

Scavenging Gammaridean Amphipods from the Deep-Sea Floor*

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Five species of gammaridean amphipods belonging to the family Lysianassidae, none of which had previously been reported from the Japanese waters, were obtained by setting baited traps on the sea floor of Enshu- and Kumano-nada, off central Japan, at depths of 330-1015 m. They are: *Anonyx hayashii* n. sp., *A. lilljeborgi*, *Euonyx laqueus*, *Schisturella pulchra* and *Scopelocheirus hopei*.

Keywords: Scavengers, Deep-sea gammarids, Lysianassid, Baited trap

Running title: Deep-sea scavenging amphipods

Baited traps and cameras lowered into the deep-sea have revealed enormous quantities of highly mobile and scavenging amphipods (SHULENBERGER and HESSLER, 1974; HESSLER *et al.*, 1978) of which very little is known. These large-sized amphipods have been collected principally from the abyssal waters in various regions of the world (HESSLER *et al.*, 1972; SHULENBERGER and HESSLER, 1974; SHULENBERGER and BARNARD, 1976; HESSLER *et al.*, 1978).

Japanese fishermen had already developed baited trap-fisheries (pot fisheries) which they generally set on the deep-sea floor to capture commercially valuable benthic or near-bottom animals, mainly prawns and crabs (SASAKAWA, 1981). However, in certain coastal waters such as the Enshu- and Kumano-nada, central Japan, where our traps have been set on the deep-sea floor at depths to 1000m, these baited traps became filled with scavenging giant bathynomid isopods wholly lacking economic value, and often failed to collect the commercially profitable animals due to hopeless damage to the bait by scavenging isopods (SEKIGUCHI *et al.*, 1981, 1982).

It then became evident that other scavenging animals, which could pass through the large-sized meshes (2 cm) of the baited container, were also greatly attracted to the bait since large-sized amphipods were sometimes found adhering to various parts of the bait by means of their grasping appendages. Therefore, to better understand the dynamics of deep-sea benthic communities in which the mobile megafauna including scavenging amphipods and isopods may play a significant role, we wrapped the baited container with fine mesh in order to collect the scavenging amphipods. This paper is a report of our study.

* This paper is dedicated to Dr. Ryuzo MARUMO in commemoration of his sixtieth anniversary.

Study Area and Methods

Details of the baited trap employed are illustrated in Plate 1. This trap is popularly utilized in the Japanese pot fisheries for catching commercial prawns and crabs. We used the same container with bait of 1 to 3 kg fish frozen until use, but wrapped in fine mesh with 2 mm mesh-openings. The baited traps were set on the floor of Enshu- and Kumano-nada along the Pacific coast of central Japan. They were

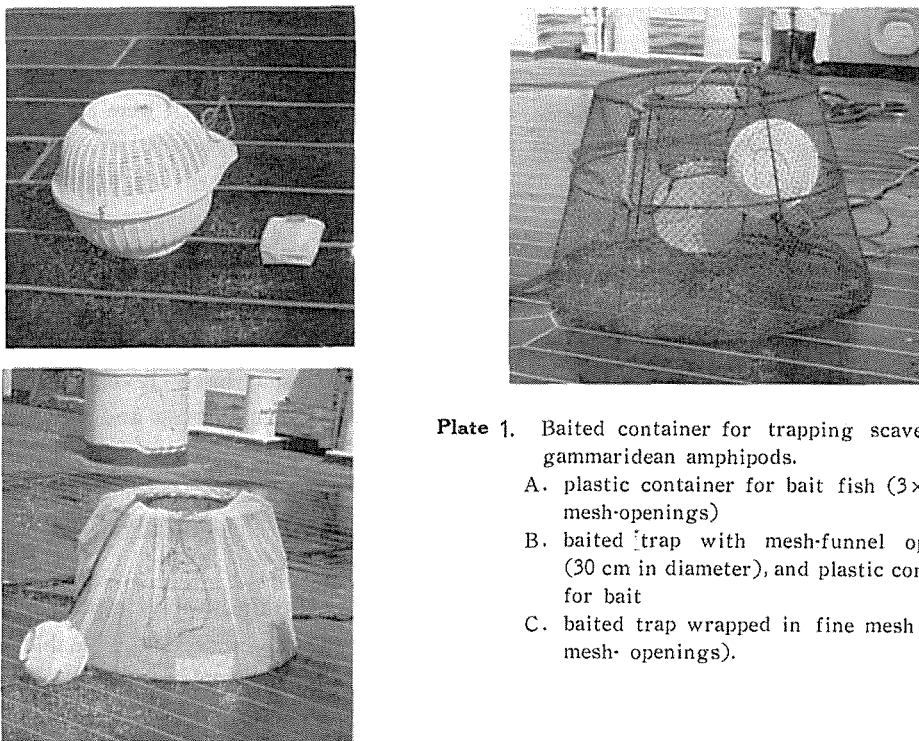


Plate 1. Baited container for trapping scavenging gammaridean amphipods.

- A. plastic container for bait fish (3×12mm mesh-openings)
- B. baited trap with mesh-funnel opening (30 cm in diameter), and plastic container for bait
- C. baited trap wrapped in fine mesh (2mm mesh-openings).

Table 1. Data for sampling of scavenging gammaridean amphipods collected in baited traps.

