwate Pref.).

Material examined. A total of 74 pieces of carapaces, chelipeds and ambulatory legs. One of the carapaces in a block of silty rock is broken into several parts, but useful to get the information about the general shape and size, the surface ornamentation, and the armature of the frontal and anterolateral borders except for the posterior halves of both sides; length of the carapace is about 6 cm, and breadth may attain

8 cm or more. A piece of carapace is associated with anterior part of the thoracic sternum and represents the nature of median part of the anterolateral border of right side. Two pieces of carapaces sufficiently represent the armature of the anterolateral borders of both sides. Other specimens of carapaces are fragmentary, representing only the areolation and granulation. Chelipeds are comprised by 51 pieces; merus (1), carpus (3), carpus and palm (4), palm (20, and 4 fragments), palm and immovable finger (6), palm and movable finger (1), and finger (12). Two palms are much larger than the others, measuring about 3.7 and 3.3 cm along the lower border.

Diagnosis. General shape of carapace typical for *Cancer*, with transversely ovate contour; dorsum weakly convex in both directions, indistinctly areolated, and covered with fine granules which are almost uniformly dispersed, but more or less prominent on areolae. Front tridentate, the median tooth being a little narrower and apparently exceeding each lateral one. Anterolateral teeth except for last tooth at lateral angle of carapace broad triangular, with tip directed obliquely forward, being separated from one another by small V-shaped notches and closed fissures; margin of each tooth irregularly serrated with fine serrulations by granules, and sometimes subdivided into two or three parts in larger specimens; last tooth narrowly triangular, sharp and directed obliquely forward.

Chelipeds heavy. Carpus smooth with a strong tubercle at its inner angle and a subsidiary smaller one below the main one, being bordered with a band of close-set granules; upper surface with two ridges, one from articulation with palm to median part of inner border and the other from median part of proximal border to central part of upper surface. Palm longer than high, and its outer surface orna-



Text-fig. 5. Fossil remains of *Cancer minotoserratus* NAGAO. a, Carapace.
b, Left anterolateral part. c, Right anterolateral part. IPMM 40070 $\times 1$.

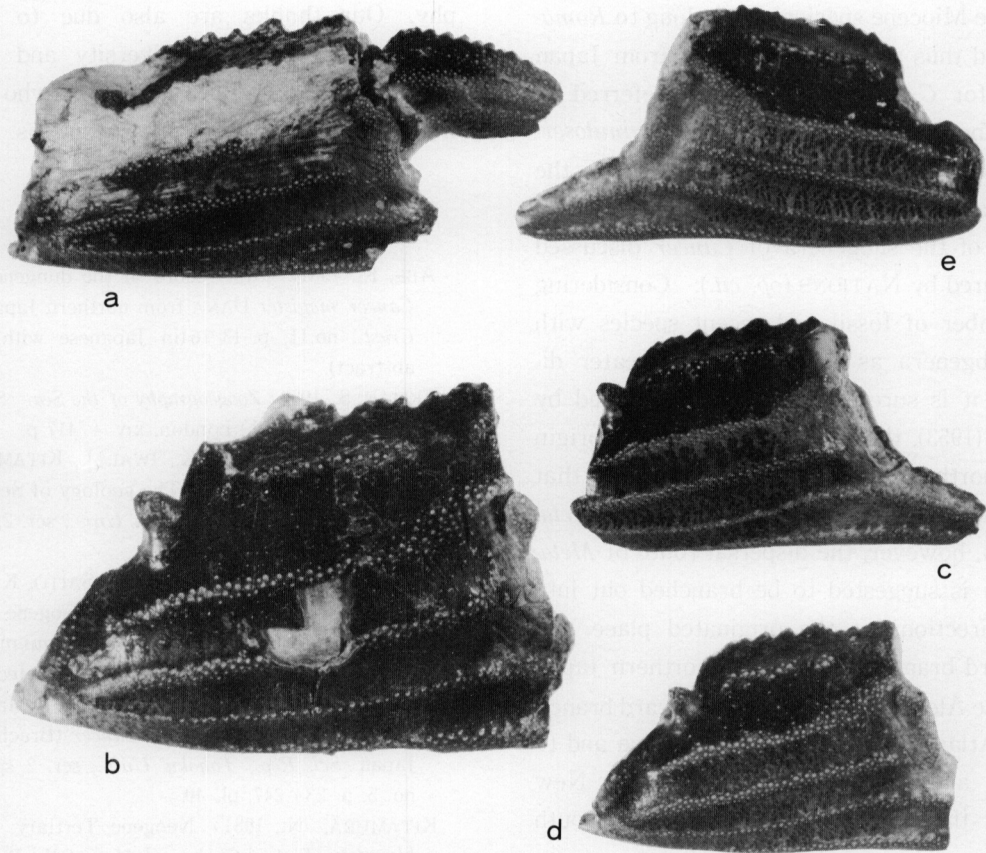
mented with five longitudinal, granulated ridges; the first or uppermost sharp, but markedly strong; the second longer than the first and as long as the third or median, curving upward at its distal part; the fourth and fifth or lower two extended onto immovable finger along cutting edge and lower border, respectively; upper border of palm sharply serrated with several pointed teeth of small variable size. Movable finger minutely but sharply serrated on its upper border; both fingers curving inward distally.

