

THE MESOPELAGIC CARIDEAN SHRIMP *NOTOSTOMUS*  
*JAPONICUS* BATE IN THE NORTHEASTERN PACIFIC

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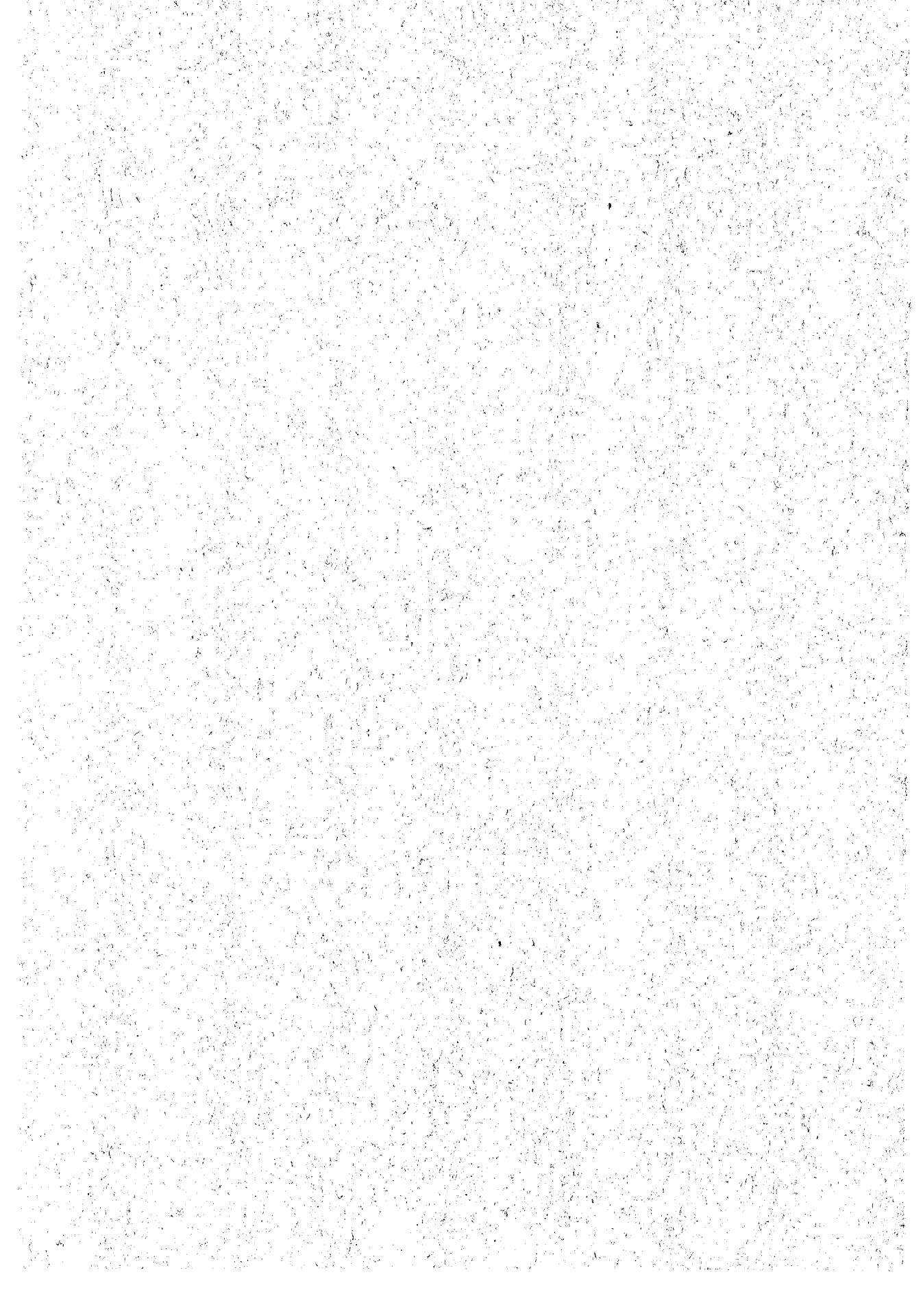
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The relative scarcity of extensive series of *Notostomus* in study collections and the deficiency of several of the original descriptions have contributed to the confusion that has long characterized the species of this unusual genus of the family Ophiophoridae. Among the decapod crustaceans obtained by William Aron during a survey of the mesopelagic fauna of the northeastern Pacific Ocean — a program supported in part by the National Science Foundation (Grant No. G-6168) and in part by the Office of Naval Research (Contract Nonr-477(10)) — are 32 specimens of a shrimp that we have identified as *Notostomus japonicus* Bate. Inasmuch as this species has been known previously only from the unique, incomplete type specimen, it seems desirable to redescribe the species from the material now available.