Station	Date	Position	Depth
81-R-2a	May 8, 1981	34°-04.5' N 136°-36.0' E	470- 493 m
81-R-2b	May 9, 1981	34°-00.1' N 136°-47.5' E	855-1015 m
81-R-3	May 21, 1981	33°-46.6' N 136°-09.0' E	330 m
81-R-6	Sept. 17, 1981	34°-21.0' N 137°-59.5' E	520 m
81-R-8	Oct. 15, 1981	33°-46.5' N 136°-08.3' E	400- 527 m
81-R-10	Nov. 7, 1981	34°-05.1' N 136°-38.6' E	486- 519 m

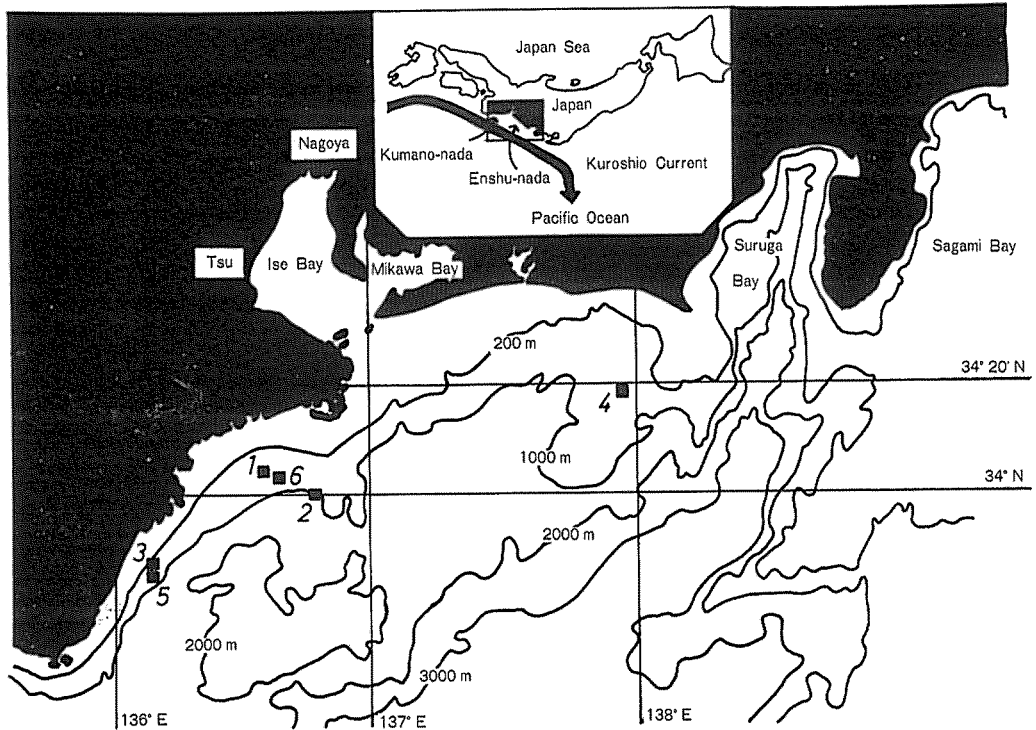


Fig. 1. Area of study and sampling locations. Black squares; sampling locations. Numbers indicate sampling locations as follows; 1, 81-R-2a; 2, 81-R-2b; 3, 81-R-3; 4, 81-R-6; 5, 81-R-8; 6, 81-R-10

lowered at night and remained there for 12 hours.

Positions where the traps were set are shown in Fig. 1 and data for sampling the gammaridean amphipods are summarized in Table 1. The Enshu- and Kumano-nada are located inside of the warm Kuroshio Current and because of the depth, proximity to land and high productivity of their waters, are two of the most prosperous fishing grounds for pelagic and benthic animals.

Notes on the Scavenging Gammaridean Amphipods Trapped

Our traps set on the floor of Enshu- and Kumano- nada captured numerous specimens of *Anonyx hayashii* n. sp., *A. lilljeborgi* BOECK, *Euonyx laqueus* J. L. BARNARD *Schisturella pulchra* (HANSEN) and *Scopelocheirus hopei* (COSTA). The amphipods described here belong to the Family Lysinassidae of which numerous species are present in the deep-sea. More than 32 species of the genus *Anonyx*, 8 of *Euonyx*, 11 of *Schisturella* and 2 of *Scopelocheirus* have been described to date. The *Anonyx* species are arctic to boreal and littoral to abyssal, the *Euonyx* are cosmopolitan and epi- to bathyal, the *Schisturella* are coldwater and littoral to hadal, and the *Scopelocheirus* are

cosmopolitan and bathy-abyssal (BARNARD, 1969).

Although it is difficult to distinguish definite tendency in Table 2, we discovered some interesting points on the gammarids. One was that the relative species composition and total catch of the gammarids differed considerably among sampling stations despite the relatively short distance between the stations. This could mean that these gammarids would show local aggregations which leave the factor open to question in the fauna of the deep-sea scavenging gammaridean amphipods of Enshu- and Kumano-nada.

Table 2. Species composition of scavenging gammaridean amphipods collected in baited traps.*

Station	Depth	Species				
		<i>A. hayashii</i>	<i>A. lilljeborgi</i>	<i>E. laqueus</i>	<i>S. pulchra</i>	<i>Sc. hopei</i>
81-R-2a	470- 493 m	3	0	583	8	0
81-R-2b	855-1015 m	0	3	3	0	0
81-R-3	330 m	54	16	24	0	1
81-R-6	520 m	240	75	0	23	0
81-R-8	400- 527 m	0	9	16	0	0
81-R-10	486- 519 m	17	0	0	51	1
	total	314	103	626	82	2

* Containers were lowered at night and left on the floor 12 hours. Numbers; individual number/container.