Remarks. The original description is good for the subsequent identification and right in comparing it with *C. plebejus* POEPPING from the west coast of South America as a nearest kin. The present species is also somewhat similar to *C. edwardsii* BELL from the west coast of South America and *C. novaezealandiae* (JACQUINOT) from New Zealand, in which the serration of the anterolateral teeth is much

more distinct.

The genus *Cancer* LINNAEUS, 1758, was extensively revised by NATIONS (1975) based on the recent and fossil specimens, who recognized four subgenera, *Cancer* s. s., *Romaleon* GISTL, 1848, *Metacarcinus* A. MILNE EDWARDS, 1862, and *Glebocarcinus* newly erected. Afterwards, TAKEDA (1977) discussed the systematic status of the genus *Platepistoma* RATHBUN, 1906, and reduced it to subgeneric rank of *Cancer*, and thus *Platepistoma* replacing *Glebocarcinus* on the basis of priority.

C. minotoserratus recorded in the present paper is characteristic in the formation of the serrulated anterolateral teeth and without doubt included in the subgenus *Metacarcinus* along with 15 species referred by NATIONS (*op. cit.*). In addition to the close relatives, *C. plebejus*, *C. edwardsii*, and *C. novaezealandiae* of the same subgenus, *C. bellianus* JOHNSON from the northeastern Atlantic and *C. borealis*



Text-fig. 6. Fossil remains of *Cancer minotoserratus* NAGAO. a—d, Right chelae. e, Left chela. IPMM 40070 $\times 2$.

STIMPSON from the northwestern Atlantic are somewhat similar in the general formation of the anterolateral teeth, but they are the representatives of the subgenus *Cancer* with the coarsely granulated carapace and chelipeds.

In Japan the genus *Cancer* comprises 6 recent and 3 extinct species, viz., *C. gibbosulus* (DE HAAN, 1835), *C. japonicus* ORTMANN, 1893, *C. amphioetus* RATHBUN, 1898, *C. tumifrons* YOKOYA, 1933, †*C. minotoserratus* NAGAO, 1940, †*C. sanbonsugii* IMAIZUMI, 1962, †*C. odosensis* IMAIZUMI, 1962, *C. nadaensis* SAKAI, 1969, and *C. sakaii* TAKEDA et MIYAKE, 1972. Recently, ABE (1981) recorded a living crab referable to *C. magister* DANA, 1852, which was trawled from a depth of 15 m, off Kushiro, the

Pacific coast of Hokkaido. This northeastern Pacific species known as the dungeness crab or common edible crab is important as fishery resources in Canada and U.S.A. The occurrence in the northwestern Pacific is biogeographically interesting, but it is not sure whether the adult crab was migrated by the influence of northern current, or the young crab or juvenile was transported with the ballast water of a ship.

