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Tanaidacea (Crustacea: Peracarida) of Australian coral reefs

Tanaidacea (Crustacea: Peracarida) raf koralowych Australii

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CONTENTS

1. INTRODUCTION

Tanaidacea is an order of crustaceans classified to the Malacostraca that occurs in virtually all marine benthic habitats (Błażewicz-Paszkowycz et al. 2012). Their representatives burrow in soft sediments composed of sand and mud, but they also are noted on coral reefs, wood falls, polymetalic nodules or as epibionts associated with marine macroalgaes or animals (Băcescu 1976a,c; Drumm 2003; Larsen 2006; Błażewicz-Paszkowycz & Bamber 2011).

Tanaidaceans are collected from all latitudes, and in over a full depth range (Guţu 2006; Jóźwiak et al. 2011; Błażewicz-Paszkowycz et al. 2012). They live buried in sediment or in self-constructed tubes (Johanson & Attramadal 1982). Thanks to well-developed pleopods some males are able to swim for short distances (Błażewicz-Paszkowycz et al. 2014a).

Most of the tanaidacean occur in marine habitats, however some species are occasionally noted in brackish water. For example *Heterotanais oerstedii* (Krøyer, 1842) was found in the Baltic Sea (Jażdzewski & Konopacka 1993) while *Longiflagrum amphibium* Stępień & Błażewicz-Paszkowycz, 2009 is known from estuarine in Western Australia. A few species are able to live in fresh water, for example *Pseudohalmyrapseudes aquadulcis* Larsen & Hansknecht, 2004 that was collected from spring in Northern Territory, Australia.

Currently over 1300 species of Tanaidacea are described (Andersen 2013, WoRMS 2014) and apparently they belong to the least understood groups of marine fauna. It was assessed that mentioned 1300 species of tanaidaceans represent just 2-3% of their total diversity (Appeltans et al. 2012; Błażewicz-Paszkowycz et al. 2012).

Tanaidacea together with five other orders as: Cumacea, Isopoda, Amphipoda, Mysidacea and Mictaceaspaleogriphacea are classified to suborder Peracarida. Females of those crustaceans develop a marsupium during their brooding periods. Marsupium is formed by oostegites which grow up from the basis of the pereopods. Fertilized eggs develop in the brood pouch until juvenile stage called manca will release (Johanson & Attramadal 1982; Błaszak 2011). The juvenile organism resembles the adult, however its last pereonite and the last pair of pereopods are not fully developed. Manca stays inside maternal tube for a few days after leaving the brood pouch, and next builds their own tube close to the female tube upon leaving the maternal tube (Johanson & Attramadal 1982).

Since Tanaidacea demonstrate truly low mobility and lack of planktonic larva their dispersal ability is restricted (Bamber 1998). Those poor dispersal potential places Tanaidacea among the ideal bioindicators (Błażewicz-Paszkowycz et al. 2012).

Tanaidacea are important element of benthic communities (Błażewicz-Paszkowycz & Jażdżewski 2000; Błażewicz et al. 2012). They have been found in surprisingly high densities which can exceed several thousand of specimens per surface unit (Larsen 2005). In the Antarctic shelf the density of the organism have been recorded to overcome 146 000 ind./m^2 (Delille et al. 1985). In the samples collected from Esperance (SWAustralia) tanaidaceans were more numerous than Amphipoda, Isopoda and Mysidacea (Bamber 2005). Similar results were observed during investigation of the continental slope off Western Australia (Poore et al. 2014), while in the material collected from continental slope of North-West Atlantic Tanaidacea constitute 80% of the crustacean communities (Sanders et al. 1965).

AUSTRALIAN TANAIDACEA

Tanaidacea of Australa are poorly known (Poore et al. 2014). Bamber (2005) sumarized the knowledge about the Australian Tanaidacea and listed 28 species. Sixteen of those species were collected near the coast of Queensland and the New South Wales (*Longiflagrum caeruleus* (Boesch, 1973); *L. estuarius* (Boesch, 1973); *Synapseudes australianus* Băcescu, 1981; *Kalliapseudes obstusifrons* Haswell, 1882b; *Hodometrica australis* (Haswell, 1882); *Macrolabrum boeri* Băcescu, 1981; *Pagurapseudes abrucei* Băcescu, 1981; *P. spinipes* Whitelegge, 1901; *Whiteleggia multicarinata* (Whitelegge, 1901); *W. stephensoni* Boesch, 1973; *Pseudowhiteleggia typica* Lang, 1970; *Paratanais maleficus* Larsen, 2001; *P. malignus* Larsen, 2001; *P. perturbatius* Larsen, 2001; *Sinelobus stanfordi* (Richardson, 1905); *Bathytanais culteriformis* Larsen & Heard, 2001), four occurred in the vicinity of Darwin Harbour (*Apseudes gallardoi* Shiino, 1963; *Gollumudes larakia* (Edgar, 1997); *Gutuapseudes manda* Edgar, 1997; *Apseudomorpha wagait* Edgar, 1997), five were found at South-East coast of Australia (*Agathotanais spinipoda* Larsen, 1999; *Collettea cylindratoides* Larsen, 2000; *Bathytanais fragilis* Larsen & Heard, 2001; *Pseudobathytanais gibberosus* Larsen & Heard, 2001; *Neotanais noelietaiti* Larsen & Hansknecht, 2002), and three were known from North-West coast (*Bathytanais arenamans* Larsen & Heard, 2001; *Numbakulla pygmaeus* Guţu & Heard, 2002b; *Tanais dulongii* (Audouin, 1826)).

Due to investigation in the Esperance a list of Australian Tanaidacea was supported by next 24 taxa. Only a few samples were collected in narrow range of depth of that area indicating a high biodiversity of Tanaidacea and their important role in shaping the benthic communities (Larsen 2001; Guţu 2006; Błażewicz-Paszkowycz & Bamber 2007a,b; Bamber 2008b; Edgar 2008; Bamber & Błażewicz-Paszkowycz 2012).

Currently 126 species classified to 88 genera and 22 families are known from Australian waters, although the expected number of the shallow water taxa is probably much higher and can exceed 2000 species (Bamber & Błażewicz-Paszkowycz 2013).

A high fraction of the Australian Tanaidacea are apparently endemics. Most of the species, 17 genera and one family (e.g. Whiteleggiidae Guţu, 1972) are known only from that part of World Ocean (Bamber & Błażewicz-Paszkowycz 2013). The only species noted outside of Australia are: *Sinelobus stanfordi* (Richardson, 1901), *Hexapleomera robusta* (Moore, 1894) and *Tanais dulongii* (Audouin, 1826), and were formerly considered cosmopolitan. The type locality of those species is in the Galapagos, off New Jersey coast and Mediteranean Sea, respectively and the current knowledge about the restricted dispersal ability of tanaidacenas makes them to suppose to be the complexes of sibling species (Egdar 2012).

AUSTRALIAN CORAL REEFS

Australian coral reefs constitute 17% of world coral reefs (Spalding et al. 2001). Great Barrier Reefs (GBR) belongs to the biggest and the most diverse reef complex. It extends along about 2 200 km from 27º to 8º of eastern coast and their width can reach even 400 km (Huchings et al. 2009)

Coral reefs of the West Australia present manly fringing reefs with its biggest complex known as Ningaloo Reef.

In the North of Australia coral reefs almost absent. High sedimentation and flow of fresh water limit the development of the corals. Those factors along with temperature, salinity and character of substrate are considered the most important factors restricting reefs development (Spalding et al. 2001).

Coral reef are recognized as one of the most speciose marine ecosystem, that is compared which diversity compared with tropical forests. Currently 3000 species of Mollusca and 600 species of Echinodermata were described from Great Barrier Reef (GBR) (Ayong 2009; Byrne 2009; Willan 2009). Decapoda with 800 species belong to the best known group within Crustacea in GBR.

The research of diversity of Tanaidacea in Australia concentrated so far mainly in South and South-East coast e.g. Esperance and Morton Bays and Bass Strait (Bamber

2005, 2008b; Błażewicz-Paszkowycz & Bamber 2007a,b, 2012). The North of Australia stay almost unstudied in terms of tanaidaceans and just 19 species were described from coral reefs so far (Băcescu 1981; Edgar 1997; Guţu 2006). It is worthy to emphasise that 9 from those 19 species were described based on material collected during the Creefs Program (see below), thus from the same materials which is a scientific object of the current dissertation (Błażewicz-Paszkowycz & Bamber 2009; Błażewicz-Paszkowycz & Zemko 2009; Stępień & Błażewicz-Paszkowycz 2009, 2013; Stępień 2013).

CENSUS OF CORAL REEFS

The aim of the international and interdisciplinary Program Census of Marine Life (CoML) was to increase the knowledge about the diversity, distribution and abundance of marine organisms and to judge how the economic activity may influence on marine ecosystems (Crist et al. 2009). Program was divided into 18 projects concentrating on various poorly recognized geographic areas or different regions of oceanic bottom (e.g. coastal zone, abyssal, Southern Ocean, vents and seeps). The program was kept going for 10 years and has resulted in a publishing of the descriptions of 1200 species new to the science, although a few thousand of species are still waiting for publishing .

Census of Coral Reefs (CReefs) was the project of CoML (http://www.coml.org/projects/census-coral-reefs-creefs) covering three areas: Hawaii and Gulf of Mexico (American Node), and Australia (Australian Node). The material collected from the Australian coral reefs is a scientific object of the present dissertation. Detailed information about the field works were described in the Part 1 of the Results

Main aim of the thesis was to estimating biodiversity of Tanaidacea collected during CReefs (Australian Node). The aim was achieved in following stages:

1. Taxonomical identification of Tanaidacea

Seventy two species classified to 53 genera and 20 families were identified from CReefs collection. The results from the research on the diversity of Tanaidacea are presented in the Part 1 of the Results.

2. Description of new species classified to family Letpcheliidae Lang, 1973

Representives of the family Leptocheliidae Lang, 1973 constitute more than half of all tanaidacean individuals collected during CReefs field works. The members of the family are recognized as a common tanaidaceans in all swallow temperate and tropical marine ecosystems. The only species that is known from the Antarctic waters is *Leptochelia antarcticus* (Lang, 1953) (Błażewicz-Paszkowycz et al. 2012) Some representatives of Leptocheliidae as *Leptochelia dubia* (Krøyer, 1842) and *L. savignyi* (Krøyer, 1842) were recorded in various distant localities (Lang 1973). Most recent research indicated that those species are complex of cryptic species with a high preferences of the environmental conditions (Bamber 2008b).

Currently 76 species in 14 genera are classifies to the family. Members of Leptocheliidae occur mainly on sand, mud, but also might be associated with coral reefs or bryozoans (Shino 1965; Heard et al. 2004; Larsen & Reymont 2002).

The family Leptocheliidae in CReefs collection was represented by nine species, in three genera and one subfamily new to the science. The morphology, diagnosis and discussion on the systematic of the new taxa are presented in the Part 2 of the Results.

3. Revision of the genus *Synapseudes* (Metapseudidae) based on phylogeny analysis and Principal Components Analysis (PCA).

The family Metapseudidae Lang, 1973 was the second in terms of number of species and abundance in CReefs collection. From the fifteen species identified in the collection, four have been already formally described (Stępień & Błażewicz-Paszkowycz 2013).

The Metapseudidae with 86 species classified to 18 genera and four subfamilies belongs to the most rich in species families within suborder Apseudomorpha (Anderson 2013, WoRMS 2014). Members of the family are considered as a typical element of the coral reefs ecosystems. Thirty three species of metapseudids were described from that habitat only (Stebbing 1910; Menzies 1949, 1953; Băcescu 1975, 1976a,c, 1981; Edgar 1997; Heard et al. 2004; Larsen 2002; Bamber & Sheader 2005; Guţu 2006, 2007; Guţu & Anguspanish 2006; Stępień & Błażewicz-Paszkowycz 2013). The metapseudids occasionally occurs in temporary zone (Gardiner 1973; Sieg 1986) and usually in depth range from 0 to 100 m, however deeper there are known also deeper records in that family (Guţu 1989).

Phylogenetic analysis (Jóźwiak et al. unpubl. data) indicated a polyphyletic nature of the Metapseudidae. The matapseudid subfamily – Chondropodinae Guţu, 2008 is much close related to shallow-water Apseudidae rather than Metapseudidae thus it should be erected to a range of family. Similarly, monogeneric subfamily Msangiinae Guţu, 2006, with the genus *Msangia* Băcescu, 1976, should be consider as a higher than subfamily taxonomic unit. The third subfamily of Metapseudidae – Synapseudinae

Guţu, 1972 groups taxa with a reduced pleon and again the phylogenetic analysis indicates for is highly polymorphic character.

Species classified to the genus *Synapseudes* have high morphological variability. Heterogeneity within the *Synapseudes* and need for revision of this genus was already mentioned in the literature (Băcescu 1978; Guţu & Ortiz 2009).

The results from morphological analysis of species classified to *Synapseudes* supported by phylogenetic analysis and PCA has allowed to amend the definition of the genus and has proved a high morphological diversity within the genus and that one of its member, *S. ideos*, apparently represents a new genus.

2. STUDY AREA

Australian node of CReefs was sponsored by BHP Bilton (http://www.aims.gov.au/creefs). In total nine expedition were organized by Australian Institute of Marine Research in 2008–2010 to Lizard Island (Northern GBR), Heron Island (Southern GBR) and Ningaloo Reef on Western coast (Fig. 2.1), during which large collection of Tanaidacea was obtained.

Detailed information about study area with distribution of sampling localities are presented in Results Part 1.

Fig. 2.1. Distribution of sampling areas. A, A' Ningaloo Reef (A material collected in 2008, A' material collected in 2009); B Heron Island; C Lizard Island.

3. MATERIAL AND METHODS

<u>SAMPLES</u>

Piece of dead corals were collected by hand during SCUBA diving and placed in mesh bag with 0.3 mm mesh (Pic. 3.1). At the laboratory samples were put into bucket (20 L) with a few drops of formaldehyde or fresh water to encourage animals to leave their microhabitats (Pic. 3.2). After an hour samples with still alive animals were washed through fine mesh (0.3 mm). The residue were sorted under microscope and preserved into 80% ethanol.

Ninety nine samples from 47 localities were collected in vicinity of Heron Island (3518 individuals), 63 samples from 131 localities near Lizard Island (4446 individuals). Seventy three samples from 26 localities were gathered from Ningaloo (1976 individuals). Collection was loaned from Museum of Tropical Queensland (MTQ) and Western Australian Museum (WAM).

Pic. 3.1. Collecting of samples during SCUBA diving (pic. made by N. Bruce).

Pic. 3.2. Samples in a sea water with few drops of formaldehyde (pic. made by M. Błażewicz-Paszkowycz)

MORPHOLOGICAL ANALYSIS

Tanaidacea were identified to the species level based on Wägele definition (2005) which indicate that a species consist of a group of individuals with the same morphology.

Individuals were dissected and their appendages were mounted on a slides. Details of their morphology were illustrated with microscope Carl Zeiss Axiolab equipped with drawing tubes. Digital drawings was done using tablet WACOM DTF 720, based on Coleman (2003) instruction.

Terminology:

Tanaidacea belong to Malacostraca, which is composed of head, thorax and pleon. Head consist of five segments and acron. Thorax is built by eight segments, while pleon is six-segmented, and ends with telson.

In case of Tanaidacea two first thorax segments fuse with the head to form a cephalothorax, which is covered by calcified carapace. Last segment of pleon fuses with telson to form pleotelson. Thus thorax of Tanaidacea is composed of six free segments (pereonites), while pleon of five free segments (pleonites) (Fig. 3.1).

The appendages of the head are paired: antennule and antenna, mandible, maxillule and maxilla. Labium and labrum are an extension of cephalothorax that surround the mouth (Fig. 3.2, 3.3). The first thorac segment which fused with head bears maxilliped associated with epignath (Fig. 3.4), on the second fused segment paired thoracopods - chelipedes are situated (Fig. 3.5).

Each of the pereonites is equipped with pair of pereopod. These appendages are composed of protopod and endopod. Coxa and basis form the protopod, while ischium, merus, carpus, propodus and dactylus with unguis – the endopod. Exopod, if present is two or three articulated (Fig. 3.5).

The free pleonites segments can bear appendages called pleopods. The pleopod is composed of basis, endopod and exopod (Fig. 3.4).

Pleotelson is tipped by a pair of uni or biramous uropod (Fig. 3.4).

Some differences in morphology of appendages between representatives of the suborder Apsedomorpha and Tanaidomorpha are observed.

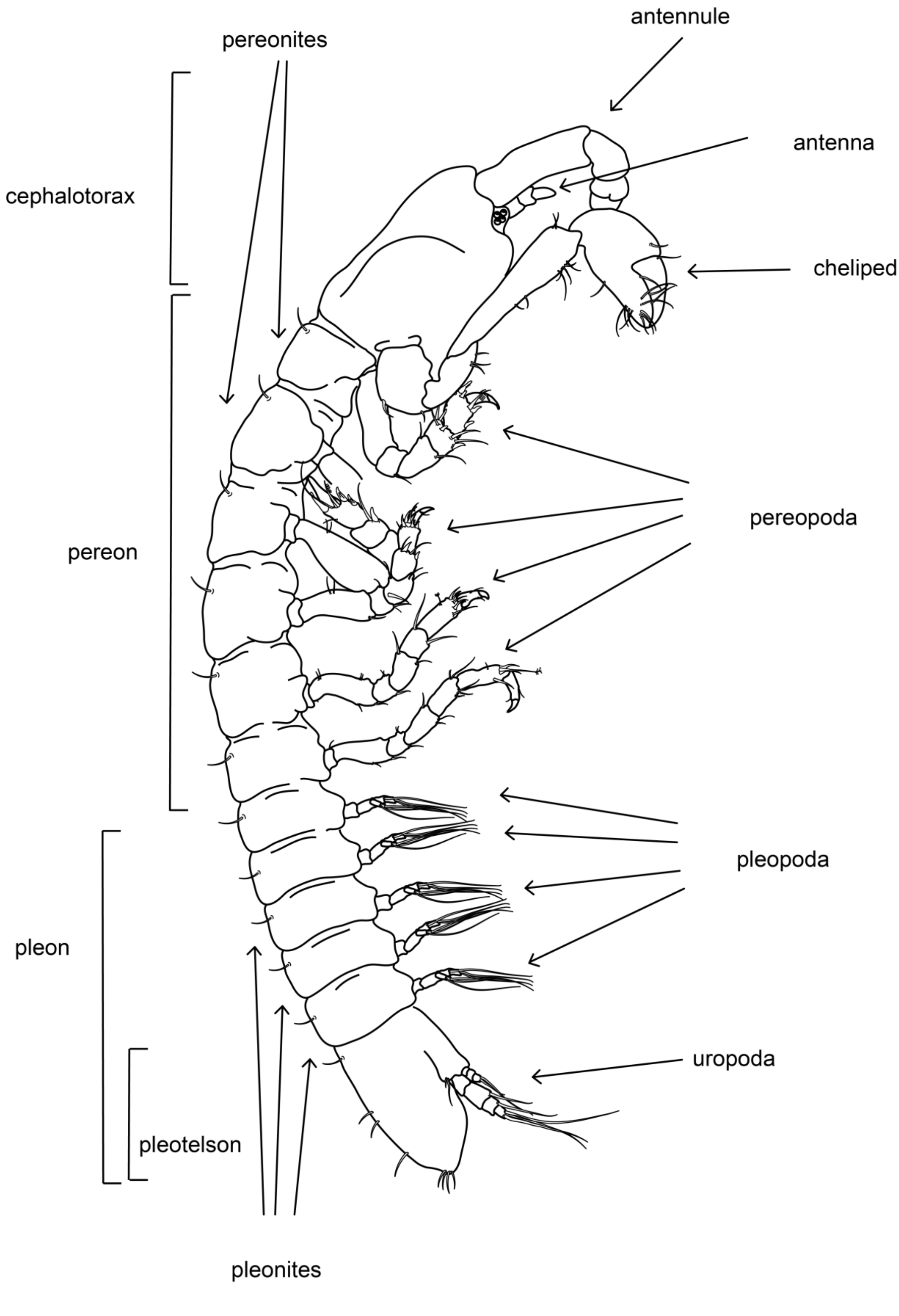


Fig. 3.1. General tanaidacean morphology based on *Msangia mussida* Stępień & Błażewicz-Paszkowycz, 2013.

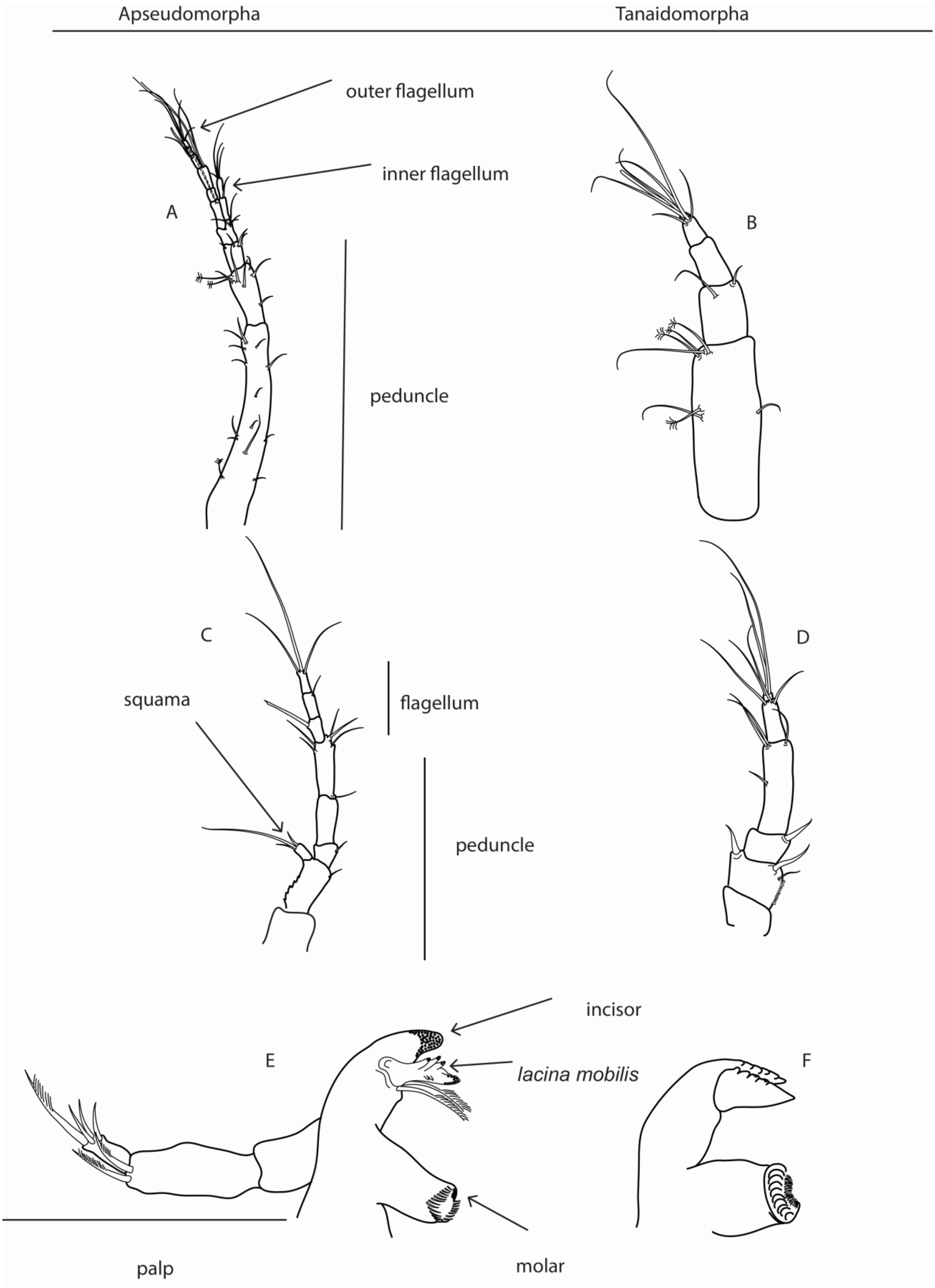


Fig. 3.2. Mouthparts of Apseudomorpha (A, C, E) and Tanaidomorpha (B, D, F). A, B antennule; C, D antenna; E, F mandible.

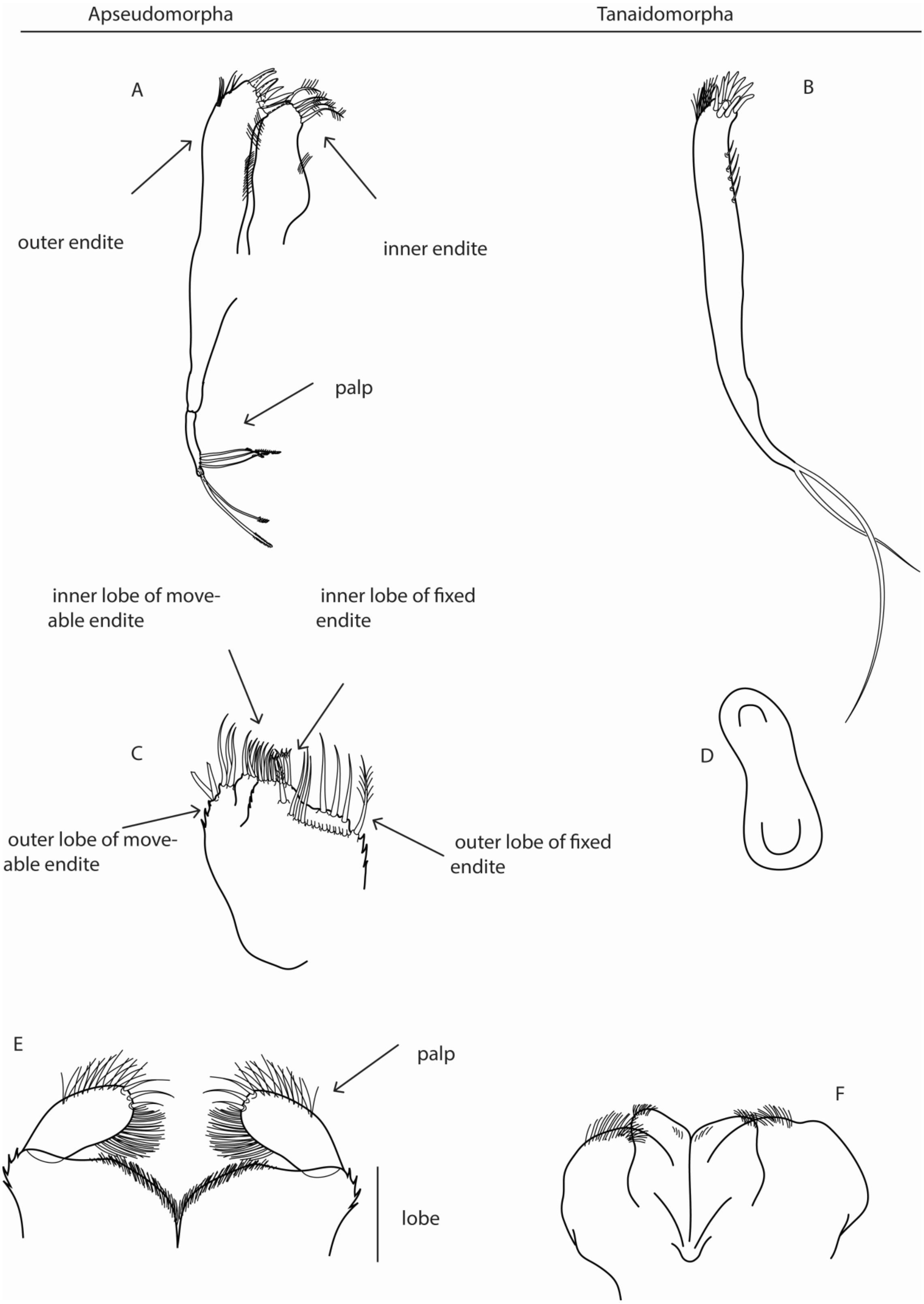


Fig. 3.3. Cephalotorax appendages of Apseudomorpha (A, C, E) and Tanaidomorpha (B, D, F). A, B maxillule; C, D maxilla; E, F labium.

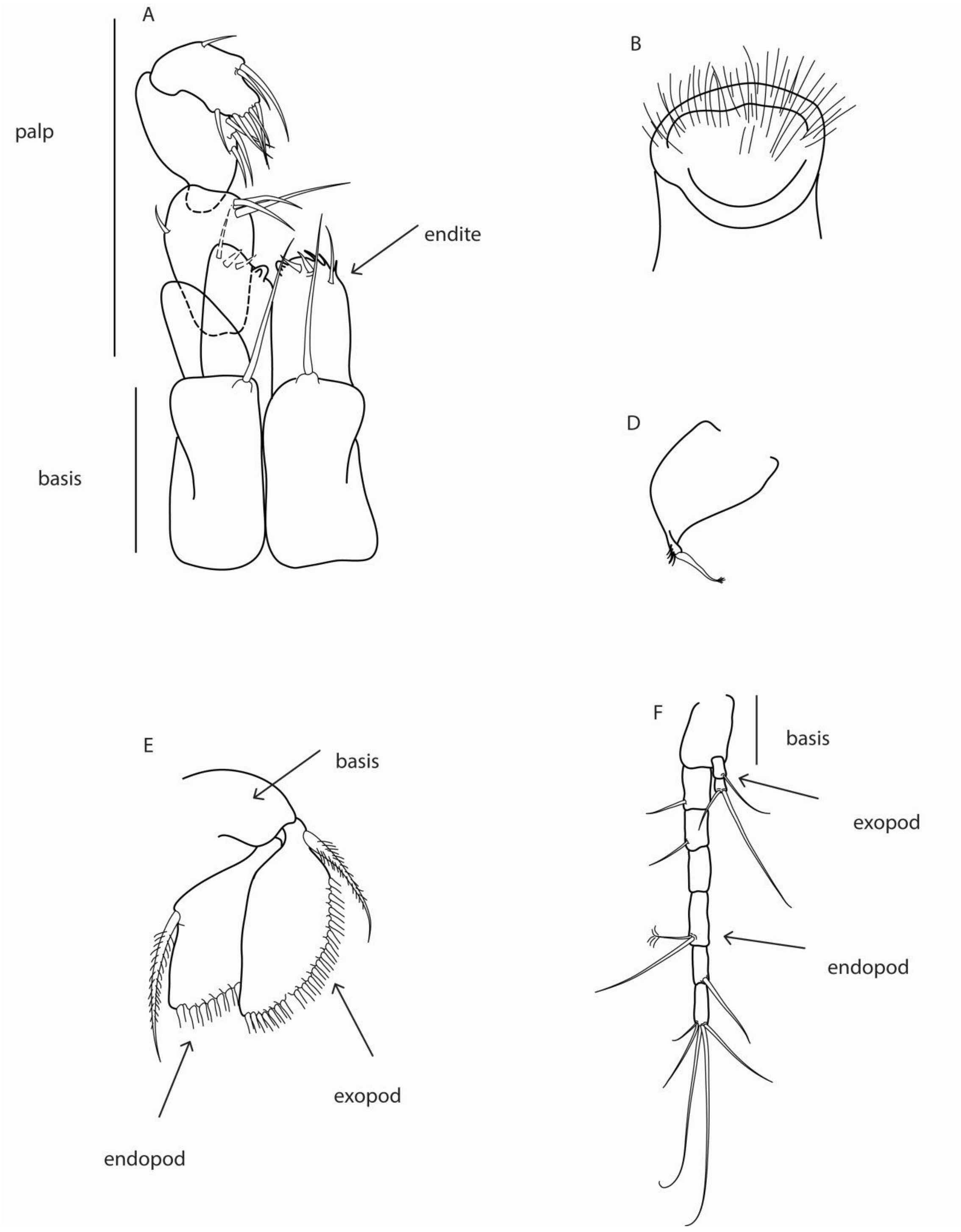


Fig. 3.4. Cephalotorax appendages (A, B, C) and appendages of pleon (D, E). A maxilliped; B labrum; C epignath; D pleopod; E uropodia.

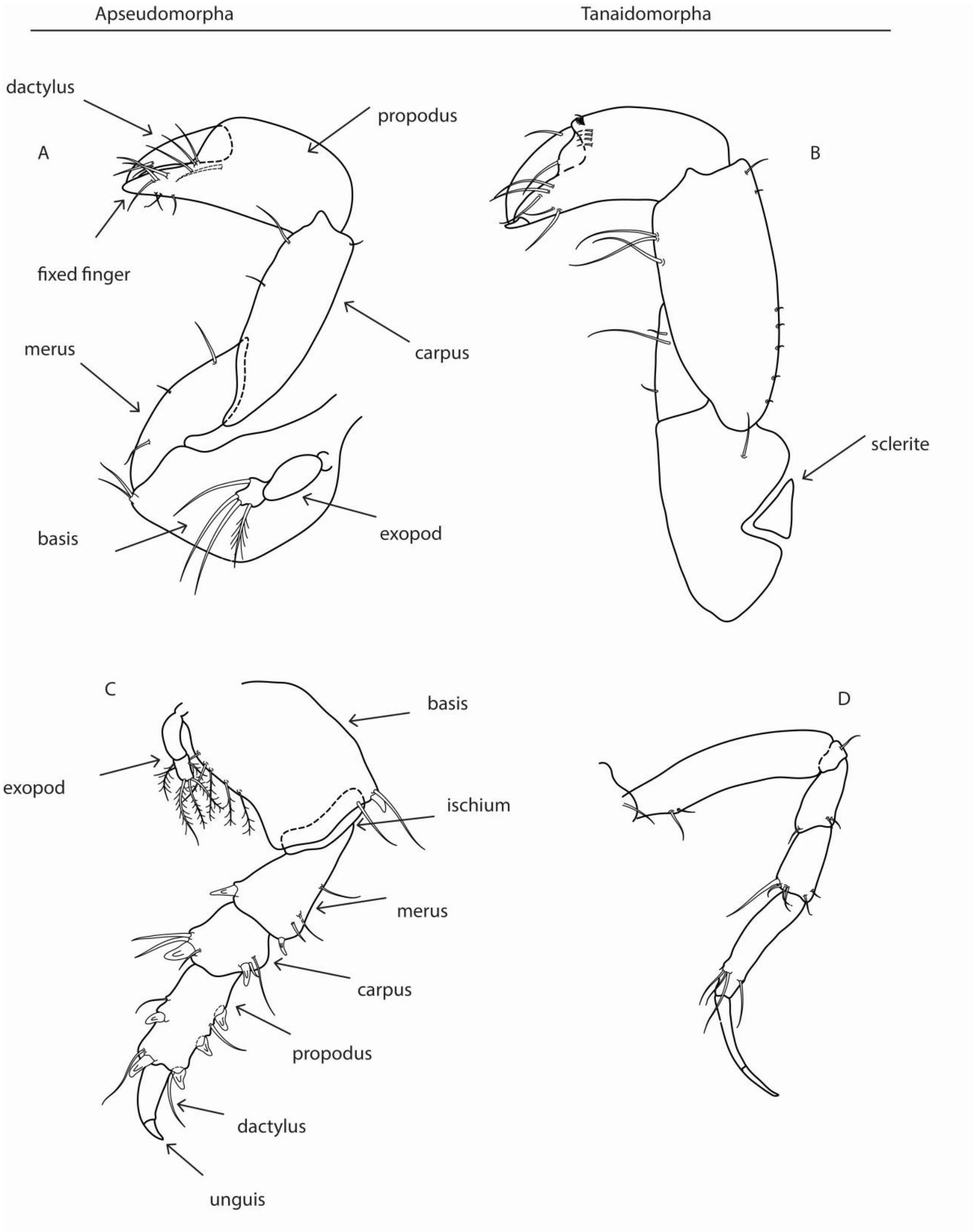


Fig. 3.5. Cheliped and pereopods of Apseudomorpha (A, C) and Tanaidomorpha (B, D). A, B cheliped; C, D pereopod-1.

The antenna and antennule

Members of the Apseudomorpha have biramous antennule. This appendage is composed of three-articulated peduncle and two flagellae: inner and other. Between peduncle and flagella article in common is present.

Antenna of representatives of the Apsedomorpha is biramous as well. Exopod is reduced and is called squama (Fig. 3.2A, C).

In the Tanaidomorpha both antennule and antenna are always uniramous (Fig. 3.2D).

The mouthparts

Mandible of the Apseudmorpha is equipped with a palp (Fig. 3.2E). The labium has two lobes, each with uniatriculated palp (Fig. 3.3E). The maxillule consist of two endites, outer endite can be tipped with a palp (Fig. 3.3A). Representatives of the suborder have maxilla divided into moveable and fixed endite (Fig. 3.3C). Maxilliped is composed of basis, endite and palp. In the Apseudomorpha basis and endites are always unfused. Epignath is wide and well developed.

Mandible of the Tanaidomorpha is not equipped with palp (Fig. 3.2F), the labium consist of one or two lobes without palp (Fig. 3.3F). The maxillule has one endite with palp (Fig. 3.3B). The maxilla is reduced to oval lobe (Fg. 3.3D). Endites and basis of maxillpedes can be completely or partially fused (Fig. 3.4A). Epignath is weakly developed.

The cheliped

Exopod of cheliped can be present or absent in representatives of the Apseudomorpha, but it is always absent in the Tanaidomorpha. The tanaidomorphan cheliped is often attached by sclerite (Fig. 3.5B).

The pereopoda

The first pair of pereopoda in the Apseudomorpha can be equipped with triarticulated or reduced exopod. Pereopod-1 can be similar to the following pereopods, or it can be larger and wider which is adaptation to borrow in sediments (Fig. 3.5C).

First pair of tanaidomorphan pereopod always lacks exopod. The pereopod-1 is longer than the following pereopods, and is specialized to spin mucus strands used for construction of the tubes (Fig. 3.5).

4. RESULTS

Part I.

CReefs program confirms a high diversity of Tanaidacea in Australian coral reefs

Coral reefs are recognized as the most diverse marine ecosystems on oceanic shelves (Roberts et al. 2002; Bouchet 2006), which support a high number of rare species (Selig et al. 2014). Those ecosystems are recognized as the most endangered and least sampled marine ecosystems (Poloczanska et al. 2007; Plaisance et al. 2011; De'ath et al. 2012). Reaka-Kudla (1997) has estimated that the number of species on coral reefs is close to one million, but the assessments of the diversity of coral reefs mainly rely on only a few surrogates such as corals, sponges, bryozoans, fish or mollusks (Kohln 1997; Kensely 1998); thus a different outcome might result if smaller and poorly studied organisms are included (Appeltans et al. 2012).

The CReefs Program – Australian node linked to the Census of Marine Life has aimed to complete a broad-scale taxonomic survey to collect information about distributions and estimate diversity of invertebrates at three sites of Australian reefs e.g. Ningaloo (NW Australia), Lizard Island and Heron Island (GBR). That program was a 'green-light' also for collecting less recognized organisms, often species that are small and difficult to sample (http://www.aims.gov.au/creefs). The extensive collections were made by various experts during in total nine field trips in three successive years (2008–2010) they have given a backbone for the latest statistical approach, in which diversity of multicellular species living on coral reefs was estimated between 0.55 and 1.33 million (Fisherat et al. in press).

During the CReef Program – Australian node, a large collection of Peracarida of order Tanaidacea was obtained. These crustaceans represent the smallest macrobenthos and are important elements of many of marine benthic communities of all latitudes and in full depth range (Larsen 2005; Błażewicz-Paszkowycz et al. 2014c; Pabis et al. 2014; Poore et al. 2014). The order is currently represented by over 1200 species (Anderson 2013) and it is considered the most grossly underestimated group of marine organisms, of which only 2–3% is currently known to science (Appeltans et al. 2012, Błażewicz-Paszkowycz et al. 2014c). Tanaidacea are sediment burrowing or tube building organisms occasionally occurring in a high densities (Bamber 2005). The majority of them are detritivores (Błażewicz-Paszkowycz & Ligowski 2002), although they also members other trophic guilds (Alvaro et al. 2011, Heard 2011; Błażewicz-Paszkowycz et al. 2014b).

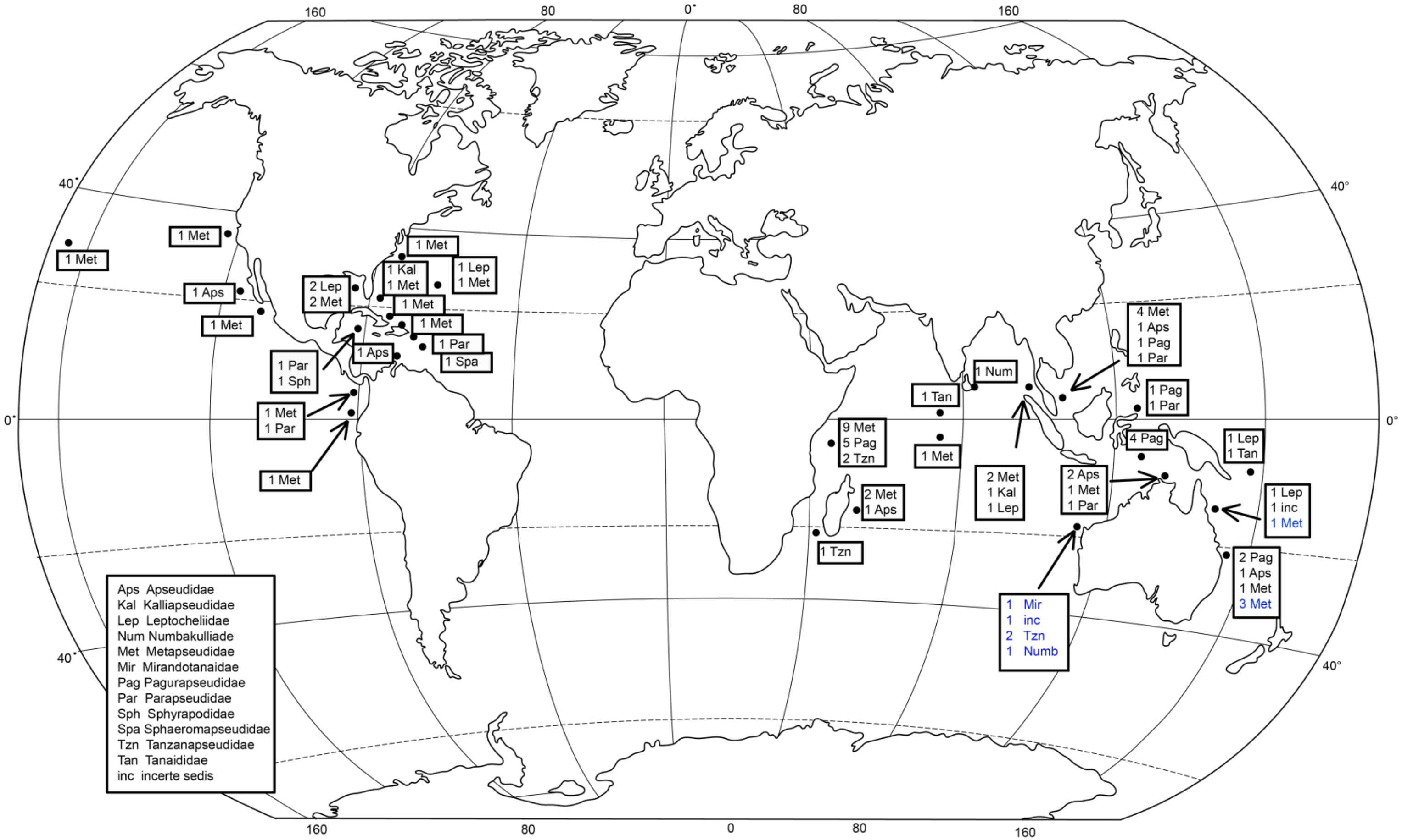
Tanaidacea associated with coral reefs remain almost completely unknown and the list of 66 species recorded so far as a fauna associated with those diverse ecosystems is undoubtedly incomplete (see Fig. 4.1.1 and citation there in). From Australian coral reefs 19 species are known so far and they were reported from strictly taxonomic approaches. Three of them – *Whitelegiia multicarinata* (Whitelegge, 1901), *Macrolabrum boeri* Băcescu, 1981 and *Paradoxapseudes larakia* (Edgar, 1997) were known before CReefs and nine others e.g. *Tanzanapseudes nieli* Stępień & Błażewicz-Paszkowycz, 2009, *T. levis* Stępień & Błażewicz-Paszkowycz, 2009, *Bamberus jinigudirus* Stępień & Błażewicz-Paszkowycz, 2013, *Metatanais bipunctatum* Błażewicz-Paszkowycz & Zemko, 2009, *Creefs heronum* Stępień & Błażewicz-Paszkowycz, 2013, *Curtipleon chadi* Stępień & Błażewicz-Paszkowycz, 2013, *Numbaculla pii* Stępień, 2013, *Msangia mussida* Stępień & Błażewicz-Paszkowycz, 2013 and *Pooreotanais ningaloo* Błażewicz-Paszkowycz & Bamber, 2009, have been described based on CReefs - Australian node collections.

The main purpose of this part of the dissertation is to present a poorly known tanaidacean fauna collected in three locations of Australian reefs (Lizard Island, Heron Island and Ningaloo Reef) and provide the details about their diversity, dominance and distribution.

Study Area

During the CReef Program-Australian node field-work organized by Australian Institute for Marine Research (AIMS), crustaceans from the order Tanaidacea were collected during six expeditions in total: two to Lizard Island, two to Heron Island, both located at Great Barrier Reef (GBR), and two to Ningaloo Reef in the West Australia.

Fig. 4.1.1. State of knowledge on tanaidaceans from coral reefs (Stebbing 1910; Menzies 1953; Băcescu 1975, 1976; Sieg 1980, 1982; Müller 1992; Guţu 2001, 2006; Guţu & Heard 2002; Heard et al. 2004; Błażewicz-Paszkowycz & Bamber 2009; Błażewicz-Paszkowycz & Zemko 2009; Stępień & Błażewicz-Paszkowycz 2009, 2013; Stępień 2013). Blue – species known from CReefs collection.



NINGALOO REEF

Ningaloo Reef is a 290 km long fringing reef system in West Australia that extends from North West Cape southward to Gnaraloo (21°40'S to 23°34'S and 113°45'E) (Spalding et al. 2001; Westera et al. 2003). Ningaloo Marine Park is a protected area and is part of the diverse reef system of the Indian Ocean classified as one of the least anthropogenically disturbed (Spalding et al. 2001). This area is characterized by well-developed reef flats and shallow lagoons with mean width 2.5 km (Smalwood et al. 2011), and corals exposed to oceanic waves are relatively low and compact. The continental shelf in the region is relatively narrow (20 km offshore); thus the reef crest extends between some 200 m to 7 km, forming lagoons not wider than 3 km diversified by patch and nearshore platform reefs.

HERON ISLAND

Heron Island situated in the most southern part of the GBR (23.25'S 151.59'E) is a typical coral island included in the Capricorn-Bunker group situated over 50 km offshore. The region is influenced by warm water (East Australian Current) and cooler water from southern Australia. The flow of cool water results in lower coral diversities (Hutchings et al. 2001).

LIZARD ISLAND

Lizard Island (14.41'S 145.28'E) is located in the northern part of Great Barrier Reef and together with two smaller islands (Bird and Palfrey) makes a small archipelago of continental origin surrounded by fringing reefs. The group of islands lays in a mid-continental shelf region, 30 km from the Australian shore and 19 km from the other barrier reefs (Litmann et al. 2008).

CURRENTS

The GBR and West Australian coral reefs are under various oceanographic regimes. The part of the South Equatorial Current that reaches the continental slope (Ganachaud et al. 2007) splits into two branches between 15–19 ºS that flow southward and northward as the East Australian Current (EAC) and Coral Coastal Current, respectively. The first forms the Tasman Front and warm eddies in the distinctively cooler Tasman Sea (Suthers et al. 2011), while the latter makes the Hiri Current (Choukroun et al 2010). The Queensland Plateau and GBR apparently reduce the westwind flow from the Pacific, and the currents entering the GBR, although weak, are highly variable. The mass of water that flows into the GBR can reside there for a few days to weeks and later form a strong and consistent jet northward and a substantially weaker but more variable jet southward (Choukroun et al. 2010). Some westward jet from the Coral Sea enters the Arafura Sea (Gordon 2005; Saint-Cast & Condie 2006) through the shallow Torres Strait with depth > 20 m, extending between the Cape of York and Papua New Guinea (Wolanski et al. 1988).

The Pacific-Indian waters that get through the straits and passages constrained between the islands and archipelagos of the Indo-Pacific region heat up and decrease substantially their salinity (Church et al. 1989; Jones 2003). The flow from the Timor Sea is directed southward along the continental shelf of West Australia. The Leeuwin Current is a narrow (50 m wide) warm, low-salinity surface that turns eastward around Cape Leeuwin and enters the Great Australian Bight.

Material and methods

SAMPLING

At each station, different habitats (e.g. coral rubble, sediments, algae, sand gravel) were arbitrarily chosen while SCUBA diving. Samples were collected from depths of 0–30 m by hand, placed in a mesh bag of 0.3 mm mesh, and transported in 20 L buckets to the laboratory, where after adding 5 ml of formaldehyde or fresh water they were left for an hour. After washing with seawater the sampled tanaidaceans were sorted alive under a dissecting microscope and then preserved in 80% ethanol.

MATERIAL

Seventy-three samples from 26 localities were collected at the Ningaloo Reef (Fig. 4.1.2). Tanaidacea were identified in 131 samples collected in 63 localities in the closest vicinity of Lizard Island, as well from the barrier reefs as: Carter, Younge, Day, Hick, Martin, North Direction, Yewell, and Waining (Fig. 4.1.3),

Tanaidacea were identified from 99 samples collected from 47 localities in the reef surrounding Heron Island (e.g. Heron Reef), as well as from a few reefs in the neighborhood: Broomfield, Must Head, Lamont, Sykes, and Wistari Reefs (Fig. 4.1.4).
(For coordinates see Appendix 4.1.1–4.1.3).

Fig. 4.1.2. Study area and location of the samples collected on Ningaloo Reef during CReefs program. A samples collected at 2008; A' samples collected at 2009.

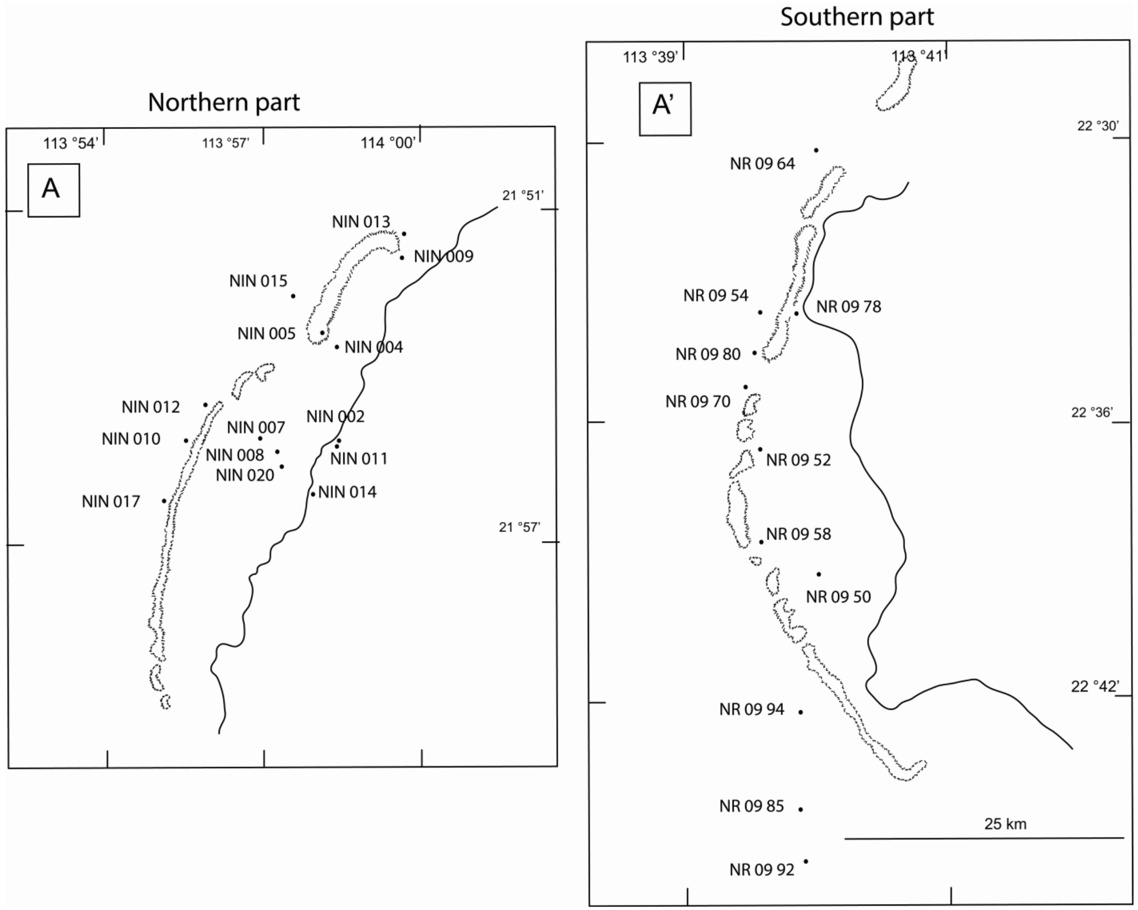


Figure 4.1.3. Study area and location of the samples collected in vicinity Heron Island during CReefs program.

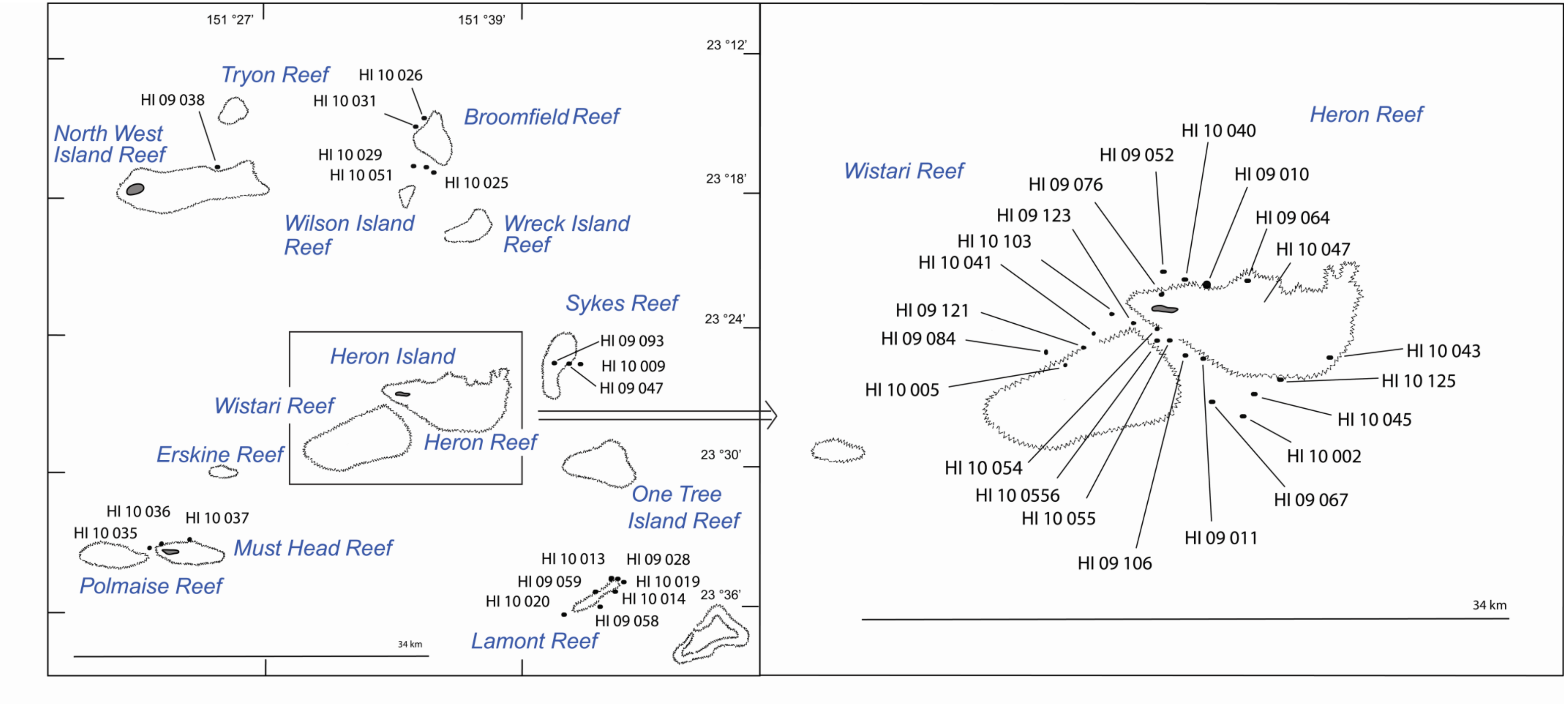
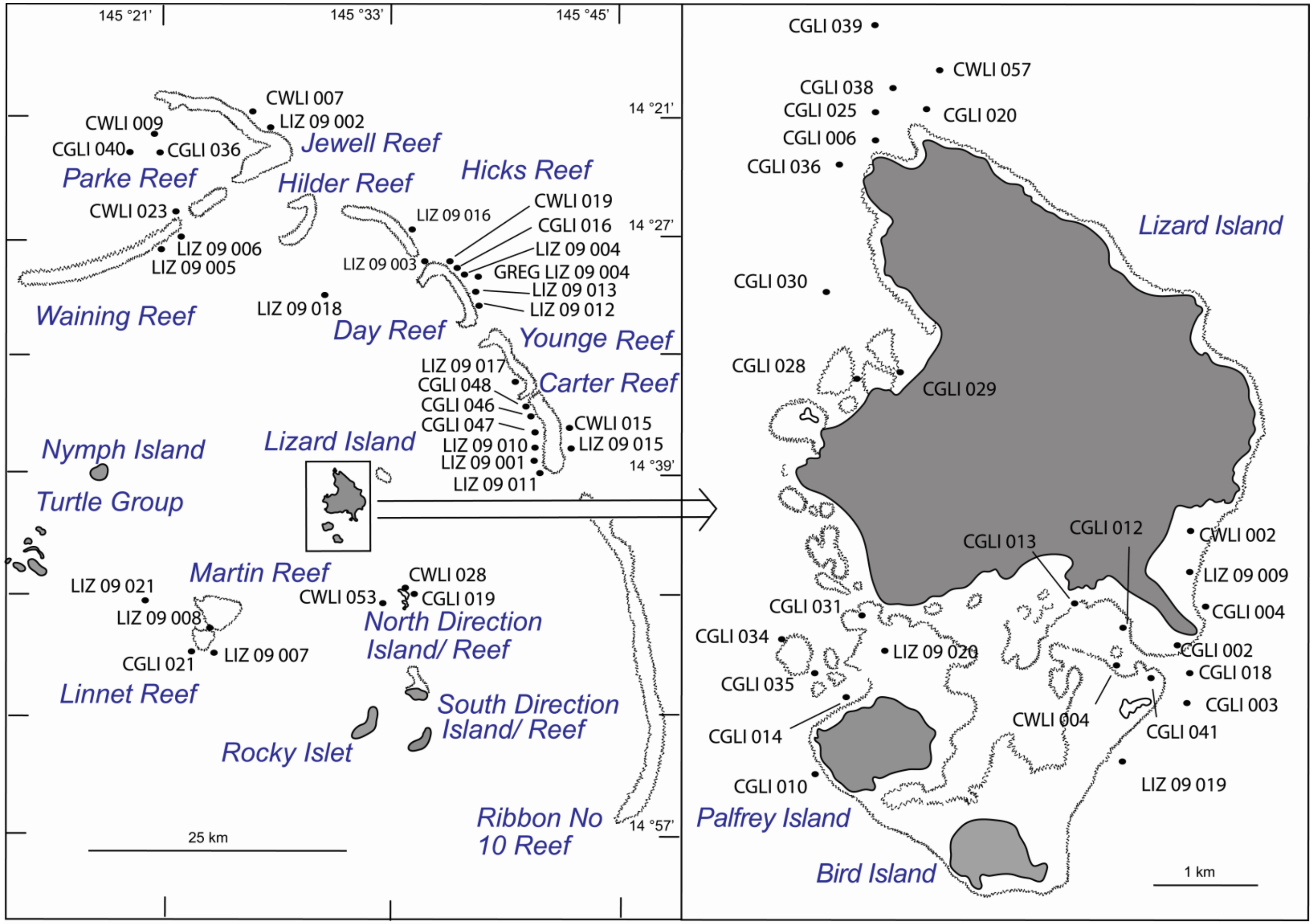


Figure 4.1.4. Study area and location of the samples collected in vicinity Lizard Island during CReefs program.



ANALYSIS

Frequency of occurrence and dominance were measured for each species in each area. Frequency is defined as the percentage of samples in which a species was found in the total number of samples; dominance as the percentage of specimens classified to a species in the total number of specimens.

Species-area curves were calculated for each area. The curve is calculated by adding the cumulative number of different species observed as samples are added randomly. Species-area curves were calculated with Primer v.5 with 999 permutations (Clarke & Gorley 2001).

Results

The study of the collection made during CReefs-Australian node yielded 9895 specimens of tanaidaceans belonging to 20 families, 53 genera and 72 species in total (Tab. 4.1.1). Close to half of the collection comes from Lizard Island (45%, 4446 ind., see appendix 4.1.4) and one third from Heron Island (35%, 3518 ind., appendix 4.1.5). The smallest collection was made from Ningaloo (20%, 1976 ind., appendix 4.1.6). Species-area curves was calculated, it is presented in fig. 4.1.5

From the three studied sites Heron Island was the most diverse with 47 species classified to 35 genera and 15 families, followed by Lizard Island with 44 species, 39 genera and 15 families. Less numerous and less diverse were samples from Ningaloo with 32 species classified to 29 genera and 14 families. Some of the species were recognized as in common between all three study area (Tab 4.1.2).

The most diverse families were Metapseudidae Lang, 1970 and Leptocheliidae Lang, 1973. The first was represented by 5, 11, and 8 species respectively; the other - Leptocheliidae included 6, 4, and 8 species, at Ningaloo, Heron I. and Lizard I., respectively.

A significant majority (95%) of the identified species of Tanaidacea were apparently new to science, although from twelve species known from Australian coral reefs (see Introduction) nine were described from CReefs collections (Błażewicz-Paszkowycz & Bamber 2009; Błażewicz-Paszkowycz & Stepień 2009, 2013; Błażewicz-Paszkowycz & Zemko 2009; Stepień 2013).

Tab. 4.1.1. Number of species (N), dominance (D) and frequency (F) calculated for the species from Ningaloo Reef (NIN), Heron I. (HER) and Lizard I. (LIZ).The highest value are marked in bold.

family/ species	**NIN** 26 station 73 samples			**HER** 47 stations 99 samples			**LIZ** 63 stations 131 samples		
Apseudidae	**N**	**D**	**F**	**N**	**D**	**F**	**N**	**D**	**F**
Apseudes sp.	25	1.27	15.07	12	0.34	10.10	20	0.45	8.40
Bilobatus sp.				7	0.20	2.02	1	0.02	0.76
Bunakenia sp.	125	7.69	6.85						
Paradoxapseudes larakia (Edgar, 1997)				80	2.27	20.20	474	**10.77**	**42.75**
Paradoxapseudes sp. 1	56	2.83	12.33						
Paradoxapseudes sp. 2				53	1.51	18.18			
Pugiodactylus sp. 1				1	0.03	1.01	7	0.16	1.35
Pugiodactylus sp. 2				136	3.87	30.30	12	0.27	4.58
Pugiodactylus sp. 3							7	0.16	2.29
Kalliapseudidae									
Kalliapseudes sp. 1				19	0.54	3.03			
Kalliapseudes sp. 2				1	0.03	1.01			
Metapseudidae									
Apseudomorpha sp.				40	0.14	13.13			
Bamberus jinigudirus Stępień & Błażewicz-Paszkowycz, 2013	15	0.76	5.48						
Creefs heronum Stępień & Błażewicz-Paszkowycz, 2013				72	2.05	5.05			
Cryptoapseudes sp.				2	0.06	2.02	3	0.07	1.35
Curtipleon chadi Stępień & Błażewicz-Paszkowycz, 2013				18	0.51	6.06	5	0.11	0.76
Cyclopoapseudes sp.	11	0.56	8.22						
Julmarichardia sp.	6	0.30	4.11	3	0.09	2.02	96	2.18	14.50
Msangia sp.							6	0.14	3.82
Msangia mussida Stępień & Błażewicz-Paszkowycz, 2013				29	0.82	4.04			
Pseudoapseudomorpha sp. 1	11	0.56	4.11	21	0.60	6.06	26	0.59	4.58
Pseudoapseudomorpha sp. 2				29	0.82	10.10	19	0.43	3.05
Pseudoapseudomorpha sp. 3				24	0.68	10.10			
Pseudoapseudomorpha sp. 4				4	0.11	4.04			
Synapseudes sp. 1	348	**17.61**	**46.58**	87	2.47	21.21	126	2.86	17.56
Synapseudes sp. 2							42	0.95	8.40
Numbakullidae									
Numbakulla pii Stępień, 2013				53	1.57	5.05			
Pagurapseudidae									
Indoapseudes sp.							11	0.25	4.58
Macrolabrum boeri Bacescu, 1981				24	0.68	7.07			
Macrolabrum sp.	12	0.61	9.59				8	0.18	5.34
Pagurapseudes sp.	4	0.20	4.11	14	0.40	7.07	4	0.09	3.05

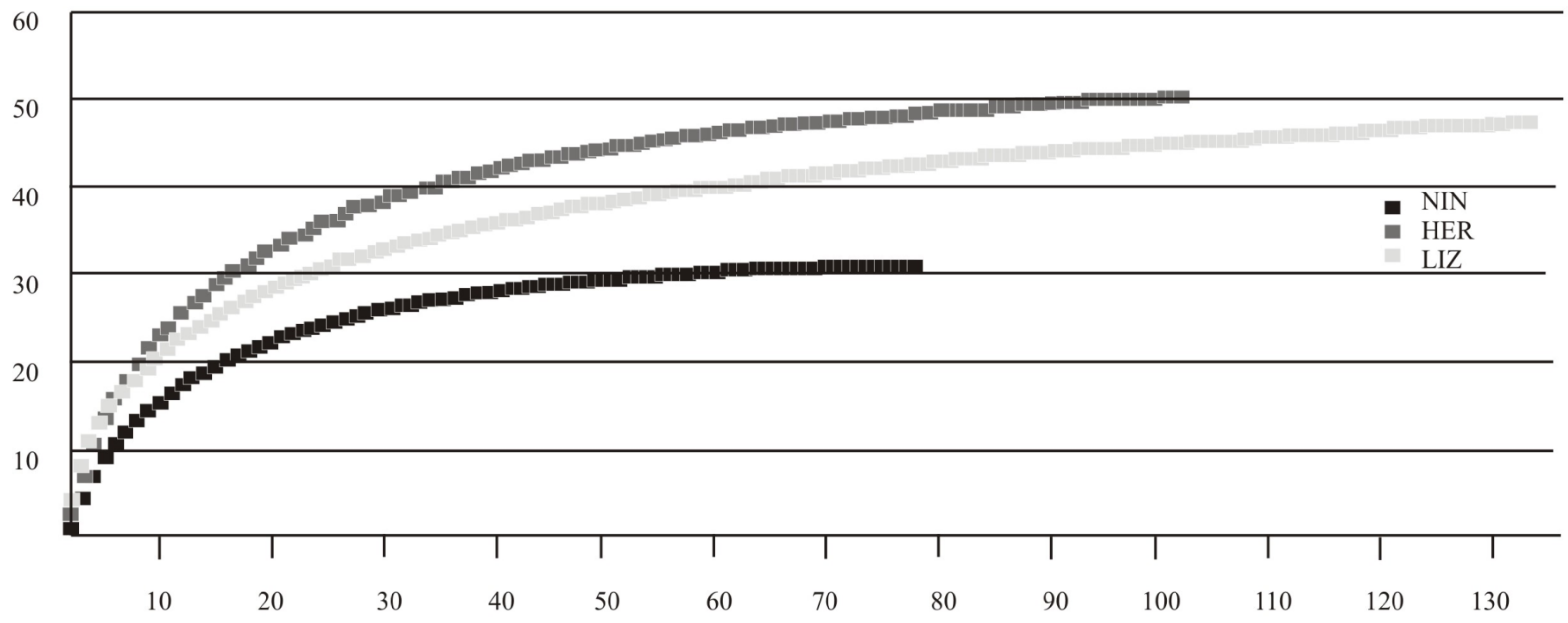
family/ species	NIN			HER			LIZ		
	N	**D**	**F**	**N**	**D**	**F**	**N**	**D**	**F**
Pagurapseudopsidae									
Paguropseudopsis sp.				20	0.57	3.03			
Parapseudidae									
Brachylicoa sp.	12	0.61	10.96	5	0.14	4.04	18	0.41	5.34
Pakistanapseudes sp.	5	0.25	4.11	3	0.09	1.01	3	0.07	2.29
Parapseudes sp. 1				142	4.04	26.26			
Parapseudes sp. 2				3	0.09	3.03			
Parapseudes sp. 3				36	1.02	8.08	3	0.07	1.53
Saltipedis sp.	22	1.11	12.33						
Sphaeromapseudidae									
Sphaeromapseudes sp.							8	0.18	1.53
Tanzanapseudidae									
Tanzanapseudes nieli Stępień & Błażewicz-Paszkowycz, 2009	5	0.25	2.74						
Tanzanapseudes levis Stępień & Błażewicz-Paszkowycz, 2009	1	0.05	1.37						
Whiteleggiidae									
Whiteleggia multicarinata (Whitelegge, 1901)	2	0.10	2.74	5	0.14	4.04	1	0.02	0.76
Cryptocopidae									
Iugentotanais sp.	2	0.10	1.37	2	0.06	2.02	20	0.45	11.45
Heterotanoididae									
Heterotanoides sp.							134	4.27	16.79
Leptocheliidae									
Araleptochelia sp.	*2*	0.10	2.74						
Araleptocheliinae gen.1 sp.	140	7.09	26.03	277	**7.87**	**42.42**	1103	**20.54**	**48.85**
Araleptochelinae gen. 2 sp.	256	**12.69**	24.066	65	1.85	20.20	904	3.43	17.76
Grallatotanais sp.							151	0.18	3.82
Konarus sp.	19	0.69	10.96	55	1.56	20.20	8	3.54	23.66
Leptochelia sp.	356	**18.02**	**53.42**	1616	**45.94**	**80.81**	156	**25.06**	**74.05**
Leptocheliinae gen. 1 sp.	*225*	**11.39**	30.14				6	7.66	10.69
Neoleptochelia sp.							337	0.14	3.05
Poorea sp.							188	3.04	0.76
Mirandotanaidae									
Pooreotanais ningaloo Błażewicz-Paszkowycz & Bamber, 2009	2	0.10	2.74						
Nototanaidae									
Nesotanais sp.	5	0.25	5.48	15	0.43	7.07	81	1.84	16.79
Paratanaidae									
Bathytanais sp. 2				2	0.06	2.02			
Pseudobathytanais sp. 1				1	0.03	1.01	1	0.02	0.76
Paratanais sp.	1	0.05	1.37						
Paratanais sp. 2	22	1.11	8.22	107	3.04	29.29			
Paratanais sp. 3	234	**11.84**	**49.32**	**259**	**7.36**	**51.52**	310	7.04	**45.80**
Pseudotanaidae									
Pseudotanais sp. 1	3	0.15	2.74	79	2.25	26.26	25	0.57	6.11
Pseudotanais sp. 2				3	0.09	1.01			

family/ species	NIN			HER			LIZ		
	N	D	F	N	D	F	N	D	F
Typhlotanaidae									
Antiplotanais sp.							25	0.57	4.58
Tanaidae									
Tanais sp.							26	0.59	1.53
Zeuxo sp. 1	17	0.86	12.33	42	1.19	17.17	13	0.30	4.58
Zeuxo sp. 2				20	0.14	1.01			
Zeuxo sp. 3				5	0.57	5.05			
Incerte sedis									
Metatanais bipunctata Błażewicz-Paszkowycz & Zemko, 2009	4	0.20	5.48	6	0.17	5.05	1	0.02	0.76
Tangalooma sp.				12	0.34	8.08			
Incerte sedis gen. 1 sp.							1	0.02	0.76
Incerte sedis gen. 2 sp.							2	0.05	1.53
Incerte sedis gen. 3 sp.	1	0.05	1.37	9	0.26	6.06	9	0.20	0.76

Table 4.1.2. Common species in each of Ningaloo Reef, Heron Island and Lizard Island

	Lizard I.	**Heron I.**	**Ningaloo**
Lizard I.	13 (29%)	x	x
Heron I.	28	17 (36%)	x
Ningaloo	19	20	10 (31%)

Figure 4.1.5. Species area curve calculated for Ningaloo Reef (NIN), Heron Island (HER) and Lizard Island (LIZ).