The deep-sea lysianassids are both pelagic and benthic in habitat (BARNARD, 1961). In view of the bathyscaphe's observation in the deep-sea by WOLFF (1971), these gammarids would probably be classified into a benthopelagic group which is to spend much of their life close to the deep-sea floor (MARSHALL, 1979). It is, however, one of the most difficult problems to decide whether the gammarids trapped in the present study are benthopelagic, or not. The gammarids were always caught abundantly, together with numerous giant bathynomid isopods, the result being that the scavenging amphipods and isopods regularly showed overwhelming dominance in the baited traps set on the floor of Enshu- and Kumano- nada (SEKIGUCHI *et al.*, 1981, 1982).

Description

The following abbreviations have been used in captions on the Figures:

Ant 1-2	Antennae 1-2
Ep-Up	Epistome-Upper lip complex
L. L.	Lower lip
Max 1-2	Maxillae 1-2

Md	Mandible
Mxp	Maxilliped
Gn 1-2	Gnathopod 1-2
Pr 1-5	Pereiopod 1-5
Ep 1-3	Pleonal epimeron 1-3
Ur 1-3	Uropod 1-3
T	Telson

Anonyx hayashii n. sp. (Fig. 2a, b)

Diagnosis: Eyes scarcely visible; lateral cephalic lobe projecting forward subtly; epistome and upper lip separated by slit, upper lip projecting strongly in front of epistome; gnathopod 1 subchelate, article 5 and 6 nearly same in length, palm transverse and serrated or comb-toothed, opposing finger somewhat chelately with short

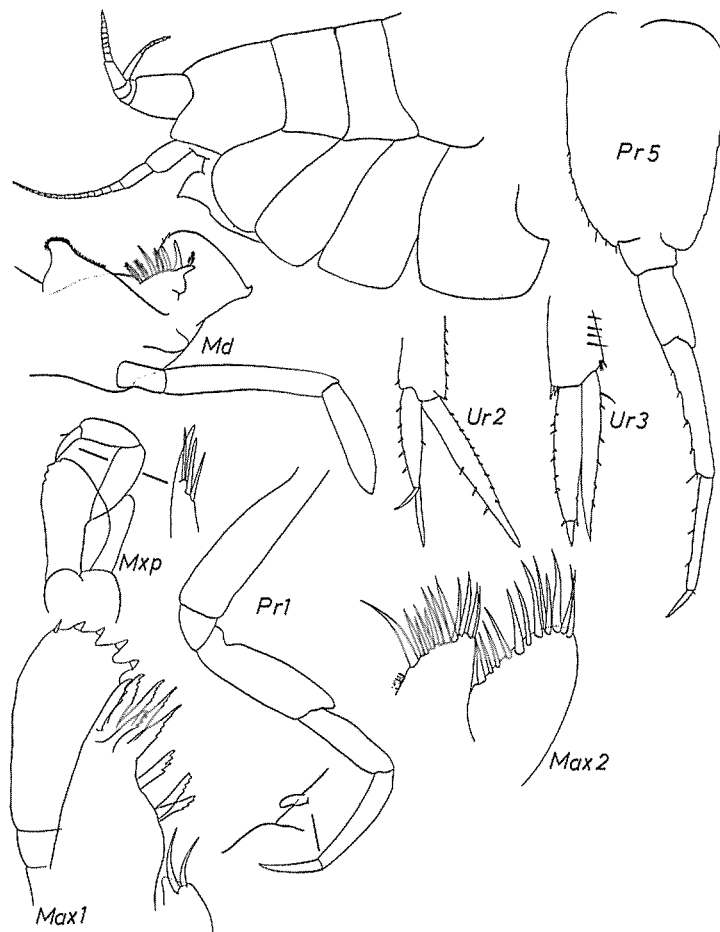


Fig. 2a. *Anonyx hayashii* n. sp., holotype, female, 11.0mm

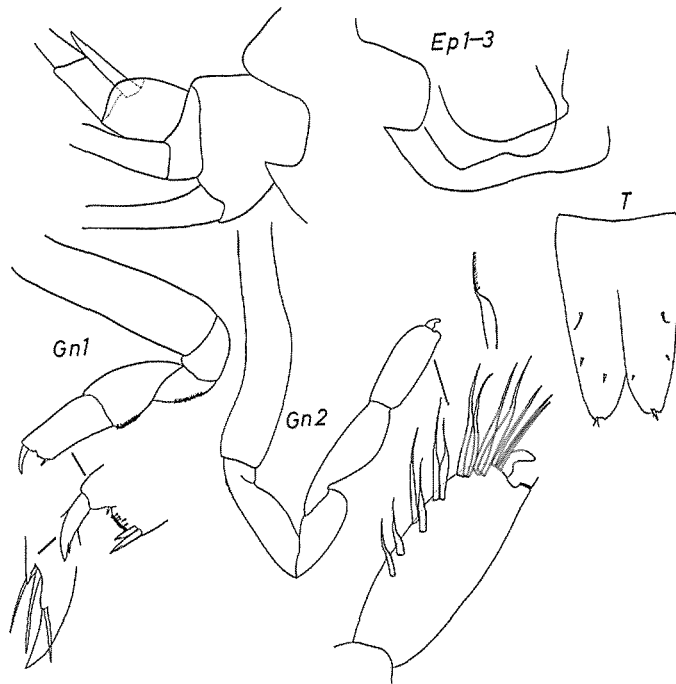


Fig. 2b. *Anonyx hayashii* n. sp., holotype, female, 11.0mm

setae; gnathopod 2 subchelate, article 6 furnished with about 15 peculiar-formed bristles much swollen at base, palm serrated and posterodistal corner not produced distally in sharp, finger with short setae; pleonal epimeron 3 with acute posteroventral tooth distally separated by body of epimeron.

