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Xiphoarcturus – a new genus and two new species of the family Antarcturidae (Isopoda: Valvifera) from the Mar del Plata submarine canyon and its phylogenetic relationships

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Abstract. *Xiphoarcturus kussakini* **gen.n.**, **sp.n.** and *Xiphoarcturus carinatus* **gen.n.**, **sp.n.** are described from the Mar del Plata submarine canyon, South-West Atlantic Ocean. The new genus *Xiphoarcturus* has an elongate endopod of the uropod that extends to the end of the acuminate pleotelson; this elongate endopod is a novel character for the family Antarcturidae. A parsimony analysis based on 40 morphological characters for 20 species of the family Antarcturidae was performed. The consensus tree clusters *Xiphoarcturus* **gen.n.** with the genera *Mixarcturus, Chaetarcturus*, *Fissarcturus* and the species *Acantharcturus acutipleon*. The relationships among the genera *Acantharcturus*, *Cylindrarcturus*, *Chaetarcturus*, *Fissarcturus*, *Furcarcturus*, *Glaberarcturus*, *Globarcturus* and *Mixarcturus* are discussed. Monophyly was recovered to all the genera except for *Acantharcturus*, which resulted paraphyletic in all the trees obtained.

Key words. Argentina, deep sea, phylogeny, *Xiphoarcturus carinatus* **sp.n.**, *Xiphoarcturus kussakini* **sp.n.**

1. Introduction

Valviferan isopods are distributed mainly in polar regions, while some families are more speciose in the Arctic, others show their highest diversity in the Antarctic (Poore & Bruce 2012). In particular, Antarcturidae is one of the most species-rich families amongst the Southern Hemisphere Valvifera, with a bathymetrical distribution from shelf depths to slope and abyssal depths (Poore & Bruce 2012).

Currently, the family Antarcturidae Poore, 2001 includes over 100 species distributed in 17 genera (Poore 2001, 2015a,b). Of these, 13 genera are characterized by the presence of conspicuous spines all over the body surface, viz., *Antarcturus* zur Strassen, 1902, *Pleuroprion* zur Strassen, 1902, *Acantharcturus* Schultz, 1981, *Caecarcturus* Schultz, 1981, *Chaetarcturus* Brandt, 1990, *Fissarcturus* Brandt, 1990, *Mixarcturus* Brandt, 1990, *Oxyarcturus* Brandt, 1990, *Tuberarcturus* Brandt, 1990, *Abyssarcturus* Kussakin & Vasina 1995, *Glaberarcturus* Kussakin & Vasina, 1998, *Marmachius* Poore, 2012, and *Halearcturus* Poore, 2015 (zur Strassen 1902; Schultz 1981; Brandt 1990; Kussakin & Vasina 1995, 1998; Poore 2012, 2015a). In contrast, the genus *Litarcturus* Brandt, 1990 only has supraocular spines and/or caudolateral pleotelsonic spines, and the genus *Furcarcturus* Baltzer, Held & Wägele, 2000 only has caudolateral pleotelsonic spines (Brandt 1990; Baltzer et al. 2000). Finally, the genera *Cylindrarcturus* Schultz, 1981 and *Globarcturus* Kussakin & Vasina, 1994 are spineless (Schultz 1981; Kussakin & Vasina 1994).

The phylogenetic relationships within this family are almost unknown, only a preliminary analysis for eight species based on 16S rRNA gene sequences was performed (see Baltzer et al. 2000). In addition, Poore (2015a) acknowledged that the characters used to differ-

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entiate the genera of Antarcturidae remain unclear, and that several species are difficult to place and others are undescribed.

In order to improve our knowledge of this family, *Xiphoarcturus* **gen.n.** is erected, *X. kussakini* **sp.n.** and *X. carinatus* **sp.n.** are described, and the phylogenetic placement of this new genus is evaluated on the basis of morphological characters.

2. Material and methods

2.1. Material

Specimens of *Xiphoarcturus kussakini* **sp.n.** and *X. carinatus* **sp.n.** were collected on board the RV *Puerto Deseado* during the surveys Talud Continental I (2012), II and III (2013) using a bottom otter trawl, and an epibenthic sledge equipped with a 1 mm mesh-size net. The sledge is a modified version of Hessler & Sanders (1967). The material was fixed with 10% seawater buffered formalin on board and transferred to 70% ethanol in the laboratory. Some specimens were fixed directly in 96% ethanol for molecular studies.

2.2. Methods

2.2.1. Taxonomy

The described specimens were stained with Chlorazole Black E®, and the appendages were dissected and temporarily mounted in glycerin. Drawings were prepared with a Leica MZ8 stereoscopic microscope and a Carl Zeiss (Axioskop) compound microscope, both equipped with camera lucida. Line drawings were rendered in a digital format using a Wacom tablet and the Adobe Illustrator program (Coleman 2003). LM photographs were taken with a digital camera Sony Cyber-shot DSC-WX1. For SEM micrographs the specimen was dehydrated through a graded series of ethanol ending in 100%, critical point dried, gold-palladium sputter coated, and examined under a Philips XL30 TMP microscope.

The holotype, paratypes and additional material of *Xiphoarcturus kussakini* **sp.n.** and *X. carinatus* **sp.n.** were deposited in the Invertebrate collection of the Museo Argentino de Ciencias Naturales "Bernardino Rivadavia" (MACN).

2.2.2. Cladistic analysis

To examine the phylogenetic placement of *Xiphoarcturus* **gen.n.** and to test the relationships with other eight genera, a preliminary cladistic analysis was conducted. The taxa used for this analysis were chosen based in the morphological similarities to *Xiphoarcturus* **gen.n.** The genera *Acantharcturus*, *Cylindrarcturus* and one species of *Mixarcturus* share with the new genus the pleotelson projected in an apex. The genera *Fissarcturus* and *Chaetarcturus* are spinose, whereas the monotypic genera *Furcarcturus*, *Glaberarcturus* and *Globarcturus* are defined by a specific combination of characters that are also present in the previous mentioned taxa. Because Chaetiliidae displays several plesiomorphic characters (Poore 2001), a species of this family was chosen as outgroup.

Forty morphological characters (33 binary and 7 multistate) were coded based on the original and supplementary descriptions of 21 species (see Table 1; Monod 1925, 1926; Nordenstam 1933; Kussakin 1967; Schultz 1981; Pires & Sumida 1997; Brandt 1990, 2002, 2007; Wägele 1991; Kussakin & Vasina 1995, 1997, 1998; Baltzer et al. 2000; Poore 2003; Poore et al. 2009).

The morphological data set was assembled using Mesquite v.3.4 (Maddison & Maddison 2018). The analysis was performed in TNT v.1.5 (Goloboff & Catalano 2016). All characters were treated as unordered and unweighted. An exact solution algorithm (*implicit enumeration*) was implemented to find the most parsimonious trees. As support measures we used Bremer support (Bremer 1994; TNT commands: *hold 20000*; *sub n*; *ienum*; *bsupport*; where '*n*' is the number of extra steps allowed) and Jackknifing frequencies expressed as GC frequency differences, with 1000 replicates of implicit enumeration, with p = 36 (Goloboff et al. 2003).

2.2.3. Characters used in the description and the cladistic analysis

Terminology. The terms used for body parts and setae follow those employed by Kussakin (1967), Brandt (1990), Poore (2001) and Garm (2004). *Xiphoarcturus carinatus* **sp.n.** shows a novel type of seta, herein named *setulate conate seta* (Fig. 13B).

Ornamentation. The terminology for the spines of the head, pereonites, pleonites and pleotelson refers to their relative position with the specimen in dorsal view (Fig. 1). – Head: the *supraocular spines* are one or two pairs of spines placed above and between the eyes; the *posterior supraocular spines* are one or two pairs of spines posterior to the supraocular spines. – Pereonites, pleonites and pleotelson: the *middorsal spine* is a single spine placed on the middorsal line (present in *Acantharcturus acutipleon* and *Mixarcturus acanthurus*); the *submedial spines* are one or more pairs of spines immediately laterad from the middorsal spine or line; the *sublateral spines* are one or more pairs of spines immediately laterad from the submedial spines; the *lateral* (= *supracoxal*) *spines* are one or more pairs of spines on the lateral margins; and the *caudolateral spines* are a pair of spines placed near the pleotelson tip. For the pereonites, intraspecific variation in the spine morphology or spine pattern has been reported by Nordenstam (1933), Kussakin (1967) and Brandt (2007). Hence, in the current cladistic analysis only the spines present on the head and pleotelson were considered.

Measurements. Body lengths were measured in dorsal view, from the frontal margin of the head to the tip of

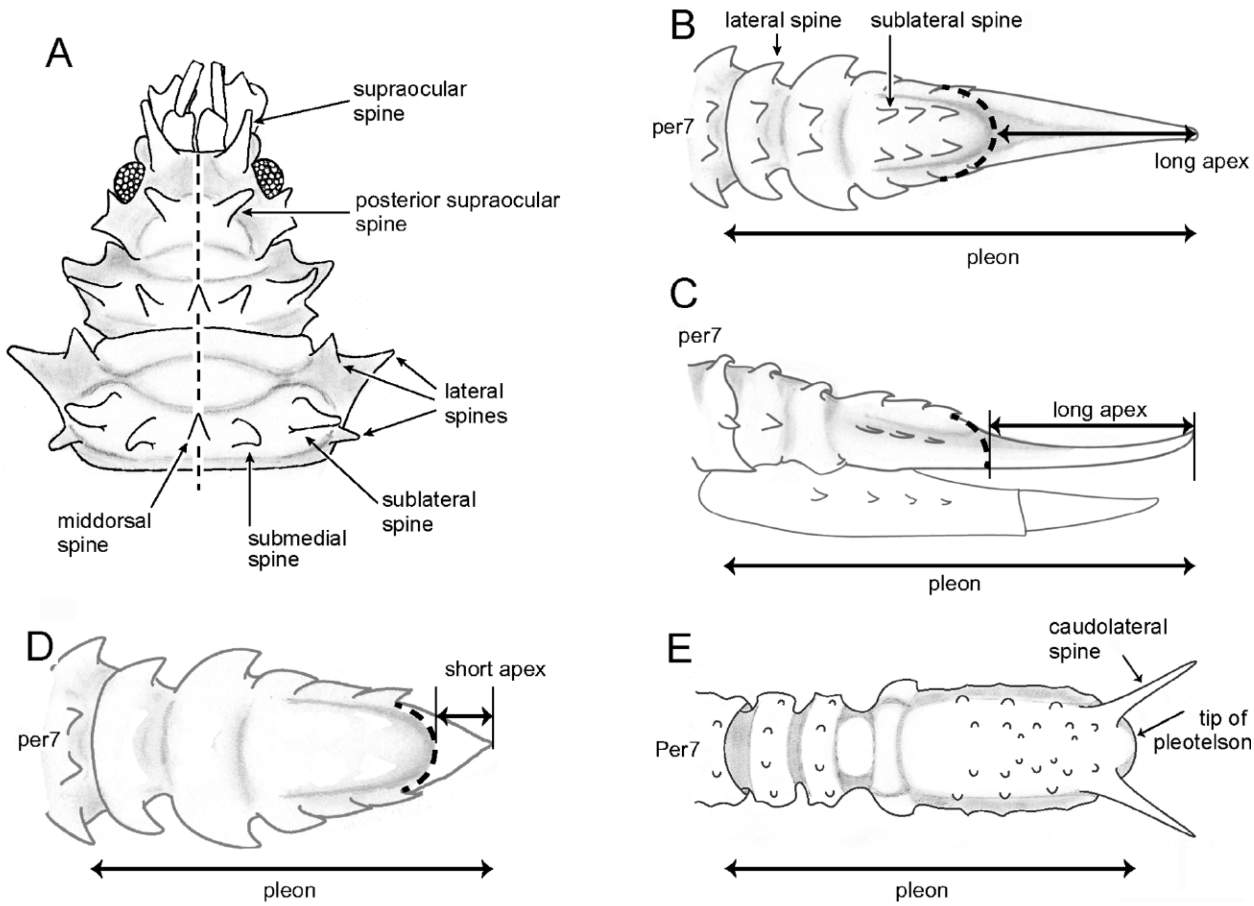

Fig. 1. Antarcturidae: schematic representations illustrating measurements and terminology. **A**: Head and first two pereonites in dorsal view. **B**,**C**: Pleotelson projecting into a long apex, in dorsal (B) and lateral (C) views. **D**: Pleotelson projecting into a short apex, in dorsal view. **E**: Pleotelson with rounded tip and two caudolateral spines, in dorsal view. — ***Abbreviation***: per – pereonite.

the pleotelson. Pleon length was measured from the posterior margin of pereonite 7 to the tip of the pleotelson (Fig. 1B–E). The distal projection of the posterior margin of pleotelson is defined as the *apex*. The length of the apex was estimated by tracing an imaginary curved line joining both distolateral margins of the pleotelson (Fig. 1B-D). The apex is long when apex length is > 25% of pleon length (Fig. 1B,C); it is short when apex length is ≤ 25% of pleon length (Fig. 1D). Appendages were measured after Hessler (1970).

Mouthparts. According to Poore (2012) these appendages proved to have no specific and generic value within the family Antarcturidae. Thus, the mouthparts were omitted in the current cladistic analysis.

