Festschrift in Honour of James K. Lowry

edited by

Penelope B. Berents, Shane T. Ahyong, Alan A. Myers, and Lucia Fanini

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Festschrift in Honour of James K. Lowry

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Five Decades in Carcinology—a Tribute to Jim Lowry

James Kenneth Lowry arrived at the Australian Museum in 1976 with a recent PhD from the University of Canterbury, New Zealand, and loads of enthusiasm. He was appointed as Curator of Crustacea, a role that was later changed to Research Scientist, and then Principal Research Scientist. Jim made a huge impact on the study of Crustacea as a taxonomist, editor, and an avid collector.

A search of the Marine Invertebrates collection database at the Australian Museum returned 12,790 registered lots collected by Jim. This number will grow as more collections made by Jim are studied and registered.

From his retirement in 2015 until his death in 2021, Jim continued his research as a Senior Fellow with the Australian Museum, still writing papers and dreaming up new research questions.

He believed in the importance of good taxonomy, encouraged students and developed collaborations with both fledgling and experienced research scientists. It was Jim's collaborative and friendly nature that encouraged visitors from around the world to come to the Australian Museum to work on Crustacea and add to the collections, not just in the Amphipoda but other groups, such as cumaceans, ostracods, decapods, isopods, and mysids.

The response to the call for papers for this volume in memory of Jim is indicative of his influence. Six of the papers are by former students and papers have been contributed by authors around the world describing research and new taxa of amphipods, mysids, and decapods. Fourteen new species are named in Jim's honour.

Many of the authors have used Delta (DEscription Language for Taxonomy) databases in preparing their contributions. Jim was a keen advocate of DELTA, conducting workshops around the world where he promoted and encouraged the use of Delta databases to improve the rigour of taxonomic descriptions and ease of handling taxonomic data.

It is fitting that Jim's memorial volume be published in *Records of the Australian Museum*. He was Editor of the *Records* (as we often referred to it) for 15 years from 1983 and introduced a new style with double columns and large format to update the journal. The range of papers published in this volume is testimony to Jim's influence in carcinology around the world.

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Obituary—Dr Jim Lowry

Penelope B. Berents

Australian Museum Research Institute, Australian Museum, 1 William Street, Sydney NSW 2010, Australia

James Kenneth Lowry devoted his life and career to the study of the Amphipoda. He was born in Kansas City, Missouri on 2 October 1942 and grew up in Chuckatuck near Chesapeake Bay, Virginia. Living around Chesapeake Bay stirred Jim's interest in natural places, the sea and estuaries, and led to a BA majoring in Biology at the University of Richmond, Virginia.

Jim completed an MA in Marine Science at the College of William and Mary in Virginia in 1969. Much of this work was carried out at Palmer Station, a United States Antarctic research station on Anvers Island, where Jim studied the soft bottom benthic community of Arthur Harbour. Jim was recognized for his time at Palmer Station by having Mount Lowry (1,020 m a.s.l.) in the Pensacola Mountains, Antarctica, named after him.

Jim's interest in the Antarctic was central to his research for the next decade. He was enticed to the University of Canterbury in Christchurch, New Zealand, to undertake a PhD with Professor George Knox, who had extensive experience in studying Antarctic biology and established the Antarctic Research Institute. Jim studied the effects of latitude on marine soft bottom communities and was awarded his PhD in 1976 for his thesis "Studies on the macrobenthos of the Southern Ocean". Prof. Knox used his many contacts in Antarctic research to secure berths on ice breakers and other vessels to allow Jim to work in Antarctic and Sub-Antarctic waters, including Cape Bird, Campbell Islands, Auckland Islands and Stewart Island. Jim spent two winters at the New Zealand base on Ross Island near McMurdo Station.

Jim maintained his interest in the Antarctic and Sub-Antarctic when he joined the Australian Museum as Curator of Crustacea in 1976. Jim organized and led an expedition to Macquarie Island in the summer of 1977–1978 accompanied by Dr Donald Horning, Dr Gary Poore and Rob Ricker. The team performed 84 scuba dives, collecting 406 marine samples of invertebrates and algae. Although Jim had been collecting and studying the macrobenthos, by this time the Amphipoda had singularly captured his attention and they would hold his focus for the remainder of his career at the Australian Museum (retiring as a Principal Research Scientist in 2015), and as a Senior Fellow of the museum until his death.

Jim was intrigued by the biogeography of the Sub-Antarctic islands of New Zealand and Australia. He worked on amphipod collections from The Snares, Auckland Islands, Campbell Islands and Macquarie Island and described the gammaridean Amphipoda in papers jointly authored with Helen Stoddart and Dr Graham Fenwick.

Jim's interest in biogeography and lysianassoid amphipods led to questions about the role of scavenging guilds along the Australian east coast. The result was the SEAS project (Scavengers of Eastern Australian Seas, 1993–1996): an ambitious project, to sample scavenging Crustacea using baited traps set from small fishing boats at six sites from Cairns (latitude 16°41'S) to Hobart (43°08'S) along cross-shelf transects from 50 m to 1000 m depth. Jim successfully sought funding for this project from the Fisheries Research and Development Corporation and collected 283 species of invertebrate scavengers represented by approximately 800,000 individuals, with almost 70% of the species new to science. The project revealed the complex composition of scavenging guilds in Australian waters.

In 2005 the amphipod fauna of the Great Barrier Reef was still poorly known and the Australian Museum's Lizard Island Research Station provided the perfect location to collect and describe the amphipod fauna. Jim and Dr Penny Berents raised funds and organized a workshop to bring together 20 Australian and international taxonomists at Lizard Island. Jim and Prof. Alan Myers encouraged and cajoled the workshop participants who documented and described 256 amphipod species from the Great Barrier Reef in a 930 page monograph published by *Zootaxa* (Lowry & Myers, 2009).

Jim was a taxonomist at heart, publishing his first taxonomic paper in 1972 on *Microprotopus.* His research focus for many years was to describe the Australian lysianassoids and revise the world families of Amphipoda. Much of this work was done with Helen Stoddart, and later with Dr Lauren Hughes and Dr Niamh Kilgallen, resulting in more than 50 papers. Jim became interested in the taxonomy of cerapodine amphipods while studying in New Zealand and continued this work at the Australian Museum along with Dr Penny Berents in a project describing Australian and Indo-Pacific cerapodines resulting in 3 new genera and 16 new species. Jim later turned his attention to talitrid amphipods to describe the Australasian coastal talitrid fauna with Roger Springthorpe and Dr Lauren Hughes. He revised the world talitroid genera and developed a taxonomic catalogue and keys to world genera and species with Prof. Alan Myers. A lifetime studying the Amphipoda culminated in a revision of the higher classification with the first of a number of papers with Prof. Alan Myers published in 2017 (Lowry & Myers, 2017). Jim and Alan were still working on this project at the time of Jim's death. During his career, Jim described 31 ordinal taxa, 92 family-group taxa, 129 genera, and 548 species. He published on more than 770 species in total.

Jim was strongly influenced by his mentor and friend, the late Dr Jerry Laurens Barnard, of the National Museum of Natural History, Washington DC. Dr Barnard was the first person to make a serious attempt to collect and document the Australian amphipod fauna and was a frequent visitor to Australia from 1968 until his death in 1991. He collaborated with Australians who were trying to document the Australian fauna and set new standards for the descriptive work required for amphipod taxonomic studies. Jim continued where Jerry Barnard left off and did more to document the Australian amphipod fauna than anyone before him. Jim frequently referred to Jerry and to his unwavering dedication to good taxonomy. Jim adopted the same philosophy and standards. Jim was an early adopter of computer systems and software to assist with museum catalogues, taxonomic studies and large datasets. During his PhD studies in the early 1970s, Jim recognized the power of mainframe computer systems to handle his benthic community data. As Curator of Crustacea at the Australian Museum, Jim started the first database of crustacean type specimens in the museum's collections. Jim produced several checklists and catalogues including the massive *Zoological Catalogue of Australia* for the Amphipoda, Cumacea, and Mysidacea, jointly edited with Helen Stoddart (Lowry & Stoddart, 2003). He pioneered the use of the taxonomic database DELTA (DEscriptive Language for TAxonomy) in amphipod taxonomy and conducted workshops around the world to encourage taxonomists to adopt DELTA.

As an enthusiastic field biologist, Jim made extensive subtidal collections on scuba around the Australian coast and territorial islands including Western Australia, Norfolk Island, Christmas and Cocos Keeling, and in the Indo-Pacific (Papua New Guinea and New Caledonia). He was assisted by colleagues and students on these trips, in particular, Helen Stoddart, Roger Springthorpe and Dr Lauren Hughes. Jim spent three summers at Madang Lagoon in Papua New Guinea collecting marine plants and animals for biodiversity studies.

Jim recognized the need for easy access to taxonomic literature and harnessed a team of keen volunteers at the Australian Museum to scan his extensive library and reprint collection. In conjunction with Dr Oliver Coleman, the scanning project has made more than 6000 books and articles available to taxonomists around the world. He was generous with his knowledge and always encouraged students and novice taxonomists, co-supervising 12 MSc and PhD projects on the ecology and systematics of amphipod and isopod crustaceans. From 1983 to 1998 Jim was the Editor of *Records of the Australian Museum* and introduced a new style and large format to update the journal.

Jim met Dr Lucia Fanini at the 14th International Amphipod Colloquium in Seville in 2010. They were married on Scotland Island in Sydney in 2012 and Rafael was born in Crete in 2013. Lucia joined Jim in Sydney for a time and in 2015 Jim moved to Crete where Lucia held a position at the Hellenic Centre for Marine Research. Jim and Lucia worked together on the ecology and systematics of talitroids and published five papers together.

In July 2021 the family moved to Lecce in Italy, where Lucia had been appointed to a position at the Università del Salento. On 4 November 2021, Jim died. It is hard to believe that his lifetime contribution to taxonomy, evolution, and biogeography has come to an end. His contribution to carcinology is immense and he is missed by his many colleagues, students, and friends. Jim is survived by his loving wife Lucia, his young son Rafael and adult son Ken.

ACKNOWLEDGEMENTS. This obituary has benefited from discussions and review with Shane Ahyong, Lucia Fanini, Graham Fenwick, Alan Myers, and Gary Poore.

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Jim the Man: Reminiscences by his Friends

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Introduction

This volume celebrates the many achievements of Jim Lowry. He was without doubt one of the foremost amphipod taxonomists of his time and his publication record is testament to this. To his friends, however, he was much more than the sum of his scientific works. He was a warm and generous colleague who enriched our lives. There follow some reminiscences by his friends, reliving memorable times spent in his company, along with a selection of photos taken over the last three decades (Fig. 1).

Alan Myers

I was fortunate to know and work with Jim for over forty years. We spent many hours together enjoying music, art, good food, and drink, and of course we discussed some of our pet grievances: over-population of the world by humans, lack of action by politicians on the environment and the long-term problems of the Sydney water supply! Because he despised what humans were doing to this planet, he sometimes couldn't resist the temptation to add derogatory remarks to our manuscripts in preparation. The intention, of course, was to remove these remarks before submission. On one occasion, the references section of one of our manuscripts included the paper by Peart & Lowry "The genus *Arcitalitrus* in New South Wales forests", but what he had actually written was "The genus *Arcitalitrus* in what is left of New South Wales forests". This was typical of the cryptic remarks that one had to search out and delete before submission!

Jim grew up on a peanut farm in Virginia. Perhaps this instilled in him his love for nature. He recalled strolling down to the river to watch the geese as they arrived during their migration. He was a fan of old cars and bought himself an MG sports car in such a bad state that his stepfather had insisted that he should not buy it. However, Jim, being Jim, took no notice of the advice and spent hours working on it until he had it fully renovated and his father had to eat humble pie when he saw it with its gleaming paintwork. Later, one of the outhouses at the farm burnt down and Jim lost all of his books and possessions in the fire. At the University in Virginia, he commenced a degree in English, but his love of nature and time spent in the company of the renowned marine

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biologist and environmentalist Joel Hedgepeth converted him to marine biology.

After graduating, Jim then spent time in Antarctica. Many of us have a few amphipods named after us, but who of us has a mountain named after him or her? Jim did, Mt. Lowry, in the Patuxent Range. One of Jim's more hair-raising adventures in Antarctica is described in great detail later by Oliver.

Jim's first home when he arrived in Sydney was in Paddington, but before long he had moved to Pittwater on Scotland Island. He left it with considerable misgivings when, after his retirement, he moved to Crete. It was not the first time he had left his beloved Scotland Island, because he had moved to live with his then wife in Balmain, inner Sydney for a few years. However, he never became accustomed to urban life and was delighted when the opportunity arose for him to buy back his house and once again live on Scotland Island. He welcomed his friends to stay at his house and his "friends" included native wildlife. Parrots flew into his living room for titbits of food and he had a special place for a butcher-bird which dined off the best steak money could buy. He did, however, take exception to the sulphur-crested cockatoos that destroyed the railing of his deck with their strong beaks when he didn't feed them on time. He was also proud of the large goanna that climbed up onto his deck and strolled nonchalantly among his startled guests. Being American, Jim was brought up on bourbon as his whisky of choice, but in his latter years when I introduced him to single malt Scotch and Irish Whisky these quickly became his favourite tipple.

Although he drove a large 4-wheel drive Jeep, his real love was his motorbike—he owned several, his last being a BMW—and he liked nothing more than going on long "safaris" into the outback with his friend Pat whose reminiscences follow later. He had several quite serious crashes, but typical of him, after his worst crash he somehow managed to get himself home and although badly hurt, nursed himself back to health with no medical help whatsoever.

Jim travelled to many parts of the world on collecting trips. The downside of this was that when he tried to get Australian citizenship, he discovered that he did not have the required length of uninterrupted residency, as a result of being so often out of the country on research trips. He did manage to achieve it before he left.

Jim made Ireland his second home, making many trips to stay in Cork for weeks at a time. He was at his happiest taking walks by the sea. He particularly enjoyed Irish folk music and was able to go with us to a number of music sessions in pubs and elsewhere. On one occasion we went to hear one of his favourite Irish folk singers. He was excited by the prospect of talking to him, but admitted to us afterwards that he couldn't understand a word he said due to the Cork accent. Although he was brought up on American Country & Western music, it was left to us to introduce him to the American singer Nancy Griffith, who became a favourite of his.

One thing I learned about Jim quite early was, that when travelling on his own, he was a disaster waiting to happen (as Lauren also recounts later). On one occasion we arrived at Cork airport for his flight home to discover that his plane had left the previous day. *"I was sure it was Wednesday"—"no Jim it says Tuesday!"* On another occasion when he visited us, we dutifully waited at the airport arrivals hall until every passenger from his flight had come through—where was Jim? It turned out that he had missed the connecting flight at London airport, because he had misread the time. Once you had realized that it was essential to check all Jim's documents for him, life proceeded smoothly. When travelling to foreign parts, although collecting amphipods was his main objective, he also immersed himself in the local culture and wildlife. In Madang he enjoyed visiting the local market and seeing all the artefacts such as masks and story-boards from the Sepik region, as well as the hawkers trying to sell us cuddly cuscus and impressive hornbills. He brought several select items (but not the animals) to his house on Scotland Island.

It was amphipods that brought us together in the first place and it was unravelling their phylogeny that gave us particular satisfaction. We sat side by side with our computers at Jim's house on Scotland Island, at my house in Cork, in a thatched rondavel in Tioman Island, Malaysia, at Panwa Marine Biological Center, Thailand, and in Kokkini Hani in Crete, from dawn (Jim was a very early riser) until late in the evening, sometimes for three or four weeks at a time, stopping only for food and perhaps a glass of single malt (or Mekong in Phuket) when the sun was over the yardarm. We exchanged DELTA files, nexus files, PAUP trees, and MacClade trees, the slog broken only occasionally by shouts of "Eureka!" when things seemed to fall into place.

The opportunity of a lifetime must be taken during the lifetime of the opportunity. I will always be grateful that I had the opportunity in my lifetime, to have Jim as my friend.

Penny Berents

I first met Jim in 1976 when he arrived at the Australian Museum (AM) as the new Curator of Crustacea. I was a Research Assistant at the AM and looking for a Masters project. Jim was keen to take on students to learn about amphipod taxonomy and that was the beginning of a long friendship. I knew Jim as my mentor, colleague, friend, and ultimately as his boss. Jim was generous with his knowledge and encouraged students to be thorough and meticulous in their work. Jim had friends and colleagues around the world and he encouraged me to make contact with his network of amphipod workers to foster my studies.

Jim was fun, irreverent, generous, enthusiastic, dedicated to his work and a keen observer of the natural world. He was interested in plants, birds, boats, art, good design, motorbikes, and bicycles. He loved running, cycling, skiing, bushwalking, diving, and natural materials like wood. He despaired of the world that "the humans" (as he would say) were creating. Jim always regarded himself as a southerner but did not believe in patriotic ties. He was a world citizen living and working around the world: USA, New Zealand, Antarctica, Australia, Papua New Guinea, Ireland, Denmark, Greece, and Italy.

Jim was a friend and colleague of Jerry Barnard, whom he held in high regard. Jim challenged himself to exceed the standards set by Jerry. Jerry would be proud of what Jim has achieved in the amphipod world. Jerry was a frequent visitor to Australia and I was so lucky to be tutored by these two masters of amphipod taxonomy.

Jim was always dreaming up new projects and new questions about amphipods. Somehow, he managed to find funds for many of his ideas. I remember late one day he came to my office and was describing a new project to study

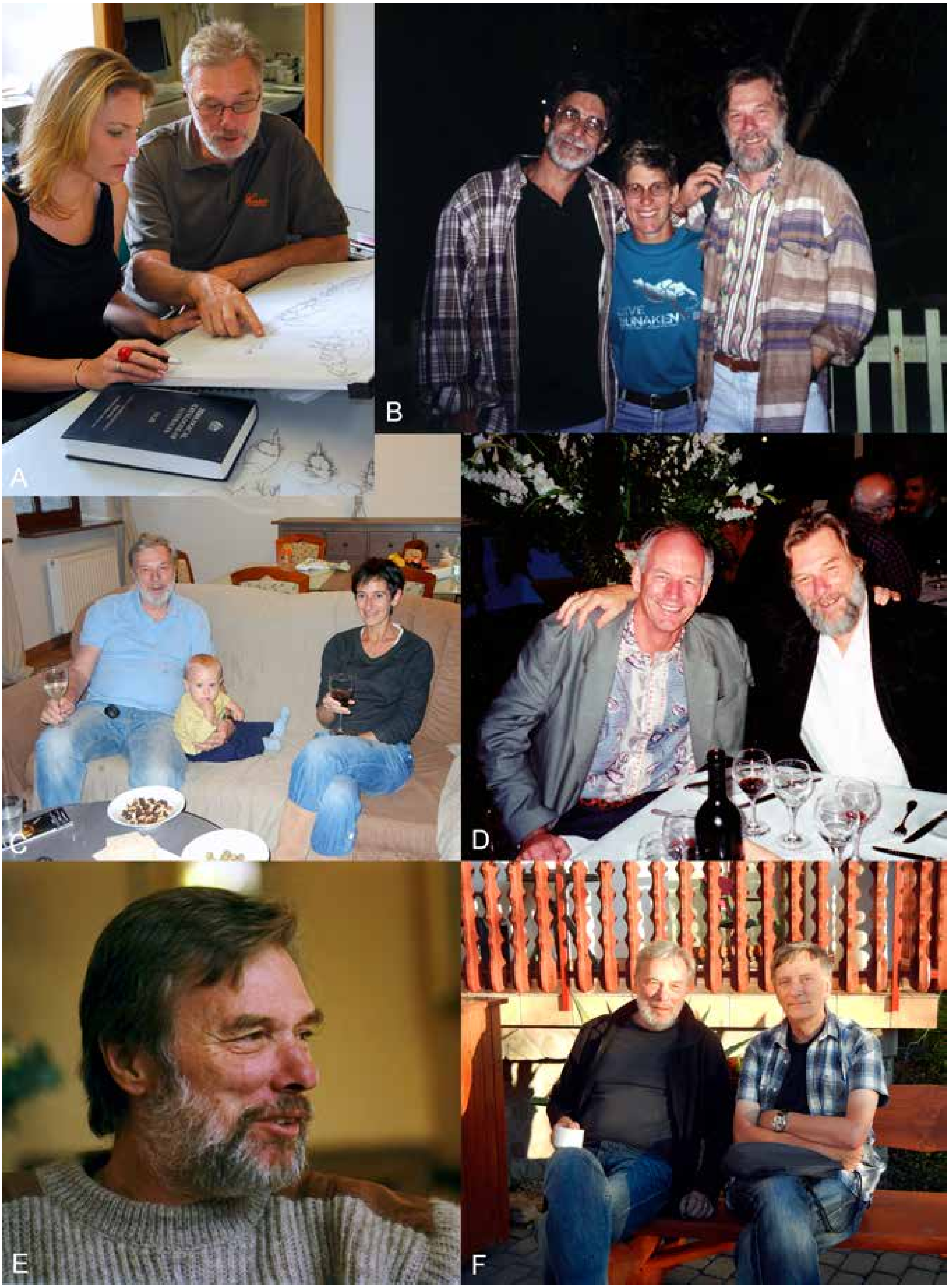

Figure 1. (*A*) Jim Lowry and Lauren Hughes at the Australian Museum; (*B*) Rick Brusca, Penny Berents and Jim Lowry in Sydney, 1994; (*C*) Jim Lowry, Rafael Lowry and Lucia Fanini at the 15th International Amphipod Colloquium, Szczawnica, Poland, 2013; (*D*) Gary Poore and Jim Lowry, Sydney 1994; (*E*) Jim Lowry; (*F*) Jim Lowry and Alan Myers at the 15th International Amphipod Colloquium, Szczawnica, Poland. Photo credits: A (Stuart Humphries, Australian Museum); B, D, E (courtesy of Rick Brusca); C, F (Penny Berents).

scavenging communities along the Australian east coast with transects from 50 metres to 1000 metres depth and spanning hundreds of kilometres from south to north. He described the traps that he would use on small fishing boats. Great idea Jim but how will you fund that!? Sure enough, he raised the funds, and the SEAS project was born (Scavengers of East Australian Seas). It yielded much information about scavengers in Australian waters. Jim led many expeditions to build the amphipod collections of the AM and these collections are still a resource for species discovery at the AM and beyond.

In recent years I continued to work with Jim on cerapodines and I enjoyed the friendship of Jim and Lucia. I was privileged to be at their wedding and to visit them both in Crete after the birth of Rafael. I treasure my memories of Jim.

Shane Ahyong

It was a Friday afternoon in 1992 when I first met Jim. Back then, I was an undergraduate biology student and had come to the then sub-basement of the Australian Museum to examine stomatopods. That day, in the office, instead of the person I'd come to see, was Jim, relaxed and engaging (I think he was wearing a cap and possibly a Che Guevara T-shirt). We canvassed all sorts of topics well away from carcinology and somehow finished on Blue Swimmer Crab trawl by-catch in Moreton Bay—neither my major interest nor his at that time. This was my first glimpse of Jim's expansive curiosity (extending well beyond crustaceans) and there'd be many more wide-ranging conversations over the next three decades.

Ever impressive was Jim's energy and infectious enthusiasm for all things Amphipoda. It seemed he could talk amphipods all day long and his team was like a production-line generating a steady stream of new crustacean knowledge. That Jim was a single-minded scientist is not in doubt but he was not to be tied to just one line of inquiry, being never short of new ideas and plans—the SEAS Project, the Lysiannasoid Project, Crustacea.net, and the Circum-Australian Amphipod Project, to name just a few. In his later years, he was also very concerned for the future of taxonomic research and lamented the lack of opportunities for new taxonomists.

Jim was in many ways a larger-than-life character—personable, easy-going, widely read and a brilliant raconteur to be sure, but more fundamentally, I remember him as driven and restless. The drive to go further, discover more and understand more deeply; restlessness that would never be satisfied standing still. That combination occasionally fomented conflict but probably also contributed to his success. Whatever it was, it worked for him, and his impact on amphipod taxonomy remains for all to see.

Amphipods always held sway, but Jim did have other vices. Physical fitness was particularly important and running was a regular part of his week. He enjoyed sports and didn't mind a drink but motor bikes must have been at or near the top of his list. A mutual colleague often commented that Jim had nine lives, and perhaps with some justification. More than once, Jim arrived at work looking the worse for wear after coming off his bicycle or motor bike, and I recall one day spending some hours in the museum loading dock driveway helping re-attach the broken indicator light on his motorbike after a misadventure on the way to work. It was a new bike and he was so disappointed. I don't remember which bike (there were several), but whichever it was, Araldite wouldn't stick to the plastic parts; we fixed it another way.

After spending some years overseas, in 2010 I returned to the Australian Museum; Jim was as active as ever. By this time, the Circum-Australian Amphipod Project had given way to his rapidly growing interest in talitroids. Although his mind for science remained sharp, within a few years, Jim seemed to many of us to have slowed somewhat, seeming not quite as driven to run each day and perhaps somehow more mellowed. By this time, he'd met Lucia, whom we all could see must have been good for him; soon enough, he moved to Crete. And, after knowing him for decades, we also thought he could no longer surprise us, even with word he'd soon re-marry; however, the additional news that would also be a father again….well, amazing. Restless no longer.

Even to very late in the piece, we were corresponding on taxonomic and other matters. We didn't always see things in the same way but remained friends and colleagues. Jim was the first to tell me about the beautiful original d'Orbigny crustacean prints that can be had from street vendors on the banks of the Seine, just around the corner from the Paris Museum. One now hangs on my wall at home.

Oliver Coleman

It was in July 2001 during the 5th International Crustacean Congress in Melbourne that Jim and I first met. We had been in contact before, but then I met this man in person whom I admired so much. He invited me to work with him in Sydney on a collection of iphimediids and I spent two months in a visitor's laboratory just around the corner from his office. Very quickly I experienced Jim's great sense of humor when he nicknamed some of the most conspicuous taxa with provisional names. For example, a spinose species collected in the Tasman Sea he called "Tasmanian Devil" another with a saddle-like dorsal depression "Mr. Ed the talking horse" (the female we called Mrs. Ed), named after an American sitcom from 1960s. Later these nicknames were of course changed into reasonable names. When we ran out of new names, we immortalized the first names of the three most helpful ladies of the museum library (Carol, Leona, Nina) combining them into one species name: *Ochlesis caroleoninae* unaware whether they would actually like it to be forever trapped together in one name!

Jim had a small, very cosy wooden house on Scotland Island that Alan has previously referred to. It was full of beautiful Melanesian indigenous sculptures brought home from his stays at the Madang research station and also Australian aboriginal dot paintings. They were hanging in perfect harmony with paintings created by the Scotland Island artist Nettie Lodge who lived next door.

When we worked together on a manuscript, we often sat with our notebook computers on the deck or in the living room. As the house was on the slope of the hill, we looked into the green canopy of eucalyptus trees, the blue of Pittwater shimmering through the leaves. Swarms of lorikeet-parrots and cockatoos would make a stopover on the railing of the deck waiting for food. Jim always had food for them and loved it when they would land on his hand. He kept meat and cheese in the refrigerator for species like magpies or kookaburras. And he always had grapes in store, the preferred treats for currawongs. His favorite birds were the gentle king-parrots, who regularly distracted us from our work by flying into the living room. They always found something to eat in a black wooden bowl on the dining table, a souvenir Jim had brought from Papua New Guinea. There were other animals coming into the house. Sometimes possums sneaked in at night eating all the fruit in the kitchen. They were very cute, but also a nuisance. We once caught one in a trap and took it away from the island at 4 o'clock in the morning, so none of the islanders could see us kidnapping the cute little bugger. And then there was the scary 1.5 m long Goanna lizard who liked to rest on Jim's bed. As in many warm regions of the world, the house was an Eldorado for cockroaches. They were everywhere, even running up my legs while cooking in the kitchen. I wondered how they could get even inside cookie tins. To control them, Jim always had bait boxes, so-called "roach hotels" which I liked for the advertisement motto: "they check in, but they never check out".

Jim was very athletic and aside from his beloved BMW motorbike he had two expensive pushbikes, a street bike and a mountain bike. We made regular bike trips into the close by Ku-ring-gai Chase National Park. One day we were running down a very steep hill and we both fell. Jim got a bad bruise on the knee and I fell into a thorny bush and I looked like a porcupine, but we both laughed and had a beer as a cure. Regularly, we were running around Scotland Island. I had to take care to lag behind during the last few metres of our race, giving him the chance to win. Jim was very competitive and hated to lose, even against somebody 20 years younger than he was.

Jim was a great storyteller and he loved to share his many adventures with me when relaxing on the porch at night. The best story of all goes back in time to Jim's PhD research when he worked in the Antarctic at the small New Zealand run field station Cape Bird on Ross Island. One day Jim and his three friends Graham Fenwick, Paul Sagar, and Warren Farrelly decided to make a short trip with the glass fibre trimaran "Clione", normally used as a research platform. They did not make it far when the motor died and they did not notice that they were drifting away from the station into the open water of McMurdo Sound. After a while the four scientists decided to abandon the trimaran, grabbed what might be useful from the boat and moved onto an ice floe. They jumped from floe to floe towards the shore, but the floes were too far apart. Jim tried to cross a stretch of thin ice and moved on his belly over the black ice, broke in and fell into the -1.8°C cold water. After a terribly cold night, while they tried not to fall asleep, currents moved their ice floe quite close to the station. But then a strong storm came up and their floe was pushed far into the open water again. Another night on the floe and Paul became lethargic, so the friends made him move, they were singing songs in order to stay awake. Day four on the ice and an *Orca* came close to their floe. They did not move, fearing that the whale might tip them over as they do when hunting seals. The same day a penguin jumped on their floating ice sheet, so Jim caught it, killed it, and shared the bloody meat with his friends. It gave them energy and revived their spirits. On the fifth day a rescue helicopter flew over them, but the crew did not see them. At least somebody was searching for them! For the next time they wanted to be prepared and cut of the legs of their rubber boots in order to ignite a smoky fire to draw attention. By the sixth day all of them were very desperate, far out in the open ocean without any other ice floes nearby. But then they saw a C130 Hercules plane which had taken off at McMurdo Base and they signaled the pilots with a little hand-mirror. They were finally rescued by a helicopter, frostbitten, snow-blind but happy. This nightmare story was later documented in the New Zealand TV program "Against the Odds" and more recently in *New Zealand Geographic* https://www.nzgeo.com/stories/at-the-mercy-of-the-ice/.

Gary Poore

I first met Jim in my office at the University of Canterbury in Christchurch, New Zealand, in 1970. He was just starting his PhD with George Knox on Antarctic benthos. I had returned on holiday to my alma mater from Melbourne, Australia, where I was employed to report on the benthos of Port Phillip Bay. We soon discovered our common interest in peracarid crustaceans, an interest that we were able to share for the next half-century. Soon after Jim moved to the Australian Museum, he visited Melbourne to invite me to join him on the 1977–1978 expedition to Macquarie Island. By that time, we had both begun to describe the many new species being discovered locally, amphipods by Jim and isopods by me, both choices influenced by our regular meetings with Jerry Barnard. The three-month Macquarie Island expedition involved two other divers besides Jim and me. A stay of this period on a cold, rainy, and isolated island (no email then) is certainly an opportunity to get to know someone. While Jim was the initiator and organizer his leadership was low-key but effective. He and I became close friends. We all shared in the onerous tasks that were necessary to collect from the shore: day-long hikes from the base carrying wetsuits, air tanks, weight-belts, samples of algae, sometimes food, and even an air compressor. We became exceptionally fit and certainly had no fear. Our inflatable boat was used to get divers beyond the fringing kelp but on one occasion we were unable to row it home into the headwind. We had to beach under a 200 metre cliff that we then climbed and walked home with our samples. Jim and I recovered the boat later.

For 30 years, 1979–2009, Jim and I held equivalent positions in the museums in Sydney and Melbourne (he started earlier than I and left after I had retired). Our roles, variously titled, were in part to document the Australian crustacean fauna and this brought us into frequent contact, in both Sydney and Melbourne. Jim was an extremely focussed researcher. For many years he concentrated almost entirely on lysianassoids, then later it was talitroids. He was an early adopter of the taxonomic software DELTA and influenced its development. It was Jim's encouragement that got me using the program for my own work but he had to explain its advantages and subtleties several times over. I recall getting up early while staying at his home on Scotland Island to discover Jim had been working since the very early hours converting yet another amphipod family into DELTA format.

Our friendship extended easily beyond working hours. Jim was relaxed and entertaining company. I always enjoyed visiting and discussing his collection of books and art. Together we explored Pittwater in his tinnie and spent evenings discussing the world's ills over good food and wine. He stayed with my wife Lynsey and me in Melbourne whenever he visited and got to know our children well. His friendship with our son continued professionally when Alistair moved to UNSW in Sydney where they collaborated on the taxonomy and biology of amphipods.

In 2011 Jim and I visited Tonga in the South Pacific. He was looking for a particular shore amphipod in its type locality. I offered to keep him company and search for intertidal ghost shrimps—I was recently "retired" and was free to go exploring. It was a relaxed expedition befitting two naturalists of our age but we found what we wanted and enjoyed each other's company as we always had.

Roger Springthorpe

I had the privilege of knowing Jim Lowry for over forty years. As friends and colleagues, we had our ups and downs but were still collaborating until his health deteriorated suddenly. I remember many anecdotes concerning Jim and I would like to share some of them.

Jim had a great mind for amphipods, but not so much for bureaucratic machinations. For many years Jim had all his personal mail, including bills and the like, sent to his Australian Museum address. Under his desk, was a large cardboard box into which he filed any envelope with a window or hint of officialdom, without even opening it. This included phone bills, electricity bills, car driver's license, car registration and so forth. Many a time there would a flurry of activity to locate the required bill to restore power or evade large fines, interspersed with cries of "It's lost"! But then that cry was often heard when something was misplaced—in plain sight!

Not only did Jim have a love of amphipods, but also for natural history in general. For many years he lived on Scotland Island in Pittwater and enjoyed the proliferation of wildlife there. He would feed grey butcher birds, sulphur crested cockatoos and king parrots which would visit of a morning to sit on the deck rail or inside the house on the back of a chair, expectantly. Goannas too would wander through looking for tasty morsels. Alas, as the dog population on the Island grew, the goanna population declined much to Jim's disgust. He didn't like dogs very much. He also had a strong interest in Australian native plants and developed a beautiful bush garden at his house as well as a DELTA database of the Sydney sandstone flora, doing many bush walks in Ku-ring-gai National Park to take photographs of flowering plants. He railed against needless and apparent wanton destruction of the environment at the hands of greedy corporations and couldn't understand why governments were blind to the approaching climate disaster.

Cycling and running were two other pursuits for Jim, and he would occasionally come to work with harrowing tales and physical proof of some close encounter with road base or tree branch. To avoid traffic congestion travelling between home and work, Jim used to ride a motor cycle on most days. Sadly, though, he came to grief when he collided with a car and spent some time in hospital. I went to visit him to find him outraged at being placed in the geriatric ward. Even though he was well over sixty at the time, he didn't seem that old, but it knocked him around a bit.

Scuba diving was a necessity for Jim's research interests, and his underwater swimming technique was clearly influenced by his love of cycling. This interesting circular motion of his fins, however, did little for the efficiency of his underwater swimming but didn't hinder his ability to make excellent collections of amphipods.

To commute from Scotland Island to the mainland each day, he used a boat that he called the *Flying Scud*. When Jim left the Island to live in Balmain for a few years the *Flying Scud* resided on a trailer and became the department's defacto research vessel, and the name is entrenched in the collection data. It was a good dive boat.

Jim was an avid reader and had quite an extensive library of mostly science-related volumes some of which were rare. He also had an eclectic art collection of paintings and artifacts by local artists and from his many field trips to exotic places.

After Jim and Lucia were married, he decided that it was time to retire. Whereas many retirees opt for golf or gardening in their later years, Jim chose to start a new family. Together, Jim, Lucia, and Rafael moved to Crete where Jim could continue to indulge his study of amphipods and Lucia could continue her work at the institute in Gournes Pediados. We visited them there in 2018 and had a fabulous time. Jim and Lucia were our tour guides. He was working hard as usual on things amphipodous and was happy with his life in Crete. We had a lot of fun and that's how I remember Jim.

Lauren Hughes

I met Jim when I was a 20-year-old, impressionable and keen, honours student. The opportunity to work with him led to a collaboration over the next 22 years and it was a privilege to share an office with him for just over a decade. You can never quite put into words the amount of knowledge absorbed through daily conversation and the familiarity of spending hours in proximity (as regularly commented, more waking hours than you spend with your home life).

Visitors to the Australian Museum will know that eating lunch together on Stanley Street, or the surrounding suburb, was a daily work ritual. On the odd day when you attempted to get out of lunch, Jim would not be happy, so it was always better to go along, which wasn't much of a burden as it was a chance to talk amphipod research in great company and eat great food. The size and type of meal was proportional to the work being completed on that day—quick take away sushi if there was a manuscript to finish; sit down Thai food or sushi train when there was a longer discussion about a difficult to place taxon, Italian, usually associated with departure or return from travel, fieldwork or the arrival of guest researchers. At one point over the years, we were both fond of steak, pomme frites and Tasmanian oyster stout at the French restaurant for a celebration or for tough days to lift the mood—great fun on either occasion.

The opportunity to work in Jim's lab resulted in a lot of amazing travel to remote places for fieldwork. Looking back now, it was even more fantastic than I took it to be at the time (Lizard Island, Heron Island, Torres Strait, Christmas Island, Cocos Keeling Island, Norfolk Island, Timor-Leste and Ningaloo Reef twice). There were always so many nuisances to organize with boats, travel, accommodation, processing space, freight, and so forth to keep me grounded and busy. Jim's calm attitude was a little frustrating at times with so much needing to come together—wind, rain, and high seas, can all scupper six months of planning. Yet there was also a great confidence and the awareness that he was giving me the opportunity to lead and learn. Jim was an incredible teacher, with an effortless and casual manner. Although I sometimes felt that I was being left to do "everything" it made me an independent and confident scientist with the experience of so many successful trips.

Jim was always ready to embrace new technology and had the innate ability to think big. Every time I had just a single new species, I found myself coerced into databasing the entire world genera for the family. Although I grumbled about it at the time, I did the work and only afterwards realized how much I had gained from the experience. He initiated a volunteer programme to scan amphipod literature, I remember thinking "what a pipe dream it will never get finished". Now, the resulting pdf library of the majority of the amphipod literature is shared and reshared throughout the peracarid community. His World Amphipod Checklist became a *magnum opus*. When he discovered that Microsoft word is unstable after 50,000 pages, he persisted in splitting the file. He would work every morning at home, bike to the museum, then return home to work until late in the evening and after four year's his 9,500 records formed the kernel of the WoRMS amphipod database (see Horton *et al*., this edition).

I can still recite Jim's birthday 2-10-42. He liked to sing it along with his passport number when we travelled overseas to conferences and workshops. Again, I am struck by how many working and travel opportunities were open through Jim's strong work ethic and friendships. Jim was slightly disorganized with documents constantly losing passports or forgetting to book the accommodation, so I would manage these documents. Although he was notorious for borrowing $10 for lunch and forgetting to return the funds, or borrowing money from me, a struggling PhD. student, and forget to find a cash machine, he also showed unexpected kindness. Heading to the Seville Amphipod Colloquium we stayed in Madrid as the stop over (because I wanted to see the Prado and Jim, Guernica at the Reina Sophia one of his favourite images). Post conference I returned to Australia early and Jim went back to Madrid, I made the booking arrangements for him to stay at the same hotel near the train station and restaurant area. Sometime later when we were both back in the office in Sydney, Jim came in very sheepishly that morning and gave me a travel gift. It was very out of the usual, a delicate ceramic sea urchin lantern that I still cherish. He told me how he had wanted to go back to a deli we had seen which had a fantastic small-goods display, but ended up getting terribly lost for several hours and could find no one to direct him, nor could Jim remember the hotel name. Jim admitted that he realized at that point just how much he depended on me for getting around, because he discovered the hotel business card that I had put in his wallet, just in case! The other very kind gesture is a limited edition print of an indigenous artist Abby Loy that always hangs in my lounge room. Jim picked it out from a local Sydney gallery as a gift to commemorate the Circum-Australian Amphipod Project coming to a successful end, we had worked with a number of indigenous and local groups as part of the fieldwork. The print remains a treasured item, a memory of all the adventures and a great symbol of the friendship that only an unexpected gesture purveys.

Jim was a remarkable scientist in the field of Crustacea, "one of the greats"; what is more, he was a brilliant conversationalist with interests in art, photography, music, motorbikes, and travel. Jim was a people person, warmly engaging with local communities, and had an enormous network of friends around his home on Scotland Island (and later in Crete) and internationally through his productive career. Having shared so many in hours of office, field, and travel work Jim was instrumental in shaping my life and remains so. His companionship and encouragement was an amazing honour for all who knew him, both personally and professionally.

Pat Filmer-Sankey

How to describe Jim? Generous, funny, impulsive, a dedicated scientist, and as we know, sometimes brusque. So many memories and of course so many regrets, including hovering over him, nominally helping with an air-lift sample somewhere on the Great Barrier Reef, with my eyes full of sunscreen and my mask full of tears and snot, ardently wishing that he would get a move on, his leading of a most ill-advised but joyfully joined game on the *Flamingo Bay* returning from Elizabeth and Middleton Reefs when, as in heavy seas, we approached Sydney Heads, he had all of the Australian Museum expeditioners on the foredeck, standing on one leg to see who would last longest.

We shared so many memorable moments with our joint love of motorcycles. Our trips together included the Oodnadatta Track to Alice Springs along tracks rendered almost impassable by the cyclones Yasi and Carlos (our timing was impeccable), a trip he took against the advice of his optometrist who feared he might lose a retina, shameless flirting with the pilot who flew us over Lake Eyre, his BMW F800 going down six times, once pinning him where he lay until I, on my cautious Honda CX 500 arrived to pick him up and dust him down, the failure of the zip on his micro-tent which left him at the mercy of a hungry and diverse mosquito hoard, when we woke (if we had ever managed to sleep) to find our small camp decorated with camel pad tracks, our rain drenched farewell at the top of the escarpment above Port Augusta and my visiting him in hospital (with a small bottle of Jim Beam), where he lay with broken ribs after demounting from his Honda in an uncontrolled manner and how we could NOT stop laughing despite the obvious pain. His innate generosity was epitomized when he lent me the deposit for a '74 Honda GL 1000, insisting that I do not miss the opportunity to buy it.

He was almost shy and diffident when he first told me about his great love for Lucia and how they planned to marry, so at odds with his sometimes-casual air. Lucia tells me, that being pregnant, she was the ONLY one who was sober at their joyful wedding on Scotland Island. His doting love and affection for the lively Rafael was exemplified by the spectacular bruise that had been accidentally inflicted by a toy fire truck. He wore it as a badge of pride, throwing himself wholeheartedly into fatherhood. This was one of the very last times I saw Jim.

These are a few of the things I think of when I recall Jim—someone who marked all who knew him indelibly and who is sorely missed.

John Dermand

Jim was not only a great host but also a perfect guest. We didn't live in the same city for the last 25 years but we visited each other often. His closest living relative; Aunt Dorothy lived in Long Beach and that brought Jim to Los Angeles most years. As many who knew him know, Jim was the easiest person to have as a guest. He had a quiet easy-going manner and was always up for good food and wine. The only time I saw that manner change was when we compared notes about conservative politics and how the planet was suffering.

I learned early on what a respected scientist he was and about his dedication to his work. It must have been a challenge for him to explain some of the complexities of his work to a non-scientist like myself. He was patient and always generous with his time. It was a challenge and fun to keep up with him and his endless curiosity about people and the world. I sure miss him.

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The Contribution of J. K. Lowry (1942–2021) to Amphipod Systematics: New and Revisionary Taxonomy

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ABSTRACT. James K. Lowry (1942–2021) was one of the most prolific crustacean taxonomists of the late 20th through early 21st century, authoring some 214 publications over a period of some 55 years in which he named some 800 new taxa including 5 suborders, 62 families, 129 genera, and 548 species of primarily amphipod crustaceans. The present work provides a complete list of Jim Lowry's scientific publications along with the new taxa that he described therein.

Introduction

Dr James K. (Jim) Lowry (1942–2021) was one of the most prolific crustacean taxonomists of the late 20th through early 21st centuries, authoring 214 publications over a period of 55 years. Jim's taxonomic career can be grouped into a number of phases that resulted in multiple publication outputs: early studies of the New Zealand fauna arising from taxonomic investigations from his PhD based in New Zealand and working in the sub-Antarctic; the beginnings of the world lysianassoid work; the Papua New Guinea publications; the *Zoological Catalogue of Australia* on Amphipoda, Cumacea, and Mysidacea; Great Barrier Reef Amphipod Expedition; Circum-Australian Amphipod Project; consolidation of the lysianassoid work; and talitroid revisions. Importantly, weaved across the decades, were the higher classification studies with Alan Myers and many fruitful collaborations in between.

At the time of writing, Jim had contributed 800 new taxa to, as the late Thomas Roscoe Rede Stebbing would write, Amphipodous Crustaceaology. This includes 5 new suborders, 62 new families, 129 new genera and 548 new species (Table 1), yet this number will increase in the coming years as collaborating authors finalize manuscripts. This is fitting, as Jim collaborated widely, with more than 50 international colleagues during his five decades of taxonomic publishing.

Jim's legacy in amphipod taxonomy provides a continuation of the iconic work of his dear friend and mentor, the late Dr J. Laurens (Jerry) Barnard, whose publications between the 1950s and early 1990s are foundational for modern researchers. Jim first corresponded with Jerry in the 1970s during his PhD Jerry, as a formative mentor, was well established in what would become a phenomenal contribution to understanding higher relationships of amphipods across five decades, a field that had largely been left untouched since Stebbing at the beginning of the century. Jim is the second most productive amphipod worker in history, behind only Jerry Barnard for both descriptive and revisionary work. Jim's 55 year history of research undeniably identifies him as a great contributor with broad ranging alpha-taxonomy

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providing the basis for more detailed evolutionary analysis.

Jim's first taxonomic amphipod publication was in 1972 on the distribution of the *Microprotopus raneyi* Wigley, 1966 from North America, a species collected during a summer programme while in the Marvin L. Wass lab (Virginia Institute of Marine Science). In total, Jim went on to publish on more than 1,000 taxa, either as new species, redesriptions or new distribution records within the broader Peracarida.

During Jim's twenty-year collaboration on amphipod higher classification with Alan Myers, they instated 27 families and introduced several hierarchical placements new to the classification of Amphipoda to contextualize relationships (i.e., Parvorder, EpiFamily). The hypothesis of these relationships between groups, based on morphology, gives a comprehensive platform to test and refine by future researchers, without which our shared language of the diversity of an important, highly diverse group would remain much behind that of other Arthropoda. The Myers-Lowry syntheses of the higher classification of the amphipods represent the zenith of a publishing collaboration of more than 40 years across many amphipod groups.

Jim's most productive taxonomic collaboration was with Helen Stoddart, producing over 378 new or revised species/genera/families. Over 97 new or revised taxa were also documented in collaboration with Kilgallen, Myers, Springthorpe, and Hughes. As the sole author, Jim produced work on 51 species, and, with his leading 10 collaborators, described 548 new species (see Table 2). Jim's appetite for new collaborations and projects had consequences for the long standing lysianassoid work, which began in the 1980s with a tour of major European museums to establish the location of type material, validate specimens, borrow and illustrate material. This enormous project was supported by Helen Stoddart, who assisted with manuscript preparation and illustration. Roger Springthorpe began contributing illustration and plate preparation from the 1980s onwards. As the decades rolled on and other exciting projects took prime place for completion, the grand challenge of revising all the lysianassoids at generic level faltered. After 30 years, other projects led to the dissolution of Helen and Jim's collaboration, which is where we see the series of Lowry-Kilgallen papers commence. Niamh Kilgallen, having recently completed a PhD, was able to step in to bring the alpha taxonomy to fruition with figures already prepared, specimens already sorted and working identifications already made through Roger's and Helen's years of dedication. Lauren Hughes also finished some smaller papers on lysianassoids, though much credit goes to Helen for years of dedication to the lysianassoid project, her attention to detail and skills as a taxonomist. The larger world lysianassoid revision, which was already progressed with scored databases and standardized illustrations for the type species of each genus/family, was thus published for the most part in piecemeal fashion. Although not in the intended "grand book", the collective work on lysianassoids remains essential for the taxonomic understanding of the group. The final resulting tally of 598 lysianassoid species/genera/families is in no way diminished.

It is not surprising that the lysianassoids and talitroids are the two groups about which Jim published the most, whereas *Floresorchestia*, *Tryphosella*, *Ichnopus*, *Elasmopus*, and *Cheiromedon* were the genera most published on, when based on taxon counts. Many trivialities can be extracted from reviewing the great list of species but perhaps a sense of Jim's partialities and spirit is best left to the reflections of colleagues. Jim would gladly share that over patronyms or descriptive terms. Jim found inspiration for new scientific names often from such things as shipwrecks or the euphony of Australian First Nations' words. Table 1 lists new taxa named by Jim.

Publications of James K. Lowry (214)

1966

Calder, D. R., J. R. Thornborough, and J. K. Lowry. 1966. Record of *Ecteinascidea turbinata* (Ascidiacea, Porophoridae) in the York River, Virginia. *Chesapeake Science* 7(4): 223–224.
https://doi.org/10.2307/1350443

1968

Wulff, B. L., E. M. T. Wulff, B. H. Robison, J. K. Lowry, and H. J. Humm. 1968. Summer marine algae of the jetty at Ocean City, Maryland. *Chesapeake Science* 9(1): 56–60.
https://doi.org/10.2307/1351284

1972

Lowry, J. K. 1972. Taxonomy and distribution of the genus *Microprotopus* along the East Coast of the United States (Amphipoda, Isaeidae). *Crustaceana* Supplement 3: 277–286.

1974

Lowry, J. K. 1974a. A new species of the amphipod *Biancolina* from the Sargasso Sea. *Transactions of the American Microscopical Society* 93(l): 71–78.
https://doi.org/10.2307/3225221

Lowry, J. K. 1974b. Key and checklist to the gammaridean amphipods of Kaikoura. *Mauri Ora* 2: 95–130.

1975

Lowry, J. K. 1975. The soft bottom macrobenthic community of Arthur Harbor, Antarctica. *Antarctic Research Series* 23(1): 1–19.
https://doi.org/10.1029/AR023p0001

1976

Lowry, J. K. 1976. *Neoxenodice cryophile*, a new podocerid from the Ross Sea, Antarctica (Amphipoda). *Crustaceana* 30(1): 98–104.
https://doi.org/10.1163/156854076X00459

Lowry, J. K., and S. Bullock. 1976. Catalogue of the marine gammaridean Amphipoda of the Southern Ocean. *Royal Society of New Zealand Bulletin* 16: 1–187.

1977

Knox, G. A., and J. K. Lowry. 1977. A comparison between the benthos of the Southern Ocean and the North Polar Ocean with special reference to the Amphipoda and the Polychaeta. In *Polar Oceans*, ed. M. J. Dunbar. Arctic Institute of North America, Calgary, pp. 423–462.

1978

Lowry, J. K. 1978. Exploring Macquarie Island. Part 2. Subantarctic refuge. *Australian Natural History* 19(7): 242–245.

Lowry, J. K., D. S. Horning, G. C. B. Poore, and R. W. Ricker. 1978. *The Australian Museum Macquarie Island Expedition, summer 1977–78*. The Australian Museum Trust, Sydney, pp. 1–152.

1979

Lowry, J. K. 1979. New gammaridean Amphipoda from Port Pegasus, New Zealand. *New Zealand Journal of Zoology* 6(2): 201–212.
https://doi.org/10.1080/03014223.1979.10428358

1981

Lowry, J. K. 1981a. The amphipod genus *Cerapus* in New Zealand and subantarctic waters (Corophioidea, Ischyroceridae). *Journal of Natural History* 15(2): 183–211.
https://doi.org/10.1080/00222938100770161

Lowry, J. K. 1981b. A redescription of *Sphaerophthalmus grobbeni* Spandl based on type material from the Red Sea and new material from the Great Barrier Reef (Amphipoda, Dexaminidae). *Crustaceana* 41(2): 190–198.
https://doi.org/10.1163/156854081X00237

1982

Lowry, J. K. 1982. The status of the gammaridean Amphipoda collected by the Australasian Antarctic Expedition 1911–1914. *Crustaceana* 42(1): 319–320.
https://doi.org/10.1163/156854082X00425

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https://doi.org/10.1080/00222938200770091

1983

Lowry, J. K., ed. 1983. Papers from the conference on the biology and evolution of Crustacea. *Australian Museum Memoir* 18: i–x, 1–218.
https://doi.org/10.3853/j.0067-1967.18.1983.1551

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2022

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2023

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Table 1. New taxa named by Lowry and co-authors. The valid name of taxa currently in synonymy is given in brackets and indicated by "=". Species are listed in their original combination; where applicable, current generic placement is indicated in brackets. Note: ordinal-group taxa are not regulated by the Zoological Code, so the Principal of Coordination does not apply to these taxa. As such, authorship of ordinal-group taxa newly introduced by Lowry & Myers (2013, 2017) are attributed to those authors, rather than originators of the family-group name from which most of the ordinal-group names were derived.

Suborders (5)

Amphilochidea Lowry & Myers, 2017
Colomastigiwdea Lowry & Myers, 2017
Hyperiopsidea Lowry & Myers, 2017
Senticaudaudata Lowry & Myers, 2013a
Pseudingolfiellidea Lowry & Myers, 2017

Infraorders (8)

Amphilochida Lowry & Myers, 2017
Bogidiellida Lowry & Myers, 2013a
Carangoliopsida Lowry & Myers, 2013a
Colomastigida Lowry & Myers, 2017
Hadziida Lowry & Myers, 2013a
Hyperiopsida Lowry & Myers, 2017
Lysianassida Lowry & Myers, 2017
Pseudingolfiellida Lowry & Myers, 2017

Parvorders (18)

Amphilochidira Lowry & Myers, 2017
Bogidiellidira Lowry & Myers, 2013a
Carangoliopsidira Lowry & Myers, 2013a
Colomastigidira Lowry & Myers, 2017
Crangonyctidira Lowry & Myers, 2013a
Eusiridira Lowry & Myers, 2017
Hadziidira Lowry & Myers, 2013a
Haustoriidira Lowry & Myers, 2017
Hyperiopsidira Lowry & Myers, 2017
Lysianassidira Lowry & Myers, 2017
Maxillipiidira Lowry & Myers, 2017
Metaingolfiellidira Lowry & Myers, 2017
Oedicerotidira Lowry & Myers, 2017
Pagetinidira Lowry & Myers, 2017
Podosiridira Lowry & Myers, 2017
Pseudingolfiellidira Lowry & Myers, 2017
Synopiidira Lowry & Myers, 2017
Talitridira Lowry & Myers, 2013a

Superfamilies (9)

Aetiopedesoidea Myers & Lowry, 2003
Alicelloidea Lowry & De Broyer, 2008
Aristioidea Lowry & Stoddart, 1997
Chevalioidea Myers & Lowry, 2003
Magnovioidea Alves, Lowry & Jonsson, 2020
Microprotopoidea Myers & Lowry, 2003
Podosiroidea Lowry & Myers, 2012b
Pseudingolfielloidea Lowry & Myers, 2012a
Rakirooidea Myers & Lowry, 2003

Epifamilies (1)

Protorchestoidae Myers & Lowry, 2020a

Families (62)

Acidostomatidae Stoddart & Lowry, 2012
Adeliedillidae Lowry & Myers, 2017
Aetiopedesidae Myers & Lowry, 2003
Alicellidae Lowry & De Broyer, 2008
Amaryllididae Lowry & Stoddart, 2002c
Ambasiidae Lowry & Myers, 2017
Arcitalitridae Myers & Lowry, 2020a
Aristiidae Lowry & Stoddart, 1997
Australomicroprotopidae Myers, Lowry & Billingham, 2016
Brevitalitridae Myers & Lowry, 2020a
Cebocaridae Lowry & Stoddart, 2011a
Chevaliidae Myers & Lowry, 2003
Chillagoeidae Lowry & Myers, 2012a
Conicostomatidae Lowry & Stoddart, 2012b
Crangoweckellidae Lowry & Myers, 2012a
Curiotalitridae Myers & Lowry, 2020a
Cyclocaridae Lowry & Stoddart, 2011a
Cyphocarididae Lowry & Stoddart, 1997
Derjugianidae Lowry & Myers, 2017
Dussartiellidae Lowry & Myers, 2012a
Endevouridae Lowry & Stoddart, 1997
Eriopisidae Lowry & Myers, 2013a
Eurytheneidae Stoddart & Lowry, 2004
Falklandellidae Lowry & Myers, 2012a
Giniphargidae Lowry & Myers, 2012a
Hirondelleidae Lowry & Stoddart, 2010a
Izinkalidae Lowry & Stoddart, 2010c
Kairosidae Lowry & Myers, 2013b
Kamakidae Myers & Lowry, 2003
Kergueleniidae Lowry & Stoddart, 2010d
Kerguelenioli dae Lowry & Myers, 2013a
Lepidepecreellidae Stoddart & Lowry, 2010c
Magnovidae Alves, Lowry & Johnsson, 2020
Makawidae Myers & Lowry, 2020a
Microprotopidae Myers & Lowry, 2003
Miramarrassidae Lowry, 2006
Nuuanuidae Lowry & Myers, 2013a
Opisidae Lowry & Stoddart, 1995c
Pakynidae Lowry & Myers, 2017
Paragammaropsidae Myers & Lowry, 2003
Paragissidae Lowry & Myers, 2017
Podoprionidae Lowry & Stoddart, 1996
Podosiridae Lowry & Myers, 2012b
Protorchestiidae Myers & Lowry, 2020a
Pseudamphilochoidae Lowry & Myers, 2017
Pseudingofiellidae Lowry & Myers, 2012a
Rakiroidae Myers & Lowry, 2003
Regaliidae Lowry, 2006
Sanchoidae Lowry, 2006
Sandroidae Lowry & Myers, 2012a
Scopelocheiridae Lowry & Stoddart, 1997
Sensonatoridae Lowry & Myers, 2012a
Thoriellidae Lowry & Stoddart, 2011a
Thurstonellidae Lowry & Zeidler, 2008
Tryphosidae Lowry & Stoddart, 1997
Uhlorchestiidae Myers & Lowry, 2020a
Unciolidae Myers & Lowry, 2003
Uronyctidae Lowry & Myers, 2012a
Valettiopsidae Lowry & De Broyer, 2008
Vemanidae Lowry & Myers, 2017

Wandinidae Lowry & Stoddart, 1990
Zaramillidae Lowry & Myers, 2016

Subfamilies (18)

Acuminodeutopinae Myers & Lowry, 2003
Amaryllidinae Lowry & Stoddart, 2002a
Aorchinae Myers & Lowry, 2003
Bonnierellinae Myers & Lowry, 2003
Cleonardopsinae Lowry, 2006
Conicostomatinae Lowry & Stoddart, 2012b
Exampithoinae Myers & Lowry, 2003
  [= Ampithoinae Boeck, 1871]
Floresorchestiinae Myers & Lowry, 2020a
Kamakinae Myers & Lowry, 2003
Paracallisominae Kilgallen & Lowry, 2015
Parepimeriinae Lowry, 2006
Platorchestiinae Lowry & Myers, 2022
Protomedeiinae Myers & Lowry, 2003
Pseudorchestoideinae Myers & Lowry, 2020a
Tryphosinae Lowry & Stoddart, 1997
Unicolinae Myers & Lowry, 2003
Viyajiinae Lowry & Stoddart, 2002
Waldeckiinae Lowry & Kilgallen, 2014

Tribes (2)

Haplocheirini Myers & Lowry, 2003
Paracorophiini Myers & Lowry, 2003

Genera (129)

Acheronia Lowry, 1984b
Africorchestia Lowry & Coleman, 2011
Albidiator Lowry & Myers, 2019a
Amphiatlantica Lowry & Myers, 2019a
Amphorites Lowry & Stoddart, 2012b
Aotearorchestia Hughes & Lowry, 2023
Asiaorchestia Lowry & Myers, 2019a
Australomicroprotopus Myers, Lowry & Billingham, 2016
Australorchestia Serejo & Lowry, 2008
Austrocallisoma Kilgallen & Lowry, 2015a
Austromaera Lowry & Springthorpe, 2005b
Austropacifica Lowry & Springthorpe, 2019
Bamarooka Lowry & Stoddart, 2002a
Bathypoma Lowry & Berents, 1996
Bellorchestia Serejo & Lowry, 2008
Boca Lowry & Stoddart, 1997
Britorchestia Lowry & Bopiah, 2012
Bulychevia Lowry & Myers, 2019a
Calviator Lowry & Myers, 2019a
Canariorchestia Lowry & Myers, 2019a
Capeorchestia Lowry & Baldanzi, 2016
Cardomanica Lowry, 1985b
Carpentaria Lowry, Springthorpe & Myers, 2020
Chevreuxiana Lowry & Myers, 2019a
Chroestia Lowry & Fanini, 2023
Clippertonia Lowry & Myers, 2020
Cochinorchestia Lowry & Peart, 2010
Cocorchestia Lowry & Myers, 2022
Conicostoma Lowry & Stoddart, 1983
Coriolisa Lowry & Stoddart, 1994
Cryptorchestia Lowry & Fanini, 2013
Curiotalitrus Lowry & Coleman, 2012
Dallwitzia Lowry & Myers, 2019a
Dana Lowry, 2011
Debroyerella Lowry & Kilgallen, 2015a
Defeo Lowry & Myers, 2019a
Demaorchestia Lowry & Myers, 2022
Dendrorchestia Lowry & Myers, 2019a
Derzhavinia Lowry & Myers, 2019a
Des Lowry & Kilgallen, 2014c
Deshurleyella Lowry, Myers & Nakano, 2019
Devo Lowry & Stoddart, 2002a
Dracorchestia Lowry & Myers, 2019a
Drummondia Lowry, 1984b
Eclecticus Lowry & Stoddart, 1997
Ekelofia Lowry, 1984b
Erikus Lowry & Stoddart, 1987
Fleuria Lowry & Myers, 2019a
  [= *Fleuriella* Lowry, Myers & Nakano, 2019]
Fleuriella Lowry, Myers & Nakano, 2019
Fluviadulzura Myers, Lowry & Billingham, 2017
Galaporchestia Lowry & Myers, 2019a
Gazia Lowry & Springthorpe, 2019
Gbroidea Lowry & Azman, 2008
Gippsia Lowry & Stoddart, 1995a
Glorieusella Kilgallen & Lowry, 2014
Gondwanorchestia Lowry, Myers & Perez-Schultheiss, 2020
Haliogeneia Lowry & Stoddart, 1998
Hermaniator Lowry & Myers, 2019a
Hermesorchestia Hughes & Lowry, 2017
Hoho Lowry & Fenwick, 1982
Houlia Lowry & Myers, 2019a
Hurleyella Lowry & Myers, 2019a
  [= *Deshurleyella* Lowry, Myers & Nakano, 2019]
Ignamborchestia Lowry & Myers, 2019a
Indiorchestia Lowry & Myers, 2019a
Insulariator Lowry & Myers, 2019a
Insularorchestia Lowry & Myers, 2022
Jeanjustia Lowry & Myers, 2003
  [= *Parepimeria* Chevreux, 1911]
Kaalorchestia Lowry & Myers, 2019a
Kakanui Lowry & Stoddart, 1983b
Kapalana Berents & Lowry, 2018
Kellyduncania Lowry & Myers, 2019a
Kohuroa Lowry, Myers & Nakano, 2019
Laniporchestia Lowry & Myers, 2019a
Laurenia Lowry & Myers, 2019a
Leslieorchestia Lowry & Myers, 2019a
Lutriwita Lowry & Myers, 2012a
Lutruwitiator Lowry & Myers, 2019a
Magnovis Alves, Lowry & Johnsson, 2020
Mauritiorchestia Green, Appadoo, Lowry & Myers, 2021
Memana Stoddart & Lowry, 2010b
Minamitalitrus White, Lowry & Morino, 2013
Miramaera Lowry & Springthorpe, 2005b
Morinoia Lowry & Myers, 2019a
Nagada Lowry & Stoddart, 1995c
Notopoma Lowry & Berents, 1996
Notoprotella Takeuchi & Lowry, 2019
Notoprotomima Takeuchi & Lowry, 2015
Notorchestia Serejo & Lowry, 2008
Oamaru Lowry & Myers, 2019a
Omaiorchestia Lowry & Myers, 2019a
Opunorchestia Lowry & Myers, 2019a
Pakynus Lowry & Myers, 2017
Panamapisa Alves, Lowry, Neves & Johnsson, 2021

Patonga Lowry & Kilgallen, 2014b
Persianorchestia Momtazi, Lowry & Hekmatara, 2017
Photosella Lowry & Stoddart, 2011b
Pickorchestia Lowry & Myers, 2019a
Pictonorchestia Lowry & Springthorpe, 2021
Pratinas Stoddart & Lowry, 2010b
Rakiroa Lowry & Fenwick, 1982
Renella Lowry & Stoddart, 2012a
Richardsoniella Lowry, Myers & Nakano, 2019
Riwo Lowry & Stoddart, 1995c
Scolopostoma Lowry & Stoddart, 1983
Sheardella Lowry, 1984b
Sinbadorchestia Lowry & Myers, 2019a
Smaraldia Lowry & Stoddart, 2012a
Snaresorchestia Lowry & Myers, 2019a
Speziorchestia Lowry & Myers, 2019a
Stephonyx Lowry & Stoddart, 1989c
Subantarctorchestia Hughes & Lowry, 2023
Swaziator Lowry & Myers, 2019a
Tagua Lowry & Fenwick, 1982
Tasmanella Lowry & Myers, 2019a
  [= *Richardsoniella* Lowry, Myers & Nakano, 2019]
Tasmanosa Lowry & Kilgallen, 2014b
Tatahipeke Hughes & Lowry, 2023
Tayabasa Kilgallen & Lowry, 2015a
Thaumodon Lowry & Stoddart, 1995a
Thiorchestia Lowry & Fanini, 2023
Thurstonella Lowry & Zeidler, 2008
Tongorchestia Lowry & Bopiah, 2013
Ulladulla Lowry & Kilgallen, 2015a
Ultimachelium Lowry & Stoddart, 2012a
Vallorchestia Lowry, 2012
Verdeia Lowry & Springthorpe, 2007
Wairua Lowry & Myers, 2019a
  [*Kohuroa* Lowry, Myers & Nakano, 2019]
Wandin Lowry & Stoddart, 1990
Wonga Lowry & Stoddart, 2002a
Zhadia Lowry & Fenwick, 1982

Species (548)

Aborolobatea insidiosa Hughes & Lowry, 2009b
Acheronia pegasus Lowry, 1984b
Acidostoma australis Stoddart & Lowry, 2012
Acidostoma merimbula Stoddart & Lowry, 2012
Acidostoma namibiensis Stoddart & Lowry, 2012
Acidostoma tuberculata Lowry & Stoddart, 1983b
Africorchestia meridionalis Lowry & Baldanzi, 2016
Amaryllis carrascoi Lowry & Stoddart, 2002a
Amaryllis croca Lowry & Stoddart, 2002a
Amaryllis dianae Lowry & Stoddart, 2002a
Amaryllis kamata Lowry & Stoddart, 2002a
Amaryllis keablei Lowry & Stoddart, 2002a
Amaryllis migo Lowry & Stoddart, 2002a
Amaryllis moona Lowry & Stoddart, 2002a
Amaryllis olinda Lowry & Stoddart, 2002a
Amaryllis philatelica Lowry & Stoddart, 2002a
Amaryllis quokka Lowry & Stoddart, 2002a
Amaryllis spencerensis Lowry & Stoddart, 2002a
Ampelisca ballina Lowry & Poore, 1985
Ampelisca bidura Lowry & Poore, 1985
Ampelisca calooma Lowry & Poore, 1985
Ampelisca capella Poore & Lowry, 2023
Ampelisca dimboola Lowry & Poore, 1985
Ampelisca euroa Lowry & Poore, 1985
Ampelisca jingera Lowry & Poore, 1985
Ampelisca katoomba Poore & Lowry, 2023
Ampelisca mingela Poore & Lowry, 2023
Ampelisca narooma Lowry & Poore, 1985
Ampelisca tilpa Lowry & Poore, 1985
Ampelisca toora Lowry & Poore, 1985
Ampelisca yuleba Lowry & Poore, 1985
Amphorites annasona Lowry & Stoddart, 2012b
Ampithoe caddi Poore & Lowry, 1997
Ampithoe ngana Poore & Lowry, 1997
Andaniotes bagabag Lowry & Stoddart, 1995c
Andaniotes kavkar Lowry & Stoddart, 1995c
Arcitalitrus belbucca Peart & Lowry, 2006
Arcitalitrus bundeena Peart & Lowry, 2006
Arcitalitrus moonpar Peart & Lowry, 2006
Arcitalitrus nana Peart & Lowry, 2006
Arcitalitrus orara Peart & Lowry, 2006
Arcitalitrus thora Peart & Lowry, 2006
Aristias captiva Lowry & Stoddart, 1997
Aristias coriolis Lowry & Stoddart, 1993
Aristias eden Stoddart & Lowry, 2010b
Aristias gomoni Stoddart & Lowry, 2010b
Aristias nowra Stoddart & Lowry, 2010b
Aristias otway Stoddart & Lowry, 2010b
Aristias poorei Stoddart & Lowry, 2010b
Aristias thio Lowry & Stoddart, 1994
Aristias uokonia Lowry & Stoddart, 1994
Aristias verdensis Lowry & Stoddart, 1993
Aroui americana Lowry & Stoddart, 1997
Aroui hamatopodus Lowry & Stoddart, 1989a
Australomicroprotopus megacoxa Myers, Lowry & Billingham, 2016
Australorchestia occidentalis Serejo & Lowry, 2008
Australorchestia tantabiddyensis Lowry & Springthorpe, 2015b
Austrocallisoma jerryi Kilgallen & Lowry, 2015a
Bamarooka anomala Lowry & Stoddart, 2002a
Bamarooka dinjerra Lowry & Stoddart, 2002a
Bamarooka endota Lowry & Stoddart, 2002a
Bamarooka kimbla Lowry & Stoddart, 2002a
Bamarooka tropicalis Lowry & Stoddart, 2002a
Bathyamaryllis kapala Lowry & Stoddart, 2002a
Bathyamaryllis ouvea Lowry & Stoddart, 1994
Bathynomus brucei Lowry & Dempsey, 2006
Bathynomus bruscai Lowry & Dempsey, 2006
Bathynomus crosnieri Lowry & Dempsey, 2006
Bathynomus keablei Lowry & Dempsey, 2006
Bathynomus kensleyi Lowry & Dempsey, 2006
Bathynomus richeri Lowry & Dempsey, 2006
Bathypoma enigma Lowry & Berents, 1996
Bellorchestia mariae Lowry, 2012
  [= *B. pravidactyla* Haswell, 1880]
Bellorchestia richardsoni Serejo & Lowry, 2008
  [= *B. pravidactyla* Haswell, 1880]
Biancolina brassicacephala Lowry, 1974a
Boca campi Lowry & Stoddart, 1997
Boca elvae Lowry & Stoddart, 1997
Boca megchela Lowry & Stoddart, 1997
Bolttsia myersi Azman & Lowry, 2009
Bonassa bonairensis Lowry & Stoddart, 1997
Byblis bega Lowry & Poore, 1985
Byblis gerara Lowry & Poore, 1985
Byblis liena Poore & Lowry, 2023
Byblis mildura Lowry & Poore, 1985
Byblis pialba Poore & Lowry, 2023
Byblis tinamba Lowry & Poore, 1985
Byblis wadara Poore & Lowry, 2023
Cardomanica andersoni Lowry, 1985b
Cardomanica quadricornuta Lowry, 1985b
Carpentaria tropicalis Lowry, Springthorpe & Myers, 2020
Cedrosella cito Lowry & Kilgallen, 2014b
Ceradocopsis macracantha Lowry & Fenwick, 1982

Ceradocus circe Lowry & Springthorpe, 2005b
Cerapus bundegi Lowry & Berents, 2005
Cerapus chaomai Lowry & Berents, 2002
Cerapus cudjoe Lowry & Thomas, 1991
Cerapus fallohideus Lowry, 1981a
  [*Notopoma* Lowry & Berents, 1996]
Cerapus harfootus Lowry, 1981a
  [*Notopoma* Lowry & Berents, 1996]
Cerapus murrayae Lowry & Berents, 2005
Cerapus oceanicus Lowry, 1985a
Cerapus pacificus Lowry, 1985a
Cerapus stoorus Lowry, 1981a
  [*Notopoma* Lowry & Berents, 1996]
Cerapus volucola Lowry & Berents, 2005
Cerapus yuyatalay Lowry & Berents, 2002
Cheirimedon chevreuxi Kilgallen & Lowry, 2015c
Cheirimedon danai Kilgallen & Lowry, 2015c
Cheirimedon gurjanovae Kilgallen & Lowry, 2015c
Cheirimedon hendrycksi Kilgallen & Lowry, 2015c
Cheirimedon hurleyi Kilgallen & Lowry, 2015c
Cheirimedon margaretae Kilgallen & Lowry, 2015c
Cheirimedon norna Kilgallen & Lowry, 2015c
Cheirimedon posidonia Kilgallen & Lowry, 2015c
Cheirimedon rodondo Kilgallen & Lowry, 2015c
Cheirimedon stebbingi Kilgallen & Lowry, 2015c
Cheirimedon thirroul Kilgallen & Lowry, 2015c
Cheirimedon towamba Kilgallen & Lowry, 2015c
Cheirimedon trigonum Kilgallen & Lowry, 2015c
Cheirimedon truncatus Kilgallen & Lowry, 2015c
Chroestia amoa Lowry & Fanini, 2023
Clepidecrella abeona Lowry & Stoddart, 2010d
Clepidecrella cataraqui Lowry & Stoddart, 2010d
Clepidecrella colliboi Lowry & Stoddart, 2010d
Clepidecrella ira Lowry & Stoddart, 2010d
Clepidecrella tropicalis Lowry & Stoddart, 1994
Clippertonia schmitti Lowry & Myers, 2020
Coboldus mbrensis Lowry & Myers, 2003
Cochinorchestia lindsayae Lowry & Springthorpe, 2015b
Cochinorchestia metcalfeae Lowry & Springthorpe, 2015b
Cochinorchestia morrumbene Lowry & Springthorpe, 2015b
Cochinorchestia poka Lowry & Springthorpe, 2015b
Cochinorchestia tulear Lowry & Springthorpe, 2015b
Conicostoma fenwicki Lowry & Stoddart, 1984b
  [*Ocosingo* Lowry & Stoddart, 2012b]
Conicostoma karta Lowry & Stoddart, 1984b
Coriolisa novacaledonia Lowry & Stoddart, 1994
Corophium colo Lowry, 2004
Curdia knoxi Lowry & Myers, 2003
Curdia ramonae Lowry & Myers, 2003
Cymadusa alyxis Hughes & Lowry, 2009a
Cymadusa hoeyae Hughes & Lowry, 2009a
Cymadusa khbarnardi Hughes & Lowry, 2009a
Cymadusa mariabyrneae Hughes & Lowry, 2009a
Cymadusa munnu Poore & Lowry, 1997
Cymadusa smilodonta Hughes & Lowry, 2009a
Cyphocaris ananke Hughes & Lowry, 2015c
Cyphocaris bellona Lowry & Stoddart, 1994
Cyphocaris nesoi Hughes & Lowry, 2015c
Cyphocaris tartaros Hughes & Lowry, 2015c
Cyphocaris tunicola Lowry & Stoddart, 1997
Demaorchestia hatakejima Lowry & Myers, 2022
Demaorchestia mie Lowry & Myers, 2022
Demaorchestia pseudojoi Lowry & Myers, 2022
Des griffin Lowry & Kilgallen, 2014c
Devo dubuc Lowry & Stoddart, 2002a
Devo grahami Lowry & Stoddart, 2002a
Didymochelia ledoyeri Lowry & Stoddart, 1995b
Dissiminassa homosassa Lowry & Stoddart, 1997
Drummondia corinellae Lowry, 1984b
Drummondia luce Lowry & Stoddart, 2012a
Drummondia marlo Lowry & Stoddart, 2012a
Drummondia parviramus Lowry, 1984b
Drummondia tridentata Lowry & Stoddart, 2012a
Dulichiella guinea Lowry & Springthorpe, 2007
Dulichiella lecroyae Lowry & Springthorpe, 2007
Dulichiella oahu Lowry & Springthorpe, 2007
Dulichiella pacifica Lowry & Springthorpe, 2005b
Dulichiella terminos Lowry & Springthorpe, 2007
Dulichiella tomioka Lowry & Springthorpe, 2007
Dulichiella tulear Lowry & Springthorpe, 2007
Dulzura taylorae Springthorpe & Lowry, 2009
Eclecticus eclecticus Lowry & Stoddart, 1997
Ekelofia eltanin Lowry & Stoddart, 2012a
Elasmopus arafura Hughes & Lowry, 2011
Elasmopus arrawarra Hughes & Lowry, 2006
Elasmopus carteri Hughes & Lowry, 2011
Elasmopus hyperopia Hughes & Lowry, 2011
Elasmopus leveque Hughes & Lowry, 2011
Elasmopus mcluerensis Hughes & Lowry, 2011
Elasmopus otus Hughes & Lowry, 2011
Elasmopus shepherdi Hughes & Lowry, 2011
Elasmopus slatyeri Lowry & Hughes, 2009b
Elasmopus varanocephalensis Lowry & Hughes, 2009b
Elasmopus warra Kelaher & Lowry, 2002
Elasmopus woodjonesi Hughes & Lowry, 2011
Endevoura inusitata Lowry & Hughes, 2015a
Endevoura prodigium Lowry & Hughes, 2015a
Ensayara evax Lowry & Hughes, 2015a
Ensayara iara Lowry & Stoddart, 1983b
Ensayara laetum Lowry & Hughes, 2015a
Epimeria rafaeli Coleman & Lowry, 2014
Ericthonius forbesii Hughes & Lowry, 2006
Ericthonius rodneyi Hughes & Lowry, 2006
Erikus dahli Lowry & Stoddart, 1987
Eriopisella morteni Myers, Lowry & Barnes, 2018
Eucallisoma barnardi Lowry & Stoddart, 1993
  [*Tayabasa* Kilgallen & Lowry, 2015a]
Euonyx urania Lowry & Kilgallen, 2014c
Euonyx xarifa Lowry & Kilgallen, 2014c
Eurythenes thurstoni Stoddart & Lowry, 2004
Exampithoe (Melanesius) kutti Poore & Lowry, 1997
Figorella angulosa Lowry & Stoddart, 2012a
Figorella corindon Lowry & Stoddart, 1993
Figorella formosa Lowry & Stoddart, 2012a
Figorella franklin Lowry & Stoddart, 2012a
Figorella tasmanica Lowry, 1984b
Floresorchestia andrevo Lowry & Springthorpe, 2015a
Floresorchestia australis Lowry & Springthorpe, 2009c
  [*Austropacifica* Lowry & Springthorpe, 2009]
Floresorchestia itampolo Lowry & Springthorpe, 2015a
  [*Gazia* Lowry & Springthorpe, 2019]
Floresorchestia kalili Lowry & Springthorpe, 2015a
Floresorchestia laurenae Lowry & Springthorpe, 2015a
Floresorchestia oluanpi Lowry & Springthorpe, 2015a
Floresorchestia palau Lowry & Myers, 2013c
Floresorchestia papeari Lowry & Springthorpe, 2015a
Floresorchestia pohnpei Lowry & Myers, 2013c
Floresorchestia poorei Lowry & Springthorpe, 2009b
Floresorchestia serejoae Lowry & Springthorpe, 2015a
Floresorchestia seringat Lowry & Springthorpe, 2015a
Floresorchestia yap Lowry & Springthorpe, 2015a
Fluviadulzura spinicauda Myers, Lowry & Billingham, 2017
Gabophlias gabiae Coleman & Lowry, 2012b
Gabophlias kerstinae Coleman & Lowry, 2012b
Galathella bassiana Lowry & Stoddart, 1995a
Galathella palana Lowry & Stoddart, 1995a
Gammarella hybophora Lowry & Fenwick, 1982
Gammaropsis legoliath Hughes & Lowry, 2006

Gazia gazi Lowry & Springthorpe, 2019
Gbroidea dingaalana Lowry & Azman, 2008
Gippsia jonesae Lowry & Stoddart, 1995a
Gondwanorchestia tristanensis Lowry, Myers & Perez-Schultheiss, 2020
Halic sublittoralis Lowry, 1979
Haliogeneia crosnieri Lowry & Stoddart, 1998
Haploops oonah Lowry & Poore, 1985
Hermesorchestia alastairi Hughes & Lowry, 2017
Hippomedon hake Lowry & Stoddart, 1983b
Hippomedon hippolyte Kilgallen & Lowry, 2015b
Hippomedon manene Lowry & Stoddart, 1983b
[*Paracentromedon* Chevreux & Fage, 1925]
Hippomedon matikuku Lowry & Stoddart, 1983b
[*Paracentromedon* Chevreux & Fage, 1925]
Hippomedon pensacola Lowry & Stoddart, 1997
Hippomedon tourville Kilgallen & Lowry, 2015b
Hippomedon vao Lowry & Stoddart, 1994
Hirondellea diamantina Lowry & Stoddart, 2010a
Hirondellea endeavour Lowry & Stoddart, 2010a
Hirondellea franklin Lowry & Stoddart, 2010a
Hirondellea kapala Lowry & Stoddart, 2010a
Hirondellea naturaliste Lowry & Stoddart, 2010a
Hoho cornishi Hughes & Lowry, 2006
Hoho hirtipalma Lowry & Fenwick, 1982
Ichnopus annasona Lowry & Stoddart, 1992
Ichnopus capricornus Lowry & Stoddart, 1992
Ichnopus caritus Lowry & Stoddart, 1992
Ichnopus comorensis Lowry & Stoddart, 1992
Ichnopus cribensis Lowry & Stoddart, 1992
Ichnopus malpatum Lowry & Stoddart, 1992
Ichnopus parriwi Lowry & Stoddart, 1992
Ichnopus wardi Lowry & Stoddart, 1992
Icilius caledoniana Watson, Lowry & Steinberg, 2004
Icilius crinocolus Watson, Lowry & Steinberg, 2004
Icilius puchellus Watson, Lowry & Steinberg, 2004
Ingolfiella australiana Lowry & Poore, 1989
Ingolfiella bassiana Lowry & Poore, 1989
Insularorchestia susorum Lowry & Myers, 2022
Iphimedia beesleyae Coleman & Lowry, 2006b
Iphimedia caledoniana Lowry & Myers, 2003
Iphimedia damawan Lowry & Myers, 2003
Iphimedia filmersankeyi Coleman & Lowry, 2006b
Iphimedia kateae Coleman & Lowry, 2006b
Iphimedia lisae Coleman & Lowry, 2006b
Iphimedia maitrensis Lowry & Myers, 2003
Iphimedia mizeqwadan Lowry & Myers, 2003
Iphimedia neuweileri Coleman & Lowry, 2006b
Iphimedia oetkeri Coleman & Lowry, 2006b
Iphimedia phuketensis Lowry & Myers, 2003
Iphimedia poorei Coleman & Lowry, 2009b
Iphimedia rachanoi Lowry & Myers, 2003
Iphiplateia jakei Coleman & Lowry, 2012a
Iphiplateia marleneae Coleman & Lowry, 2012a
Iphiplateia verenaae Coleman & Lowry, 2012a
Izinkala griffithsi Lowry & Stoddart, 2010c
Jeanjustia pedra Lowry & Myers, 2003
[*Parepimeria* Chevreux, 1911]
Kakanui punui Lowry & Stoddart, 1983b
Kapalana amelga Berents & Lowry, 2018
Kapalana durraween Berents & Lowry, 2018
Kapalana kimbla Berents & Lowry, 2018
Kapalana maia Berents & Lowry, 2018
Kapalana michaelmas Berents & Lowry, 2018
Kapalana stebbingi Berents & Lowry, 2018
Kapalana wadei Berents & Lowry, 2018
Kerguelenia euroka Lowry & Stoddart, 2010d
Kerguelenia kanowna Lowry & Stoddart, 2010d
Kerguelenia kawatiri Lowry & Stoddart, 2010d
Kerguelenia koutoumo Lowry & Stoddart, 1994
Kerguelenia leura Lowry & Stoddart, 2010d
Kerguelenia lifou Lowry & Stoddart, 1994
Kerguelenia matilda Lowry & Stoddart, 2010d
Lepidepecreella nellae Stoddart & Lowry, 2010c
Lepidepecreella sarcelle Lowry & Stoddart, 1994
Lepidepecreoides bassi Lowry & Stoddart, 2002b
Lepidepecreoides chincui Lowry & Stoddart, 2002b
Lepidepecreoides talboti Lowry & Stoddart, 2002b
Lepidepecreoides torresi Lowry & Stoddart, 2002b
Lepidepecreum andamanensis Lowry & Stoddart, 2002c
Lepidepecreum baudini Lowry & Stoddart, 2002b
Lepidepecreum dampieri Lowry & Stoddart, 2002b
Lepidepecreum flindersi Lowry & Stoddart, 2002b
Lepidepecreum freycineti Lowry & Stoddart, 2002b
Lepidepecreum hirayamai Lowry & Stoddart, 2002c
Lepidepecreum somchaii Lowry & Stoddart, 2002c
Lepidepecreum takeuchii Lowry & Stoddart, 2002c
Lepidepecreum tourville Lowry & Stoddart, 2002b
Liljeborigia polonius Hughes & Lowry, 2006
Linguimaera schicklae Lowry & Springthorpe, 2005b
Lutriwita bradburyi Lowry & Myers, 2012a
Lysianella lui Lowry & Kilgallen, 2014b
Lysianella moonamoona Lowry & Kilgallen, 2014b
Lysianopsis ozona Lowry & Stoddart, 1997
Lysianopsis tieke Lowry & Stoddart, 1983b
Magnovis elizabethae Alves, Lowry & Johnsson, 2020
Mallacoota capricornia Lowry & Hughes, 2009b
Mallacoota chandaniae Lowry & Springthorpe, 2005b
Mallacoota euroka Lowry & Springthorpe, 2005b
Mallacoota kameruka Lowry & Springthorpe, 2005b
Mallacoota malua Lowry & Springthorpe, 2005b
Mallacoota scopulosa Lowry & Hughes, 2009b
Mauritiorchestia fayetta Green, Appadoo, Lowry & Myers, 2021
Maxillipius commensalis Lowry, 1984a
Melita ophicola Lowry & Springthorpe, 2005b
Melita sampsonae Lowry & Springthorpe, 2009d
Memana sarda Stoddart & Lowry, 2010b
Membrilopus kensleyi Lowry & Springthorpe, 2005a
Meraldia birgeri Coleman & Lowry, 2006a
Meraldia madeleinae Coleman & Lowry, 2006a
Meraldia yorki Coleman & Lowry, 2006a
Metaprotella guileri Takeuchi & Lowry, 2019
Metaprotella solitaria Takeuchi & Lowry, 2019
Microlysias soela Lowry & Kilgallen, 2014b
Microprotopus shoemakeri Lowry, 1972
Microrchestia bousfieldi Lowry & Peart, 2010
Microrchestia ntensis Lowry & Springthorpe, 2015b
Microrchestia watsonae Lowry & Peart, 2010
Minamitaltrus zoltani White, Lowry & Morino, 2013
Miramaera thetis Lowry & Springthorpe, 2005b
[*Maeropsis* Chevreux, 1919]
Monoculodes tropicalis Hughes & Lowry, 2009b
Nagada garagassi Lowry & Stoddart, 1995c
Nagada papua Lowry & Stoddart, 1995c
Nagada uwedoae Lowry & Stoddart, 1995c
Neoxenodice cryophile Lowry, 1976
Normanion hipposideros Stoddart & Lowry, 2010a
Normanion whoi Stoddart & Lowry, 2010a
Notopoma africana Lowry & Berents, 1996
Notopoma moorea Lowry & Berents, 1996
Notopoma stoddartae Lowry & Berents, 1996
Notoprotella cornuta Takeuchi & Lowry, 2019
Notoprotomima smithi Takeuchi & Lowry, 2015
Notorchestia lobata Serejo & Lowry, 2008
[= *N. quadrimana* (Dana, 1852)]
Notorchestia naturaliste Serejo & Lowry, 2008
Nuuanu kata Lowry & Watson, 2002
Ochlesis caroleoninae Coleman & Lowry, 2006a

Ochlesis morgani Coleman & Lowry, 2006a
Ocosingo yatala Lowry & Stoddart, 2012b
Onesimoides abyssalis Lowry & Stoddart, 1994
Onesimoides castellatus Lowry & Stoddart, 1993b
Onesimoides mindoro Lowry & Stoddart, 1993b
Onesimoides noseybeensis Lowry & Stoddart, 1996
Onesimoides sandroi Lowry & Stoddart, 1996
Oradarea dawa Lowry & Myers, 2003
Orchestia forchuensis Myers & Lowry, 2020b
Orchestia perezi Myers & Lowry, 2020b
Orchestia tabladoi Myers & Lowry, 2020b
Orchestia xylino Lowry & Fanini, 2013b
Orchomene aahu Lowry & Stoddart, 1983b
  [*Orchomenella* Sars, 1890]
Orchomenella perdido Lowry & Stoddart, 1997
Orchomenella thomasi Lowry & Stoddart, 1997
Orthoprotella berentsae Takeuchi & Lowry, 2007b
  [*Notoptotella* Takeuchi & Lowry, 2007]
Pachychelium fucaensis Lowry & Stoddart, 2012a
Pachychelium nichollsi Lowry, 1984b
  [*Ultimachelium* Lowry & Stoddart, 2012a]
Pachychelium schellenbergi Lowry, 1984b
  [*Ultimachelium* Lowry & Stoddart, 2012a]
Pachychelium tropicalis Lowry & Stoddart, 2012a
Pachynus denticulatum Lowry, 1984b
  [*Pakynus* Lowry & Myers, 2017]
Pachynus obsolescens Lowry & Stoddart, 2012a
  [*Pakynus* Lowry & Myers, 2017]
Pachynus pugilator Lowry, 1984b
  [*Pakynus* Lowry & Myers, 2017]
Panamapisa guaymii Alves, Lowry, Neves & Johnsson, 2021
Paracallisoma woolgoolga Kilgallen & Lowry, 2015a
  [*Haptocallisoma* Kilgallen & Lowry, 2015a]
Paracallisoma zivianii Kilgallen & Lowry, 2015a
Paracentromedon pacificus Lowry & Stoddart, 1993b
Parachevreuxiella justi Lowry & Stoddart, 2011a
Paralysianopsis capricornia Lowry & Kilgallen, 2014b
Paralysianopsis dandenong Lowry & Kilgallen, 2014b
Paralysianopsis mazamoz Lowry & Stoddart, 1995c
Paralysianopsis padoz Lowry & Stoddart, 1995c
Paralysianopsis pomona Lowry & Kilgallen, 2014b
Paralysianopsis ruffoi Lowry & Kilgallen, 2014b
Parawaldeckia angusta Lowry & Stoddart, 1983b
Parawaldeckia dabita Lowry & Stoddart, 1983a
Parawaldeckia hirsuta Lowry & Stoddart, 1983a
Parawaldeckia karaka Lowry & Stoddart, 1983b
Parawaldeckia parata Lowry & Stoddart, 1983b
Parawaldeckia pulchra Lowry & Stoddart, 1983a
Parawaldeckia suzae Lowry & Stoddart, 1983a
Parawaldeckia vesca Lowry & Stoddart, 1983a
Parelasmopus cymatilis Lowry & Hughes, 2009b
Parelasmopus sowpigensis Lowry & Springthorpe, 2005b
Parschisturella martrudan Lowry & Kilgallen, 2014c
Parschisturella medora Lowry & Kilgallen, 2014c
Parschisturella pilot Lowry & Kilgallen, 2014c
Patonga nona Lowry & Kilgallen, 2014b
Peramphithoe parmerong Poore & Lowry, 1997
  [*Sunamphitoe* Poore & Lowry, 1997]
Pereionotus dieteri Coleman & Lowry, 2012c
Pereionotus hartmuti Coleman & Lowry, 2012c
Pereionotus hirayamai Coleman & Lowry, 2012c
Pereionotus yongensis Coleman & Lowry, 2012c
Perioculodes talboti Hughes & Lowry, 2009b
Persianorchestia nirvana Momtazi, Lowry & Hekmatara, 2017
Photis nigrocula Lowry, 1979
Photis phaeocula Lowry, 1979
Platorchestia ano Lowry & Bopiah, 2013
Platorchestia paraplatensis Serejo & Lowry, 2008
Platorchestia exter Myers & Lowry, 2023
Platorchestia griffithsi Myers & Lowry, 2023
Platorchestia negevensis Myers & Lowry, 2023
Platorchestia oliveirae Myers & Lowry, 2023
Platorchestia smithi Lowry, 2012
Podoprion ruffoi Lowry & Stoddart, 1996
Podoprionella bulla Stoddart & Lowry, 2010a
Podoprionella dagadugaban Lowry & Stoddart, 1995c
Podoprionides akantha Stoddart & Lowry, 2010a
Podoprionides moonamoona Stoddart & Lowry, 2010a
Prachynella epa Lowry & Stoddart, 2012a
Prachynella oculata Lowry & Stoddart, 2012a
Prachynella shijiki Lowry & Stoddart, 2012a
Pratinas ludmilla Stoddart & Lowry, 2010b
Prosocratus carolinae Coleman & Lowry, 2009a
Protohyale solitaire Hughes & Lowry, 2006
Protorchestia ceduna Serejo & Lowry, 2008
Pseudamaryllis andresi Lowry & Stoddart, 1993b
Pseudambasia dartnalli Kilgallen & Lowry, 2013
Pseudambasia lochi Kilgallen & Lowry, 2013
Pseudambasia ponderi Kilgallen & Lowry, 2013
Pseudambasia poorei Kilgallen & Lowry, 2013
Pseudambasia sheardi Kilgallen & Lowry, 2013
Pseudambasia springthorpei Kilgallen & Lowry, 2013
Pseudocyphocaris gosema Lowry & Stoddart, 1990
Pseudocyphocaris lobata Lowry & Stoddart, 1990
Quadriviso saerina Lowry & Springthorpe, 2005b
Rakiroa rima Lowry & Fenwick, 1982
Regalia juliana Lowry & Springthorpe, 2005a
  [*Tepidopleustes* Karaman & Barnard, 1979]
Rhachotropis elliottana Lowry & Springthorpe, 2005a
Rhinolabia elliotti Lowry & Stoddart, 1995c
  [*Paralysianopsis* Schellenberg, 1931]
Rhinolabia jebbi Lowry & Stoddart, 1995c
  [*Paralysianopsis* Schellenberg, 1931]
Rhinolabia paeowai Lowry & Stoddart, 1995c
  [*Paralysianopsis* Schellenberg, 1931]
Rimakoroga floridiana Lowry & Stoddart, 1997
Riwo mizeui Lowry & Stoddart, 1995c
Riwo zeidleri Hughes & Lowry, 2015b
Sancho kuiteri Lowry & J. L. Barnard, 2001
Schisturella rosa Kilgallen & Lowry, 2014
Scopelocheirus sossi Zettler, Bastrop & Lowry, 2023
Scolopostoma darwinensis Lowry & Stoddart, 2012b
Scolopostoma keurboomstrandensis Lowry & Stoddart, 2012b
Scolopostoma norah Lowry & Stoddart, 2012b
Sheardella kapala Lowry, 1984b
Sheardella tangaroa Lowry, 1984b
Shoemakerella barnardi Lowry & Stoddart, 2009b
Shoemakerella subchelata Sorrentino, Senna & Lowry, 2014
Smaraldia springthorpei Lowry & Stoddart, 2012a
Socarnella delectabilis Hughes & Lowry, 2015b
Socarnes rurutu Lowry & Stoddart, 1994
Socarnes tiendi Lowry & Stoddart, 1994
Socarnes tuscarora Lowry & Stoddart, 1994
Socarnopsis honiara Lowry & Stoddart, 1994
Socarnopsis tandai Lowry & Stoddart, 1994
Sophrosyne abyssi Lowry & Stoddart, 2010b
Sophrosyne californica Lowry & Stoddart, 2010b
Sophrosyne cantractia Lowry & Stoddart, 2010b
Sophrosyne integricauda Lowry & Stoddart, 2010b
Sophrosyne inverarae Lowry & Stoddart, 2010b
Sophrosyne ledoyeri Lowry & Stoddart, 2010b
Sophrosyne moorei Lowry & Stoddart, 2010b
Sophrosyne peartae Lowry & Stoddart, 2010b
Sophrosyne rodondo Lowry & Stoddart, 2010b
Sophrosyne ruffoi Lowry & Stoddart, 2010b
Stephonyx rafaeli Lowry & Kilgallen, 2014c
Stomacontion hurleyi Lowry & Stoddart, 1983b
  [*Amphorites* Lowry & Stoddart, 2012b]

Stomacontion pungapunga Lowry & Stoddart, 1983b
[*Amphorites* Lowry & Stoddart, 2012b]
Sunamphitoe graxon Freewater & Lowry, 1994
Tagua aporema Lowry & Fenwick, 1982
Talorchestia anaka Lowry & Springthorpe, 2019
Talorchestia brucei Lowry & Springthorpe, 2009a
Talorchestia bunaken Lowry, Springthorpe & Azman, 2017
Talorchestia dampieri Lowry & Springthorpe, 2015b
Talorchestia dili Lowry, Springthorpe & Azman, 2017
Talorchestia lakshadweepensis Trivedi, Lowry, Myers & Keloth, 2020
Talorchestia qeshm Lowry & Momtazi, 2015
Talorchestia seringat Lowry, Springthorpe & Azman, 2017
Talorchestia sipadan Lowry, Springthorpe & Azman, 2017
Talorchestia yoyoae Lowry, Springthorpe & Azman, 2017
Tasmanosa tasman Lowry & Kilgallen, 2014b
Tasmanosa toogooloo Lowry & Kilgallen, 2014b
Tegano atkinsae Lowry & Springthorpe, 2009d
Telsosynopia trifidilla Hughes & Lowry, 2006
Tepidopleustes coffsiana Hughes & Lowry, 2006
Thaumodon poorei Lowry & Stoddart, 1995a
Thiorchestia caledoniana Lowry & Fanini, 2023
Thrombasia evalina Kilgallen & Lowry, 2014
Thrombasia saros Kilgallen & Lowry, 2014
Thrombasia umina Kilgallen & Lowry, 2014
Tongorchestia borabora Lowry & Bopiah, 2014
Tongorchestia pangaimotu Lowry & Bopiah, 2013
Tongorchestia towneri Lowry & Bopiah, 2013
Transorchestia marlo Serejo & Lowry, 2008
Trischizostoma crosnieri Lowry & Stoddart, 1993b
Trischizostoma richeri Lowry & Stoddart, 1994
Tropicorchestia derbyensis Lowry & Springthorpe, 2015b
Tropicorchestia glasbyi Lowry & Springthorpe, 2015b
Tryphosella ama Lowry & Stoddart, 1994
Tryphosella apalachicola Lowry & Stoddart, 1997
Tryphosella astrolabensis Lowry & Stoddart, 1995c
Tryphosella bet Lowry & Stoddart, 2009b
Tryphosella betka Lowry & Stoddart, 2011b
Tryphosella bicheno Lowry & Stoddart, 2011b
Tryphosella cameloides Lowry & Stoddart, 2009b
Tryphosella charlotteae Lowry & Stoddart, 2009b
[*Photosella* Lowry & Stoddart, 2011b]
Tryphosella chinchilla Lowry & Stoddart, 2011b
Tryphosella cooee Lowry & Stoddart, 2011b
Tryphosella flynnana Lowry & Stoddart, 2009b
Tryphosella fortescue Lowry & Stoddart, 2011b
Tryphosella freycinet Lowry & Stoddart, 2011b
Tryphosella martrudan Lowry & Stoddart, 2011b
Tryphosella oupi Lowry & Stoddart, 1994
Tryphosella rodondo Lowry & Stoddart, 2011b
Tryphosella schellenbergi Lowry & Bullock, 1976
[*Uristes* Dana, 1849]
Tryphosella seasana Lowry & Stoddart, 2009b
Tryphosella serans Lowry & Stoddart, 1983b
Tryphosella sorell Lowry & Stoddart, 2011b
Tryphosella tathra Lowry & Stoddart, 2011b
Tryphosella toowoomba Lowry & Stoddart, 2011b
Tryphosella tuckanarra Lowry & Stoddart, 2011b
Tryphosella wangaratta Lowry & Stoddart, 2011b
Tryphosella wongada Lowry & Stoddart, 1995c
Tryphosites colmani Lowry & Kilgallen, 2014b
Tryphosites psittacus Lowry & Kilgallen, 2014b
Ulladulla selje Lowry & Kilgallen, 2015a
Ultimachelium tac Lowry & Stoddart, 2012a
Victoriopisa marina Lowry & Springthorpe, 2005b
Waldeckia bamberi Lowry & Kilgallen, 2015b
[*Charcotia* Chevreux, 1906]
Waldeckia dempseyae Lowry & Kilgallen, 2014a
[*Charcotia* Chevreux, 1906]
Waldeckia selayarensis Lowry & Kilgallen, 2014a
[*Charcotia* Chevreux, 1906]
Waldeckia tangaroa Lowry & Kilgallen, 2014a
[*Charcotia* Chevreux, 1906]
Waldeckia warreen Lowry & Kilgallen, 2014a
[*Charcotia* Chevreux, 1906]
Wandin griffini Lowry & Stoddart, 1990
Wonga wonga Lowry & Stoddart, 2002a
Zhadia subantarctica Lowry & Fenwick, 1982

Table 2. Number of new species co-authored with Lowry.

co-author	number of new species co-authored
Helen Stoddart	215
Niamh Kilgallen	55
Roger Springthorpe	54
Lauren Hughes	40
Alan Myers	33
Gary Poore	23
Oliver Coleman	23
Penny Berents	16
Rachael Peart	8
Bin Abdul Rahim Azman	7

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The World Amphipoda Database: History and Progress

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Institutional affiliations listed at end of paper.

Abstract. We provide an overview of the World Amphipoda Database (WAD), a global species database that is part of the World Register of Marine Species (WoRMS). Launched in 2013, the database contains entries for over 10,500 accepted species names. Edited currently by 31 amphipod taxonomists, following WoRMS priorities, the WAD has at least one editor per major group. All accepted species are checked by the editors, as is the authorship available for all of the names. The higher classification is documented for every species and a type species is recorded for every genus name. This constitutes five of the 13 priorities for completion, set by WoRMS. In 2015, five LifeWatch grants were allocated for WAD activities. These included a general training workshop in 2016, together with data input for the superfamily Lysianassoidea and for a number of non-marine groups. Philanthropy grants in 2019 and 2021 covered more important gaps across the whole group. Further work remains to complete the linking of unaccepted names, original descriptions, and environmental information. Once these tasks are completed, the database will be considered complete for 8 of the 13 priorities, and efforts will continue to input new taxa annually and focus on the remaining priorities, particularly the input of type localities. We give an overview of the current status of the order Amphipoda, providing counts of the number of genera and species within each family belonging to the six suborders currently recognized.

Introduction

The order Amphipoda forms part of the superorder Peracarida, uniting a diverse group of small shrimp-like taxa that brood their young in a pouch, with no independent larval dispersal stage. Amphipods range in size from a millimetre in length to the supergiant amphipod, *Alicella gigantea* Chevreux, 1899, at 340 mm body length. Amphipods can be found in all marine habitats from beaches to the deepest ocean trenches, and have also colonized freshwaters and terrestrial habitats. Amphipods are important herbivores, detritivores, micropredators, scavengers, and ectoparasites and they form an important component of aquatic ecosystems. The World Amphipoda Database (WAD)

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(Horton *et al*., 2022; https://www.marinespecies.org/amphipoda/) is a global species database, providing the most up-to-date classification and catalogue of amphipod species names from all habitats, and is based on published literature. It is part of The World Register of Marine Species, a community-driven program to provide "An authoritative classification and catalogue of marine names" (WoRMS Editorial Board 2022; https://www.marinespecies.org/; (Horton *et al*., 2017; Vandepitte *et al*., 2018), which is now accepted as a global standard for marine species names (Vandepitte *et al*., 2018). As a global species database, WAD includes not only marine species, but also brackish, freshwater, and terrestrial amphipods. WoRMS (and WAD) is managed within the Aphia platform (Vandepitte *et al*., 2015) following a successful collaborative model between taxonomists and data managers (Costello *et al*., 2018; Kroh *et al*., 2018). Each taxonomic editor is responsible for the updating and curation of a taxon (or taxa). This editing process can take place online through the editor interface or, if uploads of larger amounts of data are needed, with the help of the Data Management Team (DMT).

The aim of the World Register of Marine Species is to provide an authoritative and comprehensive list of names of marine organisms, including information on synonymy and the most up-to-date higher classification. While highest priority goes to valid names, other names that have been used are included in order to serve as a guide to interpret the taxonomic literature and results in a scientifically valuable catalogue and bibliography. Each taxon page can hold a great deal of information in addition to the currently accepted taxonomic name and authority. Associated data can include, but is not limited to, the original description of the taxon (including links to the actual publication), additional references, type locality, type specimen, environment, geographic distribution and images.

In contrast to many earlier web-based checklists, WoRMS has a permanent host institution, the Flanders Marine Institute, VLIZ, in Belgium, that is a professional data centre, collaborating with the scientific community through an editorial board of around 300 peer-selected experts from all around the world and for all taxonomic groups. WoRMS is open-access and archived monthly with a Digital Object Identifier (DOI) to ensure long-term preservation of content, and is working towards full compliance with FAIR data practices (Wilkinson *et al.,* 2016).

This collaboration between a team of expert amphipod taxonomists and the DMT support of the WoRMS database has resulted in the generation of a freely available global database of amphipod names. This is a large dataset of more than 10,600 accepted species names (as of 6 November 2023 there are 15,897 total name entries, including higher taxa and unaccepted names), which can be used for a wide range of research and non-research applications. WAD/WoRMS can be used by individuals checking on the validity of names or conducting research on the dataset, and also by institutes and other globally important scientific databases (e.g., GenBank (GenBank, 2022; Benson *et al*., 2008); Barcode of Life Data System (BOLD, 2022; Ratnasingham & Hebert, 2007); Catalogue of Life (CoL; Bánki *et al*., 2022); Global Biodiversity Information Facility (GBIF; GBIF, 2022); and Ocean Biodiversity Information System (OBIS; OBIS, 2022)), which use WoRMS as the taxonomic backbone for their own databases. Beneficiaries of the information, which is often accessed through other databases that are fed by WoRMS, include scientists, consultants, conservationists, journalists, the general public, and many others.

The WAD has facilitated several studies on the Amphipoda, including analyses of the taxonomic impediment (Coleman, 2015), species discovery (Arfianti *et al*., 2018), global biogeography (Arfianti & Costello, 2020), surveys of types in museum collections (Lo Brutto, 2017), and genetic barcode gap analysis (Jażdżewska *et al*., 2021). Amphipod taxonomists and others also make frequent use of the WAD, to provide or confirm information on the systematic and taxonomic status of entities from the species level and upwards (e.g., to provide the most up-to-date list of species in a particular genus). This is exemplified by the 328 citations of the WAD to date (via google scholar) and the number of web hits for the database (800K in 2021).

History of the World Amphipoda Database

The World Amphipoda Database, in its current format, arose from a merger in 2010 of the World Amphipoda List, compiled over many years by Jim Lowry, with the European Register of Marine Species (ERMS) amphipod list, compiled by Mark Costello, Denise Bellan-Santini and Jean-Claude Dauvin, and edited up until 2013 with significant additions from the Register of Antarctic Marine Species (RAMS) Amphipoda list (De Broyer *et al*., 2007) and from other regional editors.

Original Amphipoda editors within WoRMS were Mark Costello, Denise Bellan-Santini, Jean Claude-Dauvin, & Wim Vader, with Claude de Broyer as editor of the Register of Antarctic Marine Species (RAMS) Amphipoda. The north-Atlantic lists were initially compiled from Costello *et al*. (1989), Brattegard (1997) and Vader *et al*. (1997). The Mediterranean and south Atlantic lists were compiled from Bellan-Santini *et al*. (1998), Marques and Bellan-Santini (1990; 1991), and Lopes *et al*. (1993). Antarctic species were compiled from De Broyer *et al*. (2007). Additional species were then found in Dauvin (1999) and Dauvin & Bellan-Santini (2002) for the French metropolitan coasts, and for Arctic seas, from Palerud & Vader (1991) and Vader & Bryzagin (1998).

Jim Lowry had, for many years, compiled an unpublished list for his own use and to share with other taxonomists. This comprehensive catalogue extended over four Microsoft Word documents in alphabetical order by amphipod family, and was submitted by Jim Lowry to the Data Management Team at VLIZ for incorporation into the APHIA database in 2009. In 2010, the information was added to WoRMS, after which Jim Lowry became Chief Editor of the World Amphipoda Database.

A new editorial team and launch of the World Amphipoda Database (WAD)

In 2012, following efforts to improve the list of deep-sea Amphipoda in the World Register of Deep-Sea Species (WoRDSS; Glover *et al*., 2022), it was recognized that although Jim Lowry's catalogue had been incorporated into WoRMS in 2010, the database had not been comprehensively

Figure 1. The logo of the World Amphipoda Database, with a diversity of amphipods, featuring from left to right, *Caprella mutica* Schurin, 1935; *Epimeria oxicarinata* Coleman, 1990; *Eusirus propeperdentatus* Andres, 1979; *Cyamus boopis* Lütken, 1870; *Cyphocaris richardi* Chevreux, 1905; and *Pegohyperia princeps* K. H. Barnard, 1931.

edited or updated since that time, and an entry page with an introduction to the database was lacking. The chief taxonomic editors, Tammy Horton, Claude de Broyer, and Jim Lowry, therefore enlisted 30 amphipod taxonomists to each take on responsibility for particular taxa in the database. With almost 10,000 species to manage, it was recognized that more experts were needed to share the task of keeping the database up-to-date and to enter more information about each taxon (e.g., original descriptions, environments, type localities, life-history traits etc.). Particular expertise was required to cover the non-marine amphipod taxa. An independent account and enumeration of all freshwater amphipod taxa had been made in connection with the global Freshwater Animal Diversity Assessment project, FADA (Väinölä *et al*., 2008; Balian *et al*., 2008). The list from that project was integrated with the WoRMS database when the WAD was established. The > 2100 amphipod species and subspecies recorded from fresh or inland waters account for *ca.* 20 % of the total known amphipod diversity (Väinölä *et al.*, 2008; Horton *et al*., 2022).

In July 2013 the World Amphipoda Database http://www.marinespecies.org/amphipoda was launched and it was first presented at the 15th International Colloquium on Amphipoda, in Szczawnica, Poland, in September 2013. A front page was created with a logo (Fig. 1), a comprehensive introduction to the database, and a menu allowing users to access additional information, including the back catalogue of Amphipod Newsletters, which was first produced in 1972 and is still produced annually (https://www.marinespecies.org/amphipoda/newsletter.php). By the time it was launched, the order Amphipoda contained 9329 species divided into four suborders; there were just over 200 unchecked names and 30 quarantined taxa. The first job was to deal with these, and then to add all the new taxa that had been described since Jim Lowry's catalogue had been incorporated. This was managed with the help of the Data Management Team at VLIZ and involved the addition of data from around 200 publications. Once the database was more up-to-date, focus was turned to improving other aspects (see below) and continuing to add new taxa annually.

Priorities for improvement and aims for completion

The main priority of WoRMS, and therefore WAD, is to ensure that all valid species names are entered into the database, enabling users to find information on which names are currently accepted, which are unaccepted and which are uncertain (or temporary names) (Horton *et al*., 2017). Every newly input species requires data in addition to the species name and authority, and there is a priority list for entering further information on older taxa into the database.

The WoRMS Steering Committee (SC) has provided priority aims for completing the database over the next ten years. These are:

1. *To have at least one active editor per taxonomic group*
2. *To mark (accepted) species as "checked by editor"*
3. To document the basionym (original name)
4. *To complete missing authorships*
5. To document the original description of each species
6. To complete the environment flags
7. *To document higher classification*
8. To document type localities
9. *To document type species*
10. To document all published name combinations
11. To make available at least one image per species
12. To document (the general) distribution for each species
13. To document relevant species traits

Italicized priorities have been completed already for the WAD. These extra pieces of information are critical to the usability of the dataset. The authority and date of publication must be included, and the original description is linked to the original name as a reference, but preferably also made available as a PDF. This is particularly important when adding older taxa, as some older literature is hard to find. Unaccepted names including synonyms and older name combinations are also added to the database and linked to the currently accepted name. This allows users to find the valid name even if their taxon list is old and changes have taken place (as often happens in taxonomy!). Literature references that record changes in taxonomic status are linked to the taxon page so that the user can access this information. All information entered into the World Amphipoda Database reflects what is already published.

When the database was launched in 2013, many of the priority aims were far from completion, but targeted work through small grants since then has greatly improved the quality of the information in the database.

LifeWatch Data Grants 2015

The E-Science European LifeWatch Infrastructure for Biodiversity and Ecosystem Research targets different aspects of biodiversity research, and the Taxonomic Backbone of LifeWatch aims at bringing together taxonomic

Figure 2. Attendees at the World Amphipoda Database Editor Workshop at VLIZ, Oostende, Belgium, 2015. *Back row from left to right*: Ronald Vonk, Mikhail Daneliya, Sofie Vranken*, Bart Vanhoorne*, Claude De Broyer, Jim Lowry, Michal Grabowski, Lauren Hughes, Tomasz Mamos, Wim Vader, Anne-Nina Lörz, Oliver Coleman, Mike Thurston, Wolfgang Zeidler, and Risto Väinölä. *Front row from left to right:* Rebeca Gasca, Jean-Claude Dauvin, Stefanie Dekeyzer*, Krystof Jażdżewski, Kris White, Traudl Krapp-Schickel, Ed Hendrycks, Tammy Horton, Anne Helene Tandberg, Cris Serejo, and Leen Vandepitte*. Data Management Team (*).

and species-related data and filling gaps in our knowledge, expanding the content and enhancing the quality of taxonomic databases. In 2015, five Lifewatch grants were awarded to support amphipod editors to facilitate improvements to the taxonomic quality of WoRMS and the World Amphipoda Database (WAD) through editorship of particular taxa. These included an editor training workshop for all Amphipoda editors, and four small data grants for the non-marine Gammaroidea (excluding Baikalian taxa), other non-marine amphipod families, the superfamily Lysianassoidea and the family Niphargidae.

Amphipod editor workshop

Since the original launch of the WAD, bringing together the editorial team, there had not been a meeting of the editors and it became evident that the editing team would benefit from meeting physically together and having the opportunity to organize their editorial responsibilities. A further meeting was therefore planned that would provide training on how the editing should take place in a consistent manner, illustrate the methods and requirements of editing, work on particular projects and propose new analyses for the future. The workshop took place in 2015 at the Flanders Marine Institute (VLIZ), the host institute of WoRMS (Fig. 2). By the time of the workshop, the database held 9,915 valid species names. Priority editing tasks that needed to be completed were tackled to ensure that the database was an accurate reflection of the published literature, that it was up-to-date with newly published species, and that it remained the authoritative global list of amphipod species.

Non-marine Gammaroidea (excluding Baikalian taxa)

Taxon data (including original name, authority, environment, fossil status) were edited for 319 taxa on-line in Aphia, and updates for a further 105 taxa (*Echinogammarus* Stebbing, 1899, and *Chaetogammarus* Martynov, 1924) were provided to the data management team for upload. Missing genera (*Boeckia* G. O. Sars, 1894, *Fontogammarus* S. Karaman, 1931, *Rivulogammarus* S. Karaman, 1931, *Trichogammarus* Hou & Sket, 2016) were added with their respective constituent (child) taxa. Type localities and holotype specimen information were added when this information was available in the literature. Distribution and habitat information was added with appropriate reference sources linked for each taxon. Original description references as well as additional sources (re-descriptions, identification keys) were linked and in many cases supplemented by pdf files (Mamos & Grabowski, 2015).

Selected non-marine Amphipod families

Data were revised and added for all taxa within the families Bogidiellidae, Artesiidae, Hadziidae, and Metacrangonyctidae, partly for the Crangonyctidae, and for a number of very small families. These comprised about 250 valid non-marine species, 45 additional marine species from the same families, and about 560 names in total, including original names, synonyms, and genus-group names (*ca.* 100). The progress corresponded to about 40% of the unattended groups that need to be covered for the non-marine Amphipoda (Väinölä *et al.*, 2015).

Superfamily Lysianassoidea

The Lysianassoidea is a large superfamily that, at the time of the grant, contained 22 families, 173 genera, and just over 1000 accepted species in the WAD list (1,447 total accepted and unaccepted names). Targeted work resulted in the addition of 115 taxon names to the Lysianassoidea (54 accepted names, 21 of which were described in 2014–2016; 47 unaccepted, with the remainder being temporary names etc.). The 29 taxa (unaccepted) without authority were checked and the authority added; 316 original names and 271 original descriptions were linked. An additional 353 edits were made to existing taxon names in the database (Horton & Thurston, 2015).

Family Niphargidae

The Niphargidae is a large family of freshwater Amphipods living almost exclusively in subterranean waters of the Western Palearctic. The original lists of genera and species (nine accepted genera; 274 accepted species) in the WAD were outdated and incomplete. The data grant allowed one genus (*Niphargopsis* Chevreux, 1922) to be moved to *Niphargus* Schiödte, 1949, and two new genera (*Exniphargus* G. S. Karaman, 2016, *Niphargobatoides* G. S. Karaman, 2016) were added; 111 subspecies were raised to species rank; 34 new species were added; two species were moved into synonymy. The original names for 377 taxa (species and subspecies) were documented and missing original description sources were scanned and linked (Fišer & Horton, 2015). The authorities were completed for all taxa, and years of publication were revised where necessary. Type or neotype localities for 379 taxa were documented and information on the deposition of type, lectotype or neotype material was documented for 91 taxa. The etymology for 219 taxa was documented. The environmental requirements were revised for all species. The distribution for 379 taxa was documented at the level of country and FADA biogeographical regions (Fišer & Horton, 2015). This revision was a major improvement to the taxonomic backbone and eased all subsequent work on the group.

The “Talitraits” project

In 2018, a group targeting the inclusion of talitrids’ traits (“Talitraits”) in WoRMS met at the Hellenic Centre for Marine Research, Crete, for a workshop sponsored by LifeWatch Belgium, https://www.marinespecies.org/amphipoda/talitraits.php. The workshop supported the broad vision to combine taxonomy and ecology, to allow the formulation of clear, testable hypotheses with respect to the category “talitrids” in a species-environment approach. Providing a taxonomic backbone for talitrids and related traits was identified as the crucial passage to do so. A dataset in WoRMS was seen as the first step towards this timely change, and the “Talitraits” project was initiated to support this aim.

“Talitraits” thematic editors met to select a set of traits, consistent with the attributes already present in WoRMS, and sufficient to define coastal talitrids. Traits were prioritized and addressed, using the published literature. Priority traits were defined, and a set of traits common to the whole group of talitrids was identified to include: qualitative body size (2–200 mm); feeding strategy (omnivorous); and development (direct development). These traits were assigned to Talitridae shared at the family level and currently linked to https://www.marinespecies.org/traits/.

Agreement was met on the curation of coastal talitrids only (excluding the ecological category of “land-hoppers”, i.e. species inhabiting moist substrates, such as grasslands, forest floors, leaf litter, stream banks) and among them specifically sand-hoppers and beach-hoppers. This restricted the focus to 195 species, rather than the approximately 364 species of Talitridae known, and to the selection of the “Country name—Exclusive Economic Zone” to be used when defining each species’ distribution. The list of species and related literature from Jim’s catalogue were made available on WoRMS.

The traits defined were scaled by priority, on the basis of availability in the literature of information related to the trait for most of the species considered; ecological relevance of the trait; link of the trait to other WoRMS datasets and working groups (e.g., parasites). Qualitative body size was defined as the first trait to be curated, given its availability for all species, and is now completed. A set of additional traits (such as behavioural traits), were indicated for a future focus.

VLIZ-WoRMS Philanthropy grants 2019 and 2021

More recently, two VLIZ-WoRMS Philanthropy Grants were awarded within the VLIZ Philanthropy project “Support the WoRMS editors”, enabling focussed work to target particular gaps within the whole WAD. Within the Amphipoda, 1004 accepted taxa remained without original names documented (as of 24 June 2019). This gap was targeted, with an aim to complete the original name information for all accepted species within the World Amphipoda Database, and to reduce considerably the total number of amphipod species without an original name linked (a further 1198 unaccepted species) at the same time. As a result of this grant, all of the 1004 accepted species without an original name linked were completed. A total of 882 taxon names were added to the World Amphipod Database and 2785 edits were made to taxa in the database during the grant period, including linking the original name, linking the original description and correcting the environment and fossil status (Horton & Valls Domedel, 2019). Of the 1325 taxa without an environment documented, 519 remained. Additionally, 115 edits were made to the sources (including creation, addition of PDF documents to existing sources, or addition of links to journals when PDF versions of the articles were not available).

The 2021 Philanthropy grant allowed further work on the remaining gaps to be completed. All of the 167 accepted species and sub-species level taxa without an original name linked were completed, and all 2108 genera (accepted and unaccepted) in the WAD now have a type species linked

(> 400 of these were edited during the grant period). 1436 accepted species-level taxa had the original description source linked (more than half of the 2621 which were missing an original description at the beginning of the grant). More than 1100 edits were made to existing entries in the database including linkage to the original name, to the original description and edits of the habitat information or the fossil range (Horton & Valls Domedel, 2019).

Current Status of the World Amphipoda Database

Despite the considerable amount of work to complete gaps for the agreed priorities, the editing of the WAD is not yet complete. Work remains to complete the linking of original names (964 unaccepted taxa remain) and linking of original descriptions (780 unaccepted taxa remain). In addition, 234 species (of which 203 are unaccepted) remain without an environment flag (marine, brackish, fresh or terrestrial). Filling of these gaps will remain high on the priority list and will be managed on an ad-hoc basis until completed. Once these gaps are filled, the work will continue to input information on the new taxa described annually, which is currently an average of 137 per year (see Table 1), and focus will turn to completing the remaining priorities, particularly the input of type localities.

Table 1. Numbers of accepted taxa described per year since 2000, data from World Amphipoda Database (as of 12 May 2022).

year	all accepted names	species/subsp. names only
2000	69	55
2001	149	126
2002	174	126
2003	144	119
2004	137	116
2005	82	75
2006	159	144
2007	105	90
2008	66	51
2009	211	192
2010	134	109
2011	116	95
2012	257	211
2013	154	139
2014	149	135
2015	178	155
2016	109	87
2017	166	144
2018	114	103
2019	142	89
2020	117	88
2021	91	79
2022	25	18
total	**3,048**	**2,546**
average 2000–2021	**137**	**115**
average 2000–2010	**130**	**109**
average 2010–2020	149	123

Following major revisions of the higher-level systematics of the Amphipoda since 2003 (Myers & Lowry, 2003; Lowry, 2006; Lowry & Myers, 2012a, 2012b, 2013, 2016, 2017), the order Amphipoda in the WAD is now (as of 12 May 2022) comprised of six suborders: Amphilochidea, Colomastigidea, Hyperiidea, Hyperiopsidea, Pseudingolfiellidea & Senticaudata; 13 infraorders, 22 parvorders, 56 superfamilies, 242 families, 1766 genera, and 10,455 species. These revisions required the addition of previously unused ranks within the Amphipoda (parvorder and infraorder). Table 2 shows the breakdown of accepted and unaccepted taxa within the available ranks of Amphipoda in the WAD. The ingolfiellids (Ingolfiellidea) were traditionally a suborder within the Amphipoda ever since their description by Hansen in 1903. They were placed outside the Amphipoda by Lowry & Myers (2017) and raised to the rank of order Ingolfiellida. They continue to be maintained as part of the World Amphipoda Database owing to their historical placement. The ingolfiellidans are now a sister group to the amphipods and comprise 51 species (of which 19 are freshwater species), and about 100 taxon names (including species names and higher taxa). The taxonomy displayed in the WAD cannot always incorporate all the newest aspects of systematic relationships due to conflicting views, but does strive to provide information on alternative classifications and names used. An example of this is provided by the recent works on the systematics and diversity of freshwater gammaroid amphipods (Hou & Sket, 2016; Sket & Hou, 2018).

We present a list of accepted infraorders, superfamilies and families within each of the six suborders, providing counts of the number of genera and species within each family in three tables (Table 3: Amphilochidea; Table 4: Hyperiidea, Hyperiopsidea, Pseudingolfiellidea & Colomastigidea; Table 5: Senticaudata) to give an overview of this information. This provides a stable reference for the current state of amphipod systematics following the extensive higher-level revisions in recent years. The majority of taxa are in the suborders Amphilochidea (688 genera, 4196 species) and Senticaudata (974 genera, 5813 species).

Table 2. Number of taxon names at each of the available taxonomic ranks in the World Amphipoda Database (as of 12 May 2022). Note that "Unaccepted" includes all types of unaccepted names.

	accepted	unaccepted
suborder	6	3
infraorder	13	3
parvorder	22	0
superfamily	56	5
family	242	26
genus	1,766	339
subgenus	55	64
species	10,410	4,787
subspecies	177	697

Table 3. Suborder Amphilochidea: Alphabetical list of infraorders, superfamilies and families, providing counts of the number of genera and species within each family; data from the World Amphipoda Database (Horton *et al*., 2022; https://www.marinespecies.org/amphipoda/; downloaded 12 May 2022).

infraorder	superfamily	family	authority	genera	species
Amphilochida	Amphilochoidea	Amphilochidae	Boeck, 1871	14	92
		Bolttsiidae	J. L. Barnard & Karaman, 1987	1	2
		Cressidae	Stebbing, 1899	2	10
		Cyproideidae	J. L. Barnard, 1974	20	46
		Didymocheliidae	Bellan-Santini & Ledoyer, 1987	3	5
		Nihotungidae	J. L. Barnard, 1972	1	3
		Pleustidae	Buchholz, 1874	36	143
		Sebidae	Walker, 1908	1	25
		Seborgiidae	Holsinger in Holsinger & Longley, 1980	1	9
		Stenothoidae	Boeck, 1871	46	276
	Eusiroidea	Bateidae	Stebbing, 1906	1	14
		Eusiridae	Stebbing, 1888	12	123
		Miramarassidae	Lowry, 2006	1	1
		Thurstonellidae	Lowry & Zeidler, 2008	1	1
	Iphimedioidea	Acanthonotozomatidae	Stebbing, 1906	1	10
		Acanthonotozomellidae	Coleman & J. L. Barnard, 1991	4	8
		Amathillopsidae	Pirlot, 1934	4	21
		Dikwidae	Coleman & Barnard, 1991	1	2
		Epimeriidae	Boeck, 1871	2	90
		Iphimediidae	Boeck, 1871	15	105
		Lafystiidae	Sars, 1893	3	6
		Laphystiopsidae	Stebbing, 1899	3	8
		Ochlesidae	Stebbing, 1910	4	21
		Odiidae	Coleman & J. L. Barnard, 1991	6	20
		Sicafodiidae	Just, 2004	1	2
		Stilipedidae	Holmes, 1908	4	24
		Vicmusiidae	Just, 1990	1	2
	Leucothoidea	Leucothoidae	Dana, 1852	5	198
	Liljeborgioidea	Liljeborgiidae	Stebbing, 1899	3	121
	Liljeborgioidea	Pseudamphilochidae	Lowry & Myers, 2017	1	1
	Maxillipioidea	Maxillipiidae	Ledoyer, 1973	2	3
	Oedicerotoidea	Exoedicerotidae	J. L. Barnard & Drummond, 1982	12	20
		Oedicerotidae	Lilljeborg, 1865	46	252
		Paracalliopiidae	J. L. Barnard & Karaman, 1982	6	20
Lysianassida	Alicelloidea	Alicellidae	Lowry & De Broyer, 2008	7	17
		Parargissidae	Lowry & Myers, 2017	1	2
		Podoprionidae	Lowry & Stoddart, 1996	1	4
		Valettidae	Stebbing, 1888	1	2
		Valettiopsidae	Lowry & De Broyer, 2008	2	12
		Vemanidae	Lowry & Myers, 2017	1	4
	Aristioidea	Acidostomatidae	Stoddart & Lowry, 2012	2	11
		Ambasiidae	Lowry & Myers, 2017	2	3
		Aristiidae	Lowry & Stoddart, 1997	5	42
		Conicostomatidae	Lowry & Stoddart, 2012	6	19
		Derjugianidae	Lowry & Myers, 2017	1	1
		Endevouridae	Lowry & Stoddart, 1997	2	19
		Izinkalidae	Lowry & Stoddart, 2010	1	2
		Kergueleniidae	Lowry & Stoddart, 2010	2	26
		Lepidepecreellidae	Stoddart & Lowry, 2010	1	12
		Pakynidae	Lowry & Myers, 2017	12	38
		Sophrosynidae	Lowry & Stoddart, 2010	1	14
		Thoriellidae	Lowry & Stoddart, 2011	5	7
		Trischizostomatidae	Lilljeborg, 1865	1	18
		Wandinidae	Lowry & Stoddart, 1990	2	4
	Dexaminoidea	Atylidae	Lilljeborg, 1865	6	40
		Dexaminidae	Leach, 1814	12	127
		Lepechinellidae	Schellenberg, 1926	5	41

Table 3. (Continued).

infraorder	superfamily	family	authority	genera	species
		Melphidippidae	Stebbing, 1899	4	18
		Pardaliscidae	Boeck, 1871	23	80
	Haustorioidea	Cheidae	Thurston, 1982	3	3
		Condukiidae	J. L. Barnard & Drummond, 1982	1	1
		Haustoriidae	Stebbing, 1906	8	46
		Ipanemidae	J. L. Barnard & Thomas, 1988	1	1
		Otagiidae	Hughes & Lörz, 2013	1	1
		Phoxocephalidae	G. O. Sars, 1891	79	371
		Phoxocephalopsidae	J. L. Barnard & Drummond, 1982	5	14
		Platyischnopidae	J. L. Barnard & Drummond, 1979	10	18
		Pontoporeiidae	Dana, 1852	3	4
		Priscillinidae	d'Udekem d'Acoz, 2006	1	2
		Sinurothoidae	Ren, 1999	1	2
		Urohaustoriidae	J. L. Barnard & Drummond, 1982	9	23
		Urothoidae	Bousfield, 1978	6	64
		Zobrachoidae	J. L. Barnard & Drummond, 1982	5	6
	Lysianassoidea	Adeliellidae	Lowry & Myers, 2017	1	3
		Amaryllididae	Lowry & Stoddart, 2002	8	37
		Cebocaridae	Lowry & Stoddart, 2011	9	15
		Cyclocaridae	Lowry & Stoddart, 2011	1	4
		Cyphocarididae	Lowry & Stoddart, 1997	2	19
		Eurytheneidae	Stoddart & Lowry, 2004	1	10
		Hirondelleidae	Lowry & Stoddart, 2010	1	20
		Lysianassidae	Dana, 1849	29	130
		Opisidae	Lowry & Stoddart, 1995	4	19
		Scopelocheiridae	Lowry & Stoddart, 1997	12	26
		Tryphosidae	Lowry & Stoddart, 1997	43	385
		Uristidae	Hurley, 1963	26	189
	Stegocephaloidea	Stegocephalidae	Dana, 1852	26	109
	Synopioidea	Ampeliscidae	Krøyer, 1842	4	318
		Argissidae	Walker, 1904	1	1
		Synopiidae	Dana, 1853	17	108
			total	688	4,196

Conclusions and future plans

The World Amphipoda Database provides an example of a successful collaboration between taxonomist experts and database managers. It would not exist if it were not for the immense work of Jim Lowry to collate the original world catalogue. At the time of writing this article Jim and his network of collaborators had contributed 62 new families, 129 new genera, and 548 new species of amphipods from the time he published his first taxonomic paper on the group in 1972 across a career spanning 55 years (Hughes *et al*., 2023).

The WAD is an ever-expanding database, with an average of 137 newly described taxon names entered into the database annually (Table 1), with edits to and additions of older names being made all the time. The database still contains residual errors and there are certain taxa that have received less focussed attention and will need targeted improvement in the future. Amphipoda systematics are in a state of flux, particularly due to new insights from molecular data and the fact that this information is not yet available for many of the relevant taxa (Copilaş-Ciocianu *et al*., 2020).

Users of the database are encouraged to point out errors to the Data Management Team using the single contact email info@marinespecies.org and queries will be passed to the relevant editor. Contributors are acknowledged annually on the WAD webpages.

Table 4. Suborders Hyperiidea, Hyperiopsidea, Pseudingolfiellidea & Colomastigidea: Alphabetical list of infraorders, superfamilies and families, providing counts of the number of genera and species within each family; data from the World Amphipoda Database (Horton *et al*., 2022; https://www.marinespecies.org/amphipoda/; downloaded 12 May 2022).

suborder/Infraorder	superfamily	family	authority	genera	species
Hyperiidea					
Physocephalata	Phronimoidea	Bougisidae	Zeidler, 2004	1	1
		Cystisomatidae	Willemöes-Suhm, 1875	1	6
		Dairellidae	Bovallius, 1887	1	1
		Hyperiidae	Dana, 1852	7	29
		Iulopididae	Zeidler, 2004	1	2
		Lestrigonidae	Zeidler, 2004	6	17
		Phronimidae	Rafinesque, 1815	2	11
		Phrosinidae	Dana, 1852	3	8
	Platysceloidea	Amphithyridae	Zeidler, 2016	3	9
		Anapronoidae	Bowman & Gruner, 1973	1	2
		Brachyscelidae	Stephensen, 1923	1	5
		Eupronoidae	Zeidler, 2016	2	9
		Lycaeidae	Claus, 1879	2	11
		Lycaeopsidae	Chevreux, 1913	1	2
		Oxycephalidae	Dana, 1852	8	18
		Parascelidae	Bovallius, 1887	4	7
		Platyscelidae	Spence Bate, 1862	4	11
		Pronoidae	Dana, 1852	1	1
		Thamneidae	Zeidler, 2016	1	1
		Tryphanidae	Boeck, 1871	1	1
	Vibilioidea	Cyllopodidae	Bovallius, 1887	1	2
		Paraphronimidae	Bovallius, 1887	1	3
		Vibiliidae	Dana, 1852	2	19
Physosomata	Lanceoloidea	Chuneolidae	Woltereck, 1909	1	3
		Lanceolidae	Bovallius, 1887	2	16
		Megalanceolidae	Zeidler, 2009	2	4
		Metalanceolidae	Zeidler, 2009	1	1
		Microphasmidae	Stephensen & Pirlot, 1931	2	2
		Mimonecteolidae	Zeidler, 2009	1	7
		Prolanceolidae	Zeidler, 2009	1	1
Physosomata	Scinoidea	Archaeoscinidae	K. H. Barnard, 1930	2	6
		Microscinidae	Zeidler, 2012	1	1
		Mimonectidae	Bovallius, 1885	3	13
		Mimoscinidae	Zeidler, 2012	1	3
		Scinidae	Stebbing, 1888	4	49
Total (Hyperiidea)				76	282
Hyperiopsidea					
Hyperiopsida	Hyperiopsoidea	Hyperiopsidae	Bovallius, 1886	2	11
		Vitjazianidae	Birstein & M. Vinogradov, 1955	1	1
	Podosiroidea	Podosiridae	Lowry & Myers, 2012	2	3
Pseudingolfiellidea					
Pseudingolfiellida	Pseudingolfielloidea	Pseudingolfiellidae	Lowry & Myers, 2012	1	4
Colomastigidea					
Colomastigida	Colomastigoidea	Colomastigidae	Chevreux, 1899	2	55
	Pagetinoidea	Pagetinidae	K. H. Barnard, 1931	1	4
Amphipoda incertae sedis					
null	null	Iciliidae	Dana, 1849	1	7
		Paramphithoidae	G. O. Sars, 1883	1	7
		Regaliidae	Lowry, 2006	1	3
		Sanchoidae	Lowry, 2006	2	4
total (all suborders and incertae sedis)				90	381

Table 5. Suborder Senticaudata: Alphabetical list of infraorders, superfamilies and families, providing counts of the number of genera and species within each family; data from the World Amphipoda Database (Horton *et al*., 2022; https://www.marinespecies.org/amphipoda/; downloaded 12 May 2022).

infraorder	superfamily	family	authority	genera	species
Bogidiellida	Bogidielloidea	Artesiidae	Holsinger, 1980	2	9
		Bogidiellidae	Hertzog, 1936	37	115
		Parabogidiellidae	Cannizzaro & Sawacki *in* Cannizzaro, Gibson & Sawacki, 2020	2	2
		Salentinellidae	Bousfield, 1977	2	14
Carangoliopsida	Carangoliopsoidea	Carangoliopsidae	Bousfield, 1977	1	1
		Kairosidae	Lowry & Myers, 2013	1	1
Corophiida	Aetiopedesoidea	Aetiopedesidae	Myers & Lowry, 2003	1	1
		Paragammaropsidae	Myers & Lowry, 2003	2	2
	Aoroidea	Aoridae	Stebbing, 1899	26	260
		Unciolidae	Myers & Lowry, 2003	17	43
	Caprelloidea	Caprellidae	Leach, 1814	96	447
		Caprogammaridae	Kudrjaschov & Vassilenko, 1966	1	2
		Cyamidae	Rafinesque, 1815	8	29
		Dulichiidae	Dana, 1849	7	30
		Podoceridae	Leach, 1814	8	89
	Cheluroidea	Cheluridae	Allman, 1847	3	4
	Chevalioidea	Chevaliidae	Myers & Lowry, 2003	2	14
	Corophioidea	Ampithoidae	Boeck, 1871	16	241
		Corophiidae	Leach, 1814	25	162
	Isaeoidea	Isaeidae	Dana, 1852	2	5
	Microprotopoidea	Australomicroprotopidae	Myers, Lowry & Billingham, 2016	1	1
		Microprotopidae	Myers & Lowry, 2003	1	5
	Neomegamphoidea	Neomegamphopidae	Myers, 1981	6	22
		Priscomilitaridae	Hirayama, 1988	2	3
	Photoidea	Ischyroceridae	Stebbing, 1899	51	287
		Kamakidae	Myers & Lowry, 2003	10	41
		Photidae	Boeck, 1871	18	235
	Protodulichioidea	Protodulichiidae	Ariyama *in* Ariyama & Hoshino, 2019	1	1
	Rakirooidea	Rakiroidae	Myers & Lowry, 2003	1	1
Gammarida	Allocrangonyctoidea	Allocrangonyctidae	Holsinger, 1989	1	2
		Crymostygidae	Kristjánsson & Svavarsson, 2004	1	1
		Dussartiellidae	Lowry & Myers, 2012	2	3
		Kergueleniolidae	Lowry & Myers, 2013	1	1
		Pseudoniphargidae	Karaman, 1993	3	74
	Crangonyctoidea	Austroniphargidae	Iannilli, Krapp & Ruffo, 2011	3	5
		Chillagoeidae	Lowry & Myers, 2012	1	1
		Crangonyctidae	Bousfield, 1973	10	234
		Giniphargidae	Lowry & Myers, 2012	1	1
		Kotumsaridae	Messouli, Holsinger & Ranga Reddy, 2007	1	1
		Neoniphargidae	Bousfield, 1977	7	22
		Niphargidae	Bousfield, 1977	9	432
		Paracrangonyctidae	Bousfield, 1983	1	2
		Paramelitidae	Bousfield, 1977	16	70
		Perthiidae	Williams & J. L. Barnard, 1988	1	2
		Pseudocrangonyctidae	Holsinger, 1989	2	38
		Sandroidae	Lowry & Myers, 2012	1	3
		Sternophysingidae	Holsinger, 1992	1	8
		Uronyctidae	Lowry & Myers, 2012	1	1
	Gammaroidea	Acanthogammaridae	Garjajeff, 1901	34	122
		Anisogammaridae	Bousfield, 1977	12	65
		Baikalogammaridae	Kamaltynov, 2002	1	1
		Bathyporeiidae	d'Udekem d'Acoz, 2011	2	24
		Behningiellidae	Kamaltynov, 2002	3	4
		Carinogammaridae	Tachteew, 2001	1	1
		Crypturopodidae	Kamaltynov, 2002	9	37
		Eulimnogammaridae	Kamaltynov, 1999	16	114

Table 5. (Continued).

infraorder	superfamily	family	authority	genera	species
		Falklandellidae	Lowry & Myers, 2012	3	3
		Gammaracanthidae	Bousfield, 1989	1	4
		Gammarellidae	Bousfield, 1977	2	6
		Gammaridae	Leach, 1814	37	441
		Iphigenellidae	Kamaltynov, 2002	1	3
		Luciobliviidae	Tomikawa, 2007	1	1
		Macrohectopidae	Sowinsky, 1915	1	1
		Mesogammaridae	Bousfield, 1977	6	8
		Micruropodidae	Kamaltynov, 1999	3	41
		Ommatogammaridae	Kamaltynov, 2010	3	5
		Pachyschesidae	Kamaltynov, 1999	1	16
		Pallaseidae	Tachteew, 2001	8	21
		Paraleptamphopidae	Bousfield, 1983	3	5
		Phreatogammaridae	Bousfield, 1983	3	6
		Pontogammaridae	Bousfield, 1977	11	37
		Sensonatoridae	Lowry & Myers, 2012	1	1
		Typhlogammaridae	Bousfield, 1978	5	9
		Zaramillidae	Lowry & Myers, 2016	1	1
Hadziida	Calliopioidea	Calliopiidae	G. O. Sars, 1893	28	105
		Cheirocratidae	d'Udekem d'Acoz, 2010	7	19
		Hornelliidae	d'Udekem d'Acoz, 2010	1	13
		Megaluropidae	Thomas & J. L. Barnard, 1986	4	16
		Pontogeneiidae	Stebbing, 1906	29	168
	Hadzioidea	Crangoweckeliidae	Lowry & Myers, 2012	2	3
		Eriopisidae	Lowry & Myers, 2013	21	77
		Gammaroporeiidae	Bousfield, 1979	1	1
		Hadziidae	S. Karaman, 1943	27	93
		Maeridae	Krapp-Schickel, 2008	48	413
		Melitidae	Bousfield, 1973	31	178
		Metacrangonyctidae	Boutin & Messouli, 1988	2	20
		Nuuanuidae	Lowry & Myers, 2013	3	25
	Magnovioidea	Magnovidae	Alves, Lowry & Jonsson, 2020	1	1
Talitrida	Caspicoloidea	Caspicolidae	Birstein, 1945	1	1
	Hyaloidea	Ceinidae	J. L. Barnard, 1972	3	7
		Chiltoniidae	J. L. Barnard, 1972	10	22
		Dogielinotidae	Gurjanova, 1953	9	39
		Eophliantidae	Sheard, 1936	6	16
		Hyalellidae	Bulyčeva, 1957	1	89
		Hyalidae	Bulyčeva, 1957	12	150
		Najnidae	J. L. Barnard, 1972	2	12
		Phliantidae	Stebbing, 1899	7	32
		Plioplateidae	J. L. Barnard, 1978	1	2
		Temnophliantidae	Griffiths, 1975	2	2
	Kurioidea	Kuriidae	J. L. Barnard, 1964	2	2
		Tulearidae	Ledoyer, 1979	1	1
	Talitroidea	Arcitalitridae	Myers & Lowry, 2020	15	35
		Brevitalitridae	Myers & Lowry, 2020	8	24
		Curiotalitridae	Myers & Lowry, 2020	1	1
		Makawidae	Myers & Lowry, 2020	22	39
		Protorchestiidae	Myers & Lowry, 2020	6	24
		Talitridae	Rafinesque, 1815	77	236
		Uhlorchestiidae	Myers & Lowry, 2020	1	2
			total	974	5,813

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Spider Crabs of the *Samadinia pulchra* complex (Crustacea: Decapoda: Epialtidae)

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Abstract. The spiny spider crab, *Samadinia pulchra* (Miers *in* Tizard, Moseley, Buchanan & Murray, 1885) (type locality: Bohol Sea, Philippines) has long been considered to be widespread in the western Pacific and Indian Ocean, with *Anamathia livermorii* Wood-Mason *in* Wood-Mason & Alcock, 1891, described from the Andaman Sea, in its synonymy. Reassessment of *Samadinia pulchra* from throughout its purported range indicates that it comprises a complex of three species: *S. pulchra* sensu stricto, occurring in the northwestern Pacific, from the South China Sea to Japan; *S. livermorii*, occurring in the Indian Ocean, ranging from southwestern Indonesia to East Africa; and a new species, *S. jimlowryi* sp. nov., ranging from northwestern Australia to southeastern Indonesia.

Introduction

The spiny spider crab, *Anamathia pulchra,* was described by Edward Miers in 1886 based on a single specimen collected by the HMS *Challenger* in the Philippines. It was soon followed by description of a similarly spiny species, *Anamathia livermorii* Wood-Mason *in* Wood-Mason & Alcock, 1891, from the Andaman Sea. Presumably on account of their strong similarities, *A. livermorii* was synonymized with *A. pulchra* and transferred to *Scyramathia* (see Alcock, 1895), then to *Rochinia* (see Rathbun, 1925), and most recently to *Samadinia* Ng & Richer de Forges, 2013, a genus of 37 species to date (see Lee *et al.*, 2021; Richer de Forges *et al.*, 2021; Takeda *et al.*, 2022; Davie & Lee, 2023; Lee *et al.*, 2023). Subsequent studies reported *S. pulchra* (Miers, 1886) from wide-ranging localities including Japan and Taiwan (Sakai, 1938; Takeda, 1975; Ho *et al.*, 2004), the South China Sea (Serène & Lohavanijaya, 1973; Griffin, 1976), Indonesia (Griffin & Tranter, 1986a) and northern Australia (Griffin & Tranter, 1986b; Richer de Forges & Poore, 2008), and the western Indian Ocean from Madagascar and East Africa (Doflein, 1904; Richer de Forges & Ng, 2013; Muñoz *et al.*, 2021). Consequently, *S. pulchra* has long been regarded as wide-ranging in the Indo-West Pacific and distinguished from its congeners by the combination of strongly divergent rostral spines, and the presence of 20 long, upright dorsal spines on the carapace (including preorbital and hepatic spines). Here, we reassess *Samadinia pulchra* from throughout its purported range and recognize a complex of three species, documented below.

Keywords: Epialtidae, new species, deep sea, spider crab, taxonomy, species complex
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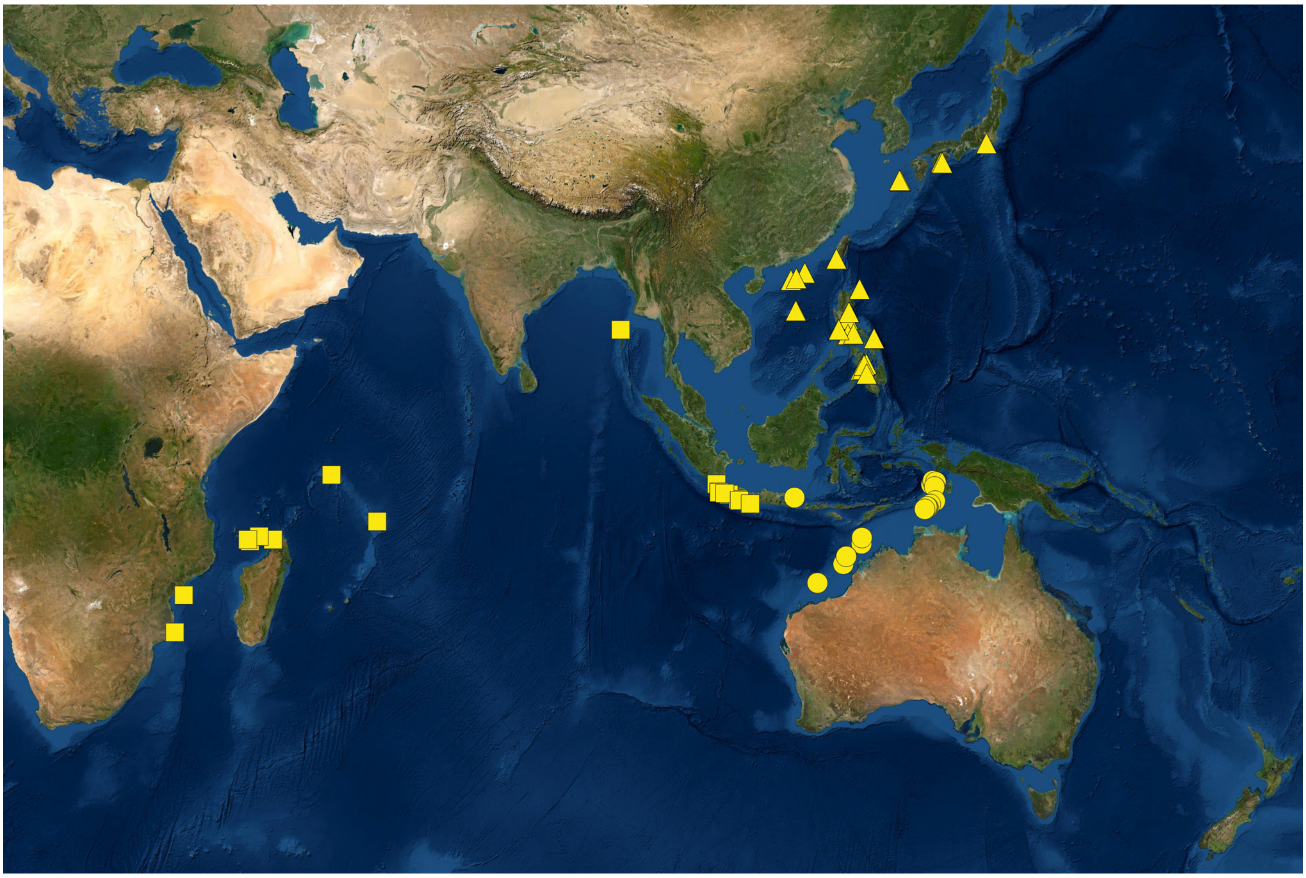

Figure 1. Distribution of species of the *Samadinia pulchra* complex: *S. pulchra* (Miers *in* Tizard, Moseley, Buchanan & Murray, 1885) (▲), *S. jimlowryi* sp. nov. (●), *S. livermorii* (Wood-Mason *in* Wood-Mason & Alcock, 1891) (■).

Materials and methods

Carapace length (cl) is measured along the dorsal midline and includes the rostral spines. Postrostral carapace length (pcl) is measured along the dorsal midline from the base of the sinus between the rostral spines and the posterior margin of the carapace. Carapace width (cw) is the greatest width across the branchial regions, excluding spines. Measurements are provided in millimetres. The abbreviations used are as follows: coll. = collector; G1 and G2 = the male first and second gonopod respectively; P1–P5 = pereopods 1–5; and stn = station.

Specimens examined are deposited in the collections of the following institutions: the Australian Museum, Sydney, Australia (AM); Muséum national d'Histoire naturelle, Paris, France (MNHN); Museum für Naturkunde, Berlin, Germany (ZMB); Museum Victoria, Melbourne, Australia (NMV); Museum Zoologicum Bogoriense, Cibinong, Bogor, Indonesia (MZB); National Museum of Natural History, Smithsonian Institution, Washington DC, USA. (USNM); National Museum of the Philippines, Manila, Philippines (NMCR); National Museum of Nature and Science, Tokyo, Japan (NSMT); Natural History Museum, London, UK (NHM); Natur-Museum und Forschungsinstitut Senckenberg, Frankfurt am Main, Germany (SMF); Western Australia Museum, Perth, Australia (WAM); and the Zoological Reference Collection, Lee Kong Chian Natural History Museum, National University of Singapore, Singapore (ZRC). The distribution map (Fig. 1) was prepared using QGIS 3.4.

Systematic account

Superfamily Majoidea Samouelle, 1819

Family Epialtidae MacLeay, 1838

Genus *Samadinia* Ng & Richer de Forges, 2013

Type species: *Samadinia longispina* Ng & Richer de Forges, 2013, by original designation.

Samadinia pulchra (Miers *in* Tizard, Moseley, Buchanan & Murray, 1885)

Figs 1–3, 7A, B

Amathia (*Amathia*) *pulchra* Miers *in* Tizard, Moseley, Buchanan & Murray, 1885: 589.

Anamathia pulchra.—Miers, 1886: xxix (list), xl, xliii (list), 26–27, pl. IV fig. 1, 1a–c (type locality: Philippine Islands).

Rochinia pulchra.—Sakai, 1938: 278 (key), 278, 279, text-fig. 35, pl. 37 fig. 4.—Serène & Lohavanijaya, 1973: 55 (key), 56, 57, figs 119–122, pl. 11 A.—Takeda, 1975: 144, 145, 151 (table), fig. 4a, b.—Sakai, 1976: 223 (key), 223, 224, pl.79 fig. 1.—Griffin, 1976: 210.—Griffin & Tranter, 1986a: 176 (key), 185, 187.—Griffin & Tranter, 1986b: 363.—Davie & Short, 1989: 182.—Ikeda, 1998: 12 (list), 14 (table), 35, pl. 37 figs 1–3.—Muraoka, 1998: 25.—Takeda, 2001: 241, 251 (table), 255 (table), 259 (table).—Casadío *et al.*, 2005: 159 (list).—Ng & Richer de Forges, 2007: 62 (list), 65.—Richer de Forges & Poore, 2008: 66 (list), 68, 69 (in part).—Ng *et al.*, 2008:

105 (list).—Ng & Richer de Forges, 2013: 362, fig. 5D.—Richer de Forges & Ng, 2013: 468, 469, fig. 1C (in part, Philippine material only).—Wang *et al.*, 2017: app. 1.—Ng *et al.*, 2017: 53 (list).—Tavares & Santana, 2018: 223 (list).—Lee *et al.*, 2019: 35, 40.

Samadinia pulchra.—Lee *et al.*, 2021: 22 (list), 33, 43 [new combination].

Holotype: NHM 1884.31, male (pcl 19.3 mm, cw 13.0 mm), S of Panglao Island, Bohol Sea, Philippines, 9°26'00"N 123°45'00"E, 375 fm (686 m), dredged, HMS *Challenger*, stn 210.

Other material examined. **Japan**: USNM 120721, 3 males (pcl 15.9 mm, cw 9.9 mm to pcl 17.6, cw 11.3 mm), 2 females (pcl 19.0 mm, cw 12.2 mm; pcl 18.8 mm, cw 12.5 mm), Tosa Bay, 33°17.5'N 133°32.88'E, coll. T. Sakai & K. Sakai, February 1966; NSMT-Cr 13615, 6 males (pcl 13.9 mm, cw 9.2 mm to pcl 21.1 mm, cw 14.1 mm), 2 ovigerous females (pcl 17.5 mm, cw 11.6 mm; pcl 17.8 mm, cw 12.2 mm), 1 female (pcl 18.3 mm, cw 12.9 mm), Tosa Bay, 33°13.5–12.8'N 133°41.6–41.4'E, 440–460 m, K00-8-400, FV *Kotaka Maru*, 24 August 2000; SMF, 4 ovigerous females (pcl 15.5 mm, cw 10.2 mm to pcl 17.3 mm, cw 11.2 mm), Tosa Bay, coll. K. Sakai, 1995; SMF, 1 male (cl 25.9 mm, pcl 16.2 mm, cw 10.7 mm), 1 ovigerous female (pcl 15.5 mm, cw 10.6 mm), Haritsunogani, Tosa Bay, TS00433, coll. K. Sakai; SMF, 1 ovigerous female (pcl 14.1 mm, cw 9.0 mm), 1 female (pcl 13.1 mm, cw 8.8 mm; with rhizocephalan), Mimase, Kochi, 10 March 1988; SMF, 1 male (cl 26.2 mm, pcl 19.0 mm, cw 12.3 mm), 1 ovigerous female (cl 26.3 mm, pcl 17.3 mm, cw 11.2 mm), off Kii, 250–350 m, coll. S. Nagai, November 1993. **Taiwan:** ZRC, 1 female (cl 29.9 mm, pcl 19.4 mm, cw 12.7 mm), SE of Kaohsiung, 22°4.2'N 120°10.2'E, 467–634 m, TAIWAN 2000 stn CP19, RV *Fishery Researcher 1*, 29 July 2000. **South China Sea**: ZRC 1968.2.13.4, 1 male (cl 26.8 mm, pcl 17.3 mm, cw 11.6 mm), northern South China Sea, SSE of Hong Kong, cruise 4/64, st. 36, trawl (247), Hong Kong Fisheries Research Station, RV *Cape St. Mary*; ZRC 1968.2.15.4, 1 male (cl 13.2 mm, pcl 8.6 mm), 135 miles SSE of Hong Kong, 20°05'N 115°03'E, 299–300 fm (547–549 m), cruise no. 4/64 st. 119, trawl (218), Hong Kong Fisheries Research Station, RV *Cape St. Mary*, coll O. T. Chan, 22 August 1964; ZRC 1968.2.15.3, 1 male (cl 31.1 mm, pcl 17.5 mm, cw 12.4 mm), SSE of Hong Kong, 394 fm (721 m), cruise 4/64 st. 121, trawl (219), Hong Kong Fisheries Research Station, RV *Cape St. Mary*, coll O. T. Chan, 22 August 1964; ZRC 1968.2.15.5, 1 ovigerous female (cl 32.9 mm, pcl 19.1 mm, cw 13.5 mm), northern South China Sea, SSE of Hong Kong, cruise 4/64, trawl (130), Hong Kong Fisheries Research Station, RV *Cape St. Mary*; ZRC 2022.0792, 3 males (cl 24.2 mm, pcl 14.5 mm, cw 9.7 mm to cl 28.7 mm, pcl 17.8 mm, cw 11.6 mm), 1 female (cl 28.4 mm, pcl 17.4 mm, cw 11.0 mm), 6 ovigerous females (cl 21.7 mm, pcl 13.9 mm, cw 8.8 mm to cl 28.0 mm, pcl 17.4 mm, cw 11.5 mm), 1 juvenile female (cl 16.7 mm, pcl 10.5 mm, cw 6.3 mm), Macclesfield Bank, 16°13.60'N 115°01.61'E to 16°11.21'N 114°59.77'E, 526–510 m, ZHONGSHA 2015 stn CP4155, 28 July 2015; ZRC 2022.0793, 1 male (cl 36.0 mm, pcl 21.4 mm, cw 14.5 mm), Macclesfield Bank, 16°13.60'N 115°01.61'E to 16°11.21'N 114°59.77'E, 526–510 m, ZHONGSHA 2015 stn CP4155, 28 July 2015; ZRC 2022.0794, 5 males (cl 22.3 mm, pcl 13.9 mm, cw 8.5 mm to cl 37.2 mm, pcl 21.2 mm, cw14.3 mm), E of Macclesfield Bank, 16°09.80'N 114°58.73'E to 16°12.19'N 115°00.53'E, 511–510 m, ZHONGSHA 2015 stn CP4156, 28 July 2015; ZRC, 1 ovigerous female (cl 25.0 mm, pcl 15.8 mm, cw 11.4 mm), W of Pratas, 20°44.86–42.28'N 116°08.01–08.01'E, 420–444 m, DONGSHA 2014 stn CP4128, 1 May 2014; ZRC 2022.0795, 1 male (cl 24.0 mm, pcl 14.6 mm, cw 9.2 mm), 19°53.06–53.03'N 114°21.68–24.74'E, 536–524 m, ZHONGSHA 2015 CP4137, 23 July 2015. **Philippines**: ZRC 2011.1059, 1 male (pcl 13.3 mm, cw 7.9 mm), NE of Luzon, 18°47.49'N 123°08.26'E, 507–540 m, AURORA 2007 stn CP2678, 23 May 2007; ZRC 2011.1052, 1 male (cl 26.4 mm, pcl 16.5 mm, cw 10.5 mm), 1 female (cl 19.6 mm, pcl 12.4 mm, cw 7.7 mm), 1 juvenile female (cl 16.9 mm, pcl 11.6 mm, cw 7.2 mm), off eastern Luzon, 15°59.07'N 121°49.22'E, 496–364 m, AURORA 2007 stn CC2745, 2 June 2007; ZRC 2011.1043, 1 male (cl 28.0 mm, pcl 17.9 mm, cw 12.6 mm), 1 female (cl 23.7 mm, pcl 15.0 mm, cw 9.9 mm), off eastern Luzon, 15°58.78–56.63'N 121°46.44–44.85'E, 182–220 m, AURORA 2007 stn CC2746, 2 June 2007; ZRC 2011.1049, 1 damaged male, 1 ovigerous female (pcl 15.7 mm, cw 9.6 mm), off eastern Luzon, 15°58.03'N 121°49.11'E, 422–431 m, AURORA 2007 stn CP2658, 20 May 2007; ZRC 2011.1053, 1 male (cl 20.0 mm, pcl 12.5 mm, cw 7.5 mm), 1 ovigerous female (cl 18.7 mm, pcl 12.2 mm, cw 7.6 mm), 1 female (cl 24.6 mm, pcl 15.6 mm, cw 9.8 mm), 3 juvenile females (cl 16.6 mm, pcl 11.5 mm, cw 6.9 mm to cl 20.4 mm, pcl 13.0 mm, cw 8.0 mm), off eastern Luzon, 15°56.41'N 121°48.88'E, 460–480 m, AURORA 2007 stn CP2659, 20 May 2007; ZRC 2013.0629, 1 ovigerous female (cl 23.0 mm, pcl 15.2 mm, cw 10.3 mm), off eastern Luzon, 15°07.61'N 121°36.95'E, 309 m, AURORA 2007 stn CP2708, 28 May 2007; USNM 49498, 1 ovigerous female (not measured), Verde Island Passage, 13°53'00"N 120°26'45"E, 454 m, *Albatross* stn 5282, 18 July 1908; USNM 49497, 1 male (not measured), Verde Island Passage, 13°48'30"N 120°28'40"E, 512 m, dark grey silt, *Albatross* stn 5283, 18 July 1908; USNM 49499, 1 male (not measured), Sibuyan Sea, SE Luzon, 13°17'45"N 122°22'00"E, 723 m, soft green mud, *Albatross* stn 5378, 4 March 1909; USNM 49495, 1 male (not measured), 1 female (not measured), Tablas Strait, E of Mindoro, 13°12'45"N 121°38'45"E, 518 m, green mud, *Albatross* stn 5123, 2 February 1908; USNM 49500, 1 female (not measured), Tablas Strait, SE of Mindoro, 12°25'35"N 121°31'35"E, 428 m, *Albatross* stn 5260, 3 June 1908; USNM 49494, 1 male (not measured), NW of Batag Island, Philippine Sea, 12°43'51"N 124°58'50"E, 564 m, green mud, *Albatross* stn 5444, 3 June 1909; ZRC, 2 females (cl 26.6 mm, pcl 16.2 mm, cw 11.2 mm; cl 25.5 mm, pcl 16.8 mm, cw 11.4 mm), same; ZRC, 1 male (cl 19.0 mm, pcl 13.3 mm, cw 9.1 mm), 1 ovigerous female (cl 25.0 mm, pcl 16.6 mm, cw 12.0 mm), S of Bohol, Bohol Sea, 9°31.4'N 124°00.6'E, 738–798 m, PANGLAO 2005 stn CP2350, 24 May 2005; USNM 49492, 1 ovigerous female (pcl 19.9 mm, cw 13.3 mm), between Siquijor and Bohol, 5.8 miles SW of Balicasag Island, Bohol Sea, 9°24'45"N 123°39'15"E, 503 m, globigerina ooze, *Albatross* stn 5528, 11 August 1909; USNM 49493, 2 males (not measured), between Panglao Island and Siquijor Island, Bohol Sea, 9°22'30"N 123°42'40"E, 717 m, globigerina ooze, *Albatross* stn 5527, 11 August 1909; ZRC, 1 ovigerous female (cl 27.5 mm, pcl 17.0 mm, cw 12.0 mm), S of Siquijor, Bohol Sea, 8°53.1'N 123°33.5'E, 516–543 m, PANGLAO 2005 stn CP2361, 26 May 2005; MNHN, 1 female (cl 43.2 mm, pcl 27.9 mm, cw 10.4 mm), Balicasag Island, Bohol Sea, 8°52.1'N 123°37.1'E, 569–583 m, PANGLAO 2005 stn CP2358, 26 May 2005; AM P.90365, 1 female (with rhizocephalan; pcl 16.4 mm, cw 11.3 mm), same; ZRC 2013.0623, 2 juvenile females (cl 19.9 mm, pcl 12.3 mm, cw 8.2 mm; cl 20.8 mm, pcl 12.7 mm, cw 8.4 mm), same; NMCR, 1 male (cl 34.5 mm, pcl 19.5 mm, cw 12.9 mm), NE of Aligbay Island, Sulu Sea, 8°46.2'N 123°16.1'E, 624–647 m, PANGLAO 2005 stn CP2384, 29 May 2005; USNM 49496, 1 male (not measured), Iligan Bay, Mindanao, 8°16'45"N 124°02'48"E, 924 m, grey mud, fine silt, *Albatross* stn 5513, 7 August 1908.

Diagnosis. Carapace with at least 20 sharp, slender, upright dorsal spines (paired preorbital; paired hepatic; 6 gastric; 1 median cardiac; 1 median intestinal; on each side, 4 pairs branchial); hepatic spine with lateral surface flattened or weakly sulcate. G1 distal margin oblique, straight to irregularly gently sinuous.

Description (specimens > 10 mm pcl). Carapace pyriform, pcl 1.4–1.7× width, regions weakly defined, entire surface with tomentum of short lobular setae.

Rostral spines usually strongly divergent for entire length (occasionally weakly divergent to subparallel), straight to outwardly curved (in dorsal view), straight to curved but slightly upcurved in lateral view; length 0.4–0.8× pcl; margins lined with short, soft, lobular setae and scattered simple setae. Dorsal orbital eave weakly expanded, produced as a long, slender upright spine, inclined anteriorly and usually slightly incurved; postorbital lobe short, anteriorly cupped; hiatus wide, U-shaped. Dorsal surface with long, slender, upright spines in following pattern: straight, near vertical hepatic spine with lateral surface flattened or weakly sulcate; gastric region with 6 slender upright spines (2 in midline; paired epigastric and protogastric spines) and usually with two shorter spines or tubercles in transverse row between anterior and posterior median spines; cardiac and intestinal regions each with straight, upright spine; branchial regions each with 4 straight, upright, spines, 2 near lateral carapace margin and directed laterodorsally, 2 on upper surface, almost vertical. Pterygostomial region with 3 or 4 tubercles in longitudinal row below moult suture, followed by tubercle on anterior branchial submargin slightly below moult suture.

Eyestalks short, sparsely setose anteriorly, cornea terminal. Basal antennal article length about twice width; surface shallowly sulcate longitudinally; anterolateral angle

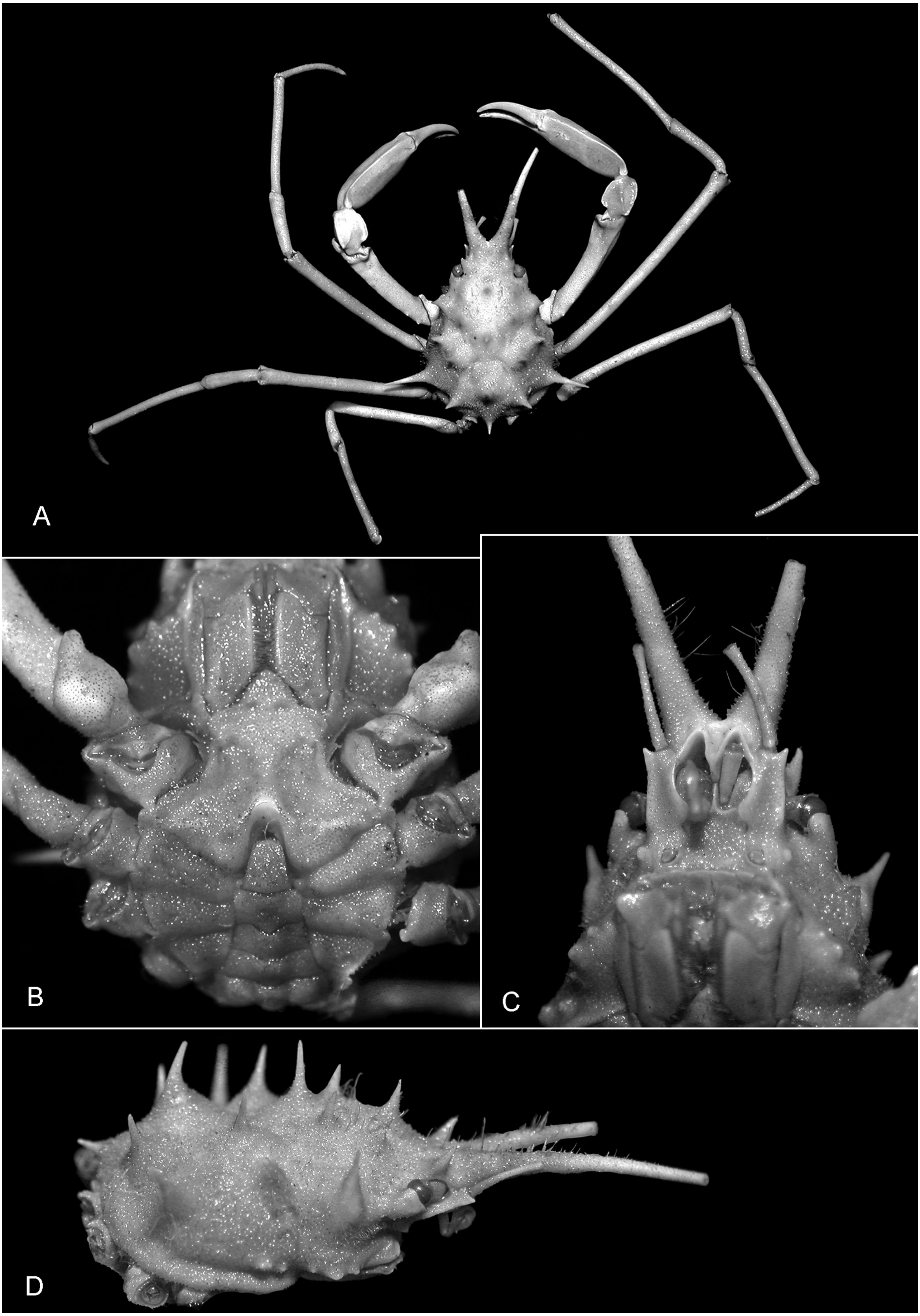

Figure 2. *Samadinia pulchra* (Miers *in* Tizard, Moseley, Buchanan & Murray, 1885), holotype male (pcl 19.3 mm, cw 13.0 mm), Philippines, NHM 1884.31. (*A*) dorsal; habitus; (*B*) thoracic sternum and pleon; (*C*) ventral anterior cephalothorax; (*D*) carapace, right lateral view.