Four families e.g.: Leptocheliidae (48–67%), Metapseudidae (7–19%), Apseudidae (8–12%) and Paratanaidae (7–13%) contributed the most to the abundance (Fig. 4.1.6). The most abundant species at Ningaloo were: *Synapseudes* sp. 1 (18%), Araleptocheliinae gen. 2 sp. (13%), *Leptochelia* sp. (18%) and *Paratanais* sp. 3 (12%); the 20 species were found in percentages usually less than 1%. Mentioned *Synapseudes* sp. 1 showed high frequency (47%), although the most frequent species were *Paratanais* sp. 3 (49%) and *Leptochelia* sp. (53%); three other species had frequency above 25% and six others above 10%. In Heron Island the most numerous species were: *Leptochelia* sp. (45%), Araleptocheliinae gen. 1 sp. (8%) and *Paratanais* sp. 3 (7%). Those species were also the most frequent taxa, with percentages of 81%, 42% and 51%, respectively. Four species revealed frequencies over 25% and ten others over 10%.

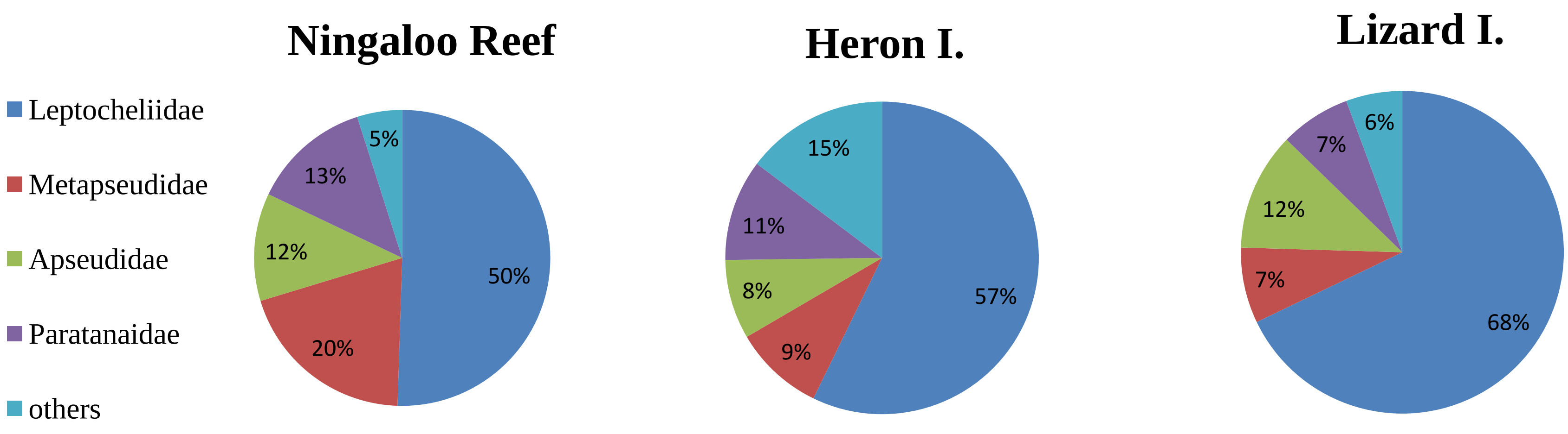
Similar to Heron I., at Lizard Island the most abundant species was *Leptochelia* sp. (25%) followed by Araleptocheliinae gen. 1 sp. (21%) and *Paradoxapseudes larakia* (Edgar, 1997) (11%). *Leptochelia* sp. and Araleptocheliinae gen. 1 sp. were also the most frequent taxa with values 74% and 49%, respectively. The third most frequent species in that collection was *Paratanais* sp. 3 (46%) (Tab. 4.1.1)

In terms of diversity, from all three sites, twelve genera (22%) were represented by more than one species: *Pseudoapseudomorpha* with four species, *Paradoxapseudes* (3), *Parapseudes* (3), *Paratanais* (3), *Pugiodactylus* (3), *Zeuxo* (3), *Kallipapseudes* (2), *Macrolabrum* (2), *Msangia* (2) *Synapseudes* (2), *Pseudotanais* (2), *Tanzanapseudes* (2), although these measures are much lower at the local scale. From Ningaloo only two genera (12%) were represented by more than one species, while in Heron Island and Lizard Island there were eight genera (22%) and four (10%) genera, respectively.

Discussion

The preliminary results on the CReefs tanaidaceans provide several significant findings. First of all it is established that Tanaidacea are diverse crustaceans on Australian coral reefs. The number of reported tanaidaceans tends to be low when compared against large and well studies organisms, such as for example shell gastropods represented in GBR by 2500 species or bivalves, brachyurans and stomatopods, each known from some 500 species at GBR (Ahyong 2009; Willan 2009) and various class of echinoderms each represented by a few dozens of species, e.g., brittle stars – 166 spp., sea stars – 137 spp., sea cucumbers – 127 spp., sea urchins –

Figure 4.1.6. Families share at Ningaloo Reef, Heron Island and Lizard Island.



110 spp., feather stars – 90 spp. (Byrne 2009). More adequate might be a comparison of tanaidacean diversity to some cryptofauna such as the other peracarids (Preston & Doherty 1994). Lowry & Mayer (2009) have demonstrated that the most diversified brood-pouch crustaceans on the GBR are Amphipoda (235 species) but this result was determined from the collections made in three distant locations (e.g. Lizard I., Orpheus I. and Heron I.) and was a result of long term and intensive field works. More reliable is comparison of the diversity of Tanaidacea with Isopoda, the peracarids with similar behavior (low mobility, burrowing) that often share similar habitats with tanaidaceans. The number of Isopoda from the collection of CReefs was approximately one hundred species (Bruce, unpubl. data), although the total number of Isopoda from Australian coral reefs is twice as large (Ayong 2009).

In each of the studied locations families such as Metapseudidae, Apseudidae, Parapseudidae, Pagurapseudidae, Leptocheliidae, Tanaidae and Paratanaidae were the most diverse and most frequent component of the material studied (Table 4.1.3). Sphyrapodidae, known from only one species in coral reefs off Cayman Island (Guţu & Heard 2002a), was generally absent in Australian shelf, although two species were recently found in sandy sediments off Brunei (Bamber & Marshall 2013). Families such as Whitelleggidae, Tanzanapseudidae, Numbacullidae recorded in each of three working areas with distribution restricted of Indo-Pacific and Australia presumably radiated in those regions (Bamber & Blażewicz-Paszkowycz 2012). On the other side Mirandotanaidae, represented in Australian waters by five species (three off NSW yet to be described) in addition to one species (*Mirandotanais vorax*) ocuring in the Antarctic, better support a hypothesis about allopatric speciation (Błażewicz-Paszkowycz in press).

A high number of the previously undescribed taxa of Tanaidacea in the CReefs material reflects a weak recognition of this group in Australian coral reefs and confirms generally high underestimation of crustaceans in these ecosystems (Plaisance et al. 2011). The shape of the accumulation curves indicates that few species remain be found in each of the three investigated localities. Nevertheless, the list of the species presented in this paper is undeniably not complete and more species should be added to the list if deeper samples and more habitats could be explored. The logistic restrictions and a respect for natural environments limited the number of deeper samples (>20 m) or samples collected from outer reefs as well as from living corals. Furthermore exploring the deeper part of the reefs (>30 m) would presumably supplement the list in the

Tanaidacea of Australian reefs with members of families such as Typhlotanaidae or Tanaellidae, which have been found in the deeper waters of Bass Strait (Błażewicz-Paszkowycz & Bamber 2012), Esperance (Bamber 2005) or in the deeper shelf of West Australia (Poore et al. 2014; McCallum et al. in press).

Probably the most unexpected result of this study are species common to all of the three investigated sites (Tab. 4.1.2) separated by direct-line distances of over two thousand km (e.g. Ninagaloo–Lizard Island and Lizard Island–Heron Island). Similarly no morphological differences were observed in specimens of *Metatanais bipunctatus* with identical color pattern collected at the three investigated sites (Tab. 4.1.1) (Błażewicz-Paszkowycz & Zemko 2009). Bearing in mind that tanaidaceans are virtually immotile benthic brooders, the substantial distance between Ningaloo and Lizard Island might be too large for effective gene flow between populations, especially if there is a lack of required habitats in between (North Australia). A strong genetic differentiation of East *versus* West Australia or Indian *versus* Pacific Ocean was reported in populations of fish or large invertebrates such as clams, starfish, or holothurians, which have long-lived planktonic larvae that promote vast geographic distribution (Benzie 1992; Wiliams & Benzie 1996; Ovenden et al. 2002). In this context we have no doubts that recorded tanaidacean species in the NW and both sites of the GBR represent cryptic species, alternatively 'pseudo-sibling' species (Knowlton 1993, 2000). The presence of cryptic taxa within widespread or even sympatric taxa was demonstrated for various taxonomic groups (Knowlton 1986; Larsen 2001; Uthickle & Benzie 2003; Poore & Andreakis 2011, 2012). Besides that, in the collection from Lizard Island two sympatric and morphologically identical species of *Leptochelia* displayed emerald and pale tint, respectively, which turned white once preserved. Without molecular tools it is impossible to say if the "emerald" and "pale" specimen are conspecific groups of individuals having only different food resources or they are rather sympatric taxa which occupy distinct niches, where the green colour might be an advantage that (for example) increases the chance of surviving (Bamber 2013; Bird 2013; Błażewicz-Paszkowycz 2007; Edgar 2012). Nevertheless presence of potential cryptic species suggests existence of hidden diversity that needs further examination by applying molecular techniques.

Tab. 4.1.3. Number of species classified to distinct families at different localities according Bamber 1997, 1998, 2000, 2005, 2008; Bamber & Bird 1997; Błażewicz-Paszkowycz & Jażdżewski 1997; Bird & Bamber 2000; Błażewicz-Paszkowycz & Bamber 2007a, b; 2012; Larsen & Shimomura 2006, 2007, 2008; Błażewicz-Paszkowycz unpubl.

		Ningaloo	Heron I.	Lizard I.	Hong Kong	Japan	Moreton Bay	Esperanza	Bass Strait	Kerguelen I.	Admiralty Bay	Ross Sea
	families/number of survey	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**many**	**1**	**many**	**1**
APSEUDOMORPHA	Metapseudidea	5	11	8		4	1		3	2		
	Apseudidae	3	6	6	8	4	2	3	9			
	Parapseudidae	3	5	3	5	6	6	4	9			
	Pagurapseudidae	2	2	3			1	2	7			
	Kalliapseudidae		2		2	1	1	1	1			
	Tanzanapseudidae	2										
	Whitellegidae	1	1	1			1		2			
	Numbacullidae		1									
	Pagurapseudopsidae		1									
	Sphaeromapsuedidae			1								
	number of families	6	8	6	3	4	6	4	6	1		
TANAIDOMORPHA	Leptocheliidae	6	4	9	2	2	9	4	4	1		1
	Tanaidae	1	3	2	3	3	2	5	2	5	1	
	Paratanaidae	3	4	2	3		5	4	6	1		
	Tanaopsidae				1		1		2	1	1	1
	Pseudotanaidae	1	2	1				1		1		2
	Akanthophoreidae						1		1	1	1	3
	Typhlotanaidae						1	1	6	2	6	1
	Tanaellidae							2	7		1	1
	Nototanaidae				1	1			2	1	2	4
	Cryptocopoidae	1	1	1								1
	Colletteidae								1	1		3
	Tanaissuidae											1
	Agathotanaidae								2			2
	Mirandotanaidae								1		1	1
	Agathotanaidae								2			2
	incertae sedis	2	3	4		2			2			4
	Neotanaidae											1
	Anarthruridae											1
	Leptognathiidae									2		4
	number of family	6	6	6	5	4	6	6	13	9	7	17
	number of family grande total	12	14	12	8	8	12	1	18	1	7	17
	number of species grande total	8	17	14	25	23	36	31	72	19	13	0

The wide distribution of recent marine fauna is justified in two ways: contemporary or paleocurrents, and paleogeography (Benize 1998). In the case of Tanaidacea, with a restricted dispersive ability (Błażewicz-Paszkowycz et al. 2012), the distribution of a single species covering NE Australia and East Australia is virtually impossible.

Passive dispersion by marine currents, rafting, and foresia, or on the geological scale by continental drift, are potential and obligatory ways for dispersion (Bamber & Błażewicz-Paszkowycz 2012; Bamber 2012). Tanaidaceans usually live in self-constructed tubes (Johnson & Attramadal 1982; Hassak & Holdich 1987); alternatively they borrow in sediments, although some are associated with mats of algae (Edgar 2012), mangroves, or sunken wood (Błażewicz-Paszkowycz et al. 2014b; Larsen et al. 2013) or are epibionts and parasites of holothurians, polychaetes or turtles (Larsen 2005). Intuitively it is feasible to imagine that inhabiting some objects increases the chance for passive distribution (but see Reidenauer & Thistle 1985). Investigated tanaidaceans were far too small for direct observation in their microhabitats, but since they were numerous in collected corral rubble samples undoubtedly they inhabit crevices, fissures and cracks of scleractinian skeletons, as many other invertebrates (Plaisance et al. 2011). One exception here might be *Tanzanpaseudes* whose flattened body is probably an adaptation for living on the surface of sponges or corals (Băcescu 1975; Müller 1992); the other *Msangia mussida* was reported from a live coral (Stepień & Błażewicz-Paszkowycz 2013). Jackson (1986 and citations therein) has emphasised the role of the benthic storms for passive transport of sessile organisms and has given an example that fragments of branching corals are transported up to 50 m during a single storm or storm season. It therefore might be possible that for some opportunistic tanaidaceans, for example members of Leptocheliidae, dispersion along with a fragment of their habitat is quite feasible.

Experimental approaches applying drifters (Choukroun et al. 2010) have documented convection in water flow between the northern and southern GBR although such potential connectedness that might minimize genetic divergence between remote populations in GBR was questioned (e.g. Planes et al. 2001; Campbell et al. 2005). Another 'narrow throat' is the shallow Torres Strait. Although there is oceanographic evidence of exchange of water between the Gulf of Carpentaria/Arafura Sea and the Coral Sea (Wolanski et al. 1988; Gordon 2005; Saint-Cast & Condie 2006) undoubtedly it makes a stark present-day zoogeographic barrier for E. Australian and Indo-Malayan or W. Australian organisms (Williams & Bensie 1998).

The current distribution of cryptic species or species complexes well reflects the geological historic processes of the Australian and Indo-Pacific regions. Cyclic climate changes in the Pleistocene trigged changes of sea level exposing reefs between Indonesia, Philippines and Malaysia, separating shallow pools in which animals could survive and radiate (Veron et al. 2011). Poore & Andreakis (2012) have documented that collision between Australia, Papua New Guinea (PNG) and Indonesia during the Miocene has merged fauna on one side (Poore & O'Hara 2007) and restricted gene flow and caused allopatric speciation of the other side. In light of this argument *Whitellegia multicarinata*, *Synapseudes* sp. 1 or *Metatanais bipunctatus* (Tab. 4.1.1) readily support this model, drafted earlier by Bamber & Błażewicz-Paszkowycz (2012). Furthermore *M. cylindricus* lives on the coasts of Japan on algal mats (Shiino 1952), so in apparently a different habitat than *M. bipunctatus*, and is also morphologically conspicuously distinct. This scenario stays in congruence with Wallace's line, although too scarce data prevent reliable conclusions.

Taxonomic notes

Order Tanaidacea Dana, 1849

Suborder Apseudomorpha Sieg, 1980

Family Apseudidae Leach, 1813

The family Apseudidae currently includes 180 species in 24 genera (Anderson 2013, WoRMS 2014) widely distributed from tropical to polar zones (e.g. Jóźwiak & Błażewicz-Paszkowycz 2007; Araŭjo-Silva et al. 2013) present in wide bathymetric range (e.g. Larsen 2005; Bamber 2008a). Phylogenetic approaches univocally indicates that the family although polyphyletic it includes most plesiomorphic tanaidaceans (Kakui et al. 2011; Jóźwiak et al. unpublished).

In Australian waters the family of Apseudidae is represented by eleven species in seven genera (1997, 2008b; Edgar 1997; Guţu 2006; Błażewicz-Paszkowycz & Bamber 2007a; Bamber & Błażewicz-Paszkowycz 2013). In the CReefs collections nine species of the family were identified, which constituted from 7% of all collected individuals.

From elsewhere the eight species of apseudid were recorded as fauna associated with coral reefs (Menzies 1953; Edgar 1997; Guţu 1998, 2001b, 2007;) and three of them *Paradoxapseudes larakia* (Edgar, 1997), *Apseudes bucospinosus* Guţu, 2006, and *Apseudes fecunda* (Guţu, 2006) come from Australian waters.

Subfamily Apseudinae Leach, 1813

Genus *Apseudes* Leach, 1813

The genus *Apseudes* is represented in Australian waters by eight species: *A. abditospinosa* Błażewicz-Paszkowycz & Bamber, 2007a, *A. quasimodo* Błażewicz-Paszkowycz & Bamber, 2012, *A. pooeri* Błażewicz-Paszkowycz & Bamber, 2007a and *A. tuski* Błażewicz-Paszkowycz & Bamber, 2007a from Bass Strait (SE Australia), *A. atuini* Bamber, 2005 form Esperance (SW Australia), as well as *A. bucospinosus* (Guţu, 2006) recorded in vicinity of Heron Island, *A. fecunda* (Guţu, 2006) in coast of Queensland and *A. splendina* (Guţu, 2006) from Moreton Bay.

***Apseudes* sp. 1**

Material: 26 specimens found in 12 samples at Ningaloo, 12 specimens from 10 samples at Heron Island, and 20 specimens found in 11 samples at Lizard I. All of the records come from coral rubble or dead *Acropora* and *Pollicipora* heads collected from depth 2–27 m.

Distribution. *Apseudes* sp. 1 is widely distributed in all three study areas. It was collected from southern and northern part of Ningaloo Reef (Fig. 4.1.7a, a'), in the vicinity of Heron I. (Fig. 4.1.8a) at Broomfiled, Heron, Wistari, Sykes, and Lamont Reefs. Near Lizard Island (Fig. 4.1.9a) it was found at reef around the island, and North Directed Reef, and barrier Waining and Day Reefs.

Remarks. This is apparently robust species, which mature specimens grow up to 5–10 mm. *Apseudes* sp. 1 in general appearance is superficially similar to *A. fecunda* reported off Darwin by Guţu (2006). Nevertheless the CReefs species is readily distinguished from *A. fecunda* by antennule outer flagellum that is only half as long as in *A. fecunda*.

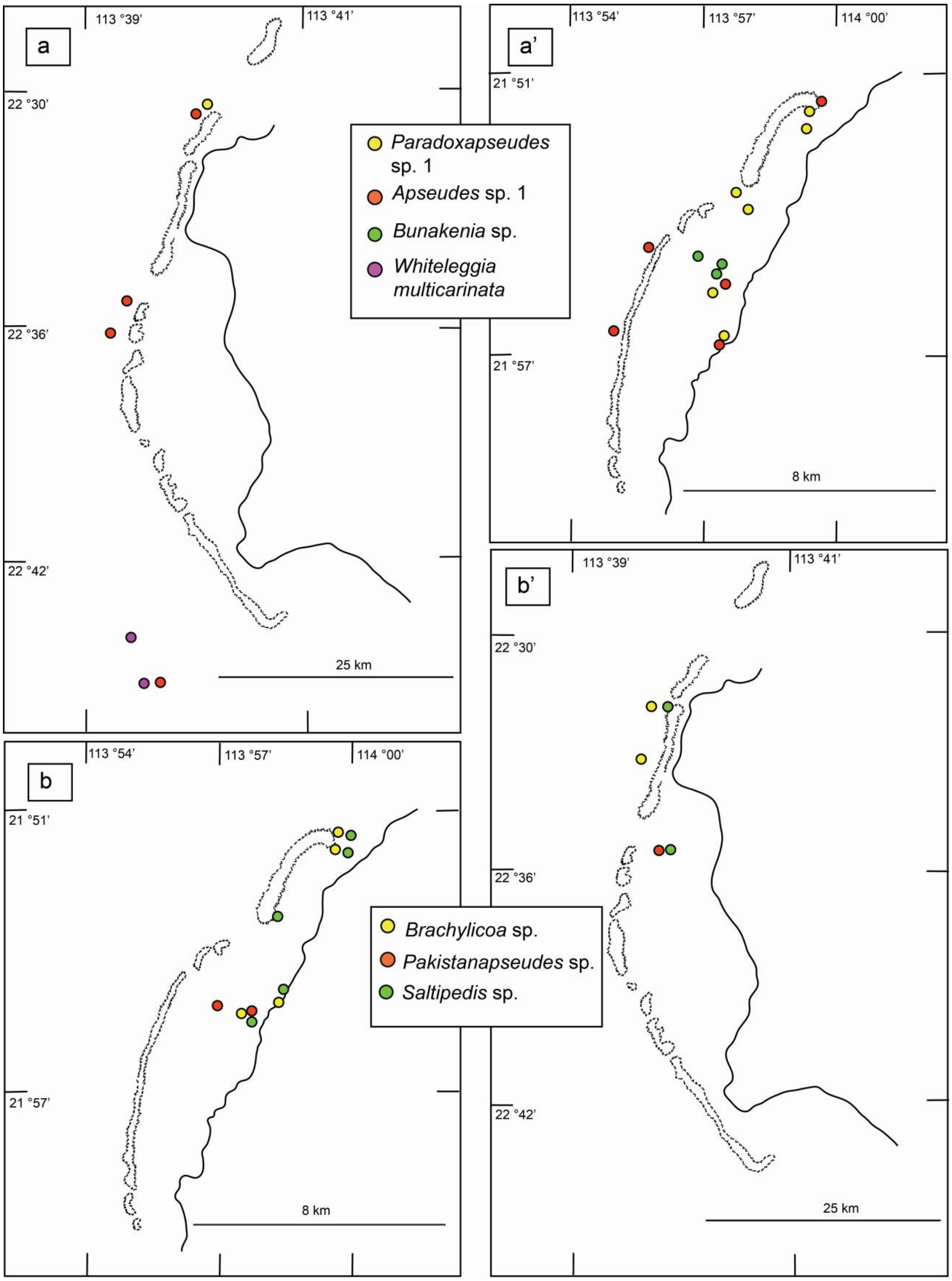


Fig. 4.1.7. Ningaloo Reef. Distribution of *Paradoxapseudes* sp. 1, *Apseudes* sp. 1, *Bunakenia* sp. *Whiteleggia multicarinata* (Whitelegge, 1901) at **a)** northern part and **a')** southern part. Distribution of *Bryachylicoa* sp., *Pakistanapseudes* sp. and *Saltipedis* sp. at **b)** southern part and **b')** northern part.

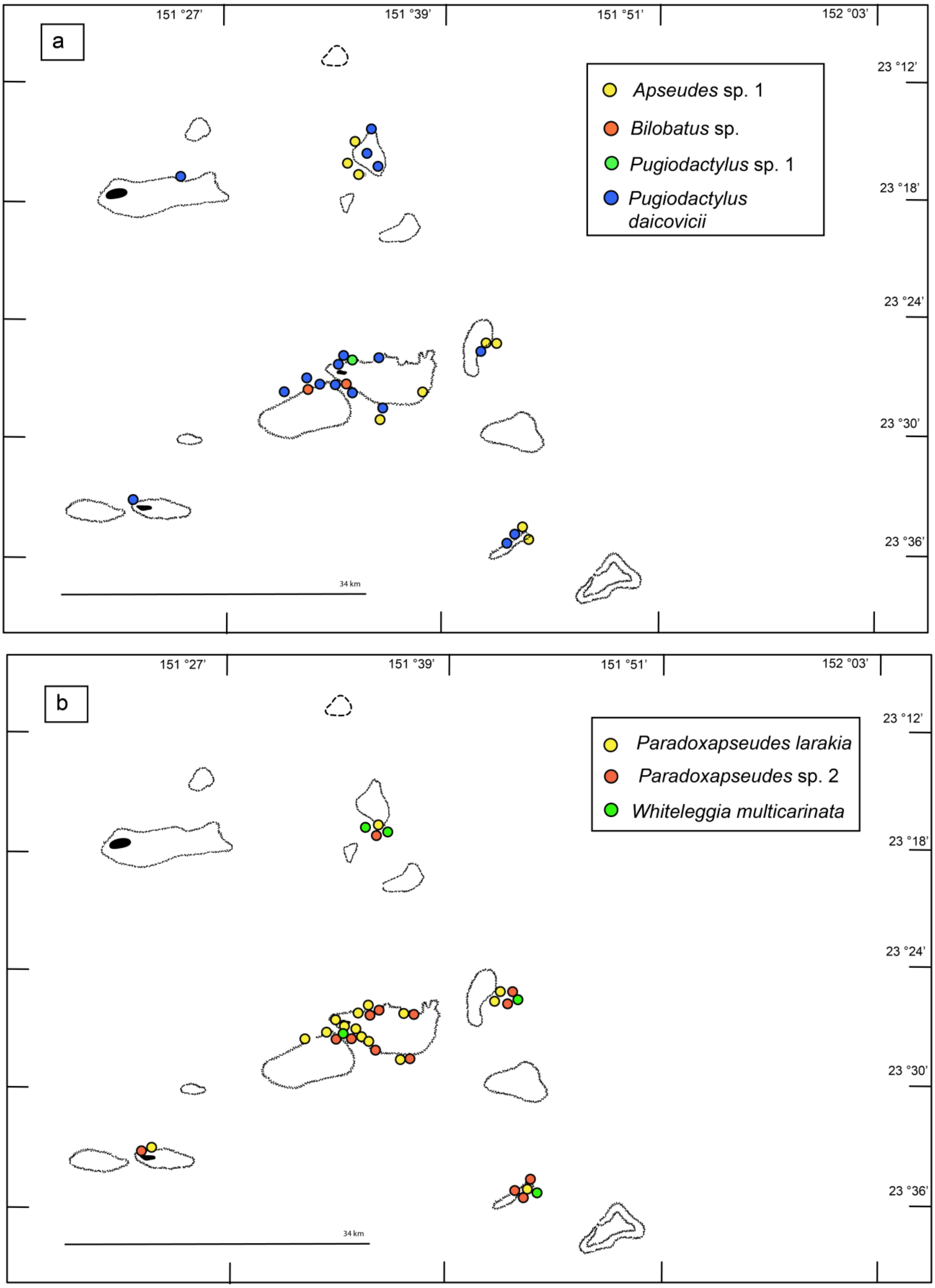


Fig. 4.1.8. Heron Island. Distribution of **a)** *Apseudes* sp. 1, *Bilobatus* sp., *Pugiodactylus* sp. 1, *Pugiodactylus daicovicii*; **b)** *Paradoxapseudes larakia* (Edgar, 1997), *Paradoxapseudes* sp. 2, *Whiteleggia multicarinata* (Whitelegge, 1901).

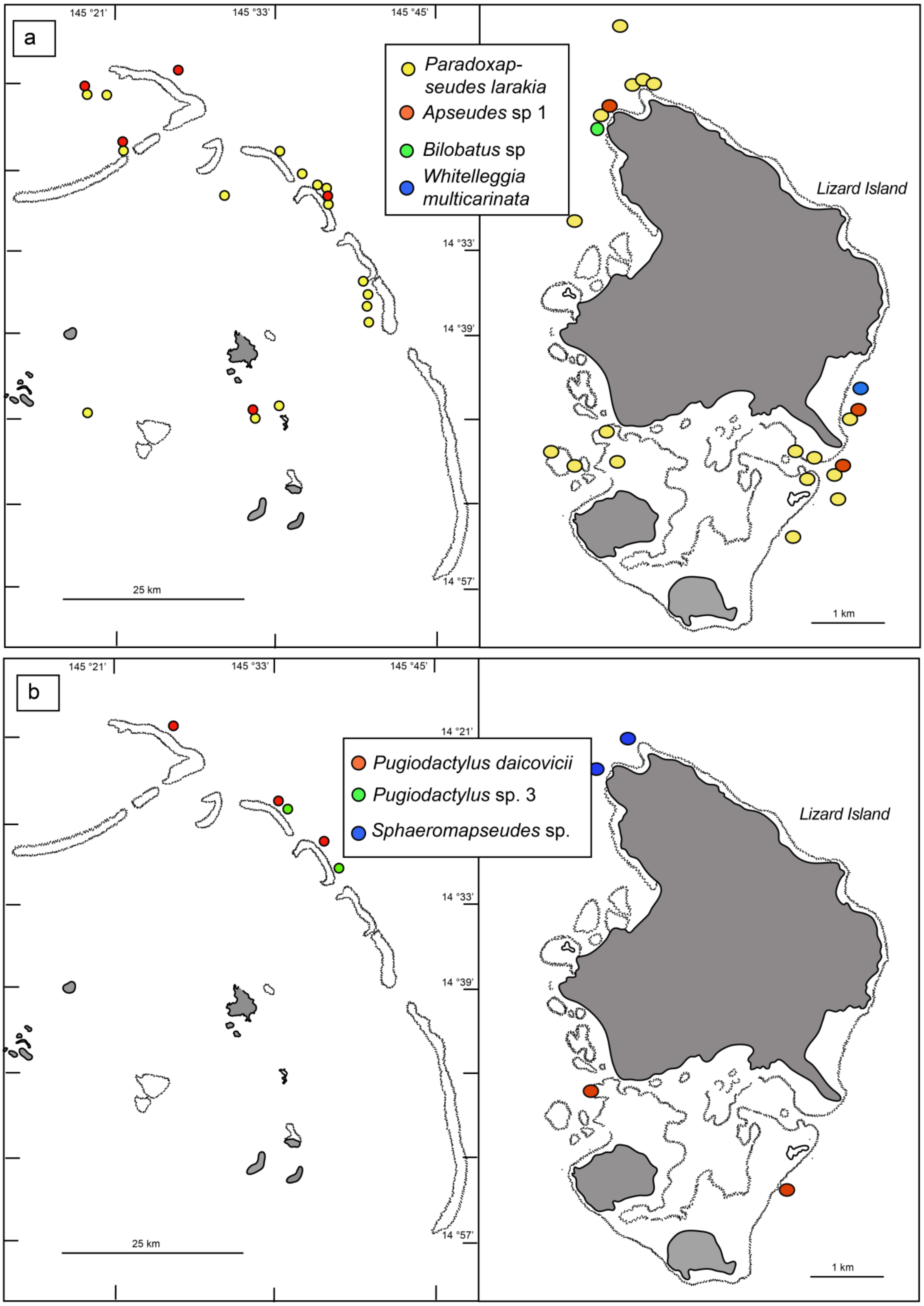


Fig. 4.1.9. Lizard Island. Distribution of **a)** *Paradoxapseudes larakia* (Edgar, 1997), *Apseudes* sp. 1, *Bilobatus* sp., *Whiteleggia multicarinata* (Whitelegge, 1901); **b)** *Pugiodactylus daicovicii* Guţu, 2006, *Pugiodactylus* sp. 3; *Shaeromapseudes* sp.

Genus *Bilobatus* Sieg, 1993

The genus is represented in Australian waters by two species: *B. gallardoi* (Shiino, 1963) known from Esperance Bay and coast of Northern Territory (Shiino 1963; Bamber 2005) and *B. rostridentatus* Guţu, 2006 recorded from the Coral Sea (Guţu 2006).

***Bilobatus* sp.**

Material: Seven specimens found in two samples at Heron I., and one specimen found in singles sample off Lizard I. in depth range from 0 to 30 m, on the coarse sand and *Halimeda.*

Distribution. The species was found only on GBR, in vicinity of Heron I. it was collected near Heron and Wistari Reefs (Fig. 4.1.8a). Near Lizard I. species was found only near the northern coast of the island (Fig. 4.1.9a).

Remarks. A bifid genital cone makes *Bilobatus* sp. similar to *B. gallardoi* (Shiino, 1963), however it could be distinguished by a number of segments in antennule inner flagellum, which is five in *Bilobatus* sp. and four in *B. gallardoi*. Beyond that *Bilobatus* sp. has a row of seta on basis of the first pereopod that absent in *B. gallardoi*.

Genus *Bunakenia* Guţu, 1995b

Bunakenia is represented by three species in Australian waters: *B. anomala* Guţu, 2006 from Moreton Bay, *B. labanticheiros* Błażewicz-Paszkowycz & Bamber, 2012 recorded at Bass Strait, and *B. salzella* Bamber, 2005 from Esperance Bay.

***Bunakenia* sp.**

Material: 152 specimens found in five samples at Ningaloo, in depth range from 2.5 to 5 m. Species was recorded on sand and coarse sand with some silt.

Distribution. *Bunakenia* sp. occurs only at northern part of Ningaloo Reef (Fig. 4.1.7a).

Remarks. Bunakenia sp. has a row of long setae on basis of the first pereopod what distinguishes it from *B. labanticheiros* Błażewicz-Paszkowycz & Bamber, 2012 with two proximal setae on basis and *B. anomala* Guţu, 2006 with four short setae. From

B. salzella Bamber, 2005 *Bunakenia* sp. could be distinguished by number of segments in antennule flagellum. Inner flagellum in *Bunakenia* sp. is composed of seven segments, and outer flagellum of 14 segments, while in *B. salzella* it is composed of five and 12 segments, respectively.

Genus *Paradoxapseudes* Guţu, 1991

Paradoxapseudes Guţu, 1991 in Australian waters is represented by three species: *P. attenuata* Błażewicz-Paszkowycz & Bamber, 2012 *P. paneacis* Błażewicz-Paszkowycz & Bamber, 2012, described from Bass Strait and *P. larakia* (Edgar, 1997) off Darwin from Norther Teritory.

Paradoxapseudes larakia

Material: 80 specimens found in 20 samples near Heron I. and 475 specimens found in 57 samples at Lizard I., collected in depth range from 1 to 30 m. It was mainly recorded from coarse sand, coral rubble, dead coral head, *Acropora*, *Halimeda* and turfs of algae.

Distribution. The species was wide distributed in vicinity of Heron I. (Heron Reef, Must Head Reef, Broomfield Reef, Sykes Reef, and Lamont Reef – Fig. 4.1.8b) and Lizard I. (reef surroundings North Direction Island and at Martin Reef, as well as at barrier Parke, Jewell, Hicks, Day, Younge and Carter Reefs – Fig. 4.1.9a).

Paradoxapseudes sp. 1

Material: 59 specimens found in 10 samples collected in Ningaloo from depth 2 to 20 m on sand, dead *Acropora* head and coral rubble.

Distribution. The species known only from the western coast e.g. Ningaloo Reef (Fig. 4.1.9a, a').

Remarks. *Paradoxapseudes* sp. 1 is morphologically similar to *P. paneacis* Błażewicz-Paszkowycz & Bamber, 2012 having carpal spine on cheliped as well as elongated setae on carpus and propodus of each pereopods. The *Paradoxapseudes* sp. 1 is distinguished from the mentioned species by presence of two spines on cheliped carpus, serrated both margins of antennule basis, and eight seta on the basis of pereopod–6. *P penaecis* has one carpal spine on cheliped and six setae on pereopod basis. Beyond that inner margin of antennule is serrated only in *P penaecis*.

***Paradoxapseudes* sp. 2**

Material: 53 specimens found in 18 samples Heron I. in depth range from 0 to 30 m, from coral rubble and dead *Acropora* head.

Distribution. *Paradoxapseudes* sp. 2 was frequent species in Heron I. at Heron Reef, Wistari, Must Head, Sykes, Broomfield, and Lamont Reefs (Fig. 4.1.8a).

Remarks. Elongated body of *Paradoxapseudes* sp. 2 makes it similar to *P. attenuata* from Bass Strait (Błażewicz-Paszkowycz & Bamber 2012), however it has four setae on antenna squama and only four setae on cheliped carpus while *P. atennuata* has six setae in squama and eight setae on cheliped carpus.

Subfamily Pugiodactylinae Guţu, 1995

Genus *Pugiodactylus* Guţu, 1995

In Australian waters *Pugiodactylus* is known from two species: *P. daicovicii* Guţu, 2006 recorded from Moreton Bay and *P. syntomos* Błażewicz-Paszkowycz & Bamber, 2007a from Bass Strait.

***Pugiodactylus daicovicii* Guţu, 2006**

Material: 136 specimens from 30 samples near Heron I. and 12 specimens found in six samples from Lizard I. from depth 2 to 21 m, mainly on coral rubble, dead *Acropora* head and algae.

Distribution. *P. daicovicii* was wide distributed in vicinity of Heron I. where was collected near Heron, Wistari, Must Head, Sykes, Broomfield, North West Island and Lamont Reefs (Fig. 4.1.8a). In vicinity of Lizard I. it was recorded at barrier Jewell, Hicks, and Day Reefs (Fig. 4.1.9b).

Remarks. This is the only member of the genus that female lacks pleopod. Guţu (2006) has mentioned the absence of the pleopods also in the male, although he based his conclusion on the single, small and probably immature specimen. The study of the

CReefs collection has allowed to examine the series of the males, with large chelipeds which prove their maturity. All of them had one pair of pleopod.

The only species of *Pugiodactylus* with one pair of pleopods in both sexes is *P. coralensis* described by Guţu (1998) from Tioman Island (West Malaysia) at the depth 1–3 m, that species however has an apparent lateral apophysis on second and fifth pleomer that absent in *P. daicovicii*.

***Pugiodactylus* sp. 1**

Material: one specimen found in Heron I. from depth 0.5 m from coral rubble.

Distribution. The species occurs only near Heron Reef (Fig. 4.1.8a).

Remarks. *Pugiodactylus* sp. 1. resembles *P. daicovicii* Guţu, 2006 in general appearance. Both species characterize in short pleon, which is about 5-6 % of the total body length. In comparison second Australian species *P. syntomos* Błażewicz-Paszkowycz & Bamber, 2007a has pleon as long as 10% of the body. Moreover female of *Pugiodactylus* sp. 1 has five pairs of pleopods, while *P. daicovicii* has no pleopods.

***Pugiodactylus* sp. 3**

Material: seven specimens found in three samples near Lizard I., from depth 10–17 m, from coral rubble and *Halimeda* turfs.

Distribution. The species recorded only at the barrier Hicks and Day Reefs (Fig. 4.1.9b).

Remarks. *Pugiodactylus* sp. 3 as *Pugiodactylus* sp. 1 and *P. syntomos* Błażewicz-Paszkowycz & Bamber, 2007a has five pairs of pleopods, but is immediately recognized from them by elongated pleon that is about 15% of total body length. The pleon is about 10% of the total body length in *P. syntomos* and 5-6% in *Pugiodactylus* sp. 1.

Family Kalliapseudidae Lang, 1956

The family includes 52 species classified to 12 genera occurring mainly in tropical and temperate zones usually at the depth shallower than 100 m. The only two species known from water deeper than 100 m are *Kalliapseudes profundus* Drumm &

Heard, 2011 and *Hemikalliapseudes makellus* Bamber, 2003.Members of the family are usually associated with soft sediments e.g. sand or mud but *Mesokalliapseudes bahamensis* (Sieg, 1982) and *Tanapseudes ormuzana* Bacescu, 1978 were recorded from coral reefs.

In the Australian water the family is represented by seven species found in Queensland and West Australian coast (Bamber 2005, 2006; Drumm & Heard 2006). In the material collected during CReef Program two species contributing in less than 1% of the total material were found in the vicinity of Heron Island.

Subfamily Kalliapseudinae Lang, 1956

Genus *Kalliapseudes* Stebbing, 1910

In Australian waters the Kalliapseudes is represented by three species: *K. langi* Guţu, 2006 recorded from Moreton Bay, *K. obtusifrons* (Haswell, 1882) from New South Wales coasts (Haswell 1882; Drumm & Heard 2006) and Bass strait (Błażewicz-Paszkowycz & Bamber 2012) and *K. struthi* Bamber, 2005 from Esperance Bay (Bamber 2005).

Kalliapseudes sp. 1

Material: 19 specimens were identified in three samples taken around Heron I. from depth 14–29 m on coarse sand and *Halimeda* turfs.

Distribution. The species recorded only at channel between Heron and Wistari Reefs (Fig. 4.1.10b).

Remarks. Kalliapseudes sp. 1 differs from all other *Kalliapseudes* known from Australian waters by combination of characters: inner flagellum of antennule with three segments, outer flagellum with 10 segments, and two or three setae located on dactylus of pereopods 4–5. In comparison *Kalliapseudes langi* Guţu, 2006 has four and nine segments in antennule inner and outer flagellum, respectively, and two setae on dactylus of pereopods 4–5. *K. struthi* Bamber, 2005 has three and eight segments of antennule flagella and two or three setae on dactylus of pereopods 4–6. According to Haswell (1882) *K. obtusifrons*, it has six and nine segments in antennule flagella, and setose brash on dactylus of pereopods 4–5.

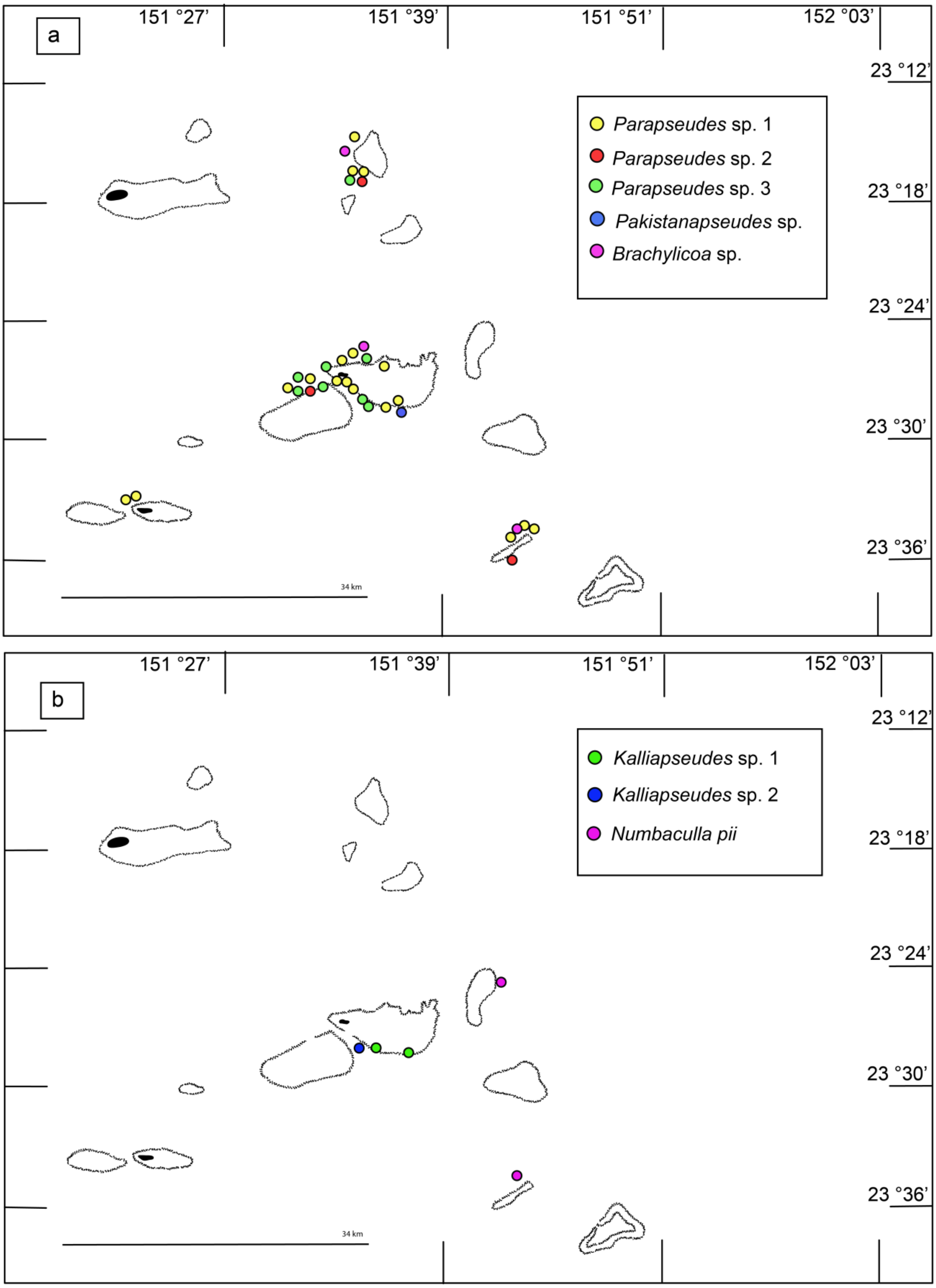


Fig. 4.1.10. Heron Island. Distribution of **a)** *Parapseudes* sp. 1, *Parapseudes* sp. 2, *Parapseudes* sp. 3, *Pakistanapseudes* sp., *Brachylicoa* sp.; **b)** *Kalliapseudes* sp. 1, *Kalliapseudes* sp. 2, *Numbaculla pii* Stepień & Błażewicz-Paszkowycz, 2013.

Kalliapseudes sp. 2

Material: one specimen of length 15 mm long was found at Heron Island from depth 40 m.

Distribution. The species collected only at channel between Heron and Wistari Reefs (Fig. 4.1.10b).

Remarks. *Kalliapseudes* sp. 2 resembles the most *K. obtusifrons* within Australian representatives of the genus. Both species have brush of setae on dactylus of pereopod 4–5. However both species differ in number of segments of antennule flagella. *Kalliapseudes* sp. 2 has four segments in inner flagellum and nine segments in outer, while *K. obtusifrons* six and nine segments respectively.

Family Metapseudidae Lang, 1970

Beside of Apseudidae, Metapseudidae is the second highly diversified family of the suborder Apseudomorpha. It currently includes 86 species in 18 genera which mainly occur in tropical, subtropical and temporary zones. The most southern record of the family belong to *Synapseudes idios* Gardiner, 1973 and *S. aflagellatus* Sieg, 1986 that are known from sand and algae in Magellan Strait (for more information on the genus see part 3).

Thirty three species of Metapseudidae (34% of all) were recorded as the taxa associated with coral reefs (Stebbing 1910; Menzies 1949, 1953; Băcescu 1975, 1976, 1981; Edgar 1997; Heard et al. 1998; Larsen 2002; Bamber & Sheader 2005; Guţu 2006, 2007; Guţu & Anguspanish 2006; Stępień & Błażewicz-Paszkowycz 2013), and most of the records are located in Gulf of Mexico and east coast of Africa (see Fig 4.1.1) (e.g., Menzies 1953; Băcescu 1976a, c).

In Australian waters the Metapseudidae are represented by six species: three from Bass Strait (Błażewicz-Paszkowycz & Bamber 2007a, 2012) and three from Queensland and Northern Territory coast (Edgar 1997; Băcescu 1981; Bamber 2008).

In the material Metapseudidae was apparently the most diversified family with 15 species in 10 genera included which made 7-19% of the total collections made during CReefs. Four of them (*Bamberus jinigudirus* Stępień & Błażewicz-Paszkowycz, 2013, *Msangia mussida* Stępień & Błażewicz-Paszkowycz, 2013, *Creefs heronum* Stępień & Błażewicz-Paszkowycz, 2013, *Curtipleon chadi* Stępień & Błażewicz-

Paszkowycz, 2013) have been described from CReefs collection and they have not been known before the Program.

Subfamily Chondropodinae Gutu, 2008b

Genus *Bamberus* Stępień & Błażewicz-Paszkowycz, 2013

***Bamberus jinigudirus* Stępień & Błażewicz-Paszkowycz, 2013**

Material: The species was recorded from sand, rubble and dead *Acropora* head, from depth 2–15 m at Ningaloo Reef. (Stępień & Błażewicz-Paszkowycz, 2013).

Distribution. The species relatively common near southern and northern part of the Ningaloo Reef (Fig. 4.1.11b).

Remarks. This monotypic genus was described from the CReefs collection (Stępień & Błażewicz-Paszkowycz 2013). Paper described the morphology of the species and discussing its relation with the other members of the subfamily and family is attached as appendix 4.1.1.

Genus *Julmarichardia* Guţu, 1989

The genus is represented by five species worldwide and so far only *Julmarichardia gutui* Ritger & Heard, 2007 is known from NW Australia (Ritger & Heard 2007).

***Julmarichardia* sp. 1**

Material: six specimens found in three samples from Ningaloo; three specimens found in two samples at Heron I., and 98 specimens found in 20 samples at Lizard I. Material was collected from the depth 3–21 m from coral rubble.

Distribution. The species was recorded at all three study areas, but it was common and relatively frequent only at Lizard I. Apart from the reef situated near the island, it was found at Martin Reef, and barrier reefs as Parke, Jewell, Hicks, Day, Younge and Carter (Fig. 4.1.12a). In the vicinity of Heron I. *Julmaricharia* sp. occurred only at Lamont Reef (Fig. 4.1.13a). On western coast species was found on southern part of the Ningaloo Reef (Fig. 4.1.11a').

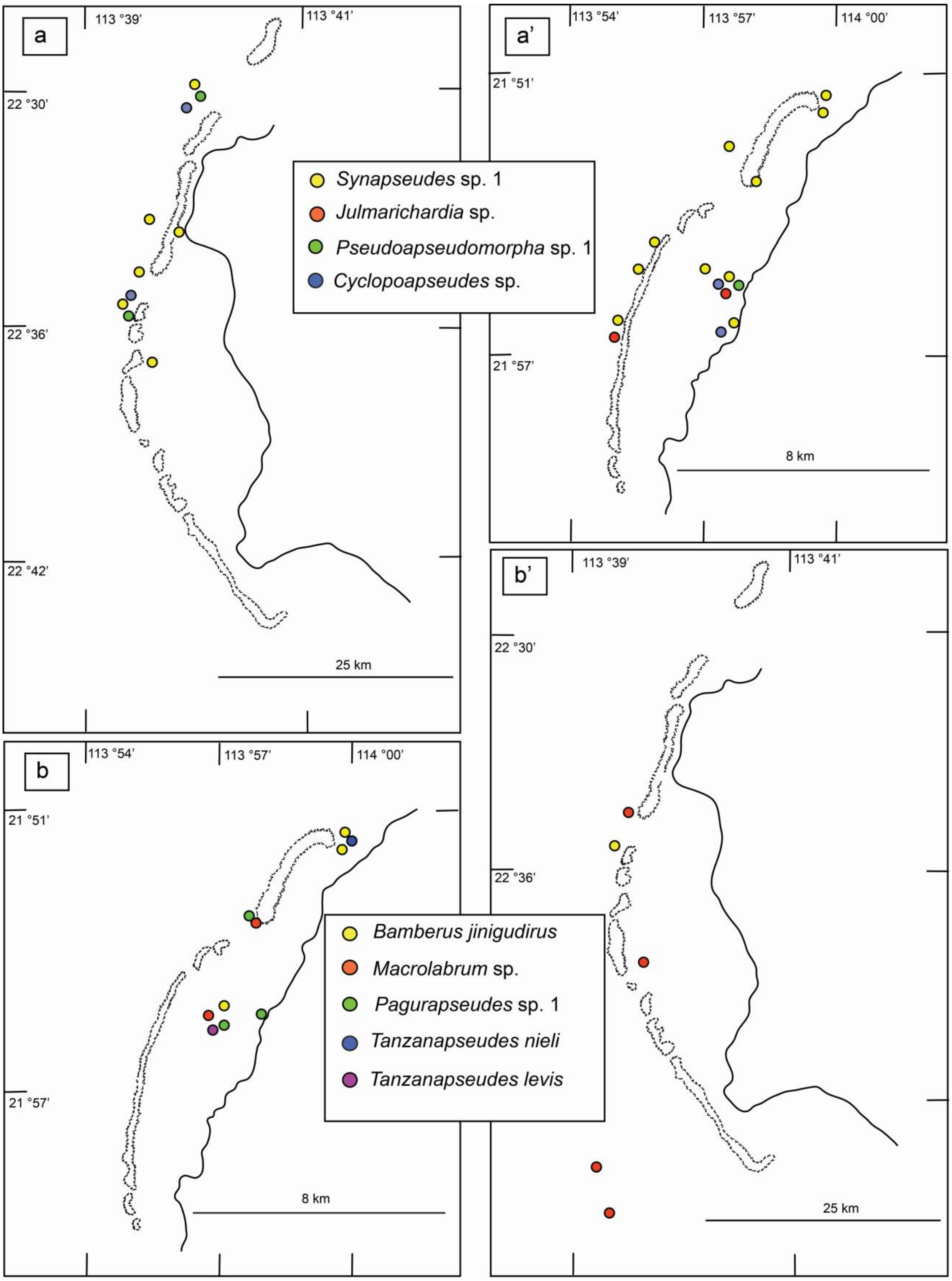


Fig. 4.1.11. Ningaloo Reef. Distribution of *Synapseudes* sp.1, *Julmarichardia* sp., *Pseudoapseudeomorpha* sp. 1, *Cyclopoapseudes* sp. at **a)** northern part and **a')** southern part. Distribution of *Bamberus jinigudirus* Stępień & Błażewicz-Paszkowycz, 2013, *Macrolabrum* sp., *Pagurapseudes* sp. 1, *Tanzanapseudes nieli* Stępień & Błażewicz-Paszkowycz, 2009, *Tanzanapseudes levis* Stępień & Błażewicz-Paszkowycz, 2009 at **b)** southern part and **b')** northern part.

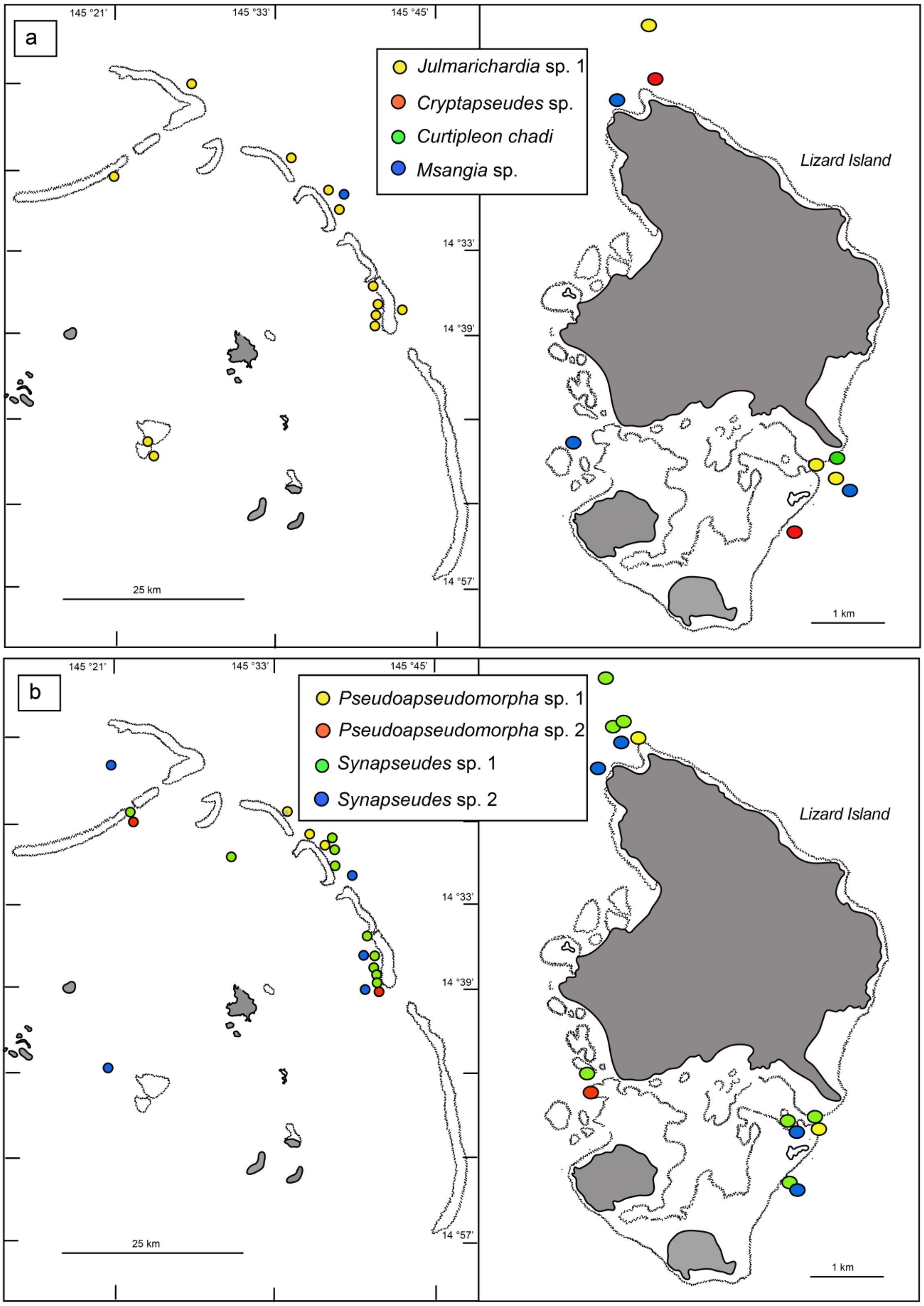


Fig. 4.1.12. Lizard Island. Distribution of **a)** *Julmarichardia* sp., *Cryptapseudes* sp., *Curtipleon chadii*, *Msangia* sp.; **b)** *Pseudoapseudomorpha* sp. 1, *Pseuoapseudomorpha* sp. 2, *Synapseudes* sp. 1, *Synapseudes* sp. 2.

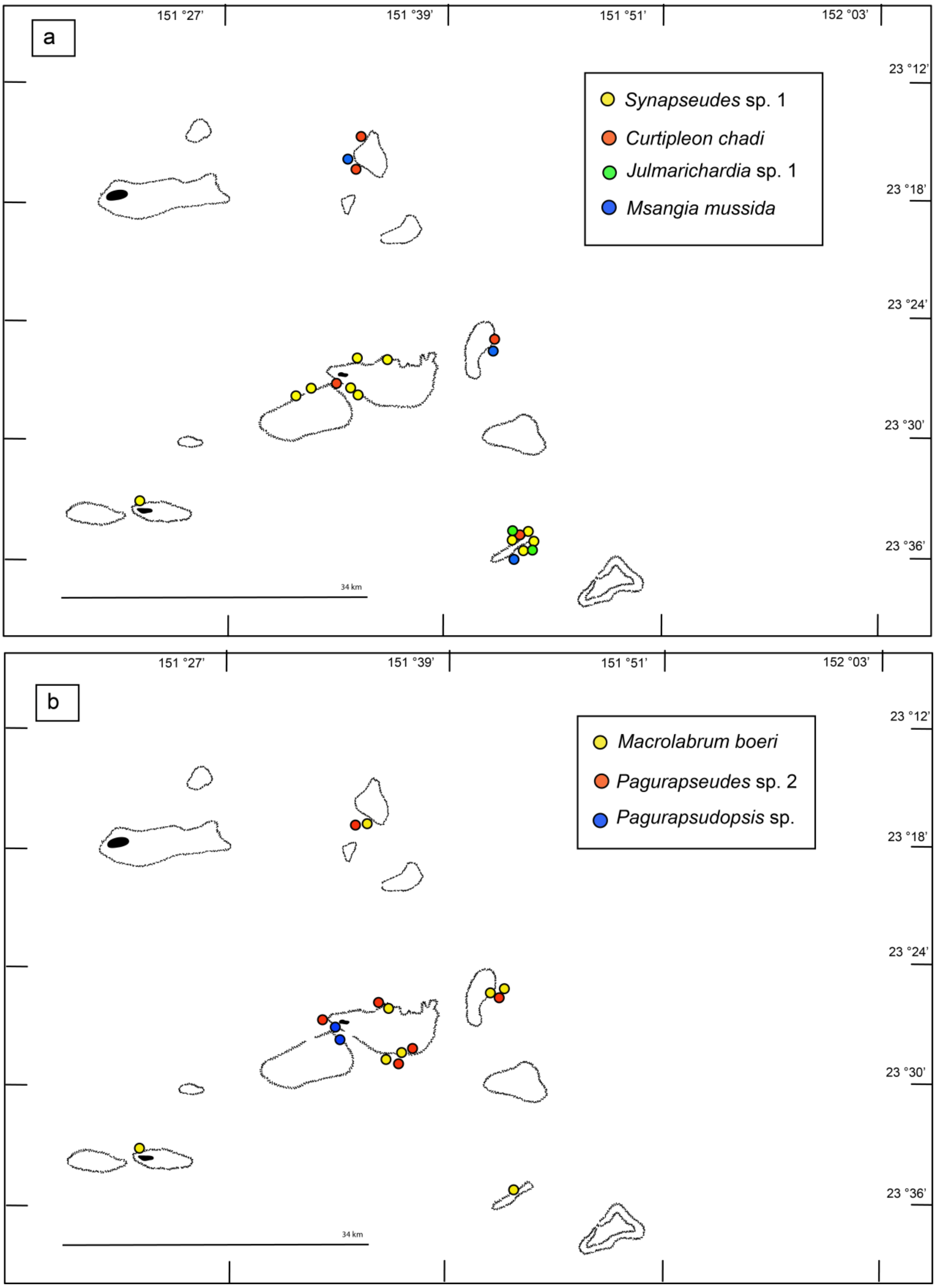


Fig. 4.1.13. Heron Island. Distribution of **a)** *Synapseudes* sp. 1, *Curtipleon chadi* Stepień & Błażewicz-Paszkowycz, 2013, *Julmarichardia* sp., *Msangia mussida* Stepień & Błażewicz-Paszkowycz, 2013; **b)** *Macrolabrum boeri* Băcescu, 1981, *Pagurapseudes* sp. 2, *Pagurapseudopsis* sp.

Remarks. The species is immediately distinguished from *J. gutui* Ritger & Heard, 2007 by lack of plumose setae on rostrum.

Subfamily Metapseudinae Lang, 1970

Genus Apseudomorpha Miller, 1940

***Apseudomorpha* sp.**

Material: 40 specimens found in 13 samples at Heron I. from depth 3–17 m, collected from coral rubble, dead *Acropora* head, green algae, and sand.

Distribution. The species was rather common in vicinity of Heron I. (Fig. 4.1.14a). It was collected near Heron, Wistari, Must Head, Sykes, Broomfield, and Lamont Reefs.

Remarks. It is the first member of the genus recorded in Australian waters. The New Zealand is nearest area, where *A. timaruvia* (Chilton, 1882) were found. Both species differ in number of antennule outer flagellum segments. *Apseudomorpha* sp. has two segments, while *A. timaruvia* more than ten (Guţu, 1987).

Genus *Pseudoapseudomorpha* Guţu, 1991

The genus is represented in Australian waters by one species: *Pseudoapseudomorpha wagait* (Edgar, 1997) recorded from Northern Territory (Edgar 1997)

***Pseudoapseudomorpha* sp. 1**

Material: 11 specimens found in three samples from Ningaloo, 21 specimens found in six samples from Heron I., and 27 specimens found in seven samples from Lizard I. All of the samples were collected at depth 2–28 m on coral rubble and dead *Acropora* head.

