Chaetarcturus cervicornis sp. n., a New Ross Sea Isopod of the Genus Chaetarcturus Brandt, 1990 (Crustacea, Malacostraca)

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Chaetarcturus cervicornis sp. n., a New Ross Sea Isopod of the Genus *Chaetarcturus* Brandt, 1990 (Crustacea, Malacostraca)

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Abstract: In the framework of the PNRA (Italian National Antarctic Research Program) project CARBONANT focusing on biogenic carbonates and held in January–February 2002, several Ross Sea banks were sampled to obtain samples of biogenic carbonates. In the Mawson Bank, species belonging to the isopod genus *Chaetarcturus* Brandt, 1990 were recorded, including a specimen that did not match any described species. In this paper we describe *Chaetarcturus cervicornis* sp. n., which is characterized by supraocular spines and two pairs of tubercle-like protrusions on the cephalothorax. The new species is very similar to *C. bovinus* (Brandt & Wägele, 1988) and *C. adareanus* (Hodgson, 1902), but has a clearly different spine pattern. The study of the species of the genus *Chaetarcturus* in the Ross Sea contributes to increase our knowledge on the diversity of the Antarcturidae in the Southern Ocean. Ross Sea banks seem to hold an interesting and not-well-known fauna, deserving attention in future research.

Keywords: Ross Sea; Mawson Bank; morphology; distribution

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1. Introduction

Our knowledge of Southern Ocean isopod taxa is still far from complete, with new species being described and new distributional data being added at each increment of the sampling efforts in a given area. Within the family Antarcturidae Poore, 2001, the discovery rate of new species was found to be strongly correlated to the scientific expeditions held in the Weddell Sea and the Antarctic Peninsula areas. In contrast, the Ross Sea seems comparatively poor in terms of new distributional records of known species as well as in terms of new species discovered. In the framework of the XVII Italian Expedition of the Italian National Antarctic Research Program (PNRA), a new antarcturid species belonging to the genus *Chaetarcturus* Brandt, 1990 was sampled in the Mawson Bank area' stations. The genus *Chaetarcturus*, according to the World Register of Marine Species (WoRMS http://marinespecies.org/index.php accessed on 1 January 2021), numbers 23 species distributed in the north, equatorial and south Pacific Ocean, the south Atlantic Ocean and in the Southern Ocean. Some of these records of *Chaetarcturus* species are very deep, for example those from the Kuril-Kamchatka area, in the Northwest Pacific, where *C. abyssalis* [1] and *C. ultrabyssalis* [1] were sampled at 5670–6135 and 6435–7280 m depth, respectively [1]. According to the WoRMS Antarctica section RAMS (http://www.marinespecies.org/rams/index.php accessed on 1 January 2021), to date only six species of *Chaetarcturus* occur in the Southern Ocean (Figure 1): *C. acutispinis* (Kussakin, 1982), *C. adareanus* (Hodgson, 1902), *C. bovinus* (Brandt & Wägele, 1988), *C. brunneus* (Beddard, 1886), *C. franklini* (Hodgson, 1902) and *C. longispinosus* Brandt, 1990. We describe a new antarcturid

from the Ross Sea as *Chaetarcturus cervicornis* sp. n. in this contribution. We decided to describe this new species due to its clearly distinct morphology and unique features that are not present in any previously described species of *Chaetarcturus*. Descriptions of new species based on the availability of a single specimen were done in the past for another *Chaetarcturus* species, i.e., *C. cryophilus* [2].

