

**A new subfamily, Bathycalliinae n. subfam.,
for *Bathycalliax geomar* n. gen., n. sp.
from the deep water cold seeps off Oregon, USA
(Crustacea, Decapoda, Callianassidae)**

KATSUSHI SAKAI & MICHAEL TÜRKAY

Abstract

A new ghost shrimp, *Bathycalliax geomar* n. gen., n. sp., is described and accommodated in the new subfamily Bathycalliinae. This subfamily differs from all others by having epipodites on the third maxilliped and the first four pairs of pereopods and also having two transverse cardial sulci on the carapace. This is the first record of thalassinidean Crustacea from chemoautotrophic communities of the deep sea.

Key words: Carcinology, Callianassidae, Bathycalliinae, Bathycalliax, new subfamily, new genus, new species, Northeastern Pacific, deep water, cold seeps.

Introduction

The segment of the Cascadia convergent margin off Oregon is the first at which tectonic dewatering has been observed and documented (KULM et al. 1986, SUESS et al. 1985). Since this discovery it has become one of the classic sites for the understanding of fluid venting processes at active margins and the formation of accretionary complexes (MOORE et al. 1990, WESTBROOK et al. 1994). Along the Cascadia margin plate, convergence builds a series of subparallel accretionary ridges where the Juan de Fuca plate collides with the North American plate. During the projects HYDROTRACE (Cruise So-109, HERZIG et al. 1997) and SO-RO (Cruise So-110/1a, SUESS & BOHRMANN 1997) with R.V. SONNE in 1996 samples were obtained from the second accretionary ridge. In the sediments of this Hydrate Ridge authigenic carbonates are intercalated with massive gas hydrates (BOHRMANN et al. 1998). Faults extend through the accreted sediments and serve as conduits and channel water and methane up to the seafloor and into the water column. This supply with reduced chemical compounds in the fluids, i.e. methane, hydrogen sulfide

and ammonia, emerging from the cold seeps is utilized by a vast and characteristic community which is dominated by vesicomyid clams. Many benthic animals have been obtained from these surveys which might be associated with this seepage, including the present species (SAHLING 1997).

Ghost shrimps (Thalassinidea) have not been found before in hydrothermally influenced areas. TÜRKAY & SAKAI (1995) described *Paragypturus calderus* as a new genus and new species from the caldera of a submerged volcano on the Esmeralda Bank in the Marianas. This was a quite shallow area with a depth range of 63–114 m. The present specimens are therefore the first members of callianassids getting known from chemoautotrophic communities at the deep sea bottom. It may therefore not be surprising that a new subfamily has to be introduced to accommodate the species.

We have used the following abbreviations in this paper: SMF: Forschungsinstitut Senckenberg, Frankfurt am Main; Mxp: maxilliped; P: pereopod; Plp: pleopod.

Authors' addresses:

Prof. Dr. Katsushi SAKAI, Shikoku University, 771-1192 Tokushima, Japan, e-mail: ksakai@shikoku-u.ac.jp.

Dr. Michael TÜRKAY, Forschungsinstitut Senckenberg, Senckenberganlage 25, D-60325 Frankfurt am Main, Germany, e-mail: mtuerkay@sng.uni-frankfurt.de.

Taxonomy

The species described in this paper, *Bathycalliax geomar* n. gen., n. sp., has a unique character composition within the Callianassidae, i. e. the presence of an epipod on Mxp3 and P/1-4, respectively, and two transverse cardiac sulci. For this reason a new subfamily, Bathycalliinae n. subfam., has to be introduced. A slender longitudinal dorsomedian carina of the carapace, and a prominent cardiac prominence with a mid-pit are found as in the subfamily Anacalliinae MANNING & FELDER 1991, however, in the Bathycalliinae the Mxp3 ischium-merus is subpediform, and the propodus and dactylus are each broadened, and the carapacial oval is not present as in the subfamily Eucalliinae MANNING & FELDER 1991. Therefore it is possible to say that this species might represent an intermediate form between Anacalliinae and Eucalliinae in the carapace and Mxp3, though the presence of the epipod on thoracic legs suggests that it belongs neither to Anacalliinae nor Eucalliinae. The presence of the cardiac prominence with a mid-pit in *Bathycalliax geomar* suggests a relationship with the subfamily Ctenochelinae MANNING & FELDER 1991, however, in *Calliax quadracuta* (BIFFAR 1970) and *C. bulimba* (POORE & GRIFFIN 1979) in the subfamily Eucalliinae a weak longitudinal dorsomedian carina of the carapace is definable, and in the genera *Calliax* DE SAINT LAURENT 1973 and *Paragypturus* TÜRKAY & SAKAI 1995 except for *Paragypturus calderus* TÜRKAY & SAKAI 1995 only a mid-pit without a cardiac prominence is present.