Distribution. The species was recorded at all three study area, from southern and northern part of the Ningaloo Reef (Fig. 4.1.11a, a’), in vicinity of Heron I. (Fig. 4.1.14a) at Lamont, Sykes, Broomfield Reefs and near Lizard I. (Fig. 4.1.12b) at reefs around the island, and barrier Hicks and Day Reefs.

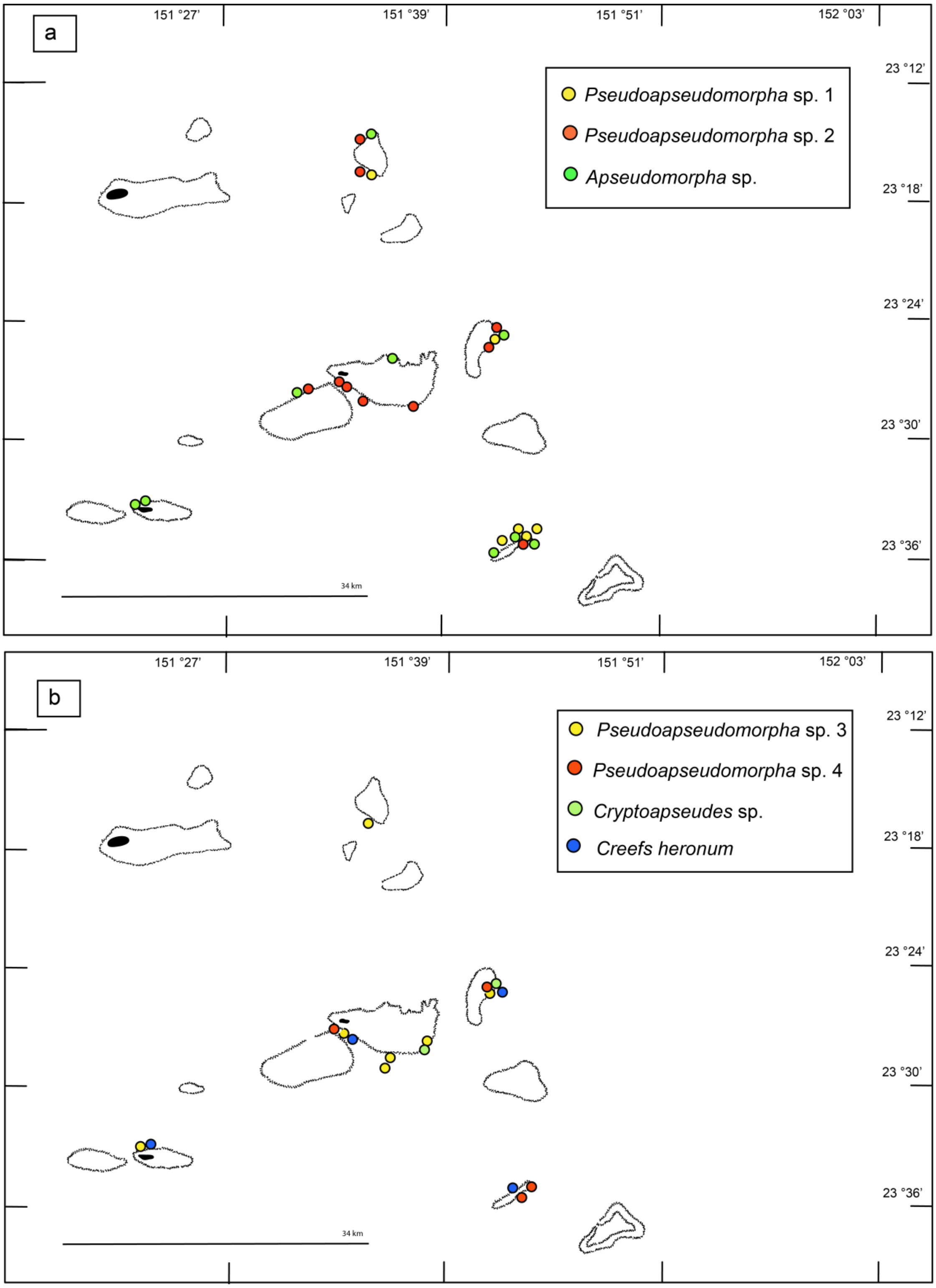


Fig. 4.1.14. Heron Island. Distribution of **a)** *Pseudoapseudeomorpha* sp. 1, *Pseudoapseudomorpha* sp. 2, *Apseudomorpha* sp.; **b)** *Pseudoapseudomorpha* sp. 3, *Pseudoapseudomorpha* sp. 4, *Cryptoapseudes* sp., *Creefs heronum* Stepień & Błażewicz-Paszkowycz, 2013.

Remarks. The absence of pleopods readily distinguishes *Pseudoapseudeomorpha* sp.1 from *P. wagait*, which female has three pairs of pleopoda.

***Pseudoapseudomorpha* sp. 2**

Material: 29 specimens found in 10 samples from Heron I., and 19 specimens found in four samples from Lizard I., collected at depth 2–30 m, from coral rubble and dead *Acropora* head.

Distribution. The species recorded only at GBR. It was collected in vicinity of Heron I. near Heron, Sykes, Lamont, and Broomfield Reefs (Fig. 4.1.14a) and near Lizard I. at reef around the island, and barrier Carter and Waining Reefs (Fig. 4.1.12b).

Remarks. Female of the *Pseudoapseudeomorpha* sp. 2 is similar to *Pseudoapseudeomorpha* sp. 1 but in contrast to *P. wagait* lacks the pleopods. Small, pointed rostrum with no denticles allows to recognize *Pseudoapseudeomorpha* sp. 2 from *Pseudoapseudeomorpha* sp. 1, which has triangle and denticulated rostrum.

***Pseudoapseudomorpha* sp. 3**

Material: 24 specimens found in 10 samples from Heron I. at depth 2–15 m, on coral rubble and dead *Acropora* head.

Distribution. The species is widely distributed in vicinity of Heron I. (Fig. 4.1.14b). It was recorded near Must Head, Heron, Sykes and Broomfield Reefs.

Remarks. *Pseudoapseudeomorpha* sp. 3 differs from the other members of the genus identified in the collection of CReefs as well as already described *P. wagait* by small and pointed rostrum and presence of two pairs of pleopods in female.

***Pseudoapseudomorpha* sp. 4**

Material: Four specimens found in four samples from Heron I. at depth 0–17 m from coral rubble and live coral.

Distribution. The species recorded only in vicinity of Heron I. (Fig. 4.1.14b) near Heron, Sykes, and Lamont Reefs.

Remarks. *Pseudoapseudomorpha* sp. 4 is the only species of Australian representatives of the genus which female has five pairs of pleopoda. Other character that allowed to distinguished it from the other species is wide and denticulated rostrum.

Genus *Cyclopoapseudes* Menzies, 1953

The genus is represented by one only species in Australian water – *Cyclopoapseudes (Exopoapseudes) plumosa* Błażewicz-Paszkowycz & Bamber, 2012 recorded from Bass Strait.

Subgenus *Cyclopoapseudes*, Menzies 1953

***Cyclopoapseudes* sp.**

Material: 11 specimens found in six samples taken in Ningaloo at depth 3.5–20 m on coarse sand and from coral rubble.

Distribution. The species recorded only in Western coast. It occurs at southern and northern part on Ningaloo Reef (Fig. 4.1.11a, a').

Remarks. Species is the only representative of the subgenus *Cyclopoapseudes* in Australian waters. Two others were recorded near the east African coast (Băcescu 1975) and near Ecuador coasts (Menzies 1953). *Cyclopoapseudes* sp. can be distinguish from east African species by rounded rostrum. In contrast *C. estafricanus* Băcescu, 1975 has narrow, pointed rostrum. Moreover species from Creefs collection has no long setae on antennule peduncle. From *C. indecorus* Menzies, 1953 *Cyclopoapseudes* sp. differs in chelae propotion. *Cyclopoapseudes* sp. has palm three times as long as fixed finger, while *C. indecorus* has it similar to fixed finger.

Subfamily Msangiinae Gutu, 2006

Genus Msangia Bacescu, 1976

***Msangia mussida* Stępień & Błażewicz-Paszkowycz, 2013**

Material: 29 specimens found in four samples at Heron I. taken from live coral and coral rubble on sand at depth 6.5–17 m. (Stępień & Błażewicz-Paszkowycz, 2013).

Distribution. The species was recorded only in vicinity of Heron I. at Broomfield, Sykes, and Lamont Reefs (Fig. 4.1.13a).

Remarks. The species has been formally described and published in an original paper during preparing this dissertation (appendix 4.1.1).

Msangia **sp.**

Material: six specimens found in five samples at Lizard Island at the depth 2–15 m on coral rubble.

Distribution. The species recorded only near Lizard I., at reefs surrounding the island and barrier Day Reef (Fig. 4.1.12a).

Remarks. Unlike *M. mussida* Stępień & Błażewicz-Paszkowycz, 2013 that has three segments in endopod uropods, this species has 4-segmented endopod of uropods.

Subfamily Synapseudinae Guţu, 1972

Genus: *Creefs* Stępień & Błażewicz-Paszkowycz, 2013

The monotypic genus found in the CReefs collection and formally erected during preparing this dissertation (appendix 4.1.1).

Creefs heronum **Stępień & Błażewicz-Paszkowycz, 2013**

Material: 72 specimens found in five samples from Heron I. taken from corral rubble and sand at depth 12–30m. (Stępień & Błażewicz-Paszkowycz, 2013).

Distribution. The species was relatively common in the collection taken from the vicinity of Heron I. It was found at Heron, Must Head, Sykes and Lamont Reefs (Fig. 4.1.14b).

Remarks. The species has been formally described, for details see appendix 4.1.1

Genus Cryptapseudes Bacescu, 1976

***Cryptapseudes* sp.**

Material: Two specimens found in two samples from Heron Island, and three specimens found in two samples from Lizard I. at 2–27 m, from coral rubble and dead coral head.

Distribution. The species occurs only on GBR. In vicinity of Heron I. it was recorded at Heron and Sykes Reefs (Fig. 4.1.14b). Near Lizard I. *Cryaptapseudes* sp. occurred only at reef near northern and southern coast of the island (Fig. 4.1.12a).

Remarks. This is the first species of the genus recorded in Australian waters. The three other members of the genus were noted from the east coasts of Africa. *Cryptapseudes* sp. resembles the most *C. romanae* Guţu, 1991 due to rosette rostrum. However both species differ in carapace, which is narrower in *Cryaptapseudes* sp. Beyond that *Cryaptapseudes* sp. lacks setae on dorsal surface on carapace, which are characteristic for *C. romanae*.

Genus *Curtipleon* Băcescu, 1976

***Curtipleon chadi* Stępień & Błażewicz-Paszkowycz, 2013**

Material: 18 specimens found in six samples at Heron I. and five specimens found in one sample near Lizard I. at depth 2–8 m from coarse sand and coral rubble (Stępień & Błażewicz-Paszkowycz, 2013).

Distribution. The species recorded in the vicinity of Heron I. from Broomfield, Sykes and Lamont Reefs (Fig. 4.1.13a). It occurs also at reef around Lizard I. (Fig. 4.1.12a).

Remarks. From the four other members of the genus *Curtipleon chadi* is the second representative of the genus in Australian waters after *C. loerzae* Bamber, 2008 that occurs in Moreton Bay (Bamber 2008). Species has been formally described and is a part of an original paper published during preparing this dissertation (appendix 4.1.1).

Genus *Synapseudes* Miller, 1940

The genus is represented in Australian waters by only one species e.g. *Synapseudes australianus* Băcescu, 1981 recorded in Heron Island (see also part 3).

Synapseudes sp. 1

Material: 348 specimens found in thirty four samples at Ningaloo, 87 specimens found in 21 samples from Heron I., and 126 specimens found in 23 samples taken from Lizard I. at depth 1–30 m on coral rubble, dead head of *Acropora* or *Pollicipora* as well as in habitats with *Halimeda*.

Distribution. The species common in all three study areas. It was recorded at southern and northern part of Ningaloo Reef, in vicinity of Heron I., Heron, Wistari, Must Head, and Lamont Reefs (Figs 4.1.11a, a'and 4.1.13a). Species found near Lizard I. at reef around the island, and barrier reefs Parke, Day, Younge, and Carter (Fig. 4.1.12b).

Remarks. *Synapseudes* sp. 1 resembles *S. australinus* Băcescu, 1981. Both species can be distinguished by ratio of length to width of antenna first article, that is wider than long in *S. australinus*, and longer than wide in *Synapseudes* sp. 1. Beyond that *Synapseudes* sp. 1 has long seta on second article of maxilliped that absent in *S. australinus.*

Synapseudes sp. 2

Material: 42 specimens found in 11 samples at Lizard I. from depth 7–18 m on coral rubble, algae and dead coral head.

Distribution. The species occurs only near Lizard I., at reef around the island and in vicinity of Martin Reef as well as barrier reefs Parke, Younge and Carter Reef (Fig. 4.1.12b).

Remarks. *Synapseudes* sp. 2 can be distinguish from *S. australinus* Băcescu, 1981 as well as *Synapseudes* sp. 1 by having one, strong apophyses on inner margin of the first antennule article. Moreover *Synapseudes* sp. 2 has two distal setae in last segment of antenna, and uropod endopod composed with four segments. In comparison *S.*

australinus and *Synapseudes* sp. 1 has row of spines on first antennule article, one seta on last segment of antenna and three segments of uropod endopod.

Family Numbaculliade Guţu & Heard, 2002

This monogeneric family is represented by three species, all found in Indopacific region. *Numbaculla srilancensis* Guţu, 2006 and *N. pii* Stępień, 2013 are associated with coral reefs, while *N. pygmaeus* Guţu & Heard, 2002 were found continental shelf of NW Australia from about 80 m depth.

Genus: Numbaculla Guţu & Heard, 2002

***Numbaculla pii* Stępień 2013**

Material: 53 specimens found in three samples Heron I. from depth 12–27m on coral rubble and sand. (Stępień 2013)

Distribution. The species occurs in vicinity of Heron I. e.g. at Sykes Reef and Lamont Reef (Fig. 4.1.10b).

Remarks. The species has been formally described and it's description is a part of an original paper published during preparing this dissertation (Appendix 4.1.2)

Family Pagurapseudidae Lang, 1970

The family includes 39 species classified to seven genera known exclusively tropical and temporary zone. Thirteen pagurapseudid species were recorded on coral reefs mainly of Indonesia and East Africa (Băcescu 1976b, 1981; Guţu 1992, 1997, 2006).

In Australia the family is well represented. So far thirteen species were described although eight of them occurred off southern coast as Bass Strait and Esperance Bay (Bamber 2005; Błażewicz-Paszkowycz & Bamber 2012). Three species were recorded from Moreton Bay (Băcescu 1981; Bamber 2008b), and two from New South Wales (Whitelegge 1901; Haswell 1882).

Only two members of the family Pagurapseudidae were from Australian coral reefs namely: *Macrolabrum boeri* Bacescu, 1981 and *M. abrucei* (Băcescu, 1981). *M. boeri* was present in the CReefs collection made in Heron Island. Contribution of all Pagurapseudidae in a studied collection was about 2%.

Subfamily Hodometricinae Guţu, 1981

Genus *Indoapseudes* Bacescu, 1976

The genus *Indoapseudes* is represented in Australian waters by two species, although only one, *I. macabre* Bamber, 2005 from Esperance Bay and Bass Strait (Bamber 2005; Błażewicz-Paszkowycz & Bamber 2012) is formally described. The other member of the genus have been recorded from the coast of West Australia (Poore et al. 2014).

Indoapseudes sp.

Material: 11 specimens found in six sample at Lizard I. at the depth 15–17 m from dead coral.

Distribution. The species occurs on reef around the Lizard Island and barrier reefs: Parke, Hick and Day (Fig. 4.1.15b).

Remarks. In general appearance *Indopaseudes* sp. is similar to *I. macabre* Bamber, 2005. However *Indopaseudes* sp. has a row of long, plumose setae on basis and carpus of chelieped. Those setae absent in *I. macabre*. Moreover males of the *Indopaseudes* sp. has five pairs of pleopods, which absent in Bamber's species.

Subfamily Pagurapseudinae Lang, 1970

Genus *Macrolabrum* Băcescu, 1976

The genus in Australia is represented by six species: *M. abrucei* (Băcescu, 1981) recorded near Queensland coast; *M. boeri* Băcescu, 1981 collected from Heron I.; *M. haikung* Błażewicz-Paszkowycz & Bamber, 2012, *M. sarda* Błażewicz-Paszkowycz & Bamber, 2012, and *M. tangaroa* Błażewicz-Paszkowycz & Bamber, 2012 from Bass Strait and *M. impedimenta* Bamber, 2005 from Western coast.

Macrolabrum boeri Băcescu, 1981

Material: 24 specimens found in seven samples taken in Heron I. at depth 3–27 m from coral rubble and sand.

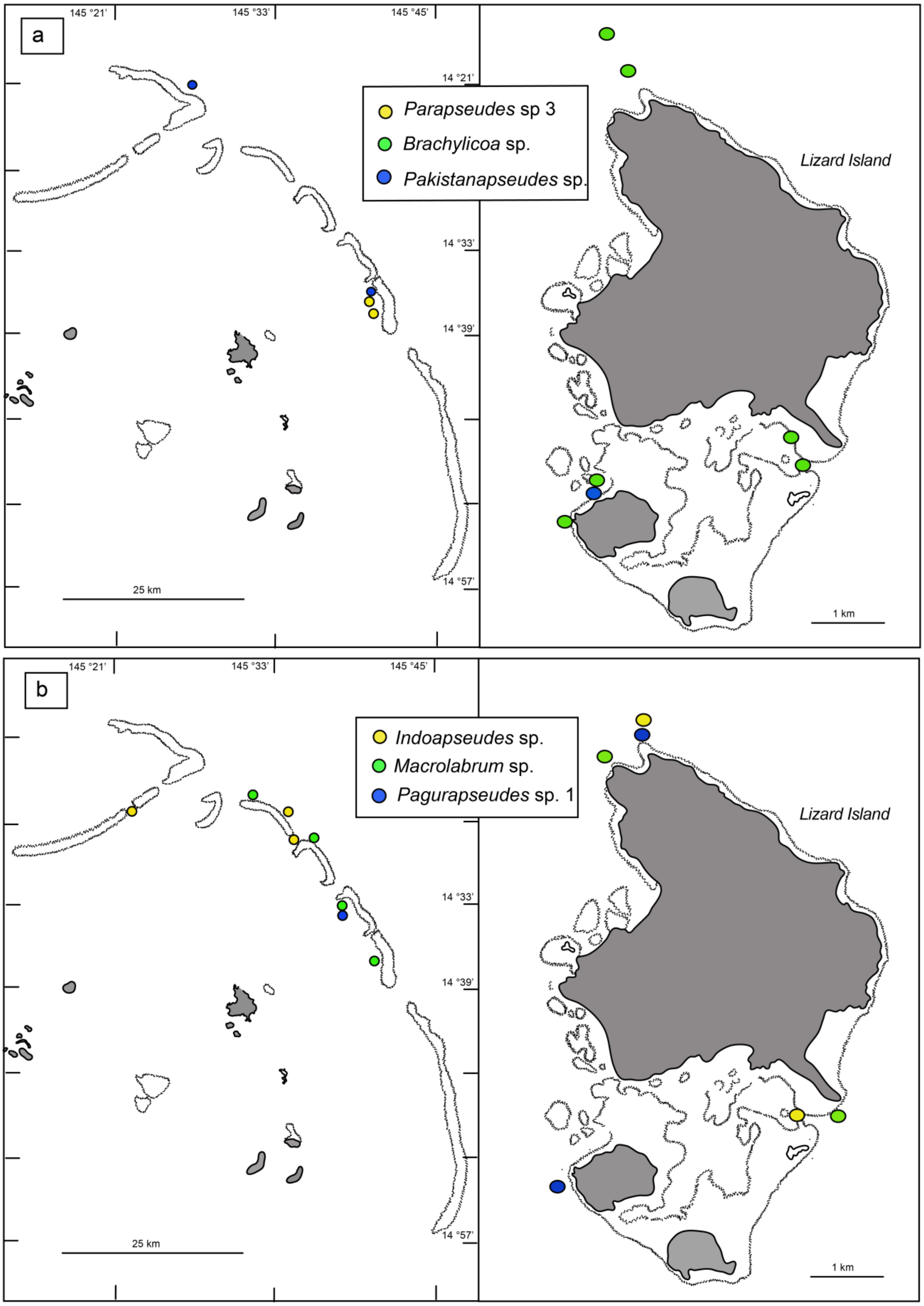


Fig. 4.1.15. Lizard Island. Distribution of **a)** *Parapseudes* sp. 3, *Brachylicoa* sp., *Pakistanapseudes* sp.; **b)** *Indoapseudes* sp., *Macrolabrum* sp., *Pagurapseudes* sp. 1.

Distribution. The species was found in vicinity of Heron I. at Heron, Must Head, Sykes, Broomfield and Lamont Reefs (Fig. 4.1.13b).

***Macrolabrum* sp.**

Material: 12 specimens found in seven samples at Ningaloo, and eight specimens found in seven samples near Lizard I. from the depth 2–30 m on coral rubble, *Halimeda*, sand grit, red algae and other fine sediment.

Distribution. The species frequently recorded in southern and northern part of Ningaloo Reef (Fig. 4.1.11b, b'). Near Lizard I. it was found at reef around the island and barrier Hicks, Day, Younge and Carter Reefs (Fig. 4.1.15b).

Remarks. *Macrolabrum* sp. differs from Australian *M. boeri* Băcescu, 1981 and *M. impediana* Bamber, 2005 by antennule second article shorter than the third article. Both already known species present inverted proportion in comparison to the *Macrolabrum* sp.

Genus *Pagurapseudes* Whitelegge, 1901

In Australian waters *Pagurapseudes* is represented by three species: *P. kimbla* Błażewicz-Paszkowycz & Bamber, 2012, *P. victoriae* Błażewicz-Paszkowycz & Bamber, 2012, both species were recorded from Bass Strait, and *P. spinipes* Whitelegge, 1901 noted from New South Wales coast.

***Pagurapseudes* sp.**

Material: four specimens found in three samples collected at Ningaloo; 14 specimens found in seven samples from Heron I., and four specimens found in four samples from Lizard I. at the depth 3–27 m, recorded on coral rubble, sand and dead *Acroporae* head.

Distribution. The species recorded at GBR and northern part of Ningaloo Reef (Fig. 4.1.11b). At Heron I., it was present at Heron, Sykes and Broomfield Reefs (Fig. 4.1.13b). Near Lizard I. *Pagurapseudes* sp. occurs near the southern cost of the Lizard I. and Palfrey Island, as well as at barrier Carter Reef. (Fig. 4.1.15b)

Remarks. Pagurapseudes sp. resembles the most *P. kimbla* Błażewicz-Paszkowycz & Bamber, 2012 recorded from Bass Strait, however both species differ in number of spines on first article of antennule. *Pagurapseudes* sp. bears four inner spines, while *P. kimbla* has them three.

Family Pagurapseudopsididae Guţu, 2006

The family is represented by five species classified to one genus, and all are known from Indonesian basin. Share of the species sorted from CReefs collection was less than 1%.

Genus *Pagurapseudopsis* Shiino, 1963

Pagurapseudopsis sp.

Material: 20 specimens found in three samples from Heron I. in depth 29–30m, recorded on coral rubble.

Distribution. The species occurs in vicinity of Heron I. at Heron and Wistari Reef (Fig. 4.1.13b).

Remarks. *Pagurapseudopsis* sp. is the first representative of the genus in Australian water and in the first record of the genus on coral reefs.

Family Parapseudidae Guţu, 1981

Eighty two species in 22 genera are currently classified to the Parapseudidae. Their representatives were noted from wide range of latitudes and longitudes, except for polar regions. Taxa are collected from shallow water and often are related with sand, mud than with coral reefs (e.g. Błażewicz-Paszkowycz & Bamber 2007b). Only six species were noted from coral reefs (Richardson 1905; Menzies 1953; Guţu 1995a, 2007; Edgar 1997; Guţu & Heard 2002).

The family, similar to the Apseudidae, is well represented in all Australian waters but the species are mainly known from southern part. Nine species were described from Bass Strait (Błażewicz-Paszkowycz & Bamber 2007b, 2012), six from Moreton Bay (Błażewicz-Paszkowycz & Bamber 2007b; Bamber 2008b) and three species were noted from tropical part e.g. Northern Teritory and Coral Sea (Edgar 1997; Guţu 2006). During the current study six species were classified to the family. Their share in the total collection was about 8%.

Subfamily Pakistanapseudinae Guţu, 2008a

Genus Pakistanapseudes Băcescu, 1978

Pakistanapseudes is represented by six species in Australian waters. *P. australianus* Guţu, 2006 noted from Moreton Bay, three others - *P. bassi* Błażewicz-Paszkowycz & Bamber, 2007b, *P. taylorae* Błażewicz-Paszkowycz & Bamber, 2012 and *P. lucifer* Błażewicz-Paszkowycz & Bamber, 2012 were recorded from Bass Strait, while *P. perulpa* Błażewicz-Paszkowycz & Bamber, 2007b is known from Moreton Bay as well as from Bass Strait. The last species - *P.ridculli* Bamber, 2005 occurs in Esperance Bay and Bass Strait.

***Pakistanapseudes* sp.**

Material: five specimens found at three samples in Ningaloo, three specimens found in one sample from Heron I. and three specimens found in three samples from Lizard I. The species was recorded from depth 2–10 m from coral rubble and coarse sand.

Distribution. The species was recorded in each of the three studied areas. It was recorded in southern and northern part of Ningaloo Reef (Fig. 4.1.7 b, b'). Moreover *Pakistanapseudes* sp. was collected in vicinity of Heron I. at Heron Reef (Fig. 4.1.10a) and near Lizard I. at reefs surrounding Palfrey Island as well as at barrier Jewell and Carter Reefs (Fig. 4.1.15a).

Remarks. Features that characterize *Pakistanapseudes* sp. are: five setae on antenna squama, five setae on exopod of the first pereopod, three spines on dactylus of pereopod–1 and lack of hyposhaenium. Those characters allow to distinguish *Pakistanapseudes* sp. from *P. perulpa* Błażewicz-Paszkowycz & Bamber, 2007b and from *P. australinus* Guţu, 2006 that have respectively: more than 10 setae on squama and six setae on exopod of pereopod–1, and six setae on squama, four setae on exopod of pereopod–1, and four spines on dactylus of pereopod–1. Number of setae on squama differs *Pakistanapseudes* sp. from the other Australian species e.g., *P. bassi* Błażewicz-Paszkowycz & Bamber, 2007b that has seven setae, from *P. taylorae* Błażewicz-Paszkowycz & Bamber, 2012 with two setae, from *P. radiculi* Bamber, 2005 with more than ten setae, and from *P. lucifer* Błażewicz-Paszkowycz & Bamber, 2012 with six setae on squama, moreover species has hyposhaeniae, which absent in *Pakistanapseudes* sp.

Subfamily Parapseudes Guţu, 1981

Genus Brachylicoa Guţu, 2006

Brachylicoa **sp.**

Material: 12 specimens found in eight samples on Ningaloo, five specimens found in four samples from Heron I., and 18 specimens found in seven samples from Lizard I. Samples were collected from depth 2–21m on coral rubble, *Acroporae*, *Pollicipora* head, *Halimeda* and other algae.

Distribution. The species occurs at all three studied areas. It was recorded in southern and northern part of Ningaloo Reef (Fig. 4.1.7b, b'), in vicinity of Heron Island, but only at Heron Reef (Fig. 4.1.10a). Species was also collected near Lizard I. and Palfrey Island (Fig. 4.1.15a).

Remarks. No representatives of *Brachylicoa* has been recorded so far from Australian waters. Currently four species are classified to the genus. Three of them were noted from Indonesia one in vicinity of Tanzania (Băcescu 1978; Guţu 1998, 2006, 2007).

Genus Parapseudes Sars, 1882

Parapseudes is represented by two species in Australian waters: *P. blandowskii* Błażewicz-Paszkowycz & Bamber, 2012 recorded from Bass Strait and *P. latifrons* (Grube, 1864) agg., recorded in Esperance Bay (Bamber 2005).

Parapseudes **sp. 1**

Material: 142 specimens found at 26 samples from Heron I. at depth 2.5–30 m, recorded on coral rubble on sand at a bummie.

Distribution. The species was quite common around Heron I. and was collected at Heron, Wistari, Must Head and Lamont Reefs (Fig. 4.1.10a).

Remarks. One of the characters used for distinguishing parapseudid species is number of spines on the basis of pereopod–1 (Guţu 1998a; b, 2001a; Bamber 2005).

Parapseudes sp. 1 with row of dorsal spines along basis could be recognized from *P. latifrons* recorded by Bamber (2005) in Australian waters that has one proximal and one subdistal spine, and *P. blandowski* Błażewicz-Paszkowycz & Bamber, 2012 that has two proximal spines and one subdistal.

***Parapseudes* sp. 2**

Material: Three specimens found in three samples from Heron I. from depth 5–20m, on coarse sand.

Distribution. The species occurs in vicinity of Heron I. at Lamont, Wistari and Broomfield Reefs (Fig. 4.1.10a).

Remarks. *Parapseudes* sp. 2 is characterized by row of setae on basis of pereopod–1. The feature allow to distinguished species from *Parapseudes* sp. 1 and other Australian species which all have distinct spines on basis.

***Parapseudes* sp. 3**

Material: 36 specimens found in eight samples from Heron I., and three specimens found in two samples from Lizard I. Material was collected from depth 3–30 m on dead coral, coral rubble, sand and *Acropora* head.

Distribution. The species was recorded in vicinity of Heron I., at Heron and Wistari Reef and in channel between those two reefs, as well as at Broomfield Reef (Fig. 4.1.10a). Species was also recorded near Lizard I. only at barrier Carter Reef (Fig. 4.1.15a).

Remarks: *Parapseudes* sp. 3 can be distinguished from two species mentioned above and two already known Australian species by simple setae and three proximal spines on basis of pereopod–1.

Genus Saltipedis Guţu, 1995

The *Saltipedis* is represented by two species in Australian waters: *S. floccus* Błażewicz-Paszkowycz & Bamber, 2012 and *S. nugoris* Błażewicz-Paszkowycz & Bamber, 2007b both recorded in Bass Strait.

Saltipedis sp.

Material: 22 specimens found in 10 samples on Ningaloo at depth 2–9 m on *Acropora* head, rocks and dead coral heads.

Distribution. Southern and northern part of Ningaloo Reef (Fig. 4.1.7b, b').

Remarks. *Saltiped* sp. could be immediately distinguished from Australian species by lack of hyposphaenium.

Family Sphaeromapseudidae Larsen, 2011

This monogeneric and monospecific family is represented by *Sphaeromapseudes plumosetosa* Larsen, 2011 from coral reefs in Caribbean Sea. During CReefs the other member of the genus was identified. Its share in the material studied was less than 1%

Genus Sphaeromapseudes Larsen, 2011

Sphaeromapseudes sp.

Material: eight specimens found in two samples from Lizard I. from depth 12–15m, recorded on coral rubble.

Distribution. The species was recorded only in North off the Lizard Island (Fig. 4.1.9b).

Remarks. *Sphaeromapseudes* sp. recovered in the study material is the first represent of that monotypic family in Australia. From *S. plumosetosa* Larsen, 2011 *Sphaeromapseudes* sp. differs by smooth body. *S. plumosetosa* has body about twice as long as wide, while *Sphaeromapseudes* sp. is about 3.5 times as long as wide.

Family Tanzanapseudidae Băcescu, 1975

Family consists of nine species in two genera, noted from coral reefs near East African coast, and Polynesia. Members of the family are characterizes by flat body which is an adaptation for living within corals and sponge (Băcescu 1975).

In the CReefs material two species were found and they are the only representatives of the family in the Australia. The species have been already described (Stępień & Błażwicz-Paszkowycz, 2009, appendix 4.1.3) and they made less than 1% of the tanaids collected during CReefs

Genus Tanzanapseudes Băcescu, 1975

Tanzanapseudes nieli Stępień & Błażewicz-Paszkowycz, 2009

Material: two specimens found in two samples from Ningaloo collected at depth 2.5–26 m from on coral rubble on sand.

Distribution. The species was recorded only in southern part of the Ningaloo Reef (Fig. 4.1.11b).

Remarks. The species has been formally described and is a part of an original paper published during preparing this dissertation (appendix 4.1.3)

Tanzanapseudes levis Stępień & Błażewicz-Paszkowycz, 2009

Material: one specimen found on Ningaloo at depth 4–5m on coral rubble.

Distribution. The species occurs only at southern part of the Ningaloo Reef (Fig. 4.1.11b).

Remarks. See appendix 4.1.3

Family Whiteleggiidae Guţu, 1972

In the study material the family was represented by *Whiteleggiia multicarinata* (Whitelegge, 1901) that made less than 1%

Genus Whiteleggiia Lang, 1970

Whiteleggiia is represented by two species in Australian waters: *W. multicarinata* (Whitelegge, 1901) originally recorded from New South Wales coast and also from Bass Strait (Błażewicz-Paszkowycz & Bamber 2012) and *Whiteleggia stephensoni* Boesch, 1973 from Moreton Bay

Whiteleggiia multicarinata (Whitellegge, 1901)

Material: Two specimens found in two samples from Ningaloo, five specimens found in four samples from Heron I. and one specimen found from Lizard I. Samples were collected from depth 2–29 m on *Halimeda* and coral rubble.

Distribution. The species was recorded at all three study areas. It was recorded at southern part of Ningaloo Reef (Fig. 4.1.7a), in vicinity of Heron I. as Heron, Broomfield, Sykes and Lamont Reefs (Fig. 4.1.8b). Species was found also in vicinity of Lizard I. at reef near Coconut Beach (Fig. 4.1.9a).

Suborder Tanaidomorpha Sieg, 1980

Superfamily Paratanoidea Lang, 1949

Family Cryptocopidae (Mac Lelland, 2008 M.C.) Bird and Larsen, 2009

Ten species in six genera are classified to the family. The members are recorded mainly in deep water (Kudinova-Pasternak 1987; McLelland 2007) with an exception of *Iungentitanais* Sieg, 1977 that was recorded from 18–28 m deep (Sieg 1977).

Genus *Iungentitanais* Sieg, 1976

The genus is monotypic with the only species *I. primitivus* has been described by Sieg (1977) from Gulf of Mexico.

Iugentitanais sp.

Material: Two specimens found in one samples taken from Ningaloo, two specimens found in two samples from Heron I. and 20 specimens found in 15 samples from Lizard

I. from the depth 0–30 m, recorded mainly on coral rubble, *Halimeda*, mangrove woods, sand, and various algae.

Distribution. The species was found at all three study areas, but it was common only in vicinity of Lizard I. e.g. North Direction Island, Martin Reef, and barrier reefs as: Waining, Jewell, Hick and Day (Fig. 4.1.16b). It was recorded also at southern part of Ningaloo Reef (Fig. 4.1.17a') and in vicinity of Heron I. at Heron Reef (Fig. 4.1.18a).

Remarks. *I. primitivus* Sieg, 1976 differs from *Iungentinotanais* sp. by more elongated antennule, which the first article is about five times as long as wide in Atlantic species, while it is twice as long as wide in *Iungentinotanais* sp. Moreover *I. primitivus* has chelieped carpus five times as long as wide, while it is only 2.5 times as long as wide in *Iungentitotanais* sp.

Family Heterotanoididae Bird, 2012

The family Heterotanaididae was erected to placed genus Heterotanaides (Bird, 2012). So far five species are classified to the genus, and family. Member of the family were found in shallow water, in mud or associated with bryozoans (Sieg 1986; Bamber & Bird 1997).

Genus *Heterotanoides* Sieg, 1977

***Heterotanoides* sp.**

Material: 188 specimens found in 22 samples from Lizard I. at depth 2–29 m recorded on coarse sand, coral rubble, *Acropora* head and *Halimeda*.

Distribution. The species occurs only on barrier reefs as Day and Carter near Lizard Island (Fig. 4.1.19a).

Remarks. *Heterotanoides* sp. is a first represent of the genus in Australian waters. The closest area where members of the genus was found in New Zeland (Bird 2012). From *H. muimui* Bird, 2012 new species can be recognized due to robus cheliped , with short merus, about 1.5 times as long as wide. *H. muimui* has merus about three times as long as wide. Beyond that *Heterotanoides* sp. has four segments in endopod of uropod, while *H. muimui* three.

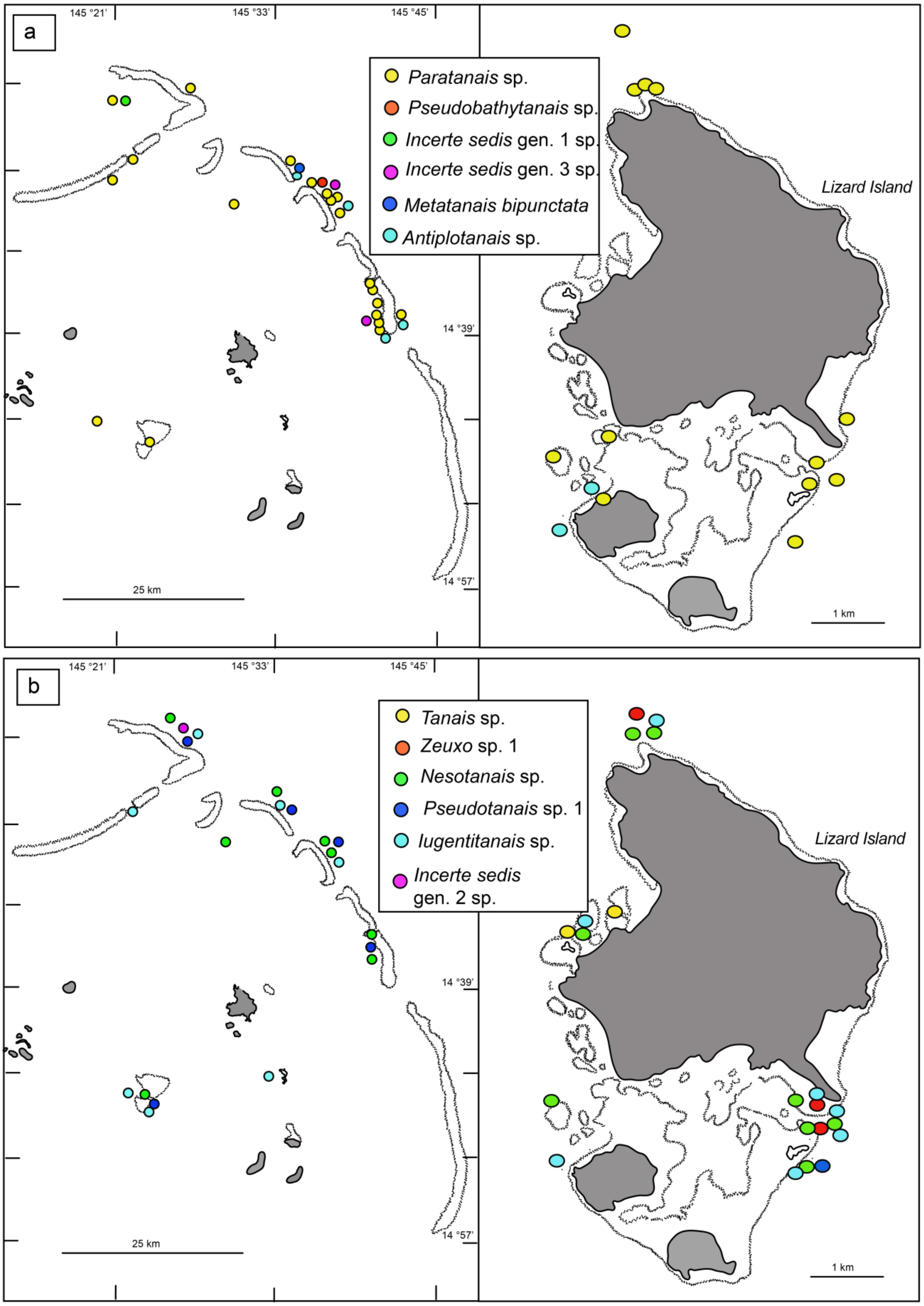


Fig. 4.1.16. Lizard Island. Distribution of **a)** *Paratanais* sp. 3, *Pseudobathytanais* sp., *Incerte sedis* gen. 1 sp., *Incerte sedis* gen. 2 sp., *Metatanais bipunctata* Błażewicz-Paszkowycz & Zemko, 2009, *Antiplotanais* sp.; **b)** *Tanais* sp., *Zeuxo* sp.1, *Nesotanais* sp., *Pseudotanais* sp. 1, *Iungentitanais* sp., *Incerte sedis* gen. 3 sp.

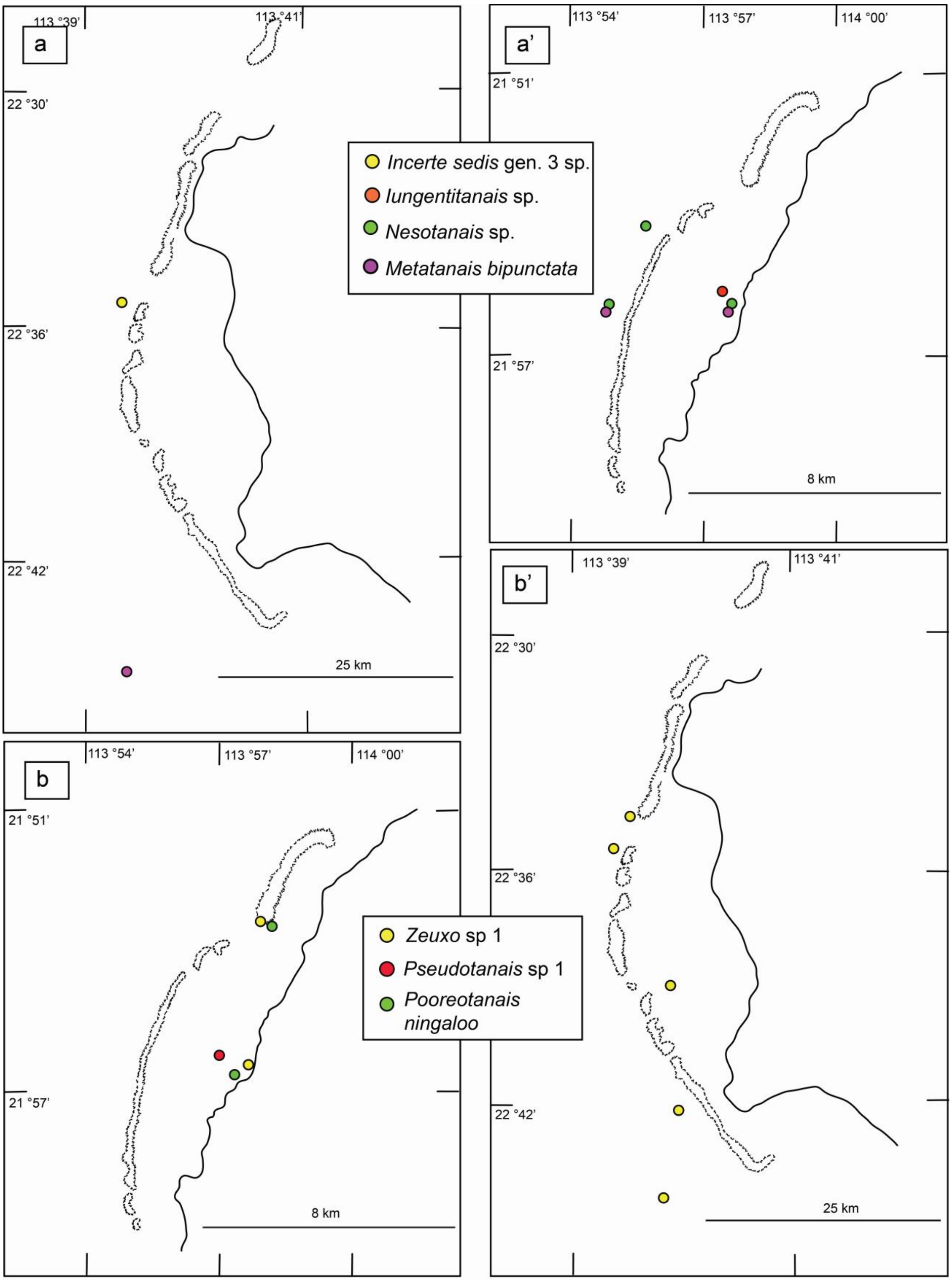


Fig. 4.1.17. Ningaloo Reef. Distribution of Incerte sedis gen. 3 sp., *Iungentitanais* sp., *Nesotanais* sp., *Metatanais bipunctata* Błażewicz-Paszkowycz & Zemnko, 2009 at **a)** northern part and **a')** southern part. Distribution of *Zeuxo* sp. 1, *Pseudotanais* sp. 1, *Pooreotanais ningaloo* Błażewicz-Paszkowycz & Bamber, 2009 at **b)** southern part and **b')** northern part.

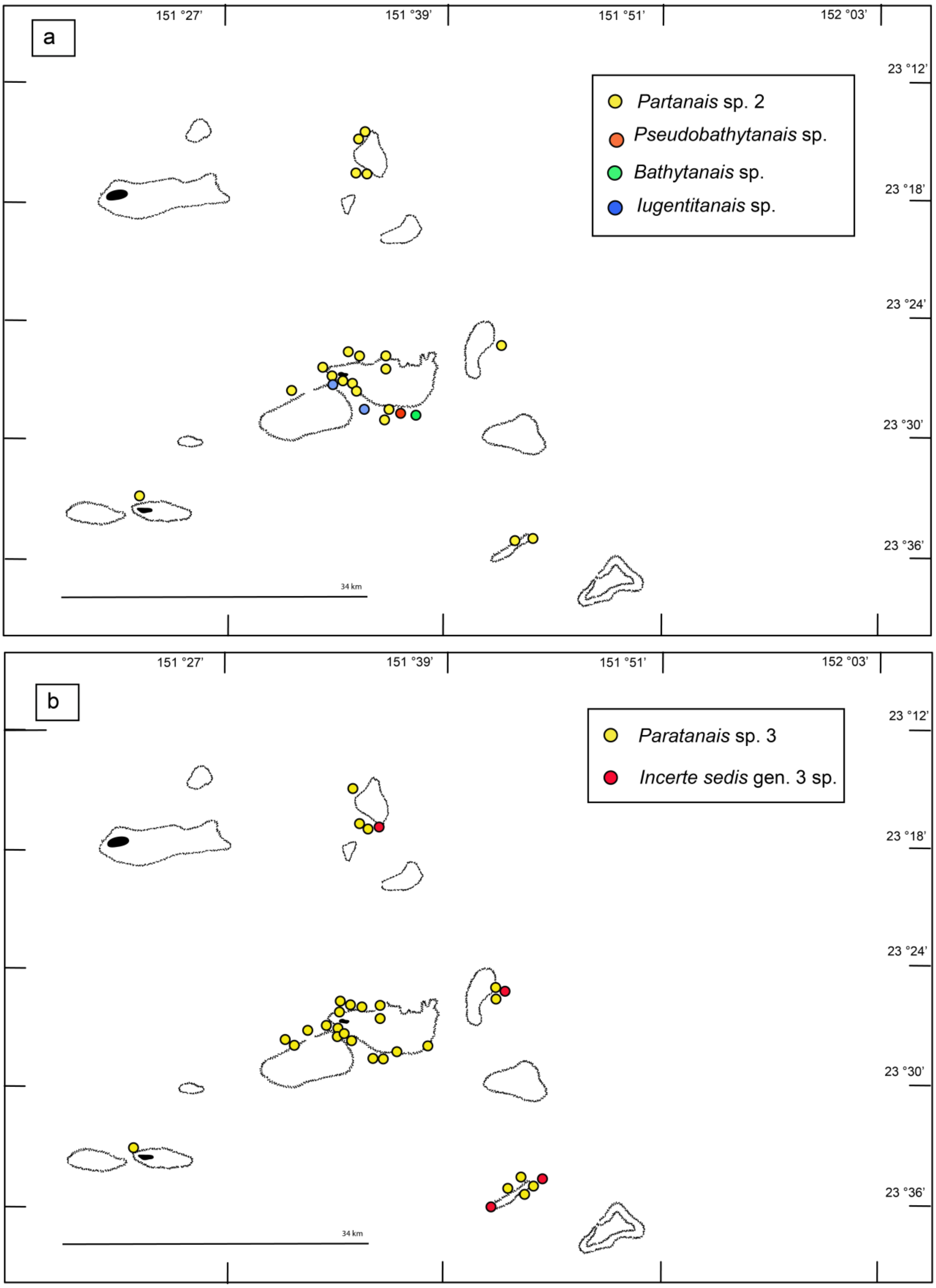


Fig. 4.1.18. Heron Island. Distribution of **a)** *Paratanais* sp. 2, *Pseudobathytanais* sp., *Bathytanais* sp., *Iungentitanais* sp.; **b)** *Paratanais* sp. 3, *Incerte sedis* gen. 3 sp.

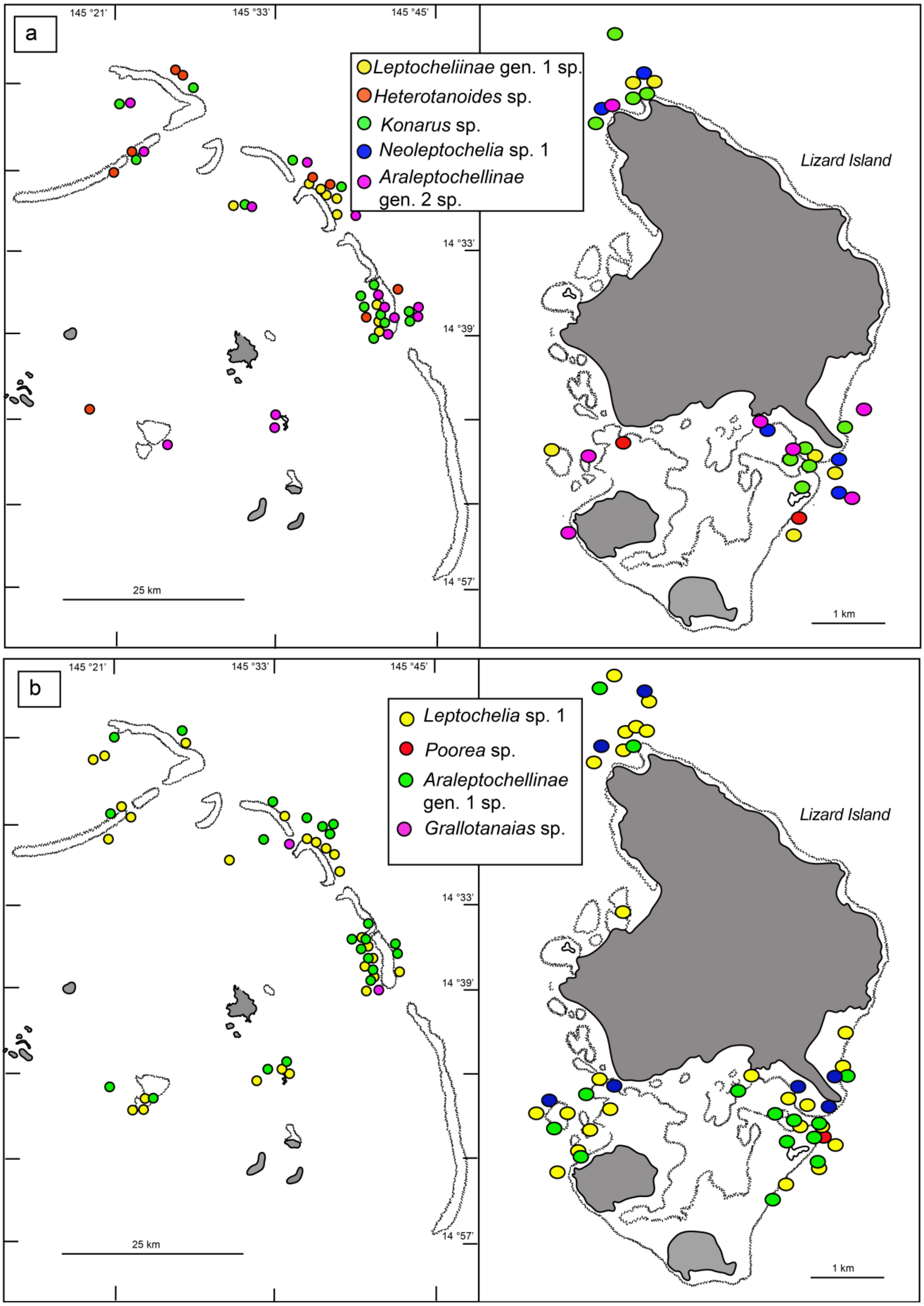


Fig. 4.1.19. Lizard Island. Distribution of **a)** *Leptocheliiane* gen. 1 sp., *Hetreotananoides* sp., *Konarus* sp., *Neoleptochelia* sp., *Araleptocheliinae* gen. 2 sp.; **b)** *Leptochelia* sp. 1, *Poorea* sp., *Araleptocheliinae* gen. 1 sp., *Grallatotanais* sp.

Family Leptocheliidae Lang, 1973

The Leptocheliidae consist of 76 species classified to 14 genera. The members of the family commonly occur in shallow water of world ocean although absent in polar region. Leptochelids are associated with different substrata like sand, mud, sponges, bryozoans, seagrass (e.g. Bamber 2005; 2006). Six species were found so far from the coral reefs (Richardson 1905; Hale 1933; Shino 1965; Heard et al. 1988; Larsen & Raymont 2002).

Representative of the family were frequently noted along Australian coast. For example nine species are known from Queensland (Bamber 2008b), eight were recorded from Western Australia (Bamber 2005; Edgar 2012), five from Victoria (Błażewicz-Paszkowycz & Bamber 2012; Bamber 2013), and one from New South Wales (Chilton 1884; Edgar 2012). The collection made during CReefs confirms a high diversity of leptochelids on coral reefs. In each of the three studied sites the family was most diverse and abundant taxon and their share in the collection was 50-60%. Thorough results on morphology of leptochelid found in the CReefs was presented in part 2.

Subfamily Catenarinae Bamber, 2013

Genus *Grallatotanais* Guţu & Ilffe, 2001

Only one species *G. antipai* has been described by Guţu & Ilffe (2001) from waters around Bahamas. *Grallatotanais* sp. recorded from CReefs is the second member of the genus and the only representative in the Australian waters.

Grallotanais sp.

Material: Two specimens found in two samples from Lizard I. at depth 2–19 m on coarse sand, and coral rubble.

Distribution. The species was found in vicinity of Lizard I. at barrier Day Reef and Carter Reef only (Fig. 4.1.19b).

Remarks. Currently the genus is classified to the subfamily Leptocheliinae Lang, 1973, however five-articulated antennule and two spines on maxilliped endite attribute it to the subfamily Catenarinae Bamber, 2013. In contrast members of the Leptocheliinae have antennule with four articles and maxillipedal endite with three spines (Bamber 2013). For this reason *Grallatotanais* is included to subfamily Catenarinae.

Subfamily Konarinae Bamber, 2013

Genus *Konarus* Bamber, 2006

Konarus is represented by one species in Australian waters: *K straddi* (Bamber, 2008) present in Moreton Bay.

Konarus sp.

Material: 19 specimens found in eight samples in Ningaloo, 55 specimens found in 20 samples from Heron I. and 157 specimens found at 32 samples from Lizard I. Material was collected from depth 1–30 m on coarse sand, coral rubble, *Acropora*, *Fungia*, *Pollicipora* head, *Halimeda* turfs, sand and green algae.

Distribution. Species was found in all three study areas. It occurs at southern and northern part of Ningaloo Reef (Fig. 4.1.20a, a'), in vicinity of Heron I. at Heron, Wistari, Must Head, Lamont, Sykes and Broomfield Reefs (Fig. 4.1.21b). Species was collected also near Lizard I. e.g. barrier reefs as Parke, Jewell, Hick and Carter Reefs (Fig. 4.1.19a).

Remarks: *Konarus* sp. differs from *K. straddi* (Bamber, 2008) by presence of short proximal article in uropod endopod.

Genus Neoleptochelia Guţu, 2011

Guţu (2011) erected the genus to accommodate the *Neoleptochelia javaensis*, recorded from Java Sea. So far no other species has been added to the genus.

Neoleptochelia sp.

Material: seven specimens found in five samples from Lizard I. from depth 2–15 m recorded on coral rubble.

Distribution. The species was found only in reefs at the Lizard Island (Fig. 4.1.19a).

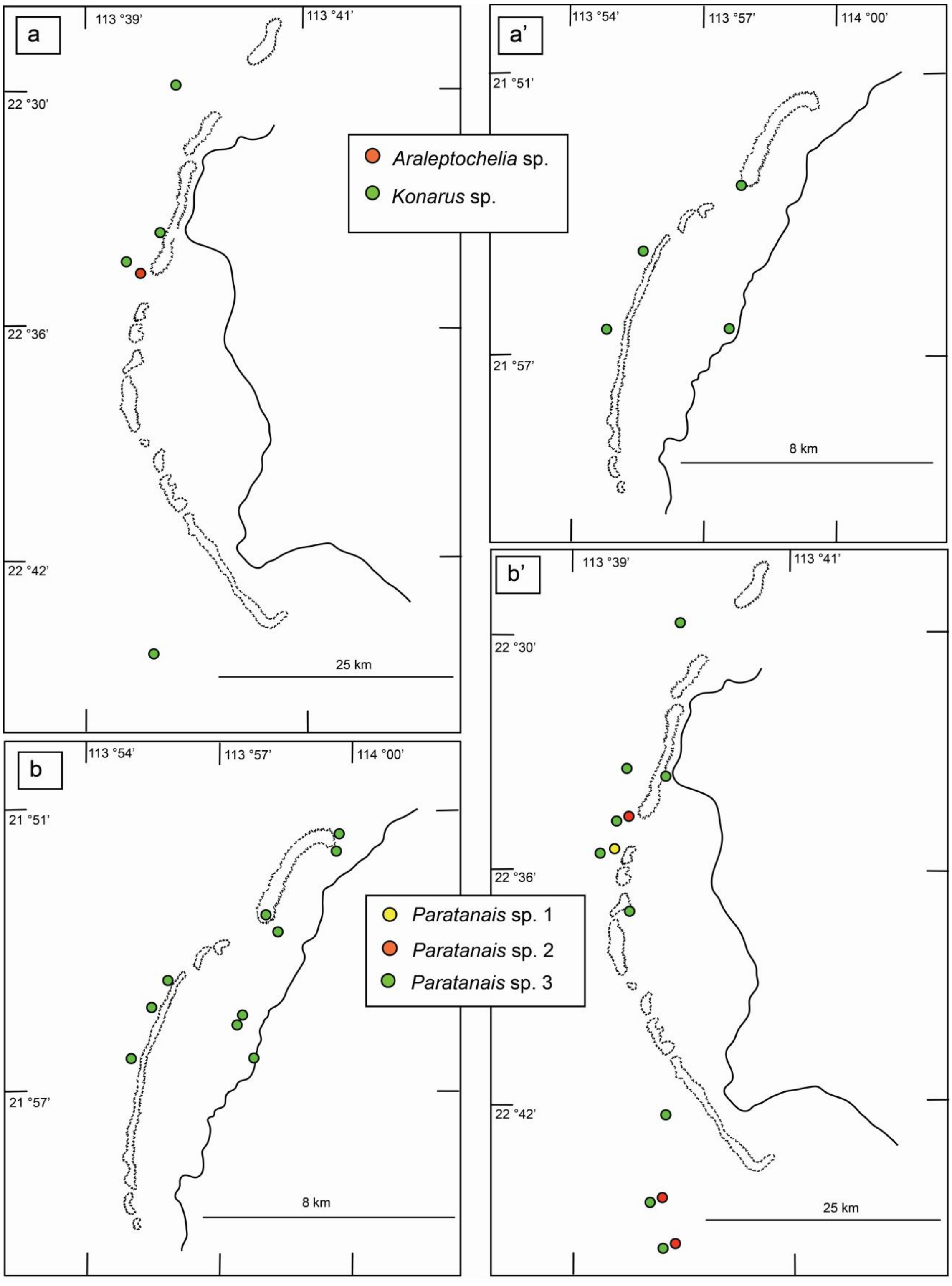


Fig. 4.1.20. Ningaloo Reef. Distribution of *Araleptochelia* sp., *Konarus* sp. at **a)** northern part and **a')** southern part. Distribution of *Paratanais* sp. 1, *Paratanais* sp. 2, *Paratanais* sp. 3 at **b)** southern part and **b')** northern part.

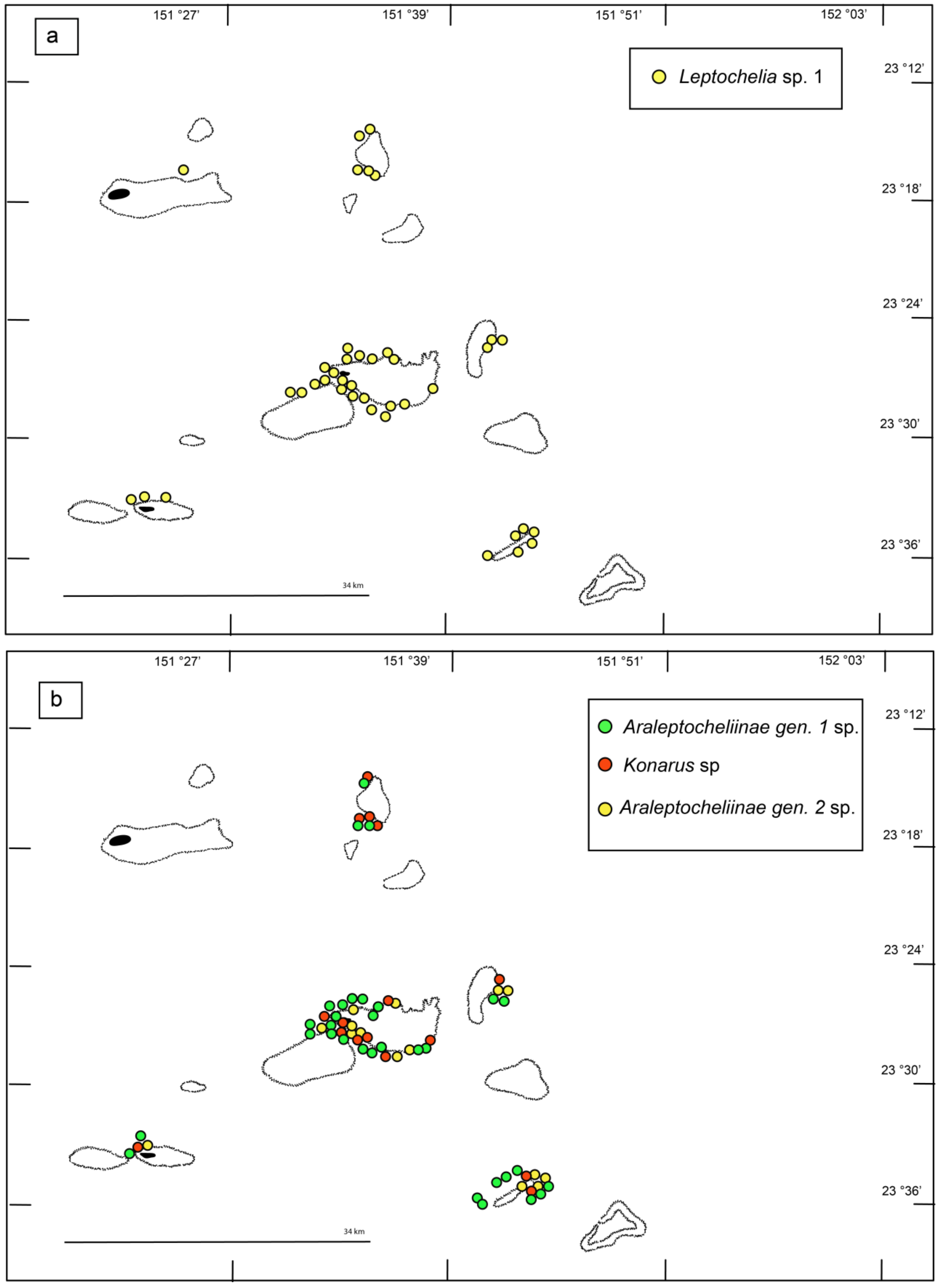


Fig. 4.1.21. Heron Island. Distribution of **a)** *Leptochelia* sp. 1; **b)** *Araleptocheliinae* gen. 1 sp., *Araleptocheliinae* gen. 2 sp., *Konarus* sp.

Remarks: *Neoleptochelia* sp. differs from *N. javaensis* Guţu, 2011 by shorter article-1 of antennule, shorther cheliped basis, less setae on maxilliped basis and less segments in uropod endopod.

Subfamily Araleptocheliinae n. subfam.

Three species from the study material possess characters attributed to the genus *Araleptochelia* Błażewicz-Paszkowycz & Bamber, 2012. However only one of sorted species fits exactly to the definition of the genus. The other species was classified as a distinct genera (see chapter 2).

Genus *Araleptochelia* Błażewicz-Paszkowycz & Bamber, 2012

Until now the genus *Araleptochelia* was represented by one species - *Araleptochelia macrostonyx* Błażewicz-Paszkowycz & Bamber, 2012 found at Bass Strait.

Araleptochelia sp.

Material: two specimens found in two samples at Ningaloo from depth 20 m, on coral rubble and sand.

Distribution. Species was found only at northern part of Ningaloo Reef (Fig. 4.1.20a).

Remarks. The new species differs from the other members of subfamily found in Creefs material by antennule article-2 shorter than article-3, pereopod 2–3 merus shorter than carpus, with elongated spines on meri, pereopod 4–6 with relatively slim basis, and short spines on meri. *Araleptochelia* sp. could be distinguished from *A. macrostonyx* Błażewicz-Paszkowycz & Bamber, 2012 by robust pereopods 2–3 that has much shorter spines on their meri.

Araleptocheliinae gen. 1 sp.

Material: 142 specimens found in 20 samples on Ningaloo; 285 specimens found in 56 samples from Heron I., and 913 specimens found in 44 samples from Lizard I. Samples were taken from depth 2–30 m from coral rubble, dead coral head, *Acropora*, rock, encrusting on oysters, sand, *Halimeda* turfs and algae.

Distribution. The species was frequent and common in all three study areas. It has been found in the northern and southern part of Ningaloo Reef (Fig. 4.1.22a, a'), in vicinity of Heron I. at Heron, Wistari, Must Head, Broomfield, Sykes and Lamont Reefs (Fig. 4.1.21b). Species was found on the reefs of Lizard I. at e.g. North Direction Island, Martin Reef, and barrier reefs as Parke, Jewell, Hick, Day, Young and Carter Reefs (Fig. 4.1.19a).

Remarks. Second article of antennule that is shorter than third article, pereopod 2–3 with merus shorther than carpus and with setae on meri, pereopod 4–6 with relatively slender basis and long spines on meri makes Araleptocheliinae gen. 1 sp. recognizable from the other genera included to the subfamily.

Araleptocheliinae gen. 2 sp.

Material: 256 specimens found in 19 samples on Ningaloo, 46 specimens found in 19 samples from Heron I. and 200 specimens found in 25 samples from Lizard I. at depth range from 2 to 30 m from coarse sand, coral rubble, *Acropora*, *Fungia* head, *Halimeda*, rock, encrusting on oysters, and sand.

Distribution. The species is common and frequent in all three study areas. It was found in the southern and northern part of Ningaloo Reef (Fig. 4.1.22a, a'), in vicinity of Heron I. on Heron, Wistari, Must Head, and Lamont Reefs (Fig. 4.1.21b), near Lizard I. at reefs surrounding the Lizard Island, North Direction Island, Martin Reef, and barrier reefs as Parke, Jewell, Hicks, Day, and Carter Reefs (Fig. 4.1.19a).