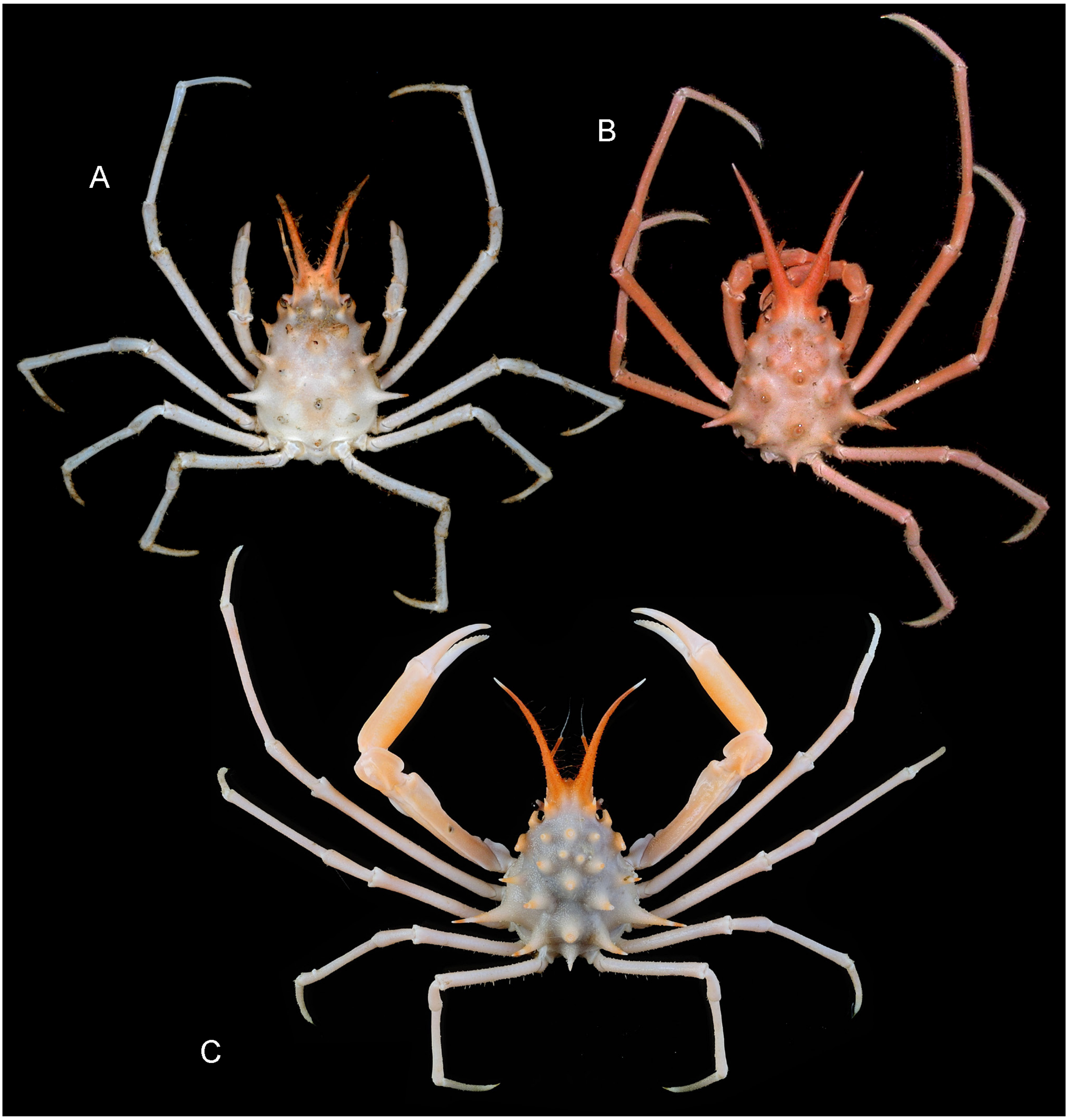

Figure 3. *Samadinia pulchra* (Miers *in* Tizard, Moseley, Buchanan & Murray, 1885). (*A*) male (pcl 12.5 mm, cw 7.5 mm), Philippines, CP2659, ZRC 2011.1053; (*B*) male (pcl 19.5 mm, cw 12.9 mm), Philippines, CP2384, NMCR; (*C*) male (pcl 21.4 mm, cw 14.5 mm), Macclesfield Bank, CP4155, ZRC. Image credits: Tin-Yam Chan.

blunt, weakly produced to small spine, visible in dorsal view; lateral margin lateral margin concave, not expanded under eyestalk; prominent tubercle situated between antennal gland and margin of ventral orbital hiatus.

Maxilliped 3 unarmed, merus subtriangular, anterolateral angle weakly produced, apex rounded, slightly wider than ischium; ischium subquadrate, outer surface with shallow longitudinal depression.

Cheliped (pereopod 1) length 1.2–2.1 (usually > 1.3) × pcl (male), 0.8–1.3 × pcl (usually < 1.2) (female); merus slightly shorter than propodus, extensor margin with proximal tubercle and small distal spine, flexor margin with 2 or 3 low, widely spaced tubercles; carpus shorter than dactylus, unarmed, although large adult males with dorsal and mesial ridge; propodus smooth, laterally compressed, dorsally cristate and more robust in adult males, palm length 1.8–3.0 × height (male), 2.6–3.4 × height (female); dactylus and pollex equal, length 0.6–0.8 × palm length (male), 0.7–0.9 × palm length (female); occlusal margins crenulate, proximal gape slight in males, absent in females.

Ambulatory legs (P2–5) slender, subcylindrical in cross-section, sparsely covered with short simple setae and short, club-like setae; merus extensor margin with short distal spine, sometimes indistinct on P5; dactyli unarmed, covered with short setae, apex corneous. Pereopod 2 length 2.2–3.0 (usually > 2.5) × pcl (male), 1.5–2.8 × pcl (usually < 2.5) (female); merus 0.8–1.2 × pcl (usually > 1.0) (male), 0.5–1.1 (usually < 0.9) (female). Pereopod 5 length 1.4–1.8 × pcl (male), 0.9–1.8 × pcl (female); merus 0.5–0.6 × pcl (male), 0.3–0.6 × pcl (female).

Pleon with 6 free somites and telson, unarmed; widest at somites 2 and 3 in males, at somites 5 and 6 in females; surface covered with short bulbous setae. Male telson triangular to linguiform, as long as wide, margins straight, apex rounded.

G1 straight, flattened; distally expanded, distolaterally produced to acute triangular point, distomesially forming low blunt lobe or obtuse angled; distal margin oblique, straight to irregularly gently sinuous. G2 simple, about ¼ length of G1; endopod absent.

Colour in life. Juveniles and small adults with carapace and pereopods overall creamy-white; rostral spines and anterior carapace spines dull orange; dorsal carapace spines distally diffusely dull orange; cheliped fingers pale pinkish (Fig. 3A). Largest specimens with pereopods dull pinkish-pale orange, carapace pale white to pale pinkish-orange centrally (Fig. 3B, C).

Remarks. *Samadinia pulchra* was described by Miers (in Tizard, Moseley, Buchanan & Murray, 1885) (see also Miers, 1886) from single male specimen collected off the Philippines. The species has since been widely reported in the Indo-West Pacific (e.g., Griffin & Tranter, 1986a; Richer de Forges & Ng, 2013). Although previously thought wide-ranging in the Indo-West Pacific, present results show that *S. pulchra* sensu stricto is restricted to the western Pacific from Japan and Taiwan to the South China Sea including the Philippines (Fig. 1). Previous records of *S. pulchra* from the Indian Ocean are referrable to *S. livermorii* (Western Indian Ocean to Andaman Sea and southwestern Indonesia) and *S. jimlowryi* sp. nov. (southeastern Indonesia to northwestern Australia). Of these, *S. pulchra* is most similar to *S. livermorii*, sharing similar G1 morphology and straight dorsal carapace spines, differing in the laterally flattened hepatic spine (versus conical or cylindrical). *Samadinia pulchra* agrees with *S. jimlowryi* in the flattened to weakly sulcate lateral surface of the hepatic spine of the carapace (Figs 2D, 4C) but differs by the simple G1 distal margin (versus bilobate) (Figs 7A, B, C, E), and straight, shorter dorsal carapace spines (prominently longer, anteriorly recurved in *S. jimlowryi*; Figs 2D, 3, 4) (see Remarks for *S. livermorii*).

As in its congeners, carapace spine length varies allometrically in *S. pulchra*, albeit attaining proportionally shorter lengths than in *S. jimlowryi* (see Remarks for that species). Sexual dimorphism in cheliped robustness and more elongate walking legs in *S. pulchra* is marked, being most evident in males 16 mm pcl and larger (Figs 2A, 3C). Females are mature by 12–15 mm with the smallest ovigerous female (pcl 12.2 mm; ZRC 2011.1053). Apart from sexual dimorphism and normal allometric changes, variation is primarily evident in rostral form, ranging from straight (the usual condition) to outwardly curved (Figs 2A, 3). The pair of tubercles or low spines, usually present in a transverse row across the gastric region (Fig. 3C), may be absent or represented on one side only.

Distribution. Western Pacific, from Japan and Taiwan to the South China Sea (including Macclesfield Bank and Hong Kong) to the southern Philippines (Fig. 1); 95–924 m (usually 500–600 m) (Takeda, 2001; present results).

Samadinia jimlowryi sp. nov.

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Figs 1, 4, 5A, B, 7C–H

Rochinia pulchra.—Griffin & Tranter, 1986a: 185, 186.—Griffin & Tranter, 1986b: 363.—Richer de Forges & Poore, 2008: 68, 69, fig. 2b [not *Amathia* (*Amathia*) *pulchra* Miers *in* Tizard, Moseley, Buchanan & Murray, 1885].

Holotype: NMV J58025, male (cl 65.6 mm, pcl 32.7 mm, cw 22.3 mm), Kulumburu L29 transect, NW Australia, 13°15.90–16.35'S 123°22.45–21.40'E, 394–390 m, beam trawl, SS05/2007/180, RV *Southern Surveyor*, coll. D. Bray, 7 July 2007. **Paratypes**: NMV J75811, 1 female (cl 55.1 mm, pcl 28.7 mm, cw 20.2 mm), collected with holotype; NMV J58172, 1 juvenile female (cl 29.9 mm, pcl 16.8 mm, cw 10.8 mm), Ashmore L30 transect, NW Australia, 12°31.766–30.833'S 123°25.633–25.367'E, 401–404 m, beam trawl, SS05/2007/192, RV *Southern Surveyor*, coll. D. Bray, 7–8 July 2007; NMV J55681, 1 immature male (pcl 11.8 mm, cw 8.0 mm), Lacepede L26 transect, NW Australia, 15°47.72–48.50'S 121°03.50–02.88'E, 119–111 m, beam trawl, SS05/2007/129, RV *Southern Surveyor*, coll. D. Bray, 1 July 2007; NMV J55947, 1 immature female (cl 43.9 mm, pcl 23.7 mm, cw 15.4 mm), Leveque L27 transect, NW Australia, 14°49.03–48.53'S 121°27.55–29.57'E, 407–392 m, beam trawl, SS05/2007/107, RV *Southern Surveyor*, coll. D. Bray, 27 June 2007; NMV J558220, 1 spent female (cl 43.9 mm, pcl 23.7 mm, cw 15.4 mm), Leveque L27 transect, NW Australia, 14°51.20–50.72'S 121°25.88–27.02'E, 403–396 m, beam trawl, SS05/2007/144, RV *Southern Surveyor*, coll. D. Bray, 3 July 2007; AM P.35501, 1 ovigerous female (cl 41.9 mm, pcl 24.3 mm, cw 16.4 mm), North West Shelf, 240 km NW of Port Hedland, 18°06'S 117°45'E, 500 m, trawl, S02/82/31, RV *Soela*, coll. J. Paxton, 7 April 1982.

Other material examined. **Indonesia**: MNHN B29063, 5 males (cl 16.1 mm, pcl 10.3 mm, cw 6.6 mm to cl 46.6 mm, pcl 27.5 mm, cw 18.4 mm), 3 females (cl 37.8 mm, pcl 22.1 mm, cw 15.0 mm to cl 49.3 mm, pcl 29.1 mm, cw 21.0 mm), Kai, 5°17'S 132°50'E, 315–349 m, KARUBAR stn CP16, 24 October 1991; MNHN B29064, 4 females (cl 35.3 mm, pcl 22.4 mm, cw 14.7 mm to cl 59.6 mm, pcl 32.1 mm, cw 23.0 mm), Kai, 5°21'S 132°30'E, 329–389 m, KARUBAR stn CC10, 23 October 1991; MNHN B29100, 4 males (cl 19.8 mm, pcl 12.3 mm, cw 7.9 mm to cl 71.6 mm, pcl 38.5 mm, cw 26.3 mm), 1 female (cl 59.0 mm, pcl 32.2 mm, cw 21.7 mm), 1 juvenile female (cl 38.9 mm, pcl 22.7 mm, cw 14.6 mm), Kai, 5°23'S 132°29'E, 368–389 m, KARUBAR stn CP09, 23 October 1991; MNHN B29099, 2 females (cl 19.2 mm, pcl 13.4 mm, cw 8.1 mm; cl 23.5 mm, pcl 13.8 mm, cw 8.9 mm), Kai, 5°23'S 132°37'E, 413–436 m, KARUBAR stn CP12, 23 October 1991; MNHN B29096, 1 female (cl 19.7 mm, pcl 11.5 mm, cw 7.5 mm), Kai, 5°30'S 132°52'E, 336–346 m, KARUBAR stn CP25, 26 October 1991; MNHN B29093, 1 male (cl 31.3 mm, pcl 19.4 mm, cw 12.4 mm), 2 juvenile females (pcl 12.8 mm, cw 8.3 mm; pcl 18.7 mm, cw 11.4 mm), Kai, 5°49'S 132°18'E, 296–299 m, KARUBAR stn CP05, 22 October 1991; MNHN B29095, 1 male (pcl 13.0 mm, cw 8.5 mm), Kai, 6°07'S 132°42'E, 241–363 m, KARUBAR stn CP37, 27 October 1991; MNHN B29061, 2 males (cl 23.7 mm, pcl 15.0 mm, cw 9.5 mm; pcl 17.2, cw 10.6 mm), 1 spent female (cl 58.0 mm, pcl 29.7 mm, cw 20.6 mm), 4 juvenile females (cl 15.4 mm, pcl 9.7 mm, cw 6.1 mm to cl 26.2 mm, pcl 16.1 mm, cw 10.5 mm), Kai, 6°08'S 132°45'E, 390–502 m, KARUBAR stn CP35, 27 October 1991; AM P.34657, 1 male (cl 25.3 mm, pcl 15.9 mm, cw 10.1 mm), off Boeleleng, Bali, 7°29'S 114°49'E, *ca.* 240 m, trawl, Th. Mortensen Java–South Africa Expedition stn 15n, 10 April 1929; MNHN B29098, 1 female (cl 26.7 mm, pcl 15.5 mm, cw 9.7 mm), Tanimbar, 7°54'S 132°47'E, 302–305 m, KARUBAR stn CP45, 29 October 1991; MNHN B29092, 2 males (cl 20.9 mm, pcl 12.9 mm, cw 7.7 mm; cl 19.3 mm, pcl 12.6 mm, cw 7.7 mm), 1 female (cl 29.1 mm, pcl 17.1 mm, cw 10.8 mm), Tanimbar, 8°20'S 132°11'E, 399–405 m, KARUBAR stn CP59, 31 October 1991; MNHN B29097, 2

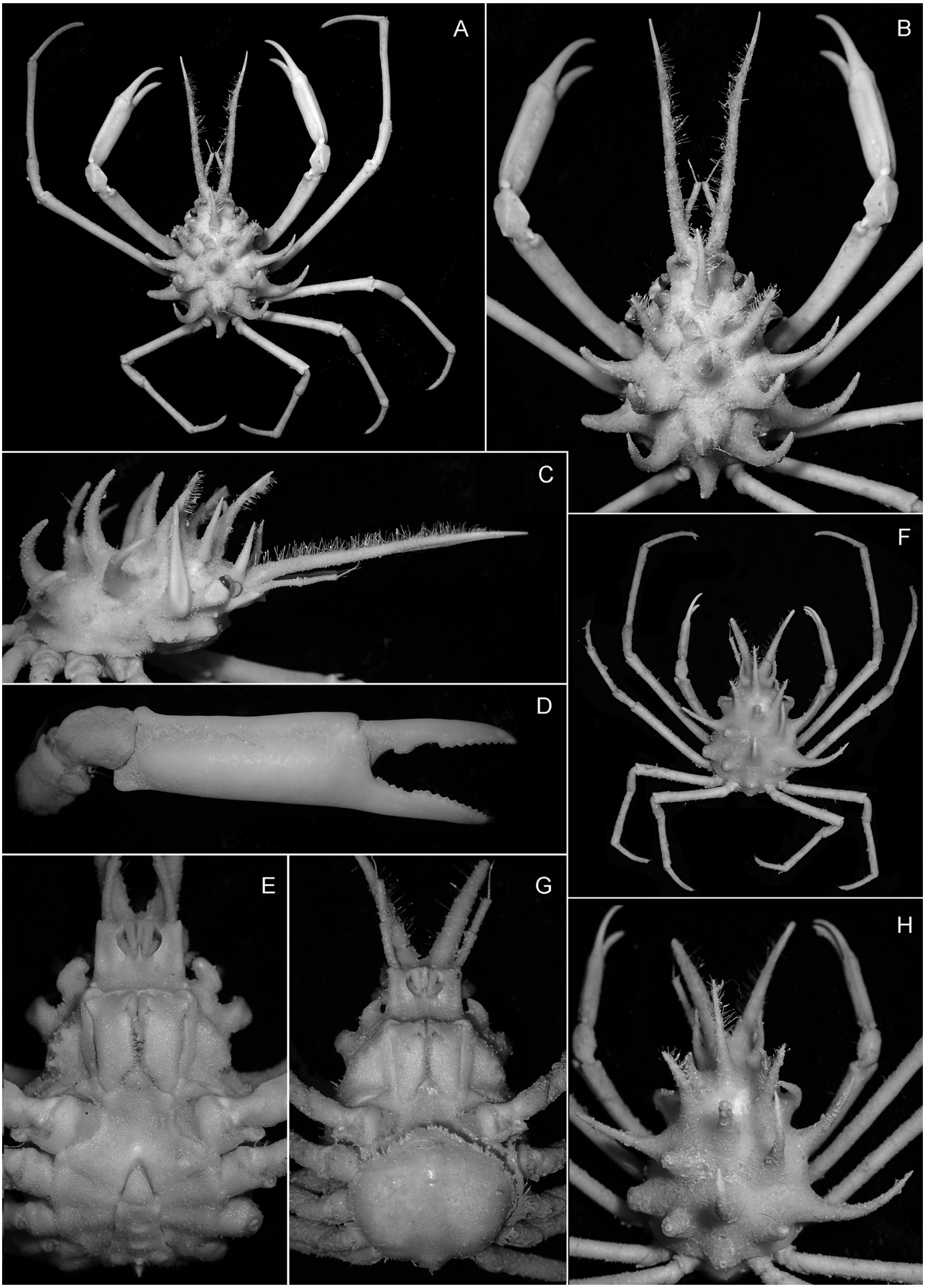

Figure 4. *Samadinia jimlowryi* sp. nov. A–E, male holotype (pcl 32.7 mm, cw 22.3 mm), northwestern Australia, NMV J75811; F–H, spent female paratype (pcl 23.7 mm, cw 15.4 mm), northwestern Australia, NMV J58220. (*A, F*) dorsal habitus; (*B, H*) carapace, dorsal view; (*C*) carapace, right lateral view; (*D*) right chela; (*E, G*) ventral cephalothorax and pleon.

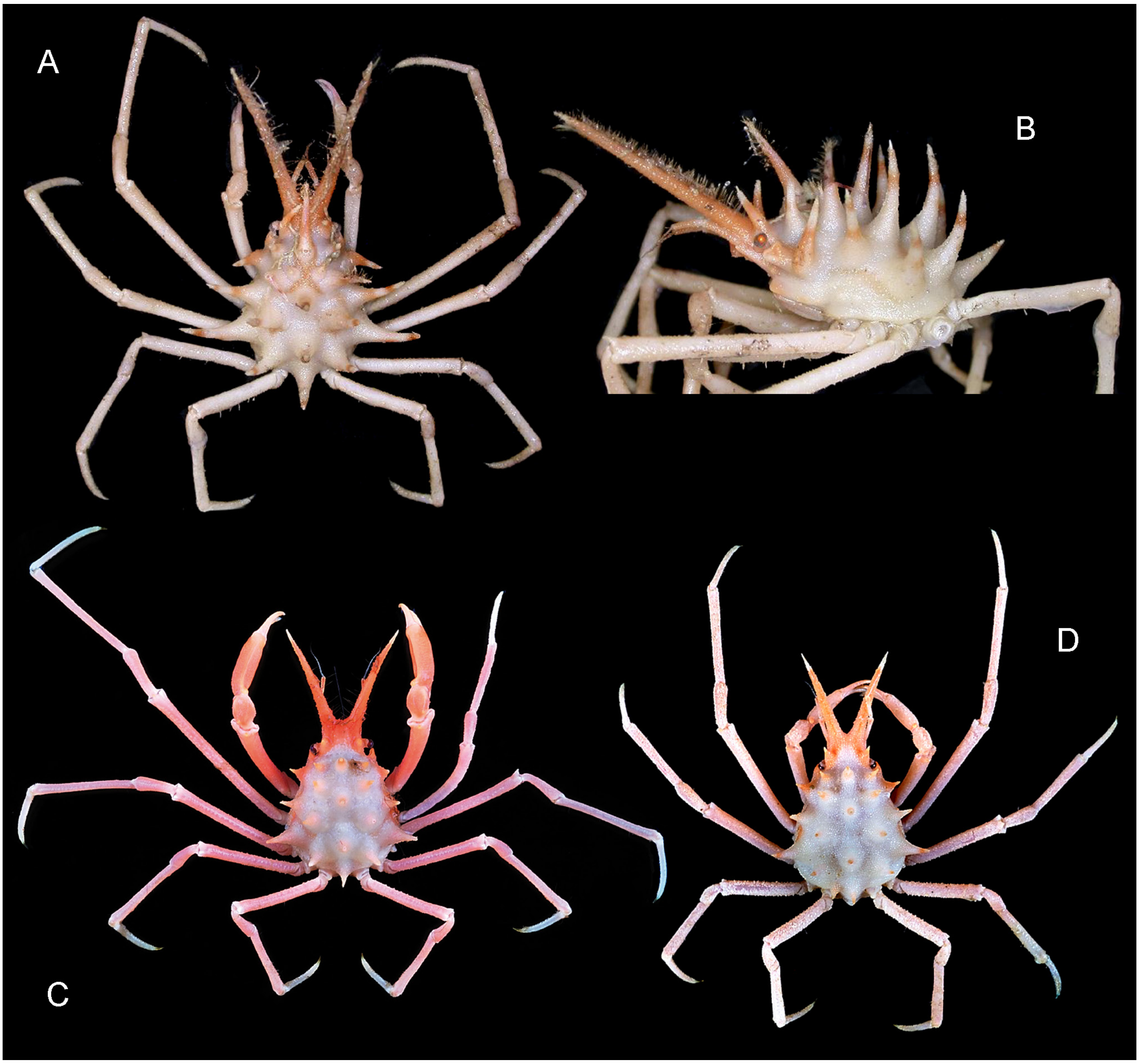

Figure 5. *Samadinia jimlowryi* sp. nov., female paratype (pcl 23.7 mm, cw 15.4 mm), Western Australia, SS05/2007/107, NMV J55947: (*A*) dorsal habitus; (*B*) carapace, left lateral view. *Samadinia livermorii* (Wood-Mason *in* Wood-Mason & Alcock, 1891): (*C*) male (pcl 14.8 mm, cw 10.0 mm), Mozambique, CC3154, ZRC 2011.1050; (*D*) ovigerous female (pcl 15.8 mm, cw 10.5 mm), Madagascar, DW3176, MNHN IU-2011-5997. Image credits: Karen Gowlett-Holmes (A, B), Tin-Yam Chan (C, D).

females (cl 17.3 mm, pcl 10.6 mm, cw 6.8 mm; cl 27.4 mm, pcl 16.1 mm, cw 10.4 mm), Tanimbar, 8°38'S 131°44'E, 477–480 m, KARUBAR stn CP71, 2 November 1991; MNHN B29094, 3 females (cl 18.1 mm, pcl 10.8 mm, cw 6.7 mm to cl 30.5 mm, pcl 17.3 mm, cw 11.1 mm), Tanimbar, 8°41'S 131°47'E, 410–413 m, KARUBAR stn CP70, 2 November 1991; MNHN B29119, 2 males (cl 57.0 mm, pcl 33.7 mm, cw 24.3 mm; cl 71.2 mm, pcl 36.8 mm, cw 25.6 mm), 7 ovigerous females (cl 46.0 mm, pcl 26.8 mm, cw 18.2 mm to cl 64.0 mm, pcl 33.5 mm, cw 24.0 mm), 1 juvenile female (cl 30.4 mm, pcl 17.5 mm, cw 12.1 mm), Tanimbar, 8°42'S 131°53'E, 356–368 m, KARUBAR stn CP69, 2 November 1991; MNHN B29062, 1 male (cl 50.9 mm, pcl 27.5 mm, cw 18.8 mm), Tanimbar, 8°57'S 131°27'E, 352–346 m, KARUBAR stn CP77, 3 November 1991.

Diagnosis. Carapace with at least 20 sharp, slender, anteriorly curved dorsal spines (paired preorbital; paired hepatic; 6 gastric; 1 median cardiac; 1 median intestinal; on each side, 4 pairs branchial); hepatic spine with lateral surface flattened or weakly sulcate. G1 distal margin oblique, with short rounded projection adjacent to distomesial projection.

Description (specimens > 10 mm pcl). Carapace pyriform, pcl 1.4–1.6× width, regions weakly defined, entire surface with tomentum of short lobular setae. Pseudorostral spines usually strongly divergent for entire length (occasionally weakly divergent to subparallel), straight to outwardly curved (in dorsal view), straight but slightly upcurved in lateral view; length 0.6–1.0 × pcl; margins lined with short, soft, lobular setae and scattered simple setae. Dorsal orbital eave weakly expanded, produced as a long, slender upright spine, inclined anteriorly and usually slightly incurved; postorbital lobe short, anteriorly cupped; hiatus wide, U-shaped. Dorsal surface with long, slender, upright spines in following pattern: straight, near vertical hepatic spine with lateral surface flattened or weakly sulcate; gastric region with 6 slender upright spines: 2 in midline (anteriormost longest, 0.5 × pcl in holotype), paired epigastric and protogastric spines, and usually with 2 shorter spines or tubercles in transverse row between anterior and posterior median spines; cardiac and intestinal regions each with spine, usually slightly curved anteriorly; branchial regions each with 4 spines, apices slightly curved anteriorly, 2 near lateral carapace margin and directed laterodorsally, 2 on upper surface, almost vertical. Pterygostomial region with 3 or 4 tubercles in longitudinal row below moult suture, followed by tubercle on anterior branchial submargin slightly below moult suture.

Eyestalks short, sparsely setose anteriorly, cornea terminal. Basal antennal article length about twice width; surface shallowly sulcate longitudinally; anterolateral angle blunt, weakly produced, not visible in dorsal view; lateral margin lateral margin concave, not expanded under eyestalk; prominent tubercle situated between antennal gland and margin of ventral orbital hiatus.

Maxilliped 3 unarmed, merus subtriangular, anterolateral angle weakly produced, apex rounded, slightly wider than ischium; ischium subquadrate, outer surface with shallow longitudinal depression.

Cheliped (pereopod 1) length 1.2–1.9 × pcl (usually > 1.4) (male), 1.2–1.4 × pcl (usually < 1.4) (female); merus slightly shorter than propodus, extensor margin with 1 or 2 small proximal spines or acute tubercles and small but distinct distal spine; carpus shorter than dactylus, unarmed, although large adult males with dorsal and mesial ridge; propodus smooth, laterally compressed, dorsally cristate and more robust in adult males, palm length 2.4–3.2× height (male), 3.1–3.5× height (female); dactylus and pollex equal, length 0.7–0.8× palm length (male), 0.8× palm length (female); occlusal margins crenulate, proximal gape slight in males, absent in females.

Ambulatory legs (P2–5) slender, subcylindrical in cross-section, sparsely covered with short simple setae and short, club-like setae; merus extensor margin with short distal spine, sometimes indistinct on P5; dactyli unarmed, covered with short setae, apex corneous. Pereopod 2 length 2.6–3.1 × pcl (male), 2.5–2.7 × pcl (female); merus 1.0–1.2 × pcl (male), 1.0–1.1 (usually 1.0) (female). Pereopod 5 length 1.5–1.8 (usually > 1.7) × pcl (male), 1.6–1.8 × pcl (usually 1.6) (female); merus 0.5–0.6 in both sexes.

Pleon with 6 free somites and telson; widest at somites 2 and 3 in males, at somites 5 and 6 in females; surface covered with short bulbous setae; somites 1 and 2 with short stout median spine; somite 3 with median tubercle. Male telson triangular, slightly longer than wide, margins straight, apex rounded.

G1 straight, flattened; distally expanded, distolaterally produced to acute triangular point, distomesially a short, rounded to bluntly angular projection; distal margin oblique, with short rounded projection adjacent to distomesial projection. G2 simple, about ¼ length of G1; endopod absent.

Colour in life. Carapace and pereopods overall creamy-white. Rostral spines and anterior carapace spines dull orange; dorsal carapace spines with dull orange subdistal band. Cheliped fingers pinkish. (Fig. 5A, B).

Etymology. Named in honour of our late colleague and friend, Jim Lowry, for his substantial contributions to carcinology.

Remarks. *Samadinia jimlowryi* sp. nov. is separable from both *S. pulchra* and *S. livermorii* by the form of the G1. In *S. jimlowryi*, the G1 apex has a narrow and blunt but prominent lobe on the anteromesial angle resulting in a prominently uneven distal margin (Fig. 7C, E–H), compared to the essentially straight or more evenly irregular margin in *S. pulchra* and *S. livermorii* (Fig. 7A, B, I, J). The new species further differs from both *S. pulchra* and *S. livermorii* in the curvature of the dorsal and lateral carapace spines. In *S. jimlowryi* the carapace spines tend to be anteriorly curved (Fig. 4A–C, F, H) (versus directed essentially vertically; Figs 1A, D, 2, 5C, D, 6A, C, D, F) being most evident in specimens above about 20 mm pcl and becoming more pronounced with increasing body size. *Samadinia jimlowryi* is similar to *S. pulchra* and further differs from *S. livermorii* in the flattened (versus rounded) lateral surface of the hepatic spine.

The length of the dorsal carapace spines in *S. jimlowryi* varies allometrically, with smallest specimens having proportionally shorter spines. The rostral spines distinctly diverge, are occasionally subparallel, and vary in length from two-thirds to as long as postrostral carapace length (Fig. 4A, B, F, H). The rostral spines in dorsal view are straight or curved outwards, and in lateral view, generally appear straight and slightly inclined dorsally. Several specimens are encrusted with sponge and barnacles.

Samadinia jimlowryi apparently matures at a larger size than either *S. pulchra* or *S. livermorii*, which are ovigerous by pcl 15 mm or less. Females of *S. jimlowryi* show a rather abrupt change in pleonal size and shape at 23–24 mm pcl, at which size they are mature. The male gonopods reach full length by *ca.* 12 mm pcl, although the final form of the oblique margin of the tip (with the acutely angular tip and two blunt lobes) is not evident until about 16–20 mm pcl (Fig. 7C, E–H). Marked inflation of the chelipeds is not evident until *ca.* 25 mm pcl. A pair of processes in transverse row (rarely on one side only) is usually present between the anterior two median gastric spines. These processes range from a low blunt tubercle in the smallest specimens (usually concealed by the surface tomentum), to a sharp spine two-thirds the height of the median gastric spines in some of the largest specimens.

Previous records of *S. pulchra* from southern Indonesia and northwestern Australia (Griffin & Tranter, 1986a, b; Richer de Forges & Poore, 2008) have been re-assessed and are referrable to *S. jimlowryi*. *Samadinia pulchra* sensu stricto is not known from Australian or Indonesian waters.

Distribution. Timor and Arafura seas, from southeastern Indonesia to northwestern Australia (Fig. 1); 240–502 m.

Samadinia livermorii (Wood-Mason *in* Wood-Mason & Alcock, 1891)

Figs 1, 5C, D, 6, 7I, J

Anamathia Livermorii Wood-Mason *in* Wood-Mason & Alcock, 1891: 260 (type locality: *Investigator* Station 56, between North and South Sentinel Island, Andaman Islands).—Alcock, 1894: 401.

Anamathia livermorei [sic].—Anonymous, 1891: 56.—Huys *et al.*, 2014: 26.

Scyramathia livermorii.—Alcock & Anderson, 1895: pl. 14 fig. 3.

Scyramathia pulchra.—Alcock, 1895: 202–203.—Alcock, 1899: 1 (list), 4 (list), 5 (list), 52.—Doflein, 1904: 84, pl. 27 fig. 12.—Rathbun, 1911: 194 (list), 250 [not *Amathia* (*Amathia*) *pulchra* Miers *in* Tizard, Moseley, Buchanan & Murray, 1885].

Rochinia pulchra.—Richer de Forges & Ng, 2013: 468, figs 1A, B, 2B (in part).—Muñoz *et al.*, 2021: 33, figs 9D, 12 [not *Amathia* (*Amathia*) *pulchra* Miers *in* Tizard, Moseley,

Buchanan & Murray, 1885].
Samadinia livermorii.—Lee *et al.*, 2023: 328.

Material examined. **Andaman Sea**: NHM 1896.5.14.7, 1 ovigerous female (cl 18.1 mm, pcl 12.3 mm, cw 8.0 mm), 13°47'30"N 92°36'00"E, 561 fm (1027 m), RIMSS *Investigator* stn 112, 7 November 1890. **Indonesia**: ZRC 2020.0032, 2 ovigerous females (cl 17.5 mm, pcl 12.5 mm, cw 8.5 mm; cl 18.8 mm, pcl 12.7 mm, cw 8.6 mm), Sunda Strait between Tabuan Island and Sumatra, 5°45.126–45.225'S 104°51.080–51.710'E, 425–442 m, SJADES 2018 stn CP08, 25 March 2018; ZRC 2020.0033, 1 spent female (cl 23.1 mm, pcl 13.6 mm, cw 9.2 mm), 1 ovigerous female (cl 24.1 mm, pcl 14.4 mm, cw 10.2 mm), S of Panaitan Island, Sunda Strait, 6°46.739–45.924'S 105°09.239–08.360'E, 559–571 m, SJADES 2018 stn CP23, 27 March 2018; ZRC 2020.0034, 1 male (cl 19.3 mm, pcl 11.5 mm, cw 7.4 mm; with rhizocephalan), S of Panaitan Island, Sunda Strait, 6°50.185–50.923'S 105°10.353–10.776'E, 876–937 m, SJADES 2018 stn CP25, 27 March 2018; MZB, 2 males (cl 24.2 mm, pcl 14.1 mm, cw 10.1 mm; cl 21.3 mm, pcl 14.0 mm, 9.7 mm), 1 juvenile female (pcl 6.9 mm, cw 4.5 mm), S of Pameungpeuk, Indian Ocean, 7°47.972–48.257'S 107°45.298–45.706'E, 476–530 m, SJADES 2018 stn CP47, 1 April 2018; ZRC 2020.0035, 1 male (cl 28.0 mm, pcl 16.4 mm, cw 14.4 mm; with epicaridean), Pelabuhanratu Bay, Indian Ocean, 7°04.874–05.348′S 106°25.396–25.044′E, 569–657 m, coll. SJADES 2018, stn CP51, 2 April 2018; MZB, 1 male (cl 28.7 mm, pcl 15.7 mm, cw 11.0 mm), same; MZB, 2 males (cl 24.3 mm, pcl 15.1 mm, cw 10.5 mm; cl 19.4 mm, pcl 13.2 mm, cw 8.5 mm), 1 ovigerous female (cl 20.8 mm, pcl 13.3 mm, cw 9.3 mm), S of Tanjong Boyongkareuceng, Indian Ocean, 7°42.912–43.255'S 107°36.559–37.234'E, 312–525 m, SJADES 2018 stn CP33, 29 March 2018; ZRC 2020.0036, 1 female (cl 26.4 mm, pcl 14.7 mm, cw 10.3 mm; with rhizocephalan), E of Tinjil Island, Indian Ocean, 6°57.221–56.664'S 105°54.754–55.315'E, 517–727 m, SJADES 2018 stn CP26, 28 March 2018; ZRC 2020.0037, 1 male (cl 21.1 mm, pcl 12.0 mm, cw 10.4 mm; with epicaridean), 1 female (pcl 11.2 mm, cw 7.2 mm), S of Tanjong Gedeh, Java, Indian Ocean, 7°51.120–51.718'S 107°46.245–46.375'E, 637–689 m, SJADES 2018 stn CP48, 1 April 2018; ZRC 2020.0038, 5 males (cl 34.7, pcl 20.3 mm, cw 14.6 mm; cl 27.2 mm, pcl 17.0 mm, cw 11.6 mm; cl 25.6 mm, pcl 15.2 mm, cw 10.6 mm; cl 25.1 mm, pcl 15.8 mm, cw 10.8 mm; cl 22.6 mm, pcl 14.5 mm, cw 10.3 mm), 1 damaged male, 9 females (cl 26.7 mm, pcl 17.3 mm, cw 12.3 mm; cl 25.3 mm, pcl 17.4 mm, cw 12.2 mm; cl 22.5 mm, pcl 14.4 mm, cw 10.3 mm; cl 14.5 mm, pcl 9.0 mm, cw 6.5 mm; pcl 8.9 mm, cw 5.4 mm), 3 females (cl 21.7 mm, pcl 15.0 mm, cw 13.3 mm; cl 23.2 mm, pcl 14.1 mm, cw 12.4 mm; cl 17.4 mm, pcl 11.4 mm, cw 9.7 mm; with epicaridean), 2 ovigerous females (cl 24.0 mm, pcl 16.5 mm, cw 11.6 mm; pcl 14.6 mm, cw 10.2 mm), S of Cilacap, Indian Ocean, 8°15.885–16.060'S 109°10.163–10.944'E, 528–637 m, SJADES 2018 stn CP39, 30 March 2018. **Seychelles**: USNM 41400, 1 male (pcl 18.1 mm, pcl 12.6 mm, cw 8.0 mm), 4°35'S 55°40'E, 62 m, Sealark expedition stn F7, RV *Sealark*, 20 October 1905. **Saya de Mahla Bank**: USNM 41399, 1 female (cl 27.5 mm, pcl 18.2 mm, cw 12.9 mm), 10°30'S 61°30'E, 229 m, Sealark expedition stn C5, RV *Sealark*, 4 September 1905. **Madagascar**: MNHN-IU-2016-6897, 1 juvenile female (cl 9.4 mm, pcl 6.8 mm, cw 4.4 mm), 12°22'S 46°25'E, 346–349 m, BIOMAGLO stn DW4788, 22 January 2017; ZRC 2011.1048, 1 male (pcl 13.5 mm, cw 9.2 mm), 1 ovigerous female (cl 23.3 mm, pcl 15.3 mm, cw 10.7 mm), 12°46'S 48°12'E, 355–380 m, MIRIKY 2009 stn CP3224, 2 July 2009; MNHN-IU-2016-9321, 1 juvenile male (cl 5.6 mm, pcl 4.0 mm, cw 2.4 mm), 12°58'S 45°15'E, 687–712 m, BIOMAGLO stn DW4866, 7 February 2017; MNHN IU-2011-5997, 1 ovigerous female (cl 23.9 mm, pcl 15.8 mm, cw 10.5 mm), 12°59'21.588"S 48°06'05.4"E, 495–509 m, MIRIKY 2009 stn DW3176, 25 June 2009. **Comores**: MNHN, 1 female (cl 26.5 mm, pcl 15.9 mm, cw 10.9 mm), W of Great Western Pass, Mayotte, 12°46'S 44°58'E, 475–510 m, BENTHEDI BENT-61F, 29 Mar 1977. **Mozambique Channel**: MNHN-IU-2011-5989, 3 males (pcl 15.1 mm, cw 10.2 mm to pcl 24.3 mm, cw 15.7 mm), 2 ovigerous females (pcl 14.9 mm, cw 10.7 mm; pcl 28.3 mm, cw 16.2 mm), 19°34.98'S 36°47.71'E, 636 m, MAINBAZA stn CC3154, 13 April 2009; ZRC 2011.1050, 2 males (cl +22.0 mm, pcl 14.8 mm, cw 10.0 mm, cl 19.8 mm, pcl 13.4 mm, cw 8.9 mm), 2 ovigerous females (pcl 18.1 mm, cw 12.1 mm; pcl 15.4 mm, cw 10.3 mm), 19°36'S 36°47'E, 636 m, MAINBAZA 2009 stn CC3154, 13 April 2009; MNHN-IU-2017-8772, 1 juvenile female (cl 9.2 mm, pcl 6.5 mm, cw 4.3 mm), 23°59'S 35°39'E, 206–210 m, MAINBAZA stn CC3160, 15 April 2009.

Diagnosis. Carapace with at least 20 slender, sharp, upright dorsal spines (paired preorbital; paired hepatic; 6 gastric; 1 median cardiac; 1 median intestinal; on each side, 4 pairs branchial); hepatic spine ovate to circular in cross-section, lateral surface rounded. G1 distal margin oblique, straight to irregularly gently sinuous.

Description (specimens > 10 mm pcl). Carapace pyriform, pcl 1.4–1.6× width, regions weakly defined, entire surface with tomentum of short lobular setae. Pseudorostral spines usually strongly divergent for entire length (occasionally weakly divergent), straight to outwardly curved (in dorsal view), straight to curved but slightly upcurved in lateral view; length 0.4–0.8 × pcl; margins lined with short, soft, lobular setae and scattered simple setae. Dorsal orbital eave weakly expanded, produced as a long, slender upright spine, inclined anteriorly and usually slightly incurved; postorbital lobe short, anteriorly cupped; hiatus wide, U-shaped. Dorsal surface with long, slender, upright spines in following pattern: straight, near vertical hepatic spine, ovate to circular in cross-section, with lateral surface rounded; gastric region with 6 slender upright spines (2 in midline; paired epigastric and protogastric spines) and usually with two shorter spines or tubercles in transverse row between anterior and posterior median spines; cardiac and intestinal regions each with straight, upright spine; branchial regions each with 4 straight, upright, spines, 2 near lateral carapace margin and directed laterodorsally, 2 on upper surface, almost vertical. Pterygostomian region with 3 or 4 tubercles in longitudinal row below moult suture, followed by tubercle on anterior branchial submargin slightly below moult suture.

Eyestalks short, sparsely setose anteriorly, cornea terminal. Basal antennal article length about twice width; surface shallowly sulcate longitudinally; anterolateral angle blunt, weakly produced to small spine, visible in dorsal view; lateral margin lateral margin concave, not expanded under eyestalk; prominent tubercle situated between antennal gland and margin of ventral orbital hiatus.

Maxilliped 3 unarmed, merus subtriangular, anterolateral angle weakly produced, apex rounded, slightly wider than ischium; ischium subquadrate, outer surface with shallow longitudinal depression.

Cheliped (pereopod 1) length 1.1–2.0 (usually > 1.4) × pcl (male), 0.7–1.3 × pcl (female); merus slightly shorter than propodus, extensor margin with proximal tubercle and small distal spine, flexor margin with 2 or 3 low, widely spaced tubercles; carpus shorter than dactylus, unarmed, although large adult males with dorsal and mesial ridge; propodus smooth, laterally compressed, dorsally cristate and more robust in adult males, palm length 2.0–3.1 (usually > 2.4)× height (male), 2.2–3.3 (usually > 2.6)× height (female); dactylus and pollex equal, length 0.6–0.9× palm length (male), 0.7–0.9× palm length (female); occlusal margins crenulate, proximal gape slight in males, absent in females.

Ambulatory legs (P2–5) slender, subcylindrical in cross-section, sparsely covered with short simple setae and short, club-like setae; merus extensor margin with short distal spine, sometimes indistinct on P5; dactyli unarmed, covered with short setae, apex corneous. Pereopod 2 length 2.0–3.4 × pcl (usually > 2.6) (male), 1.9–2.6 (usually < 2.4) × pcl (female); merus 0.8–1.3 (usually ≥ 1.0) (male), 0.7–1.0 (usually < 0.9) (female). Pereopod 5 length 1.4–1.9 (usually > 1.6) × pcl (male), 0.9–1.6 (usually < 1.5) × pcl (female); merus 0.5–0.7 (usually 0.6) × pcl (male), 0.4–0.6 (usually < 0.5) × pcl (female).

Pleon with 6 free somites and telson, unarmed; widest at somites 2 and 3 in males, at somites 5 and 6 in females; surface covered with short bulbous setae. Male telson triangular, as long as wide, margins straight, apex rounded.

G1 straight, flattened; distally expanded, distolaterally

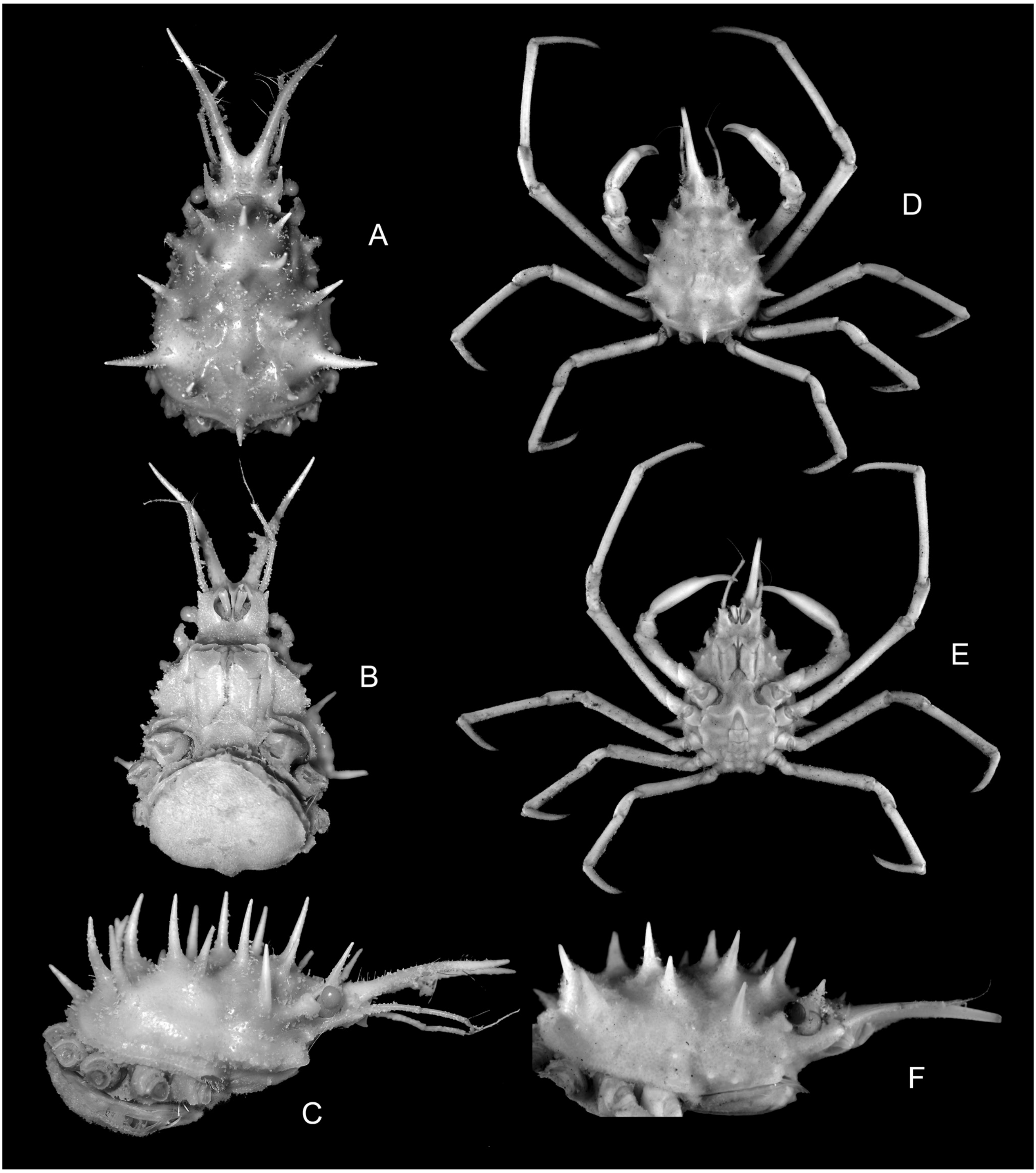

Figure 6. *Samadinia livermorii* (Wood-Mason *in* Wood-Mason & Alcock, 1891): A–C, ovigerous female (cl 18.1 mm, pcl 12.3 mm, cw 8.0 mm), Andaman Sea, NHM 1896.5.14.7; D–F, male (pcl 13.5 mm, cw 9.2 mm), Madagascar, ZRC 2011.1048. (*A*) dorsal habitus; (*B, E*) ventral cephalothorax and pleon; (*D*) habitus; (*C, F*) carapace, right lateral view.

produced to acute triangular point, distomesially bluntly approximately right-angled; distal margin oblique, straight to irregularly gently sinuous. G2 simple, about ¼ length of G1; endopod absent.

Colour in life. Carapace off-white to whitish-orange dorsally, anterior margins and rostral spines orange or pink; chelipeds and ambulatory legs pink. (Fig. 5C, D).

Remarks. Comparison of specimens from across the wide putative range of *S. pulchra*, including the *Investigator* specimen from the Andaman Sea, shows that specimens from the Western Indian Ocean to the Andaman Sea and southwestern Indonesia are not referable to *S. pulchra* sensu stricto, but to *S. livermorii*, according with recognition of both species as separate by Richer de Forges *et al*. (2021) in anticipation of present results. Other eastern Indian

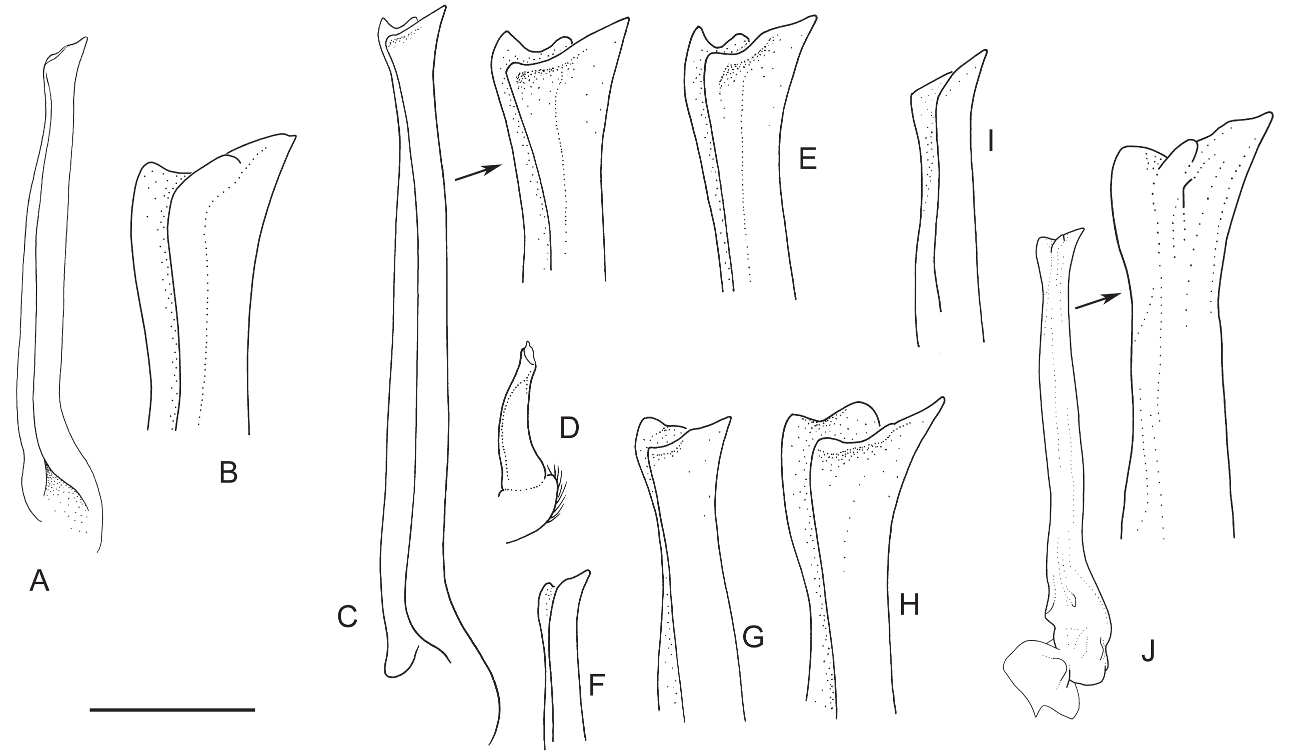

Figure 7. G1 (A–C, E–I) and G2 (D), left pleonal view. *Samadinia pulchra* (Miers *in* Tizard, Moseley, Buchanan & Murray, 1885): (A) holotype, pcl 19.3 mm, Philippines, NHM 1884.31; (B) male (pcl 17.3 mm, cw 11.6 mm), South China Sea, ZRC 1968.2.13.4. *Samadinia jimlowryi* sp. nov.: (C–D) male holotype (pcl 32.7 mm, cw 22.3 mm), NMV J58025; (E) male (pcl 15.9 mm, cw10.1 mm), Bali, AM P.34657; (F–H) male (pcl 12.3 mm, cw 7.9 mm), male (pcl 20.6 mm, cw 13.6 mm), male (pcl 38.5 mm, cw 26.3 mm), MNHN B29100. *Samadinia livermorii* (Wood-Mason *in* Wood-Mason & Alcock, 1891): (I) male (pcl 15.1 mm, cw 10.2 mm), Madagascar, MNHN IU-2011-5989; (J) male (pcl 20.3 mm, cw 14.6 mm), Indonesia, ZRC 2020.0038. Scale bars: A, C, D, J = 2.0 mm; B, F–I = 1.0 mm, E = 0.5 mm.

Ocean records attributed to *S. pulchra* (i.e., Australia and southeastern Indonesia) are based on *S. jimlowryi* sp. nov., described herein.

Samadinia livermorii was described based on a male and two females from the Andaman Sea between North Sentinel Island and South Sentinel Island (RIMSS *Investigator* stn 56, 220–240 fms) and has long been considered a synonym of *S. pulchra*. Unfortunately, the fate of the type material of *S. livermorii* is currently not known: the specimens ought to be in the Zoological Survey of India, Calcutta, but they could not be found despite extensive searches (S. Mitra, pers com.). Neither are they in the collections of the Natural History Museum (London), Smithsonian Institution (Washington DC) nor the Australian Museum (Sydney), where many specimens from the *Investigator* expeditions are now deposited. Thus, the type material of *S. livermorii* appears to be lost. Nevertheless, a non-type specimen of *S. livermorii* from the Andaman Sea collected by the *Investigator* (female, pcl 12.3 mm, NHM 1896.5.14.7) anchors our identification of the western Indonesian and western Indian Ocean specimens as *S. livermorii.*

Among the three species of the *S. pulchra* complex, *S. livermorii* morphologically resembles *S. pulchra* in the straight or slightly uneven distal margin of the adult G1 (Fig. 7A, B, I, J) (versus bilobate in *S. jimlowryi*; Fig. 7C, H) and in having typically straight, upright dorsal carapace spines (Fig. 6C, F) (versus anteriorly curved spines in *S. jimlowryi*; Fig. 4A–C, F, H). *Samadinia livermorii* differs from both *S. jimlowryi* and *S. pulchra* in having a rounded rather than flattened outer surface of the hepatic spine (Fig. 6C, F versus Fig. 2D, 4C). The length of the carapace spines is subject to allometry and individual variation, but the longest carapace spine in adult *S. livermorii* and *S. pulchra* is 0.2 × pcl, compared to 0.5 × pcl in *S. jimlowryi*.

Specimens of *S. livermorii* examined are similar throughout the range, although females from the eastern Indian Ocean might mature at a smaller size than those from the west. Eastern specimens are mature by pcl 12–13 mm, with the smallest ovigerous female at pcl 12.3 mm (NHM 1896.5.14.7) compared to pcl 14.9 mm (ZRC 2011.1050) for western Indian Ocean specimens. In other respects, the eastern and western Indian Ocean specimens agree well and so are considered conspecific. Despite the good collections of *S. livermorii* from the western and eastern Indian Ocean, none are yet known from intermediate localities, almost certainly an artefact of limited sampling at outer shelf and slope depths in the Indian region. Only in recent years have efforts to document the Indian deep-water crustacean fauna accelerated (e.g., Ahyong & Kumar, 2018; Devi *et al.*, 2019; Ng *et al.*, 2019; Macpherson *et al.*, 2020; Padate *et al.*, 2020, 2021, 2022), so it is likely that *S. livermorii* will eventually be found there. All known specimens of *S. livermorii* are from Indian Ocean localities.

Distribution. East Africa to the Andaman Sea and southwestern Indonesia (Fig. 1); 62–1027 m (usually 400–500 m).

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Two New Amphipods Associated with a Hermit Crab from the Kumano-nada, Central Japan (Crustacea: Amphipoda: Isaeidae, Stenothoidae)

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Abstract. Two new species of amphipods associated with a hermit crab *Propagurus obtusifrons* were collected from the bottom of a 190–380 m depth in Kumano-nada, central Japan. *Metopelloides lowryi* sp. nov. is characterized by the short article 2 of antenna 1, the slender mandibular palp with 3 setae, and the oblique palm of gnathopod 2. *Isaea concinnoides* sp. nov. can be distinguished from its congeners by the short carpus of gnathopod 2, the relatively stout antennae with short setae, and the oval basis of pereopod 5. Both species have prehensile pereopods 3–7 for clinging to the setae of the hermit crab.

Introduction

Amphipods live in various habitats and many associations of benthic amphipods with other animals are known; e.g., sponges, actiniarians, medusae, molluscs, brachiopods, echinoderms and tunicates (Bellan-Santini, 2015). Benthic amphipods are also associated with large decapod crustaceans and eight amphipod families are recorded as direct associates of decapods: Amphilochidae Boeck, 1871; Calliopiidae G. O. Sars, 1893; Caprellidae Leach, 1814; Iphigenellidae Kamaltynov, 2002; Isaeidae Dana, 1852; Ischyroceridae Stebbing, 1899; Pleustidae Buchholz, 1874; and Stenothoidae Boeck, 1871 (Vader & Tandberg, 2015), most of which have prehensile pereopods for clinging (Vader, 1983).

During our survey of animals on the bottom of the Kumano-nada (Ariyama & Moritaki, 2020), two amphipod species associated with the hermit crab *Propagurus obtusifrons* (Ortmann, 1892) were obtained. Closer examination revealed that they are new to science and herein we describe them as new species in detail.

Materials and methods

The hermit crab with which amphipods were associated was collected by a commercial trawl net in the Kumano-nada. The Kumano-nada is a small sea area located in the south of Mie and Wakayama Prefectures, central Japan. The hermit crab was transported to Toba Aquarium (TA) and was observed there. The amphipods dwelled on the surface of the hermit crab and usually clung to the setae. Six specimens of the amphipods were collected from the hermit crab. All the specimens were dissected and appendages were drawn using a phase-contrast microscope with an attached drawing tube. Body length (BL) was measured from the apex of rostrum to the distal end of urosomite 3 (Barnard & Drummond, 1978). The type specimens are deposited in the Osaka Museum of Natural History, Japan (OMNH).

Abbreviations used in the figures are: A, antenna; C, coxa; EP, epimeral plate; G, gnathopod; L, left; LL, lower lip; LM, large male; Md, mandible; Mp, maxilliped; Mx, maxilla; P, pereopod; Pl, pleopod; PS, plumose seta; R, right; SF, small female; SM, small male; T, telson; U, uropod; and UL, upper lip.

Keywords: Amphipoda, hermit crab associate, Isaeidae, Japan, Paguridae, prehensile pereopods, Stenothoidae, symbiosis
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Systematics

Order Amphipoda Latreille, 1816

Suborder Amphilochidea Lowry & Myers, 2017

Infraorder Amphilochida Lowry & Myers, 2017

Parvorder Amphilochidira Lowry & Myers, 2017

Superfamily Amphilochoidea Boeck, 1871

Family Stenothoidae Boeck, 1871

[Japanese name: Tatesokoebi-ka]

Genus *Metopelloides* Gurjanova, 1938

[Japanese name: Yadokari-tatesokoebi-zoku, new]

Metopelloides Gurjanova, 1938: 281, 390.—Gurjanova, 1951: 454.—Barnard & Karaman, 1991b: 693.—Lowry & Myers, 2017: 53.

Type species. *Metopella micropalpa* Shoemaker, 1930, original designation.

Diagnosis. Antenna l peduncle lacking nasiform process on article 1; accessory flagellum absent or vestigial. Mandibular palp l-articulate; palp of maxilla 1 1-articulate; inner plates of maxillipeds partially fused together. Coxa 1 very small, coxae 2–4 enlarged, coxae 5–7 small. Gnathopod 1 small, subchelate; carpus not lobate; propodus subequal to carpus in length, palm oblique. Gnathopod 2 enlarged, subchelate; carpus short, lobate; propodus broad, palm oblique or transverse. Pereopods 3–7 prehensile, bases rectolinear. Pleonite 3 and urosomite 1 lacking dorsal process, urosomites 1–3 free. Uropods 1, 2 biramous; uropod 3 uniramous, ramus 2-articulate. Telson flat, entire.

Included species. *Metopelloides lowryi* sp. nov. [Northwest Pacific]; *M. micropalpa* (Shoemaker, 1930) [Northwest Atlantic]; *M. paguri* Marin & Sinelnikov, 2012 [Sea of Okhotsk and Sea of Japan]; *M. stephenseni* Gurjanova, 1938 [Sea of Japan] and *M. tattersalli* Gurjanova, 1938 [Sea of Japan].

Remarks. Shoemaker (1955) also recorded *M. stephenseni* and *M. tattersalli* from the Arctic Ocean; however, his *M. stephenseni* is probably *M. micropalpa* because of the high degree of similarity between them.

Metopelloides lowryi sp. nov.

urn:lsid:zoobank.org:act:EAA1BF45-028A-4079-A33C-B5CA8FC5777F

[Japanese name: Yadokari-tatesokoebi, new]

Figs 1–5

Holotype: OMNH-Ar-12498 (TAMBL-CR 1775), male, 4.3 mm, Kumano-nada, off Owase City, Mie Prefecture, 34°01'22.0"N 136°20'57.6"E, 190–350 m depth, associated with *Propagurus obtusifrons* (Ortmann, 1892) (Paguridae), coll. T. Moritaki, 13 October 2016.

Type locality. Kumano-nada, off Owase City in Mie Prefecture, Japan.

Etymology. The species name is dedicated to the late Dr James K. Lowry for his great contribution to amphipod taxonomy.

Diagnosis. Antenna 1 short, peduncular article 2 0.3 times length of article 1. Gnathopod 1 small, posterior margin of dactylus bare. Gnathopod 2 stout, anterior margin of basis with several setae, palm oblique. Telson without robust setae.

Description (based on holotype, male, 4.3 mm). Body (Fig. 1) oval. *Coxa* 1 small, perfectly hidden by coxa 2; coxae 2, 3 large, coxa 4 extremely large; coxae 5–7 small, perfectly hidden by coxa 4.

Head (Figs 1, 2). *Rostrum* small. *Ocular lobes* rounded. *Eyes* large (diameter: *ca.* 0.4 times head length). *Antenna 1* short, *ca.* 0.25 times BL; peduncular articles 1–3 with length ratio of 1.0:0.3:0.25, article 1 stout, lacking setae; accessory flagellum vestigial, with 3 minute setae on tip; primary flagellum with 6 articles, article 2 short, articles 3–5 each bearing aesthetasc posterodistally. *Antenna 2* longer than antenna 1 (*ca.* 1.55 times), slender, sparsely setose; peduncular articles 3–5 with length ratio of 1.0:2.0:1.7, anteromedial surfaces with 4, 4, 2 robust setae, respectively; flagellum with 13 articles, terminal article narrow. *Upper lip* asymmetrical, ventral margin hollowed. *Mandibles*, incisors wide, with 9–10 distal denticles; laciniae mobilis broad, left one fan-shaped, with 11 denticles, right one rectangular, composed of 4 quadrate blades; accessory blades 9 in left, 11 in right; palpi relatively short, slender (length *ca.* 4.7 times width), with 3 setae. *Lower lip*, outer plate with mandibular lobe, mediodistal corner with 3 short setae. *Maxilla 1* with small inner plate bearing single short seta; outer plate with 7 robust setae apically, medial margin bearing several feeble setae; tip of palp acutely projected, with long robust seta, medial margin lined with 5 robust setae. *Maxilla 2*, inner plate triangular, tip with several setae; outer plate longer, rounded and setose distally. *Maxilliped* enlarged; distal margins of inner plates each bearing 3 short setae; distomedial lobe of outer plate short and narrow, tip with short robust seta, lateral margin bearing many feeble setae; palp stout, articles 1–3 wide, medial margins each with several robust setae, article 4 falcate, medial margin bearing many feeble setae.

Pereon (Fig. 3). *Gnathopod 1* small; basis straight, anterior margin and posterodistal corner with 3 and 1 setae, respectively; merus setose distally; carpus moderately elongate, anterodistal corner and posterior margin setose; propodus subequal to carpus in length, palm strongly oblique, defined by 2 lateral and 2 medial robust setae; dactylus almost straight. *Gnathopod 2* stout; basis straight, anterior margin lined with several evenly-spaced setae, posterodistal corner setose; ischium, posterodistal corner setose; merus rounded distally, posterior margin with several setae; carpus with posterior lobe setose distally; propodus broad, *ca.* 2.65 times length of carpus, anterodistal corner setose, palm oblique, defined by acute projection, distal half of palm convex and serrated, with several robust setae, proximal half concave; dactylus slightly curved posteriorly. *Pereopod 3* slender, longer than gnathopod 2; basis–carpus sparsely setose; propodus *ca.* 1.45 times length of carpus, slightly widened distally, distal and posterior margins with 2+3+3+3 and 2+2+1+1 robust setae, respectively; dactylus narrow. *Pereopod 4* slender, similar to pereopod 3; propodus, distal and posterior margins with 2+3+3+3 and 3+2+1 robust setae, respectively. *Pereopod 5* shorter than pereopod 4;

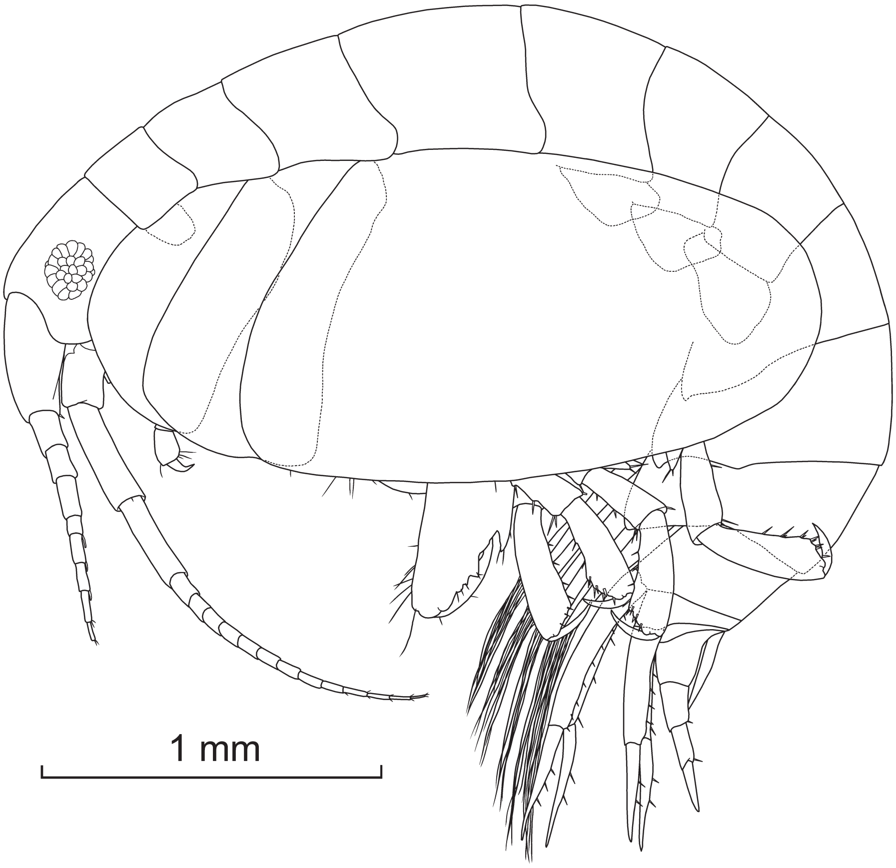

Figure 1. *Metopelloides lowryi* sp. nov., holotype male, 4.3 mm, OMNH-Ar-12498, habitus.

basis straight, anterior margin lined with several robust setae; merus, anterior and posterior margins and carpus, anterior margin each with several robust setae; propodus slightly widened distally, distal and anterior margins with 2+3+3 and 3+3+1 robust setae, respectively. *Pereopod 6* slightly shorter than pereopod 5; basis straight, posterodistal corner slightly swollen, anterior margin lined with several robust setae; merus, anterior and posterior margins each with several robust setae; carpus, anterior margin and posterodistal corner bearing several and a few robust setae, respectively; propodus slightly widened distally, distal and anterior margins with 2+3+3 and 3+3+1+1 robust setae, respectively. *Pereopod 7* subequal to pereopod 6 in length; basis straight, wider than that of pereopod 6, posterodistal corner weakly swollen, anterior margin lined with several robust setae; merus, anterodistal corner and posterior margin with a few and several robust setae, respectively; carpus, anterior margin and posterodistal corner bearing several and a few robust setae, respectively; propodus slightly widened distally, distal and anterior margins with 2+3+3 and 3+3+2 robust setae, respectively.

Pleon (Fig. 4). *Epimeral plates 1–3*, posterodistal corners strongly, moderately, and weakly produced, respectively; ventral margins bare. *Pleopods* slender, pleopod 3 shortest; pleopods 1–3, peduncles with 7, 10, 1 simple setae, respectively, outer rami longer than inner rami, former with 12, 11, 10 and latter with 8, 8, 7 articles, respectively. *Uropod 1* long; peduncle with 9 dorsolateral and 4 dorsomedial robust setae; rami shorter than peduncle, outer ramus shorter than inner ramus, with 3 dorsal robust setae, inner ramus bearing 2 dorsal robust setae. *Uropod 2 ca.* 0.75 times length of uropod 1, peduncle with 5 dorsolateral and 1 dorsomedial robust setae; outer ramus *ca.* 0.85 times length of peduncle, with 2 dorsal robust setae; inner ramus subequal to peduncle in length, bearing 2 dorsal robust setae. *Uropod 3 ca.* 0.65 times length of uropod 2, peduncle with 2 dorsodistal robust setae; single ramus 2-articulate, article 1 with 2 dorsodistal robust setae, article 2 slightly longer than article 1, tip acute. *Telson ca.* 2.05 times longer than broad, bare.

Colour in life (Fig. 5). Eyes light red. Body white with light orange bands on pereonites 1–3, 4, 6–7, coxae 2–4 (anterior part) and coxa 4 (posterior part). This coloration resembles that of the hermit crab (see Fig. 11) and is probably useful for camouflage.

Remarks. *Metopelloides lowryi* sp. nov. is characterized by: (1) a short article 2 of antenna 1 (0.3 times length of article 1); (2) a slender mandibular palp with 3 setae (length *ca.* 4.7 times width); and (3) an oblique palm of gnathopod 2. No other congeners have this combination of characters. Although *M. lowryi* has a similar gnathopod 2 to *M. micropalpa*, this new species can be distinguished by the short article 2 of antenna 1 (0.6 times length of article 1 in *M. micropalpa*).

Habitat. Bottom sediment unknown, 190–350 m depth, associated with *Propagurus obtusifrons*.

Distribution. Japan: Kumano-nada (present study).

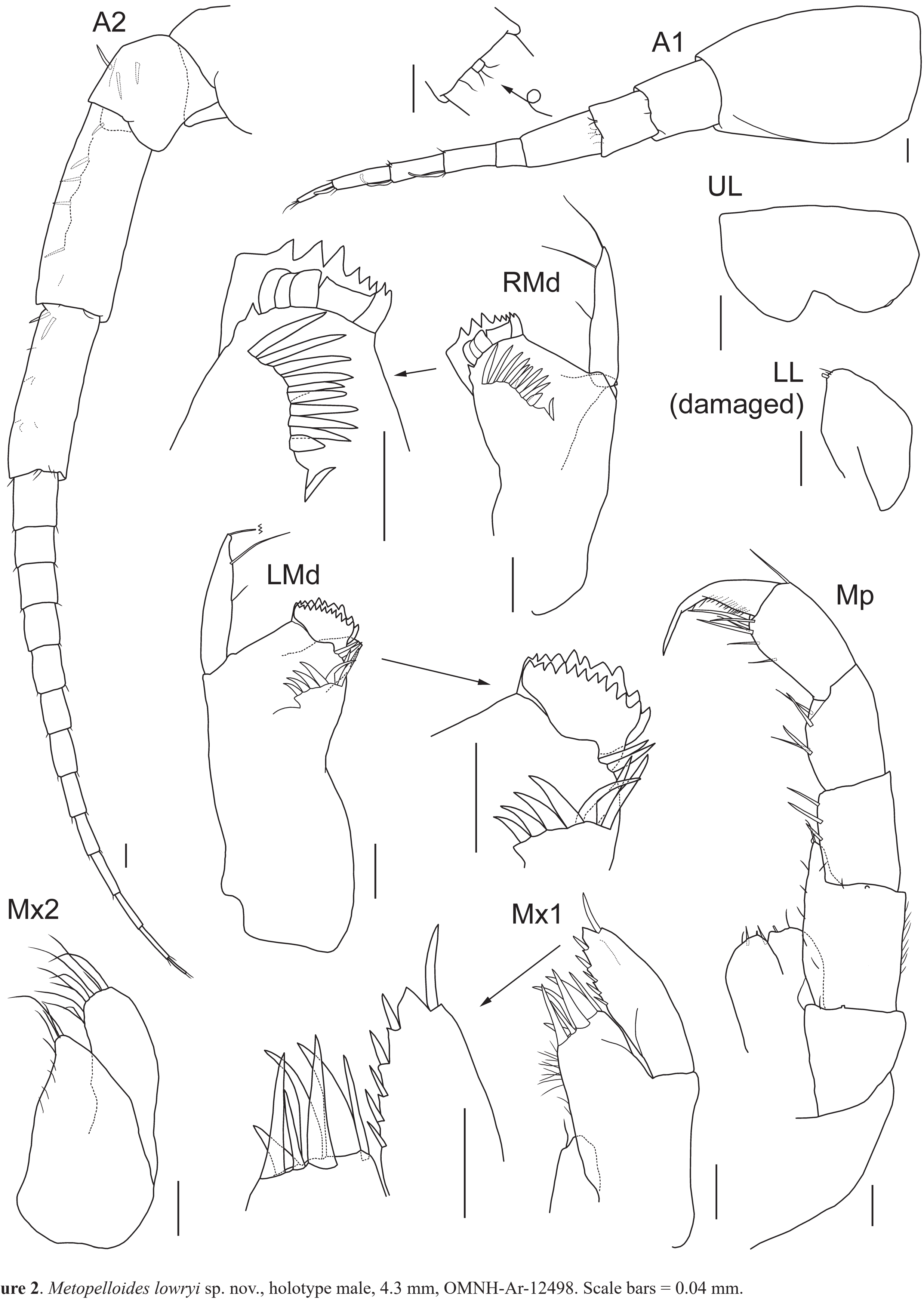

Figure 2. *Metopelloides lowryi* sp. nov., holotype male, 4.3 mm, OMNH-Ar-12498. Scale bars = 0.04 mm.

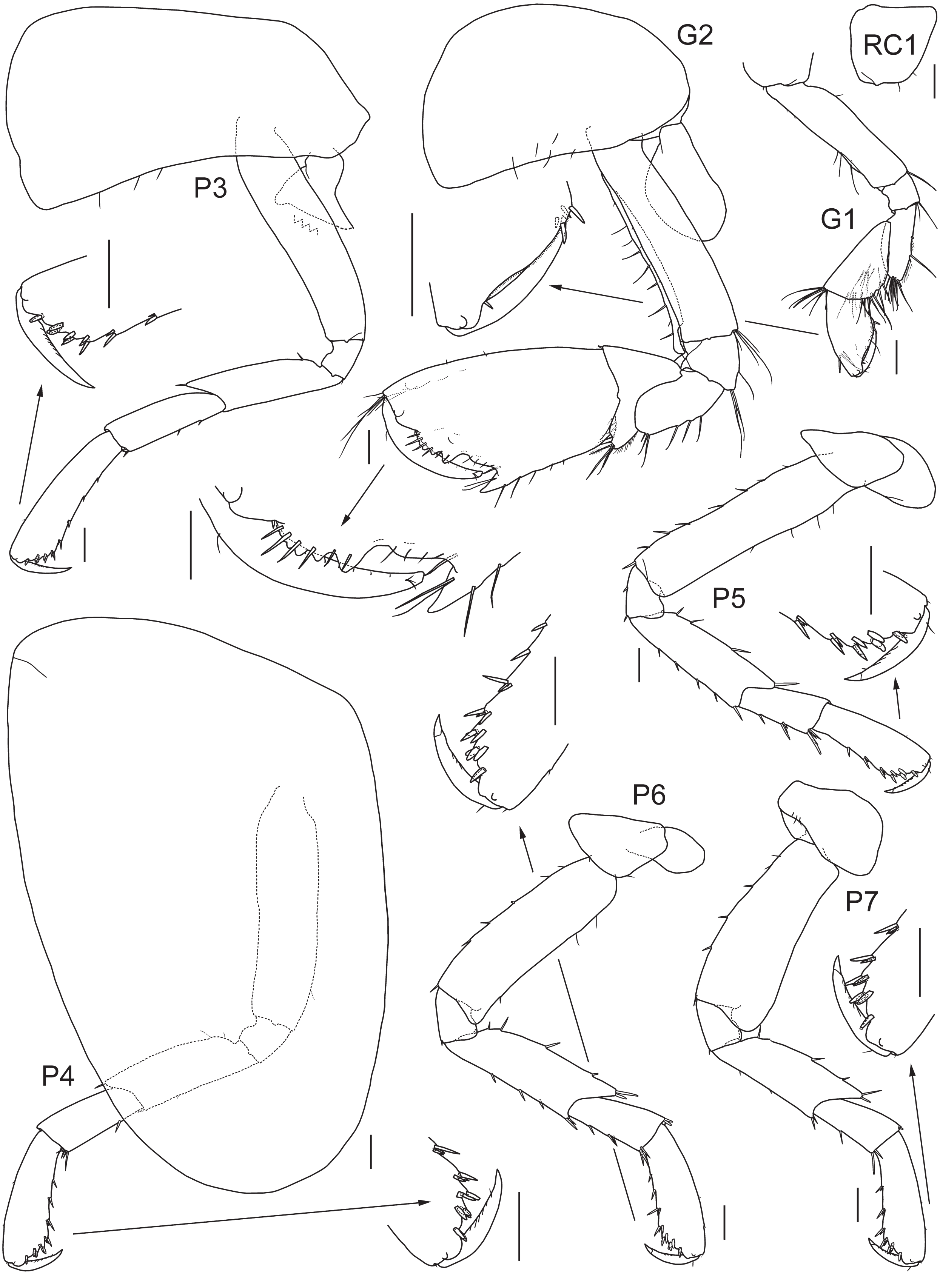

Figure 3. *Metopelloides lowryi* sp. nov., holotype male, 4.3 mm, OMNH-Ar-12498. Scale bars = 0.1 mm.

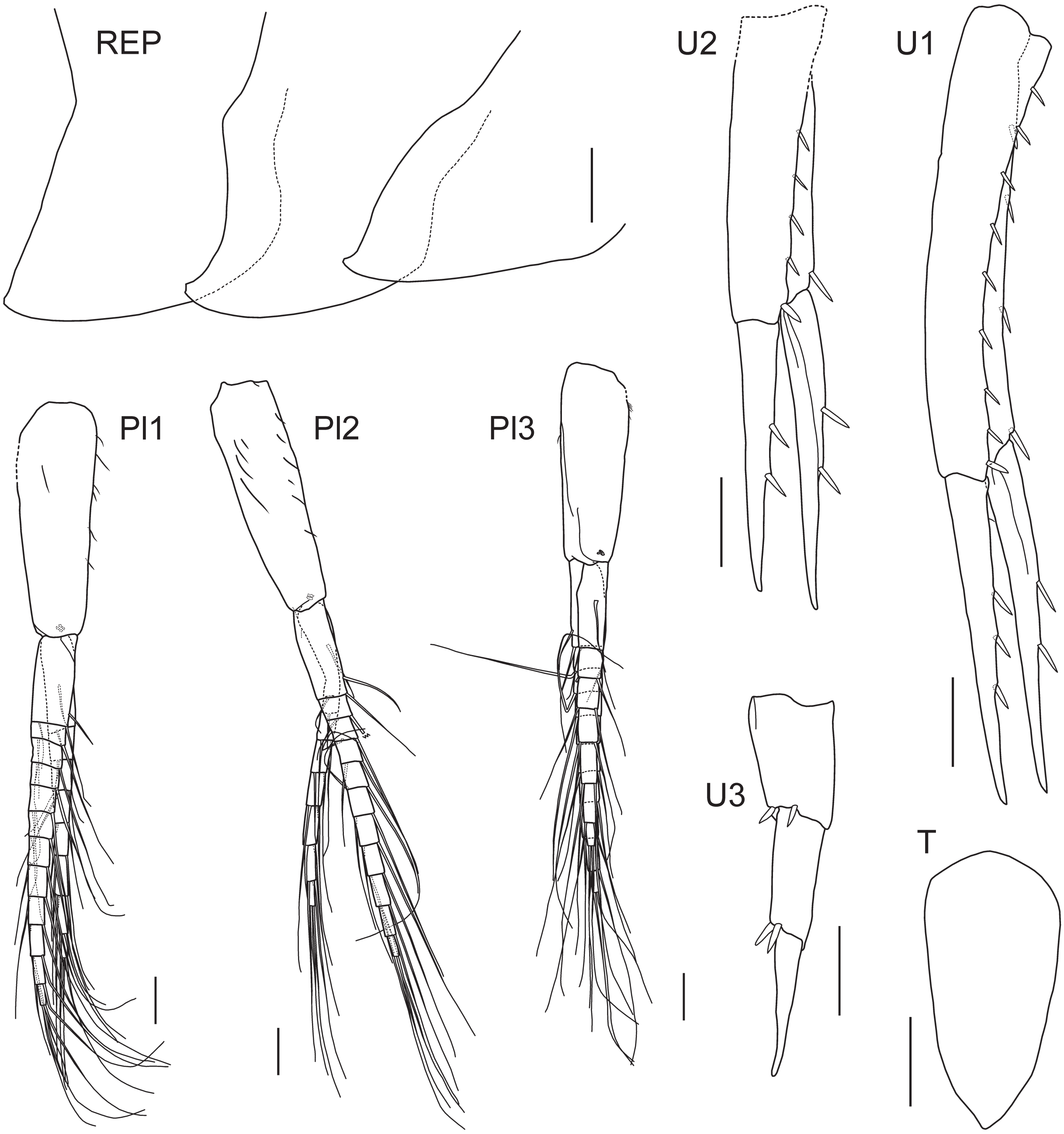

Figure 4. *Metopelloides lowryi* sp. nov., holotype male, 4.3 mm, OMNH-Ar-12498. Scale bars = 0.1 mm.

Key to species of *Metopelloides* Gurjanova, 1938

1 Antenna 1, peduncular article 2 short (less than half length of article 1) 2

—— Antenna 1, peduncular article 2 long (more than half length of article 1) 3

2 Gnathopod 1, posterior margin of dactylus setose; palm of gnathopod 2 transverse .... *M. tattersalli*

—— Gnathopod 1, posterior margin of dactylus bare; palm of gnathopod 2 oblique .... *M. lowryi* sp. nov.

3 Gnathopod 2, anterior margin of basis setose .... *M. micropalpa*

—— Gnathopod 2, anterior margin of basis bare 4

4 Telson with 2 robust setae .... *M. stephenseni*

—— Telson without robust setae .... *M. paguri*

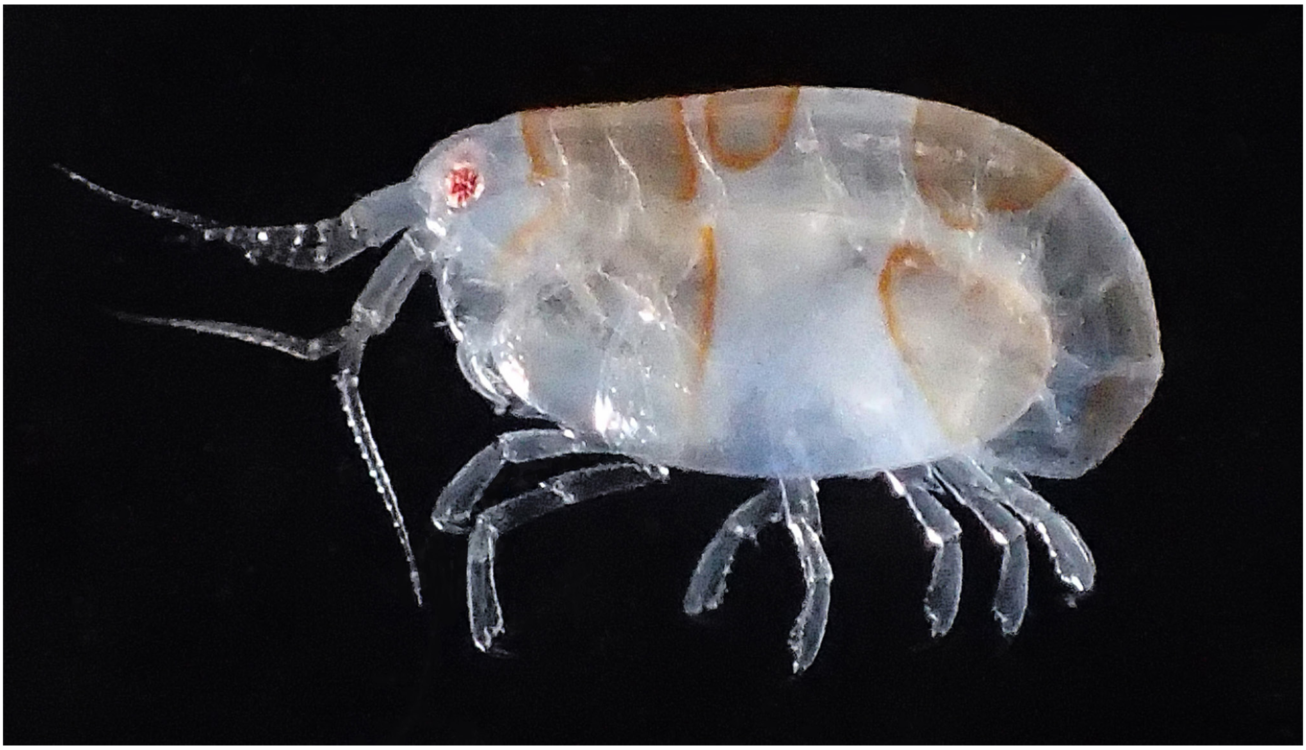

Figure 5. *Metopelloides lowryi* sp. nov., holotype male, 4.3 mm, OMNH-Ar-12498, photographed immediately after fixation, T. Moritaki.

Suborder Senticaudata Lowry & Myers, 2013

Infraorder Corophiida Leach, 1814

Parvorder Caprellidira Leach, 1814

Superfamily Isaeoidea Dana, 1852

Family Isaeidae Dana, 1852

[Japanese name: Ishiku-yokoebi-ka]

Genus *Isaea* Milne Edwards, 1830

[Japanese name: Yadokari-yokoebi-zoku, new]

Isaea Milne Edwards, 1830: 380.—Chevreux & Fage, 1925: 328.—Lincoln, 1979: 496.—Barnard & Karaman, 1991a: 197.—Myers & Lowry, 2003: 471.

Type species. *Isaea montagui* Milne Edwards, 1830, monotypy.

Diagnosis. Antenna 1, peduncular article 3 0.7–1.1 times as long as article 1; accessory flagellum with 2–6 articles. Mouth parts ordinary. Coxae 1–4 long, strongly overlapping, progressively more elongate from 1 to 4, coxae 6, 7 much smaller than anterior coxae. Gnathopods subchelate, palm oblique; gnathopod 1, propodus longer than or subequal to carpus; gnathopod 2 much larger than 1, propodus dilated, longer than carpus. Pereopods prehensile, pereopods 3, 4 not glandular. Urosomites 1–3 free. Uropods 1–3 biramous, inner ramus of uropod 3 longer than or subequal to outer ramus. Telson fleshy, entire.

Included species. *Isaea concinna* Gurjanova, 1938 [Sea of Japan and Sea of Okhotsk (Kudrjashov, 1972)]; *I. concinnoides* sp. nov. [Northwest Pacific]; *I. elmhirsti* Patience, 1909 [Northeast Atlantic]; and *I. montagui* Milne Edwards, 1830 [Northeast Atlantic and Mediterranean (Lincoln, 1979)].

Remarks. The Isaeidae include only two genera: *Isaea* and *Pagurisaea* Moore, 1983. *Pagurisaea* is distinguishable from *Isaea* in the glandular pereopods 3 and 4 and the uropod 3 with shortened inner ramus (Moore, 1983).

Isaea concinnoides sp. nov.

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[Japanese name: Yadokari-yokoebi, new]

Figs 6–11

Holotype: OMNH-Ar-12499, male, 4.8 mm, Kumano-nada, off Kumano City, Mie Prefecture, 33°48'54.0"N 136°11'42.1"E, 190–380 m depth, associated with *Propagurus obtusifrons*, coll. T. Moritaki, 7 February 2022. **Paratypes** (TAMBL-CR 1776): OMNH-Ar-12500, male, *ca.* 5.6 mm (damaged); OMNH-Ar-12501, male, 3.4 mm; OMNH-Ar-12502, male, 3.0 mm; OMNH-Ar-12503, female, 3.6 mm, off Owase City, Mie Prefecture, 34°01'22.0"N 136°20'57.6"E, 190–350 m depth, associated with *Propagurus obtusifrons*, coll. T. Moritaki, 13 October 2016.

Type locality. Kumano-nada, off Kumano City in Mie Prefecture, Japan.

Etymology. From *concinna* (closely related species) + the Greek *oides* (= resembling).

Diagnosis. Eyes medium-sized. Antennae relatively stout, with short setae on posterior margins; accessory flagellum with 2 articles. *Gnathopod 2* stout, carpus short. Basis of pereopod 5 oval. Posterodistal corner of epimeral plate 3 angular.

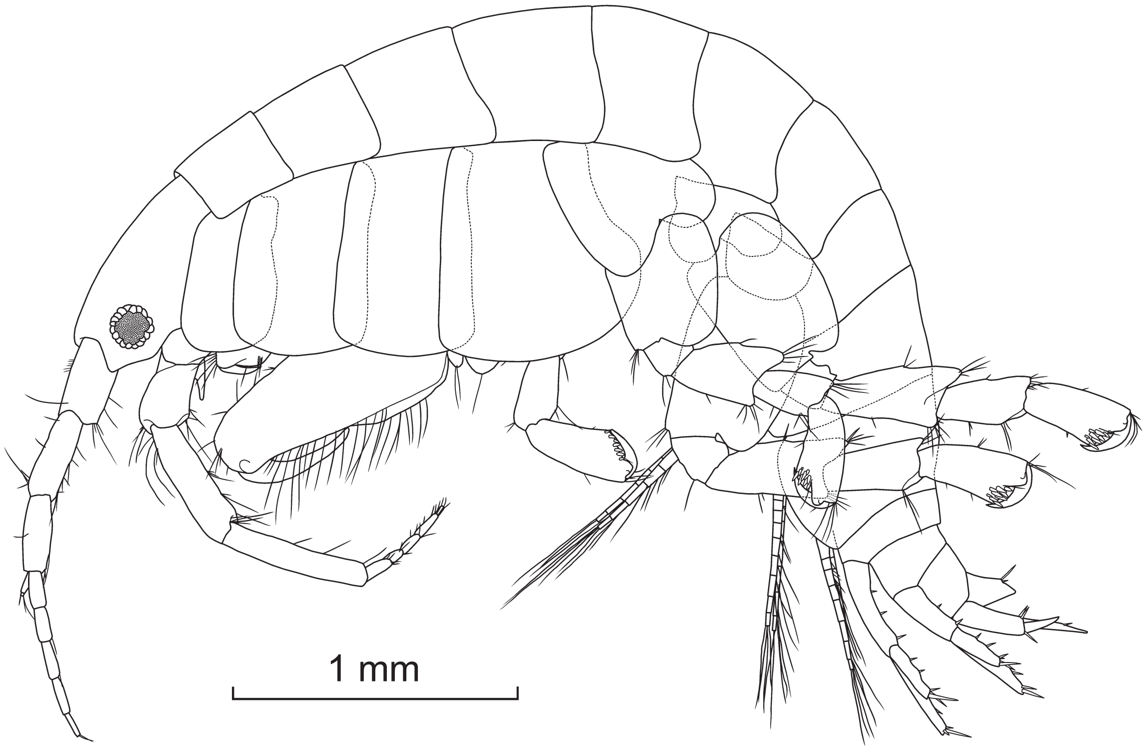

Figure 6. *Isaea concinnoides* sp. nov., holotype male, 4.8 mm, OMNH-Ar-12499, habitus.

Description. **Male** (based on holotype, 4.8 mm). Body (Fig. 6) subovate, smooth. *Coxae* 1–4 long, coxae 5–7 short.

Head (Figs 6, 7). *Rostrum* small. *Ocular lobes* subtriangular. *Eyes* medium-sized (diameter: *ca.* 0.25 times head length). *Antenna 1* relatively short, *ca.* 0.3 times BL; peduncular articles 1–3 with length ratio of 1.0:1.3:1.0, article 1 stout, posterodistal corner setose (twisted in preparation), anterodistal corner of article 2 setose; accessory flagellum short, 2-articulate, tip with several setae; primary flagellum with 5 articles, poorly setose. *Antenna 2* subequal to antenna 1 in length, stout, weakly setose; peduncular articles 3–5 with length ratio of 1.0:2.5:2.2; flagellum short, with 5 articles, terminal article minute, articles 1–4 bearing 6, 3, 3, 2 robust setae, respectively. *Upper lip* rounded ventrally, ventral margin with many minute setae. *Mandibles* stout, left and right incisors with 3 and 5 cusps, respectively, left lacinia mobilis 4-toothed and right 3-toothed, accessory blades 4 in left and 3 in right, molar well-developed, fan-shaped structure attached on distal side of left molar; palp strong, article length ratio 1.0:2.8:1.9, article 1 bare, articles 2, 3 weakly and strongly setose, respectively, article 3 clavate. *Lower lip* with acute-tipped mandibular process, mediodistal margin of outer lobe setose, dorsomedial surface covered with short thin setae; distal margin of inner plate with thin setae. *Maxilla 1* small; inner plate reduced, bullet-shaped, with bare tip; outer plate with 9 robust setae apically; tip of palp with 5 robust and 4 slender setae. *Maxilla 2* small; inner plate setose mediodistally; outer plate longer, tip setose. *Maxilliped* with inner plate bearing 4 robust and 4 plumose setae mediodistally; outer plate broad, not reaching apex of palp article 2, distomedial margin with 13 long-to-short robust setae; palp slender, weakly setose, article 4 bearing 2 long robust setae on tip.

Pereon (Figs 8, 9). *Gnathopod 1* small; basis slightly curved anteriorly, bare; posterior margins of merus and carpus heavily setose; propodus *ca.* 1.3 times as long as carpus, palm rounded, defined by long robust seta; dactylus slightly curved, posterior margin minutely serrated. *Gnathopod 2* stout; basis slightly curved anteriorly, anterior margin with 2 short setae, anterodistal corners of basis and ischium produced roundly; merus short and broad, posterodistal corner setose; carpus narrow, triangular, with setose posterior lobe, anterolateral surface with long robust seta; propodus greatly expanded, broad, *ca.* 5.5 times carpal length, palm strongly oblique, defined by short robust seta, bearing numerous plumose setae, distal part of palmer margin with triangular process; dactylus short, strongly curved posteriorly. *Pereopod 3* slender; basis poorly setose; merus, anterodistal and posterodistal corners setose; carpus short, setose posterodistally; propodus long, *ca.* 1.65 times length of carpus, widened distally, palm oblique, with 7 and 5 robust setae on lateral and medial surfaces, respectively; dactylus strongly curved posteriorly. *Pereopod 4* slender, similar to pereopod 3 except for coxa; coxa wide, posterior margin weakly excavated; palm oblique, with 5 and 4 robust setae on lateral and medial surfaces, respectively. *Pereopod 5* shorter than pereopod 4; coxa bilobed; basis broad, oval, length *ca.* 1.1 times width, posterodistal corner expanded, rounded distally, anterodistal corner setose; merus produced posterodistally, anterodistal and posterodistal corners of merus and carpus setose; propodus widened distally, palm slightly oblique, with 2+3+4 and 3 robust setae on lateral and medial surfaces, respectively. *Pereopod 6* slightly longer than pereopod 5; coxa bilobed; basis broad, subrectangular, length *ca.* 1.35 times width, posterodistal corner expanded, rounded distally, lateral surface with vertical ridge in middle, posterior half slightly bending mediodistally; propodus widened distally, palm slightly oblique, with 2+3+5 and

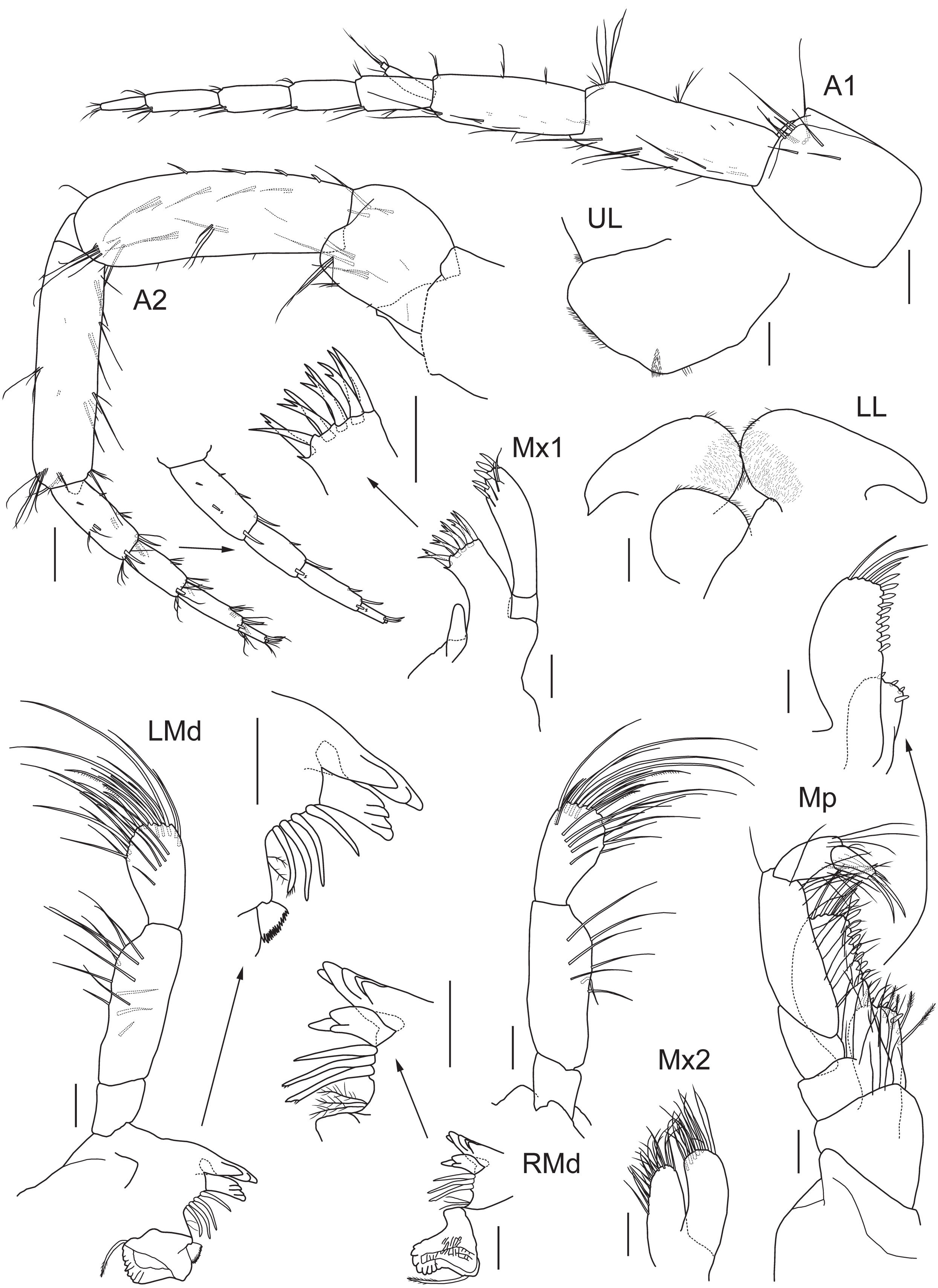

Figure 7. *Isaea concinnoides* sp. nov., holotype male, 4.8 mm, OMNH-Ar-12499. Scale bars = 0.1 mm.

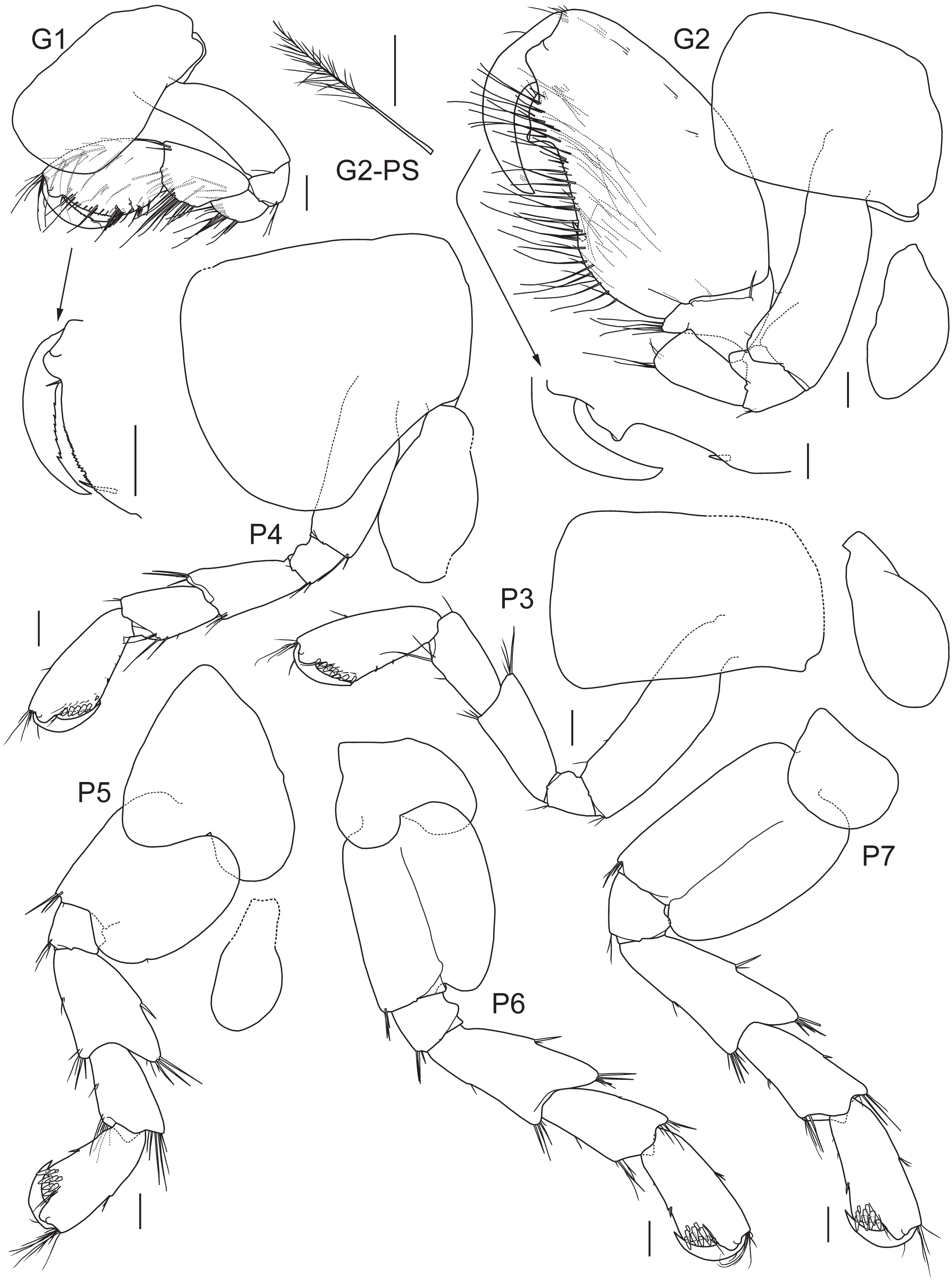

Figure 8. *Isaea concinnoides* sp. nov., holotype male, 4.8 mm, OMNH-Ar-12499. Scale bars = 0.1 mm.

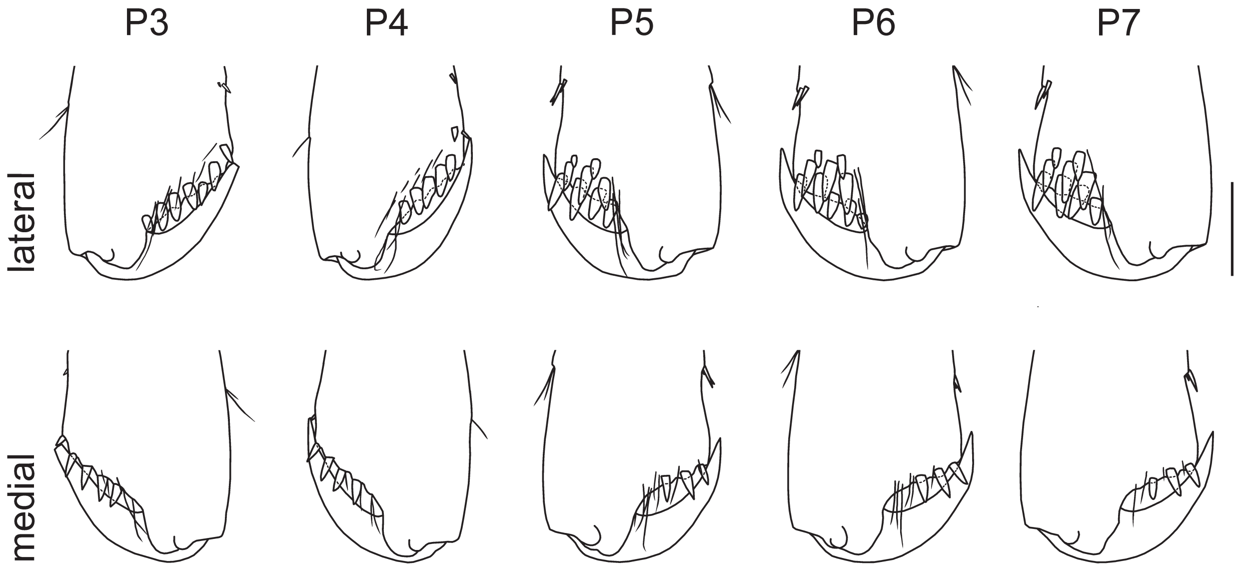

Figure 9. *Isaea concinnoides* sp. nov., holotype male, 4.8 mm, OMNH-Ar-12499, distal parts of pereopods 3–7. Scale bars = 0.1 mm.

3 robust setae on lateral and medial surfaces, respectively. *Pereopod 7* longer than pereopod 6; coxa not lobate; basis subrectangular, length *ca.* 1.4 times width, posterodistal corner expanded, rounded distally, lateral surface with vertical ridge in middle, posterior half slightly bending mediodistally; propodus widened distally, palm slightly oblique, with 2+3+4 and 3 robust setae on lateral and medial surfaces, respectively.

Pleon (Fig. 10). *Epimeral plates 1–3*, posterodistal corners round, weakly angular and angular, respectively; ventral margins bare. *Pleopods* slender, pleopod 3 shortest; peduncles with 1, 5, 8 plumose setae in pleopods 1–3, respectively; outer rami subequal to inner rami in length, former with 9, 9, 8 articles, respectively and latter each with 7 articles. *Uropod 1*, peduncle with inter-ramal process (*ca.* 0.2 times length of peduncle), bearing 3 dorsolateral and 2 dorsomedial robust setae; outer ramus shorter than peduncle, with 2 dorsolateral, 1 dorsomedial and 4 terminal robust setae; inner ramus as long as peduncle, bearing 1 dorsolateral, 2 dorsomedial and 4 terminal robust setae. *Uropod 2 ca.* 0.85 times length of uropod 1; peduncle with minute inter-ramal process (*ca.* 0.08 times length of peduncle), bearing 2 dorsolateral and 1 dorsomedial robust setae; outer ramus *ca.* 0.9 times length of peduncle, with 2 dorsolateral, 1 dorsomedial and 4 terminal robust setae; inner ramus *ca.* 1.15 times length of peduncle, bearing 1 dorsolateral, 3 dorsomedial and 4 terminal robust setae. *Uropod 3 ca.* 0.75 times length of uropod 2; peduncle lacking inter-ramal process, bearing 1 robust and 3 short setae medioproximally, distal part with 3+3+2 robust setae; outer ramus curved laterally, *ca.* 0.75 times length of peduncle, with 1 dorsomedial robust seta and 1 terminal minute robust seta; inner ramus *ca.* 0.9 times as long as peduncle, bearing 1 dorsolateral and 1 dorsomedial robust setae and 1 terminal minute robust seta. *Telson* roundish triangular, length *ca.* 0.9 times width, with pair of subapical cusps bearing 2 robust setae (1 long and 1 short) and a sensory seta, each lateral margin with 2 sensory setae.

Female (based on paratype, OMNH-Ar-12503, 3.6 mm). Immature (oostegites very small). *Gnathopod 2* (Fig. 10SF-RG2), distal process on palmer margin smaller than that of holotype.

Variation in male gnathopod 2. Paratype, large male (OMNH-Ar-12500, *ca.* 5.6 mm; Fig. 10LM-RG2), posterodistal corner of propodus produced roundly, posterior margin with large distal and small proximal processes and without robust seta. Paratype, small male (OMNH-Ar-12501, 3.4 mm; Fig. 10SM-G2), distal process on palmar margin small.

Colour in life (Fig. 11). Eyes black (they appear silver in the figure probably due to reflection of light). Body almost translucent, with poorly-defined pale yellow bands, pale brown internal organs visible.

Remarks. *Isaea concinnoides* sp. nov. is quite different from *I. elmhirsti* and *I. montagui* in the shape of the male gnathopod 2. The male gnathopod 2 of the new species closely resembles that of *I. concinna*; however, *I. concinnoides* can be distinguished from *I. concinna* by the relatively stout antennae with short setae (slender, with long setae in *I. concinna*) and the oval basis of pereopod 5 (subrectangular in *I. concinna*).

Habitat. Bottom sediment unknown, 190–380 m depth, associated with *Propagurus obtusifrons*.

Distribution. Japan: Kumano-nada (present study).

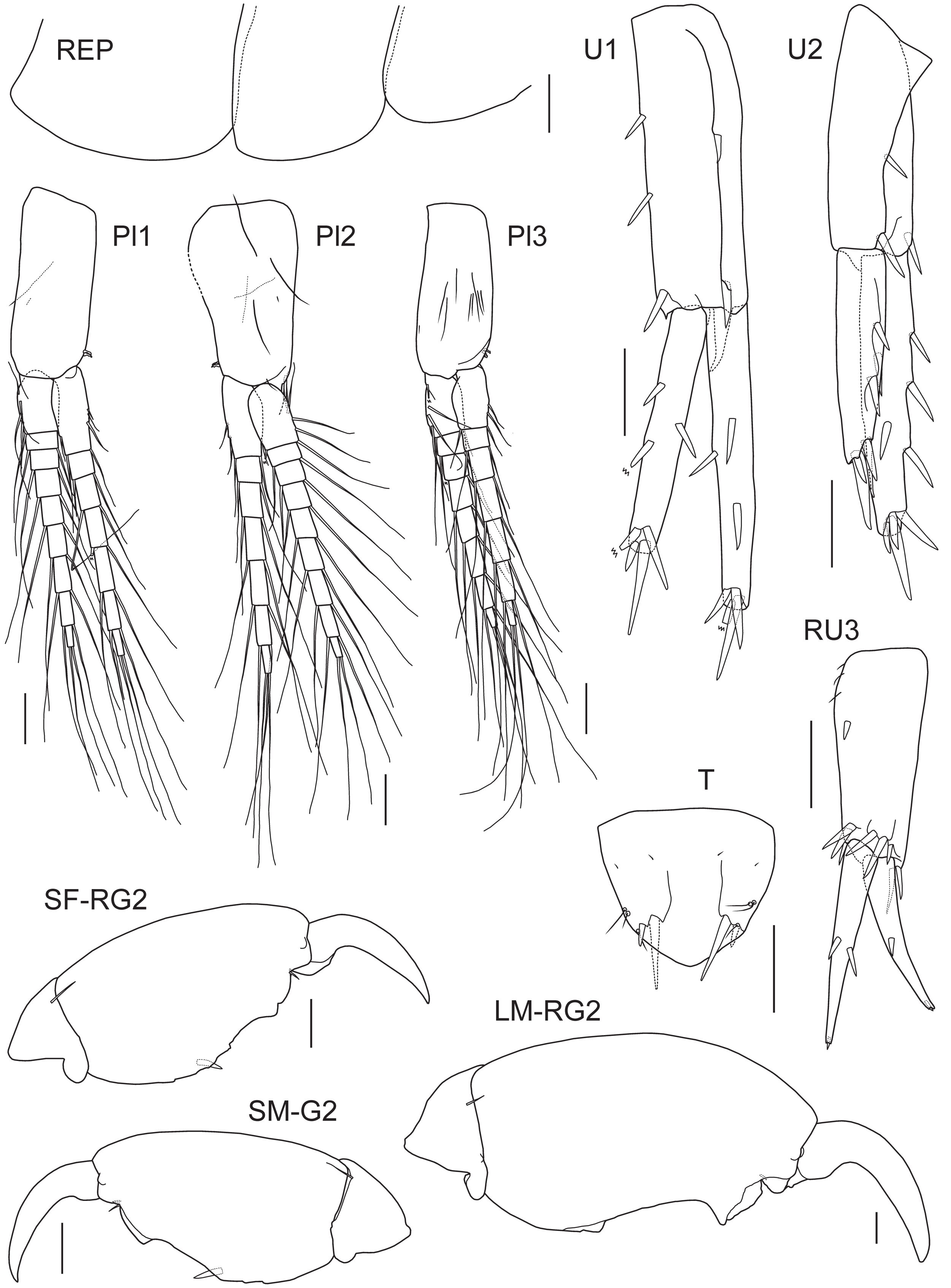

Figure 10. *Isaea concinnoides* sp. nov.: holotype male, 4.8 mm, OMNH-Ar-12499 (except for LM, SM, and SF); LM: paratype male, *ca.* 5.6 mm, OMNH-Ar-12500; SM: paratype male, 3.4 mm, OMNH-Ar-12501; SF: paratype female, 3.6 mm, OMNH-Ar-12503. Slender setae of gnathopods omitted. Scale bars = 0.1 mm.

Figure 11. *Isaea concinnoides* sp. nov., paratype male, *ca.* 5.6 mm, OMNH-Ar-12500, photographed in aquarium, T. Moritaki.

Key to species of *Isaea* Milne Edwards, 1830

1	Accessory flagellum with 3–6 articles, carpus of gnathopod 2 long (0.50–0.65 times length of propodus)	2
——	Accessory flagellum with 2 articles, carpus of gnathopod 2 short (0.15–0.25 times length of propodus)	3
2	Eyes very large; epimeral plate 3 with posterodistal tooth, posterior margin almost straight	*I. montagui*
——	Eyes medium-sized; epimeral plate 3 bearing minute posterodistal tooth with inset setule, posterior margin convex	*I. elmhirsti*
3	Antennae slender, with long setae on posterior margins, basis of pereopod 5 subrectangular	*I. concinna*
——	Antennae relatively stout, with short setae on posterior margins, basis of pereopod 5 oval	*I. concinnoides* sp. nov.

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Description of *Stenothoe lowryi* sp. nov. (Crustacea: Amphipoda: Stenothoidae), from the Straits of Malacca, Malaysia

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ABSTRACT. *Stenothoe lowryi* sp. nov. from samples collected in an intertidal pool of Pangkor Island is described and illustrated. Diagnostic features of *Stenothoe lowryi* are almost exclusively related to Salman's material of *Stenothoe gallensis* Walker, 1904 from the Arabian Gulf (Salman, 1985), in the shape of male gnathopod 2, outer plate of maxilla 2 with 2 articles, and moderately convex dorsal margin of male gnathopod 2. However, *S. gallensis* and *S. lowryi* sp. nov. have shown slight differences by the latter in having: 1) gnathopod 2 propodus with palmar margin moderately convex; 2) uropod 2 rami with only one robust seta on medial margin, and; 3) uropod 3 article 2 distinctly longer than article 1, proximally swollen, not rugose.

Introduction

In recent years, there has been an increasing interest in the amphipod fauna of the Southeast Asian (SEA) region. Lowry (2000) published the first comprehensive distributional checklist of SEA amphipods with a more recent checklist by Azman *et al.* (2022). Various taxonomic works were also focussed on amphipods from the waters of Thailand (Lowry & Berents, 2002; Lowry & Stoddart 2002; Lowry & Watson, 2002; Myers, 2002; Peart, 2002; Takeuchi & Guerra-Garcia, 2002; Taylor, 2002; Wongkamhaeng *et al.*, 2009; Wongkamhaeng *et al.*, 2012a; Wongkamhaeng *et al.*, 2012b; Wongkamhaeng *et al.*, 2013a; Wongkamhaeng *et al.*, 2013b; Wongkamhaeng *et al.*, 2016; Wongkamhaeng *et al.*, 2018, Wongkamhaeng & Boonyanusith, 2015), Indonesia (Arfianti & Wongkamhaeng 2017; Ortiz & Lalana, 2003), the Philippines (Sawicki *et al.*, 2005; Stoddart & Lowry, 2004), Vietnam (Dang & Le, 2005; Dang & Le, 2011; Dang & Le, 2012; Dang & Le, 2013), Malaysia (Azman, 2021; Azman & Melvin, 2011; Azman & Othman, 2012; Azman & Othman, 2013; Feirulsha & Rahim, 2020; Lim *et al.*, 2010; Nurshazwan *et al.*, 2020; Othman & Morino, 2006; Othman & Azman, 2007; Shin *et al.*, 2015), Singapore (Ali-Eimran *et al.*, 2020) and Timor-Leste (Hughes, 2015).

Nonetheless, stenothoid Amphipoda remain poorly studied in Southeast Asian waters, with only one species (*Stenothoe gallensis* Walker, 1904) recorded, until Krapp-Schickel (2015) described another species (*S. andamanensis* Krapp-Schickel, 2015) from the harbour of Havelock, Andaman Islands. The most recently described species are *S. irinae* Marin & Sinelnikov, 2018 and *S. nhatrangensis* Marin & Sinelnikov, 2018, from Nha Trang Bay, Vietnam.

While undertaking a faunal survey along the Straits of Malacca off the Malaysian west coast (1995–1996), a number of specimens were collected from intertidal rocks during a study of associated macrocrustaceans (including decapods and other peracarids) of Pangkor Island. This paper gives an illustrated description of a new species of *Stenothoe* from this region.

Keywords: Amphipoda, taxonomy, *Stenothoe*, *Stenothoe lowryi*, new species, Pangkor Island
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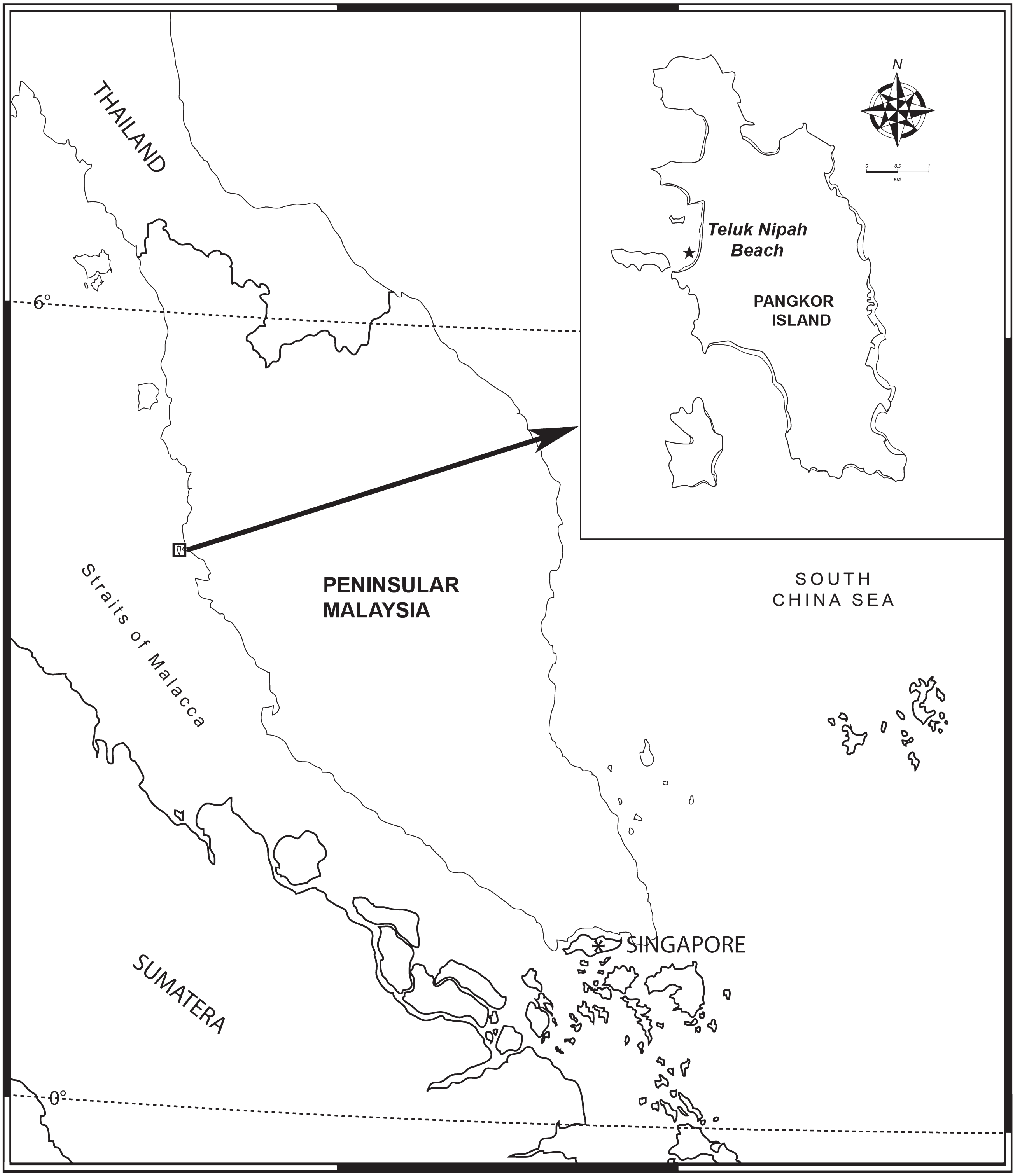

Figure 1. Map of Peninsular Malaysia with sampling site on Pangkor Island.

Materials and methods

The crustaceans were collected from washing intertidal rocks in January 1996 at the Teluk Nipah beach (4°14'00.0"N 100°31'00.0"E), Pangkor Island (Fig. 1). Intertidal rocks were collected manually and placed in a bucket with seawater. Alcohol solution was then added into the bucket and left to stand for about 30–45 min. Next, the samples were rinsed and washed with seawater passing through a 300 µm sieve. In the field, samples were fixed with about 10% formalin in seawater. Taxonomic descriptions were generated from a DELTA (Dallwitz, 2005) database to stenothoid genera and species. Material described in this study is lodged at the Universti Kebangsaan Malaysia Muzium Zoologi, Bangi, Malaysia (UKMMZ). The following abbreviations are used on the plates: **A**, antenna; **Ep**, epimeron; **G**, gnathopod; **Hd**, head; **L**, labium; **Mn**, mandible; **Mxp**, maxilliped; **Mx**, maxilla; **P**, pereopod; **T**, telson; **U**, uropod; **Ur**, urosomite; **l**, left; **r**, right.

Systematics

Family Stenothoidae Boeck, 1871

Genus *Stenothoe* Dana, 1852

Type species. *Stenothoe valida* Dana, 1852.

Stenothoe lowryi sp. nov.

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Figs 2–4

Holotype: Male, 5.3 mm (from tip of rostrum to apex of telson), UKMMZ-1133, Peninsular Malaysia, Pangkor Island, Teluk Nipah beach, 4°14'00.0"N 100°31'00.0"E, intertidal area, rock washing, 0–1 m depth, B. A. R. Azman, S. Y. Gan, J. H. C. Lim, C. F. Liong, 12 January 1996 (UKM I.D. PKR 1.3923). **Allotype**: Female, UKMMZ-1134, same station data as holotype; dissected appendages were kept in five semi-permanent slides mounted on glycerol.

Diagnosis. Stenothoidae with long antenna 1 (distinctly longer than head and pereonites 1–4) with peduncular article 1 2× longer than broad. Maxilliped palp article 3 short. Maxilla 2 well developed, with outer plate 2-articulate. Gnathopod 1 propodus about 2× as long as broad. Gnathopod 2 propodus with palmar margin moderately convex. Pereopod 7 basis proximally or slightly expanded (more than 1.5–1.8× as long as broad). Uropod 2 rami with single robust seta on medial margin. Uropod 3 article 2 distinctly longer than article 1, not rugose. Telson apically subacute.

Description. **Male** (based on holotype, 5.3 mm). Body smooth.

Head. Antenna 1 long (distinctly longer than head and pereonites 1–4), subequal in length to antenna 2; peduncle not geniculate; peduncular article 1 2× longer than broad, without anterodistal lobe, without posterodistal lobe; peduncular article 2 without anterodistal lobe; accessory flagellum absent; flagellum 20-articulate. Mandible palp absent; incisor process well developed. Maxilliped palp article 3 short. Maxilla 1 palp 2-articulate. Maxilla 2 well developed with outer plate 2-articulate.

Pereon. Gnathopods 1–2 dissimilar in shape; gnathopod 1 subchelate; merus enlarged, produced distally; carpus short (about as long as broad); propodus anterior and posterior margins subparallel (not expanded distally), about 2× as long as broad. Gnathopod 2 coxa posterior margin straight; basis anterodistal margin smooth; merus posterior margin convex, with setae; propodus narrow, oval, without posterodistal expansion, medium length (about twice as long as broad) (2.1), not transverse, palmar margin moderately convex, ventral margin with crenulation, (distally crenulate), with dense row(s) of fine setae; dactylus reaching distinctly further than half length of propodus, acute. Pereopod 3–7 setose. Pereonite 4 not elongate (similar length to pereonite 3); without dorsal carina. Pereopod 4 coxa ventral margin convex. Pereopod 5 basis not expanded. Pereopod 6 basis fully expanded; posterior margin straight. Pereopod 7 basis proximally or slightly expanded (more than 1.5× as long as broad), posterior margin convex (slightly), with crenulation; merus distally twice as wide as ischium, with ventral row of robust setae, expansion not reaching to mid-length of carpus; dactylus small (distinctly smaller than carpus).

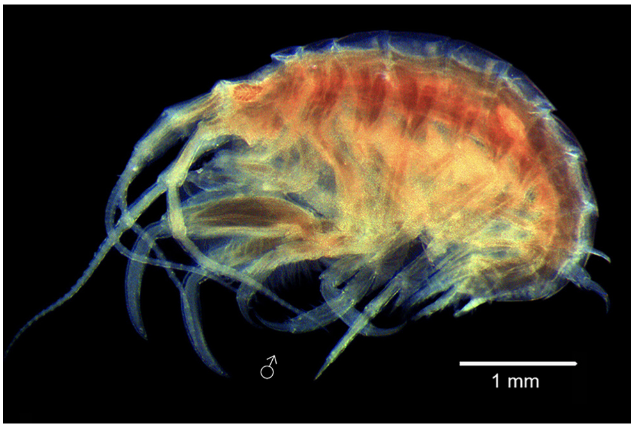

Figure 2. *Stenothoe lowryi* sp. nov., holotype male, 5.3 mm, UKMMZ-1133.

Pleon. Epimeron 3 posteroventral corner subquadrate/rounded. Uropod 1 peduncle with a distoventral spur; inner ramus well developed, subequal in length to outer ramus. Uropod 2 inner ramus well developed, subequal in length to outer ramus, rami with single robust seta on medial margin. Uropod 3 with peduncle and ramus; ramus subequal or longer than peduncle; peduncle longer than article 1; ramus 2 articulate; article 1 without marginal robust setae; article 2 distinctly longer than article 1, proximally swollen, not rugose. Telson laminar, with dorsolateral robust setae, apically subacute.

Female (sexually dimorphic characters). Gnathopod 1 propodus about 3× as long as broad. Gnathopod 2 propodus medium length (about 2 times as long as broad). Uropod 3 article 2 not swollen. Telson apically acute or subacute.

Etymology. This species is named after the late Dr J. K. Lowry, world-renowned amphipod taxonomist, in recognition for his outstanding taxonomic and systematic work on the amphipod fauna of the world.

Remarks. The material at hand is similar to *Stenothoe gallensis* Walker, 1904, a distinctive species originally described from Galle, Sri Lanka. It should be noted, however, that in Walker's original illustration, he mistakenly labelled pereopod 7 as pereopod 5. After thorough observation of the specimens from Pangkor Island, it is clear that they are not attributable to *S. gallensis*. Table 1 summarizes the characters and states reviewed from literature and the present study. Krapp-Schickel (2015) reviewed and reassessed most of the previously synonymized records of *S. gallensis* from various localities and placed *S. irakiensis* Salman, 1985 as a junior synonym of *S. gallensis.*

Comparing the descriptions and illustrations in the original texts (Salman, 1985), this new species is most morphologically similar to Salman's material of *S. gallensis* Walker, 1904 from the Arabian Gulf, in the shape of male gnathopod 2; outer plate of maxilla 2 with 2 articles; and article 2 longer than article 1 of uropod 2. Despite showing greatest morphological similarity, *S. gallensis* and *S. lowryi* sp. nov. have slight differences, with the latter having: 1) gnathopod 2 propodus with palmar margin moderately convex; 2) uropod 2 rami with only one robust seta on medial margin; 3) uropod 3 article 2 distinctly longer than article 1, proximally swollen, not rugose.

In *S. lowryi*, the separated articles of the outer plate of the

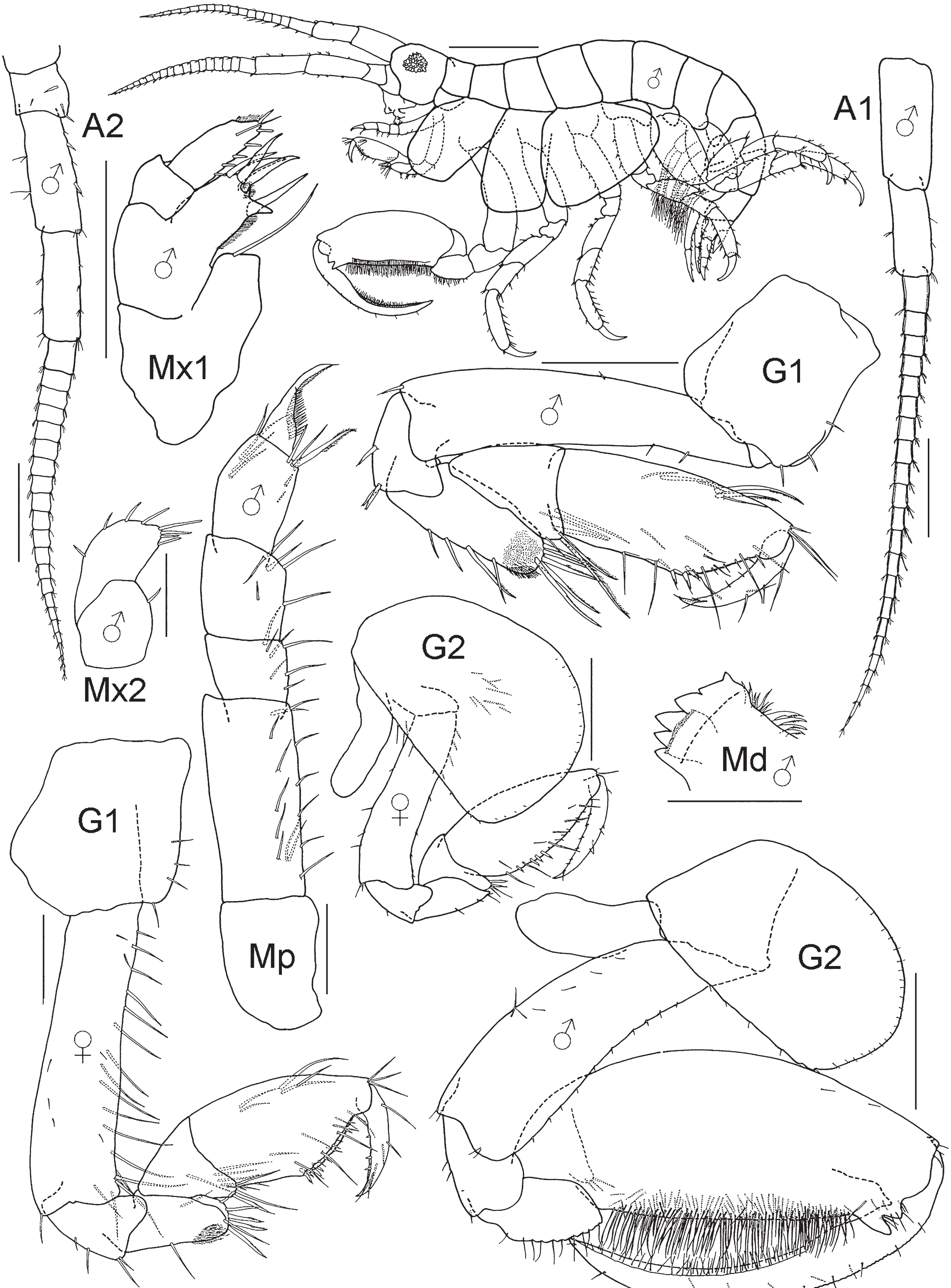

Figure 3. *Stenothoe lowryi* sp. nov., from Pangkor Island, Malaysia. Holotype male, 5.3 mm, UKMMZ-1133. Allotype female, 4.9 mm, UKMMZ-1134. Scales: A1, A2 = 0.4 mm; Mx2, Md = 0.1 mm; Mx1, Mp, G1 = 0.2 mm; remainder = 0.5 mm.

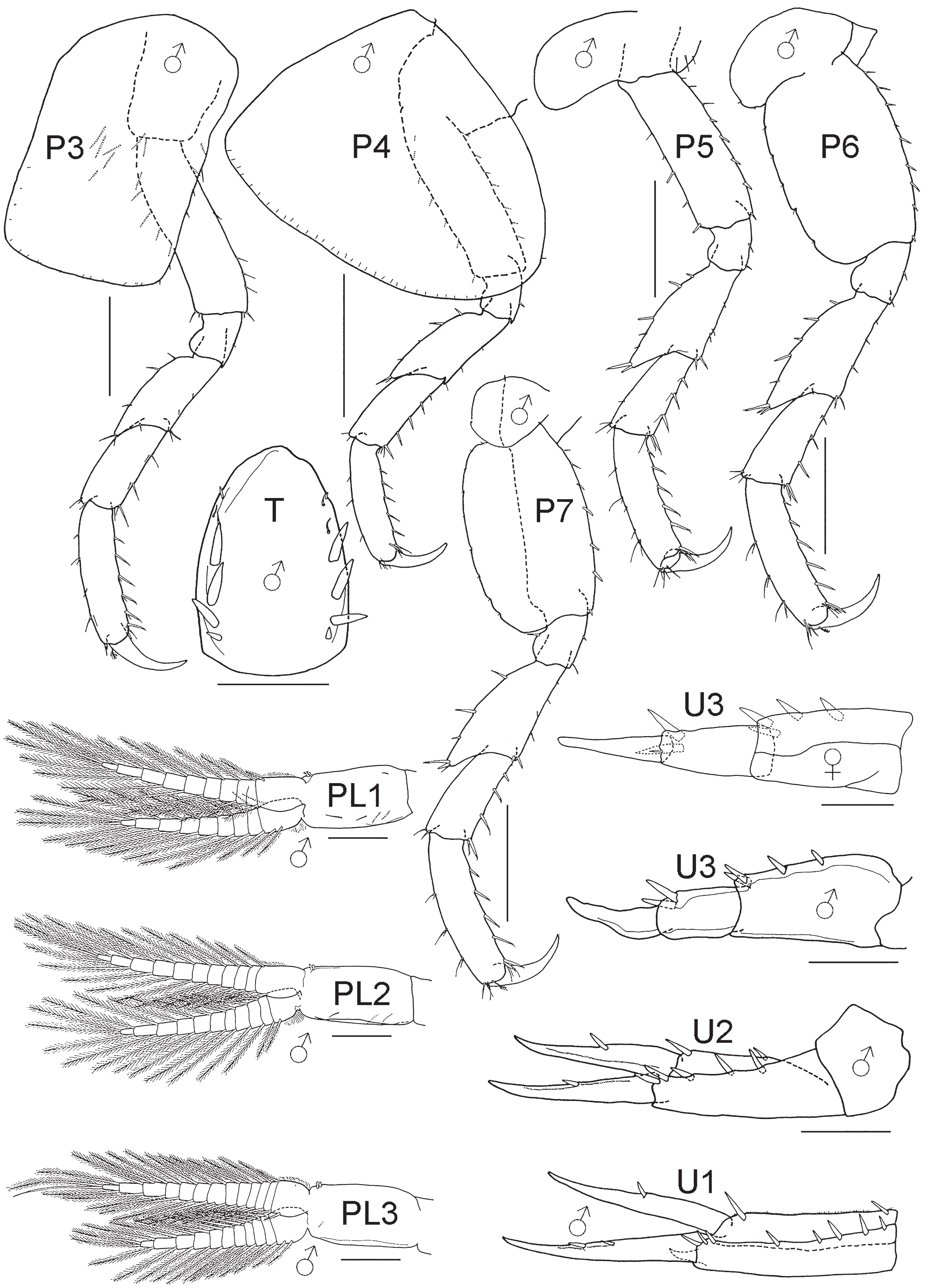

Figure 4. *Stenothoe lowryi* sp. nov., from Pangkor Island, Malaysia. Holotype male, 5.3 mm, UKMMZ-1133. Allotype female, 4.9 mm, UKMMZ-1134. Scales: P3–P7 = 0.5 mm; PL1–PL3 = 0.2 mm; remainder = 0.1 mm.

Table 1. Morphological variation in species of *Stenothoe* from Southeast Asia, including *S. lowryi* sp. nov.

Character	*S. irakiensis*	*S. irinae*	*S. nhatrangensis*	*S. andamanensis*	*S. lowryi* sp. nov.
Maxilla 2 outer plate	separated	fused	fused	separated	separated
Gnathopod 2 palmar margin (male)	moderately concave	convex	concave	moderately concave	moderately convex
Coxa 2 posterior margin	n/a	rounded	rounded	rounded and concave	straight
Uropod 2 rami medial margin setae	2 or more robust setae	1 robust setae	2 or more robust setae	2 or more robust setae	1 robust seta
Uropod 3 article length	article 2 slightly longer than article 1	subequal	article 2 distinctly longer than article 1	articles subequal	article 2 distinctly longer than article 1
Uropod 3 article 2 surface	rugose	rugose	not rugose	rugose	not rugose

Stenothoe irakiensis Salman, 1985 (junior synonym: *S. gallensis* Walker, 1904); *S. irinae* Marin & Sinelnikov, 2018; *S. nhatrangensis* Marin & Sinelnikov, 2018; *S. andamanensis* Krapp-Schickel, 2015.

second maxilla is also present in *S. andamanensis* Krapp-Schickel, 2015, but the new species can be recognized by: uropod 2 with only one robust seta on medial margin of rami (versus 2 or more robust setae in *S. andamanensis*); uropod 3, article 2 distinctly longer than article 1 (length subequal in *S. andamanensis*); and uropod 3 article 2 not rugose (article 2 rugose in *S. andamanensis*).

From *S. nhatrangensis* Marin & Sinelnikov, 2018, *S. lowryi* can be distinguished by the following features: maxilla 2 outer plate with separated articles (fused in *S. nhatrangensis*); gnathopod 2 palmar margin of male moderately convex (concave in *S. nhatrangensis*); coxa 2 posterior margin straight (rounded in *S. nhatrangensis*); and uropod 2 with only one robust seta on the medial margin of the rami (with two or more robust setae in *S. nhatrangensis*).

Finally, *S. lowryi* sp. nov. can be distinguished from *S. irinae* Marin & Sinelnikov, 2018 by: maxilla 2 outer plate with separated articles (fused in *S. irinae*); coxa 2 posterior margin straight (rounded in *S. irinae*); uropod 3 article 2 distinctly longer than article 1 (subequal in length in *S. irinae*); and uropod 3 article 2 not rugose (article 2 rugose in *S. irinae*).

Distribution. Pangkor Island, Peninsular Malaysia.

Discussion

Of the cosmopolitan species of *Stenothoe*, *S. gallensis* Walker, 1904 is one of the most widespread, recorded from localities ranging from East Africa (Indian Ocean) to South China Sea (Krapp-Schickel, 2015). Prior to the excellent summary by Krapp-Schickel (2015) of the problems associated with available names for species of the "S*tenothoe gallensis* group", *S. gallensis* had been reported from many disparate localities around the world (Table 2). In the

Table 2. Literature records of *Stenothoe gallensis* Walker, 1904; * indicates type locality.

location	author	illustrations
Indian Ocean		
* Galle, Sri Lanka	Walker (1904)	yes
East coast, India	Sivaprakasam (1968)	no
Madras Coast, India	Nayar (1959)	yes
Dar-es-Salaam	Schellenberg (1928)	no
Seychelles	Walker (1909)	no
Zanzibar	Walker (1909)	no
Mauritius	Ledoyer (1978)	no
Tuléar, Madagascar	Ledoyer (1972, 1979, 1986)	yes
Mozambique	Griffiths (1973)	no
South-eastern Africa	K. H. Barnard (1916, 1925)	no
Natal	Griffiths (1974a, b)	no
Red Sea	K. H. Barnard (1937)	no
Red Sea	Ruffo (1969)	no
Suez Canal	Monod (1937)	yes
Atlantic Ocean		
Banjul, Gambia	Reid (1951)	yes
Roscoff, France	Chevreux & Fage (1925)	yes
Plymouth, England	Lincoln (1979)	yes
Puerto Rico	Shoemaker (1935)	yes
Cuba	Ortiz & Lalana (1993)	no
North Carolina Estuaries	Williams & Bynum (1972)	no
Chesapeake Bay, USA	Feeley & Wass (1971)	no
York River, Va, USA	Marsh, 1973	no
Pacific Ocean		
Hong Kong	Ren (1994)	yes
Seto Inland Sea, Japan	Nagata (1965)	no
French Polynesia	Chevreux (1907, 1908)	yes

Indian Ocean (excluding the Red Sea), *S. gallensis* has been reported from at least 11 different localities but only three of these records can be confirmed. Only one of the three records from the Red Sea is illustrated (Monod, 1937), but not well enough for identification. *Stenothoe gallensis* has been reported at least eight times from the Atlantic Ocean, in refereed journals, but also on government websites recording invasive species along the east coast of the United States; in only four cases are the records illustrated (Chevreux & Fage, 1925; Shoemaker, 1935; Reid, 1951; Lincoln, 1979). In the Pacific Ocean there are four records from disparate localities (Chevreux, 1907, 1908; Nagata, 1965; Ren, 1994). Ren's (1994) record from Hong Kong is well documented and illustrated but only record from Japan (Nagata, 1965) is not illustrated with no chance of confirmation. Amazingly, this small tropical amphipod has been reported from all oceans except the Arctic Sea and the Southern Ocean. This paper increases the number of stenothoids from Southeast Asia and neighbouring regions (Azman *et al.*, 2022; Marin & Sinelnikov, 2018) from four to five, all being attributed to the genus *Stenothoe*. It also demonstrates the diversity of stenothoid amphipods in this region may be much greater than previously assumed.

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New Species of *Cerapus* from Australian Waters (Amphipoda: Senticaudata: Ischyroceridae)

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ABSTRACT. Five new species of tube building amphipods in the genus *Cerapus* are described from Australian waters: *Cerapus brevirostris* sp. nov., *C. chiltoni* sp. nov., *C. dildilgang* sp. nov., *C. lowryi* sp. nov. and *C. moonamoona* sp. nov. All five new species build tubes from sediment or sediment and detritus. These bring the number of species of *Cerapus* in Australian waters to ten. A key to Australian species is provided.

Introduction

This work represents a continuation of the study of the Cerapodini by J. K. Lowry and P. B. Berents. Jim Lowry's first work on the Cerapodini was to describe three new species of *Cerapus* from New Zealand (Lowry, 1981), which are now attributed to the genus *Notopoma* (Lowry & Berents, 1996). The status of the type species of the genus, *Cerapus tubularis* Say, 1817, was clarified by Lowry & Berents (1989) and the genus is now represented worldwide by 24 species (Table 1).

Five species of *Cerapus* are known in Australian waters from the northern Great Barrier Reef, south around the Australian continent to Ningaloo Reef, Western Australia, from intertidal to depths of 165 m on the continental shelf (Table 1). Five new species of Australian *Cerapus* are described herein bringing the total number of species in Australian waters to ten.

Materials and methods

The species descriptions were generated from a DELTA database (Dallwitz, 2010) to the species of Cerapodini of the world and subsequently edited to improve the language. Characters in **bolded** text are diagnostic. Material is lodged in the Australian Museum, Sydney (AM), Museums Victoria, Melbourne (MV) and the South Australian Museum, Adelaide (SAM). The following abbreviations are used in the figures: **A**, antenna; **G**, gnathopod; **P**, pereopod; **PL**, pleopod; **U**, uropod; **UR**, urosome; **l**, left; **r**, right. The terminology for cuticular structures follows Watling (1989).

Locality data presented in *Material examined* includes museum station data codes (e.g., MI WA-480, SWA-56, MI NSW 3369, K80-20-11).

Keywords: Crustacea, Amphipoda, Ischyroceridae, Cerapodini, *Cerapus*, Australia, new species, taxonomy, tube building
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Table 1. Checklist and distribution of *Cerapus* Say, 1817.

taxon	distribution
Cerapus alquirta (Barnard & Drummond, 1981)	Australia: Victoria
Cerapus benthophilus Thomas & Heard, 1979	Gulf of Mexico
Cerapus brevirostris sp. nov.	Australia: South Australia; Western Australia
Cerapus bumbumiensis Nurshazwan, Ahmad-Zaki & Azman, 2020	Malaysia: Sabah
Cerapus bundegi Lowry & Berents, 2005	Australia: Western Australia
Cerapus calamicola (Giles, 1885)	India: Bay of Bengal
Cerapus chaomai Lowry & Berents, 2002	Thailand: Trang
Cerapus chiltoni sp. nov.	Australia: New South Wales
Cerapus cudjoe Lowry & Thomas, 1991	USA: Florida
Cerapus dildilgang sp. nov.	Australia: New South Wales
Cerapus erae Bulycheva, 1952	Japan: Russia
Cerapus jonsoni Valério-Berardo, Souza & Rodrigues, 2008	Brazil: Santos Continental Shelf
Cerapus longicervicum Lim, Park & Min, 2008	Korea
Cerapus longirostris Shen, 1936	China: Shantung Peninsula; Japan: Uematsu
Cerapus lowryi sp. nov.	Australia: New South Wales; Bass Strait.
Cerapus maculanigra Zeina & Asakura, 2017	Red Sea
Cerapus micronesicus Myers, 1995	Micronesia: Kosrae
Cerapus moonamoona sp. nov.	Australia: New South Wales
Cerapus murrayae Lowry & Berents, 2005	Australia: New South Wales
Cerapus nudus Just, 2009	Australia: Great Barrier Reef
Cerapus oceanicus Lowry, 1985	Western Samoa: Upolu
Cerapus orteai Ortiz & Thomas, 2007	Costa Rica
Cerapus pacificus Lowry, 1985	Fiji: Viti Levu
Cerapus ryanadamsi Drumm, 2018	USA: Gulf of Mexico
Cerapus slayeri Drumm, 2018	USA: northwest Atlantic
Cerapus thomasi Ortiz & Lemaitre, 1997	Colombia: Gulf of Morrosquillo
Cerapus tubularis Say, 1817	USA: northeast coast
Cerapus volucola Lowry & Berents, 2005	Australia: Queensland; Papua New Guinea: Madang Lagoon
Cerapus yuyatalay Lowry & Berents, 2002	Thailand, Sikao district

Key to Australian species of *Cerapus* (male)

1 Recurved spines on telson in 2 rows 2
—— Recurved spines on telson in 3 rows .... *Cerapus nudus* Just, 2009

2 Antenna 2 longer than antenna 1 3
—— Antenna 2 equal to or shorter than antenna 1 4

3 Coxa 6 with setal fringe .... *Cerapus moonamoona* sp. nov.
—— Coxa 6 lacking setal fringe .... *Cerapus alquirta* (Barnard & Drummond, 1981)

4 Pereopods 6–7 dactylus with 2 accessory hooks 5
—— Pereopods 6–7 dactylus with 1 accessory hook 7

5 Rostrum short .... *Cerapus murrayae* Lowry & Berents, 2005
—— Rostrum long 6

6 Pereopods 3–4 coxa fused to pereonites .... *Cerapus volucola* Lowry & Berents, 2005
—— Pereopods 3–4 coxa not fused to pereonites .... *Cerapus bundegi* Lowry & Berents, 2005

7 Antenna 1 very long relative to body length (> 0.9 times body length) .... *Cerapus brevirostris* sp. nov.
—— Antenna 1 less than 0.9 times body length 8

8 Gnathopod 2, carpus palm straight .... *Cerapus dildilgang* sp. nov.
—— Gnathopod 2, carpus palm deeply excavate 9

9 Pereopod 7 basis with patch of small setae on posterior margin .... *Cerapus lowryi* sp. nov.
—— Pereopod 7 basis without patch of small setae on posterior margin .... *Cerapus chiltoni* sp. nov.

Systematic Account

Suborder Senticaudata Lowry & Myers, 2013

Infraorder Corophiida Leach, 1814

Parvorder Caprellidira Leach, 1814

Superfamily Photoidea Boeck, 1871

Family Ischyroceridae Stebbing, 1899

Subfamily Ischyrocerinae Stebbing, 1899

Tribe Cerapodini Smith, 1880

Genus *Cerapus* Say, 1817

Type species: *Cerapus tubularis* Say, 1817.

Cerapus brevirostris sp. nov.

urn:lsid:zoobank.org:act:CFB4B46E-D166-46BD-A2A4-FA5FE218D2C7

Figs 1–3

Holotype: Male, 2.4 mm, AM P.106325, Penneshaw, Kangaroo Island, South Australia, Australia, 35°43'S 137°56'E, in *Caulerpa* sp. on jetty piles, 5 m, I. Loch, 9 March 1978. **Paratypes**: 1 female, ovigerous, 2.7 mm, AM P.106326; 1 female, ovigerous, 2.5mm, AM P.106327; all with same data as holotype. 1 male, 2.8 mm, AM P.106328; 14 specimens, AM P.106329; 1 male, 2.2 mm, AM P.106330; Stokes Bay, Kangaroo Island, South Australia, Australia, 35°37'S 137°12'E, algae on vertical rock face, 7 m, I. Loch, 4 March 1978. 6 specimens, SAM C14774, Sellicks Beach, South Australia, Australia, 35°20'06"S 138°26'44"E, K. Sheard & H. M. Hale, 16 January 1937; 10 specimens, MV J.13186, north of False Island, King George Sound, Western Australia, Australia, 35°00.702'S 118°10.08'E, 27 m, scuba, SWA-57 G. C. Poore & H. M. Lew Ton, 15 April 1984.

Additional material examined. 2 specimens, SAM C14775, Sellicks Beach, South Australia, Australia, 35°20'06"S 138°26'44"E, dead low tide, outer edge, K. Sheard, April 1939; 43 specimens, MV J.13190, north of False Island, King George Sound, Western Australia, Australia, 35°01.002'S 117°25.02'E, scuba, 25 m, SWA-56, G. C. B. Poore & H. M. Lew Ton, 15 April 1984; 2 specimens, MV J.13187, south side off Eden Road, Wilson Inlet, Western Australia, Australia, 35°00.702'S 1188°10.08'E, by hand, 0.1 m, SWA-58, G. C. B. Poore & H. M. Lew Ton, 16 April 1984; 5 specimens, AM P.106331, Ningaloo Reef, Western Australia, 21°55'41"S 113°55'11"E, brown algae on rocks under jetty, 13 m, MI WA 979, N. L. Bruce & M. Blazewicz-Paszkowycz, 17 June 2008; 1 male, 6 females, several juveniles, AM P.106332, same data as holotype; 7 specimens, AM P.106333, Red Bluff, Kalbarri, Western Australia, Australia, 27°42'S 114°09'E, rocky shore, mixed coralline algae, 3–4 m, MI WA-480, R. T. Springthorpe, 10 January 1984; 1 female, ovigerous, 2 juveniles, AM P.106334, 500 m off Chinamans Rock, Kalbarri, Western Australia, Australia, 27°42'S 114°09'E, rocky bottom, brown algae with epiphytic coralline algae, 6 m, MI WA-462, J. K. Lowry, 10 January 1984; 1 male, 6 females, AM P.106335, 500 m off

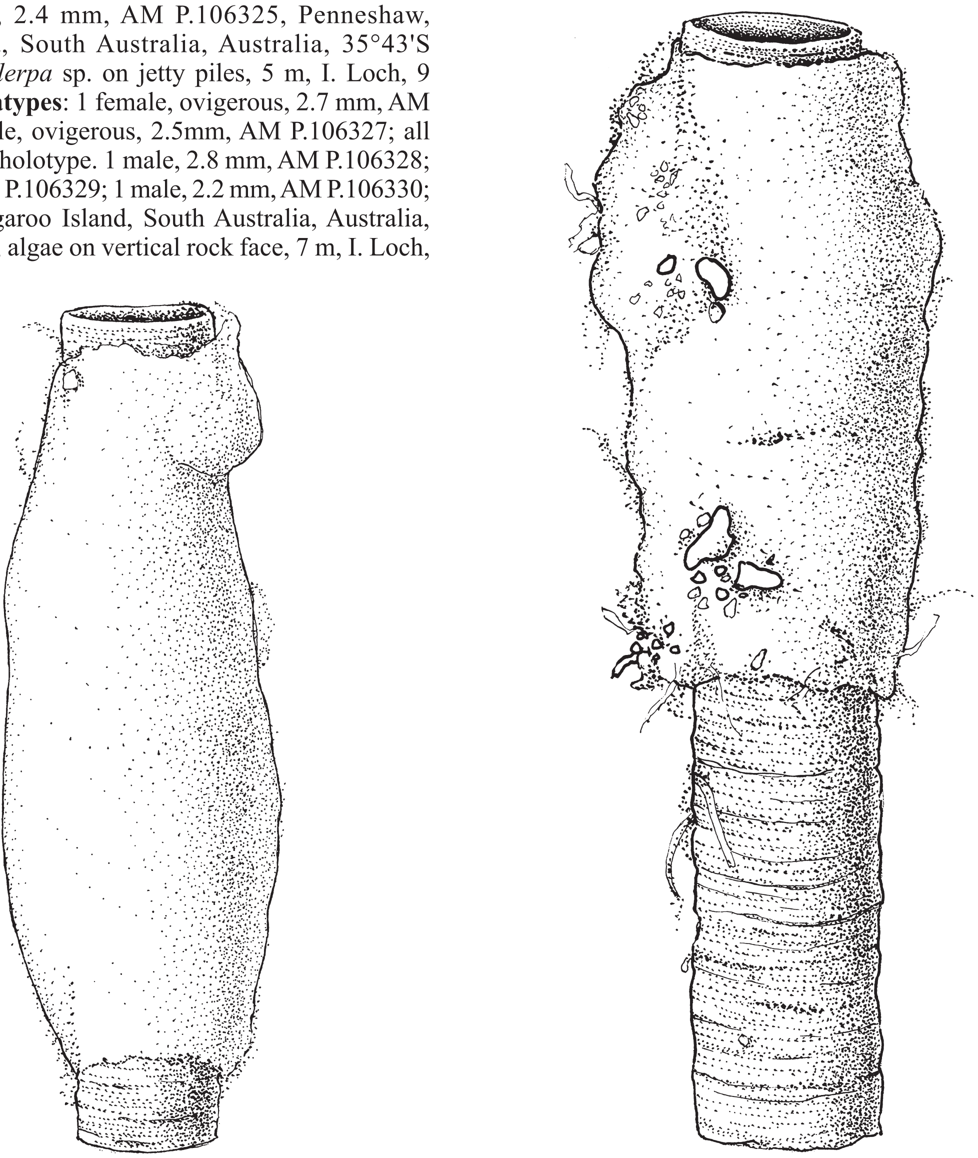

Figure1. *Cerapus brevirostris* sp. nov., tubes from paratypes, AM P.106329, Penneshaw, Kangaroo Island, South Australia, Australia, length of tubes 2–3 mm.

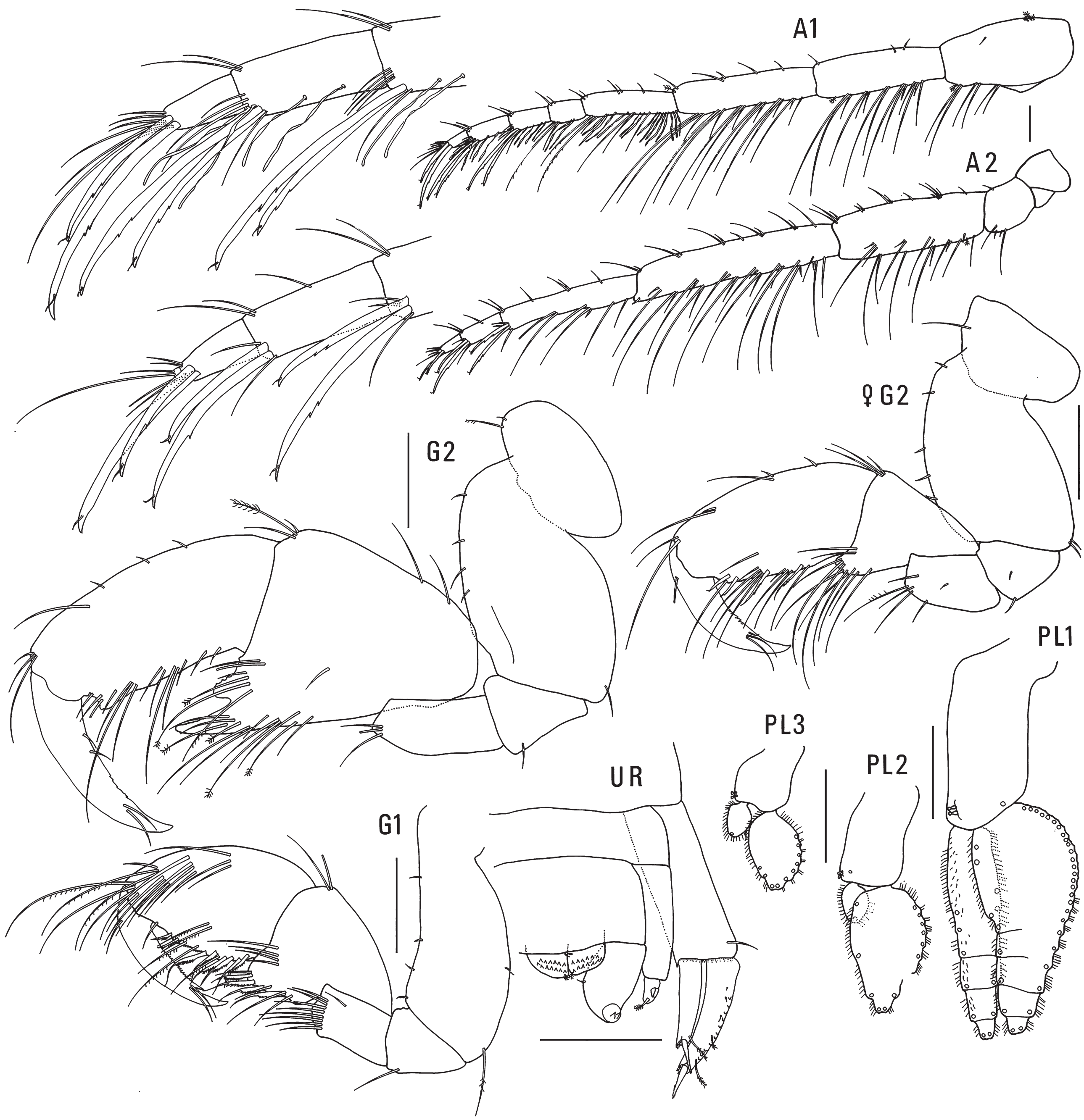

Figure 2. *Cerapus brevirostris* sp. nov.: holotype, male, 2.4 mm, AM P.106325; paratype, female, 2.7 mm, AM P.106326; Penneshaw, Kangaroo Island, South Australia. Pleopods 1–3 insertion points of setae are indicated by small circles. Scale 0.1 mm.

Chinaman's Rock, Kalbarri, Western Australia, Australia, 27°42'S 114°09'E, brown alga *Padina* sp., 6 m, MI WA-465, J. K. Lowry, 10 January 1984; 1 specimen, AM P.106336, 500 m off Chinamans Rock, Kalbarri, Western Australia, Australia, 27°42'S 114°09'E, 6 m, MI WA-460, R. T. Springthorpe, 10 January 1984; 2 females, AM P.106337, Stokes Bay, Kangaroo Island, South Australia, Australia, 35°37'S 137°12'E, 7 m, I. Loch, 4 March 1978; 1 specimen, AM P.106338, 500 m off Chinaman's Rock, Kalbarri, Western Australia, Australia, 27°42'S 114°09'E, rocky bottom, brown and coralline algae, 6 m, MI WA-459, J. K. Lowry, 10 January 1984; 20 specimens, AM P.106339, Thompsons Bay, Rottnest Island, Western Australia, Australia, 32°00'S 115°32'30"E, airlift sample from *Posidonia* sp., 3 m, MI WA-221, J. K. Lowry & R. T. Springthorpe, 20 December 1983; 3 specimens, MV J.75812, The Hotspot Reef, 9.3 km west of north end of Flinders Island, South Australia, Australia, 33°40'48"S 134°22'30"E, scuba, 21 m, SA 70, G. C. B. Poore, 20 April 1985; 1 specimen, MV J.75813, The Hotspot Reef, 9.3 km west of north end of Flinders Island, South Australia, Australia, 33°40'30"S 134°22'1"E, scuba, 17 m, SA 62, G. C. B. Poore, 19 April 1985; 1 male, AM P.106340, reef west of groyne, 2 km south of Cape Peron, Western Australia, Australia, 32°16'S 115°41'E, deep channels in limestone reef, sand from pocket in reef, 6 m, MI WA-292, J. K. Lowry, 26 December 1983; 1 male, 3 juveniles, MV J.75814, north-east side of Topgallant Island, Investigator Group, South Australia, Australia, 33°43'0"S 134°36'36"E, scuba, 12 m, SA 83, S. Shepherd & G. C. B. Poore, 22 April 1985; 1 female, ovigerous, 4 juveniles, MV J.75815, The Hotspot Reef, 9.3 km west of north end of Flinders Island, South Australia, Australia, 33°40'30"S 134°22'1"E, scuba, 7 m, SA 64, S. Shepherd, 19 April 1985.

Type locality. Penneshaw, Kangaroo Island, South Australia, Australia, 35°43'S 137°56'E.

Etymology. Named for the short rostrum of this species. Used as a noun in apposition.

Description. **Male** (based on holotype, 2.4 mm, AM P.106325).

Figure 3. *Cerapus brevirostris* sp. nov.: holotype, male, 2.4 mm, AM P.106325; paratype, female, 2.7 mm, AM P.106326; Penneshaw, Kangaroo Island, South Australia. Scale 0.1 mm.

Head. **Rostrum short, length 0.2 × head**, evenly tapered, apically subacute; lateral cephalic lobe with ventral corner acute, subocular margin weakly recessed, not reaching beyond eye, anteroventral corner subquadrate, ventral margin horizontal, posterior margin vertical.

***Antenna 1* very long, length 0.9 × body length**; peduncle without scales; peduncular article 1 subequal to article 3, length 0.9 × peduncular article 3, swollen along posterior margin, posterodistal corner not produced; peduncular article 2 anterodistal corner without distal projection; flagellum 5-articulate; article 1 long. ***Antenna 2* length equal to antenna 1;** flagellum 3-articulate.

Pereon. *Pereonite 1* without lateral keel or sternal keel. *Pereonites 2–3* without sternal keel.

Gnathopod 1 coxa not fused to pereonite 1, length 0.9 × depth, without anteroventral lobe; basis length twice depth; carpus broad, length 1.2 × depth with setose posterior lobe; propodus palm extremely acute, with barbed robust setae. *Gnathopod 2* carpochelate; coxa not fused to pereonite 2, length 1.9 × depth, **without anteroventral lobe or**

cusp; basis short, broad, length 1.5 × breadth, without anteroproximal group of long slender setae; carpus short, length 1.3 × breadth, broad, posterior margin without teeth, **palm shallowly excavate**, anterodistal tooth large, located distal to articulation with propodus, posterodistal tooth well defined, medium length, length 1.4 × width; propodus very broad, slightly curved, length 2.3 × width, **with small tooth on posterior margin**, posterodistal corner smooth; dactylus, length 0.7 × propodus.

Pereopod 3 coxa without anteroventral lobe, not fused to pereonite 3, length 1.9 × depth; basis length 1.7 × breadth, with proximal, subquadrate anterodorsal corner, with plumose setal group along anterior margin, without denticles along anterior margin; ischium short, length 1.2 × breadth; merus length 1.2 × breadth; short, without ridges. *Pereopod 4* coxa not fused to pereonite 4, with anterior lobe separated from an anteroventral lobe; basis length 1.4 × breadth, without setal group along anterior margin; ischium long, length twice breadth; merus long, length 1.8 × breadth. *Pereopod 5* coxa length 1.7 × depth, without patches of small setae, with 1 seta along ventral margin; merus with anterior lobe extending beyond anterior margin of carpus, posterior lobe with 2 plumose setae; propodus with 1 seta along posterior margin; dactylus short, uncinate with 1 accessory hook. ***Pereopod 6* coxa without setal fringe ventrally,** without patches of small setae near margins; basis without patch of small setae near anterior margin; merus, length 1.6 × breadth; dactylus short, uncinate, with 1 accessory hook. *Pereopod 7* merus length 1.3 × breadth; dactylus short, uncinate, with 1 accessory hook.

Pleon. *Pleopods 1–3* biramous, decreasing in size. *Pleopod 1* inner ramus 4-articulate; outer ramus 3-articulate, article 1 with straight medial margin; *Pleopod 2* inner ramus reduced, 1-articulate; outer ramus, broad, 1-articulate. *Pleopod 3* inner ramus reduced, 1-articulate; outer ramus broad, 1-articulate. *Uropod 1* biramous; peduncle length 1.4 × outer ramus; rami with distoventral fan of robust setae; outer ramus with lateral row of denticles, without medial setae, with 4 lateral setae, with large apical robust seta, without smaller slender setae; inner ramus, length 0.8 × outer ramus, without medial and lateral setae, with large apical robust seta. *Uropod 2* uniramous, peduncle, length 3.5 × breadth, 4.2 × length of ramus; ramus small with 2 denticles and 1 slender apical seta. *Uropod 3* uniramous, peduncle length 1.5 × breadth; ramus with 2 curved hooks. *Telson* broader than long, length 0.4 × breadth, cleft to base, **each lobe with 13 anteriorly directed recurved spines in 2 rows**.