Bathycalliinae n. subfam.

Diagnosis: Carapace without dorsal oval, bearing two transverse cardiac sulci. Mxp 3 ischium-merus subpediform, propodus and dactylus broadened, exopod rudimentary. Plp/3-5 biramous, larger than Plp/1-2. Epipods present on Mxp 3-P/4 respectively.

Type genus: *Bathycalliax* n. gen.

Remarks: According to a recent revision by the senior author (SAKAI 1999a) the family Callianassidae DANA 1852 includes four subfamilies, i.e. Callianassinae DANA 1852 Eucalliinae [pro Eucalliinae, incorrect original spelling] MANNING & FELDER 1991 Anacalliinae [pro Anacalliinae, incorrect original spelling] MANNING & FELDER 1991, and Calliapaguroipinae SAKAI 1999. Two further subfamilies were added by SAKAI (1999b), i.e. Ctenochelinae MANNING & FELDER 1991 and Gourretiinae SAKAI 1999. The present new subfamily differs basically from all other callianassids in that the epipods are present on Mxp 3 to P/4, respectively, and in having two transverse cardiac sulci.

Bathycalliax n. gen.

Diagnosis: Carapace without dorsal oval, and with a narrow longitudinal dorsomedian carina running from the posterior half of the gastric region through a conspicuous cardiac prominence to the posterior margin; cardiac prominence with a mid-pit; cervical groove and two transverse cardiac sulci present. Abdominal somite 6 without lateral projections. Eystalks triangular, dorsal surfaces depressed and in contact with each other; corneas lacking. Maxillae 2: Scaphognathite without a posterior long seta. Mxp 3: Ischium-merus subpediform and with a rudimentary exopod. P1 unequal and dissimilar. Epipods are present from Mxp3 to P4 respectively. Uropodal exopod oval, forming an anterodorsal plate in its anterior third. Male Plp 2 with appendix masculina.

Type species: *Bathycalliax geomar* n. sp.

Remarks: *Bathycalliax* n. gen. is characterised by the presence of an epipod on Mxp 3 and P/1-4, although the epipod is rudimentary on P/4; the exopod of Mxp 3 is rudimentary; and the uropodal exopod has an anterodorsal plate descending to the distal margin. The carapace is provided with a narrow longitudinal dorsomedian carina; a similar structure is found as an indistinct median swelling on the carapace of *Calliax lobata* (DE GAILLANDE & LAGARDÈRE 1966) and *Paragypturus sakaii* (DE SAINT LAURENT & MANNING 1982). Two transverse cardiac sulci are present; other genera include some species with only a single cardiac sulcus e.g. *Calliax bulimba* (POORE & GRIFFIN 1979), *Paragypturus novaebritanniae* (BORRADAILE 1900) and *Paragypturus sakaii* (DE SAINT LAURENT & LE LOEUFF 1979) (K. SAKAI 1999a); *Ctenocheles* KISHINOUE 1926 and *Gourretia* DE SAINT LAURENT 1973 have a distinct cardiac prominence, but no transverse sulci (MANNING & FELDER 1991: 784).

Etymology: The name is a combination of the Greek *bathys* [βαθύς] an adjective meaning 'deep' combined with *Calliax* because of the similar eyestalks of both otherwise unrelated genera. The gender is feminine, as in *Calliax*.

Bathycalliax geomar n. gen., n. sp.