The number and arrangement of the lateral carinae on the carapace are so important in the genus *Notostomus* that an attempt has been made to select names that might be generally acceptable for those carinae. The nomenclature finally adopted (fig. 1) is based in large part on recommendations of L. B. Holthuis after he had reviewed the existing terms for the various carapacic grooves, lines, and ridges in the Natantia.

In the preparation of this redescription, we have done little more than compile the contributions made to the study by others, whose coöperation is hereby gratefully acknowledged. Three members of the staff of the Department of Oceanography at the University of Washington were especially helpful: William Aron, by making the material available, was primarily responsible for initiation of the study; Peter McCreery prepared the careful drawings that illustrate the paper and made notes at sea on the color of living specimens; and Fay I. Linger co-ordinated

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<sup>2)</sup> Deceased, September 4, 1960.

the various contributions to the undertaking and assembled material for the final draft. Isabella Gordon of the British Museum (Natural History) very kindly examined the type specimen of *Notostomus japonicus* and furnished sketches of its diagnostic characters. Jacques Forest of the Muséum National d'Histoire Naturelle in Paris provided critical observations on the type specimens of *Notostomus elegans* A. Milne-Edwards and *N. gibbosus* A. Milne-Edwards. Finally, L. B. Holthuis of the Rijksmuseum van Natuurlijke Historie, Leiden, was most coöperative in numerous ways and offered many suggestions for the improvement of the paper.

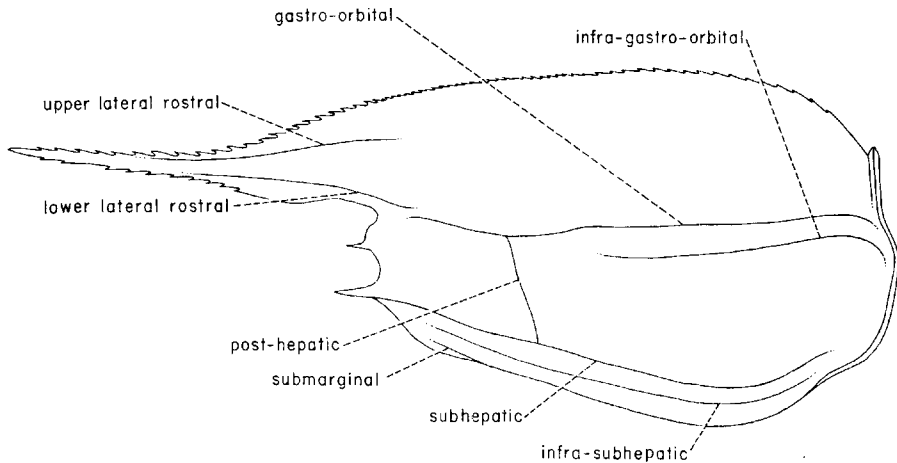


Fig. 1. Idealized *Notostomus* carapace with full complement of carinae.

### *Notostomus japonicus* Bate, 1888

*Notostomus japonicus* Bate, 1888: 830, pl. 135 fig. 1.

Material. — All specimens were collected with a 6-foot modified Isaacs-Kidd midwater trawl (Aron, 1962) from the "Brown Bear", research vessel of the Department of Oceanography, University of Washington, from 180 to 850 miles off the west coast of North America, between the latitudes of the southern end of Queen Charlotte Island, British Columbia, and Cape Blanco, Oregon, in midwater depths of 225 to 400 meters. All material is deposited in the U. S. National Museum. The figures in parentheses in the following list are carapace lengths in millimeters, measured from the hind margin of the orbit.