Female (sexually dimorphic characters). Based on paratype female, 2.7 mm, AM P.106326. *Antenna 1* peduncle without scales; flagellum 4-articulate. *Antenna 2* flagellum 4-articulate. *Pereonite 1* without lateral keel. *Pereonite 2–3* without sternal keel. *Gnathopod 1* coxa, length equalling depth; basis length 2.3 × depth; carpus length 0.9 × depth with setose posterior lobe. *Gnathopod 2* subchelate; coxa length 1.7 × depth; basis, length 1.4 × depth, without medial line of setae; palm extremely acute. *Pereopod 5* coxa length 1.4 × depth. *Oostegites* from gnathopod 2 to pereopod 5.

Tube. Smooth tube of mud and fine particles with light and dark stripes, often covered by clay-coloured sponge or pale ascidian; may be swollen in the middle; tubes often bound together by the ascidian or the sponge.

Habitat. Marine, 0.1–27 m.

Remarks. *Cerapus brevirostris* sp. nov. and *C. alquirta* are the only Australian species lacking a setal fringe on coxa 6 and with a 4-articulate outer ramus on pleopod 1. *Cerapus brevirostris* differs from *C. alquirta* in having antenna 1 and 2 equal in length. The outer ramus of pleopod 1 in *C. brevirostris* has a straight medial margin whereas all other Australian species have the margin evenly swollen. *Cerapus brevirostris* is the only Australian species with a tooth on the posterior margin of the propodus of male gnathopod 2 and with antenna 1 very long relative to body length (0.9 × body length).

Distribution. Sellicks Beach and Kangaroo Island, South Australia to Ningaloo Reef, Western Australia.

Cerapus chiltoni sp. nov.

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Figs 4–8

Cerapus flindersi.—Chilton, 1892: 1–6, pl. 1.

Holotype: Male, 4.1 mm, AM P.106341, Port Jackson, New South Wales, Australia, 33°51'S 151°16'E, R. Helms, pre-1892. **Paratypes**: Female, 3.3 mm, AM P.106345; male, 4.1 mm, AM P.106343; male 2.8 mm, AM P.106344; male, 5.5 mm, AM P.106342; male, 3.3 mm, AM P.106345; data as for holotype. Male, 4.6 mm, AM P.27296, Fly Point, Port Stephens, New South Wales, Australia, 32°43'S 152°9'E, on orange hydroid, 20 m, N. Coleman, 27 November 1977.

Additional material examined. 5 specimens, AM P.106355, north-west end of South Solitary Island, New South Wales, Australia, 30°12'07"S 153°15'59"E, coral rubble, hand collected on scuba, 14.5 m, NSW 2813, K. B. Atwood, 1 May 2005; >1000 specimens, AM P.106354, Port Jackson, New South Wales, Australia, 33°51'S 151°16'E, K. Sheard.

Type locality. Port Jackson, New South Wales, Australia, 33°51'S 151°16'E.

Etymology. Named for Professor Charles Chilton who first examined Australian Museum specimens of this species from Port Jackson and attributed them to *Cerapus flindersi* Stebbing, 1888.

Description. **Male** (based on holotype, 4.1 mm, AM P.106341).

Head. **Rostrum short, length 0.1 × head**, evenly tapered, apically subacute; lateral cephalic lobe with ventral corner rounded, subocular margin deeply recessed, reaching beyond eye, anteroventral corner subquadrate, ventral margin horizontal, posterior margin vertical. ***Antenna 1* long, length 0.6 × body length**; peduncle without scales; peduncular article 1 shorter than article 3, length 0.8 × peduncular article 3, not produced anterodistally and anteromedially, slightly swollen along posterior margin, posterodistal corner not produced; peduncular article 2 anterodistal corner without distal projection; flagellum 7-articulate; article 1 long. ***Antenna 2* length equal to antenna 1**; flagellum 9-articulate.

Pereon. *Pereonite 1* with lateral keel, without sternal keel. *Pereonite 2* with sternal keel. *Pereonite 3* without sternal keel. *Pereonite 5* length 1.9 × depth.

Gnathopod 1 coxa not fused to pereonite 1, length 1.5 × depth, without anteroventral lobe; basis length 2.2 × depth;

carpus broad, length 1.6 × depth with setose posterior lobe; propodus palm extremely acute, robust setae absent. *Gnathopod 2* carpochelate; coxa not fused to pereonite 2, length 1.9 × depth, **with strongly produced anteroventral lobe** or cusp; basis short, broad, length twice breadth, without anteroproximal group of long slender setae; carpus very long, length 1.9 × breadth, slender, posterior margin without teeth**, palm deeply excavate**, anterodistal tooth extremely produced, located near articulation with propodus, posterodistal tooth well defined, long, length 2.2 × width; propodus slender, strongly curved, length 5.3 × width, **without tooth on posterior margin**, posterodistal corner smooth, without teeth; dactylus, length 0.5 × propodus.

Pereopod 3 coxa with narrow anteroventral lobe, not fused to pereonite 3, length 1.7 × depth; basis, length 1.6 × breadth, with proximal rounded anterodorsal corner, with simple setae along anterior margin, without denticles along anterior margin; ischium long, length 1.6 × breadth; merus length 1.2 × breadth; short; without ridges. *Pereopod 4* coxa not fused to pereonite 4, with anterior lobe separated from an anteroventral lobe; basis length 1.5 × breadth, with simple setal group midway along anterior margin; ischium long, length 2.3 × breadth; merus long, length 1.3 × breadth. *Pereopod 5* coxa length 1.8 × depth, without patches of small setae, with setae along ventral margin few or absent; merus with anterior lobe not extending beyond anterior margin of carpus, posterior lobe with 1 plumose seta; propodus with 1 seta along posterior margin; dactylus short, uncinate with 1 accessory hook. ***Pereopod 6* coxa with setal fringe ventrally**, without patches of small setae near margins; basis without patch of small setae near anterior margin; merus, length 1.9 × breadth; dactylus short, uncinate, with 1 accessory hook. *Pereopod 7* coxa without posterodorsal lobe; merus length 2.3 × breadth; dactylus short, uncinate, with 1 accessory hook.

Pleon. *Pleopods 1–3* biramous, decreasing in size. *Pleopod 1* inner ramus 7-articulate; outer ramus 3-articulate article 1 evenly swollen. *Pleopod 2* inner ramus reduced, 1-articulate; outer ramus, broad, 1-articulate. *Pleopod 3* inner ramus reduced, 1-articulate; outer ramus broad, 1-articulate. *Uropod 1* biramous; peduncle, length 1.3 × outer ramus; rami with distoventral fan of robust setae; outer ramus with lateral row of denticles, without medial setae, with 3 lateral setae, with large apical robust seta, without smaller slender setae; inner ramus, length 0.6 × outer ramus, without medial and 1 lateral seta, with large apical robust seta. *Uropod 2* uniramous, peduncle, length 2.1× breadth, 5 × length of ramus; ramus small with 2 denticles and 1 slender apical seta. *Uropod 3* uniramous, peduncle length 1.7 × breadth; ramus with 2 curved hooks. *Telson* as broad as long, length 1.0 × breadth, cleft to base, **each lobe with 7–8 anteriorly directed recurved spines in 2 rows**.

Female (sexually dimorphic characters). Based on paratype female, 3.3 mm, AM P.106345. *Antenna 1* peduncle without scales; flagellum 7-articulate. *Antenna 2* flagellum 9-articulate. *Pereonite 1* without lateral keel. *Pereonites 2–3* without sternal keel. *Pereonite 5* length 1.9 × depth. *Gnathopod 1,* coxa length 1.2 × depth; basis length 1.5 × depth; carpus, length equal to depth with setose posterior lobe. *Gnathopod 2* subchelate; coxa length 2.7 × depth; basis length 1.7 × depth without medial line of setae; palm extremely acute. *Pereopod 5* coxa, length 1.9 × depth. *Oostegites* from gnathopod 2 to pereopod 5.

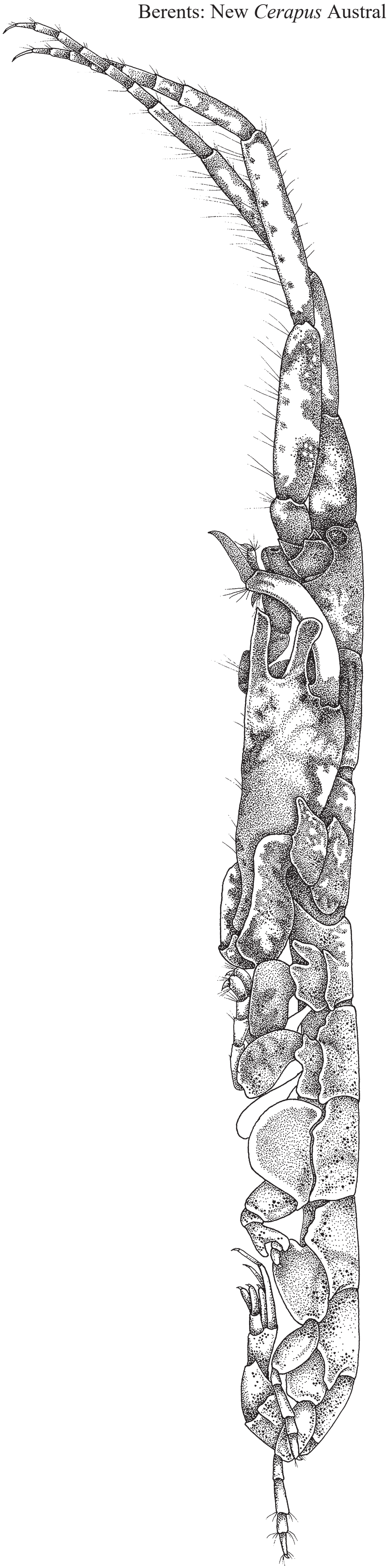

Figure 4. *Cerapus chiltoni* sp. nov., male, 4.2 mm, AM P.106351, Port Jackson, New South Wales, Australia.

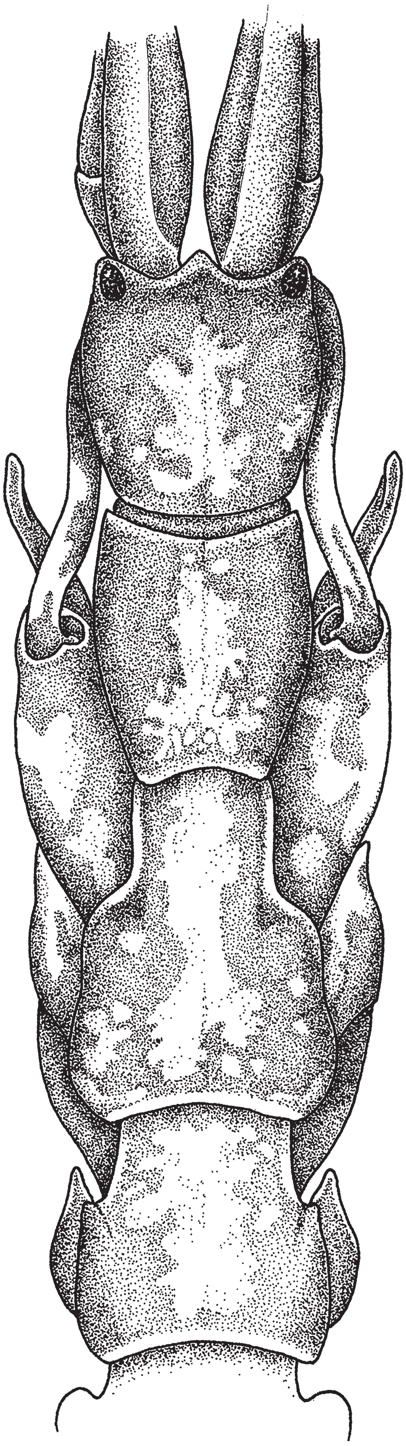

Figure 5. *Cerapus chiltoni* sp. nov., male, 4.2 mm, dorsal view of head and pereonites 1–3, AM P.106351, Port Jackson, New South Wales, Australia.

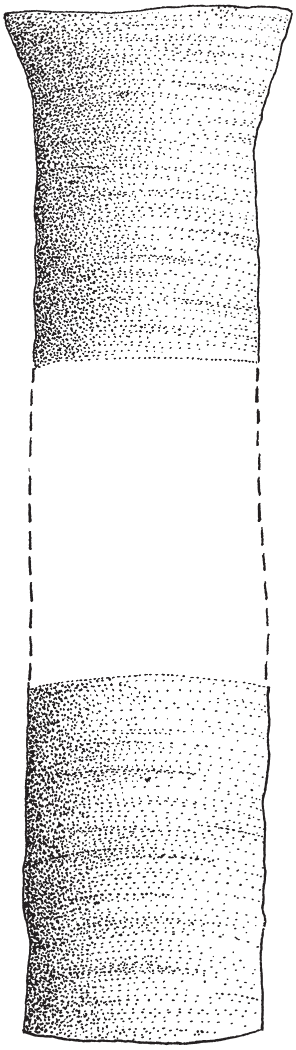

Figure 6. *Cerapus chiltoni* sp. nov., tube, AM P.106351, Port Jackson, New South Wales, Australia, length of tube 6 mm.

Tube. Composed of fine-grained grey sediment, flared at one end.

Habitat. Marine, 14.5–20 m depth.

Remarks. The Port Jackson material of *C. chiltoni* sp. nov. was collected by Richard Helms and deposited in the collections of the Australian Museum. Helms was a collector for the Australian Museum from 1888 but the precise locality and date of these collections is unknown. Specimens collected by Helms were sent to Professor Charles Chilton who published a description of amphipod specimens that were collected in Port Jackson (Chilton, 1892). Chilton illustrated and described the specimens, attributing the material to *Cerapus flindersi* Stebbing, 1888. Specimens in ethanol and seven microscope slides prepared by Chilton are held in the Australian Museum collections (4 slides of parts of large male, 1 slide of parts of smaller male, 2 slides of whole females) and are considered to be the slides used for the description and illustrations by Chilton (1892). Labels on the slides confirm that the Chilton's material was collected by Helms.

Berents & Lowry (2018) assigned *Cerapus flindersi* Stebbing, 1888 to the new genus *Kapalana* and considered Chilton's specimens to be an undescribed species of *Cerapus*. The material examined by Chilton is attributed to the new species described herein as *Cerapus chiltoni*.

The shape of the male gnathopod 2 changes with body size. The carpus and the propodus become more elongate as the male grows. The length to breadth ratio of the carpus changes from 1.3:1 in small males (up to 3.3 mm) to 1.9:1 in large

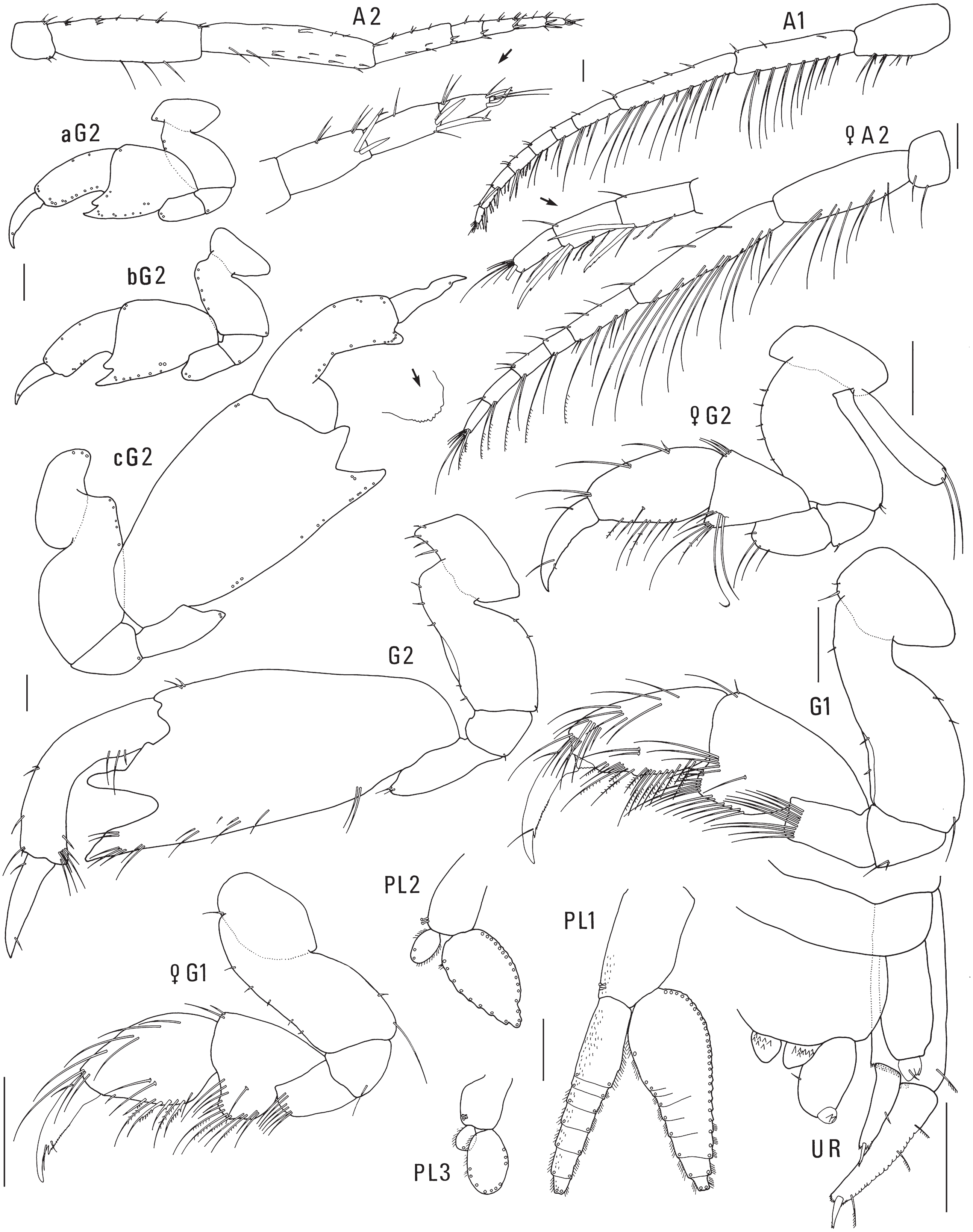

Figure 7. *Cerapus chiltoni* sp. nov.: holotype, male, 4.2 mm, AM P.106341; paratype, male "a", 2.8 mm, AM P.106344; paratype, male "b", 3.3 mm, AM P.106346; paratype, male "c", 4.1 mm, AM P.106343; paratype, female, 3.3 mm, AM P.106345; Port Jackson, New South Wales, Australia. Pleopods 1–3 insertion points of setae are indicated by small circles. Scale 0.1 mm.

males (greater than 4.0 mm). The palm changes from shallowly excavate in males less than 3.0 mm to deeply excavate in males larger than 4.0 mm. The posterodistal tooth becomes more elongate and chisel-like in large males (> 4.0 mm). The chisel-like posterodistal tooth is unique to *C. chiltoni.*

Distribution. New South Wales: Port Jackson to South Solitary Island.

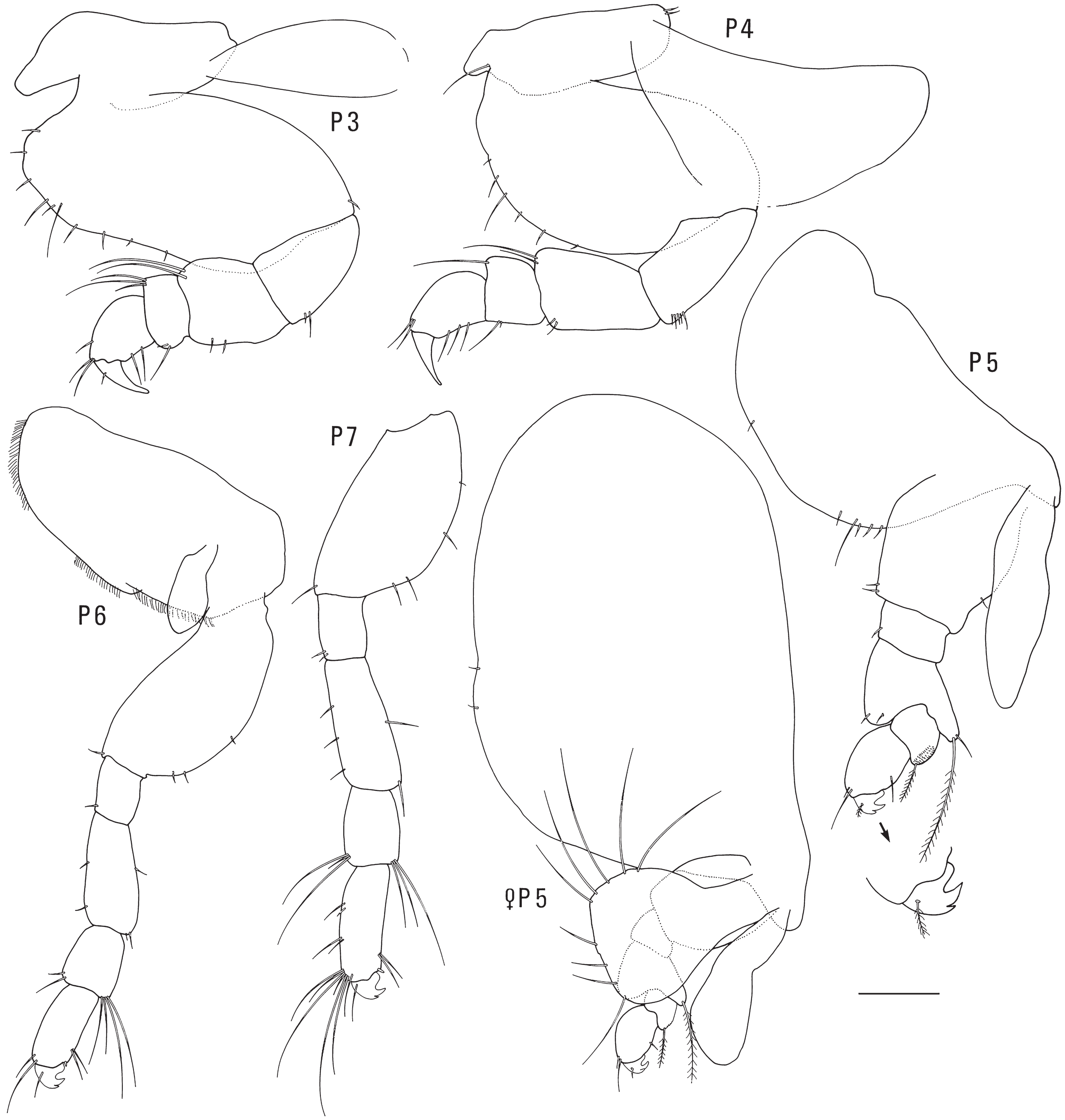

Figure 8. *Cerapus chiltoni* sp. nov.: holotype, male, 4.2 mm, AM P.106341; paratype, female, 3.3 mm, AM P.106345; Port Jackson, New South Wales, Australia. Pleopods 1–3 insertion points of setae are indicated by small circles. Scale 0.1 mm.

Cerapus dildilgang sp. nov.

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Figs 9–13

Holotype: Male, 3.8 mm, AM P.26097, off Sow and Pigs Reef, Port Jackson, New South Wales, Australia, 33°50'S 151°16'E, Smith-McIntyre benthic grab, shell and sandy mud, 5 m, J. K. Lowry & A. R. Jones, 30 September 1976. **Paratypes**: 1 female, ovigerous, 3.2 mm, AM P.106356; 1 male, 3.3 mm, AM P.106357; 1 male, 2.3 mm, AM P.106358; all with same data as holotype. 6 males, 3 females, 4 juveniles, AM P.10659, Store Beach, Port Jackson, New South Wales, Australia, 33°48'48"S 151°17'12"E, sand, detritus, and fine shell fragments, *Halodule* sp. and other algae, hand dredge on scuba, 3 m, AU 59, J. Just, P. B. Berents & R. T. Springthorpe, 26 September 1984.

Additional material examined. Many specimens, AM P.106360, same data as holotype; 157 specimens, AM P.106362, 200 m south-east of Croppy Point, Hawkesbury River, New South Wales, Australia, 33°33'S 151°14'E, sandy mud, Smith-McIntyre benthic grab, 12 m, HRS 2-3-2 Feb 84, A. R. Jones & A. Murray, 9 February 1984; many specimens, AM P.106361, just beyond beach flats, off Bagnalls Beach, Port Stephens, New South Wales, Australia, 32°43'17"S 152°7'17"E, 3 m, benthic sled, W. F. Ponder & J. Hall, 25 October 1980; 5 specimens, AM P.106363, Store Beach, Port Jackson, New South Wales, Australia, 33°48'48"S 151°17'12"E, sand, detritus, and fine shell fragments, *Halodule* sp. and other algae, hand dredge on scuba, 3 m, AU 59, J. Just, P. B. Berents & R. T. Springthorpe, 26 September 1984; 5 specimens, AM P.106364, Quarantine Beach, Port Jackson, New South Wales, Australia, 33°49'S 151°17'E, hand dredge on scuba, 2 m, J. Just, P. B. Berents & P. M. Berents, 1 March 1986; 2 males & 1 female, ovigerous, AM P.73726, Outer Latitude Rock, Forster, New South Wales, Australia, 32°12'39"S 152°34'06"E, sediment from rock face, hand collected on scuba, 16 m, NSW 2154, Australian Museum party, 18 March 2003; 1 male, AM P.106365, north of Moon Island, Swansea Heads, New South Wales, Australia, 33°05'08"S 151°40'25"E, rocky reef with barnacles, turf algae, and shelly sediment, airlift on scuba, 10 m, MI NSW 3458, R. T. Springthorpe, 5 May 2009.

Type locality. Off Sow and Pigs Reef, Port Jackson, New South Wales, Australia, 33°50'S 151°16'E.

Etymology. The species epithet means "little prawn" (prawn "dildil"; little "gang") in the language of the Dharawal people of Port Jackson. Used as a noun in apposition.

Description. **Male** (based on holotype, 3.8 mm, AM P.26097).

Head. **Rostrum short, length 0.2 × head**, evenly tapered, apically subacute; lateral cephalic lobe with ventral corner rounded, subocular margin deeply recessed, reaching beyond eye, anteroventral corner rounded, ventral margin sloping, posterior margin sloping. ***Antenna 1* long, length 0.6 × body length**; peduncle without scales; peduncular article 1 shorter than article 3, length 0.8 × peduncular article 3, not produced anterodistally and anteromedially, swollen along posterior margin, posterodistal corner not produced; peduncular article 2 anterodistal corner without distal projection; flagellum 4-articulate; article 1 long. ***Antenna 2* length equal to antenna 1**; flagellum 3-articulate.

Pereon. *Pereonite 1* with lateral keel, without sternal keel. *Pereonite 5* length 1.5 × depth.

Gnathopod 1 coxa not fused to pereonite 1, length 1.3 × depth, without anteroventral lobe; basis length twice depth; carpus broad, length 1.5 × depth with setose posterior lobe; propodus palm extremely acute, robust setae present. *Gnathopod 2* carpochelate; coxa not fused to pereonite

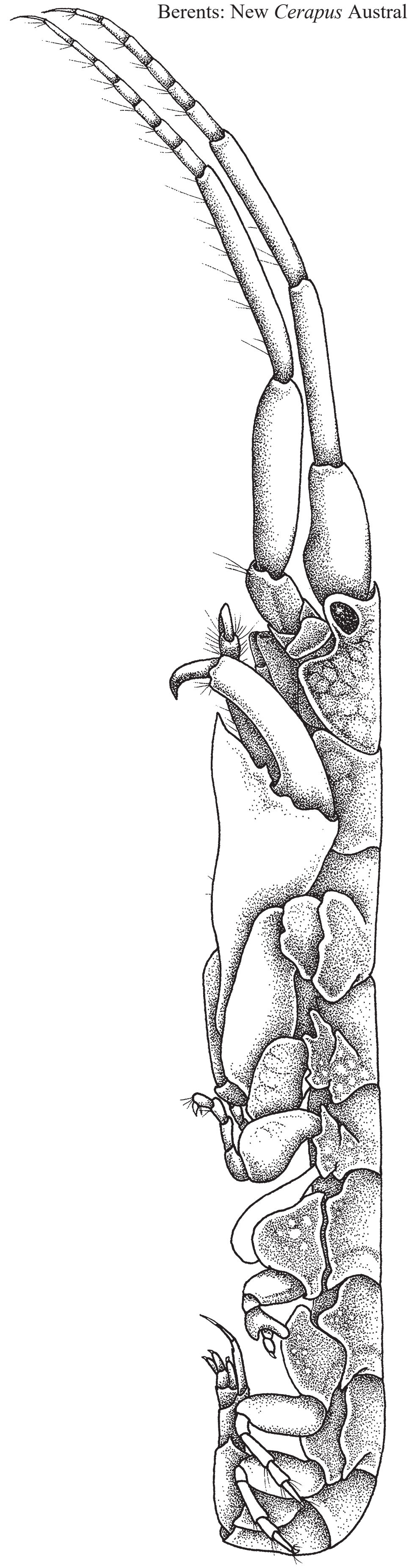

Figure 9. *Cerapus dildilgang* sp. nov., male, 3.7 mm, AM P.106360, off Sow and Pigs Reef, Port Jackson, New South Wales, Australia.

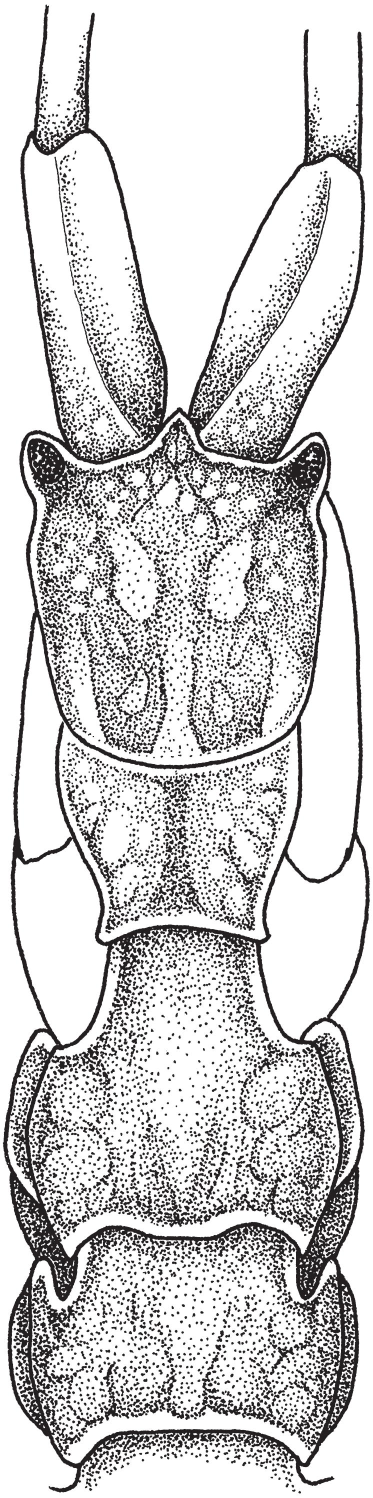

Figure 10. *Cerapus dildilgang* sp. nov., male, 3.7 mm, AM P.106360, dorsal view of head and pereonites 1–3, off Sow and Pigs Reef, Port Jackson, New South Wales, Australia.

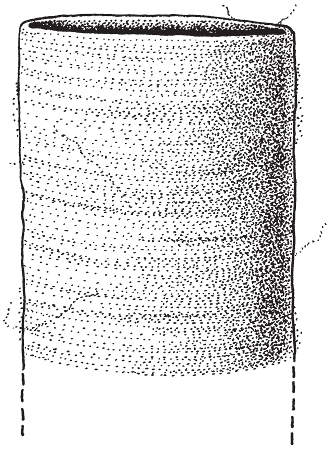

Figure 11. *Cerapus dildilgang* sp. nov., tube from AM P.106360, off Sow and Pigs Reef, Port Jackson, New South Wales, Australia, total length of tube 4 mm.

2, length twice depth, **without anteroventral lobe or cusp;** basis short, broad, length 1.7 × breadth, without anteroproximal group of long slender setae; carpus very long, length 1.9 × breadth, slender, posterior margin without teeth**, palm straight**, anterodistal tooth small, located near articulation with propodus, posterodistal tooth poorly defined; propodus slender, curved, length 4.8 × width, **without tooth on posterior margin**, posterodistal corner smooth, without teeth; dactylus length 0.5 × propodus.

Pereopod 3 coxa with narrow anteroventral lobe, not fused to pereonite 3, length 1.9 × depth; basis length 1.7 × breadth, anterior margin evenly rounded with simple setae, without denticles along anterior margin; ischium long, length 1.8 × breadth; merus length 1.1 × breadth; short; without ridges. *Pereopod 4* coxa not fused to pereonite 4, with anterior lobe separated from an anteroventral lobe; basis length 1.3 × breadth, with simple setal group midway along anterior margin; ischium long, length 2.2 × breadth; merus long, length 1.6 × breadth. *Pereopod 5* coxa length 1.5 × depth, without patches of small setae, with setae along ventral margin few or absent; merus with anterior lobe not extending beyond anterior margin of carpus, posterior lobe with 2 plumose setae; propodus with 1 seta along posterior margin; dactylus short, uncinate with 1 accessory hook. ***Pereopod 6* coxa with setal fringe** ventrally, without patches of small setae near margins; basis without patch of small setae near anterior margin; merus length 1.5 × breadth; dactylus short, uncinate, with 1 accessory hook. *Pereopod 7* coxa with posterodorsal lobe, without patch of small setae; merus length 1.4 × breadth; dactylus short, uncinate, with 1 accessory hook.

Pleon. *Pleopods 1–3* biramous, decreasing in size. *Pleopod 1* inner ramus 7-articulate; outer ramus 4-articulate, article 1 evenly swollen; *Pleopod 2* inner ramus reduced, 1-articulate; outer ramus, broad, 3-articulate. *Pleopod 3* inner ramus reduced, 1-articulate; outer ramus broad, 1-articulate. *Uropod 1* biramous; peduncle, length 1.5 × outer ramus; rami with distoventral fan of robust setae; outer ramus with lateral row of denticles, without medial setae, with 5 lateral

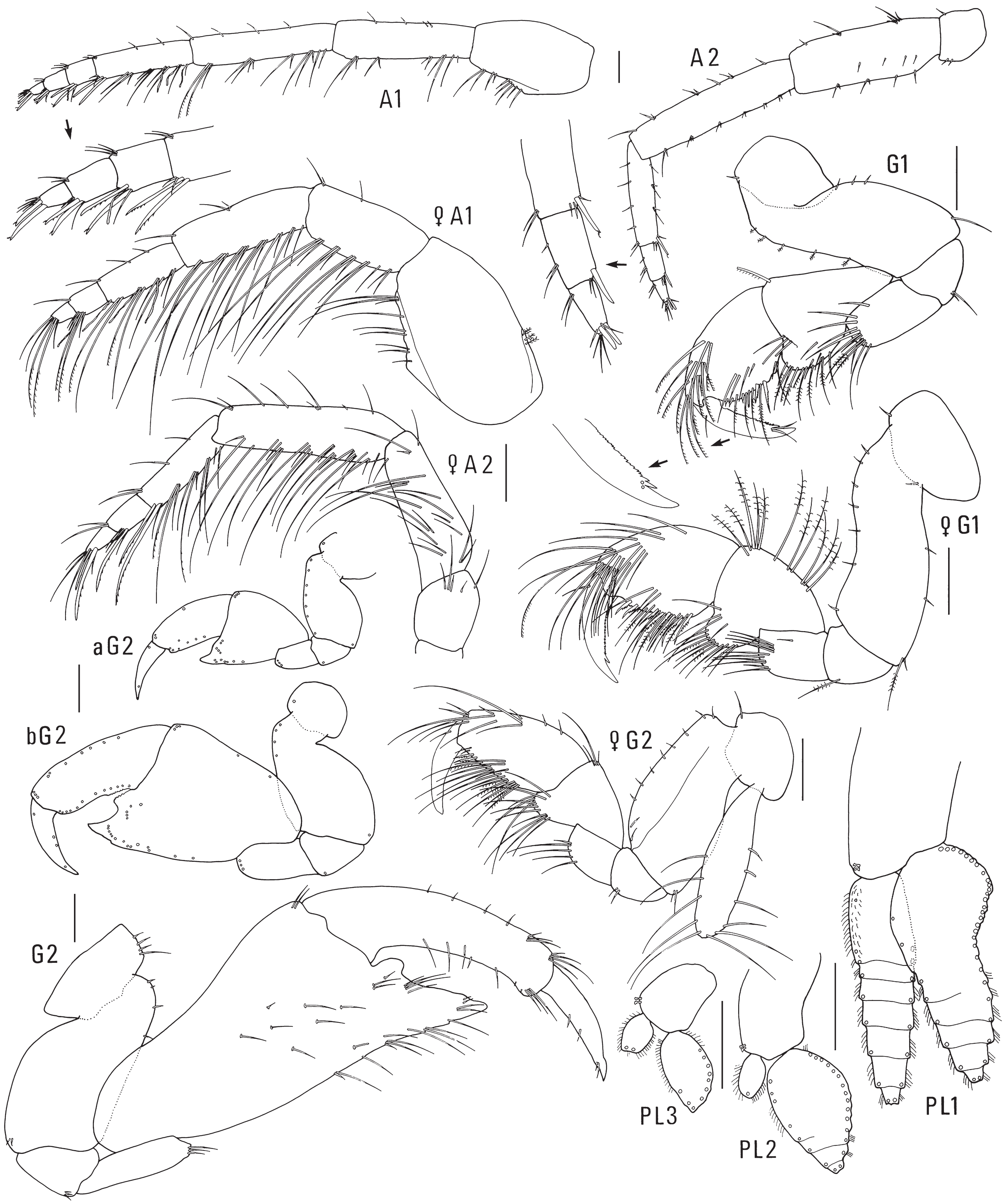

Figure 12. *Cerapus dildilgang* sp. nov., holotype, male, 3.8 mm, AM P.26097; paratype, male "a", 2.3 mm, AM P.106358; paratype, male "b", 3.3 mm, AM P.106357; paratype, female, 3.2 mm, AM P.106356; Port Jackson, New South Wales, Australia. Pleopods 1–3 insertion points of setae are indicated by small circles. Scale 0.1 mm.

setae, with large apical robust seta and smaller slender setae; inner ramus, length 0.6 × outer ramus, without medial and with 1 lateral seta, with large apical robust seta. *Uropod 2* uniramous, peduncle, length 3.6 × breadth, 5.9 × length of ramus; ramus small with 2 denticles and 1 slender apical seta. *Uropod 3* uniramous, peduncle length 1.3 × breadth; ramus with 2 curved hooks. *Telson* broader than long, length 0.4 × breadth, cleft to base, **each lobe with 12 anteriorly directed recurved spines in 2 rows**.

Female (sexually dimorphic characters). Based on paratype female, 3.1 mm, AM P.106356. *Antenna 1* peduncle without scales; flagellum 3-articulate. *Antenna 2* flagellum

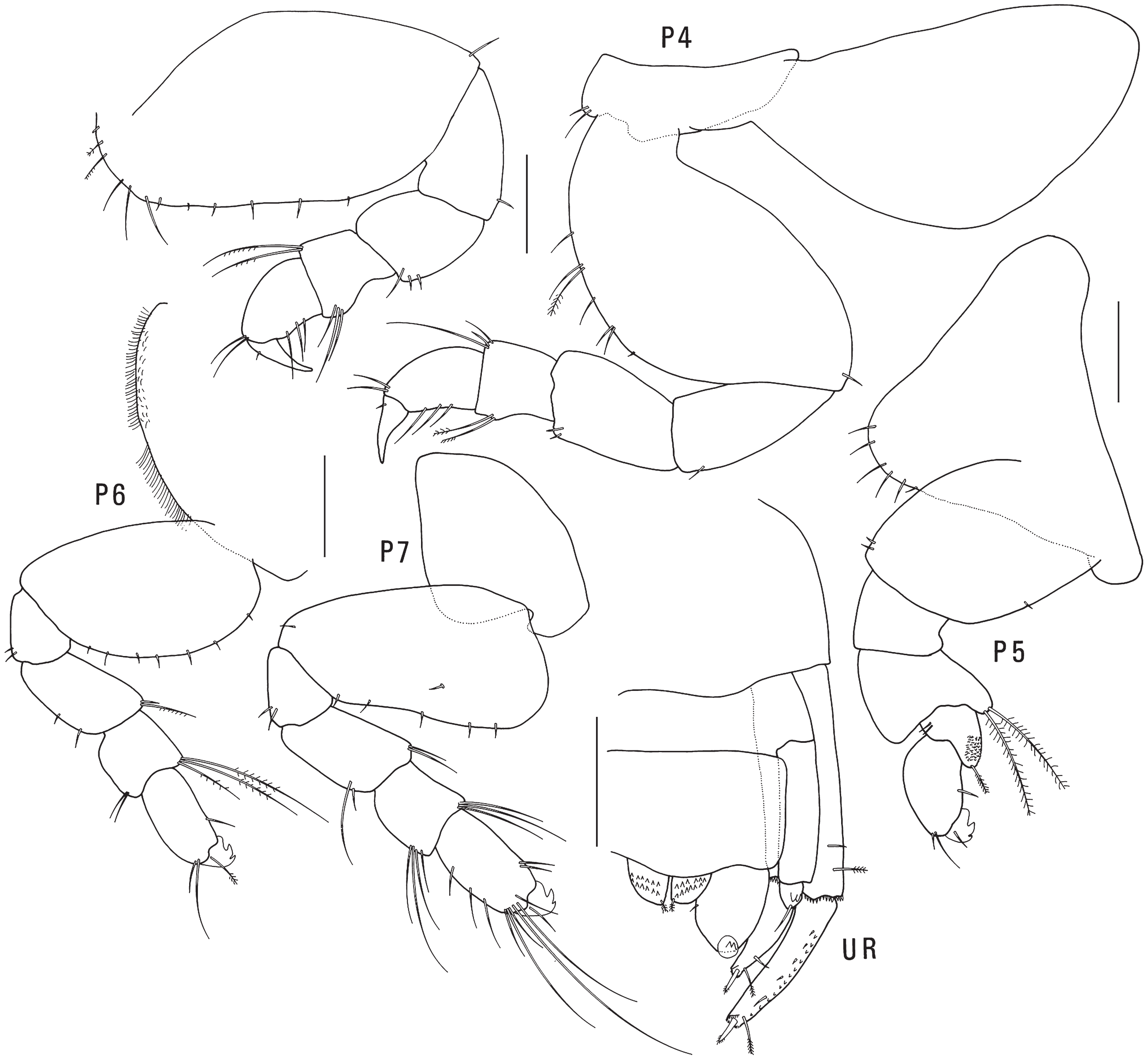

Figure 13. *Cerapus dildilgang* sp. nov., holotype, male, 3.8 mm, AM P.26097, Port Jackson, New South Wales, Australia. Scale 0.1 mm.

3-articulate. *Pereonite 1* without lateral keel. *Pereonite 2–3* without sternal keel. *Gnathopod 1* coxa length 1.5 × depth; basis length 2.6 × depth; carpus length 1.2 × depth, with setose posterior lobe. *Gnathopod 2* subchelate; coxa length 1.2 × depth; basis length 1.6 × depth, without medial line of setae; palm extremely acute *Pereopod 5* coxa length 1.6 × depth. *Oostegites* from gnathopod 2 to pereopod 5.

Tube. Fine grained smooth tube with light and dark rings.

Habitat. Marine, 2–16 m.

Remarks. The shape of gnathopod 2 propodus and carpus in *C. dildilgang* changes as males grow, with the propodus becoming curved and slender in larger males. The carpus comes more elongate in larger males with the length to breadth ratio increasing from 1.1:1 in males less than 3 mm, 1.2:1 in males up to 3.5 mm and 1.9:1 in the holotype (3.8 mm in length). On the carpus, the anterodistal tooth near the articulation with the propodus becomes more prominent in larger males. In males less than 3 mm in length the tooth is absent, and poorly defined in males up to 3.5 mm. The tooth is small but well defined in the holotype. The palm of gnathopod 2 is straight rather than excavate as in most species of *Cerapus*.

Distribution. New South Wales: Port Jackson to Port Stephens.

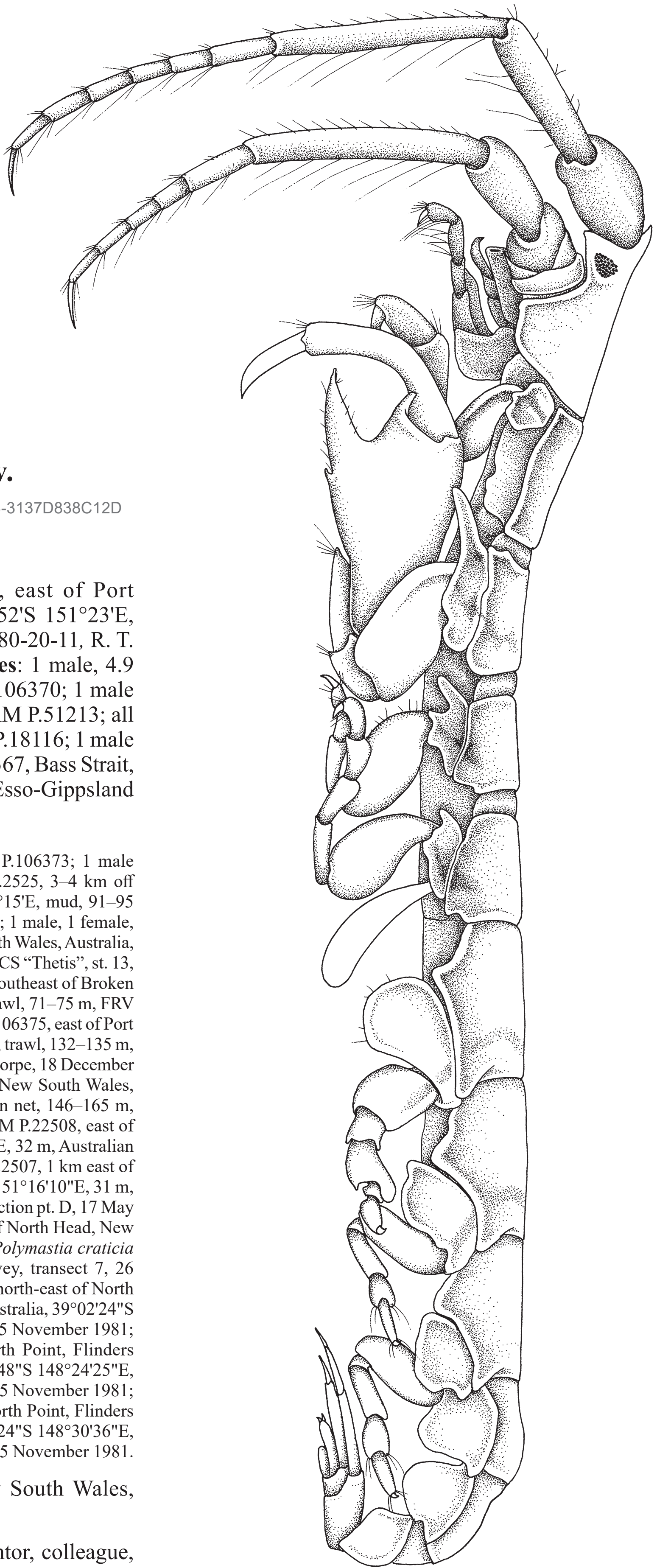

Figure 14. *Cerapus lowryi* sp. nov., paratype, male, 6.5 mm, AM P.18116, Bass Strait, Australia.

Cerapus lowryi sp. nov.

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Figs 14–18

Holotype: Male, 7.2 mm, AM P.51212, east of Port Jackson, New South Wales, Australia, 33°52'S 151°23'E, mud, epibenthic sled, 80 m, FRV *Kapala*, K80-20-11, R. T. Springthorpe, 11 December 1980. **Paratypes**: 1 male, 4.9 mm, AM P.106369; 1 male, 3.8 mm, AM P.106370; 1 male 6.1 mm, AM P.106371; 1 female, 5.1 mm; AM P.51213; all same data as holotype. 1 male, 6.5 mm, AM P.18116; 1 male 5.4 mm, AM P.106366; 2 females, AM P.106367, Bass Strait, Victoria, Australia, 39°S 148°30'E, 126 m, Esso-Gippsland st. 19, C. Phipps, 7–9 May 1969.

Additional material examined. 15 specimens, AM P.106373; 1 male AM P.106372; same data as holotype. 1 male, AM P.2525, 3–4 km off Botany Bay, New South Wales, Australia, 34°5'S 151°15'E, mud, 91–95 m, HMCS "Thetis", st. 37, E. R. Waite, 11 March 1898; 1 male, 1 female, AM P.106368, 9–12 km off Cape Three Points, New South Wales, Australia, 33°32'S 151°32'30"E, sticky mud & shell, 75–91 m, HMCS "Thetis", st. 13, E. R. Waite, 25 February 1898; 1 male, AM P.106374, southeast of Broken Bay, New South Wales, Australia, 33°36'S 151°30'E, trawl, 71–75 m, FRV "Kapala", 10 February 1986, K86-01-02; 1 male, AM P.106375, east of Port Jackson, New South Wales, Australia, 33°50'S 151°32'E, trawl, 132–135 m, FRV "Kapala", K85-21-01, J. K. Lowry & R. T. Springthorpe, 18 December 1985; 6 specimens, AM P.106376, east of Newcastle, New South Wales, Australia, 32°53'S 152°35'E, bottom tow with plankton net, 146–165 m, FRV "Kapala", K85-12-23, 15 August 1985; 1 male, AM P.22508, east of Malabar, New South Wales, Australia, 33°58'S 151°16'E, 32 m, Australian Museum Shelf Benthic Survey, 1973; 1 female, AM P.22507, 1 km east of Magic Point, New South Wales, Australia, 33°57'40"S 151°16'10"E, 31 m, Australian Museum Shelf Benthic Survey, Shipek Collection pt. D, 17 May 1972; 1 female ovigerous, 3.4 mm, AM P.22502, east of North Head, New South Wales, Australia, 33°49'S 151°18'E, on sponge *Polymastia craticia* Hallman, 1912, 26 m, Australian Shelf Benthic Survey, transect 7, 26 February 1974; many specimens, MV J.75818, 85 km north-east of North Point, Flinders Island, eastern Bass Strait, Tasmania, Australia, 39°02'24"S 148°30'36"E, dredge, 121 m, stn 169D, R. S. Wilson, 15 November 1981; 7 specimens, MV J.75817, 45 km north-east of North Point, Flinders Island, eastern Bass Strait, Tasmania, Australia, 39°31'48"S 148°24'25"E, Smith-McIntyre grab, 40 m, BSS 168G, R. S. Wilson, 15 November 1981; many specimens, MV J.75816, 85 km north-east of North Point, Flinders Island, eastern Bass Strait, Tasmania, Australia, 39°02'24"S 148°30'36"E, Smith-McIntyre grab, 121 m, stn 169G, R. S. Wilson, 15 November 1981.

Type locality. East of Port Jackson, New South Wales, Australia, 33°52'S 151°23'E.

Etymology. Named for Dr Jim Lowry, mentor, colleague, and friend, in recognition of his immense contribution to the study of the Amphipoda.

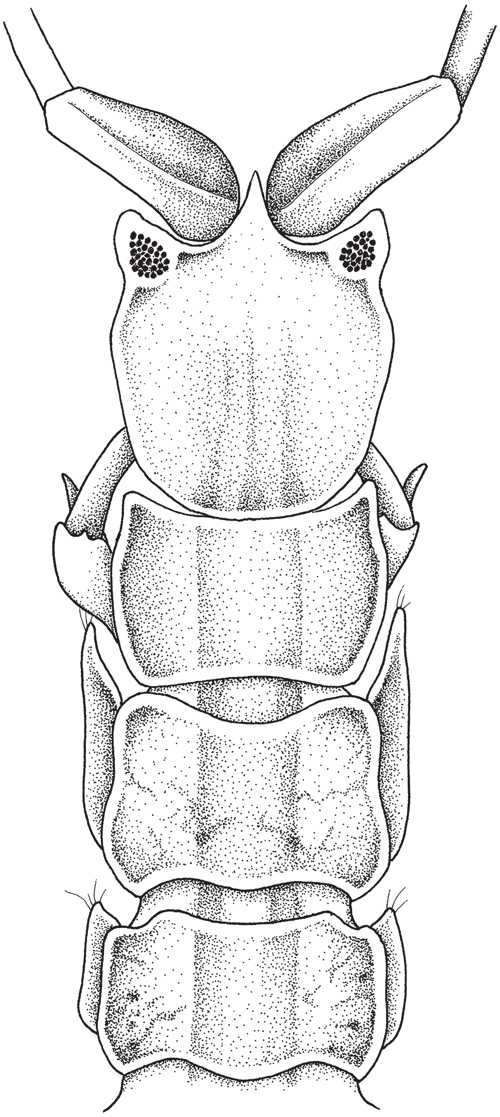

Figure 15. *Cerapus lowryi* sp. nov., paratype, male, 6.5 mm, AM P.18116, dorsal view of head and pereonites 1–3, Bass Strait, Victoria, Australia.

Description. **Male** (based on holotype, 7.2 mm, AM P.51212).

Head. Rostrum long, length 0.3 × head, evenly tapered, apically acute; lateral cephalic lobe with ventral corner acute, subocular margin deeply recessed, reaching beyond eye, anteroventral corner subquadrate, ventral margin horizontal, posterior margin sloping. ***Antenna 1* long, length 0.5 × body length**; peduncle with scales; peduncular article 1 shorter than article 3, length 0.7 × peduncular article 3 not produced anterodistally and anteromedially, with strong sub-quadrate projection along posterior margin, posterodistal corner not produced; peduncular article 2 anterodistal corner without distal projection; flagellum 5-articulate; article 1 short. ***Antenna 2* length 0.7 × antenna 1**; flagellum 5-articulate.

Pereon. *Pereonite 1* with lateral keel, without sternal keel. *Pereonite 2* with sternal keel. *Pereonite 3* without sternal keel. *Pereonite 5* length 1.6 × depth.

Gnathopod 1 coxa not fused to pereonite 1, length 1.9 × depth, without anteroventral lobe; basis length 2.1 × depth; carpus very broad, length 1.6 × depth with setose posterior lobe; propodus palm extremely acute, robust setae absent. *Gnathopod 2* carpochelate; coxa not fused to pereonite 2, length 2.6 × depth, **with a strongly produced anteroventral lobe**; basis short, broad, length 1.4 × breadth, without anteroproximal group of long slender setae; carpus long, length 1.6 × breadth, broad, posterior margin with small spine, **palm deeply excavate,** anterodistal tooth extremely produced, located near articulation with propodus, posterodistal tooth well defined, medium length, length 1.4 × width; propodus slender, strongly curved, length 5.6 × width, **without tooth on posterior margin**, posterodistal corner smooth, without teeth; dactylus, length 0.5 × propodus.

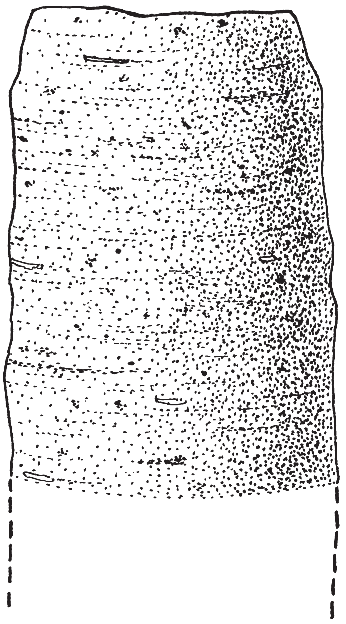

Figure 16. *Cerapus lowryi* sp. nov., tube from AM P.106373, east of Port Jackson, New South Wales, Australia, K80-20-11, length of tube 8 mm.

Pereopod 3 coxa with narrow anteroventral lobe, not fused to pereonite 3, length 1.9 × depth; basis, length 1.6 × breadth, evenly rounded, with plumose setal group and simple setae along anterior margin, with patches of denticles along medial surface; ischium long, length 2.5 × breadth; merus length 1.1 × breadth, short; without ridges. *Pereopod 4* coxa not fused to pereonite 4, with anterior lobe separated from several small anteroventral lobes; basis length 1.6 × breadth, with plumose setae along entire anterior margin; ischium long, length 3.1 × breadth; merus very long, length 2.2 × breadth. *Pereopod 5* coxa, length 1.5 × depth, without patches of small setae, with setae along ventral margin; merus with anterior lobe not extending beyond anterior margin of carpus, posterior lobe with 1 plumose seta; propodus with 2 setae along posterior margin; dactylus short, uncinate with 1 accessory hook.

***Pereopod 6* coxa with setal fringe ventrally**, without patches of small setae near margins; basis with patch of small setae near anterior margin; merus, length 1.8 × breadth; dactylus short, uncinate, with 1 accessory hook. *Pereopod 7* coxa without posterodorsal lobe**, with patch of small setae;** merus length 2.3 × breadth; dactylus, short, uncinate, with 1 accessory hook.

Pleon. *Pleopods 1–3* biramous, decreasing in size. *Pleopod 1* inner ramus 7-articulate; outer ramus 5-articulate,

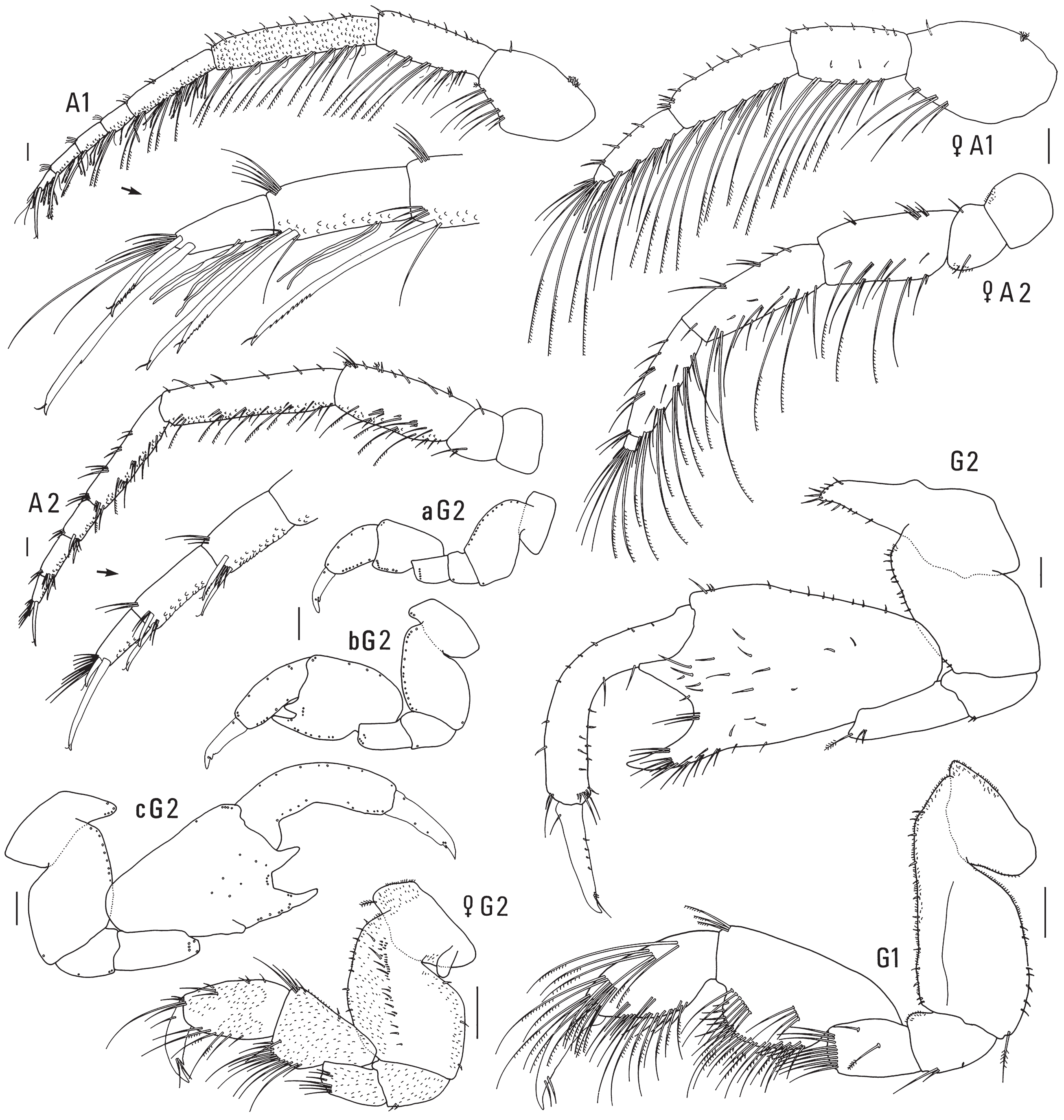

Figure 17. *Cerapus lowryi* sp. nov.: holotype, male, 7.2 mm, AM P.51212; paratype, male "a", 3.8 mm, AM P.106370; paratype, male "b", 4.9 mm, AM P.106369; paratype male "c", 6.1 mm, AM P.106371; paratype, female, 5.1 mm, AM P.51213; east of Port Jackson, New South Wales, Australia. Scales 0.1 mm.

article 1 evenly swollen; *Pleopod 2* inner ramus reduced, 1-articulate; outer ramus, broad, 1-articulate. *Pleopod 3* inner ramus reduced, 1-articulate; outer ramus broad, 1-articulate. *Uropod 1* biramous; peduncle, length 1.4 × outer ramus; rami with distoventral fan of robust setae; outer ramus with lateral row of denticles, without medial setae, with 10 lateral setae, with large apical robust seta, without smaller slender setae; inner ramus, length 0.8 × outer ramus, medial setae absent, with 8 lateral setae, with large apical robust seta. *Uropod 2* uniramous, peduncle, length 3.2 × breadth, 4.1 × length of ramus; ramus small with 6 denticles and 1 slender apical seta. *Uropod 3* uniramous, peduncle length 1.9 × breadth; ramus with 2 curved hooks. *Telson* broader than long, length 0.4 × breadth, cleft to base, **each lobe with 28–29 anteriorly directed recurved spines in 2 rows**.

Female (sexually dimorphic characters). Based on paratype female, 5.1 mm, AM P.51213. *Antenna 1* peduncle without scales; flagellum 2-articulate. *Antenna 2* flagellum 2-articulate. *Pereonite 1* without lateral keel. *Pereonites 1, 2, 3* without sternal keel. *Pereonite 5* length 1.7 × depth. *Gnathopod 1* coxa, length 1.7 × depth; basis length 1.9 × depth; carpus, length equal to depth with setose posterior lobe. *Gnathopod 2* subchelate; coxa length 1.9 × depth with short anteroventral lobe; basis length 1.1 × depth, with medial

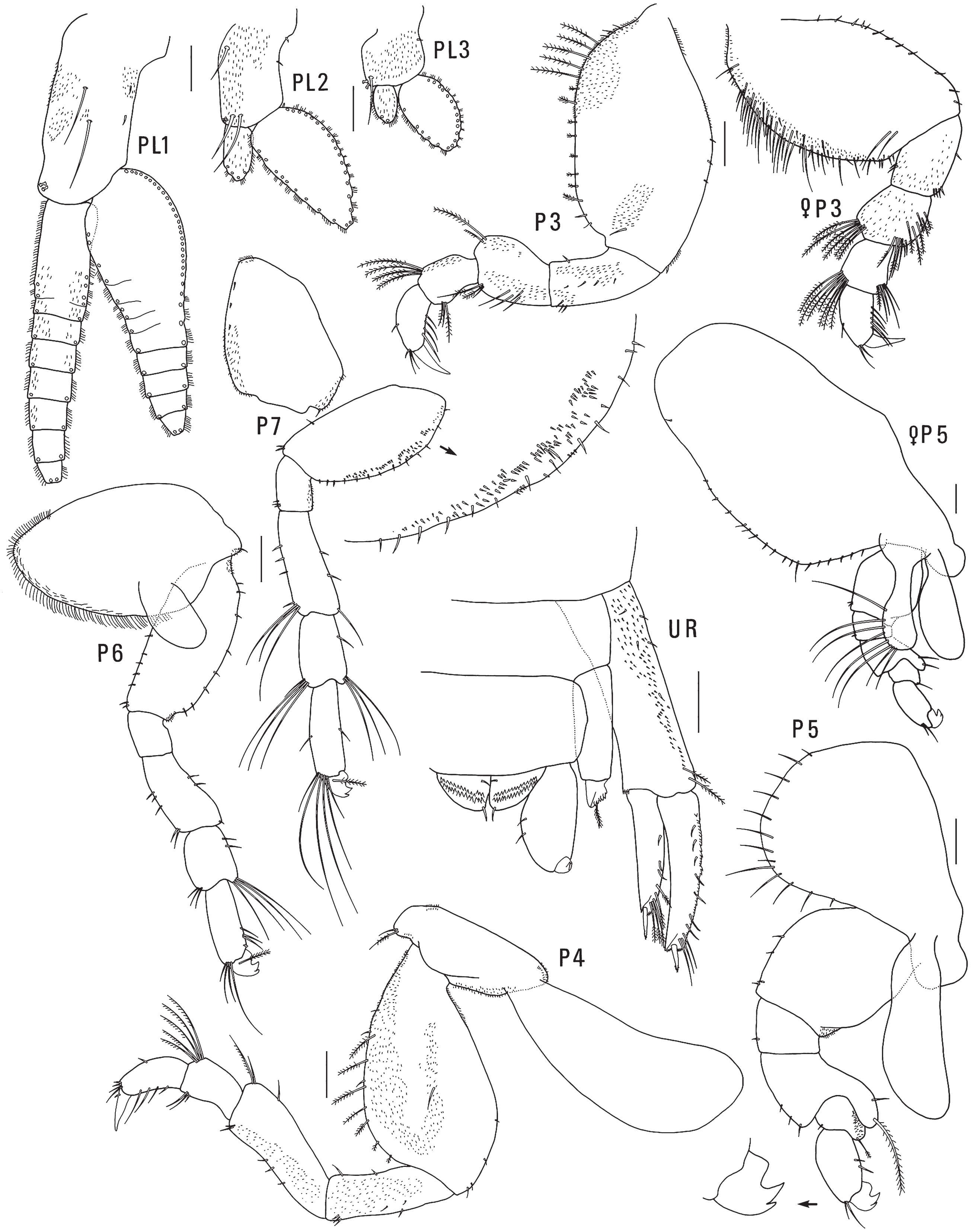

Figure 18. *Cerapus lowryi* sp. nov.: holotype, male, 7.2 mm, AM P.51212; paratype, female, 5.1 mm, AM P.51213; east of Port Jackson, New South Wales, Australia. Pleopods 1–3 insertion points of setae are indicated by small circles. Scales 0.1 mm.

line of setae; palm extremely acute. *Pereopod 5* coxa, length twice depth. *Oostegites* from gnathopod 2 to pereopod 5.

Tube. Long slender tube composed of fine grey sediment and detritus.

Habitat. Marine, 26–165 m.

Remarks. *Cerapus lowryi* and *C. chiltoni* are the only Australian species of *Cerapus* with a strongly produced anteroventral lobe on coxa 2. In *C. lowryi* the lobe becomes more produced in mature males. *Cerapus lowryi* differs from *C. chiltoni* in having a long rostrum and in the shape of the palm of gnathopod 2, which is deeply excavate in both, but narrow in *C. chiltoni* and wide in *C. lowryi* with the posterodistal tooth long in *C. chiltoni* and medium length in *C. lowryi*. The second gnathopod of *C. lowryi* also changes as males mature. The propodus becomes more curved and elongate in males greater than 7 mm in length. The carpus also becomes elongate with the ratio of length to width changing from 1:1.3 in males 3 mm to 6 mm in length, to 1:1.6 in males greater than 7 mm in length. *Cerapus lowryi* is the only Australian species with a very broad lobe on the carpus of gnathopod 1 in the male. Pereopod 3 is dimorphic in *C. lowryi* with all articles except the ischium bearing more setae in the female than the male. The basis of pereopod 7 has a patch of setae, which is unique to *C. lowryi* and *C. yuyatalay*.

Distribution. Bass Strait, Tasmania to east of Cape Three Points, New South Wales.

Cerapus moonamoona sp. nov.

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Figs 19–20

Holotype: Male, 5.0 mm, AM P.106377, off Moona Moona Creek, Jervis Bay, New South Wales, Australia, 35°02'54"S 150°41'12"E, airlift on scuba, 8 m, P. B. Berents, 17 November 1981. **Paratypes**: 1 female, ovigerous, 5.7 mm, AM P.106378, same data as holotype; 1 male, 3.7 mm, AM P.26872, north-east Botany Bay, New South Wales, Australia, 33°58'39"S 151°12'21"E, sandy mud, 7.5 m, State Pollution Control Commission, SPCC Stn. 29, 7 December 1976; 1 male, 4.2 mm, AM P.26875, east Botany Bay, New South Wales, Australia, 34°00'S 151°12'E, 11.6 m, State Pollution Control Commission, SPCC Stn.74, 27 January 1977; 1 male, 4.8 mm, AM P.106380, 1 male 4.5 mm, AM P.106381, off Moona Moona Creek, Jervis Bay, New South Wales, Australia, 35°03'S 150°40'E, silty sand with fine shell fragments, hand dredge on scuba, AU 76, J. Just, P. B. Berents & R. T. Springthorpe, 18 November 1984.

Additional material examined. 5 females, AM P.106379, same data as holotype; 1 female, 6 juveniles, AM P.106382, off Moona Moona Creek, Jervis Bay, New South Wales, Australia, 35°03'S 150°40'E, silty sand with fine shell fragments, hand dredge on scuba, AU 76, J. Just, P. B. Berents & R. T. Springthorpe, 18 November 1984.

Type locality. Off Moona Moona Creek, Jervis Bay, New South Wales, Australia, 35°2'54"S 150°41'12"E.

Etymology. Named for the type locality. Used as a noun in apposition.

Description. **Male** (based on holotype, 5.0 mm, AM P.106377).

Head. **Rostrum short, length 0.2 × head**, evenly tapered, apically subacute; lateral cephalic lobe with ventral corner subacute, subocular margin deeply recessed, reaching beyond eye, anteroventral corner acute, ventral margin horizontal, posterior margin vertical. ***Antenna 1* long, length 0.5 × body length**; peduncle without scales; peduncular article 1 longer than article 3, length 1.3 × peduncular article 3, slightly swollen, posterodistal corner not produced; peduncular article 2 anterodistal corner without distal projection; flagellum 5-articulate; article 1 long. ***Antenna 2* 1.3 × length antenna 1**; flagellum 5-articulate.

Pereon. *Pereonite 1* without lateral keel, without sternal keel. *Pereonite 2* with sternal keel. *Pereonite 3* without sternal keel.

Gnathopod 1 coxa not fused to pereonite 1, length 1.4 × depth, without anteroventral lobe; basis length 1.7 × depth; carpus broad, length 1.3 × depth with setose posterior lobe; propodus palm extremely acute, with barbed robust setae. *Gnathopod 2* carpochelate; coxa not fused to pereonite 2, length 1.7 × depth, **without anteroventral lobe or cusp**; basis short, broad, length 1.6 × breadth, without anteroproximal group of long slender setae; carpus long, length 1.6 × breadth, broad, **palm shallowly excavate, with 2 apical robust setae**, anterodistal tooth tiny, located near articulation with propodus, posterodistal tooth long, well defined, length 1.6 × width; propodus slender, curved, length 5.4 × width, **without tooth on posterior margin**, posterodistal corner smooth, without teeth; dactylus length 0.4 × propodus.

Pereopod 3 coxa with broad anteroventral lobe, not fused to pereonite 3, length 2.7 × depth; basis, length 1.8 × breadth, with proximal, subquadrate anterodorsal corner, with simple setae along anterior margin, without denticles along anterior margin; ischium long, length 1.9 × breadth; merus length 1.1 × breadth, short, with ridges. *Pereopod 4* coxa with anteroventral lobe, not fused to pereonite 4, length 2.2 × depth; basis length 1.3 × breadth, with simple setal group midway along anterior margin; ischium long, length 2.3 × breadth; merus long, length 1.3 × breadth. *Pereopod 5* coxa, length 1.5 × depth, without patches of small setae, with setae along ventral margin few or absent; merus with anterior lobe extending beyond anterior margin of carpus, posterior lobe with 3 plumose setae; propodus with 2 setae along posterior margin; dactylus short, uncinate with 1 accessory hook.

***Pereopod 6* coxa with setal fringe ventrally**, without patches of small setae near margins; basis without patch of small setae near anterior margin; merus length 1.7 × breadth; dactylus short, uncinate, with 1 accessory hook. *Pereopod 7* coxa with posterodorsal lobe, without patch of small setae; merus length 1.6 × breadth; dactylus short, uncinate, with 1 accessory hook,

Pleon. *Pleopods 1–3* biramous, decreasing in size. *Pleopod 1* inner ramus 8-articulate; outer ramus 3-articulate, article 1 evenly swollen; *Pleopod 2* inner ramus reduced, 1-articulate; outer ramus, broad, 1-articulate. *Pleopod 3* inner ramus reduced, 1-articulate; outer ramus broad, 1-articulate. *Uropod 1* biramous; peduncle, length 1.5 × outer ramus; rami with distoventral fan of robust setae; outer ramus with lateral row of denticles, without medial setae, with 6 lateral setae, with large apical robust seta, without smaller slender

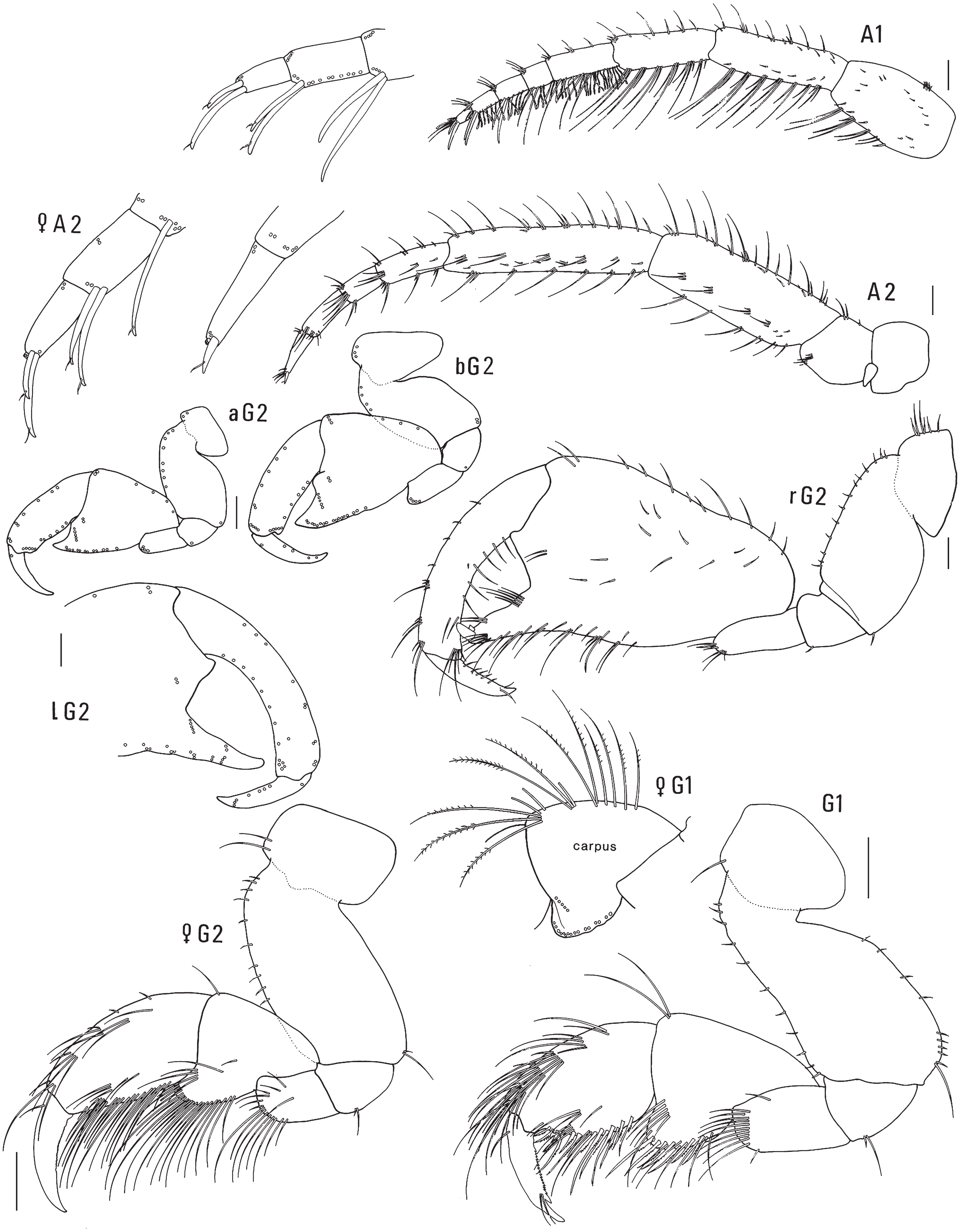

Figure 19. *Cerapus moonamoona* sp. nov.: holotype, male, 5.0 mm, AM P.106377; paratype, male "b", 4.5 mm, AM P.106381; paratype, female, 5.7 mm, AM P.106378; off Moona Moona Creek, Jervis Bay, New South Wales, Australia. Paratype, male "a", 3.7 mm, AM P.26872, north-east Botany Bay, New South Wales, Australia. Gnathopod 2 males "a", "b" and left G2 holotype insertion points of setae are indicated by small circles. Scales 0.1 mm.

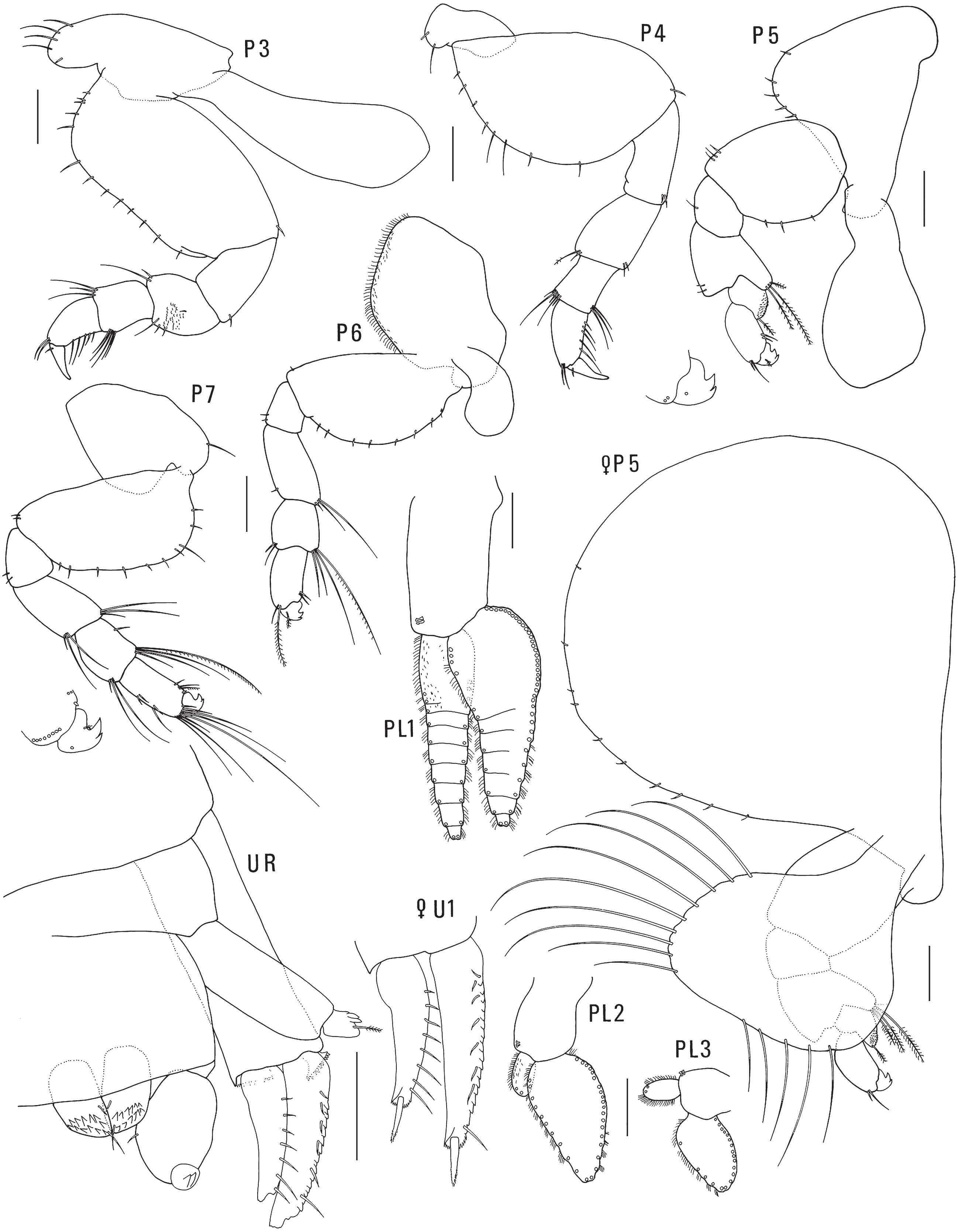

Figure 20. *Cerapus moonamoona* sp. nov.: holotype, male, 5.0 mm, AM P.106377; paratype, female, 5.7 mm, AM P.106378; off Moona Moona Creek, Jervis Bay, New South Wales, Australia. Pleopods 1–3 insertion points of setae are indicated by small circles. Scales 0.1 mm.

setae; inner ramus, length 0.7 × outer ramus, with 7 medial and no lateral setae, with large apical robust seta. *Uropod 2* uniramous, peduncle, length 2.5 × breadth, 4.2 × length of ramus; ramus small with 2 denticles and 1 slender apical seta. *Uropod 3* uniramous, peduncle length 1.4 × breadth; ramus with 2 curved hooks. *Telson* length 0.8 × breadth, cleft to base, **each lobe with 11 or 12 anteriorly directed recurved spines in 2 rows**.

Female (sexually dimorphic characters). Based on paratype female, 5.7 mm, AM P.106378. *Antenna 1* peduncle without scales; flagellum 4-articulate. *Antenna 2* flagellum 2-articulate. *Pereonite 1* without lateral keel. *Pereonite 2–3* without sternal keel. *Gnathopod 1,* coxa, length 1.4 × depth; basis, length 1.7 × depth; carpus, length 1.3 × depth with setose posterior lobe. *Gnathopod 2* subchelate; coxa, length 1.7 × depth; basis, length 1.8 × depth, without medial line of setae; palm extremely acute. *Pereopod 5* coxa, length 1.1 × depth. *Oostegites* from gnathopod 2 to pereopod 5.

Tube. Composed of fine sediment.

Habitat. Marine, 7–12 m.

Remarks. *Cerapus moonamoona* is the only Australian species with peduncular article 1 longer than peduncular article 3 on antenna 1. *Cerapus moonamoona* and *C. alquirta* are the only Australian species with the male second antenna 2 longer than antenna 1 and both species have a sternal keel on pereonite 2. *Cerapus moonamoona* differs from *C. alquirta* in having 11 or 12 recurved spines on the telson whereas *C. alquirta* has 8 recurved spines on the telson; *C. alquirta* lacks a setal fringe on coxa 6; the posterior margin of the carpus and propodus of female gnathopod 2 is more densely setose in *C. moonamoona* and male coxa 5 is twice as long as wide in *C. alquirta* compared with 1.5 times longer than wide in *C. moonamoona*. The tube of *C. alquirta* is broader at one end and the tube of *C. moonamoona* is straight.

The male gnathopod 2 of *C. moonamoona* changes in shape as the male matures. The propodus is curved and slender in males longer than 4.5 mm. The posterodistal tooth of the carpus of gnathopod 2 becomes longer and more strongly defined in males of 5.0 mm. The carpus of gnathopod 2 is more elongate in mature males with the ratio of length to width 1:1.2–1:1.3 in males of 3.7–4.5 mm and 1:1.6 in males of 5.0 mm. Mature males have 2 apical robust setae on the palm, which is unique to *C. moonamoona.*

Distribution. New South Wales: Botany Bay and Jervis Bay.

Discussion

The domiciliary tubes of cerapodinines are particular to each species and are useful in distinguishing species. Most species construct their tubes from sediment and detritus but some species construct a tube by wrapping algae and seagrass as seen in *C. bundegi*, *C. murrayae* and *C. volucola* (Lowry & Berents, 2005). The tubes of *Kapalana* spp. are characterized by the female tube with the tubes of juveniles encircling the female tube (Berents & Lowry, 2018). The five species described herein all build tubes from sediment or sediment and detritus. The tube of *C. chiltoni* is composed of sediment and has one end with a distinctive flare. The tubes of *C. brevirostris* are usually partly covered with sponge and ascidians. The tubes constructed by *C. lowryi* are long and slender. Barnard *et al*. (1991) described tube construction in amphipods, including in two species of *Cerapus,* but it is not known how tubes are constructed for any Australian species of *Cerapus*.

The large carpochelate gnathopod 2 is a distinctive character of mature male *Cerapus.* As the male grows the carpus lengthens and the propodus becomes slender and curved. The palm develops distinctive characters that vary from the straight palm of *C. dildilgang* to the shallowly excavate palm of *C. moonamoona* and *C. brevirostris,* and the deeply excavate palm of *C. chiltoni* and *C. lowryi.* Characters such as the tooth on the posterior margin of the propodus of *C. brevirostris*, the large chisel-shaped posterior tooth of the palm of *C. chiltoni* and the apical robust setae on the posterior tooth of the palm of *C. moonamoona* only appear in large males. Gnathopod 2 of immature males have a straight or shallowly excavate palm, hence gnathopod 2 is not a useful taxonomic character for smaller males.

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Electrolana Schädel, Hyžný & Haug, 2021 (Crustacea: Isopoda: Cirolanidae), a Junior Synonym of *Cirolana* Leach, 1818 and a New Species of *Metacirolana* Kussakin, 1978 from Cretaceous Amber of Myanmar

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ABSTRACT. *Electrolana madelinae* Schädel, Hyžny & Haug, 2021 was described from two excellently preserved isopod specimens from *ca*. 40-million-year-old amber from Myanmar. Appraisal of the two specimens and their comparison to extant genera and species of Cirolanidae show that the genus *Electrolana* Schädel, Hyžny & Haug, 2021 is a junior synonym of *Cirolana* Leach, 1818, and that the holotype and paratype represent two distinct species. The holotype is placed in the combination *Cirolana madelinae* (Schädel, Hyžny & Haug, 2021) comb. nov., and the paratype, a species of *Metacirolana* Kussakin, 1979, is here diagnosed and named *Metacirolana jimlowryi* sp. nov. *Brunnaega roeperi* Polz, 2005 is transferred to *Cirolana roeperi* (Polz, 2005) comb. nov.

Introduction

Schädel *et al.* (2021) described a new genus and species of isopod based on two specimens found in *ca.* 40-million-year-old amber from Myanmar. The authors classified the new genus as belonging to the Cymothoida Wägele, 1989 but not to any lower taxon. The two specimens were considered to be different developmental (ontogenetic) stages of the same species, the authors stating that the specimens "*Except for the body size, the two herein studied specimens are overall very similar*" and "*Considering the similarity between the two specimens and that the differences can easily be explained by ontogenetic changes, it appears most likely that the two specimens are conspecific*." Schädel *et al.* (2021) gave no character-based evidence for their assertion of similarity. Appraisal of the figures given by Schädel *et al.* (2021) reveals that the similarities shown by the two specimens exist solely at the family level and that the specimens display a wealth of difference at both generic and species level in the details of all visible appendages as well as body characters. The two specimens were simply misidentified at genus and species level.

The purpose of this present work is to re-identify the species named in Schädel *et al.* (2021), showing that these

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amber-preserved specimens belong to the Cirolanidae, that there are two species present in two genera and to correct the taxonomy presented in that publication. The second purpose is to demonstrate three points: 1, all isopod families are not the same with regard to development and in several families mancas and immature specimens can be unequivocally identified to genus; 2, fossil isopods need thorough comparison to extant genera and an understanding of the characters defining higher taxa to obtain the highest possible resolution identifications and so avoid publication of spurious taxa; 3, species can only be precisely and clearly described if higher-taxon characters are excluded from the species description.

Materials and methods

The specimen illustrations were traced from photographs in Schädel *et al.* (2021); because the specimens are in a single piece of amber, appendages cannot be seen in a perpendicular view, therefore pereopod figures have been reconstructed to present a standard slide-mounted perspective. The hand-inked tracings were converted into digital files using Adobe Photoshop CS6. Higher classification used follows Brand & Poore (2003). The type material is held at the Naturhistorisches Museum, Wien (Vienna) (NHMW).

Taxonomy

Cymothoida Wägele, 1989

Remarks. At subordinal level, following Brandt & Poore (2003), the apomorphic states of the anterolateral and ventral attachment of the uropodal peduncle, which articulates ventro-laterally, and the ventrally flat pleotelson unambiguously identifies the suborder as Cymothoida. The plesiomorphic state of five free (unfused) pleonites is a further consistent character, with occasional fusions of pleonites in some Cirolanidae, notably the highly derived cave-dwelling genera (see Bowman, 1975; Botosaneanu *et al.*, 1986; Bruce & Herrando-Pérez, 2005; Iliffe & Botosaneanu, 2006).

Cirolanidae Dana, 1852

Remarks. Bruce *et al.* (2021), in synonymizing *Obtusotelson* Schädel, van Eldijk, Winkelhorst, Reumer & Haug, 2020 with *Cirolana* Leach, 1818, gave a detailed stepwise account of how that identification to family was made. That is not repeated here in detail but in essence, the ambulatory pereopods 1–3 that lack a prehensile dactylus excludes all micropredator and parasitic families. The Corallanidae is excluded on several character states, including the pleonite 3 lateral margin being not posteriorly produced, pleonite 4 epimera posteriorly rounded, a proportionally narrower head than seen in cirolanids, and usually with abundant and often hyaline setae on the dorsal surface of the pleotelson and pleon and in some species variably over the pereonites.

Genus *Cirolana* Leach, 1818

Restricted synonymy:

Cirolana.—Bruce 1986: 139.—Brusca *et al.,* 1995: 17.—Hyzny *et al.,* 2013: 621.
Obtusotelson Schädel, van Eldijk, Winkelhorst, Reumer & Haug, 2020: 150 [type species *Obtusotelson summesbergeri* Schädel, van Eldijk, Vinkelhorst, Reumer & Haug, 2020; by monotypy].
Electrolana Schädel, Hyžny & Haug, 2021: 21 [type species *Electrolana madelinae* Schädel, Hyžny & Haug, 2021; by monotypy] (part, holotype only), **new synonymy**.

Remarks. The genera of Cirolanidae can be placed into three major divisions, formalized, and diagnosed by Kensley & Schotte (1989) as the subfamilies Cirolaninae Dana, 1852, Eurydicinae Stebbing, 1904 and Conilerinae Kensley & Schotte, 1989.

The holotype of *Electrolana madelinae* can be excluded from the Eurydicinae by having the following character states: frontal lamina sessile, broad, ventrally flat; clypeus ventrally flat, lacking any form of ventral blade; pereopods robust, ambulatory; pleonite 5 laterally enclosed by pleonite 4 and pleonite 3 posteriorly produced, overlapping pleonite 4. Further support for exclusion from the Eurydicinae is found in pereonite 1 in *C. madelinae* being longer than pereonite 2, and the pleon is 19% of total body length, whereas in the Eurydicinae pereonite 1 is not or only slightly longer than pereonite 2 and the pleon is usually in the range of 21–30% total body length.

Electrolana madelinae can be excluded from the Conilerinae on the basis of the pereopod morphology, primarily having simple ambulatory pereopods, lacking the produced superodistal angles of the ischium and merus of pereopods 1–3, lacking elongate acute robust setae and lacking the long setae present on all or the posterior pereopods and the expanded articles on the posterior pereopods as seen in genera such as *Natatolana* Bruce 1981 (see Keable, 2006) and *Politolana* Bruce, 1981 (see Riseman & Brusca, 2002); further, the proportions of the antennal peduncle differ, those of the Conilerinae having articles 3 and 4 about subequal in length and shorter than article 5, whereas Cirolaninae have antennal peduncle articles 1–3 short and 4 and 5 longest.

The antennular and antennal peduncle morphology of the holotype of *Electrolana madelinae* further identifies it as or close to *Cirolana*, in particular peduncle articles 1–3 short, article 4 and 5 long, rather than article 1 and 2 short, 3 and 4 long and subequal in length and article 5 longest (see Bruce, 1981, 1986; Riseman & Brusca, 2002), which is the state for genera such as *Natatolana* and *Politolana* (i.e. "Conilerinae").

Electrolana madelinae has robust pereopods with a short dactylus, and sparse setae; the robust setae are comparatively short, and as such the pereopods are typical of the genus *Cirolana*. Genera such as *Aatolana* Bruce, 1993 (Keable, 1998), *Baharilana* Bruce & Svavarsson, 2003 (Schotte & Kensley, 2005; Khalaji-Pirbalouty *et al.*, 2015) and *Odysseylana* Malyutina, 1995 (see Sidabalok & Bruce, 2015) all differ in having the posterior pereopod articles either flattened or distally expanded (among other characters). The more similar *Neocirolana* Hale, 1925 differs primarily from *Cirolana* in having a narrow mandible as well as other mouthpart reductions (Bruce & Hughes, 2020). *Neocirolana* is excluded, as, in all cases, the relative width of the head is narrower than in other genera of Cirolanidae. As the type species of *Electrolana* agrees with all of the visible comparable character states for species included in the genus *Cirolana*, both extant (see Bruce, 1986; Brusca *et al.*, 1995; Kensley & Schotte, 1989; Schotte & Kensley, 2005) and fossil (Hyžný *et al.*, 2013; Bruce *et al.*, 2021), the genus *Electrolana* Schädel, Hyžny & Haug, 2021 is here placed into junior synonymy with *Cirolana* Leach, 1818.

Brunneaga Polz, 2005 was originally placed in the Aegidae, and was transferred to the Cirolanidae by Wilson *et al.* (2011). Although described in detail from excellent material, *B. tomhurleyi* Wilson in Wilson, Paterson & Kear, 2011, however, it is incorrectly placed in *Brunnaega*. In *Brunnaega* all pleonites are laterally free and not overlapped by the preceding segment, as seen for example in *Eurydice* and most species of *Metacirolana*. *Brunnaega tomhurleyi* has pleonite 5 laterally enclosed by pleonite 4 and pleonite 3 (Wilson *et al.*, 2011: fig. 5) is also strongly posteriorly produced. Pleon morphology is highly consistent in cirolanid genera, and the difference in pleon shown between the type species *Brunnaega roeperi* Polz, 2005 and *B. tomhurleyi* is of generic merit. Without some pereopodal characters it is not possible to definitively place *B. tomhurleyi* into a genus, but as no characters exclude the species from *Cirolana* it is here tentatively placed in the combination *Cirolana tomhurleyi* (Wilson *in* Wilson, Paterson & Kear, 2011) comb. nov., pending discovery of more material.

Cirolana madelinae (Schädel, Hyžny & Haug, 2021) comb. nov.

Fig. 1

Electrolana madelinae Schädel, Hyžny & Haug, 2021: 21, figs 4, 5, 6, 7A (part, holotype only; not paratype figs 2, 3, 10A = *Metacirolana jimlowryi* sp. nov).

Holotype: Published figures (Schädel *et al.,* 2021), NHMW 2017/0052/0001.

Diagnosis. Body 2.8 as long as greatest width (at pereonite 5); pleon 19% total body length. Pleotelson 1.2 as long as anterior width; lateral margins evenly convex, converging to broadly rounded posterior margin with apically bifid median point; posterior margin with 10 robust setae (as 5+5; as counted from Schädel *et al.*, 2021: fig. 4A, RS present and notches where RS are missing). Coxae 6 and7 prominent, conspicuous in dorsal view, with prominent oblique carina, posteriorly acute; coxae 6 ventral and posterior margin forming angle of *ca.* 40°, coxae 7 *ca.* 30°; coxae 7 extending posteriorly to mid-pleonite 5. Frontal lamina broad, ventrally flat, *ca.* 3.0 as long as posterior width; anterior margin obscured, narrowly rounded or acute. Antennular flagellum extending to mid-pereonite 1. Antennal flagellum *ca.* 1.8 as long as peduncle, extending to posterior of pereonite 6. Pereopods typical of *Cirolana*, distal and inferior margins of ischium and merus with short robust setae (images indistinct), distal margin noticeably wider than proximal; pereopod 1 dactylus robust with robust unguis and secondary unguis. Uropod (details principally from left uropod) peduncle posterior lobe about 0.7 as long as endopod; extending to or very slightly beyond posterior margin of pleotelson, marginal setae in single tier, apices sub-acute. Uropodal endopod apically sub-bifid; lateral margin distally convex, without prominent excision, with 3 robust setae, mesial margin strongly convex, with 6 robust setae; lateral and mesial margins forming an angle of *ca.* 45°. Uropodal exopod apically sub-bifid; 0.8 as long as endopod, not extending to end of endopod, 2.5 times as long as greatest width; lateral margin weakly convex, setation not clear, with 4 widely-spaced robust setae; mesial margin convex, setation not clear, with 3 or 4 robust setae; lateral and mesial margins forming an angle of *ca.* 37°.

Remarks. *Cirolana madelinae* was not described as such by Schädel *et al.* (2021), but rather the specimen was described using primarily absolute measurements taken from both the holotype and paratype, together with higher-taxon characters; a short differential diagnosis was also given. The diagnosis, also based on the holotype and paratype, included several errors in interpretation of the specimens and consisted of a mixture of higher-taxon characters, non-differential characters as well as some species-level information. Specifically, pleonite 5 was misinterpreted as having free lateral margins, when pleonite 5 is clearly laterally overlapped by pleonite 4 (Schädel *et al.,* 2021: fig. 4A); further, the pleopod 5 endopod is described as lacking marginal setae, but pleopod 5 is not visible in the holotype and, in any case, that is a family level character for the Cirolanidae and therefore uninformative at genus and species level. Although not stated, the "differential diagnosis" appears to include characters of both specimens, and thereby combines characters of two species in different genera. The species diagnosis presented here is based on a standard cirolanid taxonomic character data seta as used, for example, by Sidabalok & Bruce (2017, 2018a) and Bruce *et al.* (2017) and as such does not include higher-taxon characters.

Several large and definable groups of species exist within the large genus *Cirolana* (157 species; 144 extant and 13 fossil species to date; Boyko *et al.*, 2021). One such group of species is the *Cirolana* "*parva*-group" (Bruce, 2004; Sidabalok & Bruce, 2017). All "*parva*-group" species have a rostrum that folds ventrally and posteriorly and makes contact with the anterior point of the pentagonal frontal lamina. Whereas the ventral rostral characters are not visible in the specimen, the frontal lamina, while not clear, does appear to be pentagonal. Several other character states of the "*parva*-group" are present in *C. madelinae*: the antennal flagellum extending posteriorly to or beyond pereonite 4; unornamented body surfaces; and more significantly, pleonite 4 strongly produced, extending posteriorly to or beyond pleonite 5, and while pleonite 3 is not as clearly visible, it also appears strongly posteriorly produced and acute; the linguiform pleotelson with an apical point; the pattern of robust setae on the pleotelson; and the shape of the uropodal rami, notably with acute apices and at least sub-bifid apices (apices appear at least partly damaged). *Cirolana madelinae* differs from all species in the "*parva*-group" by the long acute coxae on pereonites 4–7, those of pereonite 7 extending posteriorly to pleonite 5. A further point of distinction is that the pleon in *C. madelinae* is relatively longer than all other species of the "*parva*-group" (19% total body length versus 10.4–13.2%).

Fourteen species of fossil *Cirolana* have been described (including *Cirolana tomhurleyi* (Wilson *in* Wilson, Paterson & Kear, 2011) comb. nov. Each of these species can be excluded by having either rounded uropodal endopods,

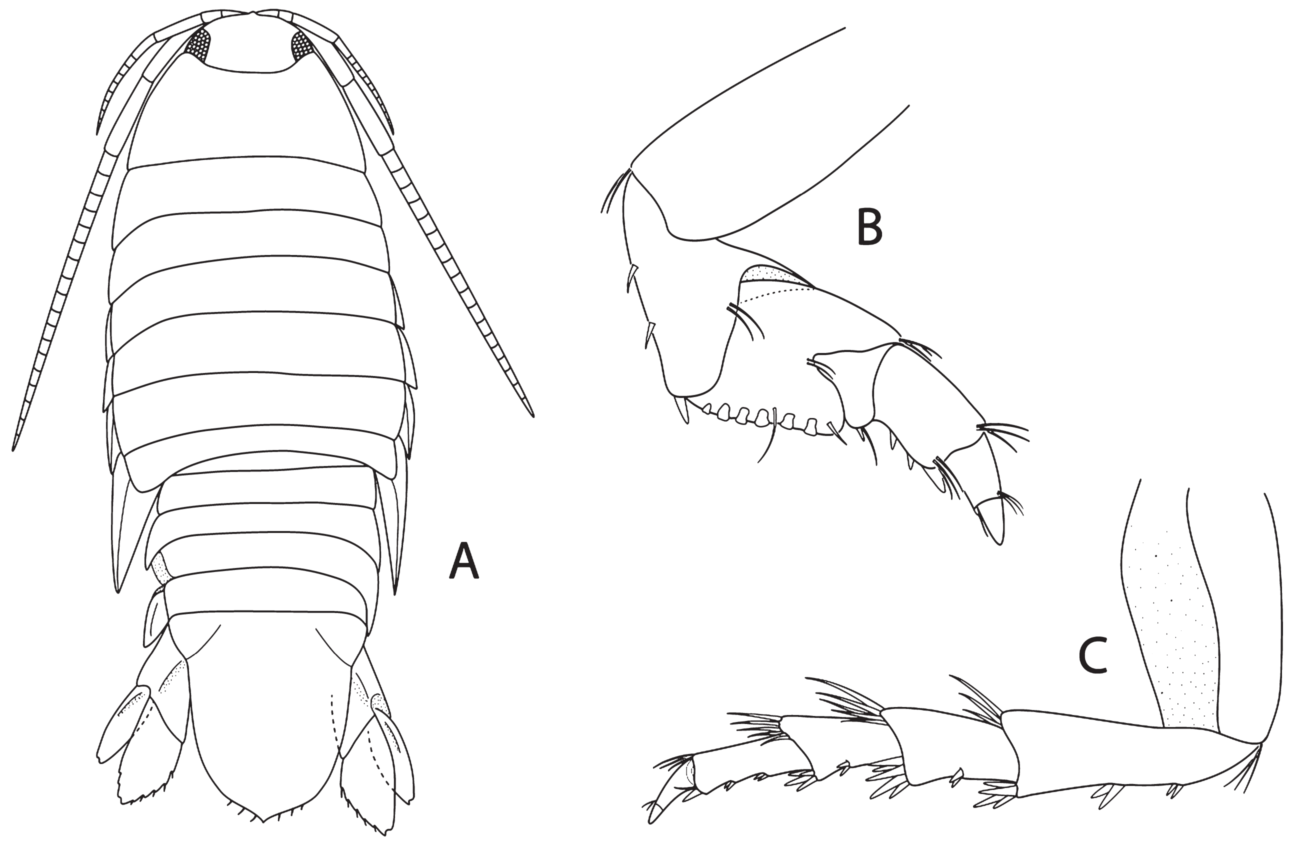

Figure 1. *Cirolana madelinae* (Schädel, Hyzny & Haug, 2021), comb. nov.: A, dorsal view; B, pereopod 1; C, pereopod 6 (partly reconstructed). Drawn from Schädel *et al.* (2021).

or the uropodal endopod being apically acute, with the rami extending clearly beyond the posterior margin of the pleotelson (e.g., Bruce *et al.*, 2021).

Metacirolana Kussakin, 1979

Restricted synonymy (complete synonymy in Bruce & Rodcharoen, 2022):

Metacirolana.—Bruce, 1981: 950.—Brusca *et al.*, 1995: 64.—Sidabalok & Bruce, 2018b: 520.—Bruce & Rodcharoen, 2021: 680.

Type species. *Cirolana japonica* Hansen, 1890; by subsequent designation (Kussakin, 1979).

Remarks. Bruce & Rodcharoen (2021) recently reviewed the genera of Eurydicinae (*sensu* Kensley & Schotte, 1989), all of which share two character states: a clypeus in the form of a ventrally or anteroventrally projecting triangular blade; and pleonites with free (not overlapped) lateral margins, notably pleonite 5 being not overlapped by pleonite 4. In some species pleonite 5 may be narrower than pleonite 4, but the posterolateral angles of pleonite 5 are visible and free rather than contained by pleonite 4. Several of these genera, notably *Metacirolana* and *Eurydice*, have a "long pleon" comprising 21–35% total body length (Bruce & Rodcharoen, 2022). Seven of the thirteen genera placed within the Eurydicinae have a posteriorly stemmed (narrowed) frontal lamina. Examination of the paratype of *Electrolana madelinae* which is described here as *Metacirolana jimlowryi* sp. nov. indicates it has these character states and unambiguously belongs to the "eurydicine" genera.

Within the "Eurydicinae", *Metacirolana jimlowryi* belongs with those genera that have the posterior of the frontal lamina markedly narrowed, a "long pleon" and relatively slender ambulatory pereopods. These are *Aphantolana* Moore & Brusca, 2003 (see Anil & Jayaraj, 2020), *Arubolana* Botosaneanu & Stock, 1979, *Eurydice* Leach, 1815 and *Metacirolana*. *Eurydice* differs on many generic-level character states, including antennular and antennal morphology, maxilliped with a reduced endite without coupling hooks and the uropod peduncle not produced (among other characters). The remaining three genera share a similar body shape, and all have a unique character state: maxilliped palp article 5 is quadrate or sub-quadrate. Of these three genera *Aphantolana* is excluded by having conate spines on the pereopods, pleonite 5 narrower than 4 and the pleotelson has strongly sinuate lateral margins. *Arubolana* is a strictly cave dwelling genus restricted to the Caribbean region, and is primarily distinguished by having a terminal or sub-terminal appendix masculina on pleopod 2, a character state not evident in the holotype of *M. jimlowryi* because the specimen is not adult. However, species of *Arubolana* can be excluded as *M. jimlowryi* has eyes (absent in *Arubolana*), and the anterior pereopods dactyli are not longer than propodus and connate spines are absent [vs. haptorial (with a long dactylus) or with connate spines in *Arubolana*]. Lastly, *M. jimlowryi* uniquely has a "putative autapomorphy" for *Metacirolana*, in antennular peduncle article 2 being longest; in all other cirolanids, antennular peduncle article 3 is the longest.

Metacirolana jimlowryi sp. nov.

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Fig. 2

Electrolana madelinae Schädel, Hyžny & Haug, 2021: 21, figs 2, 3, 8A, 10A (part, paratype only).

Holotype: Manca, NHMW 2017/0052/0002 (specimen used for published figures of the paratype of *E. madelinae* 2017/0052/0002; Schädel *et al.*, 2021; not examined in situ). Cretaceous of Myanmar.

Diagnosis. Body 2.4 as long as greatest width (at pereonite 4); pleon 21% total body length. Pleotelson as long as anterior width; lateral margins anteriorly sinuate, posteriorly straight, converging to narrowly rounded posterior margin without apical point; posterior margin robust setae not discernible. Coxae 6 not conspicuous in dorsal view, extending posteriorly to posterior of pleonite 2. Frontal lamina anterior margin rounded, with free anterior margin visible in dorsal view; clypeus with short anteroventral triangular blade. Antennular flagellum extending to anterior of pereonite 1. Antennal flagellum 2.0 as long as peduncle, extending to mid-pereonite 2. Pereopods typical of *Metacirolana*, pereopod 1 sub-prehensile, with slender dactylus and secondary unguis; pereopods 4–6 slender, distal margin not notably wider than proximally, distal and inferior margins of ischium and merus with few long acute robust setae (images indistinct). Uropod (details principally from left uropod) peduncle posterior lobe about 0.6 as long as endopod; rami extending clearly just beyond posterior margin of pleotelson, marginal setae in single tier; rami rounded, not bifid. Uropodal endopod lateral margin weakly convex, robust setae not discernible, mesial margin weakly convex, with 5 or 6 robust setae; lateral and mesial margins forming an angle of *ca.* 50°. Uropodal exopod apically broadly rounded; 0.9 as long as endopod, not extending to end of endopod, 2.9 times as long as greatest width; lateral margin straight, with 6 robust setae; mesial margin convex, setation not clear, with 3 or 4 robust setae.

Remarks. *Metacirolana jimlowryi* sp. nov. can be immediately distinguished from most other congeners by the uropodal rami having marginal robust setae and the uropodal exopod being posteriorly broadly rounded. Most species of *Metacirolana*, including all the *Metacirolana* "*serrata*-group" lack robust setae on the margins of the pleotelson and uropods. Those species that do have these robust setae are otherwise very different from *M. jimlowryi*. *Metacirolana spinosa* (Bruce, 1980), *M. halia* Kensley, 1984 and *M. riobaldoi* (Lemos de Castro & Brasil-Lima, 1976) all have a near continuous row of robust setae along the posterior margins of the uropodal endopod and pleotelson posterior margin. The large deep-water species, *Metacirolana neocaledonica* Bruce, 1996 and *Metacirolana fornicata* (Mezhov, 1981), size and habitat apart, have far more ornate body surfaces, and the uropodal endopods have subtruncate margins. There are no comparable fossil species of *Metacirolana*.

Etymology. The epithet honours the late James K. Lowry, recognizing his immense contribution to amphipod systematics, mentoring of students as well as the shared companionship both while at the Australian Museum and on the several field and other trips over the decades.

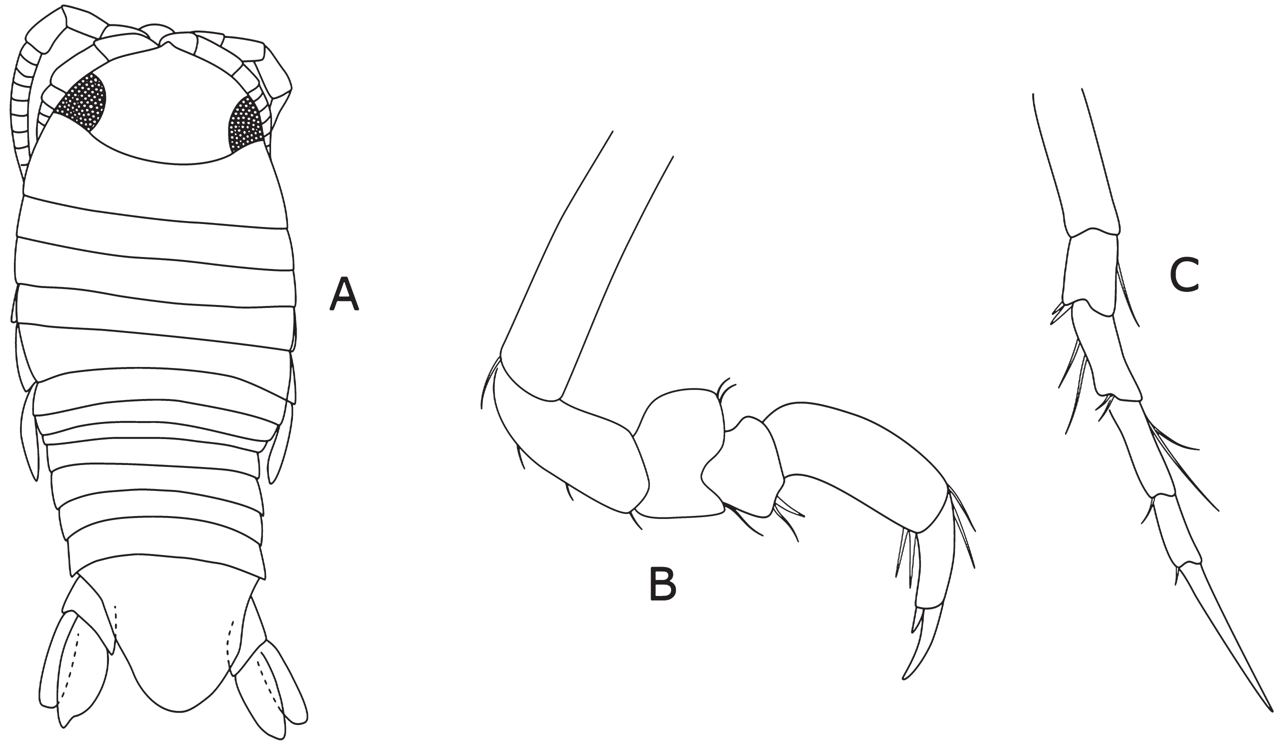

Figure 2. *Metacirolana jimlowryi* sp. nov.: A, dorsal view; B, pereopod 1; C, pereopod 6 (pereopod perspective partly reconstructed). Drawn from Schädel *et al.* (2021).

Discussion

A lengthy discussion was given by Schädel et al. (2021: 23) under the section "Systematic Interpretation …" in which most families except Cirolanidae Dana, 1852 were excluded but the only conclusion drawn, again not evidentially supported, was that "fossils with a cirolanid-like morphology must [sic] not necessarily belong to Cirolanidae" and that "The fossils could, however, also belong to a different lineage within Cymothoida that has no extant representatives." Both specimens in fact show characters of the Cirolanidae, and all other families can be confidently excluded. One of the specimens belongs to *Cirolana* and the other is here identified as belonging to *Metacirolana* Kussakin, 1979.

In naming the monotypic *Electrolana*, Schädel *et al*. (2021: 21) claimed that since "only one species will be included as of this study, no diagnosis can be given" for the genus. This is incorrect. A group within an hierarchical system containing more than one subordinate member is diagnosed by the uniquely shared features/character states of those members. In a group with only one member, the diagnosis of the group is congruent with that of its single member. It is simply the case that a group within an hierarchical system (with or without formal ranks) need not have more than one member before it can be diagnosed. Within the Linnean system, just as a family with one genus is diagnosable, so is a genus with one species. That being the case, it is fortunate for Schädel *et al*. (2021) that the provisions of Article 13 of the Zoological Code (ICZN, 1999) for availability of *Electrolana* are satisfied (albeit seemingly inadvertently). Whatever their viewpoint on binominal nomenclature, the approach of Schädel *et al*. (2021) reveals a more fundamental misunderstanding of the nature of groups and how they can be recognized.

Nevertheless, examination of the published figures shows that the two type specimens of *Electrolana madelinae* can both be identified as members of Cirolanidae, and that the two specimens represent two species that belong to different genera. Irrespective of classification and generic assignment, the two specimens of *Electrolana madelinae* present substantial differences in the detail of all visible appendages, as well as differences in the frontal lamina, clypeus, pereonite 1, pleon, pleotelson, and cannot be considered the same species, or different developmental stages of the same species. The remarks for each genus given here (above) demonstrate the genus-level differences between the two specimens. Identification of cirolanids at species level, especially in the first instance, often rests with pleotelson and uropod morphology, then details of the pereopod proportions and setation, as well as eye size, and the relative proportions of both the antennular and antennal peduncle article and flagellum. In particular, the shape and proportions of the antennular and antennal peduncle, pereopods, pleotelson, and the uropodal rami do not markedly change on maturity.

Comparing the differences between the holotype of *Electrolana madelinae* (the name bearer) and the paratype (in parentheses): pereonite 1 "long", laterally 2.16 as long as pereonite 2 (vs pereonite 1 "short", 1.07 as long as pereonite 2); pleonite 5 lateral margins laterally overlapped by pleonite 4 (pleonite 5 with free lateral margins); pleotelson 1.2 as long as wide, lateral margins convex, converging to broadly rounded apex, with median apical point (as long as wide, lateral margins straight, apex narrowly rounded, no apical point); uropodal endopod mesial margin strongly convex, apex forming an acute angle, apex sub-bifid [possibly bifid] (mesial margin proximally weakly convex and distally straight, apical angle more acute, apex not bifid); uropodal exopod lateral margin weakly convex, mesial margin convex, apex (left uropod) acute (lateral and mesial margins sub-parallel, apex broadly rounded); pereopods generally robust (vs slender); pereopod 1 with robust propodus and dactylus with robust secondary unguis (propodus sub-prehensile, dactylus relatively slender with slender secondary unguis); pereopods 5 and 6 with numerous short, stout robust setae, notably on distal margins of ischium, merus, and carpus (with few slender acute robust setae). This level of conspicuous character state difference precludes the two specimens from belonging to the same genus and same species at any stage of development. Genus-level differences are discussed under the genus accounts herein.

This straightforward genus and species misidentification seems, in part, to derive from the misunderstanding by Schädel *et al*. (2021) that immatures and mancas of Isopoda do not show family, genus, and species identifying characters, and that generic characters may change with developing maturity. The misidentification also results from the lack of any attempt to relate the specimens to the generic and species taxonomy for extant Cirolanidae. It is true that in some families, notably Sphaeromatidae Latreille, 1802 and Cymothoidae, Leach, 1818 that some taxa show very different ontogenetic stages as well as strong sexual dimorphism, and there are many publications that illustrate these male and female stages (e.g., Bruce, 1997; Hadfield & Smit, 2020; Harrison & Holdich, 1982, 1984; Trilles *et al*., 1999; Trilles & Justine, 2010). It is also true that it may not be possible to identify manca (i.e. pereopod 7 not developed) and immature stages (i.e. post-manca but not mature adult) of these families to genus. However, that is not the case for the Aegidae White, 1850, Cirolanidae Dana, 1852, Corallanidae Hansen, 1890, and Tridentellidae Bruce, 1984, in which the mancas and immature stages all show generic (and family) characters and, in many cases, species characters. None of the mentioned differences between the two specimens identified as *Electrolana madelinae* are maturity related. A further reason for this misidentification stems from the lack of rigour in comparing the specimens in relation to the generic and species level characters within the family Cirolanidae.

A large part of the content of Schädel *et al*. (2021) relates to the ontogenetic significance of the two specimens, but that discussion and the inferences drawn are meaningless as are all differences observed between the two specimens that are species in two different genera.

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On the Mysid Crustacean Genus *Deltamysis* (Mysidae: Heteromysinae), with a New Species and a New Record from Australia

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Abstract. The genus *Deltamysis,* in the tribe Mysidetini (Mysidae: Heteromysinae), previously contained a single species, *D. holmquistae*, before two additional species, *D. nana* and *D. songkhlaensis,* were transferred from *Heteromysoides* of the related tribe Heteromysini. A new member of the genus, *D. lowryi* sp. nov., found at the mouth of the Clarence River, New South Wales, in 1988, is described here from the Australian Museum collection. The collection also contained two specimens of *D. holmquistae* from the eastern Australian coasts of the Coral Sea and the Tasman Sea, not previously recorded from Australia. *Deltamysis lowryi* sp. nov. differs from the other three species of the genus by the structure of the telson, which has a wide, shallow cleft, armed with a number of spinules, and notably shortened subterminal spiniform setae. The diagnosis and the generic composition of the tribe Mysidetini, and the diagnoses of the genus *Deltamysis* and all its four species are updated. *Deltamysis* has so far been the only genus of the marine subfamily Heteromysinae diversifying in brackish estuarine water. The genus has a clear western Indo-Pacific natural occurrence, but has been introduced also to the Eastern Pacific and more recently to the Atlantic coasts of North America.

Introduction

This paper was prepared for a special issue in memory of James (Jim) Kenneth Lowry (1942–2021). Apart from his immense contribution to the amphipod taxonomy, Jim played a significant role in the organization of zoological research and knowledge. A new species of mysid, described herein, was collected by him together with Stephen Keable, as he collected many other crustaceans during his field trips. The species is named in Jim's honor.

The study is a continuation of the work on the mysid collection of the Australian Museum, which I started in 2015. In the current paper I report about the second part on the subfamily Heteromysinae Norman, 1892, dedicated this time to the genus *Deltamysis* Bowman & Orsi, 1992, of the tribe Mysidetini Holt & W. M. Tattersall, 1906. In the first part, on the genus *Heteromysis* S. I. Smith, 1873, published in the same journal (Daneliya, 2021), after the revision of *Heteromysoides* Băcescu, 1968 (tribe Heteromysini Norman, 1892) I also transferred *H. nana* Murano, 1998, and *H. songkhlaensis* Yolanda, Sawamoto & Lheknim, 2019, to *Deltamysis*. Here I describe a new species, *D. lowryi* sp. nov., from the mouth of the Clarence River in New South Wales, report the first record of *D. holmquistae* Bowman & Orsi, 1992, in Australia from the Coral Sea and the Tasman Sea coasts, and revise the generic and specific diagnoses. Combining the results from the previous study, on the tribe Heteromysini (Daneliya, 2021), and the current new data on *Deltamysis*, I also revise the diagnostics and composition of the tribe Mysidetini Holt & Tattersall, 1906, to which the genus belongs.

Keywords: *Deltamysis*, Crustacea, Mysida, Mysidae, Heteromysinae, taxonomy
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The genus *Deltamysis* was designated for an alien species of unknown source, *D. holmquistae* Bowman & Orsi, 1992, found in the delta of the Sacramento and San Joaquin Rivers in California, USA; hence the name (Bowman & Orsi, 1992). *Deltamysis*, like *Harmelinella* Ledoyer, 1989, and former species of *Heteromysoides* currently considered in *Deltamysis*, had the non-prehensile capropropodus of the pereopod 1 (pereopod 2 in the definition of Bowman & Orsi, 1992), similar to the pereopod 2, but both appendages still somehow differentiated from the rest of the pereopods, and no telson cleft, but the rudimentary pleopods in both sexes, similar to *Heteromysis*. As Bowman and Orsi stated, "If *Harmelinella* is accepted in the Heteromysini, enlargement of pereopod 2 [pereopod 1] is no longer a requirement for membership in this tribe" (Bowman & Orsi, 1992: 738), as well as the presence of the telson cleft. The similarity was also found in the structure of the antennular male process and the size of the penis. Thus, *Deltamysis* became a member of the tribe Heteromysini, at that time within the family Mysidae Haworth, 1885. Jaume & Garcia (1993) expressed hesitation that the distinguishing characters between *Deltamysis* and *Burrimysis* Jaume & Garcia, 1993, were of the generic level, but kept the genera separate.

A rather similar genus, *Kochimysis* Panampunnayil & Biju, 2007, was subsequently discovered in an estuary of the Laccadive Sea, in India (Panampunnayil & Biju, 2007), and established to accommodate a single member, *K. pillaii* Panampunnayil & Biju, 2007. In the same year, Meland & Willassen (2007) upgraded the subfamily Heteromysinae. However, the most up-to-date concept of Heteromysinae was presented in the monographic work on mysids by Wittmann *et al*. (2014), where the authors further subdivided the subfamily into the three tribes: Heteromysini, Harmelinellini Wittmann, Ariani & Legardère, 2014, and Mysidetini. *Deltamysis* and *Kochimysis* found their position in Mysidetini.

Scripter *et al*. (2020) collected new material on *D. holmquistae* from the US Atlantic coast. After a detailed morphological revision of new and the type material they found that originally *D. holmquistae* males were not carefully studied and revealed that the males had special cuticular prominences on the maxillipeds 2, similar to *K. pillaii*. In addition, a wide variability of the US material also incorporated other features of *K. pillaii*, and the authors synonymized the genus *Kochimysis* with *Deltamysis*. They also suggested a northern Indian or North-West Pacific Ocean origin of *D. holmquistae*.

As mentioned above, the second and the third species, respectively, *Deltamysis nana* (Murano, 1998), from the Timor Sea coast of Australia, and *D. songkhlaensis* (Yolanda, Sawamoto & Lheknim, 2019), from Songkhla Lagoon by the Gulf of Thailand, which both had clear characters of *Deltamysis*, became new members of the genus after their transfer from *Heteromysoides* (Daneliya, 2021). In the same work the concept of Heteromysini was revised, which also affected the diagnostics and the composition of the tribe Mysidetini.

With the inclusion of *D. nana* and *D. songkhlaensis* in *Deltamysis*, the generic range was expanded to include the Eastern Indian Ocean. Discovery in the current study of *D. lowryi* sp. nov. from the mouth of Clarence River, and the new records of *D. holmquistae* from eastern Australia, expands the range of the genus to the South Pacific.

Materials and methods

The new material contains samples from three localities along the New South Wales coast, collected in baited traps, set overnight, in expeditions of the Australian Museum (AM) in 1988. Samples were fixed in 80% ethanol. The holotype of *D. lowryi* sp. nov. and a specimen of *D. holmquistae* were partly dissected, put on permanent slides with Aquatex medium, studied in detail and illustrated using a camera lucida (tracing device) on a compound microscope. The collection is deposited in the Australian Museum, Sydney (AM).

Measurements and counts. Body length: from antero-dorsal margin of carapace to posterior margin of telson, not including terminal spiniform setae. Eye length: from cornea distal surface to proximal margin of stalk, dorsal view. Head width: between anterolateral corners of the carapace, dorsal view. Abdominal segment 6 length: from its dorsal posterior margin to dorsal posterior margin of segment 5, not including posterolateral lobes, dorsal or lateral view. Telson length: from anterior margin to posterolateral margins, excluding terminal spiniform setae, dorsal or lateral view. Telson anterior width: between the most distant points of anterior part. Telson posterior width: between outer margins of terminal spiniform setae. Telson lateral spiniform setae number: including terminal. Pereopod 1 dactylus length includes the dactylus and its unguis combined. Uropodal exopod length in comparison with endopod: from distal margin to the level of endopod proximal margin. Uropodal exopod length in comparison with its width: from distal margin to its proximal margin.

Taxonomy

Mysida Boas, 1883

Mysidae Haworth, 1885

Heteromysinae Norman, 1892

Mysidetini Holt & Tattersall, 1906

Mysidetinae Holt & W. M. Tattersall, 1906: 39.—W. M. Tattersall, 1908: 32.—Zimmer, 1909: 45, 46, 139.

Mysidetini.—Wittmann *et al*., 2014: 341.—Wittmann & Wirtz, 2017: 147.—Wittmann & Ariani, 2019: 5.—Daneliya, 2021: 5, 6, 46.—Scripter *et al*., 2020: 504.—Kou *et al*., 2020: 3.

Type genus. *Mysidetes* Holt & Tattersall, 1906, by monotypy.

Diagnosis. Pereopod 1 endopod not differentiated from pereopod 2 endopod, not prehensile, with multisegmented carpopropodus. All pleopods reduced to simple plates in both sexes.

Comparison. Mysidetini is distinguished from other heteromysine tribes by the multisegmented carpopropodus of the pereopod 1 (at least 3-segmented). From the tribe Heteromysini it also differs by the similarity of the pereopods 1 and 2. In Heteromysini, the pereopod 1 endopod is prehensile and 2-segmented (except in *Platyops stenoura* [Hanamura & Kase, 2004], in which it is 3-segmented), and pereopod 2 endopod is normal, multisegmented. An additional feature separates Mysidetini from Harmelinellini:

the rudimentary nature of all pleopods in both sexes. In Harmelinellini, the male pleopod 3 is uniquely long and 2-segmented.

Remarks. Originally, this taxon was designated as a subfamily within Mysidae (Holt & W. M. Tattersall, 1906) for a single genus *Mysidetes* Holt & Tattersall, 1906. Closely resembling Mysidellinae Czerniavsky, 1882 and Heteromysinae in the antennal scale, pleopods, and telson, Mysidetinae Holt & Tattersall, 1906 was distinguished from the two mentioned subfamilies by the structure of the maxilliped 1 (termed as "maxillipede" or "first thoracic limb") and the pereopod 1, respectively, and from Leptomysinae only by the reduced pleopods in both sexes. The characters proposed by Holt & W. M. Tattersall (1906) and Zimmer (1909) were not sufficiently diagnostic to maintain separate status of the subfamily (Hansen, 1910, 1913). In a century, Wittmann *et al*. (2014) re-established the taxon in the status of a tribe within Heteromysinae and included eight genera: *Bermudamysis* Băcescu & Iliffe, 1986, *Burrimysis* Jaume & Garcia, 1993, *Deltamysis*, *Kochimysis*, *Mysidetes*, *Mysifaun* Wittmann, 1996, *Platyops* Băcescu & Iliffe, 1986, and *Pseudomysidetes* W. M. Tattersall, 1936. All members of Mysidetini shared normal, not prehensile pereopods with the multisegmented carpopropodus, the rudimentary, non-modified and non-dimorphic pleopods, and the telson lateral margins with spiniform setae in the distal part only. Certain species of *Mysidetes* have the telson lateral spiniform setae along the entire length (*M. dimorpha* O. S. Tattersall, 1955, *M. hanseni* Zimmer, 1914, *M. microps* O. S. Tattersall, 1955, *M. morbihanensis* Ledoyer, 1995, and *M. posthon* Holt & W. M. Tattersall, 1906) or separated by a gap (*M. antarctica* O. S. Tattersall, 1965, and *M. crassa* Hansen, 1913), which means that this character is not suitable for the diagnosis.

In composing the new diagnosis, I exclude all variable characters, including the size of the male process on the antennulae, the number of the oostegites, the shape of the penes and the telson. In the previous work (Daneliya, 2021), I revised the diagnosis of Heteromysini and transferred *Platyops* and *Bermudamysis* into the redefined tribe. However, I did not provide a revised diagnosis of Mysidetini, which is specifically done here.

Composition. The tribe Mysidetini contains five genera: *Burrimysis*, *Deltamysis*, *Mysidetes*, *Mysifaun,* and *Pseudomysidetes*.

Deltamysis Bowman & Orsi, 1992

Deltamysis Bowman & Orsi, 1992: 733.—Jaume & Garcia, 1993: 234.—Müller, 1993: 218.—Bravo & Murano, 1996: 483.—Smith, 2001: 549.—Price, 2004: 68.—Petryashev, 2005: 15.—Panampunnayil & Biju, 2007: 1957.—Thorp & Rogers, 2010: 155.—Wittmann *et al*., 2014: 341.—San Vicente & Monniot, 2014: 333–334, 341.—Price, 2016: 702.—Scripter *et al*., 2020: 501, 504.

Kochimysis Panampunnayil & Biju, 2007: 1955–1957, [synonymized by Scripter *et al*., 2020].

Type species. *Deltamysis holmquistae* Bowman & Orsi, 1992; by monotypy.

Diagnosis. Male process of antennula rather small, tubercle-like, sometimes barely visible, with setae. Mandibular palp segment 2 with few (up to three) short medial setae in middle part. Pereopodal endopods 1 and 2 slightly stronger than other pereopods; their carpopropodi 3-segmented, with serrated setae. Pereopodal endopods 3–6 are 4–5-segmented. Penis longer than basis of pereopodal endopod 6. Marsupium with two pairs of oostegites. Uropodal endopods without spiniform setae.

Comparison. *Deltamysis* is uniquely distinguished from other genera of Mysidetini by the very modest mandibular palp setation, with the characteristic two or three setae in the median part of segment 2. The genus is most similar to *Burrimysis* of Jaume & Garcia (1993), clearly differing by having only a few medial setae on the mandibular palp segment 2 (numerous long setae in *Burrimysis*), the pereopodal carpopropodus 1 and 2 being 3-segmented (6-segmented in *Burrimysis*), the longer penis (shorter than the pereopod 6 basis in *Burrimysis*), the unarmed uropodal endopod (with one spiniform seta in *Burrimysis*), and the telson cleft rather shallow or absent (rather deep in *Burrimysis*).

Distribution.Western Indo-Pacific. Originally recorded from Sacramento—San Joaquin Estuary in California (Bowman & Orsi, 1992), and later also along the Atlantic US coast (Scripter *et al*., 2020), where it was supposed to be introduced. With discovery of *D. lowryi* sp. nov. on the New South Wales coast, and the transfer of the former *Kochimysis pillai* from India (Scripter *et al*., 2020), the former *Heteromysoides nana* from northern Australian coast and *H. songkhlaensis* from Thailand to *Deltamysis* (Daneliya, 2021), it is now clear that the genus is naturally distributed in the Western Indo-Pacific Region (Fig. 1).

Habitat. Marine-estuarine genus, confined to warm tropical and subtropical shallow waters.

Remarks. The genus was described by Bowman & Orsi (1992) for *D. holmquistae*, distinguished by the presence of the distal suture on the antennal scale, the pereopod 1 (mentioned as pereopod 2) not stronger than other pereopods, the rudimentary pleopods in both sexes, the unarmed uropodal endopod, the penis of moderate size, reaching basis of the pereopod 6 (indicated as pereopod 7) and the entire telson with two, short, apical spiniform setae, flanked by three pairs of longer spiniform setae. From the original generic diagnosis, I excluded the shape of the antennal scale and the pleopods for being general characters for the subfamily and the tribe, and the armature of the telson as species specific. Describing here *D. lowryi* sp. nov., which has the telson cleft, I also exclude the shape of the telson from the generic diagnosis. Jaume & Garcia (1993) expressed hesitation that the distinguishing characters between *Deltamysis* and *Burrimysis* were of generic level. In my opinion, the distinct setation pattern of the mandibular palp, somewhat enlarged endopods of the pereopods 1 and 2, with their 3-segmented carpopropodus, together with other characters make clear gap between *Deltamysis* and *Burrimysis.* Another two potential generic diagnostic characters, found in *D. lowryi* sp. nov., but not studied in other heteromysids, except in the genus *Heteromysis*, are the overlap of the posterolateral lobes of the abdominal segment 6 (Figs 2F, 6E), not overlapping in *Heteromysis* (Daneliya, 2021), and the presence of the subapical wing-like extensions on the maxilliped 1 dactylar claw (Figs 4A, 7E).

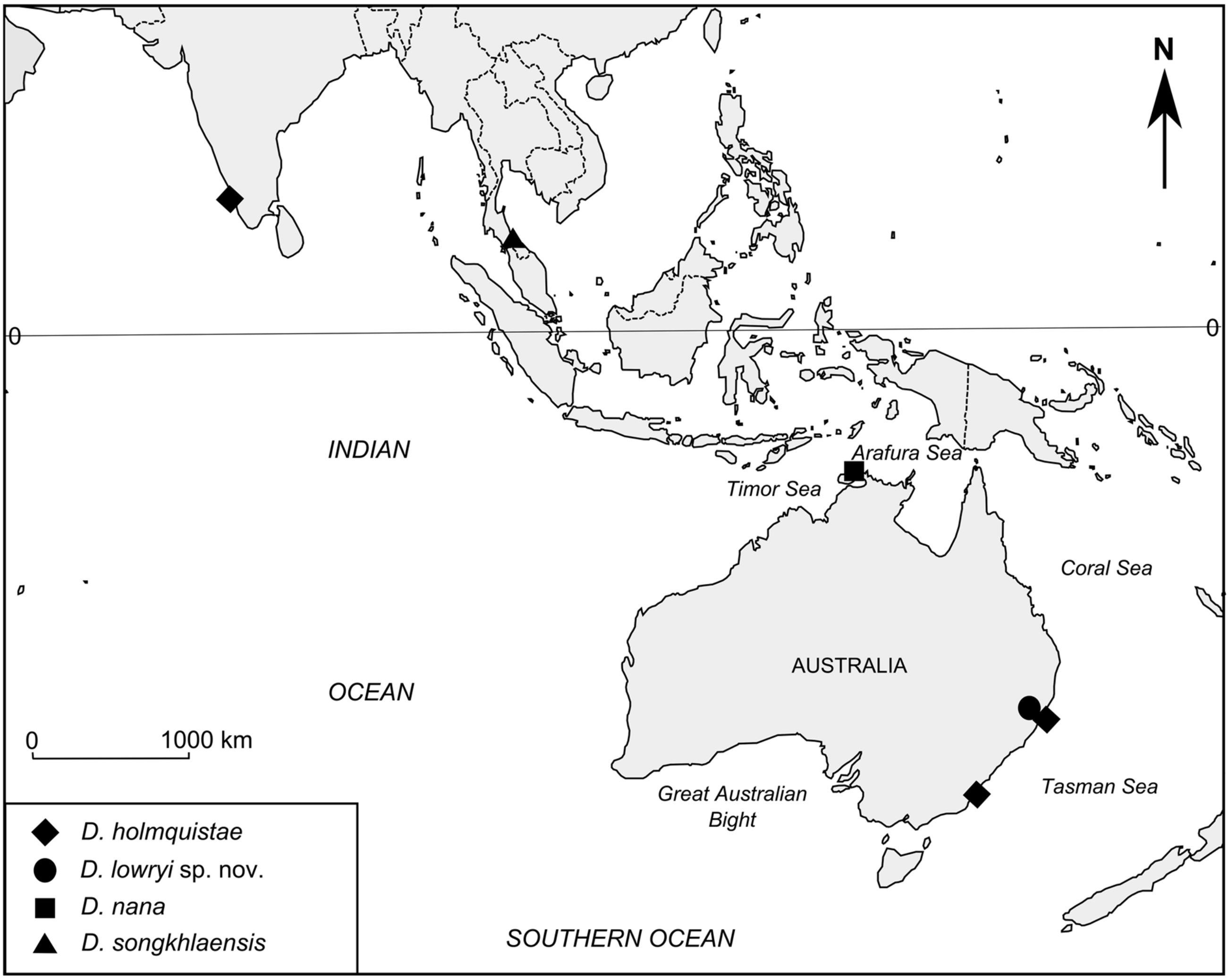

Figure 1. Distribution of the species of the genus *Deltamysis* in the West Indo-Pacific.

Panampunnayil & Biju (2007) distinguished the genus *Kochimysis* from *Deltamysis* on the basis of the male lobe presence on the antennular peduncle, the articulation absence on the antennal scale, the presence of the lacinia mobilis on the mandible and the wide segment 2 of the mandibular palp, equal size of the maxilla 2 endopod segments and the oval shape of its segment 2. Such discrimination was possible partly due to confusion (Scripter *et al*., 2020), because Bowman & Orsi (1992), describing *Deltamysis*, 1) did not notice the male lobe on the antennulae; 2) mentioned the presence of the lacinia mobilis on the left mandible and its absence of the right mandible (p. 737); 3) it was also the aspect of the mandibular palp illustration that did not show the width of the segment 2; 4) the maxilla 2 was mistakenly illustrated as 3-segmented with rather short segment 2, and the aspect did not clearly show the width of the segments. The presence or absence of the articulation on the antennal scale is a common intraspecific variation in different groups of mysids.

San Vicente & Monniot (2014) mentioned in their key that *Deltamysis* is distinguished from *Kochimysis* by the cornea being as wide as the eyestalk, the antennal peduncle as long as the antennal scale, the peduncular segments subequal and the maxilliped 2 without the notches in males. Some individuals of *D. holmquistae*, *D. lowryi* sp. nov., *D. nana* and *D. songkhlaensis*, have the cornea narrower than the stalk, the antennal peduncle longer than the antennal scale, with the peduncular segments subequal. The males of *D. holmquistae* and *D. lowryi* sp. nov. have the notches (or processes) on the maxillipeds 2. In all, I support Scripter *et al*. (2020) in their synonymization of *Kochimysis* with *Deltamysis*.

Scripter *et al*. (2020) updated the diagnosis of the genus, based on the redescription of *D. holmquistae*, the single known species at that time. The shape of the carapace, apically rounded in *D. holmquistae*, *D. lowryi* sp. nov. and *D. nana*, but pointed or blunt in *D. songkhlaensis*, is no longer diagnostic. As discussed earlier, the presence or absence of the suture in the antennal scale is a generally variable feature and not suitable for the generic diagnosis. They also included the presence of the processes ("papillations" in their terminology) on the maxilliped 2 carpus and propodus to the diagnosis. This character is absent in *D. nana* (although only a female has been known so far) and *D. songkhlaensis*, and should be excluded from the diagnosis. It is also mentioned that the pereopod 1 endopod ("thoracic endopod 3") is not stouter than other endopods. Though not prehensile like in the members of Heteromysini, I find that both pereopod 1 and 2 endopod are rather similar and clearly stouter than the endopods 3–6. The latter have 4-segmented carpopropodus in

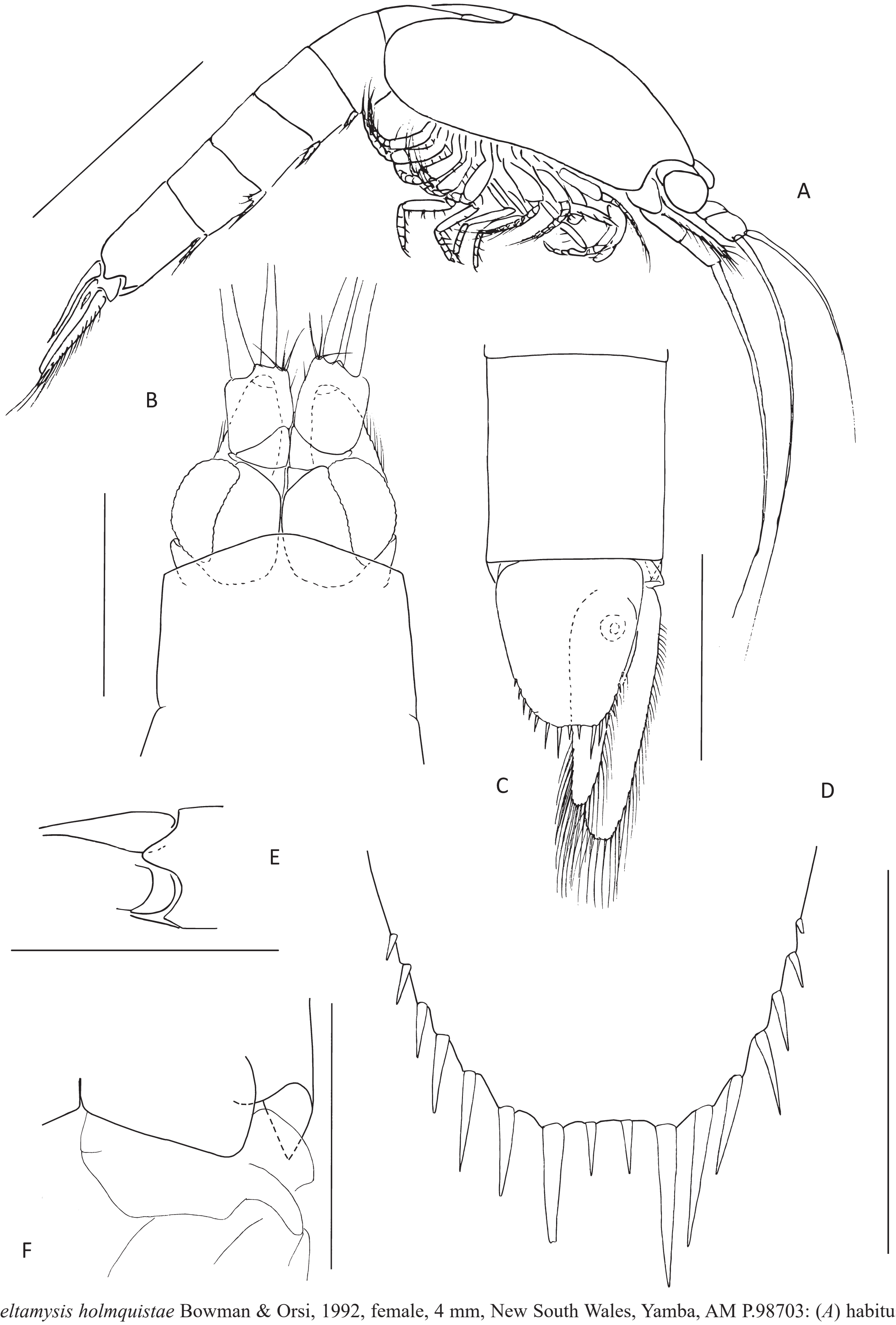

Figure 2. *Deltamysis holmquistae* Bowman & Orsi, 1992, female, 4 mm, New South Wales, Yamba, AM P.98703: (*A*) habitus, lateral; (*B*) head, dorsal; (*C*) posterior part of body with telson and uropods, dorsal; (*D*) telson posterior part; (*E*) posterolateral lobe of abdominal segment 6; (*F*) posteroventral margin of abdominal segment 6, and uropodal protopod. Scales (mm): A = 1; B, C, E = 0.5; D, F = 0.25.

D. holmquistae and *D. songkhlaensis*, but 4- or 5-segmented in *D. lowryi* sp. nov. and 5-segmented in *D. nana*. The rudimentary nature of the pleopods is the tribal character and not necessary in the generic diagnosis. The telsonal characters are also rather variable, particularly with the presence of the telson cleft in *D. lowryi* sp. nov. and, thus, should be excluded from the diagnosis.

In an updated diagnosis above, I have added new common features, particularly in the setation of the mandibular palp and the similarity of the pereopod endopods 1 and 2.

Figure 3. *Deltamysis holmquistae* Bowman & Orsi, 1992, female, 4 mm, New South Wales, Yamba, AM P.98703: (*A*) antennular peduncle distal part, dorsal; (*B*) antennal peduncle and scale, ventral view; (*C*) mandibular palp, posterior; (*D*) labrum, ventral; (*E*) maxilla 2, posterior; (*F*) pleopod 3, anterior; (*G*) pleopod 5, anterior. Scales (mm): A, B, F, G = 0.5; C–E = 0.25.

Except for *Deltamysis,* all the genera of the subfamily Heteromysinae contain exclusively marine species. *Deltamysis* is the only heteromysine genus, which has been penetrating estuaries and diversifying in brackish water. *Deltamysis holmquistae* was occasionally sampled even in fresh water.

Composition. The genus includes four species: *D. holmquistae*, *D. lowryi* sp. nov., *D. nana* and *D. songkhlaensis*.

Key to the species of the genus *Deltamysis*

1 Anterior margin of carapace triangular, apically pointed or blunt. Telson apical spinules as long as or longer than lateral terminal spiniform setae. Pereopod 3–6 carpopropodus, segment 1 longer, as long as or slightly shorter than other segments combined .... *D. songkhlaensis* (Yolanda, Sawamoto & Lheknim, 2019)

—— Anterior margin of carapace apically rounded (Figs 2B, 6B). Telson apical spinules clearly shorter than lateral terminal spiniform setae (Figs 2C, D, 6C, D). Pereopod 3–6 carpopropodus, segment 1 shorter than other segments combined (Figs 5B–E, 8E, F) 2

2 Telson rather narrow, 1.5–1.6 times as long as wide anteriorly; terminal spiniform setae 0.12 of telson length. Maxilla 2, exopod and endopod segment 2 with lateral setae .... *D. nana* (Murano, 1998)

—— Telson rather wide (Figs 2C, 6C), 1.1–1.4 times as long as wide anteriorly; terminal spiniform setae 0.2–0.4 of telson length. Maxilla 2, exopod and endopod segment 2 without lateral setae (Figs 3E, 8A) 3

3 Telson apically without cleft (Fig. 2C, D), armed with two (rarely three) spinules; lateral subterminal spiniform setae not shorter than preceding lateral spiniform setae. Maxilla 2 exopod rather small, barely reaching half of endopod segment 1 (Fig. 3E). Pereopod dactylus rather thick, nearly as long as wide (Figs 4C, D, 5A–E) .... *D. holmquistae* Bowman & Orsi, 1992

—— Telson with cleft (Fig. 6C, D), armed with seven spinules; lateral subterminal spiniform setae significantly shorter than preceding lateral spiniform setae. Maxilla 2 exopod rather big, nearly reaching endopod segment 2 (Fig. 8A). Pereopod dactylus rather thin, about twice as long as wide (Fig. 8C–G) .... *D. lowryi* sp. nov.

Deltamysis holmquistae Bowman & Orsi, 1992

Figs 2–5

Deltamysis holmquistae Bowman & Orsi, 1992: 734–741, figs 2–4.—Müller, 1993: 218.—Cohen & Carlton, 1995: 81, 146, appendix 4-2.—Modlin & Orsi, 1997: 439, 445.—Smith, 2001: 547.—Bollens *et al*., 2002: 91, table 2.—Price, 2004: 68.—Dean *et al*., 2005: 5, table 1.—Petryashev, 2005: 14, table 1.—Mecum, 2006: 1, 4, plate 2.—Panampunnayil & Biju, 2007: 1962, 1963.—Modlin, 2007: 492, plate 221C–E.—Carlton, 2009: 35, table 2.4C.—Ruiz *et al*., 2011: 231, 235, 241, appendix 1.—Simberloff & Rejmanek, 2011: 47.—Winder & Jassby, 2011: 684, table 3.—Brown *et al*., 2016: 11, table 2.—Hiebert & Rasmusson, 2016a: 541; 2016b: 548.—Price, 2016: 706, plates 16.191.02E, 03J.—Scripter *et al*., 2020: 501–515, figs 2–5.

Deltamysis sp. A.?—Ranasinghe *et al*., 2005: 681, tables 1, 4.

Kochimysis pillaii Panampunnayil & Biju, 2007: 1957–1963, figs 2–5, [synonymized by Scripter *et al*., 2020].—Biju & Panampunnayil, 2010: 50, table 1.—Manojkumar & Pavithran, 2016: 42.

Holotype: Male, USA, California, Sacramento—San Joaquin Estuary, between Brown's Island and Jersey Island, collection dates unknown, coll. J. J. Orsi (Smithsonian Institution, Washington, D.C. [USNM] 251607). **Allotype**: Female, collected together with holotype (USNM 251608). **Paratypes**: 1 male, 4 females, same as previous (USNM 251609); 7 specimens, same as previous (USNM 251610); 2 males, 7 females, Sta. 56, north of Brown's Island, date unknown, coll. J. J. Orsi coll. (USNM 251618); 1 male, 4 females, exact location unknown, 29 May 1990, coll. J. J. Orsi (USNM 251619). Data on the paratype material from Scripter *et al*. (2020).

Type locality. USA, California, Sacramento—San Joaquin Estuary, between Brown's Island and Jersey Island (Bowman & Orsi, 1992)

Australian material. Female (+slide), 4 mm, New South Wales, Yamba, northern end of Pippi Beach, 29°26.8'S 153°22.1'E, clean sand, 8 m, st. NSW 326, baited trap, set 16:00, retrieved 08:00, coll. J. K. Lowry, S. J. Keable, 07–08 Jun 1988, AM P.98703; female, 4.5 mm, New South Wales, Twofold Bay, off entrance to Curalo Lagoon, 37°03.2'S 149°55.4'E, sand bottom, 8 m, baited trap, set 15:00–16:30, retrieved 09:00–12:00, coll. J. K. Lowry & S. J. Keable, 26–27 Nov 1988, AM P.98704.

Diagnosis. Anterior margin of carapace angular, apically rounded (Fig. 2B). Cornea about as wide as eyestalk or narrower (0.70–0.96 of stalk width). Telson (Fig. 2C, D) 1.1–1.3 times as long as wide anteriorly; apically without cleft, bearing two (rarely three) spinules; its lateral margins with five to eight spiniform setae (including terminal, but not apical); subterminal spiniform setae about as long as or longer than preceding lateral; terminal spiniform setae 0.2–0.4 of telson length. Maxilla 2 (Fig. 3E), exopod

Figure 4. *Deltamysis holmquistae* Bowman & Orsi, 1992, female, 4 mm, New South Wales, Yamba, AM P.98703: (*A*) maxilliped 1 endopod, anterior; (*B*) maxilliped 2 endopod, anterior; (*C*) pereopod 1 endopod, anterior; (*D*) pereopod 1 endopod distal part, anterior. Scales (mm): A, B, D = 0.25; C = 1.

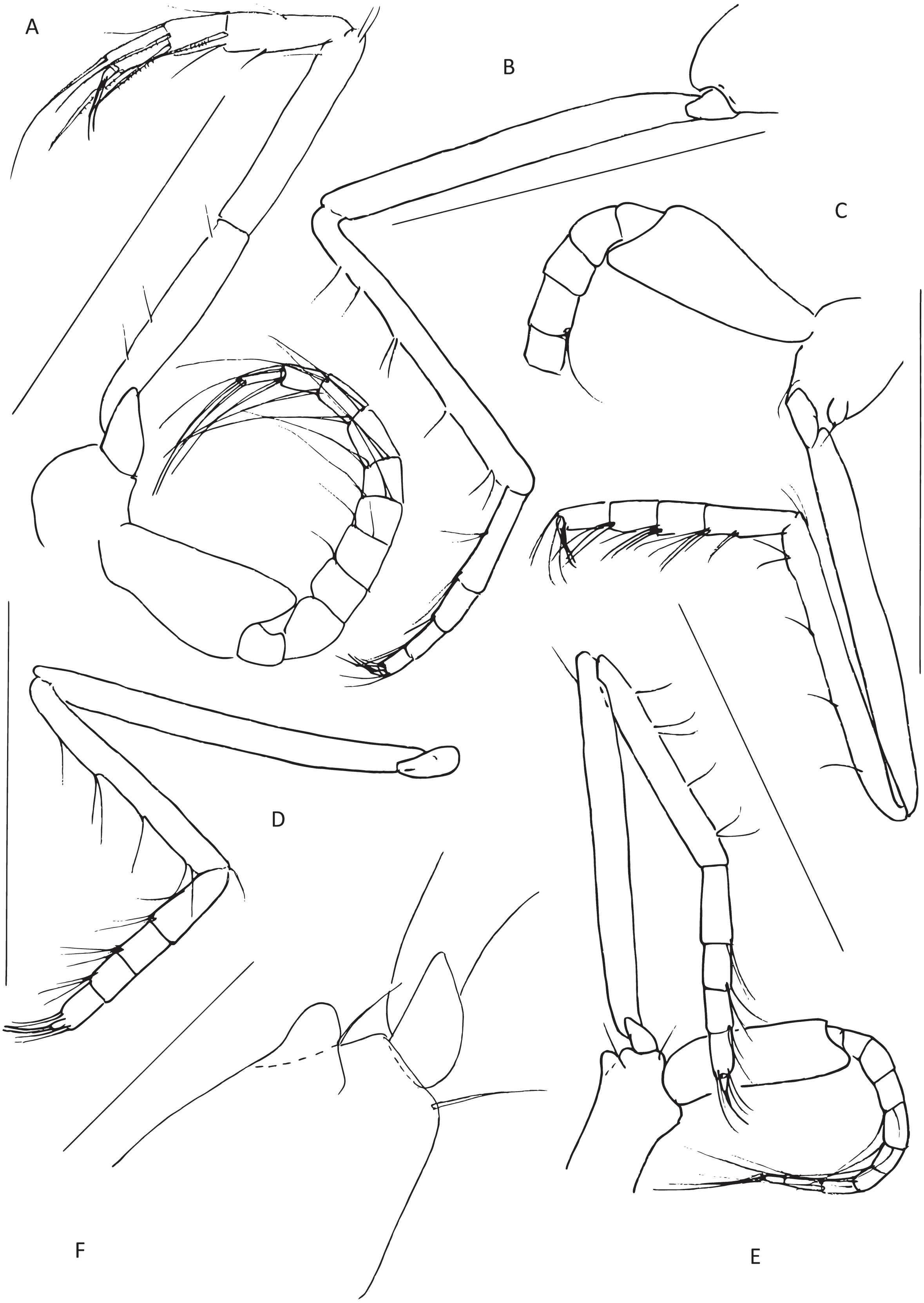

Figure 5. *Deltamysis holmquistae* Bowman & Orsi, 1992, female, 4 mm, New South Wales, Yamba, AM P.98703: (*A*) pereopod 2 endopod, anterior; (*B*) pereopod 3 endopod, anterior; (*C*) pereopod 4, anterior; (*D*) pereopod 5 endopod, anterior; (*E*) pereopod 6, anterior; (F) pereopod 6 basis distal part, anterior. Scales (mm): A–E = 0.5; F = 0.25.

reaching half of endopod segment 1, without lateral setae, and with zero to five apical setae; endopod segment 2 without lateral setae. Maxilliped 2 without lateral processes on carpus and propodus in females (Fig. 4B), and armed with triangular, apically pointed processes in males. Pereopod dactylus rather thick, nearly as long as wide (Figs 4C, D, 5A–E). Pereopod 3–6 carpopropodus 4-segmented; segment 1 shorter than segments 2–4 combined.

Body length. Males 2.6–4.5 mm, females 2.8–5 mm (Bowman & Orsi, 1992; Scripter *et al*., 2020).

Comparison. *Deltamysis holmquistae* is distinguished from other species of the genus by the telson apically without cleft and armed with two (rarely three) short spinules. It is not possible to establish affinities between the species of *Deltamysis* at the current state of our knowledge. Comparison of the diagnostic morphological characters can be seen in Table 1.

Description of Australian specimens. Telson shorter than last abdominal segment, 1.2 times as long as wide anteriorly. Lateral spiniform setae, subterminal pair about as long as or longer than previous lateral. Terminal spiniform setae 0.21 times as long as telson and 1.1 times as long as longest posterolateral spiniform setae. Telson apical margin truncated, without cleft, bearing two thin and rather long spinules, set apart, 0.33 of lateral terminal spiniform setae.

Cornea well-developed, nearly (0.95) as wide as stalk. Antennular peduncle segment 3 with two plumose and two smooth distomedial setae. Antennal scale 2.9 times as long as wide, nearly reaching distal margin of antennular peduncle segment 3, and about as long as antennal peduncle. Antennal peduncle segment 2 slightly longer than segment 3.

Labrum apically nearly rounded. Mandibular palp rather wide; segment 2 with two medial setae. Maxilla 2 exopod reaching half of endopod segment 1, without lateral setae and with zero or two apical setae; endopod segment 2 without lateral setae. Maxilliped 1 dactylar claw with subapical wing-like extensions. Maxilliped 2 endopod with smooth carpus and propodus.

Pereopod 1 and 2 endopods with ischium and merus nearly on one line, with slight bending capability in relation to each other; carpopropodus 3-segmented, with rather strong, posteriorly serrated setae. Pereopod 1 endopod, ischium 4.7 times as long as wide, with one lateral and one distomedial seta; merus 4.4 times as long as wide and 0.8 times as long as ischium, with two lateral and one distomedial bunches of setae; carpopropodus 3-segmented, segment 1 is 1.1 times as long as segments 2 and 3 combined, with two distomedial bunches of one thin seta and one strong posteriorly serrated seta; segment 3 with two paradactylary setae, posteriorly finely serrated; dactylus rather strong, nearly as long as wide, 0.4 of carpopropodus segment 3 length. Pereopod 2 exopod 9-segmented. Endopod ischium 6

Table 1. Comparison of the diagnostic morphological characters between the species of the genus *Deltamysis* (unique character states indicated in bold).

characters	species (in alphabetic order)			
	D. holmquistae	*D. lowryi* sp. nov.	*D. nana*	*D. songkhlaensis*
Anterior margin of carapace	Apically rounded	Apically rounded	Apically rounded	**Apically pointed or blunt**
Eye cornea width / stalk width	0. 7–0.96	0.7–0.95	0.8	**0.57–0.63**
Telson				
length / width	1.1–1.3	1.1–1.4	**1.5–1.6**	1.1–1.2
cleft presence	Absent	Present	Present	Absent
cleft / telson length	—	0.05	0.02	—
apical spinules number	2 or 3	**7**	2	2
apical spinules length / lateral terminal spiniform setae length	0.23–0.58	0.09–0.25	0.43	**1.0–1.1**
lateral terminal / subterminal spiniform setae length	0.51–1.5	**3.1–3.4**	0.94	0.95–1.1
subterminal / previous postero-lateral spiniform setae length	1.1–2.4	**0.48**	1.6	0.95–1.1
lateral terminal spiniform setae length/ telson length	0.20–0.42	0.22–0.23	**0.12**	0.27–0.32
Maxilla 2				
exopod and endopod lateral setae	Absent	Absent	Present	Present
exopod length	Barely reaching half of endopod segment 1	Reaching endopod segment 2	Reaching half of endopod segment 1	Reaching endopod segment 2
Maxilliped 2				
endopod carpus and propodus lateral processes	Present in males	Present in males	Absent in females, ? in males	**Absent**
Pereopod dactylus	Thick	Thin	Thin	Thick
Pereopod 3–6				
carpopropodus segment number	4	4 or 5	4 or 5	4
segment 1 / segments 2–4 (5) combined length	Shorter	Shorter	Shorter	**Longer, as long as or only slightly shorter**

times as long as wide and about as long as merus, with three medial setae; merus 6 times as long as wide, with distolateral and distomedial bunches only; carpopropodus 3-segmented, segment 1 as long as segments 2 and 3 combined.

Pereopod 3–6 basis with distomedial tubercle, endopod long and thin, preischium and ischium without setae; ischium and merus bending in relation to each other; dactylus rather thick. Pereopod 3 ischium 9 times as long as wide; merus 11 times as long as wide and 0.9 of ischium length, with five medial bunches of one or two short setae; carpopropodus 4-segmented, segment 1 is 1.3 times as long as segments 2 and 3 combined. Pereopod 4 endopod long and thin, preischium and ischium without setae; ischium 11 times as long as wide; merus 11 times as long as wide and 0.8 of ischium length, with four medial bunches of one or two short setae; carpopropodus 4-segmented, segment 1 as long as segments 2 and 3 combined. Pereopod 5 endopod long and thin, preischium and ischium without setae; ischium 13 times as long as wide; merus 9 times as long as wide and 0.7 of ischium length, with four medial bunches of one or two short setae; carpopropodus 4-segmented, segment 1 is 1.1 times as long as segments 2 and 3 combined. Pereopod 6 exopod 9-segmented, endopod long and thin, preischium without setae; ischium 11 times as long as wide; merus 8 times as long as wide and 0.6 of ischium length, with four medial bunches of one or two short setae; carpopropodus 4-segmented, segment 1 is 0.9 times as long as segments 2 and 3 combined.

Pleopod 2 longest apical seta 0.9 of ramus length. Pleopod 3 longest apical seta 0.8 of ramus length. Pleopod 5 longest apical seta 0.4 of ramus length.

Variation. Scripter *et al*. (2020) provided rather detailed information on the variation in *D. holmquistae*. I will only mention here the most diagnostically important features. The species has considerable variability in cornea size, from being clearly narrower than the eyestalk (0.7 times as wide as the eye stalk) to nearly as wide (0.96). The antennal scale is 2.5–3.6 times as long as wide and shorter, about as long as or even slightly longer than the antennal peduncle. The telson can be shorter or longer than the last abdominal segment. One of the illustrated males from Florida (Scripter *et al*., 2020, fig. 3D) had the terminal lateral spiniform setae less than half as long as the subterminal. The telson apex can be rather smoothly rounded, with apical spinules set close together, like in the specimens from India (cf. Panampunnayil & Biju, 2007), or truncated with the spinules set apart, like in the types, illustrated by Bowman & Orsi (1992) and the Australian specimens.

Distribution. USA, California: San Joaquin Estuary, Sacramento (Bowman & Orsi, 1992; Dean *et al*., 2005); Florida: Port of Jacksonville, the lower St. Johns River and surrounding St. Johns estuarine system, the Indian River lagoon, and Fort Lauderdale brackish water canals; Texas: Gulf of Mexico near Freeport (Scripter *et al*., 2020). India, Kerala: Arabian Sea inlets near Kochi (Panampunnayil & Biju, 2007). Australia, New South Wales: Coral Sea near Yamba; Tasman Sea, Twofold Bay.

Habitat. Estuarine-marine species, found in salinities from 0 to 32‰. The Australian specimens were trapped at open sea sandy beaches, at depth of 8 m.

Remarks. *Deltamysis holmquistae* was originally described by Bowman & Orsi (1992) in detail, but with the sexual dimorphism and other considerable variation unreported. The authors also illustrated maxilla 2 endopod as 3-segmented, while it is always 2-segmented in Mysida. Revising the paratypes together with additional new material, Scripter *et al*. (2020) revealed discrepancies in the original description and redescribed *D. holmquistae*. They also synonymized *K. pillaii* based on the redescription and comparison with the *K. pillaii* description. The pereopod 1 and 2 carpopropodus segment 1 was originally illustrated as longer than the segments 2 and 3 combined (Bowman & Orsi, 1992, fig. 3D). Later, in Panampunnayil & Biju (2007, fig. 4A, B) from the Indian coast, and in Scripter *et al*. (2020, fig. 2F, G) from the US coast the segment 1 was shown to be shorter than the segments 2 and 3 combined. Previous authors did not give detailed illustrations of maxilliped 1 dactylar claw, which may possess the apical wing-like extensions, described above. These could be additional diagnostic features, but further study is necessary to confirm. After the transfer of more species into the genus *Deltamysis*, it became necessary to provide a diagnosis for *D. holmquistae*, which was previously analogous to the generic diagnosis. Considering the detailed study of Scripter *et al*. (2020) and comparing the species with the other three members, I attempted above to compose a new diagnosis.

Deltamysis lowryi sp. nov.

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Figs 6–8

Holotype: Male (+slide), 4 mm, Australia, New South Wales, Yamba, off the end of the jetty at the Blue Dolphin Caravan Park, 29°26'S 153°20.5'E, 1 m, *Zostera* with anoxic mud, st. NSW 316, baited trap, set 15:00, retrieved 08:00–09:00, coll. J. K. Lowry, S. J. Keable, 06–07 Jun 1988, AM P.98699.

Etymology. The species is dedicated to carcinologist James Kenneth (Jim) Lowry, one of the two collectors of the holotype, for his support in various crustacean projects, and for his contributions to zoology.

Diagnosis. Anterior margin of carapace angular, apically rounded (Fig. 6B). Cornea narrower than eyestalk (0.7 as wide as stalk). Telson (Fig. 6C, D) rather prolonged with nearly parallel lateral margins, 1.4 times as long as wide anteriorly, apically with shallow cleft, 0.05 of telson length, bearing seven spinules, shorter than one third of lateral terminal spiniform setae; its lateral margins with eight spiniform setae; subterminal spiniform setae shorter than preceding lateral and terminal; terminal spiniform setae 0.22–0.23 of telson length. Maxilla 2 (Fig. 8A), exopod big, reaching endopod segment 2, without lateral setae, but three apical setae; endopod without lateral setae. Maxilliped 2 with lateral processes on carpus and propodus (Fig. 8B). Pereopod dactylus rather thin, about twice as long as wide (Fig. 8C–G). Pereopod 3–6 carpopropodus 4- or 5-segmented; segment 1 shorter than other segments combined (Fig. 8E, F).

Body length. 4 mm.

Comparison. *Deltamysis lowryi* sp. nov. is differentiated from all the species of its genus by having seven spinules in the telson cleft (only two, rarely three spinules in other

Figure 6. *Deltamysis lowryi* sp. nov., holotype, male, 4 mm, New South Wales, Yamba, AM P.98699. (*A*) habitus, lateral; (*B*) head, dorsal; (*C*) posterior part of body with telson and uropods, dorsal; (*D*) telson posterior part; (*E*) posteroventral margin of abdominal segment 6, and uropodal protopod; (*F*) antennular peduncle distal part, dorsal; (*G*) antennal peduncle and scale, ventral view. Scales (mm): A = 1; B, C, G = 0.5; D–F = 0.25.

Figure 7. *Deltamysis lowryi* sp. nov., holotype, male, 4 mm, New South Wales, Yamba, AM P.98699: (*A*) mandibular palp, anterior; (*B*) mandibles, ventral; (*C*) labrum, ventral; (*D*) maxilla 1 outer ramus, posterior; (*E*) maxilliped 1, anterior; (*F*) pleopod 2, anterior; (*G*) pleopod 4, anterior; (*H*) pleopod 5, anterior. Scales (mm): A–D, F–H = 0.25; E = 0.5.