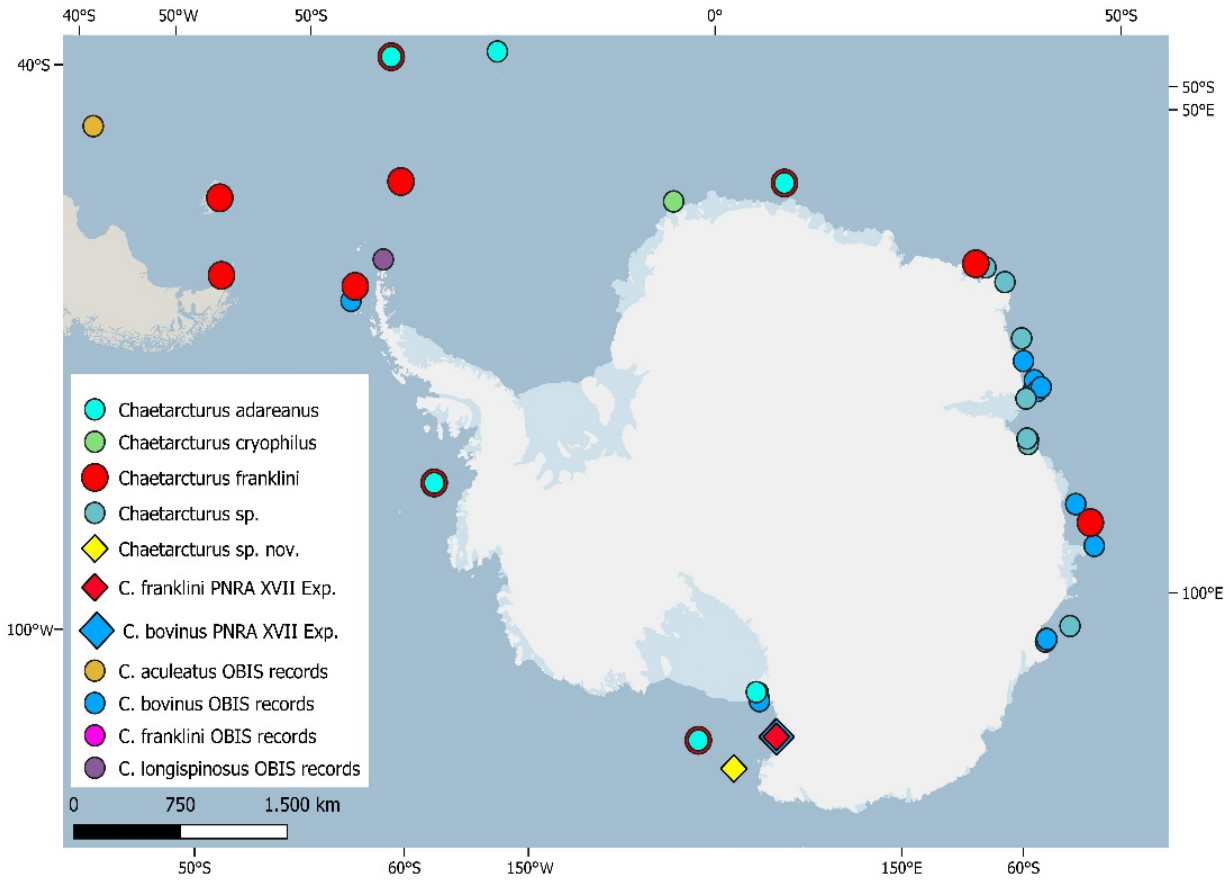

Figure 1. Distribution records of *Chaetarcturus* Brandt, 1990 species in Southern Ocean, using GBIF and OBIS database and MNA unpublished data. GBIF and OBIS database data are represented by dots, squares stand for *Chaetarcturus* species recorded during the PNRA XVII Italian Expedition 2001/02, blue and red for *C. bovinus* (Brandt & Wägele, 1988) and *C. franklini* (Hodgson, 1902) respectively. Record of *C. cervicornis* sp. n. is marked with a yellow square.

2. Materials and Methods

2.1. Taxon Sampling

The single specimen available for the present study was collected in the Mawson Bank area (Ross Sea) during the XVII expedition of the Italian National Antarctic Program (PNRA) 2001/02, on board of the RV "Italica", in the framework of the PNRA project CARBONANT (Processi genetici e significato paleoclimatico e paleoceanografico dei CARBONati marini biogenici in ANTartide; Genesis processes and paleoclimatic and paleoceanographic significance of marine Antarctic biogenic carbonates; PNRA project 4.7, PI Marco Taviani). The specimen was sampled using a dredge, at a depth of 389 m, (station Carb 34, 73° 14.56′ S, 175° 38.35′ E; Figure 2). After the first sorting on board, the specimen was stored and fixed with 96% ethanol in order to preserve it for further genetic analysis.

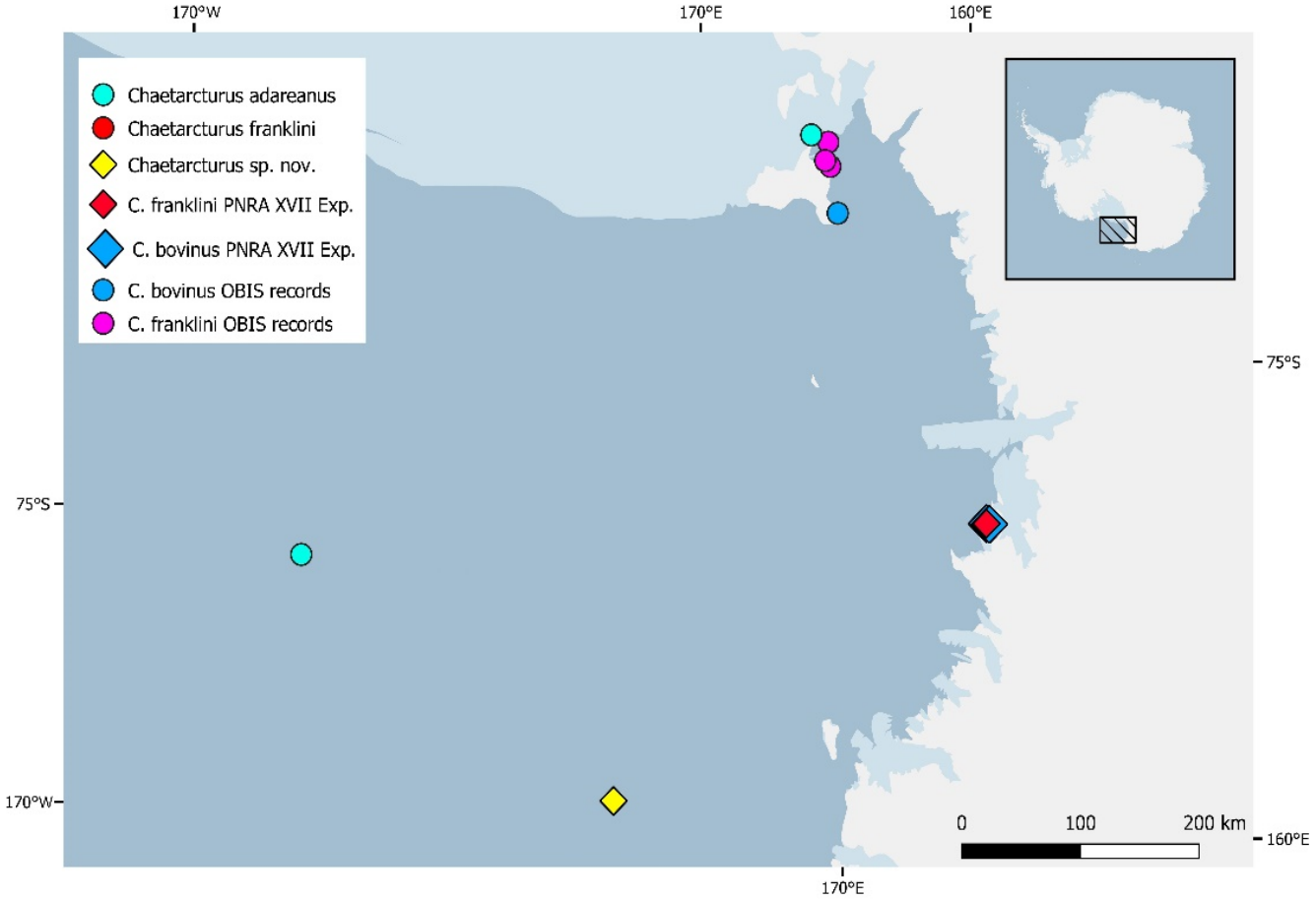

Figure 2. Distribution records of *Chaetarcturus* species in Ross Sea. Circles stand for GBIF and OBIS records, squares represent PNRA XVII Italian Expedition 2001/02; record of *C. cervicornis* sp. n. is marked with a yellow square.