Material: Holotype, female, 11.0 mm long; type-locality, 81-R-19; total 314 specimens collected by traps set on the floor of Enshu- and Kumano-nada at depths of 330-520 m.

Remarks: This species is close to *Anonyx lilljeborgi* BOECK and *A. anivae* GURJANOVA of which the latter has been obtained as follows; length ?♀ ♂, Okhotsuk Sea, Kurilo-Kamchatka waters, 40-50 m deep (GURJANOVA, 1962). This species was named after Prof. K. HAYASHI, Mie University, who kindly operated his sampling gears (baited traps) trapping the present specimens for our study.

Anonyx lilljeborgi BOECK (Fig. 3)

Syn.: *Anonyx lilljeborgi* BOECK, 1871, p.154, pl.4, fig.3; SARS, 1890, p.9, pl.32, fig.1; GURJANOVA, 1962, p.225-226, fig.70; STEELE and BRUNEL, 1968, p.1001-1010, figs.29-33; *Lakota carinata* HOLMES, 1908, p.498-500, fig.9; THORSTEINSON, 1941, p.56, pl.2, figs.16-17; GURJANOVA, 1962, p.302-303, fig.100; *Anonyx carinatus* HURLEY, 1963, p.103-108, figs.32-34; BARNARD, 1967, p.51.

Material: Length 8-10 mm with immature females and males, total 103 specimens

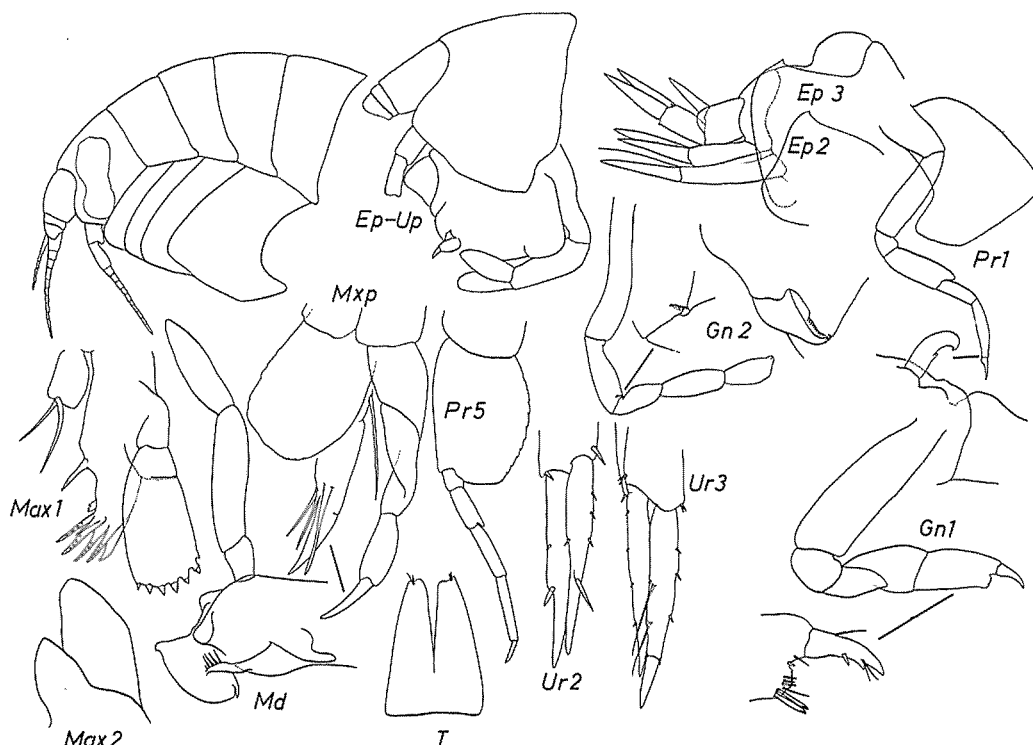


Fig. 3. *Anonyx lilljeborgi*, immature female, 8.0mm

collected by traps set on the floor (330-1015 m deep) of Enshu-Kumano-nada.

Remarks: The specimen figured here is extremely close to Hurley's figure of *Anonyx carinatus* from the west coast of North America, although in our specimens the eyes, light-brown coloured, are clearly visible. However, according to STEELE and BRUNEL (1968) who investigated so many immature and mature specimens of *A. lilljeborgi* collected from different geographic localities, Hurley's *A. carinatus* is obviously a *A. lilljeborgi* which shows moderate variations of the morphological features. *A. lilljeborgi* and/or *A. carinatus* has been found as follows; 1. *A. carinatus* (HOLMES, 1908) (6-10 mm ♀ ♂, Gulf of Alaska to southern California, 40-110 m); 2. *A. lilljeborgi* BOECK, 1871 (-19 mm ♀ ♂, North Atlantic and Pacific, 12-900 m).

Euonyx laqueus J. L. BARNARD (Fig. 4)

Syn.: *Euonyx laqueus* J. L. BARNARD, 1967, p.55-58, figs. 23-24.

Material: Length 15-28 mm with females and males. Total 626 specimens collected by the traps set on the floor (330-1015 m deep) of Kumano-nada.