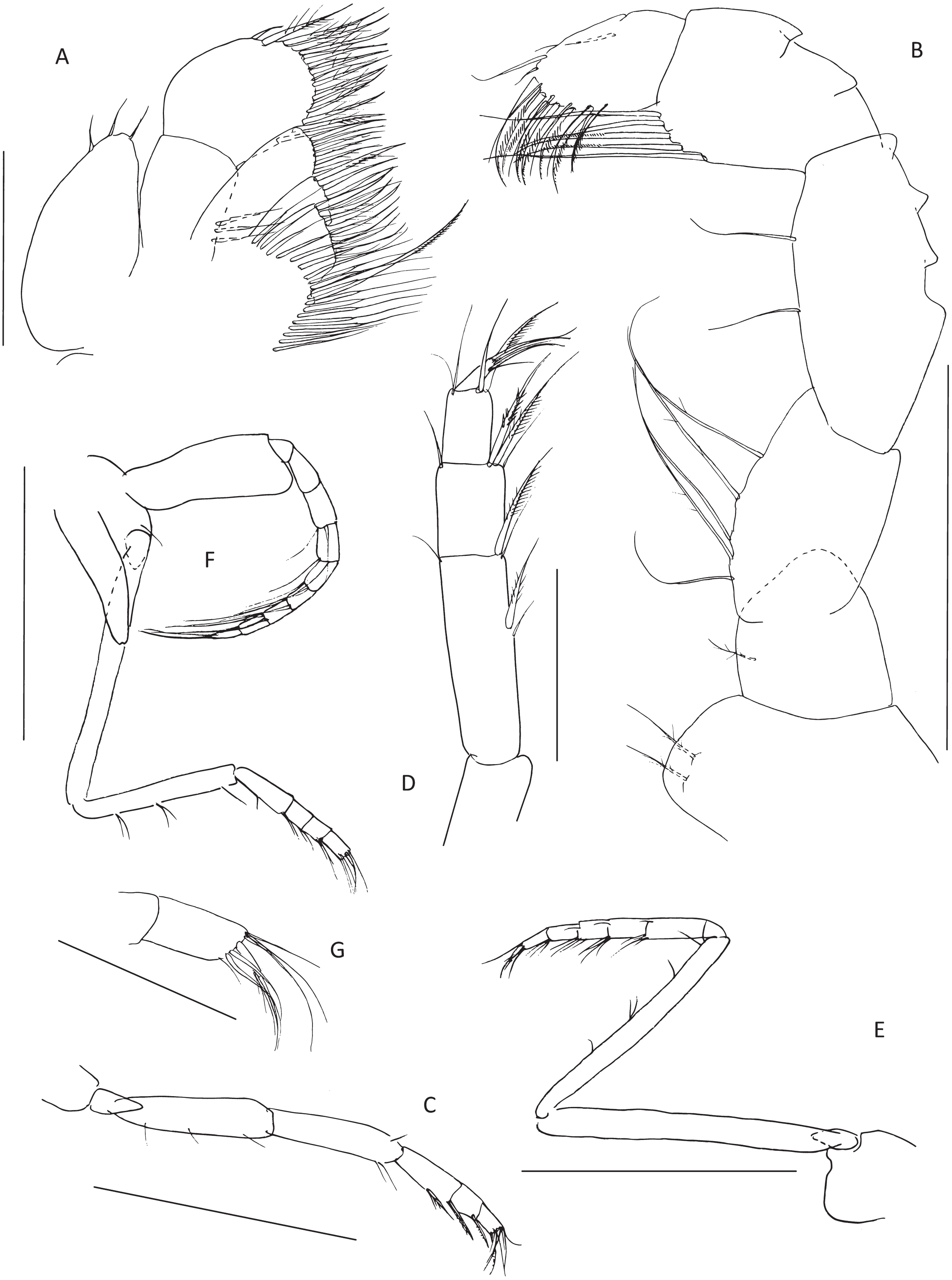

Figure 8. *Deltamysis lowryi* sp. nov., holotype, male, 4 mm, New South Wales, Yamba, AM P.98699: (*A*) maxilla 2, posterior; (*B*) maxilliped 2 endopod, anterior; (*C*) pereopod 1 endopod, posterior; (*D*) pereopod 1 distal part, posterior; (*E*) pereopod 4 endopod, anterior; (*F*) pereopod 6, posterior; (*G*) pereopod 1 distal part, posterior. Scales (mm): A, D, G = 0.25; B, C, E, F = 0.5.

species) and the telson lateral subterminal spiniform setae significantly shorter than the preceding lateral spiniform setae (longer in other species). Additional differences from particular species can be seen in Table 1.

Description of male holotype. Anterior margin of carapace slightly produced, angular, with rounded apical margin, covering eye stalk bases. Abdomen rather long, more than twice as long as cephalothorax. Abdominal segment 6, posteroventral lobes overlapping. Telson 0.93 of last abdominal segment, rather wide apically, 1.4 times as long as wide and 0.41 times as wide posteriorly (outside of terminal spiniform setae) as anteriorly. Lateral margins almost straight, with eight spiniform setae, gradually increasing in length posteriorly, except for subterminal, half as long as previous lateral and 0.3 of terminal. Terminal spiniform setae 0.22–0.23 times as long as telson and 1.6 times as long as longest posterolateral spiniform setae. Telson apical margin with slight cleft, 0.05 of telson length, bearing seven thin spinules.

Eyes quite large, 0.5 as long as head width, almost globular, 1.2 times as long as wide; stalk anteromedial part slightly produced; cornea lateral, narrower (0.7) than stalk (laterocorneal eyes). Antennular peduncle, segment 3 with one medial and three distomedial plumose setae. Antennal scale reaching about half of antennular peduncle segment 3, slightly longer than antennal peduncle, 2.5–2.6 times as long as wide. Antennal peduncle segment 2 is 1.45 times as long as segment 3. Labrum apically with smoothly rounded marginal plate. Mandible, left incisor and lacinia mobilis with three cusps. Mandibular palp, segment 2 medial margin with two thin median and three distal flagellate setae, lateral margin with one long distal seta; segment 3 is 0.4 times as long as segment 2. Maxilla 1, outer ramus with eight smooth apical spiniform setae. Maxilla 2, exopod oviform, rather big, reaching endopod segment 2, twice as long as wide, with three apical setae and without lateral setae; endopod segment 2 without lateral setae.

Maxilliped 1 exopod 8-segmented. Endopod typical for subfamily; dactylar setae smooth; unguis apically with wing-like expansions. Maxilliped 2 endopod, segments rather strong, with only medial setae (except dactylus). Basis with two plumose setae. Ischium with one plumose seta. Merus 1.6 times as long as wide and 0.8 times as long and about as wide as carpus, with five plumose setae. Carpus 2.2 times as long as wide, with two setae and four distolateral cuticular prominences (or processes). Propodus 1.5 times as long as wide, with five anteriorly finely serrated setae and two lateral prominences. Dactylus 1.7 times as long as wide and 0.7 times as long as carpus, with three lateral setae and lateromedian suture, six distomedial posteriorly serrated setae and thin setae among the latter.

Pereopod 1 endopod with ischium and merus nearly on one line, with slight bending capability in relation to each other; preischium without setae; ischium 4.4 times as long as wide, with three medial setae; merus 4.3 times as long as wide and 0.8 times as long as ischium, with one distomedial bunch of setae; carpopropodus 3-segmented, segment 1 is 1.3 times as long as segments 2 and 3 combined, with two distomedial bunches of one thin seta and one strong anteriorly and posteriorly serrated seta; segment two with distomedial bunch of one thin seta, one stronger seta with anterior and posterior fine serrations and strong seta with robust anterior and posterior serrations; segment 3 with two paradactylary setae, one smooth and one posteriorly finely serrated; dactylus rather thin, about twice as long as wide, half as long as carpopropodus segment 3, with two smooth and equally strong dactylary setae.

Pereopod 4 endopod long and thin, preischium and ischium without setae; ischium 11 times as long as wide; merus 12 times as long as wide and 0.9 of ischium length, with four medial bunches of one or two short setae; carpopropodus 5-segmented, segment 1 being 1.2 times as long as segments 2 and 3 combined. Pereopod 6 exopod 8-segmented, endopod long and thin, preischium and ischium without setae; ischium 12 times as long as wide; merus 8 times as long as wide and 0.6 of ischium length, with three medial bunches of one or two short setae; carpopropodus 4-segmented, segment 1 is 1.5 times as long as segments 2 and 3 combined; paradactylary and dactylary setae smooth; dactylus rather thin, 0.4 times as long as carpopropodus segment 4.

Penis rather long, tubiform, slightly narrowing apically. Pleopods not modified. Pleopod 2 longest apical seta 0.9 of ramus length. Pleopod 4 longest apical seta 0.7 of ramus length. Pleopod 5 longest apical seta 0.4 of ramus length. Uropodal endopod shorter than exopod, without medial spiniform setae.

Distribution. Australia, New South Wales: Clarence River mouth, Yamba.

Habitat. The only male was trapped in the river mouth conditions, on muddy bottom with *Zostera*, at depth of 1 m.

Deltamysis nana (Murano, 1998)

Heteromysoides nana Murano, 1998: 32–37, figs 4, 5.—Hanamura & Kase, 2001: 65, 70, fig. 3d; 2004: 2151.—Lowry & Stoddart, 2003: 450.—Yolanda *et al*., 2019: 535, 541.

Deltamysis nana.—Daneliya, 2021: 4.

Holotype: Female (with embryos), 3.3 mm, Australia, Northern Territory, Channel Island, mud around mangroves, coll. K. Coombes, 2 Jul 1991, NTM Cr. 008032 (Murano, 1998).

Diagnosis. Anterior margin of carapace angular, apically rounded. Cornea narrower than stalk (0.8 times as wide). Telson rather long, trapezoidal, with tapering lateral margins, 1.5–1.6 times as long as wide anteriorly; apically with barely visible cleft, 0.02 of telson length, with two spinules, less than half as long as lateral terminal spiniform setae; its lateral margins with five spiniform setae; subterminal spiniform setae about twice as long as preceding lateral and about as long as terminal; terminal spiniform setae 0.12 of telson length. Maxilla 2, exopod rather small, not reaching endopod segment 2, with numerous short lateral setae; endopod with lateral setae. Maxilliped 2 without lateral processes on carpus and propodus. Pereopod dactylus rather thin, about twice as long as wide. Pereopod 3–6 carpopropodus 4–5-segmented, segments thin, prolonged; segment 1 significantly shorter than other segments combined.

Body length. Only known female holotype is 3.3 mm (Murano, 1998).

Comparison. *Deltamysis nana* is distinguished from other species of the genus by the narrowest telson. Other specific differences can be consulted in Table 1.

Distribution. So far known only from its type locality by the Australian coast of the Timor Sea, Northern Territory, near Channel Island (Murano, 1998).

Habitat. Found among the mangroves in mud (Murano, 1998).

Remarks. Murano (1998) described and illustrated this species in detail, and assigned it to the genus *Heteromysoides*. He did not mention any particular reason for such an assignment, but presumably for the somewhat subquadrate, flattened eyes. It was already noted that *H. nana* had the shape of the eyes, telson, mandibular palp and pereopods similar to *Deltamysis*, and the species was transferred to this genus (Daneliya, 2021). Here I compare it with all known species of *Deltamysis* and revise its diagnosis.

Deltamysis songkhlaensis (Yolanda, Sawamoto & Lheknim, 2019)

Heteromysoides songkhlaensis Yolanda *et al.*, 2019: 536–542, figs 2–4.
Deltamysis songkhlaensis.—Daneliya, 2021: 4.

Type material. Holotype, allotype, and numerous paratypes, Songkhla Lagoon, Thailand, Songkhla Province, Singha-Nakhon District, Tambon Bang Khiat, Ban Bang Khiat, Thale Sap, 7°20'58.68"N 100°25'31.56"E (see Yolanda *et al.*, 2019).

Diagnosis. Anterior margin of carapace angular, apically pointed or blunt. Cornea narrower than eyestalk (0.57–0.63 times as wide). Telson rather short, with tapering lateral margins, posteriorly rounded, 1.1–1.2 times as long as wide anteriorly; apically without cleft, rather convex, and spinules nearly undistinguishable in length from neighbouring spiniform setae; its lateral margins with four to seven spiniform setae on each side, gradually increasing in length; longest terminal spiniform setae 0.27–0.32 of telson length. Maxilla 2, exopod rather large, reaching endopod segment 2, with numerous lateral setae; endopod with lateral setae. Maxilliped 2 without lateral processes on carpus and propodus. Pereopod dactylus rather thick. Pereopod 3–6 carpopropodus 4-segmented; segment 1, longer, subequal or only slightly shorter than other segments combined.

Body length. Males 3.2–4.0 mm, females 3.1–3.7 mm (Yolanda *et al.*, 2019).

Comparison. *Deltamysis songkhlaensis* is the most differentiated species in the genus, with unique shape of the carapace anterior margin (see diagnosis), the deepest reduction of the eye cornea, the telson armature and the segment ratio in pereopod 3–6 carpopropodus (Table 1).

Distribution. Currently known only from the Songkhla Lagoon system in Thailand (Yolanda *et al.*, 2019).

Habitat. Found in brackish water conditions (0.47–24.8 psu) on the muddy bottom at depths of 0.6–1.5 m (Yolanda *et al.*, 2019).

Remarks. Yolanda *et al.* (2019) in their detailed description of *D. songkhlaensis* attributed the species to the genus *Heteromysoides* (Daneliya, 2021). They noticed certain similarities of *D. songkhlaensis* to a species formerly known as *H. nana*, now also a member of *Deltamysis*, as well as other former *Heteromysoides* species, currently belonging to the genus *Platyops* (tribe Heteromysini). *Deltamysis songkhlaensis* is indeed similar to *D. nana*, but not more than to the other three species of *Deltamysis*, equally sharing with them all the generic diagnostic features. In the prior work I transferred *H. songkhlaensis* to *Deltamysis*, and here I update the species diagnosis, comparing it with other members of the genus.

Concerning the structure of the telson, it is not possible to say, whether the apical spinules are entirely missing in *D. songkhlaensis* or they are strongly developed into the large spiniform setae, which are undistinguishable from the lateral spiniform setae. I have been calling these spine-like structures "spinules", because they are normally attached to the telson without articulation. In *D. songkhlaensis* the apical spine-like structures are clearly articulated, as it was figured by Yolanda *et al.* (2019), but to maintain their presumed homology I prefer to call them "spinules".

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A New Species of *Metaprotella* (Crustacea: Amphipoda: Caprellidae) from One Tree Island, Southern Great Barrier Reef, Queensland, Australia

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ABSTRACT. *Metaprotella sandalensis* Mayer, 1898 (Caprellidae: Amphipoda: Crustacea) and related congeners are widely distributed in the Indo-West Pacific. As a first step in elucidating the species diversity of *Metaprotella* from the Great Barrier Reef, a new species, *Metaprotella lowryi* sp. nov. collected from One Tree Island in southern Great Barrier Reef is described and figured. *Metaprotella lowryi* sp. nov. differs from *M. sandalensis* [sensu stricto] by shorter antenna 1 relative to body length and shorter antenna 1 peduncle article 3. The new species of *Metaprotella* is also closely related to *M. solitaria* Takeuchi & Lowry, 2017, reported from the Solitary Islands off the northern coast of New South Wales, but differs by the characters of the head, the propodus of gnathopod 2 and the dorsodistal projections of pereonite 3.

Introduction

The taxonomy the Caprellidae (Crustacea: Amphipoda) including the genus *Metaprotella* is particularly fluid, with a legacy of "variants" listed in the taxonomic literature until the 1940s (Mayer, 1890, 1903; Schellenberg, 1938; Utinomi, 1947). With increasingly detailed study of caprellid and phtisicid morphological microstructures and application of molecular tools, many seemingly widespread species are now understood to represent species complexes (Takeuchi & Lowry, 2007b, 2015[2016], 2019; Cabezas *et al*., 2013; Takeuchi & Oyamada, 2013; Hughes & Takeuchi, 2016; Takeuchi *et al*., 2022).

The genus *Metaprotella* Mayer, 1890, currently composed of 13 species, is one of the common caprellid genera in tropical to subtropical regions of the northern Hemisphere and in tropical to temperate regions of the southern Hemisphere (McCain & Steinberg, 1960; McCain, 1968; Larsen, 1997; Guerra-Garcia, 2002, 2003a, b; Momtazi & Sari, 2013; Takeuchi & Lowry, 2007a, 2019). Of these, *Metaprotella sandalensis* Mayer, 1898 (type locality: Sandal Bay, Lifou Island, New Caledonia) is reportedly widespread in shallow waters of the tropical Indo-west Pacific (Lim & Takeuchi, 2012). *Metaprotella sandalensis* was first reported in Australia by Mayer (1913) from Western Australian and from the Great Barrier Reef by Guerra-Garcia (2006). Both studies relied on the limited original description of the species (Mayer, 1898) and the first review (Mayer, 1903), which documented *M. sandalensis* throughout the Indonesian archipelago owing to the extensive sampling by the *Siboga*

Keywords: Crustacea, Amphipoda, Caprellidae, *Metaprotella*, southern Great Barrier Reef, Australia, coral reef
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Expedition. Following the redescription of *Metaprotella sandalensis* from the type locality by Lim & Takeuchi (2012), it is now possible to more reliably assess taxonomic status of *M. sandalensis* and its congeners.

As a first step in elucidating the species diversity of *Metaprotella* from the Great Barrier Reef, a new species of *Metaprotella* from One Tree Island in the southern Great Barrier Reef is described in this paper.

Materials and methods

The material examined for this study was collected at One Tree Island as part of the Circum-Australian Amphipod Project funded by the Department of Environment, Water, Heritage and the Arts (Coleman & Lowry, 2012; Hughes & Bopiah, 2013). One Tree Island is a coral cay in the southern Great Barrier Reef, surrounded by a mature lagoonal shelf reef (Harris *et al*., 2011). The lagoonal shelf reef is located 70 km east of the Queensland coast, 20 km from the shelf edge, and surrounded by waters approximately 60 m in depth (Harris *et al*., 2011). The mouth parts and appendages were dissected in 80% ethanol. Temporary slides were made using 100% glycerol. Permanent slides were made using either Polyvinyl lactophenol or AquatexTM (Merck, Darmstadt, Germany) mounting agent. Illustrations were made with a Laborlux K (Leitz Wetzlar, Germany) Heerbrugg stereomicroscopes (Wilde, Switzerland) or Olympus BX60 (Olympus Corporation, Japan) fitted with camera lucida. Family classification follows Takeuchi & Lowry (2019).

Systematics

Family Caprellidae Leach, 1814

Genus *Metaprotella* Mayer, 1890

Type species. *Metaprotella haswelliana* (Mayer, 1882).

Metaprotella lowryi sp. nov.

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Figs 1–3

Holotype: Male, 7.08 mm, AM P.100147, outer reef of north of Third Lagoon, One Tree Island, 23°29'05"S 152°04'07"E, 18 m depth, *Halimeda* sp., QLD 1983, coll. I. Takeuchi & J. K. Lowry, 27 October 2006. **Paratypes**: Male, 8.59 mm, AM P.100148, outer reef north of Third Lagoon, One Tree Island, 23°29'05"S 152°04'07"E, 12 m depth, white hydroids, QLD 1984, coll. I. Takeuchi & J. K. Lowry, 27 October 2006, coll. I. Takeuchi & J. K. Lowry; 1 mature female, 6.02 mm, AM P.100149, outer reef north of Third Lagoon, One Tree Island, 23°29'05"S 152°04'07"E, 12 m depth, white hydroids, QLD 1984, coll. I. Takeuchi & J. K. Lowry, 27 October 2006.

Type locality. Outer reef north of Third Lagoon, One Tree Island, southern Great Barrier Reef, Queensland, Australia, 23°29'05"S 152°04'07"E.

Etymology. Named for the late Dr J. K. Lowry in recognition of his contribution to Amphipodology.

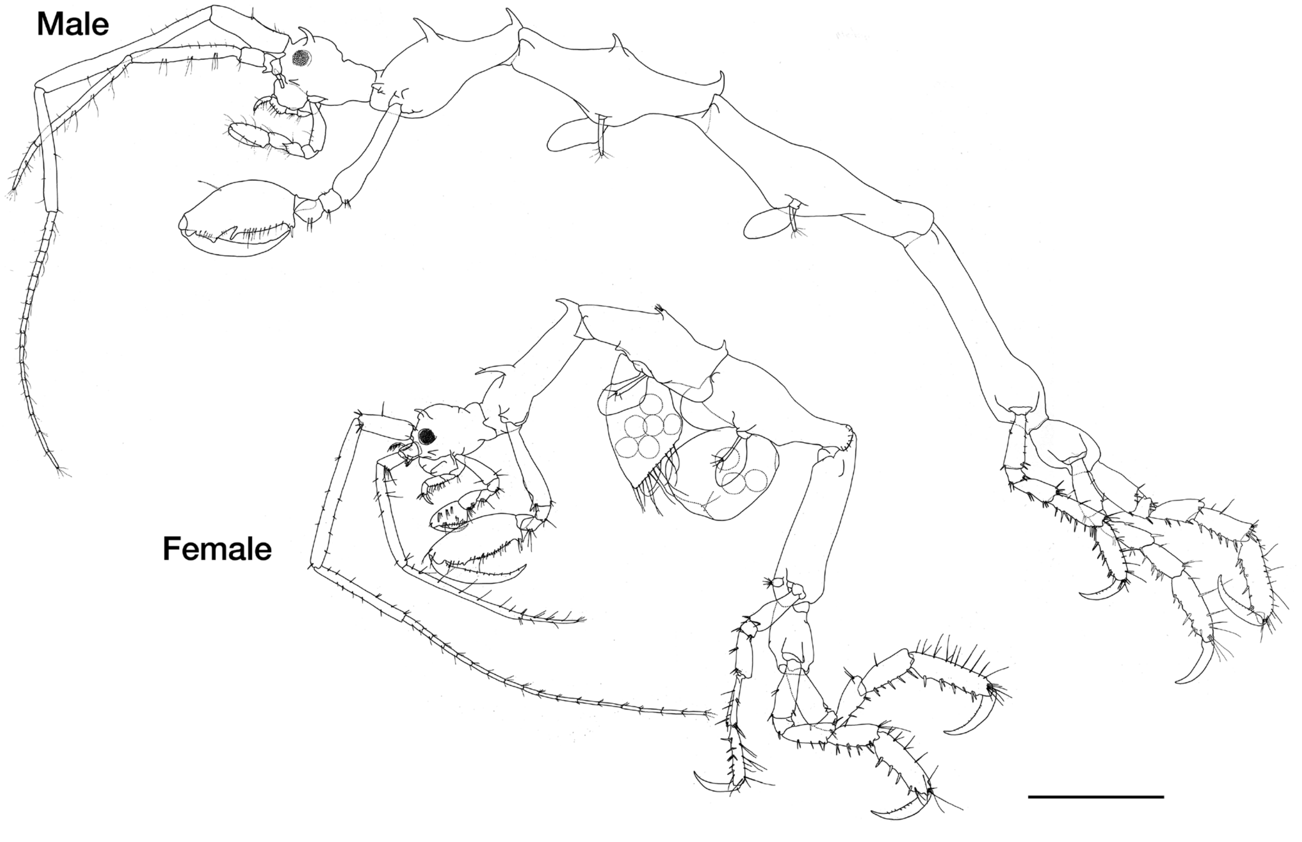

Figure 1. *Metaprotella lowryi* sp. nov., holotype male, 7.08 mm, AM P.100147, and paratype female, 6.02 mm, AM P.100149, One Tree Island, Great Barrier Reef, Queensland, Australia, 23°29'05"S 152°04'07"E. Scale 1.0 mm.

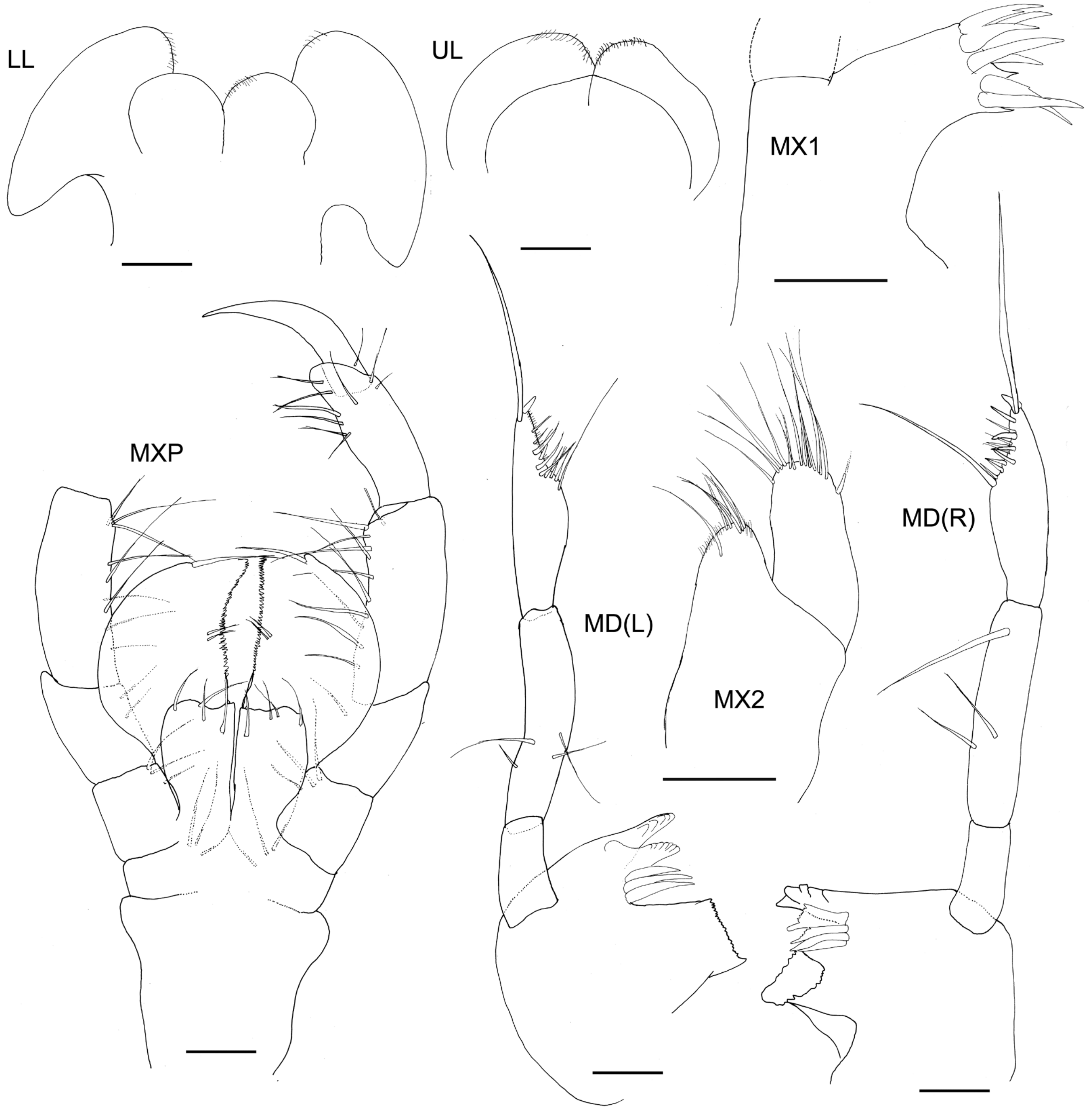

Figure 2. *Metaprotella lowryi* sp. nov., holotype male, 7.08 mm, AM P.100147, One Tree Island, southern Great Barrier Reef, Queensland, Australia, 23°29'05"S 152°04'07"E. L, left; LL, lower lip; MD, mandible; MX, maxilla, MXP, maxilliped; R, right, and UL, upper lip. Scale = 0.05 mm.

Description. **Male** (based on holotype, 7.08 mm, AM P.100147). Head and pereonites slender.

Head. With paired anteriorly curved dorsal projections and small subocular projection (i.e. projection just below the eye). Eyes large, distinctive. Antenna 1 slender, 0.60 times body length; peduncle article 2 longest; peduncular article 3 0.70 times peduncle article 2 length; flagellum 0.70 times peduncular length, with 16 articles. Antenna 2 slender; 0.5 times antenna 1 length; peduncle not strongly setose.

Upper lip notched, forming rounded quadrilateral projections. Mandible right incisor with 5 teeth; lacinia mobilis with 1 plate and 2 teeth, with 2 bundled setal rows; palp 3-articulate, article 3 setal formula 1-8-3-1; molar well developed, with flake. Mandible left incisor with 5 teeth; lacinia mobilis with 5 teeth, 3 bundled setal rows; palp 3-articulate; article 3 setal formula 1-9-3-1; molar well developed. Lower lip finely setose on inner and outer lobes. Maxilla 1 outer plate with 7 stout apical setal-teeth (palp lacking during dissection). Maxilla 2 inner plate triangular, with 7 setae; outer plate elongate, with approximately 15 apical setae. Maxilliped basal endite (inner plate) subquadrate, with 1 small nodular setae, with 4 setae near distal margin; ischial endite (outer plate) oval, 2.5 times length of inner plate, inner margin blade-like, with many fine setae, with 1 large seta on apical lateral margin, with 2 setae on middle lateral margin; palp article 2 setose on inner margin; palp article 3 expanded, with moderately dense distal setae; palp article 4 (dactylus) weakly falcate.

Pereon. Pereonite 2 with small anterolateral projection, with small midlateral projection, with paired anteriorly

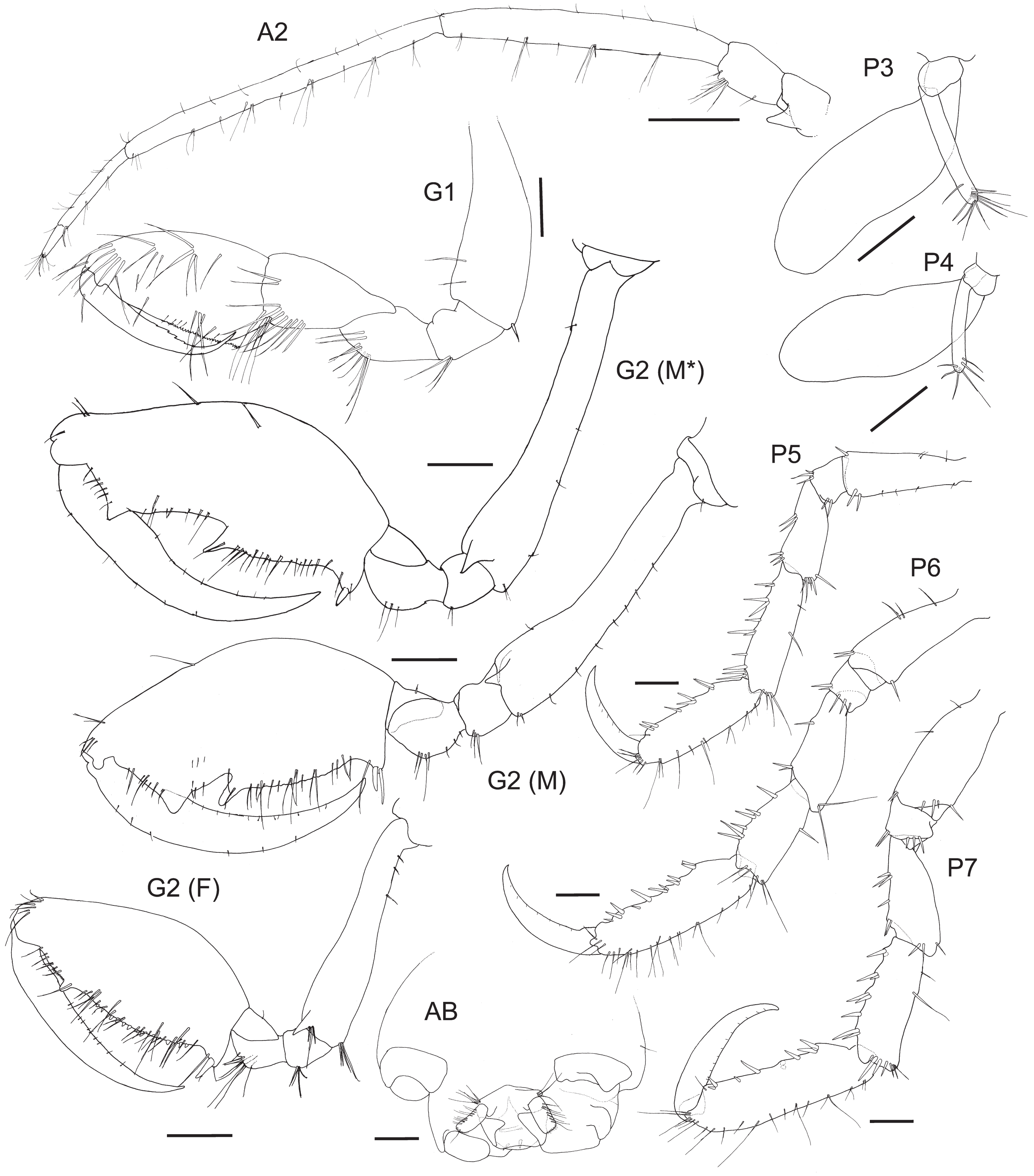

Figure 3. *Metaprotella lowryi* sp. nov.: One Tree Island, southern Great Barrier Reef, Queensland, Australia, 23°29'05"S 152°04'07"E: A2, G1, G2 (M), P3–P7, holotype male, 7.08 mm, AM P.100147; G2 (M*), AB, paratype male, 8.59 mm, AM P.100148; G2 (F), paratype female, 6.02 mm, AM P.100149. A2, antenna 2; AB, abdomen; F, female; G1, gnathopod 1; G2, gnathopod 2; M, male; P3–P7, pereopod 1 to pereopod 7, respectively. Scale: G1, P3, P4, and AB = 0.1 mm; 0.2 mm for all others.

curved mid-dorsal projections, with curved dorsodistal projection. Pereonite 3 with anterolateral projection, with paired anteriorly curved mid-dorsal projections, with anteriorly curved dorsodistal projection. Pereonite 4, longest, with anterolateral projection. Pereonite 5, next to pereonite 4 length, with anterolateral projection. Pereonites 6 and 7 not articulated obliquely.

Gnathopod 1 carpus setose; propodus subtriangular, palm inserting at 0.1 along posterior margin, minutely serrate, with 1 robust seta near corner of palm, dactylus slightly curved. Gnathopod 2 inserting at 0.20 along anterior margin of corresponding pereonite; coxa vestigial; basis 0.7 times length of pereonite 2, with acute projection near distal margin; propodus subovate, large, length 2 times width palm margin straight, smooth, with grasping projection with 1 grasping spine, setose on palm, with distal shelf, with sinus, with distal palm projection; dactylus falcate. Gill 3 0.25 times corresponding pereonite length, straight. Pereopod 3 with 1 article, length 8 times width, with 8 distal and 1 lateral setae. Gill 4 0.25 times corresponding pereonite length, straight. Pereopod 4 with 1 article, length 5 times width, with 5 distal setae. Pereopod 5 merus shorter than basis length; carpus equal to basis length; propodus equal to basis length, with 1 pair of grasping spine at ¼ length of posterior margin; dactylus falcate. Pereopod 7 longer than pereopod 6, both longer than pereopod 5.

Pleon (based on male, 8.59 mm, AM P.100148). Uropod 1 bi-articulate; peduncle, length about 0.5 times width, with 3 lateral setae; ramus length about 5 times peduncular length, with 9 or 10 shorter setae. Telson (dorsal lobe) present with paired setae.

Female (based on paratype, 6.02 mm, AM P.100149). Head with paired anteriorly curved dorsal projections, with small subocular projection; eye large, distinctive. Antenna 1 slender, 0.85 times body length; peduncle article 2 longest; flagellum longer than peduncular length, with + 17 articles. Pereonite 2 with 2 small anterolateral projections, with paired anteriorly curved mid-dorsal projections, with curved dorsodistal projection. Pereonite 3 with small anterolateral projection, with midlateral projection, with paired anteriorly curved mid-dorsal projections, with dorsodistal projection. Pereonite 4 small with anterolateral projection, with dorsolateral projection. Pereonite 5 with 2 small anterolateral projections. Pereonites 6 and 7 not articulated obliquely. Gnathopod 2 inserting at anterior margin of corresponding pereonite; coxa vestigial; basis 0.8 times length of pereonite 2, with triangular projection; propodus subovate.

Remarks. During a field survey of One Tree Island, southern Great Barrier Reef in October–November, 2006, Circum-Australian Amphipod Project, *Metaprotella* were collected from the outer reef of One Tree Island lagoon at around 15 m depth. The *Metaprotella* from One Tree Island closely resembles but clearly differs from *M. sandalensis* [sensu stricto] (Lim & Takeuchi, 2012) or other members of the *M. sandalensis* complex, justifying its establishment as a new species, *Metaprotella lowryi* sp. nov. *Metaprotella lowryi* differs from *M. sandalensis* in the following characteristics: (1) antenna 1 is 0.6 times body length (versus 0.8 times body length in *M. sandalensis*); (2) antenna 1 peduncle article 3 is shorter than article 2 (versus longer than article 2 in *M. sandalensis*); (3) the gnathopod 2 propodus palm lacks serratiform teeth (present in *M. sandalensis*); (4) the dorsodistal projection of both pereonites 2 and 3 is more anteriorly curved in *M. sandalensis* than in *M. lowryi*.

Metaprotella lowryi is also close to *M. solitaria* Takeuchi & Lowry, 2017 (type locality: Solitary Islands, New South Wales). The new species differs from *M. solitaria* by the following characteristics; (1) the paired dorsal projections of the head are anteriorly curved (versus straight in *M. solitaria*); (2) the gnathopod 2 propodus palm has a small distal shelf with sinus and distal palm projection, distinctly developed in the larger male (AM P.100148) (versus two distal palm projections in *M. solitaria)*; (3) mid-dorsal projections of pereonite 3 are anteriorly curved (versus straight in *M. solitaria*); (4) dorsodistal projection of pereonite 3 is anteriorly curved (versus dorsally directed in *M. solitaria*); and (5) pereonite 5 is longer than pereonite 4 (versus shorter in *M. solitaria*).

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New Data on Niphargidae (Amphipoda) from Northern Macedonia, *Niphargus lowryi* sp. nov.

(Contribution to the Knowledge of the Amphipoda 326)

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ABSTRACT. New species of subterranean freshwater species, *Niphargus lowryi*, sp. nov. (Amphipoda, fam. Niphargidae) from the springs near St. Naum Monastery on Ohrid Lake, Northern Macedonia, is described and figured. This species was collected mixed with numerous specimens of *N. sanctinaumi* S. Karaman, 1943. The relation of this species to other species of *Niphargus* from Northern Macedonia and Greece is discussed.

Introduction

The subterranean fauna of Amphipoda in Northern Macedonia has been studied intensively mainly by Stanko Karaman (1929, 1931, 1933, 1943, 1957, 1959), S. Karaman & G. Karaman (1959), and later by G. Karaman (1960, 1963, 1973, 1977, 2020a, b), Karaman & Pinkster (1987), and Gabrovsky *et al*. (2017). Regarding the family Niphargidae, nearly 20 taxa of this family have been discovered and described from 1929 to today. This fauna, however, is still only partially known, confirmed by the present discovery of a new species of *Niphargus* Schiödte, 1849 from this country, *N. lowryi* sp. nov. This species was collected in 1968 from a spring near the Monastery St. Naum at the coast of Ohrid Lake, amongst numerous specimens of *Niphargus sanctinaumi* S. Karaman, 1943. Numerous subsequent attempts to collect this species, were unsuccessful.

Materials and methods

The specimen used in this study was collected in the spring near Monastery St. Naum and preserved in 70% ethanol and is deposited in Karaman's Collection in Podgorica, Montenegro. The studied specimen was immersed in a solution of glycerin and water for study with a WILD M20 microscope and drawn manually using a camera lucida. The dissected body-parts were mounted in Liquid of Faure as permanent slides.

Some morphological terminology and setal formulae follow G. Karaman (1969, 2012): for the last mandibular palp article (A = A-setae on outer face; B = B-setae on inner face; D = lateral marginal D-setae; E = distal long E-setae) and for the propodus of gnathopods 1 and 2 (S = corner S-spine; L = lateral slender serrate L-spines; M = corner facial M-setae; R = subcorner R-spine on inner face).

The terms "setae" and "spines" are used based on shape, not origin. The study is based on morphological, ecological, and zoogeographical data.

Keywords: taxonomy, new species, *Niphargus lowryi*, Amphipoda, subterranean waters, Ohrid Lake region, Northern Macedonia
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Taxonomy

Family Niphargidae Bousfield, 1977

Niphargus Schiödte, 1849

Type species. *Niphargus stygius* (Schiödte, 1847).

Niphargus lowryi sp. nov.

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Figs 1–5

Holotype: No. S-4046, ovigerous female (22.0 mm), Spring near Monastery St. Naum, near the coast of Ohrid Lake, Northern Macedonia, 40°54'50"S 20°44'42"E, amongst specimens of *Niphargus sanctinaumi* S. Karaman, 1943, coll. G. Karaman, 21 July 1968.

Diagnosis (ovigerous female). Large species over 20 mm, metasomal segments with several short dorsoposterior marginal setae, urosomal segments 1–2 with dorsolateral spines; epimeral plates sharply angular. Antenna 1 peduncular articles progressively shorter, flagellar articles with one aesthetasc each; antenna 2 flagellum slender, as long as last peduncular article. Coxae 1–4 relatively short, coxa 4 unlobed. Maxilla 1 inner plate with 7–9 setae, outer plate spines not pectinate, palpus short. Maxilliped inner plate short, with 4 distal spines, palp article 4 with 5 marginal setae at inner margin of the dactylus. Gnathopods 1–2 large, with propodus larger than corresponding coxae, rather trapezoid, palm very oblique; L-spines of gnathopod 1 propodus sitting laterally; L-spines of gnathopod 2 propodus sitting partially behind S-spine; dactylus with row of several short outer marginal setae. Dactylus of pereopods 3–7 strong, with strong spine at inner margin near basis of nail. Pereopods 5–7 elongated, with narrowed unlobed article 2. Pleopods 1–3 with 4–6 retinacula, peduncles scarcely setose. Uropod 1 peduncle with dorsointernal row of setae, rami of equal length. Uropod 3 slender, spinose, not elongated, with very short distal article of outer ramus. Telson short, incised nearly half of its length, gaping, with 3 short distal spines and shorter lateral plumose setae.

Description of female holotype. *Body*: strong, metasomal segments 1–3 with 4 or 5 dorsoposterior marginal short setae (Fig. 4F). Urosomal segment 1 with 1 spine and 1 seta at each dorsolateral side; urosomal segment 2 with 2 spines and 1 or 2 setae on each dorsolateral side; urosomal segment 3 smooth (Fig. 1F). Urosomal segment 1 with 1 strong spine on each ventroposterior corner near basis of uropod 1-peduncle (Fig. 1F).

Epimeral plates: 1–3 nearly quadrate, sharply angular, with well-marked ventroposterior corner and poorly concave posterior margin bearing 1 stronger seta and 4–6 short single setae at at corner (Fig. 4F). Epimeral plate 2 with 1, and epimeral plate 3 with 2 ventral submarginal spines.

Head: with slightly convex dorsal margin (in lateral projection), rostrum short, lateral cephalic lobes subrounded and short, ventroanterior excavation deep; eyes absent (Fig. 1A).

Antenna 1: reaching nearly half body length; peduncular articles 1–3 moderately slender, progressively shorter (ratio: 59:48:24), very scarcely setose (all setae shorter than the diameter of articles themselves) (Fig. 1B). Main flagellum slender, with 42 scarcely setose articles, most articles with aesthetasc reaching nearly half length of article itself (Fig. 1D). Accessory flagellum very short, 2-articulated, reaching nearly half length of peduncular article 3 (Fig. 1C).

Antenna 2: moderately slender; peduncular article 3 short, nearly as long as broad, provided with distoventral cluster of setae almost as long as article itself (Fig. 1E); article 4 slightly shorter and broader than article 5 (ratio: 95:102), ventral margin with 3 clusters of setae (longest setae exceeding diameter of article itself), dorsal margin with 5 groups of short setae; article 5 with 5 ventral clusters of setae (many remarkably longer than diameter of article itself), at dorsal margin with 5 or 6 clusters of short setae; flagellum slender, nearly as long as peduncular article 5, scarcely setose, consisting of 16 articles. Antennal gland cone short (Fig. 1E).

Labrum: broader than long, slightly concave distally (Fig. 1A). Labium much broader than long, inner lobes small but well developed, outer lobes broad, entire (Fig. 2B).

Mandible: with triturative molar. Left mandible incisor with 5 teeth, lacinia mobilis with 4 teeth accompanied by 8 rakers. Right mandible incisor with 4 teeth, lacinia mobilis serrate, accompanied by 12 rakers (Fig. 2C). Mandibular palp 3-articulated: article 1 smooth, article 2 with 18 setae; article 3 subfalciform, slightly longer than article 2, more-or-less slender (Fig. 2D), with nearly 28 marginal D-setae and 6 long distal E-setae, outer face with transverse row of 7 A-setae (Fig. 2E), inner face with 4 groups of B-setae (3-4-3-1, or: 2-3-4-4) (Fig. 2D).

Maxilla 1: inner plate short, not reaching basis of outer plate-spines, with 7–9 distal setae (Fig. 4A); outer plate with 7 spines (5 spines with lateral tooth, 2 spines with 2 teeth; or 4 spines with 1 lateral tooth, 3 spines with 2 or 3 teeth); palp 2-articulated, not reaching tip of outer plate-spines and provided with 6 or 7 distal setae.

Maxilla 2: inner plate rather smaller than outer plate, with numerous distal setae, as well as marginal setae in upper half of plate (Fig. 2F); outer plate with numerous distal setae.

Maxilliped: inner plate short, with 4 distal pointed spines mixed with several setae (Fig. 2G); outer plate not exceeding half of palp article 2, at mesial margin with 3 proximal setae and 10 or 11 spines, tip with several longer setae; palp article 3 with 2 clusters of setae on outer margin and row of setae on inner margin; article 4 (dactylus) with 5 setae near basis of nail along inner margin (Fig. 2H), with median seta along outer margin; nail much shorter than pedestal.

Coxae: relatively short. Coxa 1 broader than long (ratio: 42:33), ventroanterior corner subrounded, with nearly 11 short marginal setae (Fig. 3A). Coxa 2 remarkably larger than coxa 1, nearly as long as broad, with 9 short setae along ventral margin of convex shape (Fig. 3D). Coxa 3 broader than long (ratio: 53:51), with 9 setae along the ventral margin of convex shape (Fig. 4B). Coxa 4 broader than long (ratio: 51:46), anterior margin broadly convex, with 6 or 7 setae, ventroposterior lobe absent (Fig. 4D). Coxa 5 only slightly shorter than 4, bilobed, much broader than long (ratio: 59:37), anterior lobe short, subrounded, with 4 marginal setae, posterior lobe of more quadrate shape, with 2 setae (Fig. 5A). Coxa 6 bilobed, much broader than long (ratio: 48:27), with 2 or 3 marginal setae only (Fig. 5C). Coxa 7 entire, much broader than long (ratio: 35:21), with short posterior seta (Fig. 5F).

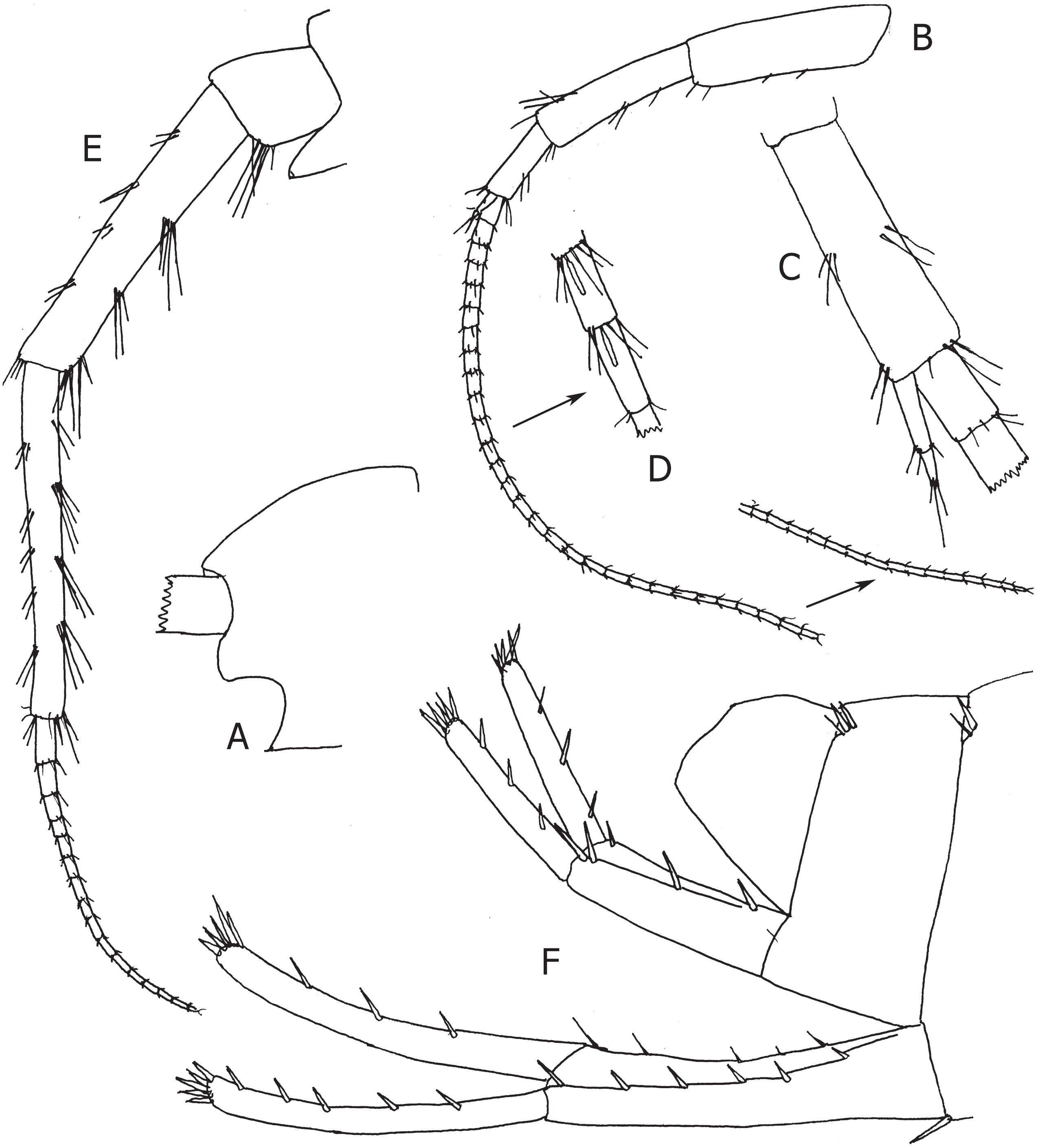

Figure 1. *Niphargus lowryi* sp. nov., spring near Monastery St. Naum, Ohrid Lake coast, female 22.0 mm (holotype): (*A*) head; (*B*) antenna 1; (*C*) accessory flagellum; (*D*) aesthetasc on antenna 1; (*E*) antenna 2; (*F*) urosome and uropods 1–2.

Gnathopods 1–2: large, propodus remarkably larger than corresponding coxa (Fig. 3A, D). Gnathopod 1 article 2 with numerous long setae at anterior and posterior margin; article 3 with distoposterior cluster of setae. Article 5 short, triangular, much shorter than propodus (ratio: 33:58), with distoanterior cluster of setae and numerous setae posteriorly (Fig. 3A). Propodus rather trapezoid (ratio: 91:77); convex posterior margin with 12 transverse rows of setae; palm convex, rather inclined over half of propodus-length, with row of numerous marginal short unequal setae (Fig. 3B), defined on outer face by corner S-spine accompanied laterally by 2 L-spines sitting very close to S-spine, and by 4 corner facial M-setae, on inner face by short subcorner R-spine (Fig. 3C). Dactylus reaching posterior margin of propodus, along outer margin a row of 6 or 7 short single or paired setae, along inner margin with row of very short setae (Fig. 3B).

Gnathopod 2 remarkably larger than gnathopod 1, article 2 with row of anterior marginal shorter setae and row of posterior long setae; article 3 with distoposterior cluster of setae. Article 5 remarkably shorter than propodus (ratio: 46:75), with distoanterior cluster of setae and numerous

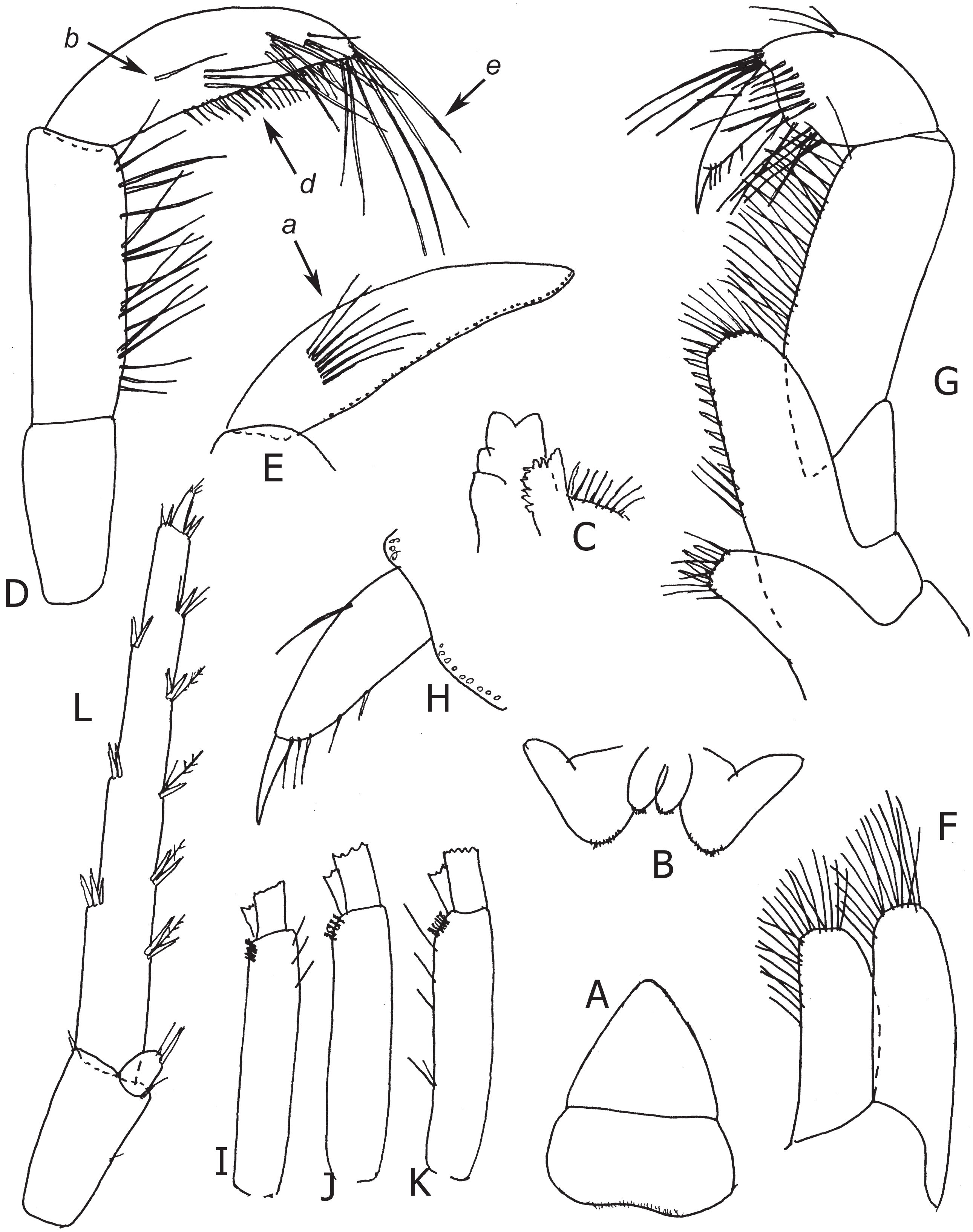

Figure 2. *Niphargus lowryi* sp. nov., spring near Monastery St. Naum, Ohrid Lake coast, female 22.0 mm (holotype): (*A*) labrum; (*B*) labium; (*C*) right mandible; (*D*) mandibular palp, inner face [*b* = facial B-setae; *d* = marginal D-setae; *e* = distal E-setae]; (*E*) mandibular palp distal article, outer face [*a*= facial A-setae]; (*F*) maxilla 2; (*G*) maxilliped; (*H*) maxilliped, distal part of palp; (*I*) pleopod 1 peduncle; (*J*) pleopod 2 peduncle; (*K*) pleopod 3 peduncle; (*L*) uropod 3.

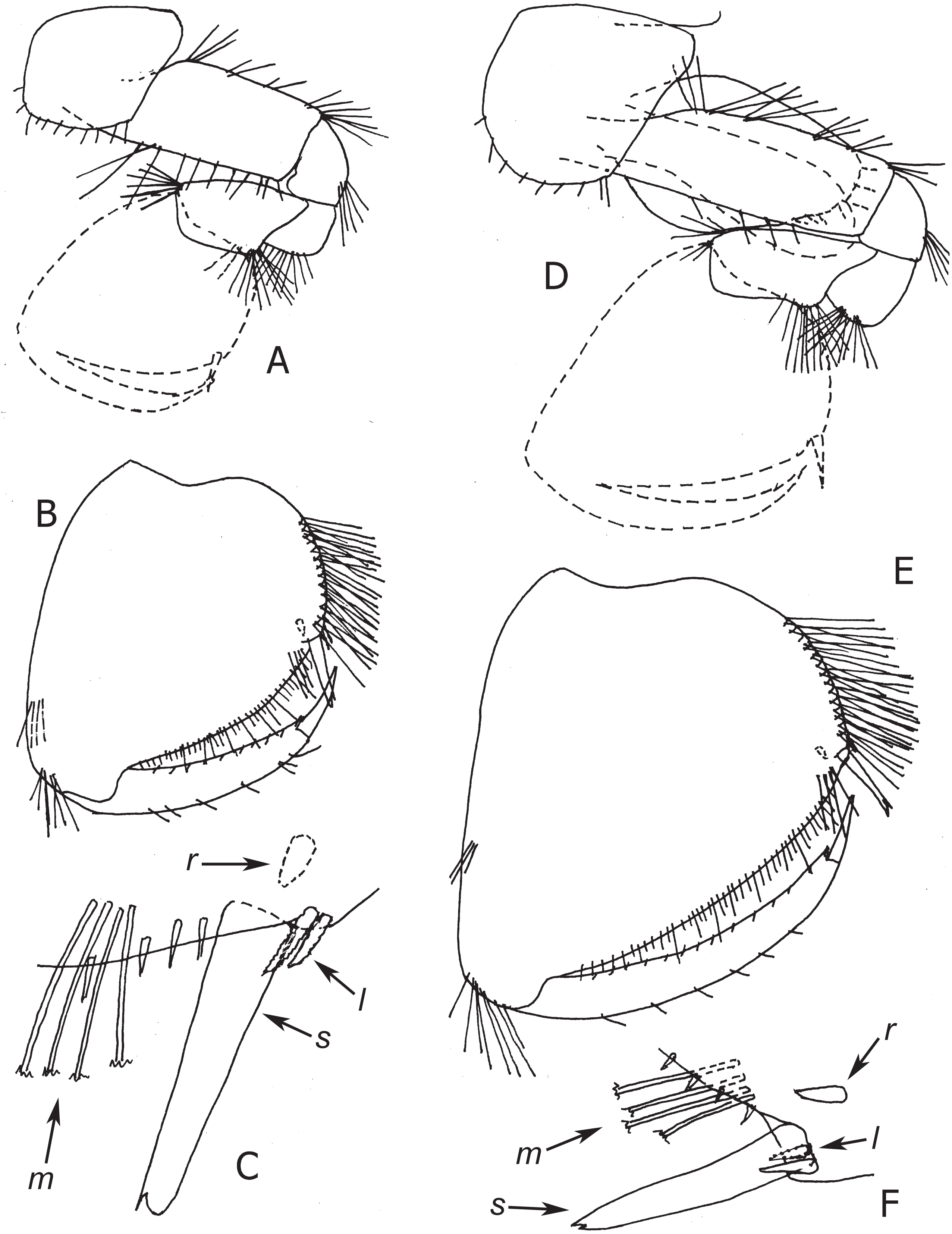

Figure 3. *Niphargus lowryi* sp. nov., spring near Monastery St. Naum, Ohrid Lake coast, female 22.0 mm (holotype): (*A–B*) gnathopod 1, outer face; (*C*) corner of gnathopod 1 propodus, outer face [*s* = corner S-spine; *l* = lateral L-spines; *r* = subcorner R-spine; *m* = corner facial M-setae]; (*D–E*) gnathopod 2, outer face; (*F*) corner of gnathopod 2 propodus, outer face [*s* = corner S-spine; *l* = lateral L-spines; *r* = subcorner R-spine; *m* = corner facial M-setae].

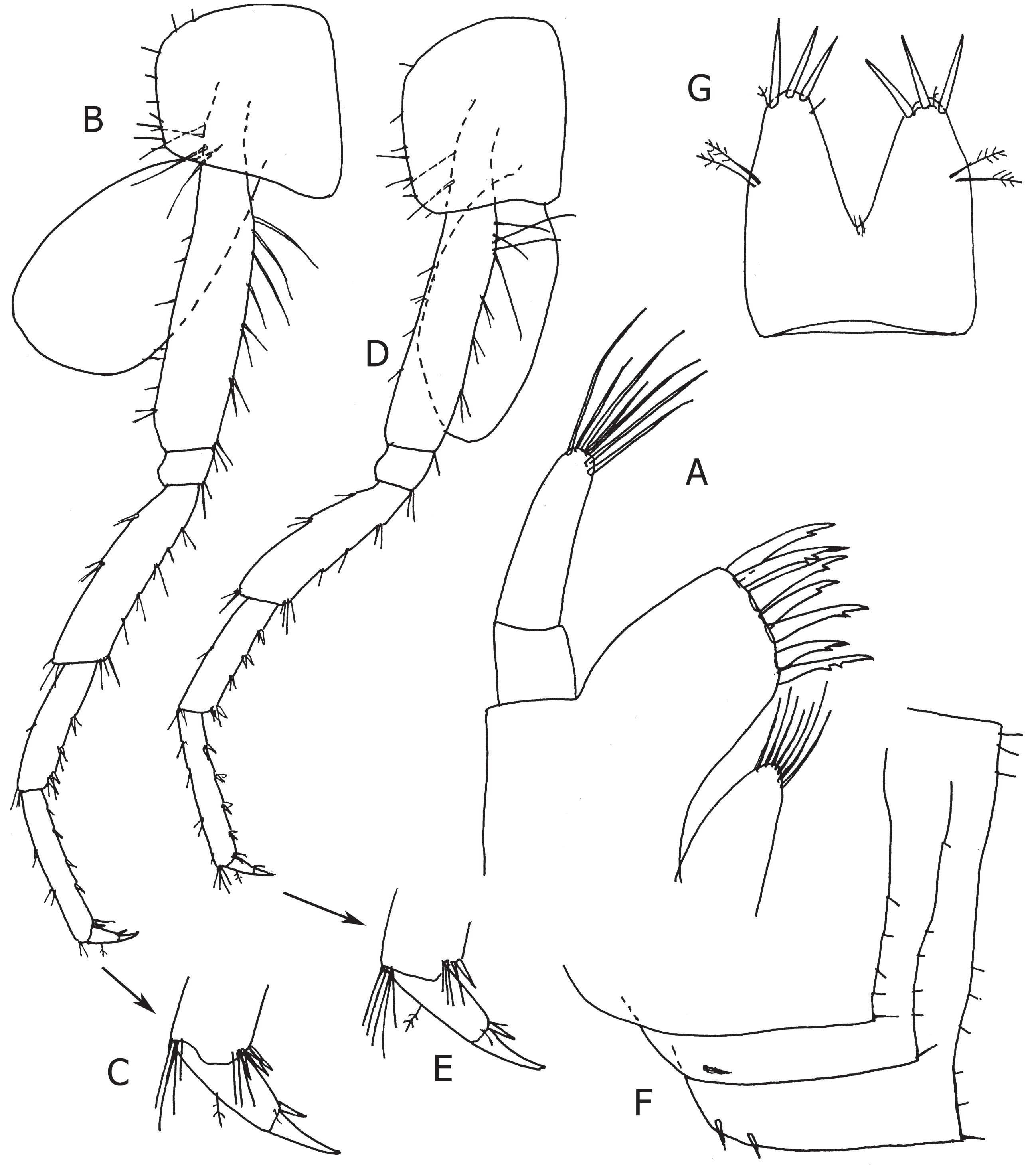

Figure 4. *Niphargus lowryi* sp. nov., spring near Monastery St. Naum, Ohrid Lake coast, female 22.0 mm (holotype): (*A*) maxilla 1; (*B–C*) pereopod 3; (*D–E*) pereopod 4; (*F*) epimeral plates 1–3; (*G*) telson.

posterior setae (Fig. 3D). Propodus longer than broad (ratio: 114:102), rather trapezoid, along posterior convex margin 14 transverse rows of setae; palm convex, inclined, nearly ⅔ of propodus-length, with row of short unequal marginal setae (Fig. 3E) and defined by corner S-spine on outer face, accompanied by 1 or 2 L-spines (heavily damaged) partially behind it and by 4 corner facial M-setae; inner face of propodus with 1 subcorner R-spine (Fig. 3F). Dactylus nearly reaching posterior margin of propodus, along outer margin with row of 6 or 7 short single setae, along inner margin with row of very short setae (Fig. 3E).

Pereopod 3: slender; article 2 with long setae at anterior and posterior margin, and shorter setae on distal part of article; articles 4–6 of different lengths (ratio: 58:42:48); article 4 posterior margin with groups of short setae (setae not exceeding diameter of article itself); posterior margin of article 5 with 3 groups of short setae mixed with short spines; article 6 posterior margin with 5 groups of short spines and

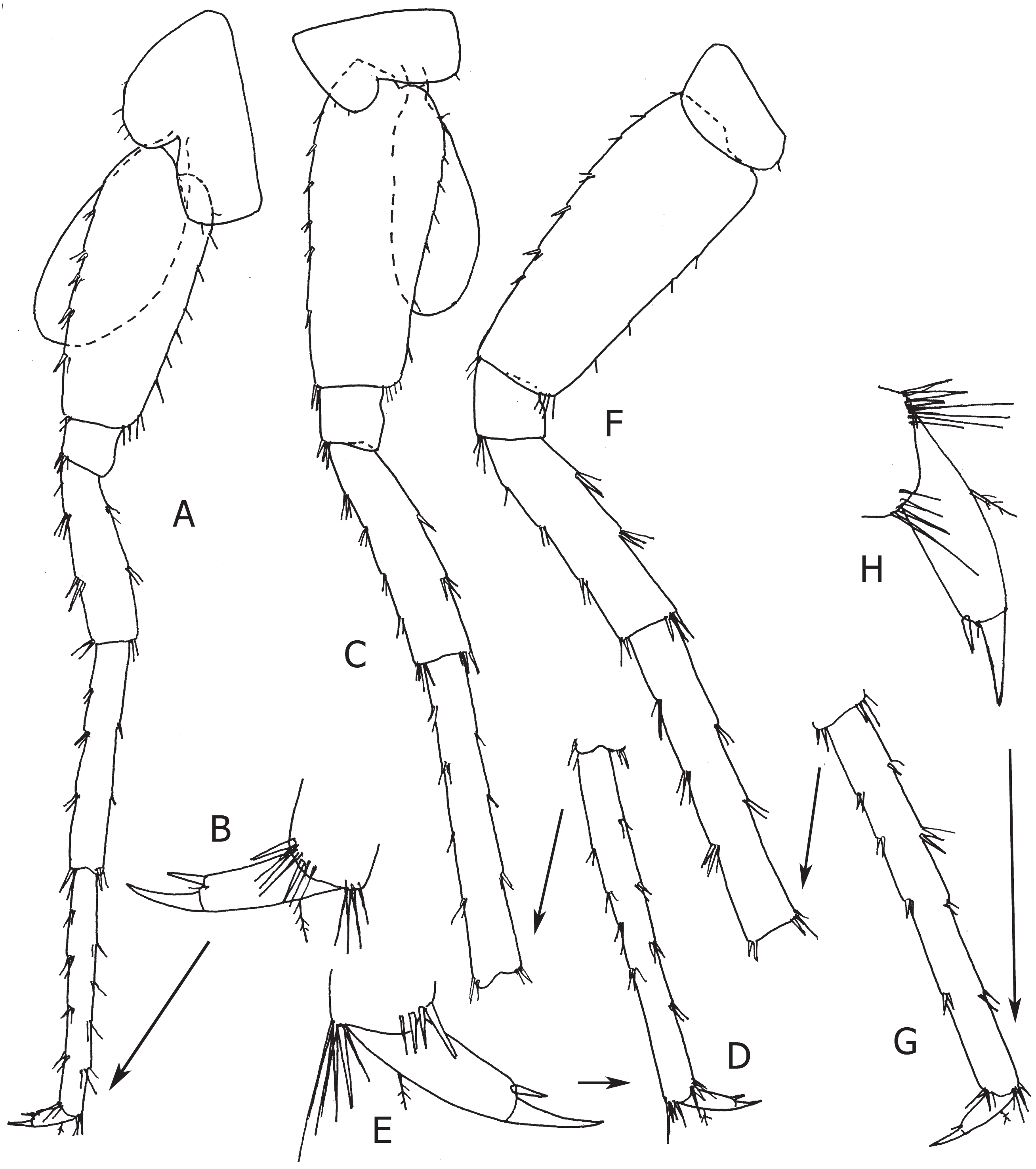

Figure 5. *Niphargus lowryi* sp. nov., spring near Monastery St. Naum, Ohrid Lake coast, female 22.0 mm (holotype): (*A–B*) pereopod 5; (*C–E*) pereopod 6; (*F–H*) pereopod 7.

single short setae (Fig. 4B). Dactylus short and strong, much shorter than article 6 (ratio: 16:48), inner margin with strong spine near the basis of nail mixed with 1 or 2 short setae, outer margin with median plumose seta (Fig. 4C); nail shorter than pedestal (ratio: 21:45).

Pereopod 4: similar to pereopod 3, slightly shorter; pilosity of articles 2–6 similar to pereopod 3. Articles 4–6 of different length (ratio: 50:38:45) (Fig. 4B). Dactylus much shorter than article 6 (ratio: 16:45), with strong spine at inner margin mixed with small seta and median plumose seta on outer margin (Fig. 4E); nail shorter than pedestal (ratio: 31:23).

Pereopod 5: distinctly shorter than pereopods 6 and 7, article 2 narrow, much longer than broad (ratio: 80:34); anterior margin with 6 groups of short spines mixed with single short setae; posterior margin almost straight, with 7 short setae; ventroposterior tip with 3–5 short setae (Fig. 5A). Articles 4–6 of different lengths (ratio: 51:66:70); articles

4–5 anteriorly and posteriorly with groups of short setae mixed with single very short spines; article 6 at anterior margin with 5 groups of short spines and short single setae, at posterior margin with 5 groups of short setae and distal spine. Article 2 longer than article 6 (ratio: 80:70). Dactylus much shorter than article 6 (ratio: 21:70), strong, with strong spine and small seta at inner margin; 1 median plumose seta on outer margin (Fig. 5B); nail shorter than pedestal (ratio: 22:40).

Pereopod 6: article 2 narrow, poorly tapering distally, much longer than broad (ratio: 91:38), with 7 groups of short spines on anterior margin and 7 or 8 short setae at posterior linear margin; 3 or 4 short setae on ventroposterior corner of article 2 (Fig. 5C). Articles 4–6 of different lengths (ratio: 66:91:102), along anterior and posterior margin with bunches of very short setae and short spines much shorter than diameter of articles themselves. Article 6 longer than article 2 (ratio: 102:91) (Fig. 5D). Dactylus strong, much shorter than article 6 (ratio: 24:102), with strong spine and short seta at inner margin near basis of nail, 1 median plumose seta on outer margin (Fig. 5E); nail shorter than pedestal (ratio: 27:55).

Pereopod 7: rather longer than pereopod 6 (mainly article 6); article 2 narrow, much longer than broad (ratio: 94:40), somewhat tapering ventrally, anterior margin almost straight bearing 7 groups of short spines and short setae, posterior margin straight, with 4 or 5 short setae, 4 short setae at ventroposterior corner (Fig. 5F). Articles 4–6 of different lengths (ratio: 67:94:119), articles along anterior and posterior margins with several groups of short spines and setae (always much shorter than diameter of articles themselves) (Fig. 5G). Article 2 is shorter than article 6 (ratio: 94:119). Dactylus remarkably shorter than article 6 (ratio: 29:119), with 1 strong spine and 1 small seta on inner margin near basis of nail and 1 median plumose seta at outer margin (Fig. 5H); nail shorter than pedestal (ratio: 25:63).

Pleopods: with elevated number of retinacula. Peduncle of pleopod 1 with 4 retinacula, and 3 distoanterior marginal simple setae (Fig. 2 I); peduncle of pleopod 2 smooth, with 5 retinacula (Fig. 2J). Peduncle of pleopod 3 with 6 retinacula and 5 posterior marginal setae (Fig. 2K).

Uropod 1: peduncle with dorsointernal row of setae and dorsoexternal row of spines (Fig. 1F), inner ramus scarcely longer than outer ramus, bearing 3 lateral and distal short spines; outer ramus with 5 lateral and 5 distal spines.

Uropod 2: peduncle with 2 lateral and 3 distal spines; inner ramus only slightly longer than outer ramus, with 3 lateral and 5 distal spines; outer ramus with 5 lateral and 5 distal spines (Fig. 1F).

Uropod 3: not elongated; peduncle longer than broad (ratio: 44:24), inner ramus very short, scale-like, with distal spine and seta; outer ramus 2-articulated: proximal article along outer margin with 4 bunches of spines, along inner (mesial) margin with 6 groups of spines mixed with single plumose setae (Fig. 2L); distal article short, narrowed, length not exceeding width of first article, with 3 very short distal simple setae.

Telson: short, nearly as long as broad, gaping, incised half of telson-length; each lobe with 3 distal spines shorter than half of telson-length; a pair of plumose setae attached mediolaterally at outer margin (Fig. 4G).

Coxal gills 2–6: ovoid, not exceeding distal margin of corresponding article 2 of pereopods (Figs 3D, 4B, D, 5A, C).

Oostegites: broad, appear on pereopods 2–5, provided with short marginal setae (Fig. 3D).

Males. Unknown.

Distribution. Northern Macedonia, endemic.

Etymology. The new species, *Niphargus lowryi*, sp. nov., is dedicated to the recently deceased great scientist-amphipodologist and my dear friend, Dr Jim Lowry, Senior Research Associate at the Australian Museum Research Institute, Australia.

Remarks and affinities. The female of *N. lowryi* sp. nov. shows high affinity to species of the subgenus *Orniphargus* S. Karaman, 1950a (type species: *Niphargus orcinus* Joseph, 1869), characterized by a large, strong and often spinose body, large gnathopods, spinose short uropod 3 in both sexes, subequal rami of uropod 1 in both sexes, various positions of L and S- spines on the gnathopods 1–2 propodus (article 6) and the maxilliped palp article 4 near the basis of the nail is provided with various numbers of setae (*Niphargus orcinus* Joseph, 1869, *N. steueri* Schellenberg, 1935, *N. trullipes* Sket, 1958). Further discovery of males of *N. lowryi* will help determine the position of *N. lowryi* within *Niphargus*.

The female of *N. lowryi* seems to be very similar to *Niphargus* (*Orniphargus*) *pellagonicus* S. Karaman, 1943 (type locality: spring on road Bitola-Magarevo, Northern Macedonia, Aegean drainage system) in numerous characters (short uropod 3, narrowed pereopods 5–7, shape of gnathopods 1–2, antennae, epimeral plates, gaping telson, number of aesthetascs on antenna 1). However, *N. lowryi* differs from *N. pellagonicus* by the elevated number of setae on the maxilla 1 inner plate and on the palp, by the elevated number of ventral setae on the maxilliped palp article 4 near the basis of the nail, by the elevated number of retinacula, by the twice longer body-size, and by the longer spines on the telson.

The second species from Bitola region, *N. bitoljensis* S. Karaman, 1943 (type locality: spring in Bitola, Northern Macedonia) differs from *N. lowryi* by the much smaller body-size, remarkably broader and shorter pereopods, telson with facial spines, having only 2 retinacula on pleopods and the lower number of inner setae on the maxilliped palp.

The three other known large species of *Niphargus* from Ohrid Lake basin (Adriatic drainage system), *N. sanctinaumi* S. Karaman, 1943 (type locality: springs of St. Naum), *N. maximus* S. Karaman, 1929 (type locality: springs Šum in Struga, at opposite side of Ohrid Lake) and *N. petkovskii* G. Karaman, 1963 (type locality: Biljanini izvori-Springs (= Studenčišće) in Ohrid Town), differ distinctly by presence of dorsofacial spines on telson, pleopods with 2 retinacula only and the less oblique palm of gnathopods 1–2.

Niphargus (*Orniphargus*) *macedonicus* S. Karaman, 1929 (type locality: Rašče Springs near Skopje (= Skoplje), Aegean drainage system, Northern Macedonia), a large species up to 20 mm long, is also rather similar to *N. lowryi* in the elevated number of retinacula, oblique palm of the gnathopods, large body-size and absence of lateral and facial spines on telson. This species differs from *N. lowryi* by the elevated number of aesthetascs on each flagellar article of antenna 1, by the maxilla 1 inner plate having 2 setae and the more pointed epimeral plate 3. As the male of *N. lowryi* is currently unknown, the taxonomic position of *N. lowryi* within *Niphargus* remains open.

From Greece, three members of the subgenus *Orniphargus* are known: *Niphargus (Orniphargus) lindbergi* S. Karaman, 1956 (type locality: Cave Draconera, Attique, Greece), *N. (Orniphargus) lourensis lourensis* Fišer, Trontelj & Sket, 2006 (type locality: spring of Louros River, Vouliasta, Ioannina, Epirus, Greece) and *N. (O.) lourensis skirosi* G. Karaman, 2018 (type locality: Molos, radar station, Skiros Island, Aegean Sea, Greece).

Niphargus (O.) lindbergi differs distinctly from *N. (O.) lowryi* by the presence of two ventroposterior spines on urosomite 1 near the basis of the uropod 1 peduncle.

Niphargus (O.) lourensis lourensis differs from *N. (O.) lowryi* by the remarkably broader article 2 of pereopods 5–7, by the lower number of setae on the maxilla 1 inner plate, shorter and less setose maxilla 1 palp, and the presence of only 2 retinacula on pleopods.

Niphargus (O.) lourensis skirosi differs from *N. (O.) lowryi* by the remarkably smaller gnathopods with a much less inclined propodus, by the lower number of retinacula, and by the partially developed ventroposterior lobe of pereopods 5–7 article 2.

From Albania, no members of subgenus *Orniphargus* are known.

Note

In the paper the classical terms "subgenus" and "subspecies" are used, being validly recognized terms in zoological nomenclature. Various molecular/genetic studies have used alternative terms such as "species aggregate" (Fišer *et al*., 2006), *Niphargus* "clades" (Flot *et al*., 2010) or "species complexes" (Ziga Fišer *et al*., 2015), "morphologically cryptic species" (Hupalo *et al*., 2022), some of which variously correspond to classical concepts used herein. Recently some authors have questioned whether the time has come to describe new species without diagnoses (see Ahrens *et al*., 2021 for review). Evidently, these issues may bear on the *International Code of Zoological Nomenclature* (ICZN, 1999). As the problems are very complex and require extensive exposition, I gave up on this discussion here.

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Carnarvonis gen. nov. and *Warregoensis* gen. nov.: Two New Genera and Species of Subterranean Amphipods (Crangonyctoidea: Chillagoeidae) Described from North-eastern Australia

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Abstract. Biological surveys are crucial and appropriate approaches for capturing invertebrate biodiversity data and specimens, particularly considering that a significantly high proportion of Australian invertebrates are thought to be undescribed. During the 2014 Carnarvon Station Reserve Bush Blitz Biological Survey, specimens of stygobiotic amphipod crustaceans were collected from a spring-fed groundwater site. Taxonomic analyses revealed that the specimens comprised two new genera and species of stygobiotic amphipods belonging to the family Chillagoeidae. Further examination required a revision of the family, which is presented herein along with the descriptions of *Carnarvonis katjae* gen. et sp. nov. and *Warregoensis lowryi* gen. et sp. nov. Importantly, the description of two new genera and species increases the total number of described stygobiotic amphipods in Queensland to three genera and species and indicates that additional and potentially diverse stygobiont taxa are likely to be discovered in the largely unexplored groundwater habitats across the region.

Introduction

A biological survey of groundwater associated sites (springs, marshes, gravel beds) on Carnarvon Station Reserve, *ca.* 600 km west of Bundaberg in central Queensland, Australia, was carried out in October 2014 as part of a Bush Blitz Biological Survey (https://bushblitz.org.au). This survey was coordinated by Bush Blitz (an Australian Government, BHP, and Earthwatch Australia partnership), partnered with Bush Heritage Australia and the Queensland Museum (Commonwealth of Australia, 2017). From a single spring-fed groundwater site, approximately 20 specimens comprising two separate species of stygobiont crangonyctoid amphipod crustaceans were collected. Initial identifications concluded that these were “paramelitid-like” amphipods based largely on the morphology of their gnathopods, gills, and uropods, but with a unique looking uniramous uropod 3.

The Paramelitidae comprise a significant component of the Australian freshwater amphipod fauna, with 14 currently described genera encompassing stygobiont and epigean taxa (Bradbury & Williams, 1999; Lowry & Myers, 2012). Yet, this family has historically remained ambiguously defined from at least two other existing freshwater amphipod families (Neoniphargidae Bousfield, 1977 and Perthiidae Williams & Barnard, 1988 (Bradbury & Williams, 1999)). Lowry & Myers (2012, 2013) attempted to extensively redefine and

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diagnose amphipod families using morphological cladistic analyses, presenting new diagnoses and arrangements for Paramelitidae, Neoniphargidae and Perthiidae, yet these families remain morphologically very similar, separated by a small selection of synapomorphic characters rather than being defined by unique characters. Importantly, Lowry & Myers (2012) also elevated three monotypic Australian stygobiont amphipod genera to their own new families (Chillagoeidae and Giniphargidae respectively for the former paramelitid taxa *Chillagoe* Barnard & Williams, 1995 from Queensland and *Ginipharqus* Karaman & Barnard, 1979 from Victoria, and Uronyctidae for the former (though uncertainly placed) crangonyctid taxon *Uronyctus* Stock & Iliffe, 1990 from South Australia). Chillagoeidae, Giniphargidae, and Uronyctidae are currently the only Australian crangonyctoid families to possess a uniramous uropod 3.

The Chillagoeidae is represented by a single species, *Chillagoe thea* Barnard & Williams, 1995, and is the only described stygobiont amphipod from Queensland. It is found in the Chillagoe cave system in Far North Queensland, which is *ca.* 900 km north-northwest of Carnarvon Station Reserve. Given the geographic distances between Chillagoe Caves and Carnarvon Station Reserve, which are within entirely separate water catchments, and the distinct groundwater habitats involved, it is likely that the two species collected at Carnarvon Station Reserve are new species, separate to *Chillagoe thea,* albeit with more work needed to establish if they should be placed in the same family.

The aims of this paper are to comprehensively examine the two new stygobiont amphipod species discovered at Carnarvon Station Reserve using morphological and molecular data to: 1) produce robust species hypotheses; 2) attempt to place the new taxa within the current classification hierarchy; and 3) provide new species descriptions.

Materials and methods

Specimens

Twenty amphipod individuals were collected at one groundwater habitat site within the Carnarvon Station Reserve: "Lady Spring", a spring-fed upwelling of groundwater within a gravel creek bed. Samples were collected using a Bou-Rouch pump and *ca.* 50 litres of water were pumped onto a 0.5 mm sieve from *ca.* 70 cm depth in the gravel bank. Specimens were immediately preserved in 95% EtOH and kept refrigerated for optimum preservation of tissue for molecular analyses.

An initial morphological examination of samples was carried out and provisional identification to "paramelitid-like" was made based on the morphology of the uropods (particularly the third uropod, but also the absence of robust basofacial setae on the peduncle of the first uropod). Morphological analyses involved micro-dissection, light microscopy and illustration using a Nikon Eclipse 80i (Nikon, Tokyo, Japan) compound microscope with a camera lucida attachment. Type material was dissected primarily along the left-hand side (as per traditional taxonomic practice) and mounted on temporary slides in glycerol for examination. Type material is deposited at the Queensland Museum, Brisbane (QM) and the South Australian Museum, Adelaide (SAMA); sequence data is available through GenBank.

DNA extraction, PCR, and sequencing

DNA was extracted from eight specimens: two or three pereopods or pleopods removed from the right side of the animal whenever possible. DNA was extracted using a modified version of the Canadian Centre for DNA Barcoding Glass Fiber Plate DNA Extraction Protocol, with Insect Lysis Solution and an Acroprep ADVANCE 96-Well Filter Plate (1 ml 3.0 µm Glass Fibre/ 0.2 µm Supor; bio-strategy; Tullamarine, VIC, Australia) (Ivanova *et al*., 2006). Partial sequences of *cytochrome c oxidase subunit I* (*COI*) were Polymerase Chain Reaction (PCR)-amplified using the degenerate Folmer primers COIF (TCWACNAAYCAYAARGAYATTGG) and COIR (ACYTCNGGRTGNCCRAARARYCA) (Folmer *et al*., 1994).

PCR-amplification was carried out in 25 µL reaction volumes containing 1 × Immolase PCR buffer (Meridian Bioscience; Cincinnati, Ohio, USA), 1.5 mM $MgCl_2$, 0.8 mM dNTP mix, 0.05 mg/ml BSA, 0.24 µM primer, 0.5 units Immolase DNA polymerase and approximately 1 ng of extracted DNA. Thermal cycling conditions for *COI* involved an initial hold at 94°C for 10 min followed by 38 cycles of denaturation at 94°C for 45 s, annealing at 48°C for 45 s and extension at 72°C for 60 s. Following the 38 cycles, a final extension step at 72°C for 6 min completed the reaction. PCR products were then verified by agarose gel. Cleanup of the PCR reaction and Big Dye Terminator sequencing in both directions was carried out at The Australian Genome Research Facility (AGRF).

Uncorrected pairwise sequence divergences were determined using PAUP* version 4.0b8 (Swofford 2001).

Results

Detailed examination of the Carnarvon Station Reserve material based on morphological and molecular data indicated that two undescribed species were present. Gnathopod, coxal and uropodal morphology indicated that they should be placed within separate genera within the family Chillagoeidae. Type specimens of *Chillagoe thea* as well as additional material were borrowed from the Australian Museum (AM) (holotype AM P44066, paratypes AM P44071, and other cited material AM P44072) for comparative analyses of all three taxa to now be included within that family, and an updated diagnosis of the family with additional characters is presented herein.

Uncorrected pairwise sequence divergence of *COI* data indicate that *Warregoensis lowryi* sp. nov. (GenBank *COI*: OP596266.1, OP596267.1, OP596268.1, OP596269.1, OP596270.1) and *Carnarvonis katjae* sp. nov. (GenBank *COI*: OP596271.1, OP596272.1, OP596273.1) are at least 15% divergent from each other and 22.7–23.2% divergent from *Chillagoe thea* sequences (Barcode of Life database (BOLD: MSAPB2517–19.COI-5P, MSAPB2518–19.COI-5P, https://www.boldsystems.org/#). Amphipod species and genus divergences have been recorded as between 5–20% for *COI* (Havermans *et al*., 2013; King *et al*., 2022) and so these divergence values correlate well with both species and genus level determinations.

Systematics

Amphipoda

Crangonyctoidea Bousfield, 1973

Chillagoeidae Lowry & Myers, 2012

Type genus. *Chillagoe* Barnard & Williams, 1995

Diagnosis. (After Lowry & Myers, 2012) Body laterally compressed. Eyes absent. Antennae 1–2 calceoli crangonyctoid (type 9). Antenna 1 longer than antenna 2; peduncular article 1 subequal to, or longer than article 2; article 2 longer than article 3; article 3 shorter than article 1; peduncular articles 1–2 not geniculate; accessory flagellum short. Mandible molar triturative; palp symmetrical. Maxilla 1 basal endite setose along medial margin or apically setose; palps symmetrical. Maxilla 2 basal endite **with oblique setal row of 2–3 setae**. Labium inner lobes vestigial or absent. Coxal gills on pereopods 2–6 or 2–7, stalked (without proximal restriction); sternal gills present, simple, paired; sternal blisters absent; oostegites fringing setae simple. Coxa 1 distinctly smaller than coxa 2, as long as broad, with a robust seta at the posterodistal corner and additional simple seat along distal margin; Coxae 2–3 similar, longer than broad with a robust seta at the posterodistal corner and additional simple seat along distal margin; coxa 4 similar length to coxae 2–3, as long as broad, with small but distinct excavated corner on the posterior margin, with a robust seta at the posterodistal corner and additional simple setae along distal margin. Coxae 5–6 similar, approximately half length of coxae 2–4, anteroventral lobe distinct, posteroventral lobe indistinct, with setae along posterior margin. Coxa 7 similar length to coxae 5–6, rounded, with setae along posterior margin. Gnathopod 1–2 subchelate, similar in males and females (not sexually dimorphic); gnathopod 1 smaller (or weaker) than or similar in size to gnathopod 2; gnathopods 1–2 **propodus lateral face with distinct excavation above and parallel to palm margin**, palm without robust setae along palm margin, **with rows of 1–5 robust setae either side of palm corner (where dactyl fits to the propodus)**. Pereopods 3–4 not sexually dimorphic. Pereopod 4 basis without distinct posteroventral lobe. Pereopod 5 shorter than pereopod 6. Pereopod 7 subequal in length to, or longer than pereopod 6. Pleonites 1–3 without dorsal carinae. Urosomites 1–3 free; with slender or robust dorsal setae. Urosomite 1 with distoventral robust seta. **Urosomites 1–2 with paired dorsolateral robust setae**. **Uropod 1 with or without basofacial robust setae on lateral margin of peduncle, distal margin of peduncle with group of 1 large and 2 small robust setae laterally and 1 large robust seta medially**. **Uropod 2 distal margin of peduncle with group of 2 small robust setae laterally and 1 small robust seta medially**. Uropod 3 not sexually dimorphic; uniramous, without plumose setae. Telson cleft; apical robust setae present.

Remarks. Examination of type material for the family and comparison of this to material of the two new taxa described herein has led to a revision of diagnostic characters of the Chillagoeidae. New characters to the diagnosis are highlighted in bold text. Significant changes include the morphology of the maxilla 2 and the setation of the uropod 1 peduncle. Firstly, the original description of *Chillagoe thea* indicated that maxilla 2 basal endite was missing an oblique row of setae, which was included as a family-level character by Lowry & Myers (2012). However, subsequent examination of the holotype and paratype material showed that while there was variation between individuals, there was an oblique setal row of at least 2–3 setae that is also present in the new genera described herein. Secondly, in the original diagnosis of Chillagoeidae the presence of a robust basofacial seta on the uropod 1 peduncle was included as an important family-level character (Lowry & Myers, 2012) but we conclude that this character is variable among genera.

More importantly, we find that the distinct gnathopod, coxal and uropodal morphology of all three genera now included within the Chillagoeidae should be raised to family-level diagnoses. This includes the sculpturing of gnathopods 1–2 propodus lateral face (with distinct excavation above and parallel to palm margin) as well as setation of the palm corner (with rows of 1–5 robust setae either side of where the dactyl fits to the propodus; coxal morphology (coxae 1 short, coxae 2–4 similar length, coxae 5–7 half length of coxae 1–4); and the setation of uropods 1–2 peduncle distal margin (uropod 1 with group of 1 large and 2 small robust setae laterally and 1 large robust seta medially, uropod 2 with group of 2 small robust setae laterally and 1 small robust seta medially). Together, a suite of characters is formed that clearly defines the family.

Chillagoeidae taxa are most easily separated from the albeit poorly defined Paramelitidae by the uniramous uropod 3 as well as urosomites 1–2 with paired dorsal robust setae. Two other Australian groundwater-associated families are also characterized in-part by a uniramous uropod 3: Uronyctidae (erected for the monotypic *Uronyctus longicaudus* Stock & Iliffe, 1990 from sinkholes in Mt Gambier, South Australia) and Giniphargidae (erected for the monotypic *Giniphargus pulchellus* (Sayce, 1899) from Gippsland, Victoria). Both of these species show significantly more "vermiform" slender bodies typically associated with true stygobiotic lifestyle, compared to Chillagoeidae taxa. In addition, *U. longicaudus* further differs from Chillagoeidae taxa in that it has sexually dimorphic gnathopods with distinctive propodus morphology, coxal gills on pereopods 2–7, coxa 4 without a distinct excavated corner on the posterior margin, pereopod 5 much shorter than pereopods 6–7 and an extremely elongate uropod 3 outer ramus. *G. pulchellus* has reduced coxae 1–7 of similar lengths, a robust antenna 2 peduncle, gnathopods with distinctive propodus morphology, coxa 4 without a distinct excavated corner on the posterior margin, and an elongate uropod 3 outer ramus of two equally sized articles.

Carnarvonis gen. nov.

urn:lsid:zoobank.org:act:C6E7BFF2-9532-4F36-8A53-63F5CBB104F5

Type species. *Carnarvonis katjae* sp. nov.

Diagnosis. Body laterally compressed, not vermiform. Eyes absent. Antenna 1 longer than antenna 2, accessory flagellum of two articles. Antenna 2 flagellum shorter than peduncle, calceoli absent. Mandibular palp of 3 articles, right and left palp with slightly different setation. Labium (lower lip) lacking inner lobes. Coxae 1–4 distinctly longer than coxae 5–7; coxa 1 distinctly shorter than coxae 2–3; coxa 4 with small but distinct excavated corner on the posterior margin. Gnathopods 1–2 not distinctly large (propodus smaller than head length), not sexually dimorphic; gnathopod 2 propodus slightly longer than in gnathopod 1; gnathopods 1–2 propodus lateral face with distinct excavation above and parallel to palm margin, palm margins smooth, without robust setae along palm margin, with 1 mesial (inner) and 1–2 lateral (outer) robust setae either side of palm corner (where dactyl fits to the propodus). Pereopod 6 and 7 of similar lengths, bases broad (less than 1.5 times as long as wide). Coxal gills on pereopods 2–6, sternal gills on thoracic segments 2–6, slender, not greater than ½ length of coxal gills. Uropod 3 outer ramus of 1 article, inner ramus absent. Telson shallowly cleft, with apical setae.

Etymology. Named for the Carnarvon Station Reserve where the holotype material was collected. Gender: feminine.

Remarks. *Carnarvonis* gen. nov. and *Warregoensis* gen. nov. share some distinct traits from *Chillagoe*. They do not have a basofacial seta on uropod 1 and the uropod 3 outer ramus is composed of a single article (vs. 1 basofacial seta present on uropod 1 and uropod 3 outer ramus of two articles in *Chillagoe*). *Carnarvonis* gen. nov. can be clearly identified from the smooth palm margin of gnathopods 1–2, a shallowly cleft telson and pereopods 5–7 bases broad (less than 1.5 times as long as wide).

Carnarvonis katjae sp. nov.

urn:lsid:zoobank.org:act:797AACEF-2E9E-46C4-BF7E-73A03D5FEA66

Figs 1–3

Holotype: QM W29606 (RL 2296.6, Genbank *CO1*: OP596273.1), female, Carnarvon Station Reserve, Lady Spring, 24.80255°S 147.8265°E, Bou-Rouch pump in gravel bank, coll. R. Leijs, 15 October 2014. **Paratypes**: QM W29607, male, Carnarvon Station Reserve, Lady Spring, 24.80255°S 147.8265°E, Bou-Rouch pump in gravel bank, coll. R. Leijs, 15 October 2014; SAMA C14815 (RL 2296.5, Genbank *CO1*: OP596271.1, OP596272.1), males and juveniles, Carnarvon Station Reserve, Lady Spring, 24.80255°S 147.8265°E, Bou-Rouch pump in gravel bank, coll. R. Leijs, 15 October 2014.

Description. Holotype, female, 4.5 mm. *Head*. Without rostrum, eyes absent. Antenna 1 length less than half length of animal; peduncle with three articles progressively shorter; accessory flagellum of two articles, distal article small; flagellum of 12 articles. Antenna 2 approximately ½ length of antenna 1; peduncle longer than flagellum, articles 4–5 of peduncle of subequal length; flagellum of 4 articles. Labrum (upper lip) evenly rounded, setose apically. Labium (lower lip) without inner lobes. Mandible incisor with 5 teeth, lacinia mobilis with 4 teeth, setal row of 5 plumose setae present, molar narrow and denticulate; palp of three articles, article 3 shorter than article 2, right palp with short row of plumose setae ("D-setae"; after Lowry & Stoddart, 1993). Maxilla 1 outer plate with nine apical denticulate robust setae; inner plate with two apical plumose setae; palp of two articles, distal article longest, with apical setae. Maxilla 2 outer plate with two rows of simple and plumose setae apically and simple setae laterally; inner plate with simple setae apically and an oblique row of medial plumose setae. Maxilliped palp slender (no articles enlarged), of four articles plus spine; outer plate with robust and simple setae along apical and lateral margin; inner plate with robust and plumose setae apically and laterally.

Pereon. Gills include coxal gills on pereopods 2–6, sternal gills on thoracic segments 2–6, slender, not greater than ½ length of coxal gills. Gnathopods 1–2 not distinctly large (propodus smaller than head length). Gnathopod 1 coxa short (only slightly longer than wide), with robust seta at posterior corner and few simple setae scattered along margin; propodus length 1.5 times width, lateral face with distinct excavation above and parallel to palm margin, palm margins smooth (no distinct crenulations), without robust setae along palm margin, with 1 mesial (inner) and 1 lateral (outer) robust seta either side of palm corner (where dactyl fits to the propodus), posterior margin of propodus with 1 oblique row of long simple setae. Gnathopod 2 coxa longer than coxa 1, distinctly longer than wide, with robust seta at posterior corner and few simple setae scattered along margin; propodus length 1.8 times width, lateral face with distinct excavation above and parallel to palm margin, palm margins smooth (no distinct crenulations), without robust setae along palm margin, with 1 mesial (inner) and 1 lateral (outer) robust setae either side of palm corner (where dactyl fits to the propodus), posterior margin of propodus with 2 oblique rows of long simple setae. Pereopod 3 coxa similar length to coxa 2, longer than wide, with robust seta at posterior corner and few simple setae scattered along margin; dactylus with single seta. Pereopod 4 coxa similar length to coxa 2–3, longer than wide, small but distinct excavated corner on the posterior margin, with robust seta at posterior corner and few simple setae scattered along margin. Pereopod 5 coxa with rounded anteroventral lobe with seta, posteroventral lobe indistinct, with 1 seta on posterior margin. Pereopod 6 similar length to pereopod 7; coxa with rounded anteroventral lobe, posteroventral lobe indistinct, with 1 seta on posterior margin; basis 1.5 times as long as wide; propodus longer than carpus; dactylus with single seta. Pereopod 7 coxa rounded, with 1 seta on posterior margin; basis 1.6 times as long as wide; propodus longer than carpus; dactylus with single seta.

Pleon. Epimera 1–3 posteroventrally subquadrate, posteroventral corner with robust seta and posterior margins with several small robust setae along length; epimera 2–3 with robust setae along the ventral margin. Urosomite 1 with distinct distoventral robust seta, with paired dorsolateral setae on distal margin. Urosomite 2 with paired dorsolateral setae on distal margin. Uropod 1 peduncle without basofacial robust seta, distal margin of peduncle with group of 1 medium-large and 2 small robust setae laterally and 1 large robust seta medially. Uropod 2 distal margin of peduncle with group of 2 robust setae laterally and 1 small robust seta medially. Uropod 3 distal margin of peduncle with robust setae laterally and medially; outer ramus of 1 article, approximately 3 times length of peduncle, with clusters of 2–3 robust setae along length; inner ramus absent. Telson cleft shallowly, with robust and simple setae apically.

Etymology. Named for Dr Katja Hogendoorn, scientist and partner of Remko Leijs.

Remarks. *Carnarvonis katjae* sp. nov. is clearly a distinct genus and species with 15% *CO1* divergence from *Warregoensis lowryi* sp. nov. and 22% *CO1* divergence from *Chillagoe thea*.

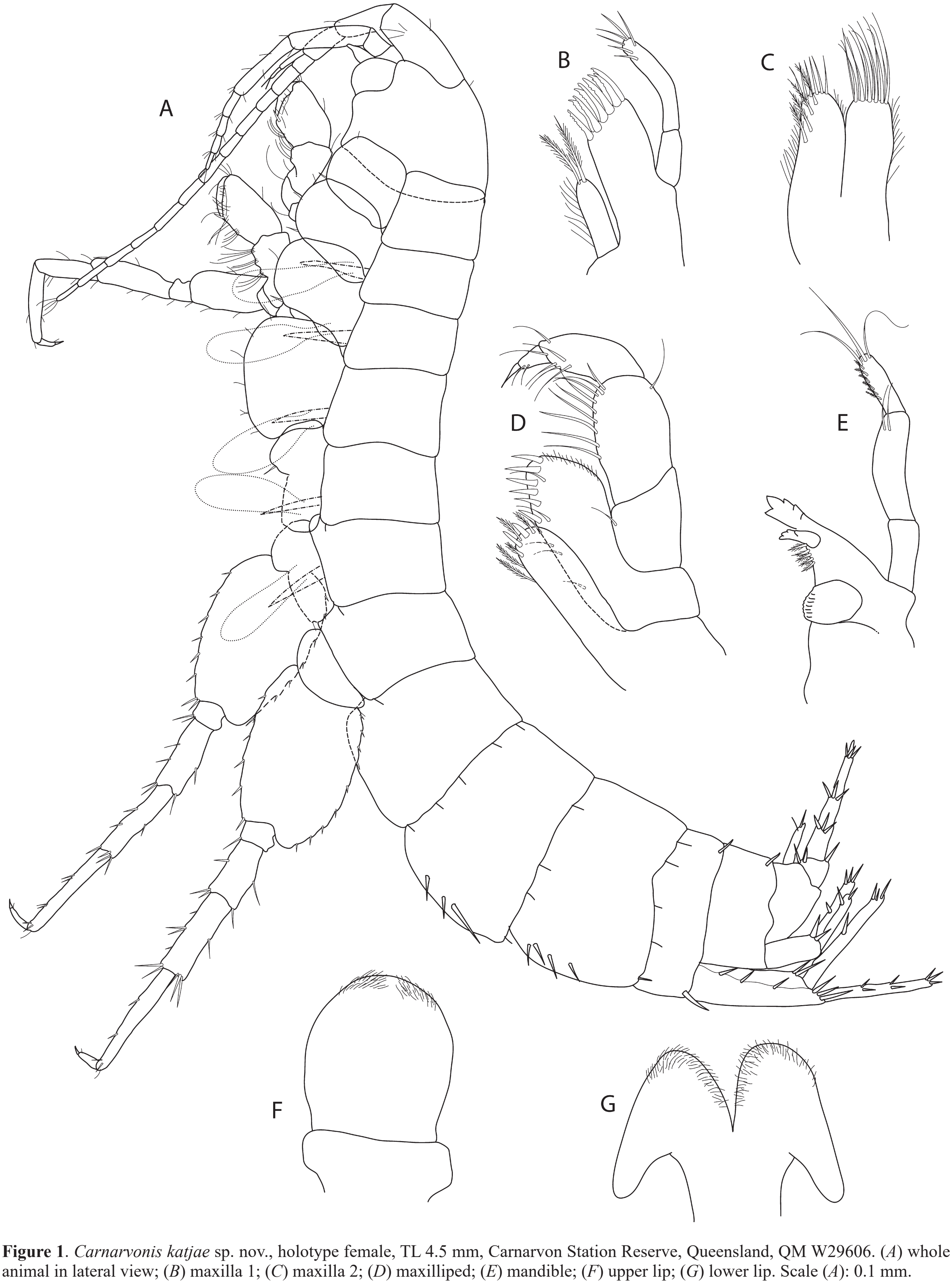

Figure 1. *Carnarvonis katjae* sp. nov., holotype female, TL 4.5 mm, Carnarvon Station Reserve, Queensland, QM W29606. (*A*) whole animal in lateral view; (*B*) maxilla 1; (*C*) maxilla 2; (*D*) maxilliped; (*E*) mandible; (*F*) upper lip; (*G*) lower lip. Scale (*A*): 0.1 mm.

Figure 2. *Carnarvonis katjae* sp. nov., holotype female, TL 4.5 mm, Carnarvon Station Reserve, Queensland, QM W29606. (*A*) gnathopod 1; (*B*) gnathopod 2.

Warregoensis gen. nov.

urn:lsid:zoobank.org:act:5B239C3B-3E9D-4CB2-AB23-9D139C0AE8B2

Type species. *Warregoensis lowryi* sp. nov.

Diagnosis. Body laterally compressed, not vermiform. Eyes absent. Antenna 1 longer than antenna 2, accessory flagellum of two articles. Antenna 2 flagellum shorter than peduncle, calceoli absent. Mandibular palp of 3 articles. Labium (lower lip) lacking inner lobes. Coxae 1–4 distinctly longer than coxae 5–7; coxa 1 distinctly shorter than coxae 2–3; coxa 4 with small but distinct excavated corner on the posterior margin. Gnathopods 1–2 large (propodus as large or larger than head length), not sexually dimorphic; gnathopod 2 propodus slightly longer than in gnathopod 1; gnathopods 1–2 propodus lateral face with distinct excavation above and parallel to palm margin, palm margins crenulate and with 2 excavations, without robust setae along palm margin, with rows of 3 mesial (inner) and 2–3 lateral (outer) robust setae either side of palm corner (where dactyl fits to the propodus). Pereopod 6 and 7 similar lengths, bases narrow (close to 2 times as long as wide). Coxal gills on pereopods 2–7, sternal gills on thoracic segments 2–6, slender, around ½ length of coxal gills. Uropod 3 outer ramus of 1 article, inner ramus absent. Telson cleft to ⅓ depth, with apical setae.

Etymology. Named for the Warrego River Basin where the type specimens of *Warregoensis lowryi* sp. nov. were collected. Gender: masculine.

Remarks. *Warregoensis* gen. nov. can be clearly identified from the large overall size of the adult animals (6.2 mm vs 4.5 mm for *Carnarvonis katjae* sp. nov.), the large gnathopods 1–2, and crenulations of the palm margin in gnathopods 1–2, telson cleft to ⅓ depth, and pereopod 5–7 bases narrow (close to 2 times as long as wide).

Warregoensis lowryi sp. nov.

urn:lsid:zoobank.org:act:D631937A-D112-46F2-8D55-E713B7E92030

Figs 4–6

Holotype: QM W29604 (RL 2296.4, Genbank *CO1*: OP596266.1), male, Carnarvon Station Reserve, Lady Spring, 24.80255°S 147.8265°E, Bou-Rouch pump in gravel bank, coll. R. Leijs, 15 October 2014. **Paratypes**: QM W29605 (RL 2296.3, Genbank *CO1*: OP596269.1), female, Carnarvon Station Reserve, Lady Spring, 24.80255°S 147.8265°E, Bou-Rouch pump in gravel bank, coll. R. Leijs, 15 October 2014; SAMA C14814 (RL 2296.1, RL2296.2, Genbank *CO1*: OP596268.1, OP596270.1), female and male, Carnarvon Station Reserve, Lady Spring, 24.80255°S 147.8265°E, Bou-Rouch pump in gravel bank, coll. R. Leijs, 15 October 2014.

Description. Holotype male, 6.2 mm. *Head*. Without rostrum, eyes absent. Antenna 1 length greater than half length of animal; peduncle with three articles progressively shorter; accessory flagellum of two articles, distal article small; flagellum of 18 articles. Antenna 2 approximately ⅔ length of antenna 1; peduncle longer than flagellum, articles 4–5 of peduncle of subequal length; flagellum of 7 articles. Labrum (upper lip) evenly rounded, setose apically. Labium (lower lip) without inner lobes. Mandible incisor with 5 teeth, lacinia mobilis with 4 teeth, setal row of 5 plumose setae

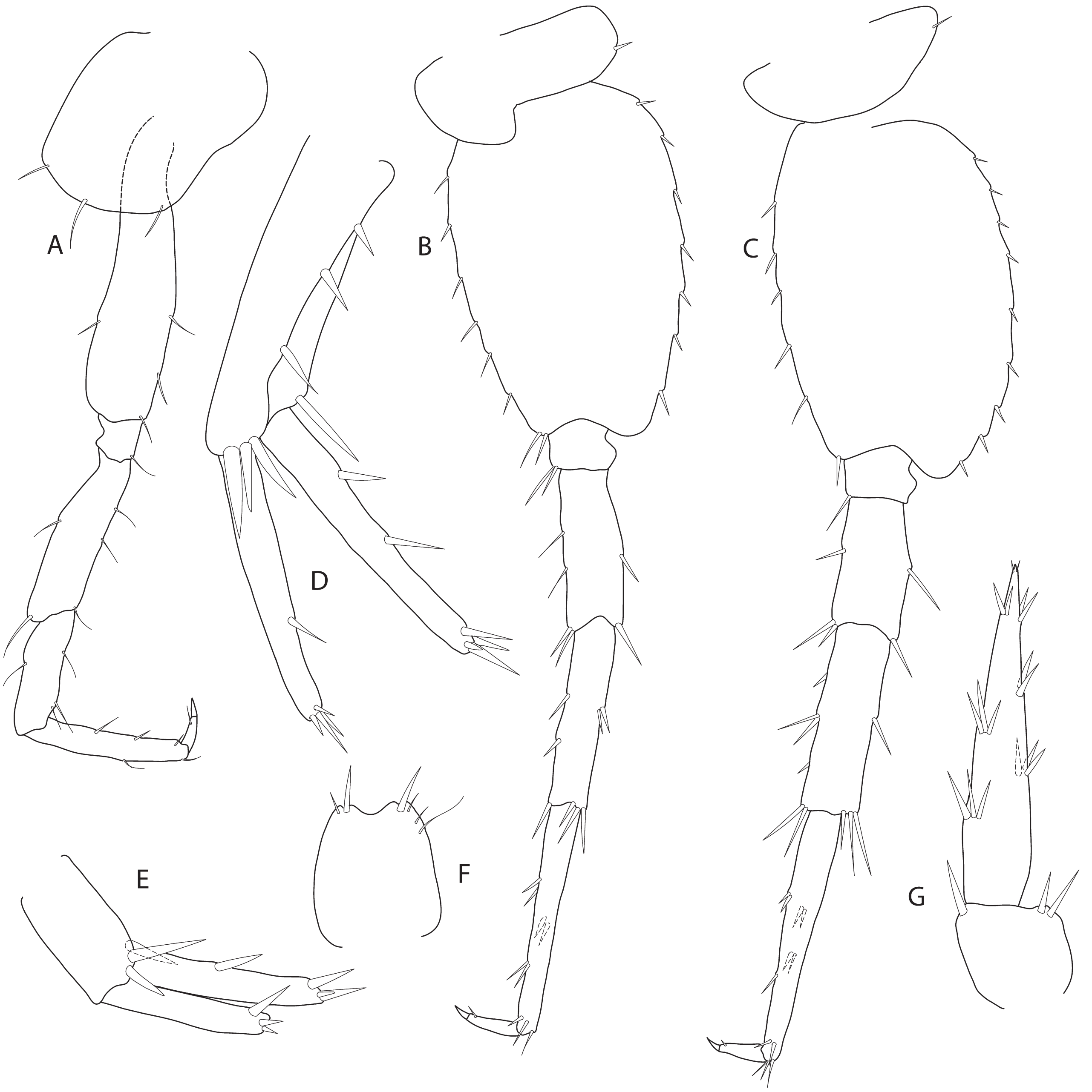

Figure 3. *Carnarvonis katjae* sp. nov., holotype female, TL 4.5 mm, Carnarvon Station Reserve, Queensland, QM W29606. (*A*) pereopod 3; (*B*) pereopod 6; (*C*) pereopod 7; (*D*) uropod 1; (*E*) uropod 2; (*F*) telson; (*G*) uropod 3.

present, molar narrow and denticulate; palp of three articles, article 3 shorter than article 2, with short row of plumose setae ("D-setae"; after Lowry & Stoddart, 1993). Maxilla 1 outer plate with seven apical denticulate robust setae; inner plate with two apical plumose setae; palp of two articles, distal article longest, with apical setae. Maxilla 2 outer plate with two rows of simple and plumose setae apically and simple setae laterally; inner plate with simple setae apically and an oblique row of medial plumose setae. Maxilliped palp slender (no articles enlarged), of four articles plus spine; outer plate with robust and simple setae along apical and lateral margin; inner plate with robust and plumose setae apically and laterally.

Pereon. Gills include coxal gills on pereopods 2–7; sternal gills on thoracic segments 2–6, slender, around ½ length of coxal gills. Gnathopods 1–2 large (propodus similar length to head). Gnathopod 1 coxa short (wider than long), with robust seta at posterior corner and few simple setae scattered along margin; propodus length 1.8 times width, lateral face with distinct excavation above and parallel to palm margin, palm margins crenulate and with 2 excavations, without robust setae along palm margin, with rows of 3 mesial (inner) and 3 lateral (outer) robust setae either side of palm corner (where dactyl fits to the propodus), posterior margin of propodus with 4 oblique rows of long simple setae. Gnathopod 2 coxa longer than coxa 1, distinctly longer than wide, with robust seta at posterior corner and few simple setae scattered along margin; propodus length 2 times width, lateral face with distinct excavation above and parallel to palm margin, palm margins crenulate and with 2 excavations, without robust setae along palm margin, with rows of 3 mesial (inner) and 2 lateral (outer) robust setae either side of palm corner (where

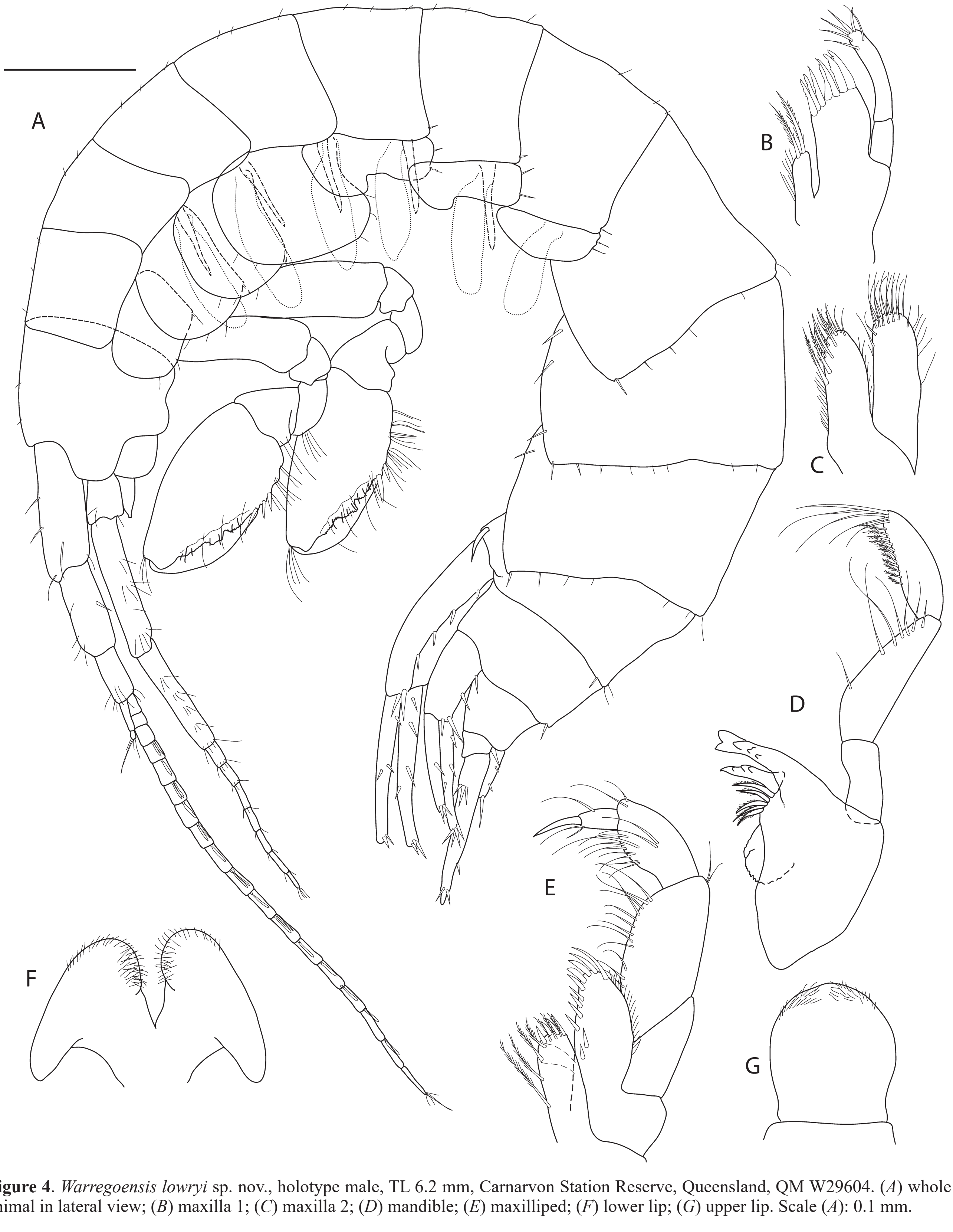

Figure 4. *Warregoensis lowryi* sp. nov., holotype male, TL 6.2 mm, Carnarvon Station Reserve, Queensland, QM W29604. (*A*) whole animal in lateral view; (*B*) maxilla 1; (*C*) maxilla 2; (*D*) mandible; (*E*) maxilliped; (*F*) lower lip; (*G*) upper lip. Scale (*A*): 0.1 mm.

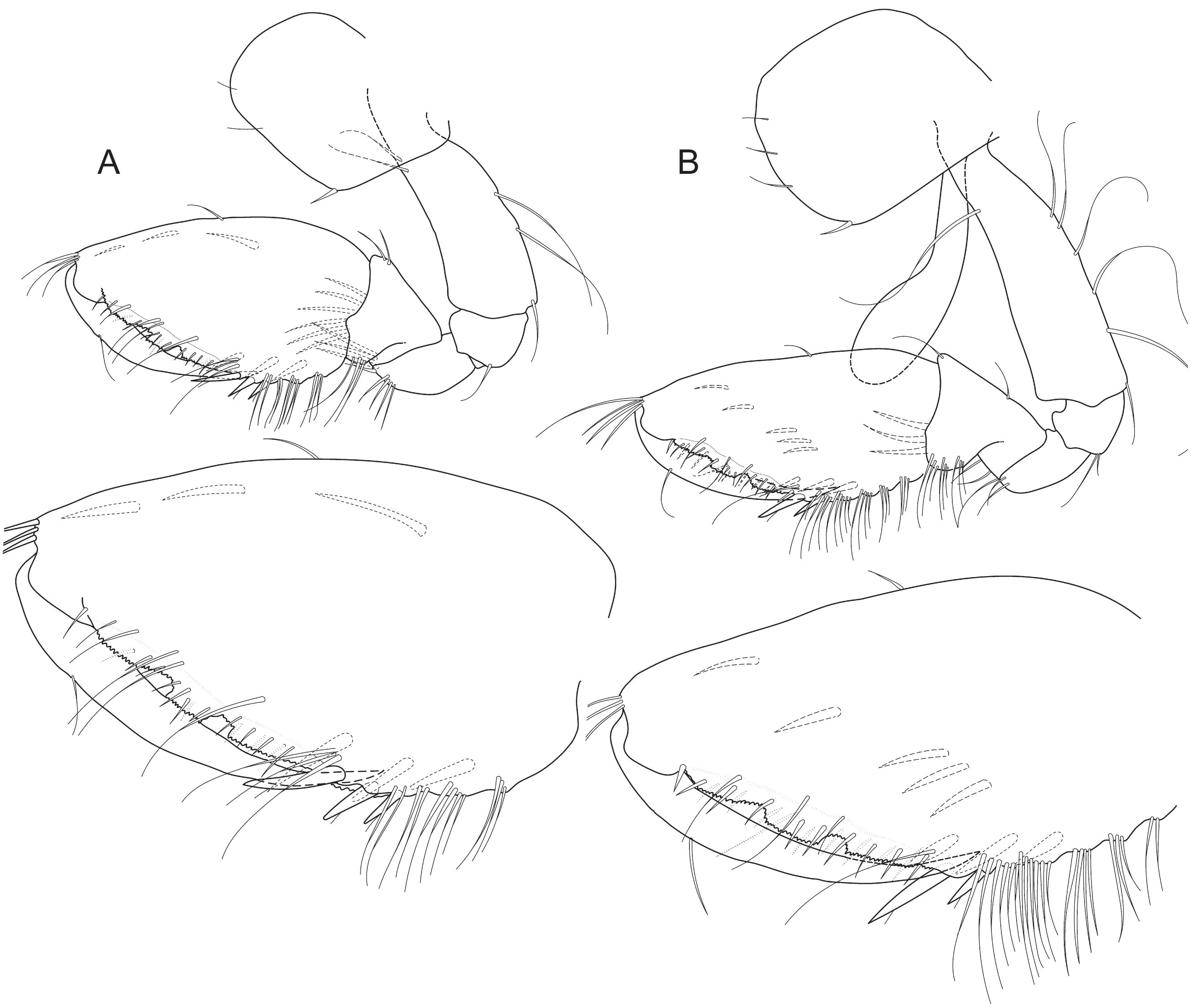

Figure 5. *Warregoensis lowryi* sp. nov., holotype male, TL 6.2 mm, Carnarvon Station Reserve, Queensland, QM W29604. (*A*) gnathopod 1 with enlargement to show palm detail; (*B*) gnathopod 2 with enlargement to show palm detail.

dactyl fits to the propodus), posterior margin of propodus with 5 oblique rows of long simple setae. Pereopod 3 coxa similar length to coxa 2, longer than wide, with robust seta at posterior corner and few simple setae scattered along margin. Pereopod 4 coxa similar length to coxa 2–3, longer than wide, small but distinct excavated corner on the posterior margin, with robust seta at posterior corner and few simple setae scattered along margin; dactylus with single seta. Pereopod 5 shorter than pereopods 6–7; coxa with rounded anteroventral lobe with seta, posteroventral lobe indistinct, with two setae on posterior margin; basis 1.7 times as long as wide; propodus longer than carpus; dactylus with single seta. Pereopod 6 similar length to pereopod 7; coxa with rounded anteroventral lobe, posteroventral lobe indistinct, with two setae on posterior margin; basis 1.9 times as long as wide; propodus longer than carpus; dactylus with single seta. Pereopod 7 coxa rounded, with two setae on posterior margin; basis 1.9 times as long as wide; propodus longer than carpus; dactylus with single seta.

Pleon. Epimera 1–3 posteroventrally subquadrate, posteroventral corner with robust seta and posterior margins with several small robust setae along length; epimera 2–3 with robust setae along the ventral margin. Urosomite 1 with distinct distoventral robust seta, with paired dorsolateral setae on distal margin. Urosomite 2 with paired dorsolateral setae on distal margin. Uropod 1 peduncle without basofacial robust seta, distal margin of peduncle with group of 1 large and 2 small robust setae laterally and 1 large robust seta medially. Uropod 2 distal margin of peduncle with group of 2 small robust setae laterally and 1 small robust seta medially. Uropod 3 distal margin of peduncle with robust setae laterally and medially; outer ramus of 1 article, approximately 3 times length of peduncle, with clusters of 2–3 robust setae along length; inner ramus absent. Telson cleft to 1/3 depth, with robust and simple setae apically.

Etymology. Named in honour of Dr Jim Lowry, a friend and colleague.

Remarks. *Warregoensis lowryi* sp. nov. is clearly a distinct species with 15% *CO1* divergence from *Carnarvonis katjae* sp. nov. and 22% *CO1* divergence from *Chillagoe thea*.

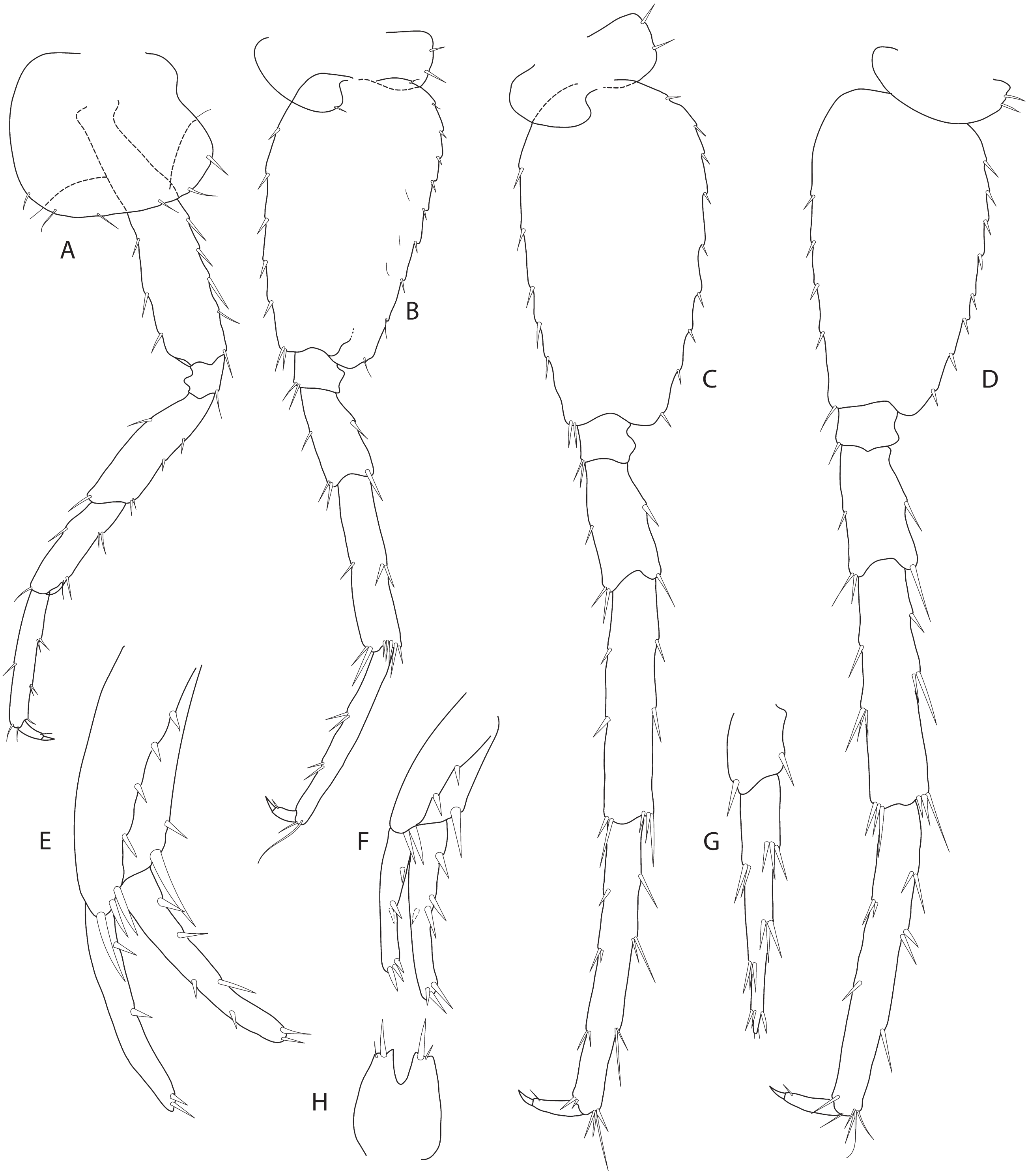

Figure 6. *Warregoensis lowryi* sp. nov., holotype male, TL 6.2 mm, Carnarvon Station Reserve, Queensland, QM W29604. (*A*) pereopod 4; (*B*) pereopod 5; (*C*) pereopod 6; (*D*) pereopod 7; (*E*) uropod 1; (*F*) uropod 2; (*G*) uropod 3; (*H*) telson.

Conclusion

Herein, we present two species hypotheses, largely based on morphological analyses, but with corroborating *CO1* divergence data. We describe two distinct new genera and species, *Carnarvonis katjae* sp. nov and *Warregoensis lowryi* sp. nov. within the family Chillagoeidae, existing within a single spring at Carnarvon Station Reserve in north-eastern Australia. We have revised the family Chillagoeidae and present new diagnostic characters that unite the three monotypic genera within the family. There are now three species of stygobiotic amphipods described from two discrete groundwater systems in north-eastern Australia, and it is highly likely that additional and potentially diverse stygobiont taxa will be discovered as groundwater habitats across the region are further explored.

Acknowledgements. We thank the editors Shane Ahyong, Alan Myers, Lucia Fanini and Penny Berents for their invitation to contribute to this memorial volume for Jim Lowry. Over the course of Rachael King's career, Jim has been a mentor, colleague, professional champion, and living encyclopaedia of all things Amphipoda and he will be missed.

We thank Dr Tessa Bradford (South Australian Museum) for generating the molecular data as part of the Framework DNA barcode datasets for Australia Program (Subterranean Invertebrate Biodiversity Dataset), funded by Bioplatforms Australia (BPA), Australian Biological Resources Study (ABRS) and the University of Adelaide. This paper would not have been completed without the support of the Bush Blitz program provided through ABRS, and we thank members of the 2014 Bush Blitz team (including Mim Jambrecina, Beth Tully, and Brian Hawkins) for their fabulous support in the field. Thanks to Dr Stephen Keable (Australian Museum) for loaning the type specimens of *Chillagoe thea*. This work was supported by a Bush Blitz Tactical Taxonomy Grant from the Australian Government through ABRS (2017–2018) to Remko Leijs. Specimens were collected under permit DNP-ABRS-1415-005 to the Queensland Museum with additional permissions obtained from Bush Heritage to collect within the Carnarvon Station Reserve.

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Amathillopsidae (Crustacea: Amphipoda) from New Zealand, Including the Description of a New Species

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ABSTRACT. *Amathillopis lowry*, a new species of the family Amathillopsidae is described from the south west Pacific. *In situ* images show this amphipod species new to science clinging to a stalked sponge in 4600-metre depth. This increases the number of New Zealand amathillopsid amphipods to three.

Introduction

The genus *Amathillopsis* currently consists of 13 species globally with only one (prior to this paper), *Amathillopsis grevei* J. L. Barnard, 1961, recorded from New Zealand waters. There are, however, three species known from neighbouring regions: *Amathillopsis australis* Stebbing, 1883, from the Coral Sea; and *A. charlottae* Coleman, 1998 and *A. roroi* Coleman & Coleman, 2008, both from the Antarctic Peninsula. Species of *Amathillopsis* are often enigmatic, being recorded only rarely and mostly in more recent years as deep-sea exploration technology has developed.

Recently in New Zealand waters, amathillopsid amphipods have been observed to cling to stalked sponges in over 4000 m depths. Photographs and video footage were taken by the Remotely Operated Vehicle *Kiel 6000* from the RV *Geomar Kiel* and samples of amphipods collected. Species of *Amathillopsis* have now been observed by ROVs and other camera systems on a number of occasions globally, clinging in pairs (and occasionally in larger numbers), to tubular or stalk-like structures growing in soft substrates, and also on corals attached to hard substrates (Lörz & Horton, 2021). This recently observed species of *Amathillopsis* has been identified as new to science and is described here in detail. An extension of range for the Antarctic *Amathillopsis charlottae* into the New Zealand EEZ (recorded here) now brings the total of species in this genus in New Zealand waters to three (Fig. 1).

The new species, and hence this paper, is dedicated to Dr Jim Lowry as his exploration of both New Zealand and Antarctic waters lead to the discovery of many new amphipod species as well as range extensions of others.

Materials and methods

Collection methods and locations. During the SO254 expedition on the RV *Sonne*, the ROV *KIEL 6000* was deployed in northern New Zealand waters at station 10ROV03, in the abyssal basin between the Three Kings Ridge and Colville Ridge, Pacific Ocean (30°59.448396'S 177°30.059508'W, depth 4159.4 m), conducting photo and video transects as well as physical sampling. The specimens of the new species of *Amathillopsis* were initially photographed and filmed *in situ*, after which the ROV collected them into a sampling box. Once on board, the specimens collected were immediately photographed and preserved in ethanol.

Keywords: Amphipoda, new species, New Zealand, Remotely Operated Vehicle (ROV), abyssal
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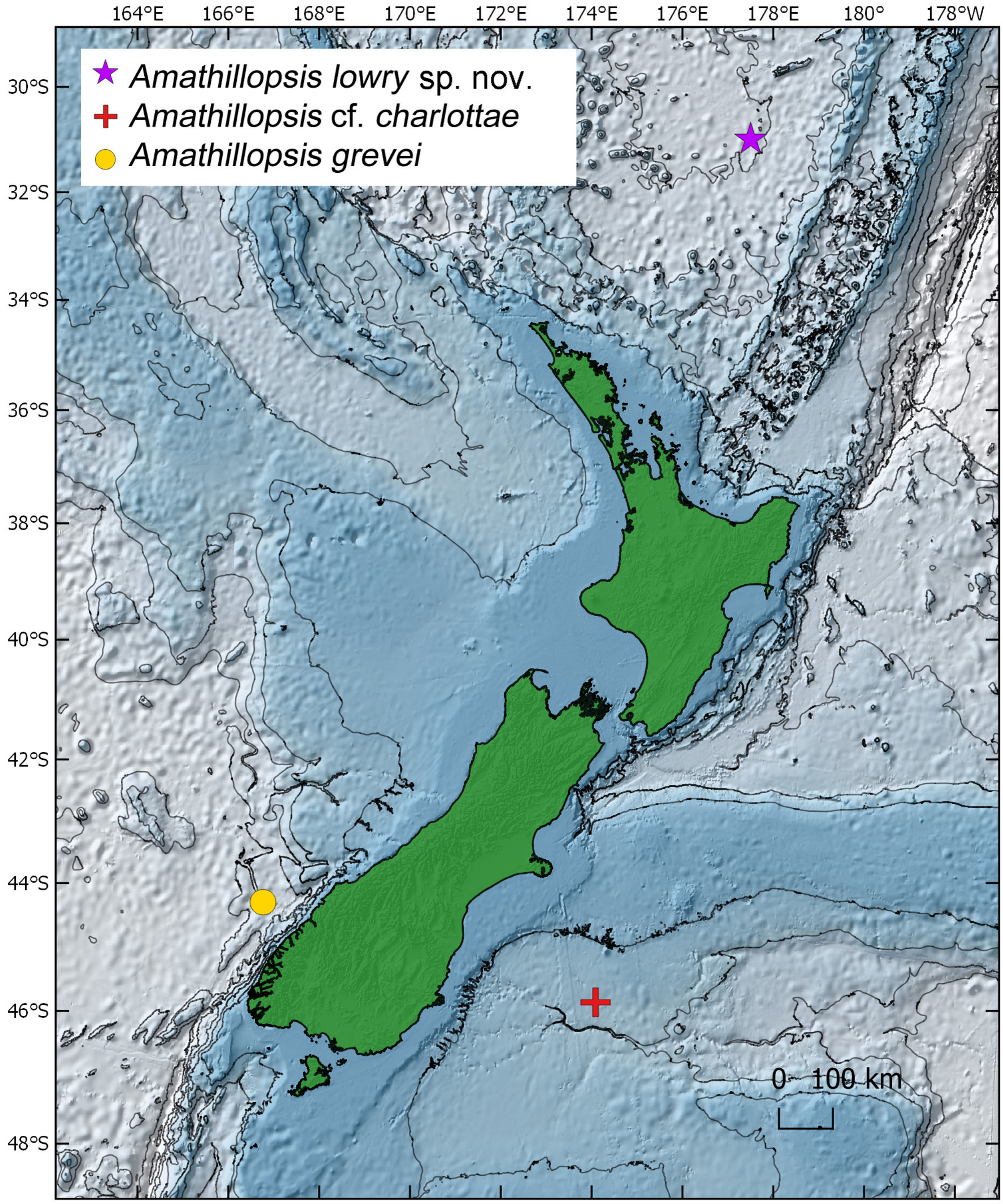

Figure 1. Distribution of the three species of *Amathillopis* known from New Zealand waters: *Amathillopis lowry* sp. nov.; *A. grevei* Barnard, 1961; and *A.* cf. *charlottae* Coleman, 1998.

Taxonomic methods. The adult male holotype and female paratype specimens were photographed *in situ* by the ROV *KIEL 6000* and photographed on board of the RV *Sonne*.

The pencil drawings were made using both a Leica M9.5 (dissecting microscope) and a Zeiss Axioskope 2plus (compound microscope). Pencil drawings were scanned and inked digitally using Adobe® Photoshop and a WACOM™ digitize r tablet. Type material is deposited in the Invertebrate Collection of the National Institute of Water & Atmospheric Research, Wellington, New Zealand (NIWA). Setal and mouthpart classifications follow Watling (1989) and Lowry & Stoddart (1992, 1993, 1995).

The following abbreviations are used in Figs 2, 3–5, 9, 10: A, antenna; G, gnathopod; H, head; Hb, habitus; LL, lower lip; Md, mandible; Mx, maxilla; Mxp, maxilliped; P, pereopod; T, telson; U, uropod; UL, upper lip; L, left; R, right.

Genetic methods. DNA was extracted from specimens using the Qiagen DNeasy Blood and Tissue kit (Qiagen GmbH, Hilden) according to the manufacturer's instructions. Tissue was extracted from the second pleopod of the animals. DNA was diluted at 1:10 before amplification by PCR. Each PCR reaction contained 5 µL of 5× reaction buffer, 25 pmol of both the forward and reverse primer, dNTPs to a final concentration of 0.2 mM each, and 0.5 U Kapa 2G Robust Hotstart DNA polymerase Taq (Sigma-Aldrich, St Louis, MO). The COI marker was amplified and sequenced using primers LCO1490 and HCO2198 (Folmer *et al*., 1994). PCR settings for amplifying CO1 sequences consisted of initial denaturing of 5 min at 95°C, 35 cycles of 30 s at 95°C, 30 s at 48°C, 45 s at 72°C, and final extension of 5 min at 72°C. PCR products were purified using ExoSAP-IT (USB, Cleveland, Ohio, USA) according to the manufacturers' instructions, and were sequenced at Macrogen Inc., (Seoul, South Korea).

Sequences were trimmed and aligned using Geneious Prime 2021.2.2 (https://www.geneious.com) and compared to sequences in GenBank using BLAST (Altschul *et al*., 1990). COI derived from the New Zealand specimens were aligned with representative sequences from other *Amathillopsis* species in GenBank. Relevant voucher information, taxonomic classification and sequence were deposited in GenBank (ON644605).

Systematics

Order Amphipoda Latreille, 1816

Suborder Amphilochidea Lowry & Myers, 2017

Family Amathillopsidae Pirlot, 1934

Subfamily Amathillopsinae Pirlot, 1934

Amathillopsis Heller, 1875

Amathillopsis Heller, 1875: 35.—Stebbing, 1906: 384.—Gurjanova, 1955: 209 (key).—J. L. Barnard, 1969: 394.—J. L. Barnard & Karaman, 1991: 390.

Acanthopleustes Holmes, 1908: 533 (type species *Acanthopleustes annectens* Holmes, 1908, by original designation).

Type species. *Amathillopsis spinigera* Heller, 1875 (by original designation).

Species composition. *Amathillopsis affinis* Miers, 1881, *A. annectens* (Holmes, 1908), *A. atlantica* Chevreux, 1908, *A. australis* Stebbing, 1883, *A. charlottae* Coleman, 1998, *A. comorensis* Ledoyer, 1986, *A. grevei* J. L. Barnard, 1961, *A. inkenae* Lörz & Horton, 2021, *A. pacifica* Gurjanova, 1955, *A. pacifica margo* J. L. Barnard, 1967, *A. roroi* Coleman & Coleman, 2008, *A. septemdentata* Ledoyer, 1978, *A. spinigera* Heller, 1875, *A. takahashiae* Tomikawa & Mawatari, 2006.

Amathillopsis lowry sp. nov.

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Figs 2–8

Holotype: NIWA 127043, male, 34.5 mm, abyssal basin between Three Kings and Colville Ridges, Pacific Ocean, 30°59.448396'S 177°30.059508'W, depth 4159.4 m, SO254_10ROV03, 01 February 2017. **Paratype**: NIWA 156301, female, 29.5 mm, collected with holotype.

Diagnosis. Pereonite 3 without mid-dorsal projection, pereonite 4 with small, rounded mid-dorsal projections. Pereonites 5–7 with large mid-dorsal projections, increasing in size. Pleonites 1–3 mid-dorsal projections large and angular. Urosomite 1 mid-dorsal projection small and rounded, urosomites 2 without obvious carination and urosomite 3 with slight rounded hump distally. Male gnathopod 1–2 posterodistal basis lobe reduced, female gnathopods 1 and 2 strongly developed. Small, acute tooth on posterodistal corner of epimeron 3. Telson elongated (longer than wide), developed into a weakly trifid apex.

Description of holotype (male, 34.5 mm, NIWA127043). *Head* slightly shorter than pereonites 1 and 2 combined, rostrum very short, pointed, lateral cephalic lobe strongly quadrate, eyes present, pigmented, white in fresh specimen. Pereonites 1–3 indistinctly keeled dorsally; pereonite 4–7 with mid-dorsal curved processes, increasing in length. Pleonites 1–3 each with posteriorly curved mid-dorsal process. Epimeral plate 1 with ventral margin rounded, posteroventral corner rounded; epimeral plates 2 with ventral margin rounded, posteroventral corner toothed; epimeral plate 3 with ventral margin curved and posteroventral corner produced into a small acute tooth. Urosomite 1 weakly carinated with rounded process, urosomite 2 lacking dorsal armature, urosomite 3 weakly dorsally carinate with small, rounded mid-dorsal process. Antenna 1 as long as body length, with peduncular articles 1, 2, and 3 in length ratio of 1.0: 1.1: 0.4, respectively; peduncular 1 article 1 longer than head length; accessory flagellum uniarticulate, spine-like; primary flagellum consisting of more than 60 articles. Antenna 2 0.8 times as long as antenna 1; peduncular article 3 reaching to one-third length of peduncular article 1 of antenna 1; peduncular article 4 long, 1.7 times as long as peduncular article 5, flagellum slightly longer than peduncle, 54-articulate.

Mouthparts. Upper lip with slight depression in apical margin, bearing 2 groups of setae. Lower lip with outer lobes broad, setulose; inner lobes indistinct, fused. Mandibles with left incisor bearing 9 teeth, left lacinia mobilis with 4 teeth; accessory setal row with 12 setae, some bearing row of minute protuberances. Right mandible incisor with 6 teeth, lacinia mobilis with 4 teeth, and accessory setal row with 12 setae. Molar developed, triturative. Palp articles 1, 2, and 3 in length ratio of 1: 3: 3, respectively (for both left and right sides), article 1 with setae on distal corners, article 2 with marginal and submarginal setae, and article 3 with marginal and terminal setae. Maxilla 1 with inner plate ovoid and bearing 3 short, and 4 long slender plumose setae; outer plate rectangular, with 10 large robust setae (5 toothed); palp 2-articulate, longer than outer plate, terminally with 10 long robust setae, outer lateral margin lined with 7 slightly plumose slender setae. Maxilla 2 inner plate slightly broader than outer plate, bearing row of long plumose setae. Maxilliped inner plate reaching base of palp, with 3 robust nodular setae on distomedial margin, distolateral margin with apical robust setae; outer plate exceeding distal margin of palp article 1. Maxilliped palp long, raptorial, broken off; articles 2 and 3 heavily setose.

Pereon. Coxae 1 rounded, coxae 2–4 produced angularly anteroventrally. Coxae 5 and 6 wider than long, bilobate. Coxa 7 small and rounded. Gnathopod 1 subchelate, basis posterior margin without robust setae, posterodistal lobe vestigial; ischium about half length of merus; merus produced posterodistally to form narrow rounded lobe; carpus slightly shorter than propodus, posteroventral lobe

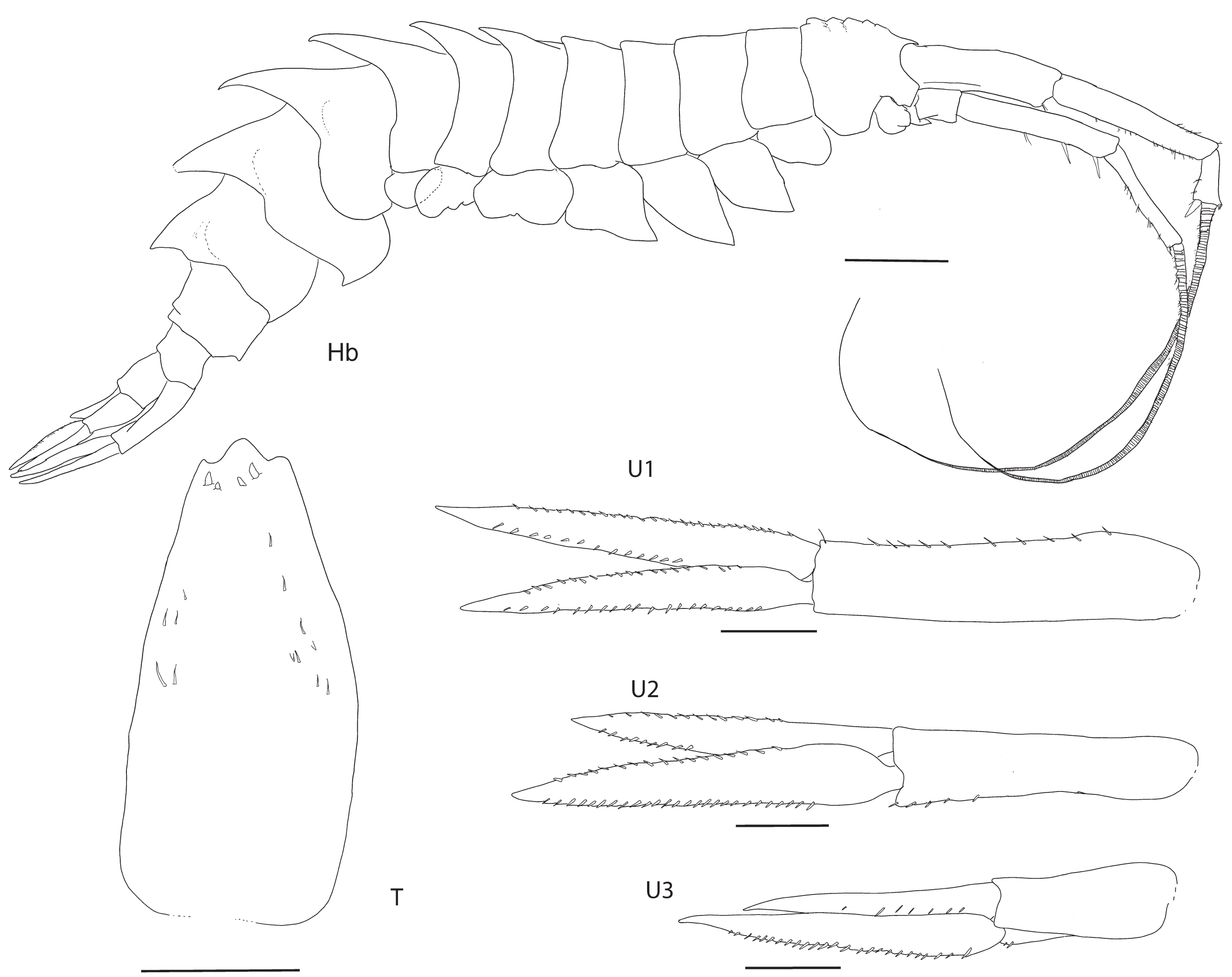

Figure 2. *Amathilliopsis lowry* sp. nov., holotype male, 34.5 mm, NIWA 127043. Scale: Hb 5 mm, U1–3 1 mm, T 0.75 mm.

broadly rounded, allowing propodus to fold over distally; propodus 2 times longer than wide, ovoid, with 5 medial rows of 4–12 slender simple setae, anterior margin with 3 long rows of 5–15 long slender simple setae and 3 tufts of 2 or 3 separate small slender setae; palm not differentiated from posterior margin, lined with tufts of slender setae and 5 short robust setae along convex palm. Propodus with row of 12 long slender simple setae distally. Dactylus long, slender and gently curved, reaching length of propodus. Gnathopod 2 subchelate, basis with posterodistal lobe reduced; ischium half length of merus. Merus produced posterodistally to form acute lobe lined with long slender simple setae. Carpus twice as long as merus and 0.75 times as long as propodus; ventral lobe broadly rounded, slightly directed distally, positioned allowing propodus to fold over; propodus narrow (twice as long as broad), ovoid. Anterior margin lined with 5 rows of slender simple setae containing 2–10 setae; medial surface with 6 rows of 4–7. Palm not differentiated from posterior margin, convex and lined with long slender simple setae and 12 short robust setae. Dactylus long, slender, gently curved, reaching length of propodus. Pereopod 3 basis with row of robust setae along weakly convex posterior margin, ischium short, as long as wide; merus margins subparallel with slight anterior curvature, anteroventral lobe; propodus wider and longer than merus; dactylus half-length of propodus, rounded. Pereopod 4 similar to pereopod 3. Pereopods 5–7 anterior and posterior margins of basis sub-parallel, linear, posterior lobe lacking; ischium short, as long as wide; merus margins subparallel with slight anterior curvature; proportions of carpus: propodus: dactylus is 18: 22: 17.

Uropods. Uropod 1 long, peduncle as long as inner ramus, medial margin of peduncle with robust setae, inner and outer ramus lateral and medial margins with robust setae, outer ramus 0.9 times as long as inner. Uropod 2 with peduncle length 0.6 times inner ramus, lateral margin with robust setae; outer ramus same length as peduncle, lateral and medial margins with robust setae; outer ramus 0.6 times inner, lateral and medial margins with robust setae. Uropod 3 peduncle length nearly half length of inner ramus; dorsomedial margin of peduncle with 2 robust setae distally; inner ramus with lateral and medial margins bearing robust setae, outer ramus 0.8 times as long as inner, lateral and medial margins with robust setae. Telson length 1.5 times width, each side bearing 2 short robust setae apically plus a number of small slender setae medially. Apically having appearance of being trifid, however, but appearing slightly uneven, possibly owing to damage.

Table 1. Comparison of morphological characteristics of New Zealand amathillopsid species.

character	*A. lowry*	*A. grevei*	*A. charlottae*	*A.* cf. *charlottae*
pereonites 1–4 mid-dorsal	keeled on 4	absent	keeled on 2–4	absent
pereonites 5–7 mid-dorsal projections	strong, acute, increasing in size posteriorly	medium, acute, increasing in size posteriorly	strong, acute, increasing in size posteriorly	medium to strong, acute, increasing posteriorly
pleonites 1–3 mid-dorsal	strong, acute on 1–3, slightly decreasing in size	medium, acute on 1–3, decreasing in size	strong, acute on 1–2, slightly smaller on 3	strong, acute on 1–3, decreasing in size
urosomite 1	mid-dorsal projection	present (weak)	absent	absent
gnathopod posterodistal basis lobe	reduced/absent on gnathopod 1 and 2 (male), strongly developed on gnathopod 1 and 2 (female)	slightly developed on gnathopod 2 only	developed on gnathopod 1 and 2	developed on gnathopod 1 and 2
mandible palp article 3 : article 2 length	1 : 1	unknown	1 : 1	1 : 1
telson	weakly trifid	emarginate	entire	weakly emarginate
antenna 1 accessory flagellum	uniarticulate, spine-like	uniarticulate, ordinary	uniarticulate, ordinary	uniarticulate, ordinary.

Variation. Paratype female, 29.5 mm, in situ photographed (Fig. 5B) and photographed on board (Figs 7, 8). Antenna 1 peduncular articles of different proportion from male. Spine-like accessory flagellum short. Gnathopod 1 basis expanded to form large posterodistal lobe lined on both sides by many short robust setae reaching almost to junction with coxa; basis medial face lined with rows of long slender setae. Merus weakly produced to form small rounded strongly setose posterodistal lobe. Carpus expanded to form large broadly rounded lobe. Carpus medial surface with 12 long rows of 4–12 long slender simple setae. Carpus anterior margin without slender setae but defined distally by row of 8 long slender simple setae. Posterior and distal carpal margins densely lined with long slender simple setae. Carpus similar length to propodus. Propodus narrow (2.2 times as long as wide). Anterior margin of propodus lined with 3 rows of 10–12 slender, simple setae, and 2 tufts of 2 or 3 small setae. Medial face of propodus with 4 rows of 6–12 long slender setae. Gnathopod 2 basis expanded to form large posterodistal lobe lined with many short robust setae on both sides reaching up to near junction with coxa. Carpus posterior margin densely lined with rows of slender simple setae. Telson long, narrow, emarginate at apex (possibly damaged).

Etymology. The species is named for Dr Jim Lowry, our amphipod colleague who dedicated his scientific expertise to Amphipoda. Used as a noun in apposition.

Colour. In live specimens, *Amathillopsis lowry* sp. nov. has a white body and antennae; the last three segments of both gnathopods as well as the mouthparts are red. The eyes are clearly visible, solid white, in live and fresh condition, but faded when preserved.

Depth range. 4159.4 m.

Distribution. Only known from the southwest Pacific, from the abyssal basin between Three Kings and Colville Ridges, 4159.4 m.

Remarks. *Amathillopsis lowry* sp. nov. differs from all other known species of *Amathillopsis* by the combination of the following characters: pereonites 1–3 mid-dorsally smooth, pereonites 5–7 strong, acute, progressively increasing in size; urosomite 1 mid-dorsal projection reduced to a small rounded hump; gnathopod 1 and 2 posterodistal basis lobe greatly reduced and weakly setose in male but strongly present and covered in robust setae in female; telson shape entire, and longer than wide, but produced in the centre to

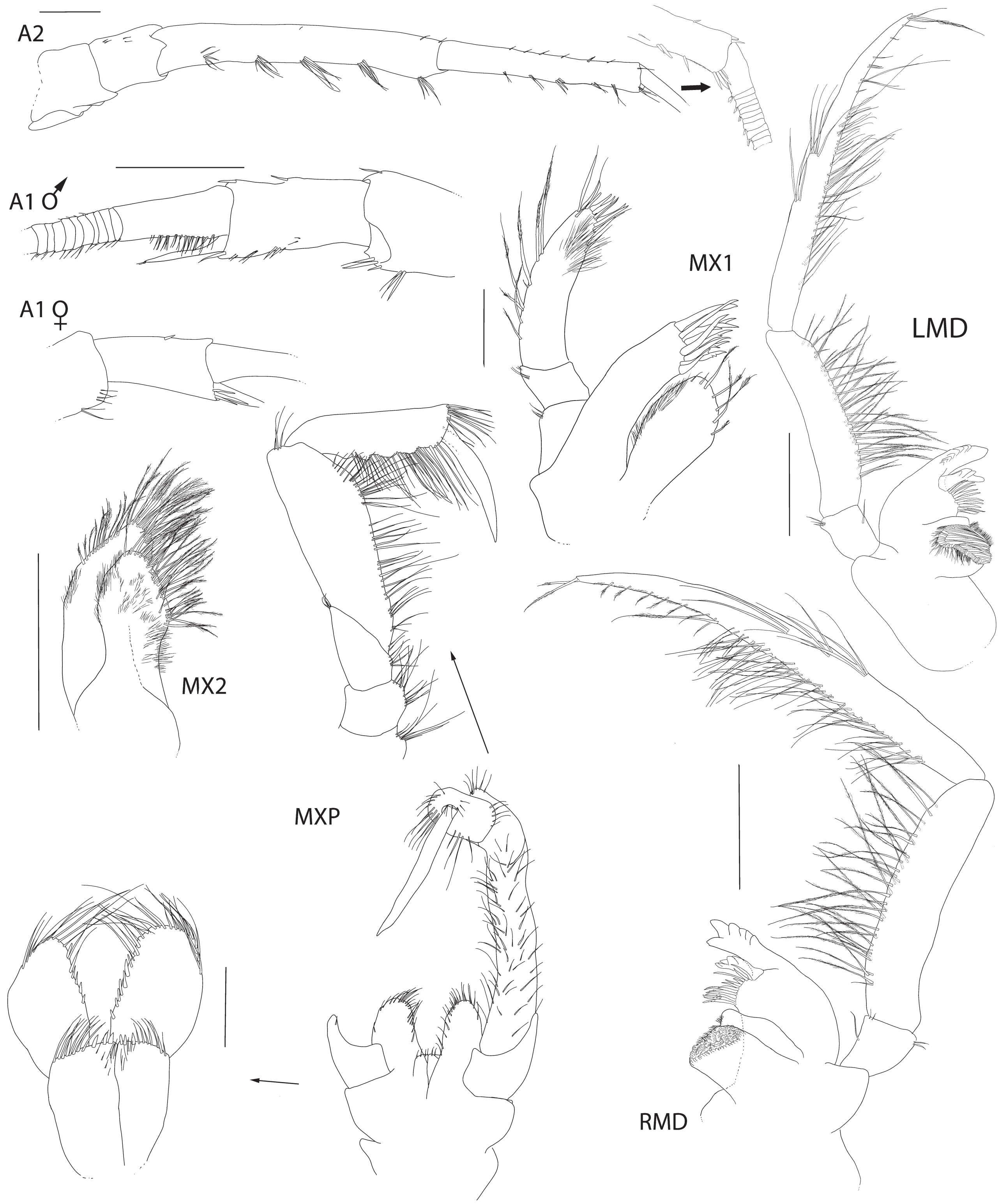

Figure 3. *Amathilliopsis lowry* sp. nov.: holotype male, 34.5 mm, NIWA 127043; paratype female, 29.5 mm, NIWA 156301 (A1 only). Scale 1 mm.

give a tridentate appearance.

Amathillopsis lowry sp. nov. is most similar to *A. charlottae*, (Table 1), collected from the Antarctic Peninsula at 607 m, and *A. grevei* from 3580 m in the Tasman Sea. The new species has a similar development of the dorsal processes and smooth urosomite 1, but no posterodistal lobes on the basis of male gnathopod 2 as in *A. charlottae*. The telson of *A. lowry* sp. nov. differs from all other species of *Amathillopsis* in the elongated shape and pseudo-trifid apical shape.

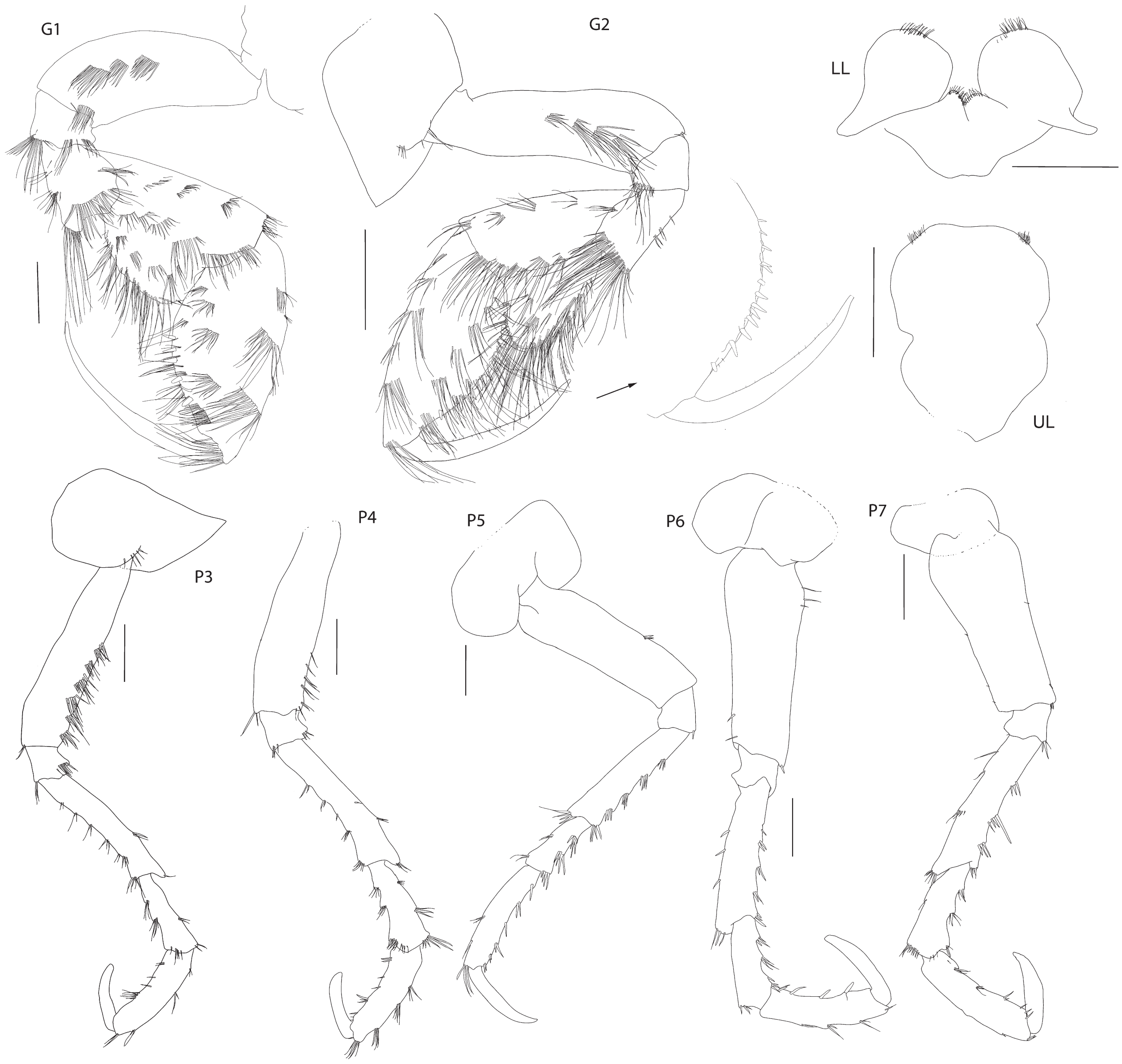

Figure 4. *Amathilliopsis lowry* sp. nov., holotype male, 34.5 mm, NIWA 127043. Scale: G1, G2 0.5 mm; all others 1 mm.

Amathillopsis grevei Barnard, 1961

Holotype: Male, 13 mm, Tasman Sea, 44°18'S 166°46'E, 3580 m, clay, 17 January 1952.

Diagnosis (after Barnard, 1961). Eyes absent; dorsal projections reaching maximum length on pereonite 7; pleonites 1–2, sometimes 3, smooth; dorsal projections commencing as small elements on pereonite 3 and increasing progressively in size through pereonite 7; anterior corners of first 4 coxae angular but not very sharp and not attenuated; coxae relatively short, quadrate; posterior lobes on propodus of gnathopods blunt, not attenuated; posterior margin of gnathopod 2 ischium slightly but not grossly lobate and bearing small marginal robust setae, this condition slightly developed on gnathopod 1; posteroventral corners of epimeron 2 and 3 greatly reduced evident; posterior end of pleonite 6 with small medial tooth; telson broad, short, apically emarginate. Accessory flagellum composed of single slender article tipped with 2 or 3 setae.

Remarks. As discussed by Lörz & Horton (2021), care should be taken in use of the relative sizes of the dorsal processes in distinguishing species because these are likely to vary ontogenetically, as in the two type specimens of *Amathillopsis inkenae* Lörz & Horton, 2021, where the larger male paratype has more pronounced, acute processes than the smaller male holotype. This is also likely to occur in other species in the genus. We consider the possibility that *Amathillopsis grevei*, which is only known from a single specimen of 13 mm, was described from an immature specimen.

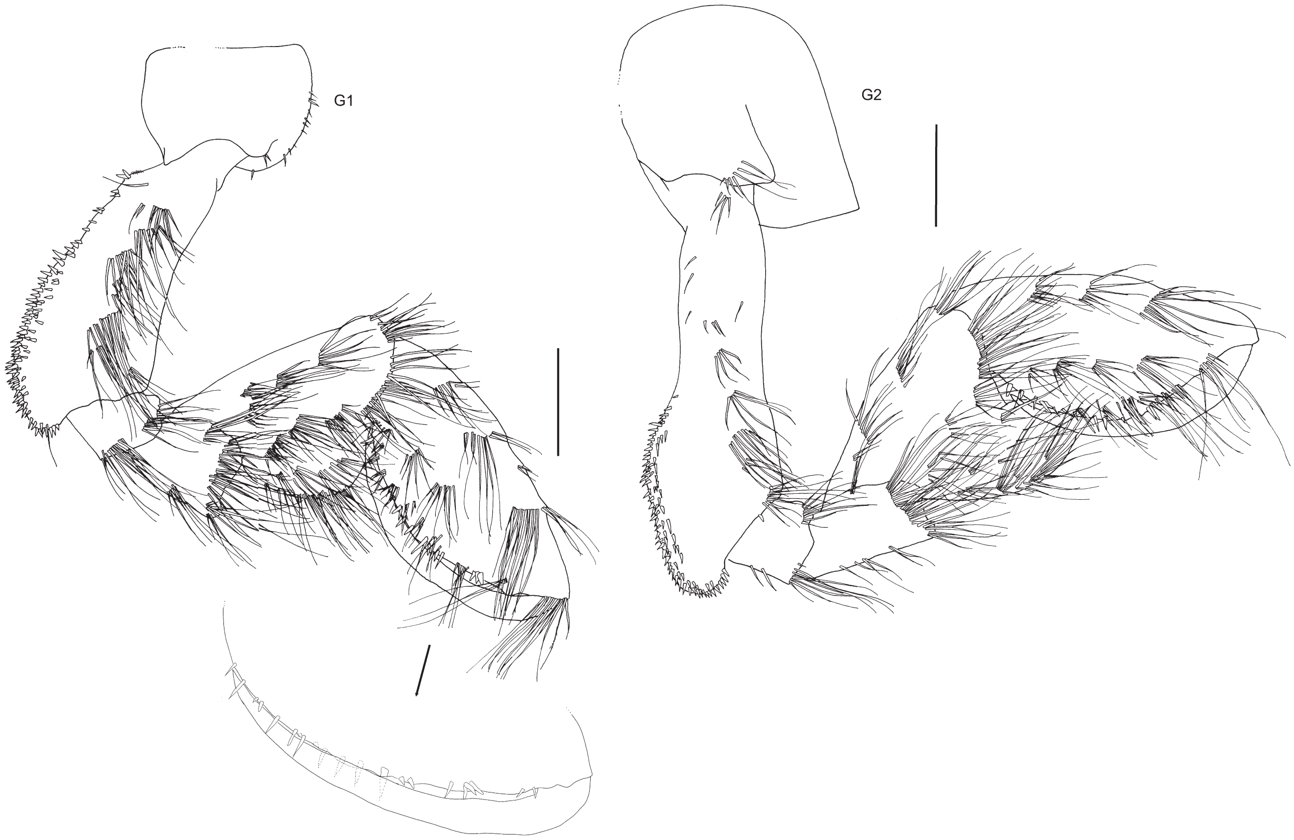

Figure 5. *Amathilliopsis lowry* sp. nov., paratype, NIWA 156301, female, 29.5 mm, gnathopods 1 and 2. Scale 1 mm.

Amathillopsis cf. *charlottae* Coleman, 1998

Figs 9–10

Type locality. Antarctic Peninsula, 66°33.10'S 68°41.90'W, depth 607 m, *Polarstern* cruise 42 ANT XIV/2, station 177, Agassiz-Trawl.

Material examined. NIWA 84392 (figured) and NIWA 156317 (3 specimens), Canterbury Basin, east of South Island, New Zealand, 45.872°S 174.082°E, 1676 m, NZOI station S152, 26 October 1979.

Diagnosis. (Based on Coleman, 1998). *Head* with short rostrum, anteroventral angle deeply excavate, ocular lobe with short acute process, with ridge parallel to ventral margin; Pereonite 1 somewhat longer than 2 and 3. Pereonite 2–4 indistinctly keeled dorsally; pereonite 5 with short carina and 5 or 6 with long pointed, weakly posteriorly curved processes. Similar but slightly longer processes on pleonites 1–2 and a shorter one on pleonite 3, about half length of that on pleonite 2. Epimeral plate 1 ventrally truncate, obtuse posteroventrally; plate 2 posteroventrally acute, plates 1 and 2 laterally ridged; posterolateral margin of epimeral plate 3 sinuous, posteroventral angle acute. Urosomite 1 as long as segment 2 and 3 combined; urosomite 2 shortest; urosomite 3 with shallow keel, slightly overreaching posterior margin, with shallow depression in lateral view.

Distribution. Southern Canterbury basin, New Zealand, Antarctic Peninsula.

Remarks. While analysing the Amathillopsidae held in the NIWA collection, we encountered specimens collected off southeast New Zealand that were remarkably similar to *A. charlottae*, originally described by Coleman (1998) from the Weddell Sea. While Coleman (1998) stated that *A. charlottae* had no eyes "or pigments lost in alcohol", the New Zealand material shows distinct small, round eyes. The lateral surface of the New Zealand material seems smoother than Coleman's Antarctic material. The morphological differences between the New Zealand and the Weddell Sea specimens were too minute to establish a new species, and our attempts to secure DNA sequences failed. We therefore refer to the New Zealand specimens as *A.* cf. *charlottae*.

ACKNOWLEDGEMENTS. Specimens were collected as part of the project "PoribacNewZ" by the Insitut fur Chemie und Biologie des Meeres, University Oldenburg, on the German flagship RV *Sonne*, using the GEOMAR ROV *Kiel 6000* with participation and funding from GEOMAR, DSMZ, LMU, NIOZ, NIWA, and ETH-Zurich. NIWA voyage participation was funded through MBIE SSIF Enhancing Collections project. We are grateful to Sadie Mills (National Institute of Water & Atmosphere, Wellington) for joining the *Sonne* expedition, curating the samples and managing the registration database. We appreciate the extra sampling effort and great in-situ images taken by the ROV team led by Fritz Abegg from the GEOMAR Helmholtz Zentrum Kiel. Peter Schlupp, University Oldenburg, took the board photographs. Michelle Kelly (NIWA Auckland) kindly identified the sponge tube from a photograph. We are grateful to Kareen Schnabel and Jaret Bilewich for molecular assistance.