2.2. Photography and Laboratory Analyses

Only one specimen was found during the campaign and it represents the holotype of the new species. The holotype was not dissected in order to preserve it for further observations and it was drawn in standard view [2]. Drawings were performed using a camera lucida, followed by digital inking made by combining the stack photos and the scanned hand-made drawings as layers. The graphic software used was Autodesk SketchBook, digital inking was performed with a XP-PEN Deco 02 graphic tablet. Stacks were obtained by using a Canon EOS 600D and a Leica 125 C, mounting a Leica DMC 4500 camera. The use of stack photos as base layer of a digital-inking work is not new for crustacean illustrations (see for example the paper by Verheye and D'Udekem D'Acoz [3]).

2.3. Additional Distribution Data

Additional *Chaetarcturus* species distribution data [1,4–25] were provided through GBIF (Global Biodiversity Information Facility, available from https://www.gbif.org/ accessed on 1 January 2021) and OBIS (Ocean Biodiversity Information System https://obis.org/ accessed on 1 January 2021). Quality check and data cleaning were performed using bibliographic research and rgbif package (https://CRAN.R-project.org/package=rgbif accessed on 1 January 2021) in RStudio software. Maps were drawn using QGIS (QGIS.org 2021 accessed on 1 January 2021) package QAntarctica [26].

2.4. Morphological Abbreviations

A1 = antennula

A2 = antenna
P = pereopod
PL = pleopod
UR = uropod
BL = body length
MNA = Italian National Antarctic Museum (Section of Genoa), Genoa
PNRA = Italian National Antarctic Research Program

Using OBIS and GBIF data, in addition to MNA samples dataset, a *Chaetarcturus* presence-absence table was created (Table 1). Areas in this study are AP (Antarctic Peninsula), SOI (South Orkney Islands), SGA (South Georgia Area), SSI (South Sandwich Islands), WS (Weddell Sea), DML (Dronning Maud Land), EA (East Antarctica), CI (Crozet Islands), PEI (Prince Edward Islands), RS (Ross Sea), BSE (Bellingshausen Sea East). Red "x" indicates new records, based to the study of MNA samples. New records, regarding Ross Sea (RS) area, are *Chaetarcturus bovinus* (Brandt & Wägele, 1988), and *Chaetarcturus cervicornis* sp. n. (species new to science). Then percentage of individuals counted in MNA, OBIS and GBIF datasets was calculated (Figure 3): in AP 42.86% *C. longispinosus* Brandt, 1990, 14.29% *C. franklini* (Hodgson, 1902), *Chaetarcturus* Brandt, 1990 (ND), *C. bovinus*, and *C. adareanus* (Hodgson, 1902); in SOI 33.33% *C. adareanus*, *C. brunneus* (Beddard, 1886), and *C. franklini* (Hodgson, 1902); in SGA 25% *C. longispinosus*, *C. franklini*, *C. brunneus spinulosus* (Nordenstam, 1933), and *C. adareanus*; only *C. adareanus* present in SSI; in WS 33.33% *C. adareanus*, *C. bovinus*, and *C. franklini*; in DML 11.11% *Chaetarcturus* (ND), *C. adareanus*, and *C. franklini*, 33.33% *C. bovinus*, and *C. cryophilus* Hille, Held & Wägele, 2002; in EA 6.90% *C. adareanus*, and *C. franklini*, 41.38% *C. bovinus*, 44.83% *Chaetarcturus* (ND); in CI 8.33% *C. adareanus*, *C. brunneus*, and *C. franklini*, 75% *C. aculeatus* (Kussakin, 1967); only *C. aculeatus* is present in PEI; in RS 14.29% *C. adareanus*, 40.26% *C. bovinus*, 41.56% *C. franklini*, 2.60% *Chaetarcturus* (ND), and 1.30% *C. cervicornis* sp. n.; in BSE 50% *C. adareanus* and *C. franklini*.

Table 1. *Chaetarcturus* Brandt, 1990 species presence-absence table: "x" indicates presence in the area, red "x" indicates MNA new record in the area. Areas in this study are AP (Antarctic Peninsula), SOI (South Orkney Islands), SGA (South Georgia Area), SSI (South Sandwich Islands), WS (Weddell Sea), DML (Dronning Maud Land), EA (East Antarctica), CI (Crozet Islands), PEI (Prince Edward Islands), RS (Ross Sea), BSE (Bellingshausen Sea East). "ND" in "*Chaetarcturus* Brandt, 1990" indicates undetermined *Chaetarcturus*.

Species	AP	SOI	SGA	SSI	WS	DML	EA	CI	PEI	RS	BSE
C. aculeatus (Kussakin, 1967)								x	x		
C. adareanus (Hodgson, 1902)	x	x	x	x	x	x	x	x		x	x
C. bovinus (Brandt & Wägele, 1988)	x				x	x	x			x	
C. Brandt, 1990	x					x	x			x	
C. brunneus (Beddard, 1886)		x						x			
C. brunneus spinulosus (Nordenstam, 1933)			x								
C. cervicornis n. sp.										x	
C. cryophilus Hille, Held & Wägele, 2002						x					
C. franklini (Hodgson, 1902)	x	x	x		x	x	x	x		x	x
C. longispinosus Brandt, 1990	x		x								