3. Results

3.1. List of characters

The morphological characters used in the analysis are discussed below. The starting point for the character matrix was Poore (2001), but it was adapted to the family Antarcturidae.

1 Dorsal sculpture of body: **(0)** smooth; **(1)** with spines; **(2)** with carinae; **(3)** granulate.

2 Head and pereonite 1: **(0)** free; **(1)** fused. — Head and pereonite 1 are free when a complete transverse suture is distinctly in dorsal view. Contrary, head and pereonite 1 are fused when the articulation is demarcated by a transverse groove (without suture).

3 Head, supraocular spines: **(0)** absent; **(1)** present.

4 Head, length of supraocular spines: **(0)** not surpassing the frontal margin of head; **(1)** surpassing the frontal margin of head, but not extending beyond the peduncular article 2 of antenna; **(2)** surpassing the distal margin of the peduncular article 2 of antenna. — Character not applicable to taxa showing state (0) in character 3.

5 Head, posterior supraocular spines: **(0)** absent; **(1)** present.

6 Head, total number of posterior supraocular spines: **(0)** 2; **(1)** 4. — Character not applicable to taxa showing state (0) in character 5.

7 Compound eyes: **(0)** > 10 ommatidia (well developed); **(1)** 1–10 ommatidia (poorly developed); **(2)** no ommatidia (absent).

8 Male, pereonite 4 length / pereonite 3 length ratio: **(0)** ≤ 1.5; **(1)** > 1.5. — In females the pereonites 3 and 4 are subequal in length.

Table 1. Data matrix for the species of Antarcturidae (ingroup) and Chaetiliidae (only *Macrochiridothea estuariae*; outgroup) included in the phylogenetic analysis. — ***Symbols***: * type species; ? missing data; – character not applicable to a taxon; several states occurring (polymorphism): **X** = [3,4], **Y** = [0,1].

Characters	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	4
Taxon	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**0**
Macrochiridothea estuariae	0	0	0	–	0	–	1	0	1	1	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	–	?	0	–	–	1
*Acantharcturus acutipleon**	1	1	1	2	1	1	0	0	1	0	0	1	1	0	2	0	1	1	1	0	2	1	1	1	1	0	0	1	0	1	?	?	1	0	0	0	1	1	1	1
Acantharcturus longipleon	1	1	1	0	1	0	0	0	0	0	0	0	1	0	2	0	0	1	1	0	?	?	?	1	?	0	0	0	0	0	0	1	0	0	?	0	1	1	0	1
Acantharcturus brevipleon	1	1	1	1	1	0	0	?	1	1	0	1	1	0	1	1	1	1	1	0	4	0	0	1	0	0	0	0	0	0	0	1	0	0	?	?	?	?	?	?
*Xiphoarcturus kussakini** sp.n.	1	1	1	1	1	0	0	0	1	0	0	1	1	0	2	0	0	1	1	0	4	1	1	1	0	0	0	0	0	1	0	1	1	1	1	0	1	1	0	1
Xiphoarcturus carinatus sp.n.	2	1	1	1	1	0	0	?	1	0	0	0	0	0	2	0	0	2	1	0	4	1	1	0	0	0	0	0	0	1	0	1	0	1	1	?	?	?	?	?
*Cylindrarcturus elongatus**	0	1	0	–	0	–	0	?	0	0	0	0	0	0	2	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	1	0	0	0	?	?	?	?	?
Cylindrarcturus leucophthalmus	0	1	0	–	0	–	1	1	1	1	0	0	0	0	2	0	0	1	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Cylindrarcturus longitelson	0	1	0	–	0	–	0	1	0	0	0	0	0	0	2	0	0	1	0	0	2	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0	1	1
*Globarcturus angelikae**	0	1	0	–	0	–	2	?	1	0	0	0	0	0	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	–	0	1	0	0	1
Mixarcturus acanthurus	1	0	1	1	1	0	0	0	1	0	0	0	1	0	2	1	0	1	1	1	4	1	1	1	0	0	1	1	1	1	1	?	1	0	0	1	1	1	0	1
*Mixarcturus abnormis**	1	1	1	0	1	0	0	?	1	0	0	0	1	0	0	0	0	1	1	1	4	1	1	1	0	0	1	1	1	1	1	0	1	0	0	?	?	?	?	?
Mixarcturus digitatus	1	1	1	1	1	0	0	0	1	0	0	1	1	0	1	0	0	1	1	1	3	1	1	1	0	0	1	1	1	1	0	1	1	0	?	1	1	1	0	1
*Chaetarcturus longispinosus**	1	1	1	2	1	1	0	?	0	0	0	1	1	1	0	0	1	1	1	0	0	1	1	1	1	0	1	1	0	1	0	0	1	0	–	0	1	1	0	1
Chaetarcturus aculeatus	1	1	1	2	0	–	0	0	0	0	0	1	1	1	0	1	1	1	1	0	0	1	1	1	1	0	1	1	0	1	0	0	1	0	–	0	1	1	0	1
Chaetarcturus tenuispinatus	1	1	1	2	0	–	0	?	0	0	0	1	0	1	0	0	0	1	1	0	?	1	1	1	1	0	1	1	0	1	0	0	1	0	–	0	1	1	0	1
*Furcarcturus polarsterni**	3	1	0	–	0	–	0	0	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	–	1	1	0	0	1
*Glaberarcturus stellae**	0	1	1	1	0	–	2	?	1	0	0	0	0	1	0	0	0	1	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	–	?	?	?	?	?
*Fissarcturus emarginatus**	1	1	1	1	1	1	0	0	0	0	0	1	1	1	0	0	1	2	1	0	3	?	1	1	0	2	0	0	0	1	0	0	0	0	–	1	1	0	0	1
Fissarcturus bathyweddellensis	1	1	1	2	1	1	0	0	0	0	0	1	1	1	0	0	0	2	1	0	1	1	1	1	1	2	0	0	1	1	0	0	X	0	–	1	1	0	0	1
Fissarcturus rugosus	1	1	1	0	1	0	0	0	0	0	0	1	1	1	0	0	0	2	1	0	Y	1	1	1	1	2	0	?	?	?	?	0	0	0	–	1	1	0	0	1

9 Pleonite 1 demarcated by transverse suture: **(0)** absent; **(1)** present. — State (0) is also applicable when pleonite 1 is demarcated by a transverse groove; state (1) is applicable when a complete transverse suture is clearly visible.

10 Pleonite 2 demarcated by transverse suture: **(0)** absent; **(1)** present. — Same criteria as for preceding character.

11 Pleonite 3 demarcated by transverse suture: **(0)** absent; **(1)** present. — Same criteria as for preceding character.

12 Pleotelson, dorsal spines: **(0)** absent; **(1)** present.

13 Pleotelson, lateral spines: **(0)** absent; **(1)** present.

14 Pleotelson, caudolateral spines: **(0)** absent; **(1)** present.

15 Pleotelson, distal margin: **(0)** not projected; **(1)** projected into a long apex (its length > 25% of pleon length); **(2)** projected into a short apex (its length ≤ 25% of pleon length) (Fig. 1B–D).

16 Pleotelson, distal tip: **(0)** simple; **(1)** bifurcate. — State (1) is only present in *Mixarcturus acanthurus* (Monod 1926: fig. 26).

17 Antennula, spines on peduncle article 1: **(0)** absent; **(1)** present. — State (1) is applicable to any spine placed on peduncle article 1.

18 Antennula, peduncle article 2 length / peduncle article 3 length ratio: **(0)** < 1; **(1)** 1–2; **(2)** > 2.

19 Antenna, spines on peduncle articles 2 and 3: **(0)** absent; **(1)** present. — State (1) is applicable to one or more spines placed on one or both articles.

20 Antenna, distal spines on peduncle article 2: **(0)** absent; **(1)** present. — State (1) is applicable when distal spines (1 dorsal, 1 ventral) are both present (these spines are visible in lateral view); this state is present only in the genus *Mixarcturus* (Monod 1926: fig. 28; Kussakin 1967: fig. 31; Poore 2003: fig. 14).

21 Antenna, number of flagellar articles: **(0)** ≥ 7; **(1)** 6; **(2)** 5; **(3)** 4; **(4)** 3. — The distal minute article, usually named "claw-like structure" (see Brandt 1990), is considered as an article in the current analysis (i.e., *Xiphoarcturus kussakini* **sp.n.** has 3 flagellar articles).

22 Pereopod II, basis spines: **(0)** absent; **(1)** present. — State (1) is applicable to one or more spines placed along the article.

23 Pereopod II, ischium spines: **(0)** absent; **(1)** present. — Same criteria as for preceding character.

24 Pereopod II, merus spines: **(0)** absent; **(1)** present. — Same criteria as for preceding character.

25 Pereopod II, carpus spines: **(0)** absent; **(1)** present. — Same criteria as for preceding character.

26 Pereopod II, dorsal claw length / dactylus length ratio: **(0)** < 0.5; **(1)** 0.5–1; **(2)** > 1.

27 Pereopods II–IV, dactylus long filter setae: **(0)** absent; **(1)** present.

28 Pereopod VII, basis spines: **(0)** absent; **(1)** present. — State (1) is applicable to one or more spines placed along the article.

29 Pereopod VII, ischium spines: **(0)** absent; **(1)** present. — Same criteria as for preceding character.

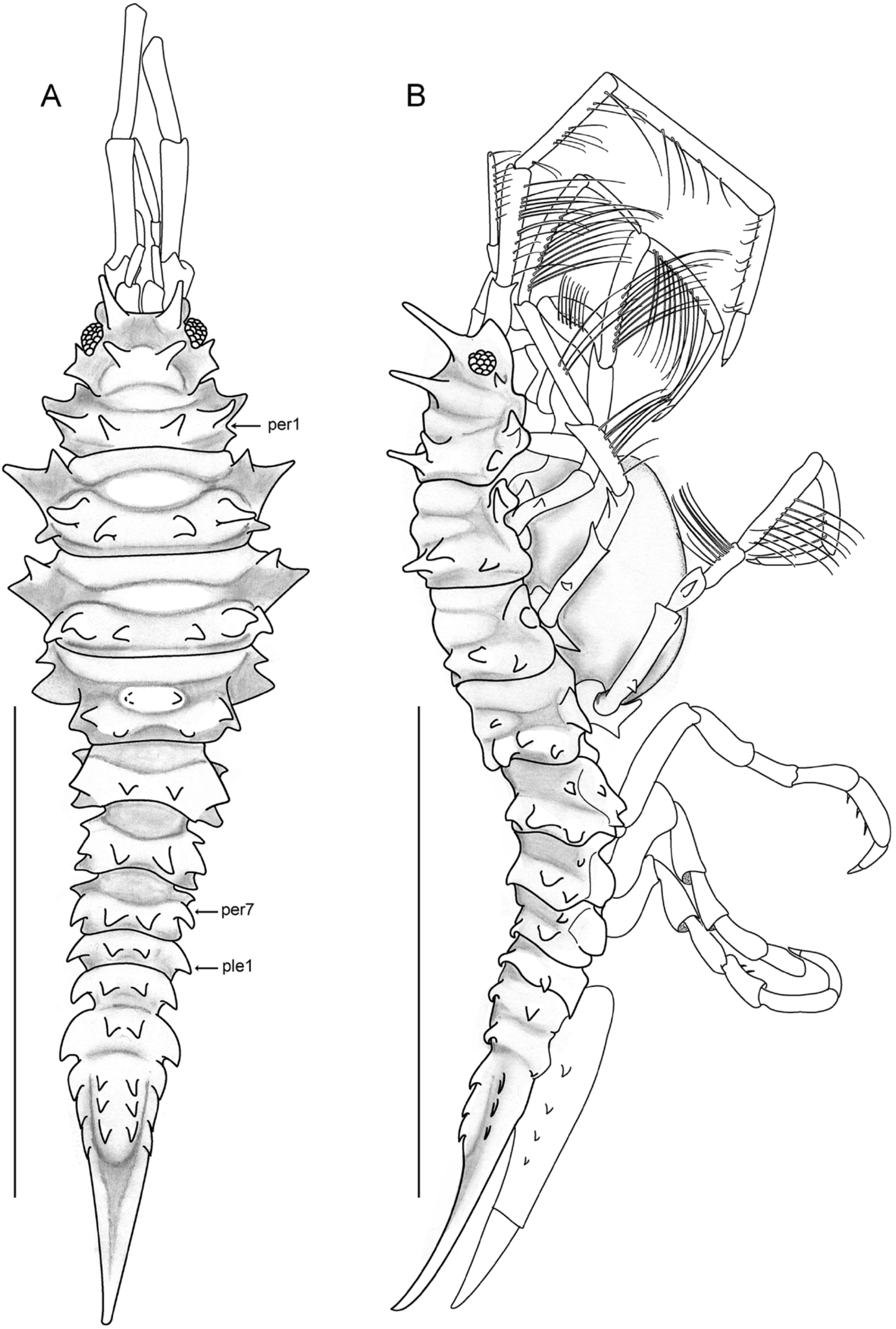

Fig. 2. *Xiphoarcturus kussakini* sp.n. holotype female (MACN-In 42215). Habitus in dorsal (**A**) and lateral (**B**) views. — ***Abbreviations***: per – pereonite, ple – pleonite. — ***Scale bars***: 5 mm.