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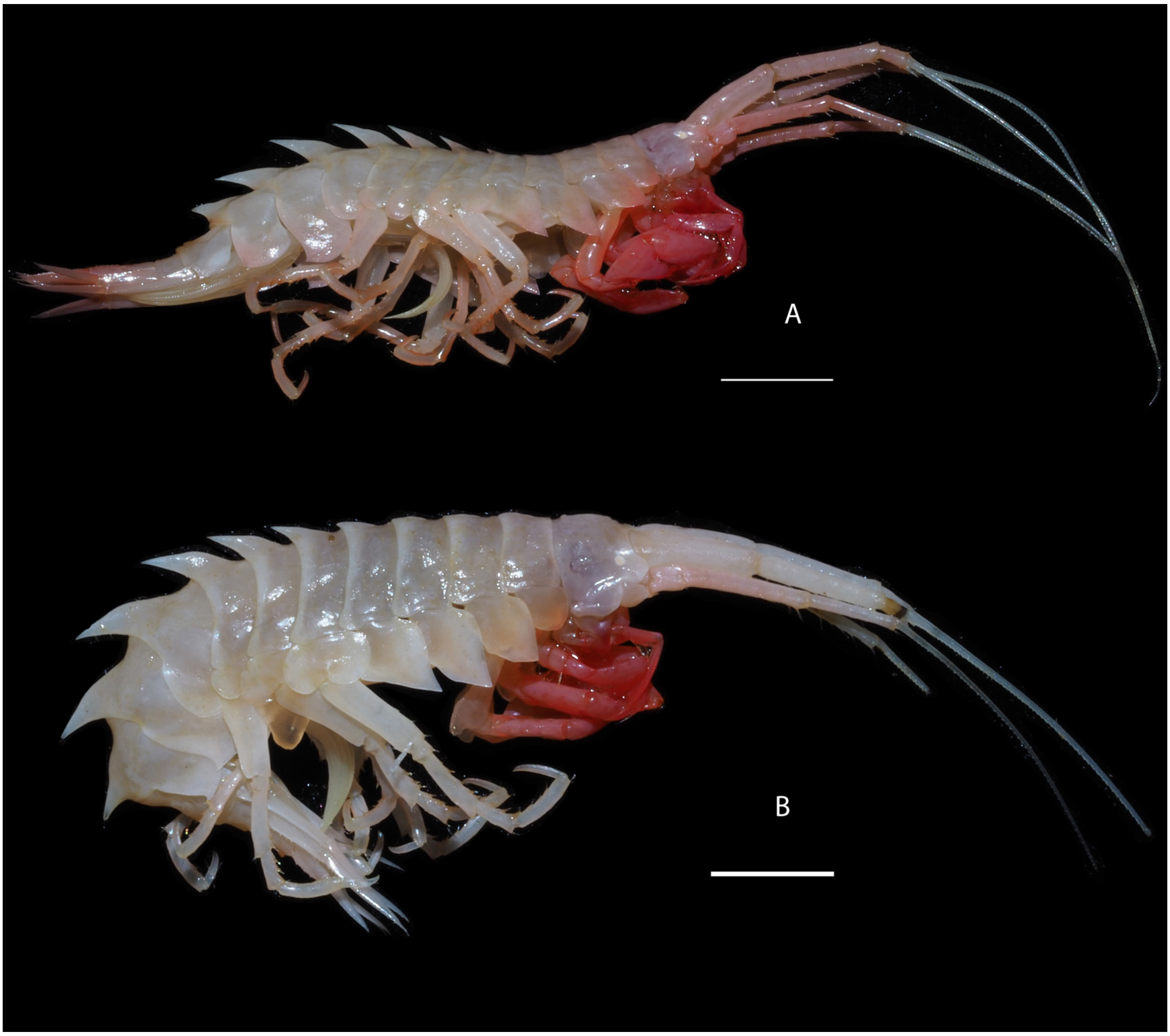

Figure 6. *Amathilliopsis lowry* sp. nov.: (A) holotype male 34.5 mm, NIWA 127043; (B) paratype female, 29.5 mm, NIWA 156301. Photographed immediately after capture. Scale 5 mm.

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Figure 7. In situ image of three specimens of *Amathillopsis lowry* sp. nov. on sponge tubes, ROV *Kiel 6000*, Geomar, 4159 m depth, abyssal basin between Three Kings Ridge and Colville Ridge, Pacific Ocean.

Figure 8. In situ image of paratype *Amathillopsis lowry* sp. nov., NIWA 156301, 4159 m abyssal basin between Three Kings Ridge and Colville Ridge, Pacific Ocean.

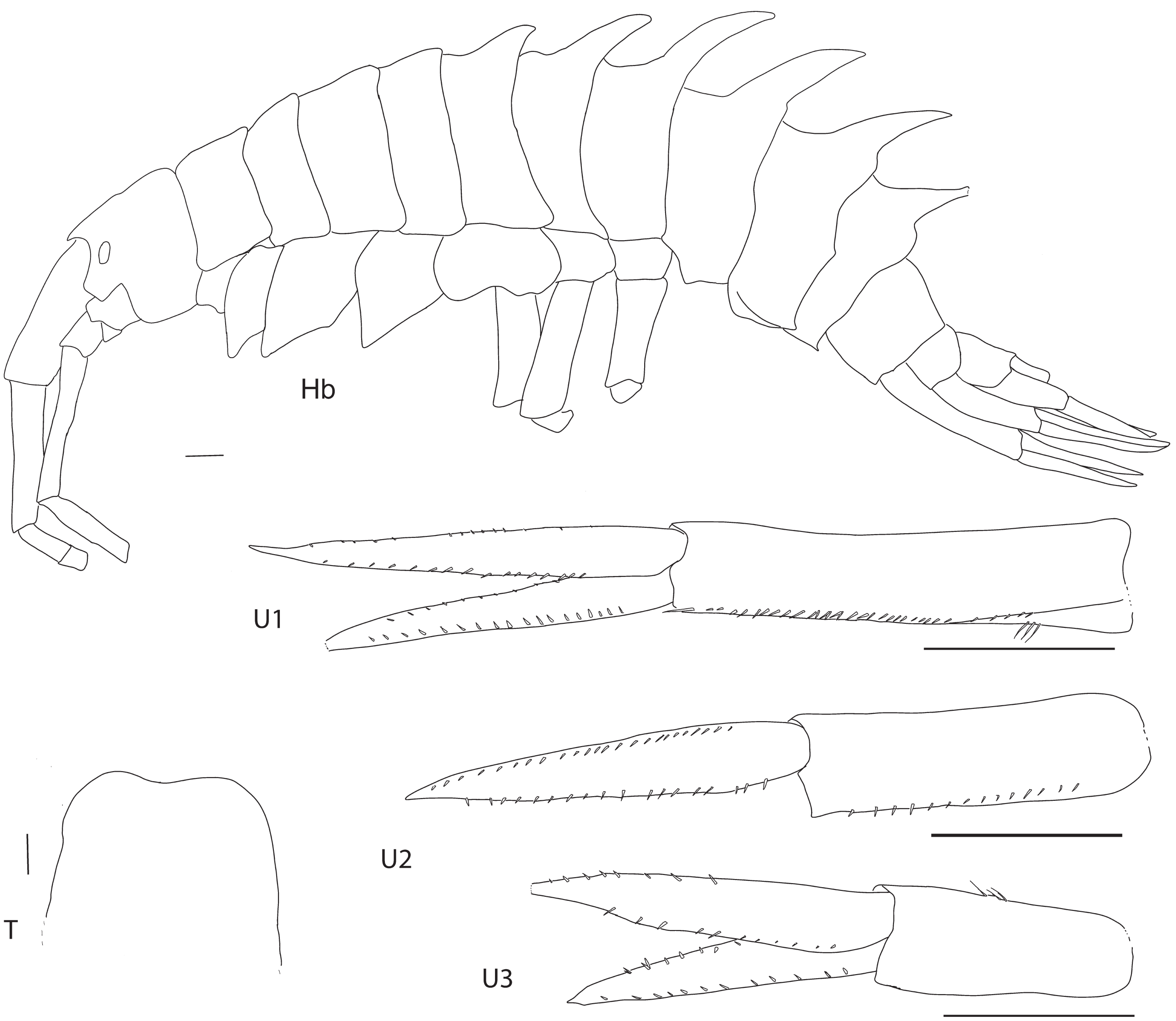

Figure 9. *Amathillopsis* cf. *charlottae* Coleman, 1998, male, 21.5 mm, NIWA 84392. Scale: Hb, U1–3 1 mm, T 0.2 mm.

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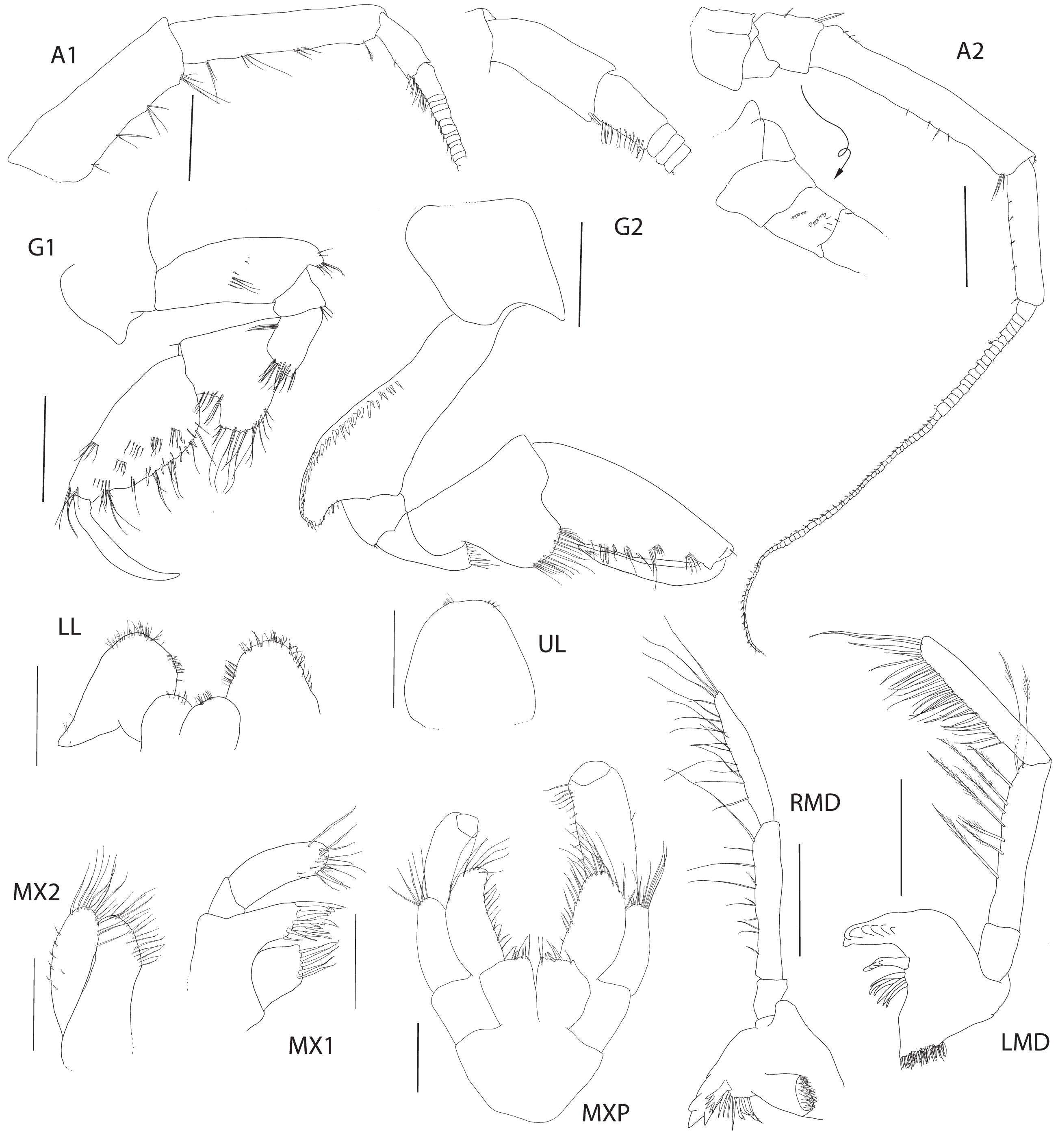

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The Coastal Talitroid Amphipods of New Caledonia (Amphipoda: Talitroidea)

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ABSTRACT. One new genus and three species of talitrid amphipods are described from New Caledonia: *Chroestia amoa* sp. nov., *Talorchestia spinipalma* (Dana, 1852), *Thiorchestia caledoniana* gen. et sp. nov. Descriptions are accompanied by basic ecological information on beaches where the specimens were collected.

Introduction

Five species of terrestrial talitroid amphipods are currently known from New Caledonia: *Chiltonorchestia pusilla* (Chevreux, 1915); *C. starmuhlneri* (Ruffo & Vesentini Paiotta, 1972); *Ignamborchestia sarasini* (Chevreux, 1915); *Chevreuxiana antennulata* (Chevreux, 1915); and one beach-hopper, *Talorchestia spinipalma* (Dana, 1852). Most are well described and all but one species appear to be associated with fresh water at altitudes of 300–1000 m. In this paper, based on a collection from around the coastline, we describe two beach-hoppers, i.e., mainly coastal supralittoral / intertidal leaf-litter / wrack, non-substrate modifying talitroids: *Chroestia amoa* sp. nov. and *Thiorchestia caledoniana* gen. et sp. nov., and report new records of *Talorchestia spinipalma* (Dana, 1852) bringing the total talitroidean taxa from New Caledonia to eight.

We also report the sites along the coastline where talitroids were found, and those where no talitroids were found, after applying the same sampling effort. In fact, through a meta-analysis of data from 201 beaches worldwide, McLachlan & Defeo (2017) concluded that, in terms of resident macrofauna, beaches "behave" like ecological islands, so the single beach unit dimension becomes extremely relevant to describe the distribution of organisms. From this perspective we consider it important to report also those sites where no talitroids were found, as informative zeros. On the assumption that the integration of disciplines requires both clear protocols and matching units (Oberg, 2011), we here present the organism along with standard information related to the "beach unit" where it was collected (unit dimensions summarized in Fanini *et al*., 2021). Information remains quantitative, though it supports the depiction of patterns and baselines. We encourage further studies based on collections of coastal talitroids to utilize this approach.

Material and methods

From 24 December 2014 to 6 January 2015 J. K. Lowry and L. Fanini circumnavigated Grand Terre, New Caledonia collecting coastal talitroids at a number of sites (Table 1). Beach units (hereafter "sites") around the coastline of Grand

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Table 1. Sampling sites ordered from North to South. **Bold text** indicates sites where talitroids were found.

sites	verbatim coordinates	collectors' notes
Poum	20°13.894'S 164°01.413'E	Shingle beach
Malabou	20°17.530'S 164°06.426'E	Sand beach close to touristic infrastructure
Pouebo	20°22.777'S 164°34.993'E	Estuarine beach
Yambe	20°26.018'S 164°39.283'E	Sand beach
Tao	20°30.967'S 164°46.094'E	Estuarine beach
Koumac	20°33.718'S 164°17.219'E	Shingle beach
Kalaa gomein	20°41.293'S 164°21.848'E	Estuarine beach
Hiengene	20°41.473'S 164°56.552'E	Shingle beach
Amoa	20°45.713'S 165°11.541'E	Estuarine beach
Poindimie	20°55.635'S 165°19.093'E	Sand beach
Voh	20°57.976'S 164°39.384'E	Sand beach
Oundjo	21°02.560'S 164°41.884'E	Mangrove
Mou	21°06.105'S 165°26.924'E	Sand beach
Poe	21°36.802'S 165°24.214'E	Sand beach
Thio mission	21°37.261'S 166°15.598'E	Sand beach
Bourake	22°18.076'S 166°27.443'E	Sand beach close to small port and village

Terre, New Caledonia were searched by J. K. Lowry & L. Fanini, by removing substrate along transects perpendicular to the shoreline, from the detritus strand line to the base of the dune. The process was repeated for parallel lines, spaced five metres apart. Talitroids moving out of the substrate were hand collected with an entomological aspirator. Talitroids were recorded as absent if none were found after 30 minutes of searching the supralittoral zone as described above.

Standard variables for beach ecology are: beach width, beach slope and substrate grain size, recorded at low tide (after Schlacher *et al*., 2008). Beach width and beach face slope were assessed after McLachlan & Defeo (2017); sand classification based on mean grain size follows Blott & Pye (2001). Given the striking difference among substrates where species were found, the substrate was analysed in detail and a sand colour analysis was added (but see Mestanza-Ramón *et al*. (2020) for integrating substrate parameters into target-oriented beaches characterization). Sand colour determination follows CIE-L*a*b methodology, returning variables of lightness (L*) on a scale of 0–100, yellow-blue and red-green (a* and b*) ranging from -200 to +200. Values are inter-convertible with the Munsell scale (Vodyanitskii & Kirillova, 2016) (Table 2).

Specimens were preserved in 70% ethanol immediately after collection time, then prepared for SEM analyses following steps 1–9: 1) soaked in Tween 10 for a few minutes to remove any dirt/grime on the body; 2) washed several times in water to remove the Tween 10; 3) Sonicated in water to shake off the dirt/grime; 4) dissection of one half of the animal, with all parts placed in individual vials and identified; 5) specimen and bits taken through an ethanol grade series: 70, 80, 90, 95, 100, 100, 100; 6) critical point drying all parts and specimens; 7) legs and mouthparts were mounted on carbon tabs and aluminium stubs, with mouthparts usually

Table 2. Beach and substrate metrics recorded for the sites where talitroids were found.

site	beach width (m)	beach face slope (°)	substrate (mean grain size in mm)	sand colour (CIE-L*a*b)	coarse substrate fraction (% of sample weight)	beach unit	wrack presence
Thio mission	10.5	7.86	fine-medium sand (0.23)	dark a*3.97 b*9.85	0	extended	yes
Mou	7.0	6.15	coarse sand (0.70)	fair L*66.41 a*4.19 b*17.66	83.18	pocket	yes, also leaf litter
Amoa	7.0	4.50	very coarse sand (1.37)	dark L*38.93 a*5.73 b*13.56	2.95	estuarine	yes
Malabou	5.0	7.00	medium sand (0.38)	white L*71.33 a*3.16 b*13.77	0	embayment	yes

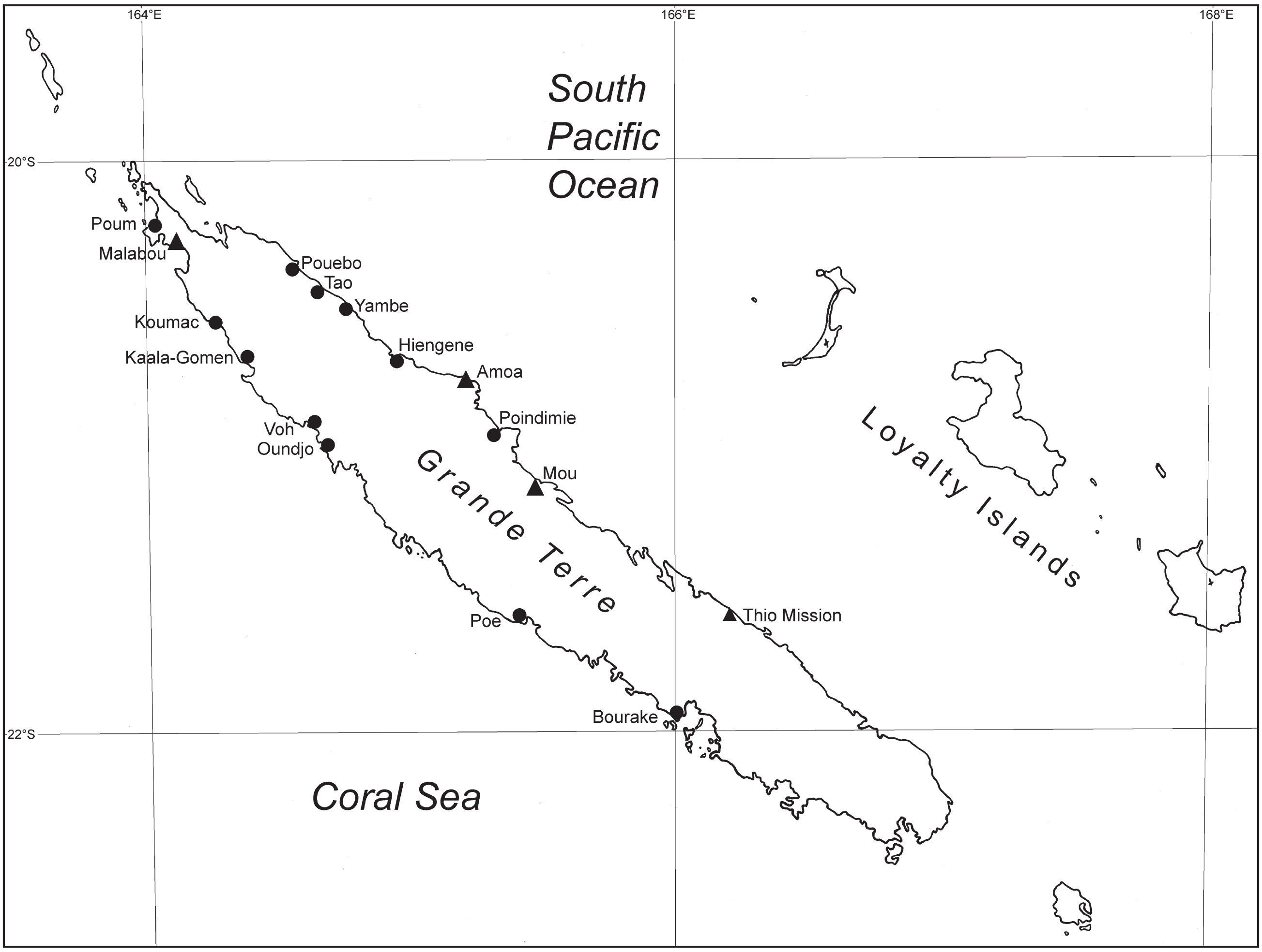

Figure 1. Map of Grand Terre, New Caledonia showing collecting sites in this study. Triangles indicate stations positive for talitroids. Circles indicate stations negative for talitroids.

Table 3. Occurrence of species of talitroids at each site.

sites: toponym and collection date	specimens collected and registration number	collection notes
Thio mission 27 December 2014	*Talorchestia spinipalma*, 5 males (adults and juveniles), 4 females (adults and juveniles) AM P.97475, and *Thiorchestia caledoniana*, 2 males, 5 females, AM P.105706	Supralittoral of an extended black sand beach with pumice.
Mou 2 January 2015	*Thiorchestia caledoniana*, 4 males, 1 juvenile female, AM P.97476	Supralittoral of a pocket beach, with leaves, coarse sand and pumice, amphipods burrowed in the sand, lots of crickets on the supralittoral.
Amoa 2 January 2015	*Chroestia amoa*, 3 males, 24 females, AM P.97477	Supralittoral of an estuarine sandy beach.
Malabou 31 December 2014	*Chroestia amoa*: 1 male, AM P.100369, 1 female, AM P.100370; 19 males, 22 females, AM P.97473; 6 males, 3 females, AM P.97474	Supralittoral of a sandy beach within a bay, covered in wrack, mainly *Zostera*.

mounted on one stub in a row, so it was possible to image each part at 90° and move to the next, and then rotate the stub to image the other side; 8) the whole mount was made using a pin; and 9) all parts and the whole mount were then gold sputter coated.

Taxonomic descriptions were generated from a DELTA database (Dallwitz, 2018) to the talitroid genera and species of the world. **Bolded text** indicates diagnostic characters. Material collected in this study is lodged in the Australian Museum, Sydney (AM). The following abbreviations are used for museum collections: Museo Civico di Storia Naturale di Verona, Italy (MVR), Museum national d'Histoire naturelle, Paris, France (MNHN) and the Osaka Museum of Natural History, Japan (OMNH). Standard abbreviations on the figures are: A, antenna; D, dactylus; EP, epimeron; G, gnathopod; H, head; LL, lower lip; lm, lacinia mobilis; MD, mandible; MP, maxilliped; MX, maxilla; Oost, oostegite; P, pereopod; sp, setal patch; T, telson; U, uropod; UL, upper lip; UR, urosome; L, left, R, right.

The list of known material, including types of known New Caledonian talitroids, is reported for completeness in the Systematics section, even not all specimens were examined or designated in this paper.

Results

Circumnavigation of Grand Terre, New Caledonia, revealed an uneven presence of talitroids on beaches. Out of 16 sites sampled (Fig. 1, Table 1), ranging from estuarine to mangrove environments, with different exposure ("extended" to "pocket" beach), and on different coastlines of the island, talitroid amphipods were collected from only four sites. There is essentially no common environmental feature among the collection sites, except for the absence from the western shore of the island.

Different species were found in different and non-contiguous environments (in terms of beach morphology, exposure, and substrate characteristic), on the eastward coastline of Grand Terre (Table 3). Stranded wrack was observed on beaches both with and without talitroids, hence the availability of organic inputs was excluded as a limiting factor. Indeed, while continuous coastlines host macro-scale gradients of populations of the same species such as *Vallorchestia dispar* (Dana, 1852) along the New South Wales coast of Australia (Lowry, 2012), *Platorchestia platensis* (Krøyer, 1845) along the Uruguayan and Brazilian coasts (Serejo, 2004), the pattern here reported is puzzling and raises novel questions regarding the distribution of talitroid amphipods on islands.

Systematics

Talitroidea Rafinesque, 1815

Makawidae Myers & Lowry, 2020

Chiltonorchestia pusilla (Chevreux, 1915)

Parorchestia pusilla Chevreux, 1915: 11, pl. 3.—Ruffo & Vesentini Paiotta, 1972: 253, figs 4, 8(2).
Chiltonorchestia pusilla.—Bousfield, 1984: 203, tab. 5.—Ruffo & Krapp-Schickel, 2005: 36.—Iannilli & Ruffo, 2007: 23.—Lowry, 2007: 286.

Lectotype: Female, ovigerous (labelled as female B by Chevreux; ethanol and 1 slide of gnathopods plus last two segments of the urosome), MNHN-IU-2013-19685, Lac en Huit, New Caledonia, along margin, coll. F. Sarasin & J. Roux. **Paralectotypes**: 4 specimens (undissected, ethanol), MNHN-IU-2013-19686, Lac en Huit, New Caledonia, along margin, coll. F. Sarasin & J. Roux; 1 female (dissected, ethanol), MNHN-IU-2013-19687, New Caledonia; 1 male (labelled as male B by Chevreux; 1 slide, gnathopods), MNHN-IU-2013-19688, Lac en Huit, New Caledonia, along edge of lake.

Type locality. Lac en Huit, on gorse near the river (altitude 244 m), New Caledonia.

Ecological type. Riparian-hopper.

Habitat. Freshwater. Among gorse, near the shore (Chevreux, 1915). Seems to be an aquatic form, having always been collected in shallow water (Ruffo & Vesentini Paiotta, 1972).

Distribution. New Caledonia (Chevreux, 1915).

Chiltonorchestia starmuhlneri (Ruffo &Vesentini Paiotta, 1972)

Orchestia starmuhlneri Ruffo & Vesentini Paiotta, 1972: 258, figs 5–8(1).
Chiltonorchestia starmuhlneri.—Bousfield, 1984: 203, tab. 5.—Ruffo & Krapp-Schickel, 2005: 36, 69, 78, 86.—Iannilli & Ruffo, 2007: 23.—Lowry, 2007: 286.

Holotype: Male, 9 mm, MVRCr 255, tributary of White River, near forest road to ranger station at Blockhouse Ouénarou on west slope of Mount Pouèdihi (altitude 300 m), New Caledonia.

Type locality. Tributary of the White River, near the forest road to the ranger station at Blockhouse Ouénarou on the west slope of Mount Pouèdihi (altitude 300 m), New Caledonia.

Ecological type. Riparian-hopper.

Habitat. Living in or near freshwater.

Distribution. New Caledonia (Ruffo & Vesentini Paiotta, 1972).

Ignamborchestia sarasini (Chevreux, 1915)

Parorchestia sarasini Chevreux, 1915: 8, pl. 2.
Chiltonorchestia sarasini.—Bousfield, 1984: 203, tab. 5.—Iannilli & Ruffo, 2007: 23.
Ignamborchestia sarasini.—Lowry & Myers, 2019: 42, fig. 18.

Lectotype: Female (undissected, ethanol), MNHN-IU-2013-19689, summit of Mount Ignambi, 1300 m, coll. F. Sarasin & J. Roux,15 April 1911. **Paralectotypes**: 2 specimens (undissected, ethanol), MNHN-IU-2013-19690, summit of Mount Ignambi, 1300 m; 1 female (labelled as female A by Chevreux; head in ethanol and 11 slides of maxillae 1–2 left and right, gnathopods, pereopods 3–7, pleopods 1–3, uropods, and telson), MNHN-IU-2013-19691; 1 female (labelled as female B by Chevreux; ethanol and 2 slides of mouthparts, gnathopods 1, 2 and branchiae), MNHN-IU-2013-19692; 1 male (2 slides, antennae 1–2, maxilla 1, maxillipeds and gnathopods), MNHN-IU-2013-19693, Ignambi Forest.

Type locality. Mt Ignambi, forest, 700–1300 m altitude, north-eastern New Caledonia.

Ecological type. Forest-hopper.

Habitat. Forest floors at 700–800 m altitude.

Remarks. Differs from *Chiltonorchestia* in its short antenna 1.

Distribution. New Caledonia: Mt Ignambi (Chevreux, 1915); Farino; Pouembout (Iannilli & Ruffo, 2007).

Talitridae Rafinesque, 1815

Talitrinae Rafinesque, 1815

Chevreuxiana antennulata (Chevreux, 1915)

Talorchestia antennulata Chevreux, 1915: 5, pl. 1.
Chevreuxiana antennulata.—Lowry & Myers, 2019: 22, fig. 7.

Lectotype: Female (23 mm; ethanol and 10 slides of antenna 1–2 / mouthparts / gnathopods / pereopods 1, 3 and 5 (broken) / pleopods 1–3 / pleopod 2 / pleopod 3 / pereopods 2–4 / uropods 1–2 / uropod 3, telson), MNHN-IU-2013-19694, New Caledonia, Mount Canala, 800–1000 m. **Paralectotypes** (all New Caledonia): 2 specimens, juvenile (undissected ethanol), west coast of New Caledonia, G. Dupuis coll., 1888, MNHN-IU-2013-19695; 4 specimens (undissected ethanol), Mount Canala, 700 m, MNHN-IU-2013-19696; 6 specimens (males and females) (undissected ethanol), Mount Humboldt, MNHN-IU-2013-19697; 1 female (dissected, ethanol, and 1 slide, gnathopod 1), Mount Canala, 700 m, MNHN-IU-2013-19698; 1 male, 9 mm (4 slides of head / gnathopods / pereopod 5 / pleopod 3, uropod 1–2), Mount Humboldt 1100 m, MNHN-IU-2013-19699.

Type locality. Mt Canala, 800–1000 m, under rotten leaves.

Ecological type. Forest-hopper.

Habitat. Living under rotten leaves at 200–1000 m altitude.

Distribution. New Caledonia: Tchalabel; Oubatche; Mt Ignambi, forest 600 m altitude; Hienghiène; Mt Panié, forest, 500–1600 m altitude; Coné; Vallée de la Tiouaca; Mt Canala, 700–1000 m; Mt Humboldt, 1100–1600 m altitude; Ngoï Valley, forest, 200 m altitude; Yaté. Loyalty Islands: M: area, Kaoua (Chevreux, 1915).

Chroestia Marsden & Fenwick, 1985

Chroestia Marsden & Fenwick, 1985: 843.—Lowry & Stoddart, 2003: 271.

Type species. *Chroestia lota* Marsden & Fenwick, 1984, monotypy.

Included species. *Chroestia amoa* sp. nov., *C. lota* Marsden & Fenwick, 1985.

Category. Mascupod.

Ecological type. Beach-hoppers (mainly coastal supralittoral/intertidal leaf-litter/wrack, non-substrate modifying talitrids).

Habitat. *Chroestia* is common in thick mats of *Zostera* and mangrove debris on a small sand-gravel beach at the top of an extensive mud flat area.

Diagnostic description. **Male** (based on Marsden & Fenwick, 1985).

Head. *Eye* medium (⅕–⅓ head length). *Antenna 1* short, rarely longer than peduncular article 4 of antenna 2. *Antenna 2* peduncular articles slender or slightly incrassate (expanded); article 3 without plate or process ventrally. *Labrum epistome* without robust setae. *Mandible* left lacinia mobilis 4-cuspidate. *Maxilliped* outer margin of precoxa not stepped; palp article 2 with distomedial lobe; article 4 reduced, button shaped.

Pereon. ***Gnathopod 1*** sexually dimorphic; subchelate; **posterior margin of carpus and propodus each with lobe covered in palmate setae; palm transverse**. ***Gnathopod 2*** subchelate; propodus palm acute; posterior margin of merus, carpus, and propodus each without lobe covered in palmate setae; **dactylus attenuated distally**. *Pereopods 3–7* bi-cuspidactylate. *Pereopod 4* dactylus thickened proximally with notch midway along posterior margin. *Pereopod 5* dactylus long, slender, not inflated. *Pereopod 6* not sexually dimorphic; shorter than pereopod 7. *Pereopods 6–7* without row of short setae along posterior margin of the dactyli. *Pereopod 7* not sexually dimorphic. Propodus without large distal tuft of setae.

Pleon. *Pleonites 1–3* without dorsal spines. *Oostegites* setae with curled tips. *Pleopods1–3* all well-developed. *Epimera 1–3* slits absent. ***Uropod 1*** peduncle distolateral robust seta present (large), with simple tip; rami without apical spear-shaped setae; **outer ramus without marginal robust setae**; inner ramus with marginal robust setae in 1 row. ***Uropod 2*** rami without apical spear-shaped setae; outer ramus with marginal robust setae in 1 row; **inner ramus with marginal robust setae in 1 row**. *Uropod 3* ramus shorter than peduncle. ***Telson*** longer than broad, tapering distally, apically incised, with marginal and apical robust setae, **with 7 to 10 or more robust setae per lobe**.

Remarks. *Chroestia* is confined to Australia and New Caledonia which separated from each other about 65 million years ago (Coleman, 1980) and may indicate a possible minimal age for *Chroestia*, but also shows the morphological stability of species within the genus.

Distribution. Australia: Lota, Queensland (Marsden & Fenwick, 1985). New Caledonia: Malabou and Amoa, Grand Terre (this paper).

Chroestia amoa sp. nov.

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Figs 2–4

Holotype: Male, 10.8 mm, AM P.100369 (SEM pin and 4 SEM stubs), Malabou, Grand Terre, New Caledonia, 20°17.530'S 164°6.426'E, bay, supralittoral, sandy beach covered in wrack, mainly *Zostera*, coll. J. K. Lowry & L. Fanini, 31 December 2014. **Paratypes**: 1 female, AM P.100370 (SEM pin and 1 SEM stub); 19 males, 22 females (wet specimens), AM P.97473; 6 males, 3 females (wet specimens), AM P.97474, same data as holotype. 3 males, 24 females (wet specimens), AM P.97477, near Amoa, Grand Terre, New Caledonia, 20°45.713'S 165°11.541'E, estuary supralittoral, sandy beach, coll. J. K. Lowry & L. Fanini, 2 January 2015.

Type locality. Malabou, Grand Terre, New Caledonia (20°45.713'S 165°11.541'E), estuary supralittoral, sandy beach.

Ecological type. Beach-hopper.

Habitat. Estuary supralittoral, sandy beach.

Etymology. Named for the town of Amoa, Grande Terre, New Caledonia.

Description. **Male** (based on holotype, 10.8 mm, AM P.100369).

Head. *Eye* medium (⅕–⅓ head length). *Antenna 1* short, not reaching midpoint of peduncular article 5 of antenna 2. *Antenna 2* peduncular articles slender, with many small robust setae; article 1 enlarged, bulbous. *Mandible* left lacinia mobilis 4-cuspidate. Maxilla 1 inner plate with 2 apical plumose setae; palp vestigial, 2-articulate, without apical seta. Maxilla 2 inner plate with one large plumose seta along inner margin. *Maxilliped* palp broad, article 2 with distomedial lobe; article 4 reduced, button shaped.

Pereon. ***Gnathopod 1*** sexually dimorphic; subchelate; coxa much smaller than coxa 2; **posterior margin of carpus and propodus each with lobe covered in palmate setae**; carpus longer than propodus, length more than 2 × width; propodus anterior margin with 3 groups of robust setae, "subtriangular" with well-developed posterodistal lobe, palm transverse; dactylus simplidactylate. ***Gnathopod 2*** subchelate; with distally rounded anterodistal lobe on medial surface; posterior margin of merus, carpus, and propodus each without lobe covered in palmate setae; **propodus palm** acute, **evenly rounded**, **without proximal sinus**, without large distal sinus, without proximal spine or thumb defining palm, without large projection near dactylar hinge; **dactylus attenuated distally, slightly curved**, subequal or slightly longer than palm; posterior margin smooth; shorter than posterior margin of propodus. *Pereopods 3–7* dactyli cuspidactylate (bicuspidactylate), with anterodistal denticulate patch. *Pereopod 4* significantly shorter than pereopod 3; carpus significantly shorter than carpus of pereopod 3; dactylus amplidactylate, thickened proximally with notch midway along posterior margin. *Pereopod 5* short, less than ⅔ length of pereopod 6; merus broad, longer than broad, expanded distally. *Pereopod 6* shorter than pereopod 7; not sexually dimorphic; coxa posterior lobe with anteroventral corner rounded, not produced; basis expanded. *Pereopod 7* not sexually dimorphic; posterior margin with broad, small serrations, each with a small seta, posterodistal lobe present, shallow, broadly rounded; merus expanded distally, subtriangular, anterior margin straight; carpus unexpanded; subrectangular; shorter than propodus; propodus broad; length 6.6 × width. *Oostegites* (female) present, setae with curled tips.

Pleon. *Pleopods 1–3* all well-developed. *Epimera 1–3* ventral margin without robust or slender setae. *Uropod 1* peduncle distolateral robust seta present (large), large (¼ length of outer ramus), with simple tip; **exopod without marginal robust setae**; endopod with marginal robust setae in 1 row. *Uropod 2* exopod with marginal robust setae in 1 row; endopod with marginal robust setae in 1 row. *Uropod 3* ramus shorter than peduncle; peduncle with 1 or 2 very long robust setae dorsal margin, linear (narrowing). ***Telson*** as broad as long, tapering distally, completely cleft, with apical and marginal robust setae, **with at least 10 robust setae per lobe**.

Female (sexually dimorphic characters). Based on paratype female, AM P.100370. ***Gnathopod 1*** posterior margin of merus, carpus, and propodus each without lobe covered in palmate setae. *Propodus* subrectangular, anterior margin with 2 groups of robust setae, palm acute; dactylus simple, longer than palm. ***Gnathopod 2*** mitten-shaped; basis slightly expanded; ischium without lobe on anterior margin; posterior margin of merus, carpus, and propodus each with lobe covered in palmate setae. *Carpus* well developed (not enclosed by merus and propodus), posterior lobe present, projecting between merus and propodus. *Palm* obtuse, nearly straight. *Dactylus* curved, posterior margin smooth, shorter than palm. ***Oostegites*** long (length greater than 2 × width), longer than wide, setose, setae with curled tips.

Remarks. This is the first record of *Chroestia* outside Australia. *Chroestia amoa* is very similar to *C. lota* Marsden & Fenwick, 1985 from Moreton Bay, Queensland, Australia. The main morphological difference between these species is the shape of the palm of male gnathopod 2, which is evenly rounded in *C. amoa*, but has a distinctive proximal sinus in *C. lota*.

Distribution. New Caledonia: Malabou and Amoa, Grand Terre.

Thiorchestia gen. nov.

urn:lsid:zoobank.org:act:8EEBA7EA-0B81-47F2-A9B7-53FC6DF3C8F3

Figs 5–7

Type species. *Thiorchestia caledoniana* sp. nov., monotypy.

Included species. *Thiorchestia caledoniana* sp. nov.

Category. Mascupod.

Ecological type. Beach-hopper.

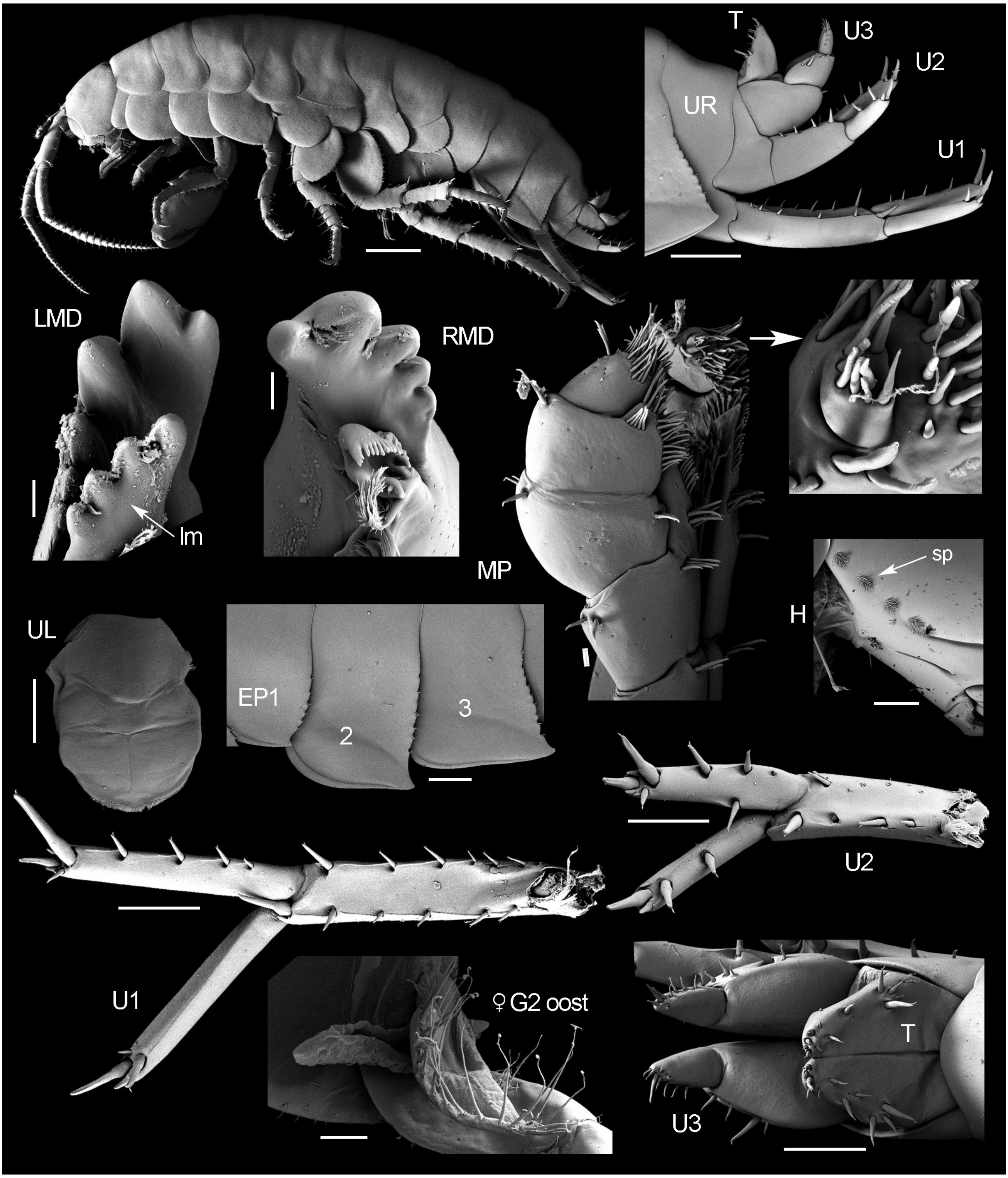

Figure 2. *Chroestia amoa* sp. nov., holotype, male, 10.8 mm, AM P.100369; paratype, female, AM P.100370, New Caledonia. Scale: MD 0.02 mm; H, LL, MP, UL, oost, T 0.2 mm; EP1–3, U1–2, UR 0.5 mm.

Habitat. Supralittoral zone of sandy beaches.

Etymology. Named for Thio mission, Grande Terre, New Caledonia, the type locality and very first site visited by the authors, their son, and their hosts Bertrand and Paule. Gender feminine.

Size. 9.8 mm.

Diagnosis of male. Head. *Antenna 1* slender or slightly incrassate. *Gnathopod 1* subchelate; posterior margin of carpus and propodus each with palmate lobe; dactylus cuspidactylate. *Pereopod 4* dactylus thickened proximally with notch along posterior margin. *Epimera 1–3* without slits. *Pleopods* well developed. *Uropod 1* exopod without marginal robust setae. *Uropod 3* subequal in length to peduncle.

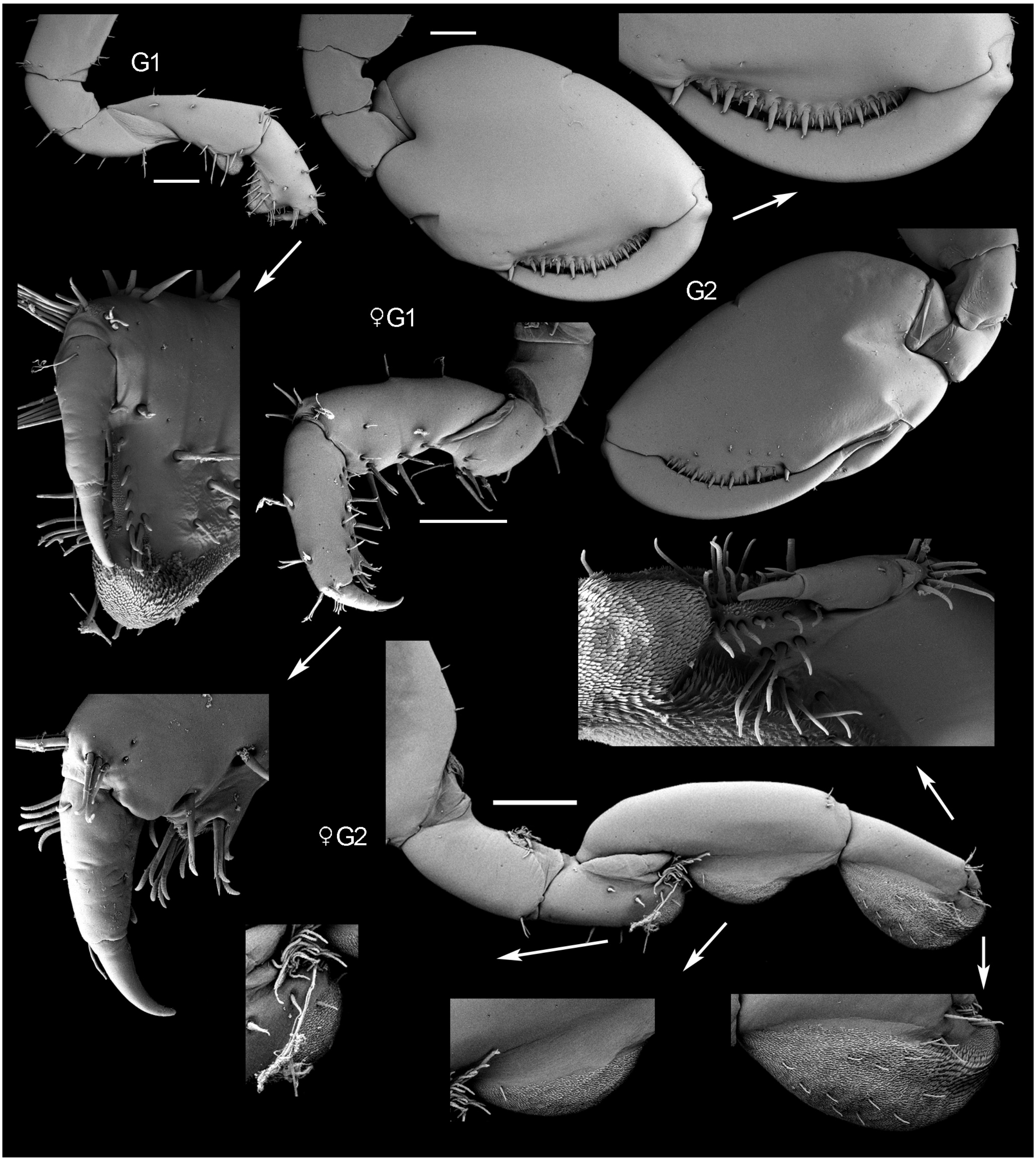

Figure 3. *Chroestia amoa* sp. nov., holotype, male, 10.8 mm, AM P.100369; paratype, female, AM P.100370, New Caledonia. Scale: male G2 0.2 mm; remainder 0.1 mm.

Remarks. *Thiorchestia* is very similar to the Caribbean genus *Tethorchestia* Bousfield, 1984. The ramus of uropod 3 is subequal in length to the peduncle in *Thiorchestia* (shorter in *Tethorchestia*). Other differences are considered at species level and the genera are considered convergent.

Distribution. New Caledonia.

Thiorchestia caledoniana sp. nov.

urn:lsid:zoobank.org:act:1514C5F2-9B6D-410E-B3B2-5907296E6184

Figs 5–7

Holotype: Male, 9.8 mm, AM P.100367 (SEM pin and 3 SEM stubs), Thio mission, Grand Terre, New Caledonia, 21°37.261'S 166°15.598'E, supralittoral, and extended black sand beach with pumice, hand collection with entomological aspirator, J. K. Lowry & L. Fanini, 27 December 2014.

Figure 4. *Chroestia amoa* sp. nov., holotype, male, 10.8 mm, AM P.100369, New Caledonia. Scale: 0.5 mm.

Paratypes: 1 female, AM P.100368 (SEM pin and 1 SEM stub), 1 male, 4 females (wet specimens**),** AM P.105706, Thio mission, Grand Terre, New Caledonia, 21°37.261'S 166°15.598'E, supralittoral, and extended black sand beach with pumice, hand collection with entomological aspirator, J. K. Lowry & L. Fanini, 27 December 2014.

Additional material examined. 4 males, 1 female, AM P.97476, Mou, Grand Terre, New Caledonia, 21°06.105'S 165°26.924'E, estuary supralittoral, sandy beach, J. K. Lowry & L. Fanini, 2 January 2015.

Type locality. Thio mission, Grand Terre, New Caledonia.

Diagnostic description. **Male**. **Head**. ***Antenna 1* slender or slightly incrassate**. *Mandible* lacinia mobilis 5-cuspidate. Maxilliped palp article 2 with distomedial lobe; article 4 reduced, button shaped. ***Gnathopod 1*** subchelate; **posterior margin of carpus and propodus each with palmate lobe**; **dactylus cuspidactylate**. *Gnathopod 2* dactylus shortened distally, recurved. *Pereopods 3–7* cuspidactylate (bicuspidactylate). ***Pereopod 4* dactylus thickened proximally with notch along posterior margin**.

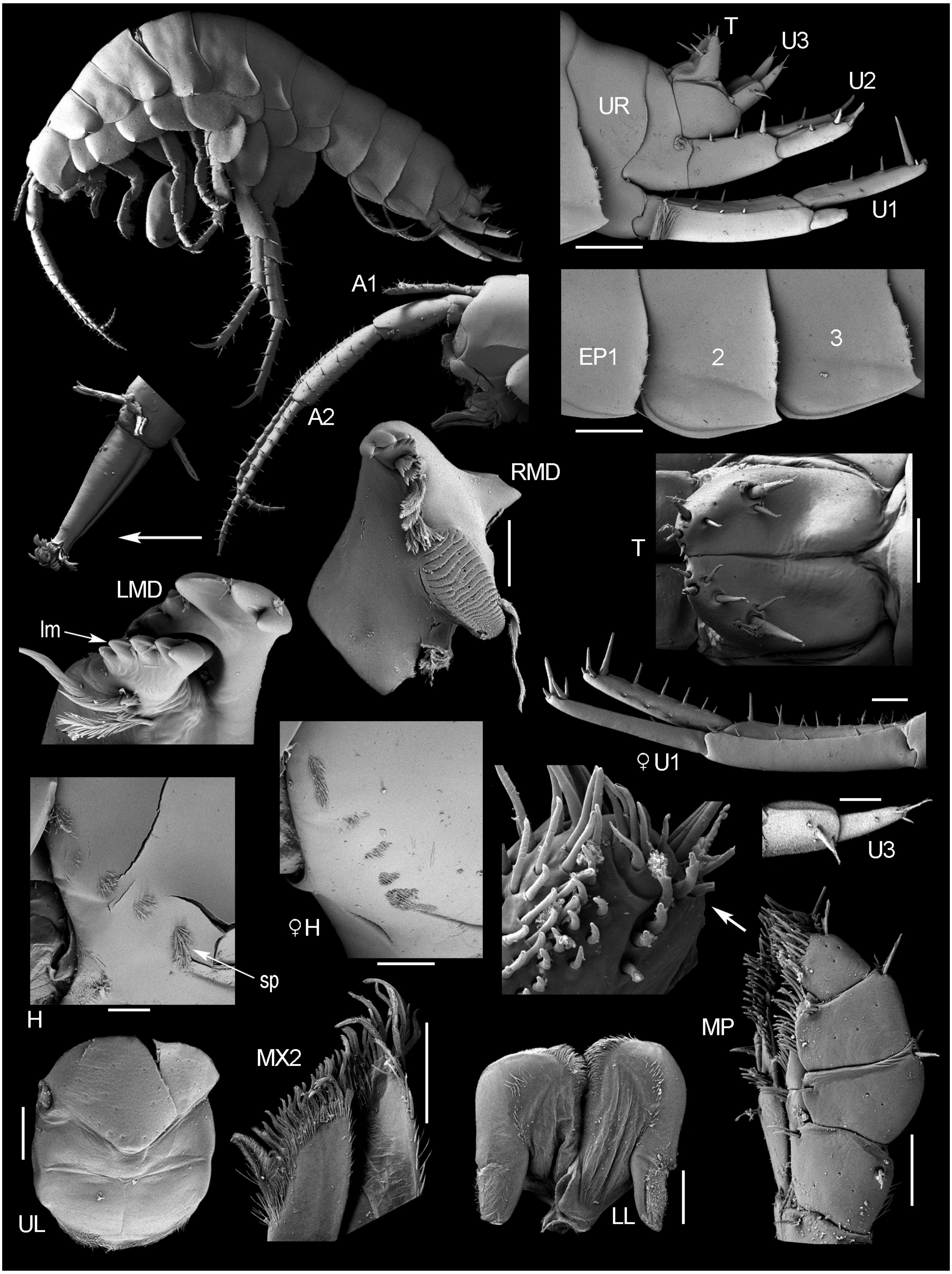

Figure 5. *Thiorchestia caledoniana* sp. nov., holotype, male, 9.8 mm, AM P.100367; paratype, female, AM P.100368, New Caledonia. Scale: EP, H, MD, U1, UR 0.2 mm; remainder 0.1 mm.

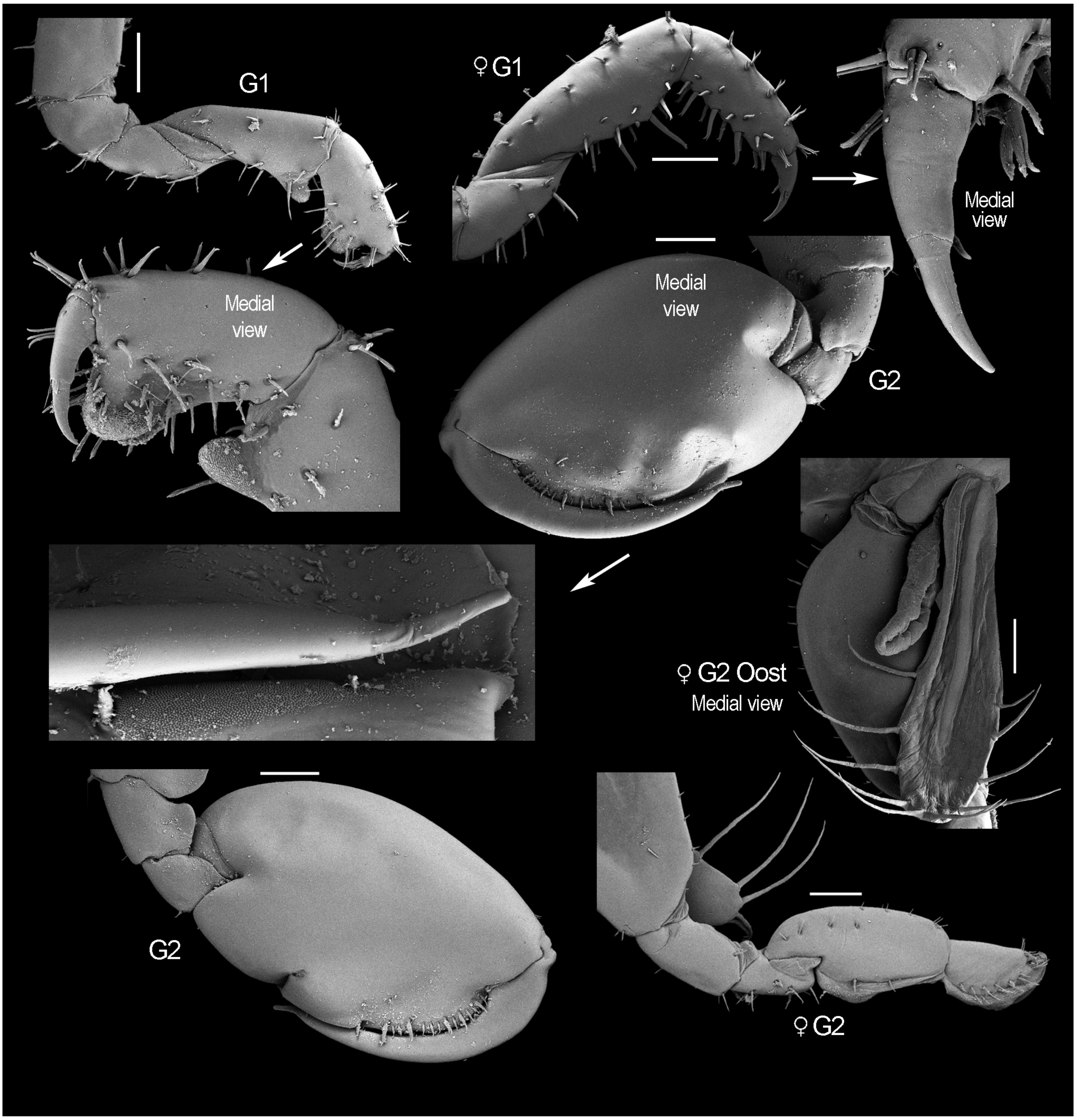

Figure 6. *Thiorchestia caledoniana* sp. nov., holotype, male, 9.8 mm, AM P.100367; paratype, female, AM P.100368, New Caledonia. Scale: 0.2 mm.

Pereopod 7 not sexually dimorphic. ***Epimera 1–3* without slits**. ***Pleopods* well-developed**. ***Uropod 1* exopod without marginal robust setae**. ***Uropod 3* subequal in length to peduncle**. *Telson* completely cleft with 6 marginal and apical robust setae.

Female (sexually dimorphic characters; based on paratype, AM P.100368). ***Gnathopod 1*** posterior margin of merus, carpus, and propodus each without lobe covered in palmate setae. *Propodus* subrectangular, anterior margin with 4 groups of robust setae, palm acute. *Dactylus* simple, longer than palm. ***Gnathopod 2*** mitten-shaped; basis slightly expanded; ischium without lobe on anterior margin. Posterior margin of *carpus* and *propodus* each with lobe covered in palmate setae. *Carpus* well developed (not enclosed by merus and propodus), posterior lobe present, projecting between merus and propodus; palm obtuse, nearly straight. *Dactylus* curved, posterior margin smooth, shorter than palm. ***Oostegites*** long (length greater than 2 × width), longer than wide, setose, setae with simple smooth tips.

Distribution. New Caledonia: Thio mission and Mou, Grand Terre.

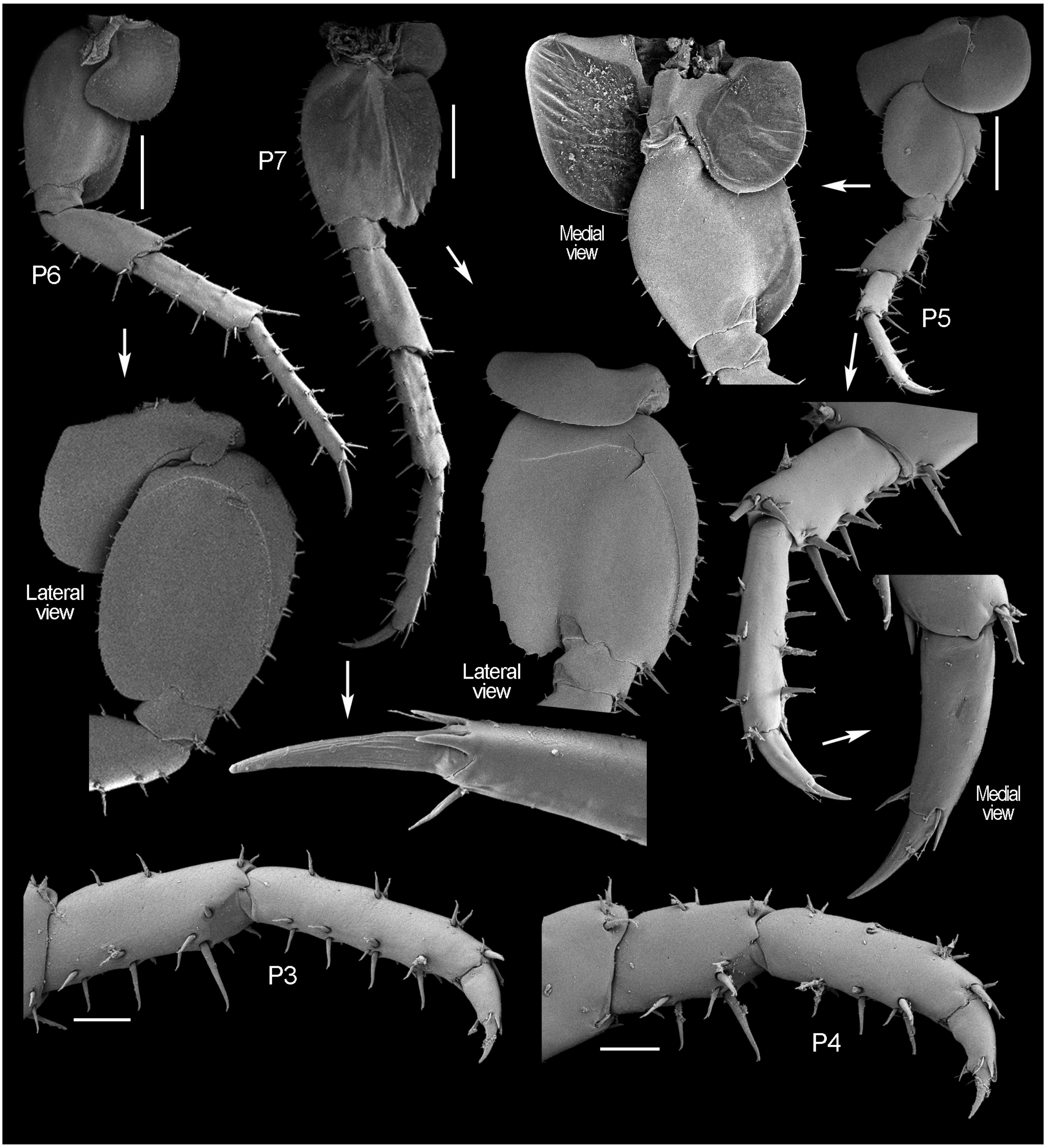

Figure 7. *Thiorchestia caledoniana* sp. nov., holotype, male, 9.8 mm, AM P.100367, New Caledonia. Scale: P3, P4 0.1 mm; remainder 0.2 mm.

Talorchestia spinipalma (Dana, 1852)

Orchestia spinipalma Dana, 1852: 203.—Dana, 1853: 875, pl. 59, fig. 4a–e.—Bate, 1862: 28, pl. 4, fig. 9.

Talorchestia spinipalma.—Stebbing, 1906: 552 (in part, part = *T. terraereginae*). Stephensen, 1935: 12.—Schellenberg, 1938: 66.—J. L. Barnard, 1960: 24, figs 7, 8.—Bousfield, 1970: 163.—Morino & Miyamoto, 1988: 95, figs 4–6.—Lowry & Springthorpe, 2009: 905.—Serejo, 2009: 895, figs 3, 4.—Lowry & Bopiah, 2013: 354, figs 5–8.

Not *Talorchestia spinipalma*.—Lowry & Stoddart, 2003: 276 (= *T. terraereginae* Haswell, 1880).

Neotype: Male, 16.5 mm, AM P.87317, just north of Liku'alofa Beach Resort, Tongatapu, Tonga, 21°04'50.29"S 175°20'39.10"W, fine white sand on steep narrow beach.

Other material examined. 5 males (adults and juveniles), 4 females AM P.97475, Thio mission, Grand Terre, New Caledonia, 21°37.261'S 166°15.598'E, supralittoral, and extended black sand beach with pumice, hand collection with entomological aspirator, J. K. Lowry & L. Fanini, 27 December 2014.

Osaka Museum of Natural History New Caledonian

Key to male New Caledonian talitroid amphipods

1	G1 posterior margin of carpus and propodus each with palmate lobe	2
——	G1 posterior margin of merus, carpus, and propodus each with palmate lobe	4
2	G1 parachelate. G2 propodus palm with large, recurved robust setae lining palmar margin	*Talorchestia spinipalma* Dana, 1852
——	G1 subchelate. G2 propodus palm without large, recurved robust setae lining palmar margin	3
3	G2 dactylus attenuated distally	*Chroestia amoa* sp. nov.
——	G2 dactylus short, recurved distally	*Thiorchestia caledoniana* gen. et sp. nov.
4	G2 propodus with midpalmar sinus	*Chevreuxiana antennulata* (Chevreux, 1915)
——	G2 propodus without palmar sinuses	5
5	Telson with apical and marginal robust setae	*Ignamborchestia sarasini* (Chevreux, 1915)
——	Telson with apical robust setae only	6
6	G2 dactylus apically acute. Gills bilobate. Telson with 2 apical setae	*Chiltonorchestia pusilla* (Chevreux, 1915)
——	G2 dactylus recurved distally. Gills quadrilobate. Telson with 4 apical setae	*Chiltonorchestia starmuhlneri* (Ruffo & Vesentini Paiotta, 1972)

Collections (not examined). Six males, 3 females, Isle of Pines, New Caledonia, 6–13 June 1958; 4 males, 6 females, Magenta, New Caledonia, 8, 14 October 1958; 3 males, 4 females, Nou Vata, Noumea, New Caledonia, 8 October 1958; 1 male, 1 female, Mount d'Ore, New Caledonia, 18 October 1958.

Type locality. Just north of Liku'alofa Beach Resort, Tongatapu, Tonga, 21°04'50.29"S 175°20'39.10"W.

Habitat. Under dried *Turbinaria* and other algae in the supralittoral zone.

Remarks. Habitat reported referred to Tonga (Lowry & Bopiah, 2013); the habitat in New Caledonia is also supralittoral, an extended black sand beach with pumice.

Distribution. Australia: Queensland: Port Douglas (Serejo, 2009). Marshall Islands: Yap; Kusaie Island (J. L. Barnard, 1960). New Caledonia: NouVata, Noumea; Isle of Pines; Magenta (Morino & Miyamoto, 1988), Thio mission, Grand Terre (this paper). Papua New Guinea: Ralum, Bismarck Archipelago (Schellenberg, 1938); Motupore Island (9°31'30"N 147°16'40"E) (Morino & Miyamoto, 1988). Philippine Islands: Ubay, Bohol (Schellenberg, 1938). Solomon Islands: Gizo (Morino & Miyamoto, 1988). Rennell Islands (Bousfield, 1970). Tonga: Tongatapu (Dana, 1852; Lowry & Bopiah, 2013).

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The Beach-hopper Genus *Platorchestia* (Crustacea: Amphipoda: Talitridae) on Atlantic Ocean Coasts and on those of Associated Seas

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Abstract. Five species of *Platorchestia* Bousfield, 1982, are described and figured from Atlantic Ocean shores (including the Caribbean, Baltic, and Mediterranean seas). Four of these are new to science. All five species had previously been illustrated in the literature but four of them had incorrectly been allocated to either *Orchestia platensis* Krøyer, 1945 or *O. monodi* Mateus, Mateus & Afonso, 1986.

Introduction

The genus *Platorchestia* Bousfield, 1982, is widespread on shores of the Atlantic Ocean (including the Caribbean, Baltic, and Mediterranean seas) where it has been reported from South America, Central America, the Caribbean, the Gulf of Mexico, North America, Bermuda, Canada, the United Kingdom, the Baltic, the Mediterranean, Nigeria, and South Africa. All recorded examples attributable to the genus *Platorchestia* in the Atlantic had previously been assigned to either *Orchestia platensis* Krøyer, 1845 (including as *Platorchestia platensis*) or to *Orchestia monodi* Mateus, Mateus & Afonso, 1986. An examination of material from around Atlantic shores has revealed that in the Atlantic Ocean there is a complex of at least five cryptic species in the genus *Platorchestia*. These are *P. platensis*, *P. oliveirae* sp. nov., *P. exter* sp. nov., *P. negevensis* sp. nov. and *P. griffithsi* sp. nov. Males of these species develop an incrassate pereopod 7 that only reaches its terminal development in hyperadult males. These are sexually mature males that have continued to develop secondary sexual characters to a complexity that is beyond that of the normal mature male. The terminal morphology of the carpus of the male pereopod 7 is species specific, but since hyperadult males may be quite rare in a population, further character states need to be examined for the purposes of identification. *Platorchestia* also occurs on the Australian plate (*P. paraplatensis* Serejo & Lowry, 2008 and *P. smithi* Lowry, 2012) the Pacific plate (*P. ano* Lowry & Bopiah, 2013) and the Asian plate (*P. munmui* Jo, 1988, *P. pachypus* Derzhavin, 1937, *P. pacifica* Miyamoto & Morino, 2004).

Hupalo & Grabowski (2018) present support for close genetic relatedness between populations of putative *P. platensis* on either side of the Atlantic, based on the mitochondrial cytochrome oxidase subunit 1 (CO1) gene. Falk *et al.* (2022) showed that CO1 sequences can be excellent at supporting the hypothesis that two taxa are different species, but can fail to reveal much difference between what are patently different, but closely related species. Falk *et al.* (2022) cite the case of two Nomad bees that are clearly separate species based on good morphological and ecological differences, but which cannot be distinguished by CO1. Henzler & Ingolfsson (2007) considered that there was little genetic distance, based on CO1, between Icelandic

Keywords: Amphipoda, Taxonomy, Talitridae, *Platorchestia*, new species, Atlantic, Baltic, Mediterranean, Caribbean
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and European populations of *Orchestia gammarellus* (Pallas, 1766). Myers & Lowry (2020), however, showed that the species of *Orchestia* Leach, 1814 inhabiting Iceland is not *O. gammarellus*, but a distinct, closely related species, *O. forchuensis* Myers & Lowry. BOLD is becoming an important "go to" in taxonomic studies, but it is important to understand and work within the limitations of CO1. Where species are separable by morphological techniques but cannot be separated using CO1, it perhaps indicates a relatively recent radiation. Sibling species may require additional mitochondrial and/or nuclear markers or even full genome sequences to be elucidated.

The present study describes morphological differences between European, American, and African *Platorchestia* species and allocates them to several sibling species.

Materials and methods

Material for study was kindly made available to us by Dr Philippe Ste-Marie, Museum of Nature in Ottawa and by Dr Michael Zettler, Rostock, Germany.

Specimens for study were dissected in 70% alcohol and body parts were mounted on glass microscope slides in glycerine. They were examined under a Nikon Optiphot compound microscope with interference contrast attachment and drawn with the use of a drawing tube. Type material is deposited in the National Museum of Canada, Ottawa (CNMC), in the Natural History Museum of Denmark, Copenhagen (NMUC) and in the Hebrew University of Israel.

Abbreviations used in figures: A1, 2 = Antenna 1, 2; Hd = head; G1, 2 = gnathopods 1, 2; P4–7 = pereopods 4–7; Ep 1–3 = epimera 1–3; U1–3 = uropods 1–3; C6 = coxa 6; d = dactylus; M = male; F = female.

Systematic section

Suborder Senticaudata Lowry & Myers, 2013

Infraorder Talitrida Serejo, 2004

Parvorder Talitridira Serjo, 2004

Superfamily Talitroidea Rafinesque, 1815

Family Talitridae Rafinesque, 1815

Subfamily Talitrinae Rafinesque, 1815

Platorchestia Bousfield, 1982

Platorchestia Bousfield, 1982: 26.

Included species. *Platorchestia* includes 11 established species: *P. ano* Lowry & Bopiah, 2013; *P. exter* sp. nov.; *P. griffithsi* sp. nov.; *P. munmui* Jo, 1988; *P. negevensis* sp. nov.; *P. oliveirae* sp. nov.; *P. pachypus* (Derzhavin, 1937); *P. pacifica* Miyamoto & Morino, 2004; *P. paraplatensis* Serejo & Lowry, 2008; *P. platensis* (Krøyer, 1845)—type species by original designation; *P. smithi* Lowry, 2012 and one putative species, the incompletely described *P. crassicornis* (Costa, 1867).

Diagnosis. *Antenna 1* short, not longer than article 4 of antenna 2. *Antenna 2* peduncle article 3 without ventral plate; articles 4–5 generally incrassate in males. *Maxilliped* palp article 2 with distomedial lobe; article 4 reduced, button-shaped. *Gnathopod 1* sexually dimorphic; subchelate, cuspidactylate. *Gnathopod 2* subchelate in males, mitten-shaped in females. *Pereopods 3–7* cuspidactylate. *Pereopod 7* often incrassate in terminal males. *Uropod 1* endopod without marginal setae. *Telson* with apical and marginal robust setae.

Remarks. Beach hoppers of the genus *Platorchestia* live amongst algal debris, high on marine shores sometimes in estuaries and among mangroves. One Atlantic species has become riparian. In males, pereopod 7 is generally sexually dimorphic, being more robust or incrassate in males—the only exception to this among Atlantic species is *P. negevensis* sp. nov., although it is a frequent state elsewhere. In particularly large males (herein referred to as hyperadults), the carpus of pereopod 7 becomes markedly incrassate, either subrectangular or subovoid and sometimes the anterior margin may be crenulate or notched. Hyperadult males may be quite uncommon in a population, so that large samples of a population may be collected including relatively large males, none of which exhibit full incrassation of pereopod 7. Nevertheless, the type of incrassation found in hyperadult males is of specific importance. When hyperadult males are not represented in a collection, other character states must be observed for correct identification.

Platorchestia platensis (Krøyer, 1845)

Figs 1–4

Orchestia platensis Krøyer, 1845: 304, pl. 2, fig. 2a–i.—Stebbing, 1888: 210.—Spandl, 1924: 462.—Chevreux & Fage, 1925: 276, fig. 287.—Dahl, 1946: 11.—Karlbrink, 1969: 327.—Karaman, 1971, 12, figs 3-4.—Geldiay *et al.*, 1971: 369.—Lincoln, 1979: 220, fig. 101, a–h.—Teigsmark, 1981: 165.—Bellan-Santini, 1993: 749, fig. 514.—Stefanidou & Voultsiadou-Koukoura, 1995: 603, tab. 1.—Holmes *et al.*, 1997: 186.—Gönlügür-Demirci, 2006: 1133.

Orchestia incisimana Chevreux, 1888: 347, pl. 6 figs 1, 2.

Orchestia gammarellus.—Della Valle, 1893: 499 (in part).

Platorchestia platensis.—Jo, 1988: 166, fig. 8.—Köhn & Gosselck, 1989: 61, fig. 19, 3.—Krapp-Schickel & Zavodnik, 1996: 461.—Miyamoto & Morino, 2004: 81, fig. 7.—Serejo, 2004: 19, fig. 10.—Ruffo & Krapp-Schickel, 2005: 36.—Sezgin & Katağan, 2007: 5, tab. 1.—Serejo & Lowry, 2008: 194, figs 25, 26.—Christodoulou *et al.*, 2013: 12, tab. 2.—Zakhama-Sraieb *et al.*, 2017: 498 (checklist).—Zettler & Zettler, 2017: 345, figs 243–244.— Copilaş-Ciocianu *et al.*, 2020: 461, 462, fig. 1, 2.

Not *Orchestia platensis*.— Spence Bate, 1862: 19, pl. 3, fig. 3 [=?*Orchestia*].—Shoemaker, 1921: 101.—Shoemaker, 1933: 17.—Shoemaker, 1935: 241 (= *P. oliveirae* sp. nov.).—Iwasa, 1939: 257, figs 1–3, pl. 9 (= *P. joi* Stock & Biernbaum, 1994).—Stephensen, 1945: 57, figs 15–16 (= *P. joi* Stock & Biernbaum, 1994).—Gurjanova, 1951: 807, fig. 562 (= *P. joi* Stock & Biernbaum, 1994).—Oliveira. 1953: 329, figs. 1012 (= *P. oliveirae* sp. nov.).—Bulycheva, 1957: 159, figs 57a–b (= *P. joi* Stock & Biernbaum, 1994).—Bousfield, 1973, 159, fig. 46.2 (= *P. exter* sp. nov.).—Morino, 1975: 172, figs 1–3 (= *P. joi* Stock & Biernbaum, 1994).—Griffiths, 1975,

Figure 1. *Platorchestia platensis* (Krøyer, 1845), male (14 mm), Bornova, Turkey.

79, fig. 52B (= *P. griffithsi* sp. nov.—Fox & Bynum, 1975: 228 (= *P. oliveirae* sp. nov.). —Soares, 1979: 97 (= *P. oliveirae* sp. nov.).—Heard, 1982: 42, fig. 49 (= *P. oliveirae* sp. nov.).—Ciavatti, 1989: 135, figs. 6–8 (= *P. oliveirae* sp. nov.).—Diemer, 2016, 207, figs. 4, 6 (= *P. griffithsi* sp. nov.).—Herbst & Dimentman, 1983: 20, fig. 3 (= *P. negevensis* sp. nov.).

Not *Platorchestia platensis*. —Myers, 1985: 134, figs 108, 109 (= sp. nov.).—Morino & Ortal, 1995: 829, fig. 4 (not identifiable to any known species).

Lectotype: Male, 12.3 mm, ZMUC CRU 8221 (selected by Serejo, 2004). **Paralectotypes**: 1 male, 6.8 mm; 1 female, 7.6 mm, 7 damaged specimens, Montevideo, 13/12/40, ZMUC 7803.

Other material examined. 4 males and 4 females, Bornova, Izmir, Turkey, Aegean Sea, Ahmet Koçatas, 22.05.1976, CNMC 1982-0358; 4 males 1 female Warnow Estuary, northern Breiting, Rostock/Hohe Dune, Baltic Sea, 07.05.1998, M. L. Zettler; 4 males, 4 females, Gulf of Guinea, Port Harcourt, Creek Market, Nigeria, 23.10.1997, S. Reino Freeman, CMNC 1982-0359; 4 males, 4 females, Ceuta, Morocco, 36°04'N 05°36'W, 03.08.1960, Richard J. Vockeroth, CMNC1982-0357.

Type locality. Rio de la Plata, Montevideo, Uruguay.

Description. **Male** (based on adult male, 14 mm).

Head. *Eyes* black, medium size. *Antenna 1* short, not longer than article 4 of antenna 2. *Antenna 2* peduncle incrassate; article 5 longer than 4; peduncular articles with sparse, small robust setae.

Pereon. *Gnathopod 1*; subchelate; posterior margin of carpus and propodus with rugose lobe; carpus of moderate length, about two-and-a-half × as long as its broadest width and about one and one quarter length of propodus, rugose lobe broad; propodus palm transverse; dactylus weakly overlapping palm, cuspidactylate. *Gnathopod 2* sexually dimorphic; subchelate; basis weakly expanded, subrectangular; merus without medial lobe; carpus reduced, enclosed by merus and propodus; **propodus posterior margin nearly straight,** palm acute, with sinuous margin and subdistal notch, posterodistal corner with protuberance; dactylus scythiform, overlapping posterior margin. *Coxae 2–4* as wide as deep. *Pereopods 3–7* cuspidactylate. *Pereopod 4* significantly shorter than pereopod 3; dactylus thickened different from that of pereopod 3. *Pereopod 5* propodus distinctly longer than carpus. *Pereopod 6* not sexually dimorphic, shorter than pereopod 7; coxa posterior lobe with weak serrations and **posteroproximal corner extended into a distinct lobe**. *Pereopod 7* sexually dimorphic; basis almost as broad as long, posterodistal lobe present; **carpus elongate suboval,** length 1.6 × breadth**, anterior margin weakly crenulate;** carpus: propodus length ratio = 5:6.

Pleon. *Epimera 1–3* with posterior margin slightly scalloped; posteroventral corner of epimera 2–3 moderately produced, subacute. *Uropod 1* peduncle 1.5 × length of rami, with robust setae in two rows, distolateral robust seta weak; endopod subequal in length to exopod and with 3 marginal inner robust setae and 4 marginal outer robust setae; endopod without marginal robust setae. *Uropod 2* peduncle inner

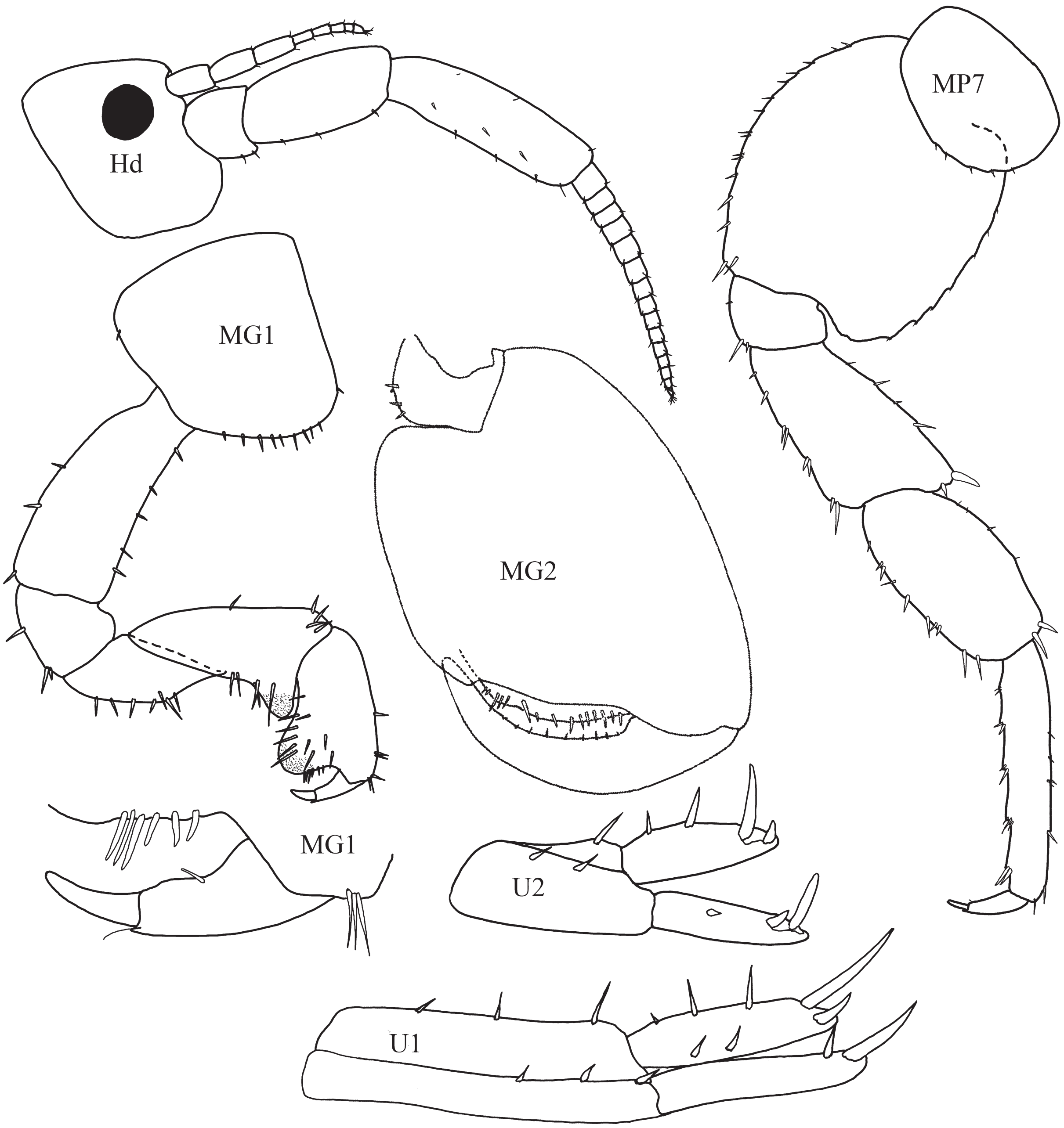

Figure 2. *Platorchestia platensis* (Krøyer, 1845), male paralectotype (12 mm), Montevideo, Uruguay (After Serejo, 2004, except uropods 1–2 from SEM).

margin with about 5 robust setae and outer margin with 3 robust setae; inner ramus subequal in length to exopodite; endopodite with 2 marginal inner robust setae, exopodite with 2 marginal robust setae. *Uropod 3* peduncle 1.5 × length of ramus, with 2 or 3 robust setae; ramus stout, less than 3 × longer than broad, with 0-2 marginal setae, and 3 or 4 apical setae. *Telson* longer than broad, apically incised, with marginal and apical robust setae; each lobe with 3–5 robust setae.

Female (sexually dimorphic characters). *Antennae 2* slender, not incrassate, *Gnathopod 1* without rugose lobes on carpus and propodus. *Gnathopod 2* mitten-shaped; basis anterior margin strongly convex proximally, weakly concave anteriorly. *Pereopod 7* carpus slender.

Remarks. *Platorchestia platensis* shares the presence of a knob-like extension on the posteroproximal margin of coxa 6. with *P. exter* sp. nov. and probably with *P. negevensis* sp. nov., (unconfirmed) among Atlantic species and *P. pacifica* Miyamoto & Morino, 2004 and *P. paraplatensis* Serejo & Lowry, 2008 elsewhere. The knob is absent in the Atlantic species *P. oliveirae* sp. nov. and *P. griffithsi* sp. nov., and is also absent in the non-Atlantic species, *P. ano* Lowry & Bopiah, 2013, *P. smithi* Lowry, 2012, *P. munmui* Jo, 1988 and *P. pachypus* Derzhavin, 1937. *Platorchestia platensis* differs from *P. exter* sp. nov. in the length of the propodus on the male gnathopod 1 that is about two-thirds as long as broad (almost as broad as long in *P. exter* sp. nov.) and in the ramus of uropod 3 being about 2× as long as broad (about 3×

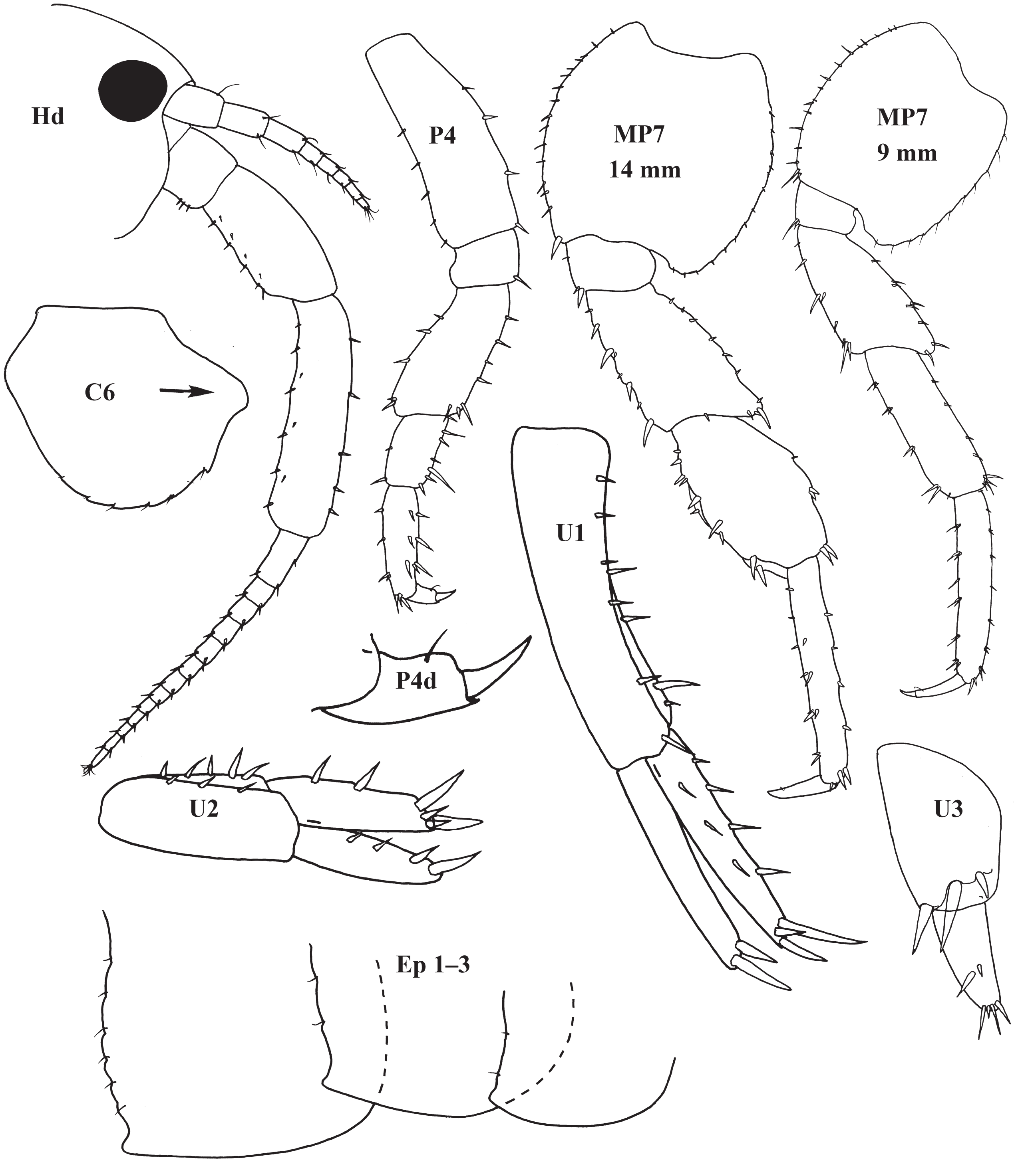

Figure 3. *Platorchestia platensis* (Krøyer, 1845), male (14 mm), Bornova, Turkey.

as long as broad in *P. exter* sp. nov.). It differs from all other Atlantic species by the nearly straight posterior margin of the propodus of the male gnathopod 2 (convex in other species). It differs from *P. negevensis* sp. nov. in the incrassation of the male pereopod 7 (unexpanded in *P. negevensis* sp. nov.) and in the dactylus of gnathopod 1 being almost equal in length to the palm (significantly shorter than the palm in *P. negevensis* sp. nov.). It differs from *P. griffithsi* sp. nov. in the presence of the aforementioned knob-like process on the posteroproximal margin of coxa 6 (absent in *P. griffithsi* sp. nov.), in the nearly straight posterior margin of the propodus of the male gnathopod 2 (convex in *P. griffithsi* sp. nov.) and in the much shorter propodus of the male pereopod 7. For the several differences between *P. platensis* and *P. oliveirae*, see under the remarks for *P. oliveirae*.

Habitat. In beach algal debris on high shore of protected beaches.

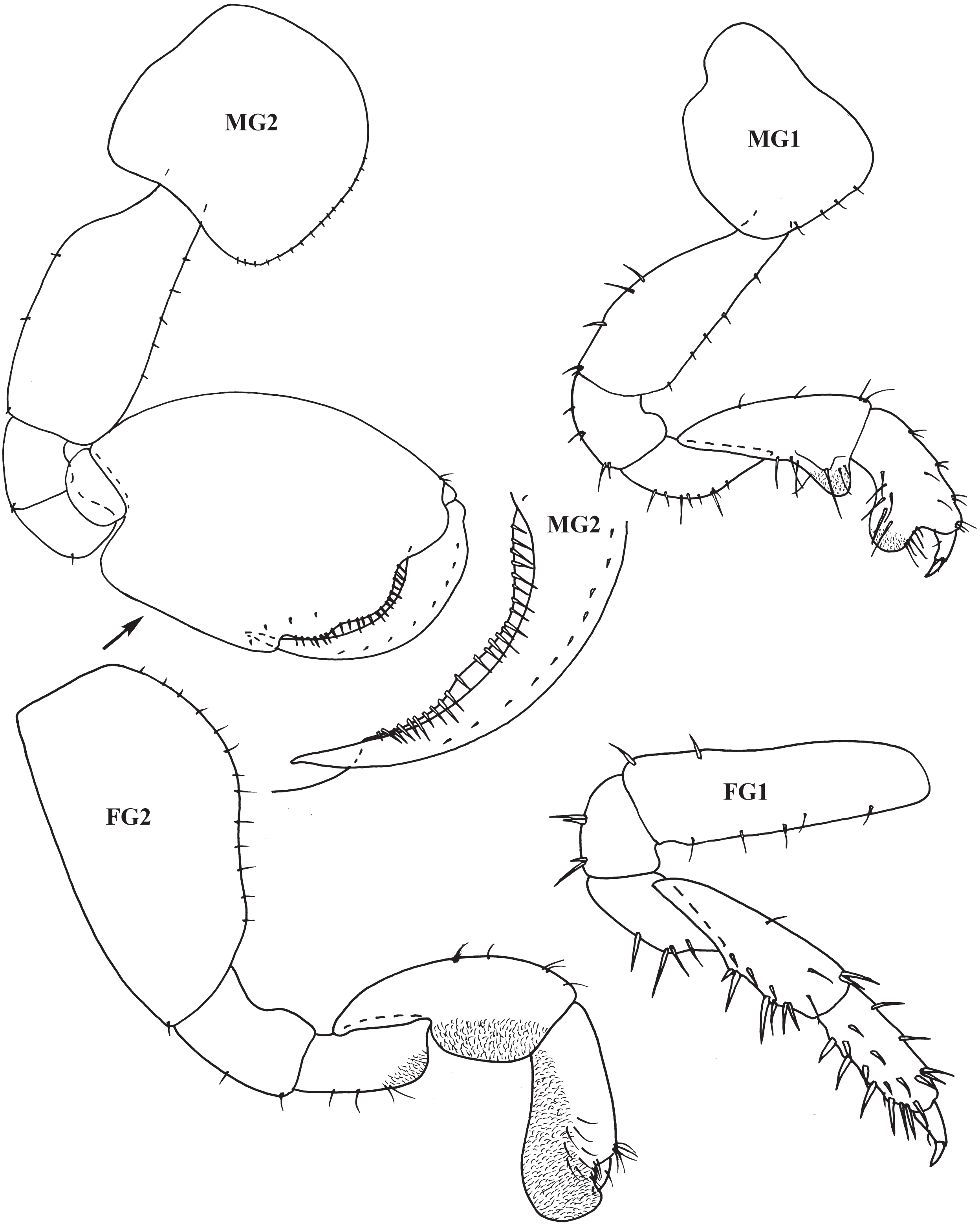

Figure 4. *Platorchestia platensis* (Krøyer, 1845), male (14 mm), female (12 mm), Bornova, Turkey.

Distribution. South America: La Plata, Uruguay (Krøyer, 1845); Mediterranean: Marseille (Bellan-Santini, 1993), Monaco, Minorca, Naples, Algeria, Egypt, Palestine (Chevreux & Fage, 1925); Montenegro, Boka Kotorska (Karaman, 1971); Turkey (Geldiay *et al.*, 1971; present investigation); Black Sea (Copilaş-Ciocianu *et al.*, 2020); Africa: Morroco (present investigation); Nigeria (present investigation); England (Lincoln, 1979); Baltic: Denmark (Jo, 1988), Germany (Zettler & Zettler, 2017; present investigation).

Platorchestia oliveirae sp. nov.

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Figs 5–7

Orchestia platensis Kunkel, 1910: 63, fig. 24.—Shoemaker, 1921: 101.—Shoemaker, 1933: 17.—Shoemaker, 1935: 241.—Oliveira, 1953: 329, figs. 1012.—Soares, 1979: 97.—Fox & Bynum, 1975: 228.—Heard, 1982: 42, fig. 49.—Ciavatti, 1989: 135, figs. 6–8.

Platorchestia platensis.—LeCroy *et al.*, 2009: 963.—Gable *et al.*, 2010: 140, appendix 1.

Orchestia monodi.—Serejo, 2004: 14, figs 7–9.—Wildish *et al.*, 2016: 1919.

Not *Orchestia platensis* Krøyer, 1845: 304, pl. 2 figs 2a–i.

Not *Orchestia monodi* Mateus, Mateus & Afonso, 1986: 100, figs 1–7.

Holotype: Male 9.0 mm, Caioba, Parana State, Brazil, Fritz Plauman, 06.1958, CNMC-1962-0352. **Paratypes**: 65 males and females, same data as holotype, CNMC-1962-0352.1.

Other material examined. 4 males, 4 females, Patos Island, Venezuela, under stones, HW level, Victor C. Quesnel, 1959, CNMC-1962-0421; 4 males, 4 females, Trinidad and Tobago, P. Wagenaar Hummelinck, 11.01.1955, CNMC-1984-0995; 3 males, 3 females, Fort de France, Martinique, Arthur H. Clarke, 27.03.1960, CNMC-1962-0424; 4 males, 4 females, Great Bay, St Maarten, P. Wagenaar Hummelinck, 24.06.1949, CNMC-1984-0977; 4 males, 4 females, Ocean Springs Highway, 90 Bridge, Jackson County, Mississippi, R. Moore, 08.02.1960, CNMC-1963-0076; 4 males, 4 females, Cedar Key, Levy County, Florida, sand beach under debris, Robert A. Menzies, 11.1959, CNMC-1963-0141; 4 males, 4 females Tuckers Town Cove, Bermuda, sand, plant, HW line, Eric L. Mills, 29.05.1962, CNMC-1962-0405.

Type locality. Caioba, Parana State, Brazil.

Etymology. Named after Dr L. P. H. de Oliveira who first described material attributable to this taxon from Rio de Janeiro.

Description. **Male (**based on adult male holotype, 9 mm).

Head. *Eyes* black, medium size. *Antenna 1* short, not longer than article 4 of antenna 2. *Antenna 2* peduncle incrassate; article 5 longer than 4; peduncular articles with sparse, small robust setae.

Pereon. *Gnathopod 1* subchelate; posterior margin of carpus and propodus with rugose lobe; **carpus and propodus elongate; carpus 3.5 × longer than its median width, rugose lobe narrow; propodus elongate, parallel sided**, **not including the palmate lobe**; **dactylus overlapping palm**. *Gnathopod 2* sexually dimorphic; subchelate; basis weakly expanded, subovate; merus without medial lobe; carpus reduced, enclosed by merus and propodus; propodus subovate, posterior margin evenly convex, palm acute, with strong V-shaped, midpalmar notch, posterodistal corner with protuberance; dactylus scythiform, overlapping posterior margin. *Coxae 2–4* as wide as deep. *Pereopods 3–7* cuspidactylate. *Pereopod 4* shorter than pereopod 3; dactylus thickened but not pinched posteriorly, different from that of pereopod 3. *Pereopod 5* propodus distinctly longer than carpus. *Pereopod 6* shorter than pereopod 7, not sexually dimorphic; **coxa posterior lobe with strong serrations, anteroproximal corner not produced**. *Pereopod 7* weakly incrassate; basis almost as broad as long, posterodistal lobe present; **carpus broad, rectangular, weakly expanded;** carpus:propodus length ratio = 5:6.

Pleon. *Epimera 1–3* with posterior margin serrated**; posteroventral corner of epimeron 2 produced into strong acute spine**. ***Uropod 1*** **peduncle elongate, 1.7 × length of rami,** with robust setae in two rows, distolateral robust seta absent; endopodite subequal in length to exopodite with 4 marginal inner robust setae and 3 marginal outer robust setae; endopodite without marginal setae. *Uropod 2* peduncle inner margin with 7–10 robust setae, outer margin with 3 or 4 robust setae; endopodite subequal in length to exopodite; endopodite with two marginal robust setae; exopodite without marginal robust setae. ***Uropod 3*** **peduncle 1.5 × length of ramus,** with 1 robust seta; ramus less than 3 × as long as broad, almost parallel-sided, with 2 or 3 marginal setae, and 3 or 4 apical setae. *Telson* longer than broad, apically incised, with marginal and apical robust setae; each lobe with 5 or 6 robust setae.

Female (sexually dimorphic characters). *Antennae 2* slender, not incrassate. *Gnathopod 1* carpus and propodus without rugose lobes. *Gnathopod 2* mitten-shaped; basis anterior margin weakly concave anteriorly, strongly convex proximally. *Pereopod 7* not incrassate.

Growth stages. The male gnathopod 2 propodus changes both its general shape and in the palm ornamentation with age. The propodus becomes less elongate and the midpalmar notch develops gradually.

Habitat. In beach debris on protected beaches and mangroves.

Remarks. Adult males of *P. oliveirae* sp. nov. have a much more robust pereopod 7 than do females, but only minimal incrassation of the carpus of pereopod 7 has been observed even in the largest males. A number of large males from a wide range of locations have been examined, but the possible existence of hyperadult males with a more incrassate P7 cannot be dismissed. *P. oliveirae* sp. nov. differs from all other Atlantic species in the structure of the male gnathopod 1 in which the carpus length is >3× breadth (length <3× breadth in *P. platensis*, *P. exter* sp. nov. and *P. griffithsi* sp. nov.) and, in addition, the dactylus is long, overlapping the palm whereas it is scarcely equal to or shorter than the palm in all other Atlantic species. The male gnathopod 2 has the basis anterior margin markedly convex, whereas it is nearly straight or at most weakly convex in other Atlantic species and the propodus is very subovoid due to a very convex posterior margin and develops a deep mid-palmar triangular notch in large males. No other Atlantic species has such a notch. Among Asian species. *P. munmui* Jo, 1988 has a small, non-triangular midpalmar notch, but that species has a weak posterodistal spine on epimeron 2, the carpus of the male gnathopod 1 is not strongly elongate, the rugose lobe broad and the posterior lobe of coxa 6 is weakly serrated (strongly serrated in *P. oliveirae* sp. nov.). In *P. oliveirae* sp. nov., coxa 6 does not have a posteroproximal knob (present in *P. platensis* and *P. exter* sp. nov.). In *P. oliveirae* sp. nov. there is a very strong acute spine on the posterodistal corner of epimeron 2 (short and blunt in other species except *P. negevensis* sp. nov., where it is subacute).

Distribution. From Brazil northwards to Bermuda. Brazil (Oliveira, 1953; Soares, 1979; Serejo, 2004;

Figure 5. Above *Platorchestia exter* sp. nov., male holotype (11 mm), Newfoundland; below, *Platorchestia oliveirae* sp. nov., male holotype (9 mm), Parana State, Brazil.

present investigation); Venezuela (present investigation); Barbados (Shoemaker, 1921); Trinidad and Tobago (present investigation); Martinique (present investigation); Guadeloupe (Ciavatti, 1989; present investigation); Saint Maarten (present investigation); Dominican Republic (Shoemaker, 1933), Puerto Rico (Shoemaker, 1935), North Carolina (Fox & Bynum, 1975); Mississippi (present investigation); Florida (present investigation); northern Gulf of Mexico (Heard, 1982); Bermuda (Gable *et al.*, 2010; Wildish *et al.,* 2016; present investigation).

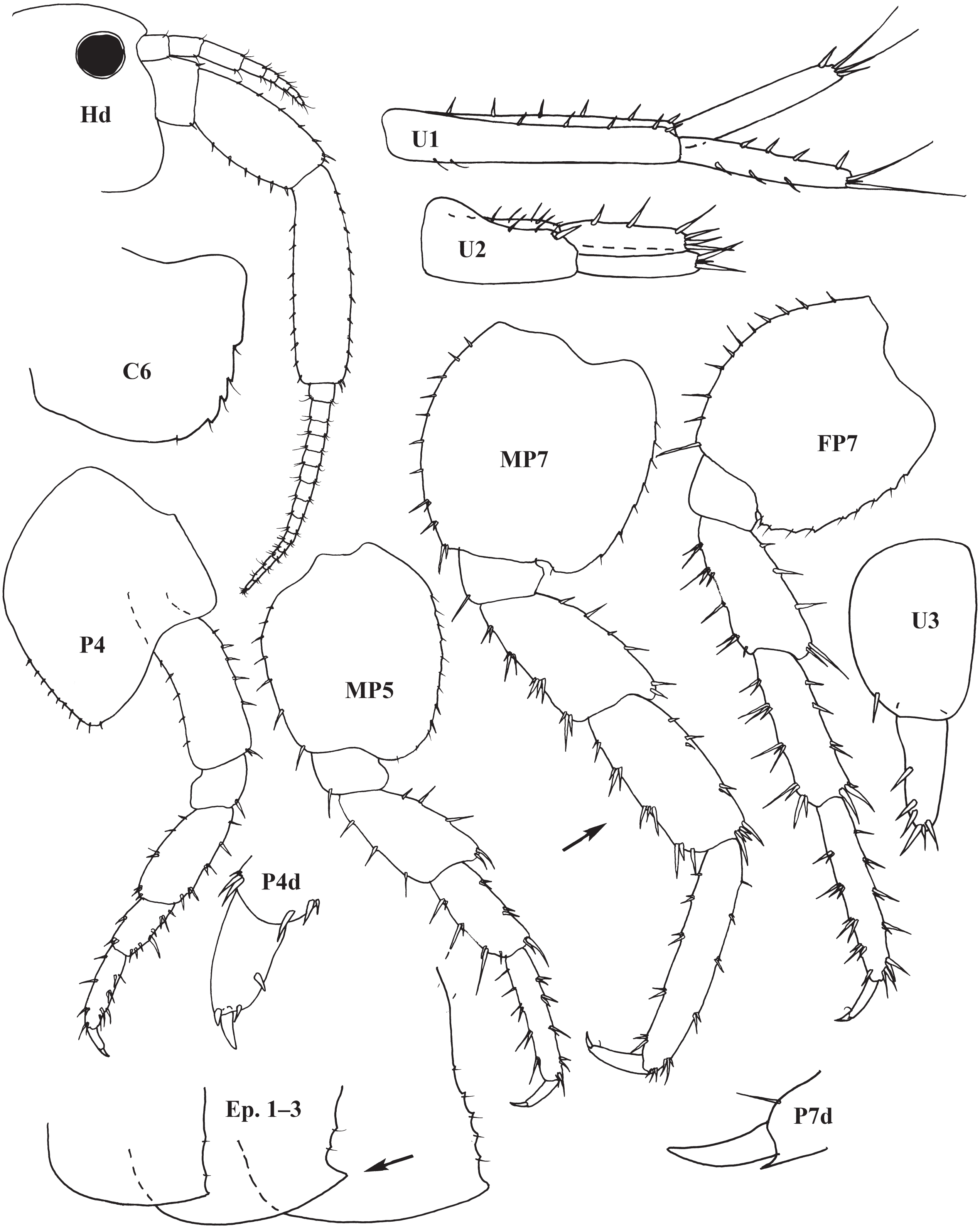

Figure 6. *Platorchestia oliveirae* sp. nov., male holotype (9 mm), Parana State, Brazil.

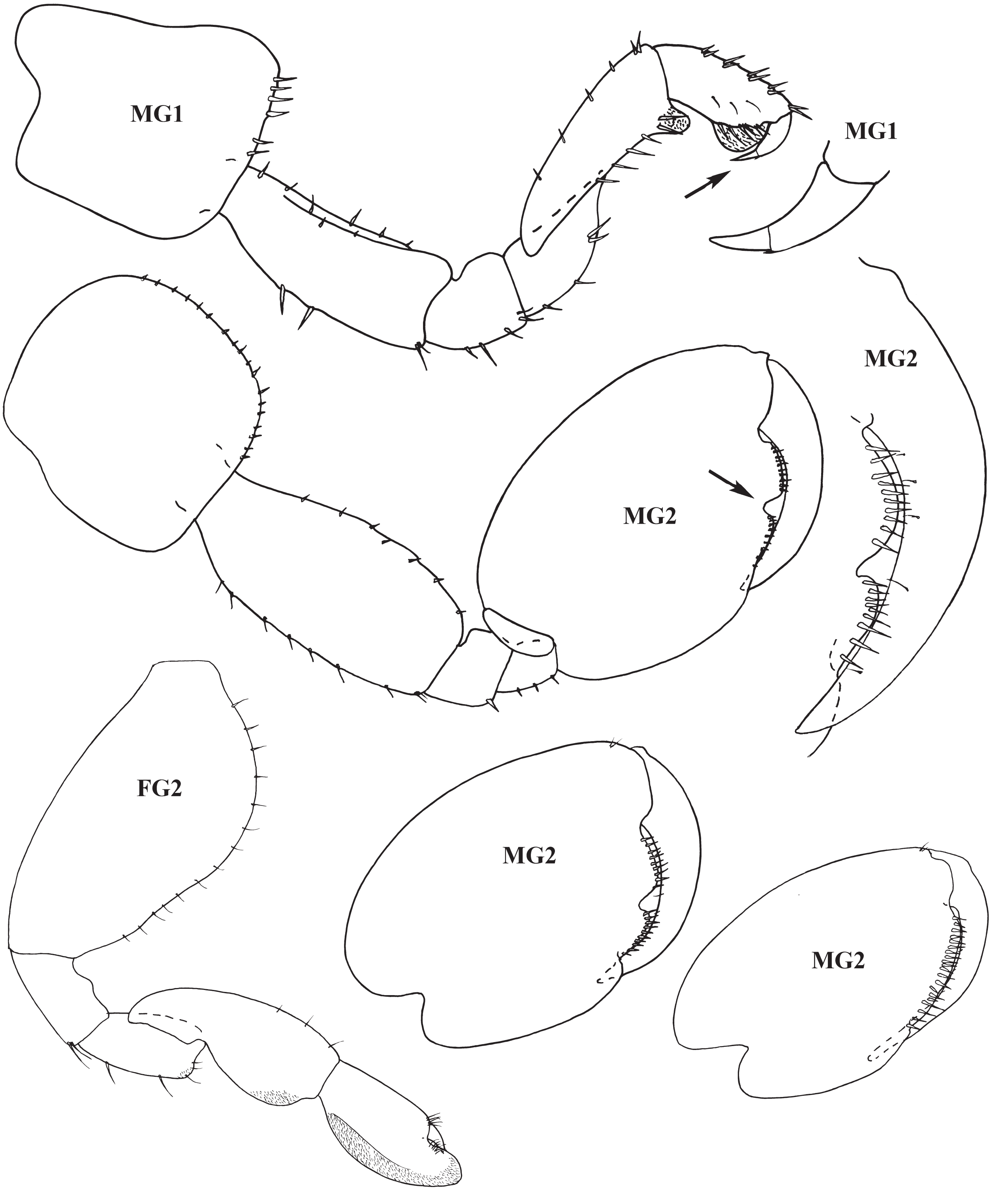

Figure 7. *Platorchestia oliveirae* sp. nov., male holotype (9 mm), female paratype (8 mm), Parana State, Brazil.

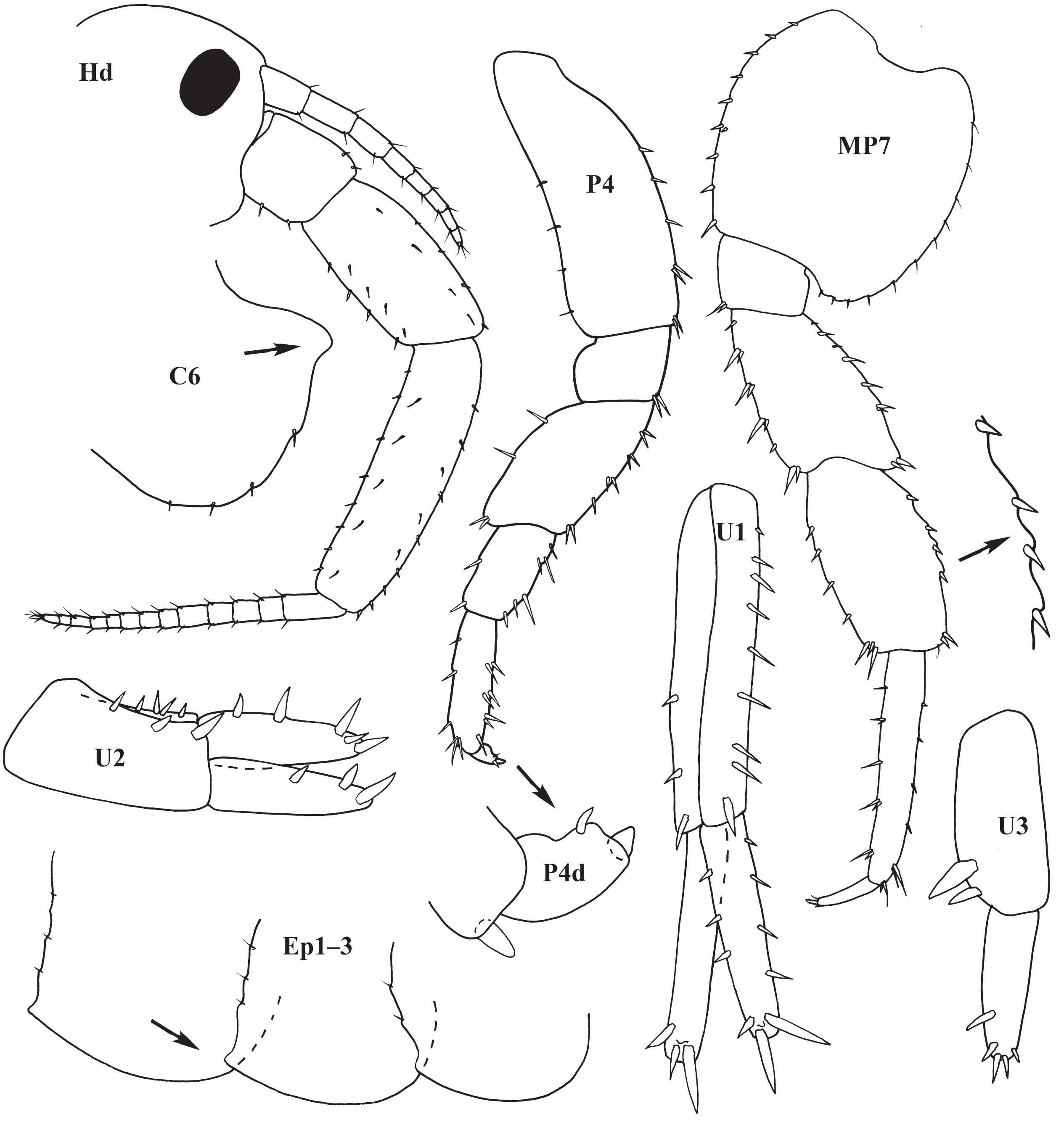

Figure 8. *Platorchestia exter* sp. nov., male holotype (11 mm), Newfoundland.

Platorchestia exter sp. nov.

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Figs 5, 8, 9

Orchestia platensis Bousfield, 1955: 141.—Bousfield, 1956: 32.—Bousfield, 1958: 883, figs 1c, 10b.—Feeley & Wass, 1971: 20.—Bousfield, 1973: 159, fig. 46.2.—Brunel, Bosse & Lamarche, 1998: 200.

Platorchestia platensis.—Bousfield, 1982: 28, fig. 11.—Halcrow & Bousfield, 1987: 277, fig. 16.—?Wildish *et al.*, 2016: 1919.

Not *Orchestia platensis* Krøyer, 1845: 304, pl. 2, figs 2a–i.

Holotype: Male 11.0 mm, Port au Port, Newfoundland, north side of isthmus, 48°33'35"N 58°43'24"W, E. L. Bousfield, 13.07.1954, CNMC-1982.0236. **Paratypes**: 44 males and females, same data as holotype, CNMC-1982.0236.1.

Type locality. Port au Port, Newfoundland.

Etymology. From the Latin *exter* referring to the scalloped anterior margin of the hyperadult male pereopod 7 carpus. Used as a noun in apposition.

Ecological type. Beach hopper.

Description. Adult male holotype. 9 mm.

Head. *Eyes* black, medium size. *Antenna 1* short, not longer than article 4 of antenna 2. *Antenna 2* peduncle incrassate; article 5 longer than 4; peduncular articles with sparse, small robust setae.

Pereon. *Gnathopod 1* subchelate; posterior margin of carpus and propodus with rugose lobe; **carpus less than 3 × as long as its median width, rugose lobe narrow**; propodus short, triangular; dactylus cuspidactylate, shorter than palm. *Gnathopod 2* sexually dimorphic; subchelate; basis weakly

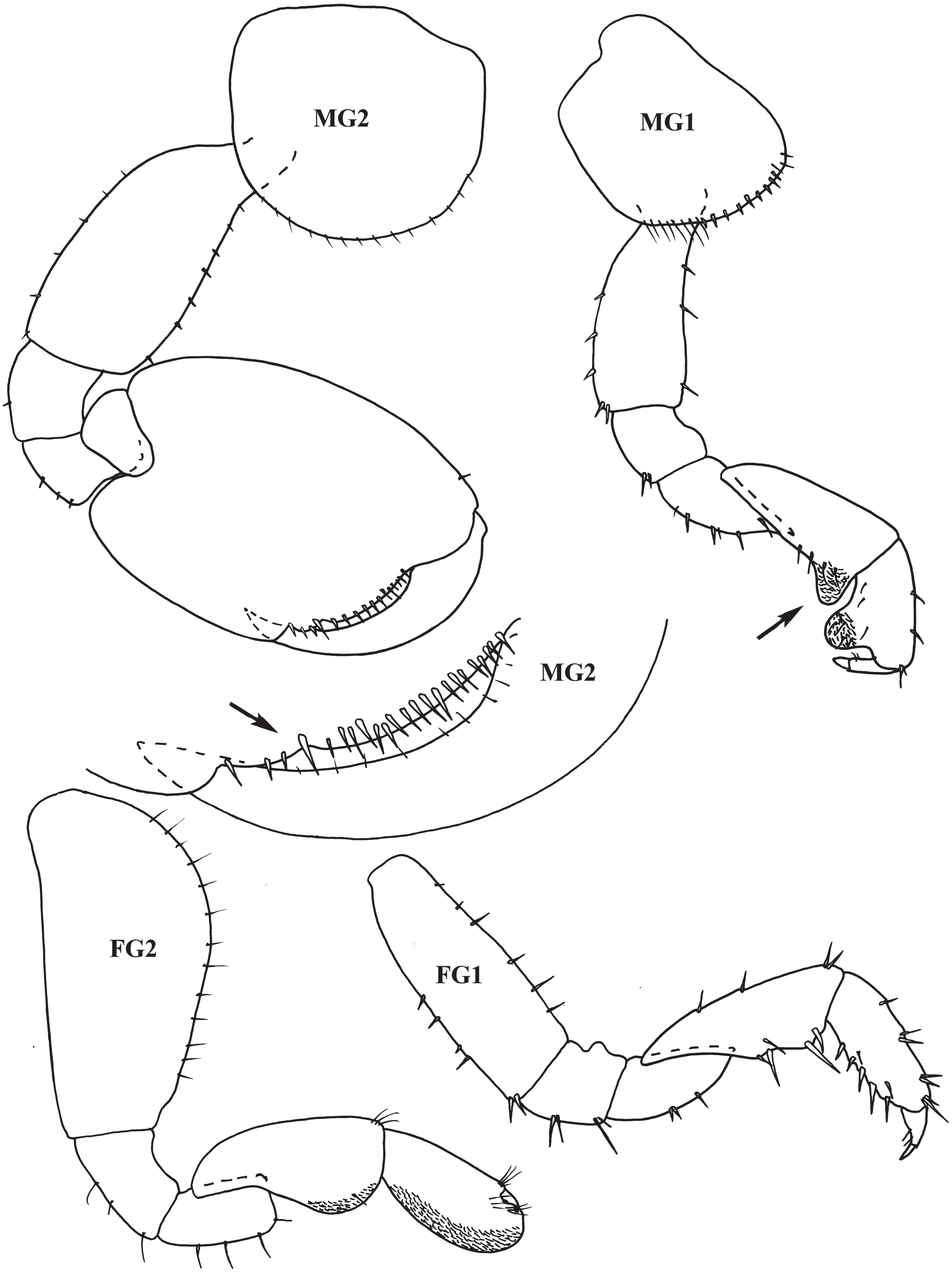

Figure 9. *Platorchestia exter* sp. nov., male holotype (11 mm), female paratype (10 mm), Newfoundland.

expanded, almost parallel-sided; merus without medial lobe; carpus reduced, enclosed by merus and propodus; propodus subovate, posterior margin evenly convex. palm acute, with 2 medio-distal weak indentations, posterodistal corner with rounded protuberance; dactylus scythiform, overlapping posterior margin. *Coxae 2–4* as wide as deep. *Pereopods 3–7* cuspidactylate. *Pereopod 4* significantly shorter than pereopod 3**;** dactylus thickened pinched posteriorly, different from that of pereopod 3. *Pereopod 5* propodus distinctly longer than carpus. *Pereopod 6* not sexually dimorphic, shorter than pereopod 7; coxa posterior lobe with strong serrations**, posteroproximal corner extended into a distinct lobe**. *Pereopod 7* sexually dimorphic; basis almost as broad as long, posterodistal lobe present; **carpus very enlarged, weakly subovoid, anterior margin crenulated, each protrusion with a robust seta;** carpus: propodus length ratio = 5:6.

Pleon. *Epimera 1–3* with posterior margin slightly serrated; posteroventral corner of epimera 1–3 produced into a small spine. *Uropod 1* peduncle 1.4 × length of rami, with robust setae in two rows, distolateral robust seta absent; endopodite subequal in length to exopodite and with 3 marginal inner robust setae and 4 marginal outer robust setae; endopodite without marginal setae. *Uropod 2* peduncle inner margin with 5 or 6 robust setae and outer margin with 2 robust setae; endopodite subequal in length to exopodite; endopodite with 2 marginal inner robust setae; exopodite with 1 marginal robust seta. *Uropod 3* peduncle 1.4 × length of ramus, with 1 robust seta; ramus slender, more than 3 × longer than broad, parallel-sided, with 3 marginal setae, and 3 or 4 apical setae. *Telson* longer than broad, apically incised, with marginal and apical robust setae; each lobe with 3–5 robust setae.

Female (sexually dimorphic characters). *Antennae 2* slender, not incrassate. *Gnathopod 1* carpus and propodus without rugose lobes. *Gnathopod 2* mitten-shaped; basis anterior margin convex proximally, nearly straight anteriorly. *Pereopod 7* not incrassate.

Habitat. Amongst debris, high on seashores.

Remarks. *Platorchestia exter* sp. nov. shares with *P. platensis* the presence of a knob-like extension on the posteroproximal margin of coxa 6 (absent in other species). It differs from *P. platensis,* however, in the narrow-based rugose lobe on the carpus of male gnathopod 1 that is broad based in *P. platensis*, in the short propodus of the male gnathopod 1 that is almost as broad as long (about two-thirds as long as broad in *P. platensis*), in the shape of the gnathopod 2 propodus posterior margin that is evenly convex in *P. exter* sp. nov. (but nearly straight in *P. platensis*) and in having a long slender ramus on uropod 3 about 3× as long as broad (2× as long as broad in *P. platensis*). The male antenna 2 is also more strongly incrassate in *P. exter* sp. nov. than it is in *P. platensis*.

Bousfield (1973) provides a drawing of an entire male *Orchestia platensis* from New England, but he does not present enlarged drawings of individual male appendages apart from the mouthparts. Appendage metrics derived from the whole animal drawing are unreliable. Non-metric character states based on relative shape, that can be derived from the whole animal drawing include the very stout, incrassate antenna 2 and the narrow-based rugose lobe on the male gnathopod 1 carpus. These character states indicate that the species figured is *P. exter* sp. nov.

Platorchestia exter sp. nov. differs from *P. oliveirae* sp. nov. in the enlarged, crenulate carpus of pereopod 7 in hyperadult males (broad rectangular weakly expanded in *P. oliveirae* sp. nov.). In *P. exter* sp. nov., the rugose lobe on the carpus of the male gnathopod 1 is narrower than in other species.

Distribution. The recorded distribution from material examined together with published descriptions, is from Newfoundland (Bousfield, 1958) south through Nova Scotia (Bousfield, 1956, 1982) to New England (Bousfield, 1973). It probably occurs much farther south on the American mainland, but records of the species (as *P. platensis*) from further south have not been substantiated by examination. A record (as *P. platensis*) from Bermuda (Wildish *et al.,* 2016) may be this species, but Wildish *et al.* (2016) provide no description or figures. The incrassate pereopod 7 character state used in the key (p. 1922) for *P. platensis* is compatible with *P. exter* sp. nov.

Platorchestia negevensis sp. nov.

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Figs 10–11

Orchestia platensis.—Herbst & Dimentman, 1983: 20, fig. 3 (in part).
Platorchestia monodi.—Morino & Ortal, 1995: 825, figs 1–3.
Not *Orchestia platensis* Krøyer, 1845: 304, pl. 2 figs 2a–i.
Not *Orchestia monodi* Mateus, Mateus & Afonso, 1986: 100, figs 1–7.

Syntypes: 3 males (8.0–9.5 mm), 2 females (7.7–8.5 mm), En Hameara, Negev Desert, Israel, IES 2088 Amp 1246 and IES 5352, Hebrew University of Israel.

Type locality. En Hameara, Negev Desert, Israel.

Etymology. Named after the Negev Desert in which the type locality is located.

Ecological type. Riparian-hopper.

Description. Based on figures of Morino & Ortal (1995) (male 9.5 mm).

Head. *Eyes* black, large. *Antenna 1* shorter than article 4 of antenna 2. *Antenna 2* peduncle very weakly incrassate; article 5 longer than 4; peduncular articles with sparse, small robust setae.

Pereon. *Gnathopod 1* subchelate; posterior margin of carpus and propodus with rugose lobe; carpus 3 × longer than its median width, rugose lobe broad; propodus subtriangular; dactylus cuspidactylate, shorter than palm. *Gnathopod 2* sexually dimorphic; subchelate; basis weakly expanded, parallel-sided; merus without medial lobe; carpus reduced, enclosed by merus and propodus; propodus subovate, posterior margin nearly straight; palm acute, convex, with small notch and protuberance near posterodistal corner; dactylus scythiform, overlapping posterior margin. *Coxae 2–4* as wide as deep. *Pereopods 3–7* cuspidactylate; *Pereopod 4* significantly shorter than pereopod 3; dactylus short with mini-wavy posterior margin. thickened but not pinched different from that of pereopod 3. *Pereopod 5* propodus longer than carpus. *Pereopod 6* shorter than pereopod 7, not sexually dimorphic, **coxa posterior lobe without process.** ***Pereopod 7*** **not incrassate**; basis a little longer than broad, posterodistal lobe present.

Pleon. *Epimera 1–3* with posterior margin slightly serrated, posteroventral corners produced. *Uropod 1* peduncle with robust setae in two rows, distolateral robust seta absent; rami three quarters length of peduncle; endopodite subequal in length to exopodite with 4 marginal inner setae and 4 marginal outer setae; exopodite without marginal setae. *Uropod 2* peduncle inner margin with 5 setae; outer margin with 3 or 4 strong, robust setae; endopodite subequal in length to exopodite with two rows of 3 marginal robust setae; **exopodite with 2 marginal robust setae**. ***Uropod 3*** **peduncle a little longer than ramus, with 3 robust setae; ramus almost parallel-sided**; with 2 marginal setae, and 2 or 3 apical setae. *Telson* longer than broad, apically incised, with marginal and apical robust setae; each lobe with 5–7 robust setae per lobe.

Female (sexually dimorphic characters). *Gnathopod 1* carpus and propodus without rugose lobes. *Gnathopod 2* mitten-shaped; basis anterior margin irregularly notched, weakly convex proximally, anteriorly nearly straight.

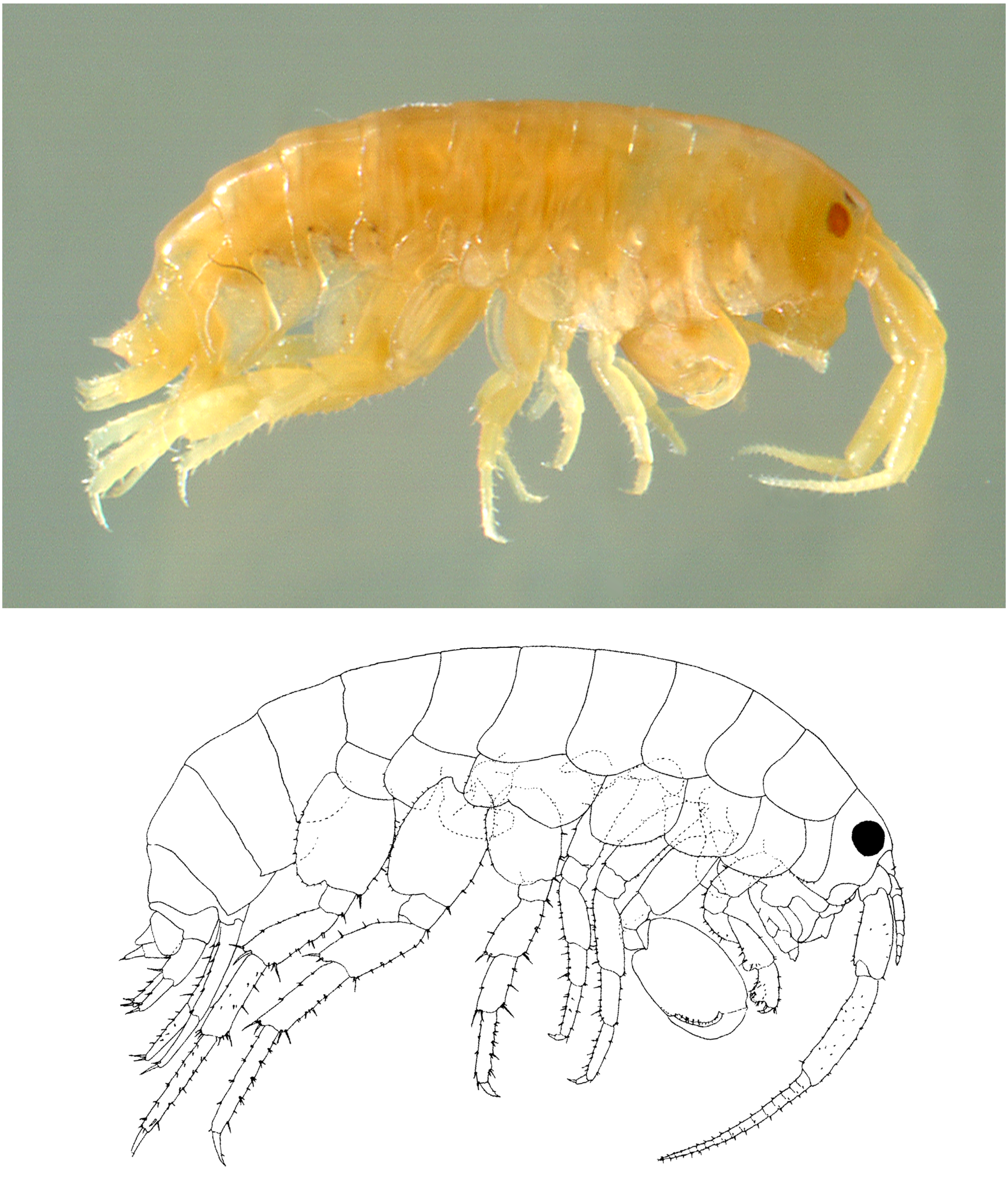

Figure 10. Above *Platorchestia griffithsi* sp. nov., male holotype (9 mm), Knysna lagoon, South Africa; below *P. negevensis* sp. nov., male (9.5 mm), Negev desert (after Morino & Ortal, 1995).

Habitat. Near springs and wells (Morino & Ortal, 1995). Restricted to enclosed perpetually moist habitats such as wells or small springs in caves. It displays an amphibious lifestyle, often being collected in debris and moist sandy soil outside the water (Herbst & Dimentman, 1983).

Remarks. *Platorchestia negevensis* sp. nov. resembles *P. platensis* (Krøyer, 1845) from which it was probably derived during a sea-level regression. It differs in having a neotenous, non-incrassate condition of pereopod 7. It is the only Atlantic species that has this character state neotenous, but the state

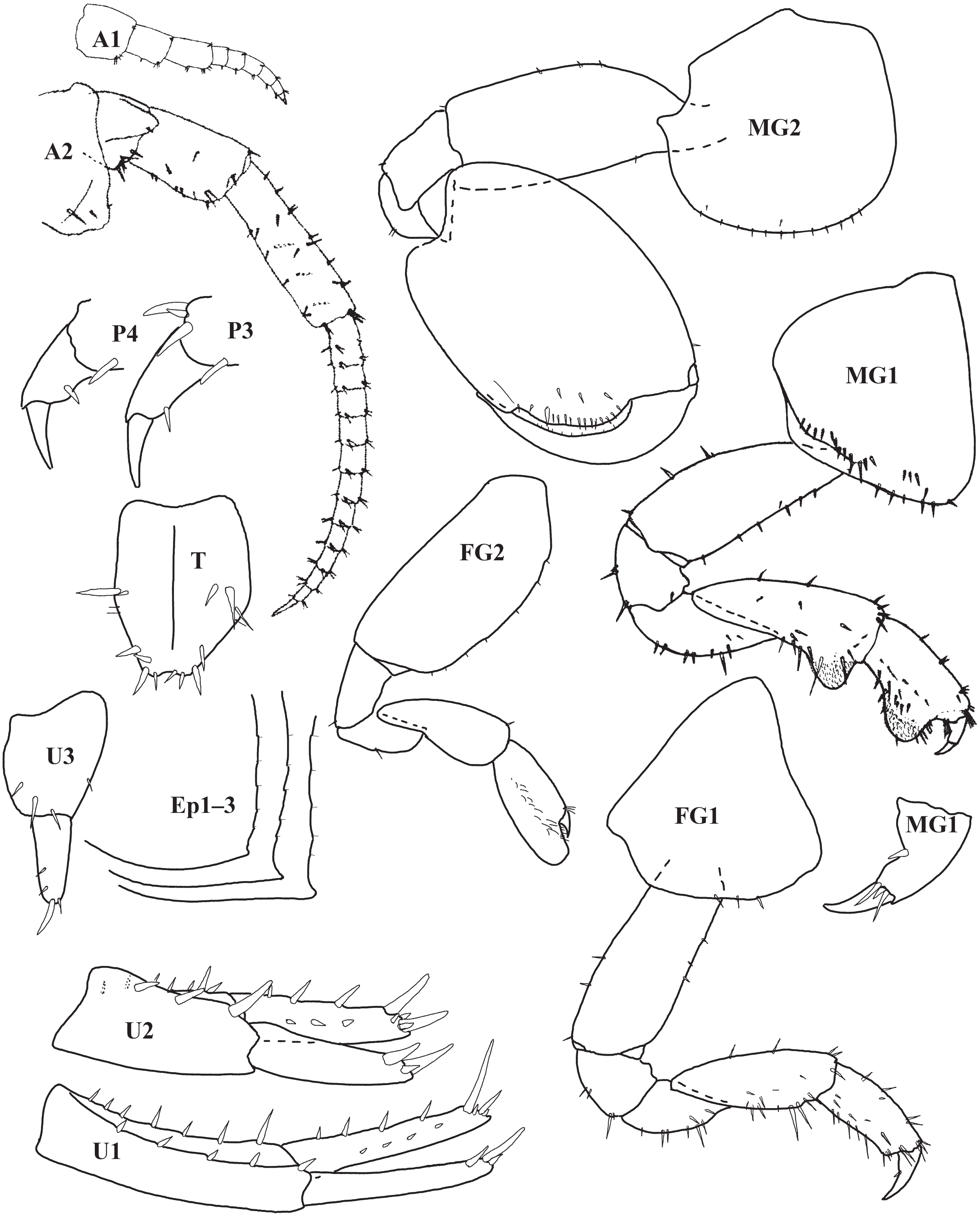

Figure 11. *Platorchestia negevensis* sp. nov., male (9.5 mm), female (8.5 mm), Negev desert (after Morino & Ortal, 1995).

does occur in some non-Atlantic species (*P. ano* Lowry & Bopiah, 2013, *P. pachypus* Derzhavin, 1937 and *P. smithi* Lowry, 2012). It differs from *P. ano* in the relatively short carpus of gnathopod 1 and the poorly incrassate male antenna 2. Both *P. pachypus* and *P smithi*, unlike *P. negevensis* sp. nov., have a strongly incrassate male antenna 2. The dactylus of the male gnathopod 1 of *P. negevensis* sp. nov. is distinctly shorter than the palm, whereas in *P. platensis* it is scarcely shorter than the palm.

Distribution. Israel: Sinai and Negev Deserts (Herbst & Dimentman, 1983; Morino & Ortal, 1995).

Platorchestia griffithsi sp. nov.

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Figs 10, 12, 13

Orchestia platensis.—Griffiths, 1975: 79, fig. 52B.
?Orchestia platensis.—Macnae, 1953: 1027.
Platorchestia platensis.—Mead *et al.*, 2011: 1998, tab. 1.—Milne & Griffiths, 2013: 77.—Diemer, 2015: 15, 24, 35.—Diemer *et al.*, 2016: 207, figs 4–6.
Not *Orchestia platensis* Krøyer, 1845: 304, pl. 2 figs 2a–i.

Holotype: Male, Knysna lagoon, South Africa, University of Cape Town, 04.15.1949, CMNC-1982-0356. **Paratypes**: 4 males, 4 females, same data as holotype, CMNC-1982-0356.1.

Type locality. Knysna lagoon, South Africa

Etymology. Named after Charles Griffiths in recognition of his important work in documenting the amphipod fauna of South Africa.

Description. Adult male 9 mm.

Head. *Eyes* black, medium size. *Antenna 1* short, not longer than article 4 of antenna 2. *Antenna 2* peduncle strongly incrassate; article 5 longer than 4; peduncular articles with sparse, small robust setae.

Pereon. *Gnathopod 1* subchelate; posterior margin of carpus and propodus with rugose lobe; carpus moderately elongate, about 2.5 × as long as its broadest width and over one- and one-half length of propodus; propodus palm transverse; **dactylus much shorter than palm,** cuspidactylate. *Gnathopod 2* sexually dimorphic; subchelate; basis weakly expanded, subrectangular; merus without medial lobe; carpus reduced, enclosed by merus and propodus; propodus subovate, posterior margin evenly convex; palm acute, with subdistal notch, posterodistal corner with protuberance; dactylus scythiform, overlapping posterior margin. *Coxae 2–4* as wide as deep. *Pereopods 3–7* cuspidactylate. *Pereopod 4* significantly shorter than pereopod 3; dactylus thickened weakly pinched posteriorly, different from that of pereopod 3. *Pereopod 5* propodus distinctly longer than carpus. *Pereopod 6* not sexually dimorphic, shorter than pereopod 7; coxa posterior lobe with weak serrations, **posteroproximal corner not extended into a distinct lobe**. *Pereopod 7* sexually dimorphic; basis almost as broad as long, posterodistal lobe present; **carpus subovoid, anterior margin crenulate; carpus: propodus length ratio = 5:7**.

Pleon. *Epimera 1–3* with posterior margin slightly serrated**; epimeron 3 posteroventral corner with weak spine**. *Uropod 1* **peduncle 1.3× length of rami,** with robust setae in two rows, distolateral robust seta absent; endopodite subequal in length to exopodite and with 4 marginal inner setae and 2 marginal outer setae; endopodite without marginal setae. *Uropod 2* peduncle inner margin with 5–7 setae and outer margin with 2 or 3 setae; endopodite subequal in length to exopodite; endopodite with one row of marginal robust setae; exopodite with 1 marginal seta. *Uropod 3* peduncle 1.3 × length of ramus, with 3 robust setae; ramus narrowing distally; with 1 marginal seta, and 3 apical setae. *Telson* longer than broad, apically incised, with marginal and apical robust setae; each lobe with 3–5 robust setae.

Female. (sexually dimorphic characters). *Antennae 2* slender, not incrassate. *Gnathopod 1* carpus and propodus without rugose lobes. *Gnathopod 2* mitten-shaped; basis anterior margin strongly convex proximally, anteriorly nearly straight; **carpus and propodus very slender, almost 3× as long as broad**. Pereopod 7 not incrassate.

Remarks. *Platorchestia griffithsi* sp. nov. differs from *P. platensis* and *P. exter* sp. nov. in lacking a knob-like projection on coxa 6 and in the shape of the male gnathopod 2 propodus, which has a distinctly convex posterior margin (nearly straight in *P. platensis*). It differs from all other described species in the very long propodus on the male pereopod 7. In the female, *Platorchestia griffithsi* has a very elongate and slender gnathopod 2 carpus and propodus compared with other species. It differs from *P. oliveirae* sp. nov. and *P. negevensis* sp. nov. in the crenulate anterior margin of the carpus in the hyperadult male pereopod 7.

Habitat. In beach debris on high shore of protected beaches.

Distribution. South Africa from Langebaan Lagoon in the Western Cape to Swartkops Estuary in the Eastern Cape.

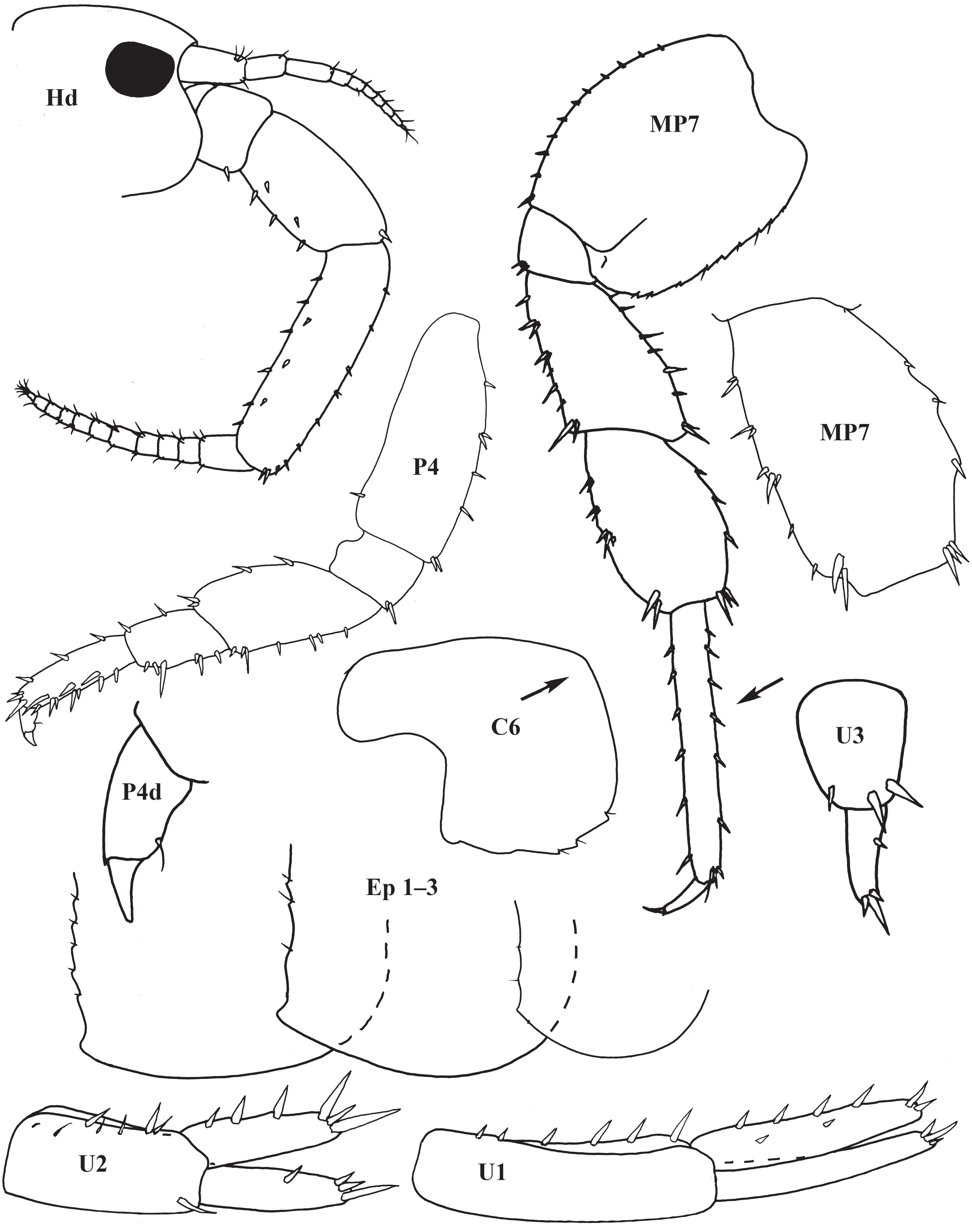

Figure 12. *Platorchestia griffithsi* sp. nov., male holotype (9 mm), Knysna lagoon, South Africa.

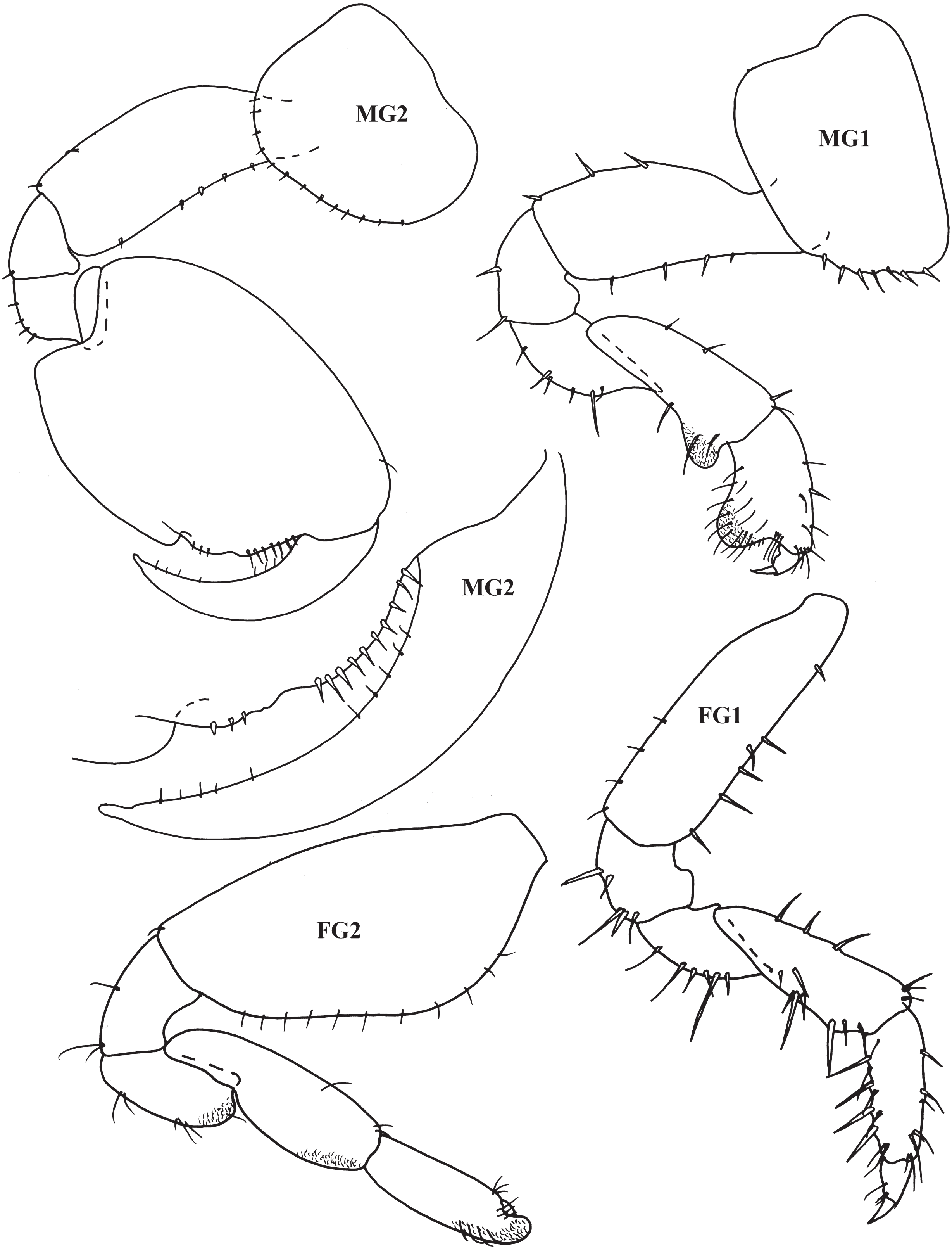

Figure 13. *Platorchestia griffithsi* sp. nov., male holotype (9 mm), female paratype (8 mm), Knysna lagoon, South Africa.

The enigmatic *Platorchestia platensis*

Atlantic species of *Platorchestia*, with one exception, are endemic to clearly defined single continuous regions (Fig. 14). It is remarkable, then, that *P. platensis* (Krøyer, 1845) is now known to occur in two widely separated localities, the northeastern Atlantic on the one hand, where it is widespread, and the southwestern Atlantic on the other, where it is currently known from a single collection only in the La Plata river in Uruguay (the type locality). It is tempting to assume that the Uruguay population has been introduced from Europe, since Montevideo has been an important commercial destination for European ships for centuries. Whether upper shore wrack inhabiting talitrids could be, or have been in the past, transported through ship's ballast as suggested by Mead *et al.* (2011), is difficult to determine. Unfortunately, little collecting of beach amphipods has been reported from Uruguay or Argentina. If *P. platensis* is found to be of wide occurrence along Uruguayan and Argentinian coasts, then introduction may not be the most plausible explanation. If, on the other hand, no other records are forthcoming, then introduction from Europe may be the most parsimonious explanation.

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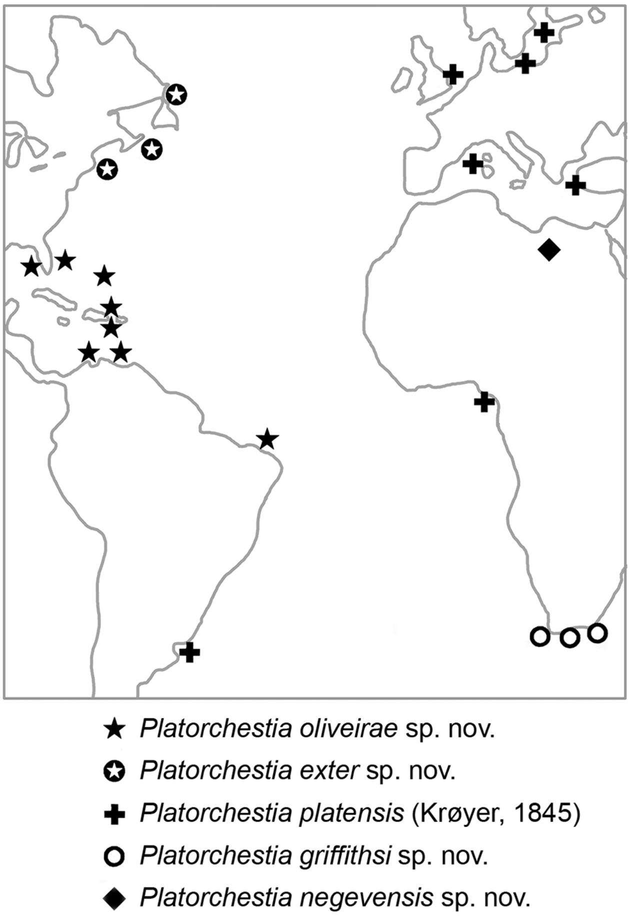

Figure 14. Distribution of *Platorchestia* in the Atlantic Ocean and associated seas.

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A New Species of the Genus *Rhachotropis* (Crustacea: Amphipoda: Eusiridae) from Japan

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Abstract. A new eusirid amphipod, *Rhachotropis lowryi* sp. nov., is described from off Amamioshima Island, Japan, at 402 m depth. This new species differs from its congeners by the features of urosomite 1, pereopods 5–7 bases, uropod 3, and telson. A key to species of *Rhachotropis* from Japanese and adjacent waters is provided. Additionally, a nucleotide sequence of mitochondrial cytochrome *c* oxidase subunit I from the holotype of *R. lowryi* was determined for the future study.

Introduction

The genus *Rhachotropis* Smith, 1883 occurs in shallow to deep waters of the world's oceans (Barnard & Karaman, 1991; Lörz *et al.*, 2018a, b). This genus is composed of carnivorous amphipods that prey on zooplankton, such as copepods (Fanelli *et al.*, 2009; Lörz *et al.*, 2018b), and many species live as planktonic predators. To date, 64 species of *Rhachotropis* have been described (Lörz *et al.*, 2018a, b; Okazaki *et al.*, 2020). Nine species have been recorded from Japanese and adjacent waters: *R. aculeata* (Lepechin, 1780); *R. distincta* (Holmes, 1908); *R. inflata* (Sars, 1883); *R. macropus* Sars, 1893; *R. marinae* Lörz, Jażdżewska & Brandt, 2018; *R. natator* (Holmes, 1908); *R. oculata* (Hansen, 1887); *R. reiwa* Okazaki, Ohtsuka & Tomikawa, 2020; and *R. saskia* Lörz, Jażdżewska & Brandt, 2018 (Okazaki *et al.*, 2020).

Field surveys of the deep-sea amphipod fauna around Amamioshima Island, Amami Islands, Japan, have produced several previously undescribed species. One of these was described recently as *Rhachotropis reiwa* Okazaki, Ohtsuka & Tomikawa, 2020. In this study, we describe another new species of *Rhachotropis*.

Materials and methods

Collection. The present specimens were collected using a beam trawl (mouth opening 50 cm × 170 cm; mesh 15.5 mm) deployed from the TRV *Toyoshio-Maru* (Hiroshima University). The specimens were preserved in 99% ethanol on-board ship. For DNA extraction, muscle tissue was removed from the dorsal side of the pleon of the holotype.

Morphological examination. Appendages were dissected in 70% ethanol and mounted in gum-chloral medium on glass slides under a stereomicroscope (Olympus SZX7). The specimen was examined using a light microscope (Nikon Eclipse Ni) and illustrated with the aid of a camera lucida. Bodies were dehydrated through a graded ethanol series, and dried using hexamethyldisilazane (HMDS) (Nation, 1983). They were then sputter-coated with gold and observed using scanning electron microscopy (SEM, JSM-6510LV). The body length from the tip of the rostrum to the base of the telson was measured along the dorsal curvature to the nearest 0.1 mm. The specimens are deposited in the Tsukuba Collection Center of the National Museum of Nature and Science, Tokyo (NSMT).

Keywords: Amami Islands, Japan, Northwest Pacific Ocean, *Rhachotropis lowryi*, new species, taxonomy
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DNA sequencing. The extraction of genomic DNA from pleon muscle followed Tomikawa *et al*. (2014). The cytochrome *c* oxidase subunit I (COI) gene [LCO1490 and HCO2198 (Folmer *et al*., 1994)] primer set was used for PCR and cycle sequencing (CS) reactions. PCR reactions and DNA sequencing were performed following Tomikawa *et al*. (2016). DNA sequences have been deposited with the International Nucleotide Sequence Database Collaboration (INSDC) through the DNA Data Bank of Japan (DDBJ).

Taxonomy

Eusiridae Stebbing, 1888

Rhachotropis Smith, 1883

Type species. *Rhachotropis aculeata* (Lepechin, 1780).

Rhachotropis lowryi sp. nov.

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[New Japanese name: Amami-ryūgū-yokoebi]

Figs 1–5

Holotype: NSMT-Cr 30790, ovigerous female (6.4 mm, G1746), off Amamioshima Island, Kagoshima, Japan, 27.9675°N, 129.4005°E, 402 m depth, coll. K. Tomikawa, 26 May 2008. **Paratypes**: NSMT-Cr 30791, female (5.6 mm); NSMT-Cr 30792 female (5.5 mm); NSMT-Cr 30793, female (4.8 mm); NSMT-Cr 30794, 2 females (4.6 mm, 5.9 mm); data as for holotype.

Diagnosis. Head with developed rostrum; eyes large. Pereonites 1–7 dorsally smooth, weakly rugose. Pleonites 1–3 each with middorsal and dorsolateral teeth, those of pleonite 3 minute. Epimeral plate 3 with strongly serrate posterior margin. Pereopods 5–7 with posteriorly produced basis. Telson cleft for 44%.

Description of holotype. Head (Fig. 1A, C, D) dorsally smooth; rostrum longer than half of head, pointed; eyes large, ovate; lateral cephalic lobe weakly produced, anterodistal corner squarish; antennal sinus absent. Pereonites 1–7 (Fig. 1A) dorsally smooth, weakly rugose. Pleonites 1–3 (Fig. 1A, B, E) each with middorsal and dorsolateral teeth, those of pleonite 3 minute. Epimeral plates 1–3 (Figs 1B, 2A–C) with posterodistal corner rounded, posterior margin of epimeral plate 3 strongly serrate. Dorsal margin of urosomites smooth (Fig. 1A, E).

Antenna 1 (Fig. 2D) with peduncular articles 1–3 1.0: 0.7: 0.2 in length ratio; peduncular article 1 with long setae on posterior margin; peduncular article 2 with calceoli (Fig. 1F) on anterior margin; primary flagellum with 9 articles, bearing calceoli; accessory flagellum not seen. Antenna 2 (Fig. 2E): peduncular articles 4 with calceoli on anterior margin, posterior margin with long setae; peduncular article 5 slightly shorter than article 4, with calceoli on anterior margin, posterior margin with a few short setae; flagellum 12-articulate with calceoli.

Upper lip (Fig. 2F) with ventral margin weakly convex, with setae. Mandible (Fig. 2G, H) incisor with distal tooth, left lacinia mobilis (Fig. 2G) wide, 6-dentate, right (Fig. 2H) narrow with minute teeth; accessory setal row with blade setae, molar process weakly triturative, edges lined with short blades; palp 3-articulate, length ratio of articles 1–3 1.0:2.3:2.3, article 1 with minute setae, article 2 with 15 setae, anterior margin of article 3 lined with setae. Lower lip (Fig. 2I) with broad outer lobes, setulose; inner lobes distinct, fused medially. Maxilla 1 (Fig. 2J) with narrow inner plate, bearing 2 plumose setae apically; outer plate subrectangular with 9 serrate robust setae; palp 2-articulate, article 1 subrectangular with 2 setae; article 2 with 7 apical and 2 inner marginal robust setae, and subapical slender setae. Maxilla 2 (Fig. 2K) with broad inner plate; outer plate slightly longer than inner plate, bearing long setae on apical margin. Maxilliped (Fig. 2M) with ovate inner plate, short, not reaching half-length of palp article 1; outer plate exceeding distal part of palp article 1, medial margin almost straight, lined with setae; palp 4-articulate.

Gnathopod 1 (Fig. 3A), coxa strongly produced anteriorly, with short setae; basis weakly curved, anterior and posterior margins with short setae, anterodistal corner with long setae; carpus lobate posteriorly with setae; propodus oval, width 0.5 times length, anterior submargin with short setae, palmar margin convex, setose; dactylus long, slender, reaching end of palm. Gnathopod 2 (Fig. 3B), coxa subrectangular, bearing short setae; basis curved, anterior and posterior margins with short setae, anterodistal and posterodistal corners with long setae; carpus lobate posteriorly with setae; propodus oval, width 0.5 times length, anterior margin without setae, palmar margin convex, setose; dactylus long, slender, reaching end of palm.

Pereopod 3 (Fig. 3C), coxa subrectangular; basis long, straight, anterior and posterior margins with short setae and a few long setae; length ratio of merus, carpus, propodus, and dactylus 1.0:1.6:1.7:1.3; dactylus slender, slightly curved, with short setae. Pereopod 4 (Fig. 3D), coxa with shallow posterior concavity; posterior margins of basis with long setae; merus and carpus with long setae on posterior margins; length ratio of merus, carpus, propodus, and dactylus 1.0:1.5:1.4:1.4. Pereopod 5 (Fig. 3E), coxa bilobate, anterior and posterior lobes equal in size; basis produced posteriorly; anterior margin of merus with long setae; length ratio of merus, carpus, propodus, and dactylus 1.0:1.0:1.9:1.0. Pereopod 6 (Fig. 4A) with coxa bilobate, posterior lobe larger than anterior one; basis strongly expanded posteriorly, posterodistal margin with long setae; anterior margin of merus with long setae; length ratio of merus, carpus, and propodus and dactylus 1.0:1.0:1.9:0.9. Pereopod 7 (Fig. 4B), coxa rounded; basis broad, strongly expanded posteriorly with short setae.

Coxal gills (Figs 3C–E, 4A) large, broad, present on gnathopod 2 to pereopod 7.

Pleopods 1–3 (Fig. 4C–E), peduncle broad, inner distal corner with paired retinacula (Fig. 4F).

Uropod 1 (Fig. 5A) peduncle long, length 3.8 times width, with robust setae on medial and lateral margins; inner ramus 1.1 times length peduncle, with 3 robust setae on medial margin; outer ramus 0.9 times length of inner ramus, lateral margin with 5 robust setae. Uropod 2 (Fig. 5B), peduncle length 2.5 times width, with robust setae on medial and lateral distal corners; inner ramus 1.9 times length of peduncle, with 7 and 3 robust setae on medial and lateral margins, respectively; outer ramus 0.8 times length of inner ramus, with 7 robust setae on lateral margin. Uropod 3 (Fig. 5C), peduncle short, length 1.6 times width, with

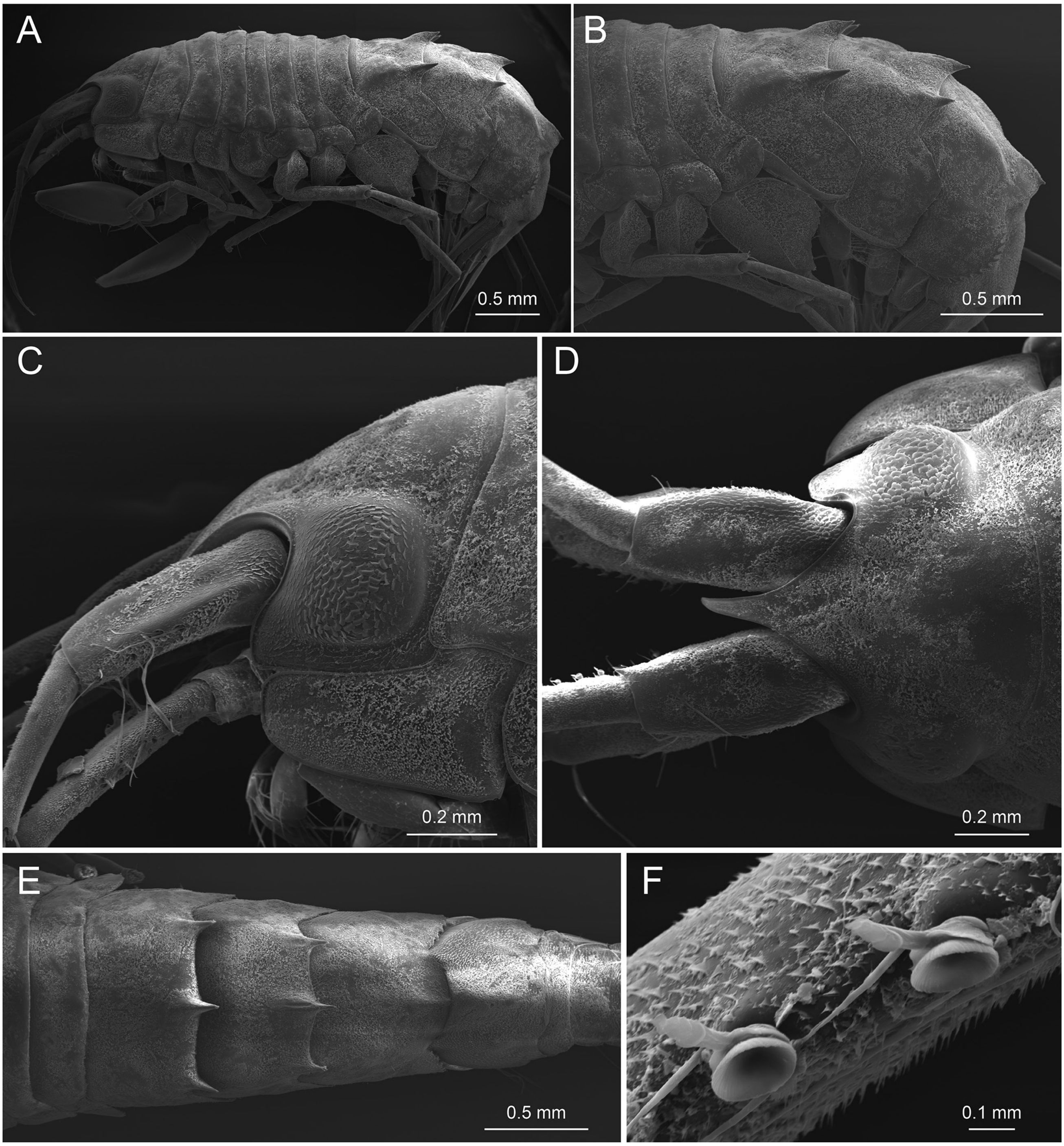

Figure 1. SEM photographs of *Rhachotropis lowryi* sp. nov.: (*A–C, F*) paratype female, 5.6 mm, NSMT-Cr 30791; (*D*, *E*) paratype female, 4.8 mm, NSMT-Cr 30793. (*A*) habitus, lateral view; (*B*) posterior part of body, lateral view; (*C*) head, lateral view; (*D*) head, dorsal view; (*E*) posterior part of body, dorsal view; (*F*) calceoli on antenna 1.

slender setae on medial margin; inner ramus, length 2.4 times peduncle, medial and lateral margins with 4 and 2 robust setae, respectively; outer ramus almost as long as inner ramus, lateral margin with 5 robust setae. Telson (Fig. 5D) length 1.9 times width, cleft for 44%, with lateral plumose setae on basal part.

11 eggs.

Nucleotide sequence. One 658 bp COI sequence of holotype was determined (GenBank accession number LC727553). Among available data in the INSDC database, the sequence of *R. lowryi* sp. nov. and that of *R. reiwa* Okazaki, Ohtsuka & Tomikawa, 2020 have the highest similarity (23.8% uncorrected *p*-distance).

Distribution. Known only from the type locality.

Etymology. Named after Dr James K. Lowry.