Holotype: ♂ [TL 57.0, CL 13.0] (SMF 23866) So-109/119 (44°40.146'N, 125°06.685'W), Aleutian Subduction-Zone off Oregon, USA, 625 m depth GTV, 24. vi. 1996, R. V. SONNE.

Paratype: 1 ♂ [TL 48.0, CL 11.5] (SMF 23867), So-109/121 (44°40.193'N, 125°06.605'W) Aleutian Subduction-Zone off Oregon, USA, 627 m depth, GTV, 25. vi. 1996, R. V. SONNE.

Description of male holotype: Rostrum triangular in dorsal view. Carapace (Fig. 1a, 2a-b) almost smooth, though bearing soft setae marginally; dorsal surface slightly convex anteriorly, and with narrow longitudinal dorsomedian carina from gastric region to posterior margin of carapace; conspicuous cardiac prominence with a mid-pit present. Cervical groove located dorsally in the posterior fourth of carapace including rostrum. Cardiac region provided with two conspicuous transverse sulci; anterior one located medially, extending laterally to branchial region across linea thalassinica; second one situated at posterior fourth. Linea thalassinica extends along entire length of carapace. Abdominal somites smooth, glabrous dorsally, with few puncta-bearing short setae; somites 1-2 smooth and glabrous dorsally; pleurites 3-5 each with vertical row of setae laterally; somite 6 broadly concave on lateral margin in posterior half.

Telson (Fig. 2d) subquadrate, slightly longer than broad; lateral margin slightly convex at anterior fourth, then gradually convergent posteriorly to broadly rounded corner with tuft of long setae; posterior margin convex, with short sparse setae; dorsal surface weakly elevated anteromedially, divided into two parts by median Y-shaped convexity, medially depressed posteriorly, and followed by a lower mid-dorsal convexity extending to posterior margin. Uropodal endopod oval, 1.5 times as long as broad, rounded on posterior margin; dorsal surface convex and without longitudinal carina. Uropodal exopod oval, more than 1.5 times as long as broad; dorsal surface provided with anterodorsal plate in its anterior third, descending to distal margin.

Eyestalks (Fig. 2a-b) subtriangular, as long as broad, with an obtusely angular tip, which overreaches slightly the distal end of antennular basal article; dorsal surface depressed and carinate along lateral margin; cornea scarcely pigmented. Antennular peduncle shorter than antennal peduncle, terminal article about 1.5 times length of penultimate, almost reaching to proximal margin of antennal terminal article;

Table 1. Branchial formula in *Bathycalliax geomar* n. gen. n. sp. (r = rudimentary).

	Maxillipeds			Pereiopods				
	1	2	3	1	2	3	4	5
Exopods	1	1	r	—	—	—	—	—
Epipods	1	1	1	1	1	1	r	—
Podobranchs	—	1	—	—	—	—	—	—
Arthrobranchs	—	—	2	2	2	2	2	—
Pleurobranchs	—	—	—	—	—	—	—	—

penultimate and terminal articles ventrally with rows of sparse long setae; rami of flagella almost subequal in length, but ventral ramus slightly more slender and slightly overreaching dorsal ramus. Second article of antennal peduncle distolaterally with tuft of long setae; dorsal scale small and oval; third article short; terminal article distinctly longer than, but slightly narrower than penultimate; antennal flagellum about 3.5 times length of antennular flagellum. Maxillule 2 scaphognathite without long posterior bristle. Maxilliped 3 (Fig. 2e) with rudimentary exopod; endopod with long setae on mesial margin; length of merus-ischium exceeding twice width; ischium subrectangular, 1.5 times as long as broad, and slightly produced on proximomesial margin, internal surface with crista dentata bearing curved row of sharp denticles; merus subrectangular, slightly broader than long and truncate distally; carpus 1.5 times as long as broad, heavy and subtri-

angular; propodus subquadrate, length subequal to carpal height; dactylus divergent in height, longer than height of propodus, and terminally truncate with brush of stiff bristles.

Branchial formula including exopods and epipods as shown in table 1; branchiae limited to a single podobranch on Mxp1 and a pair of arthrobranchs on Mxp3 to P/4.