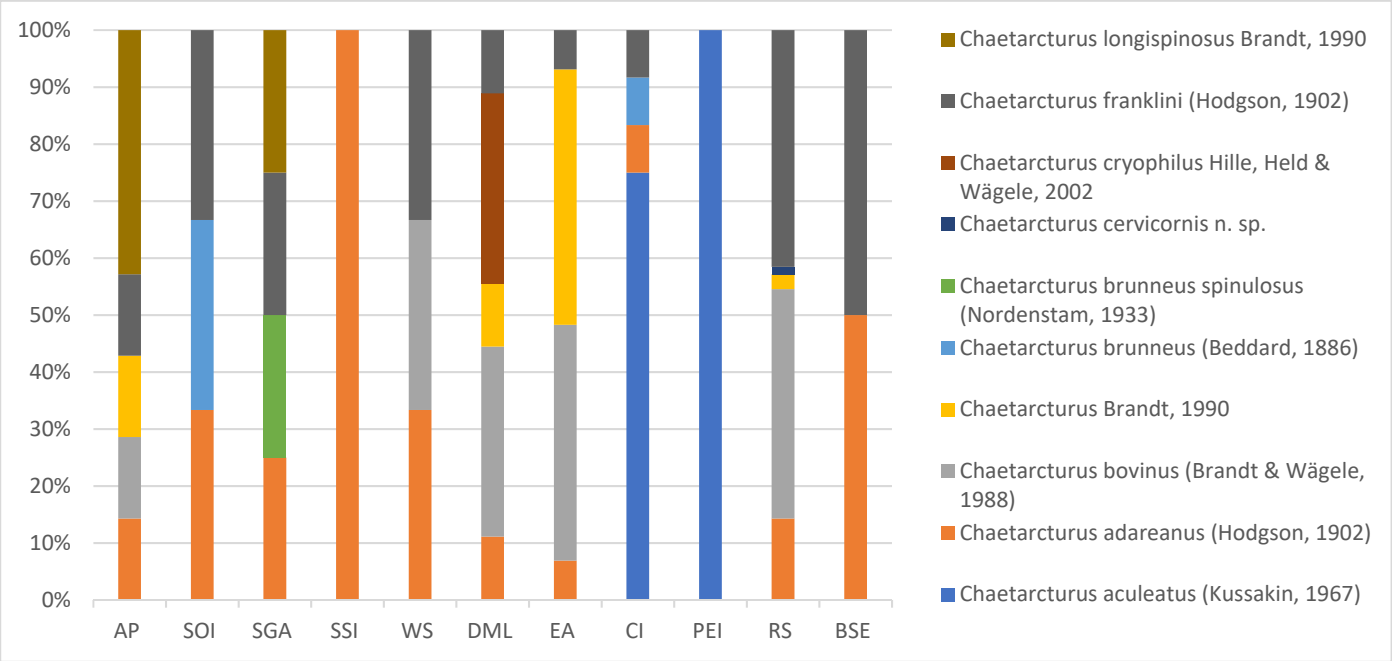

Figure 3. Percentage of MNA individuals of *Chaetarcturus* Brandt, 1990 species related in each area: areas in this study are AP (Antarctic Peninsula), SOI (South Orkney Islands), SGA (South Georgia Area), SSI (South Sandwich Islands), WS (Weddell Sea), DML (Dron-ning Maud Land), EA (East Antarctica), CI (Crozet Islands), PEI (Prince Edward Is-lands), RS (Ross Sea), BSE (Bellingshausen Sea East).

3. Results

3.1. Taxon treatment

Chaetarcturus cervicornis Noli, Brandt, Di Franco & Schiaparelli, sp. n.

3.1.1. Material

Holotype:

Kingdom: Animalia; phylum: Arthropoda; class: Malacostraca; order: Isopoda; family: Antarcturidae; genus: *Chaetarcturus*; continent: Antarctica; locality: Mawson Bank; verbatimDepth: 389; decimalLatitude: −73.24266; decimalLongitude: 175.63916; eventID: Carb 34; samplingProtocol: bottom trawl; year: 2002; month: 1; day: 15; individualCount: 1; sex: male; lifeStage: adult; catalogNumber: MNA 10739; identifiedBy: Nicholas Noli; dateIdentified: 2019; type: PhysicalObject; basisOfRecord: PreservedSpecimen.

3.1.2. Description

Zoobank link: urn:lsid:zoobank.org:pub:608C8365-8853-42FC-BDD1-9EB2431F9757

Generic diagnosis: body slender, elongated, dorsally bearing stout spines, a pair of long terminal spines on pleotelson. A2 longer than body, flagellum long, with more than 4 articles; spine-like processes on peduncular articles 1–3 or 1–4. Cephalotorax with 2 or 4 straight and long spines: the pair of supraocular spines is always present, and often caudally a further, shorter pair; further spines may be present. Pereonites dorsally with long spines and/or spiny tubercles. Shallow groove between P1 and cephalotorax. Supracoxal spine on P1 short or long, further supracoxal spines on P2–7 present or reduced. A1 short, A2 longer than body. Dactylus of P1 not swollen. All pleonites fused, fusion lines distinct by lateral and dorsolateral furrows marking pleonites 1–3. Pleotelson dorsally with acute spines or spiny tubercles, caudolateral pair of spines long, acute, caudal margin rounded [27].

Description (based on holotype male):

Measurements. BL = 20 mm.

Body long and slender. Whole-body surface is covered by very small spines and tubercles, especially on lateral and caudal margins of the somites (Figures 4A,B and 6A,B).