Remarks. The third article of antennule is similar in length to article-2, pereopods 2–3 merus longer than carpus with robust spines, pereopods 4–6 have robust basis and long spines on merus. The characters makes Araleptocheliinae gen. 2 sp. distinguishable from the two other genus.

Subfamily Leptocheliinae Lang, 1973

Genus Leptochelia Dana, 1849

Leptochelia is represented by twelve species in Australian waters: *L. daggi* Bamber, 2005 (Esperance Bay), *L. dijonesae* Bamber, 2008, *L. guduroo* Bamber, 2008, *L. karragarra* Bamber, 2008, *L. myora* Bamber, 2008, *L. opteros* Bamber, 2008

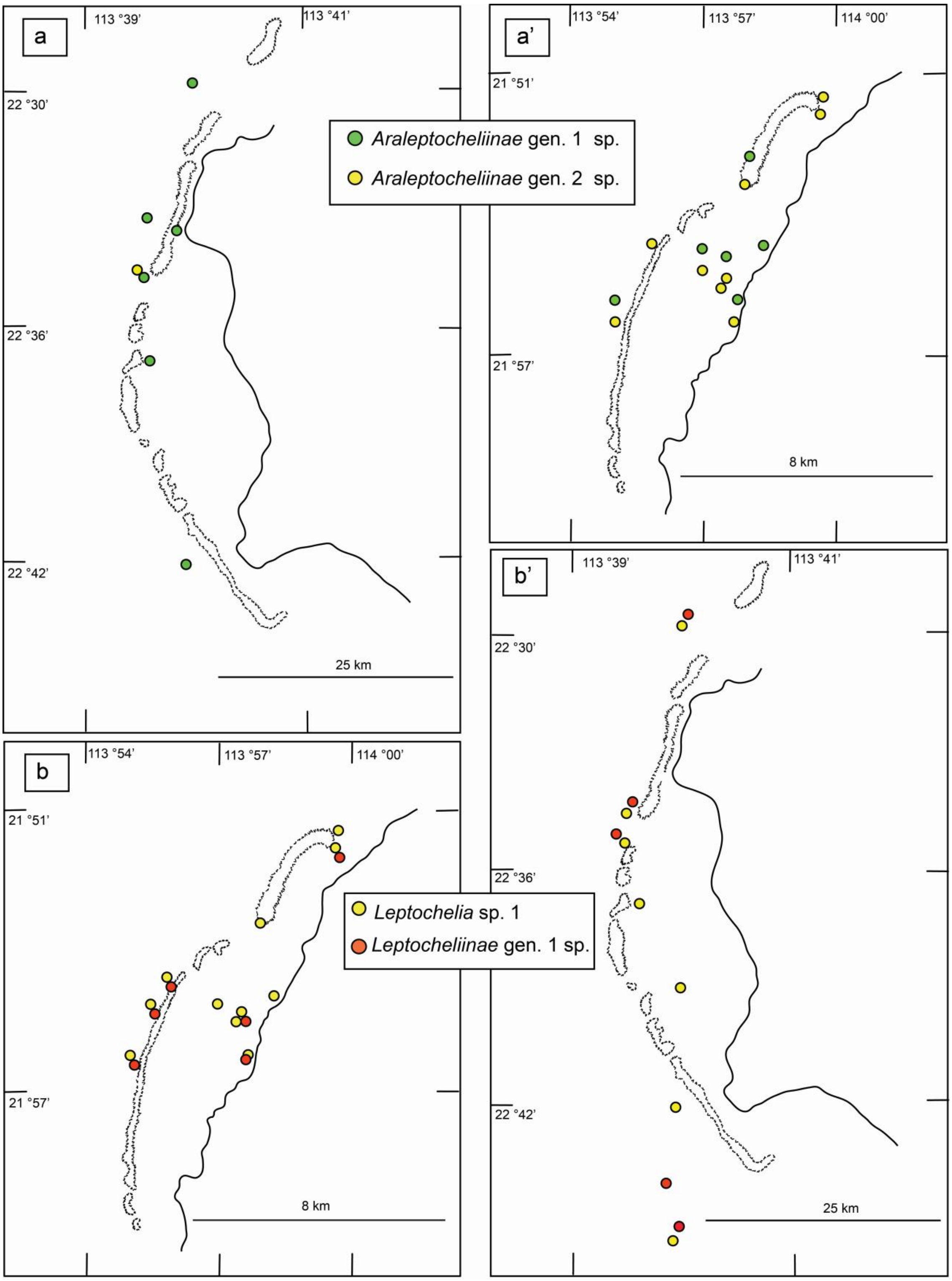


Fig. 4.1.22. Ningaloo Reef. Distribution of *Araleptocheliinae* gen. 1 sp., *Araleptocheliinae* gen. 2 sp., at **a)** northern part and **a')** southern part. Distribution of *Leptochelia* sp. 1, *Leptocheliinae* gen. 1 sp. at **b)** southern part and **b')** northern part.

(Moreton Bay), *L. vimesi* Bamber, 2005 (Esperance Bay), *L. billambi* Błażewicz-Paszkowycz & Bamber, 2012 and *L. occiporta* Błażewicz-Paszkowycz & Bamber (Bass Strait), *L. evansi* Edgar, 2012, *L. gadgeti* Edgar, 2012(Western coast), *L. ignota* (Chilton, 1885) (New South Wales coast).

***Leptochelia* sp.**

Material: 74 specimens found in 29 samples on Ningaloo, 977 specimens found in 73 samples from Heron I. and 1013 specimens found in 83 samples from Lizard I. from depth 0–30 m from coral rubble, sand, *Acropora*, *Fungia*, *Pollicipora* head, rock, encrusting on oysters, bryozoans rubble, green algae.

Distribution. The species was common and frequent in all three study area. *Leptochelia* sp. occurs at southern and northern part of Ningaloo Reef (Fig. 4.1.22b, b'), as well as in vicinity of Heron I., at Heron, Wistari, Must Head, North West Island, Broomfield, Sykes and Lamont Reefs (Fig. 4.1.21a). The species occurs also near Lizard I. at reefs surrounding Lizard Island and North Direction Island and Martin Reefs as well as the barrier reefs as Parke, Jewell, Hicks, Day and Carter (Map 4.1.19b).

Remarks. *Leptcochelia* sp. resembles the most *L. billambi* Błażewicz-Paszkowycz & Bamber, 2012, although the new species has slightly longer cheliped carpus, and two long setae on carpus of pereopod-1, in contrast to *L. billambi* that has one seta. Moreover *Leptcochelia* sp. has three distodorsal setae in pereopods 4–5, while *L. billambi* has them four.

Genus Poorea Edgar, 2012

Poorea is represented by three species in Australian waters: *P. johannesi* Edgar, 2012 recorded in vicinity of Tasmania, *P. nobbi* (Bamber, 2005) and *P. wrighti* Edgar, 2012 present in western Australia.

***Poorea* sp.**

Material: 134 specimens found in one sample from Lizard I. collected at depth 2 m on coral rubble.

Distribution. The species was found only near Coconut Beach at Lizard Island (Fig. 4.1.19b).

Remarks. Amended diagnosis of the genus is proposed in part 2 of this thesis. *Poorea* sp. similar to *P. wrighti* Edgar, 2012 and *P. nobbi* (Bamber, 2005) has three-articulated endopod of uropod. *Poorea johannesi* Edgar, 2012 with five segments of endopod is probably not a member of that genus.

Poorea wrigthi was described based only on male thus comparison with *Poorea* sp. is impossible. *Poorea* sp. differs from *Poorea nobbi* by number of setae on maxilliped basis, slimmer spine on meri of pereopods 2–3, and more compact segments of antennule.

Leptocheliinae gen. 1 sp.

Material: 214 specimens found in 19 samples on Ningaloo, and 337 specimens found in 14 samples from Lizard I. at depth 2–21m from coral rubble, *Acropora*, *Pollicipora* head.

Distribution. The species occurs at southern and northern part of the Ningaloo Reef (Fig. 4.1.22a, a') and near Lizard I. at reefs near the Island, and barrier reefs as Parker, Jewell, Day and Carter (Fig. 4.1.19a).

Remarks. Leptocheliinae gen. 1 sp. differs from other members of the subfamily in compact antennule articles, relatively wide cheliped, with carpus 1.6 times as long as wide, and wide pereopods 2–3. Moreover species found in Creefs collection has four-segmented endopod of uropod and one-segmented exopod which is as long as proximal segment of endopod. For details see part 2.

Family Nototanaidae Sieg, 1976

Family is represented by 11 species in seven genera. Most of them were found in tropical and temporary region. Only *Nototanais* were recorded from polar zone (Błażewicz-Paszkowycz & Jażdżewski 2000). There are no represents of the family described from Australian waters.

In the material taken during CReefs one member of *Nesotanais* was recognized that contributed in 2% to the collection.

Genus *Nesotanais* Shiino, 1968

Nesotanais sp.

Material: five specimens found in four samples on Ningaloo, 15 specimens found in seven samples from Heron I. and 82 specimens found in 23 samples from Lizard I. Material was collected from depth 2–29 m on coral rubble, *Acropora*, *Pollicipora* head, *Halimeda*, mangrove woods and sand.

Distribution. The species occurs at all three study areas. It was collected at southern part of Ningaloo Reef (Fig. 4.1.17a') as well as in vicinity of Heron I. at Heron, Sykes, Must Head and Broomfield Reefs (Fig. 4.1.23b). Species quite common near Lizard I. where was recorded at reef surrounding the Island, Martin and barrier reefs as Jewell, Hicks, Day and Younge (Fig. 4.1.16b).

Remarks. *Nesotanais* sp. is the first representative of the genus in Australian waters. Other species classified to the genus were recorded so far from Indonesian basin from shallow water (Rennell Island and Palau Island), however none of them from coral reefs (Shiino 1968; Guţu & Iliffe 1989).

Family Typhlotanaidae Sieg, 1984

One hundred and eight species in 13 genera are classified to the family. Typhlotanaidae represents occur usually in deep sea, although occasionally are known also on the shelf (e.g. Błażewicz-Paszkowycz 2007; Błażewicz-Paszkowycz &Bamber 2012). One of the exception is genus *Antiplotanais* Bamber, 2008 that was recorded on the shelf (see below), present also in the CReefs collection.

Genus *Antiplotanais* Bamber, 2008

The genus *Antiplotanais* is represented by three species in Australian waters: *A. actuarius* Błażewicz-Paszkowycz & Bamber, 2012 recorded from Bass Strait, *A. coochimudlo* Bamber, 2008 from Moreton Bay, and *A. lutze* (Bamber, 2005) from Esperance Bay.

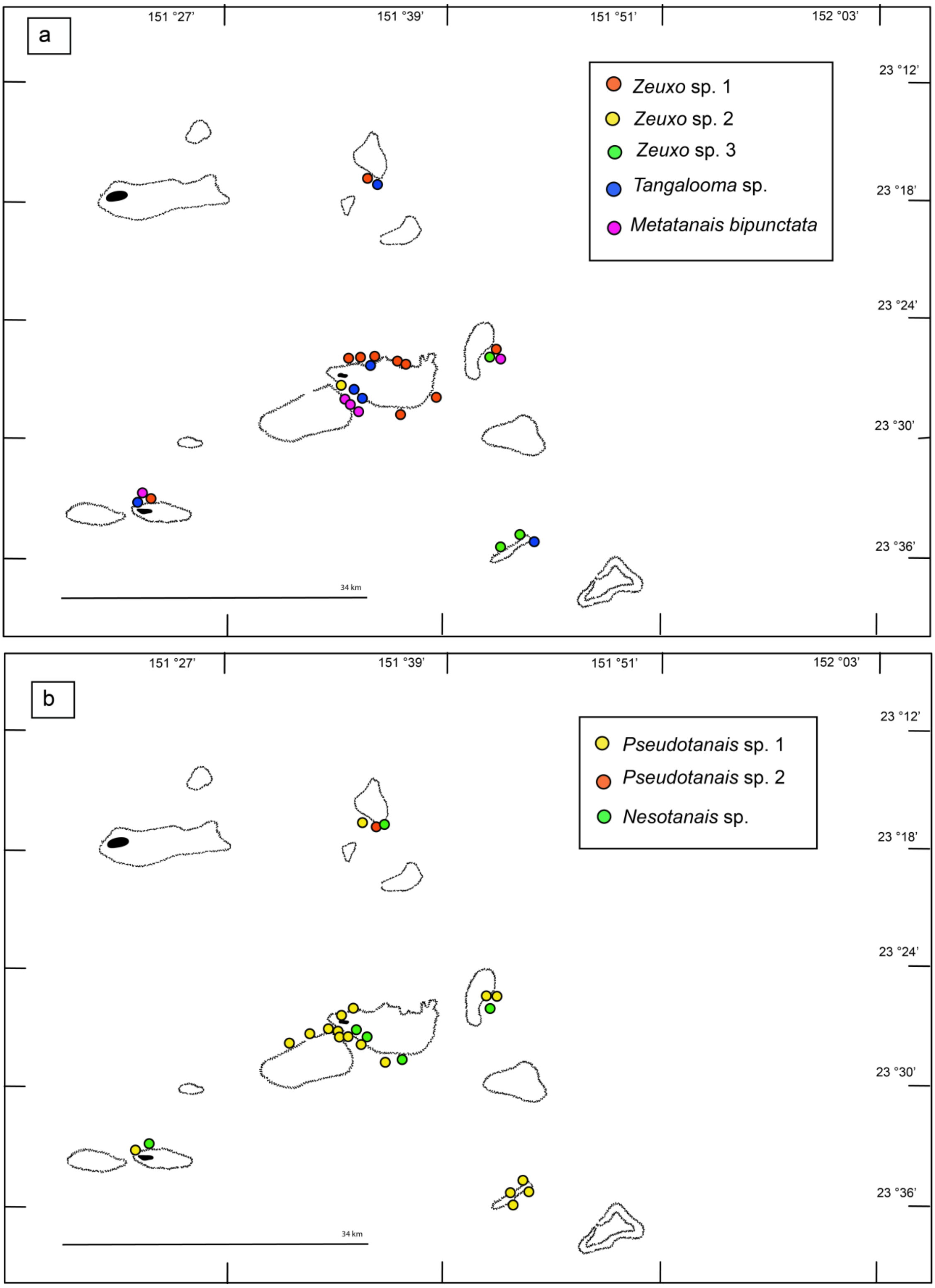


Fig. 4.1.23. Heron Island. Distribution of **a)** *Zeuxo* sp. 1; *Zeuxo* sp. 2, *Zeuxo* sp. 3, *Tangalooma* sp., *Metatanais bipunctata* Błażewicz-Paszkowycz & Zemko, 2009; **b)** *Pseudotanais* sp. 1, *Pseudtanais* sp. 2, *Nesotanais* sp.

Antiplotanais sp.

Material: 25 specimens found in six samples from Lizard I. at depth 2–30 m recorded on coral rubble, *Acropora*, *Fungia* head and sand.

Distribution. The species occurs near Lizard I. at reefs surrounding Palfrey Island as well as reefs as: Hicks, Day and Carter (Fig. 4.1.16a).

Remarks. *Antiplotanais* sp. differs from *A. lutze* (Bamber, 2005) by length of uropod exdopod in relation to endopod. The exopod is about 0.8 times as long as endopod in *Antiplotanais* sp., while in *A. lutze* it is shorter, about 0.4 times of endopod lenght. *Antiplotanais* sp. is distinguished from *A. coochimudlo* Bamber, 2008 and *A. actuaries* Błażewicz-Paszkowycz & Bamber, 2012 by antennule proportion. First article in *Antiplotanais* sp. is three times as long as wide and 2.6 times as long as third article. The proportion in *Antiplotanais coochimudlo* are 3.3 and 2 respectively and in *A. actuaries* 2 and 4 respectively.

Family Mirandotanaidae Błażewicz-Paszkowycz & Bamber, 2009

The family is represented by four species classified to three genera, found near Florida (Suárez-Morales et al. 2011), Australia (Błażewicz-Paszkowycz & Bamber 2009) and Antarctica (Kudinova-Pasternak Pasternak 1974; Błażewicz-Paszkowycz & Jażdżewski 1996). Members of the *Pooreotanais* are known only from the Australia.

Genus Pooreotanais Błażewicz-Paszkowycz & Bamber, 2009

Pooreotanais is represented by two species in Australian water: *P.gari* Błażewicz-Paszkowycz & Bamber, 2009 recorded from Bass Strait and *P. ningaloo* Błażewicz-Paszkowycz & Bamber, 2009 found in vicinity of Ningaloo.

Pooreotanais ningaloo Błażewicz-Paszkowycz & Bamber, 2009

Material: Two specimens found in two samples from Ningaloo, at depth range from 4 to 10 m, recorded on coral rubble and dead coral heads.

Distribution. The species was found only at northern part of Ningaloo Reef (Fig. 4.1.17b).

Family Paratanaidae Lang, 1949

The family Paratanaidae includes 36 species in six genera. Members are widely distributed in World Ocean, the most northerly record was from Kurile Island (Kussakin & Tzareva 1972) and southerly from Kerguelen (Vanhoffen 1914). They occur in wide depth range, although members of the subfamily Paratanainae Lang, 1949 are noted from shallow water down to 300–400 m (Barnard 1920), while members of subfamily Bathytanainae Larsen & Heard, 2001 can be found even at 3000 m (Bird & Holdich 1989). Represents of the family are related to different substrata, but none were found within coral reefs so far.

The family is well represented in Australia by seventeen species in total. Eleven of those species were found in south-eastern part of Australia in Bass Strait, Esperance (e.g. Larsen & Heard 2001; Bamber 2005; Błażewicz-Paszkowycz & Bamber 2012), five species in Moreton Bay (Bamber 2008b), and six along western coast (Larsen & Heard 2001; Bamber 2005).

In the studied material six species were recognized and they contributed to the total tanaidacean collection in 7-13%.

Subfamily Bathytanaidae Larsen & Heard, 2001

Genus: *Bathytanais* Beddard, 1886

The genus *Bathytanais* is represented by six species in Australian water: *B. arenamans* Larsen & Heard, 2001 recorded from NW Australia, *B. bathybrotes* (Beddard 1886) from Moreton Bay and Bass Strait (Bamber 2008b; Błażewicz-Paszkowycz & Bamber 2012), *B. culterformis* Larsen & Heard, 2001 from Queensland and Western coast, *B. fragilis* Larsen & Heard, 2001 from Victoria coast, *B. greebo* Bamber, 2005 recorded from Esperance Bay, *B. juergeni* Larsen & Wilson, 1998 from Moreton Bay and New South Wales coast, and *B. parageios* Błażewicz-Paszkowycz & Bamber, 2012 recorded from Bass Strait.

Bathytanais sp.

Material: one specimen found in two samples from Heron I. at depth 13–29 m on coral rubble and sand.

Distribution. The species was collected only at Heron Reef (Fig. 1.18a).

Remarks. The species is characterized by square extension on second article of antenna extended to half-length of the third article and distal sharp apophyses on the third article. These features make *Bathytanais* sp. similar to *B. arenamans* Larsen & Heard, 2001 and *B. juergeni* Larsen & Wilson, 1998. However *Bathytanais* sp. can be recognized from them due to distinct apophyses on third article. Both *B. arenamans* and *B. juergeni* have only small spine on that article.

Genus *Pseudobathytanais* Kudinova-Pasternak, 1990

The genus *Pseudobathytanais* is represented by one species in Australian waters — *P. gibberosus* Larsen & Heard, 2001 recorded from south-eastern coast.

Pseudobathytanais sp.

Material: one specimen found at Lizard I. and one near Heron I. from depth 10 m on delicate rubble and sand.

Distribution. The species occurs only at barrier Day Reef, in vicinity of Lizard I. (Fig. 4.1.16a), and near Heron Reef (Fig. 4.1.18a).

Remarks. *Pseudobathytanais* sp. could be recognized from *P. gibberosus* Larsen & Heard, 2001 by sharp apophyses on the second article of antenna, which absent in *P. gibberosus*. Next feature that differs both species is length of cheliped dactylus. It is shorter than body of chelae in *Pseudobathytanais* sp. 1 and longer in *P. gibberosus*.

Subfamily Paratanainae Lang, 1949

Genus *Paratanais* Dana, 1852

The genus *Paratanais* is represented by seven species in Australian waters: *P. gaspodei* Bamber, 2005 from Esperance Bay, *P. maleficus* Larsen, 2001 from New South Wales, *P. malignus* Larsen, 2001 from NSW coast and Bass Strait, *P. perturbatius* Larsen, 2001 out off NSW, *P. tanyherpes* Błażewicz-Paszkowycz & Bamber, 2012 recorded from Bass Strait, *P. vetinari* Bamber, 2005 from Esperance Bay and Bass Strait, and *P. wanga* Bamber, 2008 from Moreton Bay.

***Paratanais* sp. 1**

Material: one specimen found at Ningaloo at depth 15 m on sand and fine rubble.

Distribution. The species was collected only at northern part of Ningaloo Reef (Fig. 4.1.20b')

Remarks. *Paratanais* sp. 1 was classified to the genus due to the plates on carapace and lateral, plumose setae on pleonites. However the species has smooth basis of pereopods 4–6, similar to basis of pereopods 1–3. All other represents if the genus have basis of posterior pereopods much stronger than basis of anterior pereopods.

***Paratanais* sp. 2**

Material: 22 specimens found in six samples on Ningaloo, 109 specimens found in 30 samples from Heron I., from depth 0–29 m, recorded on coral rubble, *Acropora* head and green algae.

Distribution. The species occurs in the northern part of Ningaloo Reef (Fig. 4.1.20b') and in the vicinity of Heron I. at reefs as: Heron, Sykes, Must Head Broomfield and Lamont (Fig. 4.1.18b).

Remarks. *Paratanais* sp. 2 resembles the most *P. gaspodei* Bamber, 2005 within Australian species. Both *Paratanais* sp. 2 and *P. gaspodei* have uropod with one segmented exopod and endopod consisting two segments. However length of uropods in the *Paratanais* sp. 2 is similar to length of pleotelson, while *P. gaspodei* has longer uropoda, about 1.2 times as long as pleotelson. Moreover *Paratanais* sp. 2 differs in cheliped carpus proportion that in *Paratanais* sp. 2 is twice as long as wide, while in *P. gaspodei* the carpus 1.4 times longer than wide.

***Paratanais* sp. 3**

Material: 236 specimens found in 33 samples on Ningaloo, 270 specimens found in 53 samples from Heron I., and 319 specimens found at 62 samples from Lizard I. Samples were collected from different types of coral rubble as *Acropora*, *Fungia*, *Faviidae*, *Pollicipora* head, *Halimeda* as well as sand from the depth 1–30 m.

Distribution. The species is wide distributed in all three study areas. It occurs at southern and northern part of Ningaloo Reef (Fig. 4.1.20b, b'), in vicinity of Heron I. at Heron, Sykes, Must Head, Broomfield and Lamont Reefs (Fig. 4.1.18b). Species was also collected near Lizard I. at its southern and northern parts as well at Martin Reef and barrier reefs as Parke, Jewell, Hicks, Day Younge and Carter (Fig. 4.1.16a).

Remarks. *Paratanais* sp. 3 is characterized by short uropods, that are half as long as pleotelson, and relatively wide chaliped, with carpus 1.7 times as long as wide. The characters makes *Paratanais* sp. 3 the most similar to *P. malignus* Larsen, 2001. Both species differ in uropod exopod length, which is longer than the first segment of endopod in *Paratanais* sp. 3. Inverted proportion characterizes *P. malignus.* Furthermore *Paratanais* sp. 3 has no seta on cheliped dactylus, while one seta is present in *P. malignus*.

Family Pseudotanaidae (Sieg, 1973 M.S.) Sieg, 1976

The family consists of forty four species classified to three genus. Members of Pseudotanaidae were recorded from tropical to polar zone (e.g. Hansen 1913; Sieg 1973; Błażewicz-Paszkowycz & Siciński 2014). Species classified to the family occur in wide depth gradient, from shallow water to depth more than 3000 m (Hansen 1913; Sieg 1977). Represents of Pseudotanaidae are connected with various substrata and habitats e.g. sand, mud, hydrothermal vents however there are no records from coral reefs.

In Australia family is represented by one species, noted from Esperance Bay (Bamber 2005). During the investigation two next species were classified to the family which share was about 3%.

Subfamily Pseudotanainae (Sieg, 1973 M.S.) Sieg, 1977

Genus *Pseudotanais* Sars, 1882

The genus *Pseudotanais* is represented by one species in Australian waters: *P. (Akanthinotanais) scrappi* Bamber, 2005 recorded from Esperance Bay.

Pseudotanais sp. 1

Material: three specimens found in two samples from Ningaloo, 82 specimens found in 29 samples from Heron I, and 25 specimens found in eight samples from Lizard I. Samples were collected from depth 2–10 m on coral rubble, *Acropora* head, *Halimeda* and other algae.

Distribution. The species occurs in all three study areas. It was found in southern part of Ningaloo Reef (Fig. 4.1.17b), in vicinity of Heron I. e.g. at reefs as Heron, Sykes, Broomfield, Must Head and Lamont (Fig. 4.1.23b) and south off Lizard I. and Martin Reef, as well as barrier reefs - Jewell, Hicks, Day and Carter (Fig. 4.1.16b).

Remarks. *Pseudotanais* sp. 1 differs from *P. scrappi* Bamber, 2005 by lack of setae on cheliped carpus and shorter fixed finger and dactylus, which are 0.8 times as long as body of chelae. Moreover it has two-segmented exopod of uropod. In contrast *P. scrappi* has two setae on cheliped carpus, fixed finger and dactylus as long as body of chelae and one segment in uropod endopod.

Pseudotanais sp. 2

Material: three specimens found in one sample from Heron I. at depth 16 m on *Acropora* rubble.

Distribution. The species occurs only at Broomfield Reef in vicinity of Heron I. (Fig. 4.1.23b).

Remarks. *Pseudotanais* sp. 2 can be distinguish from *P. scrappi* Bamber, 2005 and *Pseudotanais* sp. 1 by elongated chelieped, that carpus is 2.5 times as long as wide, and fixed finger 0.3 times as long as wide. Moreover *Pseudotanais* sp. 2 has one segment in exopod and endopod of uropod with two elongated segments, each about five times as long than wide.

Family Incerte sedis

Genus *Metatanais* Shiino, 1952

Two members of the genus are known so far. The first, *Metatansis cylindricus* Shiinoi, 1952 was reported from off Japan coast. The other *M. bipunctata* Błażewicz-

Paszkowycz & Zemko, 2009 was originally collected during CReefs in vicinity of Ningaloo Reef and near Lizard Island. During study the material species was found also near Heron Island.

Metatanais bipunctata **Błażewicz-Paszkowycz & Zemko, 2009**

Material: four specimens found in four samples at Ningaloo, six specimens found in five samples at Heron I. and one specimen found at Lizard I. Material was collected from depth 1–21 m on coral head, rubble on sand, and *Acropora* head (see also Błażewicz-Paszkowycz & Zemko, 2009).

Distribution. The species was present at all three studied areas: northern and southern part of Ningaloo Reef (Fig. 4.1.17a, a'), Heron I. at Heron, Sykes, and Must Head Reefs (Fig. 4.1.23a) and near Lizard I. at barrier Hicks Reef (Fig. 4.1.16a).

Genus *Tangalooma*

Only one species within the genus *Tangalooma* Bamber, 2008 is known. *T. rous* was described by Bamber, 2008 from Moreton Bay associated with bryozoans. In CReefs material one species belonging to the genus was identified which share in the total material was less than 1%.

Tangalooma **sp.**

Material: Twelve specimens found in eight samples from Heron I. at depth 10–30 m recorded on coral rubble, coarse sand, and *Acropora* head.

Distribution. The species was rather common in vicinity of Heron I.: Heron, Broomfield, Must Head, and Lamont Reefs (Fig. 4.1.23b).

Remarks. *Tangalooma* sp. differs from *T. rous* Bamber, 2008 by chelieped with more elongated carpus, which is 2.6 times as long as wide in *Tangalooma* sp. and twice as long as wide in *T. rous*. Moreover *Tangalooma* sp. has uropoda with elongated segments of endo- and exopod, each about 2.5–3 times as wide as long. In comparison uropod segments of *T. rous* are shortened, each about 1.5 times as wide as long.

Incerte sedis n. gen. 1

Material: one specimen found at Lizard Island from 3m deep, from coral rubble.

Distribution. The taxon recorded only at barrier Parke Reef near Lizard I. (Fig. 4.1.16a).

Remarks. Within the tanaidomorphs genera with three articles on antennule the new taxon resembles the most *Tanaissus* Norman & Scott, 1906 because untypical shape of carapace that is elongated, narrowing in anterior part. However they differ in apparence of uropoda. The new taxon has endopod with one segment, and very small exopod, looking like protrusion of basis, while the *Tanaissus* has two segmented endopod and fully developed, two segmented exopod.

***Incerte sedis* gen. 2**

Material: two specimens found in two samples from Lizard I. in depth range 7–15 m, recorded on coral rubble.

Distribution. The species was recorded only at barrier Day Reef near Lizard I. (Fig. 4.1.16a).

Remarks: This taxon is 1.2 mm long and has antennule with three articles. Furthermore it has eyes with pigment, cheliped carpus with strong setae at midlength, and elongated uropod, with one-segmented endopod and exopod. Mentioned features exclude the taxon from each of currently defined genera of Tanaidomorpha.

***Incerte sedis* gen. 3**

Material: one specimen found at Ningaloo, nine specimens found in six samples at Heron I., and one specimen found at Lizard I. Samples were collected from depth 6–28 m, mainly on coarse sand, coral rubble and *Halimeda*.

Distribution. The species occurs at southern part of Ningaloo Reef (Fig. 4.1.17a), in vicinity of Heron I. at Broomfield, Sykes and Lamont Reefs (Fig. 4.1.18b), and near Lizard I. at barrier Jewell Reef (Fig. 4.1.16b).

Remarks. The species sorted from the Creefs collection resembles the most genus *Collettea* Lang, 1973 due to: lack of eyes, elongated pleon, which is similar in length to rest of the body, four articulated antennule, lack of pleopods in female, although present in male. The new taxon has very short exopod of uropod, which is fused with the basis. Members of the *Colletea* have both rami of uropods well separated from basal article.

Superfamily Tanaoidea Dana, 1849

Family Tanaididae Dana, 1949

The family includes 77 species in 19 genera recorded from tropical (Miller 1940), temporary (Bamber 2005) and subpolar zone (Sieg 1980), mainly from shallow water. Some of them as *Hexapleomera robusta, Sinelobus stanfordi* and *Tanais dulongii* were considered as an ubiquitous. Detailed study reveals that each of the species is in fact group of cryptic species (Edgar 2008). Members of Tanaididae are usually associated with kelp holdfast, algae, seagrass, or sand (e.g. Bamber 2005; Edgar 2008) and only three species so far are known from the coral reefs (Sieg 1980; Shino 1965).

In Australia family is well known, 23 species were recorded so far, from which 18 were noted along southern and southwestern coast e.g. Tasmania and Esperance Bay (Bamber 2005; Edgar 2008) and only six are known out off Queensland (Bamber 2008b).

In the CReefs material four representatives of the family were recognized which contributed in about 1% to the total collection.

Subfamily Pancolinae Sieg, 1980

Tribe *Anatanaini* Nordenstam, 1930

Genus *Zeuxo* Templeton 1840

Subgenus *Paraxeuxo* Sieg, 1980

The subgenus *Parazeuxo* is represented by four species in Australian waters: *Z. (P). amiti* Bamber, 2008 from Moreton Bay, *Z. (P). belli* Edgar, 2008 from Queensland coast, *Z. (P). mooneyi* Edgar, 2008, and *Z. (P). russi* Edgar, 2008 both from New South Wales coast.

Zeuxo sp. 1

Material: 17 specimens found in nine samples from Ningaloo, 20 specimens found in one sample from Heron I., and 13 specimens found in six samples from Lizard I., in depth 1 m on columnar dead coral.

Distribution. The species was collected at all three study areas, at southern and northern part of Ningaloo Reef (Fig. 4.1.17b, b') and in vicinity of Heron I. at Heron, Broomfield, Sykes, and Must Head Reefs (Fig. 4.1.23a). *Zeuxo* sp. 1 occurs also near southern and northern coast of Lizard I. (Fig. 4.1.16b).

Remarks. *Zeuxo* sp. 1 can be distinguished from *Z. amiti* Bamber, 2008 due to number of setae on pleopod basis. *Zeuxo* sp. 1 has 5–6 basal setae, while *Z. amiti* only four. The Creefs species differs from *Z. belli* Edgar, 2008, *Z. mooneyi* Edgar, 2008, and *Z. russi* Edgar, 2008 in smooth first inner setae on pleopod endopod. The setae in denticulated in mentioned species (Edgar 2008). Moreover four articles of uropod allowed to distinguish *Zeuxo* sp. 1 from Australian species. *Z. belli* and *Z. russi*, both have five articles in uropod, *Z. mooneyi* three and *Z. amity* six articles.

Sugenus _Zeuxo_ Templeton, 1840

The subgenus *Zeuxo* is represented by six species in Australian waters: *Z.* (*Z.*) *angua* Bamber, 2005 from Esperance Bay, *Z* (*Z.*) *kirkmani* Edgar, 2008, *Z* (*Z.*) *nannioggae* Bamber, 2005 both species from Western coast, *Z* (*Z.*) *normani* (Richardson, 1905a) noted from New South Wales and Tasmanian coast, *Z* (*Z.*) *odohertyae* Edgar, 2008 from Tasmanian coast, and *Z* (*Z.*) *shepherdi* Edgar, 2008 recorded in vicinity of Cape Jaffa.

Zeuxo sp. 2

Material: 46 specimens found in 18 samples from Heron I. at depth 2–27 m on *Acropora* head, *Halimeda*, and flat coral pavement.

Distribution. The species was found only at Heron Reef (Fig. 4.1.23a).
Remarks. *Zeuxo* sp. 2 could be distinguished from Australian species by combination of several characters. The species has four articles in uropod what differs it from *Z. shepherdi* Edgar, 2008, *Z. kirkamni* Edgar, 2008 and *Z. angua* Bamber, 2005 with five

articles, and *Z. odoherthyae* Edgar, 2008 as well as *Z. normani* (Richardson, 1905a) with six to seven articles.

Beyond that *Zeuxo* sp. 2 has five inner setae on pleopod basis and one outer setae on pleopod endopod. Number of pleopod setae differs between other Australian species. *Z. shepherdi*, *Z. kirkamnai*, and *Z. normani* which have six basal setae, and respectively six, three and two to four setae in endopod. *Z. odoherthyae* has nine basal setae and five setae on endopod, *Z. nanniogae* three basal basal, and *Z. angua* four basal and two on endopod.

***Zeuxo* sp. 3**

Material: five specimens found in five samples from Heron I. at depth range 10–27 m, recorded on coral rubble and *Acropora* head.

Distribution. The species occurs only at Sykes and Lamont Reefs in vicinity of Heron I. (Fig. 4.1.23a).

Remarks. *Zeuxo* sp. 3 is characterized by five segments on uropod, what differs the species from *Z. nanniogae* Bamber, 2005, *Z. normani* (Richardson, 1905a) and *Z. odoherthyae* Edgar, 2008. Moreover *Zeuxo* sp. 3 has five to six inner setae on pleopod basis and one outer seta on endopod. The feature allows to distinguish *Zeuxo* sp. 3 from other Australian species as well as from *Zeuxo* sp. 2.

Subfamily Panainae Dana, 1849

Genus *Tanais* Latreille, 1831

The genus *Tanais* is represented by two species in Australian water: *T. cf dulongi* (Audouin, 1826) recorded by Edgar (2012) from Western coast, and *T. pongo* Bamber, 2005 from Esperance Bay.

***Tanais* sp.**

Material: 26 specimens found in two samples from Lizard I. from depth less than 1m, recorded on mangrove wood, rock, and encrusting on oysters.

Distribution. The species occurs only off west coast of Lizard I. (Fig. 4.1.16b).

Remarks. The species was classified to genus based on presence of four pleonites, dorsal rows of setae on first two pleonites, and aestheascs on last segment of antennule. An unusual character within the genus is one outer setae on pleopod basis. This feature make the species different from the two previously known Australian species. *T. cf dulongi* has seven to eleven setae and *T. pongo* has 26 setae on pleopod basis.

Part II.

Unrevealed diversity of family Leptocheliidae from Australian coral reefs.

The family Leptocheliidae Lang, 1973 was erected for tanaidomporphs with four articulated antennule, six articulated antenna, and uropod endopod consisting more than two segments in female. Primarily four genera were included to the family, namely *Leptochelia* Dana, 1849, *Pseudoleptochelia* Lang, 1973, *Hargeria* Lang, 1973, and *Pseudonototanais* Lang, 1973. Lang (1973) designated *Leptochelia savignyi* (Krøyer, 1842) a type species, although according to the ICZN the type species of *Leptochelia* is *L. minuta* Dana, 1849 (see Bamber 2010).

Leptocheliids are common and occasionally abundant elements of marine communities in shelf of tropical, subtropical and temperate zones (e.g. Larsen & Rayment 2002, Bamber 2005, 2007; Błażewicz-Paszkowcz & Bamber 2012; Edgar 2012) although some are found below shelf break (e.g. *Bathyleptochelia* Larsen, 2003, *Mesotanais* Dollfus, 1897 and *Pseudonototanais* Lang, 1973) and polar zone (Błażewicz-Paszkowycz et al. 2012). A great diversity of the niches leptocheliids inhabit implies a sympatric speciation and thus a high taxonomical diversity. Since pioneering works (Krøyer 1982; Dana 1984; Lang 1973) thoroughly summarized by Bamber (2010), the number of the species classified to the family increased several folds and currently includes ninety-three species in seventeen genera and four subfamilies (Anderson 2013, WoRMS 2014).

Regardless the recent taxonomical efforts (Bird & Bamber 2000; Bamber 2005, 2007, 2008, 2010; Błażewicz-Paszkowcz & Bamber 2012; Edgar 2012) and substantial progress in understanding the natural system of Leptocheliidae (Bamber 2010, 2013; Bird 2011) there are still numerous gaps in the knowledge which seeking an inquiry. A conspicuous ontogenetic variation, polymorphism, existence of cryptic and sympatric species and highly dimorphic males are the major obstacles in studding Leptocheliidae (Larsen & Raymont 2002; Bamber 2013). Highly dimorphic males of Leptocheliidae are more straightforward identifiable than the females (Edgar 2012; Bamber 2013), but they are scarce element in the populations (Ishimaru 1985; Bird & Bamber 2000; Błażewicz-Paszkowycz & Bamber 2012) thus identification of the females is much pragmatic. Some species like *Leptochelia savignyi* (Krøyer, 1842) or *Leptochelia dubia* (Krøyer, 1842) were considered cosmopolitan until conscientious morphological analysis supported by detailed morphometry revealed a complex of a sibling species (Ischimaru 1985; Bamber & Bird 2000; Larsen & Raymont 2002). Bamber (2010) has established a list of over twenty morphological characters that facilitate attribution of *Leptochelia* to the subfamily and genus. Following this tuition we identified a large collection of leptochellids made during CReefs Program - Australian Node (2008–2010) from three sites of Australian coral reefs e.g. Lizard Island and Heron Island (Great Barrier Reef) and Ningaloo (NE Australia).

From Australian waters 22 species classified to seven genera are known (Bamber 2005; 2006, 2008; Błażewicz-Paszkowycz & Bamber 2012; Edgar 2012). They were described mainly from southern basin from Esperance Bay (Bamber 2005), Moreton Bay (Bamber 2008b), Bass Strait (Błażewicz-Paszkowycz & Bamber 2012) and Tasmania (Edgar 2012). None of those species were so far recorded from coral reefs.

Material and methods

Material was collected during Census of Coral Reefs program in vicinity of Heron Island, Lizard Island (East Australia, Great Barrier Reef) and Ningaloo Reef (West Australia). Piece of dead corals were collected by hand during SCUBA diving, and later put into bucket with a few drop of formaldehyde or fresh water due to encourage animals to leave their tubes. Samples were later washed over a fine mesh (0.3 mm) and preserver in alcohol.

The material was stored in Museum of Tropical Queensland, Australia (MTQ) and West Australian Museum (Perth).

Terminology follows Bamber & Sheader 2005.

Systematic:

Superfamily Paratanaoidea Lang, 1949

Family Leptochelidae Lang, 1973

Subfamily Catenariinae Bamber, 2013

Genus *Grallatotanais* Guţu & Iliffe, 2001

Diagnosis (amended after Guţu & Iliffe, 2001). Antennule with four fully developed articles and distal cap article; four fully developed articles almost subequal. Antenna peduncle article-2 with slender dorsodistal spine, article-3 with ventrodistal seta only. Maxilliped basis with one distal seta; endites distally with two sharp spines, and one long seta. Unguis of pereopod-1 longer than dactylus. Merus of pereopods 4–6 with one or two short spines; carpus with one short spine; propodus of pereopod 4–5 with three distal setae. Pereopod-6 with four distal setae. Uropod exopod with two segments; endopod with 5-segmented; segment-4 at less half as long as segment-3 or -5.

Type species: *Grallatotanais antipai* Guţu & Iliffe, 2001.

Species included: *G. antipai* Guţu & Iliffe, 2001; *Gralatotanais* sp.

Remarks. Four fully developed, subequal articles in antennule, single seta on basis of maxilliped, five-segmented uropods, with four segments apparently shorter than all the others, as well propodus of pereopods 4–5 and 6 with three and four distal setae, respectively, make the new species most similar to monotypic *G. antipai* Guţu & Iliffe, 2001 thus it is assigned to the genus *Grallatotanais*.

Bamber (2013) in his essential studies toward understanding a natural system of Leptocheliidae, classified *Grallatotanais* to subfamily Leptocheliinae predicating on the figures made by Guţu & Iliffe (2001). Since the definition of the family Catenariine base on the shape of spines located on the distal edge of maxillipeds, those presented for *G. antipa* (Guţu & Iliffe 2001: Fig 1J) impede its classification to the family. The examination of the *Gralatotanais* sp. found in the CReefs collection revealed two distinct spines on maxilliped endites, apparently those present in the monotypic and monogeneric *Catenarius daviei* Bamber, 2008. This suggests transferring the genus *Grallatotanais* to subfamily Catenarinae Bamber, 2013.

Grallatotanais sp.

Figs 4.2.1–4.2.3

Material: *Holotype*: LIZ 09-10F, 14.61383S, 145.61820E, Younge Reef, back reef, small coral rubble on sand, depth 15 m, 2009-02-18. *Paratypes*: one specimen, detailed included in Appendix 4.1.4 (Lizard I.)

Diagnosis. Pereopods 2–3 ischium with one seta. Pereopods 4–6 merus spines short.

Description of female. Body (Fig. 4.2.1) 0.8 mm long, 5.8 times as long as wide. Carapace 18% of total body length, nearly as long as wide, with two pairs of lateral setae: at midlength and near eye lobes. Eyes present, with pigment. Pereon 58% of total body length, pereonite-1 shortest, 0.2 times as long as wide, pereonites 2, 3 and 6 similar in length, half times as long as wide; pereonite-4 and -5 longest, similar in length, 0.8 times as long as wide; each pereonite with a pair of lateral setae. Pleon together with pleotelson 22% of total body length; pleonites subequal, 0.1 times as long as wide, each pleonite with pair of lateral setae; pleotelson as long as two first pleonites combined, with pair of posterior setae.

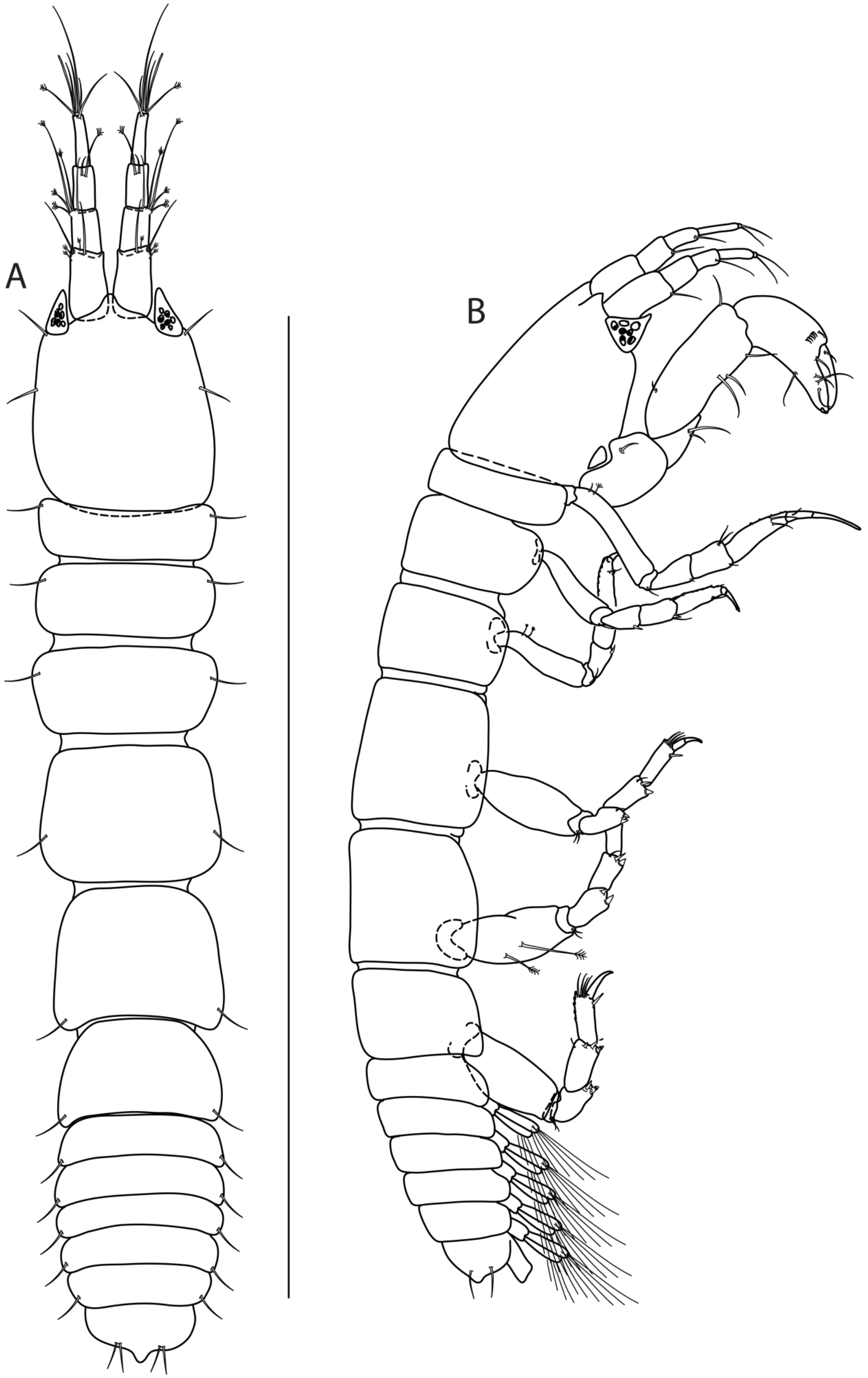


Fig. 4.2.1. *Grallatotanais* n. sp., holotype female. A body dorsal view; B body lateral view. Scale line = 1mm.

Antennule (Fig. 4.2.2A) with five articles. Article-1 1.4 times as long as wide, with two simple and three broom setae distally; article-2 1.2 times as long as wide, one simple and four long broom setae distally; article-3 as long as second article, with simple and broom setae; article-4 3.5 times as long as wide, 0.6 times as long as second and third article combined, with one distal seta; article-5 minute, with one aesthetasc, four simple and one broom seta.

Antenna (Fig 4.2.2B) with seven articles. First article missing; second article 1.2 times as long as wide, with dorsodistal slender spine; third article similar in length to article-2, with dorsodistal spine; fourth article 2.5 times as long as wide, with one simple and four broom setae distally and robust microtrichia in the middle of dorsal margin; fifth article 1.2 times as long as wide, with on distal seta; sixth article minute, with three distal setae.

Mouthpart. Labrum smooth (Fig. 4.2.2C). Left mandible (Fig. 4.2.2E) *lacinia mobilis* crenulate; incisor with distal crenulation. Right mandible (Fig. 4.2.2E') with dorsal serration and distal notch; molar (Fig. 4.2.2E") wide and relatively strong, with teeth and tubercles. Maxillule (Fig. 4.2.2F) with ten distal spines. Maxilliped (Fig. 4.2.2G) palp article-1 naked; article-2 with one outer seta and three inner setae; article-3 with three inner setae; article-4 with four distal, two subdistal and one outer setae; basis with one seta; endites with one tubercle, two sharp spines, one seta and few small apophyses distally.

Cheliped (Fig. 4.2.2D) basis 1.6 times as long as wide, with dorsodistal seta; merus triangular, with two ventral setae; propodus 2.7 times as long as wide, with proximal and distal setae dorsally and three ventral setae; propodus 1.6 times as long as wide, 1.8 times as long as chelae fingers, with row of short setae on inner face and one long seta near dactylus insertion; fixed finger with one ventral seta and three inner setae; dactylus 0.7 times as long as propodus, with proximal seta.

Pereopod-1 (Fig. 4.2.3A) basis 5.8 times as long as wide with small simple and broom dorsoproximal setae; ischium half times as long as wide, with one ventral seta; merus 1.5 times as long as wide, similar in length to carpus, with minute distoventral seta; carpus half times as long as propodus, with two dorsodistal setae and one minute distoventral seta; propodus 3.4 times as long as wide, with two subdistal setae, and tubercles along dorsal margin; dactylus together with unguis 1.2 times as long as propodus, with a proximal seta; unguis twice as long as dactylus.

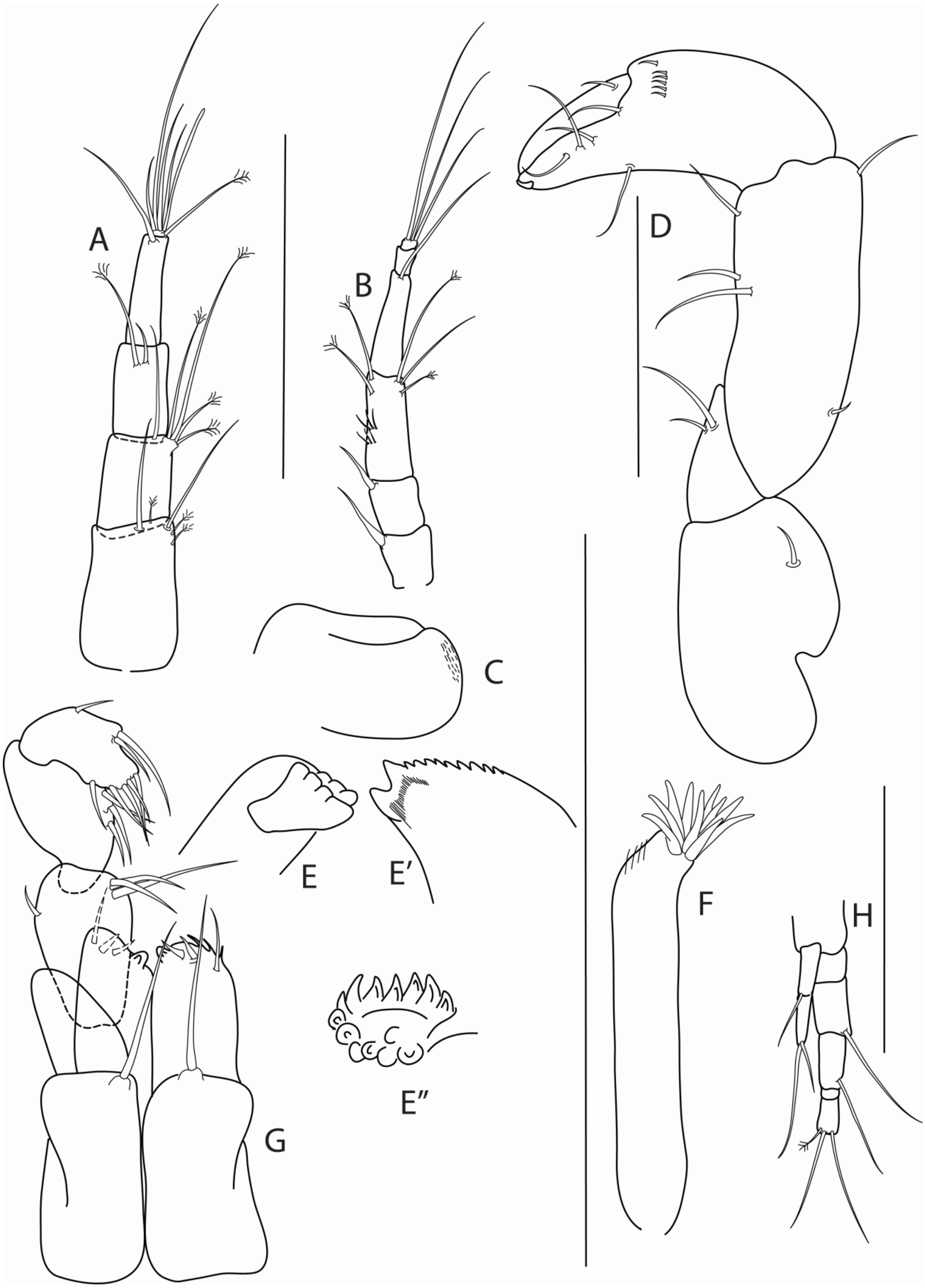


Fig. 4.2.2. *Grallatotanais* n. sp. A. antennule; B antenna; C labrum; D cheliped; E right mandible; E' left mandible; E'' pars molaris; F maxillule; G maxilliped; H uropod. Scale line = 0.1 mm.

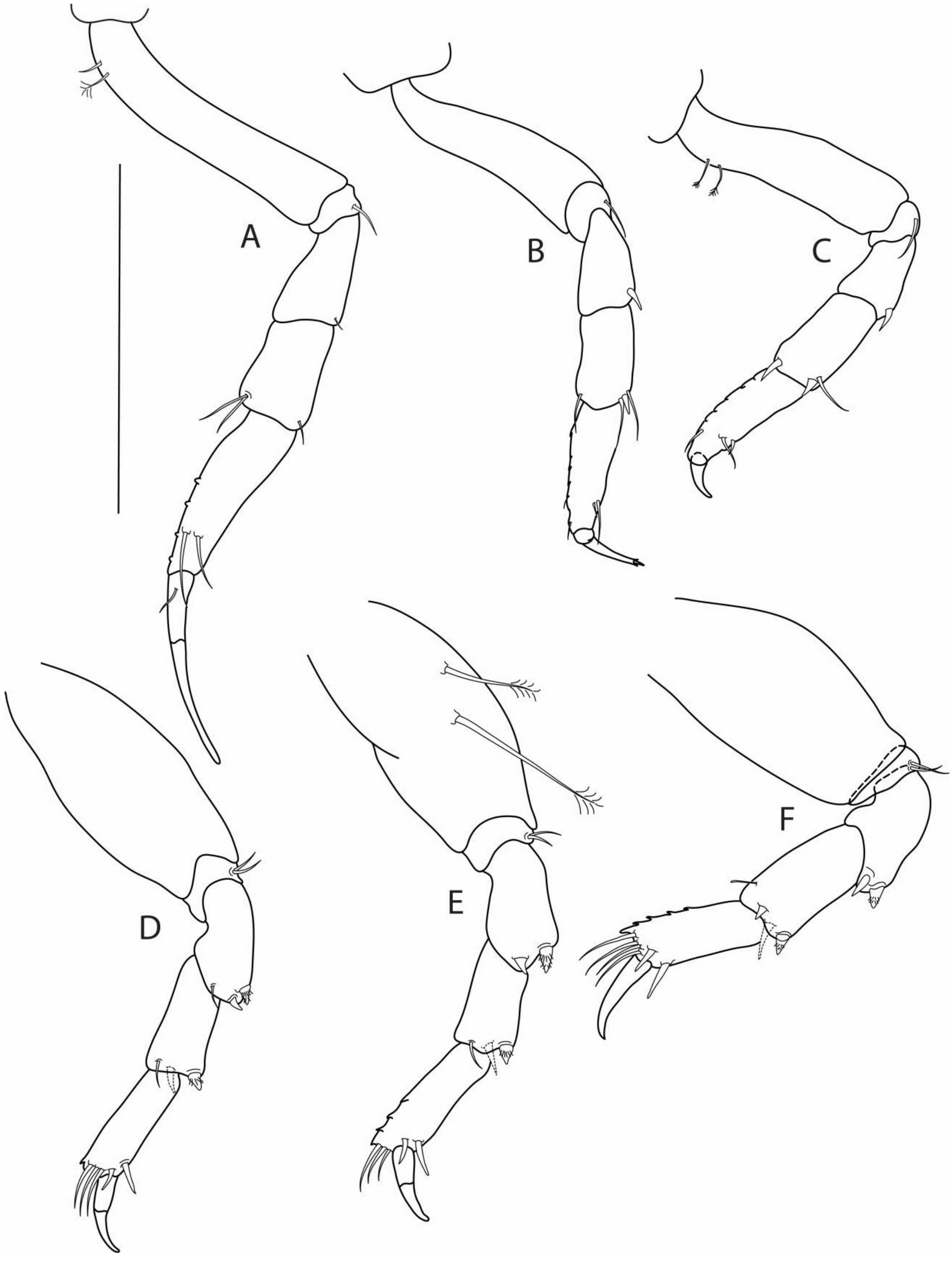


Fig. 4.2.3. *Grallatotanais* n. sp. A pereopod 1; B pereopod 2; C pereopod 3; D pereopod 4; E pereopod 5; F pereopod 6. Scale line = 0.1 mm.

Pereopod-2 (Fig. 4.2.3B) basis 3.8 times as long as wide, naked; ischium 0.3 times as long as wide, with one ventral seta; merus 1.2 times as long as wide, 0.6 times as long as carpus, with one ventrodistal spine; carpus 1.7 times as long as wide, 0.6 times as long as propodus, with one dorsal seta, and one spine and seta distoventrally; propodus 3.8 times as long as wide, with small spine and seta distoventrally, dorsal margin serrated; dactylus together with unguis 0.4 times as long as propodus.

Pereopod-3 (Fig. 4.2.3C) similar to pereopod-2, but basis with two proximal setae.

Pereopod-4 (Fig. 4.2.3D) basis 2.3 times as long as wide, naked; ischium 0.3 times as long as wide, with two ventral setae; merus 1.2 times as long as wide, similar in length to carpus, with two spines and one seta distoventrally; carpus 0.8 times as long as propodus, two spines and single seta distally; propodus 2.7 times as long as wide, with two ventrodistal spines, and three dorsodistal setae; dactylus together with unguis 0.6 times as long as propodus.

Pereopod-5 (Fig. 4.2.3E) similar to pereopod-4, but basis with two large broom setae.

Pereopod-6 (Fig. 4.2.3F) similar to pereopod-5, but basis naked, and propodus with four dorsodistal setae.

Uropods (Fig. 4.2.2H) basis naked; exopod with two segments, 1.2 times as long as proximal endopod segment-1 and -2 combined, tipped by two setae; endopod with five segments, segment-2 and -3 the longest, 2.5 times as long as wide, each with single seta; segment-4 shortest, half times as long as wide.

Remarks. The new species differs from *G. antipai* Guţu & Iliffe, 2001 found in caves of Bahama by having a short spine on merus of pereopod-2 and -3, respectively and one seta in ischium of pereopod-2 and -3, respectively .

Subfamily Konariinae Bamber, 2013

Genus Konarus Bamber, 2006

Species classified: *Konarus cheiris* Bamber, 2006; *K. crassicornis* (Stebbing, 1905); *K. straddi* (Bamber 2008b). *Konarus* n. sp.

Type species: *Konarus cheiris* Bamber, 2006

Konarus sp.

Figs 4.2.4–4.2.6

Material: *Holotype*: CGLI 25B, 14.64567S, 145.45325E, Lizard I., North Head, fore reef (mid shelf), depth 12m, 2008-04-14. *Paratypes*: 230 specimens, details included in Appendix 4.1.6 (Ningaloo), 4.1.5 (Heron I.) and 4.1.4 (Lizard I.).

Diagnosis. Antennule article-1 distal seta short (about as long as article-2). Cheliped propodus without apophysis. Pereopod-6 with three distodorsal setae of the same length. Proximal article of uropod exopod short.

Description of female. Body (Fig. 4.2.4A, B) 1.5 mm long, five times as long as wide. Carapace 23% of total body length, 1.2 times as long as wide, with a seta near eye lobes; eye lobes conspicuous with ommatidia; dorsal cuticular line present. Pereon 54% of total body length, pereonites 1–3 subequal, 0.3 times as long as wide, pereonites 4 and 6 longest, subequal, 0.6 times as long as wide; pereonite-6 0.3 times as long as wide; all pereonites with one lateral seta on each side. Pleon together with pleotelson 23% of total body length, pleonites 1–4 subequal, 0.1 times as long as wide, pleonite-5 0.2 times as long as wide; each pleonites with one pair of lateral setae; pleotelson little shorter than pleonites 1–2 combined, with three pairs of posterior setae.

Antennule (Fig. 4.2.5A) with three articles. First article 1.5 times as long as wide, 1.4 times as long as articles second and third combined, with one middle seta, and three simple and one broom setae distally; second article 0.7 times as long as wide, with three distal setae longer than article; third article 2.4 times as long as wide, 1.1 times as long as second article, distally with five simple setae, two broom setae and one aesthetasc.

Antenna (Fig. 4.2.5B) second article 0.8 times as long as wide, with distodorsal seta, fine ventral seta, and crenulation of dorsal margin; third article 0.6 times as long as wide, with dorsodistal seta; fourth article 2.7 times as long as third article, with three long, simple and three broom setae distally; fifth article 0.4 times as long as fourth article, with simple distal seta; sixth article minute, with four setae.

Mouthpart. Labium (Fig. 4.2.5C) hood-shape, with distal setation. Left mandible (Fig. 4.2.5E) *lacina mobilis* and incisor distally crenulated, molar with numerous finger-like apophyses (Fig. 4.2.5E’’). Right mandible (Fig. 4.2.5E’) similar to left, but without *lacina mobilis*. Labium (Fig. 4.2.5H) wide, bilobed, distally finely setose, with lateral pointed apopyses. Maxillule (Fig. 4.2.5F) with nine distal spines, bunch of long, subdistal hair setae and few hair setae on inner margin. Maxilliped (Fig. 4.2.5G) article-1 naked; article-2 distally with one outer seta and four inner setae; third article with five setae along inner margin; fourth article with three long distal setae; endite (Fig. 4.2.5G’) with one seta and three spines distally.

Cheliped (Fig. 4.2.5D) basis 1.8 times as long as wide, with distodorsal seta mounted on pedestal (setose tubercle); merus triangular with seven ventral setae; carpus 1.3 times as long as wide, with four ventral setae; propodus 1.4 times as long as wide, palm 1.7

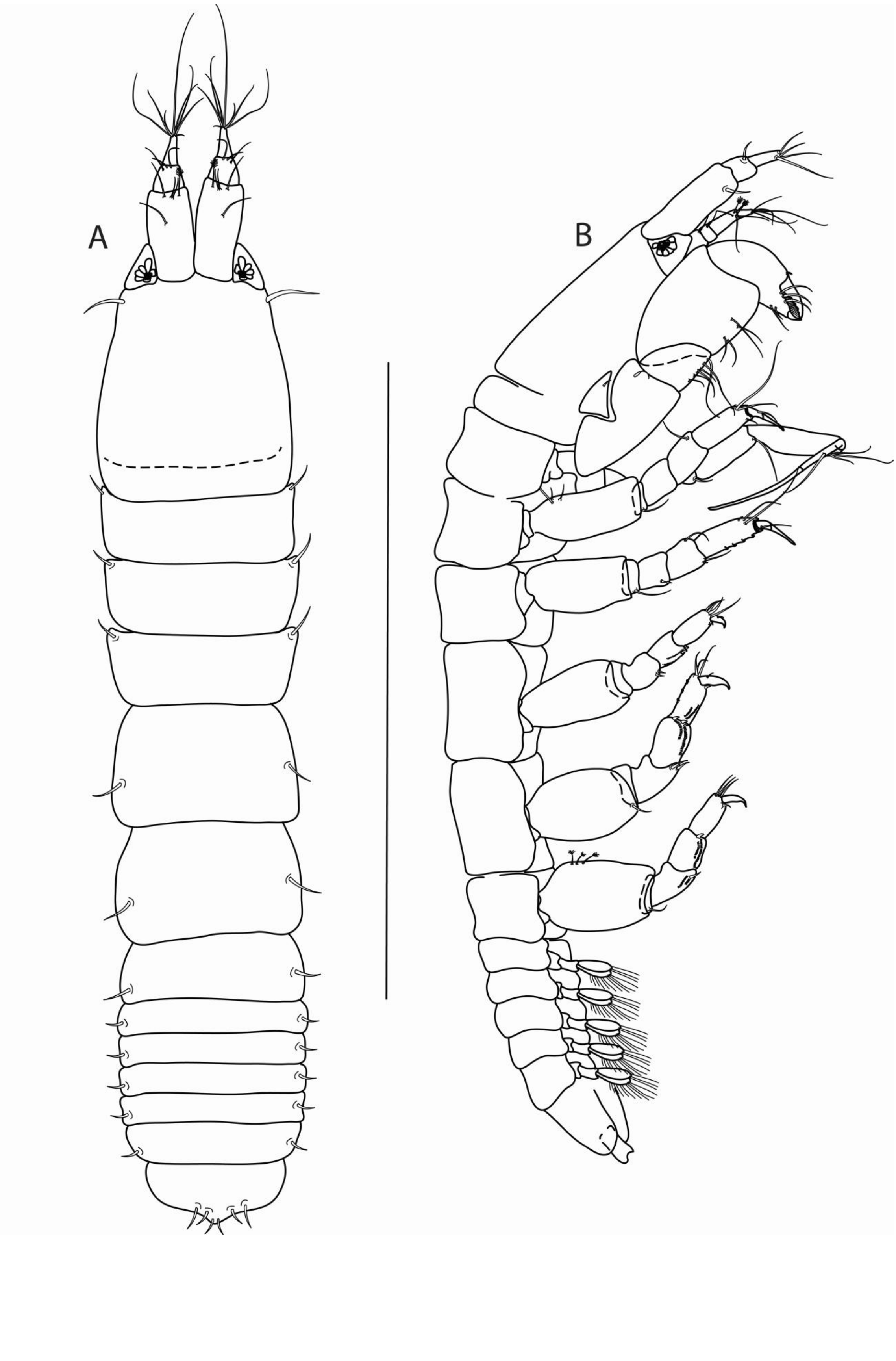


Fig. 4.2.4. *Konarus* n. sp., holotype female. A body dorsal view; B body lateral view. Scale line = 1mm.