USNM

- 231638 BB-176-124; 49° 00' N 144° 30' W; 225 m; September 17, 1957, 0004-0058: 1 female (23.0), 4 juveniles (20.8, 19.8, 19.2).  
 639 BB-199-74; 49° 48' N 145° 20' W; 225 m; July 8-9, 1958, 2317-0000: 1 male (31.9), 1 female (30.8).  
 640 BB-199-80; 49° 30' N 145° 53' W; 225 m; July 9-10, 1958, 2342-0039: 2 males (28.2, 25.9).  
 641 BB-199-93; 47° 16' N 146° 25' W; 225 m; July 11, 1958, 0314-0412: 1 female (29.0).  
 642 BB-199-112; 42° 58' N 145° 37' W; 250-300 m; July 13-14, 1958, 2308-0013: 1 female (24.8).  
 643 BB-199-290; 45° 49' N 139° 40' W; 400 m; August 13, 1958, 0245-0402: 1 female (20.2).  
 644 BB-199-296; 47° 47' N 142° 06' W; 400 m; August 14, 1958, 0250-0407: 1 female (26.2), 2 juveniles (17.9, 14.0).  
 645 BB-199-297; 48° 04' N 142° 35' W; 225 m; August 14-15, 1958, 2345-0044: 1 young male (22.2), 1 juvenile (14.7).

- 23:646 BB-202-15; 49° 50' N 133° 20' W; 400 m; September 24, 1958, 0153-0310: 1 male (31.7).  
 647 BB-202-26; 49° 59' N 138° 17' W; 400 m; September 26, 1958, 0318-0440: 1 male (29.5),  
 1 female (33.0).  
 648 BB-202-32; 48° 59' N 140° 09' W; 400 m; September 27, 1958, 0335-0451: 1 male (28.3),  
 2 females (29.3 with bopyrid branchial parasite, 22.0).  
 649 BB-202-53; 47° 58' N 132° 15' W; 400 m; September 29, 1958, 2129-2242: 1 male (27.3),  
 1 female (20.3).  
 650 BB-202-62; 47° 58' N 131° 35' W; 400 m; September 30, 1958, 0425-0539: 1 juvenile (13.4).  
 651 BB-235-17; 52° 08' N 138° 33' W; 400 m; July 19, 1959, 2205-2317: 1 male (33.1).  
 652 BB-254-23; 44° 26' N 131° 14' W; 400 m; March 20, 1960, 2227-2348: 1 young male (23.2).  
 653 BB-254-24; 44° 29' N 131° 14' W; 225 m; March 20-21, 1960, 2350-0042: 1 juvenile (9.3).  
 654 BB-254-30; 46° 14' N 130° 49' W; 400 m; March 21, 1960, 2233-2350: 1 young male (19.3),  
 1 juvenile (14.0).  
 655 BB-254-42; 47° 14' N 129° 00' W; 400 m; March 23, 1960, 0252-0400: 1 female (21.3).

Description. — Carapace (fig. 2) moderately inflated. Dorsal margin sharply carinate, finely and closely denticulate behind level of orbital margin, and rather feebly arched above level of rostrum, often nearly horizontal in posterior half.