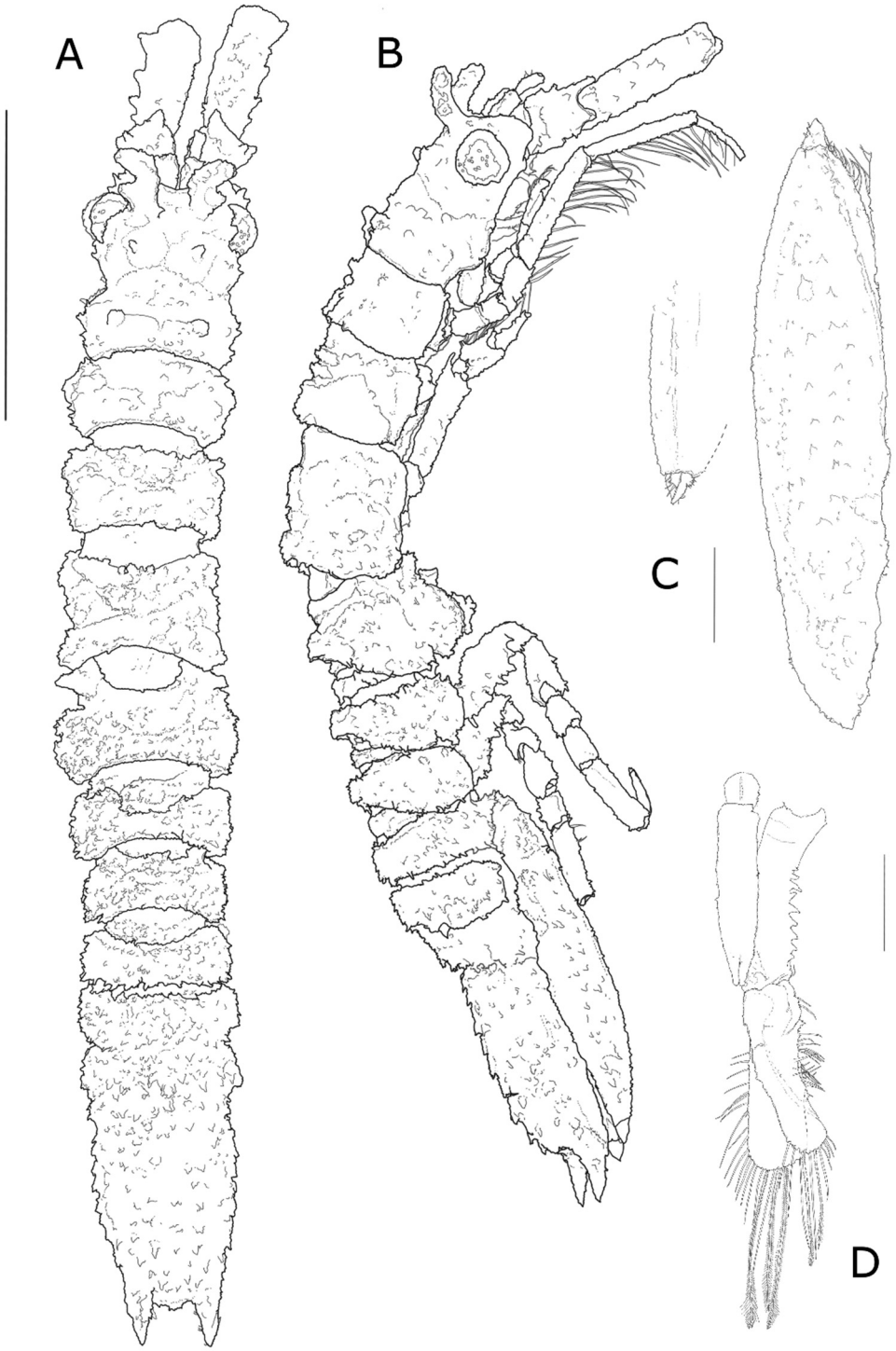

Figure 4. *Chaetarcturus cervicornis* sp. n. male holotype (MNA 10739) (**A**) dorsal view, scale bar = 5 mm (**B**) lateral view, scale bar = 5 mm (**C**) right uropod, scale bar = 1 mm (**D**) penis and left first pleopod, scale bar = 1 mm.

A1 broken in holotype; A2 is broken, only first and second peduncular articles remaining. First peduncular article approximately half size of second, with short, rounded spine

on dorsal side, laterally directed; second peduncular article twice as long as first, laterally with four short spines (Figure 6C).

Cephalothorax with large laterally protruding eyes, slightly subtriangular, blunt supraocular spines, dorsally directed and frontally curved, not surpassing the eyes in dorsal view (Figures 4B and 6A); in middle of each supraocular spine, a particular spinel shorter process is evident. Cephalothorax with two lobes that end with a short, rounded tubercular spine each; dorsolaterally on pereonite 1, a pair of small blunt and rounded spines is present, approximately twice as long as small tubercular spines of lobes and located medially on first fused pereonite; another pair of minor spines is evident in distal part of pereonite 1, and is also present on pereonite 2 (Figure 6C).

Pereonite 1 fused with cephalothorax; pereonite 2 subequal in length to pereonite 3; pereonite 4 longest; pereonite 5 subequal in length to pereonite 4; pereonites 6 and 7 smallest. Tergites of pereonites 5–7 with concave posterior border into which the following segment fits when animal bends dorsally (Figures 4A,B and 6A,B). Pereonite 1 bears short lateral supracoxal spines.

All three anterior pleonites fused with pleotelson, but first three pleonites show incisions; covered in small tubercles, and very tiny spines-like protrusions laterally, barely distinguishable (Figures 4A,B and 6A,B).

Pleotelson covered with spiny tubercles. Caudal part of pleotelson with two long and stout spines approximately one third and half of length of pleotelson, which surpasses uropods (Figure 4A,B). Dorsal pleotelsonic surface covered with small spines (Figure 4A).

P1 approximately half length of P2, basis long, carpus trapezoidal, subchelate propodus broad-oval, dactylus shorter than propodus (dactylus roughly half size of propodus), with one long and one short distal claw. All articles densely setose. Dorsal side of propodus with few setae, mostly distally, on mouthparts-directed lateral side long setulated setae, on outer-directed surface of propodus smaller and thin setae, densely setose ventrally (Figures 5A and 6E). P2-3 similar. P2 shorter (0.9 length of P3), simple setae ventrally on ischium and merus, longest setae on carpus, slightly shorter on propodus and dactylus. Basis with posterodistal semi-circular group of setae (Figures 5B,C and 6D,F). P4 severely damaged (Figure 5D), propodus and dactylus lacking. P5–7 shorter and stouter than P2–4 (0.7–0.8 of length of P2–3), basis always the longest article (almost twice as long as ischium, approximately three times as long as merus and carpus, slightly longer than propodus and twice as long as dactylus), cuticle with several spines and tubercles on posterolateral surface. Ventral side of merus and carpus of P5-7 with two rows of strong spines, one single ventral row on propodus; dactylus terminally with two claws, ventral one shorter and less stout, one small seta between claws (Figure 5E–G).