P/1 unequal in size and dissimilar in shape. Larger cheliped (Fig. 3a) massive; ischium slender, superior margin sinuous and unarmed, inferior margin with a row of sharp denticles; merus slightly shorter than ischium, about 1.8 times as long as high, superior margin arcuate and smooth, inferior margin lacking distinct enlarged lobe, regularly rounded in outline and armed with row of nine distally directed denticles, exterior surface medially swollen; carpus 1.8 times as high as long, and about half as long as palm, superior margin almost straight,

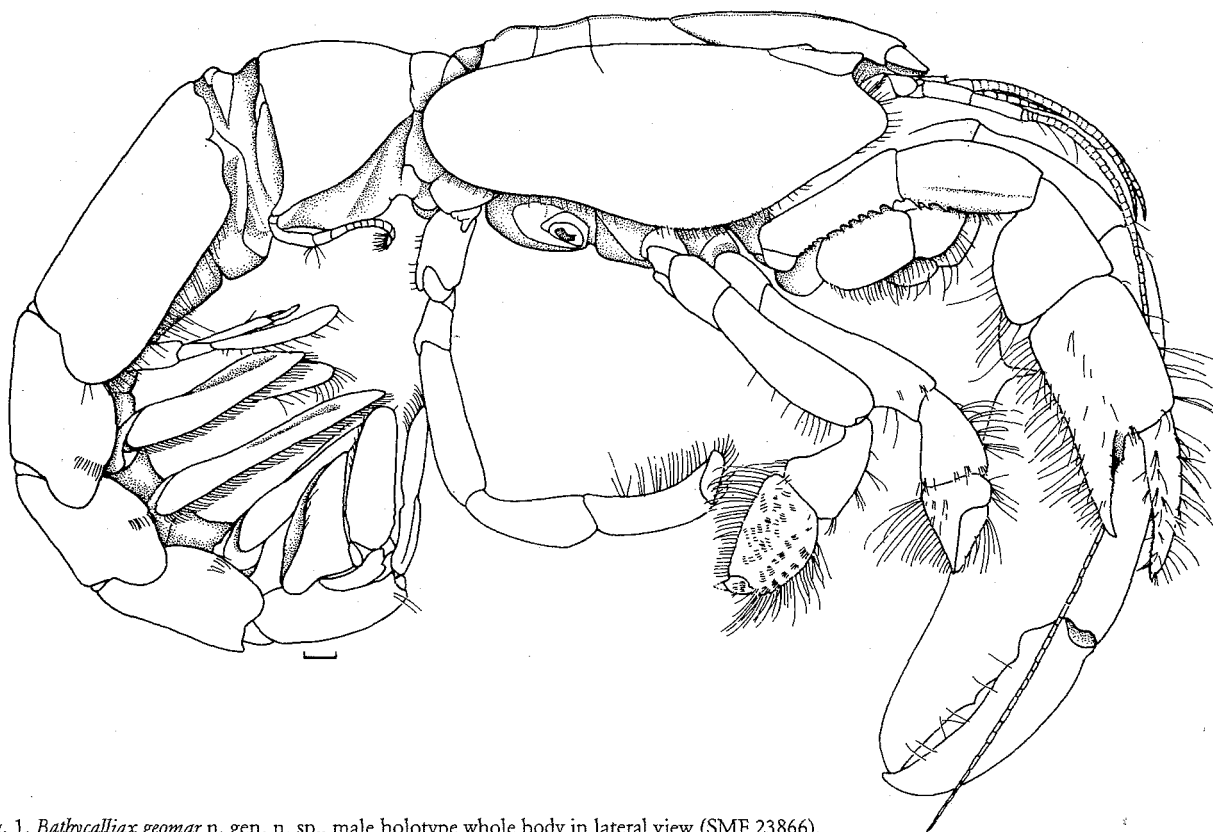


Fig. 1. *Bathycalliax geomar* n. gen. n. sp., male holotype whole body in lateral view (SMF 23866).