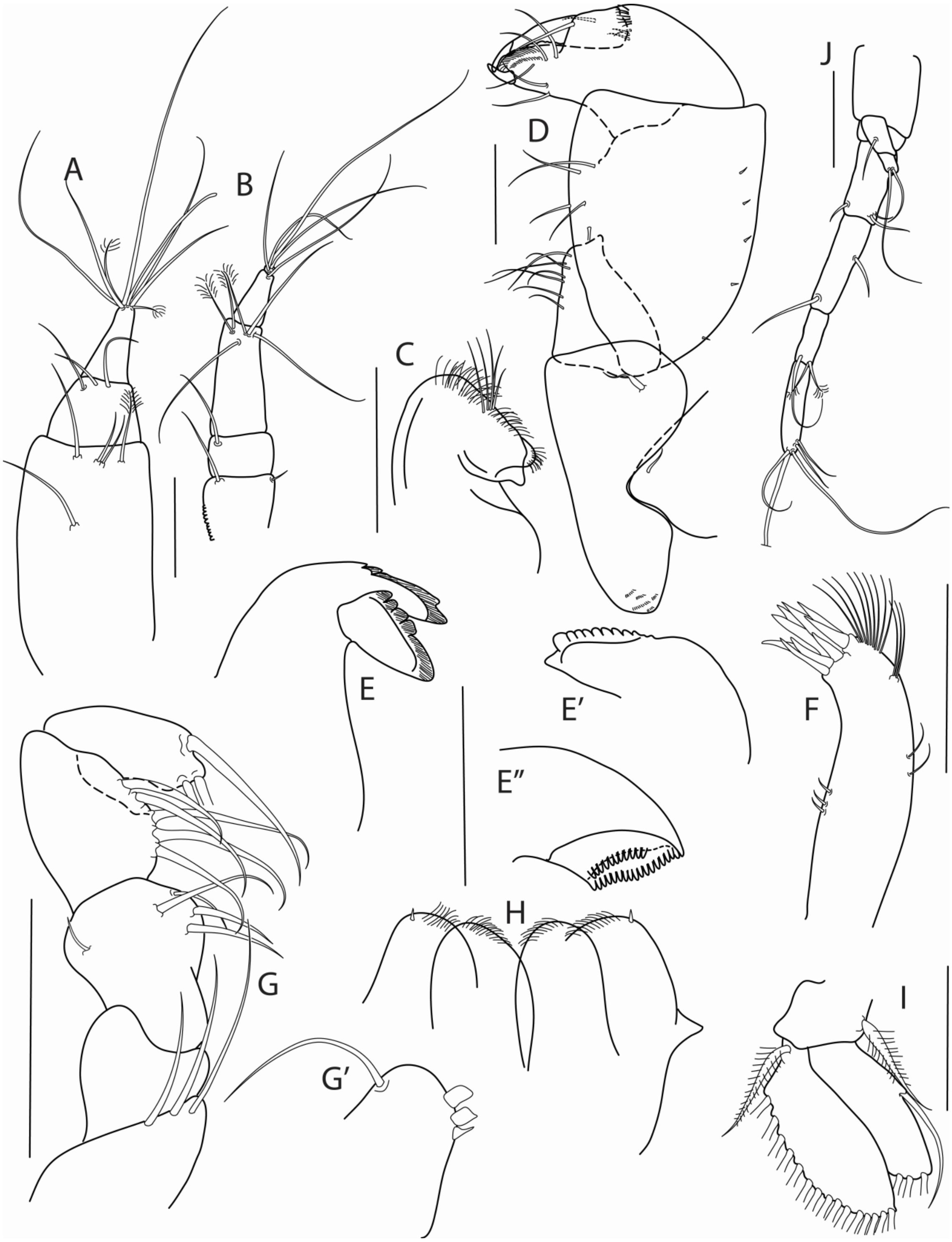


Fig. 4.2.5. *Konarus* n. sp. A. antennule; B antenna; C labium; D cheliepd; E right mandible; E' left mandible; E'' pars molaris; F maxillule; G maxilliped; H labrum; I pleopod; J uropod. Scale line = 0.1 mm.

times as long as dactylus, with row of short setae near dactylus insertion, fixed finger with two ventral setae, and three inner setae, cutting edge crenulate; dactylus subequal to fixed finger.

Pereopod-1 (Fig. 4.2.6A) basis with simple and broom dorsoproximal setae, ischium 0.3 times as long as wide, with one ventral seta; merus 2.2 times as long as wide, 0.7 times as long as carpus, with small ventrodistal seta; carpus 2.2 times as long as wide, 0.6 times as long as propodus, with short and long distoventral setae; propodus with three distal setae; dactylus together with unguis as long as propodus and carpus combined, with long, proximal seta; unguis twice as long as dactylus; the aperture of spinning glands apparently subdistally (Fig 4.2.6A').

Pereopod-2 (Fig. 4.2.6B) basis 2.2 times as long as wide, with one simple and two broom proximal setae; ischium 0.4 times as long as wide, with one ventral seta; merus three times as long as wide, 0.8 times as long as carpus, with minute spine; carpus 0.6 times as long as propodus, with minute spine and two distal setae; propodus 2.5 times as long as wide, with serrated ventral margin, short and long distodorsal setae, small ventral seta, and with row of setules near dactylus insertion; dactylus together with unguis 0.7 times as long as propodus, with one proximal seta.

Pereopod-3 (Fig. 4.2.6C) similar to pereopod-2.

Pereopod-4 (Fig. 4.2.6D, D') basis 1.5 times as long as wide, without setae; ischium 0.3 times as long as wide, with two ventral setae; merus 1.3 times as long as wide, 1.3 times as long as carpus, with two pedestal-based setae; carpus 1.2 times as long as wide, 0.7 times as long as propodus, distally with three bifid or complex spines and one distodorsal setae, ventral margin with numerous microtrichia, propodus twice as long as wide, with two long, one short dorsodistal setae and two small, complex ventrodistal spines; dactylus 0.4 times as long as propodus, with short proximal seta.

Pereopod-5 (Fig. 4.2.6E) similar to pereopod-4, but basis more robust, 1.3 times as long as wide.

Pereopod-6 (Fig. 4.2.6F) similar to pereopod-5, but basis of with three proximal broom setae and propodus with three distoproximal setae of the same length.

Pleopods (Fig. 4.2.6I) in five pairs, all alike, basis with one plumose setae; endopod with one outer setae, and row of inner setae; exopod with row of inner setae.

Uropod (Fig. 4.2.5J) basis naked, exopod two segmented, both bears setae; endopod with seven segments, each bear one or two setae, last segment tipped by five setae.

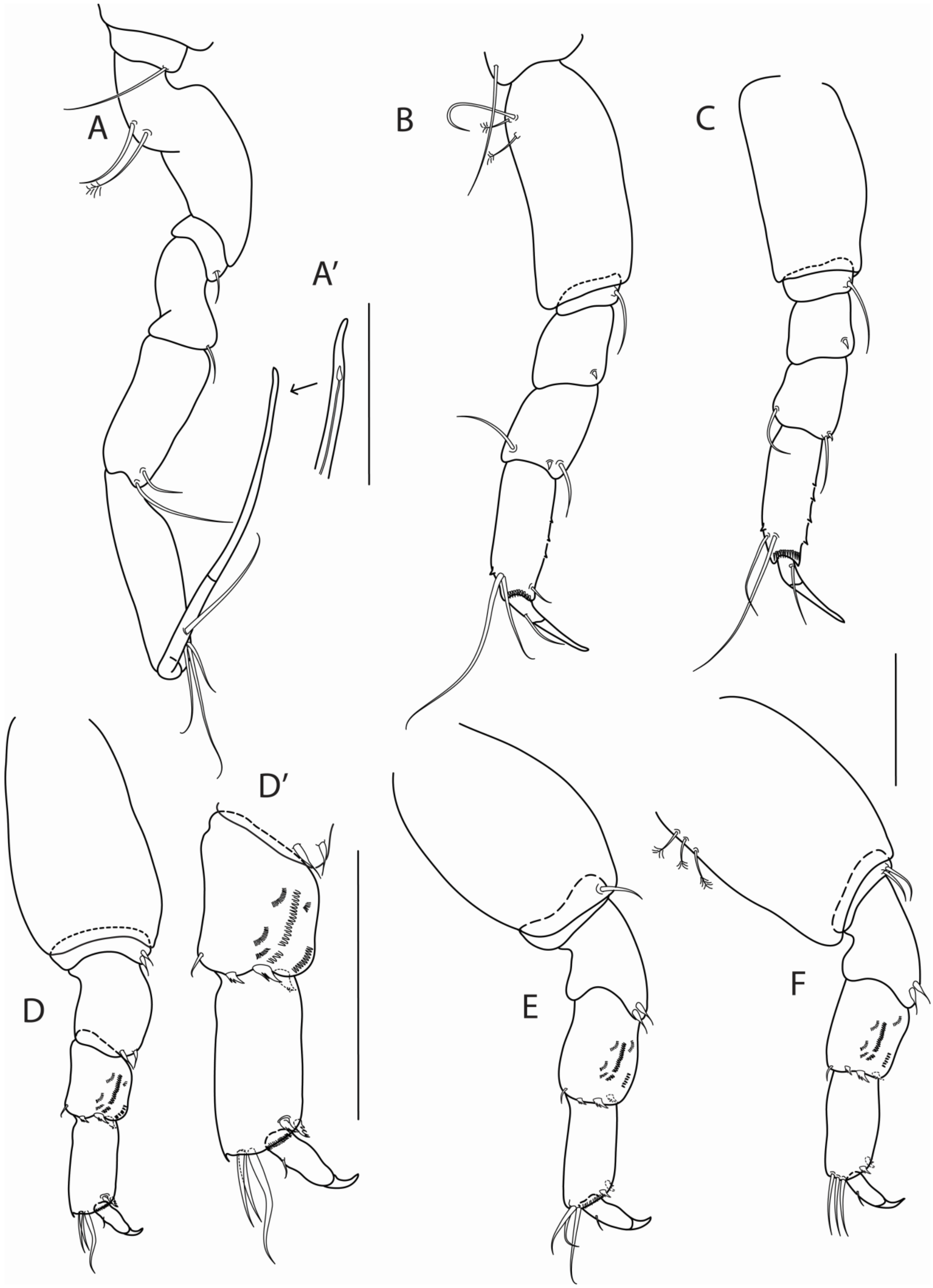


Fig. 4.2.6. *Konarus* n. sp. A pereopod 1; B pereopod 2; C pereopod 3; D pereopod 4; E pereopod 5; F pereopod 6. Scale line = 0.1 mm.

Remarks. Generally the new species fits well into the genus diagnosed by Bamber (2006, 2013), although the new species bears minute setae along dorsal margin of cheliped carpus, similar the same as in *Parakonarus* (Bird, 2011).

Konarus sp. is recognized from *K. cheiris* and *K. straddi* by presence of short proximal segment in uropod endopod. Moreover *K. cheiris* has an apophysis with the setae on cheliped propodus distal margin that absent in the new species, one long and two short distal setae on propodus of pereopod-6 which are subequal in the new species. Another peculiar character in *K. cheiris* is presence of four setae on ischium of pereopod 4–6.

A short proximal article in uropod enopod is observable in *K. crassicornis*, however it has one long and one short distal seta on antennule article-1. In the new species both setae are short e.g. about as long as article-2.

Including the new species the *Konarus* is represented by four species distributed so far: in Australia (*K. straddi*, *Konarus* sp.) New Caledonia (*K. cheiris*) and Indonesia e.g. Gulf of Manaar (*K. crassicornis*), and off Borneo (Błażewicz-Paszkowycz, unpublished data).

Genus Neoleptochelia Guţu, 2011

Type species: *Neoleptochelia javaensis* Guţu, 2011

Species included: *Neoleptochelia javaensis* Guţu, 2011, *Neoleptochelia* sp.

Remarks: In recent classification genus Neoleptochelia is included to subfamily Leptocheliinae. However character as two spines on maxilliped endites does not fit to the diagnosis of the subfamily proposed by Bamber (2013).

During examination of the Creefs collection next represent of the genus was found. Detailed observation of the species allow to observe characteristic feature - pedestal-based setae on merus of posterior pereopods. The feature in present also in members of *Konarus* and *Prakonarus*, what suggest closer relationship to that taxa. Thus it suggest to transfer the genus Neoleptochelia from subfamily Leptocheliinae Lang, 1973 to Konariinae Bamber, 2013.

Neoleptochelia sp.

Figs 4.2.7–4.2.9

Material. *Holotype*: CGLI 003 M1, 14.69117, 145.46980, Lizard I., S Coconut beach, inter-tidal, 2008-04-05. *Paratypes*: six specimens, detailed information included in Appendix 4.1.4 (Lizard I.).

Diagnosis. Antenna article-1 2.3 times as long as wide. Maxilliped basis with five, long setae. Uropod exopod longer than endopod proximal segment, and endopod 4-segmented.

Description of female. Body (Fig. 4.2.7A, B) 3 mm long, 5.8 times as long as wide; eyes present, with pigments, eye lobes conspicuous. Carapace 20% of total body length, 1.2 times as long as wide. Pereon 55% of total body length, pereonite-1 shortest, 0.4 times as long as wide; pereonites 2 and 6 similar in length, 0.4 times as long as wide; pereonites 3 and 5 similar in length, 0.5 times as long as wide, pereonite-4 longest, 0.7 times as long as wide; each pereonite with pair of lateral setae. Pleon together with pleotelson 25% of total body length, pleonites similar in length, 0.1 times as long as wide, each pleonite with two pairs of lateral setae. Pleotelson as long as three anterior pleonites combined.

Antennule (Fig. 4.2.8A) with four articles; first article 2.3 times as long as wide, with one outer seta at midlength, and two outer setae distally, and with one inner seta; second article 1.4 times as long as wide, 0.3 times as long as first article, with two simple, and one broom setae distally; third article 1.2 times as long as second article; fourth article minute, with six simple setae, one broom seta, and one aesthetasc distally.

Antenna (Fig. 4.2.8B) with six articles; first article with minute dorsal seta; second article as long as wide, with two spines distally: slender dorsal, and more robust ventral spine; third article similar in length to second article, with short dorsodistal spine; fourth article longest, 2.7 times as long as wide, with two setae on dorsal margin and distally with three simple setae, and three broom setae; fifth article half as long as fourth article; sixth article with six distal setae.

Mouthpart. Left mandible (Fig. 4.2.8D) *lacina mobilis* crenulated distally, incisor with distal crenulation. Right mandible (Fig. 4.2.8D') similar to left, but without *lacinia mobilis*, molar (Fig 4.2.8D'') robust. Maxillule (Fig. 4.2.8E) with nine distal spines, setose margins, and setal row on inner distal face. Maxilliped (Fig. 4.2.8F) palp article-1 naked, article-2 distally with one outer seta, and five inner setae; article-3 with row of eight inner setae; fourth article with five distal setae, and two setae on outer side; basis with five distal setae, exceeding to half length of third article; endites (Fig. 4.2.8F') distally with one seta, and two spatulate spines.

Cheliped (Fig. 4.2.8C) basis 1.2 times as long as wide, with dorsodistal setae; merus triangular, with three ventral setae; carpus 1.7 times as long as wide, dorsally with three short setae in proximal half, and one seta in distal half, and with three ventrodistal setae;

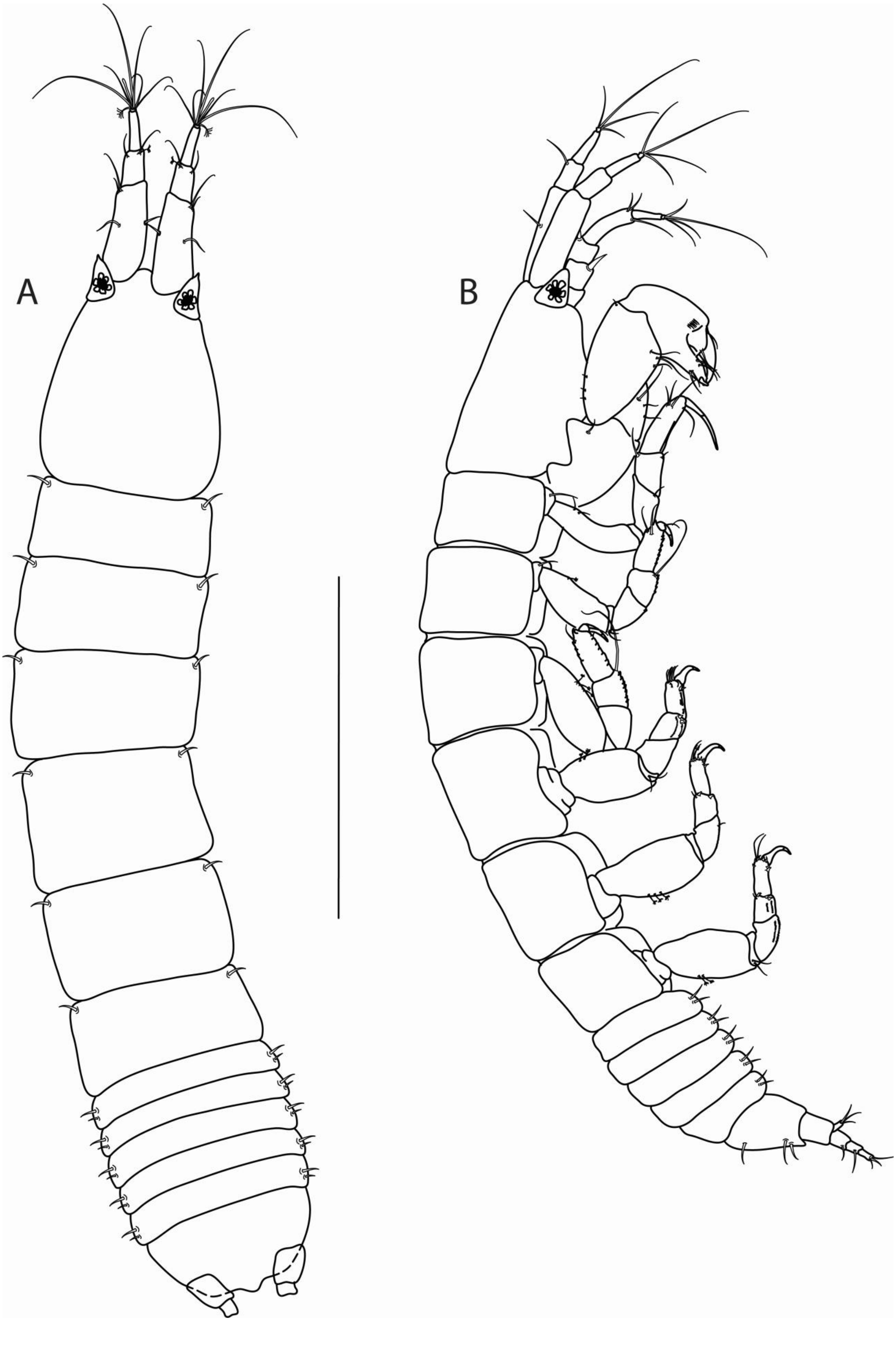


Fig. 4.2.7. *Neoleptochelia* n. sp., holotype female. A body dorsal view; B body lateral view. Scale line = 1mm.

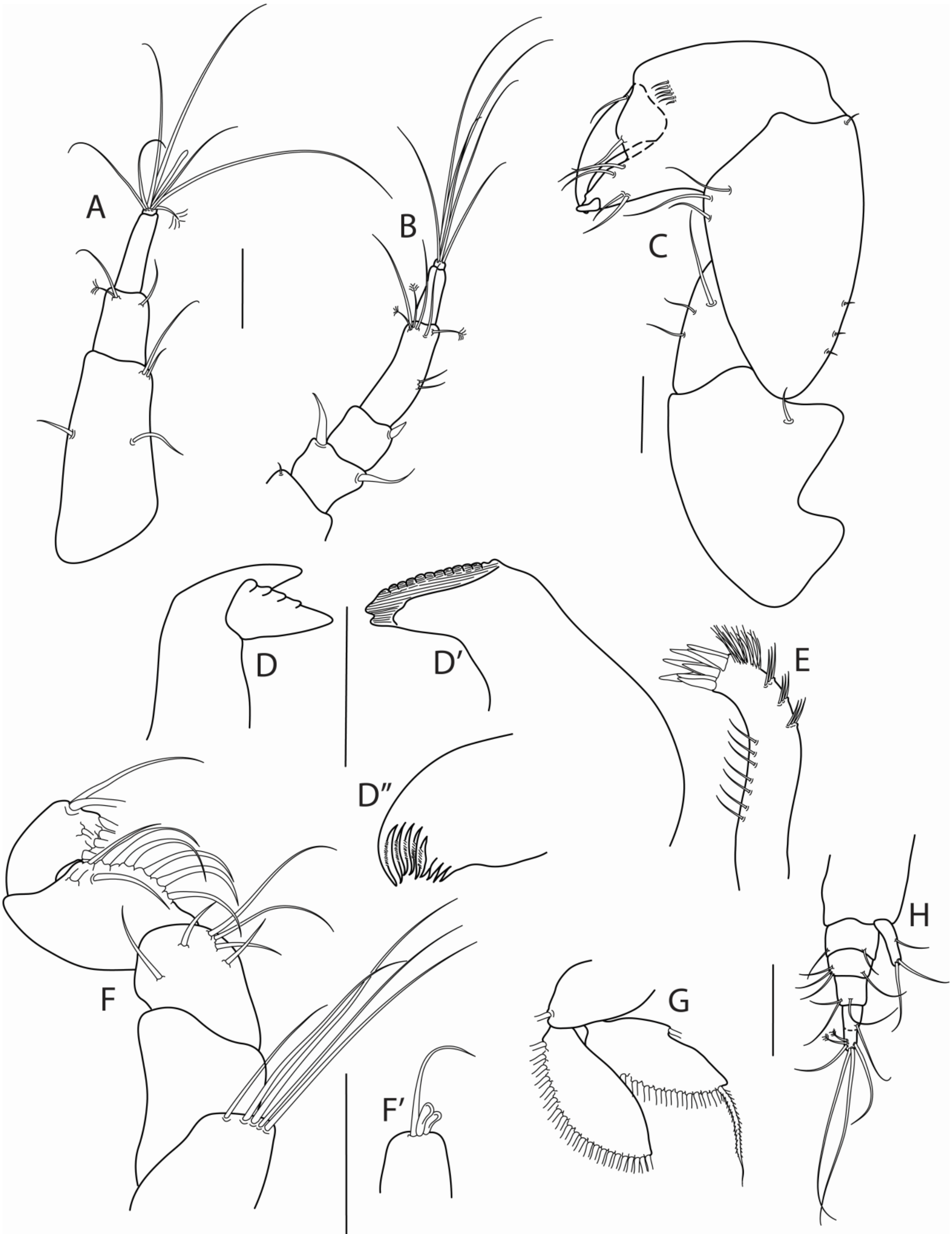


Fig. 4.2.8. *Neoleptochelia* n. sp. A antennule; B antenna; C cheliped; D right mandible; D' left mandible; D'' pars molaris; E maxillule; F maxilliped; F' endite of maxilliped; G pleopod; H uropod. Scale line = 0.1 mm.

propodus three times as long as wide, 1.6 times longer than chelae finger, with row of setae near dactylus base, and single distal seta; fixed finger with two ventral setae, and two inner setae; dactylus 0.6 times as long as propodus, with proximal seta.

Pereopod-1 (Fig. 4.2.9A) basis 3.3 times as long as wide, with two dorsal setae in proximal half; ischium 0.3 times as long as wide, with one ventral seta; merus 1.6 times as long as wide, 1.2 times as long as carpus, with two distal seta; carpus 1.2 times as long as wide, half time as long as propodus, with five distal setae, from which the longest is 0.4 times as long as propodus; propodus 3.5 times as long as wide, with three dorsodistal setae and one ventrodistal seta; dactylus together with unguis 0.8 times as long as propodus, with proximal seta; unguis 1.7 times as long as dactylus.

Pereopod-2 (Fig. 4.2.9B) basis twice as long as wide, with dorsal broom setae; ischium 0.3 times as long as wide, with two ventral setae; merus 1.3 times as long as wide, 1.2 times as long as carpus, with short ventral spine; carpus as long as wide, 0.6 times as long as propodus, with long, ventrodistal seta, which length is similar to propodus and dactylus combined, and with two short distal setae, ventral margin serrated; propodus 2.3 times as long as wide, with two dorsal setae in distal half, and serration on ventral margin; dactylus together with unguis 0.7 times as long as propodus, with proximal seta.

Pereopod-3 (Fig. 4.2.9C) similar to pereopod-2, but basis with three proximal broom setae

Pereopod-4 (Fig. 4.2.9D) basis 1.4 times as long as wide, with two broom setae in proximal half; ischium 0.2 times as long as wide, with two ventral setae; merus 1.2 times as long as wide, 1.2 times as long as carpus, with two pedestal-based setae and row of microtrichia along ventral margin; carpus as long as wide, 0.8 times as long as propodus, with three spatulate spines and short seta distally, and with row of microtrichia along ventral margin; propodus 1.8 as long as wide, with two spines on ventral margin, and three dorsodistal setae (two longer and two shorter); dactylus together with unguis 0.9 times as long as propodus.

Pereopod-5 (Fig. 4.2.9E) similar to pereopod-5, but basis with three broom setae.

Pereopod-6 (Fig. 4.2.9F) similar to pereopod-5, but basis with two broom setae, and propodus with comb of five dorsodistal setae.

Pleopods (Fig. 4.2.9G) in five pairs, all alike. Basis with one seta; endopod with inner single seta, and row of outer setae; exopod with row of outer setae.

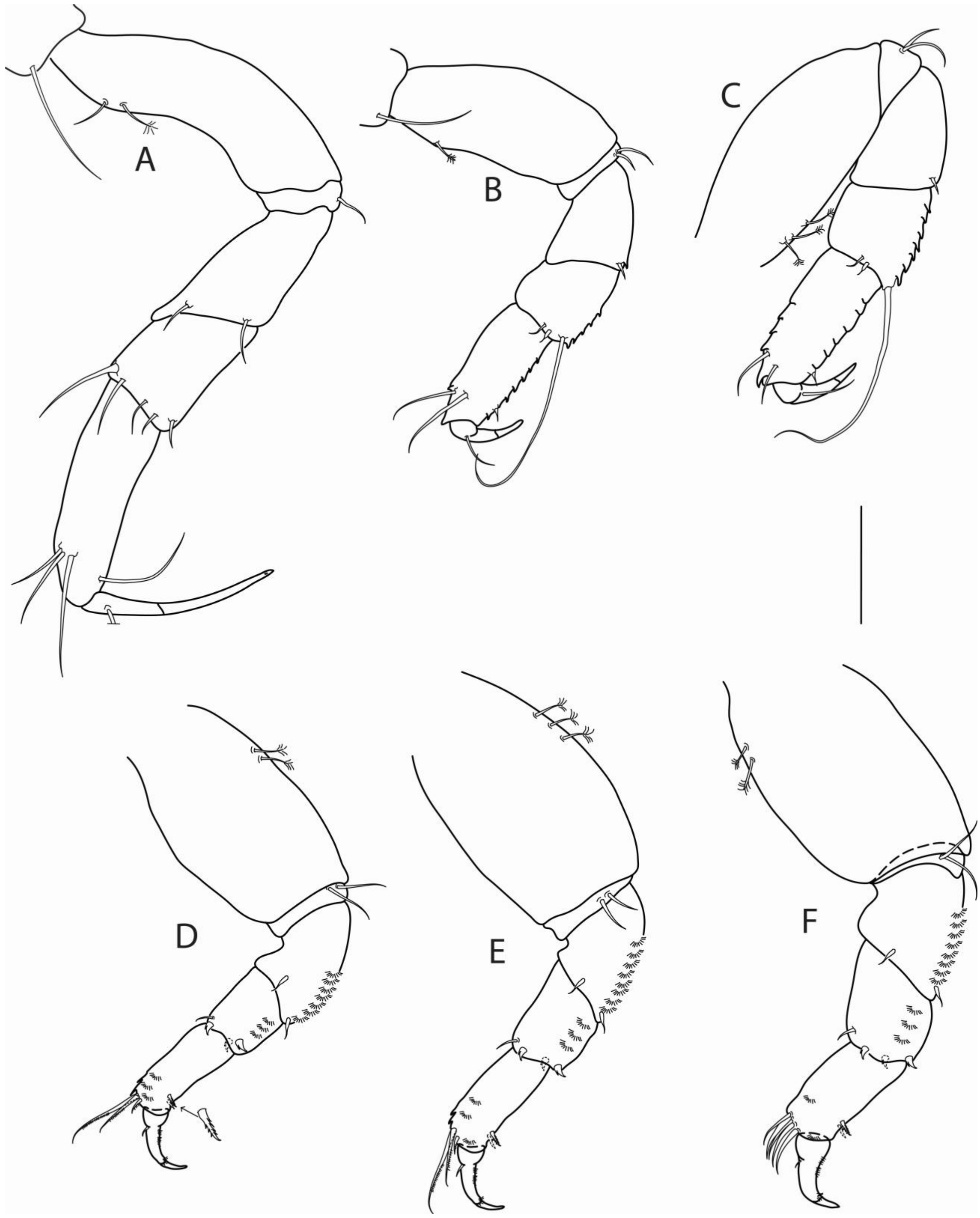


Fig. 4.2.9. *Neoleptochelia* n. sp. A pereopod 1; B pereopod 2; C pereopod 3; D pereopod 4; E pereopod 5; F pereopod 6. Scale line = 0.1 mm.

Uropod (Fig. 4.2.8H) thick, with short rami; basis naked; exopod with one segment, 1.2 times as long as proximal endopod segment, with three setae; endopod with four short segments, each bear seta, last one with four simple setae, and two broom setae distally.

Remarks. Described herein species was classified to genus *Neoleptochelia* Guţu, 2011 due to pereopod-1 unguis longer than dactylus, long distoventral setae on carpus of pereopods 2–3, which length are similar to peropod and dactylus combined, and appearance of uropod with short and robust endopod.

Neoleptochelia sp. could be distinguished from *N. javaensis* Guţu, 2011 by: (1) proportion in length to width of first antennule article, which is 2.3 in *Neoleptochelia* sp. and 3.5 in *N. javaensis*, (2) proportion in length to width of cheliped basis, which is 1.2 in *Neoleptochelia* sp. and 1.5 in *N. javaensis*, (3) number of setae on maxilliped basis: five and six respectively in *Neoleptochelia* sp. and *N. javaensis*. Moreover species described herein (4) lacks setules on propodus pereopod-1, present in Guţu *Neoleptochelia*, and lacks (5) mikrotrichia on dactylus of pereopods 2–6. Both species vary also in (6) number of uropod endopod segments: four in *Neoleptochelia* sp. and five in *N. javaensis*.

Subfamily Araleptocheliinae subfam.

Diagnosis. Female: Antennule with four slender articles, last article minute. Antenna article-2 bearing slender spines distally. Maxilliped endite has three distal spines. Cheliped elongated, with carpus at least twice as long as wide, and with slender chelae. Pereopod-1 dactylus together with unguis at least as long as propodus. Pereopods 2–3 ischia with two setae. Uropod with slender segments, exopod one or two segmented, endopod with five–six segments. Male (based on *Araleptochelia macrostonyx* Blażewicz-Paszkowycz & Bamber, 2012): antennule multisegmented; cheliped slender, sinuous; pereopods 4–6 without flange on basis.

Type genus: *Araleptochelia* Blażewicz-Paszkowycz & Bamber, 2012

Genera included: *Araleptochelia* Blażewicz-Paszkowycz & Bamber, 2012; Araleptocheliinae gen. 1 sp., Araleptocheliinae gen. 2 sp.

Remarks. During examination of the CReefs material three species with slender body and elongated appendages were found. One of them only presents characters attributed to already known genera *Araleptochelia* Błażewicz-Paszkowycz & Bamber, 2012. Remaining two species cannot be classified to the same genera, however general appearance of all three species suggest they should be treat as a one group. Thus new subfamily is proposed to placed them together.

Genus: *Araleptochelia* Błażewicz-Paszkowycz & Bamber, 2012

Diagnosis. (amended after Błażewicz-Paszkowycz & Bamber, 2012). Body 6–7 times as long as wide. Eye with prominent, directed upward apophysis. Female with 4-articled antennule, first article 2.5–3 times as long as wide, third article longer than second. Antenna articles 2 and 3 with slender distal spines only; no ventral spine on article-2. Maxilliped basis with three–four long setae. Cheliped relatively slender, carpus and propodus nearly twice as long as wide. Pereopod-1 basis four times as long as wide, dactylus as unguis, together 1.5 as long as propodus. Merus of pereopod 2–3 with one long spine, shorther than carpus. Uropod exopod 1-segmented, endopod 5-segmented. Exopod uropod equal or longer than proximal article of endopod; all uropod segments slender (each at least twice as long as wide).

Type species: *Araleptochelia macrostonyx* Blażewicz-Paszkowycz & Bamber, 2012, by monotypy.

Species included: *A. macrostonyx, Araleptochelia* sp.

Remarks. Characters as: the third article in antennule longer than second, slender article 2–3 in antenna with only dorsal spines, slender cheliped with relatively long carpus, elongated propodus and dactylus that is longer than propodus, multisegmented endopod in uropods with elongated segments fairly differ the genera from two other classified to subfamily. Moreover the new species found in Creefs collection has the same apophysis on the eyes that is observed in the types species *A. macrostonyx*, so this character can be good diagnostic character of the genus.

Araleptochelia sp.

Figs 4.2.10–4.2.12

Material examined: *Holotype*: NR 09 80D, 22.35633S, 113.37905E, Ningaloo Reef, Point Cloates, N Norwegian Channel, outer fore reef, sand in Groove, depth 20 m, 2009-05-29. *Paratypes*: one speciemen, for details see Appendix 4.1.6 (Ningaloo).

Diagnosis. Pereopods 2–3 robust, with merus bearing relatively short spines.

Description of female: Body (Fig. 4.2.10A, B) 1.8 mm long, six times as long as wide. Carapace 18% of total body length, almost as long as wide; eyes present, with pigment, eyes lobes with robust apophysis bent upward. Pereonites 63% of total body length; pereonite-1 shortest, 0.4 times as long as wide; pereonites 2 and 6 similar in length, 0.6

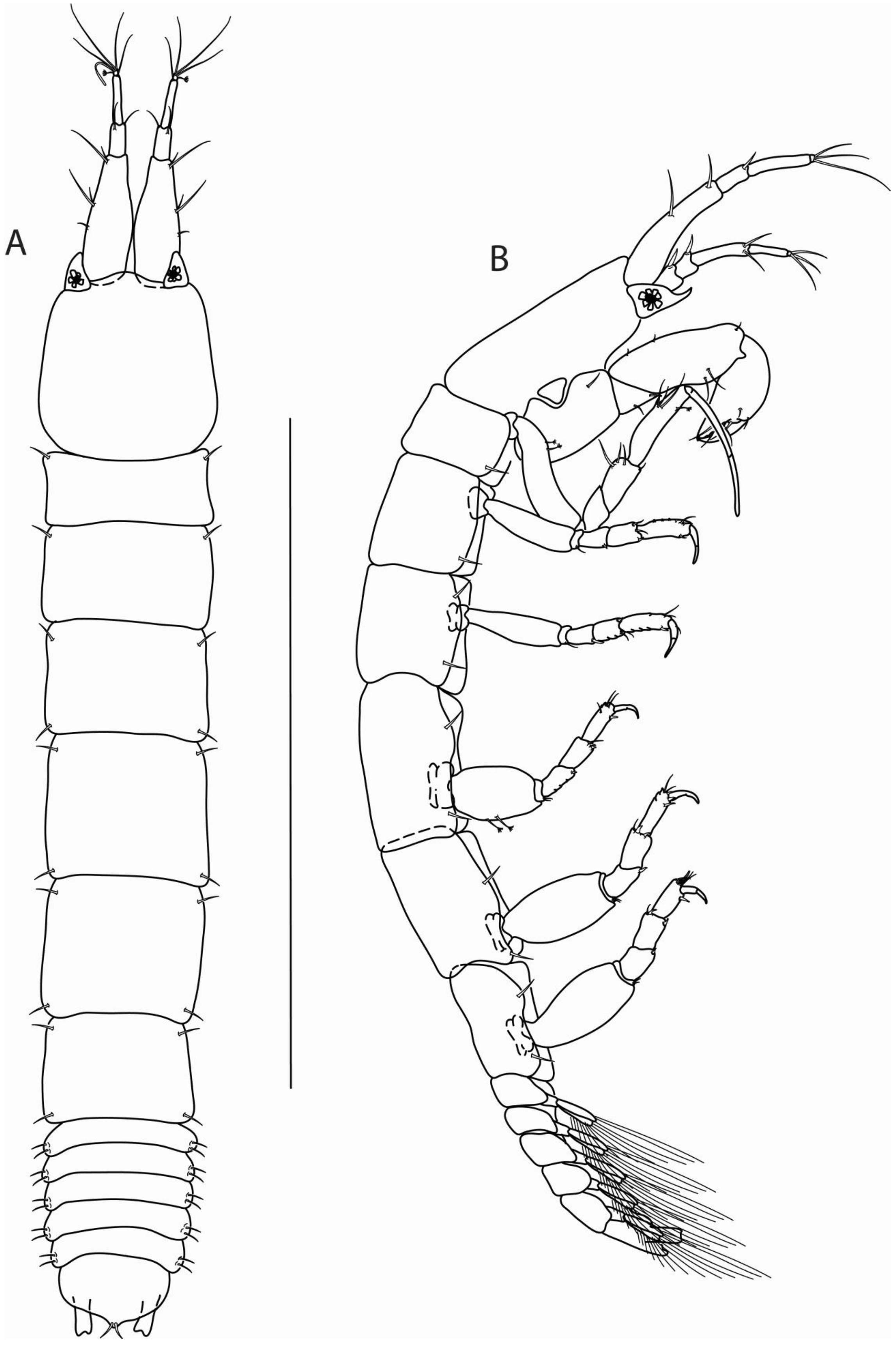


Fig. 4.2.10. *Araleptochelia* n. sp., holotype female. A body dorsal view; B body lateral view. Scale line = 1mm.

times as long as wide; pereonite-3 0.7 times as long as wide, pereonites 4 and 5 longest, similar in length, 0.8 times as long as wide. Pereonites 1–2 with a pair of lateral setae; pereonites 4–6 each with two pairs of lateral setae. Pleon together with pleotelson 19% of total body length, pleonites similar in length, 0.1 times as long as wide, each pleonite with two pairs of lateral setae; pleotelson almost as long as three first pleonites combined, with two posterior setae.

Antennule (Fig. 4.2.11A) with four articles. First article 2.4 times as long as wide, with one inner seta, and with three groups of setae on outer margin: single seta in proximal half, two setae placed at midlenght, and two setae at distal corner; second article 1.7 times as long as wide, with two distal setae; third article 1.4 times as long as second article, with one distal seta; fourth article minute, with three simple setae, one broom seta and one aesthetasc.

Antenna (Fig. 4.2.11B) with six articles. First article missing; second article twice as long as wide, with dorsodistal slender spine; third article half as long as wide, with dorsodistal slender spine; fourth article longest, 3.6 times as long as wide, with broom middle setae, one ventral seta and six distal setae; fifth article 0.7 times as long as fourth article, with two distal setae; sixth article minute, with three distal setae.

Mouthpart. Labrum (Fig. 4.2.11D) hood-shape, setose. Left mandible (Fig. 4.2.11E) *lacinia mobilis* crenulated distally; incisor with distal crenulation; molar robust, typical leptochelid. Right mandible (Fig. 4.2.11E’) similar to left, but without *lacinia mobilis*. Maxillule (Fig. 4.2.11F) with nine distal spines, dorsal margins setose and row of hair seta along inner margin; palp (Fig. 4.2.11F’) with two distal setae. Maxilliped (Fig. 4.2.11G) palp article-1 naked; article-2 with one outer seta and four inner setae; article-3 with row of eight inner setae, and one subdistal setae; article-4 with six distal setae, and one on outer margin; basis with three distal setae; endites with one simple seta and three spatulate spines.

Cheliped (Fig. 4.2.11C) basis almost twice as long as wide, with long dorsodistal seta; merus triangular, with two ventral setae; carpus 2.6 times as long as wide, with three dorsal setae: proximal, subproximal and distal, and with two ventrodistal setae; propodus 1.6 times as long as wide, 2.6 times as long as chelae finger, with row of subdistal setae, and one long distal seta; fixed finger with one ventral setae, and three inner setae, and with crenulation on cutting edge; dactylus 0.6 times as long as propodus, with one dorsal seta.

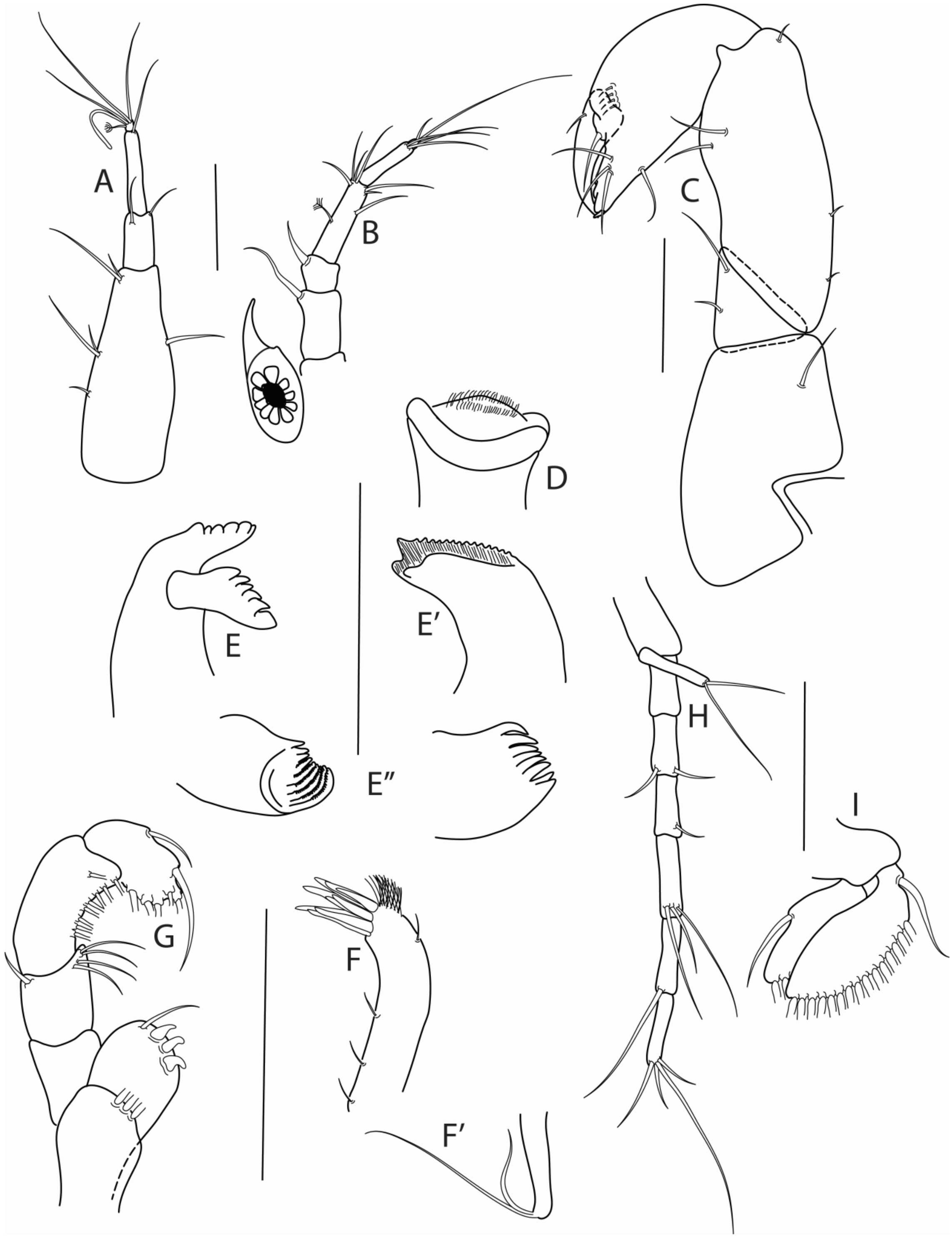


Fig. 4.2.11. *Araleptochelia* n. sp. A antennale; B antenna; C cheliped; D labium; E right mandible; E' left mandible; E'' pars molaris; F maxillule; F' palp of maxillule; G maxilliped; H pleopod; I uropod. Scale line = 0.1 mm

Pereopod-1 (Fig. 4.2.12A) basis four times as long as wide, with two subproximal broom setae; ischium 0.6 times as long as wide, with one ventral setae; merus 1.2 times as long as wide, 0.7 times as long as carpus with one minute seta; carpus 1.6 times as long as wide, half as long as propodus, with three dorsal setae and with one ventral seta; propodus 4.3 times as long as wide, with three dorsal setae in distal half and two minute ventral setae; dactylus together with unguis 1.6 times as long as propodus, with proximal seta; unguis 0.7 times as long as dactylus.

Pereopod-2 (Fig. 4.2.12B) basis 3.4 times as long as wide with two plumose and one simple subproximal seta; ischium 0.4 times as long as wide, with two ventral setae; merus 1.3 times as long as wide, 0.8 times as long as carpus, with ventrodistal slender spine; carpus 1.6 times as long as wide, 0.6 times as long as propodus, distally with three setae and one ventral spine; propodus three times as long as wide, dorsally with two distal setae and ventral spine; dactylus together with unguis 0.8 times as long as propodus, with proximal seta.

Pereopod-3 (Fig. 4.2.12C) similar to pereopod-2.

Pereopod-4 (Fig. 4.2.12D) basis 1.5 times as long as wide, with two ventroproximal broom setae; ischium 0.3 times as long as wide, with two ventral setae; merus 1.6 times as long as wide, similar in length to carpus, with two ventral spines; carpus 1.6 times as long as wide, 0.7 times as long as propodus, with three spines and one seta distally; propodus three times as long as wide, with two dorsodistal setae, and one bipinnate spine, and with two ventral spines; dactylus together with unguis 0.7 times as long as propodus.

Pereopod-5 (Fig. 4.2.12E) similar to pereopod-4, but basis without setae.

Pereopod-6 (Fig. 4.2.12F) similar to pereopod-5, but propodus with five dorsodistal setae.

Pleopods (Fig. 4.2.11I) in five pairs, all alike; basis without seta; endopod with inner plumose seta, and row of outer setae; exopod with row of outer setae.

Uropod (Fig. 4.2.11H) basis naked; exopod with one segment, 1.3 times as long as proximal endopod segment, with two distal setae; endopod with six segments.

Remarks. From *A. macrostonyx* the new species can be distinguished by robust pereopods 2–3 with relatively small ventral spines on merus and short bipinate distal seta on pereopod 4. In *A. macrostonyx* the spines on merus and propodus of pereopod 2–3 are apparently big and reaching over half of the carpus, while distal bipinate seta on propodus of the fourth pair is as long as the other setae.

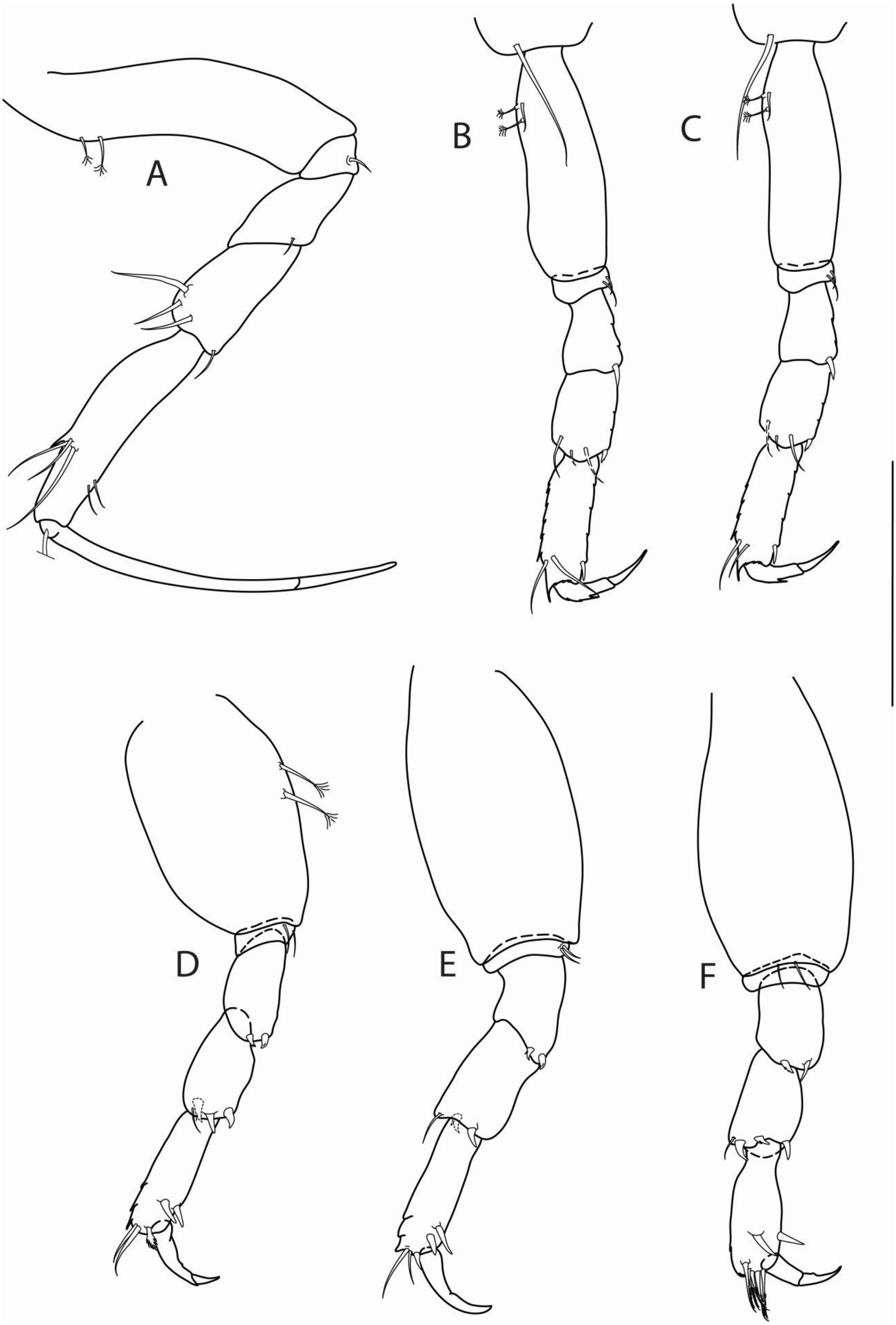


Fig. 4.2.12. *Araleptochelia* n. sp. A pereopod 1; B pereopod 2; C pereopod 3; D pereopod 4; E pereopod 5; F pereopod 6. Scale line = 0.1 mm.

So far *Araleptochelia* is known only from Australian waters e.g. from Bass Strait (*A. macrostonyx*) and Ningaloo.

Genus: Araleptocheliinae gen. 1

Diagnosis. Body 6.5 times as long as wide. Eyes conspicuous, but without proximal apophysis. Antennule with four articles, first article 3.3 times as long as wide, second article shorter than third. Slender spines on second and third article of antenna. Maxilliped basis with four setae. Cheliped basis similar in length to width, carpus elongated, twice as long as wide. Pereopod-1 basis 3.7 times as long as wide, dactylus 2.1 times as long as unguis, together as long as propodus. Pereopods 2–3 merus with ventrodistal seta, merus shorther than carpus. Uropod endopod with six segments, exopod with two segments, shorter than proximal endopod segment. All segments about twice as long as wide.

Type species: Araleptocheliinae gen. 1 sp. by monotypy

Remarks. Within genera classified to the new subfamily Araleptocheliinae genus 1 presents the least elongated antennule, cheliped, and uropod. Moreover single, ventrodistal seta on merus of pereopods 2–3 instead of spine and relatively thin basis of pereopods 4–6 allow to distinguish Araleptocheliinae gen. 1 from Araleptocheliinae gen. 2 and *Araleptochelia.*

Appearance of antennule, slender spine on antenna together with two segmented uropod exopod makes Araleptocheliinae gen 1. sp easily distinguished from other Australian species. While two first characters are unique within the Australian leptochelids, 2-segmented uropod is characteristic also for *Leptochelia dijonase* Bamber, 2008, *L. occiporta* Błażewicz-Paszkowycz & Bamber, 2012, and *L. vimesi* Bamber, 2005. However Araleptocheliinae gen 1. sp vary from that species in: (1) shorter unguis of pereopod-1 in relation to dactylus, (2) different proportion of length of cheliped merus to its width and to length of the basis, and (4) shorter uropod exopod (for detailed see Tab.4.2.1)

Tab. 4.2.1. Comparison between Australian Araleptocheliinae n. subfam. and Leptocheliinae members. Charakter 1 - number of setae on maxilliped basis, 2 - antennule article-1 length to width, 3 - length of article-3 of antennule to article-2, 4 - pereopod-1 basis length to width, 5 - length of dactylus of pereopod-1 to unguis, 6 - length of dactylus together with unguis of pereopod-1 to propodus, 7 - cheliped basis: length to width, 8 - cheliped carpus: length to width, 9 - length of cheliped carpus to basis, 10 – number of segments of uropod endopod, 11 – number of segments of uropod exopod, 12 - length of uropod exopod to first endopod segment.

species/ characters	**1.**	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	**8.**	**9.**	**10.**	**11.**	**12.**
Araleptochelia sp.	3	2.4	1.4	4.0	2.9	1.6	1.0	2.6	1.3	6	1	longer
Araleptocheliinae gen. 1 sp.	4	3.3	1.7	3.7	2.1	1.1	1.2	2.0	1.5	6	2	0.8
Araleptocheliinae gen. 2 sp.	6	2.5	similar	3.8	1.9	1.5	1.8	2.2	1.2	6	2	longer
Leptochelia billambi Błażewicz-Paszkowycz & Bamber, 2012	5	4	similar	5.2	1.6	similar	2.3	2.1	1.2	5	1	similar
Leptochelia daggi Bamber, 2005	4	2.5	similar	4.6	1.8	1.25	1.2	2.2	1.3	5	1	longer
Leptochelia dijonesae Bamber, 2008	4.5	2.7	similar	3.4	1.6	1.28	1.5	1.7	1.1	4.5	1.2	

species/ characters	**1.**	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	**8.**	**9.**	**10.**	**11.**	**12.**
Leptochelia evansi Edgar, 2012										6	1	1\3
Leptochelia guduroo Bamber, 2008	4.5	2.75	similar	3.8	1.4	1.14	1.2	1.8	1.2	5	1	equal
Leptochelia gadgeti Edgar, 2012										5	1	longer
Leptochelia ignota (Chilton, 1884)	5	3.4	similar	4.6	1.5	similar	1.25	1.7	1.1	4.5	1	longer
Leptochelia karragarra Bamber, 2008	3	2.2	1.2	4.1	2.1	similar	1.25	2.1	0.7	5	1	similar
Leptochelia myora Bamber, 2008	4	2.9	similar	2.8	1.5	1.26	1.1	1.9	1.2	4	1	half
Leptochelia occiporta (Błażewicz-Paszkowycz & Bamber, 2012)	4.5	3.3	similar	3.7	1.6	1.4	1.1	1.7	1.2	5. 6	2	similar
Leptochelia opteros Bamber, 2008	4	2.7	similar	4.5	1.25	1.1	1.1	1.5	1.2	5	1	shorter

species/ characters	**1.**	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	**8.**	**9.**	**10.**	**11.**	**12.**
Leptochelia vimesi Bamber, 2005										5	2	longer
Leptochelia sp.	5	3	similar	4.6	1.7	similar	1.9	2	1.3	5	1	0.9
Leptocheliinae gen. 1 sp.	5	3.3	similar	4.6	1.2	1.0	1.3	2	1.2	3	1	0.5
Poorea nobbi (Bamber, 2005)	3	3.3	similar	3	1.4	0.9	1.6	1.8	1.1	3	1	half

Araleptocheliinae gen. 1 sp.

Figs 4.2.13–4.2.15

Material examined: *Holotype*: CGLI 18A 14.68900S, 145.47000E, Lizard I., patch reef near lagoon entrance, lagoon (patch reef), depth 2 m, 2008-04-11. *Paratypes* :1312 specimens, for detailed see Appendix 4.1.6, 4.1.5 and 4.1.4.

Diagnosis. As for the genera.

Description of female. Body (Fig. 4.2.13A, B) 1.8 mm long, 6.5 times as long as wide. Carapace 20% of total body length, 1.2 times as long as wide; eyes present, with pigment. Pereon 55% of total body length; pereonite-1 shortest, 0.3 times as long as wide; pereonites 2, 3 and 6 similar in length, about 0.4 times as long as wide; pereonites 4 and 5 longest, similar in length, half times as long as wide. Pleon together with pleotelson 25% of total body length; pleonites similar in length, 0.1 times as long as wide; pleotelson as long as two first pleonites combined, with pair of posterior seta.

Antennule (Fig. 4.2.14A) with four articles. First article 3.3 times as long as wide, with three groups of outer setae: three broom setae in proximal half, and single, long setae atmidlength, and one simple, one broom setae at distal corner, and with single inner seta at midlenght, and broom seta at inner distal corner; second article 1.4 times as long as wide, 0.2 times as long as first article, with two distal setae; third article 4.8 as long as wide, 1.7 times as long as second article, with one distal seta; fourth article minute, with four distal setae.

Antenna (Fig. 4.2.14B) with six articles. First article compact, naked; second article 1.3 times as long as wide, with dorsodistal slender spine; third article square, with ventrodistal slender spine; fourth article longest 6.2 times as long as wide, with three dorsal setae in proximal half, and three distal setae; fifth article 0.3 times as long as fourth article, with one distal seta; sixth article minute, tipped by four setae.

Mouthpart. Left mandible (Fig. 4.2.14E) *lacinia mobilis* crenulate distally; incisor with distal crenulation; *pars molaris* robust. Right mandible (Fig 4.2.14E') similar to left, but without *lacinia mobilis*. Maxillule (Fig. 4.2.14F) with ten distal spines, setose margin and row of setules on inner distal face. Maxilliped (Fig. 4.2.14G) palp first article naked; second article with outer distal setae, and group of four inner distal setae; third article with row of seven inner setae; fourth article with four distal setae, and two setae

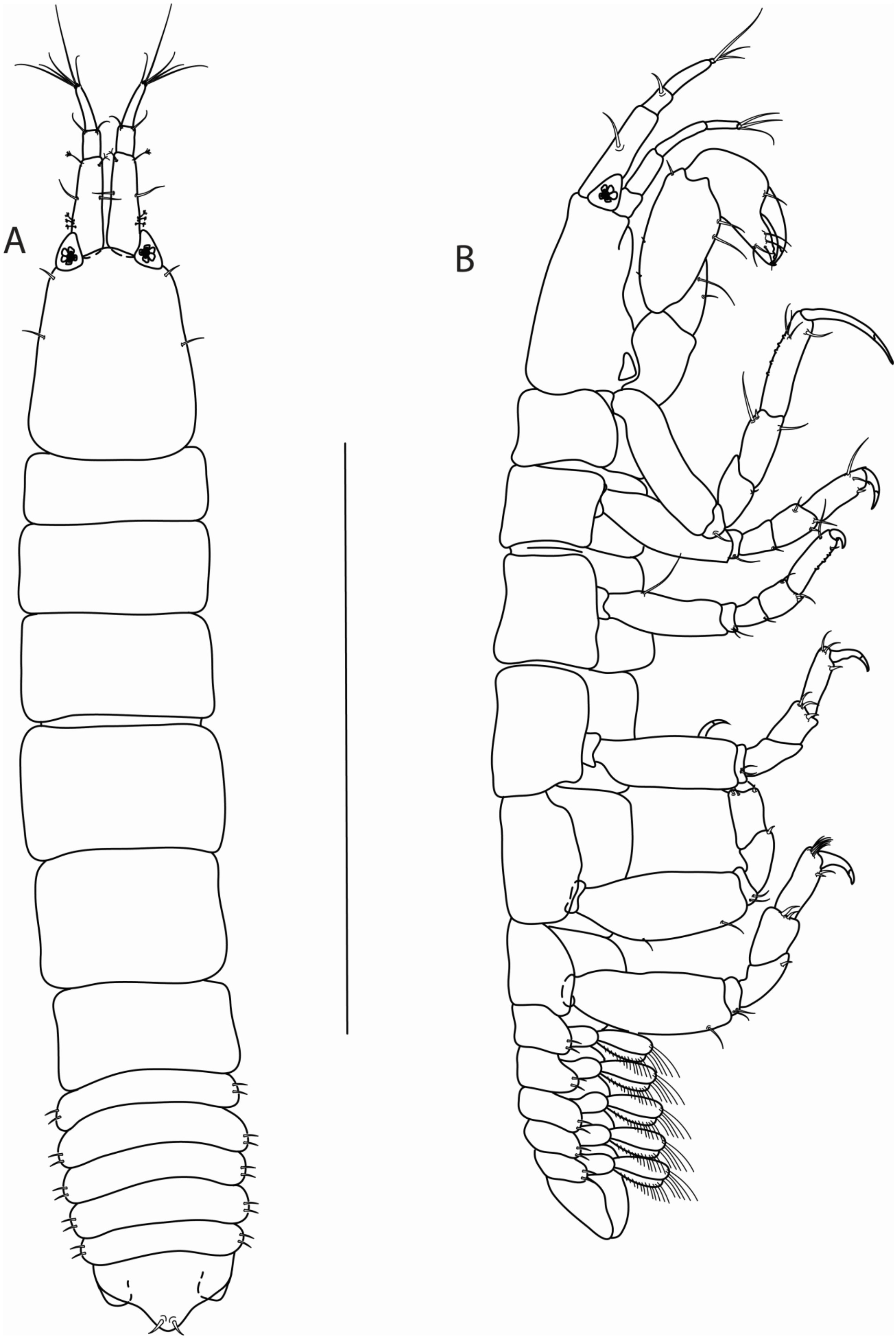


Fig. 4.2.13. *Araleptochelinae* n. gen 1 sp., holotype female. A body dorsal view; B body lateral view. Scale line = 1mm.

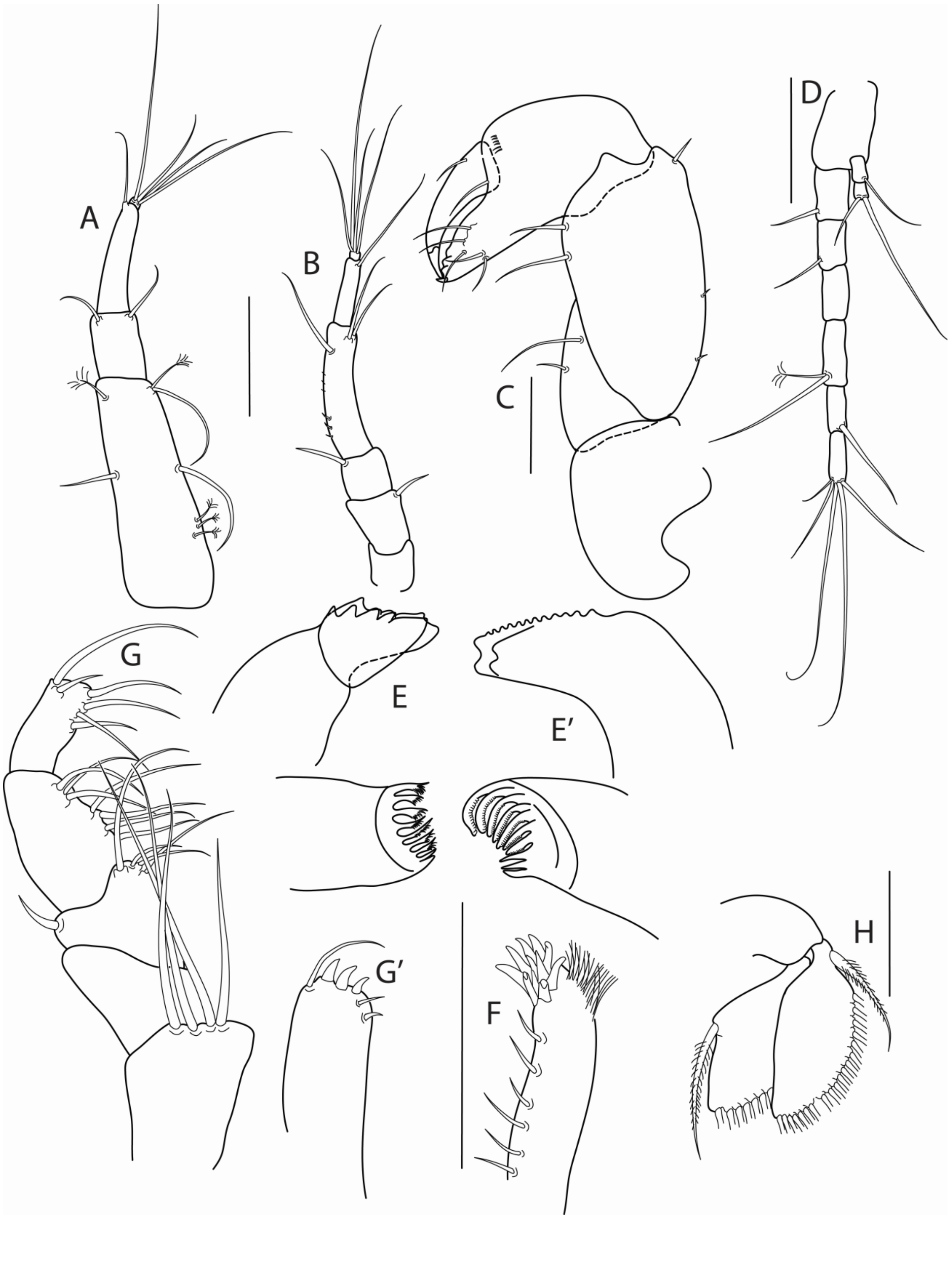


Fig. 4.2.14. *Araleptochelinae* n. gen 1 sp. A antennule; B antenna; C cheliped; D uropod; E right mandible; E' left mandible; F maxillule; G maxilliped; G' endite of maxilliped; H uropod. Scale line = 0.1.

at outer distal corner; basis with four distal setae, exceeding to distal margin of third article; endites (Fig. 4.2.14G’) distally with single seta, and three spines.

Cheliped (Fig. 4.2.14C) basis 1.1 times as long as wide; merus triangular, with two ventral setae; carpus twice as long as wide, dorsally with two short setae in proximal half and distal single setae, and with two ventrodistal setae; propodus 1.3 times as long as wide, 1.7 times as long as chelae finger, with subdistal row of setae, near base of dactylus and single distal seta; fixed finger with two ventral setae, three inner setae, and crenulate cutting edge; dactylus 0.8 times as long as propodus, with proximal seta.

Pereopod-1 (Fig. 4.2.15A) basis 3.7 times as long as wide; ischium 0.4 times as long as wide, with one ventral seta; merus 1.2 times as long as wide, 0.6 times as long as carpus, with short ventrodistal seta; carpus 2.1 times as long as wide, 0.6 times as long as propodus, distally with five setae, the longest seta is half times as long propodus; propodus four times as long as wide, with three dorsodistal setae, and one ventrodistal seta, small tubercles on dorsal margin; dactylus together with unguis as long as propodus; unguis 0.4 times as long as dactylus.

Pereopod-2 (Fig. 4.2.15B) basis three times as long as wide, with long dorsal seta; ischium half times as long as wide, with two ventral seta; merus 1.3 times as long as wide, 0.8 times as long as carpus, with ventrodistal setae; carpus 1.2 times as long as wide, 0.6 times as long as propodus, distally with four setae; propodus 2.8 times as long as wide, with two dorsal setae, and one ventral spine; dactylus together with unguis 0.6 times as long as propodus.

Pereopod-3 (Fig. 4.2.15C) similar to pereopod-2.

Pereopod-4 (Fig. 4.2.15D) basis 2.7 times as long as wide; ischium 0.2 times as long as wide, with two ventral setae; merus 1.2 times as long as wide, similar in length to carpus, with two ventral spine; carpus 1.4 times as long as wide, with three spines and seta distally; propodus three times as long as wide, with three dorsodistal setae (two longer and one shorther), and two ventrodistal spines; dactylus together with unguis 0.7 times as long as propodus.

Pereopod-5 (Fig. 4.2.15E) similar to pereopod-4, but basis 2.3 times as long as wide, with two ventral setae.

Pereopod-6 (Fig. 4.2.15F) similar to pereopod-5, but propodus with dorsodistal comb of six setae.