Pleopods hidden in respiratory chamber formed by pleotelson and uropod; PL1 with row of nine teeth laterally on sympodite. Exopod of PL1 with medially protruding lateral lobe and ridge from this edge diagonally to distolateral margin, where many simple setae insert; diagonal ridge ends distally at base of setulated setae. Endopod with marginal plumose setae on apical side; penial processes about 2 mm, genital papilla not surpassing protopod of PL1, subequal in length (Figures 4D and 6G). PL2 exopod slightly shorter than endopod. Exopod and endopod of PL2 bearing long plumose setae, appendix masculine acute, slender, surpassing PL2 endopod in length (Figure 7A,B).

Uropods oval, elongated, dorsal surface covered with acute tubercles; caudal rami bearing short setae (Figure 4C).

3.1.3. Etymology

This species is characterized by its supraocular spines, somewhat resembling the antlers of a deer, hence the name *cervicornis*.

3.1.4. Distribution

Only known from type locality, the Mawson Bank, Ross Sea (Antarctica), found at 389 m.

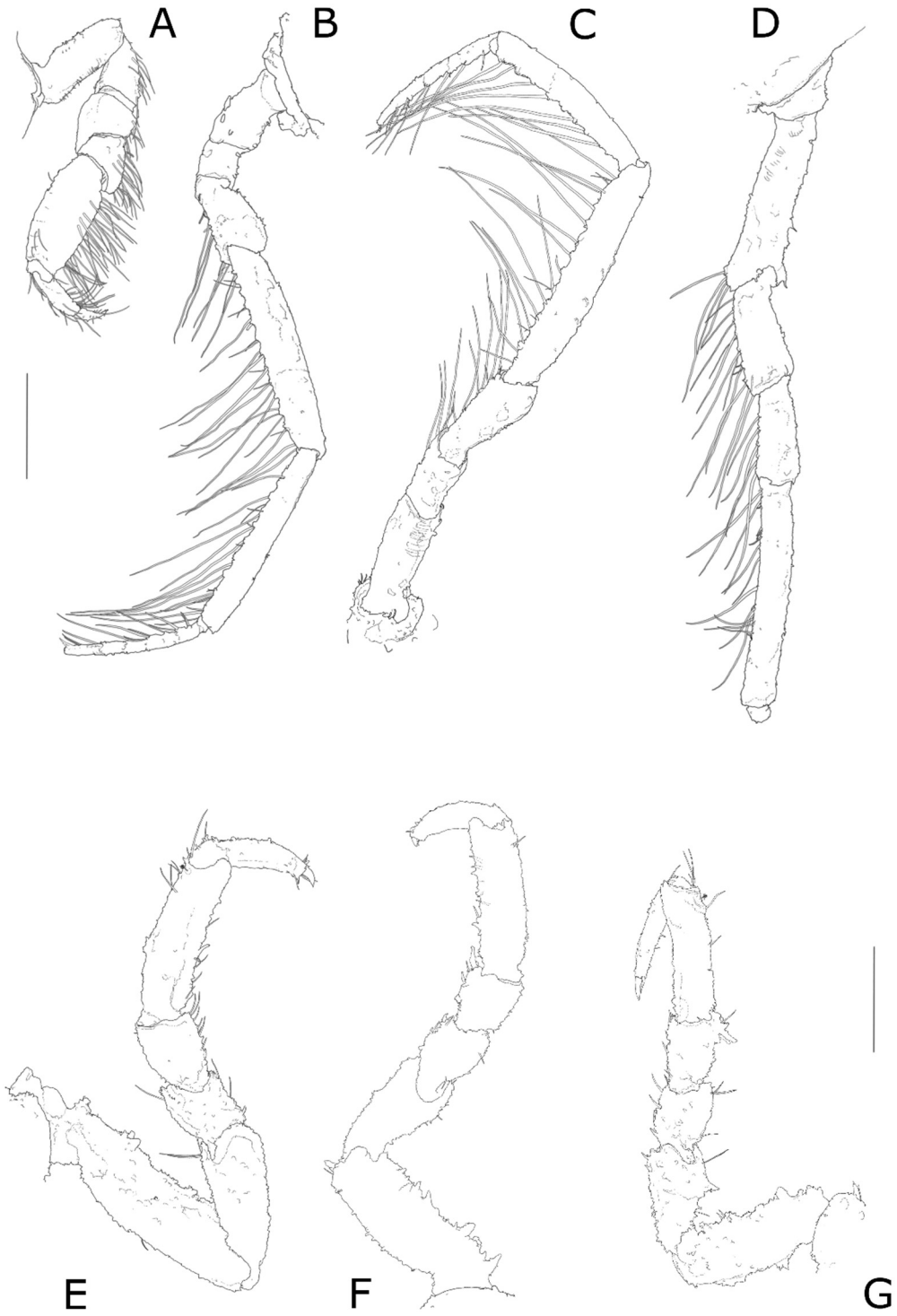

Figure 5. *Chaetarcturus cervicornis* sp. n., male holotype (MNA 10739) (**A**) left first pereopod (**B**) second pereopod (**C**) left third pereopod (**D**) left fourth pereopod (broken) (**E**) left fifth pereopod (**F**) right sixth pereopod (**G**) right seventh pereopod. All scale bars = 1 mm.