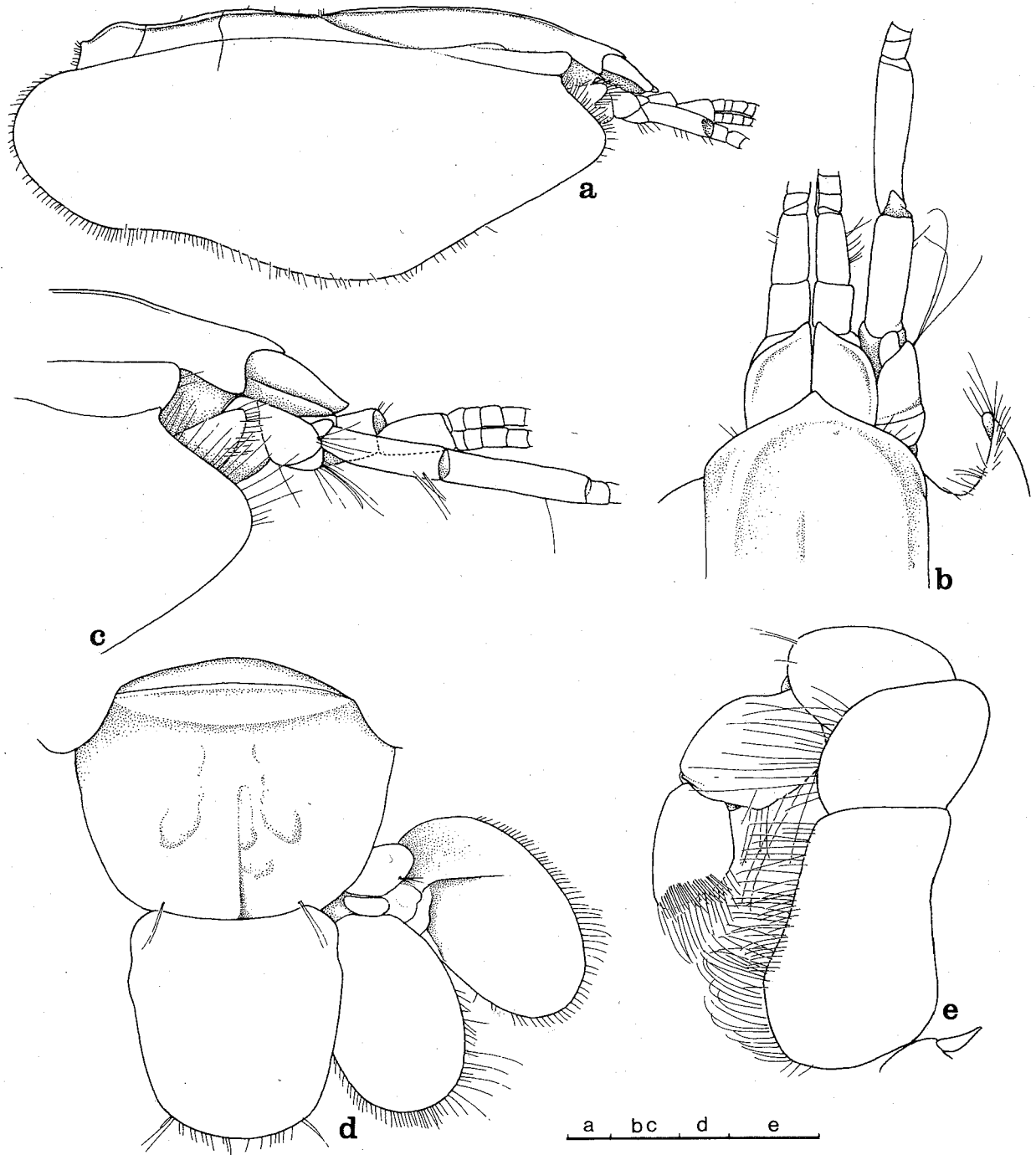


Fig. 2. a. carapace, lateral view b. anterior part of carapace, dorsal view; c. same, lateral view; d. abdominal somite 6 and tail-fan, dorsal view; e. third maxilliped, external surface. a-c, SMF 23866, male holotype; d-e, SMF 23867, male paratype.