Remarks. *Rhachotropis lowryi* sp. nov. differs from its congeners by the combination of the following features: 1) urosomite 1 without dorsal process; 2) pereopod 5 basis with produced posterior margin; 3) uropod 3 with peduncle shorter than 0.5 times the outer ramus; 4) uropod 3 with inner and outer rami of the same length; and 5) telson cleft

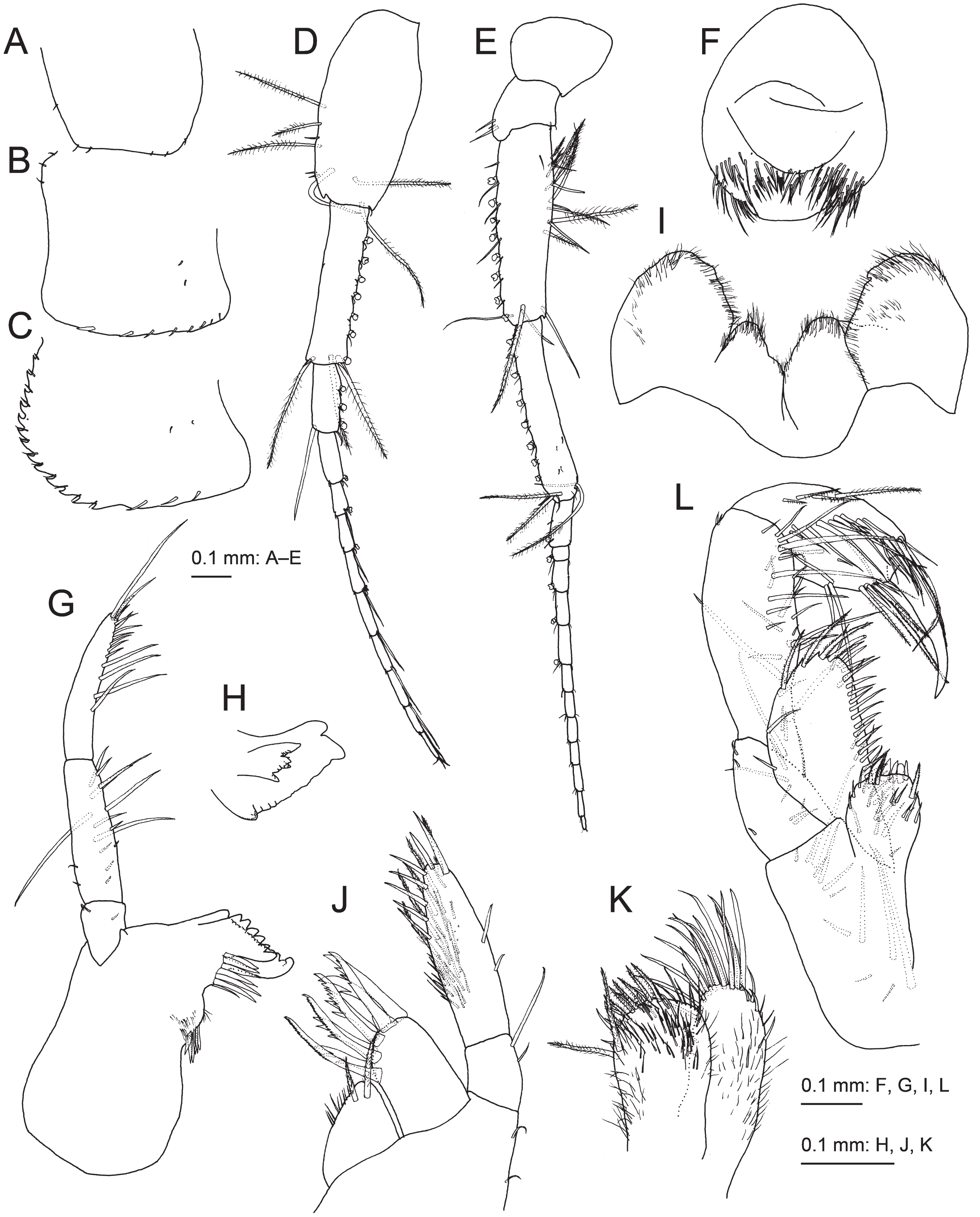

Figure 2. *Rhachotropis lowryi* sp. nov., holotype female, 6.4 mm, NSMT-Cr 30790: (*A–C*) epimeral plates 1–3, lateral view; (*D*) antenna 1, medial view; (*E*) antenna 2, medial view; (*F*) upper lip, anterior view; (*G*) left mandible, medial view; (*H*) incisor and lacinia mobilis of right mandible, medial view; (*I*) lower lip, anterior view; (*J*) maxilla 1, anterior view; (*K*) maxilla 2, anterior view; (*L*) maxilliped, anterior view.

for 44% of its length. The new species is similar to *R. reiwa* Okazaki, Ohtsuka & Tomikawa, 2020, described from off Amamioshima Island, in having pereopods 5 and 6 with a posteriorly produced basis and relatively deeply incised telson (more than 38% of telson length). However, *R. lowryi* sp. nov. is distinguished from *R. reiwa* by the following features (features of *R. reiwa* in parentheses): (1) pereonite 7 dorsally smooth (bearing middorsal tooth); (2) epimeral plate

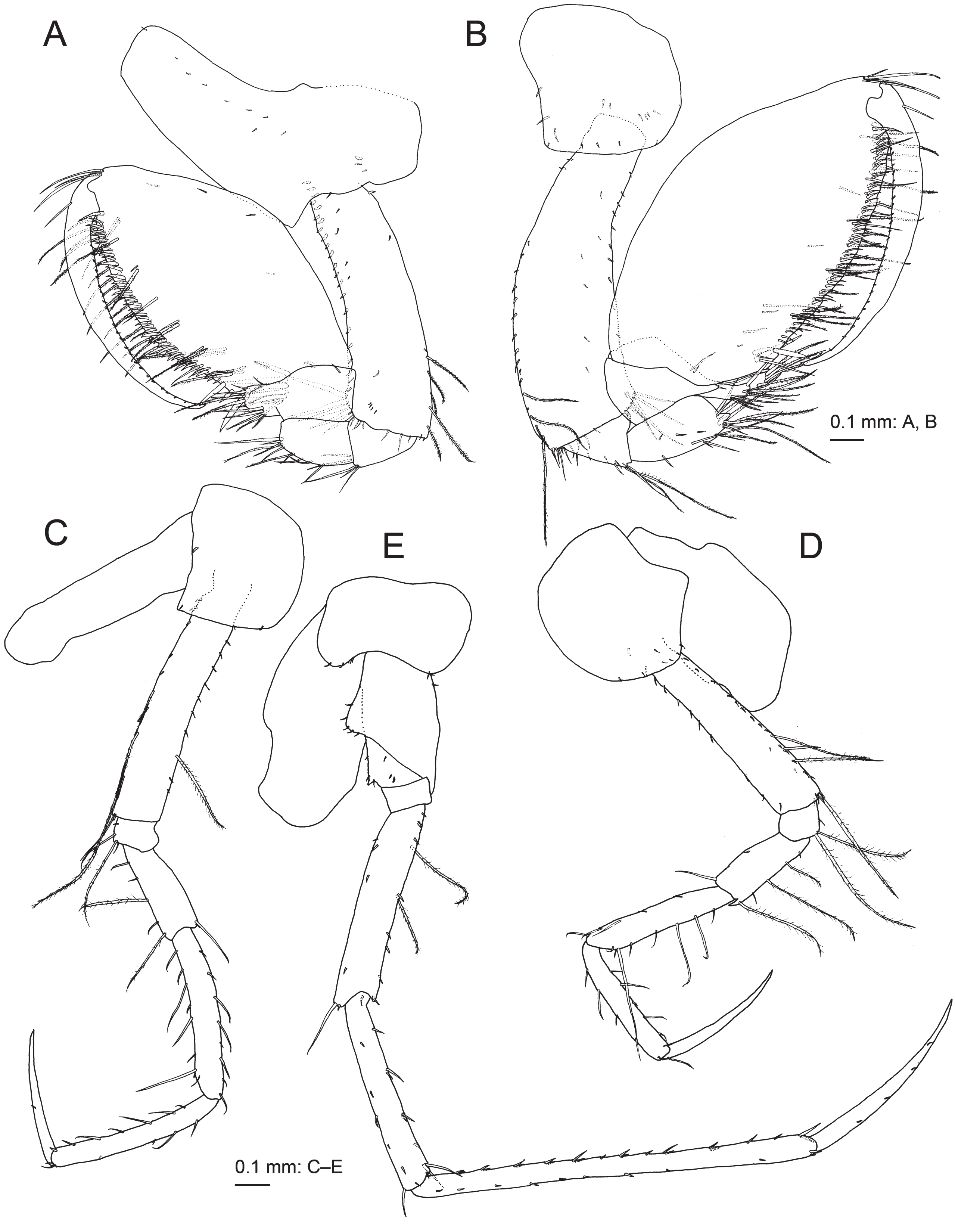

Figure 3. *Rhachotropis lowryi* sp. nov., holotype female, 6.4 mm, NSMT-Cr 30790: (*A*) gnathopod 1, lateral view; (*B*) gnathopod 2, lateral view; (*C–E*) pereopods 3–5, lateral view.

3 with strongly serrate posterior margin (weakly serrate); (3) pereopod 7 with basis strongly produced posteriorly (rounded but not produced); and (4) uropod 3 with inner and outer ramus of the same length (outer ramus slightly shorter than inner). Although this new species and *R. reiwa* occur in the same geographic area, the two species are highly differentiated genetically (23.8% uncorrected *p*-distance), indicating that they are clearly distinct species. *Rhachotropis*

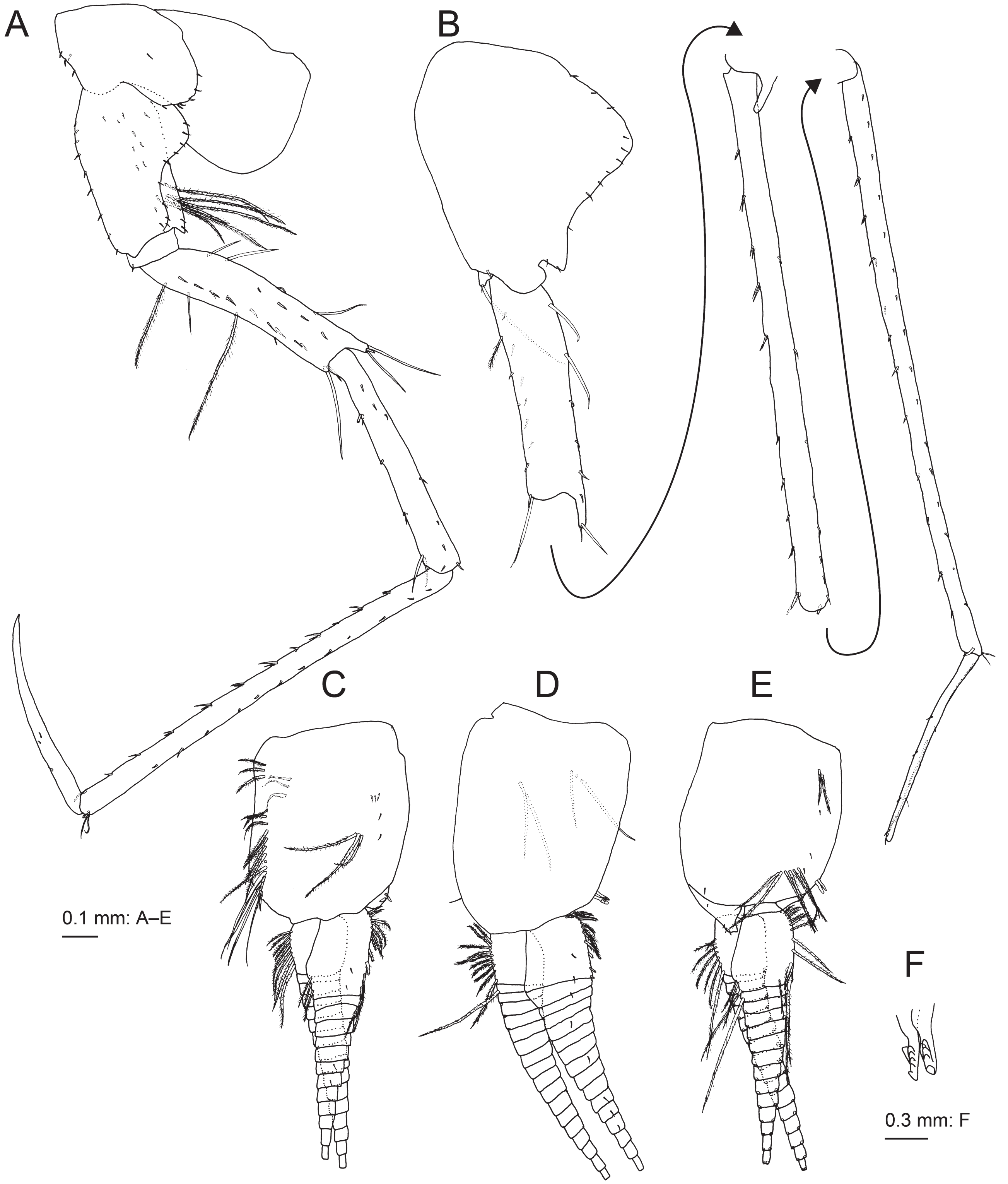

Figure 4. *Rhachotropis lowryi* sp. nov., holotype female, 6.4 mm, NSMT-Cr 30790: (*A*) pereopod 6, lateral view; (*B*) pereopod 7 (coxa broken), lateral view; (*C–E*) pleopods 1–3, posterior views; (I) retinacula of pleopod 2, posterior view.

lowryi sp. nov. shares the features of a prominent posterior margin of the basis of pereopod 5 with the following five species: *R. aculeata* (Lepechin, 1780), *R. gubilata* J. L. Barnard, 1964, *R. oweni* Lörz, 2015, *R. palporum* Stebbing, 1908, and *R. reiwa*. A comparison of features with these five species is shown in Table 1.

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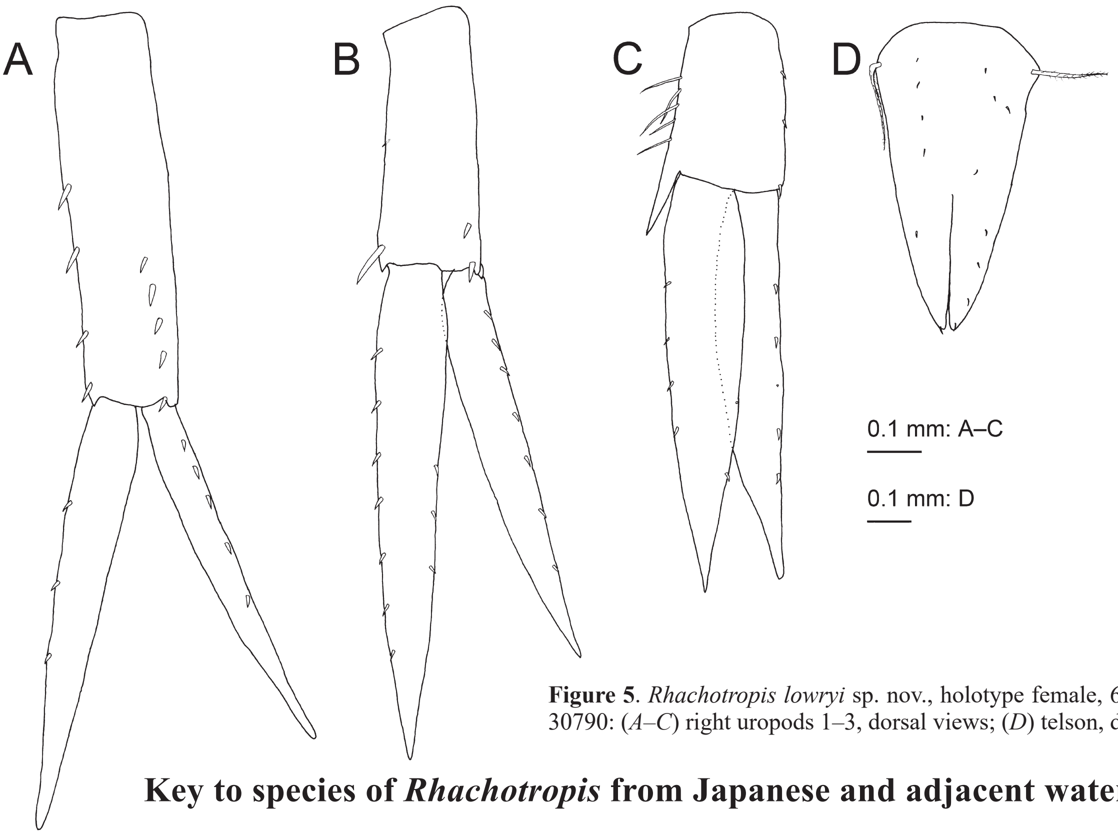

Figure 5. *Rhachotropis lowryi* sp. nov., holotype female, 6.4 mm, NSMT-Cr 30790: (*A–C*) right uropods 1–3, dorsal views; (*D*) telson, dorsal view.

Key to species of *Rhachotropis* from Japanese and adjacent waters

1	Head with dorsal protrusion	2
——	Head dorsally smooth	3
2	Pereopods 5 and 6 basis produced posteriorly	*R. aculeata*
——	Pereopods 5 and 6 basis not produced posteriorly	*R. marinae*
3	Pereonite 7 with middorsal tooth	4
——	Pereonite 7 dorsally smooth	6
4	Pleonite 3 and urosomite 1 with middorsal tooth	*R. macropus*
——	Pleonite 3 and urosomite 1 without middorsal tooth	5
5	Pereopod 5 basis not produced posteriorly. Pereopod 6 basis oval	*R. oculata*
——	Pereopod 5 basis strongly produced posteriorly. Pereopod 6 basis triangular	*R. reiwa*
6	Urosomite 1 with dorsal tooth	7
——	Urosomite 1 dorsally smooth	8
7	Pereonites dorsally smooth. Telson cleft for 5% of its length	*R. distincta*
——	Pereonites with dorsal protrusion. Telson cleft for 10% of its length	*R. saskia*
8	Eyes small, not pigmented. Telson elongate, length 3.8 times width	*R. natator*
——	Eyes large, pigmented. Telson not elongate, length shorter than 2 times width	9
9	Pereopods 5–7 basis produced posteriorly	*R. lowryi* sp. nov.
——	Pereopods 5–7 basis not produced posteriorly	*R. inflata*

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Table 1. Morphological comparison among species of *Rhachotropis* [*R. aculeata* (Lepechin, 1780); *R. gubilata* J. L. Barnard, 1964; *R. oweni* Lörz, 2015; *R. palporum* Stebbing, 1908; and *R. reiwa* Okazaki, Ohtsuka & Tomikawa, 2020] with pereopod 5 basis produced posteriorly. Note that pereopod 5 has not been described in some species.

	eyes	pereonite 7 dorsal and dorsolateral processes	pereonite 7 lateral process	epimeral plate 3 posterior margin	urosomite 1 dorsal process	coxa 1	pereopod 7 basis posterior margin	uropod 3 rami	telson
R. lowryi sp. nov.	large	absent	absent	strongly serrate	absent	produced anteriorly with rounded tip	produced with rounded margin	same length	cleft for 44%
R. aculeata	large	present	present	serrate	present	produced anteriorly with acute tip	produced with rounded margin	outer ramus shorter than inner	cleft for 30%
R. gubilata	small	absent	present	?	absent	produced anteriorly with acute tip	produced with acute tip	outer ramus slightly shorter than inner	slightly cleft
R. oweni	small	absent	absent	not serrate	absent	not produced anteriorly	extremely produced with rounded tip	outer ramus slightly shorter than inner	cleft for 10%
R. palporum	absent	absent	present	not serrate	present	produced anteriorly with acute tip	extremely produced with acute tip	same length	cleft for 14%
R. reiwa	large	present	absent	weakly serrate	absent	produced anteriorly with rounded tip	not produced	outer ramus slightly shorter than inner	cleft for 38%

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A Pulsing-Mirror Eye in a Deep-Sea Ostracod

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ABSTRACT. In the deep sea, it is unknown how eyes that use concave mirrors to focus can distinguish between the small bioluminescent lights of their prey and those larger lights of more distant predators. Beyond 1000 m depth, where sunlight is no longer perceptable, the deep sea contains a continuous field of (mostly) blue, bioluminescent lights. Here, some predators, such as the ostracods of the genus *Gigantocypris*, famed for their gooseberry-like appearance, are attracted to their prey through the prey's bioluminescence. The enigmatic eyes of *Gigantocypris* spp. focus light using large, parabolic mirrors. Here, I show that the mirrors flex, pulsing continuously, so causing large, distant light sources to pass in and out of focus while small, nearby light sources remain in focus with each pulse cycle. This distinguishes predators from prey and constitutes a new type of eye.

Introduction

Species of the "giant" myodocopid ostracod (Crustacea) genus *Gigantocypris* Müller, 1895, are pelagic crustaceans with shrimp-like bodies enclosed within spherical, bivalved "shells", 10 to 32 mm in diameter, and are emblematic of the deep sea. They live between about 600 and 2,300 m depth world-wide and use a pair of oar-like antennae to swim and hunt small, bioluminescent, pelagic animals such as copepods and small fish (Land, 1984; Land & Nilsson, 2002). Species of *Gigantocypris* are characterized by a pair of large (naupliar) eyes, which, rather than using convex lenses to focus light onto a retina, use concave, parabolic mirrors about 3 mm wide, appearing like car headlights (Land, 1984). These are considered the parabolic reflecting eye type, one of the 10 fundamentally different types of eye (Land & Fernald, 1992).

Each retina of *Gigantocypris* sp. is not a flat sheet, as is usual for an eye, but condensed into a light-bulb shape (Land & Nilsson, 2002). The curvature of each mirror in the horizontal and vertical planes is different, which means that the image of a point source will be astigmatic: a line at right angles to the mirror (Land & Nilsson, 2002). The retina is also elongated in this direction (about 750 microns long), and "so may have some capacity to resolve these linear images" (Land & Nilsson, 2002). At a depth of 1000 m there is no remaining sunlight (Denton, 1990; Herring, 2002), so the function of these eyes has been assumed to assist predation by tracking down the bioluminescent organisms, which are common at such depths (Land & Nilsson, 2002). However, our current understanding (Land & Nilsson, 2002) cannot account for this required function.

In a deep field of bioluminescence produced by very different animals from large fish to tiny planktonic shrimps, a predator such as *Gigantocypris* sp. must distinguish between the light of a large predator at distance and a small prey animal nearby. Although the former light emerges from a larger and brighter source (photophore), if the small prey animal is closer to an observer's eye, both lights may appear equal. Indeed, small prey that are conspicuous may be afforded protection through "mimicry" as a result of this phenomenon. A discovery made from examining *living* specimens of an unidentified species of *Gigantocypris* revealed another, critical character of the *Gigantocypris* eye that enables it to distinguish its prey.

Keywords: eye function, new type of eye, predation, bioluminescent light, concave mirrors, Crustacea, Ostracoda
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Figure 1. *Gigantocypris dracontovalis* Cannon, 1940, whole animal, lateral view; muscles (yellow) behind parabolic mirrors of left eye evident (dorsal left-centre).

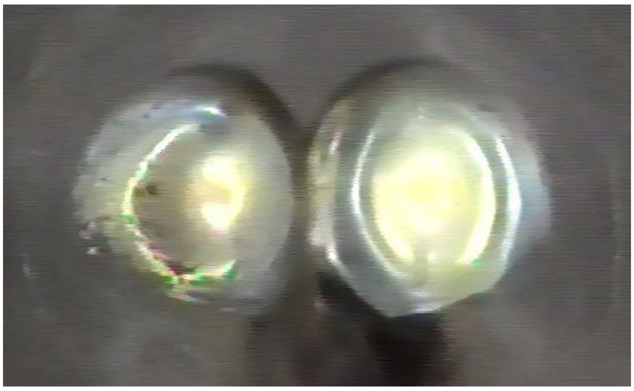

Figure 2. Frame from a magnified video recording of a resting *Gigantocypris* sp. showing paired eyes only, anterior view. The mirrors appear silver; the layer of black, absorbing pigment beneath is not visible. A white-yellow light is back-reflected.

Living *Gigantocypris* observed

Studies of the eye of *Gigantocypris* to date have considered only preserved specimens, and their optical apparatus. However, an examination of a whole, preserved animal led to the discovery of four large muscles behind each eye, attached to the near-lateral edges of the reflector, i.e., behind the parabolic part (Fig. 1). These muscles provided evidence that the mirrors move, prompting an examination of living specimens.

In 1999, living specimens of *Gigantocypris* sp. were collected by a mid-water trawl off the Cape Verde Islands during RRS *Discovery* Cruise 243. Video recordings were made of several specimens free-swimming in a kreisel tank, including close-ups showing detail of their large eyes. In these recordings, from anterior and dorsal views, the parabolic mirrors of the eyes were observed to flex and pulse. In a resting specimen (Fig. 2), the eyes could be magnified and observed in detail: the parabolic parts of the mirrors were measured to flex back to a maximum position as shown in Fig. 3B and pulse regularly at a rate of 0.5 cycles per second (n = 28 cycles). The spherical part of the mirrors, in the dorso-ventral (“vertical”) plane, was not observed to move.

Ray tracing calculations revealed that when the luminous object is far, the oscillations of the parabolic reflector cause the object to go in and out of focus at the retina, as the reflector is relaxed then “flattened” (Fig. 3A, B). However, when the luminous object is nearby, the oscillations of the parabolic reflector cause little change to the image focused on the retina (Fig. 3C, D). This principle was confirmed using a model flexible, parabolic mirror and a laser. Therefore, during a pulse cycle of the retina, a light source nearby will remain detected by the ostracod (appearing always “on”), whereas a light source far away will appear to turn on and off twice per second. The latter light will appear to flicker; a flickering light is more conspicuous than a steady light (Haamedi & Djamgoz, 1996) and hence a distant predator will appear particularly perceptible. In conclusion, *Gigantocypris* sp. can distinguish its prey within a field of bioluminescent light sources, while probably requiring less information processing than for rigid lens type eyes.

Such a “pulsing mirror eye” functions in a radically different way to any other eye. Since this eye type is not evident from preserved specimens, other species with parabolic reflecting eyes, such as the deep-sea amphipod *Scypholanceola* (from a similar environment), should be re-assessed while alive. On another note, the transparent window in the carapace of *Macrocypridina castanea* (Parker *et al.*, 2019; 2021), was found to have applications in commerce. In a similar manner, examination of the submicron structure of the *Gigantocypris* mirror, particularly how it withstands continuous flexing to maintain a flawless mirror, may be relevant to the mirror of the Hubble telescope—a comparable imaging system whose mirror does develop flaws over time.

Acknowledgements. I thank Martin Angel for providing Fig. 1, Michael Land and Justin Marshall for providing the film taken of *Gigantocypris* on a RRS Discovery cruise and for Fig. 2, the BBC Natural History Unit for providing film taken of a *Gigantocypris in situ* on a RRS *Discovery* cruise for the “Blue Planet” program, and Julian Partridge for providing details of the RRS *Discovery* cruises and permission to use his data. I am particular grateful to Jim Lowry for introducing me to ostracods and for his role as supervisor of my PhD and postdoctoral research projects. Jim proved inspirational in my career that followed.

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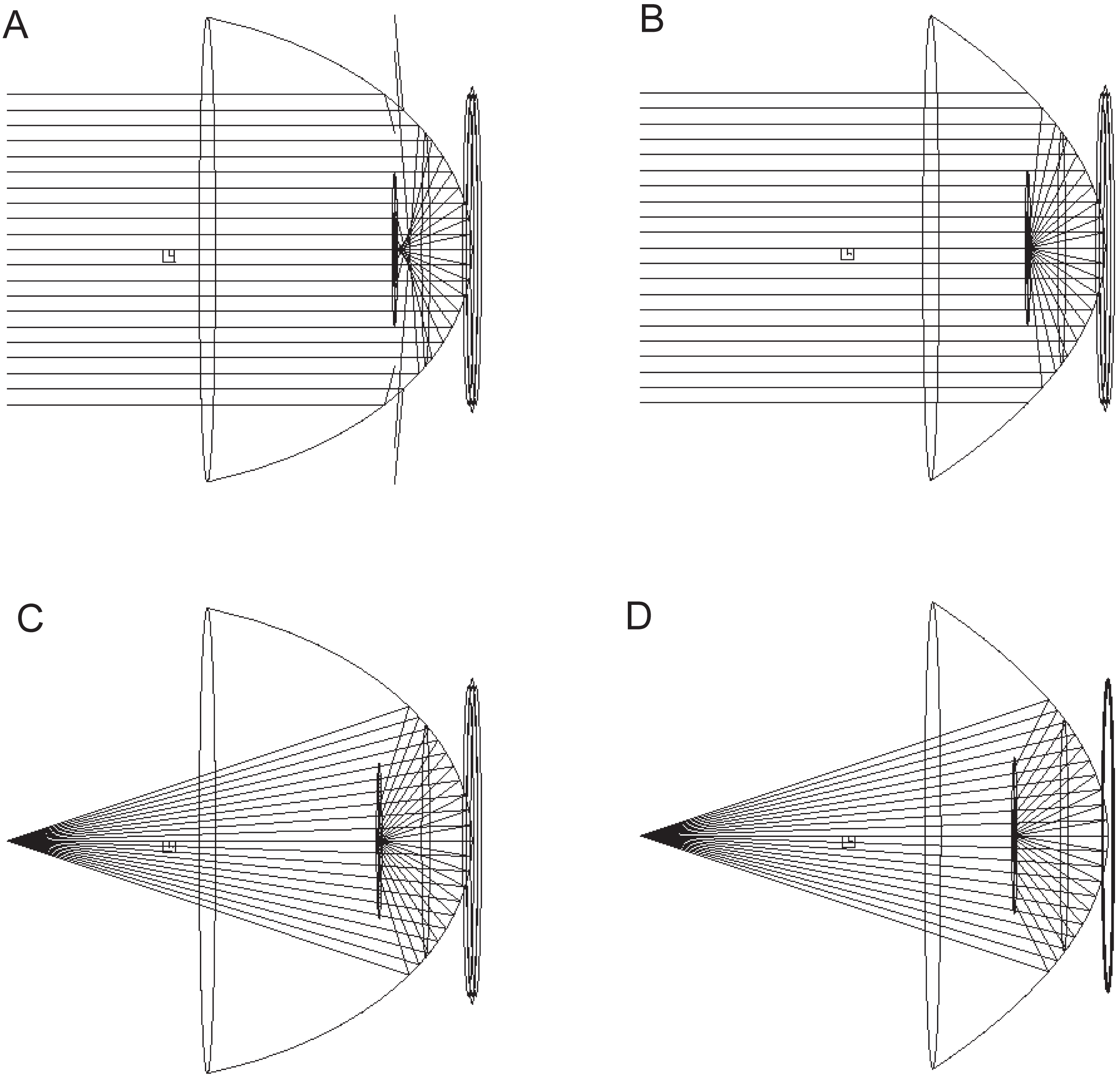

Figure 3. Ray tracing of light imaged on the *Gigantocypris* sp. retina: (*A–B*) when the luminous object is distant, the oscillations of the parabolic reflector cause the object to go in and out of focus at the retina, as the reflector is relaxed and then "flattened"; (*C–D*) when the luminous object is nearby, the oscillations of the parabolic reflector cause little change to the image focused on the retina.

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New Australian Species of Ampeliscidae (Crustacea: Amphipoda) from the Great Barrier Reef and Eastern Australia with a Key to Australian Species

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ABSTRACT. Six new species of Ampeliscidae are described: *Ampelisca capella* sp. nov., *Ampelisca mingela* sp. nov., *Byblis pialba* sp. nov. and *Byblis wadara* sp. nov. from the Great Barrier Reef; *Ampelisca katoomba* sp. nov. from the New South Wales shelf; and *Byblis liena* sp. nov. from the Queensland slope. *Byblisoides esferis* J. L. Barnard, 1961 is recorded from southeastern Australia, the first record of the genus in Australia. These bring the number of eastern Australian species to twenty-six. Distributions of three other species are extended northwards into Queensland. A key to all eastern Australian species is provided.

Introduction

Ampeliscid amphipods occur worldwide on soft sedimentary environments from intertidal to abyssal depths and can be abundant. Forty years ago, Jim Lowry and I agreed to collaborate on papers on the taxonomy of Amphipoda. We chose as a starting point, Ampeliscidae, for the simple reasons that the family was first in an alphabetical list of families, that we were both aware of several undescribed species found in benthic surveys in Victoria and New South Wales, and that Jerry Barnard who was active in Australia then, had no immediate interest in the family. We published one paper on 12 species of *Ampelisca* Krøyer, 1842, five species of *Byblis* Boeck, 1871 and one of *Haploops* Liljeborg, 1856, all from southeastern Australia but did not complete descriptions of others that we recognized and named at the time (Lowry & Poore, 1985). Jim and I also collaborated on the first ingolfiellid amphipods from Australia (Lowry & Poore, 1989). Here, we complete the figures of six new species that we recognized in the 1980s, mostly from tropical Australia, and extend the geographical range of others. The opportunity is taken to record *Byblisoides esferis* J. L. Barnard, 1961 from deep water in southeastern Australia. Australian ampeliscid species now number 26 but the fauna of Western Australia has not been studied.

I am pleased to complete our study of ampeliscid amphipods and to dedicate this contribution to the memory of Jim Lowry.

Materials and methods

The collections of new species come from sediment samples taken at One Tree Island, Clack Island, Lizard Island and Heron Island, Great Barrier Reef islands in Queensland, and from benthic surveys off New South Wales and Queensland made by the Australian Museum in the late 1970s from FRV *Kapala*. Collections of already described species derive from a series of grab samples taken along the Qld coast from the Queensland Department of Primary Industries' FRV *Gwendoline May* in February and March 1998 by GCBP

Keywords: Crustacea, Amphipoda, Ampeliscidae, Ampelisca, *Byblis*, *Byblisoides*, taxonomy, new species
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and Joanne Taylor as part of Museums Victoria's Australian Shelf Benthos (ASB) program.

The camera-lucida pencil drawings (Figs 1–5 and part of Fig. 8) that were made by Jim were inked in the traditional way on plastic film in the early 1980s by Roger Springthorpe; Figs 7 and 9 and part of Fig. 8 were "digitally inked" in Adobe Illustrator® using the methods described by Coleman (2003) from pencil drawings newly made by GCBP. Descriptions were modelled on our earlier study and more recent work (King, 2009; Myers, 2012). They were prepared by augmenting an unpublished DELTA database (Dallwitz, 2018) of Australian Ampeliscidae prepared by J. K. Lowry, P. B. Berents and R. T. Springthorpe. Material is lodged at the Australian Museum, Sydney (AM) and Museums Victoria, Melbourne (NMV). As before, "New specific epithets are Australian Aboriginal place names chosen only for their euphony, and are treated as arbitrary combinations of letters" (Lowry & Poore, 1985). Abbreviations used in figures are: A1, A2, antennae 1, 2; C1–C3, coxae 1–3; Ep1–Ep3, pleonal epimera 1–3; G1, G2, gnathopods 1, 2; Md, mandible; P3–P7, pereopods 3–7; T, telson; U1–U3, uropods 1–3; Ur, urosomite. Total length (tl.) is measured along the dorsal margin.

Taxonomy

Family Ampeliscidae Krøyer, 1842

Key to species of Ampeliscidae from eastern Australia

1 Head as long as deep. Lobe on pereopod 7 basis not expanded distally, with posterior margin nearly vertical .... *Haploops*
(One species, *H. oonah* Lowry & Poore, 1985)

—— Head longer than deep. Lobe on pereopod 7 basis expanded distally, with posterior margin oblique 2

2 Flagella of antennae 1 and 2 poorly developed, with 2–4 articles. Anterolateral corner of head produced .... *Byblisoides esferis* J. L. Barnard, 1961

—— Flagellum of antenna 2, and usually flagellum of antenna 1, with more than 10 articles. Anterolateral corner of head not produced 3

3 Pereopod 7, free anterior margin of basis lacking setae near junction with ischium; dactylus broad at base, not spine-like .... *Ampelisca* 4

—— Pereopod 7, free anterior margin of basis setose near junction with ischium; dactylus spine-like .... *Byblis* 20

4 With 1 pair of eyes and cuticular lenses .... *A. capella* sp. nov.

—— With 2 pairs of eyes and cuticular lenses, or eyes absent 5

5 Uropod 3 outer ramus ovate. Telson with robust setae along cleft and terminally .... *A. bidura* Lowry & Poore, 1985

—— Uropod 3 rami lanceolate. Telson with slender setae on dorsal ridges on each lobe 6

6 Antenna 1 much longer than antenna 2 peduncle. Pereopod 7 basis overlapping merus 7

—— Antenna 1 shorter than, subequal to, or little longer than antenna 2 peduncle. Pereopod 7 basis not overlapping merus 10

7 Pereopod 7 ischium longer than merus. Uropod 2 outer ramus without subterminal spine. Coxae 1–3 without posteroventral teeth. Mandibular palp article 2 inflated .... *A. euroa* Lowry & Poore, 1985

—— Pereopod 7 ischium shorter than or equal to merus. Uropod 2 outer ramus with subterminal spine. Coxae 1–3 with posteroventral teeth. Mandibular palp article 2 linear 8

8 Eyes and cuticular lenses absent. Uropod 2 rami each with 1 upper spine row. Pereopod 7 basis without setae along distal margin .... *A. narooma* Lowry & Poore, 1985

—— Two pairs of eyes and cuticular lenses present. Uropod 2 rami each with 2 upper spine rows. Pereopod 7 basis with dense setal row along distal margin 9

9 Antennae 1 and 2 subequal in length. Epimeron 3 with square posteroventral corner .... *A. calooma* Lowry & Poore, 1985

—— Antenna 1 shorter than antenna 2. Epimeron 3 with strongly projecting tooth .... *A. jingera* Lowry & Poore, 1985

10 Pereopod 7 propodus linear, more than twice as long as broad 11

—— Pereopod 7 propodus inflated, rarely more than 1.5 times as long as broad 12

11 Urosomites 2–3 with prominent dorsal keel. Antenna 1 peduncular article 2 more than twice as long as article 1. Epimeron 3 without posteroventral tooth .... *A. acinaces* Stebbing, 1888

—— Urosomites 2–3 without dorsal keel. Antenna 1 peduncular articles 1 and 2 subequal. Epimeron 3 with posteroventral tooth .... *A. ballina* Lowry & Poore, 1985

12 Urosomite 1 with saddle-shaped dorsal keel. Pereopod 7 basis, anterodistal corner of lobe obscuring distal margin of ischium ... *A. toora* Lowry & Poore, 1985

—— Urosomite 1 with simple or upturned dorsal keel. Pereopod 7 basis, anterodistal corner of lobe not obscuring distal margin of ischium 13

13 Uropod 2 inner ramus with 2 upper rows of short spines 14

—— Uropod 2 inner ramus with 1 upper row of long and short spines 15

14 Pereopod 7 basis distal margin oblique. Urosomite 1 with evenly convex dorsal crest; urosomites 2–3 dorsum concave .... *A. australis* Haswell, 1879

—— Pereopod 7 basis distal margin truncate. Urosomite 1 with asymmetrical triangular dorsal crest; urosomites 2–3 with prominent bilobed dorsal crest .... *A. katoomba* sp. nov.

15 Urosomite 1 with prominent dorsal keel, obliquely truncate posteriorly. Pereopod 7 basis distal margin transverse, reaching as far as angle on posterior margin of ischium. Antenna 1 reaching to end of antenna 2 article 4 .... *A. dimboola* Lowry & Poore, 1985

—— Urosomite 1 with more or less acutely projecting dorsal keel. Pereopod 7 basis distal margin oblique, reaching beyond angle on posterior margin of article 3. Antenna 1 reaching well along or beyond antenna 2 article 5 16

16 Pereopod 7 basis about as wide as length of anterior margin. Uropod 2 outer ramus with 2 long subterminal spines. Telson 1.5 times as long as wide .... *A. tilpa* Lowry & Poore, 1985

—— Pereopod 7 basis narrower than length of anterior margin. Uropod 2 outer ramus with 1 long subterminal spine. Telson 1.65–1.90 times as long as wide 17

17 Telson with prominent pair of posterior teeth separated from lateral margins by obvious notches. Urosomite 1 with low rounded crest 18

—— Telson with apices not separated from lateral margins by obvious notches. Urosomite 1 with triangular crest 19

18 Epimeron 3 posterior margin concave. Mandibular palp article 2 five times as long as wide. Antenna 1 reaching slightly beyond antenna 2 article 4. Telson twice as long as wide .... *A. dingaal* King, 2009

—— Epimeron 3 posterior margin straight. Mandibular palp article 2 three times as long as wide. Antenna 1 reaching to end of antenna 2 article 5. Telson 1.6 times as long as wide .... *A. mingela* sp. nov.

19 Antenna 1 reaching to midpoint of antenna 2 article 5. Telson tapering from proximal one-third to right-angled apex. Head anterolateral lobe level with rostrum; without accessory eye pigmentation .... *A. yuleba* Lowry & Poore, 1985

—— Antenna 1 reaching beyond antenna 2 article 5. Telson tapering from midpoint to broad apex. Head anterolateral lobe more anterior than rostrum; with dorsal accessory eye pigmentation .... *A. jiigurru* King, 2009

20 Cuticular lenses absent. Gnathopod 1 subchelate, palm slightly oblique. Telson lobes with apical spine .... *B. gerara* Lowry & Poore, 1985

—— With 1 or 2 pairs of eyes and cuticular lenses. Gnathopod 1 simple. Telson lobes without apical spines 21

21 Antennae 1 and 2 subequal in length 22

—— Antenna 1 shorter than antenna 2 23

22 Telson semicircular, wider than long, with 2 pairs of submarginal robust setae. Pereopod 7 basis lobe with oblique truncate distal margin reaching end of merus. With 2 pairs of cuticular lenses .... *B. tinamba* Lowry & Poore, 1985

—— Telson triangular, longer than wide, with 1 pair of posterior robust setae. Pereopod 7 basis lobe with rounded distal margin overlapping carpus. Without cuticular lenses .... *B. liena* sp. nov.

23 Telson posterior margin bilobed. Antenna 1 reaching to midpoint of antenna 2 article 3; flagellum of 2 articles .... *B. wadara* sp. nov.

—— Telson posterior margin truncate or rounded. Antenna 1 reaching to midpoint of antenna 2 article 3; flagellum of at least 6 articles 24

24 Telson with truncate posterior margin. Antenna 2 about as long as body length; article 5 as long as article 4 .... *B. pialba* sp. nov.

—— Telson with rounded posterior margin. Antenna 2 about half as long as body length; article 5 shorter than article 4 25

25 Coxa 1 not reaching anterior margin of head. Telson wider than long .... *B. mildura* Lowry & Poore, 1985

—— Coxa 1 almost reaching anterior margin of head. Telson as wide as long .... *B. bega* Lowry & Poore, 1985

Ampelisca Krøyer, 1842

Type species. *Ampelisca eschrichtii* Krøyer, 1842 (by monotypy).

Remarks. Species of *Ampelisca* are distinguished from other genera in the family by the absence of setae on the anterior margin of the basis and the tapered broadly-based dactylus of pereopod 7. Species number 206 world-wide (Horton *et al*., 2023). Lowry & Poore (1989) added ten new species to the two already known from Australia, largely from extensive collections made by environmental benthic surveys undertaken during the 1970s. Since then, two species have been described from the Great Barrier Reef by King (2009).

Ampelisca capella sp. nov.

urn:lsid:zoobank.org:act:2C53BB0C-D0AC-4E05-A010-05A81202086F

Figs 1, 2

Holotype: AM P.85991 (with 2 microslides), female, tl. = 6.5 mm, Australia, Queensland, Lizard Island, 200 m NW of Palfrey Island, 14°40'S 145°28'E, J. K. Lowry, 16 Oct 1978. **Paratypes**: AM P.105873, 8 individuals collected with holotype; AM P.105875, 26 specimens, NMV J2132, 5 specimens, Australia, Queensland, Lizard Island, 3 m, light traps, D. F. Smith and J. Marshall, Sep 1976; AM P.105874, 16 specimens, Heron Island, bommie west of harbour entrance, 23°26'S 151°55'E, J. K. Lowry, 7 Dec 1978.

Other material examined. AM P.105846, 2 specimens, Australia, Queensland, Clack Island, 14°03'S 144°16'E, 3–7 m; AM P.105820–105833, P.105835, P.105837, P.105838, P.105841–105843, P.105845, P.105847, P.105851, P.105852,

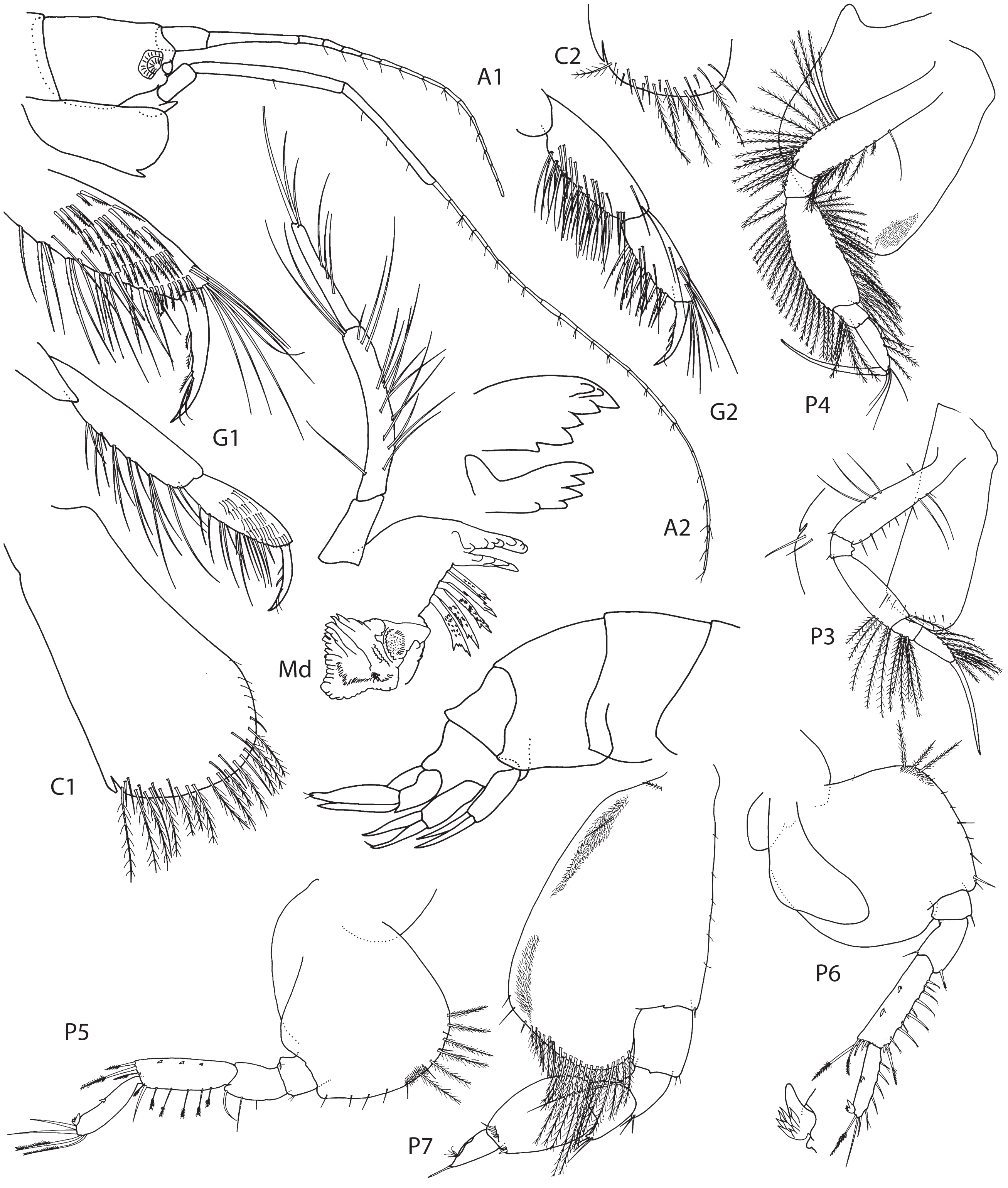

Figure 1. *Ampelisca capella* sp. nov., holotype, female, 6.5 mm, AM P.85991.

41 specimens, Lizard Island, 14°40'S 145°27'E, various localities, 3–18 m; AM P.105834, P.105836, P.105839, P.105840, P.105844, P.105848–105850, 11 specimens, One Tree Island, 23°30'S 152°05'E, various localities, 1–6 m.

Description of holotype. Head. *Head* 1.2 times as long as deep; anteroventral margin oblique-horizontal; eyes present, with one pair of cuticular lenses. *Antenna 1* peduncular article 2 long, about twice length of article 1; flagellum short, slightly longer than peduncle of antenna 2. *Mandible* palp article 2 slender.

Pereon. *Coxae 1–3* with small posteroventral hooks on coxae 1 and 2 (obsolete on coxa 3). *Gnathopod 1* coxa anterior margin slightly concave, anteroventral corner not produced. *Pereopod 3* merus with 1 distal seta on extensor margin, with 4 distal setae on flexor margin; carpus with 6 setae on flexor margin; propodus with 7 setae on extensor margin; dactylus twice as long as propodus. *Pereopod 4*

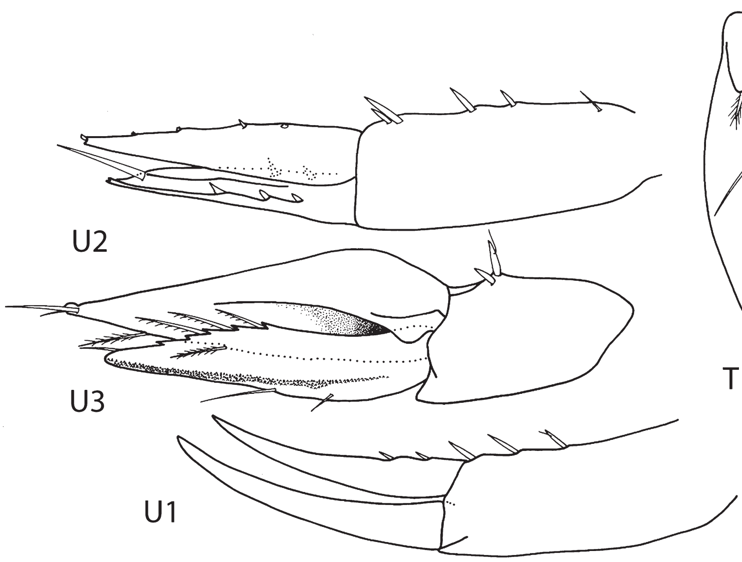

Figure 2. *Ampelisca capella* sp. nov., holotype, female, 6.5 mm, AM P.85991.

coxa about 1.2 times as long as wide; merus 2.5 times as long as wide, with setose margins; dactylus twice as long as propodus. *Pereopod 5* basis anterior margin semicircular, with 6 long, plumose setae; ischium-dactylus 1.3 times as long as basis. *Pereopod 6* basis subcircular, anterior margin with 3 long, plumose setae; ischium-dactylus 1.5 times as long as basis. *Pereopod 7* basis posterodistal margin overlapping ischium, convex, oblique, distal margin densely setose; ischium longer than merus; merus anterior lobe slightly produced along anterior margin of carpus; carpus short (about as long as broad), carpus anterior lobe slightly produced; propodus inflated; dactylus lanceolate.

Pleon. *Epimeron 1* with anteroventral curved seta. *Epimeron 2* posteroventral corner with small tubercle. *Epimeron 3* ventral margin with posterior dorsal inflection, posteroventral corner with broad rounded posteriorly directed tooth under shallow notch. *Urosomite 1* with distally upturned carina. *Urosomites 2–3* dorsal margin concave. *Uropod 1* reaching beyond base of uropod 2 rami. *Uropod 2* inner ramus with upper row of short robust setae; outer ramus with 1 long subterminal robust seta, upper margin with 2 short robust setae, outer margin with 3 short robust setae. *Uropod 3* inner ramus broadly lanceolate, margins without setae; outer ramus 5 times as long as wide, distal upper margin serrate, with 4 plumose setae. *Telson* 1.6 times as long as wide, deeply cleft (75%), lateral margins evenly convex, with sublateral ridge bearing few setae; with pair of posterior small teeth separated from lateral margins by minute notches bearing 2 pairs of subapical setae.

Distribution. Australia, Queensland (Great Barrier Reef), lagoon, to 3 m.

Remarks. *Ampelisca capella* sp. nov. is immediately recognizable in Australia by the possession of only one pair of eyes with cuticular lenses on the anterior margin. Of the eight species described by Lowry & Poore (1985) with antenna 1 about as long as the peduncle of antenna 2, the new species differs from all in the shape of the pereopod 7 basis (narrower than most), shape of the telson (narrow with small apical teeth), and epimeron 3 (with a blunt posteroventral tooth). *Ampelisca capella* sp. nov. is most easily distinguished from the two species described from Lizard Island by King (2009) by the eyes, telson, and pereopod 7.

Ampelisca dimboola Lowry & Poore, 1985

Ampelisca dimboola.—Lowry & Poore, 1985: 271–273, figs 11, 12.—King, 2009: 133–135, fig. 1.

Material examined. NMV J71694–71696, 4 specimens, Australia, Queensland, N side of Noddy Reef, 13.6°S 143.8°E, 42 m (ASB-2 stns); NMV J71697, 1 specimen, N of Green Island, 16.7°S 145.9°E, 52 m (ASB-3 stn); NMV J71698–71793, 34 specimens, N end of Hervey Bay, off Burnett Heads, 24.5°S 152.8°E, 11–49 m (ASB-5 stns); NMV J71714–71731, 65 specimens, 150 km N of North Point, end of Moreton Island, 26.9°S 153.5°E, 36–53 m (ASB-6 stns).

Distribution. Australia, Queensland (13°S) to eastern Victoria, shelf and bays, 4–53 m.

Remarks. *Ampelisca dimboola* is recognized by the combination of the short antenna 1, truncate basis of pereopod 7, reaching only halfway along the ischium, and the oblique posterior margin of the crest on urosomite 1. The species was re-illustrated by King (2009) who extended the distribution from eastern Victoria and New South Wales to Fantome Island, Queensland (18°S). The new records extend the species' range further north to 13°S.

Ampelisca euroa Lowry & Poore, 1985

Ampelisca euroa Lowry & Poore, 1985: 273–278, figs 13, 14.

Material examined. NMV J71740–71742, 3 specimens, Australia, Queensland, 1 km E of Yorke Island, Torres Strait, 09.8°S 143.4°E, 41 m (ASB-1 stns); NMV J71744–71747, 7 specimens, N side of Noddy Reef, 13.6°S 143.8°E, 42 m (ASB-2 stns); NMV J71748, 1 specimen, N of Green Island, 16.7°S 145.9°E, 52 m (ASB-3 stn); NMV J71749–71755, 12 specimens, N end of Hervey Bay, off Burnett Heads, 24.5°S 152.8°E, 46–49 m (ASB-5 stns).

Distribution. Australia, Queensland (9°S) to South Australia, shelf and bays, 3–176 m.

Remarks. *Ampelisca euroa* is distinguished from other

Australian species in the broad second article of the mandibular palp and the absence of a tooth on coxae 1–3. The species is the commonest and most widespread species of *Ampelisca* in eastern Australia. It occurs on the shelf of South Australia and throughout Bass Strait; its northern and eastern distribution is here expanded from New South Wales to Torres Strait, Queensland (9°S).

Ampelisca katoomba sp. nov.

urn:lsid:zoobank.org:act:06D290FB-969E-4E1E-BE56-406D48286398

Fig. 3

Holotype: AM P.85993, female (carcass lost, 4 microscope slides present, length unknown). Australia, New South Wales, E of Wollongong, 34°24'S 151°19'E, 278 m, 13 Dec 1978 (stn K78-27-08).

Description of holotype. Head. *Head* 1.2 times as long as deep; anteroventral margin oblique, at 45 degrees; eyes present, with 2 pairs with cuticular lenses. *Antenna 1* short, much shorter than peduncle of antenna 2 (reaching midlength

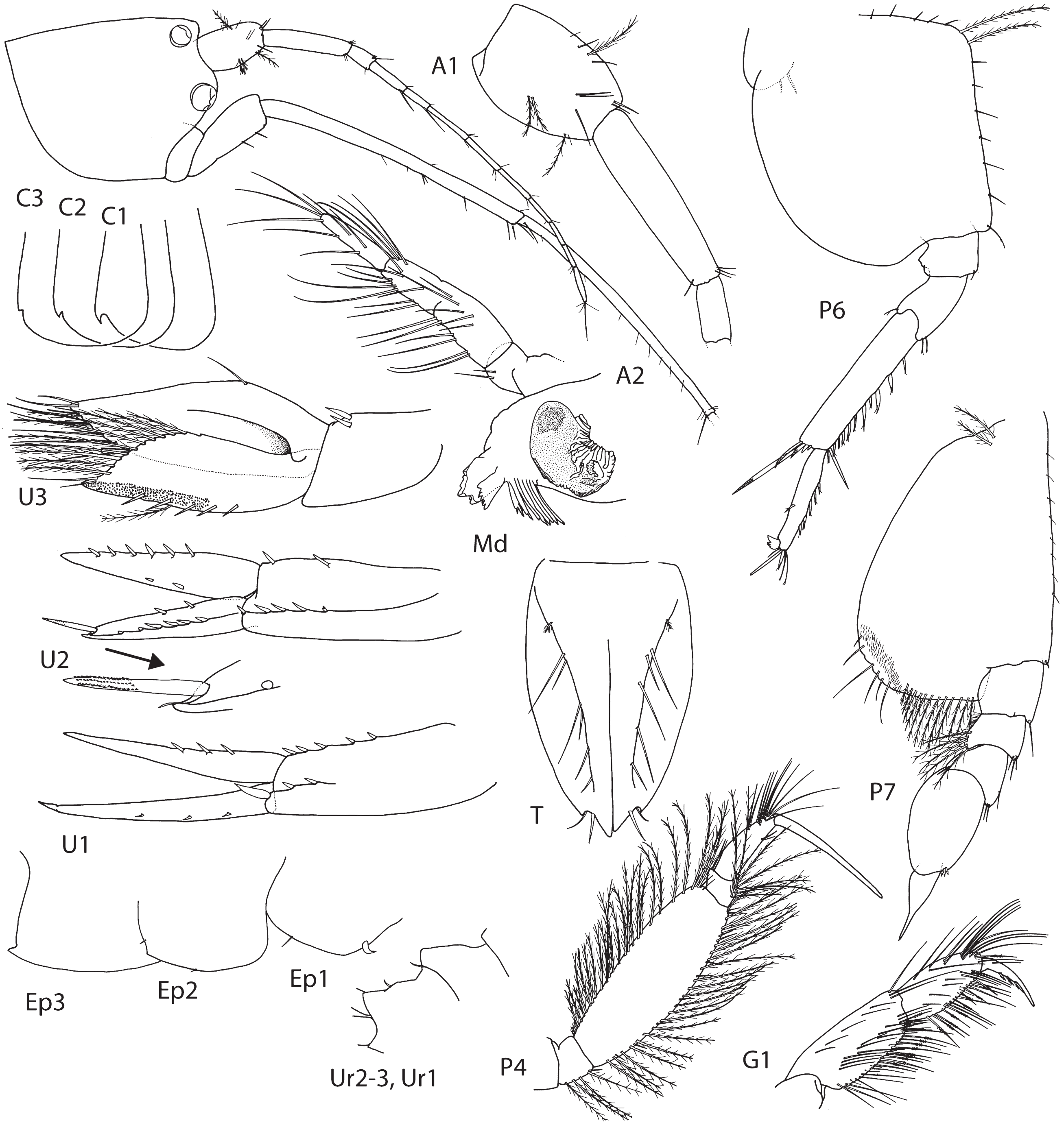

Figure 3. *Ampelisca katoomba* sp. nov., holotype, female, AM P.85993.

of antenna 2 article 5); peduncular article 2 1.5 times length of article 1. *Mandible* palp article 2 tapering distally.

Pereon. *Coxae 1–3* each with small posteroventral hooks. *Gnathopod 1* coxa anterior margin straight, anteroventral corner not produced. *Pereopod 4* merus 2.8 times as long as wide, with setose margins; dactylus twice as long as propodus. *Pereopod 6* basis anterior margin with prominent rounded angle, with 2 long, plumose setae; ischium-dactylus 1.6 times as long as basis. *Pereopod 7* basis distal margin reaching half-length of ischium, transverse, distal margin densely setose; ischium longer than merus; merus anterior lobe slightly produced along anterior margin of carpus; carpus short (about as long as broad), carpus anterior lobe overlapping one-quarter length of propodus; propodus inflated; dactylus lanceolate.

Pleon. *Epimeron 1* with anteroventral hooked seta. *Epimeron 2* posteroventral corner with small tubercle. *Epimeron 3* ventral margin convex, posteroventral corner with small sharp triangular tooth under straight posterior margin. *Urosomite 1* with prominent asymmetrical carina. *Urosomites 2–3* dorsal margin with high triangular crest having low anterior elevation. *Uropod 1* reaching beyond base of uropod 2 rami. *Uropod 2* inner ramus upper margin with 6 short robust setae, lower margin with 2 robust setae; outer ramus with 1 long subterminal robust seta, upper margin with 2 short robust setae, outer margin with 6 short robust setae. *Uropod 3* inner ramus broadly lanceolate, upper margin with 1 seta, lower margin with distal setae; outer ramus 3 times as long as wide, distal upper margin with 12 long, plumose setae. *Telson* 1.25 times as long as wide, deeply cleft (70%), lateral margins evenly convex, with sublateral ridge bearing few setae; with pair of posterior triangular teeth separated from lateral margins by shallow notches bearing 2 pairs of subapical setae.

Distribution. Australia, New South Wales, slope, 278 m (known only from type locality).

Remarks. *Ampelisca katoomba* sp. nov. from the New South Wales slope was not included in the list of species from southeastern Australia described by Lowry & Poore (1985). Following their key to species leads to *A. australis* Haswell, 1879, which differs in having antenna 1 reaching the end of article 4 of antenna 2 (exceeding this point in *A. katoomba* sp. nov.), much longer tooth below a convex posterior margin on epimeron 3 (small tooth, straight posterior margin), a longer distal margin on the basis of pereopod 7 (more rounded posterodistally) and a prominent keel on fused urosomites 2–3. Such a urosomite keel is unique among Australian species.

Ampelisca mingela sp. nov.

urn:lsid:zoobank.org:act:6EC8E9AB-00A8-40A0-AE4E-0FF1D562224A

Figs 4, 5

Holotype: AM P.85992 (with 4 microslides), female, tl. = 9.0 mm. Australia, Queensland, Lizard Island, between Mangrove Beach and South Island, 14°41'S 145°28'E, 30 Sep 1978. **Paratypes**: AM P.105871, 2 specimens, Lizard Island lagoon, 14°40'S 145°27'E, plankton tow, J. M. Leis, 24 Jul 1979; AM P.105863, 1 specimen, Lizard Island, Blue

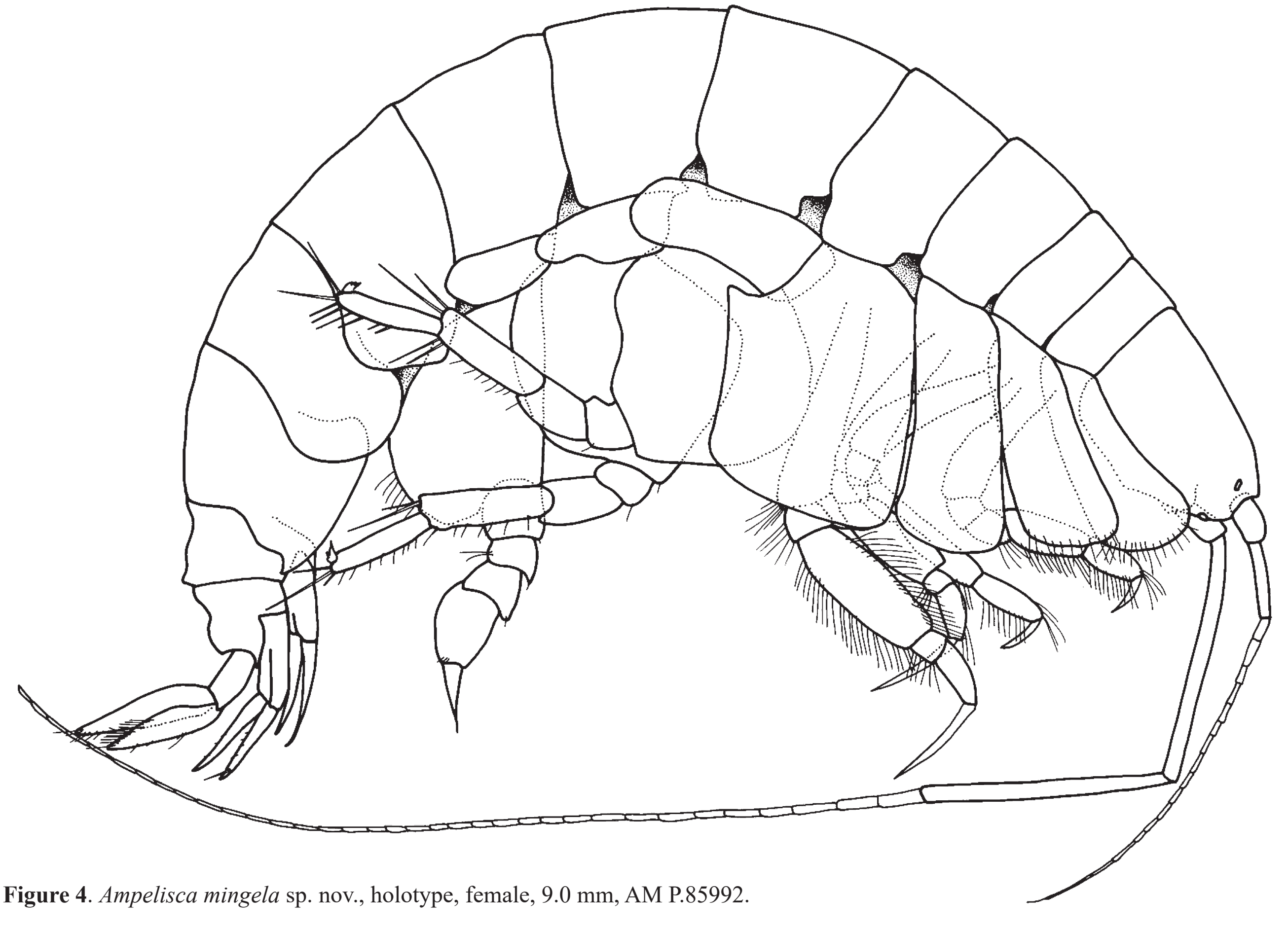

Figure 4. *Ampelisca mingela* sp. nov., holotype, female, 9.0 mm, AM P.85992.

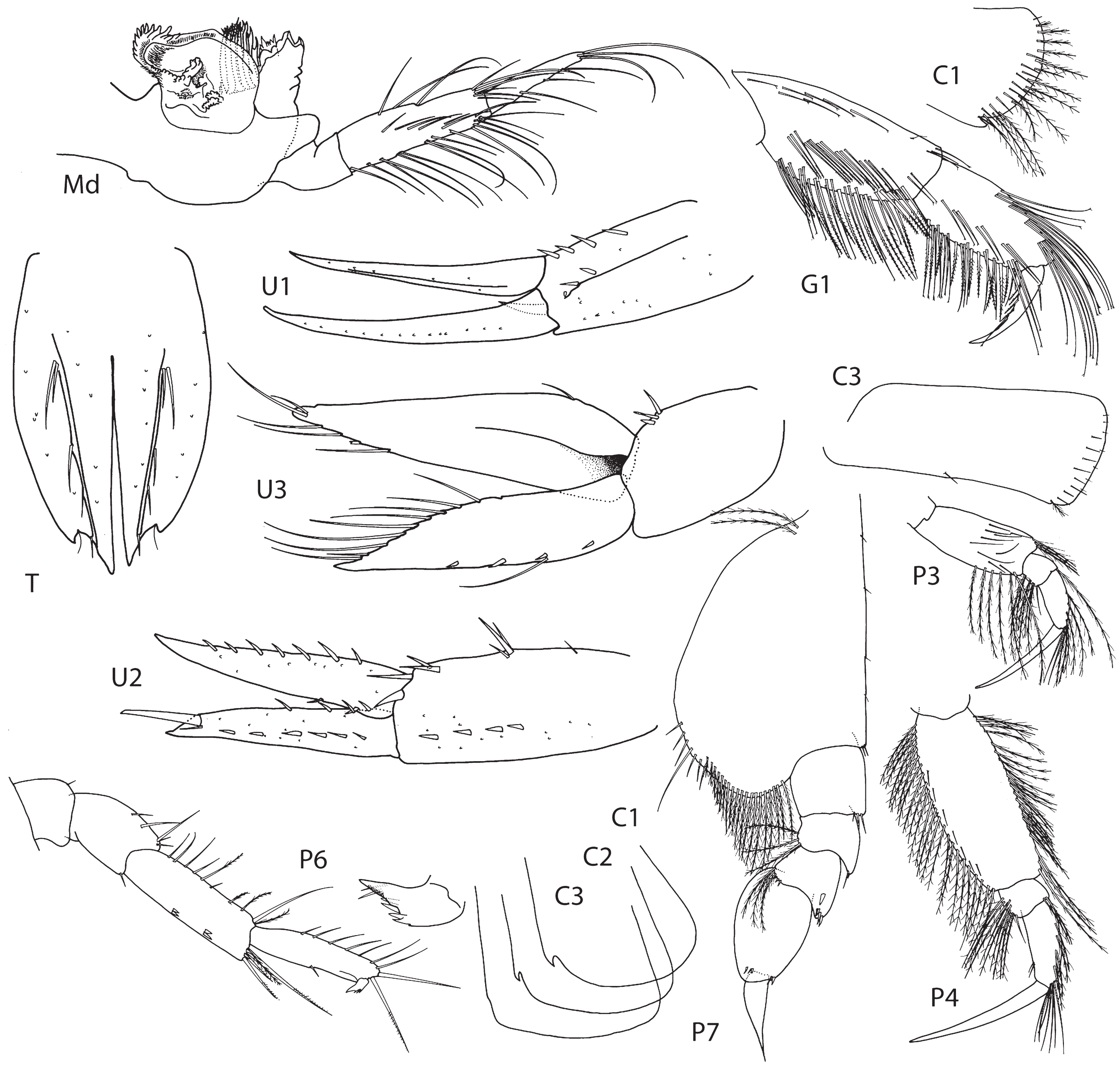

Figure 5. *Ampelisca mingela* sp. nov., holotype, female, 9.0 mm, AM P.85992.

Lagoon, 500 m east of Palfrey Island, 14°40'S 145°28'E, A. R. Jones & C. J. Short, 9 Oct 1978; AM P.105864, 1 specimen, Lizard Island, Blue Lagoon, 500 m east of Palfrey Island, 14°40'S 145°28'E, A. R. Jones & C. J. Short, 9 Oct 1978; AM P.105866, 4 specimens, Lizard Island, fringing reef between Bird Islet and South Island, 14°41'S 145°27'E, J. K. Lowry, 7 Oct 1978; AM P.105868, 2 specimens, Lizard Island, fringing reef between Bird Islet and South Island, grass beds, 14°40'S 145°28'E, P. C. Terrill, 9 Oct 1978; AM P.105862, 2 specimens, Lizard Island, halfway between Mangrove Beach and South Island, 14°40'S 145°28'E, A. R. Jones & C. J. Short, 30 Sep 1978; AM P.105865, 1 specimen, Lizard Island, mid-channel between Bird Islet and Trawler Beach, 14°40'S 145°28'E, A. R. Jones, 12 Oct 1978; AM P.105867, 1 specimen, Lizard Island, off southern point of Mermaid Cove, 14°41'S 145°28'E, C. J. Short & P. C. Terrill, 8 Oct 1978; AM P.105869, 3 specimens, Lizard Island, reefs at western end of Blue Lagoon, 14°40'S 145°28'E, P. C. Terrill, 5 Oct 1978; AM P.105870, 1 specimen, near Lizard Island, 1.6 km south-west of Eagle Island, 14°38'S 145°22'E, air lift, J. K. Lowry, 17 Oct 1978; NMV J2164, 6 individuals, Australia, Queensland, Lizard Island, Blue Lagoon, 10 m, 30 Oct 1978. AM P.105872, 4 specimens, Heron Island, bommie west of harbour entrance, 23°26'S 151°55'E, J. K. Lowry, 7 Dec 1978.

Description of holotype. Head. *Head* 1.5 times as long as deep; anteroventral margin oblique-horizontal; eyes present, with 2 pairs with minute cuticular lenses. *Antenna 1* peduncular article 2 1.5 times length of article 1; flagellum almost reaching end of peduncle of antenna 2. *Mandible* palp article 2 tapering distally.

Pereon. *Coxae 1–3* with small posteroventral hooks on coxae 1 and 2. *Gnathopod 1* coxa anterior margin straight, anteroventral corner not produced. *Pereopod 3* merus with 2 distal setae on extensor margin, with 6 distal setae on flexor margin; carpus with 3 setae on flexor margin; propodus with 7 setae on extensor margin; dactylus twice as long as propodus. *Pereopod 4* merus 2.3 times as long as wide, with setose margins; dactylus twice as long as propodus. *Pereopod 7* basis posterodistal margin reaching half ischium length, convex, oblique, distal margin densely setose; ischium longer than merus; merus anterior lobe slightly produced along anterior margin of carpus; carpus short (about as long as broad), carpus anterior lobe overlapping one-quarter length of propodus; propodus inflated; dactylus lanceolate.

Pleon. *Epimeron 2* posteroventral margin broadly convex. *Epimeron 3* ventral margin convex, posteroventral corner with sharp triangular tooth under shallow notch. *Urosomite 1* with distally upturned carina. *Urosomites 2–3* dorsal margin concave. *Uropod 1* reaching beyond base of uropod 2 rami. *Uropod 2* inner ramus upper margin with 7 short robust setae, lower margin with 2 short robust setae; outer ramus with 1 long subterminal robust seta, upper margin with 4 short robust setae, outer margin with 6 short robust setae. *Uropod 3* inner ramus broadly lanceolate, upper margin with 1 seta, lower margin with distal setae; outer ramus 4 times as long as wide, distal upper margin with 8 setae. *Telson* 1.6 times as long as wide, deeply cleft (70%), lateral margins evenly convex, with sublateral ridge bearing few setae; with pair of posterior prominent triangular teeth separated from lateral margins by deep notches bearing 2 pairs of subapical setae.

Distribution. Australia, Queensland (Lizard Island, Heron Island), lagoon, to 10 m.

Remarks. The telson, arrangement of the two pairs of cuticular lenses, pereopod 7 and relative lengths of the antennae of *Ampelisca mingela* sp. nov. resemble those of *A. dingaal* King, 2009 also from Lizard Island. The posterior margin of epimeron 3 of *A. mingela* is convex (straight in *A. dingaal*), article 2 of the mandibular palp is three times as long as wide (five times), antenna reaches most of the way along article 5 of antenna 2 (less than halfway) and the telson is 1.6 times as long as wide (2.0 times).

Ampelisca toora Lowry & Poore, 1985

Ampelisca toora Lowry & Poore, 1985: 284, fig. 20.

Material examined. NMV J71732, 1 specimen, Australia, Queensland, 1 km E of Yorke Island, Torres Strait, 09.8°S 143.4°E, 41 m (ASB-1 stn); NMV J71733–71739, 22 specimens, N end of Hervey Bay, off Burnett Heads, 24.5°S 152.8°E, 22–49 m (ASB-5 stns).

Distribution. Australia, Queensland (9°S) to South Australia, shelf and bays, 4–176 m.

Remarks. *Ampelisca toora* is immediately recognized by the saddle-like crest on urosomite 1 and the oblique posterodistal margin of the basis of pereopod 7 (slightly concave near the distal corner). The species ranges from Spencer Gulf, South Australia, to Torres Strait, Queensland (9°S). Lowry & Poore (1985) recorded it only as far north as Fraser Island, Queensland.

Byblis Boeck, 1871

Type species. *Byblis gaimardii* (Krøyer, 1846).

Remarks. Species of *Byblis* are distinguished by the presence of setae on the anterior margin of the basis and the spine-like dactylus of pereopod 7. Species number 76 world-wide (Horton *et al*., 2023). Lowry & Poore (1989) described the only four species known from Australia, largely from extensive collections made by environmental benthic surveys undertaken during the 1970s. Here two more are added from the Great Barrier Reef and another from the continental slope of Queensland.

"*Byblis* species are rather uniform in design, with character states being found in myriad combinations. This makes it difficult to assign *Byblis* species to groups and therefore difficult to compare a new species with existing species, since each species shares a different suite of characters with different species" (Myers, 2012: 5). For this reason, the new species are compared only with those from Australia and from the Indo-West Pacific.

Byblis liena sp. nov.

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Fig. 6

Holotype: AM P.27290, female, length unknown. Australia, Queensland, E of Lady Elliot Island, 24°00'S 153°06'30"E, 475–530 m, Australian Museum party, 17 Nov 1977, fine grey ooze, sand with pteropod shells (HMAS *Kimbla* stn 1).

Description of holotype. Head. *Head* 1.4 times as long as deep; rostrum one-fifth length of head, rounded; anteroventral margin with antennal lobe, oblique; eyes weakly pigmented, without cuticular lenses. *Antenna 1* peduncular article 2 2.3 times as long as article 1; article 3 about one-third length of article 2; flagellum of 20 articles; almost as long as antenna 2.

Pereon. *Coxae 1–3* rounded, coxa 1 with setose margin. Pereopods 3, 4 dactylus as long as propodus. *Pereopod 5* basis flexor margin with prominent proximal lobe; extensor margin without plumose setae. *Pereopod 6* basis subcircular, extensor margin with 11 plumose setae. *Pereopod 7* basis posterodistal margin truncate-rounded, reaching almost to distal end of carpus, free anterior margin setose near junction with ischium; merus longer than wide, widest distally; carpus 1.5 times as long as wide, as long as ischium-merus together; propodus linear, 3 times as long as wide.

Pleon. *Epimeron 3* posteroventral margin broadly rounded. *Uropod 1* outer ramus with 4 short robust setae; inner ramus shorter, with 3 short robust setae. *Uropod 2* inner ramus rami subequal; each ramus upper margin with 1 robust seta. *Uropod 3* rami equal, inner ramus with 2 robust setae. *Telson* 1.3 times as long as wide, subtriangular, cleft about one-third of length, with pair of long dorsal robust setae; distal margin narrow, bilobed.

Distribution. Australia, southeastern Qld, slope, 475–530 m (known only from type locality).

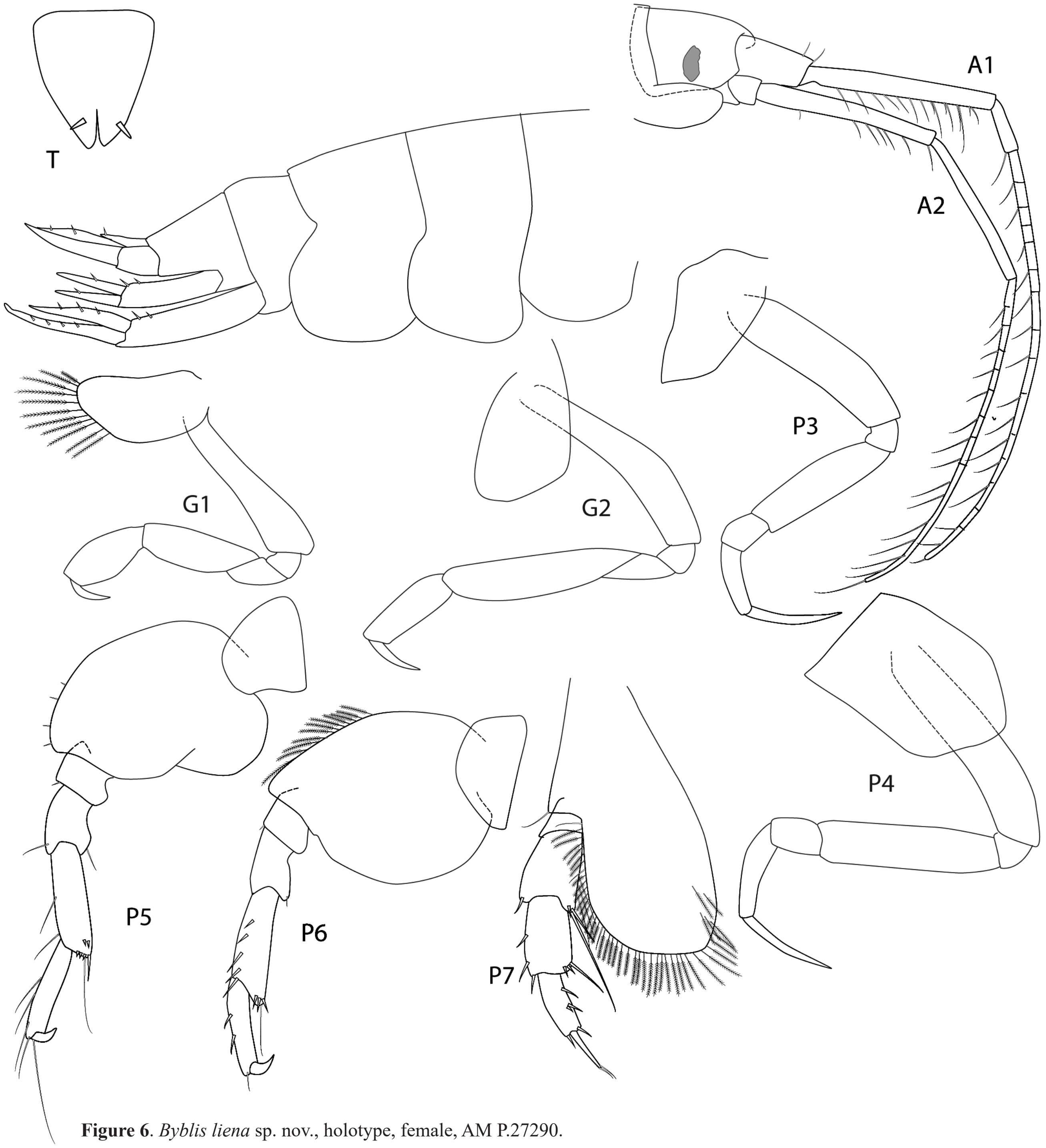

Figure 6. *Byblis liena* sp. nov., holotype, female, AM P.27290.

Remarks. *Byblis liena* sp. nov. lack cuticular lenses and the eye is weakly pigmented. The species shares with *B. tinamba* Poore & Lowry, 1985 in Australia antennae of similar lengths but differs, inter alia, in the shape of the basis of pereopod 7, a more triangular telson and a much longer uropod 3. The triangular telson is unusual but something similar is seen in *B. laterocostatus* Ren, 2006 from China.

Byblis pialba sp. nov.

urn:lsid:zoobank.org:act:73E30020-B5C5-4BAA-A9FD-25A807520B4F

Figs 7, 8

Holotype: AM P.85989, female, tl. = 5.7 mm (with 4 microslides; 1 missing), Australia, Queensland, Lizard Island, fringing reef between Bird Islet and South Island, 14°40'S 145°28'E, *Halophila*, mixed algae and sediment from grass beds off reef base, 24.4–37.6 m, P. C. Terrill, 9 Oct 1978.

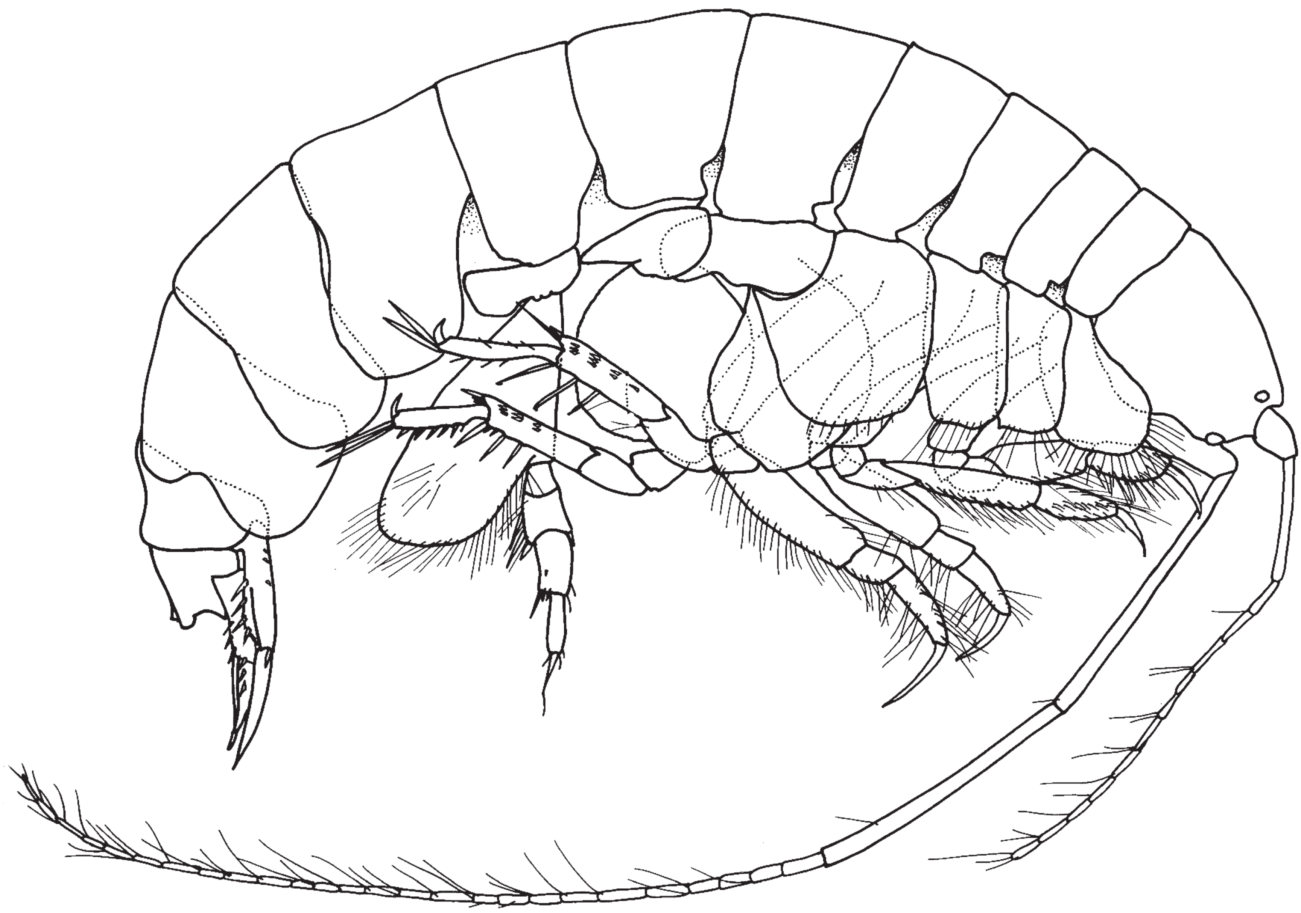

Figure 7. *Byblis pialba* sp. nov., holotype, female, 5.7 mm, AM P.85989.

Description of holotype. Head. *Head* 1.7 times as long as deep; rostrum minute; anteroventral margin strongly concave; eyes present, with 2 pairs with cuticular lenses. *Antenna 1* peduncular article 2 2.5 times length of article 1; flagellum of 11 articles; almost reaching end of peduncle of antenna 2. Antenna 2 about as long as body length; peduncular article 5 as long as article 4. *Mandible* palp article 2 tapering distally.

Pereon. *Coxae 1–3* with denticulate lower margin (less obvious on third). *Gnathopod 1* coxa anterior margin slightly concave, anteroventral corner broadly convex. Pereopods 3, 4 dactylus shorter than propodus. *Pereopod 5* basis flexor margin with prominent proximal lobe; extensor margin without plumose setae. *Pereopod 6* basis subcircular, extensor margin with 8 plumose setae. *Pereopod 7* basis posterodistal margin broadly rounded, reaching to distal margin of merus, free anterior margin setose near junction with ischium; merus slightly longer than wide; carpus 1.5 times as long as wide, as long as ischium-merus together; propodus linear, 2.5 times as long as wide.

Pleon. *Epimeron 3* posteroventral margin broadly rounded. *Uropod 1* rami with 2 short robust setae each. *Uropod 2* inner ramus inner ramus shorter than outer ramus, upper margin with 4 robust setae. *Uropod 3* rami margin of inner ramus serrate over distal two-thirds, margin of outer ramus serrate over middle third. *Telson* 1.3 times as long as wide, cleft over posterior 40%, with 3 pairs of submarginal setae; distal margin truncate, minutely serrulate.

Distribution. Australia, Queensland, northern Great Barrier Reef, reef sediment, 24–38 m (known only from type locality).

Remarks. *Byblis pialba* is the only species of the genus in Australia with antenna 2 about as long as the body length. *Byblis brachyura* Ren, 2006*, B. longiflagella* Ren, 2006, *B. orientalis* J. L. Barnard, 1967 and *B. pirloti* Margulis, 1968 are the only species among the 29 figured by Ren (2006) with a long antenna 2.

Byblis wadara sp. nov.

urn:lsid:zoobank.org:act:3DBF80DF-670A-417B-AD7C-F9FFA74D379A

Fig. 9

Holotype: AM P.85990, female, tl. = 5.4 mm (with 3 microslides), Australia, Queensland, Heron Island, bommie west of harbour entrance, 23°26'S 151°55'E, 21 m, J. K. Lowry, 7 Dec 1978.

Description of holotype. Head. *Head* 1.7 times as long as deep; rostrum minute; anteroventral margin oblique-horizontal; eyes present, with 2 pairs with cuticular lenses. *Antenna 1* peduncular article 2 as long as article 1; flagellum of 2 articles; reaching to midlength of antenna 2 article 3. Antenna 2 about half body length; peduncular article 5 about half as long as article 4.

Pereon. *Coxae 1–3* rounded, slightly scalloped on coxa 1. Pereopods 3, 4 dactylus longer than propodus. *Pereopod 5*

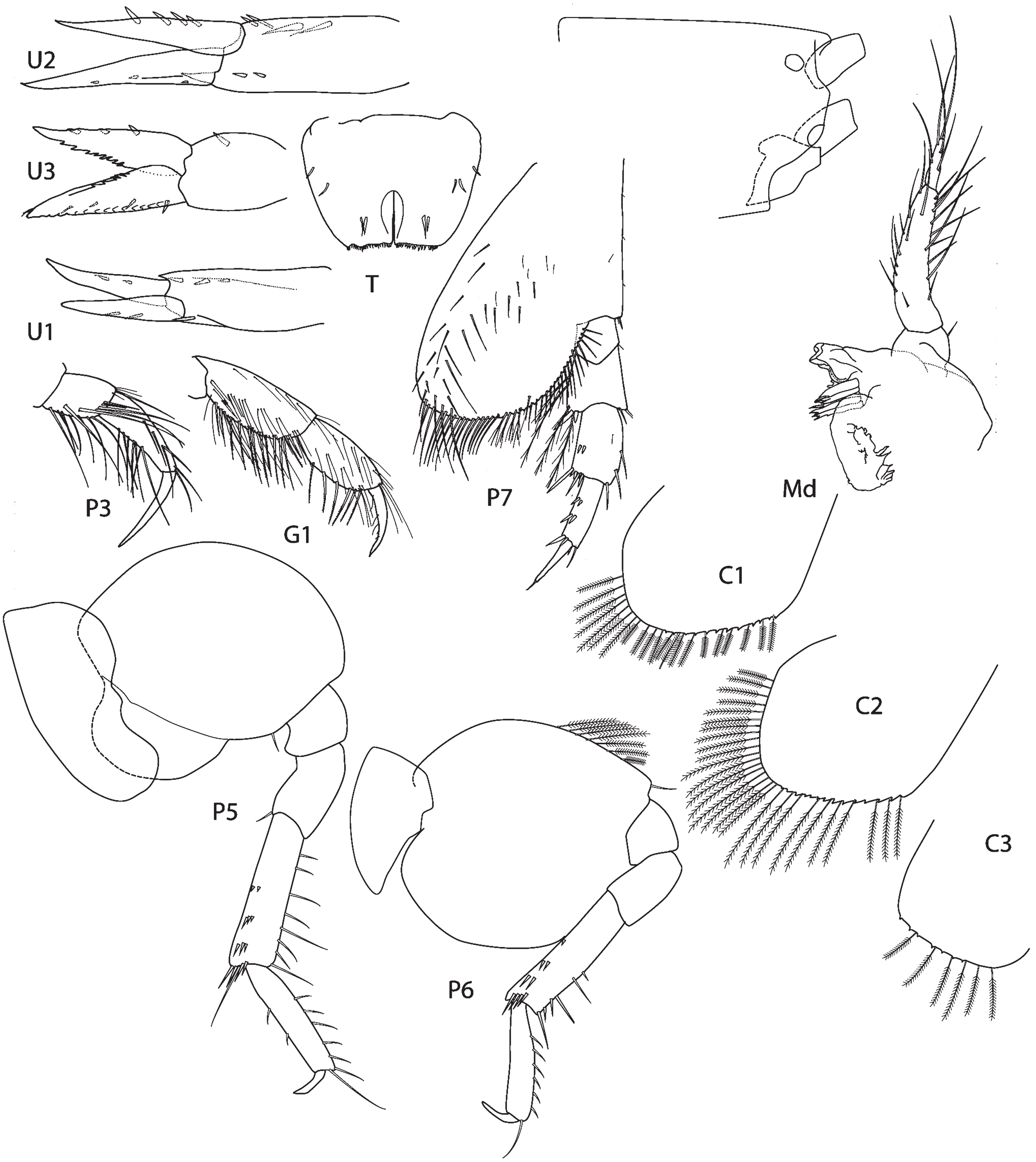

Figure 8. *Byblis pialba* sp. nov., holotype, female, 5.7 mm, AM P.85989.

basis flexor margin sinuous; extensor margin with 7 plumose setae. *Pereopod 6* basis subcircular, extensor margin with 4 plumose setae. *Pereopod 7* basis posterodistal margin truncate-rounded, reaching to midlength of carpus, free anterior margin setose near junction with ischium; merus wider than long; carpus 1.3 times as long as wide, as long as ischium-merus together; propodus subrectangular, 1.5 times as long as wide.

Pleon. *Epimeron 3* posteroventral margin broadly rounded. *Uropod 1* outer ramus with 2 short robust setae. *Uropod 2* inner ramus inner ramus shorter than outer ramus, upper margin with 2 robust setae. *Uropod 3* rami inner margins of both rami microscopically serrate. *Telson* 1.7 times as long as wide, strongly tapering, cleft about one-third of length, with pair of long dorsal robust setae; distal margin bilobed, distal margin minutely serrulate.

Distribution. Australia, Qld, southern Great Barrier Reef, 21 m (known only from type locality).

Remarks. *Byblis wadara* sp. nov. is notable for the exceptionally short antenna 1, its flagellum of only two articles. It would appear to be the only species like this.

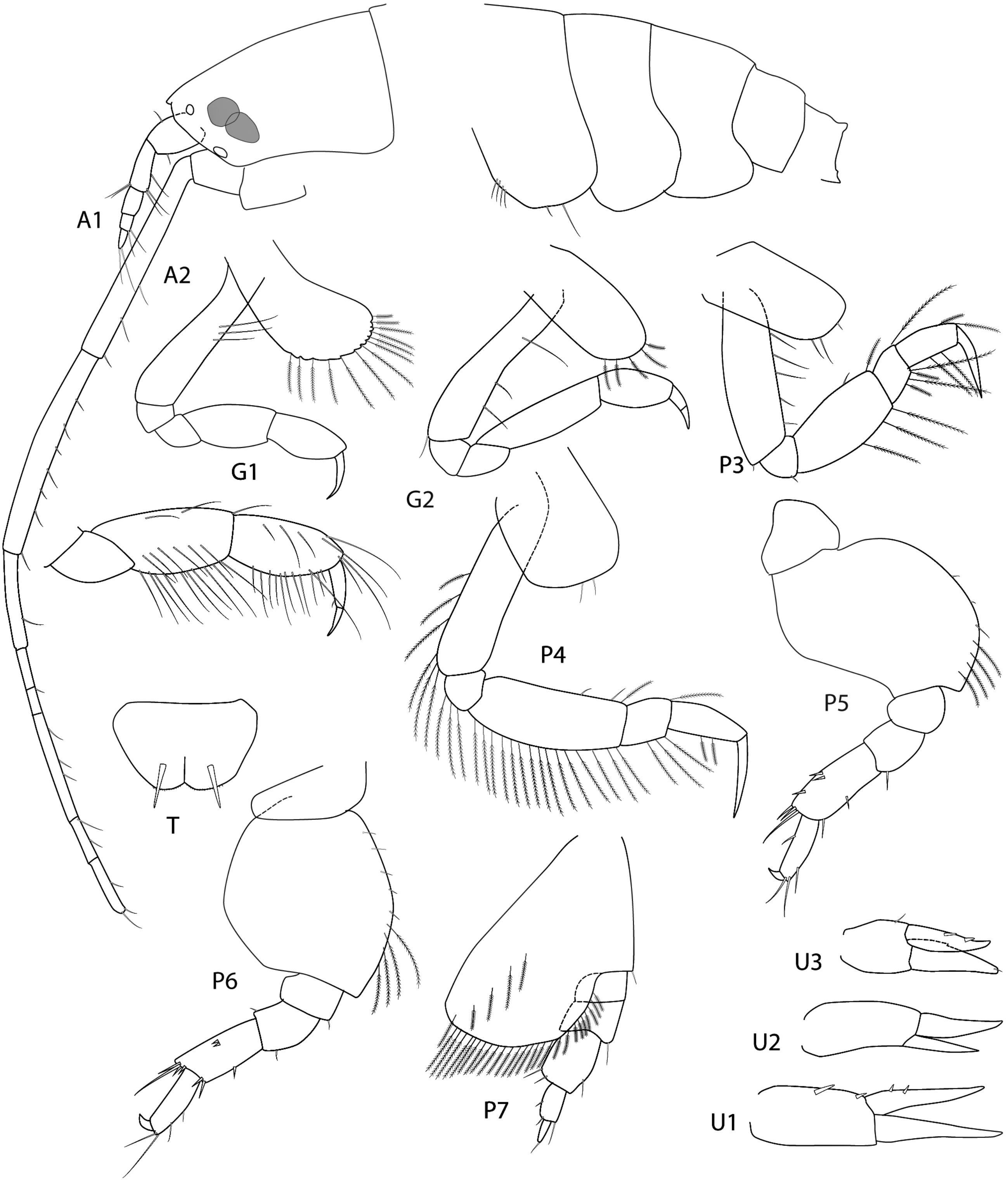

Figure 9. *Byblis wadara* sp. nov., holotype, female, 5.4 mm, AM P.85990.

Byblisoides K. H. Barnard, 1931

Byblisoides esferis J. L. Barnard, 1961

Byblisoides esferis J. L. Barnard, 1961: 65–66, fig. 36.—Peart, 2018: 347–363.

Material examined. NMV J21801, 2 females, 13.4, 6.0 mm, Australia, Victoria, 67 km S of Point Hicks, 38°23.95'S 149°17.02'E, 1277 m, fine mud, G. C. B. Poore *et al*., 25 Oct 1986 (stn SLOPE 67). NMV J21797, female, 4.5 mm, Australia, Victoria, S of Point Hicks, 38°25.90'S 148°58.60'E, 1850 m, muddy sand, G. C. B. Poore *et al*., 22 Jul 1986 (stn SLOPE 25).

Distribution. Tasman Sea, west coast of New Zealand, southeastern Victoria; 610–1277 m.

Remarks. Three individuals of *Byblisoides* were identified using the key of Peart (2018). They are recognized by the combination of the absence of setae on the anterior margin of the carpus of pereopod 7 and the absence of a carina on the urosomites, an unusual feature among species of the genus. J. L. Barnard (1961) recorded *Byblisoides esferis* from 610 m off the west coast of the South Island of New Zealand. These specimens agree well with J. L. Barnard's description and figure but comparison with type material is necessary to check for minor specific differences.

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Finally, I appreciate the invitation from Penny Berents, Shane Ahyong, Alan Myers, and Lucia Fanini to contribute to this special volume celebrating the life and work of colleague and friend Jim Lowry.

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A New Species of Spider Crab of the Genus *Leptomithrax* Miers, 1876 (Crustacea: Brachyura: Majidae) from New Caledonia

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Abstract. A new species of spider crab of the genus *Leptomithrax* Miers, 1876, is described from New Caledonia. *Leptomithrax lowryi* sp. nov. belongs to a group species that includes *L. bifidus* (Ortmann, 1893) and *L. sinensis* Rathbun, 1916, but differs in the structure of the carapace spines and teeth, ischium of the third maxilliped, male thoracic sternal structure, shape of the male telson and the first gonopod.

Introduction

The waters of New Caledonia have been intensively sampled during the last 40 years, and our knowledge of the decapod Crustacea has been significantly increasing (Ng & Richer de Forges, 2007; Richer de Forges *et al*., 2013). Much of its waters were designated as a marine park in 2014, the "Parc naturel de la mer de Corail", but explorations, especially of the deep sea, are still uncovering new species on a regular basis.

In the Majidae Samouelle, 1819 (sensu Ng *et al*., 2008), it is somewhat surprising that the genera *Maja* Lamarck, 1801 and *Leptomithrax* Miers, 1876 have not been reported from New Caledonia so far (cf. Ng & Richer de Forges, 2007). The main difference between these closely related genera is the position of the antennal flagellum: it is distinctly outside of the orbit in *Leptomithrax* but is inside the orbit in *Maja* (Sakai, 1976; Griffin & Tranter, 1986; Ng & Richer de Forges, 2015). *Maja* was recently revised by Ng & Richer de Forges (2015) who split it into 10 genera, with only one, *Sakaija* Ng & Richer de Forges, 2015, reported from New Caledonia (see also Ng & Richer de Forges, 2021). *Leptomithrax* needs to be revised, with Ng & Richer de Forges (2015) noting it was not monophyletic. Ng & Richer de Forges (2015) removed one doubtful species of *Leptomithrax* (*L. kiiensis* Sakai, 1969) to a new genus, *Rathbunaja*, with *Maja bisarmata* Rathbun, 1916, as the type species. Of the 15 recognized species of *Leptomithrax*, four are from northwestern Asia: *L. edwardsii* (De Haan, 1835), *L. bifidus* (Ortmann, 1893), *L. sinensis* Rathbun, 1916, and *L. eldredgei* Richer de Forges & Ng, 2015 (Sakai, 1976; Dai & Yang, 1991; Ng *et al*., 2017); six from southern Australia: *L. gaimardii* (H. Milne Edwards, 1834), *L. sternocostulatus* (H. Milne Edwards, 1851), *L. tuberculatus* Whitelegge, 1900, *L. waitei* (Whitelegge, 1900), *L. globifer* Rathbun, 1918, and *L. depressus* Richer de Forges, 1993 (Richer de Forges, 1993; Davie, 2002; Poore *et al*., 2008), and the remaining taxa are from New Zealand (Bennett, 1964). The present paper describes the first species of *Leptomithrax* from New Caledonia.

Keywords: Decapoda, Majoidea, taxonomy, new species, comparative morphology, western Pacific
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Materials and methods

Specimens examined are deposited in the Muséum national d'Histoire naturelle, Paris (MNHN); and the Zoological Reference Collection of the Lee Kong Chian Natural History Museum, National University of Singapore (ZRC). Measurements provided, in millimetres, are of the total carapace length (including spines) (cl); post-pseudorostral carapace length (base of spines to posterior carapace margin) (pcl); maximum carapace width (across tips of spines) (cw); and carapace width across base of spines (pcw). The abbreviations G1 and G2 are used for the male first and second gonopods, respectively.

Comparative material. For comparative material of *Leptomithrax*, including *L. bifidus* and *L. sinensis*, see Richer de Forges & Ng (2015), Ng & Richer de Forges (2015), and Wong *et al*. (2018).

Taxonomy

Superfamily Majoidea Samouelle, 1819

Family Majidae Samouelle, 1819

Subfamily Majinae Samouelle, 1819

Genus *Leptomithrax* Miers, 1876

Type species. *Leptomithrax longimanus* (Miers, 1876).

Leptomithrax lowryi sp. nov.

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Figs 1–5

Holotype: MNHN-IU-2022-187, male (cl 40.7 mm, pcl 34.3 mm, cw 37.0 mm, pcw 30.7 mm), station DW 5238, east of Atoll de la Surprise, New Caledonia, 18°06.5'S 163°03.4'E, 254–274 m, coll. SPANBIOS cruise, N.O. "Alis", 22 July 2021. **Paratypes**: MNHN-IU-2018-5013, 1 male (cl 35.6 mm, pcl 29.3 mm, cw 29.4 mm, pcw 24.2 mm), 1 subadult female (cl 17.1 mm, pcl 14.8 mm, cw 13.7 mm, pcw 12.1 mm) same data as holotype; MNHN-IU-2020-3639, 1 male (cl 28.0 mm, pcl 22.4 mm, cw 23.6 mm, pcw 17.7 mm), station DW 5171, south of Atoll Pelotas, New Caledonia, 19°01.4'S 163°26.8'E, 262–272 m, coll. SPANBIOS cruise, N.O. "Alis", 8 July 2021; ZRC 2022.0045, 1 male (cl 32.3 mm, pcl 31.7 mm, cw 32.2 mm, pcw 27.5 mm), station DW 5207, east of Atoll de la Surprise, New Caledonia, 18°09'S 163°05.3'E, 239–248 m, coll. SPANBIOS cruise, N.O. "Alis", 17 July 2021; ZRC 2022.0046, 1 female (cl 38.0 mm, pcl 30.8 mm, cw 30.9 mm, pcw 26.3 mm), 1 female (cl 38.1 mm, pcl 32.1 mm, cw 32.1 mm, pcw 26.2 mm), station DW 5207, east of Atoll de la Surprise, New Caledonia, 18°09'S 163°05.3'E, 239–248 m, coll. SPANBIOS cruise, N.O. "Alis", 17 July 2021; MNHN-IU-2021-3746, 1 female (cl 30.1 mm, pcl 24.5 mm, cw 26.4 mm, pcw 20.2 mm), 1 juvenile, station DW5174, south of Atoll Pelotas, New Caledonia, 18°57.8'S 163°23.2'E, 320–342 m, coll. SPANBIOS cruise, N.O. "Alis", 8 July 2021; MNHN-IU-2022-186, 1 male (cl 30.8 mm, pcl 21.9 mm, cw 25.0 mm, pcw 16.6 mm), 1 subadult female (cl 14.1 mm, cw 10.8 mm), station DW727, slope southwest of Dumbéa passage, New Caledonia, 22°48.03'S 167°29.03'E, 299–302 m, coll. BATHUS 2 cruise, N.O. "Alis", 12 May 1993.

Diagnosis. Carapace very wide posteriorly, inflated medially; dorsal surface strongly granulous, anterior half gently convex. Pseudorostral spines divergent. Supraocular eave wide; intercalated spine narrow, distally blunt, almost totally closing gap between antorbital and postorbital spines; postorbital spine long, foliaceous, divided distally into 2 spines, proximal angle with distinct tooth. Basal antennal article surface almost flat, outer margin distinctly convex. Third maxilliped with junction of merus and ischium gently swollen; ischium with distinctly Y-shaped median furrow, anteroexternal angle forming large tooth with rounded tip. Ambulatory legs, especially meri, with smooth dorsal margin. Male thoracic sternites with lateral surfaces shallowly but distinctly excavated. Male telson subpentagonal. G1 slender, distal one-third curving outwards; distal part relatively long, gently sinuous.

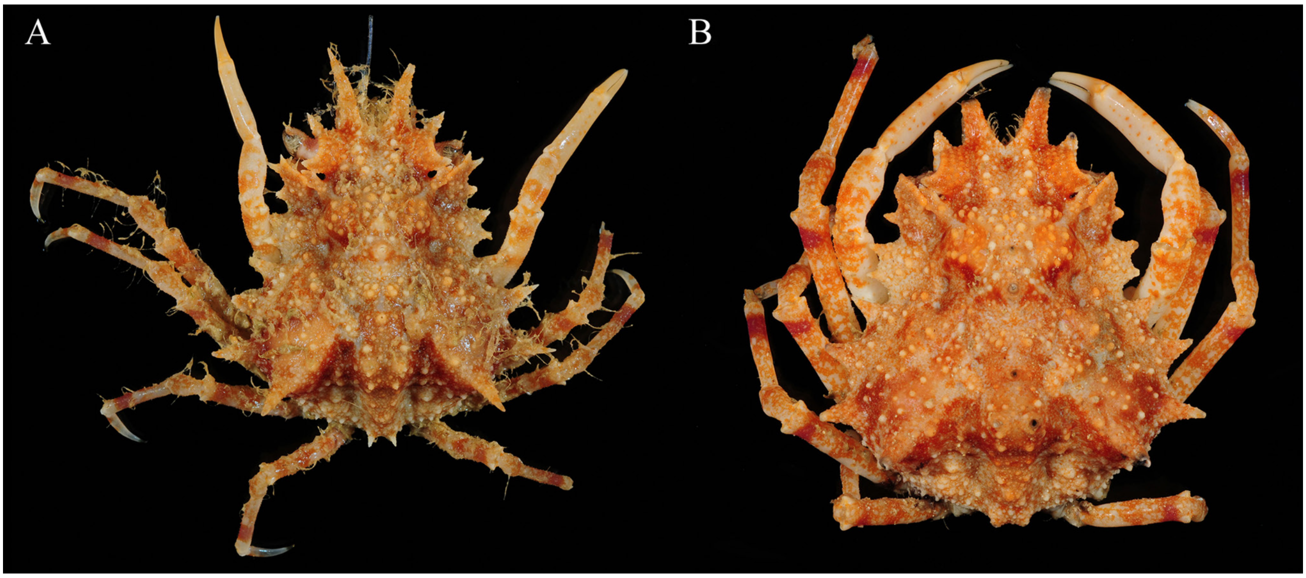

Figure 1. Colouration of fresh specimens of *Leptomithrax lowryi* sp. nov., New Caledonia: (*A*) paratype male (cl 28.0 mm, pcl 22.4 mm) (MNHN-IU-2020-3639); (*B*) paratype male (cl 32.3 mm, pcl 31.7 mm) (ZRC 2022.0045). Photographs Laure Corbari.

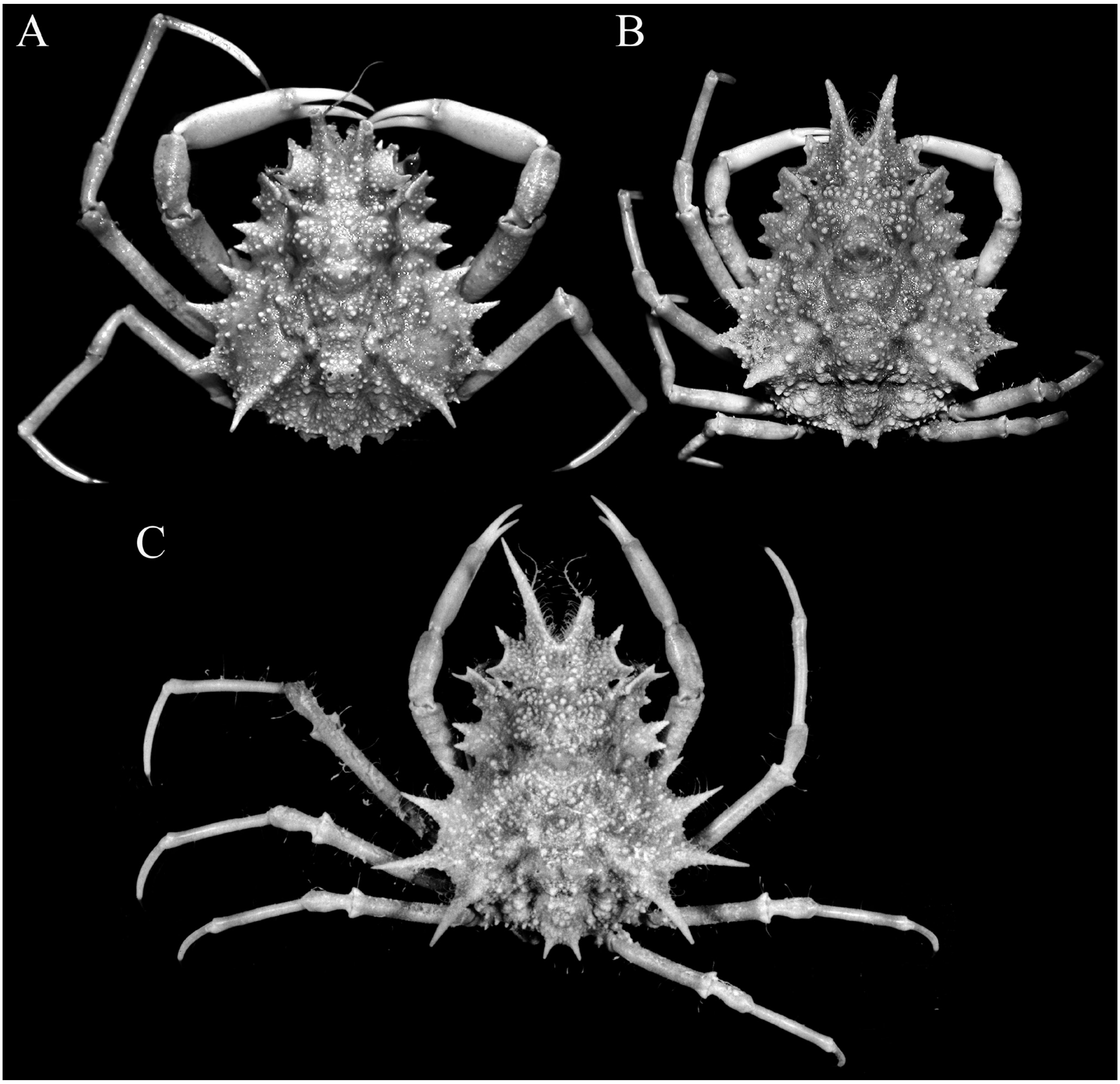

Figure 2. *Leptomithrax lowryi* sp. nov., New Caledonia, dorsal habitus: (*A*) holotype male (cl 40.7 mm, pcl 34.3 mm) (MNHN-IU-2022-187); (*B*) paratype female (cl 38.0 mm, pcl 30.8 mm) (ZRC 2022.0046); (*C*) paratype male (cl 30.8 mm, pcl 21.9 mm) (MNHN-IU-2022-186). All from New Caledonia.

Description. Carapace pyriform, very wide posteriorly; dorsal surface very granulous, anterior half gently convex; gastric and branchial regions distinct, separated by distinct grooves; carapace and pereiopods covered with scattered short setae, not obscuring surface or margins (Figs 2, 3A–C). Pseudorostral spines sharp, gently curved, diverging, cylindrical in cross-section, lateral margins without distinct spines or tubercles (Figs 1, 2, 3A–C). Proepistome with sharp, gently curved spine, visible in dorsal view (Figs 3B, C, 4C). Supraocular eave wide, forming sharp anterior and posterior angles, deeply convex above eye; intercalated spine narrow, distal part acute with proximal part subtruncate, almost totally closing gap between antorbital and postorbital spines with narrow basal fossae visible; postorbital spine long, foliaceous, divided distally into 2 short spines, proximal angle with distinct tooth (Figs 2, 3A, B, 4A, B). Carapace inflated medially, with granulated tubercles but no spine; posterior margin of carapace with 2 short sharp divergent spines; hepatic area with 2 strong spines directed outward; 4 lateral branchial spines, with posterolateral part armed with 3 sharp long spines, posteriormost one subdorsal in position, directed posteriorly and upwards, distinctly longer than other spines (Figs 2C, 3D, 4F). Basal antennal article wide, surface smooth, almost flat, completely fused with carapace, internal distal margin forming blunt tooth, outer margin distinctly convex, smooth; urinary article with subrectangular orifice; separated from postorbital spine by basal fossa (Fig. 4B); antenna deeply protected, far from orbit, flagellum long (Figs 3B, D, 4A–D). Eye short, protected by inner surface of postorbital tooth; cornea ovate, large, with small granule at distal tip (Fig. 4C–D). Epistome medially depressed with smooth surface (Fig. 4D). Epistome transversely rectangular;

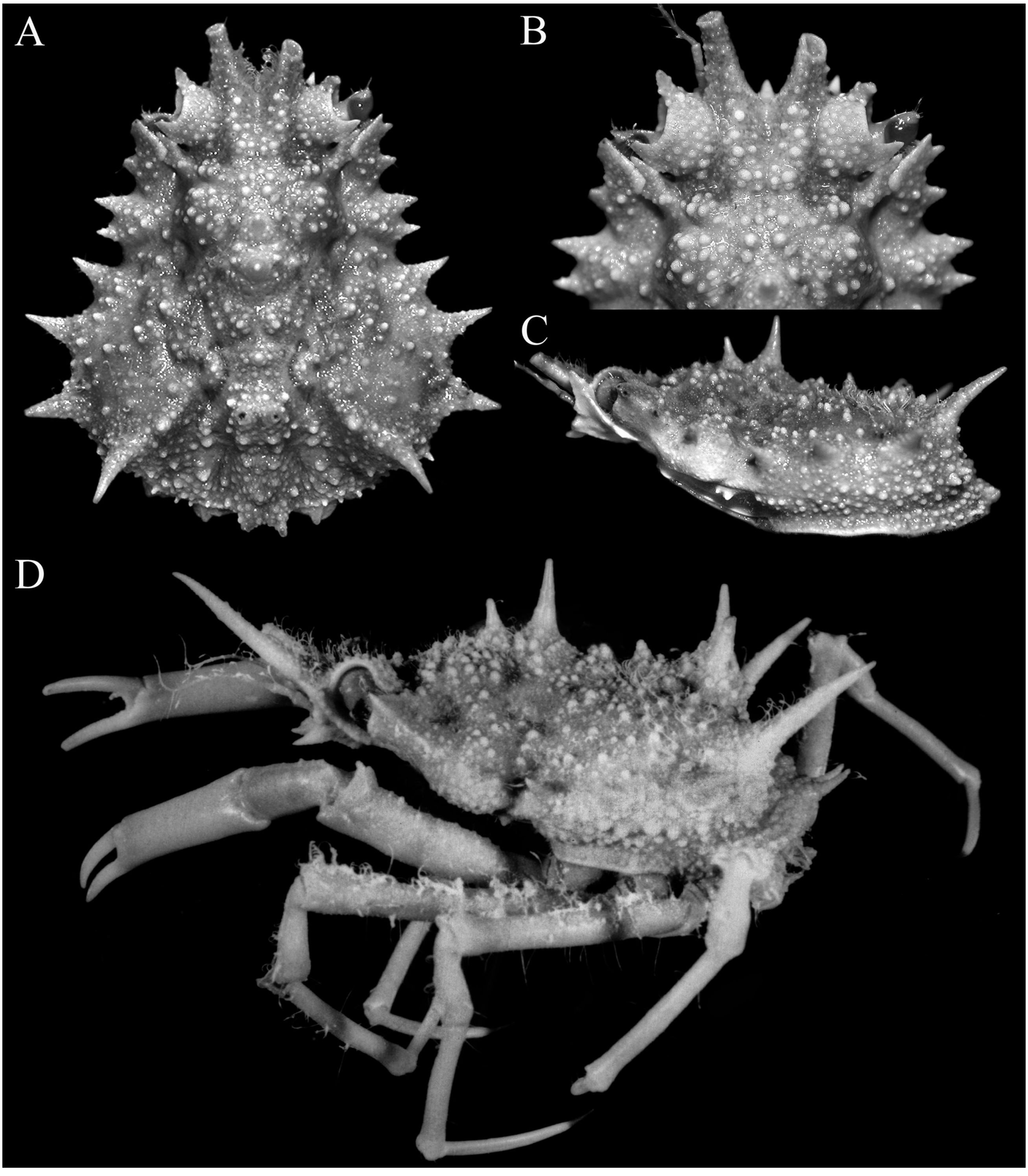

Figure 3. *Leptomithrax lowryi* sp. nov. (*A–C*) holotype male (cl 40.7 mm, pcl 34.3 mm), New Caledonia (MNHN-IU-2022-187); (*D*) paratype male (cl 30.8 mm), pcl 21.9 mm (MNHN-IU-2022-186): (*A*) dorsal view of carapace; (*B*) anterior part of carapace (denuded); (*C, D*) lateral view of cephalothorax.

posterior margin with broad, subtruncate median plate, with deep median fissure; separated from lateral parts by deep V-shaped cleft (Fig. 4C, D).

Third maxilliped short, with smooth surface, bordered by setae on margin of merus; junction of merus and ischium gently swollen medially; ischium with distinctly Y-shaped median furrow, outer branch of furrow about three-quarters length of inner branch, anteroexternal angle with large tooth with rounded tip; merus short, anteroexternal angle auriculiform, distal median margin with rounded tooth, separated from inner part by deep cleft; exopod relatively slender, reaching to median part of merus, with long flagellum (Fig. 4D, E).

Chelipeds not elongate; merus short, dorsal margin lined with rounded and sharp granules, without distal spine; carpus short, proximal dorsal surface with granules, rest

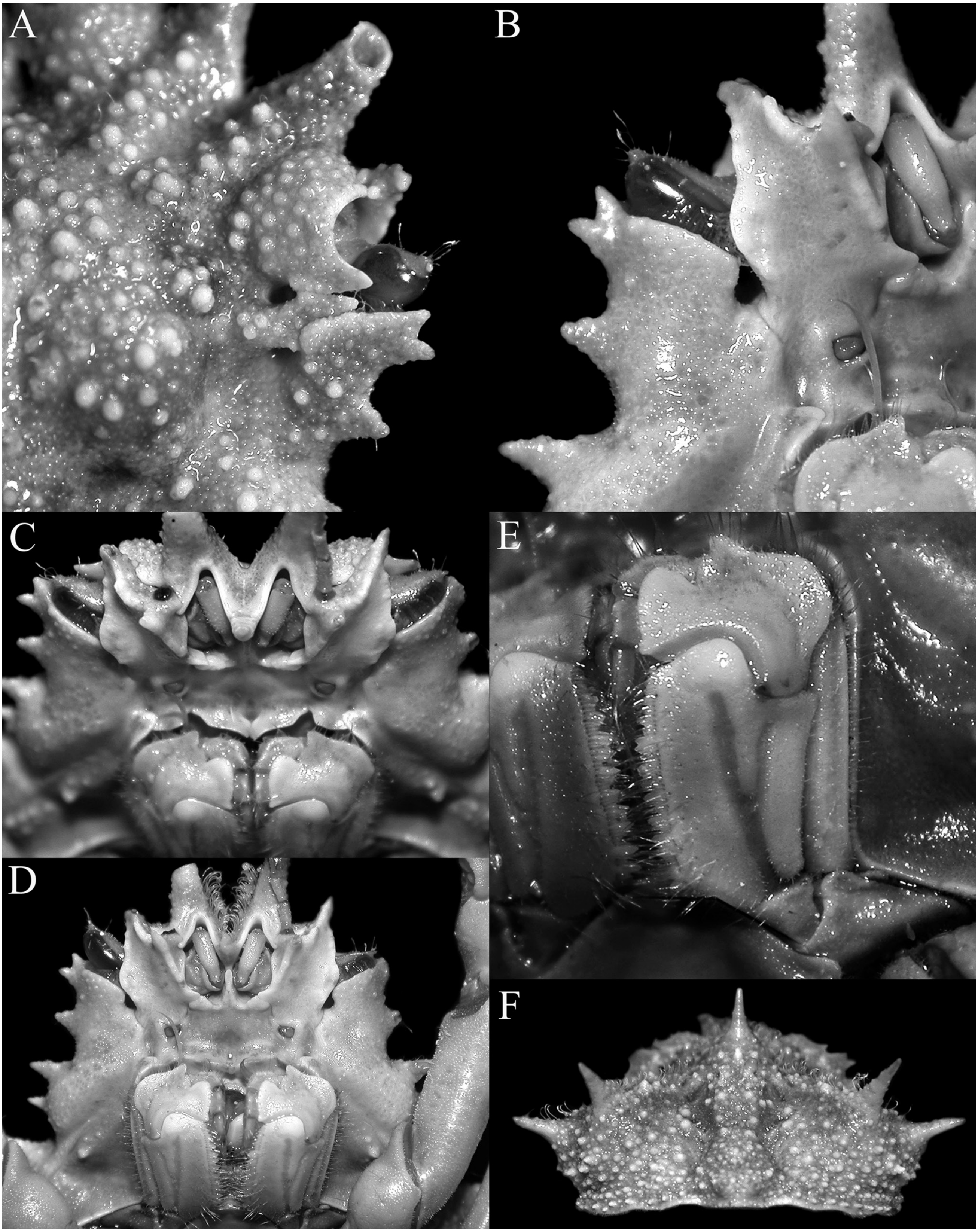

Figure 4. *Leptomithrax lowryi* sp. nov., holotype male (cl 40.7 mm, pcl 34.3 mm) (MNHN-IU-2022-187), New Caledonia: (*A*) right side of orbital region (dorsal view); (*B*) right side of orbital region (ventral view); (*C, D*) epistome, antennae, antennules, buccal cavity and third maxillipeds; (*E*) left third maxilliped; (*F*) posterior view of carapace.

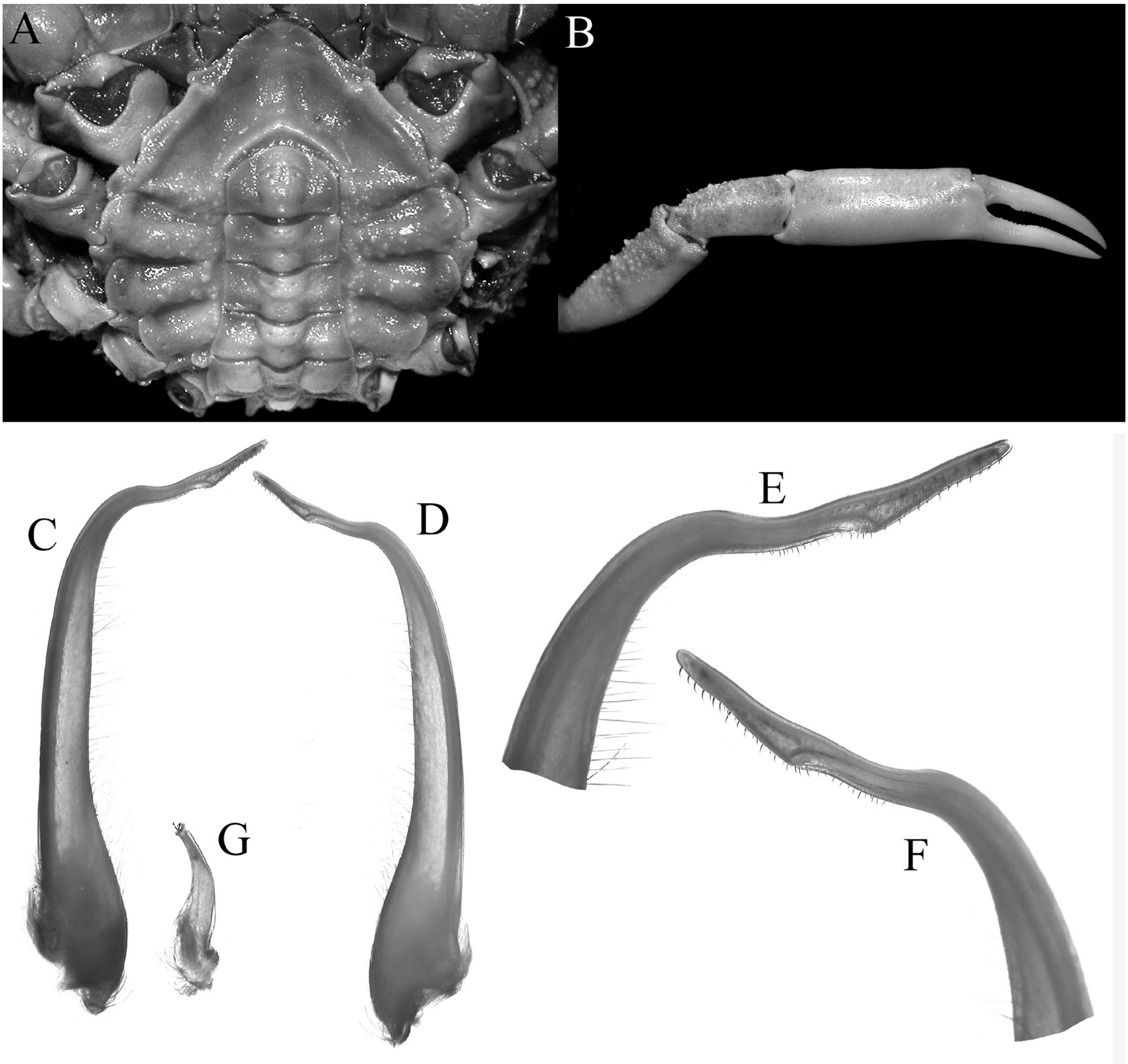

Figure 5. *Leptomithrax lowryi* sp. nov., holotype male (cl 40.7 mm, pcl 34.3 mm) (MNHN-IU-2022-187), New Caledonia: (*A*) thoracic sternum and pleon; (*B*) right cheliped; (*C*) left G1 (ventral view); (*D*) left G1 (dorsal view); (*E*) distal part of left G1 (ventral view); (*F*) distal part of left G1 (dorsal view); (*G*) G2.

of surface smooth; chela slender, surfaces smooth; fingers shorter than palm, almost straight, cutting margins with denticles; proximal part of cutting margin of dactylus with low concavity, followed by low, wide tooth (Figs 2, 3D, 5B).

Ambulatory legs, especially meri, proportionately long; first leg longest, fourth leg shortest; merus subcylindrical, dorsal margin smooth, distal angle of dorsal margin angular but not spiniform or dentiform; propodus longer than dactylus; dactylus gently curved with corneous tip (Figs 2, 3D).

Thoracic sternites 1–4 completely fused; proximal part of sternite 4, median surface of sternites 5 and 6 with low granules; median longitudinal ridge on sternites 3 and 4 relatively low, with lateral surfaces shallowly but distinctly excavated; distal part of sternopleonal cavity demarcated by relatively sharp C-shaped ridge; part of sternite 8 exposed when male pleon closed (Fig. 5A).

Male pleon subrectangular in shape, with 6 free somites and telson; telson subpentagonal with convex distal margin; somite 3 widest, reaching coxae of last ambulatory legs; somite 4 trapezoidal; somites 5 and 6 rectangular; (Fig. 5A).

G1 slender, distal one-third curving outwards; distal part relatively long, gently sinuous, ventral margin lined with distinct spinules (Figs 5C–F, 6A–C). G2 short, *ca.* one-fifth length of G1; tip cup-like with very short flagellum (Fig. 6D).

Colour. Dorsal surfaces orange (Fig. 1).

Etymology. This species is named in honour of our friend and colleague James (Jim) Kenneth Lowry from the Australian Museum. A prolific taxonomist of peracarids, especially amphipods of the superfamily Lysianassoidea, he was also responsible for an important revision of the giant deep-sea isopods of the genus *Bathynomus* A. Milne-Edwards, 1879.

Remarks. Griffin & Tranter (1986: 208) divided *Leptomithrax* into several species groups, separated by various carapace and third maxilliped features. One group, with

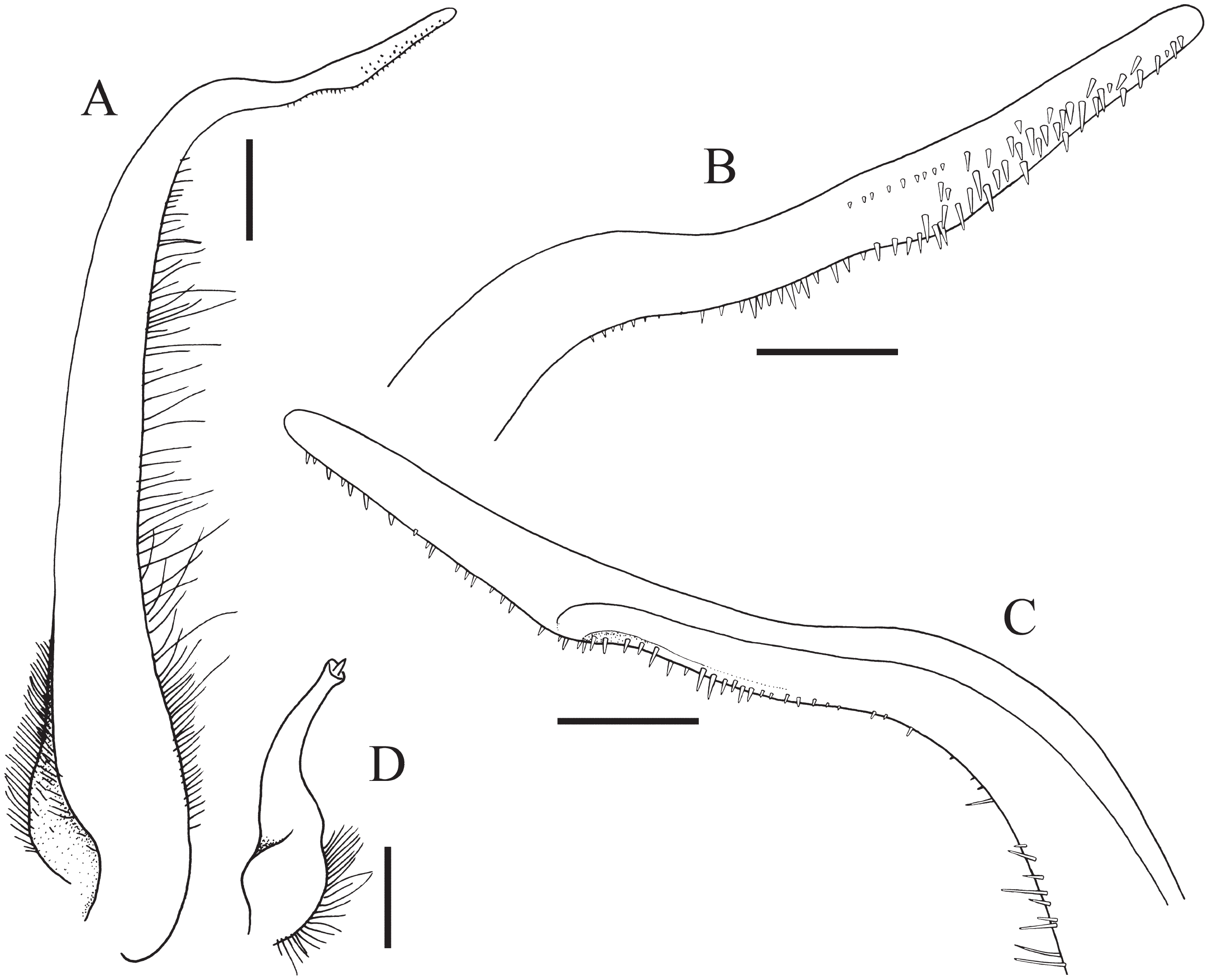

Figure 6. *Leptomithrax lowryi* sp. nov., holotype male (cl 40.7 mm, pcl 34.3 mm) (MNHN-IU-2022-187), New Caledonia: (*A*) left G1 (ventral view); (*B*) distal part of left G1 (ventral view); (*C*) distal part of left G1 (dorsal view); (*D*) G2. Scales: A, D = 1.0 mm; B, C = 0.5 mm.

L. sternocostulatus and *L. bifidus*, has the distal part of the postorbital tooth truncate or bifid, the intercalated spine is mostly excluded from the rim of the incipient supraorbital margin, the junction of the ischium and merus of the third maxilliped is swollen, and the surfaces of the thoracic sternum and/or pleon are excavated. Griffin & Tranter (1986: 208) placed *L. sinensis* elsewhere as its third maxilliped and sternal conditions were not known, but Wong *et al*. (2018) showed it was close to *L. bifidus* and should also be in this group of species. Two other species, *L. depressus* and *L. eldredgei* also belong to this group.

Leptomithrax sternocostulatus can immediately be separated from other members of this group in that it only has three lateral branchial spines and the excavations on the male thoracic sternum and pleon are very deep with rims around the depressions; all the others have four lateral branchial teeth and the excavations on the ventral surface are distinctly shallower (cf. Grant & McCulloch, 1906: pl. 3 fig. 2; Poore, 2004: figs. 111b, c, 115p). *Leptomithrax depressus* is distinct in that the anterior one-third of the dorsal surface of the carapace is more flattened than any of the congeners and can also be separated from *L. lowryi* sp. nov. in having the male pseudorostral spines proportionately shorter and subparallel (Richer de Forges, 1993: fig. 7a, b) (versus long and distinctly diverging in *L. lowryi* sp. nov.; Fig. 2); the proximal angle of the postorbital tooth is demarcated by a low rounded lobe (Richer de Forges, 1993: fig. 7b) (versus a distinctly dentiform lobe in *L. lowryi* sp. nov.; Fig. 3A, B); the intercalated spine is short, triangular with a rounded tip (Richer de Forges, 1993: fig. 7b) (versus spine longer with a sharp distal part and a more truncate base in *L. lowryi* sp. nov.; Fig. 3A, B); the fourth subdorsal branchial spine is stouter and slightly longer than the third spine (Richer de Forges, 1993: fig. 7b) (versus spine is distinctly longer and more slender in *L. lowryi* sp. nov.; Figs 2, 3A); the ambulatory legs, in particular the meri, are proportionately shorter (Richer de Forges, 1993: fig. 7a) than in *L. lowryi* sp. nov. (Fig. 2); the surface of the merus of the ambulatory legs, especially upper surface, is coarsely granular and uneven (Richer de Forges, 1993: fig. 7b) (versus smooth in *L. lowryi* sp. nov.; Fig. 2); and the distal quarter of the G1 is gently curved (Richer de Forges, 1993: fig. 7c) (versus distal part of the G1 is sinuous in *L. lowryi* sp. nov.; Figs 5C–F, 6A–C).

Leptomithrax eldredgei can be separated from *L. lowryi* sp. nov. by the more slender carapace and the proportionally shorter lateral branchial spines (compare Richer de Forges &

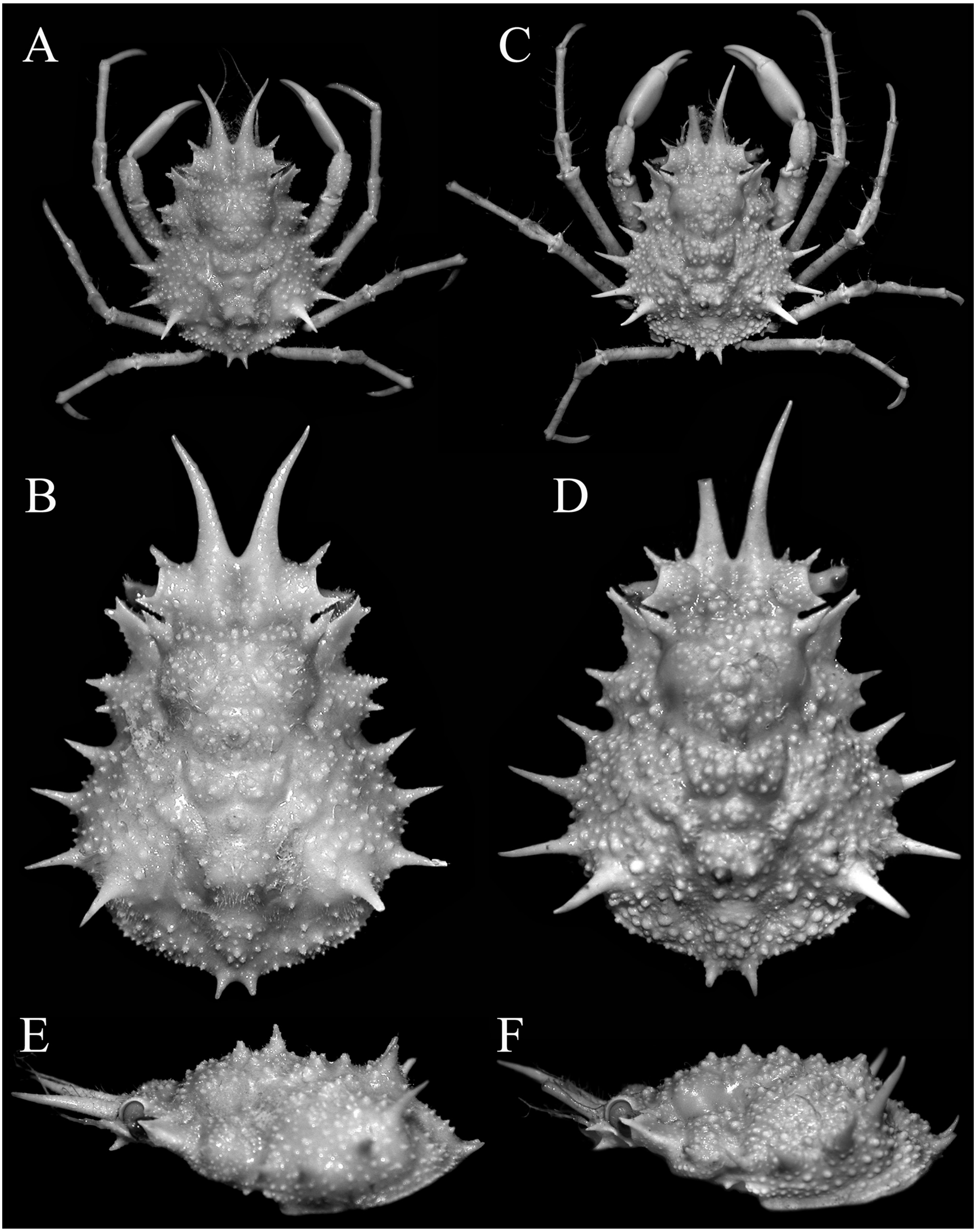

Figure 7. (*A, B, E*) *Leptomithrax bifidus* male (pcl 18.0 mm) (ZRC 2014.0354), Japan; (*C, D, F*) *Leptomithrax sinensis* male (pcl 32.1 mm, pcw 40.6 mm) (ZRC 2018.0726), Japan. (*A, C*) overall dorsal view; (*B, D*) dorsal view of carapace; (*E, F*) lateral view of cephalothorax.

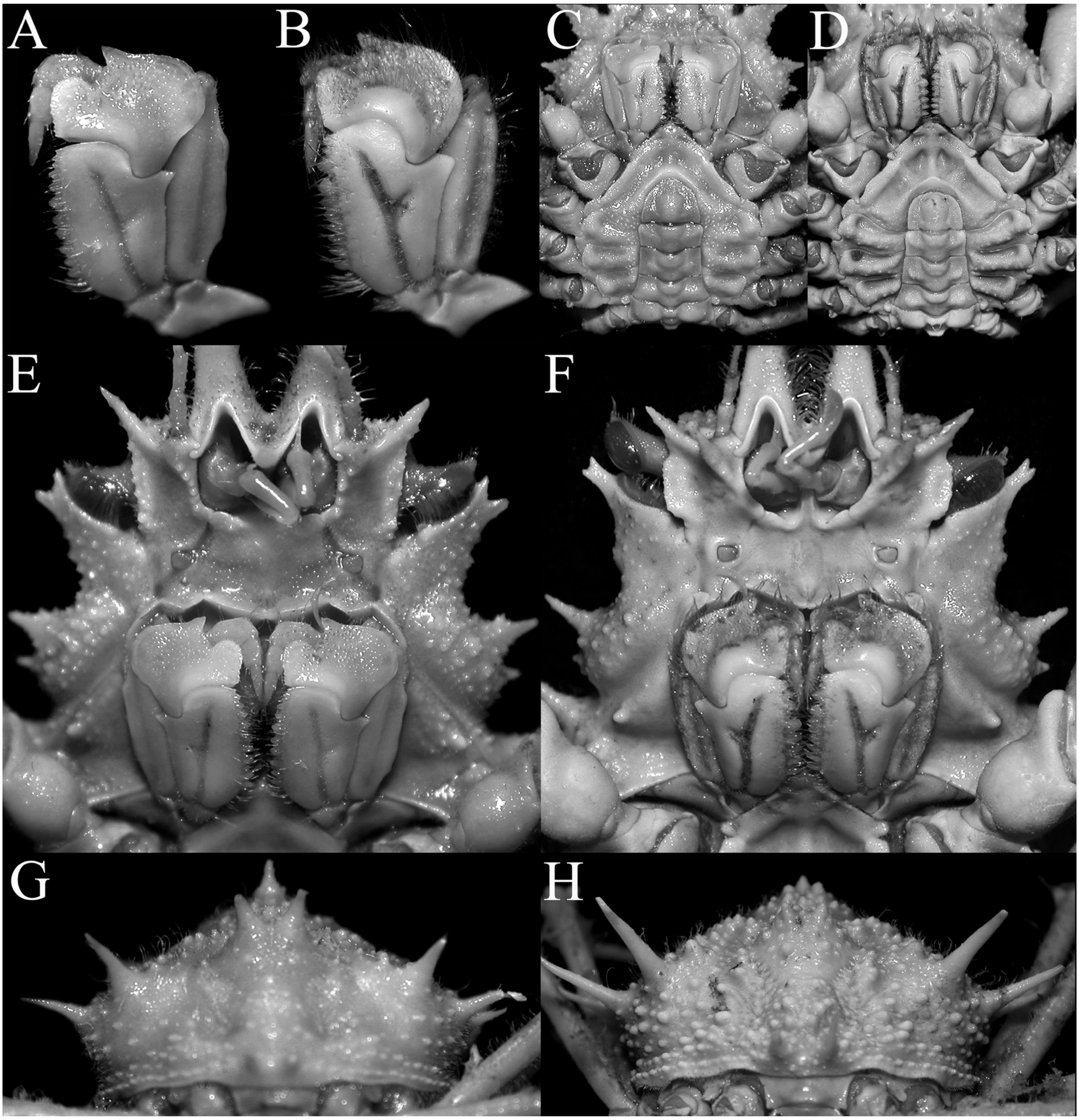

Figure 8. (*A, C, E, G*) *Leptomithrax bifidus* male (pcl 18.0 mm) (ZRC 2014.0354), Japan; (*B, D, F, H*) *L. sinensis* male (pcl 32.1 mm, pcw 40.6 mm) (ZRC 2018.0726), Japan. (*A, B*) left third maxilliped; (*C, D*) thoracic sternum and pleon; (*E, F*) epistome, antennae, antennules, buccal cavity and third maxillipeds; (*G, H*) posterior view of carapace.

Ng, 2015: fig. 1A with Figs 2, 3A); the male pseudorostral spines are proportionately shorter and subparallel (Richer de Forges & Ng, 2015: fig. 1A, D) (versus long and distinctly diverging in *L. lowryi* sp. nov.; Fig. 2); the postorbital tooth appears foliaceous and almost entire, with the distal angle marked by a low bifurcation and the posterior angle broad and rounded (Richer de Forges & Ng, 2015: fig. 1A) (versus distal and proximal parts separated by deep cleft, the proximal angle marked by a distinct tooth in *L. lowryi* sp. nov.; Fig. 3A, B); the submedian sulcus on ischium of third maxilliped is almost entire and the anteroexternal angle has a sharp tooth (Richer de Forges & Ng, 2015: fig. 1C) (versus the sulcus on the ischium is Y-shaped with the anteroexternal angle rounded in *L. lowryi* sp. nov.; Fig. 4E); and the distal part of the G1 is gently curved and proportionately shorter (Richer de Forges & Ng, 2015: fig. 2) (versus distal part of the G1 is sinuous in *L. lowryi* sp. nov.; Figs 5C–F, 6A–C).

The morphology of *Leptomithrax lowryi* sp. nov. appears to be closest to two east Asian species, *L. bifidus* Ortmann, 1893 and *L. sinensis* Rathbun, 1916 (Figs 7–9). The identity of *L. sinensis* was clarified by Richer de Forges & Ng (2015) from the type which is a dried carapace; with Wong *et al*. (2018) redescribing the species from fresh material from Taiwan and Japan and comparing it at length with *L. bifidus*.

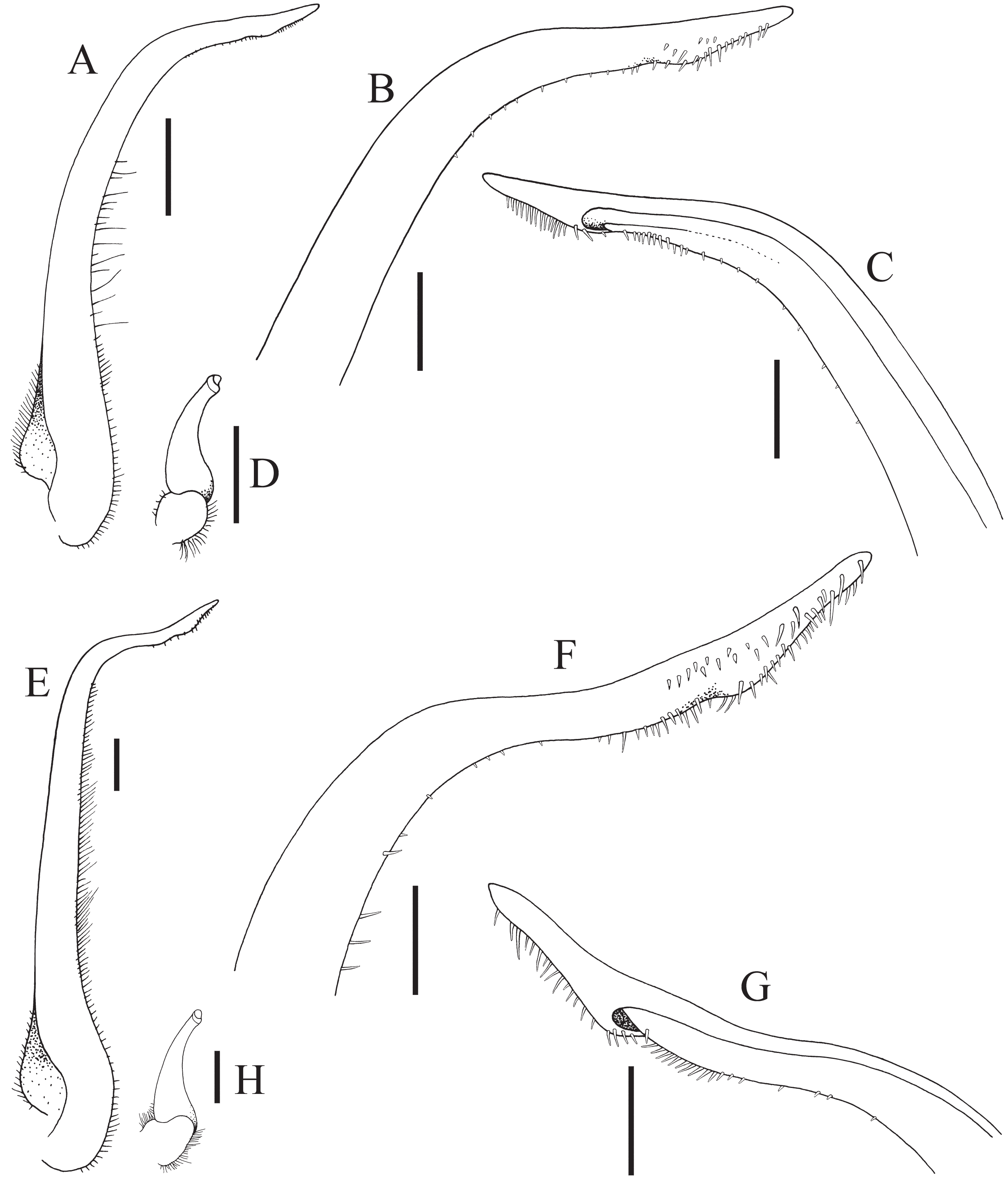

Figure 9. (*A–D*) *Leptomithrax bifidus* male (pcl 18.0 mm) (ZRC 2014.0354), Japan; (*E–G*) *L. sinensis* male (pcl 32.1 mm, pcw 40.6 mm) (ZRC 2018.0726), Japan. A, E, left G1 (ventral view); B, F, distal part of left G1 (ventral view); C, G, distal part of left G1 (dorsal view); D, H, G2. Scales: A, D, E, H = 1.0 mm; B, C, F, G = 0.5 mm.

Leptomithrax lowryi sp. nov. differs from the two species in that its carapace is proportionately wider posteriorly (Figs 2, 3A) than in *L. bifidus* and *L. sinensis* (Fig. 7A–D); the posterolateral spines are relatively stout (Fig. 3A) (versus more slender in *L. bifidus* and *L. sinensis*, Fig. 7B, D); the intercalated spine is blunt (Fig. 3A, B) (versus sharp in *L. bifidus* and *L. sinensis*, Fig. 8E, F); the pseudorostral spines are less curved and diverging (Figs 2, 3A) (versus more curved and clearly diverging in *L. bifidus* and *L. sinensis*, Fig. 7B, D); the deep furrow on the ischium of the third maxilliped is distinctly Y-shaped with the outer branch about three-quarters the length of the inner one (Fig. 4D, E) (versus furrow weakly Y-shaped with the outer branch less than half the length of the inner one in *L. sinensis* and *L.*

bifidus, Fig. 8A, B, E, F); the surface of the basal antennal article is almost flat (Fig. 4B–D) (versus gently depressed in *L. sinensis* and *L. bifidus*, Fig. 8E, F); the outer margin of the basal antennal article is distinctly convex and smooth (Fig. 4B–D) (versus almost straight, gently convex and may be lined with granules in *L. sinensis* and *L. bifidus*, Fig. 7E, F); and the median longitudinal ridge on fused male thoracic sternites 3 and 4 is relatively low, with the lateral surfaces gently depressed (Fig. 5A) (versus with median longitudinal ridge high, separating the two deep lateral depressions in *L. sinensis* and *L. bifidus*, Fig. 8C, D). The telson of the male of *L. lowryi* sp. nov. resembles that of *L. sinensis*, being subquadrate-subpentagonal in shape (Figs 5A, 8D), whereas that of *L. bifidus* is distinctly more triangular (Fig. 8C). The G1 of *L. lowryi* sp. nov. is distinctly different from that of *L. bifidus* in that the distal part is sinuous rather than gently curved (Figs 5C–F, 6A–C versus Fig. 9A–C). The G1 of *L. lowryi* sp. nov. is most similar to *L. sinensis* except that the distal spinous part is proportionately longer in the former species (Fig. 6A–C versus Fig. 9E–G).

It is noteworthy that *L. lowryi* sp. nov. from New Caledonia is morphologically closest to two East Asian species, *L. bifidus* and *L. sinensis*, rather than to taxa from Australia, viz. *L. tuberculatus, L. sternomaculatus* and *L. depressus* (cf. Griffin, 1966; Richer de Forges, 1993; Poore *et al*., 2008).

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Melita lowryi, a New Species of Melitidae (Crustacea: Amphipoda: Senticaudata) from New Zealand, and the Redescription of *Melita festiva* (Chilton, 1885) from Australia

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ABSTRACT. The identity of *Melita festiva* (Chilton, 1885) is established with the redescription and re-illustration of material collected from near the type locality Port Jackson [Sydney Harbour], New South Wales, Australia. In 1916, Chilton supplemented the original description, using misidentified material from Auckland Harbour, New Zealand. This material is described as *Melita lowryi* sp. nov. *Melita festiva* (Chilton, 1885) was tentatively placed in the genus *Ledoyeromelita* Labay, 2016, based on tenuous evidence and the reasons for the exclusion of *Melita festiva* based on current redescriptions are discussed. *Melita festiva* was previously known only from the type locality. New Australian distribution records extend its range to southern New South Wales and Victoria.

Introduction

Maera festiva Chilton, 1885, was described using material from Sydney Harbour. Chilton's original description was based on incomplete specimens and only the antennae and gnathopods were described and only the gnathopods were illustrated. The description was inadequate by modern standards to correctly assign the genus, particularly with respect to mouth parts. The species was tentatively assigned to the genus *Maera* Leach, 1814 due to the absence of third uropods (Chilton, 1885: 1029). Later, Chilton (1916: 359) obtained specimens from Rangitoto Reef, Auckland Harbour, New Zealand, which he believed were identical to *Maera festiva* from Sydney Harbour, but the presence of *Melita*-like third uropods inclined Chilton (1916) to assign *Maera festiva* to the genus *Melita* Leach, 1814. The Rangitoto Reef material together with the description and illustrations, were used to supplement the original description but were based on misidentified specimens of a different species. The gnathopods, epimera, and urosome were described but were not critically compared with the original material. Consequently, Chilton overlooked a number of differences between the two taxa. This has led to some confusion in the literature as to the identity of New Zealand material (Hurley, 1954; Barnard, 1972; Fenwick, 1976). Furthermore Chilton's (1885) original material is currently documented as missing (Shaw & Poore, 2016). In order to allay this confusion, *Melita festiva* is redescribed from new material collected from near the type locality and the New Zealand material is described from Chilton's 1916 specimens as *Melita lowryi* sp. nov.

Labay (2016) revised the genus *Melita* and re-assigned many species to other genera. The new genus *Ledoyeromelita* Labay, 2016, was erected (based on *Melita excavata* Ledoyer, 1979) to which *Melita festiva* (Chilton, 1885) was tentatively assigned as *Ledoyeromelita festiva* (Chilton, 1885). Labay

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(2016: 49) offers no explanation of the reasons for this decision other than "some of characteristics of this species are similar to *Melita excavata* Ledoyer, 1979". The present redescription of *Melita festiva* (Chilton, 1885) gives clarity to the identity of the species and confirms its place in the genus *Melita*.

Materials and methods

Material used in this study is lodged in the Australian Museum, Sydney (AM), Canterbury Museum, Christchurch, New Zealand (CMNZ) and Museums Victoria, Melbourne (NMV). Collections from the Australian Museum were fixed in 5% formalin and later transferred to 80% ethanol. Specimens were dissected in 80% ethanol. Permanent slides were made using polyvinyl lactophenol mounting agent. Chilton's New Zealand material consisted of a male and a female specimens mounted in Canada Balsam on glass slides (Shaw & Poore, 2016). The male specimen is fully dissected and mounted on 5 slides. The carcass is missing. The head of the male specimen is of similar size to that of the female specimen and therefore it is reasonable to estimate the body size of the male to be similar to the female specimen.

Illustrations were made using a Leitz Laborlux K, Wilde M20 and Wilde M5A stereomicroscopes fitted with camera lucida. The **bold** parts of the species descriptions are diagnostic characters. The terminology for spines and setae follows Watling (1989). The following abbreviations are used on the plates: A, antenna; H, head; i, incisor; UL, labrum; MD, mandible; LL, labium; MX, maxilla; MP, maxilliped; C, coxa; G, gnathopod; p, palp; P, pereopod; EP, epimeron; T, telson; U, uropod; UR, urosomite; L, left; R, right.

Systematics

Hadzioidea S. Karaman, 1943

Melitidae Bousfield, 1973

Melita Leach, 1814

Melita Leach, 1814: 403.—Sars, 1895: 507 (part).—Stebbing, 1906: 421 (part).—Chevreux & Fage, 1925: 227 (part).—Gurjanova, 1951: 746 (part).—Karaman, 1981: 41.—Barnard J. L., 1969: 245 (part).—Bousfield, 1973: 64.—Barnard & Barnard, 1983: 663–666 (part).—Jarret & Bousfield, 1996: 51.—Labay, 2016: 47.
Caliniphargus Stout, 1913: 640.
Megamoera Bate, 1862: 224 (part).

Type species. *Cancer palmatus* Montagu, 1804.

Diagnosis. (Modified from Jarret & Bousfield, 1996 and Labay, 2016). Head, with antero-ventral notch or slit, anterior and posterior lobes rounded. Pleonite segments usually lacking dorsal teeth. Urosomite 1 with or without dorsal mid-line spine. Urosomite 2 with paired dorsal spines and/or robust setae in 2 groups. Mandible left lacinia mobilis 4-dentate; palp well developed, 3-articulate, articles 2 and 3 with terminal and marginal setae. Maxilla 1, inner plate sub rectangular, elongate, with truncate or rounded distal margin, with apical setae, outer plate with 9 apical robust setae. Maxilla 2, inner plate with distal marginal setae, oblique setal row absent. Maxilliped plates strong; palp article 2 sublinear; article 3 bilobed; dactyl stout, curved. Gnathopod 1, sexually dimorphic or not, subchelate. Gnathopod 2 sexually dimorphic, subchelate; pereopod 6 coxa sexually dimorphic. Epimeron 3, hind corner moderately produced, acute or with small tooth, ventral margin smooth or weakly serrate. Uropod 1, peduncle with basofacial robust seta; Uropod 3, inner ramus scale-like; outer ramus, much longer than peduncle, 1 or 2-articulate, article 2 short. Telson deeply cleft, lobes terminally subacute, each with 2–3 robust setae.

Remarks. According to Labay (2016) and Horton *et al*. (2022) there are currently 57 species in the genus *Melita*. This paper reinstates one species and adds one new species to bring the total to 59 species. Further investigation of poorly described historical species of *Melita* is required to resolve some taxonomic issues but is outside the scope of this work.

Melita festiva (Chilton, 1885)

Figs 1–4

Maera festiva Chilton, 1885: 1037, pl. 46, fig. 2a–c.—Stebbing, 1910: 642.
Maera rubromaculata Haswell, 1885: 105 (in part).
Ceradocus rubromaculata Della Valle, 1893: 720 (in part).—Stebbing, 1906: 431, 732 (in part).
Melita festiva.—Sheard, 1937: 24 (list).—J. L. Barnard, 1972: 117 (in part = *M. lowryi* sp. nov.).—Barnard & Barnard, 1983: 665.—Zeidler, 1989: 335.—Lowry & Springthorpe, 2005: 238, tab. 1.
Abludomelita festiva.—Karaman, 1981: 40.
Ledoyeromelita festiva.—Labay, 2016: 65.
Not *Melita festiva*.—Chilton, 1916: 359, figs 1–2.—Hurley, 1957: 6.—Fenwick, 1976: 2. (= *M. lowryi* sp. nov.).

Syntypes: 2 specimens (2 micro slides), CMNZ, Sydney Harbour, New South Wales, Australia (catalogued but currently missing, Shaw & Poore, 2016: 32); 1 male, 1 female (wet specimens in alcohol), CMNZ 2015.149.154–155, Sydney Harbour, New South Wales, Australia, 1 January 1884 (labelled as "cotypes").

Additional material examined. *New South Wales*: 1 male, 10.4 mm (dissected, carcass, and 4 micro slides), AM P.18120, Bottle and Glass Rocks, Port Jackson, *ca.* 33°50.9'S 151°16.2'E, between tide marks, 28 July 1923, coll. A. A. Livingstone; 1 male (9.7 mm), 1 ovigerous female (6.7 mm), 3 females (5.8–8.5 mm), AM P.5333, Coogee, 33°55'S 151°16'E, coll. F. A. McNeill; 4 males (3.3–8.3 mm), 1 ovigerous female (6.7 mm), 5 females (3.3–8.5 mm), AM P.36647, Murrumbulga Point, Twofold Bay, 37°04.7'S 149°53.1'E, gravel and algae, S. J. Keable & J. T. van der Velde, 9 October 1984, station Q11; 1 male (8.3 mm; carcass and 3 micro slides), AM P.55021, Murrumbulga Point, Twofold Bay, 37°04.7'S 149°53.1'E, gravel and algae, S. J. Keable & J. T. van der Velde, 9 October 1984, station Q11; 1 ovigerous female (6.7 mm; dissected, carcass, and 2 micro slides), AM P.55022, Murrumbulga Point, Twofold Bay, 37°04.7'S 149°53.1'E, gravel and algae, 9 October 1984, coll. S. J. Keable & J. T. van der Velde, station Q11; 1 male (5.4 mm), 1 female (5.8 mm), AM P.55118, Murrumbulga Point, Twofold Bay, 37°04.7'S 149°53.1'E, subtidal rock platform, 2–9 m, S. J. Keable & E. A. Bamber, 11 December 1984, station Q2; 2 males (4.2–5.4 mm), AM P.55119, Murrumbulga Point, Twofold Bay, 37°04.7'S 149°53.1'E, kelp holdfast, subtidal rock platform, 3 m, S. J. Keable & E. A. Bamber, 11 December 1984, station Q2; 1 female (6.7 mm), AM P.55120, Murrumbulga Point, Twofold Bay, 37°04.7'S 149°53.1'E, subtidal rock platform, P. A. Hutchings, 9 October 1984, station Q5; 1 male (4.2 mm), 2 females (7.5–7.9 mm), AM P.106019, Murrumbulga Point, Twofold Bay, 37°04.7'S 149°53.1'E, P. A. Hutchings & S. J. Keable, 17 September 1985, station Q7; 1 female (4.2 mm), AM P.106020, Twofold Bay, Murrumbulga Point, 37°04.7'S 149°53.1'E, S. J. Keable & E. A. Bamber, 11 December 1984, station Q18.

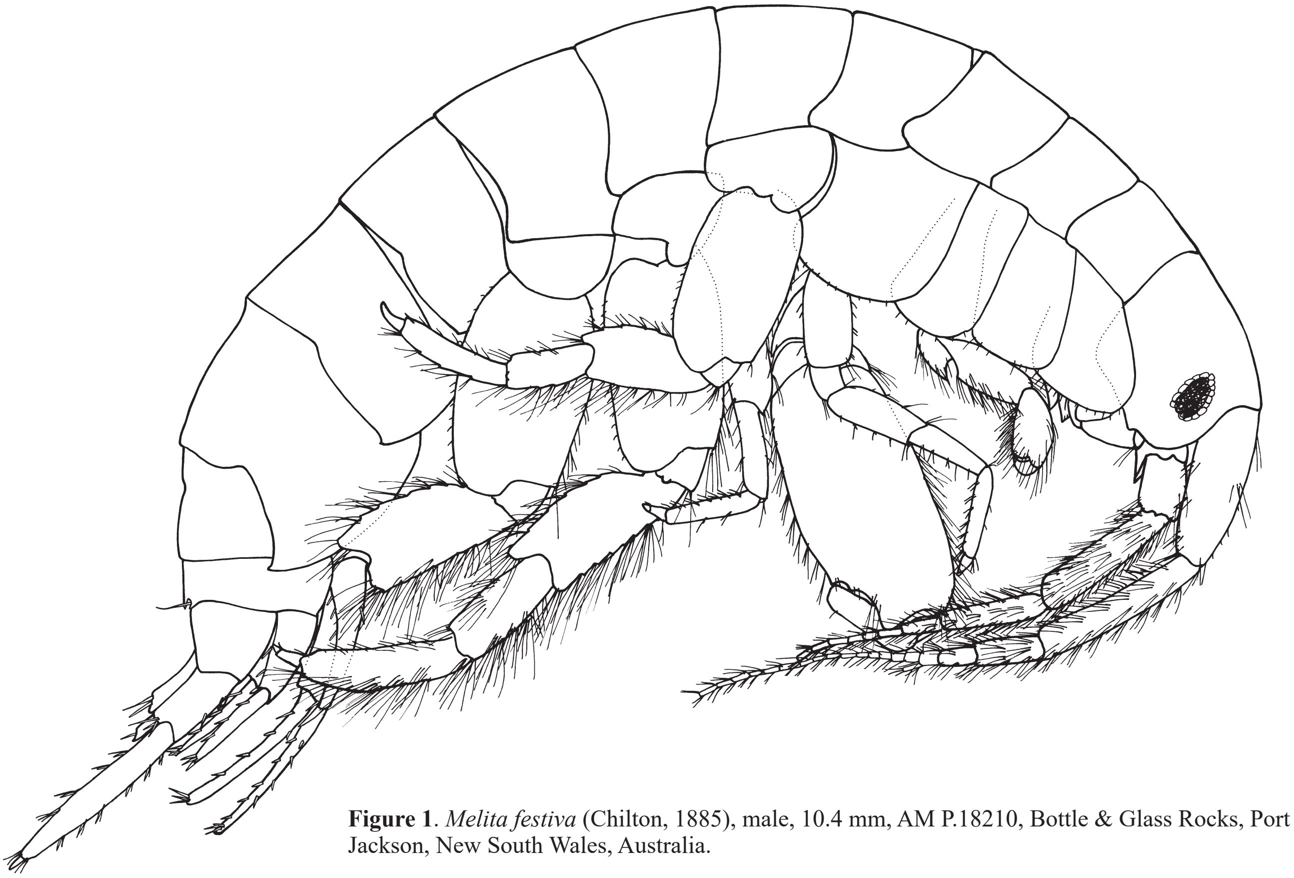

Figure 1. *Melita festiva* (Chilton, 1885), male, 10.4 mm, AM P.18210, Bottle & Glass Rocks, Port Jackson, New South Wales, Australia.

Australian Commonwealth Territory: 1 specimen (5.4 mm), AM P.92920, Murrays Beach, Jervis Bay, 35°07.5'S 150°45.5'E, hand collected, sponge-encrusted dead barnacles 0.5 m, 28 June 1981, H. E. Stoddart, station MI NSW 52.

Victoria. 2 males, 6 females, NMV J13115, off Crib Point, Western Port, 38°20.56'S 145°15.06'E, Smith-McIntyre grab, 2 m, coll. A. J. Gilmour, 5 April 1965, station CPBS-N 03; 1 male, NMV J13116, off Crib Point, Western Port, 38°20.83'S 145°13.5'E, Smith-McIntyre grab, 13 m, coll. A. J. Gilmour, 23 March 1965, station CPBS-N 32; 1 female, NMV J13117, off Crib Point, Western Port, 38°20.56'S 145°15.06'E, Smith-McIntyre grab, 2 m, coll. A. J. Gilmour, 5 April 1965, station CPBS-N 03; 1 male, 1 female, NMV J13118, off Crib Point, Western Port, 38°21'S 145°13.8'E, Smith-McIntyre grab, 11 m, coll. A. J. Gilmour, 12 October 1964, station CPBS-B 4; 1 male (7.9 mm), 1 ovigerous female (6.3 mm), AM P.106018, Hayley Point, Mounts Bay, 38°47'S 143°40'E, under stones, rocky shore low tide, R. T. Springthorpe & P. B. Berents, 4 May 1988, station MI VIC-69.

Type locality. Sydney Harbour, New South Wales, Australia, *ca.* 33°51.55'S 151°13.35'E.

Description. **Male** (based on male, 10.4 mm, AM P.18120).

Head. Anteroventral margin with large notch on anteroventral corner, anteroventral corner rounded; eyes present, well developed. Antenna 1 longer than antenna 2, peduncular article 1 shorter than 2 with 3 robust setae along posterior margin, article 2 longer than article 3; accessory flagellum 6- or 7-articulate; flagellum 31+ articulate. Antenna 2 peduncular article 4 subequal to article 5; flagellum strongly setose, 13-articulate. Mandible molar large, setal row well developed; palp well-developed, 3-articulate; article 1 not produced distally, length 0.5 times article 2, article 2 length 0.8 times article 3 with several marginal setae, article 3 rectilinear with a bunch of apical setae and several marginal setae. Maxilla 1 inner plate long, subrectangular, with 8 apical plumose setae, outer plate with 9 apical setal teeth, palp 2-articulate, slightly curved with numerous apical and subapical setae. Maxilla 2 inner plate without oblique setal row on inner face, with marginal setal row. Maxilliped plates strong, palp article 2 rectilinear, dactyl curved.