30 Pereopod VII, merus spines: **(0)** absent; **(1)** present. — Same criteria as for preceding character.
31 Pereopod VII, carpus spines: **(0)** absent; **(1)** present. — Same criteria as for preceding character.
32 Uropod: **(0)** biramous; **(1)** uniramous. — According to Poore (2001: 213) the ramus absent in state (1) is the exopod.
33 Uropodal external surface, spines: **(0)** absent; **(1)** present.
34 Uropodal endopod length / protopod length ratio: **(0)** < 0.5 (= short endopod); **(1)** ≥ 0.5 (= long endopod). — State (1) only present in *Xiphoarcturus* **gen.n.** (Figs. 2, 8, 9).
35 Uropodal endopod reaching the tip of the projected apex of pleotelson: **(0)** absent; **(1)** present. — Character not applicable to taxa showing state (0) in character 15.
36 Male pleopod I, endopod length: **(0)** subequal to exopod; **(1)** shorter than exopod.
37 Male pleopod I exopod, ridge on posterior surface: **(0)** absent; **(1)** present.
38 Male pleopod I exopod, extension of ridge on posterior surface: **(0)** ending on lateral margin; **(1)** ending on distolateral margin. — Character not applicable to taxa showing state (0) in character 37.
39 Male pleopod I exopod, degree of projection of ridge on posterior surface: **(0)** not projected or ending in a small lobe; **(1)** distinctly projected. — Character not applicable to taxa showing state (0) in character 37. State (1) is only present in *Acantharcturus acutipleon* (Schultz 1981: fig. 5F).
40 Male pleopod II, appendix masculina: **(0)** not surpassing endopod; **(1)** surpassing endopod.

3.2. Taxonomy

Family Antarcturidae Poore, 2001

3.2.1. *Xiphoarcturus* gen.n.

Type species. *Xiphoarcturus kussakini* sp.n.

Species included. *X. kussakini* sp.n. and *X. carinatus* sp.n.

Diagnosis. Body slender, geniculate. Head with 1 pair of supraocular spines and 1 pair of posterior supraocular spines. Head and pereonite 1 fused. Pereonites 1–4 with dorsal and lateral spines, or with dorsal ridges close to posterior margin. All pleonites and pleotelson fused; pleonite 1 demarcated by a transverse suture, pleonites 2 and 3 by transverse grooves. Pleotelson acuminate, projecting into a long pointed apex posteriorly (apex length > 25% of pleon length). Antenna shorter than body, 3 flagellar articles, distal one minute, claw-like. Dactylus of pereopods II–IV with 1 or 2 short claws, and without filter setae. Endopod of uropod elongated, reaching the tip of the long pointed pleotelson apex.

Remarks. The most remarkable feature of *Xiphoarcturus* gen.n. is the long endopod of the uropod, which extends all along the pleotelson apex. *Acantharcturus* and *Cylindrarcturus* are the only two other genera of the family with a pleotelson projected into a long apex. *Mixarcturus acanthurus* also shares this character. *Xiphoarcturus* gen.n. closely resembles *Acantharcturus* by the body ornamentation; in contrast, *Cylindrarcturus* has a smooth body. Finally, *Mixarcturus acanthurus* has filter setae on the dactylus of pereopods II–IV, these setae are absent in *Xiphoarcturus* gen.n.

Etymology. The generic epithet is from the Greek *xiphos* (sword) referring to the long projected pleotelson and the elongate endopod of the uropod, combined with the genus stem *Arcturus*. Gender: masculine.

3.2.2. *Xiphoarcturus kussakini* sp.n.

Figs. 2–8, 13A

Material examined. ***Type material***: Holotype brooding ♀ (10.3 mm) | "Talud Continental III", Sta. 59 (37°47′42″S 54°05′15″W), RV *Puerto Deseado*, 1398 m, bottom otter trawl, 10.ix.2013, coll. I. Chiesa (MACN-In 42215). Paratypes: 2 ♀ (10.2–10.6 mm), 1 ♂ (10.3 mm). Same data as holotype (MACN-In 42216). — ***Additional material***: 2 juveniles (5.8–8.5 mm), "Talud Continental I", Sta. 12 (37°57′55″S 54°31′56″W), RV *Puerto Deseado*, 1144 m, epibenthic sledge, 10.viii.2012, coll. I. Chiesa (MACN-In 42217). 1 ♀ (11.0 mm), "Talud Continental II", Sta. 36 (37°57′31″S 54°24′00″W), RV *Puerto Deseado*, 1289 m, bottom otter trawl, 25.v.2013, coll. I. Chiesa (MACN-In 42218).

Diagnosis. Head spines slender, much longer than eye diameter. Pereonites 1–3 with 1 pair of submedial, 1 pair of sublateral and 3 pairs of lateral spines, pereonite 4 as previous ones but with 2 pairs of submedial spines, pereonites 5–7 with 1 pair of submedial, 1 pair of sublateral and 1–2 pairs of lateral spines. Male pereon as female except for: pereonites 2 and 3 with 2 pairs of submedial spines. Pleonites 1–3, with 1 pair of submedial and 1 pair of lateral spines. Pleotelson projecting into a long pointed apex posteriorly (apex length 0.65 × pleon length), with 3 pairs of submedial and 3 pairs of lateral spines. External surface of uropod with a row of 4 spines decreasing in size posteriorly.

Description female (habitus based on holotype MACN-In 42215, appendages based on paratype MACN-In 42216-a). ***Body*** (Figs. 2, 8) cylindrical, elongate, widest at pereonite 3. Head with 2 supraocular spines and 2 posterior supraocular spines, all four longer than eyes diameter, lateral margins with 2 short spines; eyes well developed. Pereonites 1–3 with 2 submedial, 2 sublateral and 6 lateral spines; pereonite 4 with 2 additional submedial spines. Pereonites 5–6 with 2 submedial, 2 sublateral and 4 lateral spines; pereonite 7 with 2 submedial, 2 sublateral and 2 lateral spines. Pleonite 1 recognizable by transverse suture, pleonites 2 and 3 by transverse grooves; pleonites 1–3 with 2 submedial and 2 lateral spines. Pleotelson projecting into a long pointed apex posteriorly (apex length 0.65 × pleon length), with 6 submedial and 6 lateral spines. ***Antennula*** (Fig. 3A) with 3 peduncular and 3 flagellar articles. Peduncle article 1 widest, with 1 feather-like seta, 4 simple setae and cuticular combs; article 2 longest, with 5 feather-like setae and 5 simple

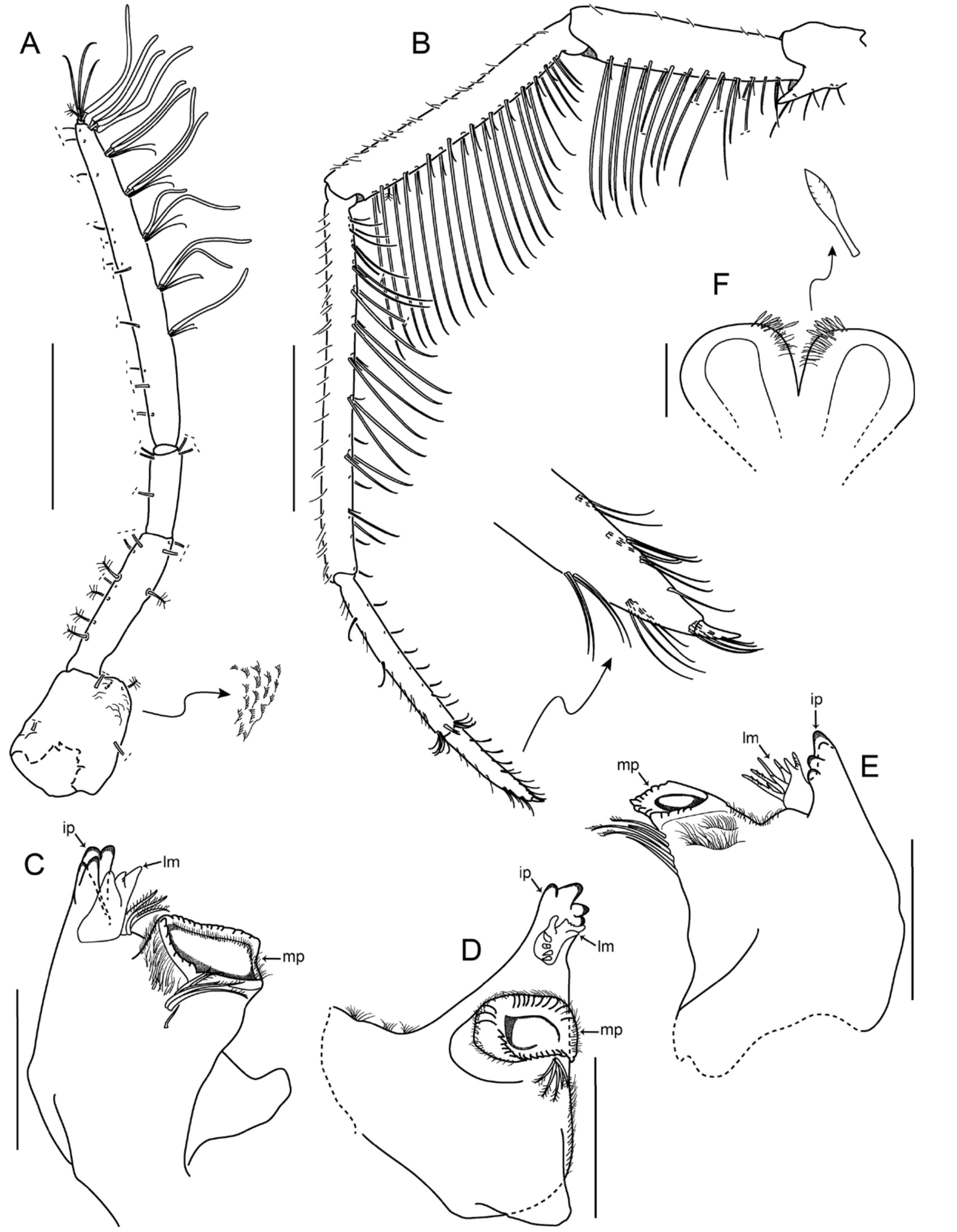

Fig. 3. *Xiphoarcturus kussakini* sp.n. paratype female (MACN-In 42216-a). **A**: Left antennula in lateral view. **B**: Left antenna and detail of second and third flagellar articles in lateral view. **C**: Left mandible in dorsal view. **D**,**E**: Right mandible in frontal and dorsal view, respectively. **F**: Paragnaths in ventral view. — ***Abbreviations***: ip – incisor process, mp – molar process, lm – lacinia mobilis. — ***Scale bars***: A – 0.5 mm; B – 1 mm; C,D,E,F – 0.2 mm.

setae; article 3 length 0.6 × article 2 length, with 5 simple setae. Flagellar article 1 short, ring-like, glabrous; article 2 longest, with 6 groups of 2 aesthetascs and 2 simple setae each (except proximal group with 1 aesthetasc only, and distal group with 3 aesthetascs and no setae), opposed margin with 11 setae; article 3 minute, knob-like, with 1 aesthetasc, 1 feather-like seta and 3 simple setae. ***Antenna*** (Fig. 3B) with 5 peduncular and 3 flagellar arti-