forming a keel ending at the distal rounded corner, proximoinferior margin regularly rounded and smooth in outline; chela heavy, length about twice height, superior margin of palm forming a keel except in distal part, inferior margin with smooth keel extending to base of fixed finger; fixed finger with prehensile margin slightly concave, armed with row of fine low serrations in proximal half, and with smooth concavity placed distal to median triangular denticle; dactylus less than 1.5 times as long as palm, prehensile margin sinuous and unarmed, terminally with acute hooked tip. Smaller cheliped (Fig. 3b) more slender

and less massive than larger cheliped; ischium narrow, inferior margin armed with a row of denticles, superior margin unarmed; merus rectangular, about as long as ischium, length about twice height, inferior margin arcuate with a few denticles proximally, external surface swollen medially; carpus subtriangular, proximoinferior margin regularly divergent to rounded distal angle, length slightly shorter than merus and about equal to height; chela 2.5 times as long as palm; palm subrectangular, length less than 1.5 times height; fixed finger distinctly shorter than dactylus, prehensile margin concave, finely serrated in proxi-

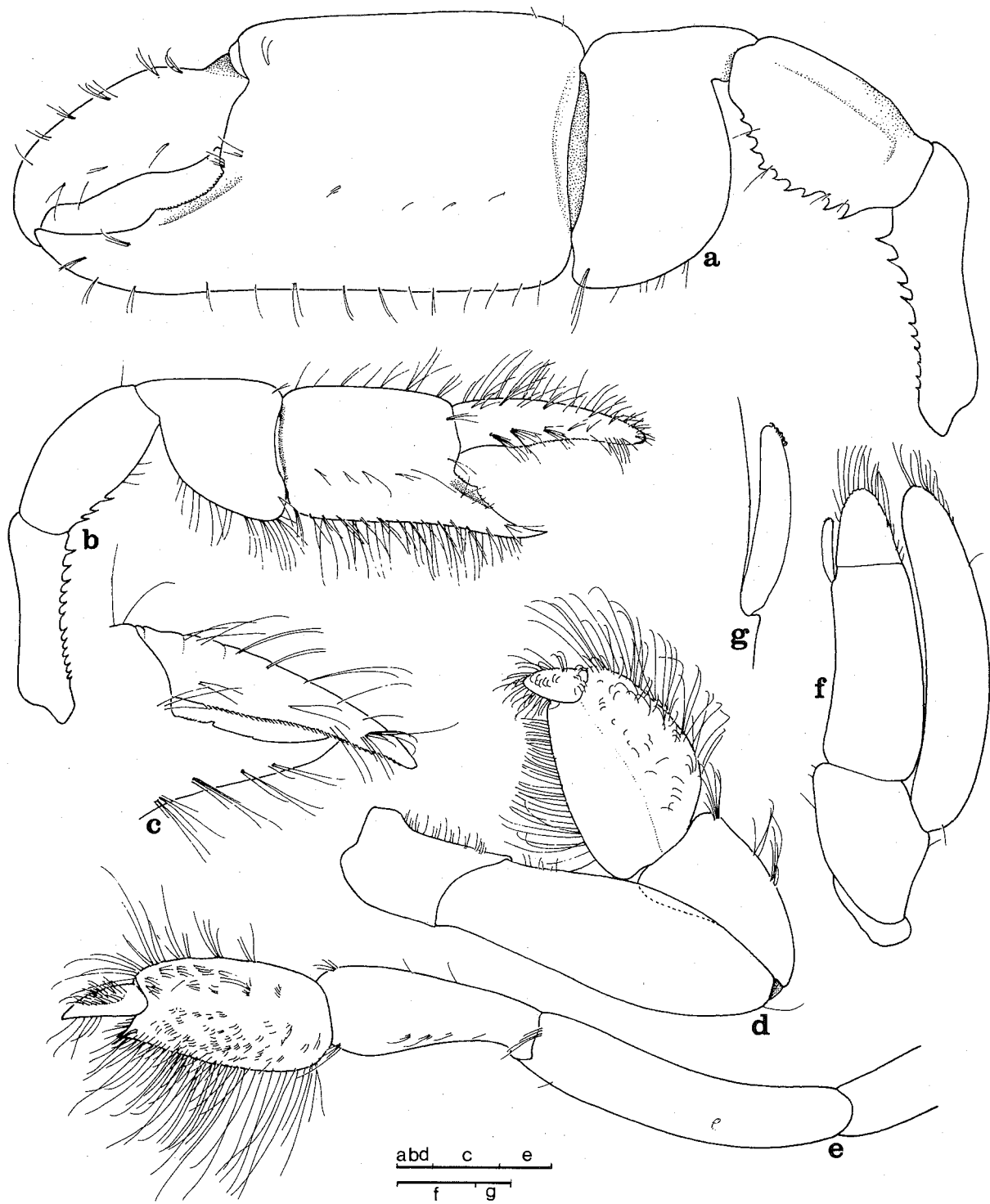


Fig. 3. a, larger cheliped, lateral view; b, smaller cheliped, lateral view; c, second pereopod, lateral view; d, fourth pereopod, lateral view; e, fourth left pereopod; f, second pleopod; g, appendix masculina on second pleopod in left side. a-b, d, SMF 23866, male holotype; c, e-g, SMF 23867, male paratype.

mal third, reduced triangular denticle at proximal third, and concave in distal two thirds armed with a few finer denticles decreasing in size towards slender tip; dactylus slightly longer than palm, conspicuously exceeding length of fixed finger, prehensile margin weakly sinuous and medially with low, distally directed fine denticles.

P/2 chelate; ischium with sparsely distributed long setae on inferior margin; merus with more closely set setae on mesial margin; carpus with a row of setal tufts on superior margin; chela with long setae on inferior margin; both fingers corneous on prehensile margins, terminating distally in thickened corneous tips; dactylus with long marginal setation on superior margin.