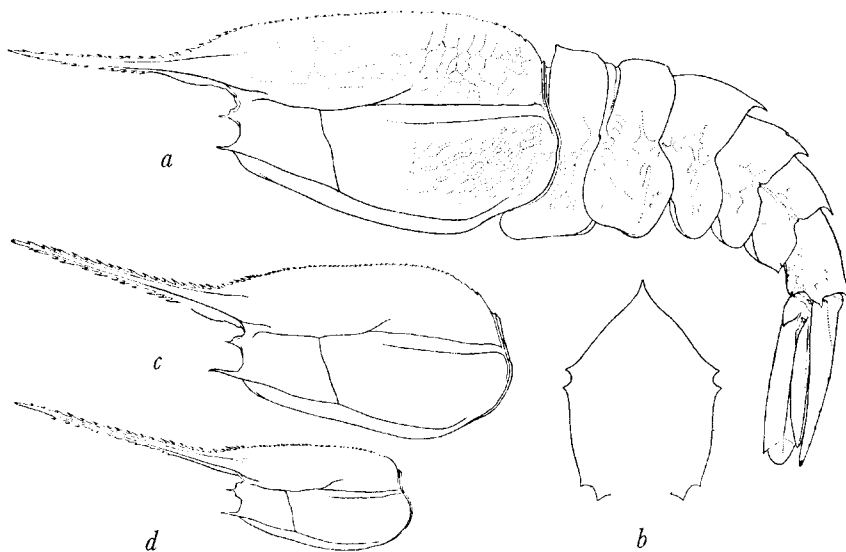


Fig. 2. *Notostomus japonicus* Bate. a, carapace and abdomen of female with carapace length of 26.2 mm from "Brown Bear" Sta. 199-296; b, transverse section of carapace of same specimen at point of maximum height; c, carapace of juvenile with carapace length of 21.3 mm from "Brown Bear" Sta. 254-42; d, carapace of juvenile with carapace length of 14.0 mm from "Brown Bear" Sta. 199-296.

Three prominent longitudinal carinae — gastro-orbital, subhepatic, and submarginal — extending for nearly entire length of lateral surface. Gastro-orbital carina not continuous with lower lateral rostral. Infra-gastro-orbital carina extending approximately two-thirds of distance from posterior margin to prominent post-hepatic carina. A characteristic, short, sometimes sinuous carina extending obliquely upward and backward from gastro-orbital carina at a point just anterior to end of infra-gastro-orbital carina. Suborbital angle usually bluntly rectangular, occasionally