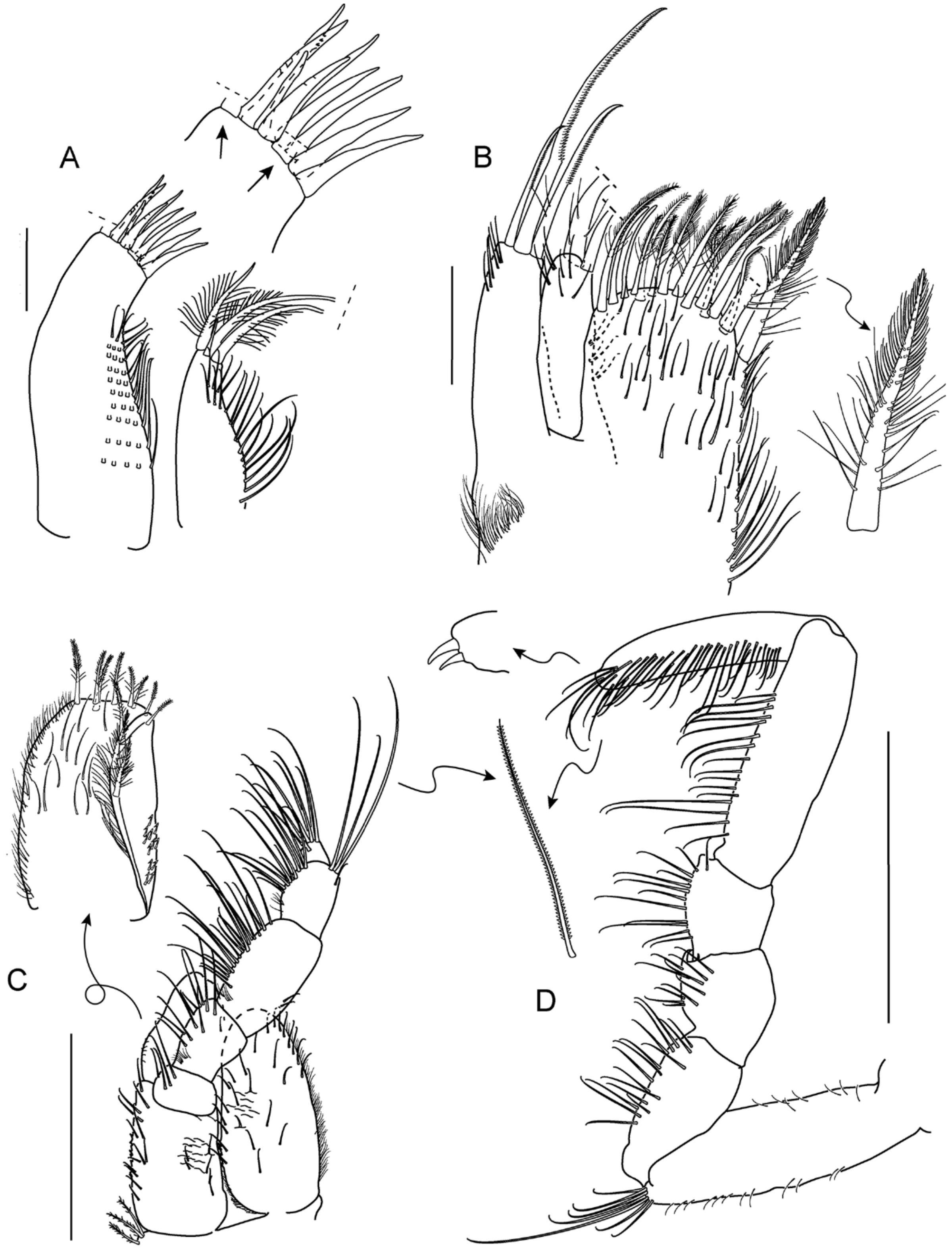

Fig. 4. *Xiphoarcturus kussakini* sp.n. paratype female (MACN-In 42216-a). **A**: Left maxillula with detail of lateral lobe in dorsal view, the arrows indicate the broken setae. **B**: Left maxilla in dorsal view, with detail of setulate seta. **C**: Left maxilliped in ventral view, with detail of endite in dorsal view. **D**: Left pereopod I in lateral view, with details of serrate seta and distal claws. — ***Scale bars***: A,B – 0.1 mm; C – 0.5 mm; D – 1 mm.

cles, distal article minute. Peduncle, article 1 (remains on the specimen, not dissected) with 1 distal spine; article 2 short and broad, with 1 distal spine and 6 simple setae; article 3 length 0.5 × article 5 length; article 4 length 0.8 × article 5 length; article 5 longest; articles 3 – 5 with 2 rows of long simple setae (1 short seta contiguous to each long seta) on ventral margin, and small setae on dorsal margin. Flagellum, article 1 longest, with 1 robust seta near

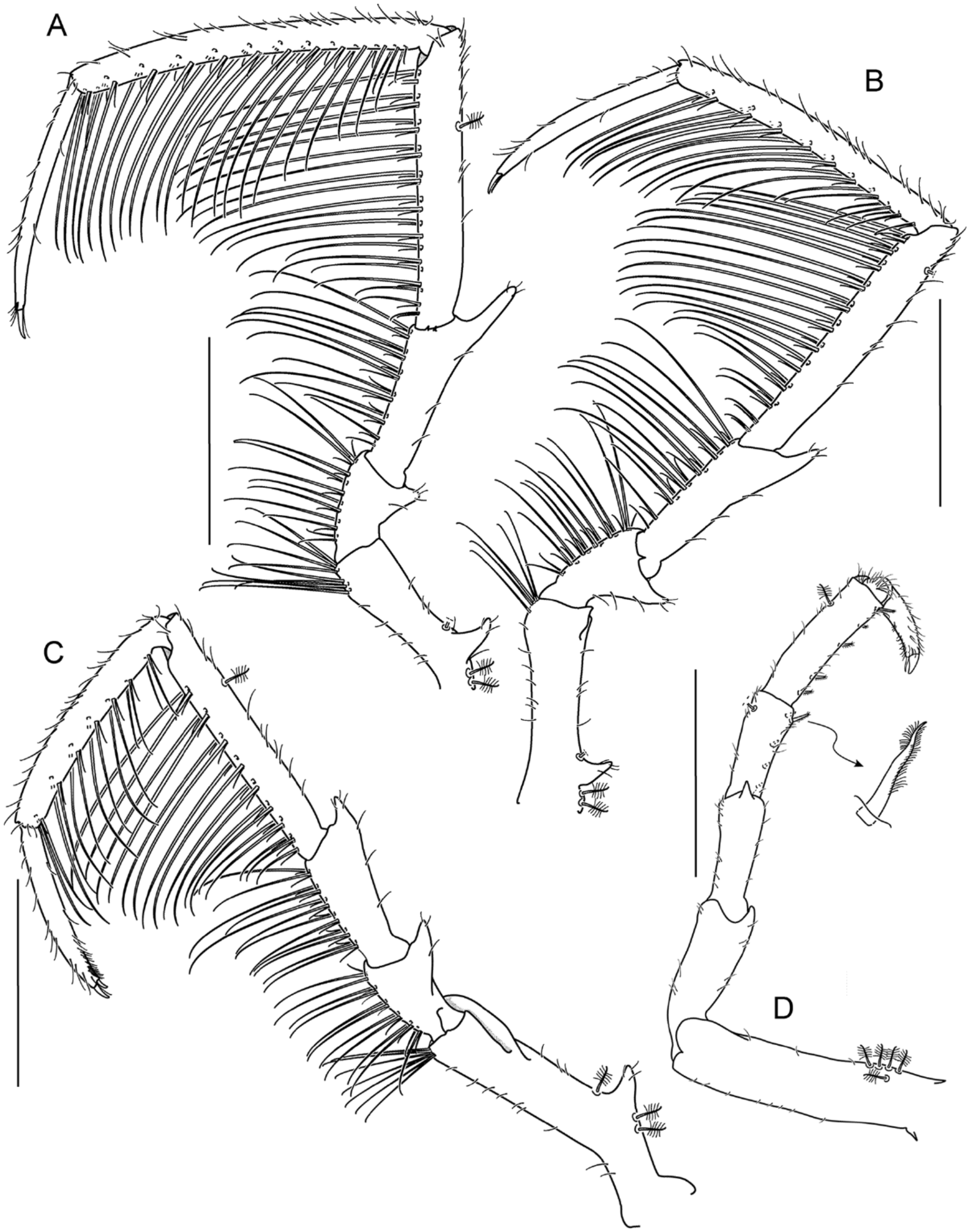

Fig. 5. *Xiphoarcturus kussakini* sp.n. paratype female (MACN-In 42216-a). **A**–**C**: Left pereopods II (A), III (B), and IV (C) in lateral view. **D**: Right pereopod V in latero-dorsal view, with detail of spine-like seta. — ***Scale bars***: 1 mm.

distal margin; article 2 length 0.6 × article 1 length; article 3 minute, claw-like; articles 1 and 2 with small setae on both margins. ***Mandibles*** (Fig. 3C–E) asymmetrical, without palp. Incisor process of both mandibles with 4 strongly sclerotized teeth. Molar process of both mandibles with grinding surface and indented margins, broadest in left mandible, with 5–6 distally setulate setae on lower margin. Left mandible, lacinia mobilis with 3 teeth and 3 setae. Right mandible, lacinia mobilis with 2 serrate teeth and a row of 4 setae. Both mandibles with small thin setae. ***Paragnaths*** (= hypopharynx, Fig. 3F) typical for the family. ***Maxillula*** (Fig. 4A) lateral lobe with 11 curved robust setae (some of them denticulated) distally. Mesial lobe with 3 setulate long setae distally. Inner margin and ventral surface of both lobes with simple setae. ***Maxilla*** (Fig. 4B) outer lobe with 3 serrate setae distally. Mesial lobe with 2 serrate setae (both broken) distally. Inner lobe with 13 setulate setae (one of them broken)

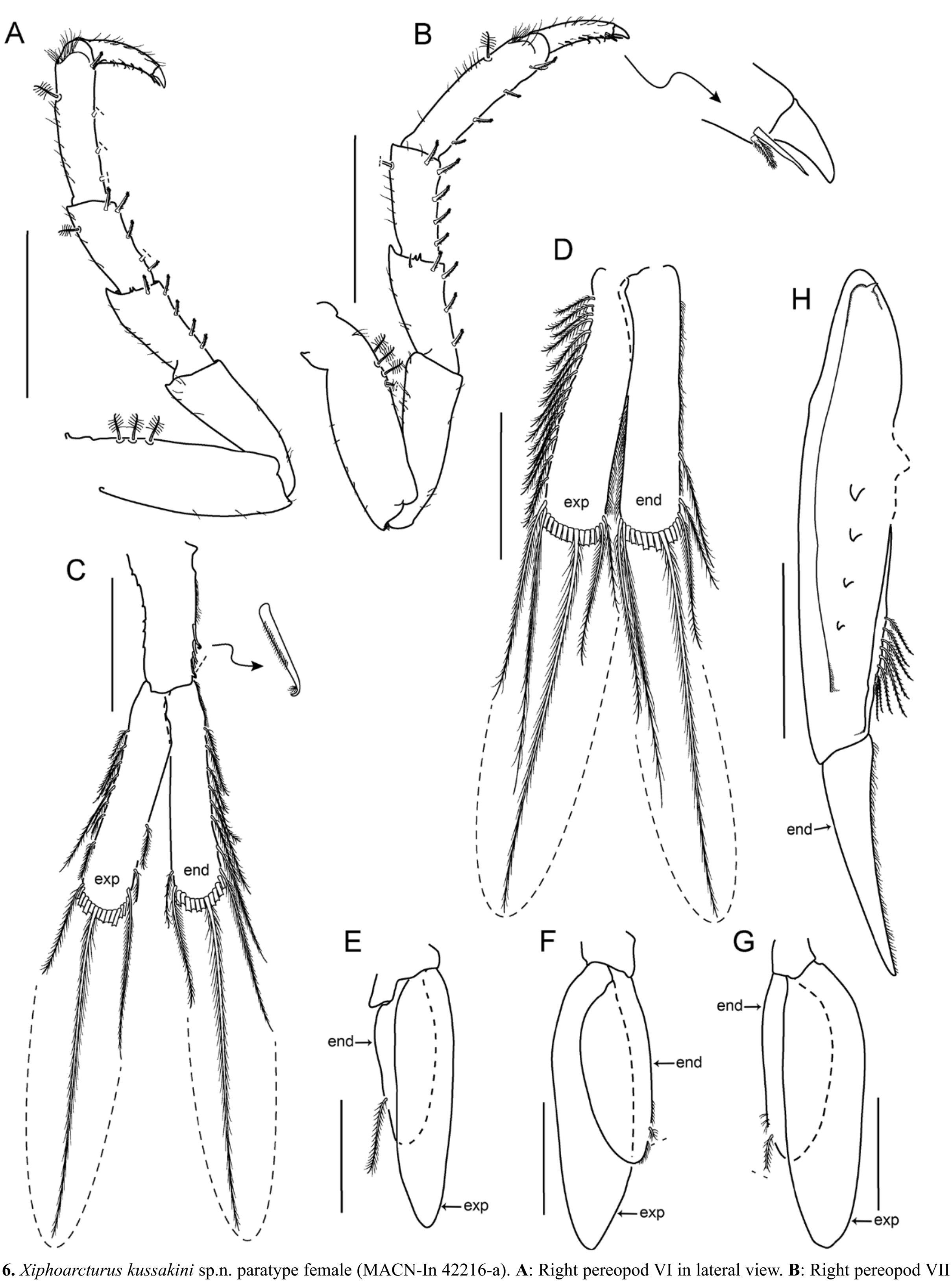

Fig. 6. *Xiphoarcturus kussakini* sp.n. paratype female (MACN-In 42216-a). **A**: Right pereopod VI in lateral view. **B**: Right pereopod VII in lateral view, with detail of distal claws. **C**: Left pleopod I in dorsal view, with detail of coupling seta. **D**: Left pleopod II in dorsal view. **E**: Left pleopod III in dorsal view. **F**: Right pleopod IV in ventral view. **G**: Left pleopod V in dorsal view. **H**: Left uropod in external view. — ***Abbreviations***: end – endopod, exp – exopod. — ***Scale bars***: A,B,H – 1 mm; C,D,E,F,G – 0.5 mm.

and 2 simple setae (with rounded tip) distally. ***Maxilliped*** (Fig. 4C). Endite short and broad, with hook-like setae on inner margin and 11 setulate setae on distal and lateral margins. Palp with 5 articles; article 1 length 0.3 × article 3 length, with 4 simple setae; article 2 length 0.7 × article 3 length, with 12 simple setae; article 3 longest, with 19 setae (some of them serrulate) on inner margin and 2 short simple setae near outer margin; article 4 length