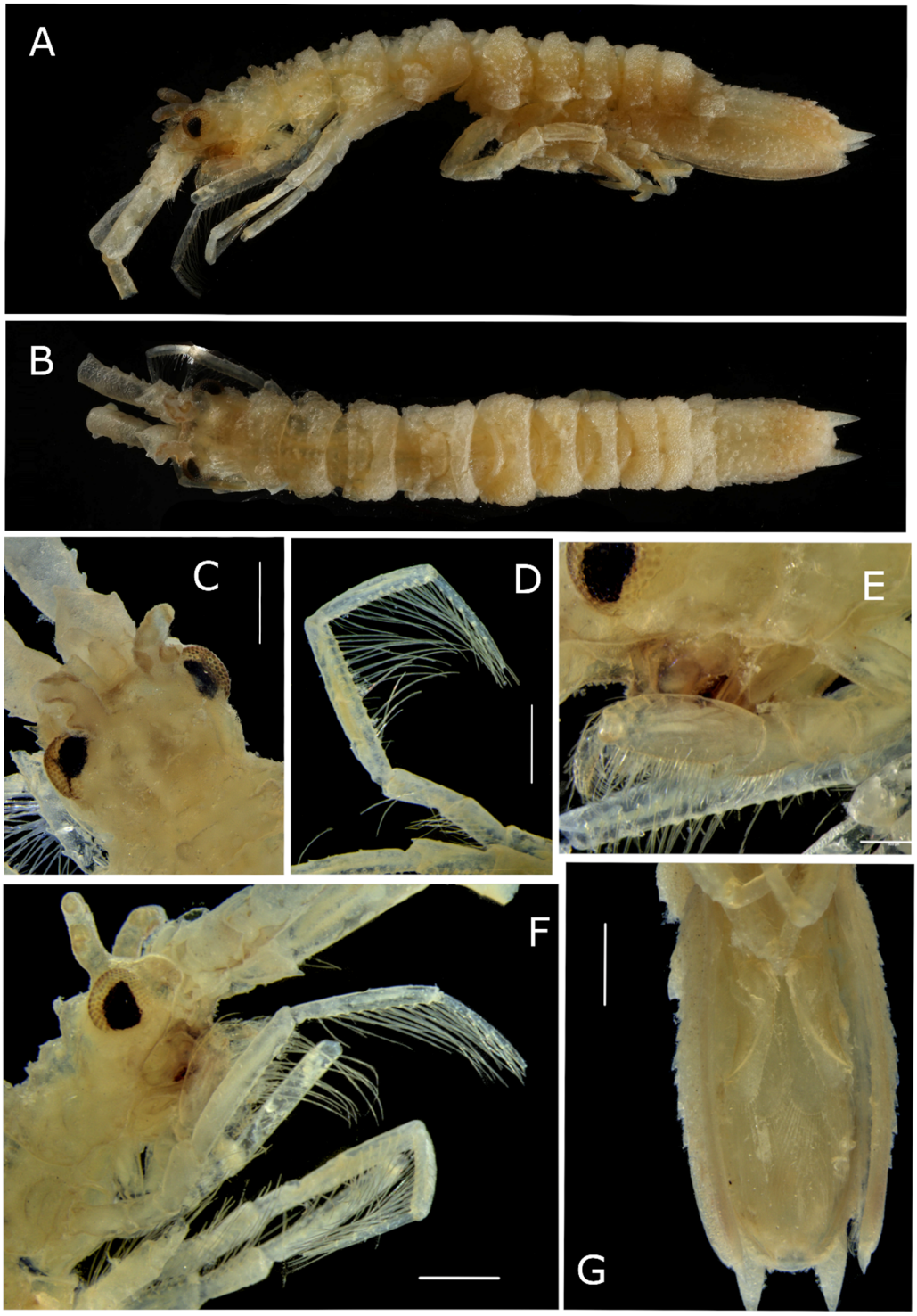

Figure 6. *Chaetarcturus cervicornis* sp. n., male holotype (MNA 10739) stack photos (**A**) lateral view (**B**) dorsal view (**C**) dorsal side of cephalothorax, where supraocular spines and the two pairs of blunt tubercle-like spines are evident (**D**) third pereopod (**E**) first pereopod (**F**) lateral side of cephalothorax, focus on second pereopod (**G**) ventral side of the pleotelson, focus on pleopods. Scale bar = 1 mm except in (**E**) where scale bar = 0.5 mm.