Pereon. Coxae 1–3 without posteroventral cusp. **Gnathopod 1 not sexually dimorphic**, subchelate; coxa anteroventral corner produced, rounded, anterior margin slightly concave; carpus about 2 times longer than broad, length 1.2 times propodus; propodus small, linear, without hump along anterior margin, without anterodistal projection or hood, posterodistal margin not swollen, palm acute and convex, entire, without anterodistal projection near base of dactylus; dactylus articulating distinctly with propodus, well developed, fitting palm, posterior margin not swollen at base. **Gnathopod 2** significantly enlarged in male, sexually dimorphic; left and right gnathopods subequal in size, subchelate; merus with sharply produced posterodistal process; carpus compressed, length about 0.5 times breadth, posterior margin lobate; **propodus expanded, with numerous rows of dense setae medially and along anterior and posterior margins, palm acute, with a row of robust setae along lateral margin, with large truncate mid palmar tooth, posterodistal corner defined by large tooth and 2 robust setae medially and laterally; dactylus apically truncate, hammer-like,** closing along palm. Pereopod 4 smaller than pereopod 3, coxa with posteroventral lobe. **Pereopods 5–7** similar in shape; **merus, carpus, and propodus with numerous dense bunches of long slender setae along anterior and posterior margins**. Pereopod 5 smaller than pereopods 6–7; basis expanded, posterior margin almost straight, minutely

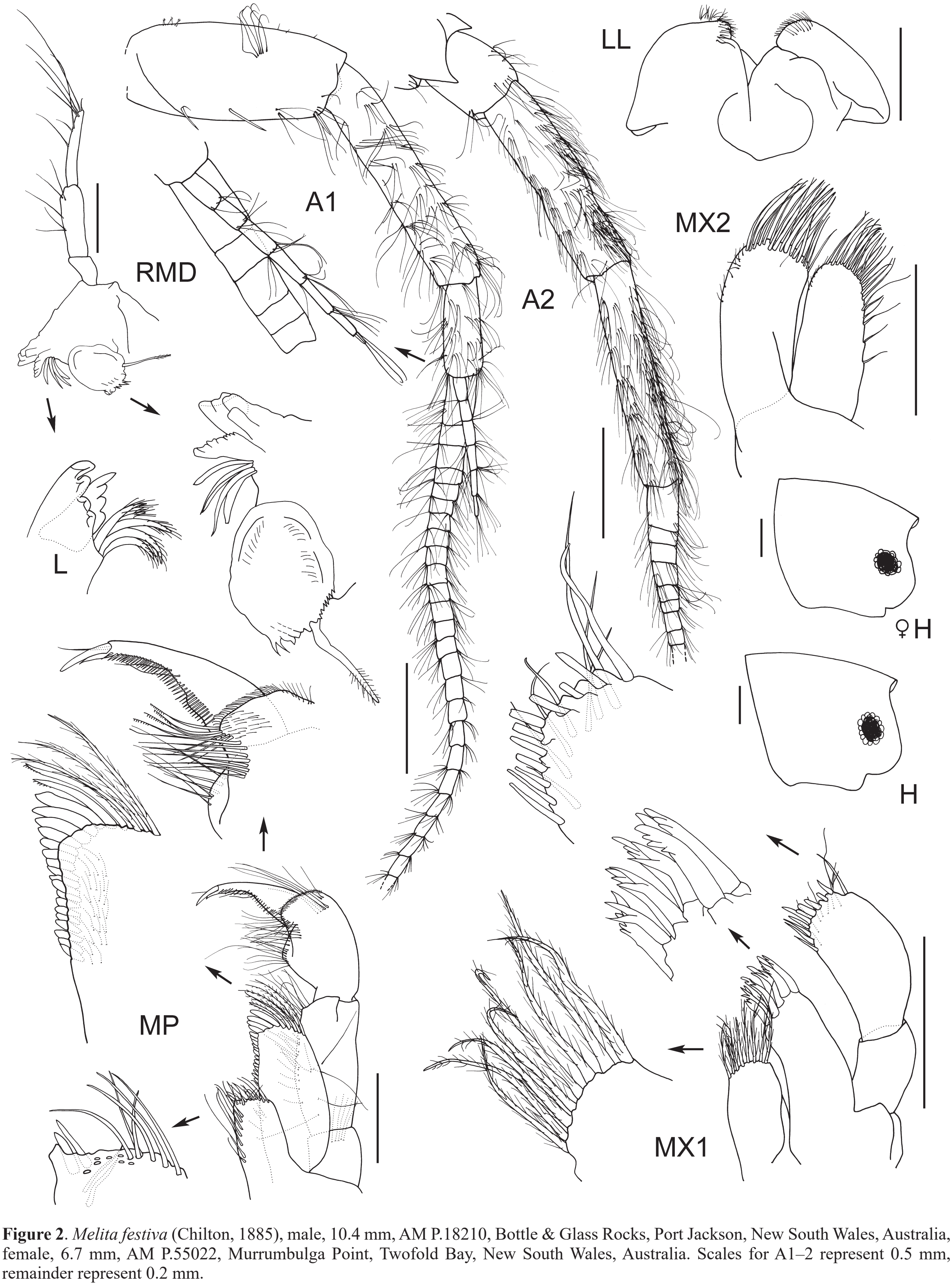

Figure 2. *Melita festiva* (Chilton, 1885), male, 10.4 mm, AM P.18210, Bottle & Glass Rocks, Port Jackson, New South Wales, Australia, female, 6.7 mm, AM P.55022, Murrumbulga Point, Twofold Bay, New South Wales, Australia. Scales for A1–2 represent 0.5 mm, remainder represent 0.2 mm.

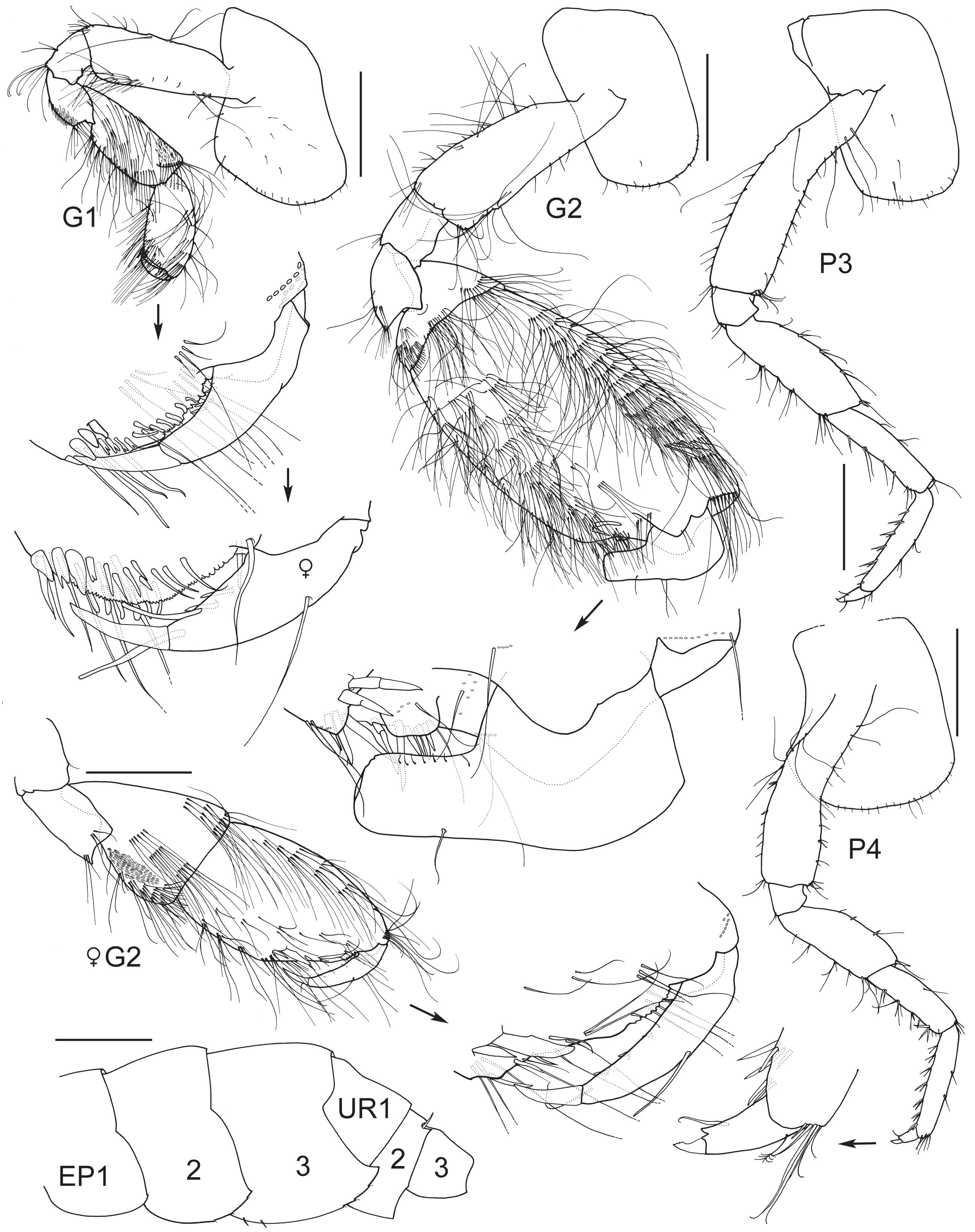

Figure 3. *Melita festiva* (Chilton, 1885), male, 10.4 mm, AM P.18210, Bottle & Glass Rocks, Port Jackson, New South Wales, Australia, female, 6.7 mm, AM P.55022 Murrumbulga Point, Twofold Bay, New South Wales, Australia. Scales represent 0.5 mm.

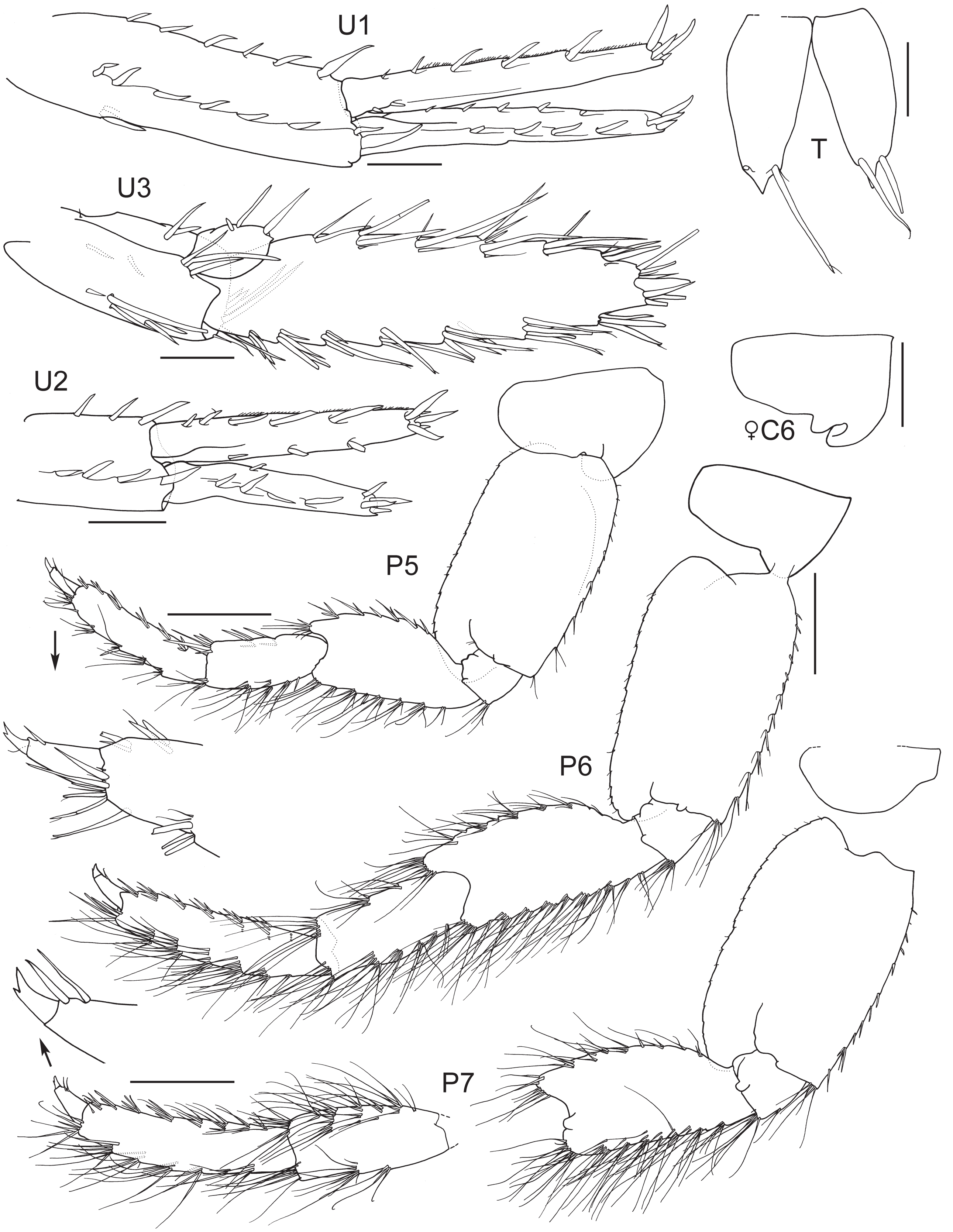

Figure 4. *Melita festiva* (Chilton, 1885), male, AM P.18210, Bottle & Glass Rocks, Port Jackson, New South Wales, Australia, female, 6.7 mm, AM P.55022, Murrumbulga Point, Twofold Bay, New South Wales, Australia. Scales for P5–7 represent 0.5 mm, remainder represent 0.2 mm.

serrate, posteroventral corner broadly rounded; dactylar unguis bifid. Pereopod 6 coxa sexually dimorphic, anterior lobe slightly produced, rounded. Pereopod 7 subequal in size to pereopod 6.

Pleon. Pleonites 1–3 without dorsal teeth, spines or setae. Epimeron 1 posteroventral corner subquadrate. Epimeron 2 posteroventral corner subquadrate. **Epimeron** 3 posterior margin smooth, **ventral margin serrate along posterior quarter**, posteroventral corner with strongly produced acute tooth. **Urosomite 1 without dorsal mid-line spine**. Urosomite 2 with 4 dorsal spines with 2 dorsal robust setae in 2 groups. Uropod 1 peduncle with basofacial robust seta. **Uropod** 3 inner ramus scale-like, much shorter than outer ramus; **outer ramus length 4.5 times breadth,** 2-articulate, article 2 short. **Telson** deeply cleft, **as long as broad**, lobes apically acute with 2 subapical robust setae on each lobe, **inner and outer margins lacking setae**.

Female (Sexually dimorphic characters). Based on female, 6.7 mm, AM P.55022. Oostegites linear, sparsely setose, present on gnathopod 2 and pereopods 3–5. **Gnathopod 2** carpus short, length 1.4 times breadth, posterior margin not lobate; **propodus** subovate, **length 1.2 times carpus, palm** acute, **corner defined by subquadrate tooth and 2 robust setae**; dactylus apically acute, closing along palm. Pereopod 6 coxa anterior lobe slightly produced, bilobate.

Habitat. Marine, rocky intertidal to 11 m depth.

Remarks. *Melita festiva* (Chilton, 1885) is distinguished from almost all other species of *Melita* by the distinctive second gnathopod in the male having an inflated sub-ovoid propodus and heavy, hammer-like, distally truncate dactyl. *Melita festiva* (Chilton, 1885) and *Melita lowryi* sp. nov. appear superficially similar in the form of male gnathopod 2. *Melita festiva* differs from *Melita lowryi* sp. nov., in the heavily setose gnathopod 2 and pereopods 5 to 7, gnathopod 2 propodus palm having a single subquadrate tooth (2 teeth in *M. lowryi*), urosomite 1 lacking dorsal mid-line spine (with dorsal mid-line spine in *M. lowryi*), uropod 3 outer ramus shorter than in *M. lowryi* and telson without medial setae (1 seta per lobe in *M. lowryi*).

Distribution. Australia. New South Wales: Port Jackson (Chilton, 1885, current study); Twofold Bay (current study). Australian Commonwealth Territory: Jervis Bay (current study). Victoria: Western Port; Mounts Bay (current study).

Melita lowryi sp. nov.

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Figs 5–7

Melita festiva Chilton, 1916: 359, figs 1, 2.—J. L. Barnard, 1972: 117.
? *Melita festiva*.—Hurley, 1957: 6.—Fenwick, 1976: 2.
Not *Ledoyeromelita festiva*.—Labay, 2016: 65.

Holotype: Male (*ca.* 12.5 mm; 5 micro slides A1–5), CMNZ 2015.149.4190, Rangitoto Reef, Auckland Harbour, New Zealand, 36°47'S 174°49.5'E, under stones, coll. W. R. B. Oliver. **Paratype**: Ovigerous female (12.5 mm; 2 micro slides B1–2), CMNZ 2015.149.4191, same data as holotype.

Type locality. Rangitoto Reef, Auckland Harbour, New Zealand, 36°47'S 174°49.5'E.

Description. Based on holotype male, *ca.* 12.5 mm, CMNZ 2015.149.4190.

Head. Anteroventral margin with large notch on anteroventral corner, anteroventral corner rounded; eyes present, well developed. Antenna 1 longer than antenna 2, peduncular article 1 shorter than 2 with 4 robust setae along posterior margin, article 2 longer than article 3; accessory flagellum 5-articulate; flagellum 20-articulate. Antenna 2 peduncular article 4 subequal to article 5; flagellum strongly setose, 13-articulate. Mandible molar unknown (not present on slides), setal row well developed; palp well-developed, 3-articulate; article 1 not produced distally, length 0.5 times article 2, article 2 length 0.8 times article 3 with several marginal setae, article 3 rectilinear with a bunch of apical setae and several marginal setae. Maxilla 1 inner plate long, subrectangular, with 8 apical plumose setae, outer plate with 9 apical setal teeth, palp 2-articulate, slightly curved with numerous apical and subapical setae. Maxilla 2 inner plate without oblique setal row on inner face, with marginal setal row. Maxilliped plates strong, palp article 2 rectilinear, dactyl curved.

Pereon. Coxae 1–3 without posteroventral cusp. **Gnathopod 1 not sexually dimorphic**, subchelate; coxa anteroventral corner produced, rounded, anterior margin slightly concave; carpus about 2 times longer than broad, length 1.2 times propodus; propodus small, linear, without hump along anterior margin, without anterodistal projection or hood, posterodistal margin not swollen; palm convex, entire, without anterodistal projection near base of dactylus; dactylus articulating distinctly with propodus, well developed, fitting palm, posterior margin not swollen at base. **Gnathopod 2** significantly enlarged in male, sexually dimorphic; left and right gnathopods subequal in size, subchelate; merus with sharply produced posterodistal process; carpus compressed, length about 0.5 times breadth, posterior margin lobate; **propodus expanded, with a few rows of setae along anterior and posterior margins, palm slightly acute, with a row of simple setae along lateral margin, with large truncate mid palmar tooth, and one large rounded proximal tooth**, **posterodistal corner subquadrate with 2 robust setae medially**; **dactylus apically truncate, hammer-like**, closing along palm. Pereopod 4 smaller than pereopod 3, coxa with posteroventral lobe. **Pereopods 5–7** similar in shape; **merus, carpus, and propodus not densely setose, with bunches of slender setae along anterior margin, posterior margin sparsely setose**. Pereopod 5 smaller than pereopods 6–7; basis expanded, posterior margin almost straight, minutely serrate, posteroventral corner broadly rounded; dactylar unguis bifid. Pereopod 6 coxa sexually dimorphic, anterior lobe slightly produced, rounded. Pereopod 7 subequal in size to pereopod 6.

Pleon. Pleonites 1–3 without dorsal teeth, spines or setae. Epimeron 1 posteroventral corner subquadrate. Epimeron 2 posteroventral corner subquadrate. **Epimeron** 3 posterior margin smooth with several minute setae, **ventral margin serrate along posterior half**, with several small robust setae along anterior half, posteroventral corner with strongly produced acute tooth. **Urosomite 1 with one dorsal mid-line spine**. Urosomite 2 with 4 dorsal spines, with 2 dorsal robust setae in 2 groups. Uropod 1 peduncle with basofacial robust seta. **Uropod** 3 inner ramus scale-like, much shorter than outer ramus, **outer ramus long, length 8.5 times breadth**,

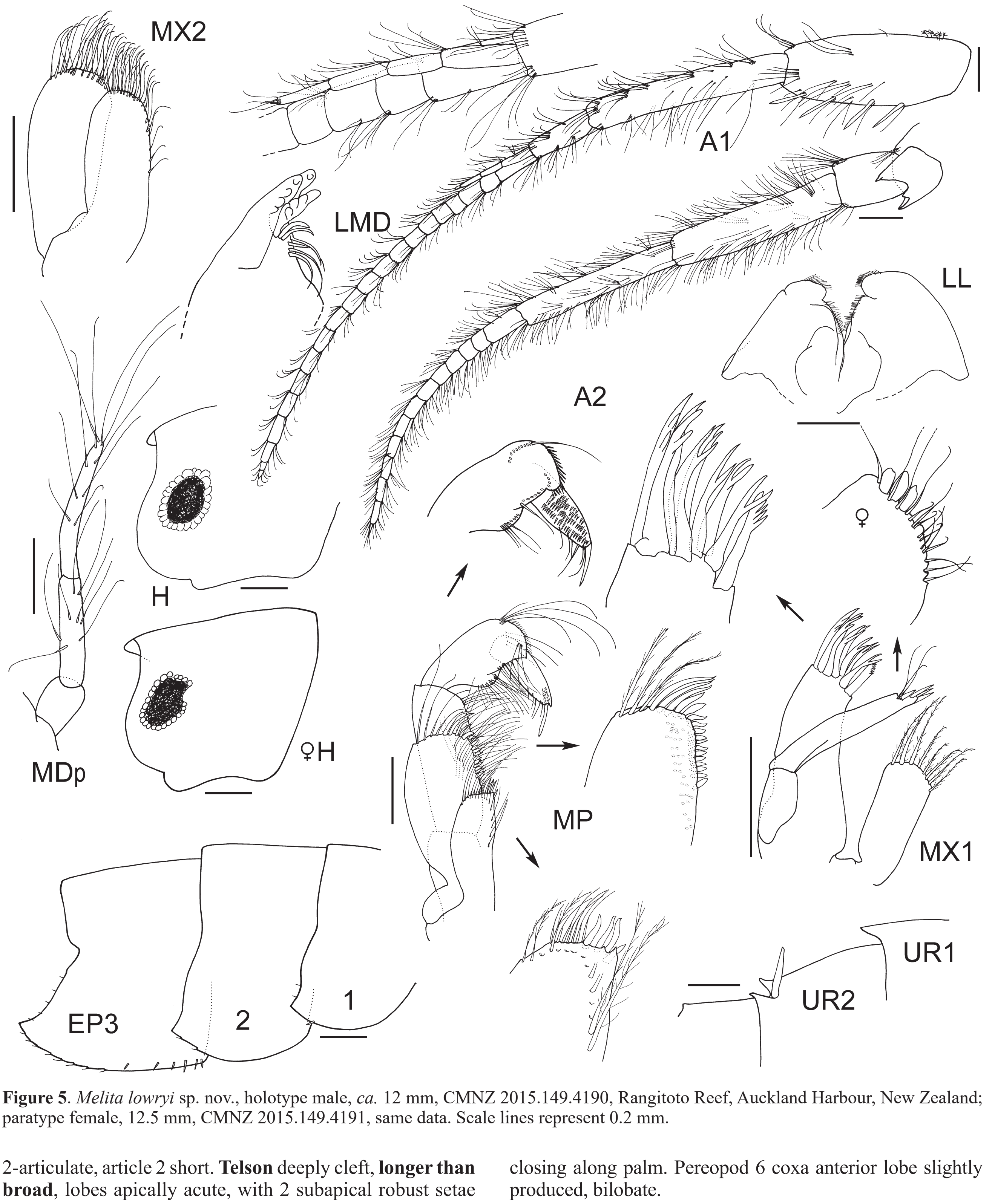

Figure 5. *Melita lowryi* sp. nov., holotype male, *ca.* 12 mm, CMNZ 2015.149.4190, Rangitoto Reef, Auckland Harbour, New Zealand; paratype female, 12.5 mm, CMNZ 2015.149.4191, same data. Scale lines represent 0.2 mm.

2-articulate, article 2 short. **Telson** deeply cleft, **longer than broad**, lobes apically acute, with 2 subapical robust setae on each lobe, robust setae along outer margins absent, **one minute seta on inner margin of each lobe**.

Female (Sexually dimorphic characters). Based on paratype female, 12.5 mm, CMNZ 2015.149.4191. Oostegites linear, sparsely setose, present on gnathopod 2 and pereopods 3–5. **Gnathopod 2** carpus short, length 1.4 times breadth, posterior margin not lobate; **propodus** subovate, **length 1.7 times carpus**, **palm acute, cuspidate**, **corner defined by acute tooth and 2 robust setae**; dactylus apically acute, closing along palm. Pereopod 6 coxa anterior lobe slightly produced, bilobate.

Habitat. Marine, rocky intertidal algae to 11 m depth.

Etymology. Named for Jim Lowry, friend and colleague, for his vast contribution to the taxonomy and natural history of the Amphipoda.

Remarks. The differences between *Melita lowryi* sp. nov. and *Melita festiva* (Chilton, 1885) are discussed under *Melita*

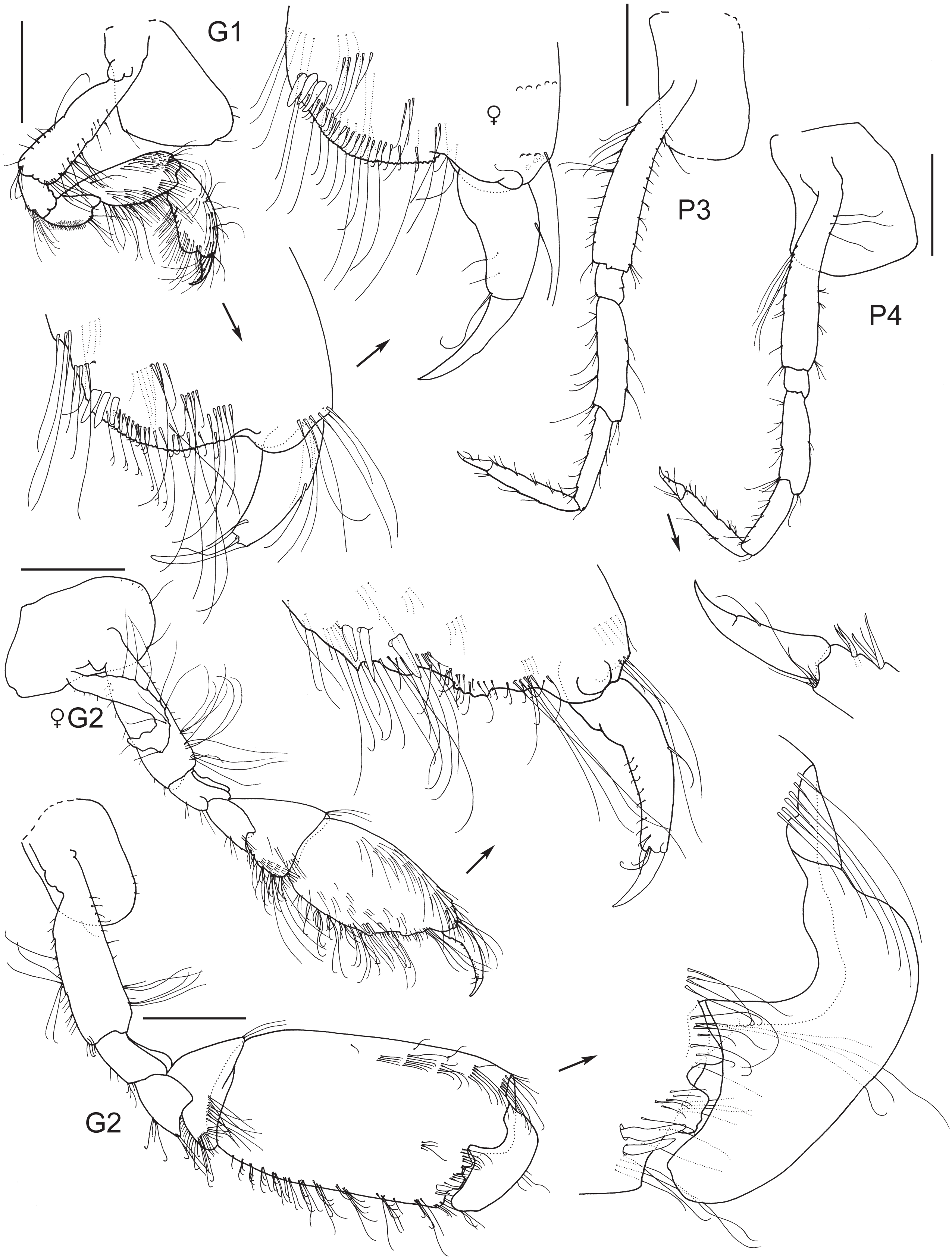

Figure 6. *Melita lowryi* sp. nov., holotype male, *ca.* 12 mm, CMNZ 2015.149.4190, Rangitoto Reef, Auckland Harbour, New Zealand; paratype female, 12.5 mm, CMNZ 2015.149.4191, same data. Scale lines represent 0.5 mm.

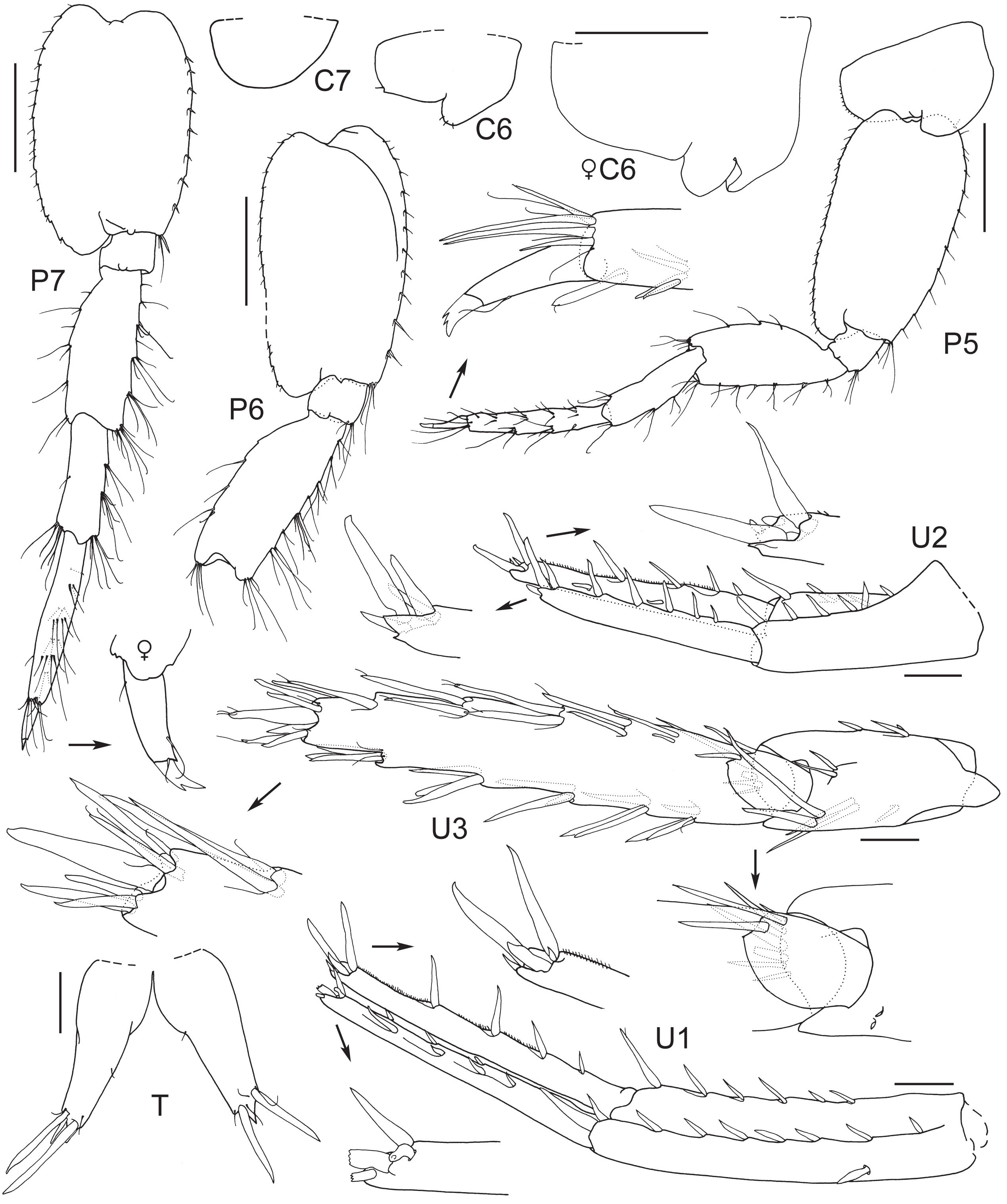

Figure 7. *Melita lowryi* sp. nov., holotype male, *ca.* 12 mm, CMNZ 2015.149.4190, Rangitoto Reef, Auckland Harbour, New Zealand; paratype female, 12.5 mm, CMNZ 2015.149.4191, same data. Scale lines for P5–7 represent 0.5 mm; remainder represent 0.2 mm.

festiva above. Both species can be distinguished from other *Melita* by the shape of gnathopod 2 propodus and dactylus, and the bifid anterior lobe of female coxa 6.

Distribution. New Zealand. Rangitoto Reef, Auckland Harbour, North Island (Chilton, 1916); ?Cook Strait (Hurley, 1957); Kaikoura, South Island (Fenwick, 1976).

Discussion

Labay (2016: 65) erected the genus *Ledoyeromelita* based on *Melita excavata* Ledoyer, 1979 and tentatively assigned *Melita festiva* (Chilton, 1885) to the new genus as *Ledoyeromelita festiva* (Chilton, 1885). Based on the redescription of *M. festiva* presented here, the species must be excluded from the genus *Ledoyeromelita* Labay, 2016 because: head anteroventral corner rounded, lacking acute process (with acute process in *Ledoyeromelita*); pleon segments 1–2 posterodorsal spines absent (present in *Ledoyeromelita*); urosomite 1 with single posterodorsal spine present (1 dorsal and 2 lateral spines in *Ledoyeromelita*); Mandible palp not reduced (reduced in *Ledoyeromelita*), article 3 subequal to 2, article 2 twice length of article 1 (articles 1–2 subequal in *Ledoyeromelita*), palp article 3 with 5 apical setae and 3 marginal setae (2 apical setae only in *Ledoyeromelita*); maxilla 1 inner plate with 9 apical plumose setae (4 setae in *Ledoyeromelita*); maxilla 2 inner plate oblique setal row absent (present in *Ledoyeromelita*); coxae 1–3 cusps on posteroventral margin absent (cusps present in *Ledoyeromelita*); gnathopod 1 basis antero-distal setae present (absent in *Ledoyeromelita*); gnathopod 2 heavily setose with numerous rows of setae on medial surface (absent in *Ledoyeromelita*); pereopods 5 to 7 with numerous setal bunches on merus, carpus, and propodus (setae sparse in *Ledoyeromelita*) and pereopod 6 merus large excavation on anterior margin absent (present in *Ledoyeromelita*).

Melita festiva (Chilton, 1885) fits the diagnosis of *Melita* (as outlined by Labay, 2016: 47) mainly in the morphology of the mouthparts, configuration of urosomite 2 armaments, and uropod 3 rami shape. However, *Melita festiva* and *Melita lowryi* do not have a sexually dimorphic gnathopod 1 or conventional *Melita*-like male gnathopod 2.

ACKNOWLEDGEMENTS. I would like to thank Jim Lowry for suggesting that the New Zealand records of *Melita festiva* may constitute a new species. Thanks to Penny Berents and Helen Stoddart (both AM) for constructive comments on the manuscript. Thanks to Alex Hegedus (AM), Helen Stoddart, Scott Reeves and Johnathon Ridden (both CMNZ) and Joanne Taylor (NMV) for curatorial assistance.

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A New Stenothoid (Crustacea: Amphipoda: Stenothoidae) from a Shallow Water Hydroid Polyp in British Columbia, Canada

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Abstract. A new stenothoid species is described from a hydroid polyp in British Columbia, Canada. The new species is provisionally assigned to *Metopa* as *M. insolita* sp. nov., pending revision of this genus.

Introduction

During scuba diving fieldwork in British Columbia in 2012, Neil McDaniel discovered a large solitary hydroid that was later named *Zyzzyzus rubusidaeus* Brinckmann-Voss & Calder, 2013. From this polyp, McDaniel also collected a stenothoid amphipod that he sent to the current authors for study. We consider this to be an undescribed species, with an exceptionally shaped gnathopod 2. In this paper, as part of a volume dedicated to the late Jim Lowry, we describe this new species based on morphology, and place it provisionally in *Metopa*, where it rests uneasily, pending a proper revision of this clearly not monophyletic genus.

Materials and methods

The material was collected by Neil McDaniel during scuba diving at 18 m depth on a polyp of *Zyzzyzus rubusidaeus* Brinkmann-Voss & Calder, 2013. The hydroid was attached to a rock in between sponges and barnacles. The diving-location is at Kuldekduma Point, near the northern tip of Vancouver Island in British Columbia, Canada (Fig. 1A) (Brinckmann-Voss & Calder, 2013). Collected material (2 specimens) was initially preserved in formaldehyde before being transferred to ethanol and sent to the authors for identification.

The habitus photo (Fig. 1B) was produced using a Leica M205C equipped with the stacking photography suite, Leica LAS V4.13. Stack-photos were collated using Zerene Stacker v 1.04. One specimen was prepared for microscope slides using a Leica M125 dissecting microscope and mounted using Faure medium before drawing using a camera lucida. Pencil drawings were inked (Adobe CC Illustrator) following the methods described by Coleman (2003, 2009).

Type material is kept in the University Museum of Bergen Zoological collections, Norway (ZMBN).

Keywords: Amphipoda, Stenothoidae, associated species, Hydroida, morphology
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Taxonomy

Order Amphipoda Latreille, 1816

Family Stenothoidae Boeck, 1871

Genus *Metopa* Boeck, 1871

Type species. *Metopa clypeata* (Krøyer, 1842), non Stimpson, 1853 (type by subsequent designation).

Metopa insolita sp. nov.

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Figs 1B, 2–5

Holotype: ZMBN104469, male, 3 mm (four permanent slides), Kuldekduma Point, Pearse Island, British Columbia, Canada, 50°35.299'N 126°50.046'W, depth 18 m, from *Zyzzyzus rubusidaeus* on rock among barnacles and sponges, coll. Neil McDaniel, 30 March 2012. **Paratype**: ZMBN, male, 3 mm (ethanol sample), same locality and collection information as for holotype.

Description. Antenna 1 subequal in length to antenna 2, both almost half body length. Antenna 1 peduncle article 1 slightly longer than article 2, article 3 short; flagellum with 17 articles, no accessory flagellum. Antenna 2 article 4 subequal to article 5; flagellum slightly longer than peduncle article 5, with 12 articles.

Head short, cephalic lobe rounded. Eyes ⅓ of head length, round, well defined.

Mandible without molar; incisor and lacinia mobilis serrate; raker setae narrow; palp 3-articulate, article 2 long, article 3 very short with 2 long apical setae.

Maxilla 1 inner plate rounded with 1 simple seta; outer plate flat at distal margin with 1 strong smooth seta and 3 cuspidate setae; palp 1-articulate, smooth with 2 rows with total of 10 simple setae.

Maxilla 2 outer plate in riding position; inner plate with 3 and outer plate with 14 simple setae.

Maxilliped slender; inner plates separate; outer plates reduced; palp 4-articulate with long, simple setae along inner margin and very few shorter and thin setae at distal outer margins of articles 2 and 3; article 4 with short simple setae along inner margin.

Pereon smooth.

Gnathopod 1 simple; coxa short with convex distal margin; basis long, narrow, with long setae on anterior margin; ischium short; merus suboval, distally free, posterior margin with short posterior and longer distal setae; carpus elongate, long simple setae along posterior margin, 3 simple setae along distal margin and 3 long simple setae medially; propodus subequal to carpus in length and slightly narrower, with long simple setae along posterior margin; dactylus narrow and almost straight, inner margin crenulate with short simple setae.

Gnathopod 2 coxa suboval, directed forwards, covering Coxa 1, with few short simple setae along posterior margin; basis straight and narrow with short simple setae along anterior margin; ischium short; merus spoon-shaped, distal margin with short simple setae; carpus triangular, posteriorly enveloped by merus, anterior margin with stridulating ridges; propodus peculiar, roughly rectangular but with large anterior protuberance at base of dactylus, palmar corner rectangular with small tooth, palm crenulate with short simple setae, posterior margin with short setae, anterior margin with stridulating ridges proximally, short setae marginally and longer simple setae distally; dactylus longer than palm, narrow and smooth, bent back over propodus.

Pereopod 3 coxa suboval, short setae at distal margin; remainder of leg slim and simple, meral lobe almost absent; dactylus half propodus length.

Pereopod 4 coxa rounded triangulate, distal margin evenly rounded and slightly thickened; remainder of leg slim but less than that of pereopod 3, with shorter and broader articles; meral lobe ¼ length of carpus.

Pereopod 5 coxa with rounded posterior lobe; basis rectilinear; remainder of leg slim with simple setae along anterior margin; meral lobe less than ¼ of carpus; dactylus slightly longer than half propodus.

Pereopod 6 coxa small with subacute posterior lobe; basis twice as long as broad, subrectangular, with posterior margin slightly concave, small posterodistal crenulated lobe; merus broadened, lobe ⅓ of carpus; carpus narrow; dactylus long and narrow, smooth, curved slightly at tip.

Pereopod 7 coxa small; basis broadly rounded with crenulated convex posterior margin; merus broadened, lobe ⅓ of carpus; dactylus long and narrow, smooth, curved slightly at tip.

Pleon smooth. Epimeral plates 1 and 3 posterodistal corner acute. Epimeral plate 2 posterodistal corner rounded.

Urosome smooth. Length of uropod 1 > uropod 2 > uropod 3. Uropod 1 peduncle twice length of rami. Uropod 2 outer ramus shorter than inner ramus; peduncle twice as long as inner ramus. Uropod 3 uniramous, ramus shorter than peduncle.

Telson flappable, long and narrow with rounded tip, 4 pairs of marginal robust setae.

Live colour. Translucent white with dark brown-red and pink patches transversally orientated on pereon segments. Eyes white with dark red margin.

Etymology. Named *insolita* (from Latin "insolitus"—unusual) referring to the unusual shape of the gnathopod 2 propodus in the male.

Ecology. Found sitting on the polyp of the large anthoathecate hydroid, *Zyzzyzus rubusidaeus* Brinckmann-Voss & Calder, 2013.

Discussion

As to generic placement, the new species does not immediately fit into any of the stenothoid genera, even though it is very clearly a stenothoid, given the lack of accessory flagellum, evanescent mandibular molar, vestigial outer plate of the maxilliped, shape and size of coxae 1–4, rectilinear basis of pereopod 5, uniramous uropod 3 and entire telson, following the diagnosis for Stenothoidae presented by Barnard & Karaman (1991). Using the key from Barnard & Karaman (1991), the primary morphological character in separating several genera within Stenothoidae is the shape of article 2 of pereopods 5–7. For the present new species, these are: P5 rectilinear, P6 moderately wide with a posterodistal lobe and a somewhat concave posterior margin, and P7 widely expanded with a crenulated rounded

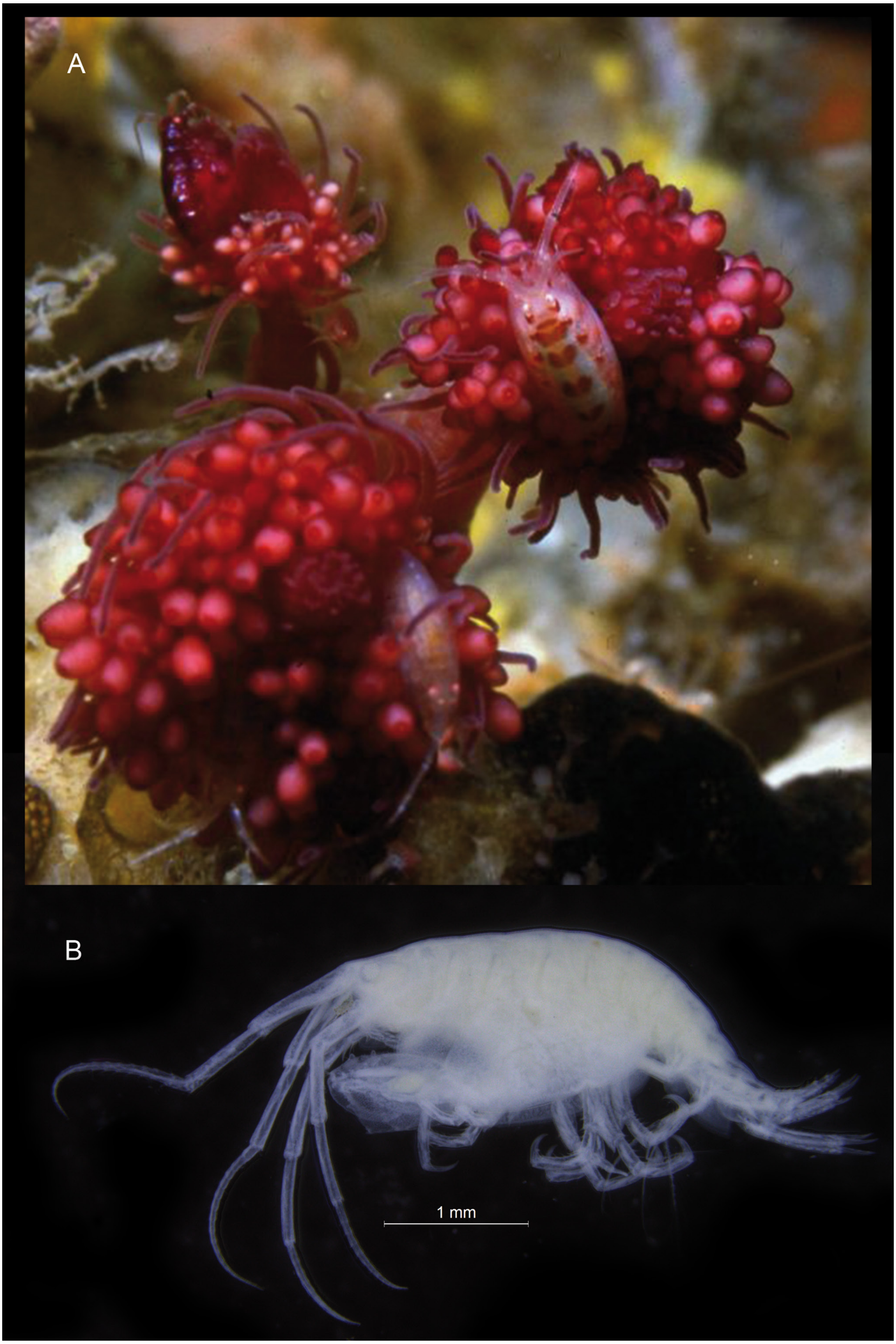

Figure 1. (*A*) *Metopa insolita* sp. nov. sitting on polyp of *Zyzzyzus rubusidaeus* Brinckmann-Voss & Calder, 2013 (Photo: Neil McDaniel); (*B*) habitus photo of paratype of *Metopa insolita* sp. nov. (Photo: A. H. S. Tandberg).

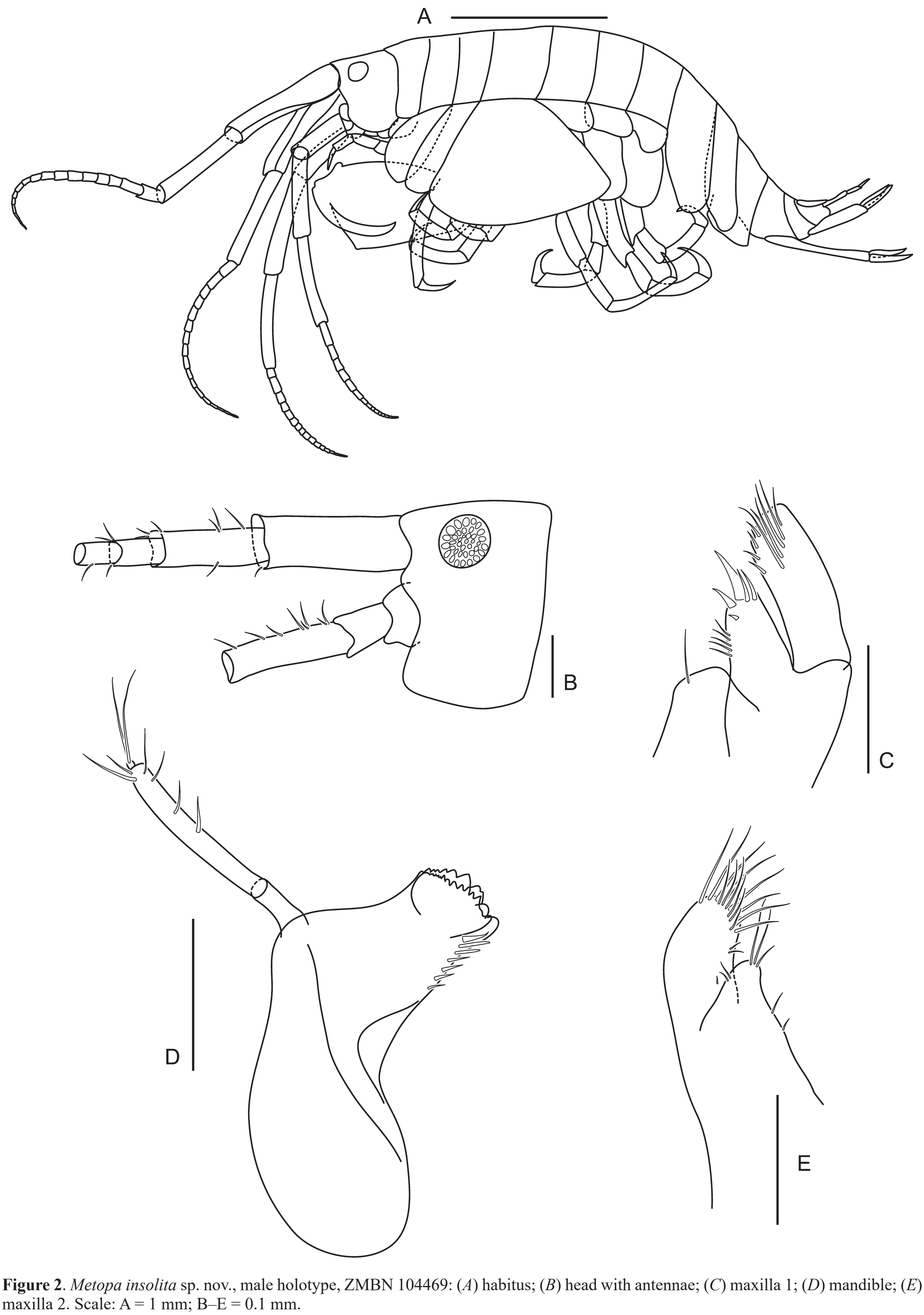

Figure 2. *Metopa insolita* sp. nov., male holotype, ZMBN 104469: (*A*) habitus; (*B*) head with antennae; (*C*) maxilla 1; (*D*) mandible; (*E*) maxilla 2. Scale: A = 1 mm; B–E = 0.1 mm.

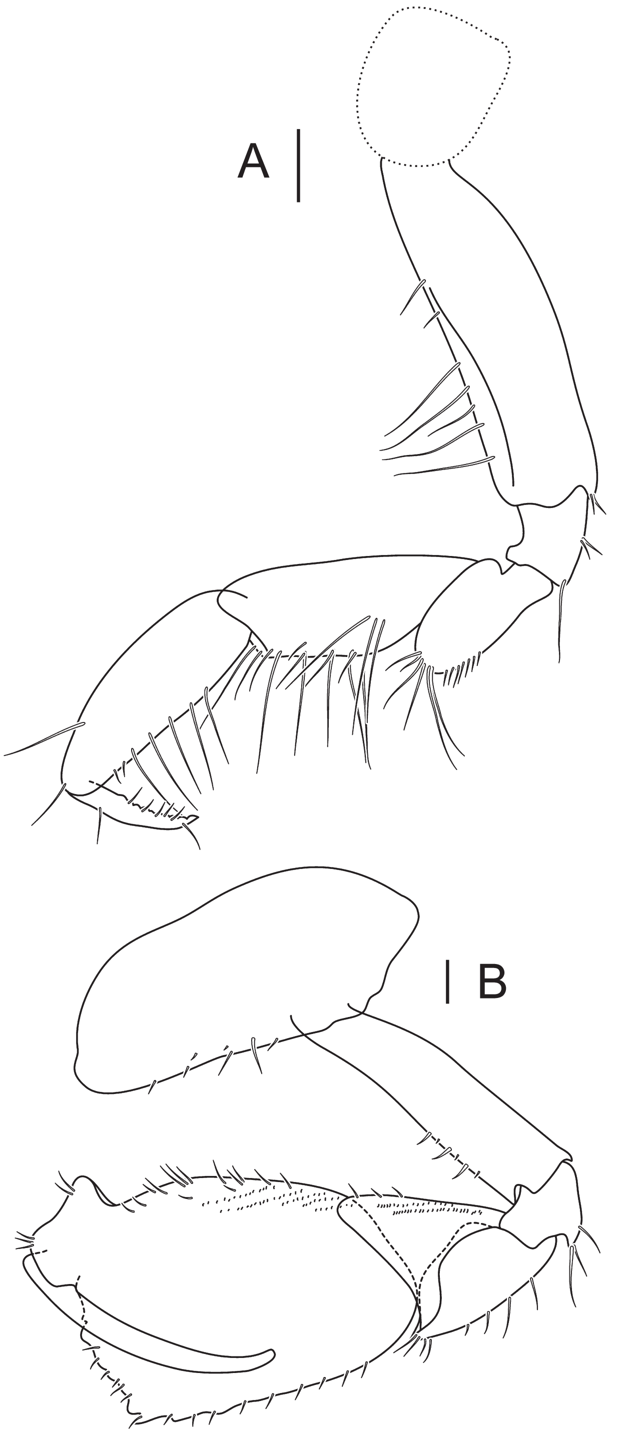

Figure 3. *Metopa insolita* sp. nov., male holotype, ZMBN 104469: (*A*) gnathopod 1; (*B*) gnathopod 2. Scale 0.1 mm.

posterior margin. With this combination of features, the new species keys out to either *Mesoproboloides* Gurjanova, 1938, or *Metopella* G. O. Sars, 1892. However, using the diagnosis for these genera in Barnard & Karaman (1991), the new species does not fully fit into either *Mesoproboloides* or *Metopella*. The diagnosis given by Barnard & Karaman (1991: 692) for *Mesoproboloides* states: "Gnathopods 1–2 subchelate, scarcely different from each other except in size…Gnathopod 2 slightly enlarged, palm oblique, article 5 short, lobed, article 6 slightly expanded apicad, elongate" and for *Metopella*: "Gnathopods 1–2 different from each other in size and shape…Gnathopod 2 slightly enlarged, palm weakly oblique, articles 4–5 short, 5 lobed. Pereopods 5–7 with rectolinear [sic] article 2, but article 2 on pereopod 7 broader than on pereopods 5 and 6 (variable)". Disregarding the difference in expansion in the bases of P6 and P7, our new species keys out to *Metopa*, with which the diagnosis of Barnard & Karaman (1991: 692) agrees in all other particulars: "Gnathopods 1–2 subchelate, different from each other in size and shape: gnathopod 1 small, almost simple (variable), article 4 incipiently chelate; article 5 elongate, barely lobed; article 6 scarcely expanded, almost linear. Gnathopod 2 enlarged, palm oblique, articles 4–5 short, 5 lobed. Pereopod 5 with rectolinear [sic] article 2, pereopods 6–7 with expanded, lobate article 2". Previous studies (Krapp-Schickel & Koenemann, 2006; Tandberg, 2011) have shown that the genus *Metopa* is not monophyletic, with great differences in especially gnathopod 1 and the mandibular palp. Pending an integrative revision of the genus *Metopa*, we have provisionally placed this new species in *Metopa*, as this presently "catch-all genus" contains other species with a somewhat similar, although less extreme, shape of the posterior pereopods (*M. boecki* G. O. Sars, 1892; *M. dawsoni* J. L. Barnard, 1962; *M. pusilla* G. O. Sars, 1892; and *M. tenuimana* G. O. Sars, 1892). *Metopa insolita* sp. nov. does not appear to be morphologically congeneric with the type species of *Metopa*, *M. clypeata* (Krøyer, 1842), which, however, in many aspects is morphologically divergent from the majority of the species now included in the genus, highlighting the need for an integrative revision of *Metopa*.

Many stenothoid amphipods have been found living in association with other marine invertebrates, often cnidarians. For a survey of such cases, see Krapp-Schickel & Vader (2015).

Acknowledgements. We are most grateful for this opportunity to honour Jim Lowry, one of the greatest amphipodologists of all time. WV also thanks him for great hospitality during his sabbatical in Sydney in 1993. We thank Neil McDaniel for sampling the material and trusting it to us. We are grateful to Traudl Krapp-Schickel for constant advice and guidance over many years in all things Stenothoid. Funding for AHST came from the Norwegian Biodiversity Information Centre grant number 16_18 NorAmph2.

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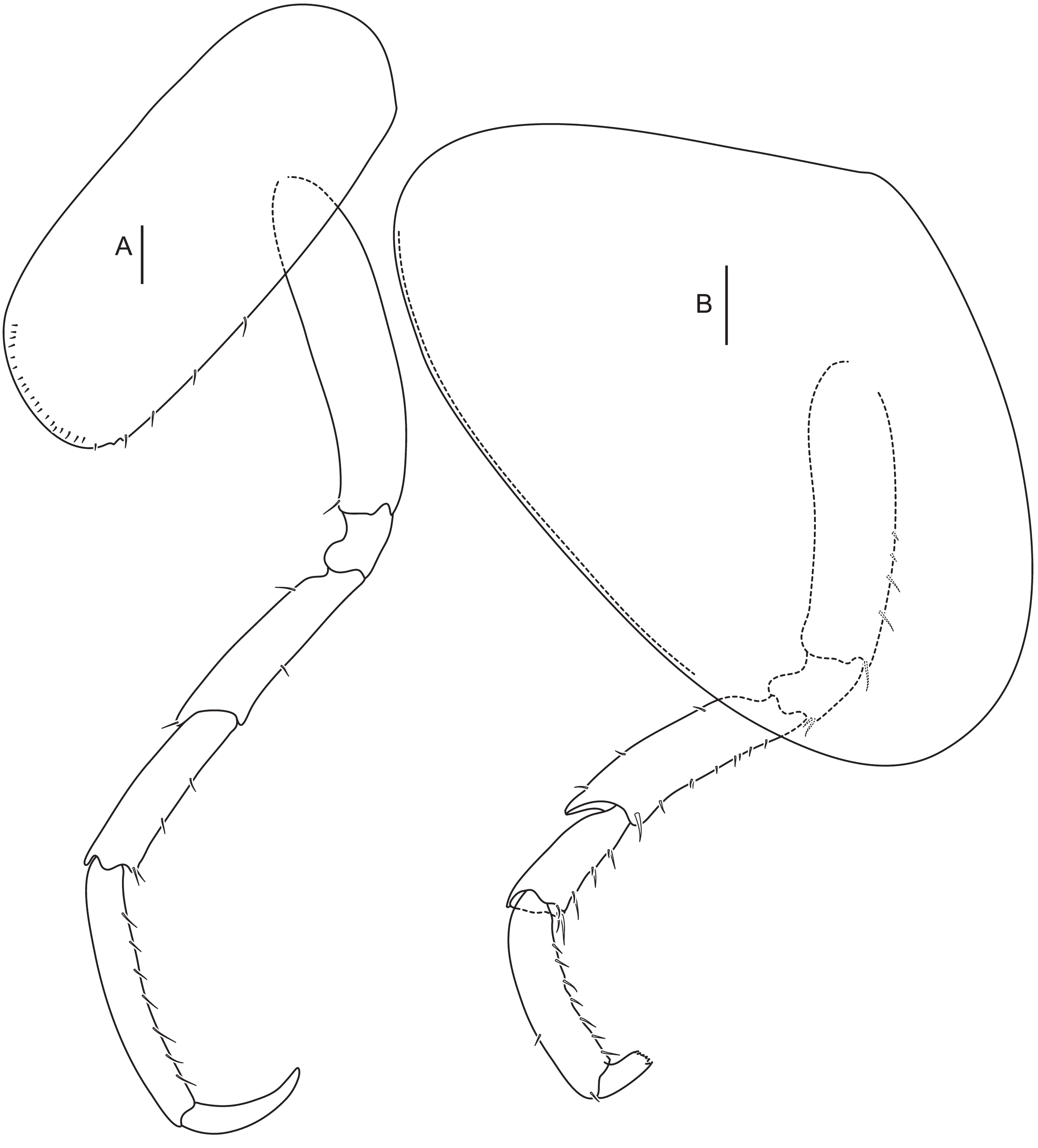

Figure 4. *Metopa insolita* sp. nov., male holotype, ZMBN 104469: (*A*) pereopod 3; (*B*) pereopod 4. Scale 0.1 mm.

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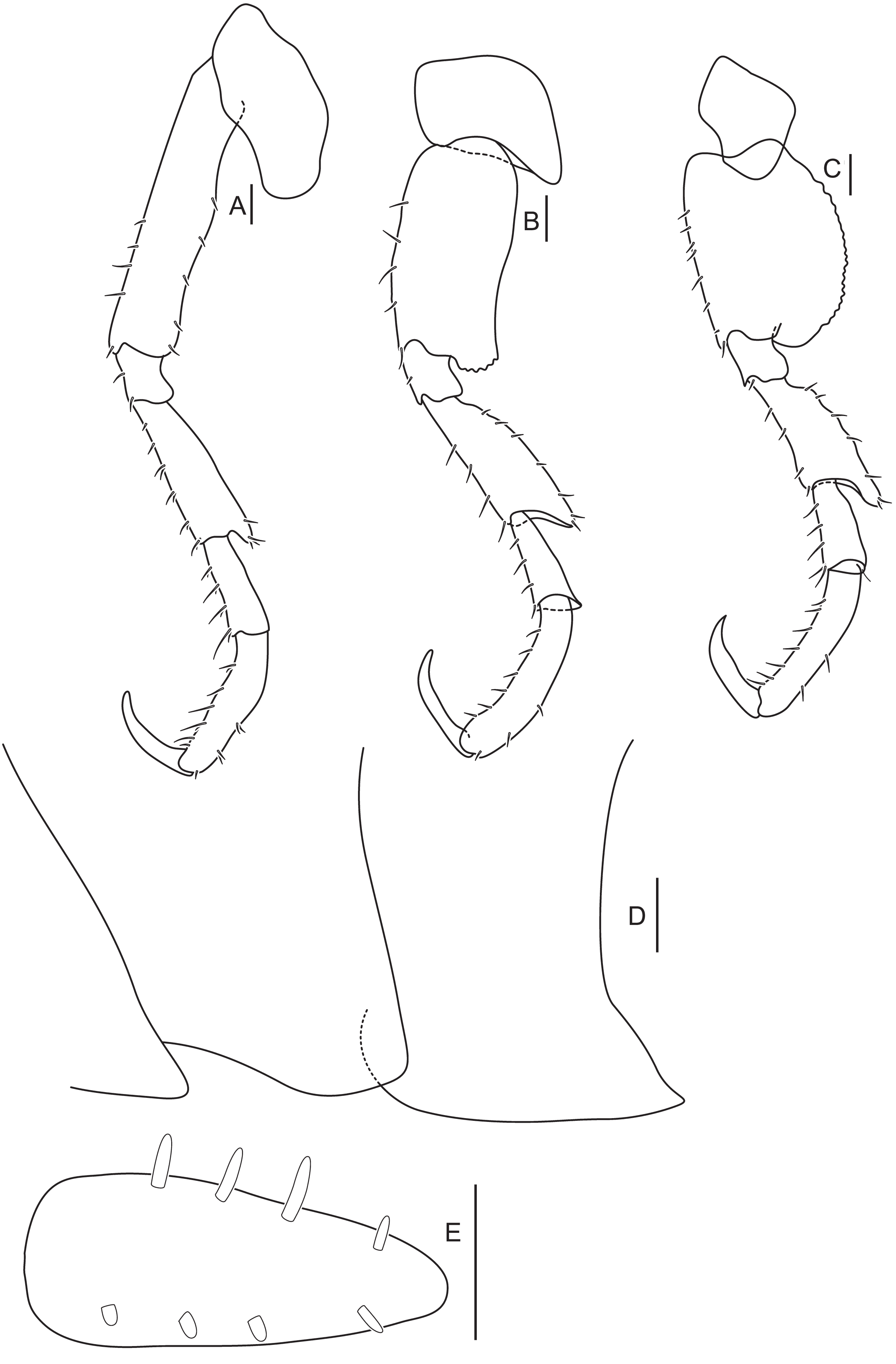

Figure 5. *Metopa insolita* sp. nov., male holotype, ZMBN 104469: (*A*) pereopod 5; (*B*) pereopod 6; (*C*) pereopod 7; (*D*) epimeral plates 2–3; (*E*) telson. Scale 0.1 mm.

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A New Genus and Five New Species of Phoxocephalidae (Crustacea: Amphipoda) from the Eastern Tasman Sea, the Otago Shelf, and The Snares, New Zealand

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Abstract. One new genus and five new species of the family Phoxocephalidae G. O. Sars, 1891 are described from material collected in waters off Aotearoa New Zealand. Within the subfamily Harpiniinae Barnard & Drummond, 1978, *Palabriaphoxus lowryi* sp. nov. and *P. barnardi* sp. nov. share morphological affinities, including the narrow basis of pereopod 5 and powerful pereopod 6 with *P. palabria* (J. L. Barnard, 1961), which is herein redescribed. Within the Phoxocephalinae, a new species, *Protophoxus munida* sp. nov. is described and the type species of the genus, *Protophoxus australis* (K. H. Barnard, 1930), is redescribed based on material collected from the Otago shelf. Additionally, *Zeaphoxus* gen. nov. is erected for two new species, *Z. senecio* sp. nov. and *Z. zealandicus* sp. nov., collected from the Tasman Sea, Otago Shelf, and The Snares.

Introduction

New species discoveries of Phoxocephalidae G. O. Sars, 1891 over the past two decades frequently do not strictly conform to the described subfamilies or genera of Barnard & Karaman (1991). The inability to assign new taxa to existing subfamilies and genera has resulted in significant revisions or the erection of new, often monotypic genera (Alonso de Pina, 1993, 2001; Ortiz & Lalana, 1999; Taylor & Poore, 2001; Taylor, 2002, 2006; Senna, 2010; Chiesa & Alonso, 2011; Andrade & Senna, 2020). Several of the new genera were established based on the recombination of known character traits rather than new or advanced ones, or on the grounds of a few unusual characteristics, with several paraphyletic taxa remaining (Taylor, 2003, 2006).

Alonso de Pina *et al.* (2008) proposed that the division of nine phoxocephalid subfamilies (Barnard & Drummond, 1978) be no longer recognized until such time that further phylogenetic studies are done. Over subsequent years, the current classification of Phoxocephalidae, based on morphology, came to recognize only two subfamilies: Harpiniinae Barnard & Drummond, 1978, diagnosed mainly by pereopod 5 with a narrow basis; and Phoxocephalinae Sars, 1891, characterized by pereopod 5 with a stout basis (De Broyer *et al*., 2007; Senna & Souza-Filho, 2011; Lowry & Myers 2017; Andrade & Senna, 2019a, b, 2020; Horton *et al*., 2022).

Phoxocephalid collections from the eastern Tasman Sea, the Otago Shelf, and shallow waters of The Snares, housed in the National Institute of Water & Atmospheric Research (NIWA), were examined by Jerry Barnard in the mid-1980s. Together with Jim Lowry, they identified five species as new and noted that the morphological diversity among the species was so great that the argument could be made to assign several to new genera. After Barnard's passing in 1991, the draft manuscript was further developed

Keywords: Amphipoda, new taxa, Phoxocephalidae, New Zealand
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by co-author Lowry in 1992, but until this time the taxa remained unpublished. Lowry shared the unpublished species descriptions and illustrations with Joanne Taylor in 1998 to include in a phylogenetic analysis using morphology as part of her PhD studies (Taylor, 2003). The phylogenetic results, differing substantially from Barnard's and Lowry's original schema, informed the decision herein to redescribe the genus *Palabriaphoxus* to accommodate two of the new species and to establish a new genus for a further two new species, described herein. In addition, the monotypic genus *Protophoxus* is redescribed based on its type species, with an additional new species named based on material collected from the Otago shelf.

Materials and methods

Abbreviations used: A, antenna; H, head; LL, lower lip; UL, upper lip; MD, mandible; MX, maxilla; MP, maxilliped; p, palp; E, epistome; G, gnathopod; P, pereopod; EP, epimera; C, coxa; U, uropod; T, telson; L, left; r, right; PL, pleopod; UR, urosome; NIWA, National Institute of Water & Atmospheric Research Ltd; AM, Australian Museum, Sydney; NHMD, Natural History Museum, Denmark (formerly Zoological Museum, University of Copenhagen), where material is lodged. All dissections and illustrations follow the conventions of Barnard & Drummond (1978) whereby the left side of the animal is illustrated unless otherwise stated. Illustrations were inked using drawing film and pens. Scanned and adjusted using Photoshop®. Descriptions of the new species closely follow that of other species described in Barnard & Drummond (1978) and Andrade & Senna (2020b). Accordingly, the carpus of gnathopod 1 is so-called "cryptic" whereby the posterior margin is concealed by the abutment of propodus and merus. Use of term Mark "M" on R3 is the point marking end of article 1 of inner ramus designated M100; length of outer ramus expressed as a percentage of the line that measures the length of inner ramus article 1.

Taxonomic account

Superfamily Haustoroidea Stebbing, 1906

Family Phoxocephalidae Sars, 1891

Subfamily Harpiniinae Barnard & Drummond, 1978

Palabriaphoxus Gurjanova, 1977

Palabriaphoxus Gurjanova, 1977: 74.—Barnard & Karaman, 1991: 623.

Type species. *Harpinia palabria* J. L. Barnard, 1961, original designation.

Diagnosis of female. Rostrum fully developed, unconstricted (tapering abruptly in *P. barnardi* sp. nov.). Eyes absent (tiny–small in *P. lowryi* sp. nov.). Antenna 1 peduncle article 2 variable in length, ventral setae narrowly to widely spread, placed apically or in middle. Antenna 2 peduncle article 1 not ensiform (weakly so in *P. barnardi* sp. nov.); article 3 with 2–5 setae; facial slender and robust setae on article 4 in 1 main row or clump or 2 or more poorly defined rows; article 5 especially short. Prebuccal parts not extended forward, truncate, not strongly distinct, neither part dominant. Right mandibular incisor with 3 teeth; molar not trituritive, small, pillow shaped, with 3 or fewer splayed, diverse, articulate to semiarticulate robust setae, palpar hump medium; right lacinia mobilis either absent or bifid, asymmetrical, (subflabellate in *P. lowryi* sp. nov., flabellate in *P. palabria*), mandibular palp thin to medium, article 1 short (slightly elongate in *P. palabria*), article 2 without outer setae (single outer setae in *P. latifrons*), apex of article 3 oblique. Maxilla 1 palp 2-articulate, inner plate with 4 setae, outer plate with 9–11 setal teeth, 1 setal tooth especially thickened. Maxilliped inner plates not basally fused, palp article 3 apex not protuberant, dactylus weakly to strongly elongate, apical nail distinct, elongate. Gnathopods small to medium, similar to diverse, gnathopod 2 not or weakly enlarged; carpus of gnathopods 1–2 short to medium, free (gnathopod 2 cryptic in *P. lowryi* sp. nov.), palms oblique, propodi ordinary to almond shaped, weakly elongate, not or poorly setose anteriorly. Pereopod 5 basis, merus and carpus narrow. Pereopod 6 merus and carpus broadened. Pereopod 7 basis without facial setae, weakly to strongly setose and moderately to strongly toothed posteroventrally, ischium enlarged, merus ordinary, (strongly lobed in *P. lowryi* sp. nov). Epimeron 1–2 with medium posterior setae, without midfacial setae above ventral edge. Epimeron 3-setose ventrally and facially (weakly in *P. barnardi* sp. nov.), not setose posteriorly, with large posteroventral tooth (elongate in *P. lowryi* sp. nov). Urosomite 3 without dorsal hook or special process. Uropod 1 peduncle without basoventral setae, without dorsolateral robust setae (present in *Palabriaphoxus barnardi* sp. nov.), outer ramus medium (shortened in *P. lowryi* sp. nov.), inner ramus with robust setae on dorsolateral and dorsomedial margins (barely 2 rows in *P. barnardi* sp. nov.), rami variously spinose. Uropod 2 peduncle with only 1 medial (sometimes enlarged) simple or robust seta confined apically, inner ramus ordinary (reduced in *P. palabria*), peduncle apices of uropods 1–2 not combed. Uropod 3 peduncle lacking extra subapical slender or robust setae, article 2 of outer ramus short to medium, without setae or carrying elongate apical setae. Telson with pair of midlateral or dorsal setules on each side, with 1–4 apical setae on each lobe. Six pairs of gills.

Sexual dimorphism. Antenna 1 peduncle articles 1–3 without patch of fine setae in males; primary flagellum with callynophore. Calceoli absent or present on peduncle of male antenna 2 (male unknown in *P. barnardi* sp. nov.). Antennae 1–2, flagella unreduced in female.

Remarks. Two new species from the Tasman Sea belonging to the subfamily Harpiniinae are described. The generic placement according to Barnard & Karaman (1991) is not straightforward for either *Palabriaphoxus barnardi* sp. nov. or *P. lowryi* sp. nov. as the diagnoses and keys rely heavily on the morphology of male antenna 2, which is unknown in the former. Both new species have a combination of morphological characters that could justify their placement in several of the genera that exhibit a narrow basis of pereopod 5. The preliminary morphological phylogeny of Taylor (2003) places both new species in a clade with representative species of seven genera that share a single strict synapomorphy (narrow basis of pereopod 5). The suggestion that several genera belonging to the Harpiniinae could potentially be synonymized into a single genus *Harpinia* was proposed by Karaman (1980) and Taylor (2003), but not until such time that all known species were included in the phylogeny as it was acknowledged that the structure of the tree may change with their inclusion. A further attempt to resolve the structure within the subfamily Harpiniinae using both morphology and the CO1 gene sequences was undertaken by Spencer (2022) and preliminary results also suggest a revision is required as not all genera are supported and the monophyly of the Harpiniinae is questioned. Options currently available for placement of these two new species from New Zealand are: 1) erect two new monotypic genera based on the recombination of known character states; 2) synonymize multiple genera with narrow basis of pereopod 5; or 3) placement in an existing genus that can be best expanded to include the new taxa. Owing to their morphological similarity to *Palabriaphoxus palabria* (J. L. Barnard, 1961) (the type species of *Palabriaphoxus*), also known from the Tasman Sea, we redescribe this genus to accommodate the two new species. Characters that the four known species of *Palabriaphoxus* share include: antenna 2 flagellum of female multiarticulate; right mandibular incisor with 3–4 teeth, mandibular molar non-trituritive, reduced to a small hump, maxilla 1 palp 2-articulate, gnathopod 1–2 similar in size (gnathopod 2 slightly enlarged in *Palabriaphoxus lowryi* sp. nov.), pereopod 5 basis of narrow form, pereopod 6 greatly enlarged with thickened merus-propodus, pereopod 7 usually with enlarged ischium.

Key to world species of *Palabriaphoxus*

1 Posteroventral corner of coxae 1–3 with prominent extended acute tooth .... [Antarctic; 180–1098 m] .... *Palabriaphoxus latifrons*

—— Posteroventral corner of coxae 1–3 smooth or with reduced small acute tooth 2

2 Uropod 1 peduncle without enlarged robust setae. Antenna 1 peduncle article 2 setae placed distally. Antenna 2 peduncle article 3 with 5 stiff robust setae. Pereopods 3–4 carpus setae displaced and dispersed near posterior margin. Rami of uropods 1–2 never fully spinose; uropod 2 peduncle with with robust setae only ... [Tasman Sea & The Snares; 7–133 m] .. *Palabriaphoxus lowryi* sp. nov.

—— Uropod 1 peduncle with enlarged robust setae. Antenna 1 peduncle article 2 setae placed in middle. Antenna 2 peduncle article 3 with 2 stiff robust setae plus setule. Pereopods 3–4 carpus setae placed near anterodistal margin. Uropods 1–2 rami with robust setae; uropod 2 peduncle with mixture of robust and slender setae 3

3 Antenna 1 peduncle article 2 elongate. Antenna 2 peduncle article 4 elongate. Maxilla 1 outer plate with 11 robust setae. Gnathopod 2 enlarged, slender seta forming dominant posterior element on pereopods 3–4 carpus. Urosome with basoventral setae. Telson with lateral robust setae. Epimera 1–2 with facial setae .... [circum-New Zealand; 10–610 m] ....*Palabriaphoxus palabria*

—— Antenna 1 peduncle article 2 shortened. Antenna 2 peduncle article 4 shortened. Maxilla 1 outer plate with 9 robust setae. Gnathopod 2 not enlarged, robust setae forming dominant posterior element on pereopods 3–4 carpus. Urosome without basoventral setae. Telson without lateral robust setae. Epimera 1–2 without facial setae .... [Tasman Sea; 520 m] .... *Palabriaphoxus barnardi* sp. nov.

Palabriaphoxus palabria (J. L. Barnard, 1961)

Figs 1–5

Harpinia palabria J. L. Barnard, 1961: 71, fig. 41.
Palabriaphoxus palabris Gurjanova, 1977: 74, fig. 4.

Holotype: NHMD CRU 7687, female, eastern Tasman Sea, 40°10'S 170°10'E, 610 m, Globigerina ooze, RV *Galathea*, PGI 0.2, Station 626, 20 January 1952. **Paratypes**: NHMD921700, 10 specimens, collected together with holotype.

Additional material examined. AM P39535, female “k”, 3.47 mm; AM P39536, female “m”, 3.35 mm; AM P39537, female “n”, 2.65 mm; AM P39538, “p”, 3.16 mm; AM P39539, “q”, 2.63 mm; eastern Tasman Sea, 42°53.9'S 170°0.5'E, anchor box dredge, 245 m, P. K. Probert on RV *Tangaroa*, 19 February 1982, cruise 1131, Station Q692. NIWA 115623, “a-1”, 3.45 mm; NIWA 115624, female “z”, 3.43 mm; NIWA 115625, male “y”, 3.38 mm; NIWA 115626, eastern Tasman Sea 41°58.5'S 170°28.1'E, anchor box dredge, 507 m, P. K. Probert on RV *Tangaroa*, 4 March 1982, cruise 1131, Station Q723.

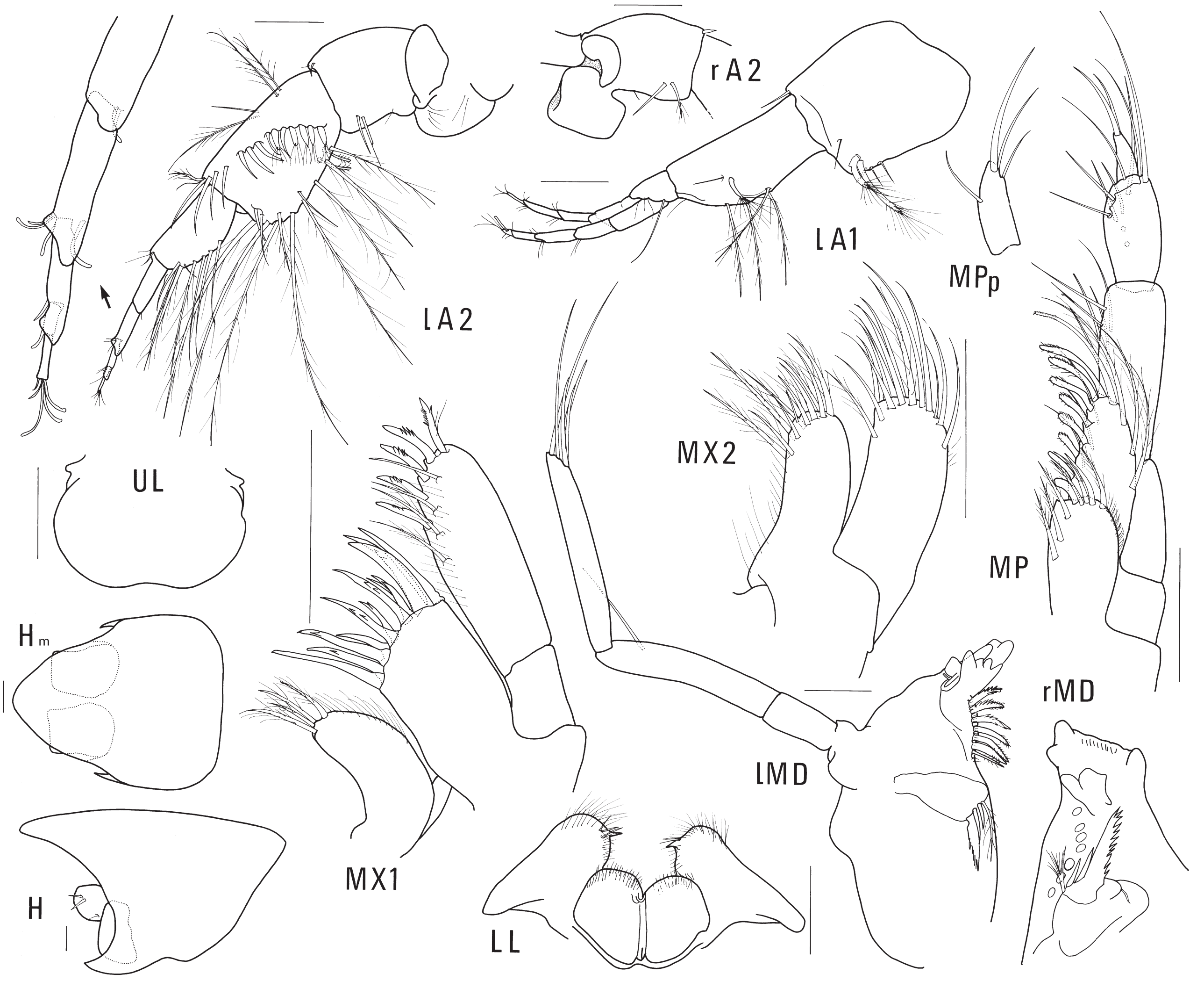

Figure 1. *Palabriaphoxus palabria* (J. L. Barnard, 1961), AM P39535, female "k", 3.47 mm; AM P39536, female "m", 3.35 mm, dorsal view of head, eastern Tasman Sea. Scales represent 0.1 mm.

Diagnosis. Eyes absent. Antenna 1 peduncular article 1 ventral apex not ensiform, peduncle article 2 elongate and setae placed in middle. Antenna 2 peduncle article 3 with 2 stiff robust setae plus setule, peduncular article 4 elongate with facial robust setae. Left mandible lacinia mobilis with 4 teeth. Right mandible lacinia mobilis bifid. Maxilla 1 inner plate shorter than outer, outer plate with 11 robust setae. Maxilliped palp article 3 not produced. Posteroventral corner of coxae 1–3 with small acute tooth. Gnathopods 1–2 carpus not cryptic. Gnathopod 2 enlarged, propodus with robust seta near palmar corner. Pereopods 3–4 carpus setae placed near anterodistal margin. Slender seta forming dominant posterior element on pereopods 3–4 carpus. Pereopod 5 basis narrow, much longer than wide. Pereopod 6 basis anterior margin setose with long robust setae, posterodistal corner produced as toothed lobe. Pereopod 7 merus, carpus, and propodus narrow; dactylus long. Urosome with basoventral setae. Epimera 1–2 with facial setae. Uropods 1–2 rami with robust seta. Uropod 1 peduncle with enlarged robust setae. Uropod 2 peduncle with mixture of robust and slender setae. Uropod 3 outer ramus article 2 with 2 long apical setae; inner ramus short, about 0.6 × the length of outer. Telson deeply cleft, apically with 3 slender plumose setae, marginally with 4 long plumose setae on each side, with lateral robust setae.

Description. FEMALE, based on non-type, AM P39535, specimen "k", 3.47 mm.

Head: Eyes absent; rostrum entire, unconstricted, reaching middle of article 1 of antenna 1; posteroventral corner of head produced into large tooth curved anteriorly. Antenna 1 peduncle article 1 stout, 1.2 × as long as wide, ventral margin with 3 setules and 2 plumose setae (distal corner), dorsal margin unproduced distally with 1 distal setule; article 2 narrower than but as long as article 1, ventral margin with 4 long plumose setae, facial margin with 1 brush seta; article 3, short, ventral margin with 2 setae, facial margin with 1 plumose and 1 simple seta; primary flagellum 5-articulate; accessory flagellum 5-articulate, fifth articles reduced. Antenna 2 peduncle article 3 ventral margin with 2 simple setae, dorsal margin with 1 short seta distally; article 4 ventral margin with 8 long plumose setae, facial margin with row of 14 robust (becoming less robust distalwards) short setae, dorsal margin with 4 long plumose setae; article 5 0.6 × length of article 4, ventral margin with 5 plumose, and 1 distal robust setae; flagellum 5-articulate.

Mouthparts: Left mandible molar weakly elongate, plaque armed with 2 short robust setae, 1 long plumose seta and 1 large-toothed robust seta, incisor with 4 teeth divided into 2 groups, lacinia mobilis with 4 teeth, accessory setal row

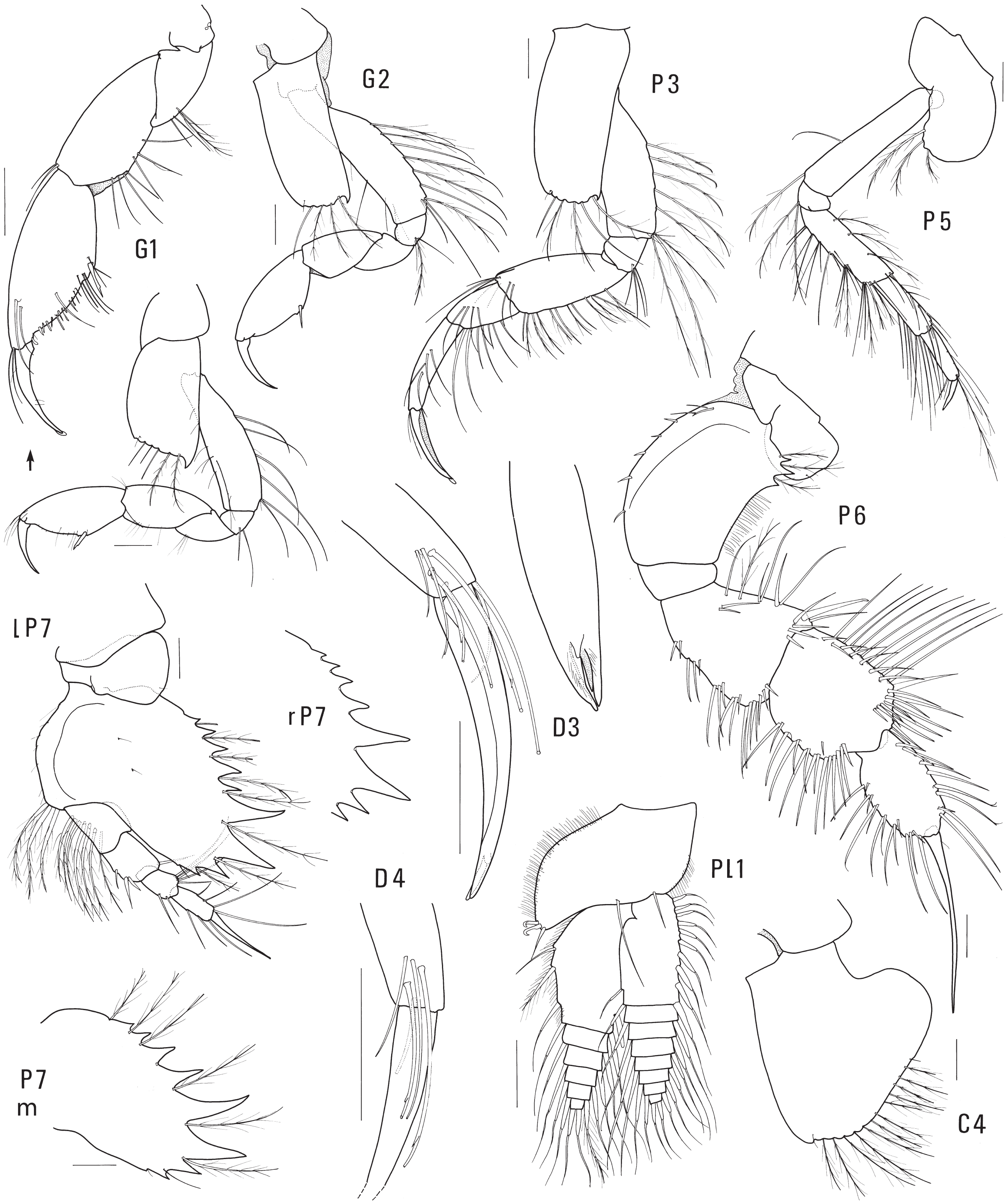

Figure 2. *Palabriaphoxus palabria* (J. L. Barnard, 1961), AM P39535, female "k", 3.47 mm, AM P39536, female "m", 3.35 mm, basis of pereopod 7, eastern Tasman Sea. Scales represent 0.1 mm.

with 7 multicuspidate stout setae, palpar hump medium; palp 3-articulate, article 1 0.5 × article 2, article 2 straight, narrow, with 1 elongate inner apical seta and no other short inner setae and no outer setae, 0.7 × article 3, article 3 apex oblique with 5 long, slender setae. Right mandible incisor blade like with 3 teeth and notch, lacinia mobilis bifid, distal branch flabellate shorter than proximal, accessory setal row with 7 multicuspidate stout setae. Maxilla 1 inner plate with 4 apical plumose setae; outer plate with 11 stout multicuspidate setae; palp 2-articulate, article 2 with 4 slender setae forming row medially and 5-toothed robust setae laterally and apically. Maxilla 2 inner plate subequal to outer plate but slightly narrower, with 11 plumose setae; outer plate with 13 long pectinate setae apically stretching laterally. Maxilliped inner plate with 1 short robust seta apically and 7 long plumose setae apicofacially and medially; outer plate with 8 medial

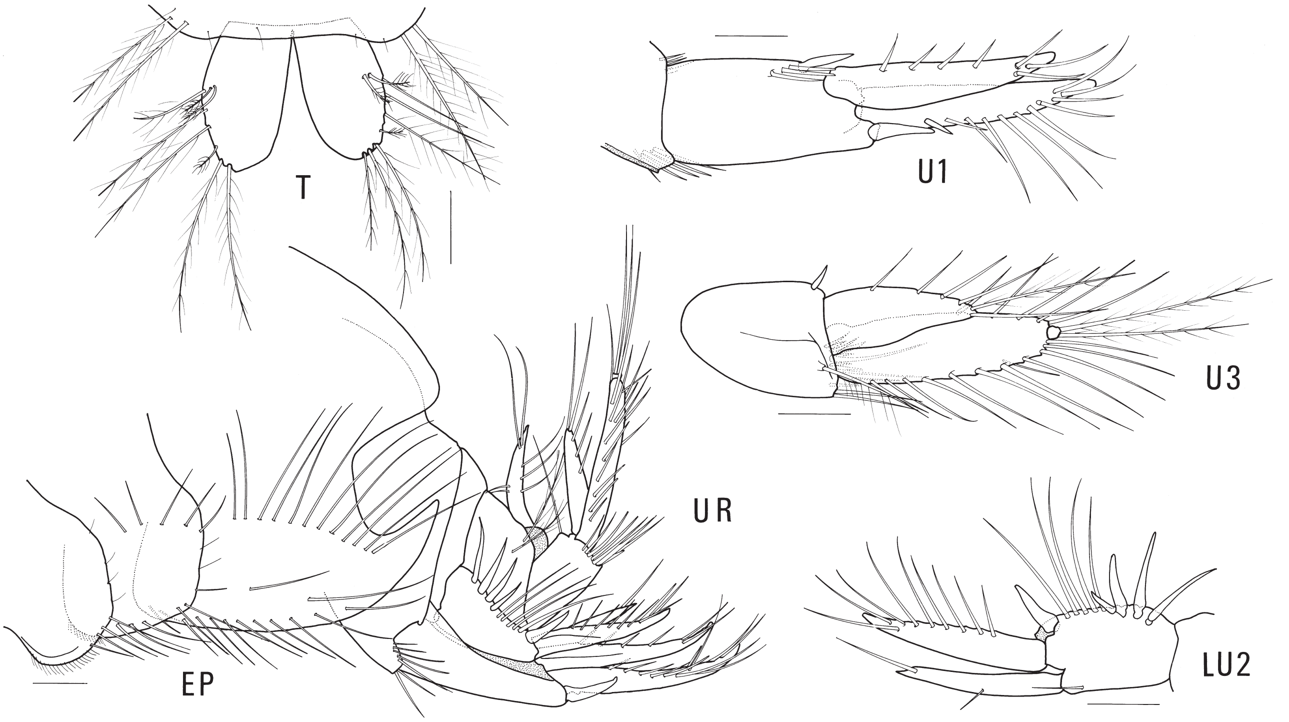

Figure 3. *Palabriaphoxus palabria* (J. L. Barnard, 1961), AM P39535, female "k", 3.47 mm, eastern Tasman Sea. Scales represent 0.1 mm.

and apical robust setae, 3 apicolateral setae; palp article 1 without apicolateral setae, article 2 medial margin weakly setose, article 3 not produced, without upper facial setae, no lateral setae, article 4 short to medium, subtriangular, with 1 seta laterally, 3 apical setae and 1 long apical nail.

Pereon: Gnathopod 1 coxa ventral margin not expanded but defined by sharp tooth, anterior margin slightly convex, with 2 plumose setae; basis about 2.4 × as long as wide, posterior margin with 4 long plumose setae medially and 2 long setae distally; ischium small and subrectangular, posterior margin with 2 simple setae; merus posterior margin with 4 plumose setae, facial margin without setae; carpus short, 2 × as long as wide, anterior margin with 2 setae distally, posterior margin with 7 long setae; propodus 2 × as long as wide, anterior margin with 2 setae distally, posterior margin without setae proximal to defining robust seta; palm setose and slightly convex, acute; dactylus reaching palmar corner, outer margin without setae, inner with 2 setae. Gnathopod 2 similar in size to gnathopod 1; coxa subrectangular with acute tooth on posteroventral corner, ventral margin with 5 plumose setae, anterior margin very weakly convex; basis about 3 × as long as wide, posterior margin with 7 long plumose setae and 2 distally, anterior margin with 2 plumose setae; ischium small and subrectangular, posterior distal corner with 3 long plumose setae; merus margins without setae; carpus short, subtriangular, 2 × longer than wide, margins without setae; propodus 2 × as long as wide, anterior margin with tuft of setae distally, posterior margin weakly setose, with 1 robust seta defining palm, palm slightly convex, acute; dactylus reaching palmar corner, outer margin without setae. Pereopod 3 coxa subrectangular, ventral margin with 6 plumose setae, posteroventral corner produced to form small acute tooth; basis 3.5 × as long as wide, posterior margin with 5 long plumose setae and distally tipped with 3 long plumose setae, anterior margin without setae; ischium small and subrectangular, posterior margin with 4 distal plumose setae; merus weakly inflated, anterodistal corner bearing 3 setae, posterior margin moderately setose with 12 medium to long plumose setae; carpus posterior margin moderately setose, with 7 plumose setae, with 4 facial plumose setae; propodus posterior margin without setae, facial surface with 4 long setae; dactylus 0.75 × length of propodus. Pereopod 4 coxa expanded posteriorly to form broadly rounded lobe, ventral margin with 12 long plumose setae and 2 very small simple setae, distal articles similar to pereopod 3. Pereopod 5 coxa weakly bilobate, expanded posteroventrally, posteroventral lobe with 3 plumose setae; basis narrow and straight sided, 4.4 × as long as wide, anterior margin with 1 long seta marginally and 1 plumose seta distally, posterior margin without setae; ischium small and subrectangular, anterior margin with 2 long plumose setae distally; merus anterior margin moderately setose, with 15 long slender plumose setae marginally and 8 distally, posterior margin with 3 long plumose setae marginally and 2 long plumose setae distally; carpus anterior margin moderately setose, with 4 long plumose setae marginally and 5 long plumose setae distally, posterior margin with 5 plumose setae marginally and with 4 setae distally; propodus anterior margin with 6 long plumose setae marginally and 2 long plumose setae distally, posterior margin with 2 long plumose setae marginally and 2 distally, no facial setae are present; dactylus 0.52 × as long as propodus. Pereopod 6 much longer than all other pereopods; coxa weakly expanded posteroventrally, posterior margin with 1 short seta and not covered with setules; basis about 1.59 × as long as wide, anterior margin convex, bearing 8 slender robust setae marginally, no distal setae, posterior margin concave distally fringed with even, fine, slender setae, expanded to form toothed proximal lobe bearing 3 long plumose setae between each tooth; ischium small and subrectangular without setae; merus: carpus: propodus length ratio 1:1.1:0.95; merus as long as wide, anterior margin without robust setae but with sets of slender

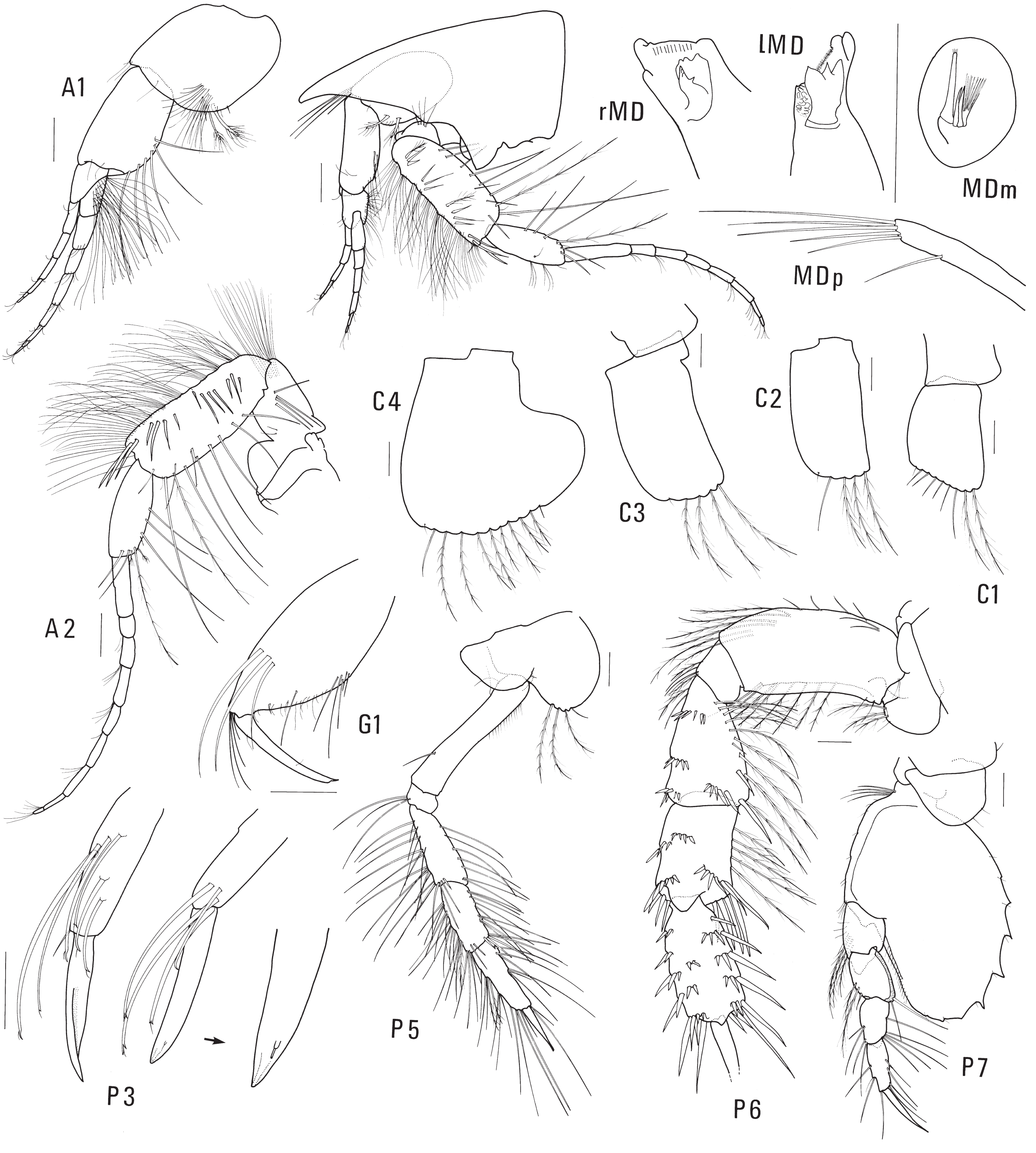

Figure 4. *Palabriaphoxus palabria* (J. L. Barnard, 1961), NIWA 115625, male "y", 3.38 mm, eastern Tasman Sea. Scales represent 0.1 mm.

simple setae (2-3-3-3-7) along margin and distally, posterior margin with 6 long slender setae (of which 1 plumose), distally with 5 slender simple setae and 1 long robust seta, 2 small slender setae on facial surface; carpus 1.2 × longer than wide, anterior margin lined with 15 long slender setae and 1 facially, posterior margin with 16 long slender setae marginally, distal corner with 1 long robust seta and 2 rows each with 6 long slender setae; propodus 1.6 × as long as wide, 0.8 × length of carpus, anterior and posterior margins lined with 15 and 10 long slender simple setae respectively; dactylus elongate, 1.6 × length of propodus. Pereopod 7 coxa small and subtrapezoidal, slightly expanded posteriorly, posterior margin with 1 short seta; basis as long as wide (including the posteroventral lobe), strongly expanded posteroventrally to form strongly-toothed posteroventral lobe reaching beyond the distal margin of propodus, anterior margin bearing 7 small slender setae marginally and 3 long plumose setae distally, posterior margin strongly serrate, with plumose setae in inter-dental notches, 8 in total, 2 small setae on facial surface; ischium subrectangular, 1.3 × as long as wide, anterior margin with 7 long slender plumose setae starting marginally and extending to facial surface; merus subequal in length to ischium, anterior margin with 2 robust and 1 slender setae, posterior margin with 1 slender seta

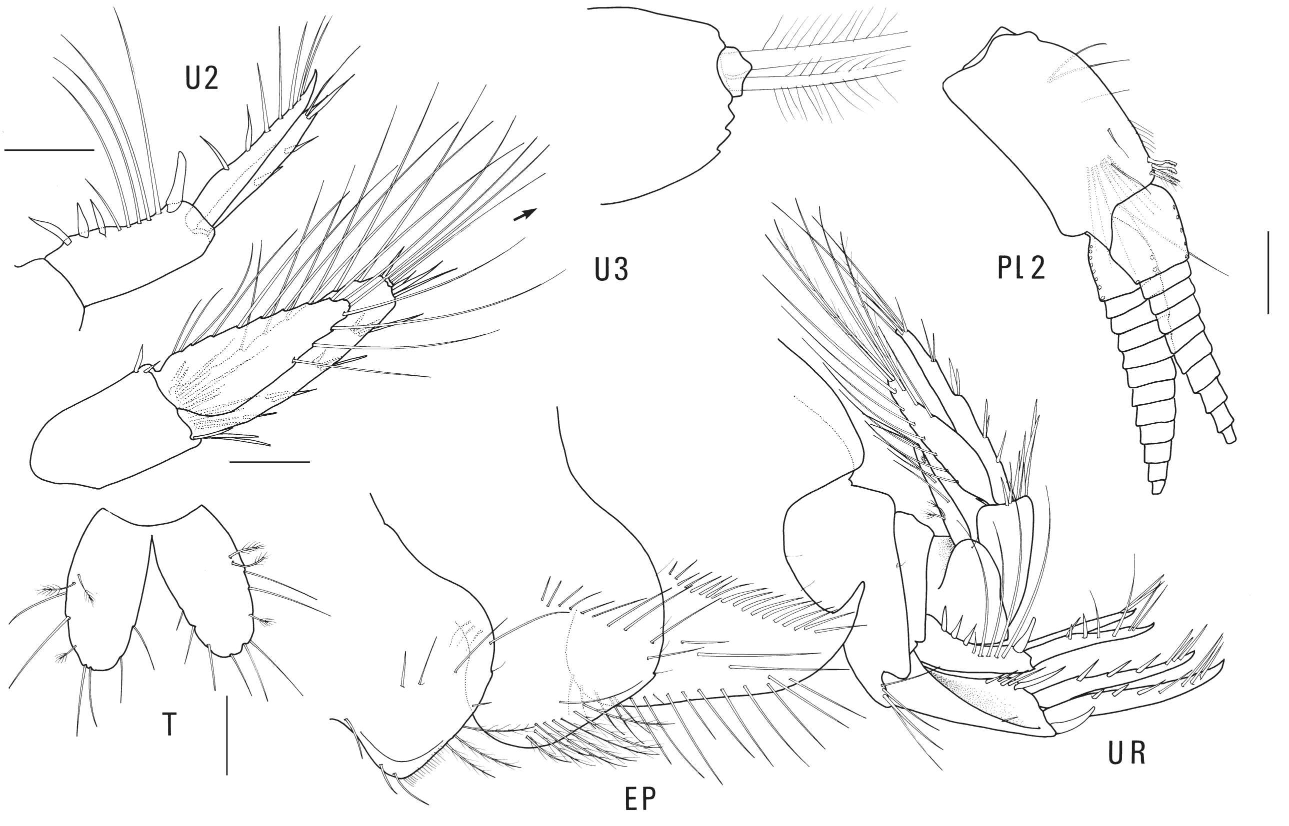

Figure 5. *Palabriaphoxus palabria* (J. L. Barnard, 1961), NIWA 115625, male "y", 3.38 mm, eastern Tasman Sea. Scales represent 0.1 mm.

distally; carpus short 0.6 × merus length, anterior margin with 2 distal slender simple setae, posterior margin with 4 slender simple setae distally; propodus narrow and 1.3 × carpus, anterior and posterior margins with 3 and 4 setae respectively; dactylus elongate, 1.2 × longer than propodus.

Pleon: Epimeron 1 anteroventral corner without setae, ventral margin with fringe of small fine setae, posterior margin convex, posteroventral corner with 4 long plumose slender setae, posterior margin with 4 small setae. Epimeron 2 anteroventral corner rounded, ventral margin with fringe of fine setae anteriorly followed by row of 7 long slender plumose setae reaching to posteroventral corner, posteroventral corner subquadrate, posterior margin straight with 4 long slender setae, facial surface with arc of 4 long slender simple setae. Epimeron 3 anteroventral corner rounded, ventral margin weakly concave lined with 12 long, slender, simple setae, posteroventral corner produced to form long acute, curved projection, posterior margin without setae, facial surface with 2 arcs of long slender, simple setae, the dorsal arc with 12 setae, ventral arc with 3 setae. Uropod 1 peduncle 1.9 × as long as wide, dorsomedial margin with 1 large robust seta and 3 long slender simple setae, dorsolateral distal corner with 1 large robust seta; outer ramus dorsal margin with 1 robust seta proximally and 7 long slender simple setae along margin and 3 slender simple setae sub-apically; inner ramus slightly shorter than outer, dorsal margin with 4 long slender simple setae marginally and 3 slender simple setae sub-apically. Uropod 2 peduncle 1.6 × as long as wide, dorsomedial margin with 1 slender, simple seta distally, dorsolateral margin with 4 long robust setae proximally, then 5 long slender simple setae marginally and then 1 large robust seta apically; outer ramus dorsal margin with 6 long slender simple setae marginally and 3 long slender simple setae sub-apically; inner ramus shorter than outer, dorsolateral margin with 1 slender seta and 1 long slender seta sub-apically. Uropod 3 peduncle 1.3 × as long as wide, with 3 long slender plumose setae ventrodistally and 1 robust seta dorsodistally; outer ramus 2-articulate, article 1 ventrolateral margin with 10 long setae and 3 long setae apically, dorsolateral margin with 3 long slender setae marginally and 1 long seta apically; article 2 tiny 0.08 × length of article 1, as long as wide, tipped with 2 long plumose slender setae; inner ramus 0.65 × length of outer ramus, outer margin lined with 4 long slender plumose setae and 2 long slender setae apically. Telson short, completely cleft, each lobe broad and weakly truncated apically, has 2 mid-facial short plumose setae, 4 slender plumose marginal setae (3 long 1 short) and 3 long slender plumose apical setae. Urosomite 3 with 2 long slender plumose setae either side of telson insertion.

MALE, based on NIWA 115625, male "y" 3.38 mm.

Head: Rostrum 0.63 × length of antenna 1; posteroventral corner of head produced into large tooth directed ventrally. Antenna 1 peduncle article 1 stout, as long as wide, ventral margin with distal tuft of slender simple setae and 2 plumose setae (distal corner), dorsal margin unproduced distally with 1 distal setule; article 2 narrower than and shorter than (0.86 ×) article 1, ventral margin with 6 long plumose setae, without facial setae; article 3 short triangular, ventral, and facial margins without setae; primary flagellum 8-articulate, last article reduced, article 1 with callynophores occupying most of surface; accessory flagellum 5-articulate, fifth article reduced. Antenna 2 peduncle article 4 ventral margin with 10 long evenly spaced plumose setae, facial margin with uneven row of 13 slender short setae, dorsal margin lined with 8 tufts of 4–12 long slender simple setae; article 5 0.5 × length of article 4, ventral margin with 3 marginal plumose setae and 3 distal long plumose setae; flagellum 9-articulate.

Mouthparts: Right mandible with 7 accessory setae, left with 8, left lacinia mobilis with 3 teeth, main robust seta of molar less serrate, on left side with 4 denticles on apex, palp with extra inner subapical seta. Palp of maxilla 1 with 5 robust setae and 3 slender facial setae, remainder as in female; inner plate of maxilla 2 with 3 medial setae, outer plate with 2 lateral setae; inner plate of maxilliped with 4 medial setae, outer plate with 8 seta-teeth and 3 setae, dactylus with 2 accessory setae.

Pereon: Coxae 1–3 ventral margins without prominent extended acute tooth on posteroventral corner. Gnathopods 1–2 palms without defining robust setae. Pereopod 6 basis proximal posterior lobe reduced and not serrate, row of setae on posterior margin distinct, composed of 8 long, slender, plumose setae, not fringe like, anterior margin with 4 short simple proximal setae, and 6 long, plumose distal setae; ischium with 4 long plumose setae on distal half of anterior margin; merus: carpus: propodus length ratio 1:0.75:0.98; merus, carpus, and propodus all narrower than in female, of different proportions; merus, carpus, and propodus all with rows of facial short robust setae, no long plumose setae. Pereopod 7 basis expanded but lobe only weakly serrate, inter-tooth setae small and simple, lobe only reaching to end of merus; carpus longer in proportion to propodus; dactylus as long as propodus.

Pleon: Epimeron 2 with more setae in facial arc. Epimeron 3 with more setae in upper facial arc, arc straight not curved. Uropod 3 peduncle 1.7 × as long as wide, with 2 robust setae distally; outer ramus, article 1, margins covered with long plumose setae, article 2, with 2 long plumose setae apically; inner ramus shorter than outer ramus, margins covered with long plumose setae. Pleopods 1–3: coupling hooks 2 and 2 accessories; posterior facial setae on peduncle = 15+-10+-10+; articles on outer rami = 12-13-12, inner rami = 10-10-10; setae on article 1 of outer and inner rami respectively, on outer and inner sides respectively = 8-2-1-5, 8-1-1-5, 8-2-1-5.

Remarks. *Palabriaphoxus palabria* has previously been recognized as the only species of this genus occurring in New Zealand waters and was thought to range around the entirety of the New Zealand coastline. This study and further observations bring this supposed expansive distribution into doubt.

Palabriaphoxus palabria can be distinguished by the long rows of facial setae on the epimera 2–3 (*P. barnardi* facial setae absent, *P. lowryi* facial setae present only on epimeron 3); coxa 1–4 of female have an obvious, small acute tooth on the posteroventral corner, the male has this tooth but greatly reduced (*P. barnardi* tooth is reduced, *P. lowryi* unable to be seen); pereopod 6 basis has a serrated (various size with male and female) proximal posterior corner (absent in *P. barnardi* and *P. lowryi*).

Palabriaphoxus palabria is closest morphologically to *P. barnardi* with the main differences being the length of the antenna 1 article 2 (*P. palabria*, elongate; *P. barnardi*, short), antenna 2 peduncle article 4 (*P. palabria*, elongate, *P. barnardi* short); basoventral urosomal setae on urosome (*P. barnardi* absent); telson with lateral robust setae (*P. barnardi* robust setae absent).

Closer investigation of the numerous collections identified as *P. palabria* from around New Zealand, beyond the scope of this study, will most likely show that many are referable to one of the two new species described below as well as additional new species. This will most likely reduce the confirmed geographical range of *P. palabria*.

Distribution. Previously regarded as circum-New Zealand, but currently known with certainty only from off Westland; other New Zealand records require confirmation. New Zealand, 10–610 m.

Palabriaphoxus barnardi sp. nov.

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Figs 6–7

Holotype: NIWA 115630, female “v”, 3.73 mm, eastern Tasman Sea, 42°48.5'S 169°53.5'E, anchor-box dredge, 520 m, P. K. Probert on RV *Tangaroa*, 20 February 1982, Cruise 1131, Station Q694. **Paratypes**: NIWA 115631, female “w”, 3.60 mm, NIWA 115632, female “x”, 3.44 mm, collected with holotype.

Etymology. Named in honour of the enormous contribution to phoxocephalid taxonomy made by Jerry Laurens Barnard.

Diagnosis. Eyes absent. Antenna 1 peduncular article 1 ventral apex not ensiform, peduncle article 2 shortened. Antenna 2 peduncle article 3 with 2 robust setae, article 4 shortened with facial robust setae. Right mandible lacinia mobilis multi-toothed. Maxilla 1 inner plate shorter than outer, outer plate with 9 multicuspidate robust setae. Maxilliped palp article 3 not produced. Posteroventral corner of coxae 1–3 with very small acute tooth. Gnathopods 1–2 carpus not cryptic. Gnathopod 2 similar sized to gnathopod 1, propodus with 1 robust seta near palmar corner. Pereopods 3–4 carpus setae placed near anterodistal margin. Robust setae forming dominant posterior element on pereopods 3–4 carpus. Pereopod 5 basis narrow, much longer than wide. Pereopod 6 basis anterior margin setose with long robust setae, posterodistal corner produced as toothed lobe. Pereopod 7 merus, carpus, and propodus narrow; dactylus long. Urosome without basoventral setae. Epimera 1–2 without facial setae. Uropods 1–2 rami with robust setae. Uropod 1 peduncle with enlarged robust setae. Uropod 2 peduncle with mixture of robust and slender setae. Uropod 3 outer ramus article 2 with 2 long apical setae; inner ramus short, about 0.7 × the length of outer. Telson deeply cleft, apically with 1 slender plumose seta per lobe, marginally without setae on each side, without lateral robust setae.

Description. FEMALE, based on NIWA 115630, holotype, female “v”, 3.73 mm.

Head: Eyes absent; rostrum entire, weakly constricted, tapering rapidly, narrow, reaching apex of peduncle article 2 on antenna 1; posteroventral corner of head weakly produced into small tooth not curved. Antenna 1 peduncle article 1 stout, 1.5 × as long as wide, 1.6 × as long as and 2.5 × as wide as article 2, ventral margin with 3 setules and 2 plumose setae (distal corner), dorsal margin unproduced distally, with 1 distal setule; article 2 narrower than and shorter than article 1, ventral margin with 5 long plumose setae, facial margin with 2 brush setae; article 3 short, triangular, ventral margin

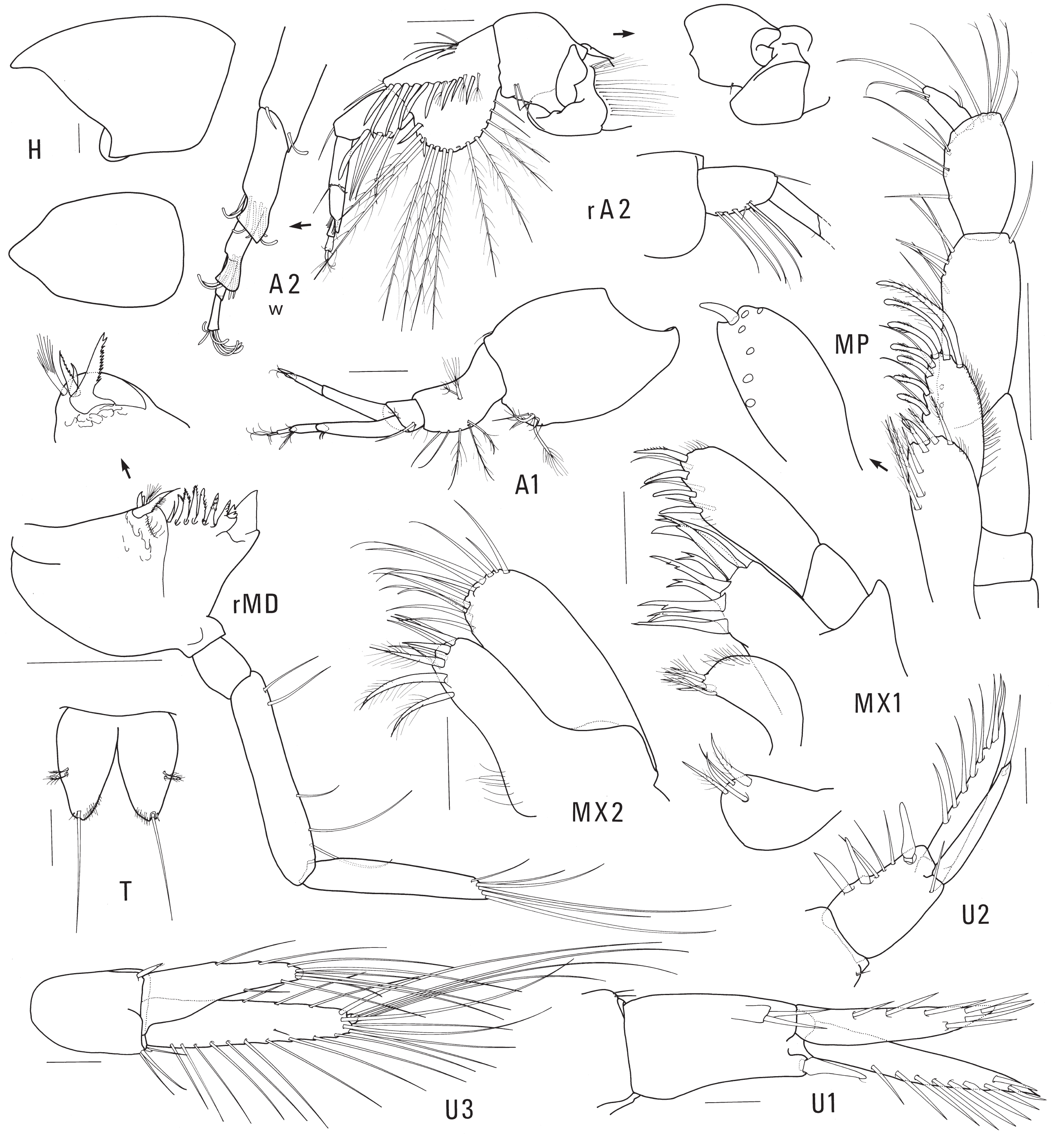

Figure 6. *Palabriaphoxus barnardi* sp. nov., holotype, female "v", NIWA 115630, 3.73 mm; paratype, female "w", NIWA 115631, eastern Tasman Sea. Scales for MX1 and MX2 represent 0.05 mm. Scales represent 0.1 mm.

with 1 seta, facial margin without setae; primary flagellum 4-articulate, first article elongate; accessory flagellum 2-articulate, first article elongate. Antenna 2 peduncle article 3 ventral margin with 2 simple setae; article 4 ventral margin with 13 long plumose setae and 2 short robust setae, facial margin with row of 9 robust (becoming longer distalwards) short setae, dorsal margin with tuft of 5 long plumose setae and 1 long robust seta on distal corner; article 5 0.7 × length of article 4, ventral margin with 5 plumose and 1 distal long robust seta; flagellum 5-articulate.

Mouthparts: Right mandible molar as weakly elongate plaque armed with 2 short robust setae, 1 short stubby plumose seta and 1 large-toothed robust seta, incisor blade like divided into 3 teeth, lacinia mobilis multi-toothed, accessory setal row with 6 multicuspidate stout setae, palpar hump small; palp 3-articulate, article 1 0.25 × article 2, article 2 straight, narrow, with 2 slender proximal setae and 3 distal slender setae on inner margin and no setae on outer margin, 1.1 × article 3, article 3 apex oblique with 6 long, slender setae. Maxilla 1 inner plate with 4 apical plumose setae, and small setules on medial margin; outer plate with 9 stout multicuspidate setae; palp 2-articulate, article 2 with 3 slender setae forming row medially and 4 weakly-toothed robust setae laterally and apically. Maxilla 2 inner plate

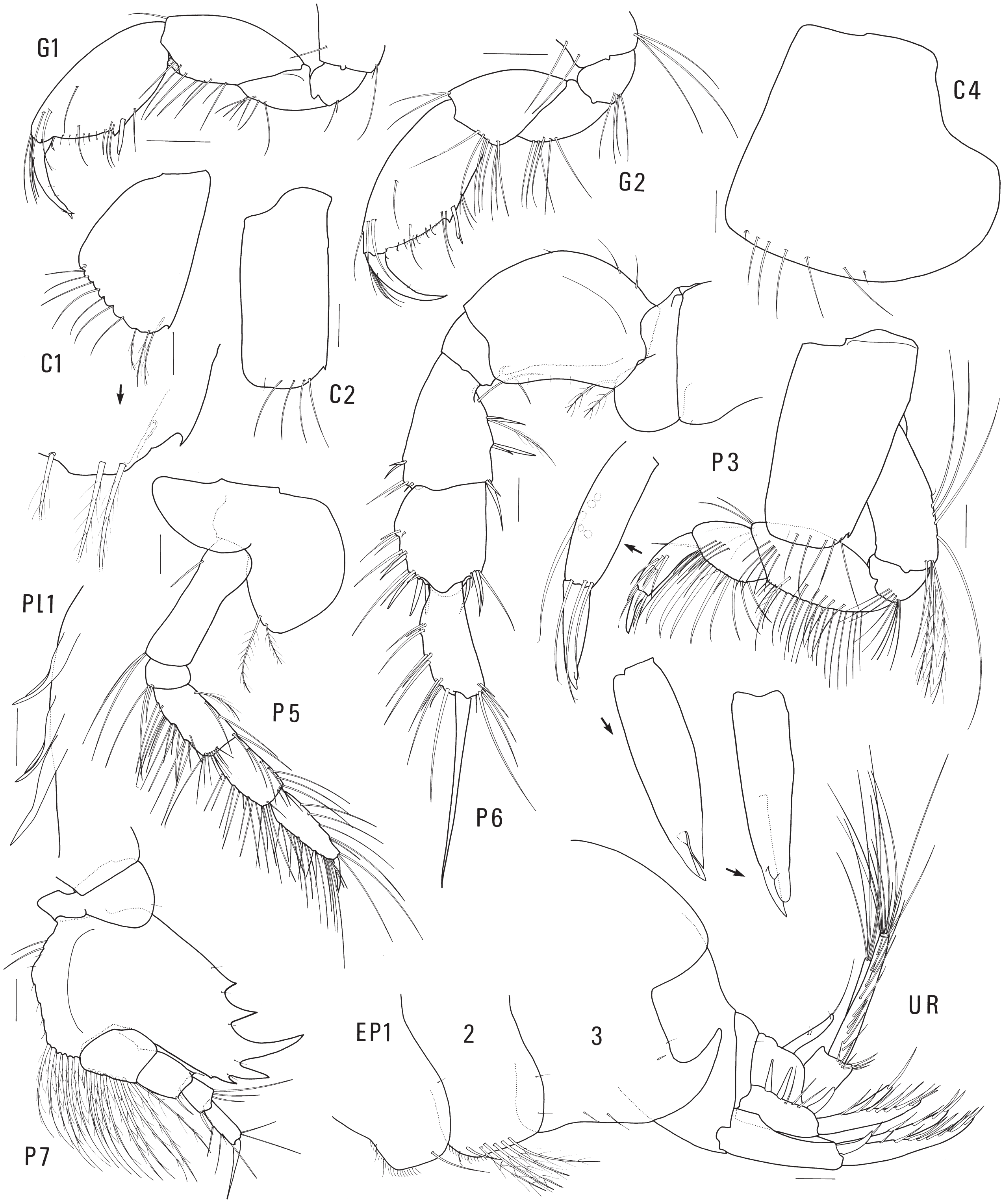

Figure 7. *Palabriaphoxus barnardi* sp. nov., holotype female "v", NIWA 115630, 3.73 mm, eastern Tasman Sea. Scales for PL1 represent 0.02 mm. Other scales represent 0.1 mm.

slightly shorter than outer plate and slightly narrower, with 9 plumose setae; outer plate with 11 long slightly plumose setae apically stretching laterally. Maxilliped inner plate with 1 short robust seta apically and 5 long plumose setae apicofacially and medially; outer plate with 7 medial and apical blunt long robust setae, 3 apicolateral setae; palp article 1 without apicolateral setae, article 2 medial margin weakly setose, article 3 not produced, without upper facial setae, with 5 medial setae, and 5 apical setae, article 4 long subtriangular, with 1 seta laterally, 2 apical setae, apical nail elongate.

Pereon: Gnathopod 1 coxa ventral margin slightly expanded posterodistally with tiny sharp tooth on posteroventral corner, anterior margin slightly convex, ventral margin with 10 long slender plumose setae; basis undocumented; ischium small and subrectangular, posterodistal corner with 2 simple setae; merus posterior margin with 5 plumose setae; carpus 2 × as long as wide, anterior margin with 1 seta distally, posterior margin with 8 long setae; propodus 2.1 × as long as wide, 1.22 × length of carpus, anterior margin with 4 setae distally, posterior margin with 1 seta proximal to defining robust seta, 5 slender setae on facial surface; palm weakly setose and slightly convex, acute and produced to form small acute tooth at definition of palm, with 1 robust seta; dactylus reaching palmar corner, inner margin with 2 setae. Gnathopod 2 of similar size to gnathopod 1; coxa subrectangular with small acute tooth on posteroventral corner, ventral margin with 4 plumose setae, anterior margin weakly convex; basis undocumented; ischium small and subrectangular, posterior distal corner with 4 long plumose setae; merus posterior margin with 6 long slender setae; carpus short, subtriangular, 1.6 × longer than wide, anterior margin without setae, posterior margin with tuft of 11 long slender setae distally; propodus 1.7 × as long as wide, 1.3 × carpus length, anterior margin with tuft of setae distally, posterior margin weakly setose, with 1 robust seta defining palm, palm slightly convex, acute, forming small acute tooth defining palm; dactylus reaching palmar corner. Pereopod 3 coxa subrectangular, ventral margin with 5 simple setae, posteroventral corner produced to form very small acute tooth; basis 2.6 × as long as wide, posterior margin with 4 long plumose setae and distally tipped with 4 long plumose setae; ischium small and subrectangular, posterior margin with 8 distal plumose setae; merus weakly inflated, anterodistal corner bearing 2 setae, posterior margin setose with 24 medium to long plumose setae, and 5 facial setae; carpus posterior margin setose with 10 slender to robust setae, with 4 facial plumose setae; propodus posterior margin without setae, facial surface with 5 robust setae; dactylus 0.6 × length of propodus. Pereopod 4 coxa expanded posteriorly to form broadly rounded lobe, ventral margin with 5 long plumose setae and 2 very small simple setae; distal articles similar to pereopod 3. Pereopod 5 coxa bilobate, expanded posteroventrally, posteroventral lobe with 2 plumose setae; basis narrow and straight sided with slight expansion proximally, 3.25 × as long as wide, anterior margin with 1 long seta marginally and 2 plumose setae distally, posterior margin without setae; ischium small and subrectangular, anterior margin with 3 long plumose setae distally; merus anterior margin setose, with 15 long slender plumose setae marginally and 10 distally, posterior margin with 3 long plumose setae marginally and 2 long plumose setae distally; carpus anterior margin moderately setose, with 12 long plumose setae marginally and 6 long plumose setae distally, posterior margin with 6 plumose setae marginally and with 3 setae distally; propodus anterior margin with 12 long plumose setae marginally and 6 long plumose setae distally, posterior margin with 5 long plumose setae marginally and 2 distally, no facial setae present; dactylus 0.35 × as long as propodus. Pereopod 6 much longer than all other pereopods; coxa weakly expanded posteroventrally, posterior margin with 2 long plumose setae and not covered with setules; basis about 1.3 × as long as wide, anterior margin convex, bearing 3 slender setae marginally, posterior margin straight without fringe of setae, 1 small slender seta, not expanded proximally; ischium small and subrectangular without setae; merus: carpus: propodus length ratio 1:1.2:0.8; merus 1.4 × longer than wide, anterior margin with 2 small robust setae, posterior margin with 2 tufts of large slender setae composed of 2 setae each, distally with 2 slender simple setae, no setae on facial surface; carpus 1.1 × longer than wide anterior margin lined with 3 rows of long robust setae each row/tuft consisting of 3 setae, 2 robust setae distally, posterior margin distal corner with 5 long robust setae; propodus 2.0 × longer than wide, similar in length to carpus, anterior margin with 3 rows of long slender setae each composed of 3 setae, and 1 long slender seta distally, posterior margin with 6 setae distally; dactylus elongate, 1.75 × the length of propodus. Pereopod 7 coxa small and subtrapezoidal, slightly expanded posteriorly, posterior margin with 1 short seta; basis 1.2 × longer than wide (including the posteroventral lobe), strongly expanded posteroventrally to form strongly-toothed posteroventral lobe reaching beyond propodus, anterior margin bearing 8 small slender setae marginally and 6 long plumose setae distally, posterior margin strongly serrate with curved teeth, with small slender seta between teeth, 5 in total, no setae on facial surface; ischium subrectangular, 1.1 × as long as wide, anterior margin with 11 long slender plumose setae marginally; merus shorter than ischium (0.8 ×), anterior margin with 1 slender seta and 1 distally, posterior margin with 1 slender seta distally; carpus short 0.7 × merus length, anterior margin with 1 distal slender simple seta, posterior margin with 3 slender simple setae distally; propodus narrow and 1.5 × carpus, anterior margin with 2 slender setae marginally and 1 distally, posterior margin with 2 slender setae distally; dactylus elongate, 1.2 × longer than propodus.

Pleon: Epimeron 1 anteroventral corner with 2 small slender setae and fringe of setules, ventral margin with 1 small slender seta, posterior margin convex, posteroventral corner without setae, posterior margin with 1 small seta. Epimeron 2 anteroventral corner rounded with fringe of small setules, ventral margin with 5 long slender plumose setae, posteroventral corner slightly rounded, posterior margin weakly convex with 2 small slender setae, facial surface without setae. Epimeron 3 anteroventral corner rounded, ventral margin weakly concave with 2 small, slender, simple setae, posteroventral corner produced to form long acute, curved projection, posterior margin with 2 small slender setae, plate facial surface without setae. Uropod 1 peduncle 1.7 × as long as wide, dorsomedial margin with 2 long slender simple setae, dorsolateral distal corner with 1 large robust seta; outer ramus dorsal margin with 7 long slender simple setae along margin and 2 slender simple setae sub-apically; inner ramus slightly shorter than outer, dorsal margin with 4 long slender simple setae marginally and 3 slender simple setae sub-apically. Uropod 2 peduncle 1.6 × longer than wide, dorsomedial margin with 1 slender, simple seta distally, dorsolateral margin with 2 long robust setae proximally then 3 long slender simple setae marginally and then 1 large robust seta apically; outer ramus dorsal margin with 7 long slender simple setae marginally and 2 sub-apically; inner ramus shorter than outer, margins without setae and with 1 long slender seta sub-apically. Uropod 3 peduncle 1.4 × as long as wide, with 3 long slender plumose setae ventrodistally and 1 robust seta dorsodistally; outer ramus 2-articulate, article 1 ventrolateral margin with 11 long setae and 3 long setae apically, dorsolateral margin with 3 long slender setae marginally and 1 long seta apically; article 2 tiny 0.06 × length of article 1, wider than long, tipped with

3 long plumose slender setae apically; inner ramus shorter than outer ramus (0.7 ×), outer margin lined with 3 long slender plumose setae and 3 long slender setae apically. Telson short, 87% cleft, each lobe narrow and weakly rounded apically, each lobe with 2 mid-facial short plumose setae and 1 long slender apical seta and fine setules covering apices. Urosomite 3 without plumose setae on either side of telson insertion.

MALE. Unknown.

Remarks. *Palabriaphoxus barnardi* sp. nov. is currently known from the type locality and from very few specimens. This situation will change once further examination of the collections identified as *P. palabria* from around New Zealand can be undertaken. *Palabriaphoxus barnardi* is the closest in morphology to *P. palabria* but differs chiefly in the shorter length of antenna 1 article 2 and antenna 2 article 4 (elongated in *P. palabria*), the absence of a serrated extended corner on the proximal posterior corner of the P6 basis, the absence of lateral robust setae on the telson and the absence of basoventral setae on the urosome (both present on *P. palabria*).

Distribution. Eastern Tasman Sea; 520 m.

Palabriaphoxus lowryi sp. nov.

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Figs 8–11

Holotype: NIWA 115627, ovigerous female "a", 5.20 mm, eastern Tasman Sea, 41°08.2'S 172°03.4'E, anchor box dredge, 51 m, P. K. Probert on RV *Tangaroa*, 5 March 1982, cruise 1131, Station Q726. **Paratype**: NIWA 115629, female "c", collected with holotype.

Additional material examined. AM P39540, male "m", 2.51 mm, AM P39541, female "m-1", 3.94 mm, AM P39542, 2 specimens "m2" and "m3"; eastern Tasman Sea, 41°38.8'S 171°39.1'E, anchor box dredge, 32 m, P. K. Probert on RV *Tangaroa*, cruise 1131, Station Q714, 27 February 1982. AM P39543, 1 female, eastern Tasman Sea, 42°24.5'S 170°57.5'E, anchor box dredge, 133 m, P. K. Probert on RV *Tangaroa*, cruise 1131, Station Q717, 28 February 1982. NIWA, specimens "h", "i" and "j"; Senecio Pool, The Snares, 48°07'S 166°36'E, among deposits of terrestrial plant detritus, 7 m, G. D. Fenwick, 6 January 1977, SA3487.

Etymology. The name is for Jim Lowry, in memory of his enthusiasm for amphipods and his mentoring of both authors.

Diagnosis. Eyes present. Antenna 1 peduncular article 1 ventral apex not ensiform, peduncle article 2 shortened. Antenna 2 peduncle article 3 with 5 robust setae, article 4 shortened with facial robust setae. Right mandible lacinia mobilis multi-toothed. Maxilla 1 inner plate shorter than outer, outer plate with 9 multicuspidate robust setae. Maxilliped palp article 3 not produced. Posteroventral corner of coxae 1–3 with very small acute tooth. Gnathopods 1–2 carpus not cryptic. Gnathopod 2 similar sized to gnathopod 1, propodus with 1 robust seta near palmar corner. Pereopods 3–4 carpus setae placed near anterodistal margin. Robust setae forming dominant posterior element on pereopods 3–4 carpus. Pereopod 5 basis narrow, much longer than wide. Pereopod 6 basis anterior margin without setae, posterodistal corner not produced to form lobe. Pereopod 7 merus, carpus, and propodus narrow; dactylus long. Urosome without basoventral setae. Epimera 1–2 without facial setae. Uropods 1–2 rami never fully spinose. Uropod 1 peduncle without enlarged robust setae. Uropod 2 peduncle only with robust setae. Uropod 3 outer ramus article 2 with 2 long apical setae; inner ramus long, about 1.2 × the length of outer. Telson deeply cleft, apically with 3 slender plumose setae per lobe, marginally without setae on each side, without lateral robust setae.

Description. FEMALE, based on NIWA 115627, holotype, female "a", 5.20 mm.

Head: Eyes present, very small and partly obscured; rostrum unconstricted, broad, reaching distal end of article 3 of antenna 1 peduncle; posteroventral corner of head produced into small tooth curved anteriorly. Antenna 1 peduncle article 1 stout, 1.3 × as long as wide, 1.85 × as long as article 2, ventral margin with 6 plumose setae (distal corner and onto ventral margin), dorsal margin unproduced distally; article 2 narrower and shorter than article 1, ventral margin with 7 long plumose setae, facial margin with 1 slender seta; article 3 short and subrectangular, ventral margin with 2 setae, facial margin with 4 plumose/brush setae; primary flagellum 7-articulate, first article elongated; accessory flagellum 6-articulate. Antenna 2 peduncle article 3 ventral margin with 5 simple setae; article 4 ventral margin expanded with 6 long plumose setae, facial margin with row of 12 robust plumose (becoming less robust distalwards) short setae, dorsal margin with 1 small seta and 16 long slender plumose setae distally and 4 long plumose setae inset facially; article 5 0.7 × length of article 4, ventral margin with 8 plumose, and 1 distal small plumose setae; flagellum 8-articulate, article 8 very small.

Mouthparts: Left mandible molar as a weakly elongate plaque armed with 2-toothed robust setae, and 1 short plumose seta, incisor blade like divided into 3 teeth, lacinia mobilis with 5 teeth, accessory setal row with 9 multicuspidate stout setae, palpar hump reduced; palp not documented. Right mandible incisor blade like with 3 teeth, lacinia mobilis reduced/broken off, accessory setal row with 9 multicuspidate stout setae; palp 3-articulate, article 1 0.14 × article 2, article 2 straight, slightly inflated, with 6 elongate inner margin setae, no outer setae, 1.06 × article 3, article 3 apex oblique with 8 long, slender setae. Maxilla 1 inner plate with 4 short apical plumose setae, and setules on lateral margin; outer plate with 11 stout multicuspidate setae; palp 2-articulate, article 2 with 8 slender setae laterally and apically. Maxilla 2 inner plate subequal to outer plate but slightly narrower, with 8 plumose setae; outer plate with 13 long pectinate setae apically stretching laterally; both plates with setules. Maxilliped inner plate with 1 short robust seta apically and 6 long plumose setae apicofacially and medially; outer plate with 8 medial and apical robust setae, 3 lateral setae; palp article 1 without apicolateral setae, article 2 medial margin weakly setose, article 3 not produced, with slender facial setae, lateral setae on both margins, article 4 long subrectangular, with 2 setae laterally, 1 apical seta and 1 long apical nail.

Pereon: Gnathopod 1 coxa ventral margin expanded to form triangular shape, no posteroventral tooth, with 8 plumose setae; basis not documented; ischium small and

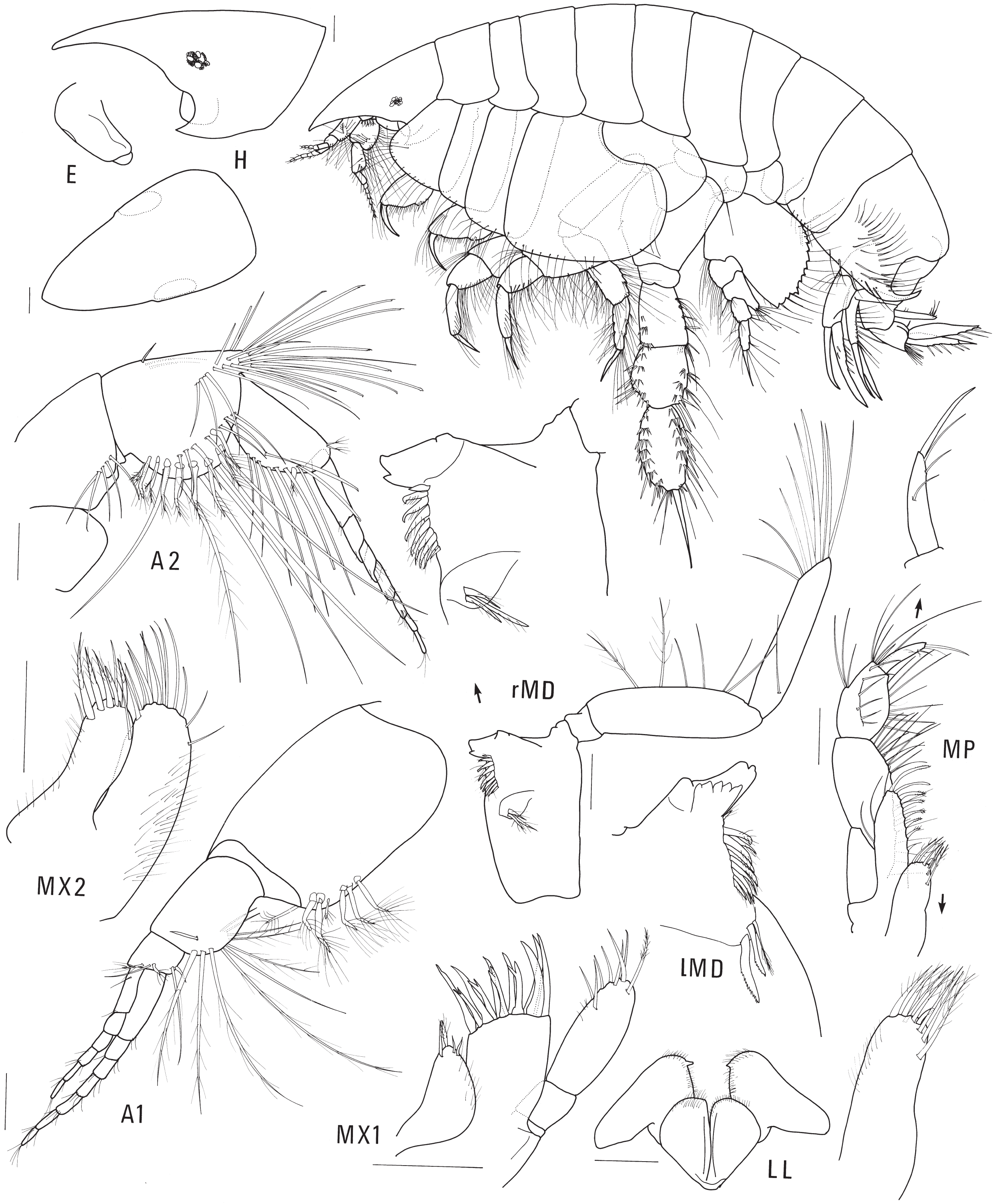

Figure 8. *Palabriaphoxus lowryi* sp. nov., holotype female "a", NIWA 115627, 5.20 mm, eastern Tasman Sea. Scales represent 0.1 mm.

subrectangular, posterior margin without setae; merus posterior margin with 13 simple slender setae, facial margin without setae; carpus short, 1.5 × as long as wide, anterior margin with 1 seta distally, posterior margin with 9 long setae; propodus 1.6 × as long as wide, anterior margin with 8 setae distally, posterior margin without setae proximal to defining robust seta, facial margin with 5 long slender setae; palm densely setose with many short robust setae and longer slender setae and slightly convex, acute, produced to form small subacute corner; dactylus reaching palmar corner, outer margin with 1 small seta. Gnathopod 2 slightly larger than gnathopod 1; coxa subrectangular without tooth on posteroventral corner, ventral margin with 5 plumose setae, anterior margin very weakly convex; basis not documented; ischium small and subrectangular, posterior distal corner with 5 long weakly plumose setae; merus subtriangular, posterior margin produced slightly to form small rounded lobe, with 13 long, slender weakly plumose setae, anterior

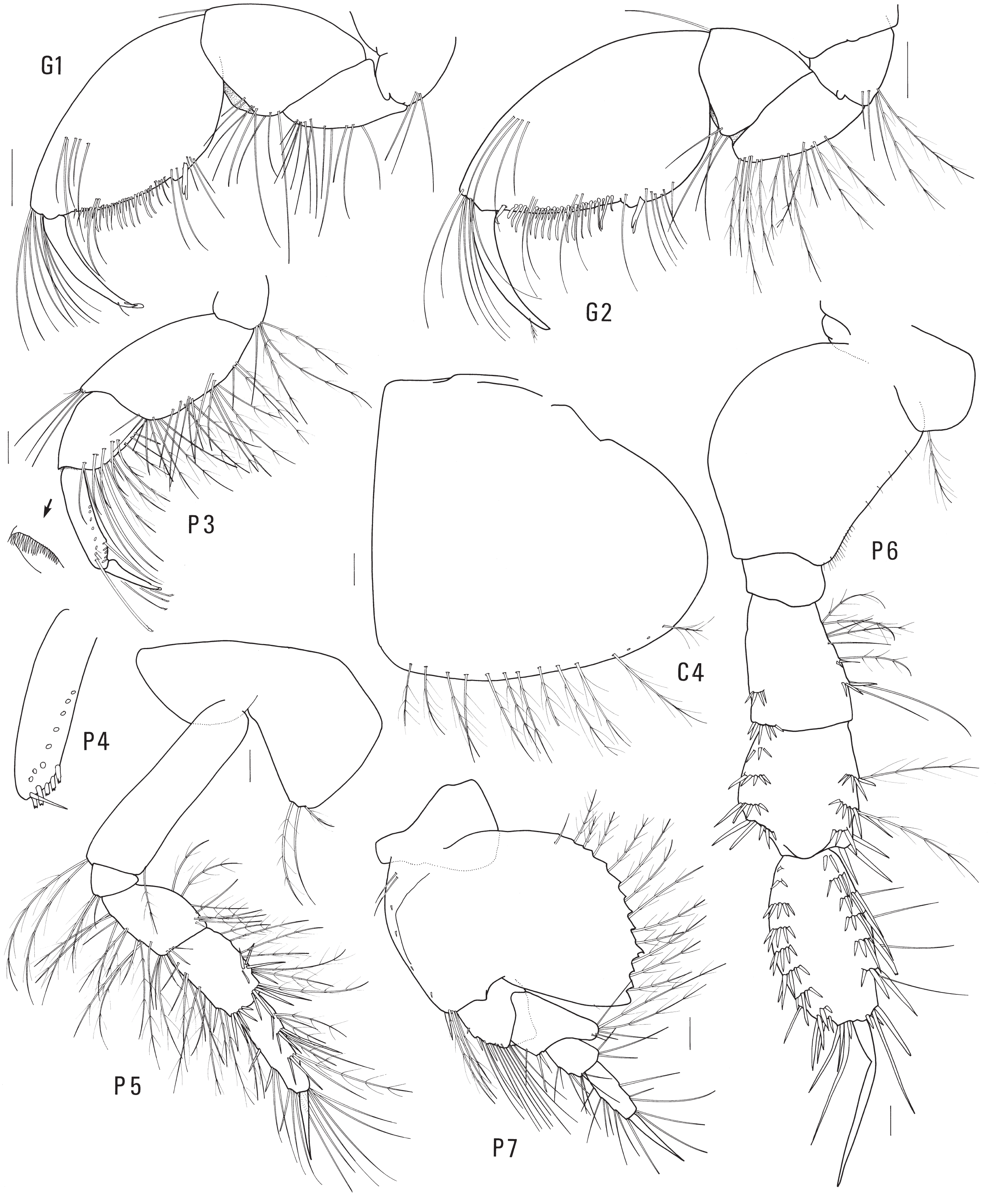

Figure 9. *Palabriaphoxus lowryi* sp. nov., holotype, female “a”, NIWA 115627, 5.20 mm, eastern Tasman Sea. Scales represent 0.1 mm.

margin reduced; carpus short, subtriangular, 0.84 × long as wide, posterior margin with 4 setae; propodus 1.6 × as long as wide, anterior margin with tuft of 7 setae distally, posterior margin weakly setose, with 1 robust seta defining palm, palm slightly convex, acute, produced posteroventrally to form small rounded defining corner; dactylus reaching palmar corner, outer margin with 1 small distal seta. Pereopod 3 coxa subrectangular, ventral margin with 7 plumose setae, posteroventral corner not produced to form tooth; basis not documented; ischium small and subrectangular, with 4 distal plumose setae; merus weakly inflated, anterior margin extended distally to form small rounded lobe bearing 3 long slender setae, posterior margin moderately setose with 20 medium to long plumose setae; carpus posterior margin setose, with 15 plumose setae, with 5 facial plumose setae, distal margin of article lined with fringe of short, dense robust

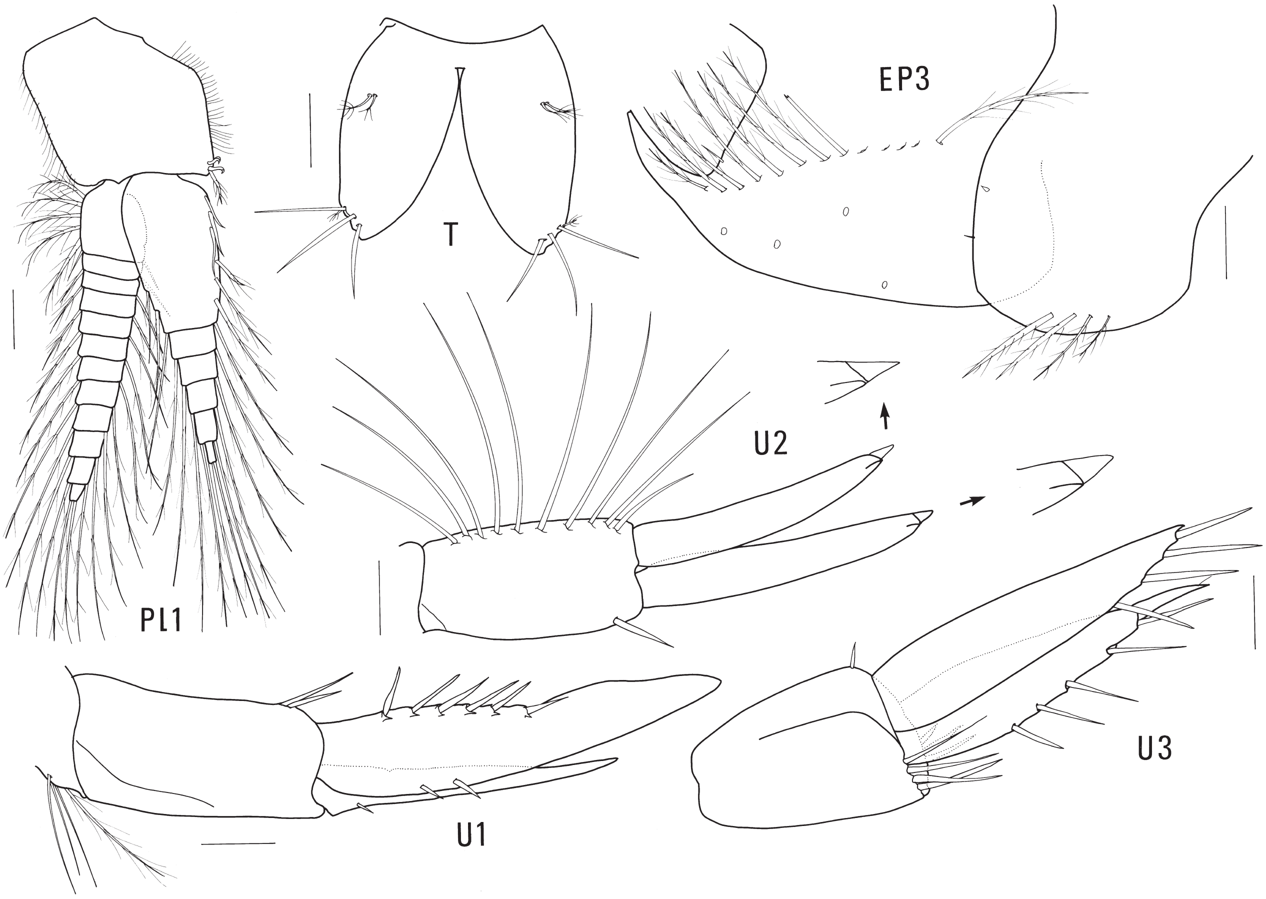

Figure 10. *Palabriaphoxus lowryi* sp. nov., holotype, female "a", NIWA 115627, 5.20 mm, eastern Tasman Sea. Scales represent 0.1 mm.

setules; propodus posterior margin without setae, facial surface with 8 long setae in long curved row; dactylus 0.53 × length of propodus. Pereopod 4 coxa expanded posteriorly to form broadly rounded lobe, all of posterior margin convex, ventral margin with 14 long plumose setae and 2 very small simple setae; distal articles similar to pereopod 3. Pereopod 5 coxa bilobate, expanded posteroventrally, posteroventral lobe angular with 3 plumose setae; basis narrow and straight sided, 4 × as long as wide, anterior margin with 2 plumose setae distally, posterior margin with 1 seta distally; ischium small and subrectangular, anterior margin with 3 long plumose setae distally; merus anterior margin moderately setose, with 10 long slender plumose setae marginally and 7 distally, posterior margin with 4 long plumose setae marginally and 3 long plumose setae distally; carpus anterior margin setose, with 11 long plumose setae marginally and 2 long plumose and 5 long robust setae distally, posterior margin with 6 plumose and 5 long robust setae marginally and with 1 long plumose and 4 robust setae distally; propodus anterior margin with 4 long simple setae marginally and 3 long simple setae distally, posterior margin with 6 long plumose and 6 long simple setae marginally and 6 distally, facial setae absent; dactylus 0.62 × as long as propodus. Pereopod 6 much longer than other pereopods; coxa weakly expanded posteroventrally, posterior margin with 1 long plumose seta and not covered with setules; basis about 1.2 × as long as wide, anterior margin strongly convex, without setae, posterior margin almost straight, distally fringed with even, fine slender setae, not expanded to form proximal lobe, without proximal teeth; ischium small and subrectangular; merus: carpus: propodus length ratio 1:1:1.4; merus 1.3 × as long as wide, anterior margin with row of 4 small robust setae marginally and row of 5 robust setae distally, posterior margin with 8 long plumose setae and 5 short robust setae, distally without setae; carpus shorter than wide (0.75 ×), anterior margin lined with 4 rows of 3–4 robust setae each, posterior margin with 2 long slender setae and 4 rows of 4–5 robust setae marginally, distal corner with 1 long robust seta; propodus 1.8 × as long as wide, 1.4 × length of carpus, anterior and posterior margins lined with rows of 4–5 short robust setae; dactylus elongate, same length of propodus. Pereopod 7 coxa small and subtrapezoidal, slightly expanded posteriorly; basis as long as wide (including the posteroventral lobe), strongly expanded posteroventrally to form weakly-toothed posteroventral lobe reaching to distal margin of merus lobe, anterior margin bearing 2 slender setae marginally and 5 long plumose setae distally, posterior margin weakly serrate, with plumose setae in inter-dental notches, 13 in total; ischium subrectangular, 1.3 × as long as wide, anterior margin with 12 long slender plumose setae starting marginally and extending to facial surface; merus longer than ischium, anterior margin with 3 slender setae, posterior margin extended distally to form long rounded lobe extending halfway along carpal posterior margin, lobe tipped with 6 long slender setae; carpus short and subrectangular 0.6 × merus length, anterior margin with 4 long slender setae and tipped with 3 small slender simple setae, posterior margin with 3 slender simple setae distally; propodus narrow and 1.6 × carpus, anterior and posterior margins with 4 and 3 setae respectively; dactylus elongate, as long as propodus.

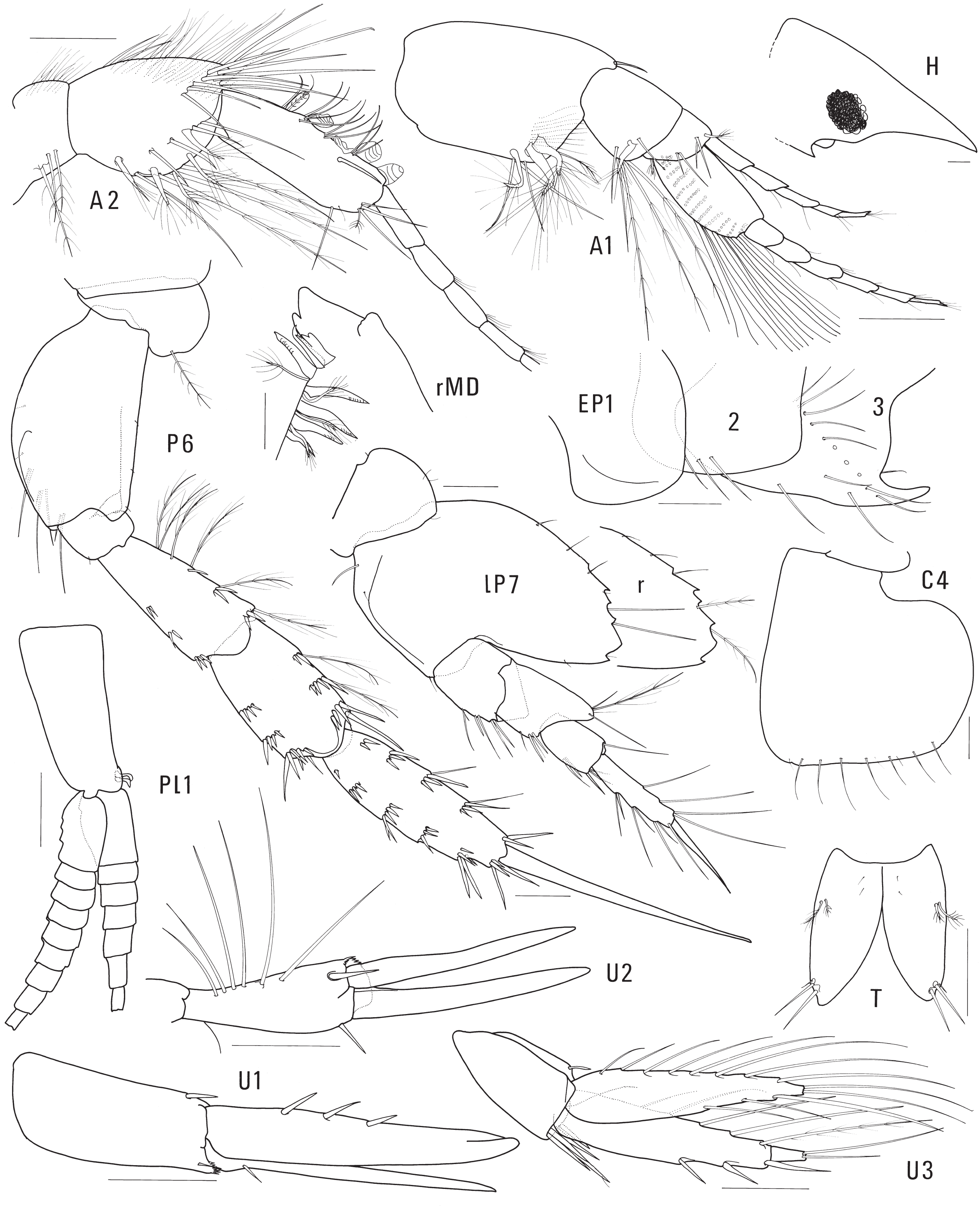

Figure 11. *Palabriaphoxus lowryi* sp. nov., paratype, male "m", NIWA 115629, 2.51 mm, eastern Tasman Sea. Scale for rMD represents 0.02 mm. Scales for other parts represent 0.1 mm.

Pleon: Epimeron 1 setation unknown. Epimeron 2 anteroventral corner rounded, ventral margin with row of 4 long slender plumose setae reaching to posteroventral corner, posteroventral corner subquadrate, posterior margin straight with 2 short slender setae, facial setae absent. Epimeron 3 anteroventral corner rounded, ventral margin weakly convex lined with 3 long, slender, simple setae, posteroventral corner produced to form long acute, straight projection, posterior margin without setae, plate facial surface with 1 long arc of 14 long slender, simple setae. Uropod 1 peduncle 1.6 × as long as wide, dorsomedial margin with 2 long slender simple setae, dorsolateral distal corner without robust seta; outer ramus dorsal margin with 6 robust setae along margin and no setae sub-apically; inner ramus shorter than outer, dorsal margin with 1 small slender simple seta marginally and no setae sub-apically. Uropod 2 peduncle 1.6 × as long as wide, dorsomedial margin with 1 slender, simple seta distally, dorsolateral margin with 10 long slender setae marginally; outer ramus margins without setae and division resembling apical nail near the apical region; inner ramus subequal to outer, margins without setae. Uropod 3 peduncle 1.2 × as long as wide, with 4 short slender setae ventrodistally and 1 short robust seta dorsodistally; outer ramus 2-articulate, article 1 ventrolateral margin with 4 long setae and 1 long seta apically; article 2 long, thin, spiniform, 0.3 × length of article 1; inner ramus 1.2 × longer than outer ramus, outer margin with 1 long slender setae apically, inner margin with 3 long slender setae. Telson short, 85% cleft, each lobe broad, narrow apically, with 2 mid-facial short plumose setae, 3 long slender apical setae. Urosomite 3 without setae on either side of telson insertion.

MALE, based on AM P39540, male "m" 2.51 mm.

Head: Rostrum as in female; posteroventral corner of head produced into small tooth directed anteriorly. Antenna 1 peduncle article 1 stout, 1.5 × longer than wide, ventral margin with distal tuft of slender simple setae and 2 plumose setae (distal corner), dorsal margin slightly produced distally with 1 distal setule; article 2 narrower than and shorter than (0.48 ×) article 1, ventral margin with 5 long plumose setae and 3 small setules, with facial robust brush setae; article 3 short triangular, ventral margin with 6 small setae, facial margin without setae; primary flagellum 8-articulate, first article elongated and broadened, last article reduced, article 1 with callynophore occupying most of surface; accessory flagellum 6-articulate, sixth article reduced. Antenna 2 peduncle article 4 ventral margin with 4 long evenly spaced plumose setae and with 8 facial robust setae, dorsal margin lined with long slender setae with 4 long slender plumose setae and 4 robust setae distally; article 5 1.2 × length of article 4, ventral margin with 3 apical long plumose setae, dorsal margin with 4 tufts of 3–4 slender setae and 5 calceoli; flagellum at least 5-articulate. Right mandible with 9 accessory setae, right lacinia mobilis with 3 weak teeth.

Pereon: Pereopod 4 coxa proximal posterior margin concave. Pereopod 6 basis posterior straight, no lobe and smooth, anterior margin with 3 slender setae and 1 wide robust seta distally; ischium without setae; merus: carpus: propodus length ratio 1:0.9:1.2; merus, carpus, and propodus are all narrower than female and different proportions; merus, carpus, and propodus all with rows of facial short robust setae, long plumose setae absent; dactylus elongated, 1.3 × length of propodus. Pereopod 7 basis also expanded but lobe only weakly serrate, only 6 inter-tooth setae small and simple, lobe shorter, almost reaching end of merus; carpus longer in proportion to propodus; dactylus slightly shorter than propodus (0.9 ×).

Pleon: Epimeron 1 longer than epimeron 2. Epimeron 2 ventral margin with 3 long slender plumose setae. Epimeron 3 with 3 setae on ventral margin, facial arc straight with 11 slender setae. Uropod 3 peduncle 1.7 × as long as wide, with 4 robust setae distally; outer ramus article 1, margins covered with long plumose setae, and 2 robust setae, article 2 with 2 long plumose setae apically; inner ramus as long as outer ramus, margins covered with long plumose setae.

Remarks. *Palabriaphoxus lowryi* sp. nov., like *P. barnardi* will probably prove to have a wider range once the extensive series in research collections, previously identified as *P. palabria*, has been examined. The most obvious difference between *P. lowryi* and its congeners is the shape of the pereopod 7 basis (rounded and weakly scalloped, *P. palabria* and *P. barnardi* have strong elongated serrations and the basis is curved and narrower), as well as the other differences noted above.

Distribution. Eastern Tasman Sea and The Snares; 7–133 m.

Subfamily Phoxocephalinae Sars, 1891

Protophoxus K. H. Barnard, 1930

Protophoxus K. H. Barnard, 1930: 335.—Barnard & Drummond, 1976: 532; 1978: 189.

Type species. *Protophoxus australis* K. H. Barnard, 1930, by monotypy.

Diagnosis. Rostrum fully developed, unconstricted or weakly constricted. Eyes present. Antennae 1–2, flagella unreduced in female. Antenna 1 peduncle article 2 shortened, ventral setae widely spread, in middle. Antenna 2 peduncle article 1 not ensiform; article 3 with 1 seta and 1 setule; facial setae on article 4 in 1–3 weak or well-defined rows; article 5 ordinary in size. Prebuccal appendages not extended forward, rounded, massive, not strongly distinct, upper lip dominant. Right mandibular incisor with 4–5 teeth; molar not triturative, small, pillow shaped, with 3 or more splayed, semiarticulate robust setae, with patch of fine setae; palpar hump medium; right lacinia mobilis bifid, thin; mandibular palp medium to thin, article 1 short, article 2 without outer setae, apex of article 3 oblique. Lower lip with salivary cones. Maxilla 1 palp 2-articulate, inner plate with 4 setae, outer plate with 11 setal-teeth, 1 setal-tooth especially thickened. Maxilliped outer plates thin, elongate, ordinarily with robust and slender setae, palp article 3 apex not or scarcely protuberant, dactylus elongate, apical nail distinct, medium. Gnathopods small, similar. Gnathopod 1 carpus medium, free, palms acute, propodi oval to rectangular, poorly setose anteriorly. Pereopods 3–4 carpus setose posteroproximally, all posterior robust setae on propodus of pereopods 3–4 thick and stiff, midapical robust setae present. Pereopod 5 basis broad, tapering. Pereopods 5–6 merus-carpus broad to medium, basis not setose posteriorly. Pereopod 7 basis without facial and ventral setae, merus not lobed. Epimera 1–2 lacking elongate posterior setae, with midfacial setae below ventral facial ridge. Epimeron 3 variously setose, smooth posteriorly. Urosomite 3 without dorsal hook or special process. Uropod 1 peduncle without apicoventral enlarged robust seta, with special enlarged apicolateral robust seta, without basoventral setae, with dorsolateral and medial robust setae widely spread; inner ramus with marginal robust setae in 1 row, no rami continuously spinose to apex. Uropod 2 peduncle with only 1 medial robust seta confined apically, apex combed. Uropod 3 peduncle lacking extra subapical robust or slender setae, article 2 of outer ramus elongate, with 2 elongate apical setae. Telson with pair of midlateral or dorsal setules on each side, with 1 or more apical robust setae on each lobe. Five pairs of gills.

Sexual dimorphism. Antenna 1 peduncle article 1 with patch of fine setae in male. Calceoli present on male primary flagellum of antenna 1 and on peduncle article 5 of male antenna 2.

Key to world species of *Protophoxus*

1 Peduncle of uropod 1 with displaced robust seta on medial and lateral apices. Epimeron 3 lacking facial setation. Head without constriction in dorsal view .... [New Zealand, Otago Shelf; 132 m depth] ... *Protophoxus munida* sp. nov.

—— Peduncle of uropod 1 with displaced robust seta only on lateral apex. Epimeron 3 with facial setation. Head with constriction in dorsal view .... [New Zealand; 0–195 m] .... *Protophoxus australis*

Protophoxus australis (K. H. Barnard, 1930)

Figs 12–14

Phoxus batei.—Thomson, 1882: 232–233, pl. 17, figs. 2a–e (not Haswell, 1879).

Protophoxus australis K. H. Barnard, 1930: 335–336, fig. 12a–c.

Pontharpinia australis.—Hurley, 1954: 581–587, figs. 1–28.

Material examined. AM P25859, specimen "q3", female, 5.5 mm, Otago Shelf, New Zealand, 45°51'S 170°57'E, sand bottom, 132 m, P. K. Probert on RV *Munida*, MU74/114, 4 June 1974; NIWA 115616, specimen "q1", juvenile male, 3.41 mm, off west coast of South Island, New Zealand, 40°51.8'S 171°28'E, 195 m, P. K. Probert on RV *Tangaroa*, Cruise 1131, Q729, 6 March 1982.

Diagnosis. Eyes present. Head with constriction in dorsal view. Antenna 1 peduncular article 1 ventral apex not ensiform, peduncle article 2 shortened. Antenna 2 peduncle article 3 with robust setae, article 4 shortened with facial robust setae. Right mandible lacinia mobilis bifid. Maxilla 1 inner plate moderately large, outer plate with 11 multicuspidate robust setae. Maxilliped palp article 3 not produced. Posteroventral corner of coxae 1–3 without tooth. Gnathopods 1–2 carpus not cryptic. Gnathopod 2 similar sized to gnathopod 1, propodus with 1 robust seta near palmar corner. Pereopods 3–4 carpus setae placed near anterodistal margin. Robust setae forming dominant posterior element on pereopods 3–4 carpus. Pereopod 5 basis broad. Pereopod 6 basis anterior margin without setae, posterodistal corner not produced to form a lobe. Pereopod 7 merus, carpus, and propodus narrow; dactylus long. Urosome without basoventral setae. Epimera 1–2 with facial setae. Uropods 1–2 rami never fully spinose. Uropod 1 peduncle with displaced robust seta only on lateral apex. Uropod 2 peduncle only with robust setae. Uropod 3 outer ramus article 2 with 2 long apical setae; inner ramus medium length, about 0.5 × the length of outer. Telson deeply cleft, apically with 2 robust setae per lobe, marginally without setae on each side, without lateral robust setae.

Description. FEMALE, based on AM P25859, female "q3", 5.5 mm.

Head: Eyes medium, largely occluded with pigment. Head about 0.20 × body length, greatest width about 0.70 × length; rostrum constricted, of medium breadth, reaching end of article 1 on antenna 1. Antenna 1 peduncle article 1 1.5 × as long as wide, 2 × as wide as article 2, ventral margin with 6 setules, weakly produced dorsal apex with 3 setae; article 2 0.6 × as long as article 1, with ventral horseshoe cycle of 20 setae; primary flagellum 11-articulate, 0.84 × as long as peduncle, lacking large aesthetascs; accessory flagellum with 9 articles. Antennae 2 peduncle article 4 facial setal formula = 5-4-3, dorsal margin with 2 robust setae, ventral margin with 6–7 groups of 1–4 long to medium setae, 1 distoventral elongate robust seta; article 5 flabellate 0.8 × as long as article 4, facial setal formula = 2-2-1, ventral margin with 4 sets of 1 short and 1 elongate seta each, 1 distoventral medium robust seta; flagellum 1.6 × as long as articles 4–5 of peduncle combined, 12-articulate.

Mouthparts: Mandibles with small palpar hump; right incisor with 5 teeth; left incisor with 5 teeth in 2 weak sections; right lacinia mobilis bifid, distal branch flabellate, scarcely shorter than proximal, proximal section simple, pointed; left lacinia mobilis with 4 teeth; right accessory setal row with 7 multicuspidate stout setae, left with 8; molar bulbous, weak, with 1 thick penicillate seta in middle, disjunct from 2 slightly smaller simple robust setae, each molar with gross patch of fine setae; palp article 1 short, article 2 with 3 elongate inner setae and 2 other short inner setae, article 3 1.1 × as long as article 2, oblique apex with 11 long, slender setae. Maxilla 1 inner plate moderately large, with 2 elongate apicofacial pappose setae (1 on each face), 2 apicolateral much shorter simple setae; palp article 2 with 2 medial marginal setae, and 5 apical marginal setae (1 robust and 4 slender simple) and 2 submarginal setae. Maxilla 2 plates extending subequally, of subequal breadth, outer with 6 apicolateral setae, inner with 2 medial setae. Maxilliped inner plate with 2 large apical robust setae, 4 apicofacial setae, 4 medial setae; outer plate with 11 medial and apical robust setae, 4 apicolateral setae; palp article 1 with 1 apicolateral seta, medial margin of article 2 moderately setose, article 3 not produced, with 9 facial setae, 3 lateral setae, nail of article 4 medium, with 1 accessory setule.