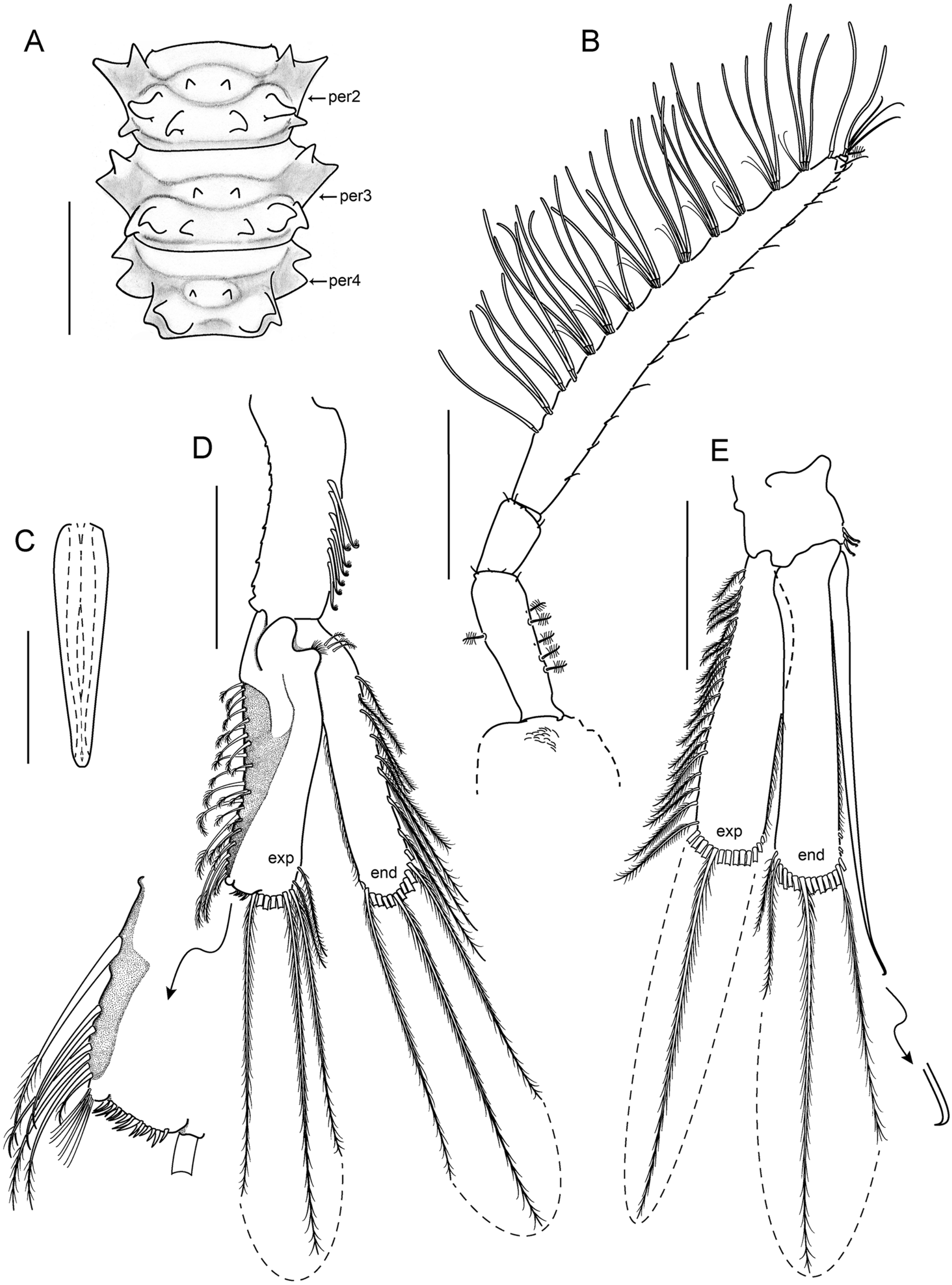

Fig. 7. *Xiphoarcturus kussakini* sp.n. paratype male (MACN-In 42216-b). **A**: Pereonites 2–4 in dorsal view. **B**: Left antennula in lateral view. **C**: Penis in ventral view. **D**: Right pleopod I in ventral view, with detail of disto-lateral margin of exopod. **E**: Right pleopod II, with detail of tip of the appendix masculina. — ***Abbreviations***: per – pereonite, end – endopod, exp – exopod. — ***Scale bars***: A – 1 mm; B,D, E – 0.5 mm; C – 0.1 mm.

0.7 × article 3 length, with 12 setae (some of them serrulate) on inner margin, and 3 long serrulate setae on outer distal angle; article 5 shortest, with 7 setae (some of them serrulate). Epipod long, oval, surpassing distal margin of palp article 2, with simple setae on ventral surface and short setae on outer margin. Basis and epipod, ventral surfaces with small setae and cuticular combs. ***Pereopod I*** (Fig. 4D) shorter and stouter than pereopods II–IV. Basis

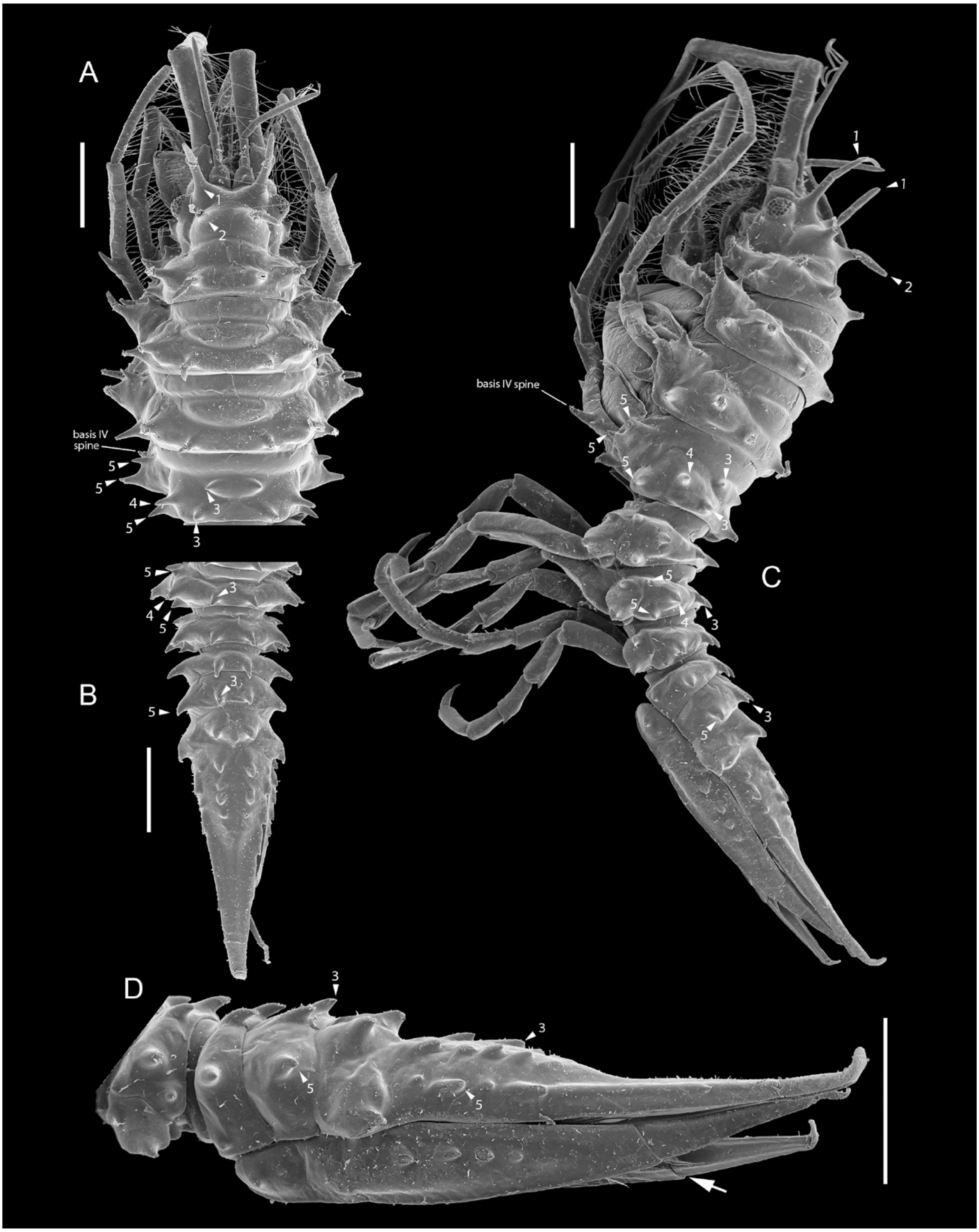

Fig. 8. *Xiphoarcturus kussakini* sp.n. SEM micrographs, paratype female (MACN-In 42216-c). **A**: Head and pereonites 1–4 in dorsal view. **B**: Pereonites 6–7 and pleotelson in dorsal view. **C**: Habitus in lateral view. **D**: Pereonite 7 and pleotelson in lateral view, arrow indicates the endopod. — ***Spine references***: 1 – supraocular spines, 2 – posterior supraocular spines, 3 – submedial spines, 4 – sublateral spines, 5 – lateral spines. — ***Scale bars***: A,B,C,D – 1 mm.

and propodus longest articles; ischium, merus and carpus lengths 0.6, 0.5 and 0.4 × propodus length, respectively; dactylus subequal in length to propodus (excluding claws), with 2 short distal claws. Ventral margin: basis to propodus with simple setae, dactylus with serrulate setae; anterior surface of all articles with serrulate setae (not drawn). ***Pereopods II–IV*** (Fig. 5A–C) similar in shape and chaetotaxy, pereopod II longest. Basis, ischium and

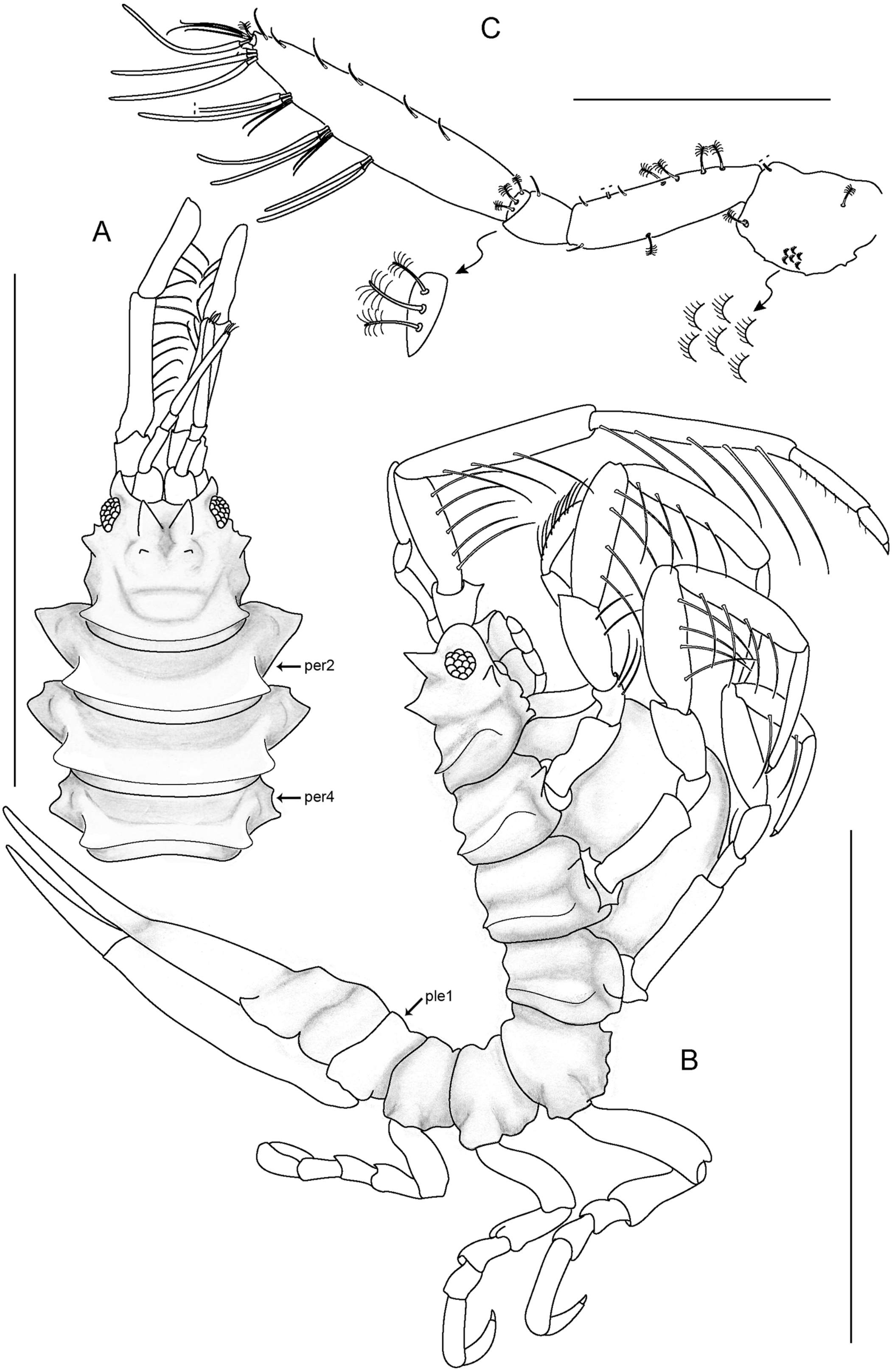

Fig. 9. *Xiphoarcturus carinatus* sp.n. holotype female (MACN-In 42391). **A**: Head and pereonites 1 – 4 in dorsal view. **B**: Habitus in lateral view. Paratype female (MACN-In 42392-a). **C**: Right antennula in lateral view, with detail of cuticular combs and first flagellar article. — ***Abbreviations***: per – pereonite, ple – pleonite. — ***Scale bars***: A,B – 5 mm; C – 0.5 mm.

