

Report to COMARGE
on
Workshop on Marine Squat Lobsters

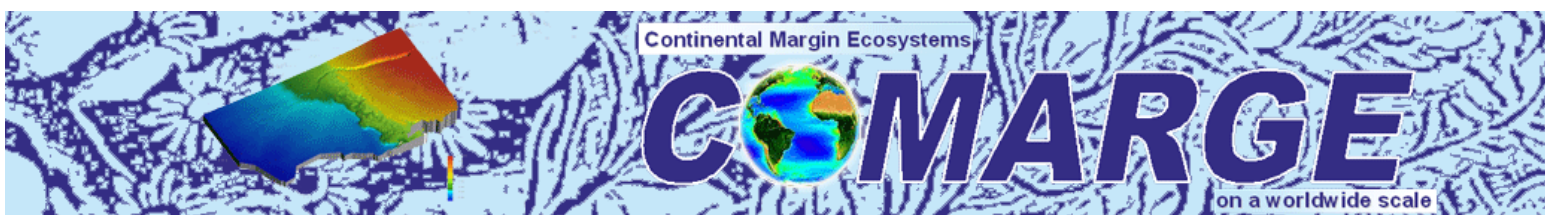
National Institute of Water and Atmosphere
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by

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Contents

Summary	1
Continental Margin Ecosystems	2
Squat lobsters – the state of play	2
Preparing for the future	2
Overall objectives of workshop	2
Specific tasks	2
The future	3
Participants	4
Abstracts of presented papers	5
Anomuran phylogeny - the story so far	
Shane Ahyong, New Zealand	5
The genus <i>Uroptychus</i> Henderson, 1888 from the Indo-Pacific	
Keiji Baba, Japan	5
Galatheidae and Chirostylidae from Colombian waters (Crustacea: Decapoda: Anomura)	
Adriana Bermúdez Tobón, Colombia (with others)	5
Application of molecular tools for the study of the taxonomy and systematic of the family Galatheidae	
Patricia Cabezas, Spain	6
Galatheoids in Taiwan seas	
Chiawei Lin, Taiwan	6
Taxonomic status of the species of <i>Munidopsis</i> and <i>Munida</i> and allied genera - geographic scope and main gaps	
Enrique Macpherson, Spain	7
State of knowledge of galatheoid taxonomy, diversity, and ecology in the western North Atlantic	
Martha S. Nizinski, USA	7
Australian squat lobsters: taxonomic history and prospects	
Gary C. B. Poore, Australia	7
The family Galatheidae (Crustacea: Decapoda: Anomura) on the Brazilian coast	
Celso Rodrigues, Brazil	8
Deep-sea downunder, species richness, habitat and distributional patterns of New Zealand squat lobsters (Chirostylidae, Anomura, Crustacea)	
Kareen Schnabel, New Zealand (with Keith Probert, Niel Bruce)	8

Summary

One of COMARGE's objectives is to foster the development of taxonomic expertise through workshops and exchange of taxonomists. Squat lobsters are dominant, numerous and highly visible crustaceans whose abundance has stimulated considerable taxonomic research especially over the last two decades resulting in hundreds of new species being described. During the week 3–7 September 2007 ten crustacean taxonomists with varying experience with the taxonomy of squat lobsters met at the National Institute of Water and Atmosphere, Wellington, New Zealand, to further CoML objectives. Their objectives were to compile taxonomic resources (species list, bibliography, electronic keys, electronic library) to publish on the web.

During the five days of the workshop each participant shared the results of their work in presented papers (abstracts below):

Shane Ahyong, New Zealand - Anomuran phylogeny - the story so far

Keiji Baba, Japan - The genus *Uroptychus* Henderson, 1888 from the Indo-Pacific

Adriana Bermúdez Tobón, Colombia (with others) - Galatheidae and Chirostylidae from Colombian waters (Crustacea: Decapoda: Anomura)

Patricia Cabezas, Spain - Application of molecular tools for the study of the taxonomy and systematic of the family Galatheidae

Chiawei Lin, Taiwan - Galatheoids in Taiwan seas

Enrique Macpherson, Spain - Taxonomic status of the species of *Munidopsis* and *Munida* and allied genera - geographic scope and main gaps :

Martha S. Nizinski, USA - State of knowledge of galatheoid taxonomy, diversity, and ecology in the western North Atlantic :

Gary C. B. Poore, Australia - Australian squat lobsters: taxonomic history and prospects :

Celso Rodrigues, Brazil - The family Galatheidae (Crustacea: Decapoda: Anomura) on the Brazilian coast

Kareen Schnabel, New Zealand (with Keith Probert, Niel Bruce) - Deep-sea downunder, species richness, habitat and distributional patterns of New Zealand squat lobsters (Chirostylidae, Anomura, Crustacea)

But most of the work during the week was devoted to compiling resources to share with future workers through the web.