Pereon: Coxa 1 scarcely expanded distally, anterior margin almost straight, main ventral setae of coxae 1–4 = 10-9-8-4, posterior most seta of coxae 1–2 shortened. Coxa 4 anterior and posterior margins divergent, posterior margin oblique, convex, posteroventral margin not bevelled, posterodorsal corner subrounded, posterodorsal margin short, concave, width to length ratio of coxa 4 = 30:35. Coxae 5–7 posteroventral setule formula = 2-4-4. Gnathopods 1–2 small, slender, weakly diverse; width ratios of carpus-propodus on gnathopods 1–2 = 11:16 and 10:16, length ratios = 23:30 and 18:29; palmar humps ordinary, palms acute; gnathopods 1–2 carpus medium and short respectively, of gnathopod 1 ovate, posterior margin of 1 rounded, of 2 scarcely lobate, of gnathopod 2 short, subtriangular. Pereopods 3–4 similar, facial setae formula on merus = 7 and 5, on carpus = 7 and 7; main robust seta of carpus extending to M. 95 on propodus, carpus without posteroproximal robust setae; setal formula of propodus = 5-5 plus 1, mid-distal robust seta acclivity on inner margin of dactyli of pereopods 3–4 moderately large.

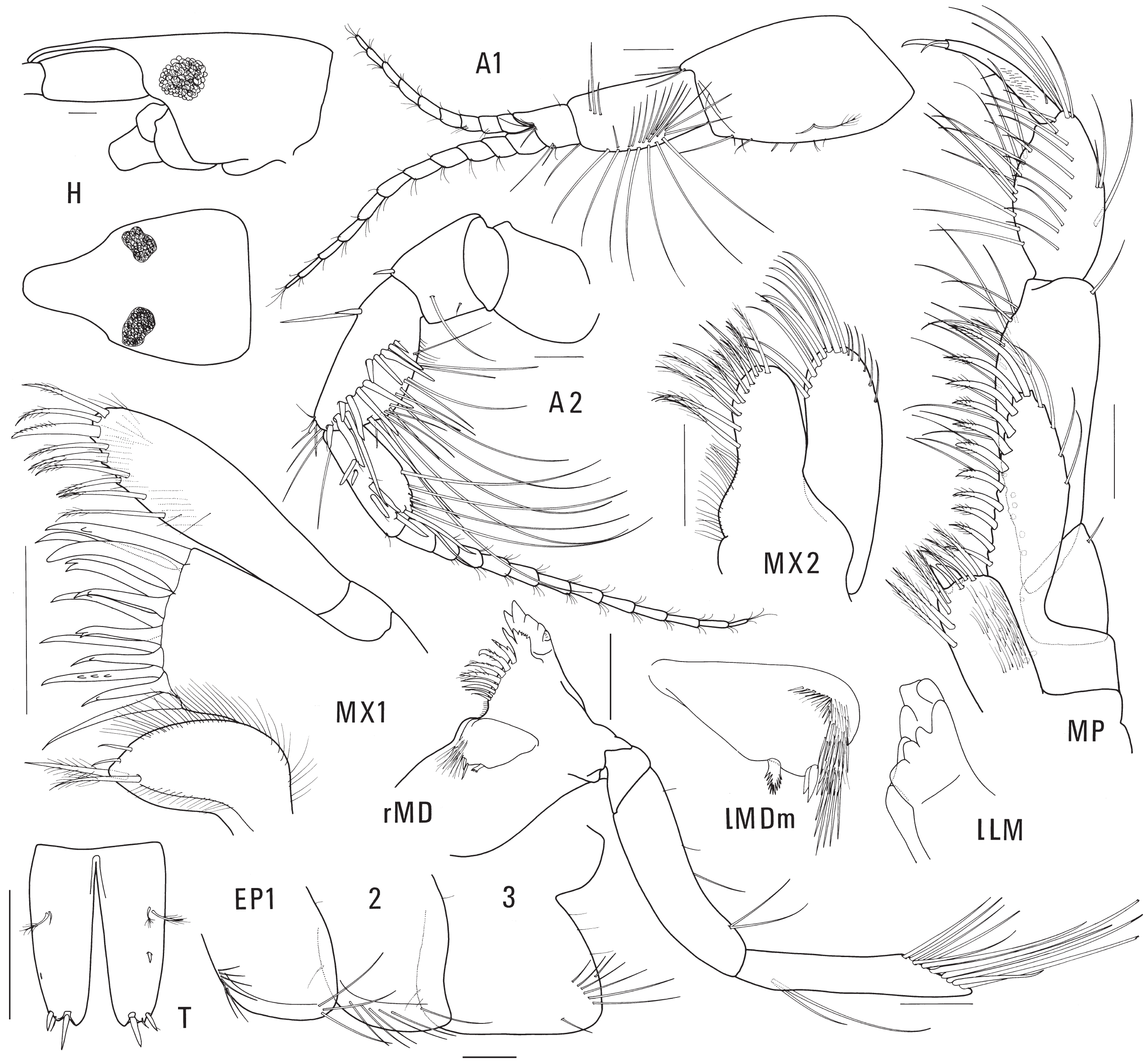

Figure 12. *Protophoxus australis* (K. H. Barnard, 1930), female "q-3", AM P25859, 5.5 mm, Otago Shelf, New Zealand. Scales represent 0.1 mm.

Pereopods 5–6 merus-carpus of medium width, facial robust setal rows poorly developed. Pereopods 5–7 basis facial ridge formula = 0-1-1, ridge of pereopod 7 long. Pereopod 5 basis slightly tapering distally; width ratios of basis, merus, carpus, propodus of pereopod 5 = 17:11:10:5, of pereopod 6 = 27: 18:9:? (broken), of pereopod 7 = 37:9:8:4, length ratios of pereopod 5 = 29:12:16:17, of pereopod 6 = 35:33: 16:?, of pereopod 7 = 40:10:11:13. Pereopod 7 basis reaching middle of carpus. Pereopods 5 and 7 merus without elongate posterodistal lobe; medial apex of propodus truncate, finely combed.

Pleon: Epimeron 1 posteroventral corner rounded, posterior margin convex, with setule, anteroventral margin with 6 short setae, ventral margin naked, posterior corner with 3 facial setae. Epimeron 2 posteroventral corner weakly and broadly protuberant, posterior margin sinuate, facial setae in 2 groups of 8 (row) and 1. Epimeron 3 posteroventral corner rounded, posterior margin convex, smooth, with 4 setules, posteroventral face with 1 seta, midposterior face with oblique row of 6 setae. Urosomite 1 with ventrolateral and ventral row of 9+ setae, no ventral robust setae at base of uropod 1. Urosomite 3 weakly protuberant dorsally. Uropod 1 peduncle with 3 apicolateral robust setae, medially with 7 marginal slender setae and robust setae becoming thicker apically, outer ramus with 5 lateral robust setae, inner with 3 medial. Uropod 2 peduncle with 6 dorsal robust setae, medially with 1 medium apical robust seta, outer ramus with 5 dorsal robust setae, inner with 2 medial robust setae. Uropods 1–2 rami with articulate enlarged apical nails, lacking accessory nails. Uropod 3 peduncle with 6 apicoventral robust setae, dorsally with 1 lateral robust seta, 1 medial robust seta and no setules; rami feminine, inner extending to M.47 on article 2 of outer ramus, apex with 1 seta, article 2 of outer ramus elongate, 0.4 × as long as article 1, with 1 long, 1 short setae, medial margin of article 1 with 1 subequal seta, lateral margin with 3 acclivities, setal formula = 2-2-2-2. Setal formula = 0. Telson elongate, length to width ratio = 15:11, almost fully cleft, each apex medium,

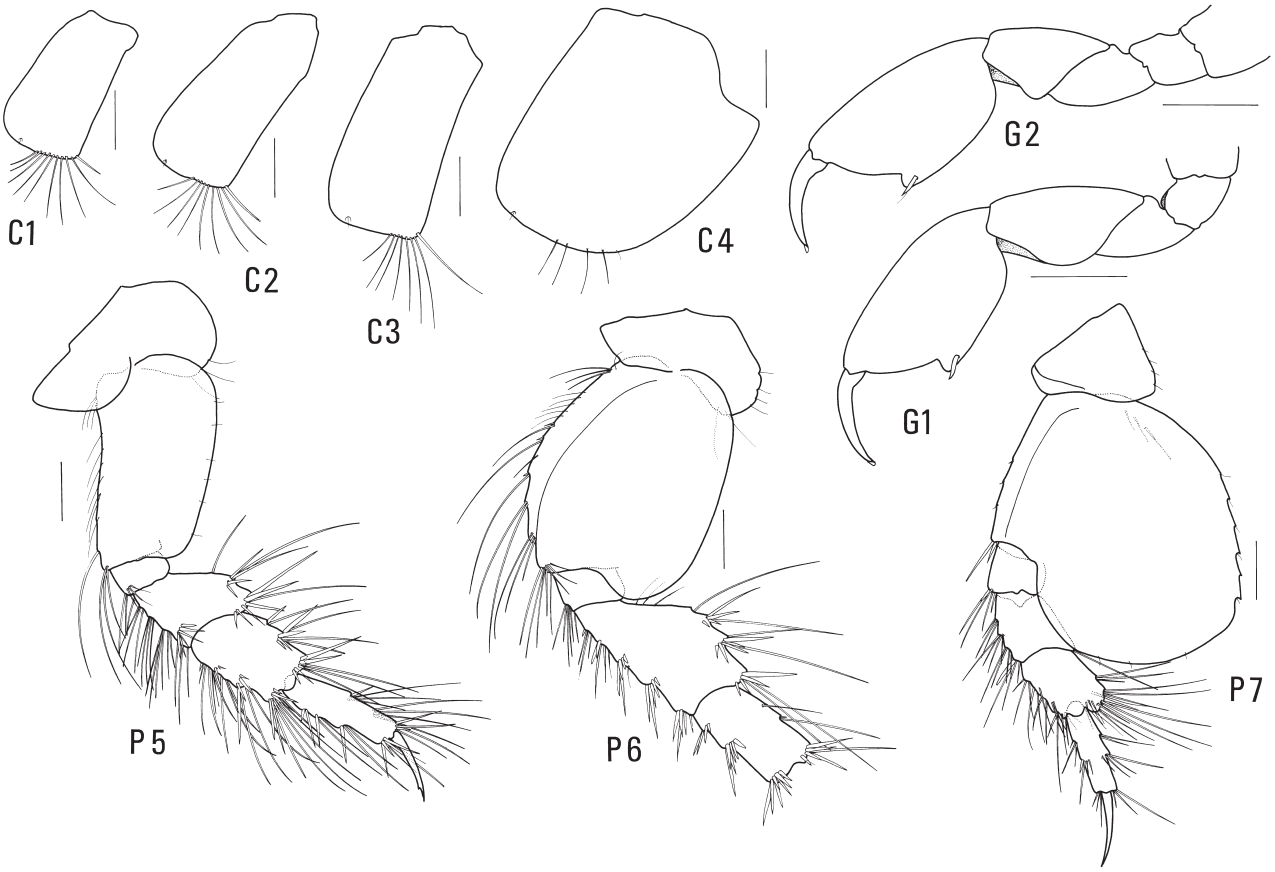

Figure 13. *Protophoxus australis* (K. H. Barnard, 1930), female "q-3", AM P25859, 5.5 mm, Otago Shelf, New Zealand. Scales represent 0.2 mm.

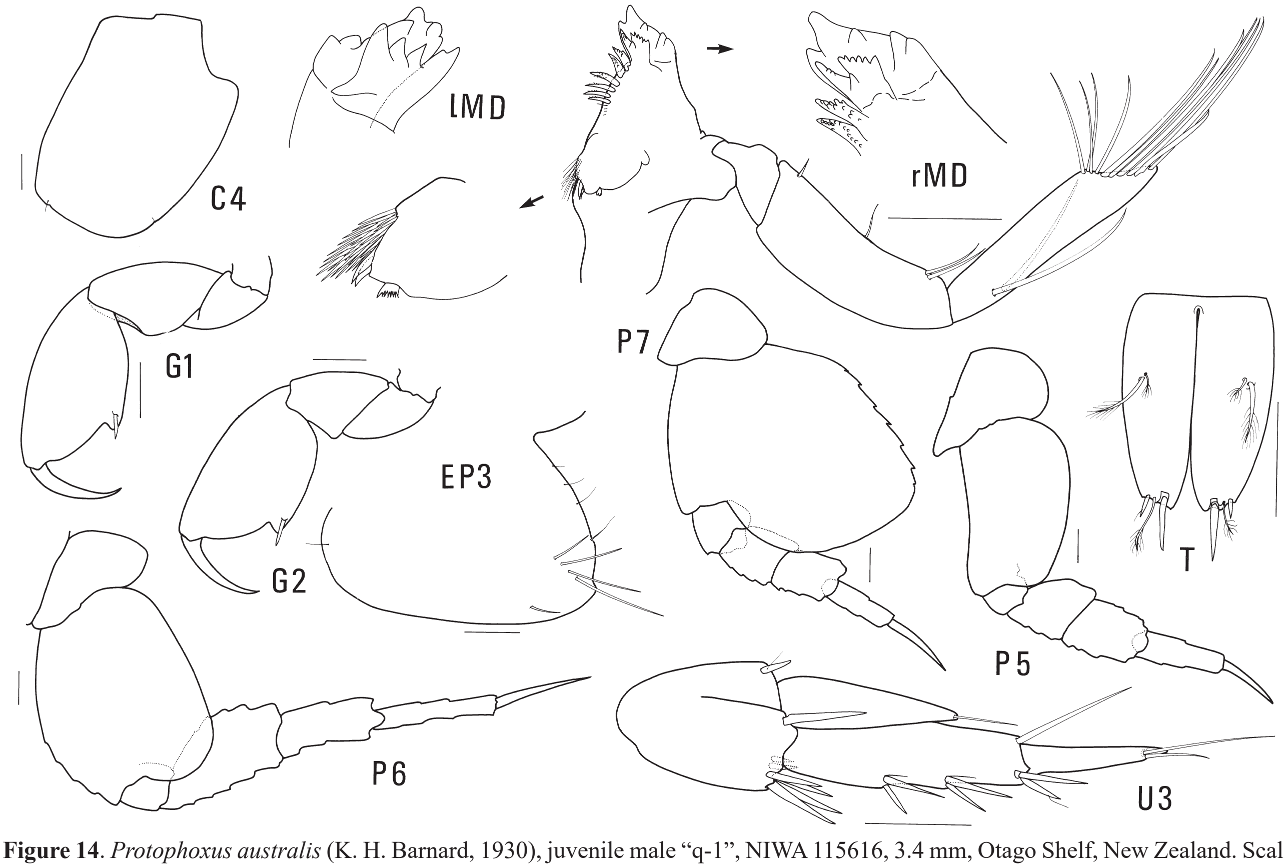

Figure 14. *Protophoxus australis* (K. H. Barnard, 1930), juvenile male "q-1", NIWA 115616, 3.4 mm, Otago Shelf, New Zealand. Scales represent 0.1 mm.

weakly notched, lateral acclivity absent, with apicolateral robust setae and medial setule, then middle apical robust setae, basodorsal setules diverse.

JUVENILE MALE, based on NIWA 115616, male "q1", 3.41 mm. Mandibular palp article 2 setae shortened and less setose. Gnathopods slightly stouter and shorter; coxa 4 slightly narrowed. Epimera broadened. Main apical robust seta on each lobe of telson elongate. Uropod 3 remaining in feminine form.

Remarks. Only the male of *Protophoxus australis* was known previously. The female differs from the male in the fewer bulbar setules on peduncle article 1 of antenna 1, the lack of calceoli on the antennae, the smaller eyes, the narrower telson with robust setae set more directly on the apices of each lobe, the weaker setation on uropod 3, the shorter inner ramus of uropod 3 (see female-like uropod 3 of "q1" specimen), the smaller epimeron 1, the weakly sinuate posterior margin of epimeron 2, the weaker spination of the pereopods, and the stronger excavation on coxa 4.

Protophoxus australis differs from *Pr. munida* sp. nov. primarily by the presence of facial setae on epimeron 3 (absent on *Pr. munida*) and the head in dorsal view abruptly tapering (not abruptly tapering in *Pr. munida*).

Distribution. New Zealand: off Three Kings Island, surface, and Spirits Bay, North Auckland; Port Chalmers; Paterson Inlet, Stewart Island; 0–195 m depth.

Protophoxus munida sp. nov.

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Figs 15–16

Holotype: AM P39544, female "q2", 6.0 mm, Otago Shelf, New Zealand, 45°51'S 170°57'E, sand bottom, 132 m, P. K. Probert on RV *Munida*, 4 June 1974, MU74/114.

Etymology. Named for the RV *Munida*, University of Otago research vessel; used as a noun in apposition.

Diagnosis. Eyes present. Head without constriction in dorsal view. Antenna 1 peduncular article 1 ventral apex not ensiform, peduncle article 2 shortened. Antenna 2 peduncle article 3 with robust setae, article 4 shortened with facial robust setae. Right mandible lacinia mobilis bifid. Maxilla 1 inner plate moderately large, outer plate with 11 multicuspidate robust setae. Maxilliped palp article 3 not produced. Posteroventral corner of coxae 1–3 without tooth. Gnathopods 1–2 carpus not cryptic. Gnathopod 2 similar sized to gnathopod 1, propodus with 1 robust seta near palmar corner. Pereopods 3–4 carpus setae placed near anterodistal margin. Robust setae forming dominant posterior element on pereopods 3–4 carpus. Pereopod 5 basis broad. Pereopod 6 basis anterior margin without setae, posterodistal corner not produced to form a lobe. Pereopod 7 merus, carpus, and propodus narrow; dactylus long. Urosome without basoventral setae. Epimera 1–2 without facial setae. Uropods 1–2 rami never fully spinose. Uropod 1 peduncle with displaced robust seta on medial and lateral apices. Uropod 2 peduncle only with robust setae. Uropod 3 outer ramus article 2 with 2 long apical setae; inner ramus medium length, about 0.5 × the length of outer. Telson deeply cleft, apically with 1 robust seta per lobe, marginally without setae on each side, without lateral robust setae.

Description. FEMALE, based on AM P39544, female, holotype, "q-2", 6.2 mm.

Head: Eyes medium, largely free of pigment. Head about 0.18 × body length, greatest width about 0.75 × length; rostrum not constricted, broad, reaching middle of peduncle article 2 on antenna 1. Antenna 1 peduncle article 1 1.6 × as long as wide, about 2 × as wide as article 2, ventral margin with about 8 setules, weakly produced dorsal apex with 3 setae; article 2 0.6 × as long as article 1, with ventral horseshoe cycle of 12 setae; primary flagellum 13-articulate, almost as long as peduncle, lacking large aesthetascs; accessory flagellum 10-articulate. Antennae 2 peduncle article 4 main setal formula = 4-5-2, dorsal margin with notch with 2 robust setae and 1 slender setae, ventral margin with 6 groups of 1–4 long to medium setae, 1 distoventral elongate robust seta; article 5 almost 0.8 × as long as article 4, facial robust setae formula = 3-2, ventral margin with 4 sets of 1 elongate seta each, 3 distoventral medium to short robust setae; flagellum about 1.45 × as long as articles 4–5 of peduncle combined, 14-articulate.

Mouthparts: Mandibles with small palpar hump; right incisor with 4 teeth; left incisor with 4 weak humps in 2 branches; right lacinia mobilis bifid, distal branch flabellate, shorter than proximal, proximal branch simple, pointed; left lacinia mobilis with 4 teeth; right accessory setal row with 8 multicuspidate stout setae; molar bulbous, weak, with 3 small amalgamated robust setae and disjunct flabellate robust setae, each molar with patch of fine setae; palp article 1 short, article 2 with 1 elongate inner seta and 3 other short inner setae, article 3 about as long as article 2, oblique apex with 10 elongate slender setae. Maxilla 1 inner plate medium, with 2 elongate apical or mediofacial pappose setae, 2 apicolateral much shorter simple setae; palp article 2 with 1 medial marginal seta, and 2 apical robust setae and 7 other robust and slender setae (2 broken off in figure). Maxilla 2 plates extending equally, of equal breadth, outer with 5 apicolateral setae, inner with 1 medial seta. Maxilliped inner plate with 2 large thick apical robust setae, 3 apicofacial setae, 5 medial setae; outer plate with 11 medial and apical robust setae, 4 apicolateral setae; some setae set into cuspidate recesses; palp article 1 with 1 apicolateral seta, medial margin of article 2 moderately setose, article 3 scarcely produced, with 8 facial setae, 4 lateral setae, nail of article 4 medium, with 1 accessory setule.

Pereon: Coxa 1 slightly expanded distally, anterior margin almost straight, main ventral setae of coxae 1–4 = 11-10-8-3, posterior most seta of coxae 1–3 shortened; anterior and posterior margins of coxa 4 almost parallel, posterior margin almost vertical, almost straight, posteroventral margin not bevelled, posterodorsal corner rounded, posterodorsal margin short, concave, width to length ratio of coxa 4 = 13:16. Coxae 5–7 posteroventral setule formula = 1-4-5. Gnathopods 1–2 slightly enlarged, weakly diverse; width ratios of carpus-propodus on gnathopods 1–2 = 12:17 and 31:30, length ratios = 31:30 and 26:29; palmar humps medium, palms acute; carpus of gnathopods 1–2 elongate to medium respectively, of gnathopod 1 subovate, posterior margin of 1 flat, of 2 lobate, of gnathopod 2 triangular. Pereopods 3–4 similar, facial setae formula on merus = 3, on carpus = 5; main robust seta of carpus extending to M. 100 on propodus, carpus without posteroproximal robust setae; setal formula of propodus = 5-4 plus mid-distal robust setae, acclivity on

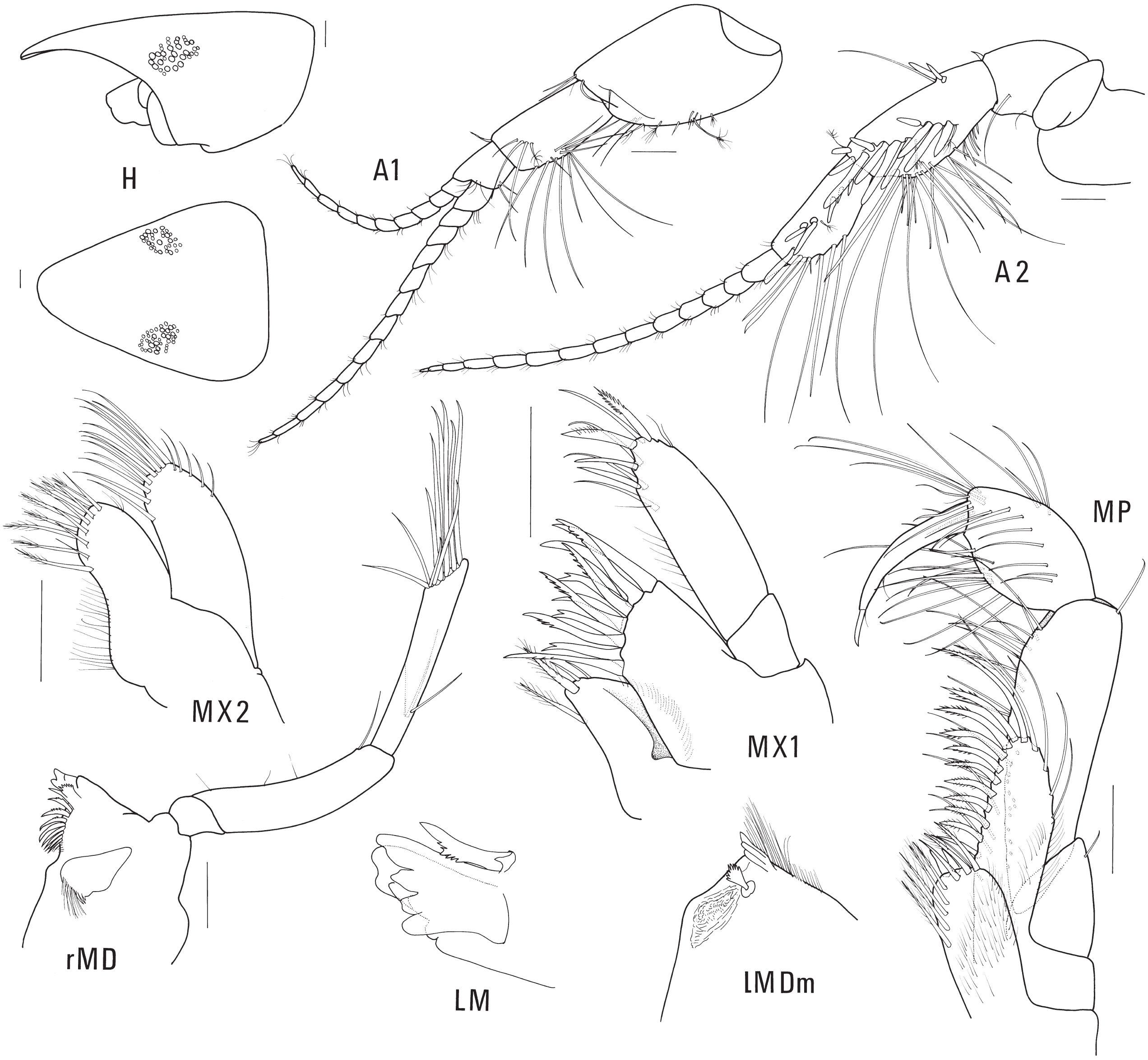

Figure 15. *Protophoxus munida* sp. nov., holotype female "q-2", AM P39544, 6.0 mm, Otago Shelf, New Zealand. Scales represent 0.1 mm.

inner margin of dactyli of pereopods 3–4 weak. Pereopods 5–6 merus-carpus narrow, facial robust setae rows poorly developed, facial ridge formula on basis of pereopods 5–7 = 0-1-1, ridge of pereopod 7 long; width ratios basis, merus, carpus, propodus of pereopod 5 = 16:10:9:4, of pereopod 6 = 27:15:9:5, of pereopod 7 = 35:7:7:3, length ratios of pereopod 5 = 27:12:15:17, of pereopod 6 = 34:32:18:24, of pereopod 7 = 41:11:10:12. Pereopod 7 basis almost reaching apex of carpus. Pereopods 5 and 7 merus without especially elongate posterodistal lobe; medial apex of propodus truncate, finely combed.

Pleon: Epimeron 1, posteroventral corner subquadrate, posterior margin almost straight, with setule, anteroventral margin with 5 short setae, posteroventral margin and corner with row of 3 elongate setae. Epimeron 2 posteroventral corner subquadrate, weakly protuberant, posterior margin almost straight, with 2 setules, facial setae in 1 row of 7, no pair set vertically. Epimeron 3 posteroventral corner rounded to quadrate, posterior margin convex, scarcely crenulate, with 2 long setae and 4 setules, ventral face with 4 small setae. Urosomite 1 with cluster of 4 midventral setae. Urosomite 3 not protuberant dorsally. Uropod 1 peduncle with 5 tiny apicolateral robust setae and very large apical robust setae, no basofacial setae, medially with 4 marginal robust setae becoming larger apically, outer ramus with 6 dorsal robust setae, inner with 3. Uropod 2 peduncle with 7 dorsal robust setae, medially with 1 medium apical robust seta, outer ramus with 5 dorsal robust setae, inner with 2. Uropods 1–2 rami with articulate enlarged apical nails, lacking accessory nail. Uropod 3 peduncle with 1 mid ventral and 1 apical robust seta, dorsally with 2–2 lateral robust setae, 1 medial robust seta; rami feminine, inner extending to M.45 on article 2 of outer ramus, apex with 1 seta, otherwise naked, article 2 with 2 elongate setae, medial margin of article 1 with 1 apical robust setae, lateral margin with 3 acclivities, setal formula = 2-2-2-2, setal formula = 0. Telson elongate, length to width ratio = 15:13, almost fully cleft, each apex broad, bevelled, acclivity absent, with ordinary lateral setule, 1 apicolateral robust seta as long as setule, basodorsal setules diverse.

MALE. Unknown.

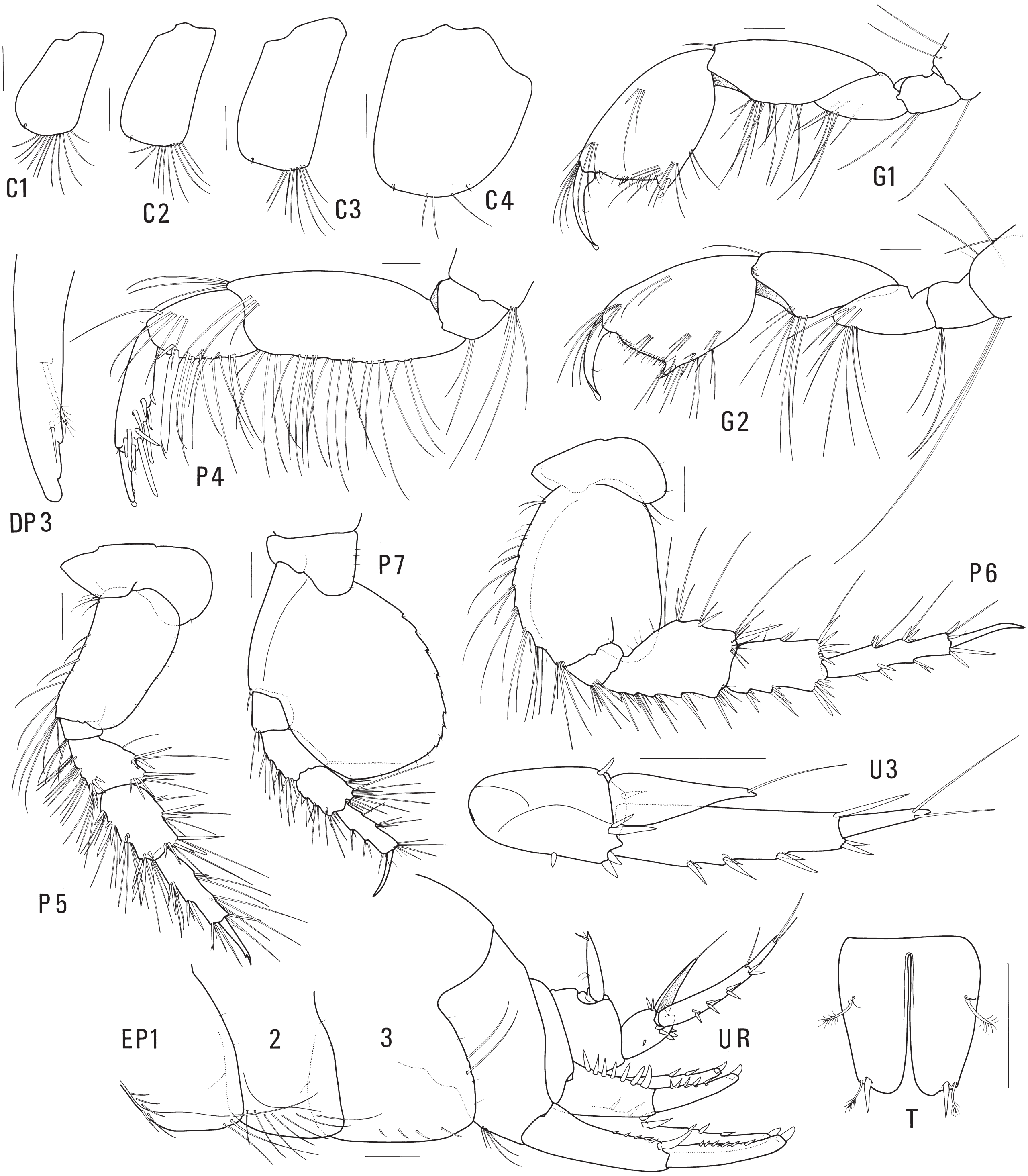

Figure 16. *Protophoxus munida* sp. nov., holotype female "q-2", AM P39544, 6.0 mm, Otago Shelf, New Zealand. Scales represent 0.2 mm.

Remarks. *Protophoxus munida* sp. nov. differs from *Pr. australis* in the presence of a large displaced robust seta on the medial apex of uropod 1 peduncle in addition to the generically important displaced robust seta on the lateral apex. The presence of this seta is also a feature of *Parharpinia* Stebbing, 1899 but *Protophoxus* further differs from *Parharpinia* in lacking the strong posterior setation on epimera 1–2, the lack of ventral setation on the pereopod 7 basis and the distinct nail on the maxillipedal palp. Thus, *Pr. munida* has a displaced robust seta on both sides of the uropod 1 peduncle and further differs from *Pr. australis* in the setation of epimeron 3, differing placement of facial setae and having sparse posterior setation, in the not constricted head from dorsal view; and in the absence of dorsal robust setae on the telson in adults.

The absence of dorsal robust setae on the telson of *P. munida* recalls species of *Birubius* from Australia, but that genus lacks any displaced robust setae on uropod 1 and has a non-tapered basis of pereopod 5.

Distribution. New Zealand, Otago Shelf; 132 m depth.

Zeaphoxus gen. nov.

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Diagnosis. Rostrum fully developed, unconstricted. Eyes present. Antennae 1–2, flagella unreduced in female. Article 2 of antenna 1 ordinary, ventral setae widely spread, in middle. Antenna 1 peduncle article 2 not or weakly ensiform; article 3 with 2 setules; facial robust setae on article 4 primarily in 1 row; article 5 ordinary. Prebuccal appendages not extended forward, rounded, massive, not strongly distinct, epistome dominant. Right mandibular incisor with 3 teeth; molar not triturative, small, pillow shaped, with 3 semi-articulate robust setae, 1 of these enlarged, with patch of fine setae; palpar hump medium; right lacinia mobilis bifid, broad; mandibular palp thin, article 1 short, article 2 without outer setae, apex of article 3 oblique, all distal setae confined to apex. Lower lip with salivary cones. Maxilla 1 palp 2-articulate, inner plate with 4 setae, outer plate with 11 robust setae, 1 robust seta especially thickened. Maxilla 2 ordinarily setose, outer plate scarcely enlarged. Maxilliped outer plates thin, elongate, spinose, and setose, apex of palp article 3 scarcely protuberant, dactylus elongate, apical nail indistinct, mostly immersed, short. Gnathopods small, weakly diverse, propodus of gnathopod 2 distinctly larger than on gnathopod 1; carpus of gnathopod 1 free, of gnathopod 2 very short and almost cryptic, palms acute, propodi ordinary, almond shaped, poorly setose anteriorly. Pereopods 3–4 carpus with posteroproximal setae, all posterior robust setae on propodus thin and stiff, midapical robust setae present. Pereopod 5 basis broad, tapering, Pereopods 5–6 basis not setose posteriorly, merus-carpus medium to narrow. Pereopod 7 basis without ventral and facial setae, with only 1 facial ridge, ischium slightly enlarged and strongly setose anteroventrally, merus not lobed. Epimera 1–2 lacking elongate posterior setae, with midfacial setae below ventral facial ridge. Epimeron 3 setose facially, smooth posteriorly. Urosomite 1 generally naked except for sparse apicoventral setae or robust setae near base of uropod 1. Urosomite 3 without dorsal hook or special process. Uropod 1 peduncle without apicoventral enlarged robust setae, with special enlarged apical robust seta, with basoventral setae, with dorsolateral robust setae narrowly spread, very weak, confined apically, medial robust setae widely spread. Uropod 1 outer ramus ordinary, inner ramus with marginal robust setae in 1 row, no rami of uropods 1–2 continuously spinose to apex. Uropod 2 inner ramus ordinary. Uropod 3 peduncle lacking extra slender or robust setae, article 2 of outer ramus short, with 2 medium apical setae. Telson with pair of midlateral or dorsal setules on each side, 2 apical robust setae on each lobe, without special dorsal and lateral slender and robust setae. Five pairs of gills.

Sexual dimorphism. Male not known.

Type species. *Zeaphoxus zealandicus* sp. nov.

Etymology. From New Zealand and “phoxus” a common root of genera in Phoxocephalidae. Gender masculine.

Remarks. *Zeaphoxus* gen. nov. and two new species, *Zeaphoxus senecio* sp. nov. from the Tasman Sea and The Snares, 7–507 m and *Zeaphoxus zealandicus* sp. nov. from the Otago Shelf, 65 m are recognized. These new species could not definitively be keyed to either a subfamily or genus according to Barnard & Karaman (1991) due in part to the recombination of characters including: structure of the molar (small, pillow shaped, and non-trituritive), length of article 2 of antennae 1 (elongate) and gnathopods 1–2 diverse in size with gnathopod 2 obviously larger than gnathopod 1. The preliminary morphological phylogeny of Taylor (2003) elucidated that they share a combination of traits with species belonging to the genera *Eyakia*, *Leongathus*, and *Mesophoxus*, including antenna 1, peduncle article 2 with ventral setae situated on middle, right mandibular incisor with 3 teeth and pereopod 5 of broad form but tapering distally. Taylor (2006) was faced with a similar dilemma when trying to place a new species collected from the Tasman Sea. The partly triturate molar but narrow basis of pereopod 5 in part informed the decision to redescribe the genus *Leongathus* to accommodate *Leongathus alannah* Taylor, 2006 rather than erecting another monotypic genus. Although these authors note *Zeaphoxus* gen. nov. has morphological affinities with both *Eyakia* and *Mesophoxus* from North Pacific waters, and with species of *Leongathus,* known from the Tasman Sea and southern Australia, the decision to establish a new genus instead of making an emended diagnosis of an existing genus is taken in this instance.

Key to the world species of *Zeaphoxus*

1 Dorsolateral margin of uropod 1 peduncle with 2 robust setae; dorsal margin of uropod 2 peduncle with short apical robust setae and elongate proximal setae. Proximal branch of right lacinia mobilis not longer than distal branch .... [New Zealand, Otago Shelf; 65 m] .. *Zeaphoxus zealandicus* sp. nov.

—— Dorsolateral margin of uropod 1 peduncle with 5 or 6 robust setae; dorsal margin of uropod 2 peduncle with all medium similar robust setae. Proximal branch of right lacinia mobilis much longer than distal branch ....[Tasman Sea & The Snares; 7–507 m] ...... *Zeaphoxus senecio* sp. nov.

Zeaphoxus senecio sp. nov.

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Figs 17–19

Holotype: NIWA 115621, female “d”, 12.58 mm, Senecio Pool, The Snares, 48°07'S 166°36'E, among deposits of terrestrial plant detritus, 7 m, SA3487, G. D. Fenwick, 6 January 1977. **Paratype**: NIWA 115622, juvenile “e”, 5.48 mm, collected together with holotype.

Other material examined. AM P39545, juvenile “f1”, 3.82 mm plus 9 specimens, eastern Tasman Sea, 41°58.5'S 170°28.1'E, 507 m, P. K. Probert on RV *Tangaroa*, cruise 1131, Station Q723, 4 March 1982; NIWA 115633, 1 specimen, eastern Tasman Sea, 41°15.102'S 170°37.5'E, 560 m, P. K. Probert on RV *Tangaroa*, cruise 1131, Station Q700, 23 February 1982; NIWA 115634, 2 specimens, eastern Tasman Sea, 42°25.5'S 171°05.502'E, 37 m, P. K. Probert on RV *Tangaroa*, cruise 1131, Station Q725, 4 March 1982; AM P25803, 3 specimens, Otago Shelf, New Zealand, 45°53'S 170°51'E, sandy gravel, bottom, 93 m, P. K. Probert on RV *Munida*, MU75/54, 19 February 1975.

Etymology. Named for the type locality; used as a noun in apposition.

Diagnosis. Eyes present. Head without constriction in dorsal view. Antenna 1 peduncular article 1 ventral apex not ensiform, peduncle article 2 shortened. Antenna 2 peduncle article 3 with robust setae, article 4 shortened with facial robust setae. Right mandible lacinia mobilis bifid, proximal branch much longer than distal branch. Maxilla 1 inner plate moderately large, outer plate with 11 multicuspidate robust setae. Maxilliped palp article 3 weakly produced. Posteroventral corner of coxae 1–3 without tooth. Gnathopods 1–2 carpus not cryptic. Gnathopod 2 similar sized to gnathopod 1, propodus with 1 robust seta near palmar corner. Pereopods 3–4 carpus setae placed near anterodistal margin. Robust setae forming dominant posterior element on pereopods 3–4 carpus. Pereopod 5 basis broad. Pereopod 6 basis anterior margin without setae, posterodistal corner not produced to form a lobe. Pereopod 7 merus, carpus, and propodus narrow; dactylus long. Urosome without basoventral setae. Epimera 1–2 without facial setae. Uropods 1–2 rami never fully spinose, rami with articulate enlarged apical nails, lacking accessory nails. Uropod 1 peduncle with 5–6 robust setae on dorsolateral margin. Uropod 2 peduncle only with robust setae. Uropod 3 outer ramus article 2 with 2 long apical setae; inner ramus medium length, about 0.5 × the length of outer. Telson deeply cleft, apically with 1 robust seta per lobe, marginally without setae on each side, without lateral robust setae.

Description. FEMALE, based on NIWA 115621, holotype, female “d”, 12.58 mm.

Head: Eyes large, largely occluded with pigment. Head about 0.20 × total body length, greatest width about 0.75 × length; rostrum not constricted, broad, reaching middle of article 2 on antenna 1. Antenna 1 peduncle article 1 1.7 × as long as wide, about half as wide as article 2, ventral margin with about 10 setules, weakly produced dorsal apex with 3 setae; article 2 about half as long as article 1, with ventral horseshoe cycle arc of 12 setae; primary flagellum 13-articulate, 0.7 × as long as peduncle, lacking large aesthetascs; accessory flagellum 11-articulate. Antenna 2 peduncle article 4 main setal formula = 2-6-4, dorsal margin with notch with 2 setae and 1 robust setae, ventral margin with 5 groups of 2–4 elongate to medium setae, 1 distoventral elongate robust setae; article 5 almost 0.8 × as long as article 4, facial robust setae formula = 3, ventral margin with 6 sets of 1 elongate seta each, 1 distoventral medium robust setae; flagellum about as long as articles 4–5 of peduncle combined, 14 articulate.

Mouthparts: Mandibles with small palpar hump; right incisor with 3 teeth; left incisor with 3 weak humps in 2 branches; right lacinia mobilis bifid, distal branch flabellate, shorter than proximal, proximal branch simple, pointed; left lacinia mobilis with 4 teeth; right accessory setal row with 10 multicuspidate stout setae, left with 11; molar bulbous, weak, with 1 large curved robust seta and 2 much smaller simple robust setae, no disjunct robust setae, each molar with patch of fine seta; palp article 1 short, article 2 with 3 elongate inner setae and 1 other short inner seta and no outer setae, article 3 about 1.1 × as long as article 2, oblique apex with 10 elongate robust setae. Maxilla 1 inner plate medium, with 2 elongate apicomedial pappose setae, 2 apicolateral much shorter setae; palp article 2 with 4 medial marginal robust setae, and 2 apical and 5 submarginal setae. Maxilla 2 plates extending subequally, of diverse breadth, outer with 4 apicolateral setae, inner with 2–3 medial setae. Maxilliped inner plate with 3 large apical robust setae, 3 apicofacial plumose setae and 2 medial setae; outer plate with 14 medial and apical robust setae, 6 apicolateral setae; some setae set into cuspidate recesses; palp article 1 with 3 apicolateral setae, medial margin of article 2 moderately setose, article 3 scarcely produced, with 8 facial setae, 2 lateral setae, article 4 long, with 2 accessory setules, nail short.

Pereon: Coxa 1 not expanded distally, anterior margin almost straight, main ventral setae of coxae 1–4 = 7-8-12-many, posterior most seta of coxae 1–4 not shortened; anterior and posterior margins of coxa 4 parallel, posterior margin almost vertical, convex, posteroventral margin not bevelled, posterodorsal corner rounded, posterodorsal margin short, concave, width to length ratio of coxa 4 = 9:10. Coxae 5–7 posteroventral setule formula = 5-8-1. Gnathopods 1–2 slightly enlarged, weakly diverse, width ratios of carpus-propodus on gnathopods 1–2 = 12:15 and 23:32, length ratios = 12:21 and 16:37; palmar humps small to medium palms acute, with 1 robust seta defining palm; gnathopods 1–2 carpus medium and short respectively, of gnathopod 1 ovate, posterior margin of 1 flat, of 2 lobate, of gnathopod 2 short, subcryptic, triangular. Pereopods 3–4 similar, facial setae formula on merus = 7 and 5, on carpus = 7 and 6; main robust setae of carpus extending to M.58 on propodus, carpus without posteroproximal robust setae; setal formula of propodus = 5-2 plus mid-distal robust setae acclivity on inner margin of dactyls of pereopods 3–4 large, weak. Pereopods 5–6 merus-carpus narrow, facial robust setal rows poorly developed. Pereopods 5–7 facial ridge formula on basis= 0-1-1, ridge of pereopod 7 long; width ratios of basis, merus, carpus, propodus of pereopod 5 = 22:11:10:6, of pereopod 6 = 33:11:10:5, of pereopod 7 = 40:9:8:4, length ratios of pereopod 5 = 30:13:16:16, of pereopod 6 = 40:22:25:25, of pereopod 7 = 45:10:11:16. Pereopod 7 basis reaching middle of merus. Pereopods 5 and 7 merus without especially elongate posterodistal lobe; medial apex of propodus truncate, uncombed.

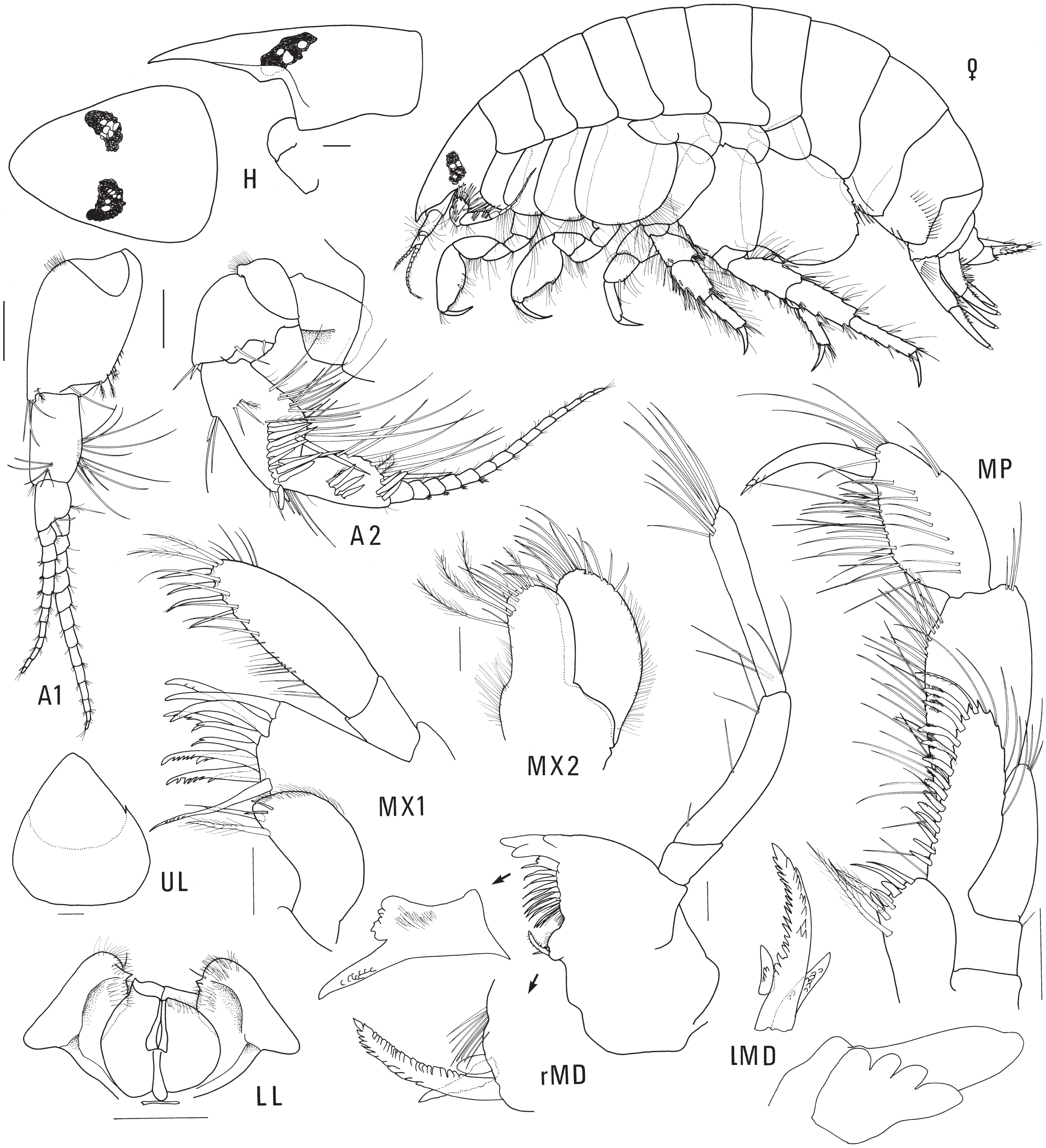

Figure 17. *Zeaphoxus senecio* sp. nov., holotype, female "d", NIWA 115621, 12.58 mm, The Snares, New Zealand. Scales represent 0.1 mm.

Pleon: Epimeron 1, posteroventral corner rounded, posterior margin convex, with setule, anteroventral margin with 9 short setae, ventral margin with 13 elongate setae. Epimeron 2 posteroventral corner quadrate, weakly protuberant, posterior margin almost straight, with setule, facial setae = 2 rows of 8-8, posterior most pair set vertically. Epimeron 3 posteroventral corner subquadrate, posterior margin almost straight, scarcely serrate, 2-setose, uppermost tiny setules, ventral margin with 3 posterior narrowly spread setae, face with obliquely horizontal middle row of 11 setae. Urosomite 1 without ventral robust setae at base of uropod 1. Urosomite 3 not protuberant dorsally. Uropods 1–2 rami with articulate enlarged apical nails, lacking accessory nails. Uropod 1 peduncle with 6 apicolateral robust setae and 7 basofacial setae, medially with 6 marginal slender setae and robust setae becoming thicker distally, outer ramus with 4 lateral and 2 medial robust setae, inner with 1 medial. Uropod 2 peduncle with 10 dorsal robust setae, medially with 1 medium apical robust setae, outer ramus with 3 dorsal robust setae, inner naked. Uropod 3 peduncle with 8 ventral robust setae, dorsally with 1 lateral robust setae, 1 medial robust setae and 2 setules; rami feminine, inner extending to M.67 on article 2 of outer ramus, apex with 2 setae, medial margin with 3 setae, article 2 of outer ramus with 2 elongate setae, medial margin of article 1 with 5 setae, lateral margin with 5 acclivities, setal formula = 2-2-2-2-2-2 (1 short robust seta).

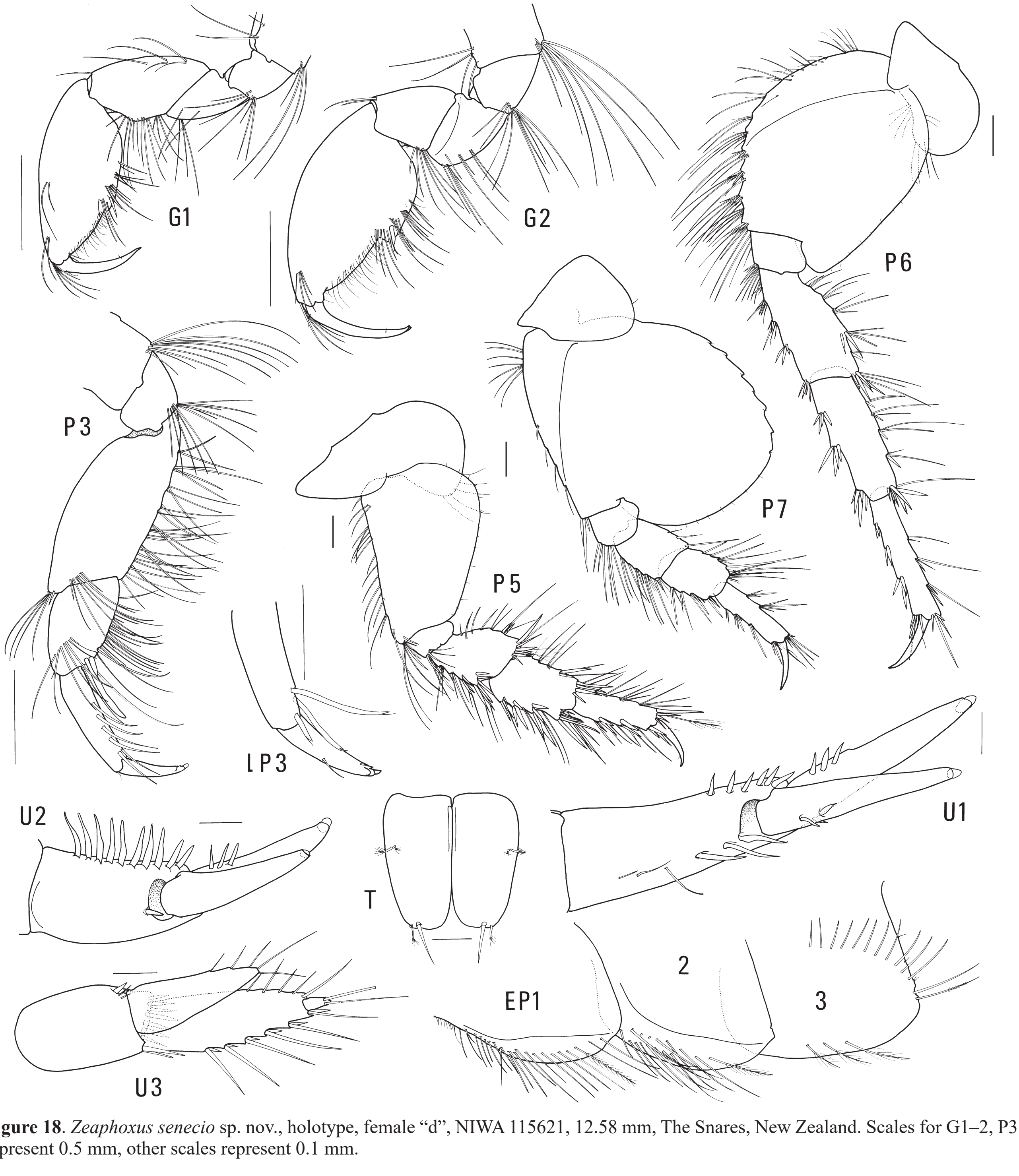

Figure 18. *Zeaphoxus senecio* sp. nov., holotype, female "d", NIWA 115621, 12.58 mm, The Snares, New Zealand. Scales for G1–2, P3 represent 0.5 mm, other scales represent 0.1 mm.

Setal formula = 0. Telson short, length to width ratio = 1:1, fully cleft, each apex broad, truncate, acclivity absent, with lateral setule, with long robust seta and setule, midlateral setules diverse.

MALE. Unknown.

JUVENILE, based on NIWA 115622, juvenile "e" 5.48 mm length. As in adult but setae sparser and other parts not as well developed: antenna 1 primary flagellum = 8-articulate, accessory = 7-articulate, article 2 of peduncle with 4 ventral setae 3-3; antenna 2 peduncle article 4 main setal formula = 4-3, article 5 = 2 and 2, dorsal robust setae of article 4 = 3, no midproximal facial robust seta set, ventral setae = 3 sets of 2 each plus pair of apicoposterior elongate robust setae, article 5 with 5 apical and ventral robust setae; right lacinia mobilis distal branch with 4 teeth, right accessory setal row with 7.5 multicuspidate stout setae, left accessory setal row with 8.5 multicuspidate stout setae. Gnathopod 1 propodus more slender and attenuated than in adult. Pereopod 3 merus facial setae = 2, of carpus = 2; setal formula on propodus of pereopods 3–4 = 2-1-1 and 3-1-1. Pereopod 7 basis posterior serrations = 5. Epimeron 2 facial setae = 6 and 1, epimeron 3

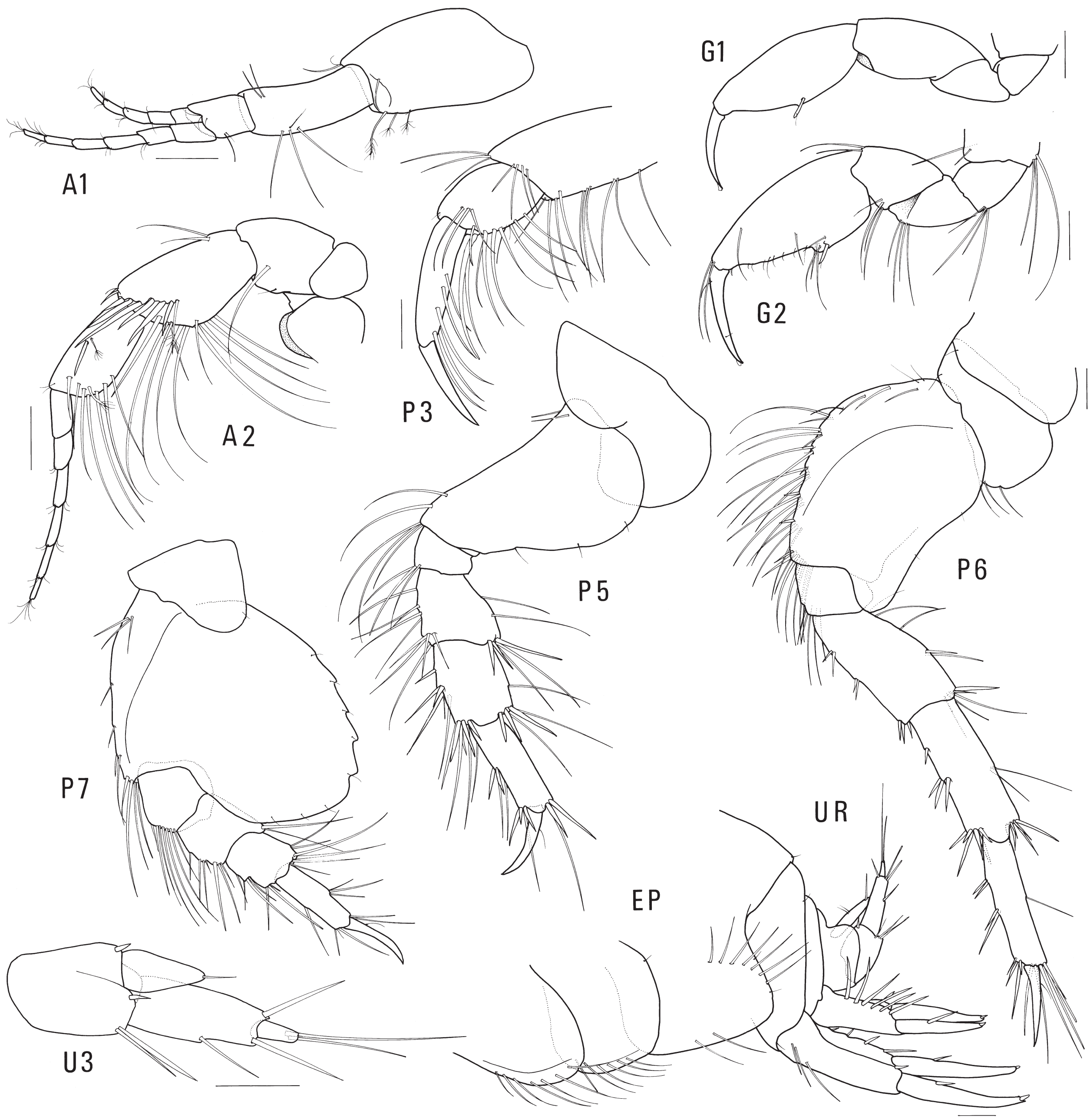

Figure 19. *Zeaphoxus senecio* sp. nov., juvenile "f-1", AM P39545, 3.82 mm, eastern Tasman Sea. Scales represent 0.1 mm.

with 1 ventral seta, 1 setule at corner, dorsal row = 1 at rear and 6 facial. Uropod 1 robust and slender setal formulas; basofacial = 3, peduncle apicolateral = 3, outer ramus = 2, inner = 1; uropod 2 peduncle = 5, outer ramus = 1, inner = 0; uropod 3 outer ramus lateral = 1-2-2.

Adults from AM P25803 show that the robust setae on the dorsolateral margin of uropod 1 peduncle vary from 5–6.

Remarks. *Zeaphoxus senecio* sp. nov. differs from *Z. zealandicus* sp. nov. in having more robust setae on the dorsolateral margin of peduncle on uropod 1, in having similar sized robust setae on the dorsal margin of peduncle on uropod 2 and in having the proximal branch of the right lacinia mobilis much longer than distal branch.

Distribution. Tasman Sea and The Snares; 7–507 m.

Zeaphoxus zealandicus sp. nov.

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Figs 20–22

Holotype. AM P25882, female "y-2", 11.7 mm, Otago Shelf, New Zealand, 45°48'S 170°51'E, gravel, sand, mud bottom, 65 m, P. K. Probert on RV *Munida*, MU74/198, 15 October 1974.

Etymology. Named for New Zealand.

Diagnosis. Eyes present. Head without constriction in dorsal view. Antenna 1 peduncular article 1 ventral apex not ensiform, peduncle article 2 shortened. Antenna 2 peduncle article 3 with robust setae, article 4 shortened with facial robust setae. Right mandible lacinia mobilis bifid, proximal

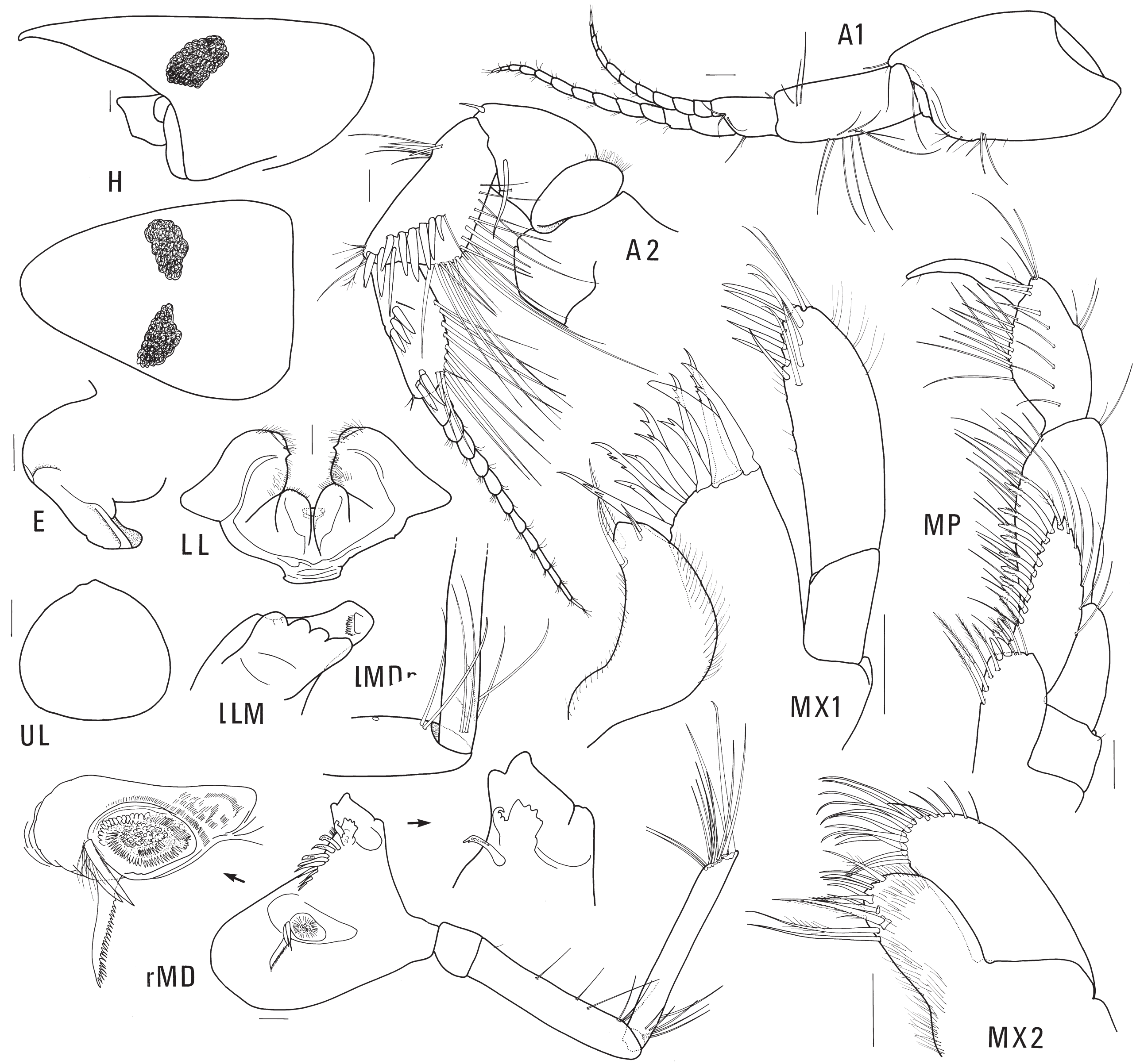

Figure 20. *Zeaphoxus zealandicus* sp. nov., holotype, female "y-2", AM P25882, 11.7 mm, Otago Shelf, New Zealand. Scales represent 0.1 mm.

branch same length as distal branch. Maxilla 1 inner plate large, outer plate with 11 multicuspidate robust setae. Maxilliped palp article 3 weakly produced. Posteroventral corner of coxae 1–3 without tooth. Gnathopods 1–2 carpus not cryptic. Gnathopod 2 similar sized to gnathopod 1, propodus with 1 robust seta near palmar corner. Pereopods 3–4 carpus setae placed near anterodistal margin. Robust setae forming dominant posterior element on pereopods 3–4 carpus. Pereopod 5 basis broad. Pereopod 6 basis anterior margin without setae, posterodistal corner not produced to form lobe. Pereopod 7 merus, carpus, and propodus narrow; dactylus long. Urosome without basoventral setae. Epimera 1–2 without facial setae. Uropods 1–2 rami never fully spinose, rami with articulate enlarged apical nails, lacking accessory nails. Uropod 1 peduncle with 2 robust setae on dorsolateral margin. Uropod 2 peduncle dorsal margin with short apical robust setae and elongate proximal setae. Uropod 3 outer ramus article 2 with 2 long apical setae; inner ramus medium length, about 0.5 × length of outer. Telson deeply cleft, apically with 1 robust seta per lobe, marginally without setae on each side, with 1 small lateral robust seta.

Description. FEMALE, based on AM P25882, female "y-2" holotype, 11.7 mm.

Head: Eyes large, largely occluded with pigment. Head about 0.19 × body length, greatest width about 0.75 × length; rostrum not constricted, broad, reaching middle of article 2 on antenna 1. Antenna 1 peduncle article 1 1.7 × as long as wide, 2.3 × as wide as article 2, ventral margin with about 9 setules, weakly produced dorsal apex with 1 seta; article 2 about 0.7 × as long as article 1, with ventral horseshoe cycle of 9 setae; primary flagellum 12-articulate about 0.6 × as long as peduncle, lacking large aesthetascs; accessory flagellum 10-articulate. Antenna 2 peduncle article 4 main setal formula = 5-3, dorsal margin with notch with 6 setae, ventral margin with 10–11 groups of 1–4 elongate to medium setae, 1 distoventral elongate robust seta; article 5 almost 0.7 × as long as article 4, facial setal formula = 3-2, dorsal

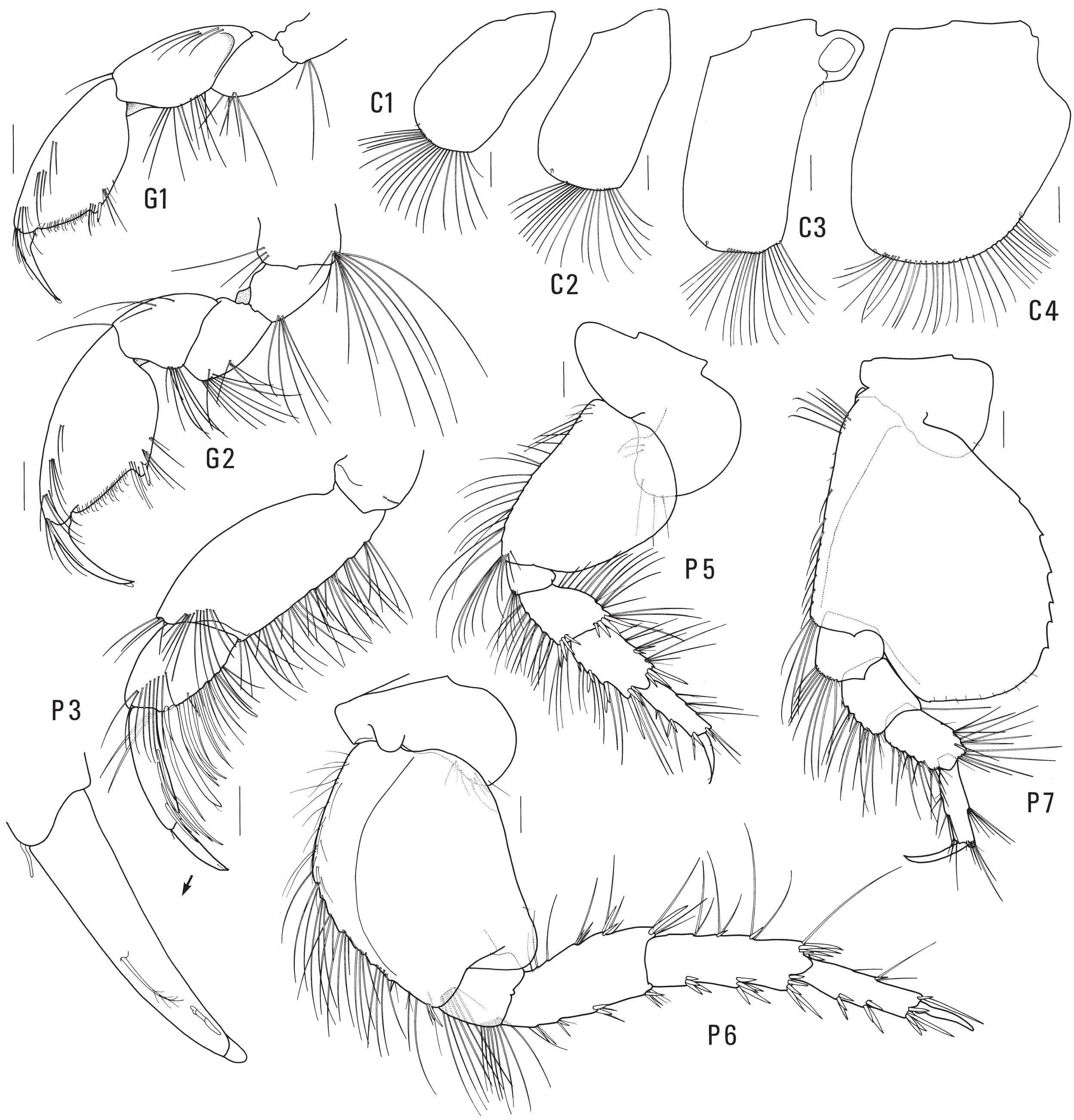

Figure 21. *Zeaphoxus zealandicus* sp. nov., holotype, female "y-2", AM P25882, 11.7 mm, Otago Shelf, New Zealand. Scales represent 0.2 mm.

margin naked, ventral margin with 10 sets of 1 elongate seta each, 1 distoventral medium robust seta; flagellum about as long as articles 4–5 of peduncle combined, 12-articulate.

Mouthparts: Mandibles with medium palpar hump; right incisor with 3 teeth; left incisor with 2 weak humps in 2 branches; right lacinia mobilis bifid, distal branch flabellate, not shorter than proximal, proximal branch weakly denticulate; left lacinia mobilis with 4 teeth; right accessory setal row with 7 multicuspidate stout setae; molar bulbous, weak, with 1 large serrate robust seta and 2 much smaller simple robust setae, no disjunct robust setae, each molar with patch of fine setae; palp article 1 short, article 2 with 5 elongate inner setae and no outer setae, article 3 about 1.1 × as long as article 2, oblique apex with 10 elongate robust setae. Maxilla 1 inner plate large, with 2 elongate subapical pappose setae, 2 apicolateral much shorter setae; palp article 2 with 1 medial marginal robust seta, and 5 apical robust setae and 5 submarginal slender setae. Maxilla 2 plates extending subequally, of subequal breadth, outer with 5 apicolateral setae, inner with 2 medial setae. Maxilliped inner plate with 2 large apical robust setae, 3 apicofacial plumose setae, 4 medial plumose setae; outer plate with 12 medial and apical seta-teeth, 6 apicolateral setae; some setae set into cuspidate recesses; palp article 1 with 1 apicolateral seta, medial margin of article 2 moderately setose, article 3 scarcely produced, with 6 facial setae, 3 lateral setae, nail of article 4 immersed and almost absent, with 2 accessory setules.

Pereon: Coxa 1 not expanded distally, anterior margin almost straight, main ventral setae of coxae 1–4 = 20-19-19-31, posterior most seta of coxae 1–2 shortened; anterior and posterior margins of coxa 4 weakly divergent, posterior margin almost vertical, straight, posteroventral margin

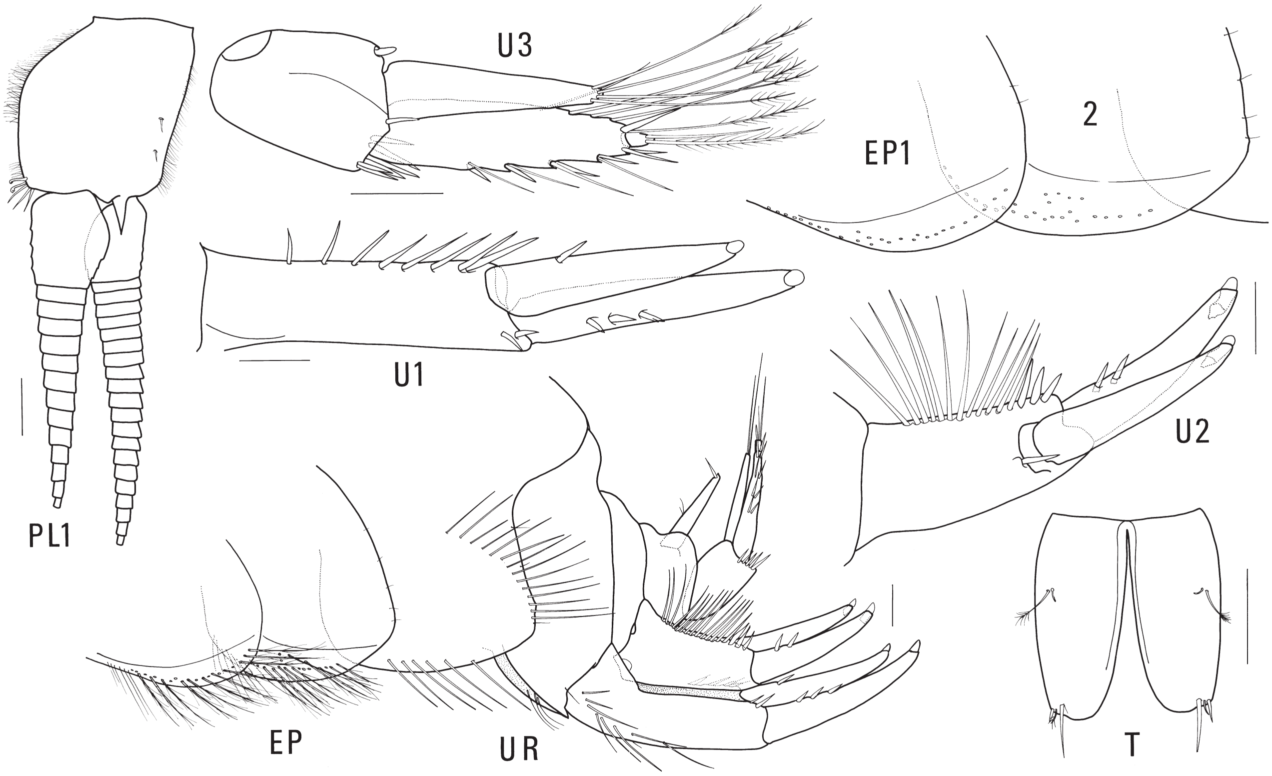

Figure 22. *Zeaphoxus zealandicus* sp. nov., holotype, female "y-2", AM P25882, 11.7 mm, Otago Shelf, New Zealand. Scales represent 0.2 mm.

not bevelled, posterodorsal corner rounded, posterodorsal margin of medium length, concave, width to length ratio of coxa 4 = 18:21. Coxae 5–7 posteroventral setule formula = 3-7-1. Gnathopods 1–2 weakly diverse, gnathopod 2 slightly enlarged, width ratios of carpus-propodus on gnathopods 1–2 = 12:14 and 13:19, length ratios = 26:27 and 19:33; palmar humps short to medium, palms acute, with 1 robust seta defining palm; gnathopods 1–2 carpus medium and short respectively, of gnathopod 1 ovate, posterior margin of gnathopod 1 flat, of gnathopod 2 lobate, of gnathopod 2 short, triangular. Pereopods 3–4 similar, facial setae formula on merus = 11, on carpus = 9; main robust seta of carpus extending to M.110 on propodus, carpus without posteroproximal robust setae; setal formula of propodus = 4-2 plus mid-distal robust setae very elongate and often curved, robust setae acclivity on inner margin of dactyls of pereopods 3–4 weak to absent. Pereopods 5–6 merus-carpus narrow, facial robust setae rows poorly developed, facial ridge formula on basis of pereopods 5–7 = 0-1-1, ridge of pereopod 7 long; width ratios of basis, merus, carpus, propodus of pereopod 5 = 23:10:8:4, of pereopod 6 = 35:13:9:6, of pereopod 7 = 42:11:8:4, length ratios of pereopod 5 = 33:12:15:14, of pereopod 6 = 48:25:29:22, of pereopod 7 = 55:12:13:15. Pereopod 5 basis tapering distally. Pereopod 7 basis reaching middle of merus. Pereopods 5 and 7 merus without especially elongate posterodistal lobe; medial apex of propodus truncate, uncombed, deeply fimbriate.

Pleon: Epimeron 1 posteroventral corner rounded, posterior margin convex, with setule (not shown), anteroventral margin with 6–9 short setae, ventral margin with 19–21 elongate setae, ragged anteriorly (some broken off in figure). Epimeron 2 posteroventral corner rounded, posterior margin convex, with 5 setules, facial setae = 2–3 irregular rows of 19, anterior setae irregular and set vertically. Epimeron 3 posteroventral corner subquadrate, posterior margin straight, scarcely serrate, with 3 setules, ventral margin with 6 widely spread setae, face with obliquely horizontal posterior row of 14 setae. Urosomite 1 with 3 midventral setae; articulation line complete in middle. Urosomite 3 weakly protuberant dorsally. Uropods 1–2 rami with articulate enlarged apical nails, lacking accessory nails. Uropod 1 peduncle with 2 small apicolateral robust setae and 8 basofacial setae, medially with 4 small marginal robust setae, outer ramus with 3 dorsal robust setae, inner with 1 medial. Uropod 2 peduncle with 12–14 dorsal setae and 3 apical robust setae, medially with 1 medium apical robust seta, outer ramus with 2 dorsal robust setae, inner naked. Uropod 3 peduncle with 6 apicoventral robust setae, dorsally with 1 lateral robust seta, 1 medial robust seta; rami submasculine, inner extending to M.80 on article 2 of outer ramus, apex with 5 setae, other margins naked, article 2 of outer ramus tiny, with 2 elongate setae, medial margin of article 1 with 4 setae, lateral margin with 4 acclivities, setal formula = 1-1-1-1-2 setal formula = 1-1-1-1-0. Telson elongate, length to width ratio = 15:30, fully cleft, each apex broad, truncate, acclivity absent, with tiny lateral robust seta, setule next medial shorter than robust seta, next medial robust setae elongate, basodorsal setules diverse.

MALE: Unknown.

Remarks. *Zeaphoxus zealandicus* sp. nov. differs from *Z. senecio* sp. nov. in having fewer robust setae on the dorsolateral margin of peduncle on uropod 1, in having variably sized robust setae on the dorsal margin of peduncle on uropod 2 and in having the proximal branch of the right lacinia mobilis more similar in size to the distal branch.

Distribution. New Zealand, Otago Shelf; 65–93 m.

Conclusion

This paper is a first step in documenting the extensive phoxocephalid fauna present in New Zealand waters. There are many species identified to only Phoxocephalidae in the NIWA Invertebrate collection, and this paper just touches the surface of the diversity and complexity of this fauna. Jim Lowry and, to some extent, Jerry Barnard worked hard to try and document and describe this diversity and were constantly struck by the extent of the diversity and range of this group of amphipods. There is much more work to be done, for many more years.

ACKNOWLEDGEMENTS. This publication is dedicated to the memory of both Jerry Barnard and Jim Lowry. The formal publication of these new taxa honors the dedication both Jerry and Jim had to advancing our understanding of the world Amphipod fauna and celebrates the multitude of new species discoveries from the southern hemisphere. The authors are especially grateful to Jim for his mentoring and guidance during their PhD studies and throughout their careers.

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Crustaceans Associated with Cold Water Corals: A Comparison of the North Atlantic and North Pacific Octocoral Assemblages

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ABSTRACT. Crustaceans live on large colonial invertebrates for a variety of reasons, but in all cases must overcome the defenses of the host animal. We surveyed the crustaceans living on deep-sea octocorals collected during expeditions to the New England and Corner Rise seamounts (2003–2005) in the Northwest Atlantic and to the Aleutian Ridge (2004) in the North Pacific. Only a small number of crustacean species were found on octocorals in the Northwest Atlantic but a great many species, especially amphipods, were found on octocorals in the Northwest Pacific. We suggest that this disparity is due to both the differences in octocoral host dominance as well as differences in the available species pool between the two oceans.

Introduction

The anthozoan subclass Octocorallia comprises a large number of colonial species living in both shallow tropical as well as polar and deep-sea cold waters. Octocoral colonies are often quite large, and in many cases house symbionts belonging to multiple invertebrate phyla. Invertebrate symbionts of cold water octocorals have been documented in the North Atlantic by Buhl-Mortensen and Mortensen (2004 a, b, 2005), Watling (2010), Buhl-Mortensen *et al*. (2010), De. Clipelle *et al*. (2015), Schwentner & Lörz (2020), and on a global basis by Watling *et al*. (2011). To date, little is known about crustacean symbionts of cold water octocorals from the North Pacific Ocean.

In this paper we summarize what is known about crustaceans living on octocorals from samples that we have collected in the Northwest Atlantic and North Pacific Oceans augmented with information from published studies.

Materials and methods

Samples for this study were obtained from octocorals collected by remotely operated vehicles (ROVs) during expeditions on the New England and Corner Rise (NES&CR) Seamounts in the Northwest Atlantic (Fig. 1) during the years 2003–2005, and on the central part of the Aleutian Ridge (AR) in 2004 (Fig. 2). Samples from NES&CR were obtained with the submersible *Alvin* in 2003 and the ROV *Hercules* operated from the NOAA ship R/V *Ron Brown* during cruises in 2004 and 2005. Samples from the AR were obtained with the ROV *Jason II* operated from the R/V *Roger Revelle* in 2004. Most samples were obtained from bathyal depths (200–3500 m).

Whole octocoral colonies (in the case of small colonies, *ca.* 20 cm or less) or pieces of colonies were collected using the hydraulic manipulator of the ROV and the samples stored in moderately insulated bioboxes until the ROV was

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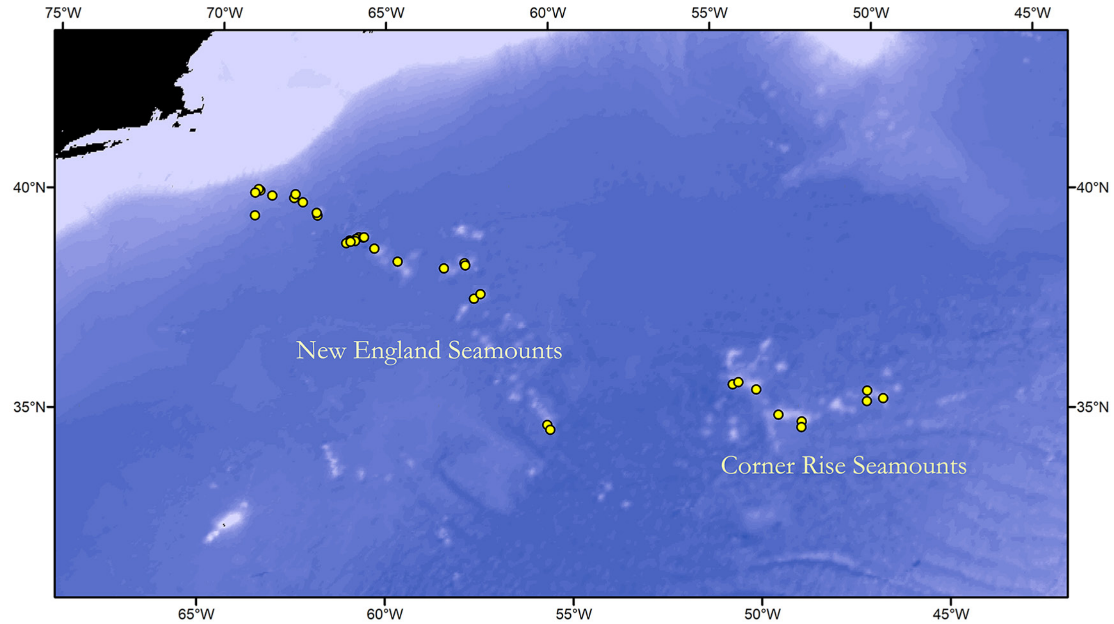

Figure 1. Remotely operated vehicle (ROV) dive locations in the New England and Corner Rise seamount groups, NW Atlantic, during cruises in 2003–2005.

retrieved on board the ship. For the most part the samples were not isolated from each other, but we noted that most symbionts were still associated with their coral host when the biobox was opened. In the lab on the ship the coral and its symbionts were photographed together as much as possible. All octocoral material was subsampled with pieces stored in 95% ethanol for future genetic work, and the remainder of the colony given a bath in 4% formalin for 12 hours followed by storage in 70 or 95% ethanol. All symbionts were preserved in 95% ethanol, with the exception of some taxa, such as polychaetes (not dealt with in this paper) that were initially fixed in formalin. All specimens either have been or will be deposited in the Yale Peabody Museum, New Haven, Connecticut, or the Bernice P. Bishop Museum, Honolulu, Hawaii, USA.

Results

From the NES&CR expeditions, 35 submersible and ROV dives were conducted on 12 seamounts (details of sample locations in Appendix Table 1A). A total of 348 octocoral colonies were collected representing 46 species mostly from the families Chrysogorgiidae, Primnoidae, Keratoisididae, Coralliidae, Paragorgiidae, Paramuriceidae, and Acanthogorgiidae. In all, 18 invertebrate species were found inhabiting some of the collected octocorals. Of these, five are crustaceans: an ascothoracid barnacle, stalked barnacles, the shrimp *Bathypalaemonella serratipalma* Pequenat, 1970, an unknown galatheid, and the chirostylid *Uroptychus* (Table 1). Other species found on the octocoral colonies included anemones, brittle stars and polychaete

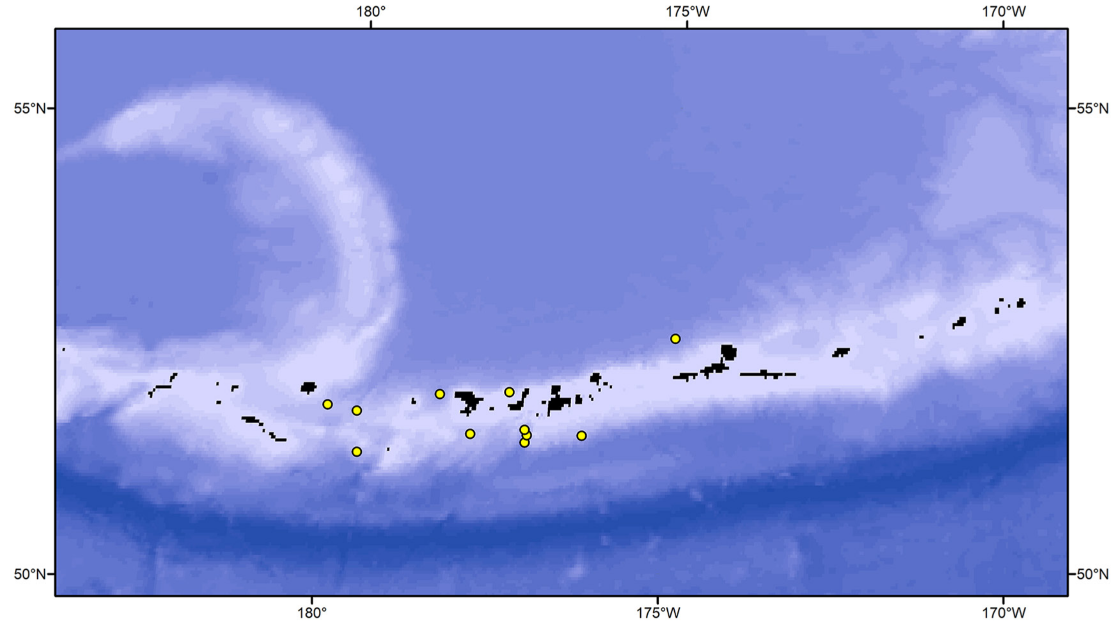

Figure 2. ROV dive locations along the Aleutian Ridge, central Aleutian Islands, Alaska, during a cruise in 2004.

Table 2. List of crustacean commensals found living on octocoral hosts during the Aleutian Ridge expedition, 2004.

Coral host **Crustacean associate**	*Acanthogorgia* sp.	*Arthrogorgia kinoshitai*	*Arthrogorgia otsukai*	*Arthrogorgia* sp.	*Calcigorgia beringi*	chrysogorgiid small	*Clavularia* sp.	*Fanellia compressa*	Keratoisididae Bxc	*Muriceides* blue	*Muriceides* purple sp. x	*Muriceides* purple sp. 1	*Paragorgia* sp.	*Parastenella ramosa*	Plexauridae golden	*Plumarella aleutiana*	*Plumarella echinata*	*Plumarella hapala*	*Plumarella robusta*	*Plumarella*-like	*Primnoa pacifica*	*Primnoa wingi*	*Radicipes* sp.	*Swiftia* sp.	*Umbellula* sp.
Acanthopleustes annectens	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	●
Aegidae	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	●	—
Amatiguakius forsberghi	—	—	—	—	—	—	—	—	—	●	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Antarcturus ?acutispinus	●	—	—	—	—	—	—	—	—	—	—	—	—	●	—	—	—	—	—	—	—	—	—	●	—
Antarcturus sp. A	—	●	—	●	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	●	—	—	—	—	—
Arcturus sp.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	●	—	●	—	—	—	—	—
Bonnierella sp.	—	—	—	—	—	—	—	—	—	—	—	—	—	●	—	—	—	—	—	—	—	—	—	●	—
Caprella sp. A	●	—	●	●	—	●	—	—	—	—	—	●	—	●	—	●	—	—	●	—	—	—	—	●	—
Chromopleustes sp. A	—	—	—	—	—	—	—	—	●	—	—	—	—	—	—	—	—	—	—	—	—	—	—	●	—
Chromopleustes sp. B	—	●	—	—	—	—	—	—	—	—	—	●	—	—	—	—	—	—	—	—	—	—	—	—	—
Erichthonius sp. A	—	—	—	—	—	—	—	—	—	●	—	—	—	—	—	—	—	●	—	—	—	—	—	—	—
Eurycopidae sp.	●	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Hippolytidae sp.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	●	—
Ischyrocerinae sp. A	—	—	—	—	—	—	—	—	—	—	—	●	—	—	—	—	—	—	—	—	—	—	—	—	—
Ischyrocerinae sp. B	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	●	—	—	—	—	—	—	—	—	—
Janira sp.	—	—	—	—	—	—	—	—	—	—	—	●	—	—	—	—	—	—	—	—	—	—	—	—	—
Metopa sp.	●	—	—	—	●	—	—	—	●	—	—	—	—	—	—	—	—	—	—	—	—	●	—	—	—
Munna sp.	—	—	—	—	—	—	—	—	—	—	—	●	—	—	—	●	—	—	—	—	—	—	—	—	—
Munnidae	—	—	—	●	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Neopleustes euacanthoides	●	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Neopleustes sp. C	●	—	—	—	●	—	—	—	—	—	—	—	●	●	—	—	—	—	—	—	—	—	—	—	—
Neopleustes sp. D	—	●	—	—	—	—	—	—	—	—	—	●	—	—	●	—	—	—	—	—	●	—	—	—	—
Pleustid A	●	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Pleustid G	—	●	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Pleustid I	—	—	—	—	—	—	●	—	—	—	—	—	—	—	—	—	—	—	—	—	●	—	—	—	—
Pleustid sp.?	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	●	—	—	—	—	—	—	—	—	—
Stenothoidae B	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	●	—
Stenothoidae C	—	—	—	●	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Stenothoidae D	—	—	—	—	—	—	—	—	—	—	●	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Stenothoidae E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	●	—	—	—	—
Thaumatotelsoninae A	—	—	—	—	—	—	—	—	—	—	—	●	—	—	—	—	—	—	—	—	—	—	—	—	—

worms. The vast majority of coral species (33) had no invertebrate associates present, which was usually confirmed by the video analysis of the coral before collection.

During the Aleutian expedition, 12 dives were conducted at depths ranging from 176 to 2947 m (Appendix Table 1B). A total of 35 octocoral colonies were collected representing 22 species primarily from the families Primnoidae, Acanthogorgiidae, Plexauridae, and Keratoisididae. In all, 48 invertebrate species were found inhabiting most of the octocoral species, of which 31 species were crustaceans: 22 amphipods, 8 isopods, and 1 decapod (Table 2). The amphipod families Pleustidae and Stenothoidae were the most diverse, with 10 and 6 species, respectively. *Caprella* sp. and two undescribed species of *Neopleustes* were

Table 1. List of crustacean commensals found on living octocorals during the New England and Corner Rise Seamounts expedition, 2004–2005.

Crustacean associate	*Paragorgia johnstoni*	*Acanella arbuscula*	*Candidella imbricata*	*Chrysogorgia averta*	*Chrysogorgia tricaulis*	*Iridogorgia splendens*
Ascothoracica sp.	—	—	—	—	●	—
Stalked barnacles	●	—	—	—	—	—
Bathypalaemonella serratipalma	—	●	—	●	●	●
Uroptychus sp.	—	●	—	—	●	—
Unknown galatheid	—	—	●	—	—	—

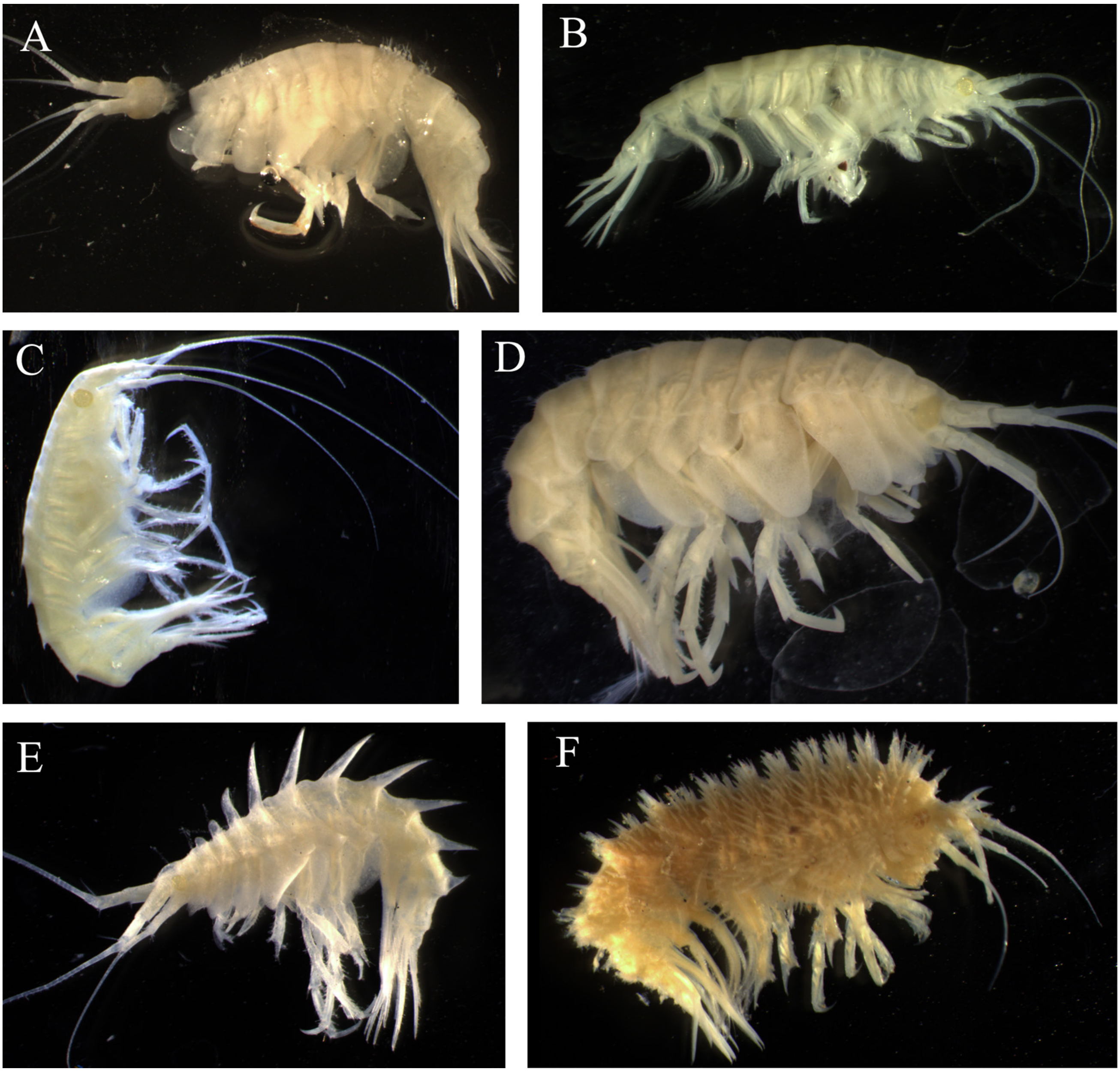

Figure 3. Photos showing some of the amphipod species found associated with deep-sea gorgonians, of which many where undescribed species belonging to the pleustid group. (*A, B*) the undescribed pleustids, *Chromopleustes s*p. A_J2099 and sp. B_J2103 respectively; (*C*) *Neopleustes* sp. C_J2098, all associated with deep–sea gorgonians occurring below 1000 m depth (e.g., *Acanthogorgia*). (*D*) *Neopleustes* sp. D_J2103 occurred on octocorals of the family Plexauridae at 400 m. (*E*) *Neupleustes eucanthoides* Gurjanova, 1972 was also from an unidentified species of *Acanthogorgia*. (*F*) the extremely well armoured *Uschakoviella echinophora* belonging to the family Epimeriidae was observed associated with the coral *Plumarella* collected at 100 m.

associated with the broadest ranges of hosts. The octocorals *Acanthogorgia* sp. 1_Aleutians_2004, *Muriceides* purple sp. 1_Aleutians_2004, and *Swiftia* sp. were inhabited by the largest number of crustacean species (Table 2).

Discussion

The results reported here are admittedly small samples of data, especially for the North Atlantic (there is only one other, as yet unpublished, set of samples for the North Pacific). Nevertheless, we suggest that these results represent the overall general pattern of octocoral-associated crustaceans for the two oceans.

In the North Atlantic, Buhl-Mortensen & Mortensen (2004a, b, 2005), working in upper bathyal waters off the Canadian province of Nova Scotia, examined the suite of invertebrates found on two large octocoral species, *Paragorgia arborea* (Linnaeus, 1758) and *Primnoa resedaeformis* (Gunnerus, 1763). Crustaceans present on *P. arborea* were considered to be either commensals or parasites and dominated other invertebrate groups in both numbers of species as well as numbers of individuals. Six of the 14 species were amphipods, three were copepods (all parasitic) including the gall-forming lamippid copepod *Gorgonophilus canadensis* Buhl-Mortensen & Mortensen, 2004, and one species each of a tanaid, an ostracod, an isopod, a decapod, and a cirripede were represented. In Norwegian waters, amphipods of the family Stegocephalidae were found in large numbers on *P. arborea* (De Clippele *et al*., 2015). Of the crustaceans, only the copepods are likely to have an obligate relationship to the octocoral. In contrast to *P. arborea*, the colonies of *P. resedaeformis* had significant areas of exposed calcareous axis that attracted many groups of invertebrates, most of whom were using the coral as a substrate for various reasons (Buhl-Mortensen *et al*., 2010) and were not likely to have a commensal relationship with the host octocoral. Those included the stalked barnacles *Ornatoscalpellum stroemii* M. Sars, 1859, and *Heteralepas cantelli* Buhl-Mortensen & Newman 2004 attached to the axis, and the isopod *Munna boeckii* Krøyer, 1839, and amphipods *Metopa bruzelii* (Goës, 1866) and *Stenopleustes malmgreni* (Boeck, 1871) lurking among the hydroids also attached to the exposed axis. As with *P. arborea*, the parasitic copepod *Enalcyonium* cf. *olssoni* (Zulueta, 1908) was found living in some of the polyps. In addition, a male-female pair of the decapod *Dorhynchus thomsoni* Thomson, 1873 and the shrimp *Pandalus propinquus* G. O. Sars, 1870 were found among the branches, but both are widespread elsewhere in the upper bathyal benthos. The gall-forming endoparasitic copepod *Gorgonophilus canadensis* described from Atlantic Canada was later observed on *Paragorgia* colonies off northern Norway (Buhl-Mortensen *et al*., 2022).

Several of the associations found in the North Atlantic samples do seem to be obligate symbionts of the octocorals with which they occur. The shrimp, *Bathypalaemonella serratipalma* is found only within the branches of some chrysogorgiid species (in both the genera *Chrysogorgia* and *Iridogorgia*) and the keratoisid, *Acanella arbuscula* (Johnson, 1862). The strong association that this shrimp has with these corals was documented by Watling (2010). A few colonies of chrysogorgiids also had ascothoracicans attached to the branches. Grygier (1984) noted that ascothoracids were common on chrysogorgiids and referred to them as parasites. Grygier (1981) also described a lamippid copepod from the keratoisid, *Acanella arbuscula*, suggesting along with Buhl-Mortensen & Mortensen (2005), that such relationships might be more widespread than realized. Only one obligate association of an amphipod with an octocoral is known from the North Atlantic, that being a species of pleustid, *Pleusymtes comitari* Myers & Hall-Spencer, 2003 from *Acanthogorgia* sp. sampled at bathyal depths off Ireland (Myers & Hall-Spencer, 2003). Watling & Maurer (1973) described a small pleustid, *Incisocalliope aestuarius* (Watling & Maurer, 1973), living among the hydroids of the fouling community.

In our North Pacific samples, we found a large number of crustacean species associated with the octocorals, but missing were decapods, i.e., shrimp and galatheoid squat lobsters that were common, if not especially diverse, in the North Atlantic. The greatest diversity of species in the North Pacific samples were pleustid amphipods (Fig. 3). Because many of these species are new and undescribed, it is difficult to know whether they have strong associations with the octocorals on which they were found. We note, however, that the pleustid fauna of the North Pacific is quite well known from the papers of Bousfield & Hendrycks (1994a, b; 1995), and in their distributional notes are some comments about faunal and floral associations where they are known.

Bousfield & Hendrycks (1994a, b; 1995) and Hendrycks & Bousfield (2004) undertook a major revision of the family in the North Pacific and made a few comments on species from the North Atlantic. From the cursory ecological data provided one can see that North Pacific pleustids occupy three major habitat types: open rocky, sandy or muddy bottoms at all depths; algal or seagrass areas, primarily intertidal or shallow subtidal; and living sessile colonial organisms, either in a loose association or as obligate symbionts. Those associated with colonial animals are species in the subfamilies Parapleustinae, Pleusymtinae, and Neopleustinae, and the three known species of obligate symbionts are members of the Parapleustinae, Dactylopleustinae and Atylopsinae.

The subfamily containing the most species associated with colonial animals is the Parapleustinae with 8 of 28 listed species described as living with sponges, coelenterates, bryozoans, and tunicates, and one species, *Commensipleustes commensalis* (Shoemaker, 1952) inhabiting the pleopods of the decapod *Panulirus interruptus* (Randall, 1840). It is not known whether those living in association with the colonial invertebrates are eating the tissue of the species they are living with or whether there is some other habitat advantage being provided by the "hosts." For example, Kumagai (2008) suggests that in an area where fish predation is intense, the pleustid *Incisocalliope symbioticus* (Gamo & Shinpo, 1992) actively chooses to live in association with the octocoral *Melithaea flabellifera* Kükenthal, 1908, taking advantage of the protection provided by chemicals produced by the octocoral that deterred fish predation.

In our deep-water samples, we found undescribed species of *Chromopleustes* (subfamily Parapleustinae) and *Neopleustes* (subfamily Neopleustinae), and four other species of pleustids with uncertain subfamily affiliations living in association with a small number of octocorals, primarily the more fleshy species, viz., the primnoids *Arthrogorgia kinoshitai* Bayer, 1952, and *Primnoa pacifica* Kinoshita, 1907, and the plexaurid *Muriceides* purple sp. 1_Aleutians_2004. Whereas one species of *Chromopleustes* has been found living in association with sponges and coelenterates in the North Pacific, the species of *Neopleustes* are generally considered to occupy open rocky, sandy, or muddy bottom areas (Labay, 2021). In contrast, we found two species of *Chromopleustes* and three species of *Neopleustes* living on a wide variety of octocoral species.

At present it is difficult to determine what is the exact nature of the relationship between the amphipods and other crustaceans and the octocorals on which they have been found. While it is tempting to suggest that there is a symbiotic association, it is equally possible that the crustaceans are using the octocorals merely as a substratum to elevate themselves above the slower waters of the benthic boundary layer (Buhl-Mortensen *et al*., 2010). That would be an advantage to species such as the arcturid isopods that are known suspension-feeders. It is also possible, as suggested by Kumagai (2008), that the octocoral may provide the crustacean with some type of chemical refuge from predation. That might be the case for the species living on the plexaurids as they are known, at least in shallow water, to secrete various terpenoid compounds (Almeida *et al*., 2014). A third explanation, which might benefit many smaller crustacean species, such as the pleustid amphipods, especially in the subfamilies such as Parapleustinae where the mandible molar is degenerate, is that the amphipods are taking advantage of the octocoral mucous secretions laden with organic detritus. These mucophagous species would not need the large, grinding molar found in species ingesting sediment or algal tissue (Watling, 1993). In the first instance, the crustaceans are facultatively using the octocoral colony, but in the following two cases, a more obligative relationship could have evolved.

The other question this study poses is: why are there so many crustaceans associated with deep-water octocoral colonies in the northern North Pacific in contrast to what was found on the seamounts of the Northwest Atlantic? We suggest two possible reasons. First, the overall species pool of crustaceans is much higher in the North Pacific than in the North Atlantic. For example, of the 143 species listed for the Pleustidae in WoRMS (Horton *et al*., 2022), only a small number, 23, are known from the Atlantic, while most of the others, 106, are from the North Pacific and/or Arctic.

Second, the octocoral fauna is quite different in the two locations. There is an abundance of fleshy octocoral species in the northern North Pacific, as exemplified by some of the primnoids and plexaurids (e.g., *Primnoa wingi* Cairns & Bayer, 2005, *Muriceides* sp.). Those taxa are largely missing from the North Atlantic deep waters. There is also a large difference in the dominant octocoral families, with the Northwest Atlantic being characterized by species in the families Coralliidae, Keratoisididae, and Chrysogorgiidae, the latter two families being represented by numerous species (Lapointe & Watling 2021). Coralliidae were not present in the Aleutian samples, and only two species of Keratoisididae and one of Chrysogorgiidae were found (unpublished observations). Both areas had several species of Primnoidae, but as noted, some of those in the Aleutian area were more fleshy, that is, the coenenchyme of the colony was much thicker. Also, plexaurids were common in both areas, but the muriceids were present only in the North Pacific.

Conclusions

Crustaceans are common associates of octocorals in the deep sea of both the North Atlantic and North Pacific, but the number of species of crustaceans living in or on octocoral hosts is far greater in the North Pacific. We hypothesize that this difference is due both to the differences in the octocoral fauna, which comprises more species that have fleshy tissue in the North Pacific vs. a higher proportion of species with thin axial tissue in the North Atlantic, as well as to the higher species richness, particularly of the amphipods and isopods, in North Pacific deep waters.

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This paper is dedicated to the memory of our dear friend and colleague, James (Jim) Lowry who was always interested in whatever crustacean endeavors we might be involved with. Jim provided a welcoming research base at his home and lab in Australia and we were very pleased to return the favor in Maine and Hawaii. Jim was always enthusiastically supporting young taxonomists and providing important training in the use of the DELTA taxonomy program.

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Appendix

Location data for dives conducted on seamounts along the New England and Corner Rise (NES&CR) seamount chains (Table 1A), and along the Aleutian Ridge (Table 1B).

Table 1A. New England and Corner Rise (NES&CR) dives.

Dive Name	Date	Minimum Depth (m)	Maximum Depth (m)	Latitude	Longitude
MAN100	13-Jul-03	1451	1734	38.26°	-60.55°
MAN200	14-Jul-03	1325	1415	38.22°	-60.51°
KEL100	15-Jul-03	1781	2073	38.79°	-64.13°
KEL200	16-Jul-03	1857	2184	38.86°	-63.90°
BEA100	17-Jul-03	1419	1781	39.93°	-67.35°
BEA200	18-Jul-03	1299	1644	39.90°	-67.35°
BEA300	18-Jul-03	1376	1435	39.87°	-67.42°
BEA400	11-May-04	1566	1632	39.95°	-67.41°
BEA500	12-May-04	1395	1869	39.88°	-67.48°
MAN300	14-May-04	1369	1250	38.22°	-60.51°
MAN400	15-May-04	1662	1933	38.15°	-61.10°
MAN500	15-May-04	1543	1786	38.15°	-61.10°
KEL300	17-May-04	3481	3935	38.73°	-64.20°
KEL400	18-May-04	1712	1781	38.82°	-63.96°
KEL500	19-May-04	2245	2427	38.77°	-63.97°
KEL600	20-May-04	1931	2125	38.85°	-63.76°
BAL100	22-May-04	1542	1933	39.36°	-65.36°
RET100	23-May-04	1979	3881	39.75°	-66.25°
LYM100	13-Aug-05	1376	1760	35.12°	-48.11°
LYM200	13-Aug-05	1943	2412	35.19°	-47.67°
LYM300	15-Aug-05	1426	1653	35.37°	-48.16°
MIL100	17-Aug-05	1280	1690	34.82°	-50.51°
VER100	18-Aug-05	1083	1318	34.66°	-49.82°
VER200	19-Aug-05	1498	2132	34.53°	-49.79°
GOO100	20-Aug-05	1851	2156	35.39°	-51.27°
KUK100	21-Aug-05	706	936	35.51°	-51.96°
KUK200	23-Aug-05	1210	1870	35.56°	-51.81°
NAS100	24-Aug-05	1775	2253	34.58°	-56.84°
NAS200	25-Aug-05	2097	2567	34.47°	-56.73°
MAN600	27-Aug-05	1320	1340	38.22°	-60.51°
REH100	29-Aug-05	1805	1936	37.46°	-59.95°
REH200	30-Aug-05	1278	1686	37.56°	-59.81°
KEL700	31-Aug-05	1829	2607	38.76°	-64.09°
BAL200	1-Sep-05	1684	1930	39.42°	-65.41°
PIC100	28-Oct-05	1943	2087	39.65°	-65.94°

Table 1B. Aleutian Ridge dives.

Dive Name	Date	Minimum Depth (m)	Maximum Depth (m)	Latitude	Longitude
J2095	25-Jul-04	840	2827	51.72°	-173.78°
J2096	27-Jul-04	2141	2947	52.50°	-174.92°
J2097	28-Jul-04	1720	1734	51.46°	-176.24°
J2098	29-Jul-04	2069	2514	51.39°	-177.08°
J2099	30-Jul-04	1269	2120	51.47°	-177.05°
J2100	1-Aug-04	1690	1802	51.53°	-177.09°
J2101	2-Aug-04	485	1341	51.48°	-177.89°
J2102	3-Aug-04	176	1386	51.29°	-179.54°
J2103	4-Aug-04	399	1348	51.80°	179.96°
J2104	5-Aug-04	395	1011	51.73°	-179.60°
J2105	6-Aug-04	889	2308	51.91°	-178.39°
J2106	7-Aug-04	937	1176	51.93°	-177.36°

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Ten thousand kilometres away and still the same species? The mystery of identity of *Scopelocheirus* sp. (Amphipoda: Scopelocheiridae) from the South Atlantic

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ABSTRACT. During two campaigns, one in the Kattegat (Denmark) in 2018, and the other off Namibia in 2019, the same fish baited trap was applied to catch scavenging amphipods at two stations each. The water depths in both areas were between 50 and 130 m. In addition to very few individuals of other species (Isopoda and Amphipoda), the samples consisted mainly of *Scopelocheirus* sp. The species from the Kattegat was identified as *S. hopei*. The question arises as to whether it is possible that the same species could dominate scavenging communities in sea areas more than 10,000 km apart. At first glance, the scopelocheirid amphipods of the northern and southern hemispheres appear identical, but subtle morphological and large genetic differences led to the conclusion that we are dealing with a previously undescribed species off Namibia. We have named it *Scopelocheirus sossi* sp. nov.

Introduction

Scavenging amphipods have a widespread distribution and occur mainly in the deep sea. Most of them belong to the Parvorder Lysianassidira, which includes the family Scopelocheiridae Lowry & Stoddart, 1997. It is a small family of scavenging amphipods containing two subfamilies, Scopelocheirinae Kilgallen & Lowry, 2015 and Paracallisominae Kilgallen & Lowry, 2015. The Scopelocheirinae contains three genera (*Aroui* Chevreux, 1911; *Paracallisomopsis* Gurjanova, 1962; *Scopelocheirus* Spence Bate, 1857), and eight species that live in temperate and boreal waters and, unlike many other scavenger species, live mainly in shallow waters of the Mediterranean, the North and South Atlantic, and the Pacific. They are scavengers feeding on carrion at the sea bed, with only few exceptions (Lowry & Stoddart, 1989). One of the most common representatives of this subfamily is *Scopelocheirus hopei* (Costa *in* Hope, 1851). It has a wide geographical distribution in the Atlantic (Kilgallen & Lowry, 2015), with records ranging from the Barents Sea (Gurjanova, 1951) in the North to Guinea-Bissau (Mateus & Mateus, 1986) in the South. It has been recorded in the North Atlantic Ocean (Stebbing, 1906; Chevreux & Fage, 1925; Palerud & Vader, 1991), in the English Channel (Dauvin, 1988), around the British Isles (Stebbing, 1906; Chevreux & Fage, 1925; Lincoln, 1979; Nickell & Moore, 1991), in the North Sea and the Norwegian Sea (Sars, 1895; Stebbing, 1906; Palerud & Vader, 1991) and in the Baltic Sea (Stebbing, 1906; Zettler & Zettler, 2017). It is also present in the Mediterranean Sea (Costa, 1851; Stebbing, 1906; Chevreux & Fage, 1925; Diviacco & Ruffo, 1989; Albertelli *et al.*, 1992; Kaïm-Malka, 2003). This

Keywords: Denmark, Namibia, *Scopelocheirus hopei*, *Scopelocheirus sossi* sp. nov., taxonomy, DNA barcodes, 18s rRNA
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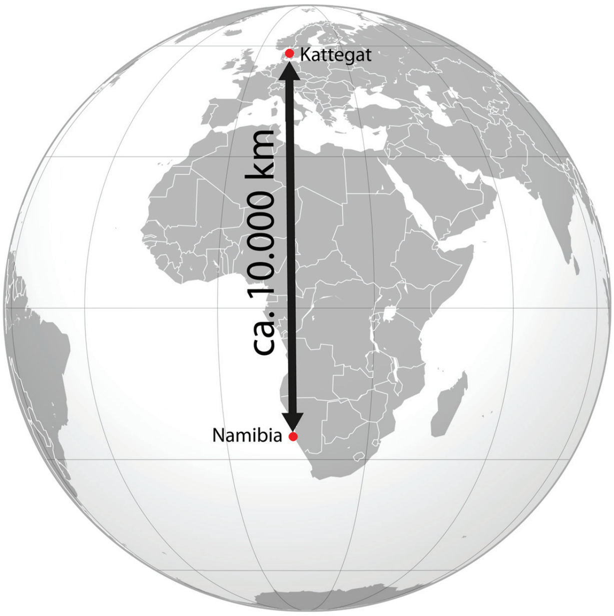

Figure 1. Sampling points are indicated by red dots.

species is present over a wide bathymetric range, from the circalittoral zone to the bathyal-abyssal zone, and it has been collected at depths ranging from 15 to 2,620 m (Kilgallen & Lowry, 2015; Zettler & Zettler, 2017).

During sampling campaigns using fish-baited amphipod traps in the Kattegat (Denmark) and southern Atlantic (Namibia), we found the genus *Scopelocheirus*. At first glance, the scopelocheirid amphipods of the northern and southern hemispheres appear identical. Using morphological and genetic methods, we were able to establish that there are two very similar species of the same genus.

Material and methods

Benthic organisms were collected with a fish-baited amphipod trap at water depths between 50 and 130 m during cruises of the RV "Elisabeth Mann Borgese" in 2018 in the Kattegat (Denmark) and the RV "Meteor" in 2019 in waters off Namibia (Fig. 1). The trap (Fig. 2) was mounted on a lander system about 1 m above the sea floor for between 17 and 40 hours. The two sampled stations in the Kattegat were northeast of the Danish island of Anholt in water depths between 50 and 118 m (see Table 1). The introduction to the Kattegat area is exemplarily described in ecological studies by Göransson (2017) and Josefson *et al.* (2017).

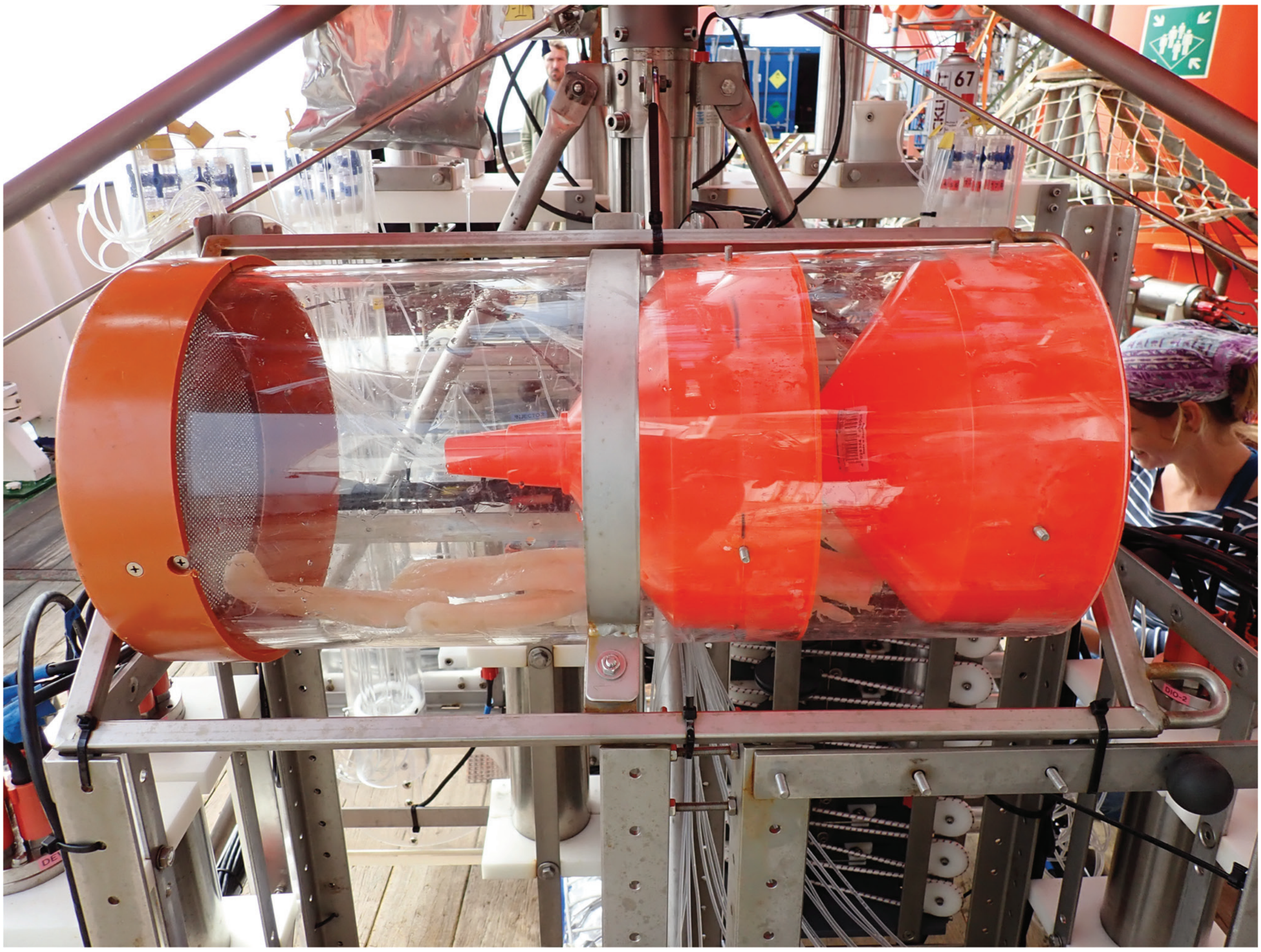

Figure 2. Double parlour style amphipod trap with fish bait mounted on lander system at *ca.* 1 m above seabed.

Table 1. List of sampling stations, where, and for how long, the amphipod traps were exposed.

station number	latitude	longitude	depth (m)	date	duration (h)
PP46	56.8492°N	11.7498°E	50	27 Aug 2018	25
PP63	57.0451°N	11.6441°E	118	29 Aug 2018	17
M157-41	25.0000°S	14.3775°E	130	05 Sep 2019	40
M157-43	25.0001°S	14.5611°E	107	06 Sep 2019	37

The two stations off Namibia were about 100 km west of Sossusvlei (Namib Desert) in 107 and 130 m water depth, respectively (see Table 1). The marine environment off Namibia belongs to the Benguela Current Large Marine Ecosystem (BCLME), which is one of the world's largest coastal upwelling areas. The introduction into the investigation area is comprehensively described in several ecological studies (Shannon *et al.*, 2006; Eisenbarth & Zettler, 2016; Zettler *et al.*, 2009, 2013; Zettler & Pollehne, 2013).

All samples were fixed in 70% ethanol solution on board. The animals were later examined using a compound microscope with up to 800× magnification. Dissected appendages were mounted in glycerine on non-permanent slides. Digital microphotographs were made using an AxioCam ICC3 and ERc5s (Carl Zeiss MicroImaging GmbH, Jena) and AxioVision software (Carl Zeiss Imaging Solutions GmbH, Jena). The resulting files were imported into Adobe Illustrator CS5 (Adobe Systems Incorporated) and digital line drawings made using a WACOM Intuos digitiser board and a microscope for zooming and controlling. The type material and other specimens of *Scopelocheirus sossi* sp. nov. are deposited in the collections of the Museum für Naturkunde, Berlin, Germany (ZMB).

Three specimens of *Scopelocheirus sossi* sp. nov. were included in the genetic study. The study of *Scopelocheirus hopei* was discontinued because the fixation of the animals after capture did not allow isolation of suitable DNA and thus no further processing.

Total DNA was extracted from ethanol preserved tissue by a silica gel-based spin column procedure according to the protocol of the innuPREP DNA Mini Kit (AJ Innuscreen GmbH). PCR amplification of cytochrome c oxidase subunit I (COI)] was carried out in 30 µL reactions containing 2-3µl DNA template, 3 µl 10× reaction buffer, 3.0 mM MgCl2, 250 µ M of each dNTP, 10 pmol of each primer and 1.1 U of Taq polymerase. All chemicals and primers were purchased from Merck (Sigma-Aldrich). Primer sequences for PCR and sequencing are listed in Table 2. New COI primers were designed using the available GenBank sequences of *Scopelocheirus* spp. New 18S primers were designed by

Table 2. Primers used for amplification and sequencing of three molecular marker genes.

gene/primer	sequence (5'–3')	direction	reference
18S rDNA			
1F	TACCTGGTTGATCCTGCCAGTAG	forward	Giribet *et al*., 1996
3F	GTTCGATTCCGGAGAGGGA	forward	Giribet *et al*., 1996
9R	GATCCTTCCGCAGGTTCACCTAC	reverse	Giribet *et al*., 1996
18Sa2.0	ATGGTTGCAAAGCTGAAAC	forward	Whiting *et al*., 1997
18Sbi	GAGTCTCGTTCGTTATCGGA	reverse	Whiting *et al*., 1997
18Sfw	CCTAYCTGGTTGATCCTGCCAGT	forward	Englisch & Koenemann, 2001
18F997	TTCGAAGACGATCAGATACCG	forward	Struck *et al*., 2002
18 L	GAATTACCGCGGCTGCTGGCACC	reverse	Halanych *et al*., 1995
18Srev	TAATGATCCTTCCGCAGGTT	reverse	Englisch & Koenemann, 2001
Sossi_18Sf1	GTAGTGACGAAATCTAACGATGCG	forward	present study
Sossi_18Sf2	AGGCACGCAAATTACCCAATCC	forward	present study
Sossi_18Sr1	GTAGCGCGCGTGCGGCCCAGAAC	reverse	present study
Sossi_18Sr2	GTTACCCGCTCCTGTCGGAGTAGG	reverse	present study
28S rDNA			
28Srd4.8a	ACCTATTCTCAAACTTTAAATGG	forward	Schwendinger & Giribet, 2005
28Srd7b1	GACTTCCCTTACCTACAT	reverse	Schwendinger & Giribet, 2005
COI			
HCO2198	TAAACTTCAGGGTGACCAAAAAATCA	reverse	Folmer *et al*., 1994
Sco_COIintf1	ATYYTAGGTGCCTGAKCAAGAG	forward	present study
Sco_COIintf2	GTARTWGTDACWGCTCATGCTTTTG	forward	present study
Sco_COIintf3	TCAACAGTRATTAATATACGAAG	forward	present study
Sco_COIintf4	GTAGAAAGAGGAGTAGGDACTGG	forward	present study
Sco_COIintr1	CTTCGTATATTAATYACTGTTGA	reverse	present study
Sco_COIintr2	CCAGTHCCTACTCCTCTTTCTAC	reverse	present study
Sco_COIintr3	GGGTCWCCTCCWCCWCTWGGGTCAA	reverse	present study

Figure 3. Habitus photograph of *Scopelocheirus hopei* (Costa *in* Hope, 1851), male, 6 mm, Kattegat (Denmark), stn. PP46.

using *S. sossi* sp. nov. 18S sequences. PCR temperature profile for amplification consisted of the following steps: initial denaturation at 94°C for 1 min; 38 cycles of 30 s at 94°C, 30 s at 50°C and 1 min at 72°C, followed by 5 min at 72°C. For amplification of 18S the PCR reaction (30 µL) consisted of 250 µM of each dNTP, 10 pmol of each primer, 1.1 U of Taq polymerase, 3 µ l 10× reaction buffer, 1.5 mM $MgCl_2$, and 3 µl DNA template. PCR profile was: 94°C for 5 min; 38 cycles of 30 s at 94°C, 50 s at 52°C and 3 min 20 s at 72°C; and 7 min at 70°C. PCR product purification procedure: The PCR products were extracted from agarose gel following to the protocol of the innuPREP Gel Extraction Kit (AJ Innuscreen GmbH).

The sequencing of PCR products was performed using dideoxy chain termination method and cycle sequencing (Sanger *et al.*, 1977) using "BigDyeTM Terminator v.1.1 Cycle Sequencing Kit" (Applied BiosystemsTM). The primers used for sequencing were the same as those for PCR amplification. Sequencing products were purified following the GenomeLab Sequencing Chemistry Protocol 3.2 (Beckman Coulter). The cycle sequencing products were analysed by using capillary separation on an Applied Biosystems Genetic Analyzer 3130xl (Hitachi) and were sequenced in both directions. All sequences obtained in this study were deposited to NCBI GenBank (see Table 3). Recorded DNA sequences were manually checked and aligned with BioEdit (Hall, 1999).

Permits for sampling from Namibian authorities. National Commission on Research, Science and Technology: RPIV00812019

Abbreviations. A 1,2 = antenna 1,2; L = labium; LM = labrum; Md = mandible; Mx1,2 = maxilla 1, 2; Mp = maxilliped; G 1,2 = gnathopods 1,2; P 3–7 = pereopods 3–7; E 1–3 = epimeral plates 1–3; U 1–3 = uropods 1–3; T = telson; ZMB = Zoological Museum Berlin

Table 3. Sequence data of *Scopelocheirus sossi* sp. nov. and GenBank accession numbers. Identical sequences were determined for all examined individuals for the respective sequence fragment.

	18S rDNA	28S rDNA	COI
accession numbers	OM503026	OM523028	OM480647
base pairs	2272	472	586

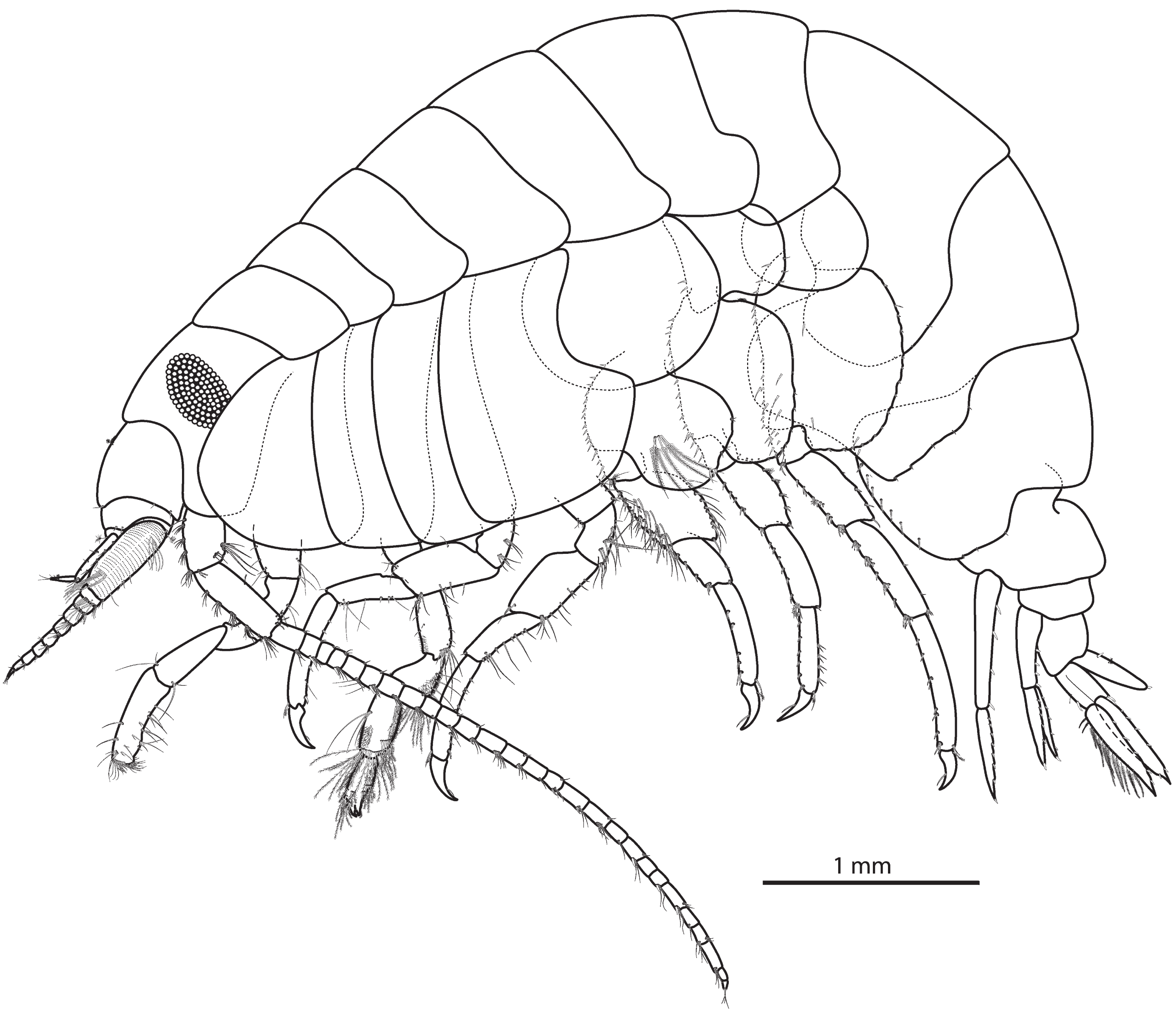

Figure 4. *Scopelocheirus hopei* (Costa *in* Hope, 1851), male, 5.9 mm, Kattegat (Denmark), habitus, Stn. PP46.

Systematics

Suborder Amphilochidea Lowry & Myers, 2017

Infraorder Lysianassida Lowry & Myers, 2017

Parvorder Lysianassidira Lowry & Myers, 2017

Superfamily Lysianassoidea Dana, 1849

Family Scopelocheiridae Lowry & Stoddart, 1997

Subfamily Scopelocheirinae Kilgallen & Lowry, 2015

Scopelocheirus Spence Bate, 1857

Callisoma O. G. Costa, 1838: 5 (nomen nudum)—A. Costa, 1851: 1 (homonym, Coleoptera).—Lilljeborg, 1865a: 33.—Lilljeborg, 1865b: 23.—Heller, 1866: 26.—Boeck, 1871: 101.—Boeck, 1872: 131.—G. O. Sars, 1890: 52.—Della Valle, 1893: 838.

Scopelocheirus Spence Bate, 1857: 138.—Stebbing, 1906: 61.—Chevreux & Fage, 1925: 54.—Stephensen, 1929: 64.—Schellenberg, 1942: 110.—Gurjanova, 1951: 241.—J. L. Barnard, 1969: 362.—Lincoln, 1979: 50.—Diviacco & Ruffo, 1989: 542.—Barnard & Karaman, 1991: 528, 434 (key), 454 (key).

Diagnosis. Mandible lacinia mobilis a stemmed, distally expanded, irregularly cusped blade; palp article 2 broadened. Maxilla 2 inner plate slightly longer than outer; outer plate without long distally barbed slender setae. Gnathopod 1 coxa margins diverging distally. Pereopod 5 slightly wider than long; basis greatly expanded posteriorly (after Kilgallen & Lowry, 2015).

Type species. *Scopelocheirus crenatus* Spence Bate, 1857.

Included species. *S. crenatus* Spence Bate, 1857*, S. hopei* (Costa *in* Hope, 1851), *S. polymedus* Bellan-Santini, 1985, *S. sossi* sp. nov.

Remarks. Until the revision of the scopelocheirid amphipods by Kilgallen & Lowry (2015), *Scopelocheirus crenatus* Spence Bate, 1857 was treated by many authors as a junior synonym of *S. hopei* (Costa *in* Hope, 1851). However, as these names have been recorded many times in the literature and appear common in the north-east Atlantic and Mediterranean, the result is a confused synonymy. As noted by Kilgallen & Lowry (2015) the issue is still not sufficiently resolved, as this will require an extensive, detailed study of materials from the type localities and known distributions of both species. This is beyond the scope of this study.

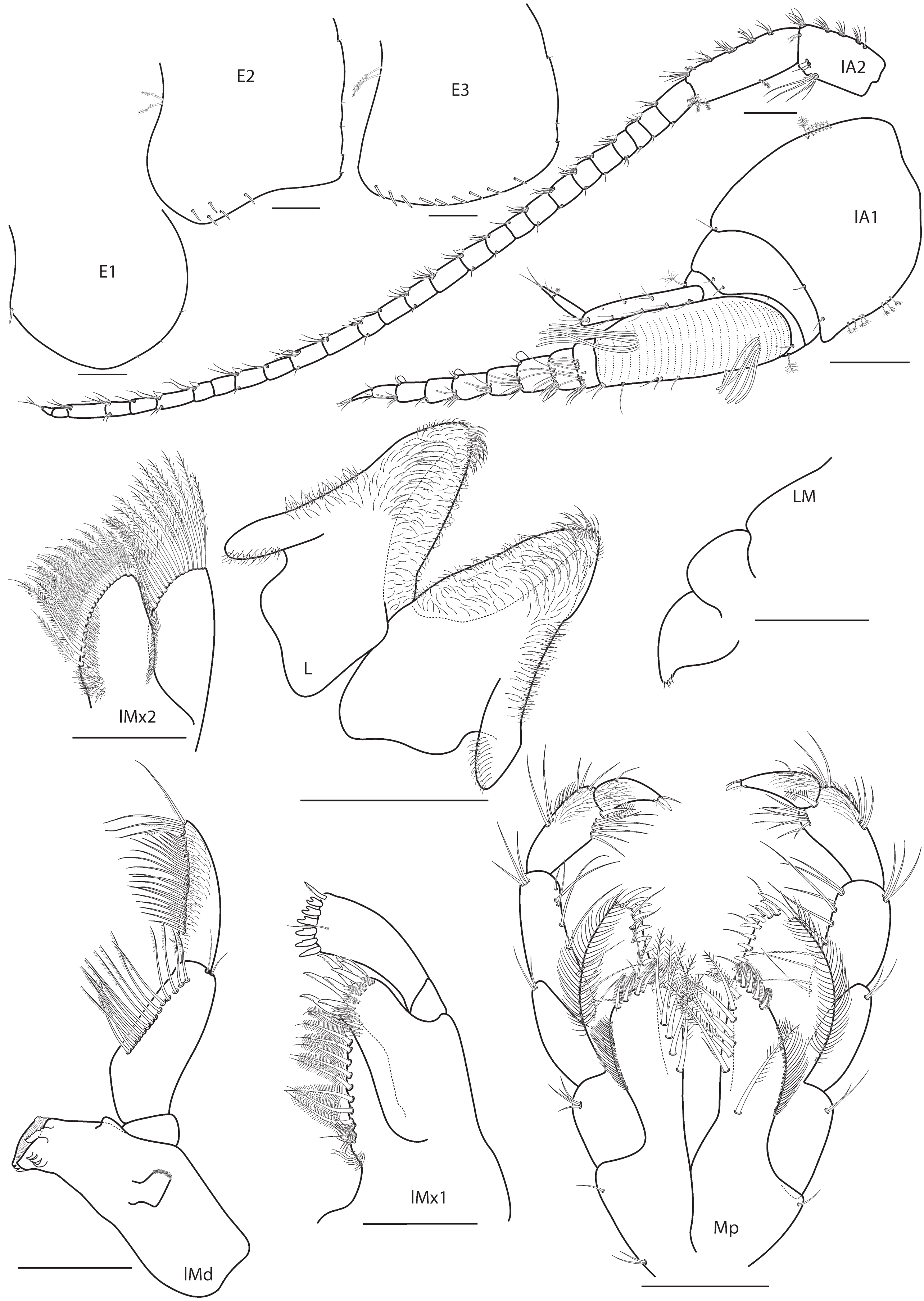

Figure 5. *Scopelocheirus hopei* (Costa *in* Hope, 1851), male, 5.9 mm, Kattegat (Denmark), scale bar 200 µm, Stn. PP46.

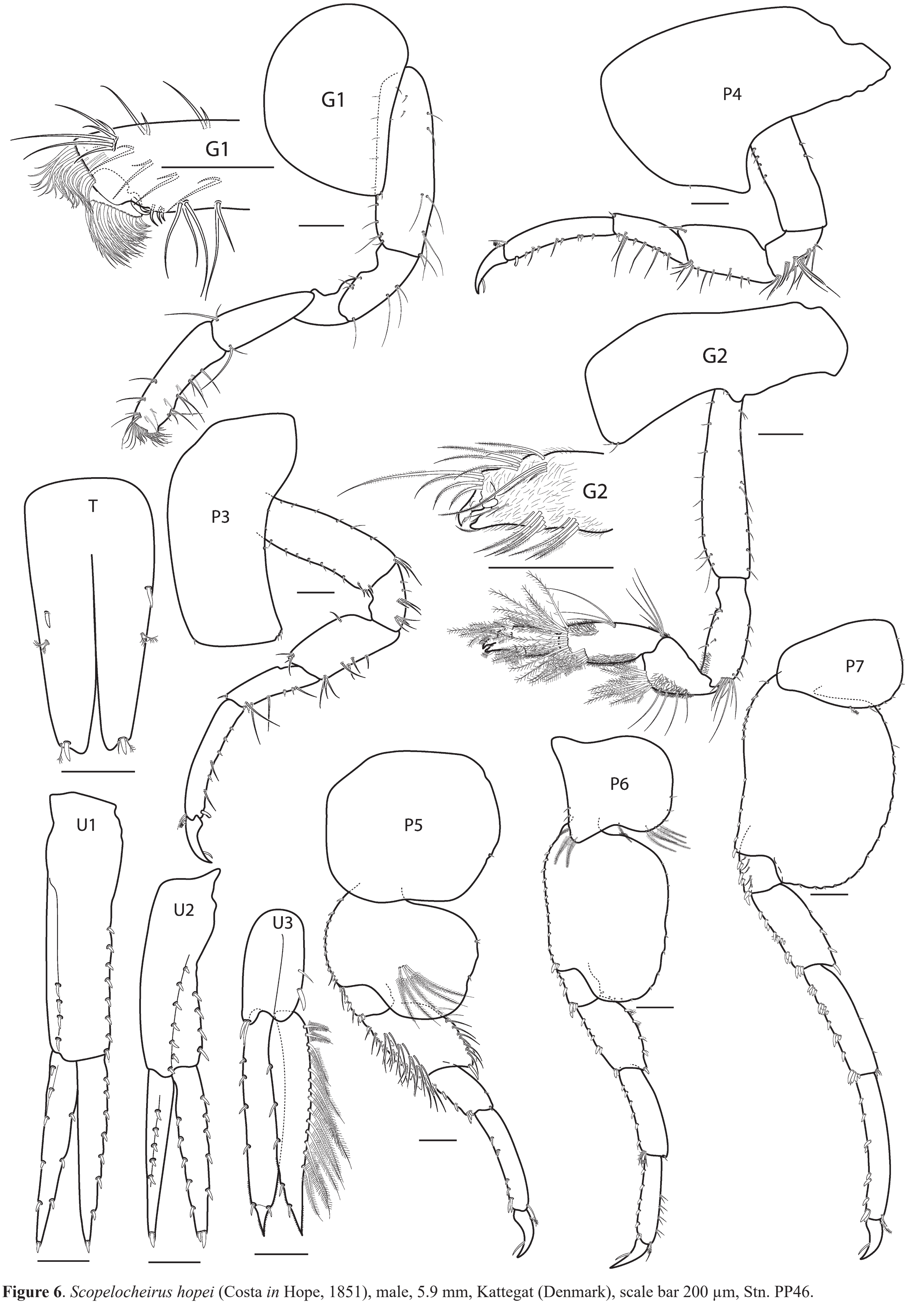

Figure 6. *Scopelocheirus hopei* (Costa *in* Hope, 1851), male, 5.9 mm, Kattegat (Denmark), scale bar 200 µm, Stn. PP46.

Scopelocheirus hopei (Costa *in* Hope, 1851)

Figs 3–6

Callisoma hopei Costa, 1851: 5–6, pl. 8, figs 1–2
Anonyx kroyeri Bruzelius, 1859: 45–46, pl. 2, fig. 7
Callisoma kroyeri.—Sars, 1890: 54–55, pl. 19, fig. 2.—Lilljeborg, 1865a: 33–34
Scopelocheirus hopei.—Stebbing, 1906: 62.—Stephensen, 1923: 15–16.—Chevreux & Fage, 1925: 55–56, fig. 39–40.—Stephensen, 1928: 79, fig. 12(20).—Stephensen, 1929: 64, fig. 16(47).—Oldevig, 1933: 42, fig. 2 on p. 41.—Schellenberg, 1942: 111, fig. 88.—Stephensen, 1942: 76.—Lincoln, 1979: 50, fig. 16.—Diviacco & Ruffo (*in* Ruffo, 1989): 544, fig. 372.—Kilgallen & Lowry, 2015: 9–12.—Zettler & Zettler, 2017: 80–83, figs. 47–49

Type locality. Mediterranean Sea, Gulf of Naples (Italy)

Material examined. Stn. PP46: Denmark, Kattegat, water depth 50 m; amphipod trap; 56.8492°N; 11.7498°E; salinity at bottom 33 psu, temperature at bottom 10°C, oxygen 4.25 ml/l, collected 27 Aug 2018; several hundred individuals, males and females. Stn. PP63: Denmark, Kattegat water depth 118 m; amphipod trap; 57.0451°N; 11.6441°E; salinity at bottom 33.5 psu, temperature at bottom 9°C, oxygen 4.0 ml/l, collected 29 Aug 2018; several hundred individuals, males and females.

Remarks. Although the material from the Kattegat evaluated here falls exactly within the range of variation of *Scopelocheirus hopei* (see Zettler & Zettler, 2017), a differentiation from *S. crenatus* Spence Bate, 1857 (and less critically also from *S. polymedus* Bellan-Santini, 1985) cannot be made. Even considering the arguments of Sars (1890), Diviacco & Ruffo (1989), and Kilgallen & Lowry (2015), we find the distinguishing features of the two latter to be ambiguous. *Scopelocheirus hopei* and *S. crenatus* co-occur in the North Atlantic and North Sea, and *S. hopei* and *S. polymedus* in the Mediterranean Sea. However, the latter is restricted to the bathyal and the others are more common on the shelf. It is very likely that many of the deeper records of *S. hopei*, particularly those from the Mediterranean region, are in fact misidentifications of *S. polymedus* and should be re-examined to confirm their identity (Kilgallen & Lowry, 2015). Two species have been genetically identified in the North Atlantic (see Fig. 11); *S. hopei* from the North Sea (Raupach *et al.*, 2015) and an undetermined *Scopelocheirus* sp. occurring around Iceland (Jażdżewska *et al.*, 2018). Unfortunately, no material from the Mediterranean Sea, the type locality of *S. hopei* and *S. polymedus*, has been analysed to date. We have identified the specimen collected in the Kattegat as *S. hopei* based on our own experience and high probability (see Zettler & Zettler, 2017), but until further research this cannot be consolidated, as mentioned above. Therefore, we provide here full illustrations of the entity from the Kattegat, to facilitate any further research on this issue.

Scopelocheirus sossi sp. nov.

urn:lsid:zoobank.org:act:697B376F-15F7-4ACF-8BE9-110545096A4F

Figs 7–10

Holotype: Male, 6.6 mm, ZMB 34580, Namibia, Namib Desert Coast, 25.0000°S 14.3775°E, water depth 130 m, amphipod trap, Stn. M157_41, salinity at bottom 33.6 psu, temperature at bottom 10.5°C, oxygen 0.22 ml/l, collected 5 Sept 2019. **Paratypes**: Paratype 1, male, 6.6 mm, ZMB 34581, data same as holotype; Paratype 2, female, 7.6 mm, ZMB 34582, data same as holotype.

Other material examined. 18 individuals, ZMB 34583, data same as holotype; 20 individuals, ZMB 34584, Namibia, Namib Desert Coast, 25.0001°S 14.5611°E, water depth 107 m, amphipod trap, Stn. M157_43, salinity at bottom 34.9 psu, temperature at bottom 10.7°C, oxygen 2.93 ml/l, collected 6 Sept 2019.

Type locality. Namibia (Province Hardap) about 100 km west of Sossusvlei (Namib Desert), 25.0000°S; 14.3775°E, in 130 m water depth.

Etymology. The name “sossi” is the Latin genitive of “sossus” and is Nama for “no return” or “dead end” and refers to Sossusvlei, a salt and clay pan, located in the southern part of the Namib Desert, which is about 100 km east of the locus typicus.

Diagnosis. Lateral cephalic lobe weak triangulate. Eyes elongated oval. Slender shape of palpus of maxilla 1. Outer and inner plate of maxilla 2 subequal, both with feathered setae. Dorsal-anterior margin of segment 2 of mandible palp without setation. Coxae 1–4 lacking ventral setae. Basis of pereopod 5 wider than long with a brush of 8 or 9 feathered setae in the inner side. Clear longitudinal keel on basis of pereopod 5–7. Epimeral plate 2, ventral margin slightly concave with up to 6 setae anteroventrally, posteroventral corner rectangular. Uropods 1 and 2 sparsely spinose. Uropod 3, inner ramus reaching end of proximal article of outer ramus; inner ramus lined with plumose setae along medial margin.

Description. Based on male holotype, 6.6 mm. **Head**. *Head* lateral cephalic lobe weak triangulate, eyes elongated oval, of medium size. *Antenna 1* short. Peduncle almost as long as head; peduncular article 1 very stout, as long as wide, dorsal margin with a row of 8 palm-like setae, ventral margin with a row of palm-like spines; peduncular articles 2 and 3 very short. Primary flagellum short, 11-articulate, 2 times as long as peduncle; flagellar article 1 large, callynophore well developed. Accessory flagellum 0.5 times as long as primary flagellum, 3-articulate; article 1 as long as primary flagellar article 1, calceoli absent. *Antenna 2* longer than antenna 1, about half as long as body; peduncular articles 4 and 5 subequal in length; flagellum 28-articulate, calceoli absent. *Labrum* with epistome, slightly produced frontally, vaulted. *Mandible* incisor broad, cutting margin smooth and slightly convex, with blunt cusp on each side, 1 subacute tooth (left) and 3 acute teeth (right) on medial side. Lacinia mobilis on left, stemmed, expanded distally, with irregularly cusped blade. Palp attached midway, 3-articulate; article 2 longest, slightly swollen anteriorly, with oblique row of 15 setae distally; article 3 weakly falcate, 0.7 × as long as article 2,

Figure 7. Habitus photograph of *Scopelocheirus sossi* sp. nov., female, 6.2 mm, Namibia, Stn. M157_41.

with 17 setae along distal ⅔ of posterior margin. *Maxilla 1* inner plate narrowing distally, setose, with 10 plumose setae along medial margin and apex; outer plate with 10 toothed setae apically and with several setae submarginally; palp bi-articulate, distal article swollen distally, apical margin oblique, with 5 bi-dentate short setae and 1 mono-dentate elongate seta. *Maxilla 2* each plate broad and subequal in length; inner plate with row of 19 plumose setae along distal half of medial and apical margins; outer plate with row of 14 plumose setae apically. *Maxilliped* inner plate with mediodistal row of plumose setae, apex with 3 nodular setae; outer plate well developed, half of palp length, lined with 12 nodular setae, several simple setae, palp 4-articulate, article 2 the longest, article 4 about ⅔ of article 3, with short apical seta.

Pereon. *Gnathopod 1* of scopelocheirin form; coxal plate triangular; basis elongate, anterior and posterior margins straight, lined with 5–7 setae; ischium 0.4 × as long as basis; carpus elongate, 0.6 × as long as basis; merus half as long as ischium; carpus elongate, longer than ischium, 0.6 × basis; propodus subrectangular, slender, and longer than carpus, with dense tuft of stout setae covering the rudimentary dactylus. *Gnathopod 2* slender; coxa subrectangular; basis elongate with parallel anterior and posterior margin lined with few long and short setae; ischium elongate, 0.7 × as long as basis; merus 0.5 × as long as ischium, round posteriorly, with many short setae and 1 bundle of long plumose setae; carpus as long as ischium, anterior margin swollen, with several clusters of short setae, long plumose setae at anterodistal and posterodistal corner reaching mid-propodus; propodus oval, 0.6 × as long as carpus, with clusters of small setae and 6 bundles of plumose setae distally; dactylus fitting palm, minutely chelate. *Pereopod 3* stout; coxa subrectangular, similar to coxa 2, slightly curved; basis rectangular, elongate with few short and three longer setae; ischium 0.3 × as long as basis, anterior lobe weak, several long setae on posterior margin; merus expanded anteriorly, half as long as basis, several long setae on posterior margin, anterodistal corner weakly produced with bundle of setae; carpus slender, 0.8 × as long as merus, with simple and robust setae on posterior margin; propodus 2 × as long as carpus, lined with robust setae on posterior margin and few longer setae, with pair of locking setae posterodistally; dactylus falcate, 0.3 × as long as propodus. *Pereopod 4* coxa 4 much broader than other coxae, with well-developed posteroventral lobe, other articles similar to pereopod 3, though propodus shorter. *Pereopod 5* coxa large, rounded; basis with a weak longitudinal keel, broadly expanded, with a row of single robust spines along anterior margin, with a brush of 8 long plumose setae in middle of inner side; ischium 0.3 × as long as basis with few long and short setae on anterior margin, merus 2 × as long as ischium with several robust and some longer setae anteriorly; posterior expansion ending in lobe with row of 9 long setae and 1 apical spine; carpus 0.8 × as long as merus lined with clusters of spines anteriorly; propodus 2 × as long as carpus, with 4 clusters of paired spines along anterior margin and 1 posterodistal seta. *Pereopod 6* longer and more slender than pereopod 5; coxa subrectangular, smaller than coxa 5, with 7 plumose setae anteriorly, and 6 plumose setae posteroventrally; basis ovoid, 1.7 × as long as wide, with weak longitudinal keel, anterior margin rounded proximally and straight distally, bearing short robust setae, posterior margin broadly expanded, smooth, weakly crenulate, bearing 10 small setae, posterodistal end reaching almost the end of ischium; ischium short half as long as merus, 1

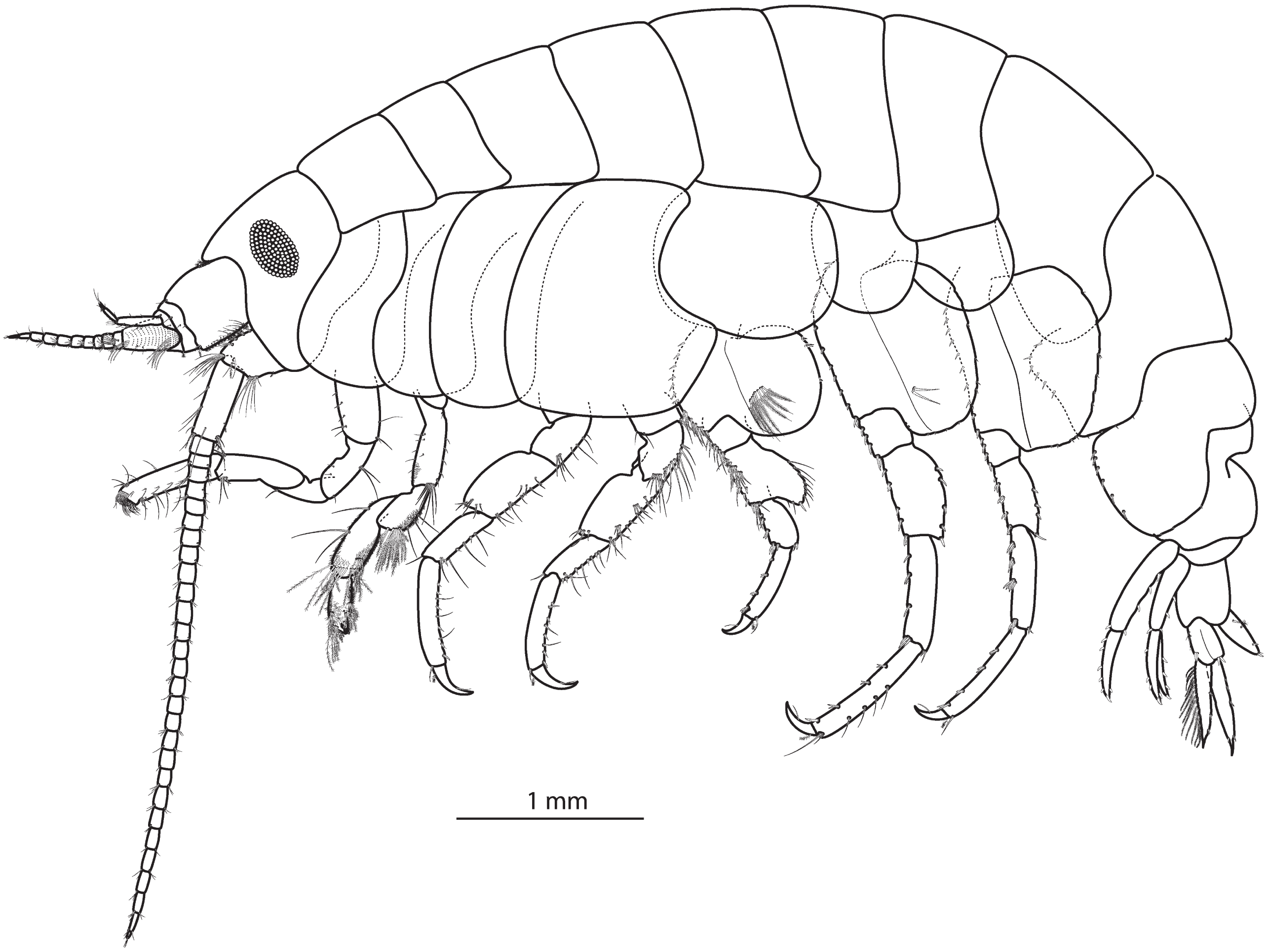

Figure 8. *Scopelocheirus sossi* sp. nov., holotype, male, 6.6 mm, Namibia, habitus, Stn. M157_41.

with 4 pairs of robust spines anteriorly; merus half as long as basis, slightly expanded posteriorly with several spines along the margins; carpus rectangular, elongate, 1.2 × as long as merus, with 4 pairs of spines anteriorly and 2 setae posterodistally; propodus linear, slightly longer than carpus, with single and paired robust setae on anterior margin and 4 simple long setae on posterior margin, posterodistal edge with 1 long spine; dactylus falcate, 0.2 × as long as propodus. *Pereopod 7* coxa rhomboid, with 3 plumose setae anteriorly; basis 1.4 times as long as wide, with weak longitudinal keel, anterior margin weakly concave armed with several small spines, posterior margin convex and crenulate with several small setae, posterodistal lobe obtuse, nearly as long as ischium; merus slender other articles similar to pereopod 6.

Pleon. *Epimeron 1* rounded, obtuse-angled anteroventrally with 1 spine. *Epimeron 2* subquadrate, concave ventrally, posterior margin crenulate, 6 spines anteroventrally. *Epimeron 3* rounded, posterior margin slightly crenulate, 6 spines on ventral margin. *Urosomite 1* with deep dorsal depression and mid-dorsal carina. *Uropod 1* peduncle longer than rami, peduncle with 6 robust setae on dorsolateral margin and 5 robust setae on dorsomedial margin; outer ramus with 6 lateral robust setae and 1 apical spine; inner ramus as long as outer ramus, with 2 medial and 2 lateral robust setae and one apical spine. *Uropod 2* as long as uropod 1; peduncle with 3 robust setae medially and 6 robust setae laterally on each dorsal margin; outer ramus with 5 lateral robust setae only and 1 apical spine; inner ramus as long as outer ramus, with 3 lateral and 2 medial robust setae and 1 apical spine. *Uropod 3* 0.8 × as long as uropod 2; peduncle with 1 pair of robust setae distally on each side and 2 long setae medially; outer ramus bi-articulate, basal article with 3 lateral setae and 2 terminal setae; inner ramus 0.8 × as long as outer ramus, reaching distal end of proximal article of outer ramus, with 3 lateral setae and row of plumose setae along medial margin. Telson longer than broad, cleft about 80%, each lobe with apical notch bearing 1 robust and 1 slender seta apically, with 2 or 3 robust setae and 1 pair of sensory setae dorsolaterally.

Female. (Paratype 2). Females in general very similar to males but slightly larger. Antenna 1 slightly shorter than in male; peduncular article 1 more slender; primary flagellum 8-articulate. Antenna 2 shorter than in male, reaching one-third of body length; flagellum 24-articulate. Oostegites present on pereopods 2–5.

Habitat. This new species occurred in water depths between 107 and 130 m on muddy sediments. The salinity ranged between 33.6 and 34.9 psu, the oxygen content in bottom water varied between 0.22 and 2.93 ml/l. The temperatures were about 10°C.

Distribution. Currently known only from the coast of Namibia.

Remarks. *Scopelocheirus sossi* sp. nov. can be separated from the Kattegat entity, herein identified as *S. hopei*, by

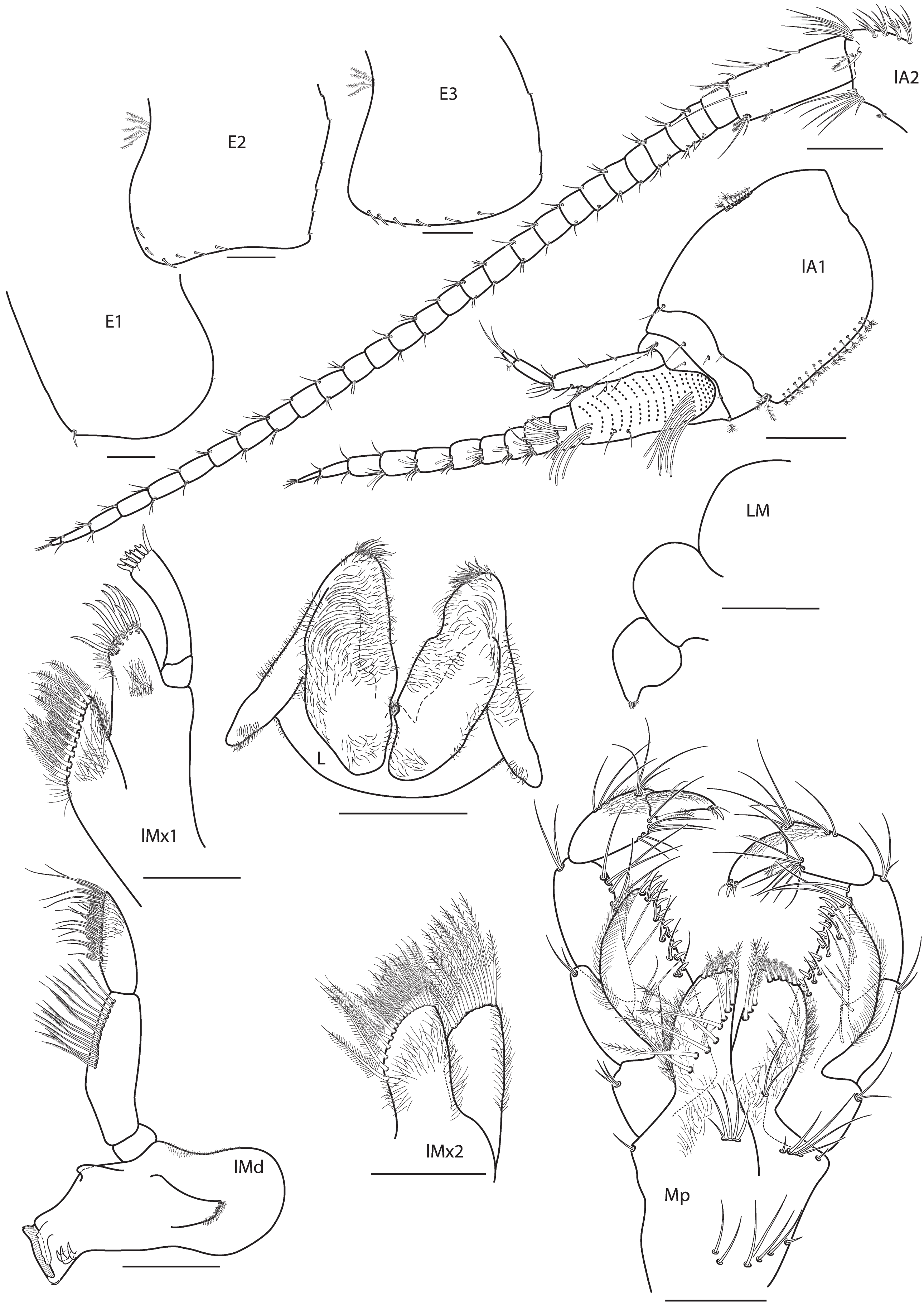

Figure 9. *Scopelocheirus sossi* sp. nov., holotype, male, 6.6 mm, Namibia, Stn. M157_41.

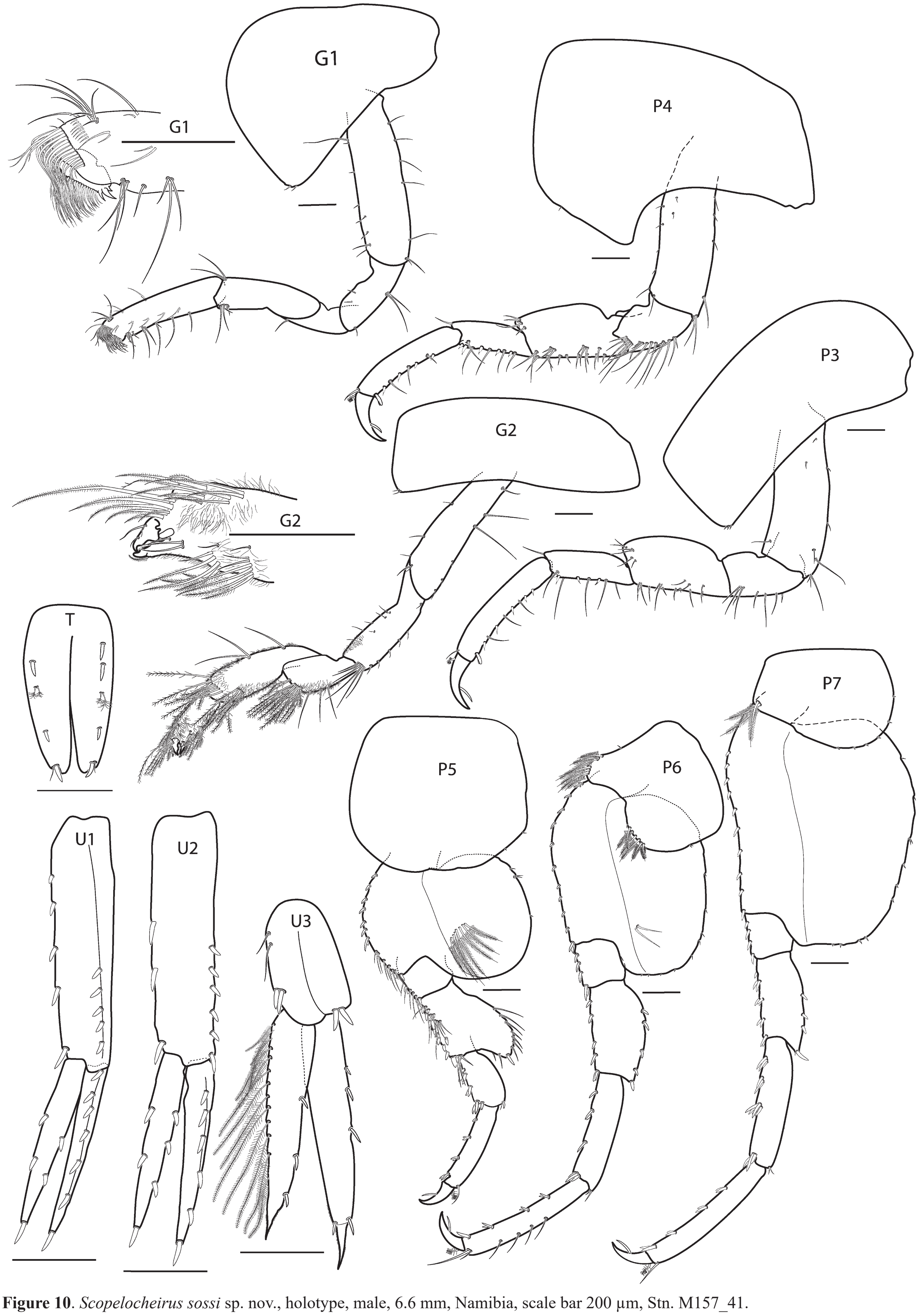

Figure 10. *Scopelocheirus sossi* sp. nov., holotype, male, 6.6 mm, Namibia, scale bar 200 µm, Stn. M157_41.

the following characters (*S. hopei* in brackets). Eyes small, 0.4 × height of head (larger, 0.5 × height of head); palp of maxilla 1 slender (broader); pereopod 5 basis with 8 or 9 plumose setae on medial surface (4 or 5); pereopod 5 merus expanded posterodistally (expanded along whole posterior margin); pereopods 5–7 basis with longitudinal keel as seen in *Aroui minusetosus* Jung, Coleman & Yoon, 2017 (keel absent); epimeron 3 ventral margin with six spines (nine spines); telson length 2 × width with 2 or 3 pairs of dorsal spines (length 2.2 × width with 1 pair of dorsal spines); body uniformly yellowish without pigment spots (body densely mottled with yellowish-orange pigment spots (in life sometimes with numerous brown spots)).

Genetics

A total of 586 aligned base pairs of the mitochondrial DNA COI fragment, and a total of 2,744 aligned base pairs of the nuclear 18S/28S rDNA of three specimens of *Scopelocheirus sossi* sp. nov. were sequenced. All three specimens of *Scopelocheirus sossi* sp. nov. possess identical haplotypes for the studied COI fragment as well as identical sequences for 18S and 28S fragments (Table 2). Blast searches revealed for all three sequences (COI, 18S, 28S) that there are no data conspecific with *S. sossi* sp. nov. in GenBank or in BOLD (Table 3). For COI, the uncorrected genetic distances between *S. sossi* sp. nov. and the congeneric species are equal to or greater than 19%.

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