Remarks: Several slight differences exist in the present specimens when compared

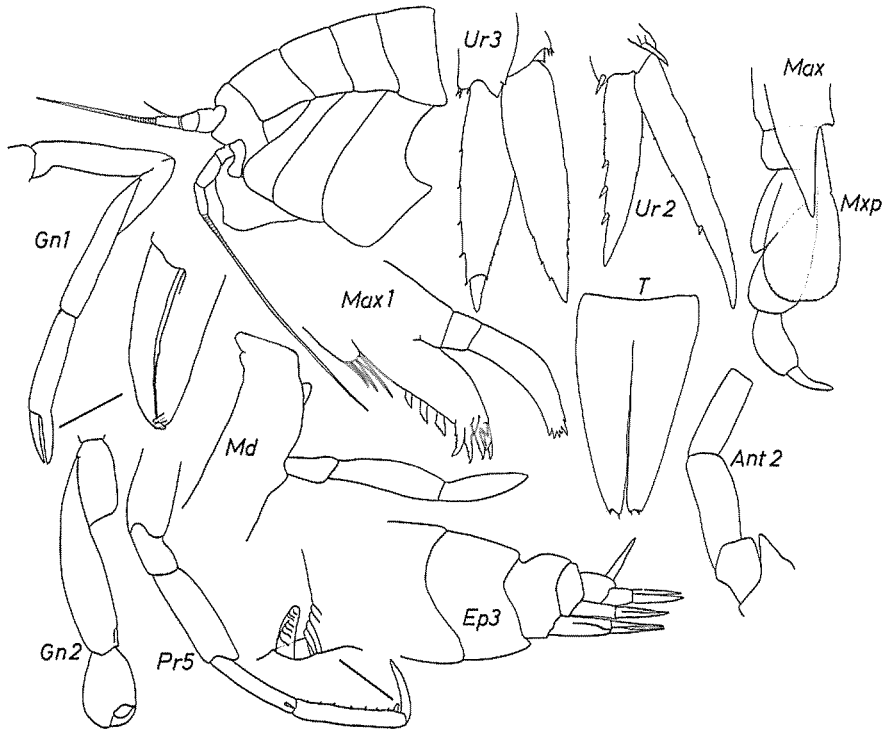


Fig. 4. *Euonyx laqueus*, male, 20.0mm

with Barnard's original figure; all of these appear to be differences in mounting and drawing techniques. In the present specimens the eyes are scarcely visible.

The *Euonyx* species have been found as follows; 1. *E. biscayensis* CHEVREUX, 1908 (13-19 mm ♀, Mediterranean, 564-1455 m; 5 mm juv., North Atlantic, 900 m); 2. *E. chelatus* NORMAN, 1967 (10 mm sex ?, North Atlantic, North Sea, 180-791 m); 3. *E. coecus* PIRLOT, 1933 (7 mm ♀, Celebes Sea, 1158 m); 4. *E. conicurus* K. H. BARNARD, 1955 (7 mm sex ?, False Bay (South Africa), 15 m); 5. *E. laqueus* J. L. BARNARD, 1967 (19 mm ♂, off Baja California, depth ?); 6. *E. normani* STEBBING, 1888 (length ? ♀, South Pacific, 1153 m); 7. *E. pirloti* SHEARD, 1938 (length ? ♀ ♂, coastal waters of southern Australia, depth ?); 8. *E. talismani* CHEVREUX, 1919 (7 mm juv.-14 mm ♂, North Atlantic, 850-970 m).

Schisturella pulchra (HANSEN) (Fig. 5a,b)

Syn.: *Tryphosa pulchra* HANSEN, 1887, p.78, pl.2, fig.6; *Ambasia pulchra* (HANSEN): STEBBING, 1906, p.52; *Schisturella pulchra* (HANSEN): SHOEMAKER, 1930, p.231-237, figs.3-6; STEPHENSEN, 1944, p.25-26; GURJANOVA, 1951, p.212, fig.79; GURJANOVA, 1962, p.197, fig.63.

Material: Length 10-15 mm with females and males. Total of 82 specimens collected by traps set on the floor (330-520 m deep) of Enshu- and Kumano-nada.