- A hierarchical list of the world's species, almost 900 species was completed by building on a database compiled over recent years by Baba and Macpherson. The list with synonymies and distribution information will be completed and submitted for publication by November 2007. With a little more work the list will be suitable to upload to marinespecies.org.
- A bibliography of 879 citations in Endnote X format was completed and pdfs (at least of the parts dealing with squat lobsters) of 82% of these were linked to the bibliography. It is planned to submit these to the AToL: Decapoda website.
- The workshop was able to update dicotomous keys to species for most of the world's almost 40 genera. Good progress was also made on translating some of these to interactive keys in DELTA format. This objective requires considerable more work but a promising start was made to electronic keys to families, all genera, and to species of smaller genera. Participants in the workshop are optimistic that these can be completed within a year and published in various media.
- Finally, the workshop provided an opportunity for those using molecular tools for taxonomic and phylogenetic research questions to compare successes and failures.

My thanks go to all those who participated, to NIWA for hosting the meeting and to COMARGE for financial support.

Continental Margin Ecosystems

COMARGE (<http://www.ifremer.fr/comarge/en/index.html>), launched in April 2005, is one of fourteen Census of Marine Life (CoML <http://www.coml.org/>) field projects dedicated to the description and understanding of biodiversity patterns on continental margins. Continental margins refer here to the deep-sea realm comprised between about 200 meters and 4000 meters depth. Once envisioned as monotonous and devoid of life, continental margins actually harbour an amazing diversity of life in a variety of habitats including deep-sea corals, cold seeps, canyons, plus others on hard and soft benthic continental slope.

The overall aim of the project is to describe biodiversity patterns on continental margins at different spatial scales and identify the contributions of environmental heterogeneities to these patterns. Central to the question of environmental forcing is the richness of continental slope habitats, as defined by their substrates and trophic sources as well as their geology, water mass and hydrodynamic features. The project is global in vision with the objective of integrating studies in different habitats and at different spatial scales on a worldwide scale. In order to get a census of marine life on continental margins and understand why there are so many species in this oceanic province, COMARGE will foster synergies between past, ongoing and future national and multinational scientific programs by coordinating a network of scientists involved in the study of continental slope ecosystems.

To achieve its goals, COMARGE intends to create a network of researchers to facilitate coordination among projects and cruises, to foster data sharing, to support data archiving and finally to assure the maximum synergistic value for continental margin studies. A challenge of the Census of Marine Life - COMARGE will be to overcome taxonomic impediments in order to disseminate through OBIS comprehensive species lists for a wide range of habitats. COMARGE's intent, together with others deep-sea CoML field projects, is to foster the development of taxonomic expertise through workshops and exchange of taxonomists.

This workshop fits into this framework.

Squat lobsters – the state of play

Squat lobsters are dominant, numerous and highly visible crustaceans on seamounts, continental margins, many shelf environments, coral reefs at all depths, and at hydrothermal vents. They feature in many still photographs and movie film taken by submersibles and are caught in large numbers by benthic dredges. Some species are so locally abundant that they form 'red tides'. One species, the so-called 'yeti-lobster' became an international press celebratory when it was reported as a new species in a new family in 2005.

Marine squat lobsters belong to three families, Galatheidae, Chirostylidae and Kiwaidae, all members of the superfamily Galatheaidea. The other two families of Galatheaidea, freshwater Aegliidae and porcelain crabs (Porcellanidae), are not dealt with in this workshop. The most recent estimate of the number of genera is 38.

The abundance and diversity of galatheids in particular has stimulated considerable taxonomic research especially over the last two decades resulting in hundreds of new species being described and the older large genera subdivided into smaller ones. A key recent publication (Baba, 2005) summarises much of this, at least for the Indo-West Pacific region.

Baba, K. 2005. Deep-sea chirostylid and galatheid crustaceans (Decapoda: Anomura) from the Indo-West Pacific, with a list of species. *Galathea Reports* 20: 1-317.