Third fossil species described by IMAIZUMI (1962), *C. ? imamurae*, was eliminated by NATIONS (1975), who referred the above recent species to *Romaleon* (*gibbosulus* and *nadaensis*), *Platepistoma* (as *Glebocarcinus*) (*amphioetus*, *tumifrons* and *sakaii*), and *Cancer* (*japonicus*). Judging from the original descriptions, two

Japanese Miocene species may belong to *Romaleon*, and thus a total of 8 species from Japan except for *C. minutoserratus* are referred to three subgenera. The fact that *C. minutoserratus* belongs to *Metacarcinus* leads to the partial amendment of the suggested dispersal pattern of the subgenera of *Cancer* discussed and figured by NATIONS (*op. cit.*). Considering the number of fossil and recent species with four subgenera as the results of greater diversity, it is sure that, as first mentioned by EKMAN (1953), the genus *Cancer* has its origin in the northeastern Pacific. On the fact that the Japanese Pliocene species belongs to *Metacarcinus*, however, the dispersal route of *Metacarcinus* is suggested to be branched out into three directions at the originated place, the westward branch extending to northern Japan along the Aleutian Islands, the eastward branch to the Atlantic coast of North America and to Europa, and the southward branch to New Zealand through the Pacific coast of South America.

Distribution. The present species is now known from the Pliocene formations of Northeast Japan; Tatsunokuchi Formation in Sendai, Kogota Formation in Kogota, and Yushima Formation in Ichinoseki and Maesawa, Miyagi and Iwate Prefectures (text-fig. 1).

Acknowledgements

We have to extend our cordial thanks to Messrs. A. MAEDA and T. YOSHIDA, the land-owners of the excavation site in Maesawa-cho, and Messrs. H. HONJO, S. SASAKI, K. IWAMURA and other staffs in the Board of Education of Maesawa-cho, for their kind arrangements during the excavation. Dr. K. OKAMI of Iwate University and Mr. T. KAWAKAMI of the second author's colleague joined the field work and discussion about the stratigra-

phy. Our thanks are also due to Dr. T. KOTAKA of Tohoku University and Dr. M. TANAI of Hokkaido University, who kindly informed us about the type specimens.

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岩手県前沢町，鮮新統油島層産の イチョウガニ *Cancer minutoserratus* NAGAO の記録 および日本産イチョウガニ類の亜属分化について

武田正倫・大石雅之・藤山家徳
(国立科学博物館動物研究部・岩手県
立博物館・国立科学博物館地学研究部)

要 旨

岩手県前沢町の鮮新統油島層からクジラとともに得られたカニ化石74片はイチョウガニ科の *Cancer minutoserratus* NAGAO と同定された。甲やはさみの一般的な形態はイチョウガニ属として典型的であるが、前側縁の前8歯がほぼ切断された形状で、それぞれ不規則な小歯に刻まれている点特徴的である。大型個体では小さな切れ込みによって各歯が2、3部に分けられていることが多く、小歯も顆粒のために縁が不規則である。はさみ脚の腕節は小顆粒が集合した稜で縁取られ、同様な稜が掌部との関節部分から内縁に向かって、また、後縁から上面中央に向かって走る。腕節内角の突起は鋭く、その下方にやや小さな突起を伴う。掌部の上縁は板状で、鋭い小歯に刻まれている。外面には顆粒からなる5本の強い稜が縦走し、下方の2本は不動指上にのびている。

イチョウガニ属は4亜属に分けられるが、日本

産の現生6種は *Cancer*, *Romaleon*, *Platepistoma* に分類されている。IMAIZUMI (1962) により記載された中新統産の3種のうち疑問符付きの1種はイチョウガニ科でないことは明らかであるが、他の2種はいずれも *Romaleon* に属する。NATIONS (1975) はイチョウガニ属発祥の地と考えられる北東太平洋から分散の方向を検討して図示したが、たまたま *C. minutoserratus* が考察から落ちていたため日本では3亜属のみが分化した形になっている。この鮮新統の種が第4の亜属 *Metacarcinus* に属することから若干の訂正が必要になった。4亜属の中では *Metacarcinus* が種分化において最も著しく、分散も一方で北西大西洋から北東大西洋、また一方で南東太平洋からニュージーランドに至るだけでなく、北西太平洋にも向いていたことが明らかになった。*C. minutoserratus* は宮城県と岩手県からのみ知られている。