merus with 1 conspicuous dorsal spine, respectively; distoventral corner of basis and ventral margins of ischium to propodus with filter setae; propodus and dactylus gradually shortened from pereopod II to pereopod IV. Pereopods II and III propodus longest article, dactylus with 1 claw and 1 simple seta distally; pereopod IV basis longest article, dactylus with 2 claws distally. ***Pereopods V–VII*** (Figs. 5D, 6A,B, 13A) similar in shape and chaetotaxy,

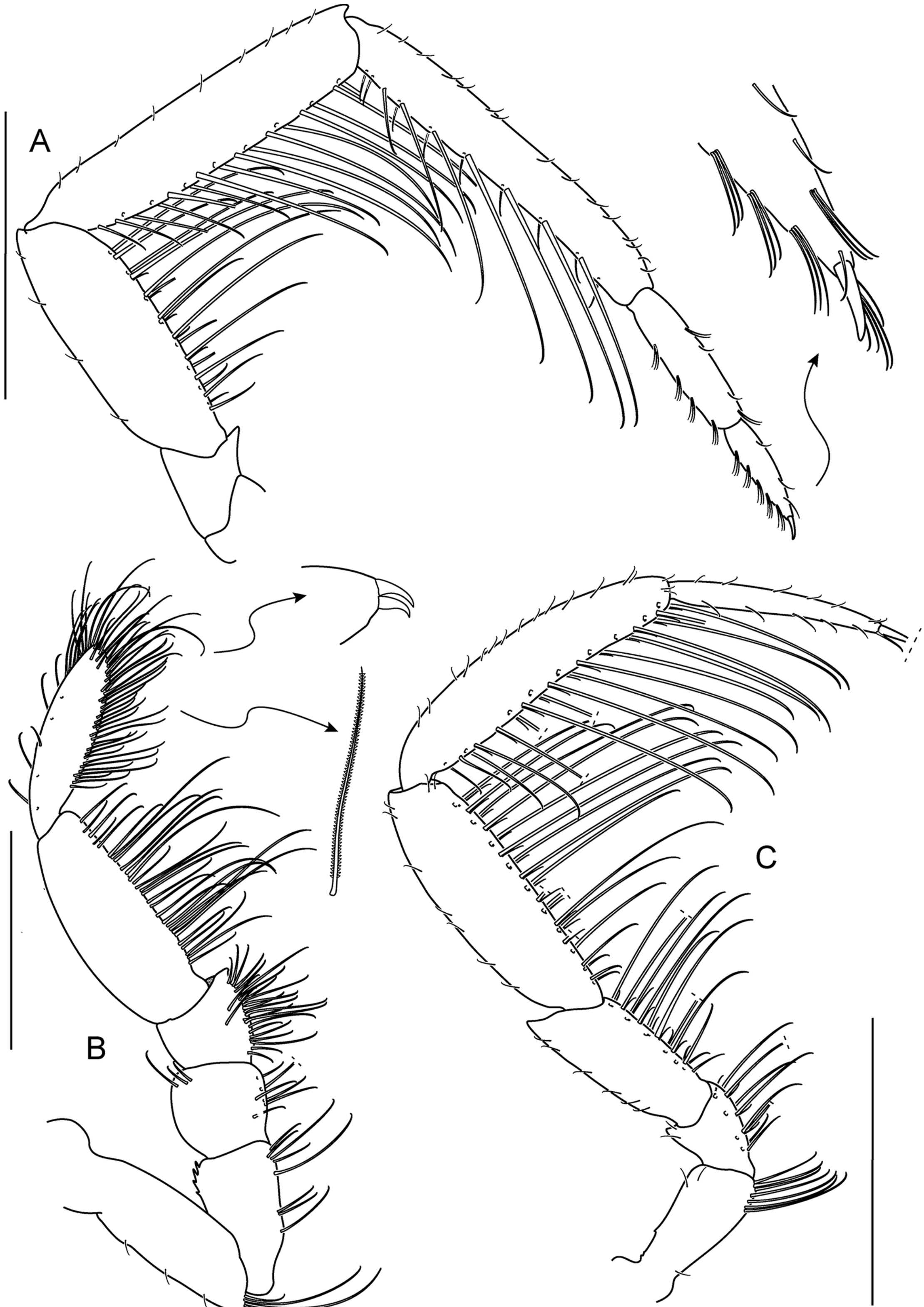

Fig. 10. *Xiphoarcturus carinatus* sp.n. paratype female (MACN-In 42392-a). **A**: Right antenna in lateral view, with detail of second and third flagellar articles. **B**: Right pereopod I in lateral view, with details of serrate seta and distal claws. **C**: Right pereopod II in lateral view. — ***Scale bars***: A,C – 1 mm; B – 0.5 mm.

shorter than pereopods II – IV, pereopod V longest. Basis longest article, with 3 – 5 feather-like setae on dorsal margin; ischium subequal in length to propodus; merus length 0.6 – 0.7 × propodus length, with 1 dorsal spine distally, 2 tiny spines on distal margin (not visible in Fig. 5D), and 4 – 5 spine-like setae on ventral margin (not visible in Fig 5D); carpus subequal in length to merus, with 1 feather-like seta on dorsal margin and 5 spine-like setae on ven-

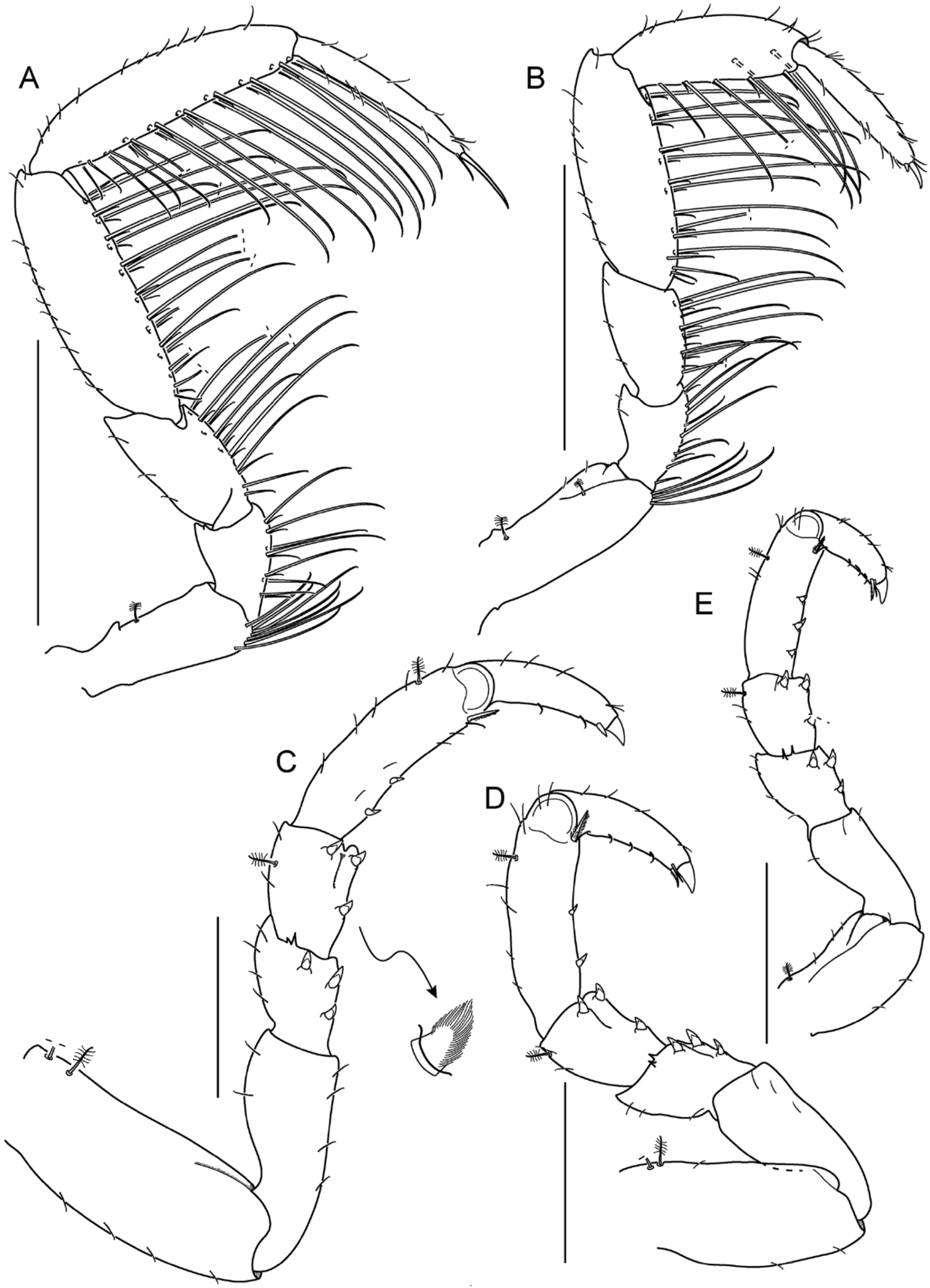

Fig. 11. *Xiphoarcturus carinatus* sp.n. paratype female (MACN-In 42392-a). **A**,**B**: Right pereopods III (A) and IV (B) in lateral view. **C**: Right pereopod V in lateral view, with detail of setulate conate seta. **D**,**E**: Right pereopods VI (D) and VII (E) in lateral view. — ***Scale bars***: A,B – 1 mm; C,D,E – 0.5 mm.

tral margin; propodus with 1 feather-like seta on dorsal margin and 4–5 spine-like setae on ventral margin; dactylus shortest article (excluding claw), with 1 claw and 1 simple seta distally, with simple setae on ventral margin (on pereopods VI and VII with 1 additional spine-like seta distally, see detail). All articles with scattered small setae on dorsal and ventral margins. ***Pleopod I*** (Fig. 6C) protopod longer than those of remaining pleopods, with

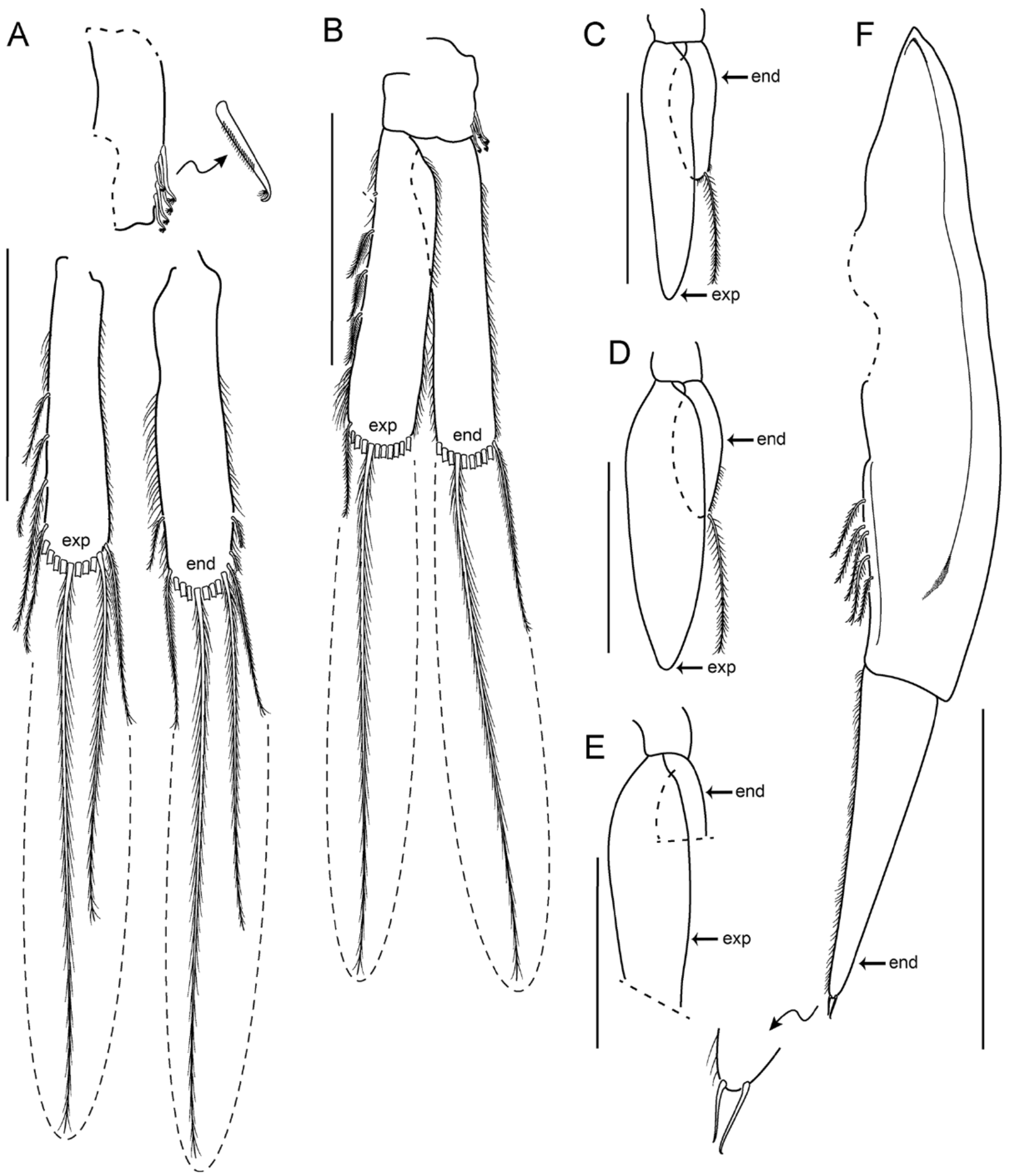

Fig. 12. *Xiphoarcturus carinatus* sp.n. paratype female (MACN-In 42392-a). **A**: Right pleopod I (protopod and rami detached) in dorsal view, with detail of coupling setae. **B–E**: Right pleopods II (B), III (C), IV (D) and V (E) in dorsal view. **F**: Right uropod in external view, with detail of tip of endopod. — ***Abbreviations***: end – endopod, exp – exopod. — ***Scale bars***: A,B,C,D,E – 0.5 mm; F – 1 mm.