P/3 (Fig. 3d) merus broadened in distal half, length more than 3 times height; carpus broadest distally, length 1.5 times height; propodus subquadrate, convergent distally in height, superior and inferior margins broadly rounded with long setation, exterior surface scattered with small tufts of short setae on dorsal half and bare in ventral half; dactylus tear-shaped, hooked outwards, external surface densely setose, terminating in corneous tip.

P/4 subchelate; merus longer than carpus; propodus rectangular, with a short triangular tooth at inferodistal corner, lateral surface scattered with soft setae; dactylus hooked outwards, external surface with a tuft of setae.

P/5 chelate; propodus forming a broad fixed finger inferodistally, interior surface with dense setation, dactylus hooked towards external side of fixed finger, tip deflexed.

Male Plp/1 uniramous, composed of proximal segment and segmented flagellum. Male Plp/2 biramous, long setae on lateral margin of exopod and distal part of lateral margin of endopod; distal lobe of endopod separated from remainder of article by a weak transverse suture; appendix masculina slender, marked by a small patch of microsetae on mesial margin. Plp/3–5 biramous, each bearing appendix interna on mesial margin of endopod. Female Plp/1–2 unknown.

Remarks: *Bathycalliax geomar* n. sp. is characterised by a narrow longitudinal median carina on the carapace. In the

species of the subfamily Anacalliacinae, *Anacalliax pixii* (KENSLEY 1975), *A. agassizi* (BIFFAR 1971) and *A. argentinensis* (BIFFAR 1971), there is a distinct dorsomedian carina on the carapace, however in *Calliax lobata* the carapace is obscurely swollen longitudinally in the cardiac region, and in *C. quadrata* (BIFFAR 1970) and *C. bulimba* (POORE & GRIFFIN 1979) it is also obscurely swollen medially around the cervical groove, however, in both cases it does not form a distinct carina. The present species is also similar to *Paragypturus novaebritanniae*, *P. sakaii*, and *Calliax bulimba* by the carapace having a single transverse sulcus in the gastric region, but it is unique in having two transverse sulci. In addition *Bathycalliax geomar* has a swollen cardiac prominence with a mid-pit like in *Calliax lobata* and *Paragypturus sakaii*.

Etymology: The species-name *geomar* is derived from the short name of the "Forschungszentrum für Marine Geowissenschaften an der Christian-Albrechts-Universität zu Kiel (GEOMAR)".

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