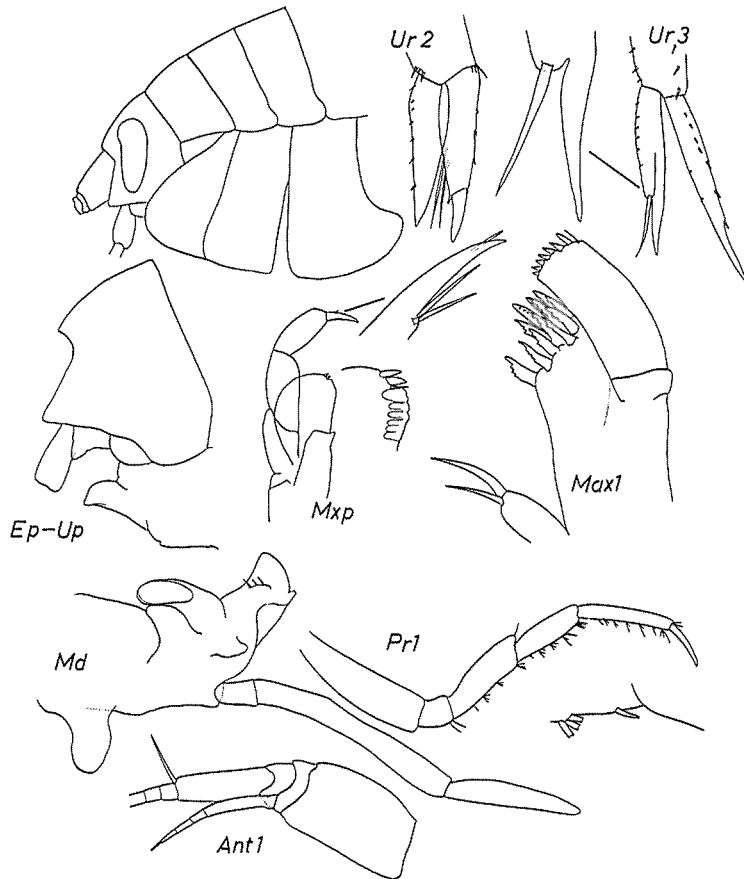


Fig. 5a. *Schisturella pulchra*, female, 10.0mm

Remarks: Based on a specific diagnosis of *S. pulchra* (see, GURJANOVA, 1962), it's without doubt that the present specimens belong to *S. pulchra*. However, several differences exist in the present specimen when compared with Gurjanova's figure: in the uropod 3 the present specimen is furnished with only 2 long setae, while in the figure of Gurjanova it is setose. The authors believe these differences do not justify erection of a new species.

Until now, the species of *Schisturella* have been found as follow: 1. *S. abyssi* (CHEVREUX, 1926) (6-10 mm ♀ ♂, Tasman Sea, off Baja California, 2667-4400 m); 2. *S. adversicola* (K. H. BARNARD, 1925) (3-9 mm ♀ ♂, South Atlantic, 564-4961 m); 3. *S. cocula* J. L. BARNARD, 1966 (7 mm ♂, off California, 162 m); 4. *S. dorotheae* (HURLEY, 1963) (3-4 mm sex ?, west coast of North America, 126-360 m); 5. *S. galathea* DAHL*, 1959 (10 mm ♀, South Pacific, 6960-7000 m); 6. *S. grabenis* J. L. BARNARD, 1967 (5 mm

* This species has previously been removed to the genus *Neoambasia* (Barnard, 1966).

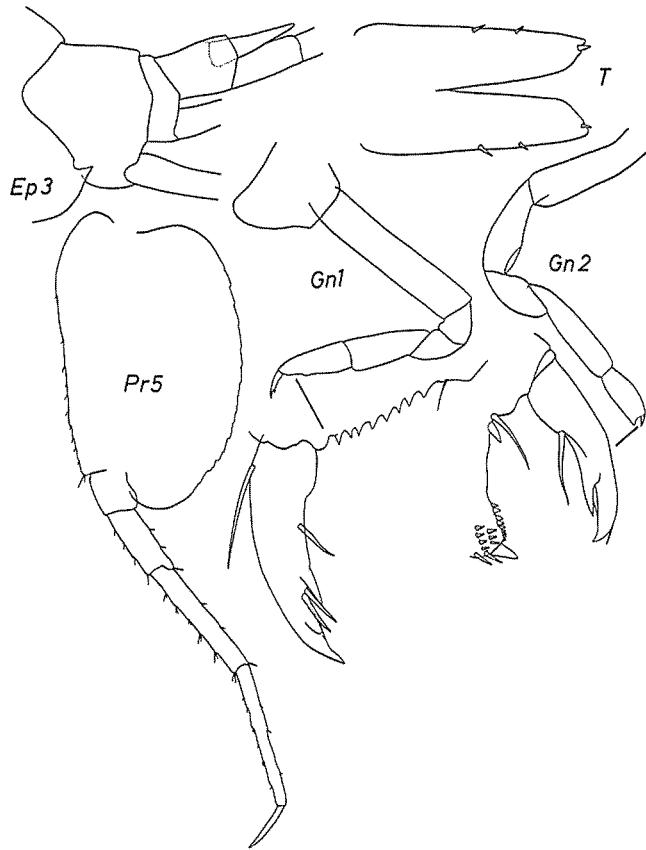


Fig. 5b. *Schisturella pulchra*, female, 10.0mm

♀, off Baja California, 1720-1748 m); 7. *S. pulchra* (HANSEN, 1887) (length ?♀ ♂, North Atlantic, North Sea, North Pacific, 30-2449 m); 8. *S. robusta* J. L. BARNARD, 1961 (7-10 mm ♀ ♂, Tasman Sea, off Baja California, 1720-3580 m); 9. *S. rotunda* (K. H. BARNARD, 1925) (2-4 mm sex?, South Atlantic, 1184-4050 m); 10. *S. totorami* J. L. BARNARD, 1967 (6 mm ♂, Santa Monica Bay (California), 183 m); 11. *S. zopa* J. L. BARNARD, 1966 (3 mm sex ?, off California, 914 m).

Scopelocheirus hopei (COSTA) (Fig. 6)

Syn.: *Calliosoma hopei* COSTA, 1851, p.5, pl.811, fig.1; *Calliosoma kroyer* BLUZELIUS, 1859, pl.2, fig.7; SARS, 1890, p.54-55, pl.19, fig.2; *Scopelocheirus hopei* (COSTA): GURJANOVA, 1951, p.241-242, fig.106.

Material: Length 10-11 mm with females. Total 2 specimens collected by traps set on the floor of Enshu- and Kumano-nada a depths of 333-519 m.

Remarks: Specific differences between the 3 species, *S. crenatus*, *S. hopei* and *S.*



Fig. 6. *Scopelocheirus hopei*, female, 10.0mm

schellenbergi (= *Bathycallisoma schellenbergi*) are described in detail by GURJANOVA (1962). This species is easily distinguished from the other species by the characteristic features of gnathopod 1 and pleonal epimeron 3.