5 coupling setae on inner margin and tiny spines along outer margin. Endopod length 0.9 × exopod length, with 7 plumose setae on inner margin and 14 plumose setae distally. Exopod with 2, 8, and 16 plumose setae on inner margin, outer margin, and distally, respectively. Some distal plumose setae longer than branches. ***Pleopod II*** (Fig. 6D) protopod quadrangular (lost in dissection). Endopod subequal in length to exopod, with 2 plumose setae on inner margin and 14 plumose setae distally. Exopod with 15 plumose setae on outer margin and 15 plumose setae distally. Some distal plumose setae longer than branches. ***Pleopods III–V*** (Fig. 6E–G) protopod short, both rami laminar. Endopod length 0.7 × exopod length, rounded distally, with 1 plumose seta on inner margin. Exopod glabrous. ***Uropod*** (Fig. 6H) uniramous. Protopod, external surface with a row of 4 spines decreasing in size posteriorly, inner margin with 8 plumose setae distally, outer margin glabrous. Endopod length 0.5 × protopod length, inner margin with tiny setae.

Description male (based on paratype MACN-In 42216-b). As female except for: ***Body*** (Fig. 7A) pereonites 2 and 3 with 2 additional submedial spines. ***Antennula*** (Fig. 7B) flagellar article 2 with 14 groups of 1–3 aes-

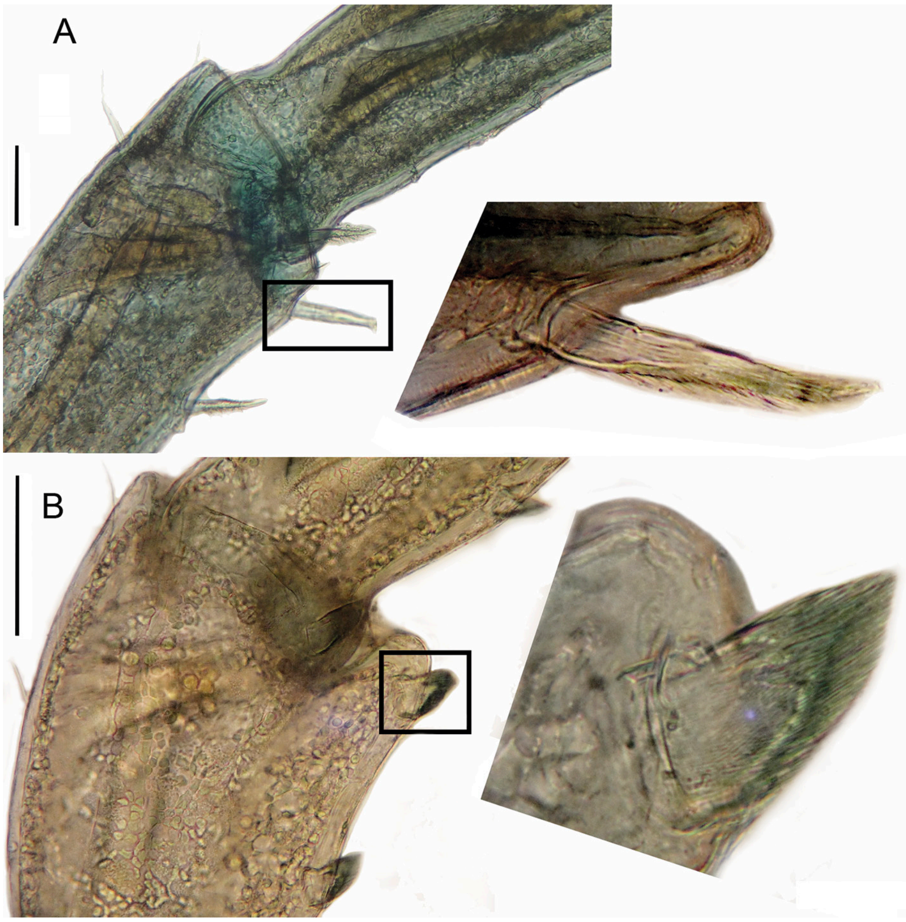

Fig. 13. **A**: *Xiphoarturus kussakini* sp.n. paratype female (MACN-In 42216-a); distal end of carpus of pereopod VI, with detail of a spine-like seta. **B**: *X. carinatus* sp.n. paratype female (MACN-In 42392-a); distal end of carpus of pereopod VI, with detail of a setulate conate seta. — ***Scale bars***: A,B – 0.1 mm.

thetascs and 0–2 simple setae. ***Penis*** (Fig. 7C) fused as elongate penial plate, tapering distally, with simple tip. ***Pleopod I*** (Fig. 7D) protopod longer than that of pleopod II, with 7 coupling setae on inner margin and some tiny spines along outer margin. Endopod subequal in length to exopod, with 3 short plumose setae proximally on posterior surface, 9 plumose setae on inner margin and 13 plumose setae distally. Exopod wider than endopod; inner margin with 2 bulges proximally; outer margin with 26 curved distal-plumose setae; posterior surface with 1 transverse ridge ending in a small setose lobe on outer distal corner (see detail); distal margin with 9 plumose setae and a tight row of small setae. Some distal plumose setae longer than branches. ***Pleopod II*** (Fig. 7E) protopod quadrangular with 3 coupling setae on inner margin. Endopod with 2 plumose setae on inner margin (broken) and 15 plumose setae distally. Appendix masculina length 1.4 × endopod length, tapering distally, with hook-like tip (see detail). Exopod subequal in length to endopod, with 21 plumose setae on outer margin and 13 plumose setae distally.

Remarks. *Xiphoarcturus kussakini* sp.n. is distinguished by the elongate endopod of the uropod, and the arrangement of its body spines.

Etymology. The new species is dedicated to the memory of the late Prof. Dr. Oleg G. Kussakin, for his great contribution to the knowledge of isopods.

Distribution. Only known from the Mar del Plata submarine canyon, off Buenos Aires Province, Argentina, 1144–1398 m depth.

3.2.3. *Xiphoarcturus carinatus* sp.n.

Figs. 9–12, 13B

Material examined. ***Type material***: Holotype brooding ♀ (10.6 mm) | "Talud Continental III", Sta. 39 (37°58′01″S 54°31′43″W), RV *Puerto Deseado*, 1144 m, epibenthic sledge, 25.v.2013, coll. I. Chiesa (MACN-In 42391). Paratypes: 1 ♀ (7.2 mm), 2 juveniles (4.0–4.1 mm). Same data as holotype (MACN-In 42392). — ***Additional material***: 1 ♀ (8.4 mm), 7 juveniles (3.2–5.5 mm), "Talud Continental I", Sta. 12 (37°57′55″S 54°31′56″W), RV *Puerto Deseado*, 1144 m, epibenthic sledge, 10.viii.2012, coll. I. Chiesa (MACN-In 42393).

Diagnosis. Head spines short and broad, about as long as eye diameter. Pereonites 1–4 with 1 transverse ridge close to posterior margin; pereonites 5–7 and pleon dorsally smooth. Pleotelson projecting into a long pointed apex posteriorly (apex length 0.43 × pleon length). Pereopods II–IV, merus to dactylus flattened. External surface of uropod smooth. Male unknown.

Description female (habitus based on holotype MACN-In 42391, appendages based on paratype MACN-In 42392-a). ***Body*** (Fig. 9A,B) cylindrical, elongate, strongly geniculate, widest at pereonite 3. Head, with 2 supraocular spines and 2 posterior supraocular spines, all four as long as eye diameter, lateral margins with 2 short spines;

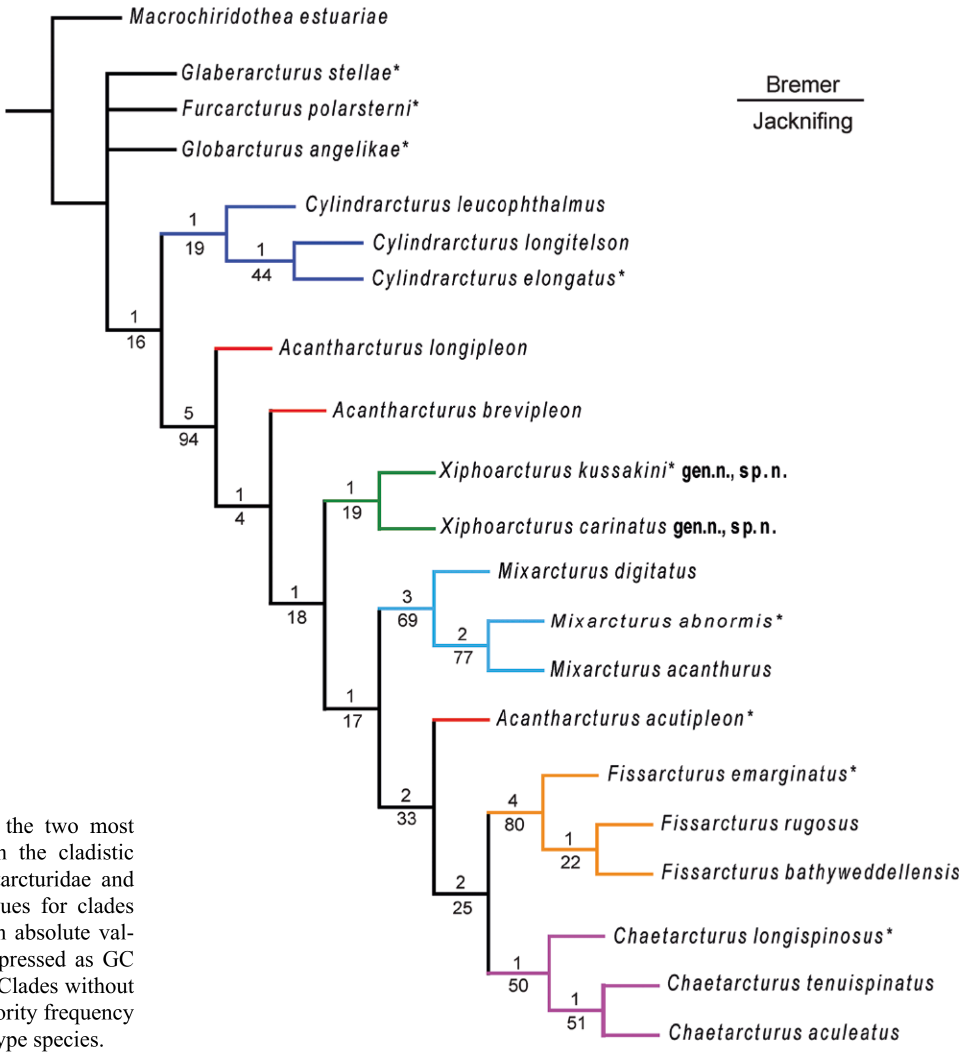

Fig. 14. Strict consensus from the two most parsimonious trees obtained in the cladistic analysis for 20 species of Antarcturidae and 1 outgroup taxon. Support values for clades expressed as Bremer support in absolute values (above), and Jacknifing expressed as GC frequency differences (below). Clades without values do not appear in the majority frequency differences tree. — ***Symbol***: * type species.