Preparing for the future

The excellent and voluminous publications over recent years provides an excellent framework on which to build an openly accessible taxonomic resource about marine squat lobsters. Electronic databases for storing and accessing taxonomic information in combination with the web enable knowledge to be universally distributed. We need to move existing information to these resources so that future taxonomists, ecologists and others who need to

identify species can do so easily. 'Easily' meaning without the need to access obscure publications in remote libraries, or without harassing the few and already overworked specialists.

The kinds of information that need to be brought together are complete lists of published species names, an acceptable and workable classification, means to identify known taxa and recognise new ones, a single bibliography, and electronic copies of critical papers.

This approach is recognised in many local and global initiatives over recent years. Notable among these are:

Encyclopedia of Life <http://www.eol.org/> (planning a species page for all species by trawling existing information on the web, and which incidentally uses *Kiwa hirsuta* as its iconic animal)

MarBEF European Register of Marine Species – <http://www.marbef.org/data/erms.php> (could be a model to build species lists, now with 52 galatheids)

Species 2000 <http://www.sp2000.org/> (compiling global species lists but now with only 94 galatheid species)

Assembling the Tree of Life – Decapoda <http://decapoda.nhm.org/> (a consortium of US and other taxonomists trying to do for all Decapoda just what we plan for squat lobsters, plus build phylogenies)

Global Taxonomy Initiative <http://www.biodiv.org/gti/default.shtml>

Crustacea.net – <http://www.crustacea.net/> (a repository for interactive keys and text about several taxa, maintained by Jim Lowry at the Australian Museum)

Overall objectives of workshop

The workshop brought together ten scientists with varying experience with the taxonomy of squat lobsters, ranging from a lifetime of study to current doctoral students. Its first objective was to ensure that these individuals have a forum to discuss their work and the issues arising from it. The second objective was to compile taxonomic resources (species list, bibliography, electronic keys, electronic library) to publish on the web. Our objective was to complete some tasks during the workshop for immediate dissemination and to build a framework for others.

Specific tasks

During the five days of the workshop significant progress was made on several fronts:

1. Each participant presented for discussion an overview of their current research – covering taxonomic and geographic scope, methods used, recent discoveries, future plans, and issues. Abstracts of these presentations follow at the end of this report.

2. A hierarchical species list was compiled into a standard formats (Filemaker, Excel, Word) including junior synonyms, type species of genera, holotype data, type locality and other records for species, and links to bibliographic information. It built on the files compiled over many years by Keiji Baba and Enrique Macpherson. This work was almost completed during the week. The list with synonymies and distribution information will be completed and submitted for publication by November 2007. With a little more work the list will be suitable to upload to marinespecies.org.

3. A bibliography was compiled into a standard format (Endnote X) by importing from privately held files and published 'literature cited'. The bibliography is now complete and totals 879 titles, and is ready to submit to the ATOL: Decapoda website.

4. pdfs of 723 key papers, 82% of the known literature, (or at least the galatheoid sections of larger works) were brought together and linked to the Endnote X database. The pdfs provide an essential portable electronic library for galatheoid workers plus a valuable source of illustrations.

5. The workshop was able to update dichotomous keys to the identification of species for most of the world's almost 40 genera. Good progress was also made on translating some of these to DELTA format. DELTA keys are illustrated, electronic, interactive and multi-

entry. They are easier to use than traditional keys and can be published on the web. As well, the DELTA format allows species descriptions and diagnoses to be prepared from the same database used for the keys. A promising start was made to a key to families, keys to all genera of Chirostyliidae and Galatheidae, and to species of some smaller genera. Participants in the workshop are optimistic that these can be completed within a year and published in various media. But this objective requires considerable work following the workshop and is only feasible with financial support for research assistance.

6. The molecular biologists within the group met separately for a short time to discuss shared successes and problems. They agreed to establish an email network to share the success and failure of various molecular techniques with different taxa and genes.

The future

During the month following the workshop some of the work started was tidied up ready for sharing with others.

The bibliography and attached pdfs were completed. Discussions are yet to be held on how this is to be shared with the wider community and how much of the scanned literature can be freely distributed.

A database comprising an annotated world list of species with distributional information was completed. A manuscript will be ready to be submitted to *Zootaxa* well before the end of 2007. Negotiations have yet to be held on how the information in this database can be distributed to websites of taxonomic and distributional data. Some financial support will be needed to accomplish this and an application to GBIF is being prepared.