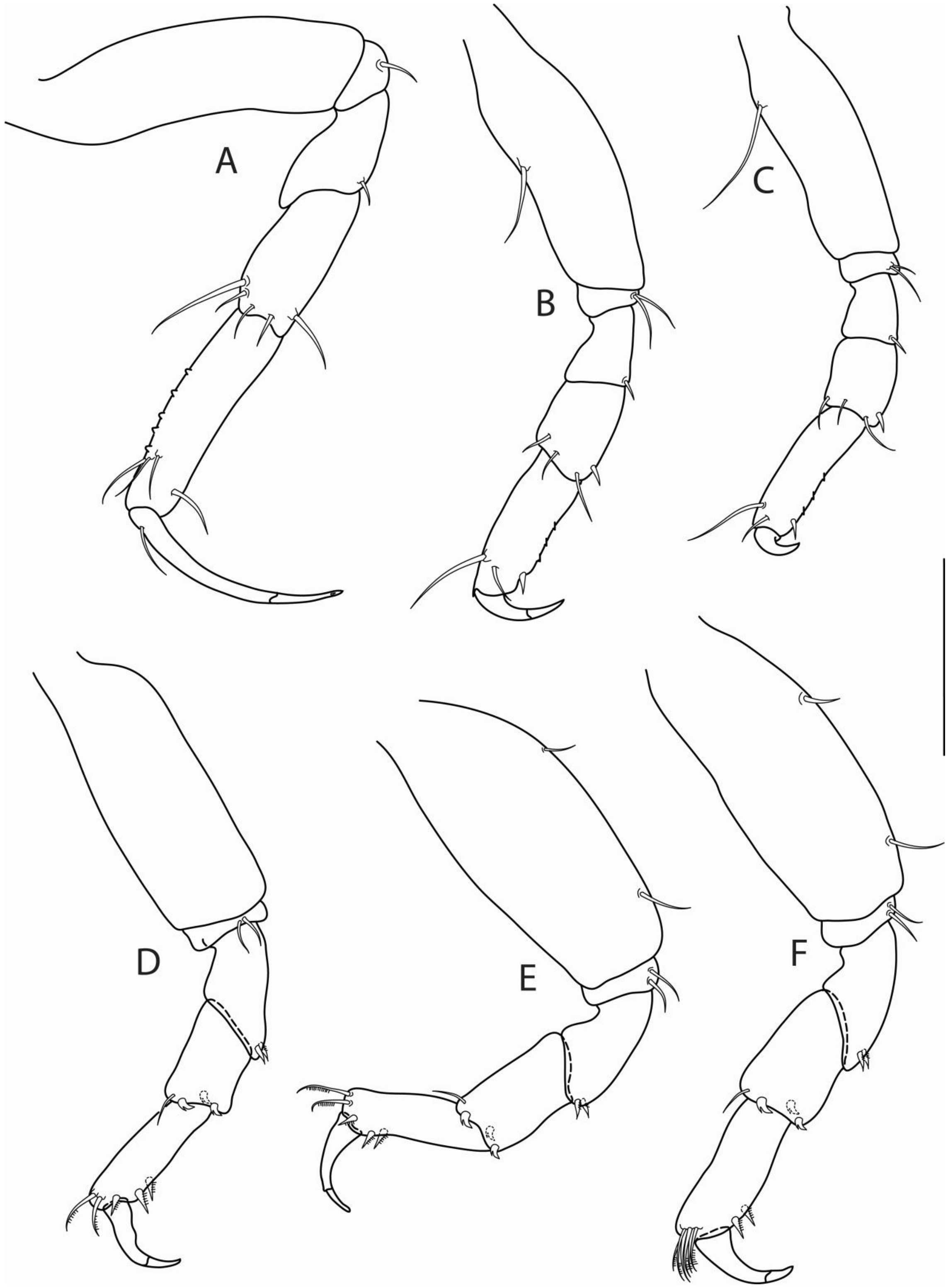


Fig. 4.2.15. *Araleptochelinae* n. gen. 1 sp. A pereopod 1; B pereopod 2; C pereopod 3; D pereopod 4; E pereopod 5; F pereopod 6. Scale line = 0.1 mm.

Pleopods (Fig. 4.2.14H) in five pairs, all alike; basis naked; endopod with single outer seta, and row of inner setae; exopod with row of inner setae.
Uropod (Fig. 4.2.14D) basis naked; exopod with two segments, combined 0.8 times as long as proximal endopod segment; first segment with one seta, second segment with two distal setae; endopod with six segments, all bear setae, last segment tipped by five setae.

Genus: Araleptocheliinae gen. 2

Diagnosis. Body about 6–7 times as long as wide. Eye with small proximal apophysis. Female antennule 4-articled, first article 2.5–3.5 times as long as wide; second article as long as distal setae; articles 2 and 3 subequal. Antenna article-2 with slender spines, article-3 with little stronger distal spine. Mandible right incisor without notch. Maxilliped basis with 5–6 setae. Cheliped basis elongated 2.5 times as long as wide, carpus 1.2 as long as basis with numerous (seven) setae along dorsal margin. Pereopod-1 basis about four times as long as wide, propodus ventral seta long (about half as long as propodus), unguis as long as dactylus, together 1.2 as long as propodus. Pereopods 2–3 robust, merus longer than carpus; merus with one robust spine only, merus, carpus and propodus margins serrated. Uropod endopod with six segments; exopod 2-segmented, at least five times as long as wide and at least as long as endopod proximal article.

Species included: *Leptochelia helenae* Guţu, 2011; Araleptocheliinae gen. 2 sp.

Type species: Araleptocheliinae gen. 2 sp.

Remarks. Robust pereopods 2–3 with merus longer than carpus and distinct spines on merus, pereopods 4–6 with robust bases and slender spines on meri and no notch on mandible are the specific characters defining the new genus. Additionally elongated antennule, which articles 2 and 3 are subequal, row of minute setae on dorsal margin of the elongated cheliped carpus and long segments in uropods are additional character defining the genus. The numerous setae on dorsal margin of cheliped carpus are characteristic for probably all Konariinae (e.g. Bird 2011, Fig 2J; Morales-Nuňez et al. 2013 Fig 4D), but are scarce (no more than three) in most member of *Leptochelia sensu strict*. Beside that the new genus has slim, elongated spines in merus of pereopod 4–6, which are short and robust in most members of Leptochellidae. An exception is Konariinae with a specific elongated spine-setae (Bamber 2005 fig. 45F; Morales-

Nuňez fig 2011 fig. 5G) on merus of pereopods 4–6, although apparently different from those present in the new genus.

Araleptocheliinae gen. 2 sp.

Figs 4.2.16–4.2.18.

Material examined: *Holotype* LIZ 09 09, 14.68441S, 145.47197E, Lizard I., Coconut Beach, reef front, 2009-02-17. *Paratypes*: 501 specimens, details included in Appendix 4.1.6 (Ningaloo), 4.1.5 (Heron I.) and Appendix4.1.4 (Lizard I.).

Diagnosis. Pereopod-2 carpus distoventral seta longer than half of propodus; pereopods 4–6 merus with slim spines.

Description of female. Body (Fig. 4.2.16A, B) 2.1 mm long, almost six times as long as wide. Carapace 20% of total body length, 1.2 times as long as wide, with two lateral pairs of setae, placed near eye lobes and at midlength; eyes present, with pigment. Pereon 57% of total body length; pereonites 1–3 and 6 similar in length, half times as long as wide; pereonites 4–5 longest, 0.9 times as long as wide; first and last segment with pair of lateral setae. Pleon together with pleotelson 22% of total body length, all pleonites similar in length, 1.1 times as long as wide, bearing lateral setae; pleotelson almost as long as two first pleonites combined, with two pairs of posterior setae.

Antennule (Fig. 4.2.17A) with four articles. First article 2.5 times as long as wide, with two inner broom setae, two short inner setae distally, and with one outer simple setae, and one long outer setae distally; article-2 0.3 times as long as first article, with three distal setae; third article similar in length to second article, with two distal setae; four article minute, but distinct tipped by three setae.

Antenna (Fig. 4.2.17B) 6-articled. Three proximal articles similar in length, 0.8 times as long as wide, first article with minute dorsodistal seta; second article with dorsodistal, slender spine and seta; third article with one dorsodistal spine; forth article 2.4 times as long as second article, with dorsal setae at midlength, and subdistally two long and three small setae; fifth article half times as long as four article, with two distal setae, terminal article minute, with five distal setae.

Mouthpart. Labrum (Fig. 4.2.17D) hood-shape, setose. Left mandible (Fig. 4.2.17E) with crenulate *lacinia mobilis*, incisor with distal crenulation. Right mandible (Fig. 4.2.17E') incisor without distal notch, but with dorsal crenulation; molar (Fig. 4.2.17E") robust, typical leptochellid. Labium (Fig. 4.2.17F) wide, bilobed, distally setose. Maxillule (Fig. 4.2.17G) with nine distal spines and distodorsal fine setae; palp

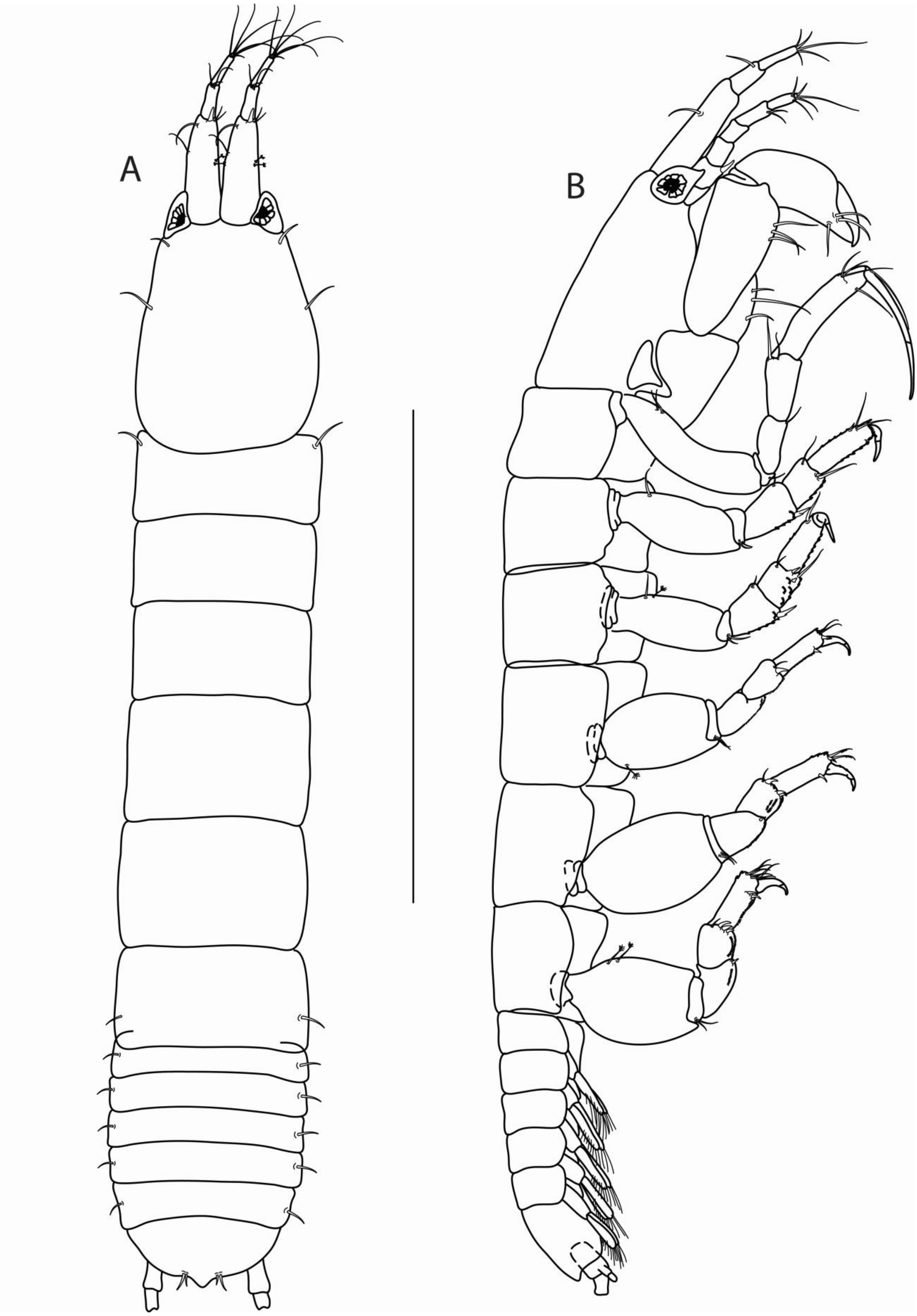


Fig. 4.2.16. *Araleptochelinae* n. sp. 2, holotype female. A body dorsal view; B body lateral view. Scale line = 1mm.

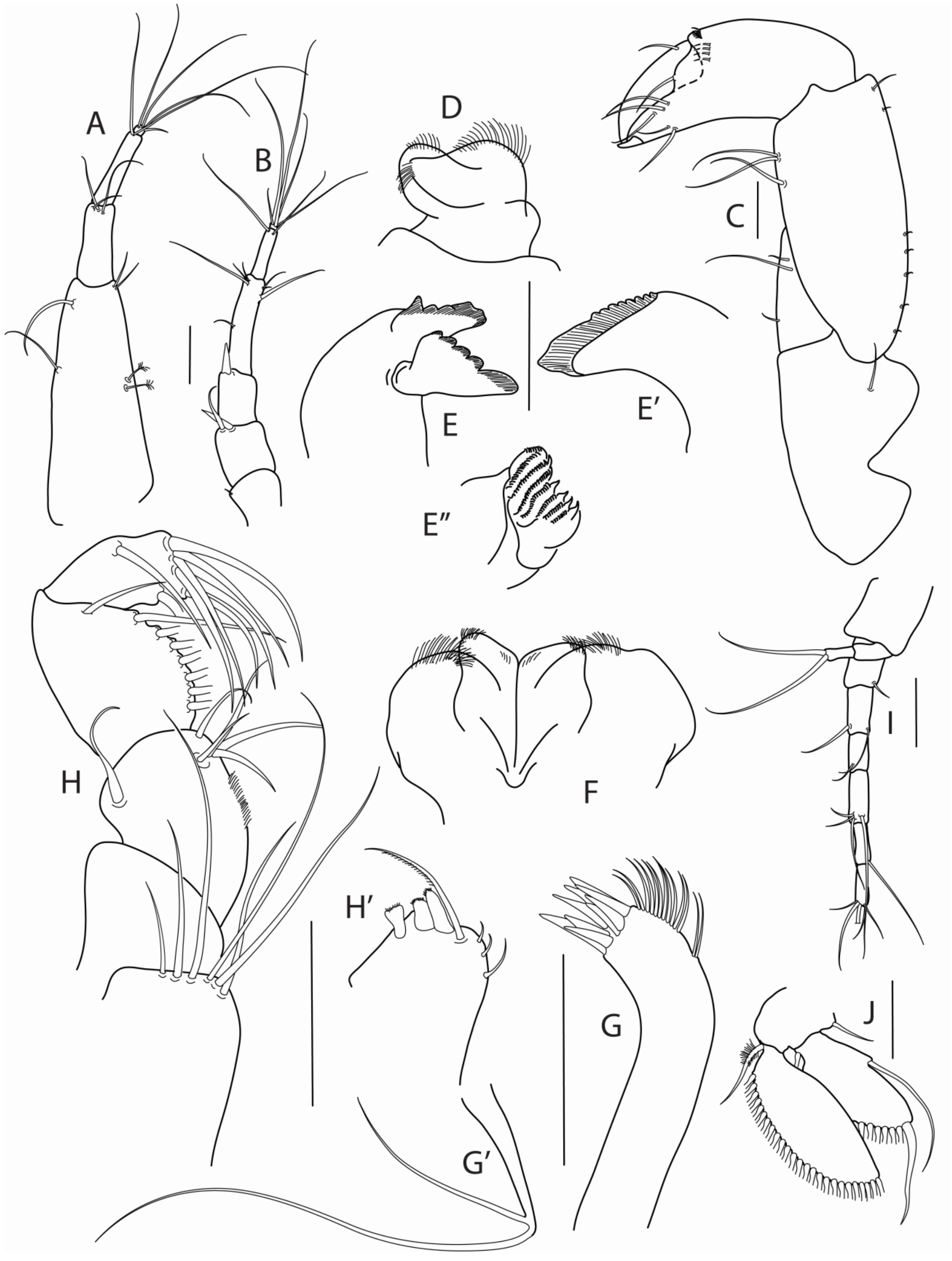


Fig. 4.2.17. *Araleptochelinae* n. sp. 2. A antennule; B antenna; C cheliped; D labium; E right mandible; E’ left mandible; E’’ pars molaris; F labrum; G maxillule; G’ palp of maxillule; H maxilliped; H’ endite of maxilliped; I uropod; J pleopod. Scale line = 0.1 mm.

(Fig. 4.2.17G') with two distal setae. Maxilliped (Fig. 4.2.17H) palp article-1 naked; article-2 with one long outer seta and four inner setae; article-3 with row of seven inner setae and subdistal seta; article-4 with six distal setae, and one subdistal seta; basis with six long setae, reaching article-3; endite (Fig. 4.2.17H') with three spatulate spines, one long seta, and three smaller setae distally.

Cheliped (Fig. 4.2.17C) basis 1.8 times as long as wide, with single dorsodistal seta; merus triangular, with three ventral setae; carpus 2.2 times as long as wide, with three ventral setae in distal half, and minute (9–10) setae along dorsal margin; propodus elongate, palm 1.5 times as long as wide, 1.3 times as long as finger, with two rows of short setae near dactylus insertion, and one long distal seta; fixed finger with two ventral setae, and three inner setae; dactylus with proximal setae.

Pereopod-1 (Fig. 4.2.18A) basis 3.8 times as long as wide, with two proximal setae; ischium 0.3 times as long as wide, with one ventral seta; merus twice as twice as long wide, 0.8 times as long as carpus, distally with one ventral and one dorsal seta; carpus 2.5 times as long as wide, 0.6 times as long as propodus, with five distal setae; propodus 4.2 times as long as wide, with three dorsal setae (one long and two short) and one long (half as long as propodus) ventral seta; dactylus together with unguis 1.5 times as long as propodus, with proximal setae, which is little shorter than dactylus; unguis 0.6 times as long as dactylus.

Pereopod-2 (Fig. 4.2.18B) basis 2.2 times as long as wide, with one proximal seta; ischium 0.3 times as long as wide, with two ventral setae; merus 1.7 times as long as wide, 1.6 times as long as carpus, with one dorsodistal seta, and one ventrodistal distinct spine, exceeding half length of the carpus, serration and microtrichia along ventral margin; carpus as long as wide, half time as long as propodus, with one distoventral setae that is as long as half of propodus and one distodorsal seta accompanied by shortspine; microtrichia along ventral margin; propodus 3.2 times as long as wide, with two dorsal setae and one ventral spine, both margins distinctively serrated; dactylus together with unguis 1.4 times as long as propodus.

Pereopod-3 (Fig. 4.2.18C) similar to pereopod-2, but basis with additional broom setae.

Pereopod-4 (Fig. 4.2.18D) basis 1.3 times as long as wide, with two broom setae proximally; ischium 0.2 times as long as wide, with two ventral setae; merus 1.5 times as long as wide, similar in length to carpus, with two slender spines and serration (microtrichiae) along ventral margin; carpus 1.5 times as long as wide, 1.7 times as long

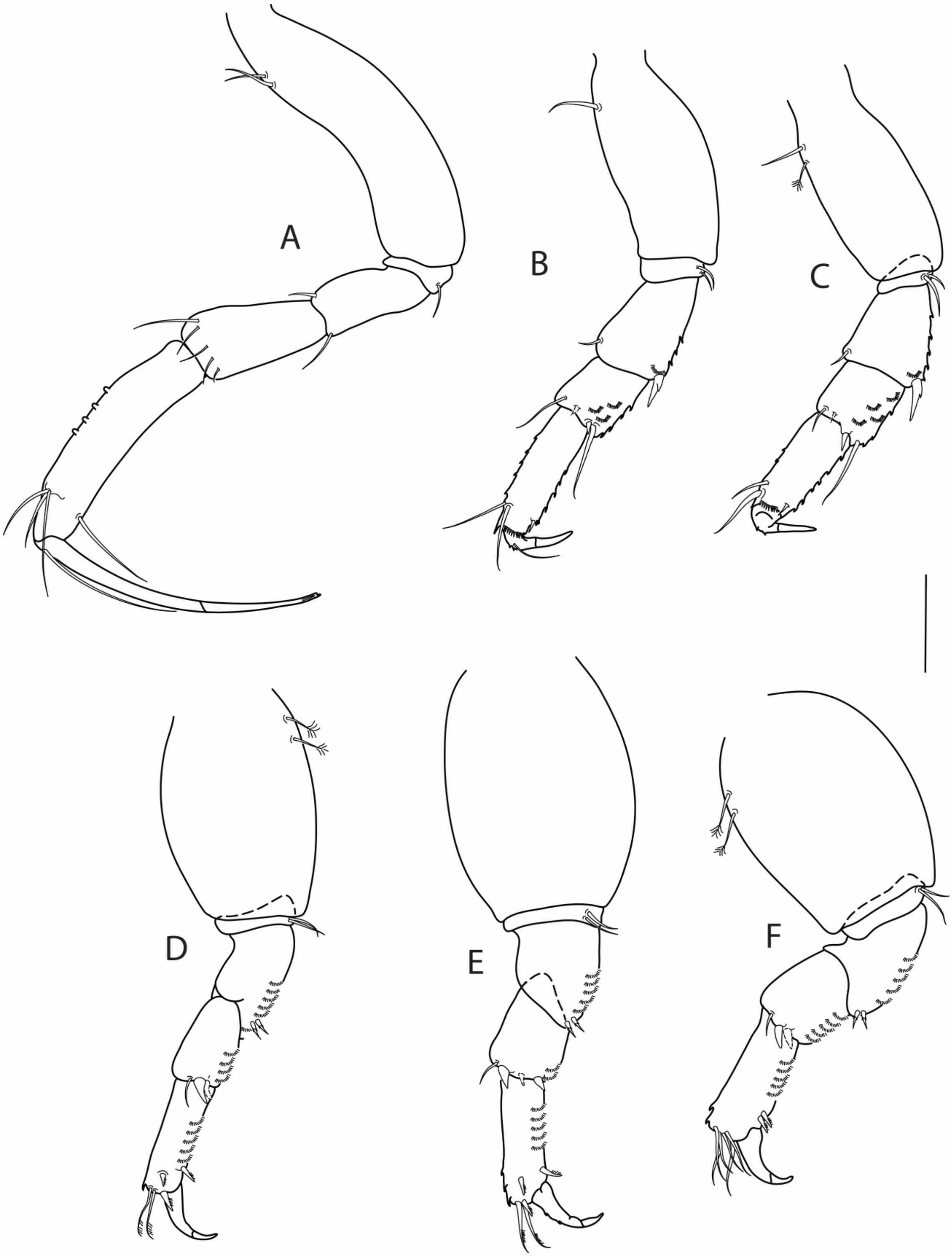


Fig. 4.2.18. *Araleptochelinae* n. sp. 2. A pereopod 1; B pereopod 2; C pereopod 3; D pereopod 4; E pereopod 5; F pereopod 6. Scale line = 0.1 mm.

as propodus, with two spines and one seta distally, and with microtrichia along ventral margin; propodus 1.3 times as long as wide, with two long and one short dorsodistal setae and two small distoventral spines; dactylus together with unguis 0.8 times as long as propodus.

Pereopod-5 (Fig. 4.2.18E) similar to pereopod-4.

Pereopod-6 (Fig. 4.2.18F) similar to pereopod-5, but propodus distally with one long and five short setae and two ventral spines.

Pleopods (Fig. 4.2.17J) in five pairs, all alike; basis with one seta; endopod with inner seta, and row of setae along outer margin; exopod with row of outer setae.

Uropod (Fig. 4.2.17G) basis naked; endopod with two segments, combined longer than proximal segment of the endopod; distal segment with two distal setae; endopod with six segments, each bear lateral setae, last one tipped by four simple setae one broom seta.

Remarks. From *Leptochelia helenae* that occurs in shallows (depth 1.5 m) of coralline sand around Bunaken Island in Celebes Sea (Guţu 2011) the new species is distinguished by the presence of the long distodorsal seta on merus of pereopod-2 that is short in *L. helenae*, and by presence of elongated slender spines on meri of pereopods from 4 to 6, which are apparently short in *L. helenae*.

Subfamily Leptocheliinae Lang, 1973

Genus Leptochelia Dana, 1849

Type species: *L. minuta* Dana, 1849

Species included: *L. affinis* Hansen, 1895; *L. africana* Larsen & Froufe, 2013 *L. algicola* (Harger, 1878); *L. anorexia* (Bamber & Bird, 2000), *L. antarcticus* (Lang, 1953) *L. barnardi* Brown, 1957; *L. billambi* Błażewicz-Paszkowycz & Bamber, 2012; *L. bispinosa* Guţu, 2011; *L. brasiliensis* (Dana, 1849); *L. bulbus* (Bamber, 2006); *L. caldera* Bamber & Costa, 2009; *L. columbina* (Brown, 1957) *L. corsica* Dollfus, 1898; *L. daggi* Bamber, 2005; *L. dijonesae* Bamber, 2008; *L. dubia* (Krøyer, 1842); *L. durbanensis* Brown, 1957; *L. ebriosus* (Bamber & Bird, 1997) *L. elongata* Larsen & Rayment, 2002; *L. erythraea* (Kossman, 1880); *L. evansi* Edgar, 2012; *L. forresti* (Stebbing, 1896); *L. gadgeti* Edgar, 2012; *L. guduroo* Bamber, 2008; *L. helenae* Guţu, 2011; *L. ignota* (Chilton, 1885); *L. inermis* Dollfus, 1898; *L. itoi* Ishimaru, 1985; *L. karragarra* Bamber, 2008; *L. longichelipes* (Lang, 1973); *L. longimana* Shiino, 1963;

L. lusei Bamber & Bird, 1997; *L. meracantilis* Smith, 1906; *L. mergellinae* Smith, 1906 *L. minuta* Dana, 1849; *L. mirabilis* Stebbing, 1905; *L. mortenseni* (Lang, 1973) *L. myora* Bamber, 2008; *L. neapolitana* Sars, 1882; *L. occiporta* (Błażewicz-Paszkowycz & Bamber, 2012) *L. opteros* Bamber, 2008; *L. parasavignyi* Larsen, 2012; *L. rapax* Harger, 1879; *L. savignyi* (Krøyer, 1842); *L. tanykeraia* Bamber, 2009; *L. tarda* Larsen & Rayment, 2002; *L. tenuicula* Makkaveeva, 1968; *L. timida* Brown, 1958; *L. vatulelensis* Guţu & Iliffe, 2011; *L. vimesi* Bamber, 2005.

Leptochelia sp.

Figs 4.2.19–4.2.21

Material examined: *Holotype*: CGLI 041B, 14.68900S, 145.46710E, Lizard I., lagoon entrance in from Bird Islet, patch reef, medium small ruble, depth 1–3m, 2008-04-19. *Paratypes*: 2063 specimens, detailed information included in Appendix 4.1.6 (Ningaloo), 4.1.5 (Heron I.), and 4.1.4 (Lizard I.).

Diagnosis. Antennule article-1 three times as long as wide. Five setae on maxilliped basis. Pereopod-1 basis 4.6 times as long as wide. Cheliped basis 1.9 times as long as wide. Uropod exopod one segmented almost as long as endopod segment-1; endopod with five segments.

Description of females. Body (Fig. 4.2.19A, B) 3.6 mm long, 6.5 times as long as wide. Carapace 20% of total body length, 1.2 times as long as wide, with two pairs of later setae (near eyelobes and at midlength); eyes present (Fig 4.2.20C), distally rounded, with pigment. Pereon 60% of total body length, pereonite-1 shortest, 0.4 times as long as wide; pereonites 2, 3 and 6 similar in length, half as long as wide; pereonites 4 and 5 subequal, 0.7 times as long as wide; all pereonites with a pair of lateral setae. Pleon together with pleotelson 20% of total body length, pleonites 1–4 similar in length, 0.2 times as long as wide, pleonite-5 shortest, 0.1 times as long as wide, all pleonites with pair of lateral setae. Pleotelson 0.6 times as long as two first pleonites combined, with pair of posterior setae.

Antennule (Fig. 4.2.20A) with four articles. First article three times as long as wide, 1.2 times as long as distal articles 2–3 together, with broom proximal seta, middle group of three simple setae and distal group of two broom setae and one simple seta, and with one middle setae on inner margin; second article 0.3 times as long as wide, with two

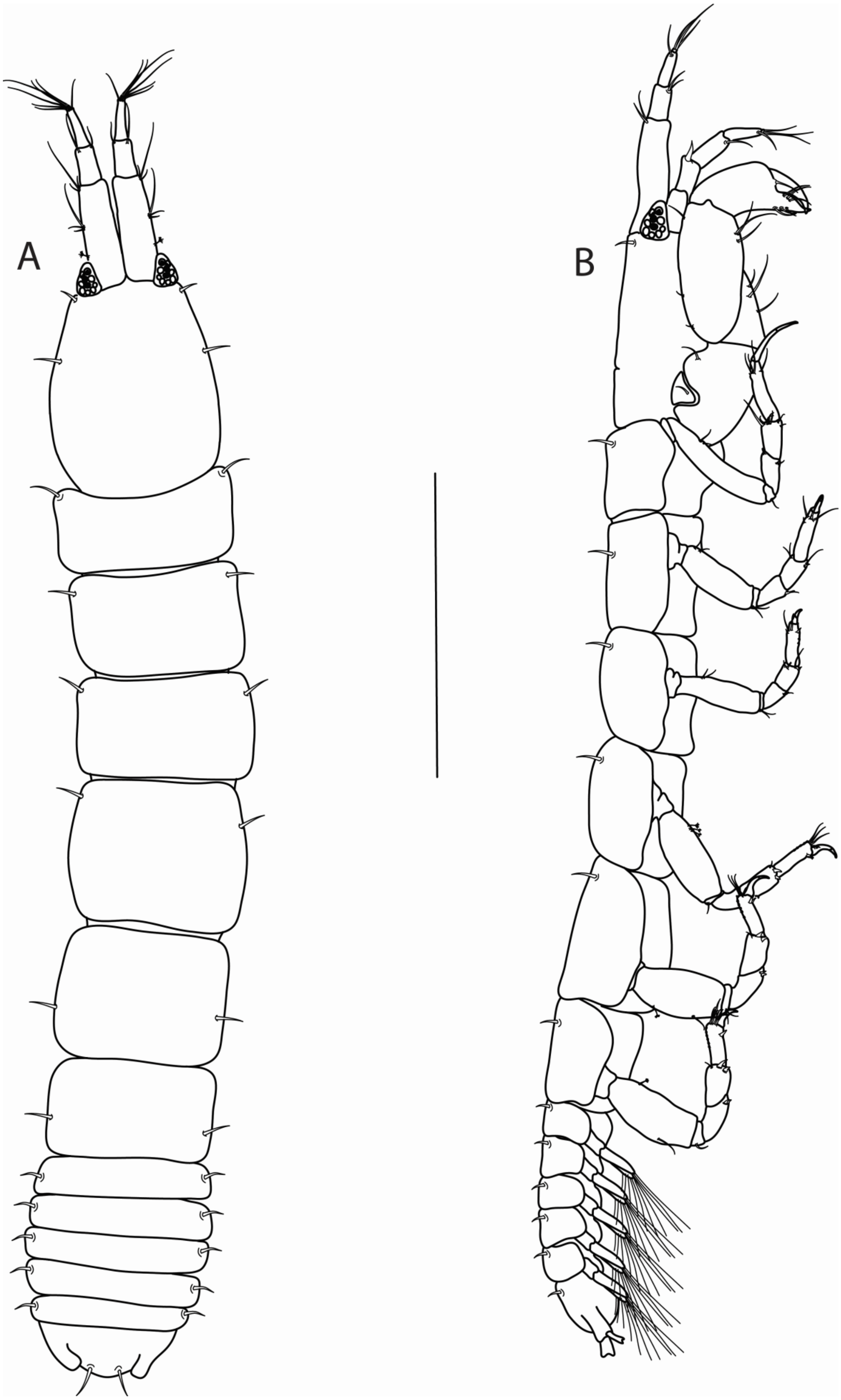


Fig. 4.2.19. *Leptochelia* n. sp., holotype female. A body dorsal view; B body lateral view. Scale line = 1mm.

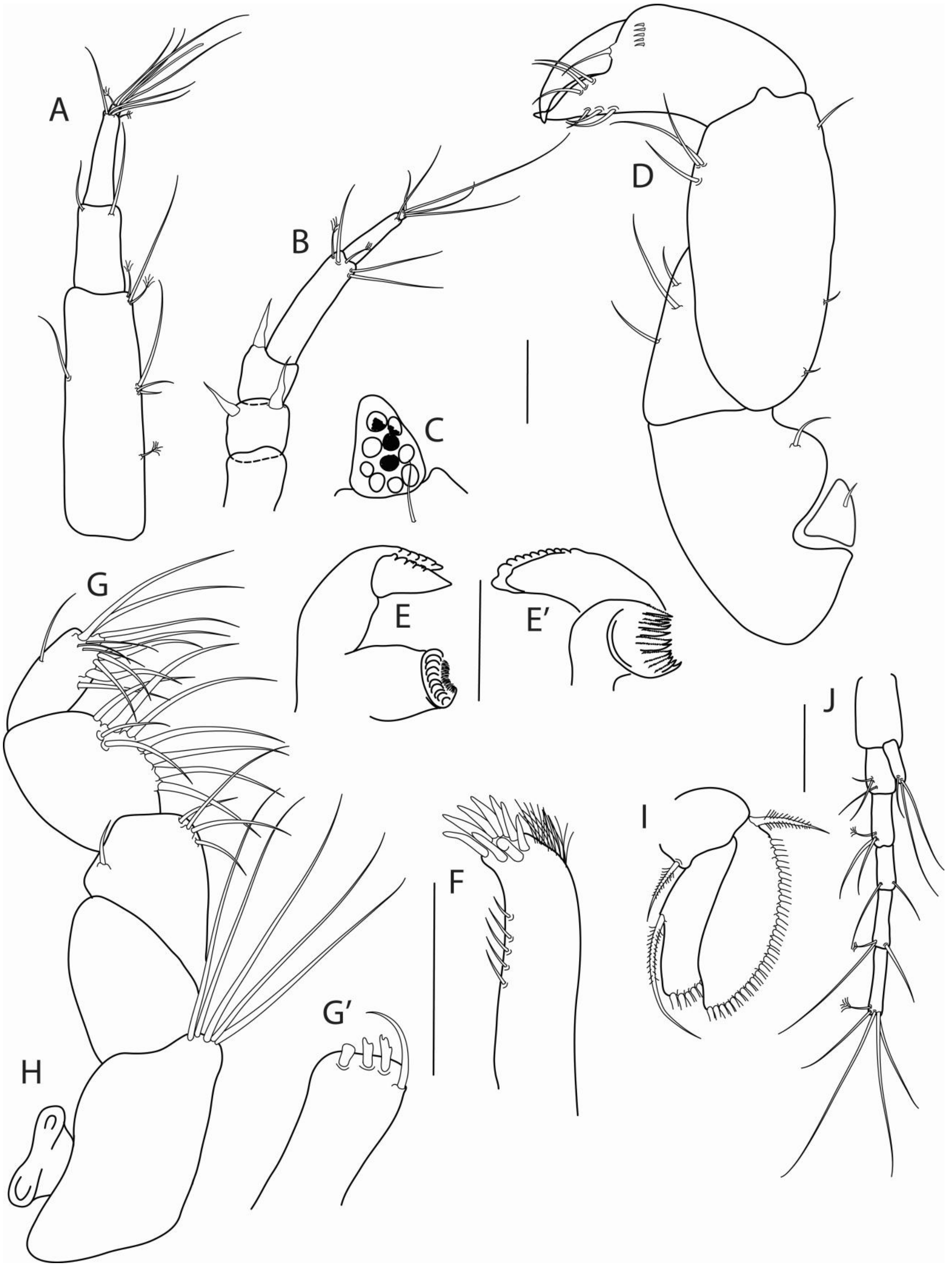


Fig. 4.2.20. *Leptochelia* n. sp. A antennule; B antenna; C eye; D cheliped; E right mandible; E' left mandible; F maxillule; G maxilliped; G' endite of maxilliped; H maxillule; I pleopod; J uropod. Scale line = 0.1 mm.

distal setae; third article similar in length to second article, with three simple and one broom setae; fourth article minute, tipped by four setae and one aesthetasc.

Antenna (Fig. 4.2.20B) with six articles. First article compact, naked; second article 0.8 times as long as wide, distally with one ventral and one dorsal spine; third article subequal second article, with dorsodistal spine; fourth article longest, 3.5 times as long as wide, with three simple setae and two broom setae distally; fifth article half as long as third article, with one distal seta; fifth article minute, with four distal setae.

Mouthpart. Left mandible (Fig. 4.2.20E) *lacinia mobilis* distally crenulated, incisor with distally crenulation; *pars molaris* robust, typical 'laptocheliid'. Right mandible (Fig. 4.2.20E') similar to left, but with distal notch and without *lacinia mobilis*. Maxillule (Fig. 4.2.20F) with nine distal setae, few simple setae along inner margin, and dense distal hair setae on outer face. Maxilliped (Fig. 4.2.20G) palp article-1 naked; article-2 with one outer and four inner setae; article-3 with row of nine setae along inner margin; article-4 with one outer seta and 11 inner setae; basis with five setae extending to the palp article-3; endite (Fig. 4.2.20G') with on seta and three spatulate spines distally.

Cheliped (Fig. 4.2.20D) basis twice as long as wide, with single dorsodistal seta; merus with three ventral setae; carpus twice as long as wide, with three ventral setae and three dorsal setae proximally, subproximally and distally; propodus 1.4 times as long as wide, with on distal seta and row of subdistal setae; fixed finger with three ventral setae, and three inner setae; dactylus 0.7 times as long as propodus.

Pereopod-1 (Fig. 4.2.21A) basis 4.6 times as long as wide, with two proximal setae; ischium with one ventral seta; merus 1.7 times as long as wide subequal carpus, with one distodorsal and two distoventral setae; carpus half as long as propodus, with five small distal setae and one robust dorsodistal seta that is half as long as propodus; propodus 4.7 times as long as wide, with three distodorsal setae (on long two short) and one ventral seta; dactylus together with unguis subequal propodus, with short proximal seta; unguis 0.6 times as long as dactylus.

Pereopod-2 (Fig. 4.2.21B) basis 2.5 times as long as wide, with simple and broom proximal setae; ischium 0.4 times as long as wide, with two ventral setae; merus 1.5 times as long as wide, similar in length to merus, with ventrodistal spine accompanied by one seta; carpus half times as long as propodus, with two distodorsal setae and one ventral spine accompanied by one seta; propodus 3.8 times as long as wide, with three

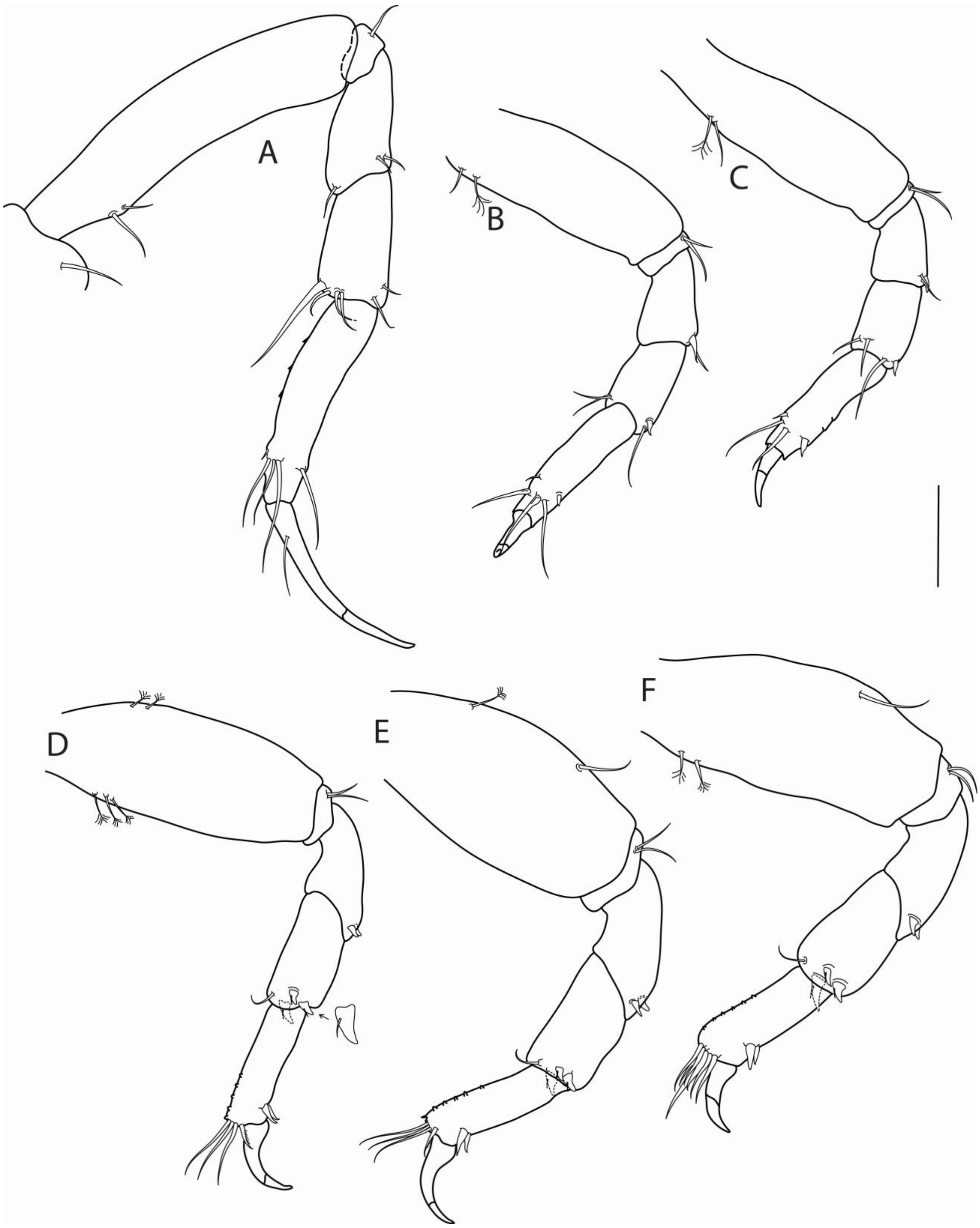


Fig. 4.2.21. *Leptochelia* n. sp. A pereopod 1; B pereopod 2; C pereopod 3; D pereopod 4; E pereopod 5; F pereopod 6. Scale line = 0.1 mm.

long subdistal setae, and one subdistal ventral spine; dactylus together with unguis 0.4 times as long as propodus.

Pereopod-3 (Fig. 4.2.21C) similar to pereopod-2, but propodus with two subdistal setae.

Pereopod-4 (Fig. 4.2.21D) basis 2.4 times as long as wide, with three proximal dorsal and two ventral broom setae; ischium 0.2 as long as wide, with two ventral seta; merus 1.9 times as long as wide, 0.7 times as long as carpus, with two ventrodistal spines; carpus twice as long as wide, 0.8 times as long as propodus, with three spines and one distodorsal seta; propodus three times as long as wide, with three long and one shorter dorsodistal setae, and two ventrodistal spines, dorsal margin serrated; dactylus together with unguis 0.7 times as long as dactylus.

Pereopod-5 (Fig. 4.2.21E) similar to pereopod-4, but basis 1.8 times as long as wide, with one simple and one broom setae ventrally.

Pereopod-6 (Fig. 4.2.21F) similar to pereopod-5, but propodus with six short and one longer dorsodistal setae.

Pleopods (Fig. 4.2.21I) in five pairs, all alike; basis with one seta; endopod with row of outer setae; exopod with one inner plumose seta, and row of inner setae.

Uropod (Fig. 4.2.21J) basis naked; exopod with one segment, 0.9 times as long as proximal segment of endopod with three distal setae; endopod with five segments, each with distal setae, terminal article tipped by four simple and one broom setae.

Remarks. From all species of *Leptochelia* recorded so far in Australian waters *Leptochelia* sp. 1 resembles the most *L. billambi* Błażewicz-Paszkowycz & Bamber, 2012 (see tab. 2.1) occurring in Bass Strait, although the new species has slightly longer cheliped carpus, two long, distodorsal setae on carpus of pereopod-1, while is apparently one in *L. billambi*, and three distodorsal seta in pereopod 4–5 while *L. billambi* has them four.

Genus Poorea Edgar, 2012

Diagnosis (amended after Egdar 2012): Antennule with four articles, article-2 similar in length to third, fourth article minute. Antenna article 2–3 with slender spines; cheliped compact, carpus about 1.5 times as long as wide; maxilliped basis with 3–5 setae; endites with two three blunt spines. Pereopod-1 basis short; pereopods 2–3 ischia with one seta; pereopods 4–6 ischia with two setae; pereopods 2–3 merus and carpus as long as wide. Uropod endopod with three articles, exopod with one article that is half as long as endopod proximal article.

Type species: *Poorea wrighti* Edgar, 2012, by original designation.

Species included: *P. wrighti*, *Poorea* n. sp.

Remarks. The genus *Poorea* was erected by Edgar (2012) based on males characters as compact antennule, antenna, cheliped, and uropod. Two species was originally classified to the genus: *P. johanessi* Edgar, 2012, and *P. wrighti* Edgar, 2012, both known only on male. Furthermore *P. nobbi* (Bamber, 2005) was transferring to the genus from *Leptochelia* as well (Edgar, 2012), because of compacted appendages, and until analysis of the CReefs collection it was the only female in the genus. Finding another member of the genus with apparently triarticulated endopod of uropod and well short uniarticulated exopod allows for amending the diagnosis of the genus. Since the articulation in the uropods are main diagnositic character, *P. johannesi* Edgar, 2012 with five-articulated endopod and with rudimental exopod cannot be a member of this genus. Because *P. johannesi* is known only from male, an investigation of the females is needed for erecting a new genus to accommodate that species.

Poorea sp.

Figs 4.2.22–4.2.24

Material examined: *Holotype*: CGLI 003 M1, 14.69117, 145.46980, Lizard I., S Coconut beach, inter-tidal, 2008-04-05. *Paratypes*: 133 specimens, from detailed information see appendix 4.1.4 (Lizard I.).

Diagnosis. Antennule proximal article 3.3 times as long as wide, maxilliped basis with five setae. Pereopod-1 basis 4.6 times as long as wide, dactylus 1.2 times longer than unguis.

Description of female. Body (Fig. 4.2.22A, B) 1.4 mm long, 5.3 times as long as wide. Carapace 25% of total body length, 1.3 times as long as wide, with two pairs of setae - one near eye lobes and at midlenght; eyes present, proximally rounded, with pigment. Pereon 53% of total body length; pereonites 1 and 2 similar in length, 0.3 times as long as wide, pereonite-3 half long as wide, peronites 4 and 5 similar in length, 0.6 times as long as wide; peronite-6 0.4 times as long as wide, each pereonite with a pair of lateral setae. Pleon together with pleotelson 22% of total body length, pleonites similar in length, 0.1 times as long as wide. Pleotelson almost as long as pleonites 1 and 2 combined.

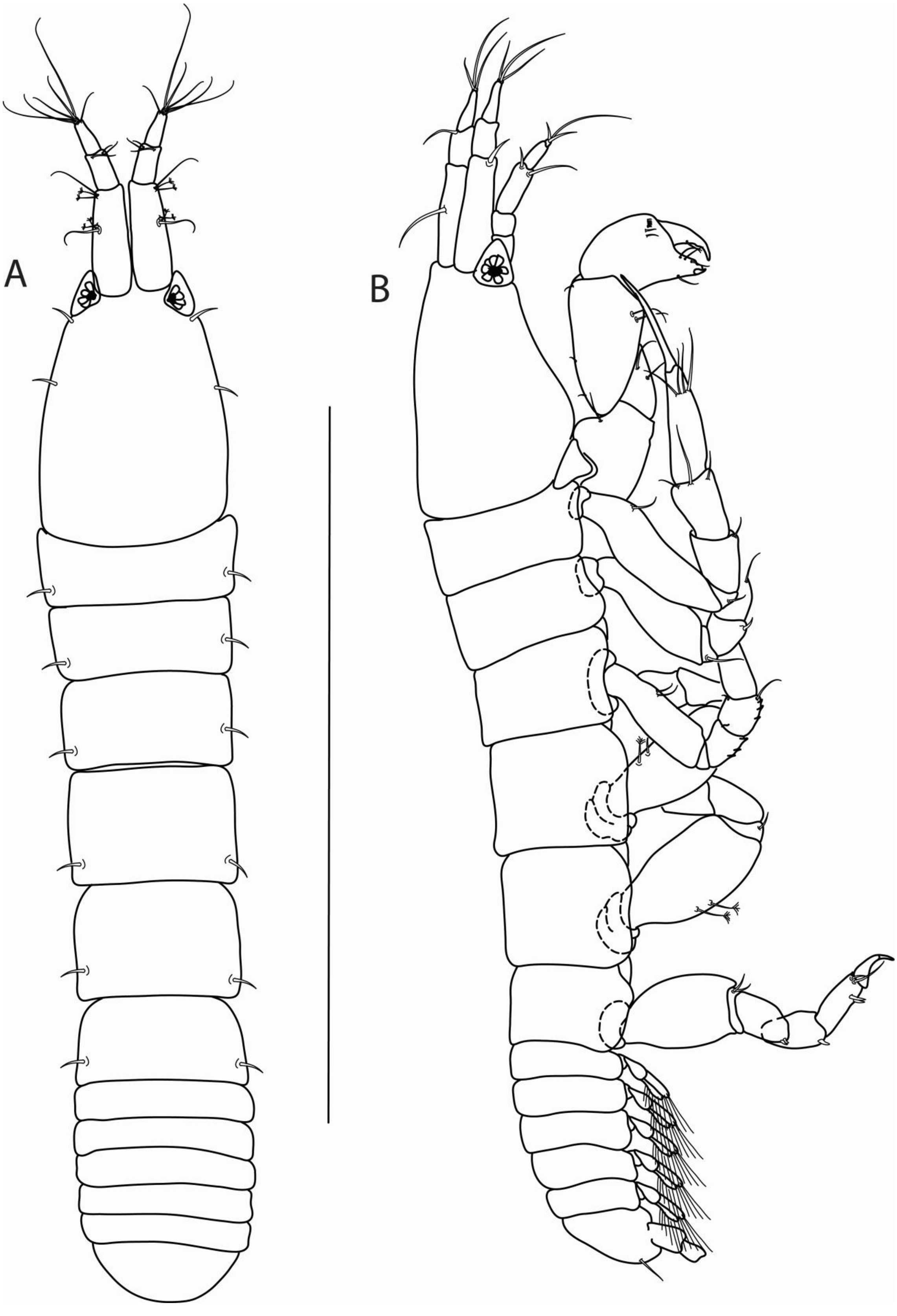


Fig. 4.2.22. *Poorea* n. sp., holotype female. A body dorsal view; B body lateral view. Scale line = 1mm.

Antennule (Fig. 4.2.23A) with four articles. First article 2.7 times as long as wide, 1.3 times as long as three distal articles together, with two groups of one simple setae and two broom setae placed at midlenght, and distoventrally; second article 1.7 times as long as wide, 0.3 times as long as first article, with three distal setae; third article subequal to second article, with two distal setae, fourth article minute, with four distal setae.

Antenna (Fig. 4.2.23B) with six articles; first article fussed with body, naked; second article 0.7 times as long as wide, with one inner and outer distal spines; third article similar to second article, with one distal spine; fourth article longest, 2.3 times as long as wide, twice as long as third article, with three simple and three broom distal setae; fifth article half as long as fourth article, with one distal seta; sixth article minute, with four distal setae.

Mouthpart. Left mandible (Fig. 4.2.23E) *lacinia mobilis* crenulate distally, incisor distally crenulated, molar robust. Right mandible (Fig. 4.2.23E') similar but with distal notch and without *lacinia mobilis*. Labium (Fig. 4.2.23D) wide, bilobated, distally finely setose. Maxillule (Fig. 4.2.23F) with 11 distal setae and row of setules distally on outer margin. Maxilliped (Fig. 4.2.23H) palp article-1 naked, article-2 with robust outer seta and three inner setae; article-3 with row of seven inner setae; article-4 with six distal setae, and with one outer seta; basis with five setae; endites (Fig. 4.2.23H') distally with one single seta and three spatulate spines.

Cheliped (Fig. 4.2.23C) basis 1.3 times as long as wide, with dorsodistal seta; merus triangular, with three ventral setae; carpus twice as long as wide, with three ventral setae and three short dorsal setae – proximal, submiddle and distal; propodus 1.1 times as long as wide, 2.3 times as long as finger, with distal row of setae near dactylus base; fixed finger with two ventral setae and three inner setae; cutting edge crenulated; dactylus 0.6 times as long as propodus, with one inner seta.

Pereopod-1 (Fig. 4.2.24A) basis 1.5 times as long as wide, with proximal seta; ischium 2.5 times as long as wide, with ventral seta; merus 1.3 times as long as wide, 0.8 times as long as carpus, with dorsoventral seta; carpus 1.4 times as long as wide, half time as long as propodus, with three distal setae, from which the longest is half time as long as propodus; propodus 3.3 times as long as wide, with four dorsodistal setae; dactylus together with unguis subequal propodus; unguis 0.8 times as long as dactylus.

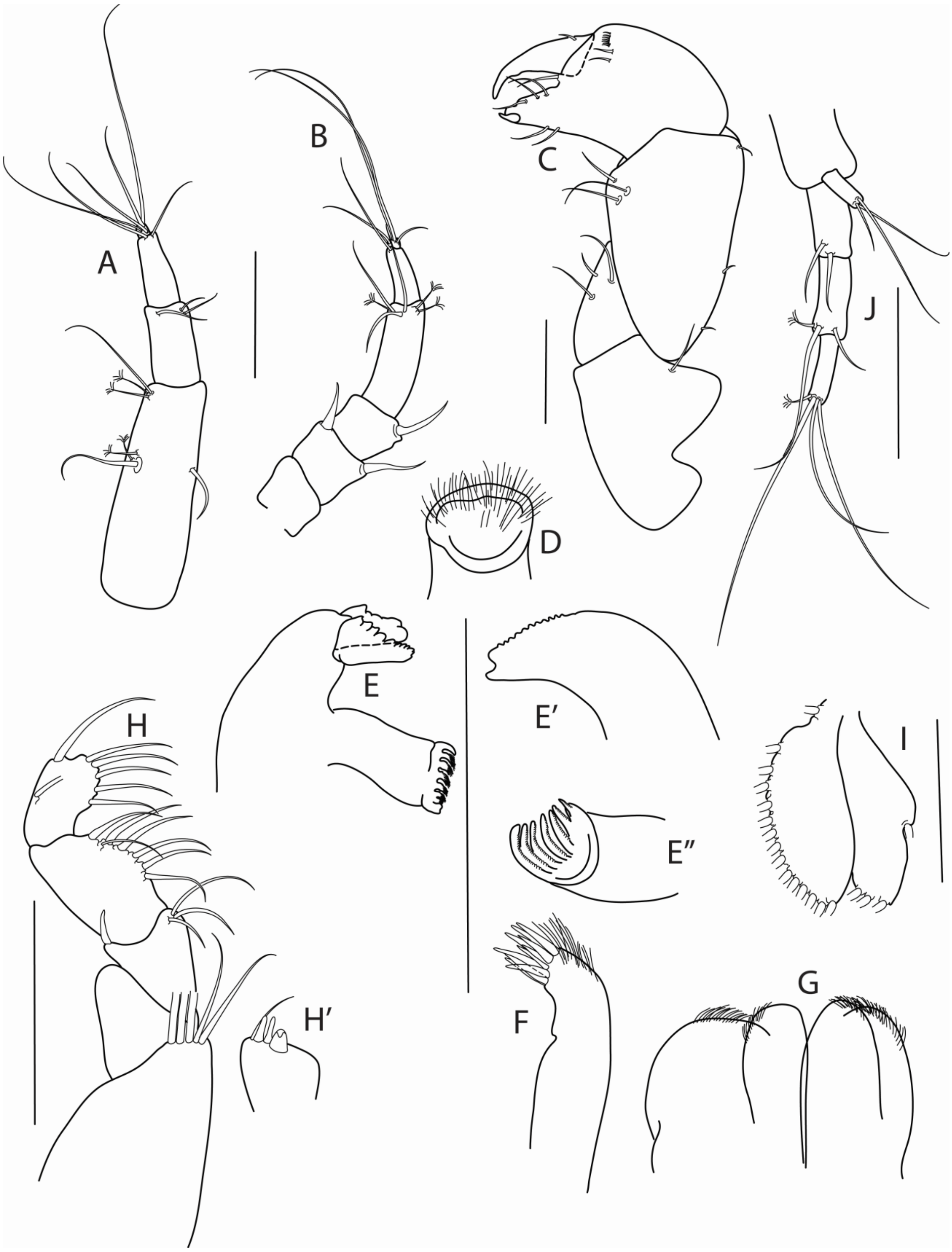


Fig. 4.2.23. *Poorea* n. sp. A antennule; B antenna; C cheliped; D labium; E right manbidle; E' left mandible; E'' pars molaris; F maxillule; G labrum; H maxilliped; H' endite of maxilliped; I pleopod; J uropod. Scale line = 0.1 mm.

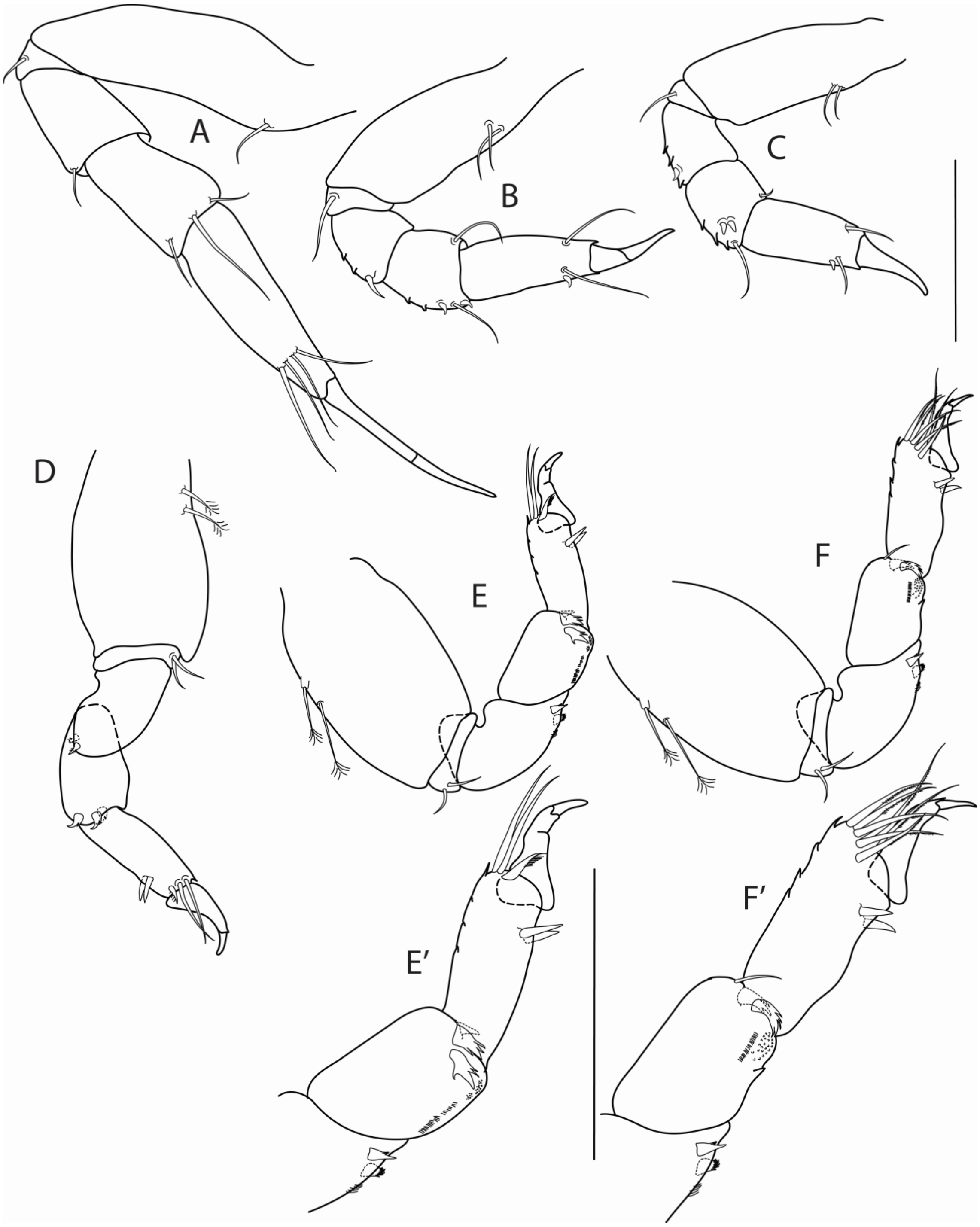


Fig. 4.2.24. *Poorea* n. sp. A pereopod 1; B pereopod 2; C pereopod 3; D pereopod 4; E pereopod 5; E’ detail of pereopod 5; F pereopod 6; F’ detail of pereopod 6. Scale line = 0.1 mm.

Pereopod-2 (Fig. 4.2.24B) basis twice as long as wide, with two dorsoproximal setae; ischium 0.4 times as long as wide, with one relatively long seta; merus 1.2 times as long as wide, subequal carpus, with distinct ventrodistal spine; carpus half times as long as propodus, with two small spines and one seta distoventrally and one seta distodorsally; propodus 2.4 times as long as wide, with one setae and minute spine distoventraly and one seta distodorsally; dactylus together with unguis 0.6 times as long as propodus.

Pereopod-3 (Fig. 4.2.24C) similar to pereopod-2.

Pereopod-4 (Fig. 4.2.24D) basis half as long as wide, with two broom setae proximally; ischium 0.4 times as long as wide, with two ventral setae; merus 1.5 times as long as wide, 0.7 times as long as carpus, with two small ventrodistal spines; carpus 1.2 times as long as wide, 0.8 times as long as propodus with three ventrodistal spines; propodus half as long as wide, with two ventral spines, and with three dorsodistal setae; dactylus together with unguis 0.6 times as long as propodus.

Pereopod-5 (Figs 4.2.24E, E') similar to pereopod-4, but basis 1.7 times as long as wide.

Pereopod-6 (Figs 4.2.24F, F') similar to pereopod-5, but propodus with five dorsodistal setae.

Pleopods (Fig. 4.2.23I) in five pairs, all alike; endopod with single inner setae, and row of outer setae; exopod with row of outer setae. All setae plumose.

Uropod (Fig. 4.2.23J) basis naked; endopod one-segmented, 0.6 times as long as proximal endopod segment, with three distal setae; endopod with three segments, each with two simple setae, proximal article tipped with three long and one broom setae distally.

Remarks. *Poorea* sp. differs from *P. nobbi* (Bamber, 2005) by number of setae on maxilliped basis, species described herein has five setae, while *P. nobbi* three setae. slimmer spine on meri of pereopods 2–3 in new species, and more compact segments of antennule, e.g first article in new species is 2.7 times as long as wide, while in *P. nobbi* 3.3 times .

Genus Leptocheliinae gen.

Diagnosis. Antennule proximal article 2.5 times as long as wide; five setae on maxilliped basis, pereopod-1 basis 3.9 times as long as wide, and dactylus 1.1 times as long as unguis; uropod with four-segmented endopod and exopod as long as proximal endopod segment.

Type species: Leptocheliinae gen. sp. by monotypy.

Remarks. Leptocheliinae gen. sp. could be distinguish from *Leptochelia* Dana, 1849 due to relatively short and wide antennule articles, compact cheliped and pereopods 2–3 and four segmented exopod of uropod.

Leptocheliinae gen. sp. resembles the most Australian *Leptochelia guduro* Bamber, 2008. Both species show similarities in cheliped basis and merus that are 1.2 times as long as wide, and 1.2 times as long as basis, respectively. Moreover both species have pereopod-1 basis about 3.9 times as long as wide. However they can be distinguished by: (1) antennule proximal article which is 2.5 times as long as wide in Leptocheliinae gen. 1 sp. and 2.8 in *L. guduro*, (2) shorter dactylus of pereopod-1 in related to unguis, that is 1.1 times as long as unguis in Leptocheliinae gen. 1 sp. and 1.4 in *L. guduro*, (3) proportion in length to width of cheliped merus, that is 1.6 and 1.8 in Leptocheliinae gen. 1 sp. and Bamber's species, respectively and (5) four segmented uropod endopod in Leptocheliinae gen. 1 sp. and five segments in *L. guduro*.

Leptocheliinae gen. sp.

Figs 4.2.25–4.2.27

Material. *Holotype*: LIZ 09 05A 14.47436S, 145.29210E, Lizard I., Waining Reef, back reef, coral rubble, depth 2 m, 2008-04-15. *Paratypes*: 564 speciemens, detailed information included in Appendix 4.1.6 (Ningaloo), 4.1.5 (Heron I.) and 4.1.4 (Lizard I.).

Diagnosis. As for the genus.

Description of female. Body (Fig. 4.2.25A, B) 2.5 mm long, 5.6 times as long as wide. Carapace 21% of total body length, 1.2 times as long as wide, eyes present, with pigment. Pereon 56% of total body length; peronites 1–2 and 6 similar in length, 0.4 times as long as wide; pereonite-3 and -5 similar in length, 0.6 times as long as wide; pereonite-4 longest, 0.7 times as long as wide. Pleon together with pleotelson 23% of total body length; pleonites similar in length, 0.2 times as long as wide. Pleotelson 0.7 times as long as two first pleonites combined.

Antennule (Fig. 4.2.26A) with four articles, first article 2.5 times as long as wide, with two groups of outer setae: one simple and one broom setae at midlenght, and three broom setae and one simple at distal corner, and with one inner seta; second article 1.6

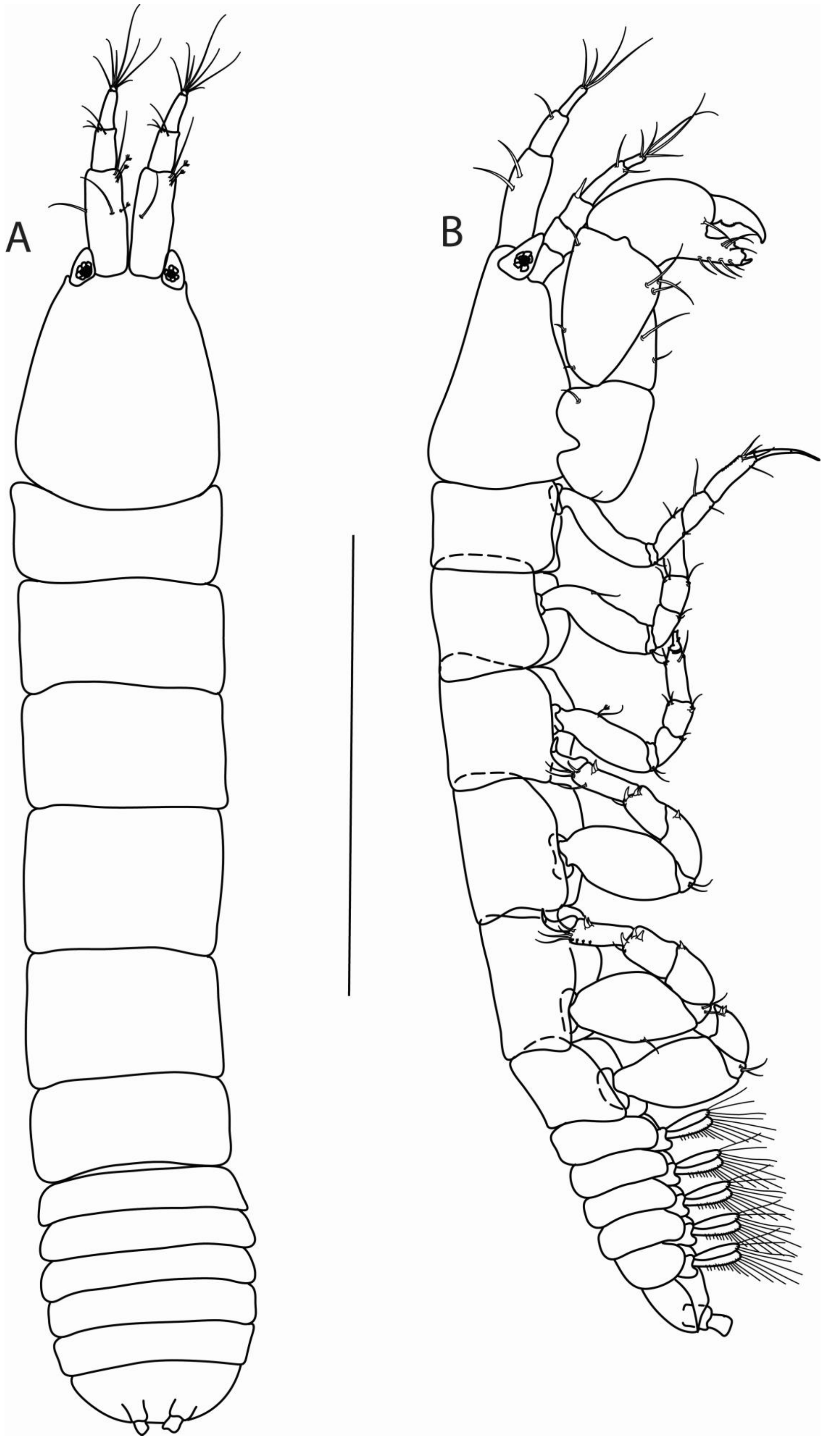


Fig. 4.2.25. Leptocheliinae n. gen. 1 sp., holotype female. A body dorsal view; B body lateral view. Scale line = 1mm.