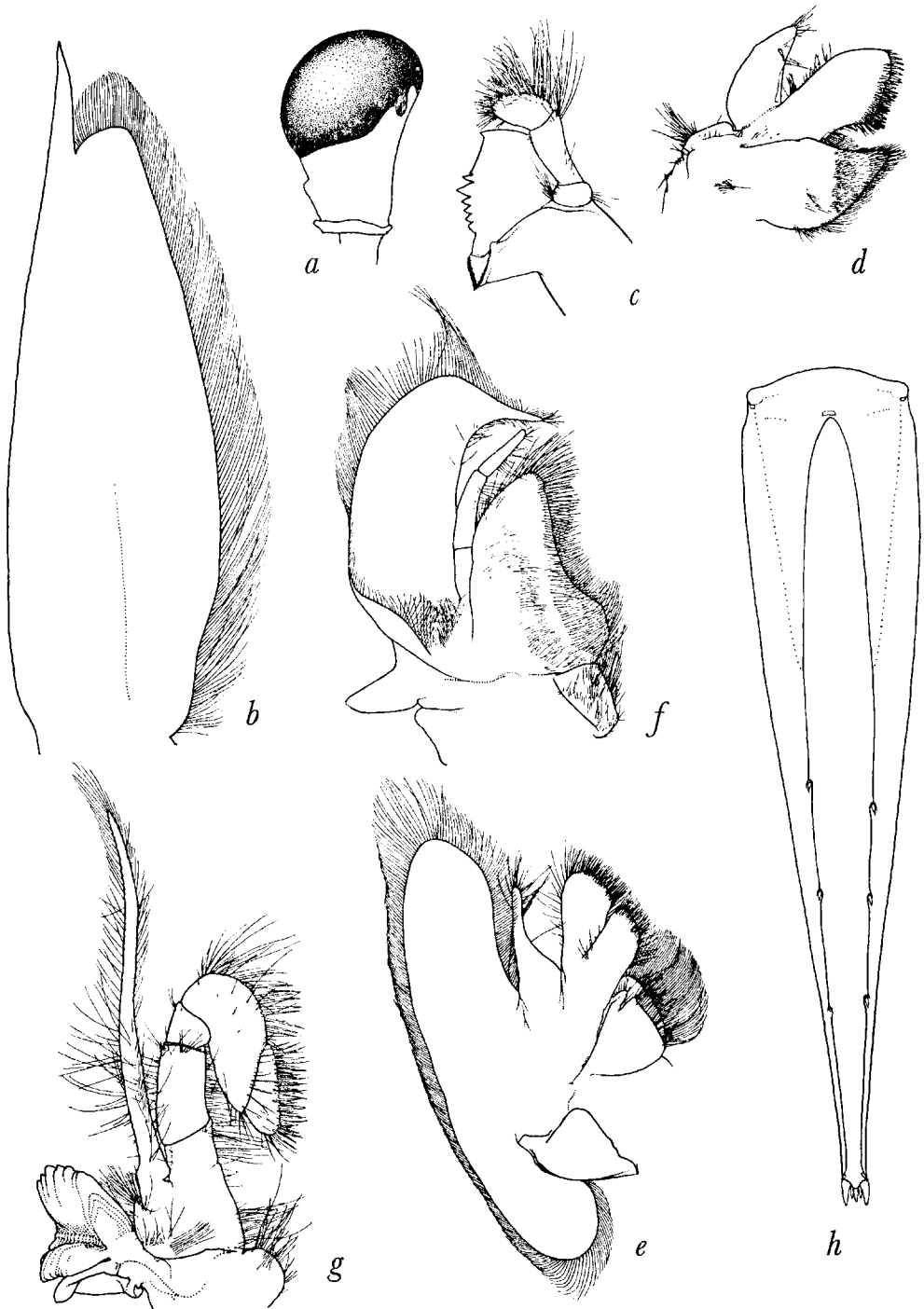


Fig. 3. *Notostomus japonicus* Bate, female with carapace length of 29.3 mm from "Brown Bear" Sta. 202-32. a, right eye in dorsal view; b, right antennal scale in ventral view; c, mandible; d, first maxilla; e, second maxilla; f, first maxilliped; g, second maxilliped; h, telson.

either subacute or somewhat obtuse. Antennal spine distinct. Branchiostegal spine very long and prominent. Rostrum from slightly longer than, to one and two-thirds as long as, carapace in juvenile specimens with carapace lengths of less than 20 mm (fig. 2d); subequal to, or slightly shorter than, carapace in young adults with carapace lengths of 20 to 25 mm (fig. 2c); scarcely more than two-thirds as long as carapace in larger specimens with carapace lengths of 25 to 33 mm (fig. 2a). Upper lateral rostral carina slightly nearer to dorsal margin than to lower lateral rostral carina. Rostrum armed with 20 to 33 dorsal and 10 to 18 ventral spines; spines of rostral series at least twice as long as denticles on dorsal margin of carapace.

Eyes (fig. 3a) wider than eyestalks. Distinct papilla on inner surface of stalk. Outer spine of basal antennular segment sharp, with expanded, sinuous outer margin. Stylocerite with long, slender terminal spine rarely reaching as far as outer spine of basal segment. Antennal scale (fig. 3b) with long, stout outer spine reaching far beyond end of blade. Mouth parts (fig. 3c-g) typical for genus. Third maxillipeds (fig. 4a) reaching to or slightly beyond outer spine of antennal scale. First pereopods (figs. 4b, c, h) reaching about halfway from end of antennular peduncle to end of antennal scale. Second pereopods (figs. 4d, e) reaching slightly beyond first pereopods but not as far as end of antennal scale. Third pereopods reaching beyond antennal scale by length of dactyl and distal one-fifth to one-half of propodus. Fourth pereopods reaching beyond antennal scale by length of dactyl and sometimes by as much as one-fourth of propodus. Fifth pereopods falling slightly short of, or slightly overreaching, end of antennal scale. First and second pleopods as figured (figs. 4f, g, i, j, see Size).

Variation. — Except for the relative height of the carapace and the length and angle of the rostrum (fig. 2), the variable characters noted (number of rostral spines, configuration of posterior margin of fifth abdominal pleuron, number of dorsal spines on telson, and relative lengths of thoracic appendages) show no correlation with the age or sex of the individual specimens.

Color. — General color in life, red with all carinae darker than rest of integument.