The most useful tools to come out of a workshop such as this are the keys to identification that enable future or non-specialist workers to put names to the species they discover. The information at hand for this taxon is more comprehensive than for most other marine crustaceans. The work done during the workshop demonstrated how straightforward it is to make electronic keys when the literature is at hand. A good start was made but can be completed with financial support for research assistance in one of the expert labs. Approaches will be made during the remaining months of 2007 to find the support needed.

Participants

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Participants in Workshop on Marine Squat Lobsters, Wellington, New Zealand.

Top row: Shane Ahyong, Gary C. B. Poore, Patricia Cabezas, Celso Rodrigues, Martha S. Nizinski, Kareen Schnabel, Enrique Macpherson. *Bottom row:* Chiaiwei Lin, Adriana Bermúdez Tobón, Keiji Baba.

Abstracts of presented papers

Anomuran phylogeny - the story so far

Shane **Ahyong**, New Zealand

The interrelationships of the anomurans have been widely contested. Most classifications recognise three major clades: the mole crabs (Hippoidea), squat lobsters and allies (Galatheaidea) and hermit crabs (Paguroidea). Although the higher level classification has remained somewhat stable, this taxonomic 'stability' disguises considerable debate about whether the classification actually reflects phylogeny, and whether even the three major groups are natural. Here I review the range of phylogenetic hypotheses proposed and results of recent explorations into the subject.

The genus *Uroptychus* Henderson, 1888 from the Indo-Pacific

Keiji **Baba**, Japan

The genus *Uroptychus* from the Indo-Pacific now contains 105 species (Ahyong & Baba, 2004; Baba, 2005). A recent study of material (about 4,000 specimens) in the collections of the Paris Museum shows that the genus is actually much more diverse. One hundred and twenty-six species were taken by French surveys in the Philippines, Indonesia, New Caledonia and vicinity, Solomon, Fiji and Tonga, 84 of which are new. Species of special interest are shown by illustrations and photos. The following three species have been transferred to *Uroptychus* defined by Baba (2005): *Chirostylus ciliatus* van Dam, 1933; *Gastroptychus chacei* Baba, 1986; and *Gastroptychus spinirostris* Ahyong & Poore, 2004. These species are still aberrant among the genus, sharing spinose carapace and pereopods. The Paris Museum collection contains 3 additional new congeners. Relationships of this aberrant group with *Gastroptychus* Caullery, 1896 (this genus may be split into two) and the other species of *Uroptychus* are discussed. Some morphological characters that have been used to distinguish species are not always useful. Intraspecific variations, especially of carapace spinations that I have come across in the Paris Museum specimens, are shown.

Galatheidae and Chirostylidae from Colombian waters (Crustacea: Decapoda: Anomura)

Adriana **Bermúdez Tobón**, Colombia

(with Gabriel Rodolfo Navas Suárez, Néstor Hernando Campos Campos, Margarita Fierro, Maria Isabel Aguilar, José Manuel Gutiérrez, Luisa Fernanda Bobadilla, Catalina Ángel, Natalia Rodríguez)

The Galatheidae and Chirostylidae have a worldwide distribution from western Africa, as far as Gulf of Mexico, Venezuela, Mediterranean Sea, Patagonia and Tierra del Fuego, northeastern Atlantic and northwestern Pacific, between surface to more than 5000 m deep. Currently are recorded around 43 species of galatheid and chirostylid from Colombian waters: 36 species at Caribbean Sea and 7 at Pacific Coast, belonging to genera *Agononida*, *Anomoeomonida*, *Eumonida*, *Galacantha* [reestablished by Macpherson (2007)], *Munida*, *Munidopsis*, *Uroptychus* and *Pleuroncodes*. The recent expeditions off Colombian Coast made by the Instituto de Investigaciones Marinas Jose Benito Vives De Andrés –INVEMAR provided a new material of Galatheidae and Chirostylidae which increase the number of species of galatheids from Colombia. In addition, these material gave a great opportunity to

begin with several studies about biology, ecology, population structure, taxonomy and systematic of some neotropical species in both Caribbean Sea and Pacific Ocean. The principal results of these studies offered a new important data about reproduction size, sexual dimorphism, molecular information, morphological variation within species and suggested a reduction of gene flow between populations of some species at the Colombian Caribbean Sea.