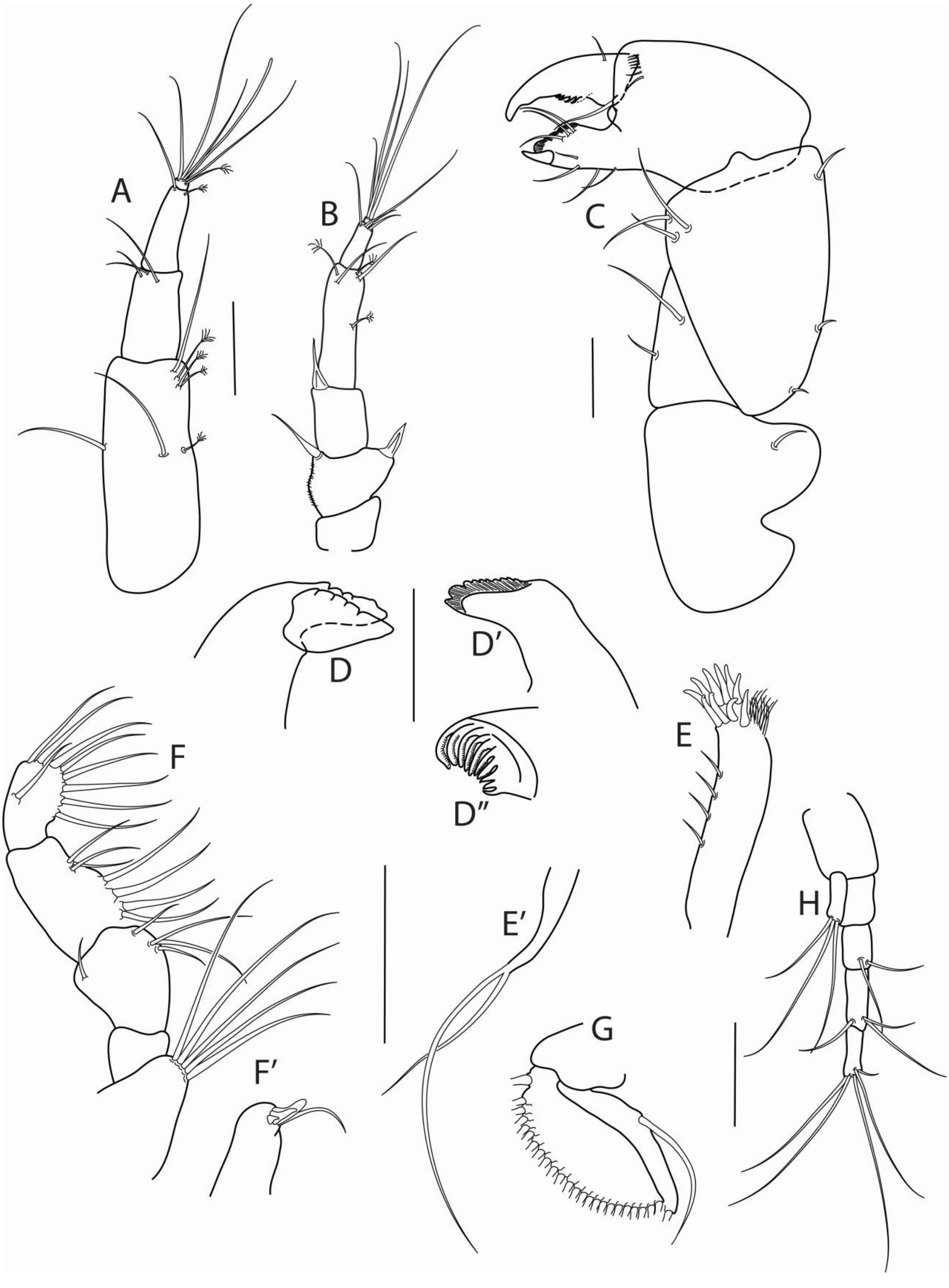


Fig. 4.2.26. Leptocheliinae n. gen. 1 sp. A antennule; B antenna; C cheliped; D right mandible; D' left mandible; D'' pars molaris; E maxillule; E' palp of maxillule; F maxilliped; F' endite of maxilliped; G pleopod; H uropod. Scale line = 0.1 mm.

times as long as wide, with three distal setae; third article similar in length to second article, with one simple and one broom setae distally; fourth article minute with four simple setae, and broom seta and aesthetasc.

Antenna (Fig. 4.2.26B) with six articles, first article compact; second article 0.7 times as long as wide, distally with two spines: one dorsal, and one slender ventral spine; third article 1.3 times as long as second article, with dorsodistal spine; fourth article 3.7 times as long as wide, with two broom and two simple setae distally and one broom setae at midlenght; fifth article 0.3 times as long as fourth article, with four distal setae; sixth article minute, with four distal setae.

Mouthpart. Left mandible (Fig. 4.2.26D) *lacinia mobilis* crenulate distally; pars incisiva with distal crenulation. Right mandible (Fig. 4.2.26D') similar to left, but without *lacinia mobilis*; *pars molaris* (Fig 4.2.26D'') robust. Maxillule (Fig. 4.2.26E) with ten distal spines, setose margin, and row of setules on inner distal face; palp (Fig 4.2.26E') with two distal setae. Maxilliped (Fig. 4.2.26F) palp article-1 naked; article-2 distally with outer single seta, and four inner setae; article-3 with row of seven inner setae; article-4 with eight distal setae and one subdistal on outer margin; basis with five setae, exceeding to proximal half of third article; endites (Fig. 4.2.26F') distally with single seta and three spines.

Cheliped (Fig. 4.2.26C) basis 1.2 times as long as wide, with dorsodistal seta; merus triangular, with two ventral setae; carpus 1.6 times as long as wide, with three dorsal setae: two in proximal half, and one seta distally, and with three ventrodistal setae; propodus 1.4 times as long as wide, twice as long as chelae finger, with subdistal row of setae and distal single seta; fixed finger with three ventral setae, and with one seta on outer face and three setae on inner face; dactylus half as long as propodus, with inner proximal bulge.

Pereopod-1 (Fig. 4.2.27A) basis four times as long as wide, with proximal seta; ischium 0.4 times as long as wide, with single, ventral seta; merus 1.6 times as long as wide, slightly longer than carpus, distally with one dorsal seta and two setae on ventral margin; carpus 1.5 times as long as wide, half times as long as propodus, with six distal setae, from which the longest is 0.6 times as long as propodus; propodus 3.3 times as long as wide, distally with three dorsal setae, and one ventral seta, and with small tubercles along dorsal margin; dactylus together with unguis 1.2 times as long as propodus, with proximal seta; unguis slightly shorter than dactylus.

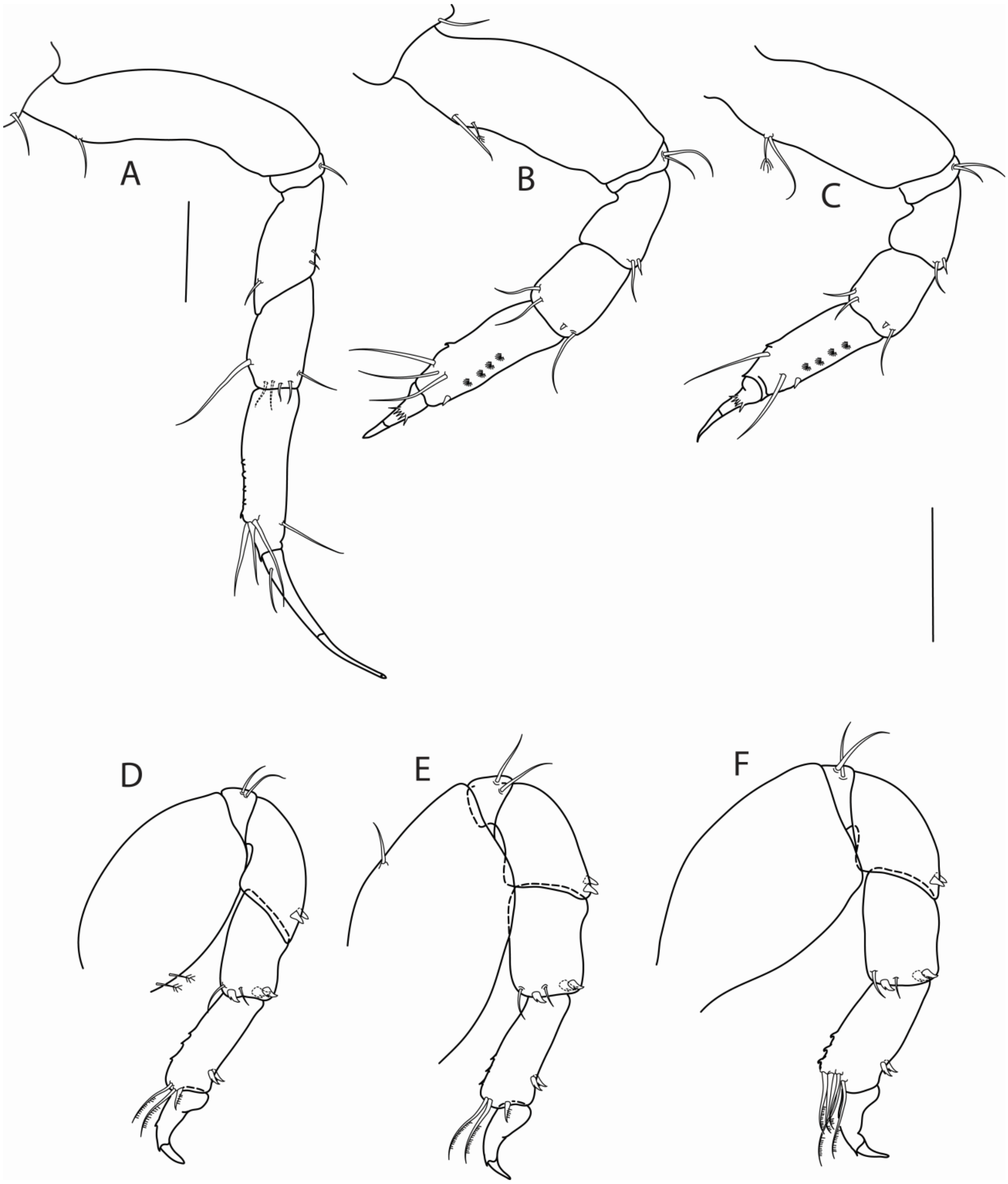


Fig. 4.2.27. Leptocheliinae n. gen. 1 sp. A pereopod 1; B pereopod 2; C pereopod 3; D pereopod 4; E pereopod 5; F pereopod 6. Scale line = 0.1 mm.

Pereopod-2 (Fig. 4.2.27B) basis 2.6 times as long as wide, with one simple and one broom proximal setae; ischium 0.3 times as long as wide, with two ventral setae; merus 1.4 times as long as wide, similar in length to carpus, with ventrodistal seta and spine; carpus 1.2 times as long as wide, 0.6 times as long as propodus, distally with two dorsal setae, and one seta accompanied by short spine on ventral margin; propodus 2.8 times as long as wide, distally with spine and three setae; dactylus together with unguis half times as long as propodus, with denticles in proximal half

Pereopod-3 (Fig 4.2.27C) similar to pereopod-2.

Pereopod-4 (Fig. 4.2.27D) basis 1.5 times as long as wide, with two broom setae in proximal half; ischium 0.3 times as long as wide, with two ventral setae; merus 1.6 times as long as wide, similar in length to carpus, with two ventrodistal spines; carpus 1.5 times as long as wide, 0.8 times as long as propodus, distally with three spines, and two seta; propodus 2.4 times as long as wide, distally with two ventrodistal spines and two longer and one short dorsodistal pinnated setae; dactylus together with unguis 0.7 times as long as wide.

Pereopod-5 (Fig. 4.2.27E) similar to pereopod-4, but basis with one simple seta.

Pereopod-6 (Fig. 4.2.27F) similar to pereopod-5, but propodus with five dorsodistal setae.

Pleopods (Fig. 4.2.26G) in five pairs, all alike. Basis without seta; endopod with inner single seta, and row of outer setae; exopod with row of outer setae.

Uropods (Fig. 4.2.26H) basis naked; exopod with one segment, similar in length to proximal endopod segment, tipped by three setae; enopod with four segments, each bear setae, last with five distal setae.

Part III

Revision of genus Synapseudes (Miller, 1940) with description of two new species from Australian coral reefs.

The genus *Synapseudes* was erected by Miller (1940) to accommodate *S. minutes* Miller, 1940 collected from Hawaiian Islands with two segmented pleon. It also lacks pleopods, exopod in both cheliped and the first pair of pereopod, and has a short rami in uropods. According to the principle of ICZN Article 68.3. *S. minutes* has become a type species by monotypy.

Synapseudes was primarily a member of the family Apseudidae until establishing Metapseudidae Lang, 1970 to which *Synapseudes* was included. Currently the genus is composed of twenty three species (Anderson 2013; WoRMS) which members occur in tropical and temporary zone (Băcescu 1976a, Błażewicz-Paszkowycz et al. 2011). The only two species that have been found in cold waters are *S. idios* Gardiner, 1973 and *S. aflagellatus* Sieg, 1986, e.g. in Magellan Strait and Isla de los Estados (Gardiner 1973; Sieg 1986) and they are also the most southern representatives of the genus. *Synapseudes* was reported from various habitats as: holdfast (Menzies 1953), algae (Bamber 2012; Menzies 1949), sponge (Băcescu 1986), rocks washing (Błażewicz-Paszkowycz et al. 2011) and as a taxon associated with coral reefs (Băcescu 1976a, c; Menzies 1953; Miler, 1940).

Heterogeneity within *Synapseudes* was mentioned in the literature many times. Lang (1968, 1970) pointed that number of free pleonites vary from two to three. He also stated that *S. minutus*, *S. rudis* Menzies, 1953, *S. dyspina* Menzies, 1953 and *S. hanocki* Menzies, 1953 have apparently three free pleonites, although the third is overlooked due to variety degree of a reduction. An awkward five free pleonites were reported for Subantarctic *S. idios*. This character makes the species much similar to *Metapseudes* Stephensen, 1927 or *Apseudomorpha* Miller, 1940 although a presence of only one pair of grossly reduced pleopods has precluded its classification to any of these two genera. Moreover *S. idios* has seven articles in antennule, which is apparently unique character for *Synapseudes*. The five pleonites and seven articles in antennule give a hint that *S. idios* might represent a new genus (Băcescu 1976a).

Guţu & Ortiz (2009) have considered a number of free pleonites as a enough argument for classification of synapseudids. They have established a genus

Synapseudoides Guţu & Ortiz, 2009 to accommodate the taxa with three free pleonites, in contrast to members of true *Synapseudes*, which retained only two free segments in abdomen.

All ten females of *S. heterocheles* (Vanhöffen, 1914) studied by Bamber (2012) had one distinct pleonite, but one of six examined males had additional pleon suture. This observation implied that number of free pleonites is ontogenetic variation and thus questioned the number of pleonites as a core character of definition genus *Synapseudes*.

Moreover Bamber (2012) mentioned that an apophysis on article 2 of antennules might be an important generic character and emphasized that it lacks in *S. heterocheles*. Nevertheless *Synapseudes* presents some more inconstant character like: number of antennule flagellum segments, which vary from two to one, or it could be fully reduced, number of antenna flagellum articles, or uropod exopod and endopod segments (Tab. 4.3.1).

The aim of this chapter is a revision of the genus *Synapseudes* based on the morphological analysis of the *Synapseudes* members described in the literature (Amar & Cazaubon 1978, Băcescu 1976a, 1977, 1981; Bamber 2012, Błażewicz-Paszkowycz et al. 2011, Gardiner 1973, Guţu 1996, 2006; Guţu & Ortiz 2009; Lang 1968, 1970; Menzies 1949, 1953; Miller 1940; Pillai 1954; Riggio 1973; Shiino 1951; Sieg 1986) including the morphology of the type species – *S. minutus* (courtesy of Professor Richard Heard, University of Southern Mississippi, US) and two other species of the genus identified from the CReefs collection. The morphological analysis provided was supported by the results of phylogenetic analysis and Principal Components Analysis based on 24 characters. The results justify in presenting an amend definition of the *Synapseudes* and erecting a new genus. Moreover two description of the two new species of the genus *Synapseudes* from the material collected during CReefs supplements this chapter.

Material and methods

Material was collected in the vicinity of Heron Island (GBR) and Ningaloo Reef during program Census of Coral Reefs in 2008 and 2009. Samples of coral rubble, dead coral head or sand were collected to mesh bags during SCUBA by Magdalena Błażewicz-Paszkowycz, Catrin Hass, Niel L. Bruce, Jane Fromont, Merrick Eckin, Claudia Arango. The samples were transported to the laboratory and placed in the

Tab. 4.3.1. Interspecyfic variation in *Synapseudes* species. 1 segments of inner antennule flagellum; 2 segments of antenna flagellum; 3 spines on second article of antennule; 4 setae on last antennule article; 5 segments of uropod exopod; 6 segments of uropod endopod.

species/ character	**1**	**2**	**3**	**4**	**5**	**6**
S. acroporae Băcescu, 1976	two	two	?	one	two	four
S. aflagellatus Sieg, 1986	reduced	two	absent	more	two	three
S. australianus Băcescu, 1981	two	two	present	one	two	three
S. comorinensis Pillai, 1954	?	?	?	?	three	three
S. cystoseirae Amar & Cazaubon, 1978	two	one	?	more	two	three
S. dispina Menzies, 1953	two	one	?	more	two	four
S. erici Błażewicz-Paszkowycz et al., 2011	two	one	present	one	two	four
S. hancocki Menzies, 1953	?	two	?	?	two	three
S. hansmuelleri Guţu, 2006	two	two	present	one	two	three
S. heterocheles (Vanhöffen, 1914)	two	two	absent	more	two	three
S. idios Gardiner, 1973	two	two	present	more	three	four
S. intumescens Menzies, 1949	two	one	present	more	two	four
S. makkaveevae Băcescu, 1976	two	?	?	?	one	three
S. mediterraneus Băcescu, 1977	one	one	present	more	two	three
S. menziesi Băcescu, 1976	two	two	present	one	two	three
S. minimus Guţu, 2006	two	two	present	one	two	three
S. minutus Miller, 1940	two	two	present	one	two	three
S. rectifrons Guţu, 1996	two	two	present	one	two	three
S. rudis Menzies, 1953	two	two	present	one	two	three
S. setoensis Shiino, 1951	two	two	absent	more	two	three
S. shiinoi Riggio, 1973	one	one	?	?	two	three
S. tomescui Guţu, 2006	two	?	present	?	two	three
S. violaceus Băcescu, 1976	two	two	present	one	two	three
Synapseudes n. sp. 24	two	two	present	more	two	four
Synapseudes n. sp. 33	one or two	two	present	one	two	three
Synapseudoides pinosensis Guţu & Ortiz, 2009	two	two	present	one	two	three

bucket with sea water and a few drops of formaldehyde to enhance animals to leave their tubes and crevices. After a few hours the samples were washed with a fine mesh (0.3 mm) and preserved with 80% ethanol. The material including the types was deposited in Museum of Queensland (Brisbane) and West Australian Museum (Perth).

MORPHOLOGY

Species were dissected and their limbs were mounted on a series of slides. The identification and figures was done with the dissecting microscope (Nikon SMZ 1200) and compound microscope (Carl Zeiss Axiolab) with camera lucida. Morphological terminology follows Bamber & Sheader (2005).

PHYLOGENY

Cladistical analysis was used to investigate the monophyletic groups between selected taxa. Data matrix (Appendix 4.3.1) was prepared in Excel and transformed to TNT format. Data set contain twenty-four unordered, continuous and numeric characters. Twenty-two characters were numerical character, sixteen were binary and six were multistate. Two characters were defined as continuous and were discrete as a ratio of width and length of the carapace (character 1) and length of the antennule to carapace (character 2). The character were treated as unortdered and unweight and were discriminated basing on literature data (Amar & Cazaubon 1978; Băcescu 1976a, 1977, 1981; Bamber 2012; Błażewicz-Paszkowycz et al. 2011; Gardiner 1973; Guţu 1996, 2006, Gutu & Ortiz 2009; Lang 1968, 1970; Menzies 1949, 1953; Miller 1940; Pillai 1954; Riggio 1973; Shiino 1951; Sieg 1986).

Ingroup

The ingroup consisted of 22 species classified to genus *Synapseudes* including two new species described below, and one species of *Synapseudoides* (Anderson 2013). From 23 species classified to *Synapseudes* three were excluded from the analysis due to insufficient or inadequate description namely: *S. commoriensis* Pillai, 1954, *S. hanocki* Menzies, 1953, *S. makkaveea* Băcescu, 1986.

Outgroup

Metapseudes wilsonii Błażewicz-Paszkowycz & Bamber, 2007a was selected as an outgroup due to its presumably close evolutionary relationship with *Synapseudes* (Gardiner 1973).

Analysis

Analysis were performed with TNT software (Goloboff et al. 2003, 2008) with settings: data format: 32 states, memory max tree: 10000. The most parsimonious trees were found with traditional search with following options: 1000 random addition sequences, 10 trees per replication, TBR (Tree Bisection and Reconnection) algorithms. Brunch support were evaluated with Bremer index (with setting 15 steps suboptimal trees search and relative fit value 0.9), which is an extra steps needed to lose a branch in the consensus tree (Bremer 1994). Consistency (CI) and Retency index (RI) were calculated. CI is defined as a sum of *m/s* calculated for each character, where *s* is the minimum number of the steps of the character exhibits on a particular cladogram and *m* is a minimum number of steps the same characters which could be shown on any cladogram (Kitching et al. 1998). The parameter describe relative amount of homoplasy (0–1), where value '1' indicates no homoplasy. RI (0-1) presents amount of homoplasy, but also evaluate synapomorphies in a tree.

Characters

1. Carapace length/width ratio: continuous character.
2. Carapace length/antennule basis length ratio: continuous character.
3. Carapace with lateral setae at midlenght: 0 – absent; 1– present.
4. Number of free pleonites: 0-five; 1-three; 2-two; 3-one. *Synapseudes idios* was scored as a species with five pleonites Gardiner (1973).
5. Width of the first pleonite: 0-all the same width; 1-wider than the others.
6. Telson with bulgae (protrusions): 0 – absent; 1 – present.
7. Antennule peduncle article 1 with apophyses: 0 – absent; 1 – present).
8. Antennule apophyses nature: 0 – sharp; 1 –rounded.
9. Antennule peduncle article 2 with apophyses or spines: 0 – absent; 1 – present.
10. Antennule inner flagellum articles: 0 – two; 1– one; 2 – none.
11. Antenna peduncle articles number: 0 – five; 1 – four; 1– less than four.
12. Antenna article 1 ornamentation: 0 – absent; 1 – present (denticled).
13. Antenna article 1 length: 0 – wider than long; 1 – longer than wide.
14. Antenna article 2 and 3 ornamentation: 0 – absent; 1 – present (denticled).
15. Antenna flagellum articles number: 0 – two; 1 – one.
16. Antenna terminal article setation: 0 – one seta; 1 – more than one setae.
17. Mandible palp article 1 setation: 0 – absent; 1– present.

18. Mandible palp article 2 with setae: 0 – absent; 1 – present.

19. Mandible palp article 3 with setae: 0 – many; 1 – two; 2 – one.

20. Maxilliped article two inner margin: 0 – without seta; 1 – with seta.

21. Pereopod 2 basis with apophyses: 0 – absent; 1 – present.

22. Pleopods: 0 – absent; 1 – present.

23. Uropod exopod segments number: 0 – three; 1 – two; 2 – one.

24. Uropod endopod segments number: 0 – four; 1 – three; 2 – two.

PRINCIPAL COMPONENTS ANALYSIS

Species relationship of Synapseudinae was analyzed with PCA in Past v. 2.17c (Paleontological Statistic Software Package for education and data analysis Hammer O., Harper D.A.T., Rayan P.D. 2001). Reduced phylogenetic matrix was used for PCA, as missing (= unknown) character precluded involving them into the analysis. As so the matrix for PCA composed of 16 species and 17 characters. Data were column standardized (Bamber 2012; Thorpe 1980) and subsequently analyzed in order to check whether the species currently classified to *Synapseudes* should be classified to one genus (see Apendix 4.3.2).

Results

PHYLOGENY

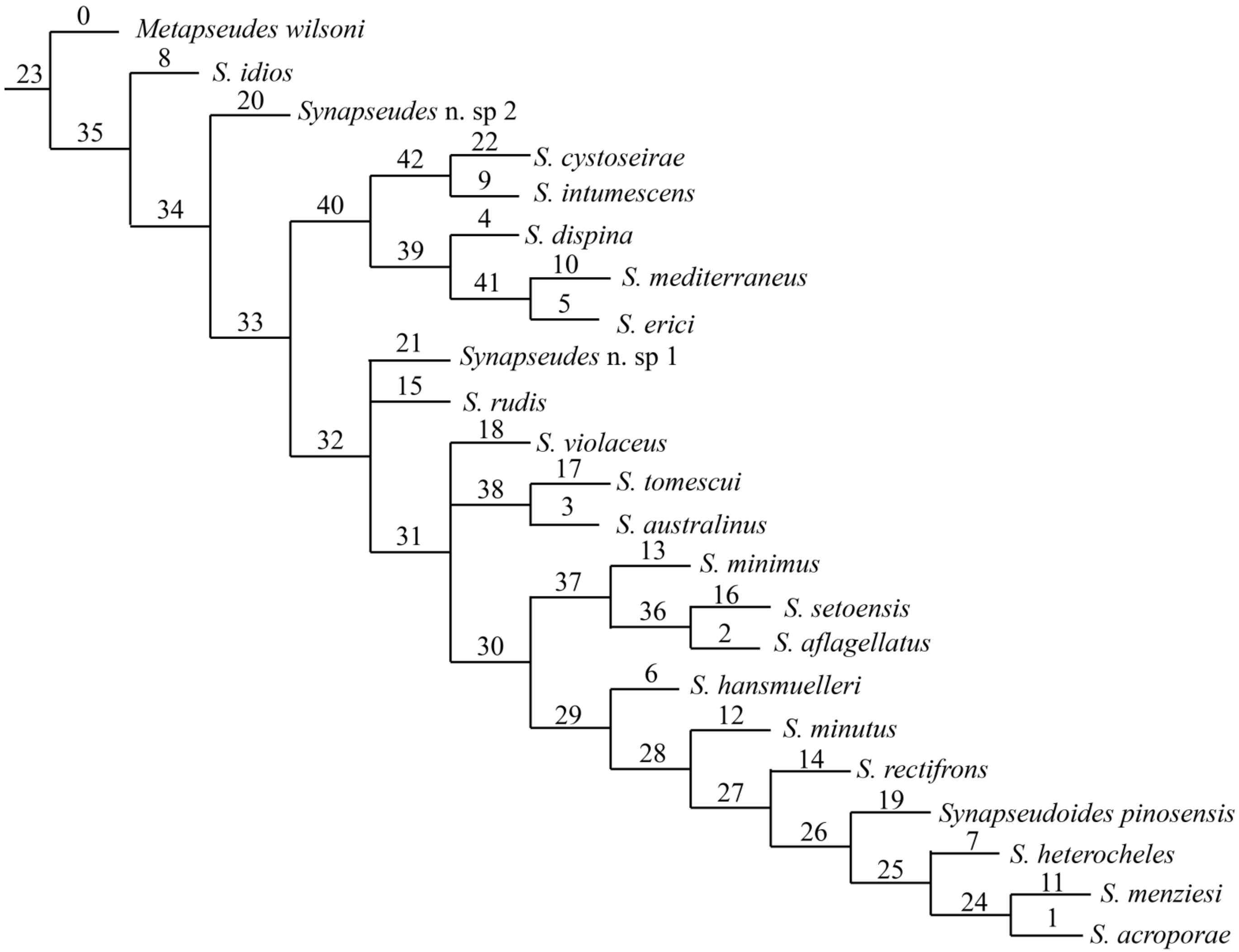
The phylogenetic yielded the most parsimonious trees of 56.92 steps. Its statistic is: consistency index (CI) = 0.48 and retency index (RI) = 0.59. Tree with implemented Bremer support is shown on the figure 4.3.1.

Clade 35 contains all synapseudids included into the analysis. They have grouped due to length to width of carapace ratio less than 1.2, and of length of antennule basis to carapace ratio more than 2.

S. idios is indefinite by synapomorphies as antenna peduncle with five articles, first article of mandible palp with setae, uropod exopod with three segments. All other synapseudids are part of clad 34, which has relatively high Bremer support value equal 3. The synapomorphies highlighted by the analysis are: three free pleonites, third article of mandible palp with two setae, and lack of pleopods.

Clad 33 contains majority of synapseudids except *Synapseudes* sp. 2. It was exculuded due to combination of characters: four articulated endopod of uropod and

Fig. 4.3.1. Phylogenetic tree.



antenna flagellum tipped by two seta. The synapomorphies highlighted by the analysis for the clad 33 are: length of carapace to antennule basis ratio more than 2.

Clade 33 is ramified to clade 40 and clade 32. The first of them is defined by two pleonites and flagellum of antenna composed of one article only, while synapomorphises in branch 32 are: one seta on distal antenna article and uropod endopod composed of three segments.

Clad 32 include two discrete taxa *Synapseudes* sp. 1 and *S. rudis*. The first species was probably not grouped because of not clear number of inner antennule flagellum, with two or one segments. The synapomorphies for the second species is combination of features: length of carapace to antennule basis ratio more than 2.4 and two free pleonites. All other species in the clad 31 share only one synapomorphy that is smooth (indenticled) margin of article 2 in antenna. The group consists of *S. violaceus* and clade 38 made by *S. tomescui* and *S. australinus* and clad 30 composed of cascade of: *S. heterocheles*, *S. minutus*, *S. rectifrons*, *Synapseudoides*, *S. menziesi* and *S. acroporae*. Species share one synapomorphy that is a presences of rounded spines on the basis of the antennule.

PCA RESULTS

PC axes 1 to 3 explain 66% of the variance in the data. Ordination of the species on PCA axes 1 and 3 is shown on the figure 4.3.2. The eigenvector plot of characters on these axes is shown on figure 4.3.3.

A distinct following groups of taxa are detected: *Metapseudes* and *S. idios* are well distinguished from the other members of *Synapseudes* along PCA3. Highlighted by the analysis characters which explain the separation are: third article of mandible palp with more than two setae and presence of pleopods. The species are separated from each other along PCA1, due to length of carapace to antennule basis ratio less than 1.5, and first article of mandible palp with setae.

S. cystroseriae, *S. erici*, *S. heterocheles*, *S. mediterrnaeus*, and *S. setoensis* make a separate group from *S. acroporae*, *S. australinus*, *S. aflagellatus*, *S. hanmuelleri*, *S. rectifrons*, *S. violaceus*, *S. minutes*, *S. synapseudoides*, *Synapseudes* n. sp. 1 and *Synapseudes* n. sp. 2. Both groups are separated on PCA 3. The separation was affected mostly by following feature number of antenna flagellum segments, number of setae on last antenna flagellum article, and number of pleonites. Species grouped above the PCA axes 3 characterize in one articulated antenna, tipped by more than two setae, with two

Fig. 4.3.2. Principal Components Analysis plot (PCA). (1 *Metapseudes wilsoni* Błażewicz-Paszkowycz & Bamber, 2007; 2 *Synapseudes acroporae* Băcescu, 1976; 3 *S. aflagellatus* Sieg, 1986; 4 *S. australianus* Băcescu, 1981; 5 *S. cystoseirae* Amar & Cazaubon, 1978; 6 *S. erici* Błażewicz-Paszkowycz et al., 2011; 7 *S. hansmuelleri* Guţu, 2006; 8 *S. heterocheles* (Vanhöffen, 1914); 9 *S. idios* Gardiner, 1973; 10 *S. mediterraneus* Băcescu, 1977; 11 *S. rectifrons* Guţu, 1996; 12 *S. setoensis* Shiino, 1951; 13 *S. violaceus* Băcescu, 1976; 14 *Synapseudes* sp. 2; 15 *Synapseudes* sp. 3; 16 *Synapseudoides pinosensis* Guţu & Ortiz, 2009; 17 *S. minutus* Miller, 1940 .

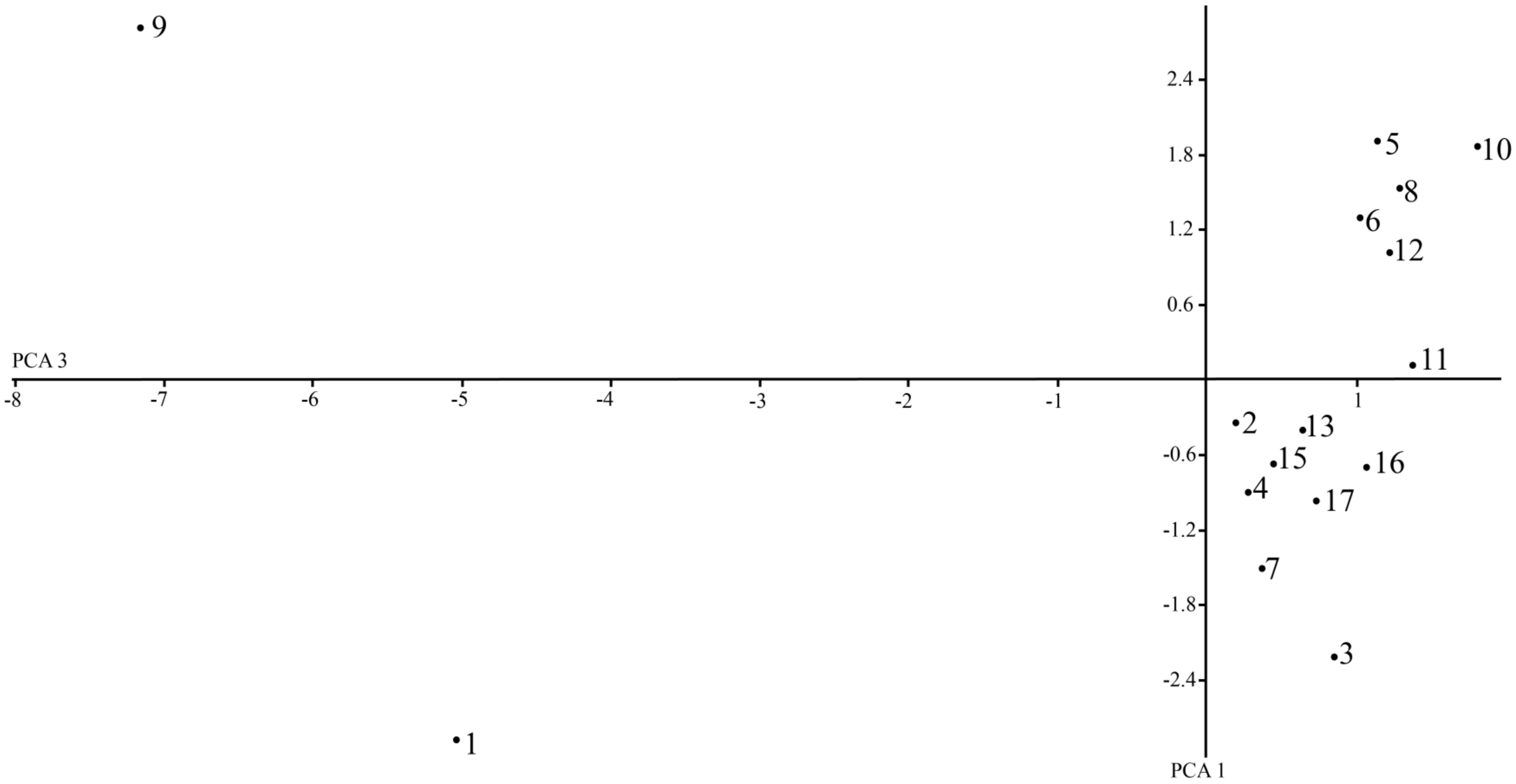
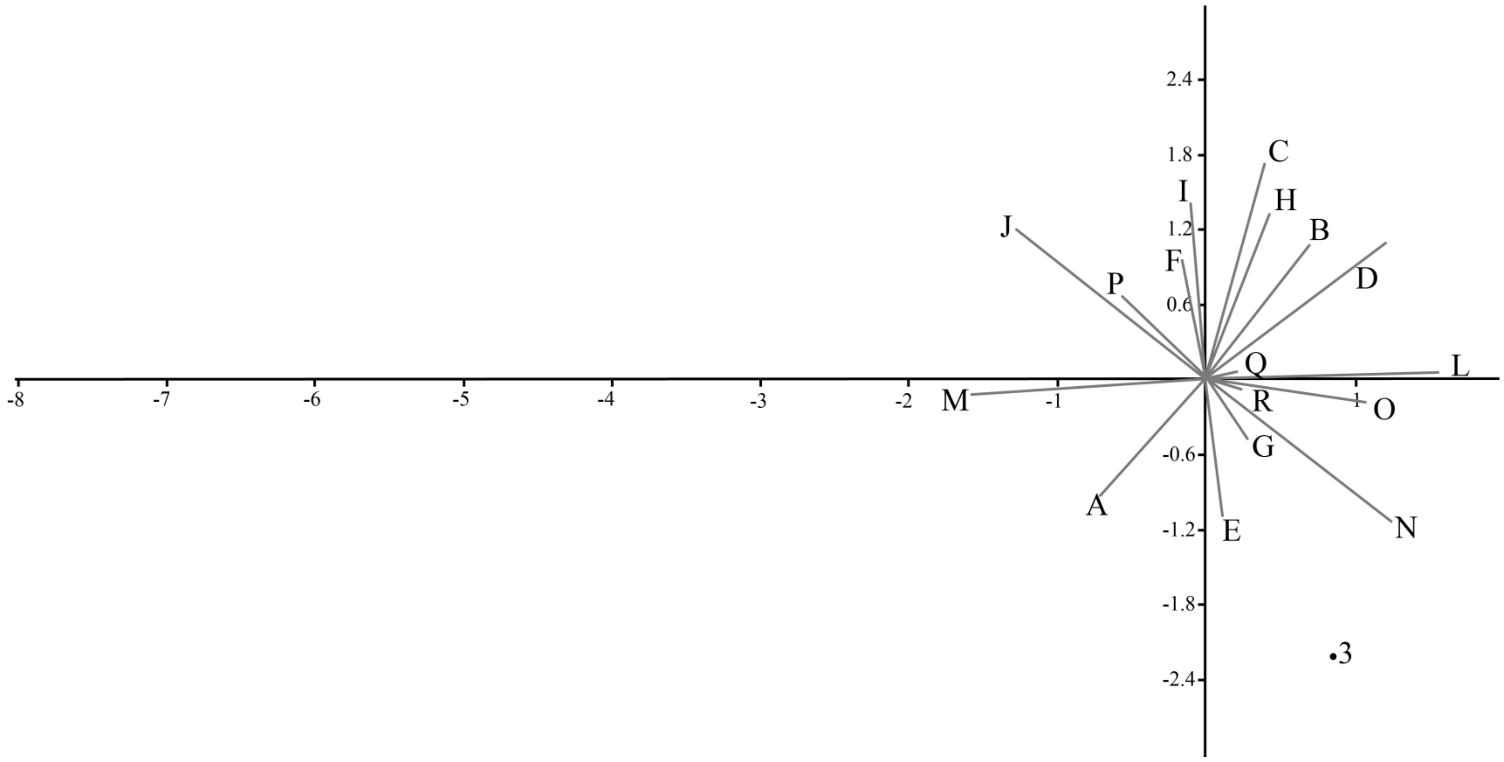


Fig. 4.3.3. Eigenvector plot on the axes PCA1 and PCA3. A Carapace length/width ratio; B Carapace length/antennule basis length; C Carapace with lateral setae at midlenght; D Number of free pleonites; E Width of the first pleonite; F Antennule peduncle article 1 with apophyses; G Antennule inner flagellum articles; H Antenna peduncle articles number; I Antenna terminal article setation; J Mandible palp article 1 setation; K Mandible palp article 2 with setae; L Mandible palp article 3 with setae; M Presence of pleopods; N Uropod exopod segments number; O Uropod endopod segments number; P Telson with bulgae (protrusions).



or less pleonites. Species grouped under the axes two articles in antenna flagellum, mostly tipped by one seta, and three free pleonites.

Discussion

Despite of five free pleonites and seven articles in antennule, apparently untypical for *Synapseudes* which members usually have two or three free pleonites, Gardiner (1973) classified *Synapseudes idios* to that genus. The free pleonites imply a similarity of *S. idios* with genus *Metapseudes*, however both sexes of *Metapseudes* have the pleopods. Considering number of free pleonites and number of pleopods Băcescu (1976a) suggested a new genus to accommodate *S. idios*. The phylogenetic analysis (Fig. 4.3.1) and PCA (Fig. 4.3.2) highly support that decision and erecting a new genus which diagnosis is proposed below.

Systematic:

Suborder Apseudomorpha Sieg, 1980a

Family Metapseudidae Lang, 1970

Subfamily Synapseudinae Gutu, 1972

Genus *Synapseudinae* gen.

Diagnosis. Body about 3.0 mm long, 5-7 times as long as wide; greatly calcified. Carapace twice as long as antennule peduncle first article. Pleon with five pleonites, pleonites 1–2 distinct, pleonites 3–5 small. Antennule peduncle first article with inner row of apophyses; second article with apophyses on distal corners; inner flagellum composed of two segments. Antenna peduncle with five articles; flagellum 2-articled, distal article with five setae. Mandible palp articles 1 and 2 with single setae, third article bearing five setae. Pleopod usually present, in one pairs; left uniramous, with two distal setae; right biramous, both rami with two distal seate. Uropod exopod with three segments, endopod with four segments.

Type species: *Synapseudes idios* Gardiner, 1973, by monotypy.

Remarks. Six genera are classified to subfamily Synapseudinae: *Creefs* Stępień & Błażewicz-Paszkowycz, 2013, *Cryptapseudes* Băcescu, 1976c, *Curtipleon* Băcescu, 1976a, *Synapseudes* Miller, 1940, *Synapseudoides* Guţu & Ortiz, 2009, and *Vicinisynades* Guţu, 2007. *Synapseudoides* is treated in the paper as synonym of *Synapseudes*.

Cryptapseudes and *Curtipleon* are characterized in fully reduced pleonites, and are easily distinguishable from *Synapseudinae* n. gen. *Vicinisynades* and *Creefs* could be also facilely recognized due to cheliped appearance, which is elongated, with palm three times longer than dactylus. New genera has compact cheliped, with palm similar in length to dactylus.

Five articled peduncle of antenna distinguished the new genus from *Synapseudes*, which members have four articles. Beside that five setae on mandible palp are present in *Synapseudinae* n. gen., while two setae within Synapseudid taxa. The new genus has three segmented uropod exopod, while two or less segments are characteristic for *Synapseudes* members.

Genus *Synapseudes* Miller, 1940

Type species: *S. minutes* Miller, 1940

Species included: *S. acroporae* Băcescu, 1976a; *S. aflagellatus* Sieg, 1986; *S. australianus* Băcescu, 1981; *S. comorinensis* Pillai, 1954; *S. cystoseirae* Amar & Cazaubon, 1978; *S. dispina* Menzies, 1953; *S. erici* Błażewicz-Paszkowycz et al., 2011; *S. hancocki* Menzies, 1953; *S. hansmuelleri* Guţu, 2006; *S. heterocheles* (Vanhöffen, 1914); *S. idios* Gardiner, 1973; *S. intumescens* Menzies, 1949; *S. makkaveevae* Băcescu, 1976a; *S. mediterraneus* Băcescu, 1977; *S. menziesi* Băcescu, 1976a; *S. minimus* Guţu, 2006; *S. minutus* Miller, 1940; *S. rectifrons* Guţu, 1996; *S. rudis* Menzies, 1953; *S. setoensis* Shiino, 1951; *S. shiinoi* Riggio, 1973; *S. tomescui* Guţu, 2006; *S. violaceus* Băcescu, 1976a.

Diagnosis. Body 0.9–3 mm length, 3.8–4.7 times as long as wide. Carapace 2.0–3.6 times as long as antennule peduncle first article. Pleon composed of one to three pleonites. Antennule peduncle first article with inner row of apophysis or one distinct spine (*Synapseudes* sp. 2); second article with or without apophyses on distal corners; inner flagellum reduced or composed of one or two segments. Antenna peduncle with four articles; flagellum with one or two articles, last article tipped by one to five setae. Mandible palp article 1 and 2 naked, third article bearing two setae. Pleopod absent. Uropod exopod with two segments (*S. makkavea* with only one segment), endopod with three or four segments.

Remarks. According to analysis number of pleonites, as well as other character used in the analysis seems to be not sufficient for dividing genera. Despite analysis highlighted number of pleonites as a synapomorphie for clad 40, synapseudid species with the same character are part of clad 27 as well.

It is suggested to incorporate *Synapseudoides pinosensis* Guţu & Ortiz, 2009 to the *Synapseudes* Miller, 1940. The genera was erected due to two segmented pleon, other feature characteristic for the genus are pereonites with rounded margin, antennule with two and three segmented flagella, antenna with six article, tipped by one setae, uropod with two and three segmented exopod and endopod of uropod respectively. All this characters are present in *Synapsedes* members.

Synapseudes sp. 1

Figs 4.3.5–4.3.7

Material examined: *Holotype*: NIN 12A, 21.54106S, 113.56010E, Ningaloo Reef, Tantabiddy, reef slope, coral heads, depth 12–14 m, coll. MBP & CH. *Paratypes*: 860 specimens, detailed included in Appendix 4.1.6 (Ningaloo), 4.1.5 (Heron I.) and 4.1.4 (Lizard I.).

Description of female. Body (Fig. 4.3.4A, B) 1.38 mm long, 4.6 times as long as wide. Carapace 26% of total body length, later margin with midlength seta; rostrum flat, with serrated margin; eyes with dark pigment; small setae present under the eyeslobes. Pereon 60% of total body length, pereonites rectangular, pereonites 1, 4 and 5 similar in length, 0.37 times as long as wide, length/width ration of pereonites 2, 3 and 6 equal 0.44, 0.52 and 0.34, respectively; all pereonites with two simple setae on anterolateral margin, on last three pereonites simple setae on posteriolateral margin is present as well. Pleon 14% of total body length, composed of three free pleonites and pleotelson; all pleonites similar in length, pleonite-1 with two simple setae, pleonite-3 with one simple seta. Pleotelson 1.6 times longer than all pleonites combined, with eight setae on surface.

Antennule (Fig. 4.3.5A) peduncle first article robust, 1.7 times as long as wide, with four broom setae and three simple along outer margin, and row of seven apophysis, and three simple setae on inner margin; second article 0.8 times as long as first article, with three setae on outer distal corner, and apophysis and two simple setae on inner distal corner; third article shorter and narrower than second article, 0.9 times as long as wide, with simple seta and broom setae distally; article in common with one distal seta; inner flagellum with one segment tipped by three setae; outer flagellum composed of three segments, with aesthetasc on segments 1 and 2; distal segment tipped by three setae.

Antenna (Fig. 4.3.5B) peduncle with four articles; first article bulgy, with denticled margin; second article with four inner apophysis and one simple setae; third article with

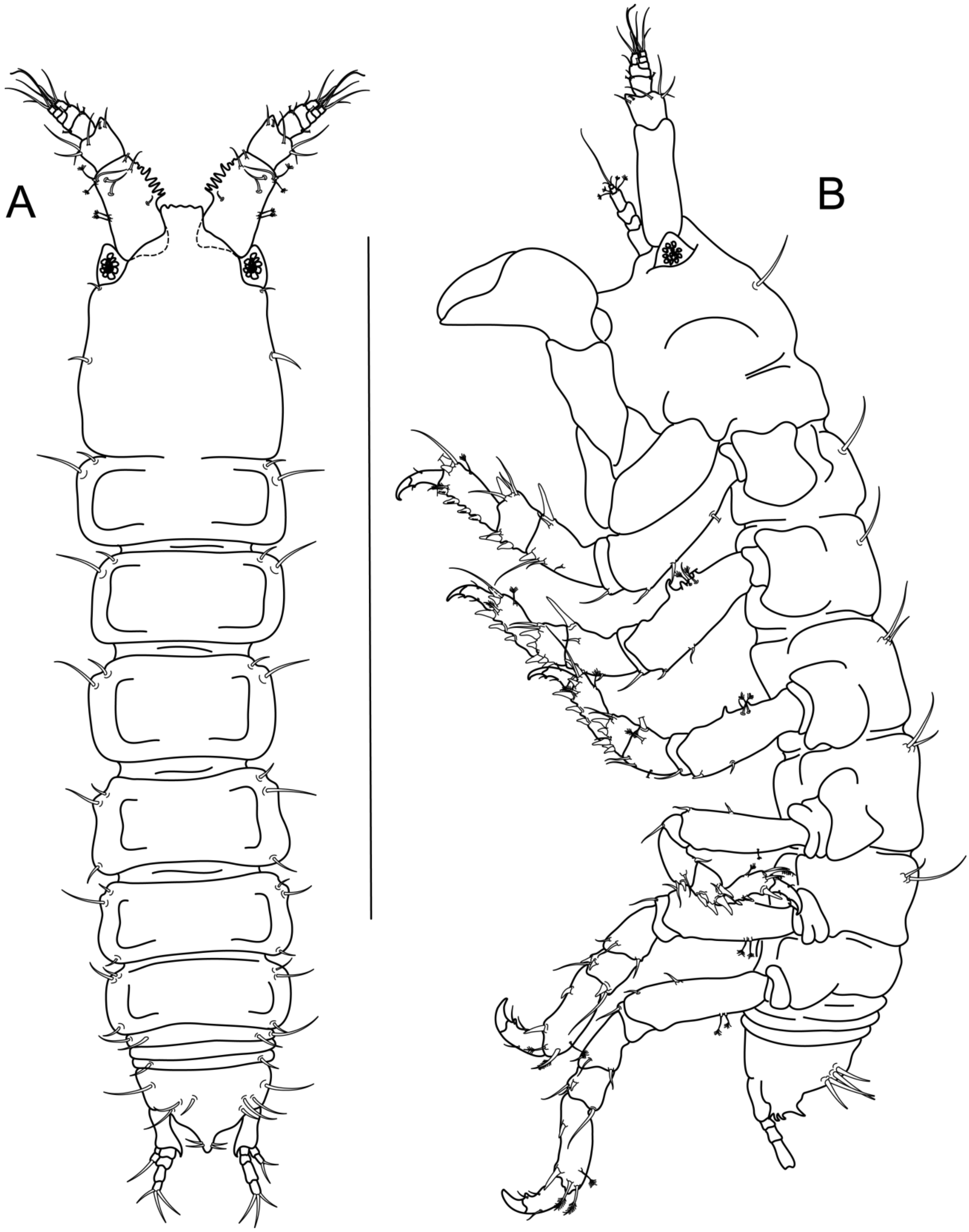


Fig. 4.3.4. *Synapseudes* sp. 1, holotype female. A body dorsal view; B body lateral view. Scale line = 1mm.

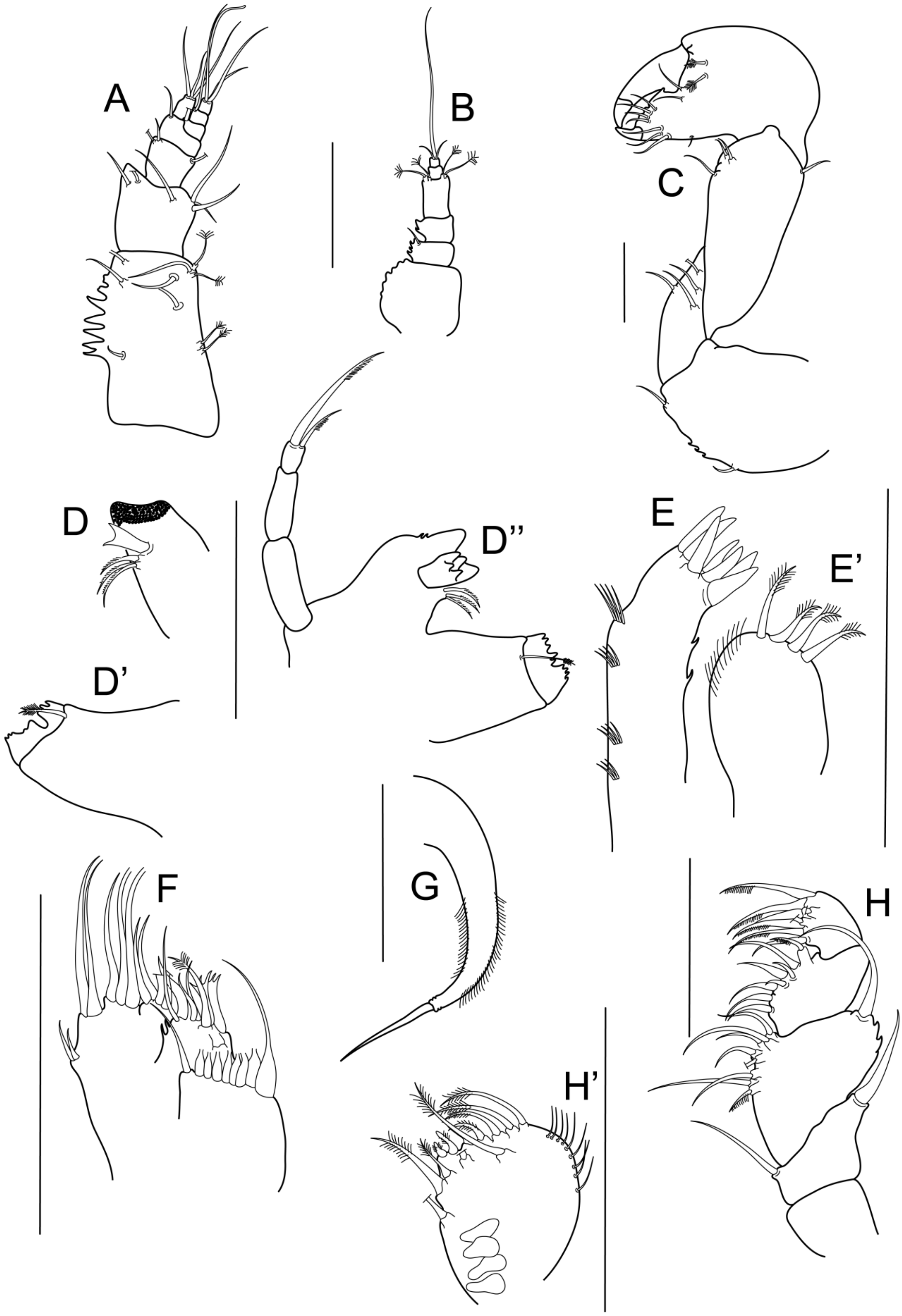


Fig. 4.3.5. *Synapseudes* sp. 1. A antenna; B antennule; C cheliped; D right mandible; D' left mandible; D'' molar; E maxillule outer endite; E' maxillule inner endite; F maxilla; G epignath; H maxilliped; H' maxilliped endite. Scale line = 0.1 mm.

two inner apophysis; fourth article twice as long as third article, with four penicillate distal setae; flagellum with two articles, distal article with one long and two short setae distally.

Mouthparts. Right mandible (Fig. 4.3.5D) incisor simple, blunt; setiferous lobe with one robust bifurcate seta and three plumose setae; molar (Fig. 4.3.5D') wide, distally well calcified and serrated, with on plumose seta. Left mandible (Fig. 4.3.5D'') incisor simple, blunt distal teeth and two small lateral apophyses; *lacinia mobilis* with five teeth, setiferous lobe with three plumose setae; molar with serrated margin and distal plumose seta; palp three articled, article 1 and 2 subequal, naked, article-3 about 0.3 times as long as article-2. Maxillule outer endite (Fig. 4.3.5E) with seven distal spines, outer margin with a few bunch of hair setae, inner margin with two small apophyses; inner endite (Fig. 4.3.5E) wide with four plumose distal stetae; outer margin setose. Maxilla (Fig. 4.3.5F) with two spine on outer margin; moveable endite outer lobe of with three distal setae and two subdistal setae; inner lobe of moveable endite with three distal setae; outer lobe of fixed endite with four simple setae, two trifurcated distally and one plumose setae subdistally; inner lobe of fixed endite with row of nine distal setae. Epignath (Fig. 4.3.5G) tipped by a strong seta with setose both margins. Maxilliped (Fig. 4.3.5H) basis naked, narrow; article-1 0.6 times as long as wide, with distal, inner simple seta and distal outer robust, long spine; article-2 0.7 times as long as wide, with eight inner setae and long seta and two apophyses on outer margin; article-3 with six distal setae and two short subdistal seta on inner margin; article-4 1.3 times as long as wide, with seven distal and subdistal plumose setae. Epignath (Fig. 4.3.5H') with four plumose setae and two blunt distal spines, and two plumose subdistal setae; inner margin with two plumose setae and four couling-hooks.

Cheliped (Fig. 4.3.5C) basis 1.3 times as long as wide, with tow ventral setae and distally and with three small apophyses; merus triangular, with four setae distally; carpus 2.2 times as long as wide, with three ventral setae and one distodorsal seta; propodus 0.7 times as long as carpus, with two plumose setae, one simple seta and apophysis near dactylus insertion; fixed finger half as long as propodus, with three long and one short ventral setae, and with four inner setae. Exopod absent

Pereopod-1 (Fig. 4.3.6A) basis 2.8 times as long as wide, with three ventral setae and with two apophyses and two penicillate setae dorsally; ischium 0.2 times as long as wide, with distal setae on ventral margin; merus 1.6 times as long as wide, with three

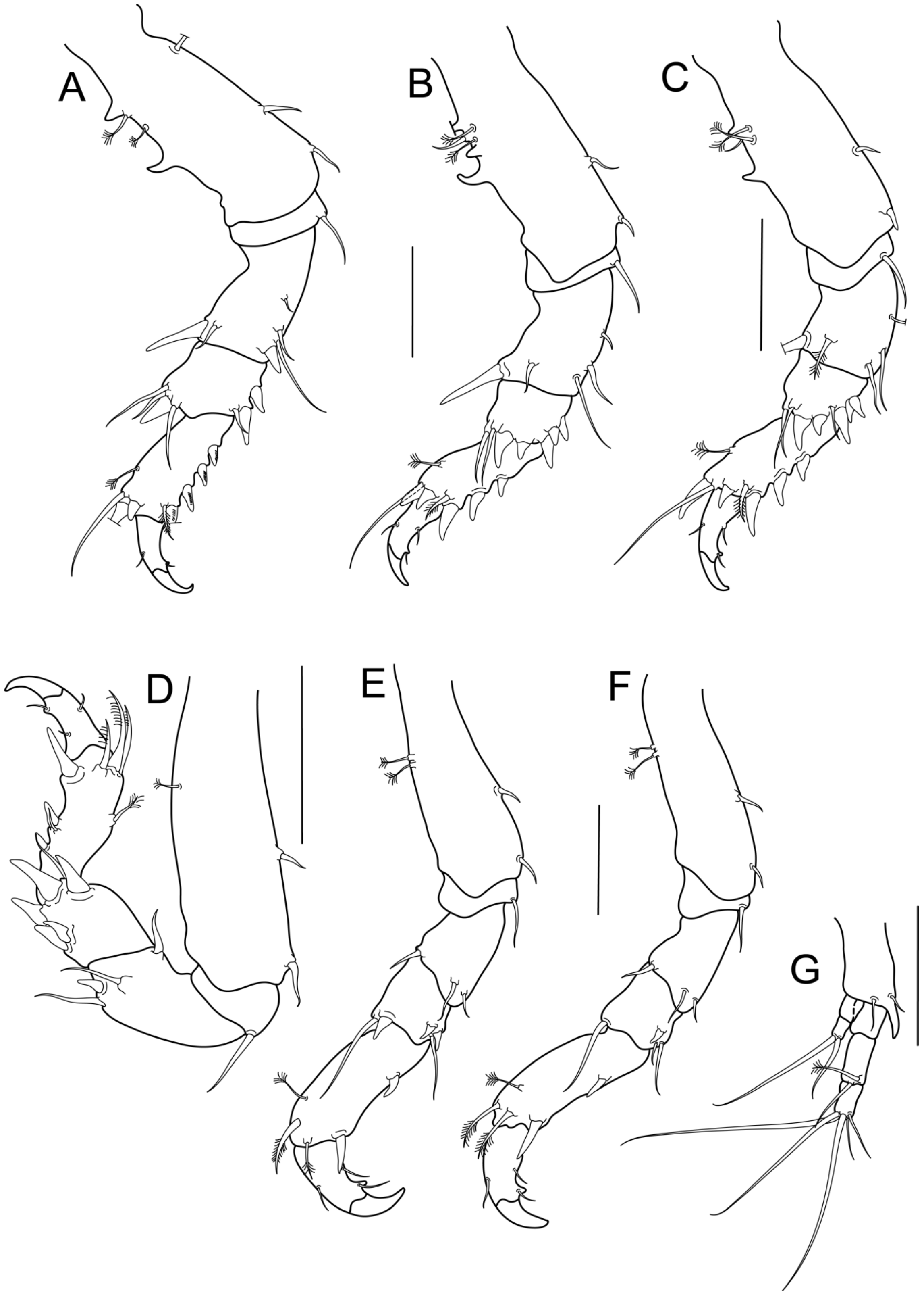


Figure 4.3.6. *Synapseudes* sp. 1. A pereopod 1; B pereopod 2; C pereopod 3; D pereopod 4; E pereopod 5; F pereopod 6; G uropods. Scale line = 0.1 mm.

setae and one spine ventrally, one distal seta and one spine distodorsal spine; carpus 0.6 times as long as merus, with five distal and distoventral spine and two distodorsal setae; propodus 1.6 times as long as carpus, with four spines and one plumose seta ventrally, one dorsal broom seta, two spines (one broken) and one simple distodorsal seta; dactylus 0.4 times as long as propodus, with two ventral setae and one dorsal seta; unguis 0.8 times as long as dactylus. Exopod absent

Pereopod-2 (Fig. 4.3.6B) basis three times as long as wide, with one ventral seta, one distoventral spine, and three apophyses and two penicillate setae on dorsal margin; ischium 2.6 times as long as wide, with distoventral seta; merus 1.4 times as long as wide, with three ventral setae, and one seta and one distodorsal spine; carpus half as long as merus, with five spines and two setae along ventral and distal margin; propodus 1.7 times as long as carpus, with three ventral setae, one dorsal penicillate setae, and one simple seta, one plumose seta and two spines near dactylus insertion; dactylus 0.7 times as long as propodus, with two ventral setae and one dorsal seta; unguis half as long as dactylus.

Propodus-3 (Fig. 4.3.6C) as pereopod-2, but basis with two dorsal apophyses.

Pereopod-4 (Fig. 4.3.6D) basis 3.1 times as long as wide, with ventral and one ventrodistal setae and one dorsal broom seta; ischium 0.6 times as long as wide, with one ventral seta; merus twice as long as wide, with two setae and two spine subdistally; carpus 0.6 times as long merus, with five robust spines and one seta distally; propodus subequal to merus, with three spines and seta along ventral margin, one dorsal penicillate seta, and three plumose distodorsal setae; dactylus half times as long as propodus, with two ventral and one dorsal minute setae; unguis 0.8 times as long as dactylus.

Pereopod-5 (Fig. 4.3.6E) basis 3.3 times as long as wide, with two ventral setae and two dorsal broom setae; ischium 0,3 times as long as wide, with ventral seta; merus 1.2 times as long as wide, with two ventrodistal and one distodorsal setae; carpus 0.8 times as long as merus, with two spines and one distoventral seta, and one spine and one distodorsal seta; propodus twice as long as merus, with two spines along ventral margin, one dorsal penicillate seta, and two plumose setae and one spine near dactylus insertion; dactylus half time as long as propodus, with two ventral setae and one dorsal seta; unguis 0.7 times as long as dactylus.

Pereopod-6 (Fig. 4.3.6F) similar to pereopod-5, but carpus with two setae and one spine distoventrally, and no distodorsal spine.

Uropods (Fig. 4.3.6G) basis twice as long as wide, with two distal setae, and distal apophyses; exopod two-segmented, distal segment with two setae; endopod 3-segmented, segment-2 with broom and simple distal setae; distal with three long and two short setae.

Description of male (Fig. 4.3.7). Body similar to female, but right chelieped enlarged, basis about as long as wide, distally with dorsal serration, and ventrally with one pennicilate seta; merus triangular, with ventral apophyses and single seta; carpus as long as wide, with denticulated margin, distally with one dorsal seta, and with three ventral setae; propodus as long as wide, with four distal setae; fixed finger with three setae along ventral margin and seven inner setae, and with crenulate inner margin; dactylus with four setae and crenulation on inner margin.

Remarks. Three free pleonites, antenna flagellum with two articles, tipped by one seta and three segmented uropod endopod make the *Synapseudes* sp. 1 similar to *S. australinus*, *S. hansmuelleri*, *S. minimus*, *S. tomescui*, and *S. violaceus*. New species differs from *S. hansmuelleri* and *S. australinus* by the appearance of antenna. First article is rounded (as long as wide) in new species 1, while elongated in *S. hansmullerei* and wider than long in *S. australinus.* Moreover new species has smooth distal margin of third antenna article, which is denticled in *S. hansmuelleri*. From *S. australinus* the new species differ also in presence of long setae on maxilliped second article, *S. australinus* lacks the seta. From *S. minimus Synapseudes* sp. 1 could be distinguished by the pereopod-1, which basis is 2.8 times as long as wide and bears two dorsal apophyses. *S. minimus* has pereopod-1 basis 3.3 times as long as wide, with smooth margin. Wider antennule allowed to recognize *Synapseudes* sp. 1 from *S. tomescui*. The new species has antennule basis 1.7 times as long as wide, while it is twice as long as wide in *S. tomescui*, beyond that *S. tomescui* has only one proximal apophysis on pereopod-2, while the new species has two, placed at the midlenght. From *S. violaceus* the new species could be recognized due to different proportion of pereopod-6 propodus length to width. It is three times as long as wide in *Synapseudes* sp. 1 and four times in *S. violaceus*. Both species differ also in appearance of pereonites, which is rectangular in *Synapseudes* sp. 1 while *S. violaceus* has pereonites with more rounded margin.