Nine species belonging to the six closely allied genera below-stated have been known to date: *Aroui* CHEVRENX. 1. *A. setosus* CHEVRENX, 1911 (length ? ♀ ♂, Algeria, 65 m). *Bathycallisoma* DAHL. 1. *B. pacifica* DAHL, 1959 (33 mm ♀, central Pacific, 6960-7000 m); 2. *B. schellenbergi* (BIRSTEIN and VINOGRADOV, 1958) (9-43 mm sex ?, tropical Atlantic, northern and central Pacific, 3000-8129 m). *Paracallisoma* CHEVREUX. 1. *P. alberti* CHEVREUX, 1903 (-26 mm ♀, tropical Atlantic, tropical to northern Pacific, 1000-4400 m); 2. *P. coecum* (HOLMES, 1908) (13 mm ♀, west coast of North America, 1000-1300 m). *Paracallisomopsis* GURJANOVA. 1. *P. beljaevi* GURJANOVA, 1962 (5 mm sex ?, northern Pacific, 150 m). *Scopelocheirus* BATE. 1. *S. crenatus* BATE, 1857 (-10 mm ♀ ♂, North Sea to Barent Sea, 40-200 m); 2. *S. hopei* (Costa, 1851) (-7 mm ♀ ♂, Mediterranean, Atlantic, Barent Sea to Norwegian Sea, 100 m). *Scopelocheiropsis* SCHELLENBERG. 1. *S. abyssalis* SCHELLENBERG, 1926 (5 mm ♀, subtropical Atlantic, 3000 m).

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References

- BARNARD, J. L., 1962. South Atlantic abyssal amphipods collected by R. V. Vema. *Abyssal Crustacea, Vema Res. Ser.*, 1 : 1-78.
- BARNARD, J. L., 1966. Amphipoda of Submarine Canyons of southern California. Part V. Systematics. *Allan Hancock Pacific Exped.*, 27 : 1-166.
- BARNARD, J. L., 1967. Bathyal and abyssal gammaridean amphipoda of Cedros Trench, Baja California. *Bull. American Mus. Nat. Hist.*, 260 : 1-205.
- BARNARD, J. L., 1969. The families and genera of marine gammaridean amphipoda. *Bull. American Mus. Nat. Hist.*, 271 : 1-535.
- BARNARD, K. H., 1925. Contributions to the crustacean fauna of South Africa, no. 8. Further additions to the list of amphipoda. *Ann. South Africa Mus.*, 20 : 319-380.
- BARNARD, K. H., 1955. Additions to the fauna list of South African crustacea and pycnogonida. *Ann. South African Mus.*, 43 : 1-107.
- BATE, C. S., 1857. A synopsis of the British edriophthalmous Crustacea. *Ann. Mag. Nat. Hist.*, ser. 2, 19 : 135-152.
- BATE, C. S., and J. O. WESTWOOD, 1863. A History of British Crustacea. John Van Voorst, London, Vol. 2. (not read)
- BIRSTEIN, A. and M. VINOGRADOV, 1958. Pelagic gammadids in the northwestern Pacific Ocean. *Trudy Inst. Okeanol., AK. Nauk SSSR.*, 27 : 219-257 (in Russian).