eyes well developed. Pereonites 1–4 with 1 transverse ridge close to posterior margin; pereonites 5–7 smooth. Pleonite 1 recognizable by transverse suture, pleonites 2 and 3 by transverse grooves; pleonite 3 with 2 short lateral spines. Pleotelson smooth, projecting into a long pointed apex posteriorly (apex length 0.43 × pleon length). ***Antennula*** (Fig. 9C) with 3 peduncular and 3 flagellar articles. Peduncle article 1 widest, with 2 feather-like setae, 1 simple seta and cuticular combs; article 2 longest, with 5 feather-like setae and 4 simple setae; article 3 length 0.3 × article 2 length, with 1 simple seta. Flagellar article 1 short, ring-like, with 3 feather-like setae; article 2 longest, with 4 groups of 2 aesthetascs (except for distal group with 3 aesthetascs), 2 setae on central groups, opposed margin with 6 setae; article 3 minute, knob-like, with 1 aesthetasc, 1 feather-like seta and 3 simple setae. ***Antenna*** (Fig. 10A) with 5 peduncular and 3 flagellar articles, distal article minute. Peduncle, article 1 glabrous; article 2 short and broad, with 1 distal spine, glabrous; article 3 length 0.6 × article 5 length; article 4 length 0.9 × article 5 length; article 5 longest; articles 3–5 with 2 rows of long simple setae (1 short seta contiguous to each long seta) on ventral margin, and small setae on dorsal margin. Flagellum, article 1 longest; article 2 length 0.7 × article 1 length; article 3 minute, claw-like; articles 1 and 2 with small setae on both margins. ***Mouthparts*** as in *X. kussakini* sp.n. ***Pereopod I*** (Fig. 10B) shorter and stouter than pereopods II–IV. Basis and propodus longest articles; ischium, merus and carpus lengths 0.7, 0.4 and 0.4 × propodus length, respectively; dactylus 0.9 × propodus length (excluding claws), with 2 short distal claws. Ventral margin: basis to propodus with simple setae, dactylus with serrulate setae; anterior surface of all articles with serrulate setae (not drawn). ***Pereopods II–IV*** (Figs. 10C, 11A,B) similar in shape and chaetotaxy, pereopod II longest. Basis without spines, ischium and merus with 1 small dorsal spine distally, merus to dactylus flattened; distoventral corner of basis and ventral margins of ischium to propodus with filter setae; propodus and dactylus gradually shortened from pereopod II to pereopod IV. Pereopods II and III propodus longest article, dactylus with 1 claw and 1 simple seta distally; pereopod IV basis longest article, dactylus with 2 claws distally. ***Pereopods V–VII*** (Figs. 11C–E, 13B) similar in shape and chaetotaxy, shorter than pereopods II–IV, pereopod V longest. Basis longest article, with 1–2 feather-like setae on dorsal margin; ischium length 0.8–0.9 × propodus length; merus length 0.4–0.5 × propodus

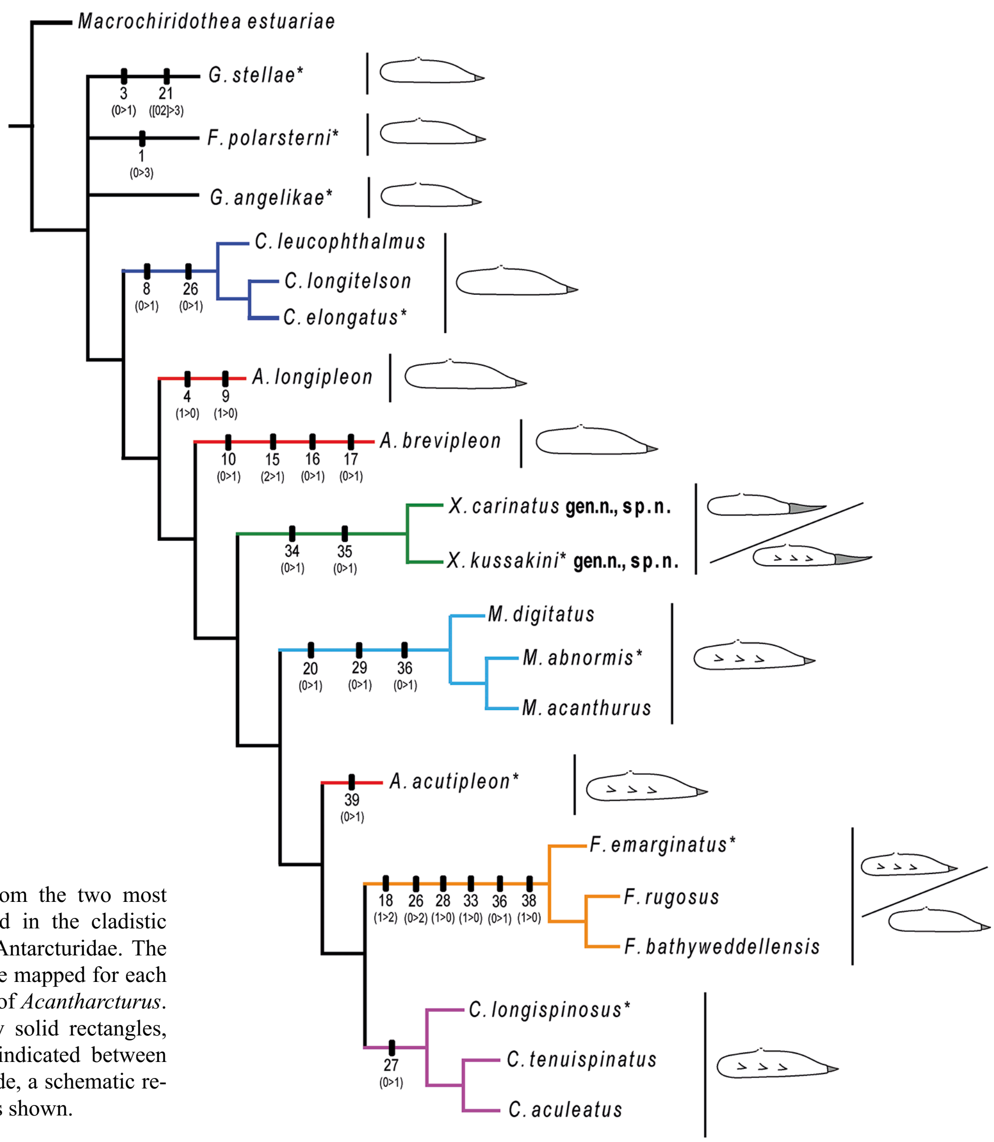

Fig. 15. Strict consensus from the two most parsimonious trees obtained in the cladistic analysis for 20 species of Antarcturidae. The syn- and autapomorphies are mapped for each genus and the three species of *Acantharcturus*. Characters are indicated by solid rectangles, and the state changing is indicated between parentheses. On the right side, a schematic representation of the uropod is shown.

length, with 1 dorsal spine distally, 2 tiny spines on distal margin, and 3 setulate conate setae on ventral margin; carpus subequal in length to merus, with 1 feather-like seta on dorsal margin and 3 setulate conate setae on ventral margin; propodus with 1 feather-like seta on dorsal margin, 2–3 setulate conate setae on ventral margin and 1 spine-like seta distoventrally; dactylus 0.6–0.7 × propodus length (excluding claw), with 1 claw and 1 simple seta distally (on pereopods VI and VII with 1 additional spine-like seta distally). All articles with scattered small setae on dorsal and ventral margins. ***Pleopod I*** (Fig. 12A) protopod longer than those of remaining pleopods, with 5 coupling setae on inner margin, outer margin broken. Endopod length 1.1 × exopod length, with 2, 1, and 10 plumose setae on inner margin, outer margin, and distally, respectively. Exopod with 4 plumose setae on outer margin and 10 plumose setae distally. Some distal plumose setae longer than branches. ***Pleopod II*** (Fig. 12B) protopod quadrangular, with 4 coupling setae. Endopod subequal in length to exopod, with 10 plumose setae distally. Exopod with 4 plumose setae on outer margin and 11 plumose setae distally. Some distal plumose setae longer than branches. ***Pleopods III–V*** (Fig. 12C–E) protopod short, both rami laminar. Pleopods III and IV, endopod length 0.5 × exopod length, rounded distally, with 1 plumose seta on inner margin; exopod glabrous. Pleopod V, rami broken. ***Uropod*** (Fig. 12F) uniramous. Protopod external surface smooth, inner margin with 5 plumose setae distally, outer margin glabrous. Endopod length 0.5 × protopod length, inner margin with tiny setae and 2 simple setae distally.

Remarks. *Xiphoarcturus carinatus* sp.n. can be separated from *X. kussakini* sp.n. mainly by the ornamentation of the body. Other features that distinguished *X. carinatus* sp.n. are the merus to dactylus of pereopods II–IV flattened, and the merus to propodus of pereopods V–VII with setulate conate setae.

Etymology. The specific epithet refers to the dorsal ridge present on first four pereonites.

Distribution. Only known from the Mar del Plata submarine canyon, off Buenos Aires Province, Argentina, 1144 m depth.

3.3. Cladistic analysis

The analysis of the data matrix (Table 1) with TNT resulted in two most parsimonious trees of 97 steps (CI = 0.52, RI = 0.74). The trees obtained differ in the relative position of the monotypic genera *Furcarcturus*, *Globarcturus* and *Glaberarcturus*. The species *Xiphoarcturus kussakini* sp.n. and *X. carinatus* sp.n. clustered as sister taxa forming a clade. The monophyly of the genera *Cylindrarcturus*, *Chaetarcturus, Fissarcturus* and *Mixarcturus* was always recovered with relatively good support values. In contrast, *Acantharcturus* was paraphyletic in all trees obtained. The strict consensus tree and support measures were calculated (Fig. 14), and generic synapomorphies from the two trees obtained were mapped (Fig. 15).

4. Discussion

The cladistic analysis performed herein, although preliminary, is the first contribution to the relationships of 9 genera of Antarcturidae based on morphological characters.

In the hypothesis proposed, the two new species clustered in a clade, named *Xiphoarcturus* gen.n., which is characterized by the long endopod of the uropod (char. 34) reaching the tip of the pleotelson (char. 35). These two synapomorphies are novel characters for the family Antarcturidae. *Xiphoarcturus kussakini* sp.n. and *X. carinatus* sp.n. differ mainly by the ornamentation of the pereonites (dorsal spines vs. transverse ridges, respectively).

Xiphoarcturus gen.n. shares the character "pleotelson projected into a long apex" (char. 15) with *Cylindrarcturus*, *Acantharcturus* and *Mixarcturus acanthurus*; however, they were not recovered to form a clade in the present analysis. It seems that this character arose at least twice in the family. Among all the taxa that possess an elongate pleotelson apex, only the species of *Xiphoarturus* gen.n. exhibit an elongate uropodal endopod. Although the functional / adaptational aspects of this character is unknown, a positive correlation between the lengths of the uropodal endopod and the plumose setae of the first two pleopods has been observed. In particular, *Cylindrarcturus leucophthalmus*, *C. longitelson*, *Acantharcturus acutipleon* and *Mixarcturus acanthurus* have a short uropodal endopod, and short plumose setae on the first two pleopods (Monod 1926; Kussakin & Vasina 1995, 1997; Brandt 2002). In contrast, in *Xiphoarcturus* the uropodal endopod is long and the plumose setae on the first two pleopods are long as well. Such a uropodal endopod could provide protection to the long plumose setae of the pleopods.

Xiphoarcturus gen.n. resulted as sister taxon of the clade *Mixarcturus* + *Acantharcturus acutipleon* + *Fissarcturus* + *Chaetarcturus*. It differs from *Chaetarcturus* and *Mixarcturus* mainly by the absence of filter setae on the dactylus of pereopods II–IV (char. 27). *Fissarcturus* is characterized mainly by having two caudolateral spines on the pleotelson (char. 14) and a long claw on pereopods II–IV (char. 26). *Acantharcturus acutipleon* is the only species in this analysis that exhibits a ridge projected (char. 39) on the exopod of male pleopod I.

In the current analysis the monophyly of the genera *Cylindrarcturus, Mixarcturus, Fissarcturus* and *Chaetarcturus* was recovered with relatively good support values. Regarding *Fissarcturus* and *Chaetarcturus* an analysis including all their species (18 and 23, respectively) is necessary to corroborate the monophyly of these two genera. Baltzer et al. (2000) obtained that the monophyly of the genus *Chaetarcturus* is well supported by the molecular data; however, only three specimens (of three species) were sequenced.

The genus *Acantharcturus* was paraphyletic in all trees obtained. The type species *A. acutipleon* clustered with *Chaetarcturus* + *Fissarcturus*, whereas *A. longipleon* and *A. brevipleon* were placed basally in the clade *Xiphoarcturus* gen.n. + *Mixarcturus* + *A. acutipleon* + *Fissarcturus* + *Chaetarcturus*. At present, there are no morphological characters that define the genus *Acantharcturus*. Most of the diagnostic characters presented by Brandt (1990) are shared by other genera of Antarcturidae, for instance, the short flagellum of antenna is shared with *Abyssarcturus*, *Caecarcturus*, *Cylindrarcturus*, *Fissarcturus*, *Glaberarcturus*, *Halearcturus*, *Mixarcturus*, *Pleuroprion* and *Xiphoarcturus* gen.n.; the posterior supraocular spines are also present in *Abyssarcturus*, *Antarcturus*, *Chaetarcturus*, *Fissarcturus*, *Marmachius*, *Pleuroprion, Tuberarcturus* and *Xiphoarcturus* gen.n.; and the lack of long filter setae on the dactylus of pereopods II–IV is shared with most of the genera of Antarcturidae (only *Caecarcturus*, *Chaetarcturus* and *Mixarcturus* bear such setae). In conclusion, a revision of the genus *Acantharcturus* is greatly needed.

Six of the 17 genera currently in the family Antarcturidae are monotypic (Poore 2001, 2015a,b); they comprise species with unique combinations of characters. The three monotypic genera analyzed in this study resulted in a polytomy. Any autapomorphies were found for *Globarturus* in the present analysis, being necessary to test additional morphological characters to find those containing phylogenetic signal.

The phylogeny of the Antarcturidae requires a larger data set containing further taxa and characters. Being Antarcturidae a deep-sea family, descriptions are frequently based on a single or a few specimens. With the aim of improving the knowledge of the antarcturids, a comprehensive phylogenetic revision of this family, including the examination of type materials and the description of new and poorly known species, is currently in progress.

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Authors' contributions

All authors contributed in the same way to the development of this work.

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