Size. — The appendix masculina is a barely visible bud in the two smallest males, with carapace lengths of 19.3 and 22.2 mm. It is one-half as long as the appendix interna in a male with a carapace length of 23.2 mm, and less than one-third as long in a specimen having a carapace length of 25.9 mm. At carapace lengths of 27.3, 28.2, and 28.3 mm, it is subequal to the appendix interna, but it is proportionately slightly shorter in a specimen with a carapace length of 29.5 mm. Only in the two largest males, which have carapace lengths of 31.9 and 33.1 mm, is the appendix masculina longer (by about one-fourth) than the appendix interna. Inasmuch as the male holotype of *N. japonicus* is considerably larger (carapace length 42 mm) than any of the specimens seen by us, and as no ovigerous specimens are represented, it is possible that none of the specimens in the present collection are fully mature.

Distribution. — The only specimen of *N. japonicus* previously recorded was trawled by the "Challenger" south of Honshu Island, Japan, in a total depth of

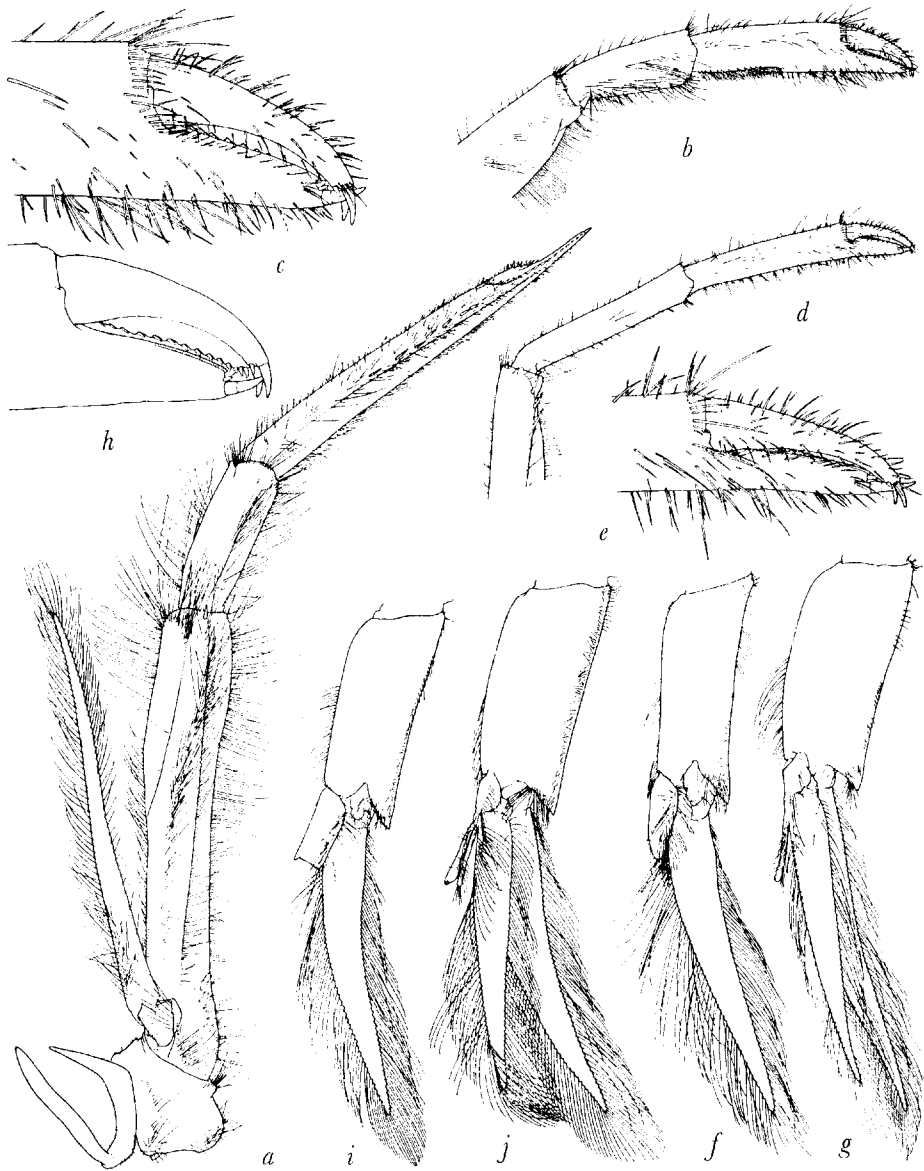


Fig. 4. *Notostomus japonicus* Bate. a, third maxilliped of female with carapace length of 29.3 mm from "Brown Bear" Sta. 202-32; b, distal segments of first pereiopod of same specimen; c, fingers of same; d, distal segments of second pereiopod of same specimen; e, fingers of same; f, first pleopod of same specimen; g, second pleopod of same specimen; h, denuded fingers of first pereiopod of female with carapace length of 29.0 mm from "Brown Bear" Sta. 199-93; i, first pleopod of male with carapace length of 28.3 mm from "Brown Bear" Sta. 202-32; j, second pleopod of same specimen.



565 fathoms. The vertical distribution of the material collected by the "Brown Bear" suggests diurnal migration. All but one of the 14 specimens found between 225 and 300 meters were taken within one hour of midnight, and the 18 specimens from 400 meters were taken either between 9:29 and 11:50 p. m. or between 1:53 and 5:39 a. m.

Remarks. — *N. japonicus* is apparently distinguished from other species of the genus by the following combination of characters: Dorsal margin of carapace not strongly arched, four longitudinal carinae on posterior half of lateral surface of carapace, upper lateral rostral carina present, gastro-orbital carina not continuous with lower lateral rostral carina, and, especially, a short carina directed obliquely upward and backward from middle of gastro-orbital carina.