Application of molecular tools for the study of the taxonomy and systematic of the family Galatheidae

Patricia **Cabezas**, Spain

The analysis of molecular data gives a complementary approach together with morphological characters. In the last years, the taxonomy and systematics of numerous animals groups have been tackled using these two views. Most of the studies about the family Galatheidae are focused in its taxonomy, but few works have tried to clarify the phylogenetic relationships of the group using both, molecular and morphological information. The study of mitochondrial genes, like COI and 16sRNA have proved useful for analyzing the phylogenetic relationships in the group, to test the phylogenetic value of subtle morphological characters and clarify the taxonomic status of different species. The evolutionary history of this group show signs of an old rapid radiation, which make it difficult to resolve the relationships in the deep nodes of the phylogenies. For that reason, the study of more conserved genes such as nuclear genes, or whole mitochondrial genomes could help to clarify this aspect. With respect to the population level, family Galatheidae has almost never been analyzed, and at present there is a study ongoing about microsatellites for the species *Munidopsis polymorpha*, endemic from Lanzarote Islands. Therefore, the analysis of molecular and morphological data is very useful for clarifying the systematics and taxonomy of Galatheidae, but further analysis will be necessary.

Galatheoids in Taiwan seas

Chiawei **Lin**, Taiwan

Before my research in Taiwan, nine genera and 36 species of galatheoid crustaceans of Taiwan were reported. Among them, type localities of three species are in Taiwan. However, these reported specimens in Taiwan were mostly collected in fishing ports, so the ecological data of these species was unavailable. In 2000, with the use of deep-sea collecting gear from France to collect samples in oceans around Taiwan, 66 species and eight genera of squat lobsters are now recorded. In addition to 56 species newly recorded, ten species are newly described. In this research, these species are described with detail of morphological characters, size, colour pattern, and distribution. Keys, line drawings, and colour photos of every family, genus and species are also included in this research. A database of squat lobsters is established for future academic reference. The horizontal and vertical distributions of squat lobsters in Taiwan are also analyzed in this research, and systematic studies of squat lobsters are examined using genetic sequence methods. Taiwan has become one of the countries that has greatest biodiversity of squat lobsters, and we have the most diversity of genus *Munidopsis*. It is known that many species are not yet recorded in Taiwan, therefore, it is possible that Taiwan could have the most diversity of squat lobsters in the near future.

Taxonomic status of the species of *Munidopsis* and *Munida* and allied genera - geographic scope and main gaps

Enrique **Macpherson**, Spain

Until recently, the family Galatheidae was divided into 14 genera, *Munida* and *Munidopsis* being the most speciose genera in the continental shelf and slope around the world. After numerous expeditions across the West Pacific some unknown species of *Munida* and related genera have been discovered in the last 15 years (ca. 150 new species have been described in the area since 1988). The genus *Munida* has thus been split into 5 genera: *Agononida*, *Crosnierita*, *Munida*, *Paramunida*, and *Raymunida*. More recently the genus *Torbenia*, *Setanida* and *Babamunida* are also added. A closely related genus, *Bathymunida*, which until the last decade was comprised of 8 species, was also enriched by the material obtained in these expeditions and now some new species and 5 new genera (*Anoplonida*, *Heteronida*, *Neonida*, *Onconida*, and *Plesionida*) are recognized in the *Bathymunida* group. The genus *Munidopsis* has been enriched in the last years by more than 30 new species, and the genus *Galacantha* has been reestablished. This high number of species is probably still an underestimate of the family's true diversity and there are numerous yet undescribed cryptic species. The number of described species is clearly higher in the waters of the West Pacific than in other oceans.

State of knowledge of galatheoid taxonomy, diversity, and ecology in the western North Atlantic

Martha S. **Nizinski**, USA

Marine faunas of the western North Atlantic are often considered to be some of the best known marine faunas in the world. However, recent expeditions to seamounts, cold seeps, and deepwater coral reefs in this region have produced new collections of galatheids and chirostylids, which suggest that these families may be much more diverse than previously known. Recent surveys using submersibles and ROVs have collected galatheoids associated with deep coral banks (off southeastern United States and north-central Gulf of Mexico), seamounts (off northeastern United States), and cold seeps (Gulf of Mexico). Several new species have been identified among material examined; geographic ranges of previously-described species are also being refined based on this new information. In situ observations and collections provide new details on behaviour and contribute new taxonomic information based on live coloration. In addition to taxonomic studies, high quality ecological data associated with the specimens are being collected. Diversity, abundances, sizes, microhabitat utilization and species-specific relationships between these crustaceans and hard substratum (i.e., live coral, rubble) were investigated. Additionally, several molecular studies are underway. DNA sequence data (CO1, 16S, 18S) will be used in a phylogenetic analysis of the group, including comparisons with sequences of Indo-Pacific species registered in GenBank, community and population genetic studies and to support genetic barcoding and the decapod Tree of Life projects.