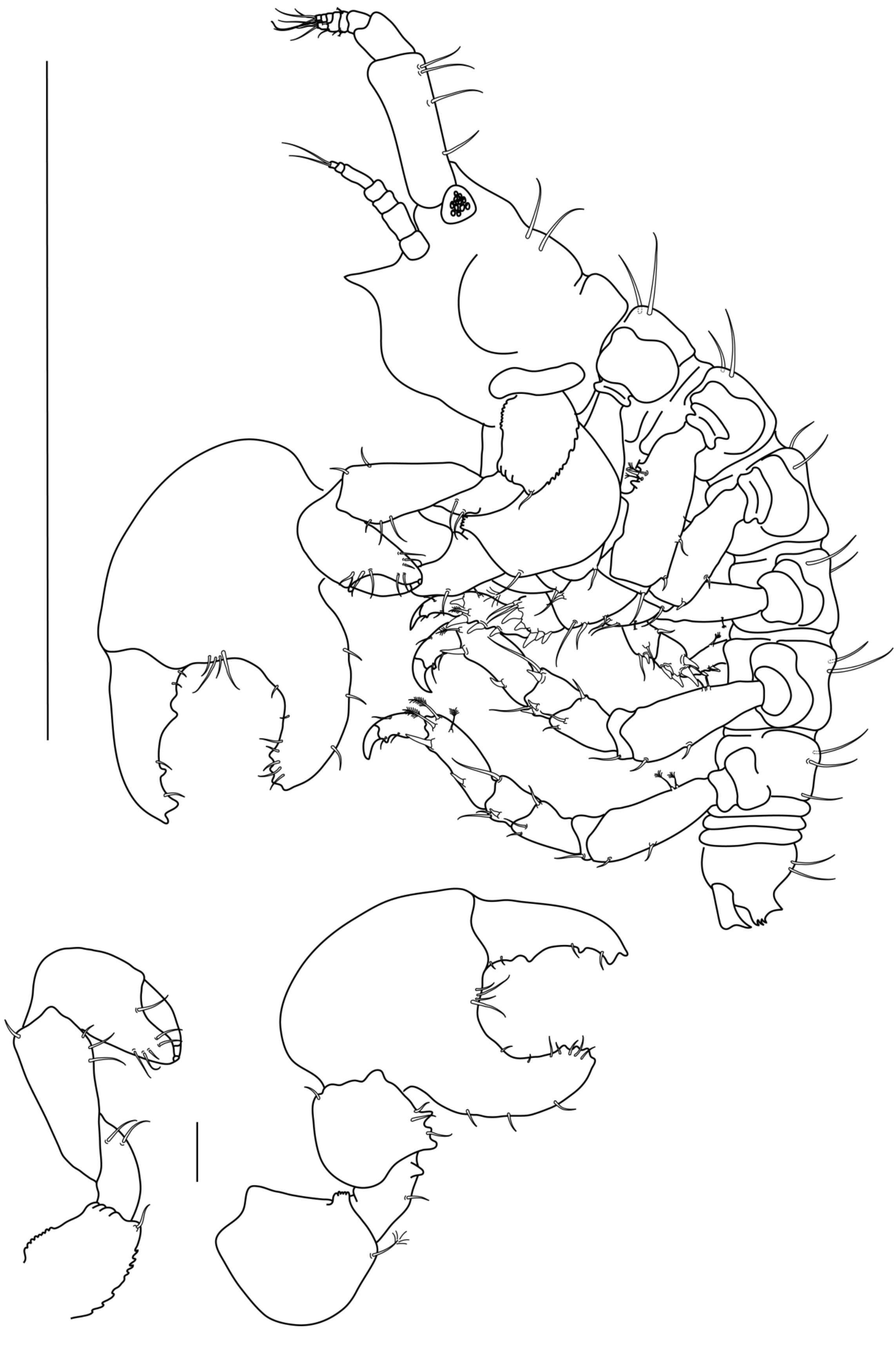


Fig. 4.3.7. *Synapseudes* sp. 1, allotype male. Scale line = 1 mm.

Synapseudes sp. 2

Figs 4.3.8–4.3.10

Material examined: *Holotype*: ♀ CGLI 36A, 14.38536S, 145.26599E, Lizard Island, Granite Bluff, fore reef (mid shelf), coarse coral rubble, depth 15 m, coll. MBP. *Paratypes*: 41 specimens, detailed information included in Appendix 4.1.4 (Lizard I.).

Description of female. Body (Fig. 4.3.8A) 1.27 mm long, 4.7 times as long as wide. Carapace 26% of total body length; rostrum flat; eyes with dark pigment. Pereon 62% of body length; pereonites rectangular, pereonites 1,2 and 4 similar in length, about 0.4 times as long as wide, pereonites 2 and 5 half as long as wide, pereonite -6 narrowest, 0.3 times as long as wide; first four pereonites with lateral setae situated on anterior corner, last two peronites additionally with pair of setae at the middle surface. Pleon 12% of body length, consist of three free pleonites and pleotelson; all pleonites similar in length; Pleotelson 2.3 times as long as length of all pleonites combined, with pair of setae place at the dorsal surface.

Antennule (Fig. 4.3.9A) peduncle article-1 3.3 times as long as wide, with two broom setae, three simple setae and one strong apophyses on outer margin, and with three inner broom setae, and small apophyses distally; article-2 about half as long as article-1, with five simple setae, three small apophyses, and three broom distally; article-3 with two distal setae; article in common with two distal setae; inner flagellum with three segments, segment-1 with aesthetasc, segment-2 with distal seta, segment-3 with one aesthetasc and three distal setae; outer flagellum with two segments, terminal segment tipped with three setae.

Antenna (Fig. 4.3.9B) peduncle four articled; article-1 robust, with serrated inner margin and two distal apophyses; article-2 with four apophyses and one simple seta; article-3 with three apophyses distally; article-4 longest, twice as long as article-3, with five broom setae along distal margin; flagellum with two articles, distal article tipped with two setae.

Mouthparts. Right mandible (Fig. 4.3.9D) incisor with two blunt lobes, setiferous lobe with one bifurcated robust setae and three simple setae; molar serrated distally; palp three-articled, articles 1 and 2 naked, article-3 with two distal setae. Maxillule outer endite (Fig. 4.3.9E') with eight spines and simple setae along outer margin; inner endite (Fig. 4.3.9E) with three plumose distal setae; palp (Fig. 4.3.9E'') with two long setae. Epignath (Fig. 4.3.9G) with long distally plumose setae. Maxilliped (Fig. 4.3.9F) basis

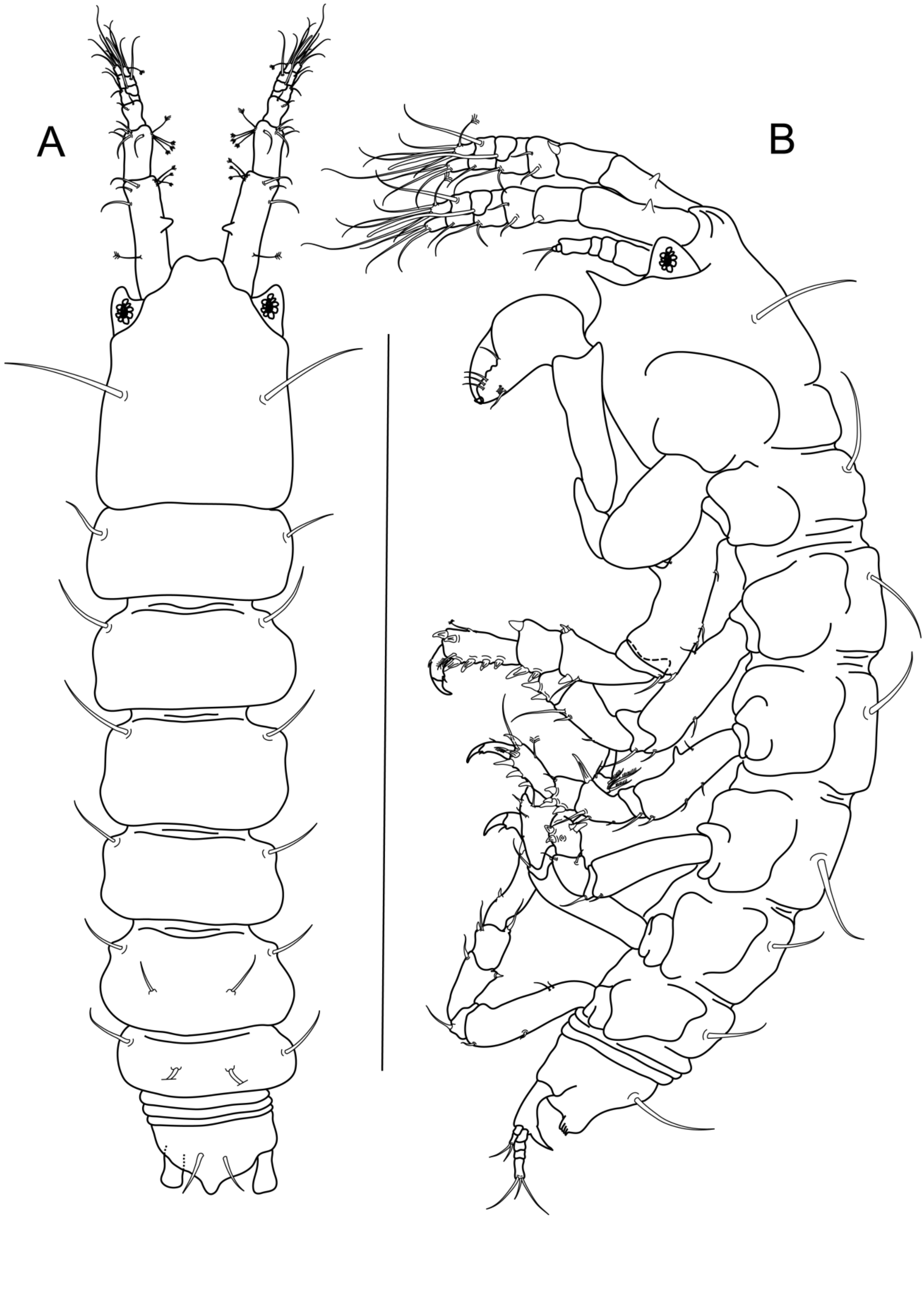


Fig. 4.3.8. *Synapseudes* sp. 2, holotype female. A body dorsal view; B body lateral view. Scale line = 1mm.

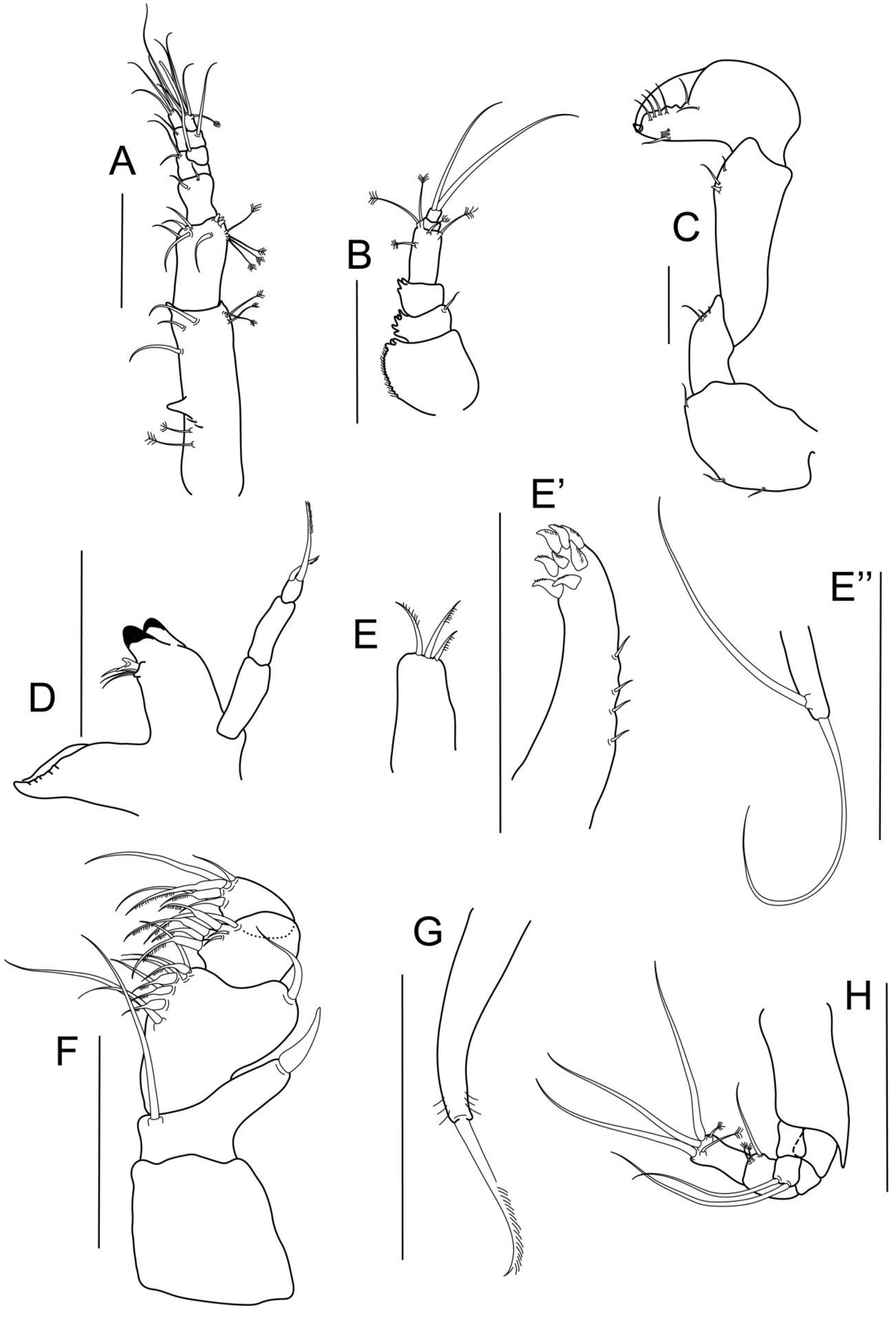


Fig. 4.3.9. *Synapseudes* sp. 2. A antenna; B antennule; C cheliped; D right mandible; E maxillule inner endite; E' maxillule outer endite; E'' maxillule palp; F maxilla; G maxilliped; H epignath; I uropod. Scale line = 0.1 mm.

as long as wide, naked; article-1 3.5 times as long as wide, outer margin expanded with one robust spine, inner margin with long, simple seta; article-2 0.9 times as long as wide, with four short plumose setae and six simple on inner margin, and one robust seta on outer margin; article-3 0.9 times as long as wide, with five plumose setae and two short setae on inner margin; article-4 1.5 times as long as wide, with two plumose setae and four simple distal setae.

Cheliped (Fig. 4.3.9C) basis 1.3 times as long as wide, with three setae along ventral margin; merus twice as long as wide, with three ventral setae; carpus 3.3 times as long as wide, with two ventral setae and one dubdistal spine; propodus half as long as carpus, with two setae near dactylus insertion; fixed finger with three ventral setae and four inner setae. Exopod absent;

Pereopod-1 (Fig. 4.3.10A) basis three times as long as wide, with three ventral setae, one distal seta and three small setae and apophyses dorsally; ischium narrow, 0.3 times as long as wide, with one seta; merus 1.7 times as long as wide, one seta and one spine distoventrally and one small spine distodorsally; carpus 0.6 times as long as merus, with two ventral spines, one spine and two setae distodorsally; propodus subequal merus, with four spines along ventral margin, one broom distoventral seta, two spines and one seta distodorsally a and one broom seta on dorsal margin; dactylus 0.3 times as long as propodus, with one ventral and one dorsal seta; unguis 0.8 times as long as dactylus.

Pereopod-2 (Fig. 4.3.10B) basis 2.8 times as long as wide, with two ventral setae, one simple seta, two penicillate setae and apophyses on dorsal margin; ischium half as long as wide, with one ventral seta; merus 2.3 times as long as wide, with three ventral setae (most distal seta long) and one distodorsal spine; carpus half as long as merus, with four ventrodistal spines and two distodorsal setae; propodus 0.8 times as long as carpus, with four setae along ventral margin, one broom dorsal seta and one spine, one simple and one plumose setae near dactylus insertion; dactylus 0.3 times as long as propodus, with one ventral and one dorsal seta; unguis 0.6 times as long as dactylus.

Pereopod-3 (Fig. 4.3.10C) similar to pereopod-2, but basis with two broom dorsal setae, merus 2.5 times as long as wide, and dactylus half as long as propodus.

Pereopod-4 (Fig. 4.3.10D) basis 3.5 times as long as wide, with two broom setae on dorsal and ventral margin and one simple setae distoventrally; ischium with one seta; merus 1.2 times as long as wide, with one spine and two setae distally; carpus subequal merus, with one simple seta and six spines ventral and distally; propodus 1.6 times as

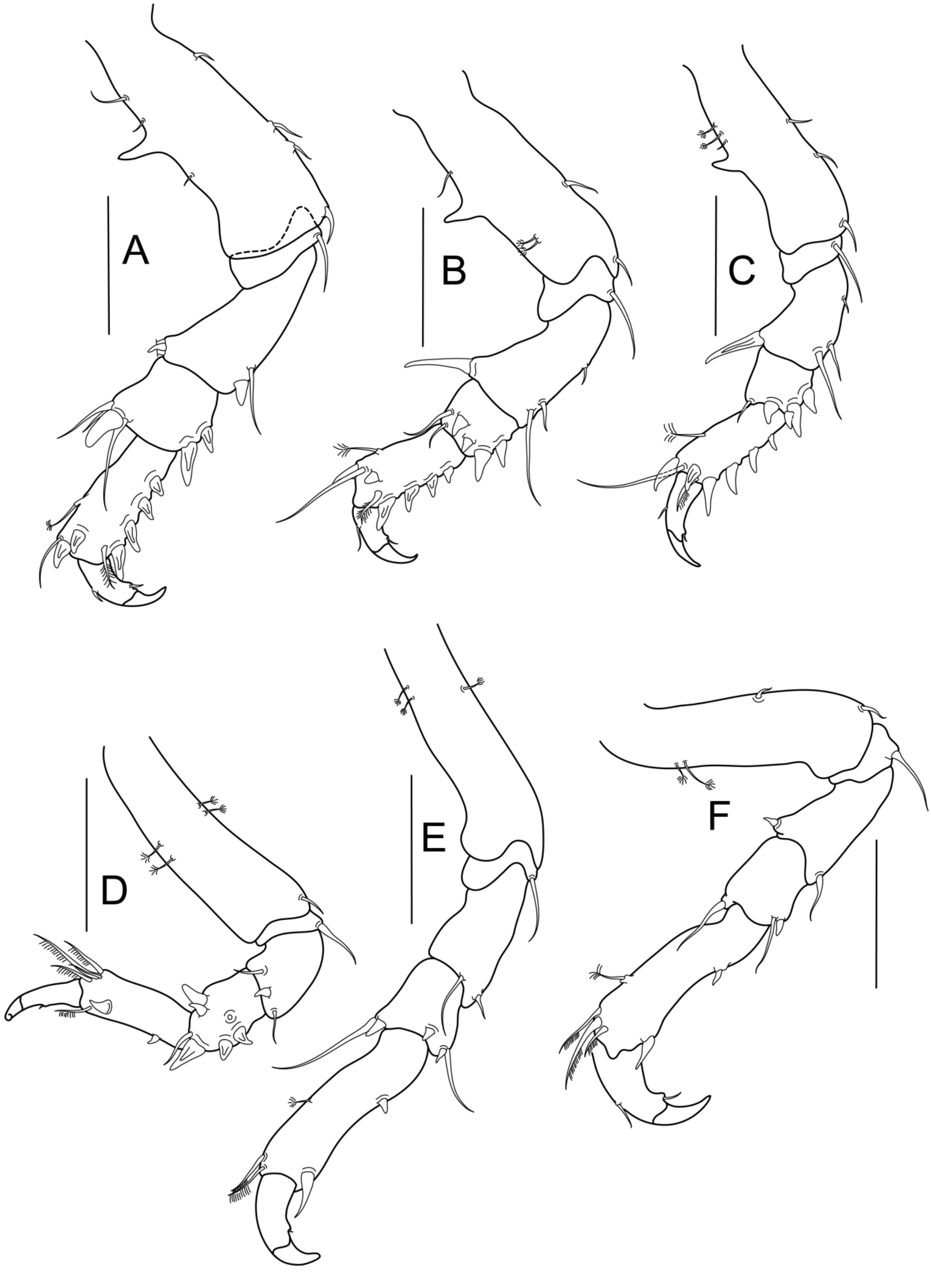


Fig. 4.3.10. *Synapseudes* sp. 2. A pereopod 1; B pereopod 2; C pereopod 3; D pereopod 4; E pereopod 5; F pereopod 6. Scale line = 0.1 mm.

long as merus, with small ventral spine, with one spines and plumose seta ventrally and four plumose distodorsal setae; dactylus half as long as wide, with ventral and dorsal setae; unguis 0.3 times as long as dactylus.

Pereopod-5 (Fig. 4.3.10E) basis 3.5 times as long as wide, with one broom ventral setae and two broom dorsal setae; ischium 0.3 times as long as wide, with one seta; merus 1.6 times as long as wide, with seta and one spine distally; carpus 0.7 times as long as merus, with three spines and two setae distally and subdistally; propodus four times as long as wide, with small ventral spine, one broom dorsal seta, robust distoventral spine and two plumose distodorsal setae; dactylus as on pereopod 4.

Pereopod-6 (Fig. 4.3.10F) basis 3.6 times as long as wide, with two small ventral setae and two broom dorsal setae; ischium 0.3 times as long wide, with one ventral seta; merus 1.6 times as long as wide, with distoventral seta and distodorsal small spine; carpus 0.9 times as long merus, with one spine and one distoventral seta, and one distodorsal seta; propodus twice as long as merus, with small ventral spine, dorsal broom seta, one distoventral spine and three plumose distodorsal setae; dactylus 0.4 times as long as propodus, with ventral and dorsal setae; ischium 0.6 times as long as dactylus.

Uropods (Fig. 4.3.9H) basis twice as long as wide, with strong apophysis; exopod with two segments, distal segment tipped with two setae; endopod with four segment, third segment with two penicillate distal setae, terminal segment with two penicillate setae and three simple distal setae.

Remarks. *Synapseudes* sp. 2 could be easily recognized from the other synapseudids due to the elongated antennule basis (3.3 times as long as wide) with one strong apophyses on inner margin. Rest represents of the genus has antennule basis less than three times as long as wide, with row of inner apophyses. *S. menziesi* has similar one strong apophyses, but it is accompanied by row of smaller apophyses. Beyond that *Synapseudes* sp. 2 could be recognized by the combination of characters: three free pleonites, two articulated antenna flagellum, tipped by two setae, and four segmented uropod endopod.

5. SUMMARY

- The Creefs collection yielded 9895 individuals, from which 72 species were identified. Species were classified to 53 genera and 20 families.
- The material collected from reefs surrounding the Heron Island (Southern Great Barrier Reef) was the most divers, 47 species were identified in that collection. Forty four species were found in the material gathered in the vicinity of Lizard Island (Northern GBR). Thirty two species were identified in the material collected on Ningaloo Reef (Western Australia).
- Vast majority (95% of the species) were new to the science.
- Families: Leptocheliidae (48–67%), Metapseudidae (7–19%), Apseudidae (8–12%) and Paratanaidae (7–13%) were the most abundant in the studied material.
- Families Metapseudidae and Leptocheliidae were the most speciose. Five, eleven and eight metapseudids were recorded on Ningaloo Reef, Heron Island and Lizard island, respectively. Number of species in family Leptocheliidae equalled six, four and eight, respectively.
- Detailed morphological descriptions of taxa classified to Leptocheliidae were presented:
    - Nine species and three genera, that were new to science were described.
    - Definition of genera: *Grallatotanais*, *Araleptochelia* and *Poorea* were amended.
    - New subfamily Araleptocheliinae was erected. Three genera were classified to the new subfamily, two of them were new to science.
- The polyphyletic genus *Synapseudes* was revised. Results demonstrated that:
    - The majority of *Synapseudes* species can be classified to this genera, although they present morphological heterogeneity.
    - According to phylogenetic analysis and Priccipal component Analysis *Synapseudes idios* should be classified as new genus.

6. STRESZCZENIE

Skorupiaki z rzędu kleszczug (Tanaidacea) to typowo morskie organizmy zaliczane do pancerzowców właściwych (Malacostraca), zasiedlające praktycznie wszystkie znane morskie habitaty denne. Obecnie znanych jest ponad 1200 gatunków kleszczug. Uznaje się jednak, że liczba opisanych gatunków stanowi zaledwie 2–3% spośród szacowanych 4000 gatunków.

Tanaidacea w określonych warunkach środowiskowych mogą osiągać zagęszczenie dochodzące do kilkunastu tysięcy osobników na jednostkę powierzchni, są zatem ważnym elementem zbiorowisk bentosowych. Ograniczona mobilność sprawia, że Tanaidacea uznawane są za bardzo dobre indykatory warunków środowiskowych.

W wodach otaczających Australię jak dotąd znanych jest 176 gatunków zaklasyfikowanych do 88 rodzajów i 22 rodzin. Przewidywana liczba płytkowodnych taksonów może jednak być znacznie wyższa i przekraczać 2000 gatunków.

Wiedza dotycząca różnorodności Tanaidacea Australii pochodzi głównie z badań południowego i południo-wschodniego wybrzeża tj.: Zatoki Esperance i Moreton oraz z Cieśniny Bassa. W północnej cześć kontynentu Tanaidacea praktycznie nigdy nie były badane i jak dotąd zaledwie 19 gatunków tych skorupiaków odnotowano na rafach koralowych Australii.

Nadrzędnym celem niniejszej rozprawy doktorskiej jest ocena różnorodności biologicznej skorupiaków z rzędu Tanaidacea raf koralowych Australii.

Materiał badawczy został zebrany w trakcie programu Census of Coral Reefs Ecosystem (CReefs), jednego z programów Census of Marine Life (CoML), poświęconego badaniom różnorodności biologicznej raf koralowych. W ramach programu CReefs w latach 2008–2010 pobierano materiały w rejonie Lizard Island (północna część Great Barrier Reef), Heron Island (południowa część GBR) oraz Ningaloo Reef (zachodnie wybrzeże Australii).

Łącznie zebrano 99 prób na 47 stacjach w rejonie Heron Island (3518 osobników), 63 próby zebrane na 131 stacjach w rejonie Lizard Island (4446 osobników) oraz 73 próby zebrane na 26 stacjach w rejonie Ningaloo Reef (1976 osobników). W materiale zidentyfikowano 72 gatunki zaklasyfikowane do 53 rodzajów i 20 rodzin. Materiał był zdominowany przez przedstawicieli rodziny Leptocheliidae, które stanowiły 48-67% wszystkich Tanaidacea. Rodzinami subdominującymi były Metapseudidae (7–19%), Apseudidae (8–12%) i Paratanaidae (7–13%).

Do najróżnorodniejszych pod względem gatunkowym należały rodziny Metapseudidae Lang, 1970 i Leptocheliidae Lang, 1973. Dziewięć gatunków, trzy nowe rodzaje oraz nowa podrodzina zaklasyfikowane do Leptocheliidae zostały opisanie i zilustrowanie.

Ponadto rewizji poddano rodzaj *Synapseudes* (Metapseudidae). Gatunki klasyfikowane do tego rodzaju wykazują dużą zmienność morfologiczną, a w literaturze pojawiły się sugestie o możliwym rozdzieleniu rodzaju na przynajmniej dwa rodzaje. Analiza filogenetyczna i analiza głównych składowych (PCA) wykazały, że znacząca większość gatunków może być klasyfikowana do rodzaju. Jedynie *Synapseudes idios* powinien reprezentować odrębny rodzaj.

ABSTRACT

Tanaidacea are group of marine benthic crustaceans classified to Malacostraca. Currently over 1200 species are described. However it is supposed that the number of known species constitute 2-3% of estimated 4000 species.

Tanaidacea can occur in high density, population over several thousand individuals/m^2 have been reported. Thus the crustaceans are important element of benthic communities. Due to their restricted mobility Tanaidacea are considered as an ideal bioindicators.

In Australian waters 176 species were described so far. Species were classified to 88 genera and 22 families. However it is predicted that number of shallow water taxa can exceed 2000 species.

Research on diversity of Australian Tanaidaceans concentrate mainly on Southern and South-Eastern coast: Esperance, Bass Strait, Morton Bay. Knowledge about Tanaidacea from Northern part is marginally, only 19 species have been described from coral reefs.

The main aim of the thesis was to estimating biodiversity of Tanaidacea from Australian coral reefs. Material was collected during CReefs program, being part of the bigger Census of Marine Life. Goal of the CReefs program was to increase knowledge about diversity of coral reefs. In 2008–2010 scientific expedition were organized to Lizard Island (Northern Great Barrier Reef), Heron Island (Southern GBR) and Ningaloo Reef (Western coast).

Collection consist of 99 samples gathered from 47 localities in vicinity of Heron Island (3519 indv.), 63 samples from 131 localities, gathered from reef around Lizard Island (4446 indv.) and 73 samples and 26 localities from Ningaloo Reef (1976 indv.).

Seventy two species in 53 genera and 20 families were identified from the CReefs collection. Material was dominated by members of the family Leptocheliidae, contributing 48-67% of all Tanaidacea. Family was followed by Metapseudidae (7–19%), Apseudidae (8–12%) and Paratanaidae (7–13%).

Metapseudidae and Leptocheliidae are the most rich in species families. Nine species, three genera and one subfamily classified to the Leptocheliidae are described and illustrated.

Beyond that the genus Synapseudes (Metapseudidea) are revised. Species classified to the genus present morphological heterogeneity, thus some scientist suggest division the genera. Phylogenetic analysis and Principal Component Analysis indicate that vast majority of the species can be classifies to the *Synapseudes*. Only one species *S. idios* should be transformed to the distinct genera.

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http://www.coml.org/projects/census-coral-reefs-creefs

List of appendix:

Appedix 4.1.1 Four new species and two new genera of Metapseudidae (Crustacea: Tanaidacea: Apseudomorpha) from Australian coral reefs (published by Stępień and Błażewicz-Paszkowycz in 2013)

Appendix 4.1.2 A new species of Numbakullidae Guţu & Heard, 2002 (Tanaidacea, Peracarida, Crustacea) from the Great Barrier Reef, Australia (published by Stępień in 2013).

Appendix 4.1.3 To new species of the genus Tanzanapseudes Băcescu, 1975 (Tanaidacea: Apseudomorpha: Tanzanapseudidae) from mid-west Australia (pblished by Stępień & Błażewicz-Paszkowycz in 2009)

Appendix 4.1.4 Study material collected in vicity of Lizard Island

Appendix 4.1.5 Study material collected in vicity of Heron Island

Appendix 4.1.6 Study material collected from Ningaloo Reef

Appendix 4.3.1. Matrix used for phylogeny analysis of genus *Synapseudes*

Appendix 4.3.2. Matrix with standardized characters used for Principal Coordinates Analysis of genus *Synapseudes*

Appendix 4.1.4 Study material collected in vicinity of Lizard Island.

	Apseudes sp.1	*Bilobatus* sp.	*Paradoxapseudes larakia*	*Pugiodactylus daicovici*	*Pugiodactylus* sp. 2	*Pugiodactylus* s.p 3	*Cryptoapseudes* sp.	*Curtipleon chadii*	*Julmarichardia* sp.	*Msangia* sp.	*Pseudoapseudomorpha* sp. 1	*Pseudoapseudomorpha* sp. 3	*Synapseudes* sp.1	*Synapseudes* sp.2	*Indoapeudes* sp.1	*Macrolabrum* sp.	*Pagurapseudes* sp.2	*Brachylicoa* sp.	*Pakistanapseudes* sp.	*Parapseudes* sp. 3	*Sphaeromapseudes* sp.	*Whiteleggia multicarinata*	*Iugentitanais* sp.	*Leptochelia* sp.	Araleptocheliinae gen.1 sp.	Araleptochelinae	*Grallotanais* sp.	*Konarus* sp.	*Neoleptochelia* sp.	*Poorea* sp.	Leptocheliinae gen. 1 sp.	Leptocheliinae gen. 2 sp.	*Nesotanais*	*Bathytanais* sp. 1	*Paratanis* sp. 3	*Antiplotanais* sp.	*Pseudotanais* sp. 1	*Tanais* sp.	*Zeuxo* sp. 1	*Matatanais bipunctata*	Incerte sedis gen. 1 sp.	Incerte sedis gen. 2 sp.	Incerte sedis gen. 3 sp.	**suma**
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	
CGLI002 A	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	7	23	0	0	0	0	0	0	2	0	0	3	0	0	0	0	0	0	0	0	40
CGLI002 B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CGLI003 A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	129	0	58	0	0	3	134	0	0	0	0	0	0	0	0	4	0	0	0	0	329
CGLI003 B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
CGLI003M3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	5	6	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	30
CGLI004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
CGLI006 A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14
CGLI008 A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	3
CGLI010	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	7
CGLI012	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	1	0	0	2	0	0	0	0	5	0	0	0	0	0	0	0	1	0	0	15
CGLI013	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	117	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	122
CGLI013 A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
CGLI014 A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0	9
CGLI014 B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
CGLI014	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
CGLI016	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
CGLI018 A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	0	12
CGLI018 B	0	0	19	0	0	0	0	5	0	1	1	0	1	0	0	0	0	0	0	0	0	0	1	19	106	0	1	0	0	0	0	1	4	0	6	0	0	0	0	0	0	0	0	165
CGLI018	1	0	5	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	21	26	0	0	0	1	0	0	0	0	0	5	0	0	0	4	0	0	0	0	64
CGLI019	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	
CGLI020	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	54	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	61
CGLI020 A	0	0	3	0	0	0	2	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	25	0	0	0	0	0	0	22	0	1	0	0	0	0	0	1	0	0	0	0	56
CGLI020 B	0	0	80	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	89	23	0	0	0	0	154	3	0	0	1	0	0	0	0	0	0	0	0	354
CGLI020 E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2
CGLI021	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
CGLI025 A	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
CGLI025 B	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	3	0	0	0	1	2	0	9	0	0	0	0	0	0	0	0	22
CGLI025 C	0	0	5	0	0	0	0	0	0	0	0	0	2	1	0	0	0	7	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	19
CGLI028	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	9	0	0	0	0	1	0	0	0	0	0	11
CGLI029	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	0	30
CGLI030	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
CGLI031	0	0	49	4	3	0	0	0	0	0	0	6	3	0	0	0	0	0	0	0	0	0	0	11	37	0	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	0	125
CGLI034	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CGLI034 A	0	0	4	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	15	43	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	68
CGLI034 B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	18
CGLI035	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27
CGLI036 A	1	0	3	0	0	0	0	0	0	1	0	0	0	8	0	1	0	0	0	0	5	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22
CGLI036 B	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
CGLI038	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	3	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	11
CGLI039	0	0	7	0	0	0	0	0	3	0	0	0	1	2	0	0	0	2	0	0	0	0	0	15	1	0	0	3	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	35
CGLI040	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
CGLI040 A	3	0	7	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20
CGLI040 B	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
CGLI041 B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
CGLI041 C	0	0	10	0	0	0	0	0	1	0	0	0	2	0	1	0	0	0	0	0	0	0	0	53	10	0	0	2	0	0	0	0	1	0	3	0	0	0	0	0	0	0	0	83
CGLI041 D	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
CGLI041 E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
CGLI041 A	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	6
CGLI046 A	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	52	19	12	0	16	0	0	0	0	0	0	11	0	8	0	0	0	0	0	0	120

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	
CGLI046 B	0	0	3	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	2	0	0	0	4	0	0	0	3	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	19
CGLI046 C	0	0	0	0	0	0	0	0	39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	10	7	0	9	0	0	0	0	2	0	16	0	0	0	0	0	0	0	0	106
CGLI047 A	0	0	0	0	0	0	0	0	15	0	0	0	1	0	0	0	0	0	0	0	0	0	0	20	1	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	40
CGLI047 B	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17
CGLI047 C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	11	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	17
CGLI048	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	6
CWLI002	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
CWLI003	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
CWLI004	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
CWLI004 E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
CWLI007	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	4
CWLI009 B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
CWLI015	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	4	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	13
CWLI019 B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
CWLI023	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	2	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	28
CWLI028	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
CWLI034	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
CWLI053	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	15	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21
CWLI057	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
GREG LIZ09 003	0	0	16	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20
GREG LIZ09-004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	2	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	12
LIZ09001 A	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	9	15	0	0	3	0	0	0	3	0	0	1	0	0	0	0	0	0	0	0	33
LIZ09-001 C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0	14
LIZ09001 D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27	6	1	0	1	0	0	0	0	0	0	3	4	0	0	0	0	0	0	0	42
LIZ09-002	5	0	19	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	39	1	0	3	6	0	0	0	0	1	0	48	0	5	0	0	0	0	0	9	140
LIZ09-002A	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	2	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22
LIZ09-002 B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	9	0	0	0	0	0	3	0	13	0	0	0	0	0	0	0	0	0	0	42
LIZ09-003	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	7	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	17

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	
LIZ09-003A	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3	0	0	0	0	0	0	0	0	7
LIZ09-003 B	0	0	6	0	1	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	9	0	1	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	31
LIZ09-004	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0	3	0	0	0	0	0	0	7
LIZ09-004A	0	0	0	0	0	0	0	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	6	13	0	0	0	0	0	0	3	0	0	1	0	1	0	0	0	0	0	0	29
LIZ09-004 B	0	0	2	0	0	0	0	0	0	0	1	0	20	0	0	0	0	0	0	0	0	0	0	4	3	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	32
LIZ09-004 C	0	0	3	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	1	4	0	0	0	0	0	0	0	0	17
LIZ09-05 A	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	34	0	0	0	0	0	73	0	0	0	1	0	0	0	0	0	0	0	0	110
LIZ09-006A	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
LIZ09-006 C	2	0	3	0	0	0	0	0	0	0	0	10	8	0	1	0	0	0	0	0	0	0	1	6	0	0	0	1	0	0	1	0	0	0	4	0	0	0	0	0	0	0	0	37
LIZ09 -007	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	1	5	6	0	1	0	0	0	0	0	6	0	0	0	2	0	0	0	0	0	0	26
LIZ09-008A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
LIZ09-008 C	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	24
LIZ09-009	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	2	0	1	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	18
LIZ09-009 B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
LIZ09-009 C	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
LIZ09-009 E	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14
LIZ09-009 F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	10
LIZ09-010A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	0	0	0	11	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	34
LIZ09-010 B	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
LIZ09-010 C	0	0	6	0	0	0	0	0	1	0	0	0	0	6	0	0	0	0	0	0	0	0	0	36	1	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	67
LIZ09-010 E	0	0	1	0	0	0	0	0	0	0	0	0	8	3	0	0	0	0	0	0	0	0	0	4	5	0	0	0	0	0	0	14	0	0	4	0	0	0	0	0	0	1	0	40
LIZ09-010 F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	6
LIZ09-011A	0	0	4	0	0	0	0	0	2	0	0	1	12	0	0	0	0	0	0	0	0	0	0	6	57	0	0	1	0	0	11	16	0	0	11	0	0	0	0	0	0	0	0	121
LIZ09-011 B	0	0	20	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	2	0	0	11	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	43
LIZ09-011D	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
LIZ09-011 E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
LIZ09-012A	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	13	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	20
LIZ09-012 B	1	0	3	0	0	0	0	0	6	0	0	0	1	1	0	0	0	0	0	0	0	0	1	12	4	0	0	0	0	0	0	0	2	0	3	0	0	0	0	0	0	0	0	34
LIZ09-012 C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	1	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	21

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	
LIZ09-012D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
LIZ09-012 F	0	0	7	0	0	3	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	11	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24
LIZ09-013A	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	24	0	0	0	0	0	0	0	0	0	0	0	43
LIZ09-013 B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	1	0	4	0	0	0	0	0	0	0	0	18
LIZ09-013 C	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	28	3	8	0	6	4	0	0	0	0	0	0	0	55
LIZ09-015A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	5
LIZ09-015 B	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	1	4	0	3	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	17
LIZ09-016A	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	5	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	17
LIZ09-016 B	0	0	9	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	7	0	0	1	0	0	0	0	0	0	5	0	0	0	0	0	0	1	0	25
LIZ09-016 C	0	0	6	0	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	3	2	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	18
LIZ09-016D	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	4	0	0	1	0	0	2	7	11	0	6	0	0	0	0	0	0	0	0	34
LIZ09-016 E	0	0	30	0	4	0	0	0	0	0	12	0	0	0	1	0	0	0	0	0	0	0	1	3	4	0	0	7	0	0	0	46	3	0	0	0	4	0	0	0	0	0	0	115
LIZ09-016 F	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	6
LIZ09-016G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	3
LIZ09-016H	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	19	31	1	0	2	0	0	0	0	1	0	0	0	55
LIZ09-017A	0	0	1	0	0	0	0	0	1	0	0	0	6	0	1	0	1	0	0	0	0	0	0	16	3	12	0	7	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	51
LIZ09-017 B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	3
LIZ09-018A	0	0	6	0	0	0	0	0	0	0	0	0	22	0	0	0	0	0	0	0	0	0	0	4	14	0	0	2	0	0	0	1	2	0	2	0	0	0	0	0	0	0	0	53
LIZ09-018 B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32
LIZ09-019A	0	0	27	0	1	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	4	22	0	0	0	0	0	1	3	0	0	3	0	1	0	0	0	0	0	0	71
LIZ09-019 B	0	0	42	0	0	0	1	0	0	0	0	0	12	0	0	0	0	0	0	0	0	0	2	0	163	0	0	0	0	0	0	0	1	0	33	0	1	0	0	0	0	0	0	255
LIZ09-019D	0	0	2	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	6	12	0	2	0	0	0	0	2	1	0	4	0	0	0	0	0	0	0	0	31
LIZ09-020A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
LIZ09-020 B	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
LIZ09-021A	0	0	5	0	0	0	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0	6	13	0	0	0	0	0	6	0	0	0	16	0	0	0	0	0	0	0	0	60
suma	20	1	474	7	12	7	3	5	96	6	26	19	126	42	11	8	4	18	3	3	8	1	20	1103	904	151	8	156	6	134	337	188	81	1	310	25	25	26	13	1	1	2	9	440 1

Appendix 4.1.5 Study material collected in vicinity of Heron Island.

	Apseudes sp.1	*Bilobatus* sp.	*Paradoxapseudes larakia*	*Paradoxapseudes* sp. 2	*Pugiodactylus* sp. 1	*Pugiodactylus* sp. 2	*Kalliapseudes* sp. 1	Kalliapseudes sp. 2	*Apseudomorpha* sp.	*Creefs heronum*	*Cryptoapseudes* sp.	*Curtipleon chadi*	*Julmarichardia* sp.	*Msangia mussida*	*Pseudoapseudomorpha* sp. 1	*Pseudoapseudoapseudomorpha* sp. 3	*Pseudoapseudmorpha* sp. 4	*Pseudoapseudomorpha* sp. 5	*Synapseudes* sp. 1	*Numbaculla pii*	*Macrolabrum boeri*	*Pagurapseudes* sp. 2	*Pagurapseudopsis* sp.	*Brachylicoa* sp.	*Pakistanapseudes* sp.	*Parapseudes* sp. 1	*Parapseudes* sp. 2	*Parapseudes* sp. 3	*Whiteleggia multicarinata*	*Iugentitanais* sp.	Araleptocheliinae gen 2 sp.	Araleptocheliinae gen 2 sp.	*Konarus* sp.	*Letpochelia* sp.	*Nesotanais* sp.	*Bathytanais* sp. 2	*Pseudobathytanais* sp. 1	*Paratanais* sp. 2	*Paratanais* sp. 3	*Pseudotanais* sp. 1	*Pseudotanais* sp. 2	*Zeuxo* sp. 1	*Zeuxo* sp. 2	*Zeuxo* sp. 3	*Metatanais bipunctata*	*Tangalooma* sp.	Incerte sedis gen. 3 sp.	**suma**
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	
HI09-010	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	58	0	0	0	0	1	0	0	1	0	0	0	0	0	63
HI09-011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
HI09-028	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
HI09-038	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	3
HI09-043	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	8
HI09045 A	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	22	0	0	73	2	0	0	0	11	1	0	1	0	0	0	0	0	113
HI09-045B	0	0	0	6	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1	0	22	0	0	0	10	5	0	0	0	0	0	0	0	0	51
HI09-045 C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	0	4	0	0	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	21
HI09-045 D	0	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	1	2	0	0	0	0	0	0	0	2	0	0	0	0	0	13
HI09-047	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	5	0	0	0	0	1	15	0	11	0	0	0	1	1	0	0	1	0	0	1	0	0	39
HI09-052 A	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	38	0	0	0	1	5	0	0	1	0	0	0	0	0	49
HI09-058 D	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	0	0	0	0	0	0	0	0	0	0	0	0	23
HI09-059 A	0	0	0	0	0	0	0	0	15	0	0	0	0	1	0	0	0	0	5	0	10	0	0	0	0	2	0	0	1	0	7	0	0	119	0	0	0	4	0	2	0	0	0	0	0	0	0	166
HI09-059 B	0	0	1	0	0	2	0	0	1	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	8	0	0	0	8	7	0	0	0	0	1	0	0	0	33
HI09-059 C	0	0	0	0	0	0	0	0	5	0	0	0	0	0	2	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	4	0	0	23	0	0	0	0	9	0	0	0	0	1	0	0	0	51
HI09059 D	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2
HI09-064 C	0	0	0	0	0	17	0	0	1	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	5	33	0	0	0	6	6	0	0	1	0	0	0	0	0	73
HI09-064 D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	6	0	0	0	0	0	6	0	0	0	1	0	15	0	0	0	0	0	0	0	2	0	0	0	0	0	32
HI09-067	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2
HI0976C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	9

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	
HI09-076 D	0	0	7	1	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	3	0	0	2	0	0	14	0	0	0	0	1	1	0	0	0	0	0	0	0	49
HI09-084 B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
HI09-084 D	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	5	3	0	0	0	0	0	0	0	0	32
HI09-084 E	0	0	3	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0	3	1	0	0	0	0	0	0	0	21
HI09-084 F	0	0	11	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26	0	0	0	0	14	0	0	0	0	0	0	0	0	56
HI09-093	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
HI09-103 B	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	57	0	0	0	0	2	0	0	0	20	0	0	0	0	80
HI09-103 C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27	0	0	0	1	0	0	0	0	0	0	0	0	0	43
HI09-106 A	0	3	19	0	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	41
HI09-106 B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	3	5	1	0	0	0	0	2	1	0	0	0	0	0	0	0	15
HI09-106 C	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	0	0	0	0	8	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	17
HI09-106 D	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	2	0	0	3	0	0	0	0	0	0	5	0	0	0	0	0	1	5	1	0	0	0	2	2	0	0	0	0	0	1	0	0	25
HI09-121 D	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
HI09-123 B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	6	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
HI09-123 E	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	7	0	0	0	8	0	0	0	0	0	0	0	0	0	33
HI09-125 A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	3	1	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19
HI09-125 B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2
HI09-125 C	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	8
HI09-022	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
HI09-064 E	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	2	1	0	0	1	0	0	0	0	0	12
HI09-076 A	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0	0	0	0	5	0	0	0	0	0	0	0	0	57
HI10-002 A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	4
HI10-002 B	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	3	1	0	0	0	0	0	0	0	0	15
HI10-002 D	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	0	0	17	0	0	0	5	1	2	0	0	0	0	0	0	0	44
HI10-002 E	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
HI10-005 A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	3
HI10-009 A	0	0	0	1	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	10
HI10-009 B	1	0	1	6	0	9	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	4	0	0	4	0	0	0	1	6	0	0	0	0	1	0	0	0	35
HI10-009 D	0	0	1	1	0	6	0	0	6	26	0	0	0	3	0	0	0	0	8	11	0	0	0	0	0	0	0	0	0	0	32	0	2	43	3	0	0	1	25	12	0	2	0	1	0	3	1	187
HI10-009 E	0	0	2	0	0	8	0	0	1	43	0	1	0	1	1	1	0	1	1	35	8	1	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	6	0	0	1	0	0	0	0	0	115
HI10-009 F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	
HI10-010 A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	11
HI10-013 A	2	0	0	1	0	3	0	0	0	0	0	0	0	0	2	0	0	0	1	5	0	0	0	1	0	0	0	0	0	0	3	2	0	18	0	0	0	0	4	0	0	0	0	0	0	0	0	42
HI10-013 B	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	7	11	1	13	0	0	0	0	5	7	0	0	0	1	0	0	0	48
HI10-014 A	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	15	0	0	0	0	0	0	0	0	0	0	0	4	0	0	1	0	0	0	9	2	1	0	0	0	0	0	1	0	35
HI10-014 B	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	2	0	0	3	0	0	0	2	17	0	0	0	0	0	0	0	0	33
HI10-014 C	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	4
HI10-019 A	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	12	1	5	6	0	0	0	0	3	1	0	0	0	0	0	0	0	32
HI10-019 B	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3
HI10-020 A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	7
HI10-020 B	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	7
HI10-020	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
HI10-025 A	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	1	13	6	0	0	0	20	0	0	0	0	0	0	1	0	56
HI10-025 C	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	4	0	0	0	0	0	0	0	3	11
HI10-026 C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
HI10-026 A	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	5	12	0	0	0	2	0	0	0	0	0	0	0	0	0	23
HI10-029	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	5	13	0	0	0	4	0	0	0	2	0	0	0	0	0	27
HI10-031 B	2	0	0	0	0	4	0	0	0	0	0	1	0	24	0	0	0	0	0	0	0	0	0	0	0	44	0	0	0	0	0	0	0	26	0	0	0	1	0	0	0	0	0	0	0	0	0	102
HI10-031 C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	1	0	0	0	0	0	0	0	0	5
HI10-035	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	11
HI10-036 A	0	0	2	1	0	1	0	0	1	1	0	0	0	0	0	0	1	0	19	0	0	0	0	0	0	13	0	0	0	0	6	2	1	93	1	0	0	4	4	6	0	18	0	0	1	1	2	178
HI10-036 B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	6	3	0	0	0	0	4	0	0	0	0	0	0	0	0	15
HI10-036 F	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	1	0	0	0	0	1	2	0	0	0	0	0	0	0	15
HI10-037 A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
HI10-037 B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	6
HI10-040	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
HI10-040 A	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	12
HI10-040 B	0	0	0	9	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	31	0	0	0	0	6	2	0	1	0	0	0	1	0	65
HI10-040 C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	7	0	0	31	0	0	0	0	2	1	0	2	0	0	0	0	1	46
HI10-040 D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	9	0	0	0	3	3	0	0	1	0	0	0	1	0	25
HI10-040 E	0	0	6	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0	2	10	0	0	0	0	0	0	0	0	37
HI10-041	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	6
H1041 A	0	0	5	4	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	6	1	0	22	0	0	0	0	4	0	0	0	0	0	0	0	0	57

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	
HI10-041 B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	20	0	0	0	0	0	1	0	0	0	0	0	0	0	23
HI10-043 A	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	29	0	0	0	0	2	0	0	1	0	0	0	0	0	40
HI10-043 B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	4
HI10-047 A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	0	0	0	0	0	0	2	0	0	0	0	0	0	6	0	0	121	0	0	0	0	0	2	0	0	0	0	0	0	0	136
HI10-047 B	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	0	200	0	0	0	0	1	3	0	0	0	0	0	0	0	240
HI10-047 C	0	0	1	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	5	0	0	46	0	0	0	0	0	1	0	0	0	0	0	0	0	58
HI10-051 A	0	0	9	6	0	3	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	1	0	0	0	0	0	0	3	0	0	3	0	0	0	0	4	6	0	0	0	0	0	0	0	38
HI10-051 B	1	0	3	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	0	2	0	0	20	0	0	0	0	0	1	3	0	0	0	0	0	0	35
HI10-051 C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28	0	0	0	1	1	0	0	0	0	0	0	0	0	31
HI10-051 D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0	2	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	7
HI10-051 E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	2	20	0	0	0	0	0	4	0	0	0	0	0	0	0	41
HI10-054 A	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	16	0	3	50	1	0	0	16	18	12	0	0	0	0	1	2	0	124
HI10-054 B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	3	1	0	0	0	0	0	0	0	15
HI10-055 A	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	1	0	0	0	14	0	0	5	0	0	0	1	5	0	1	4	0	0	0	0	5	2	0	0	0	0	0	0	0	44
HI10-055 B	0	0	1	0	0	0	0	0	0	1	0	8	0	0	0	3	0	0	6	0	0	0	5	0	0	4	0	1	0	0	1	6	0	1	1	0	0	0	0	5	0	0	0	0	2	2	0	47
HI10-056 A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	2	0	0	0	0	1	1	0	0	0	0	0	0	0	6
suma	12	7	80	53	1	136	19	1	40	72	2	18	3	29	21	29	24	4	87	53	24	14	20	5	3	142	3	36	5	2	277	65	55	1616	15	2	1	107	259	79	3	42	20	5	6	12	9	3518

Appendix 4.1.6 Study material collected at Ningaloo Reef

	Apseudes sp.	*Bunakenia* sp.	*Paradoxapseudes* sp.1	*Bamberus jinigudirus*	*Cyclopoapseudes* sp.	*Julmarichardia* sp.	*Pseudoapseudomorha* sp. 2	*Synapseudes* sp. 1	*Macrolabrum* sp.	*Pagurapseudes* sp.	*Brachylicoa* sp.	*Pakistanapseudes* sp.	*Saltipedis* sp.	*Tanzanapseudes nieli*	*Tanzanapseudes levis*	*Whiteleggia multicarinata*	*Iugentitanais* sp.	*Araleptichelia* sp.	Araleptocheliinae gen. 1 sp.	Araleptocheliinae gen. 2 sp.	*Konarus* sp.	*Leptochelia* sp.	Leptocheliinae gen. 1 sp.	*Pooreotanais ningaloo*	*Nesotanais* sp.	*Paratanais* sp.1	*Paratanais* sp. 2	*Paratnais* sp. 3	*Pseudotanais* sp. 1	*Zeuxo* sp. 1	*Metatanais bipunctata*	Incerte sedis gen. 3 sp.	**suma**
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	
NIN002	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	2	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	11
NIN004	0	0	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19
NIN004 B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
NIN005 A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	4	9	0	0	0	0	0	0	0	0	0	19
NIN005 B	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	1	1	4	0	0	0	0	0	3	0	4	0	0	16
NIN005 C	0	0	6	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	10
NIN005 D	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
NIN007 A	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	0	0	0	26
NIN007 D	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	5	44	0	8	0	0	0	0	0	0	0	0	0	0	59
NIN007 E	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	6
NIN007 G	0	0	0	0	0	0	0	15	0	0	0	1	0	0	0	0	0	0	0	132	0	20	0	0	0	0	0	0	0	0	0	0	168
NIN007 B	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	5
NIN008	2	0	0	0	0	0	0	3	0	0	0	0	1	0	0	0	0	0	0	0	0	2	1	0	0	0	0	10	0	0	0	0	19
NIN008 A	0	0	0	0	0	2	0	4	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	8
NIN008 B	0	6	0	0	0	0	0	44	0	0	0	2	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	62
NIN008 C	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	15
NIN008 D	0	0	0	0	0	0	0	3	0	0	0	0	1	0	0	0	0	0	18	39	0	7	2	0	0	0	0	5	1	0	0	0	76
NIN008 E	0	0	1	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	7
NIN008 F	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	2	0	0	0	5
NIN008 G	0	3	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
NIN008 H	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
NIN008 I	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	7	0	0	1	0	0	0	0	1	0	0	0	0	11
NIN009	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
NIN009 A	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	3
NIN009 B	0	0	3	9	0	0	0	16	0	0	0	0	6	0	0	0	0	0	0	0	0	3	4	0	0	0	1	4	0	0	0	0	46
NIN010 A	0	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	19	0	0	0	0	36
NIN010 B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
NIN010 C	0	0	0	0	0	0	0	24	0	0	0	0	0	0	0	0	0	0	0	0	0	25	33	0	0	0	0	0	0	0	0	0	82

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	
NIN011	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	55	0	0	3	0	0	0	0	0	0	0	0	0	0	59
NIN012 A	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	2	4	10	4	0	1	0	0	14	0	0	0	0	45
NIN012 B	1	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	2	0	0	0	0	17
NIN013 A	0	0	2	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	10
NIN013 B	0	0	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	0	0	2	0	3	0	0	0	0	0	3	0	0	0	0	15
NIN013 C	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
NIN013 D	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
NIN014	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	2
NIN014 A	0	0	0	0	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	6
NIN014 B	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	4
NIN014 C	1	0	3	0	0	0	0	43	0	0	0	0	0	0	0	0	0	0	0	1	2	2	2	1	1	0	0	15	0	1	0	0	72
NIN014 D	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	3	0	0	0	0	7
NIN014 E	1	0	0	0	0	0	0	33	0	0	0	0	0	0	0	0	0	0	0	2	0	11	6	0	1	0	0	16	0	0	0	0	70
NIN014 F	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	11	0	0	0	0	18
NIN015	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
NIN017	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
NIN017 A	2	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	12	0	0	54	83	0	0	0	0	8	0	0	1	0	169
NIN017 B	0	0	0	0	0	2	0	24	0	0	0	0	0	0	0	0	0	0	0	6	1	10	24	0	2	0	0	30	0	0	0	0	99
NIN020	0	134	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	135
NIN020 B	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	2	0	0	0	0	0	0	14	15	0	0	0	0	35
NR09-006	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
NR09-050 C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2
NR09-052 A	0	0	0	0	0	0	0	4	0	0	0	0	5	0	0	0	0	0	22	0	0	88	0	0	0	0	0	2	0	0	0	0	121
NR09-052 B	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
NR09-054 A	0	0	0	0	0	0	0	0	0	0	1	0	4	0	0	0	0	0	5	0	0	27	0	0	0	0	0	2	0	0	0	0	39
NR09-054 B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0	3
NR09-058 B	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
NR09-064	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
NR09-064 A	0	0	20	0	0	0	3	25	0	0	0	0	0	0	0	0	0	0	1	0	0	6	14	0	0	0	0	1	0	0	0	0	70
NR09-064 B	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3
NR09-064 C	0	0	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	0	0	0	0	0	0	0	0	0	9
NR09-070 A	5	0	0	0	0	0	7	14	0	0	0	0	0	0	0	0	0	0	0	0	0	1	9	0	0	0	0	14	0	3	0	0	53
NR09-070 B	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	1	0	1	0	0	9
NR09-070 C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
NR09-078	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	1	0	0	0	0	0	0	1	0	0	0	0	6
NR09-080 A	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	3	3	4	1	0	0	0	1	3	0	1	0	0	21
NR09-080 B	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
NR09-080 C	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	1	0	3	0	0	0	0	0	2	0	0	0	0	9

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	
NR09-085 A	8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	2	11	0	3	1	0	46
NR09-085 B	0	0	0	0	0	2	0	6	2	0	0	0	0	0	0	1	0	0	0	0	5	4	1	0	0	0	0	6	0	1	1	0	29
NR09-085 C	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	3
NR09-085 G	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	5
NR09-092 A	1	0	0	0	0	0	0	5	0	0	0	0	0	1	0	1	0	0	1	0	0	4	0	0	0	0	3	19	0	0	0	0	35
NR09-092 B	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3
NR09-094 D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	1	0	0	0	0	1	0	0	0	0	6
suma	25	152	56	15	11	6	11	348	12	4	12	5	22	5	1	2	2	2	140	256	19	356	225	2	5	1	22	234	3	17	4	1	1976

Appendix 4.3.1. Matrix used for phylogeny analysis of genus *Synapseudes*

species/ character number	**1.**	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	**8.**	**9.**	**10.**	**11.**	**12.**	**13.**	**14.**	**15.**	**16.**	**17.**	**18.**	**19.**	**20.**	**21.**	**22.**	**23.**	**24.**
Metapseudes wilsoni Błażewicz-Paszkowycz & Bamber, 2007	1.500	1.636	0	0	0	0	1	0	1	0	1	1	0	1	0	0	0	1	0	1	1	1	1	0
Synapseudes acroporae Băcescu, 1976	1.286	2.000	1	2	0	0	1	0	?	0	1	0	0	0	0	0	0	0	1	0	?	0	1	0
Synapseudes aflagellatus Sieg, 1986	1.143	2.667	0	1	1	1	0	-	0	2	1	1	1	0	0	1	0	0	1	1	1	0	1	1
Synapseudes australianus Băcescu, 1981	1.333	2.00	1	1	0	0	1	0	1	0	1	1	1	0	0	0	0	0	1	0	?	0	1	1
Synapseudes cystoseirae Amar & Cazaubon, 1978	1.166	2.333	1	2	0	1	1	0	?	0	1	1	1	1	1	1	0	0	1	0	1	0	1	1
Synapseudes dispina Menzies, 1953	1.00	2.571	1	2	0	0	1	?	?	0	1	1	[01]	1	1	1	?	?	?	?	?	0	1	0
Synapseudes erici Błażewicz-Paszkowycz et al. 2011	1.133	2.833	1	2	0	0	1	0	1	0	1	1	1	0	1	0	0	0	1	1	1	0	1	0
Synapseudes hansmuelleri Guţu, 2006	1.154	2.143	0	1	0	0	1	1	1	0	1	1	0	1	0	0	0	0	1	1	1	0	1	1
Synapseudes heterocheles (Vanhöffen, 1914)	1.143	2.000	1	3	-	0	1	1	0	0	1	0	0	0	0	1	0	0	1	1	1	0	1	1
Synapseudes idios Gardiner, 1973	1.167	2.000	1	0	0	1	1	?	1	0	0	1	1	1	0	1	1	1	0	?	0	1	0	0
Synapseudes intumescens Menzies, 1949	1.000	2.250	1	2	0	1	1	1	1	0	1	1	1	1	1	1	?	?	?	?	?	0	1	0
Synapseudes mediterraneus Băcescu, 1977	1.222	3.667	1	2	0	0	1	0	1	1	1	1	1	0	1	1	0	0	1	0	1	0	1	1
Synapseudes menziesi Băcescu, 1976	?	?	?	2	0	0	1	0	1	0	1	0	0	0	0	0	0	0	1	1	?	0	1	1
Synapseudes minimus Guţu, 2006	1.273	2.333	1	1	0	0	1	1	1	0	1	?	?	0	0	0	?	?	?	?	1	0	1	1
Synapseudes minutus Miller, 1940	1.000	2.133	1	1	1	0	1	1	1	0	1	1	0	0	0	0	0	0	1	1	1	0	1	1
Synapseudes rectifrons Guţu, 1996	1.125	2.250	1	2	0	0	1	1	1	0	1	0	0	0	0	0	0	0	1	1	0	0	1	1
Synapseudes rudis Menzies, 1953	1.000	2.429	1	2	0	0	1	0	1	0	1	1	1	1	0	0	0	?	1	?	?	0	1	1
Synapseudes setoensis Shiino, 1951	1.250	3.333	1	2	0	0	1	1	0	0	1	1	1	0	0	1	0	0	1	1	?	0	1	1
Synapseudes tomescui Guţu, 2006	1.250	1.875	1	1	0	0	1	0	1	0	?	?	?	?	?	?	?	?	?	?	1	0	1	1
Synapseudes violaceus Băcescu, 1976	1.154	2.143	1	1	0	0	1	0	1	0	1	1	1	0	0	0	0	0	1	?	?	0	1	1
Synapseudes n. sp. 1	1.237	2.23	1	1	0	0	1	0	1	[01]	1	1	1	1	0	0	0	0	1	1	1	0	1	1
Synapseudes n. sp. 2	1.250	2.083	1	1	0	0	1	0	1	0	1	1	1	1	0	1	0	0	1	1	1	0	1	0
Synapseudoides pinosensis Guţu & Ortiz, 2009	1.111	2.000	1	2	1	0	1	1	1	0	?	?	?	0	0	0	0	0	1	1	1	0	1	1

Appendix 4.3.2. Matrix with standardized characters used for Principal Coordinates Analysis of genus *Synapseudes*

species/ characters	**A.**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**
Metapseudes wilsoni Błażewicz-Paszkowycz & Bamber, 2007	2,85	-1,25	-2,10	-1,78	-0,24	0,24	-0,33	-0,45	-0,81	-0,24	2,66	-2,66	2,66	0,24	-1,50	-0,45
Synapseudes acroporae Băcescu, 1976	0,74	-0,56	0,45	0,74	-0,24	0,24	-0,33	-0,45	-0,81	-0,24	-0,35	0,35	-0,35	0,24	-1,50	-0,45
Synapseudes aflagellatus Sieg, 1986	-0,67	0,69	-2,10	-0,52	1,82	-3,88	3,45	-0,45	1,16	-0,24	-0,35	0,35	-0,35	0,24	0,63	2,10
Synapseudes australianus Băcescu, 1981	1,20	-0,56	0,45	-0,52	-0,24	0,24	-0,33	-0,45	-0,81	-0,24	-0,35	0,35	-0,35	0,24	0,63	-0,45
Synapseudes cystoseirae Amar & Cazaubon, 1978	-0,44	0,06	0,45	0,74	-0,24	0,24	-0,33	2,10	1,16	-0,24	-0,35	0,35	-0,35	0,24	0,63	2,10
Synapseudes erici Błażewicz-Paszkowycz et al. 2011	-0,77	1,00	0,45	0,74	-0,24	0,24	-0,33	2,10	-0,81	-0,24	-0,35	0,35	-0,35	0,24	-1,50	-0,45
Synapseudes hansmuelleri Guţu, 2006	-0,56	-0,29	-2,10	-0,52	-0,24	0,24	-0,33	-0,45	-0,81	-0,24	-0,35	0,35	-0,35	0,24	0,63	-0,45
Synapseudes heterocheles (Vanhöffen, 1914)	-0,67	-0,56	0,45	2,00	-2,30	0,24	-0,33	-0,45	1,16	-0,24	-0,35	0,35	-0,35	0,24	0,63	-0,45
Synapseudes idios Gardiner, 1973	-0,43	-0,56	0,45	-1,78	-0,24	0,24	-0,33	-0,45	1,16	3,88	2,66	-2,66	2,66	-3,88	-1,50	2,10
Synapseudes mediterraneus Băcescu, 1977	0,11	2,57	0,45	0,74	-0,24	0,24	1,56	2,10	1,16	-0,24	-0,35	0,35	-0,35	0,24	0,63	-0,45
Synapseudes minutus Miller, 1940	-0,98	-0,56	0,45	-0,52	1,82	0,24	-0,33	-0,45	-0,81	-0,24	-0,35	0,35	-0,35	0,24	0,63	-0,45
Synapseudes n. sp. 1	0,26	-0,56	0,45	-0,52	-0,24	0,24	-0,33	-0,45	-0,81	-0,24	-0,35	0,35	-0,35	0,24	0,63	-0,45
Synapseudes n. sp. 2	1,04	-0,41	0,45	-0,52	-0,24	0,24	-0,33	-0,45	1,16	-0,24	-0,35	0,35	-0,35	0,24	-1,50	-0,45
Synapseudes rectifrons Guţu, 1996	-0,84	-0,09	0,45	0,74	-0,24	0,24	-0,33	-0,45	-0,81	-0,24	-0,35	0,35	-0,35	0,24	0,63	-0,45
Synapseudes setoensis Shiino, 1951	0,39	1,94	0,45	0,74	-0,24	0,24	-0,33	-0,45	1,16	-0,24	-0,35	0,35	-0,35	0,24	0,63	-0,45
Synapseudes violaceus Băcescu, 1976	-0,56	-0,29	0,45	-0,52	-0,24	0,24	-0,33	-0,45	-0,81	-0,24	-0,35	0,35	-0,35	0,24	0,63	-0,45
Synapseudoides pinosensis Guţu & Ortiz, 2009	-0,67	-0,56	0,45	0,74	1,82	0,24	-0,33	-0,45	-0,81	-0,24	-0,35	0,35	-0,35	0,24	0,63	-0,45