Although Bate (1888) stated in his description of the species that "a small ridge runs from the upper margin of the rostrum and dies out above the fronto-orbital region", there is no indication of an upper lateral rostral carina in his figure. We are indebted to Isabella Gordon for examining the holotype of *N. japonicus* and verifying the existence, not only of that carina, but also of the short, oblique carina that branches from the middle of the gastro-orbital; the latter was not mentioned by Bate nor has it been recorded, to our knowledge, for any other species of *Notostomus*. The only remaining discrepancy between Bate's description and the material described above concerns the length of the telson relative to the uropods; it is not unlikely that Bate's statement that the telson "is shorter than the inner lateral plate of the rhipidura" was descriptive of the tail fan in a flexed position.

Because our material was referable to *N. elegans* A. Milne-Edwards, 1881, in the key to the species of the genus in Chace (1936), we asked Dr. Jacques Forest to re-examine the type specimen of that species in the Muséum National d'Histoire Naturelle in Paris. He very kindly reported that there is an upper lateral rostral carina in that specimen, but that it terminates at the level of the orbital margin, rather than more posteriorly as indicated in the figure in A. Milne-Edwards (1883). He also determined that the lower lateral rostral and the gastro-orbital carinae are not continuous, in contradistinction to the condition suggested by Milne-Edwards' figure. Finally, Dr. Forest informed us that there are five lateral longitudinal carinae on the posterior half of the carapace in *N. elegans*. The latter character removes the species from consideration as far as the present collection is concerned, but it suggests the need to review the identity of such species as *N. longirostris* Bate, 1888; *N. westergreni* Faxon, 1893; and *N. atlanticus* Lenz, 1914.

Our observations on the present series of specimens may assist in evaluating the status of some of the other species of *Notostomus* that are known from few specimens of different sizes. This study tends to substantiate the belief expressed by Kemp (1913: 66) that the carination of the carapace in this genus is constant during late post-larval growth.

## ZUSAMMENFASSUNG

*Notostomus japonicus* wird neubeschrieben auf Grund von 32 Exemplaren, die in 225 bis 400 m Tiefe westlich von British Columbia, Washington, und Oregon entnommen wurden. Bei Individuen mit Carapaxlängen zwischen 9,3 bis 33,1 mm sind die diagnostischen Merkmale in beiden Geschlechtern in allen Altersklassen gleich und zeigen keine signifikante Variation.

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