- BOECK, A., 1871. Crustacea amphipoda borealia et arctica. Forhandl. *Vidensk. Selsk. Christiania*, 1870 : 83-280. (not read)
- CHEVREUX, E., 1903. Note preliminaire sur les amphipodes de la famille des Lysianassidae recueillis par la Princesse-Alice dans les eaux profondes de l'Atlantique et de la Mediterranee. *Bull. Soc. Zool. France*, 28 : 81-97.
- CHEVREUX, E., 1908. Diagnoses d'Amphipodes nouveaux provenant des Campagnes de la Princesse-Alice dans l'Atlantique nord. *Bull. Inst. Oceanogr., Monaco*, 117 : 1-13.
- CHEVREUX, E., 1911. Campagnes de la Melita: Les Amphipodes d'Algeria et de Tunisie. *Mem. Soc. Zool. France*, 23 : 145-285.
- CHEVREUX, E., 1919. Notes preliminaire sur les Amphipodes recueillis par les expeditions du Travailleur et du Talisman (1880-1883). *Bull. Mus. Nat. Hist., Paris*, 25 : 574-580.
- CHEVREUX, E., 1926. Diagnoses d'Amphipodes nouveaux provenant des Campagnes de la Princesse-Alice dans l'Atlantique et dans l'Ocean Arctique. *Bull. Inst. Oceanogr., Monaco*, 475 : 1-12.
- COSTA, A., 1851. Fauna del Regno di Napoli. (not read)
- DAHL, E., 1959. Amphipoda from depths exceeding 6000 meters. *Galathea Rep.*, 1 : 211-241.
- DAYTON, P. K. and R. R. HESSLES, 1972. The role of disturbance in the maintenance of deep-sea diversity. *Deep-sea Res.*, 19 : 199-208.
- GURJANOVA, E., 1951. Gammaridean amphipoda of the SSSR and its adjacent waters. *Opred. po Faune SSSR., AK. Nauk SSSR.*, 41 : 1-1029 (in Russian).
- GURJANOVA, E., 1962. Gammaridean amphipoda from the North Pacific. *Opred. po Faune SSSR., AK. Nauk SSSR.*, 74 : 1-440 (in Russian).
- HANSEN, H. J., 1887. Malacostraca marina Groenlandiae occidentalis. Oversigt over det vestlige Gronlands Fauna af malakostrake Havkrebsdyr. *Vid. Medd. Nat. Foren., Kjobenhavn*, 1887 : 5-226. (not read)
- HESSLER, R. R., C. L. INGRAM, A. A. YANANOS and B. R. BURNETT, 1978. Scavenging amphipods from the floor of the Philippine Trench. *Deep-Sea Res.*, 25 : 1029-1047.
- HESSLER, R. R., J. D. ISAACS and E. L. MILLS, 1972. Giant amphipod from the abyssal Pacific Ocean. *Science*, 75 : 636-637.
- HOLMES, S. J., 1908. The amphipoda collected by the U. S. Bureau of Fisheries Steamer, "Albatross", off the west coast of North America, in 1903 and 1904, with descriptions of a new family and several genera and species. *Proc. U. S. Nat. Mus.*, 35 : 489-543.
- HURLEY, D. E., 1963. Amphipoda of the family Lysianassidae from the west coast of North and Central America. *Allan Hancock Found. Publ. Occ. Pap.*, 25 : 1-165.
- HURLEY, D. E., 1965. A re-description of some A. O. Walker types of "Southern Gross" Lysianassidae (Grustacea Amphipoda) from the Ross Sea. *Trans. Roy. Soc. New Zealand, Zool.*, 6 : 155-181.
- MARSHALL, N. B., 1979. Developments in Deep-Sea Biology. Blandford Press, Poole Dorset, 566 pp.
- NORMAN, A. M., 1867. Report on the committee appointed for the purpose of exploring the coasts of the Hebrides by means of the dredge, part II. On the Crustacea, Echinodermata, Polyzoa, Actinozoa, and Hydrozoa. *British Assoc. Adv. Sci., Rep. for 1866* : 193-206. (not read)
- PIRLOT, J. M., 1933. Le amphipodes de l'expedition du Siboga, Deuxieme partie: Les amphipodes, II. Les amphipodes de la profonde. I. Lysianassidae, Stegocephalidae, Pleustidae and Lepechinellidae. *Siboga-Exped.*, 330 : 115-167.
- SARS, G. O., 1890. Amphipoda. *An Account of the Crustacea of Norway*, 1 : 1-711.
- SASAKAWA, Y., 1981. Present situation and problems encountered in pot fisheries. In "Pot Fisheries", ed. by Japan Soc. Sci. Fish. Kodansha-Koseikaku, Tokyo, pp.9-21 (in Japanese).
- SCHELLENBERG, A., 1926. Die Gammariden der deutschen Sudpolar-Expedition 1901-1903. *Deutsch Sudpolar-Exped.*, 18 : 235-414.
- SCHELLENBERG, A., 1927. *Amphipoda des nordischen Plankton. Nordisches Plankton*, 20 : 589-722.
- SEKIGUCHI, H., Y. YAMAGUCHI and H. KOBAYASHI, 1981. *Bathynomus* (Isopoda: Cirolanidae) attacking sharks caught in a gill-net. *Bull. Fac. Fish., Mie Univ.*, 8 : 11-18.
- SEKIGUCHI, H., Y. YAMAGUCHI and H. KOBAYASHI, 1982. Geographical distribution of scavenging giant isopods bathynomids in the northwestern North Pacific. *Bull. Jap. Soc. Sci. Fish.*, 48 : .
- SEXTON, E. W., 1911. A new amphipod species, *Tryphosites allenii*. *Ann. Mag. Nat. Hist. ser.*,

- 8 : 510-513.
- SHEARD, K., 1938. The amphipod genera *Euonyx*, *Syndexamine* and *Paradexamine*. *Rec. South Australia Mus.*, 6 : 169-186.
- SHOEMAKER, C. R., 1930. The amphipoda of the Cheticamp Expedition of 1917. *Contr. Canadian Biol. Fish., n. ser.*, 5 : 1-141.
- SHULENBERGER, E. and J. L. BARNARD 1976. Amphipods from an abyssal trap set in the North Pacific Gyre. *Crustaceana*, 31 : 241-259.
- SHULENBERGER, E. and R. R. HESSLEX, 1974. Scavenging abyssal benthic amphipods trapped under oligotrophic central North Pacific Gyre waters. *Mar. Biol.*, 28 : 185-187.
- STEBBING, T. R. R., 1888. Report on the amphipoda collected by H. M. S. Challenger during the years 1873-76. *Rep. Sci. Res. Voy. Challenger, Zool.*, 29 : 1-1737.
- STEBBING, T. R. R., 1914. Crustacea from the Falkland Islands collected by Mr. Rupert Valentin, F. L. S., part II. *Proc. Zool. Soc. London*, 1 : 341-378.
- STEELE, D. H. and P. BRUNEL, 1968. Amphipoda of the Atlantic Arctic coasts of North America: *Anonyx* (Lysianassidae). *J. Fish. Res. Bd. Canada*, 25 : 943-1060.
- STEPHENSEN, K., 1944. Amphipoda. In "The Ecology of East Greenland" (ed. by M. Degerbol et al.), *Medd. Grland Komm. Videnskundersorg. Grnland*, 121 : 1-165.
- THORSTEINSON, E. D., 1941. New or noteworthy amphipods from the North Pacific coast. *Univ. Washington Publ. Oceanogr.*, 4 : 50-96. (not read)
- WALKER, A. O., 1903. Amphipoda of the "Southern Cross" Antarctic Expedition. *J. Linn. Soc. London, Zool.*, 29 : 33-64.
- WOLFF, T., 1971. Archimede dive 7 to 4160 meters at Madeira: observations and collecting results. *Vidensk. Meddr. Dansk. Naturh. Foren.*, 134 : 127-147.