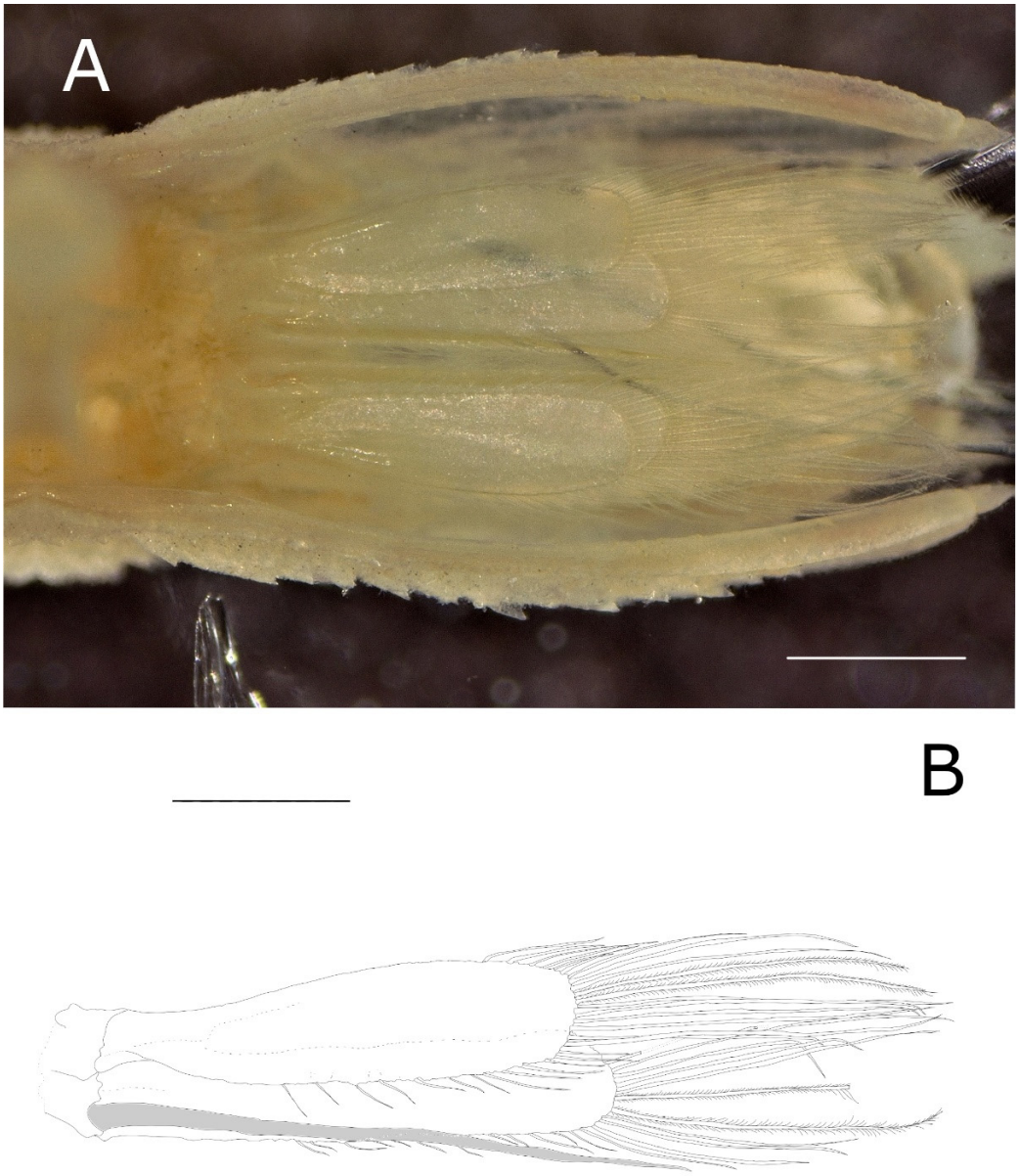

Figure 7. *Chaetarcturus cervicornis* sp. n., male holotype (MNA 10739) PL2 table (**A**) stack photo of respiratory chamber, focusing on second pleopods (**B**) second pleopod and appendix masculina (in grey) digital inking drawing. All scale bar = 1 mm.

4. Discussion

4.1. Diagnosis

The new species is characterized by the distinctive supraocular spines, consisting of a main spine, dorsolaterally directed, blunt and rounded. In the middle of the main spine is a distinct protrusion, forming a simple ramification, somewhat resembling the antlers of a deer. In addition, the spine pattern in the cephalothorax presents a second pair of short tubercle-like blunt spines, caudally to the large supraocular spines; another pair of slightly bigger (approximately 1.5 times of the first pair of protrusions) tubercle shaped elevations are present, caudally to the first pair of blunt spines (Figure 6C).

4.2. Remarks

The genus *Chaetarcturus* Brandt, 1990 is clearly distinguishable from the closely related genus *Antarcturus* Zur Strassen, 1902 by the presence of long filter spines on the dactyli of pereopods 2–4; the genus *Mixarcturus* Brandt, 1990 also presents the same filter spines, but

the lack of tergal spines and a flagellum which consists of no more than four articles make the genera clearly different [27,28]. To date, 8 species and 2 subspecies in SO belong to the genus *Chaetarcturus* (original names are given; the type species is marked with an asterisk) according to WoRMS' section RAMS (Register of Antarctic Marine Species) and GBIF and OBIS databases:

Chaetarcturus aculeatus—described in Kussakin (1982)
Chaetarcturus acutispinis—described in Kussakin 1979
Chaetarcturus adareanus—described in Hodgson (1902)
Chaetarcturus bovinus—described in Brandt and Wägele (1988)
Chaetarcturus brunneus—described in Beddard (1886)
Chaetarcturus brunneus spinulosus—described in Nordestam (1933)
Chaetarcturus cryophilus—described in Hille, Held & Wägele (2002)
Chaetarcturus franklini—described in Hodgson (1902)
**Chaetarcturus longispinosus*—described in Brandt (1990)
Chaetarcturus cervicornis sp. nov.

4.3. Differential Diagnosis

Within the genus *Chaetarcturus*, *C. adareanus* (Hodgson, 1902) and *C. bovinus* (Brandt & Wägele, 1988) share with *C. cervicornis* sp. n. the cylindrical shape of the body and the terminal spines, slightly shorter in *C. adareanus*. Rounded, blunt and stout supraocular spines are present in the new species and in *C. bovinus*. However, the unique shape of the supraocular spines of *C. cervicornis* with the two main spines bearing a second very short pair of spines transversally creating a sort of "deer horns" shape - is clearly distinguishable; another major difference between *C. bovinus* and *C. cervicornis* is the complete lack of the characteristic two pairs of longer spines on the pleotelson in *C. cervicornis*; the latter is characterized by a rough and spiny, but rather uniform, pleotelsonic spine pattern. *Chaetarcturus adareanus* differs from *C. cervicornis* by having a second pair of shorter spines caudally on supraocular ones. The main supraocular spines in *C. cervicornis* presents the second pair of caudally directed protrusions as well; however, these are more tubercular-like than spines-like. Furthermore, a second pair of tubercles located in first pereonite area, stronger than the other protrusions characterising the surface of the species, is evident.

4.4. Conclusions

The investigation of the Ross Sea, although comparatively less studied than Weddell Sea area, is gaining progressively more attention due to new discoveries. Mawson Bank stations, in particular, shows noticeable differences in foraminiferal assemblages, revealing a very high-energy ecosystem [29], with new records of *Paraliparis* Collett, 1879 snailfishes [30], and the finding of very rare sponge like *Tethyopsis brondstedi* (Burton, 1929) [31]. New studies, research, and the description of species new to science in Mawson Bank area, and in general in the Ross Sea, are therefore necessary in order to understand the complexity of this Ross Sea area, which correspond to RS-GPZi Marine Protected Area, according CCAMLR CONSERVATION MEASURE 91-05 (2016) for the Ross Sea region Marine Protected Area, specifically, addressing the priorities of Annex 91-05/C.

Author Contributions: Data curation, N.F.N.; Formal analysis, N.F.N.; Funding acquisition, S.S.; Visualization, N.F.N.; Writing—original draft, N.F.N.; Writing—review & editing, N.F.N., A.B., D.D.F. and S.S. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: All the sampling activities in Antarctica were authorized by the Italian National Antarctic Program (PNRA).

Informed Consent Statement: Not applicable.

Data Availability Statement: Distributional data relative to the new species and the other chaetarcturids will be released in the Global Biodiversity Information Facility (GBIF) in a specific datapaper (Noli et al. in prep.).

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