Australian squat lobsters: taxonomic history and prospects

Gary C. B. **Poore**, Australia

The continental margin of Australia ranges from the tropics to temperate seas. Two recent papers by Ahyong & Poore in 2004 increased the number of known species of Galatheidae from 55 species to 74 and of Chirostyliidae from eight to 34. All the new

species came from sampling on the shelf, slope and seamounts in southeastern Australia. An expedition in southwestern Australia collected 509 galatheids belonging to 43 nominal species of which 16 are undoubtedly new species. Others are new records in SW Australia of species described elsewhere. One of five species of chirostyliids is new. In 2007 further sampling on the continental margin of NW Australia enabled recognition by colour of about 40 species in the field. These remain to be identified. The Australian fauna comprises well over 100 species. Two projects will investigate connectedness and relatedness in the Australian fauna. Karen Miller (University of Tasmania) and Phil England (CSIRO) are starting a molecular study of “*Munida isos*” on Tasmanian seamounts. I with Madeleine van Oppen (AIMS) will examine the relationships of Australian fauna to that of the SW Pacific using morphological and molecular data. This last study has potential for integration with similar studies in the region.

The family Galatheidae (Crustacea: Decapoda: Anomura) on the Brazilian coast

Celso **Rodrigues**, Brazil

The first oceanographic expedition to collect a considerable number of species of the family Galatheidae was performed on board of H.M.S. “Challenger”(1873-1876), in its circumnavigation, during which 61 species were described, *Munida* and *Munidopsis* being recorded for the first time in Brazilian waters. In Brazil, oceanography expanded in the 1960s with the expeditions on board N.Oc. “Almirante Saldanha” (1967-1972) and N.Oc. “Prof. Besnard” (1968-1988), used in several programs, where abundant material of *Munida* was collected, and two new species described. After that, the samples done by N.Oc. “Marion Dufresne” (1987) and by N.R. “Astro Garoupa” (1996-2003), used in different projects, began a new era of exploration in the deep sea along the Brazilian coast, where two new species and four new records were described at depths of 5100 m. In that way, Galatheidae family are now represented in Brazil by 25 species in three genera: *Agononida*, *Munida* and *Munidopsis*. Even being a reasonably well known group on the Brazilian coast, samples from the deep sea show that much of that group has yet to be known.

Deep-sea downunder, species richness, habitat and distributional patterns of New Zealand squat lobsters (Chirostyliidae, Anomura, Crustacea)

Kareen **Schnabel**, New Zealand
(with Keith Probert, Niel Bruce)

Members of the anomuran family Chirostyliidae (squat lobsters or pinch bugs) most commonly live at depths beyond the continental shelves and are found along slopes, ridge systems and seamounts of all oceans. They can be a conspicuous and ecologically significant component of the local fauna, most notably in areas with deep-water coral where they are often found clinging among the branches. More than 180 species in six genera are known worldwide, of which only 22 in three genera occur in the Atlantic. Of the remaining species, 124 are distributed in the western Pacific. Despite this apparent diversity, only seven species have so far been recorded in New Zealand waters (five of which are considered endemic). This study is the first comprehensive effort to identify and document the chirostyliid fauna in New Zealand and adjacent waters based on collections taken since the 1950s. So far, 64 species have been found, spanning a wide range of water depths and benthic habitats. New records include widespread Indo-Pacific species as well as range extensions of species previously known only from Australia, New Caledonia or Fiji. In addition, possibly half of

the species appear to be new to science and potentially endemic to New Zealand highlighting the lack of knowledge of New Zealand's offshore macrofauna. A geographical analysis of the species distribution shows a number of patterns related to habitat and depth as well as a north-south gradient of species richness with the most diverse fauna along the ridges, seamount chains and in proximity to active hydrothermal vents north of New Zealand. In contrast only seven species have been collected south of 45°S, indicating a latitudinal gradient potentially influenced by surface primary production and cold Antarctic deep-water currents.