PREFACE — FRESHWATER DECAPOD BIOLOGY IN THE 21ST CENTURY

BY

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Among an estimated 15 000 described decapod crustaceans, about 3000 species (ca. 20%) can be considered freshwater species (De Grave et al., 2008; Yeo et al., 2008) that depend on intact freshwater habitats for their survival. The inland waters of continents and islands comprise less than 3% of the total water on earth and are highly discontinuous habitats. Despite this, the high diversity of ecological niches in freshwater habitats and the frequent occurrence of genetic isolation have resulted in the evolution of an impressively rich assemblage of species.

Most of the recent studies on freshwater decapods are the result of international collaborative efforts, bringing together taxonomic and methodological expertise and access to a broad selection of species from most parts of the world. An initial Freshwater Crab Symposium in 2008 held at the National University of Singapore brought together, for the first time, a multi-national group of specialists working on the primary freshwater crabs in all major regions of the animals' global distribution. This was a follow-up to informal collaborations that began in 2005 between several of the participants, which resulted in the publication of the first global checklist and assessment of freshwater crab diversity (Yeo et al., 2008a). The overall objective of the Freshwater Crab Symposium in Singapore was to expand collaboration on the production of more synthetic works that build on the collective expertise of primary freshwater crabs throughout their range. One of the key topics discussed was the

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conservation of freshwater crabs. Up to this point there had only been conservation assessments of regional faunas using the IUCN Red List criteria as guidelines (e.g., Ng & Yeo, 2005; Yeo et al., 2008b), and there was a clear need for a worldwide conservation assessment of the freshwater crabs now that a global checklist was available. This resulted in the first global IUCN Red List assessment of freshwater crabs (Cumberlidge et al., 2009). By then it also became evident that more collaborative works would be fruitful and indeed necessary. Consequently, the idea came up for a broader platform to discuss future approaches and to initiate a wider network of collaboration especially for tackling molecular and morphological phylogenetics of freshwater decapod taxa. Michael Türkay from the Senckenberg Research Institute, Frankfurt am Main, generously offered to organise and host this meeting (together with Peter K. L. Ng and Neil Cumberlidge), which took place in December 2010. The present volume was initiated at that meeting, and neither claims to be a synthesis of current freshwater decapod biology in general, nor an exhaustive review on the current state of systematics and phylogeny of freshwater decapods. Rather, it is a selection of 14 papers that represents a sample of the current state of research in various fields for the main freshwater decapod taxa.

The present volume includes two general overviews of freshwater decapods as a whole (Vogt — longevity and mortality; Cumberlidge — conservation); two dealing with caridean prawns (Guerao et al. — phylogenetics of Xiphocaridae; Cai — atyids of Hainan Island); one on freshwater anomurans (Santos et al. — aeglids of Uruguay); two on crayfish (Ahyong — diversity of parastacids; Furse — conservation of parastacids); and seven dealing with freshwater brachyurans (Klaus & Türkay — systematics and biogeography/ legacy of Richard Bott; Cumberlidge — overview of Afrotropical crabs; Magalhães et al. — new species of *Fredius* (Pseudothelphusidae); Keikhosravi & Schubart — new species of *Potamon* (Potamidae); Klaus & Prieto — new potamid fossils; Mendoza & Yeo — new species of *Isolapotamon*; Schubart & Santl — new subspecies of *Sesarma*). The freshwater brachyurans covered in this volume include primary freshwater crabs as well as secondary freshwater crabs. The utilitarian term "primary freshwater crabs" is preferred here as it is more descriptive and apt for referring to brachyurans in the "wholly freshwater" families of Pseudothelphusidae, Potamidae, Potamonautidae, Gecarcinucidae, and Trichodactylidae (Yeo et al., 2008; Cumberlidge & Ng, 2009), which do not necessarily represent a single monophyletic grouping, but commonly lack any marine members. Additionally the immediate marine ancestors or sister groups of the wholly freshwater crabs remain unclear. The use of "true

freshwater crabs" as the collective term for these taxa in earlier publications (e.g., Ng, 1988) could potentially cause confusion because it was not meant to refer to "partly freshwater" or secondary freshwater families, e.g., Sesarmidae, Varunidae, Gecarcinidae, Hymenosomatidae (see Yeo et al., 2008). This latter group comprises mainly marine families where although most of the members are marine or brackish water species a significant number are completely freshwater or terrestrial in habit (although many of these species found in freshwater habitats are amphidromous and their larvae need a marine or brackish water phase for development).

What is the status of freshwater decapod biology at the beginning of the 21st century? A simple literature search on the Web of Science® data base shows a rapid increase in publications on decapods in general since the 1990s, but most deal with marine species and only a small proportion of these (9%) dealt with freshwater decapods (fig. 1). Although the informative value of such statistics has to be treated with caution, it is nevertheless obvious that an exhaustive knowledge of freshwater decapod crustaceans is a goal that still needs to be realised. Basic alpha-taxonomic research has been built upon

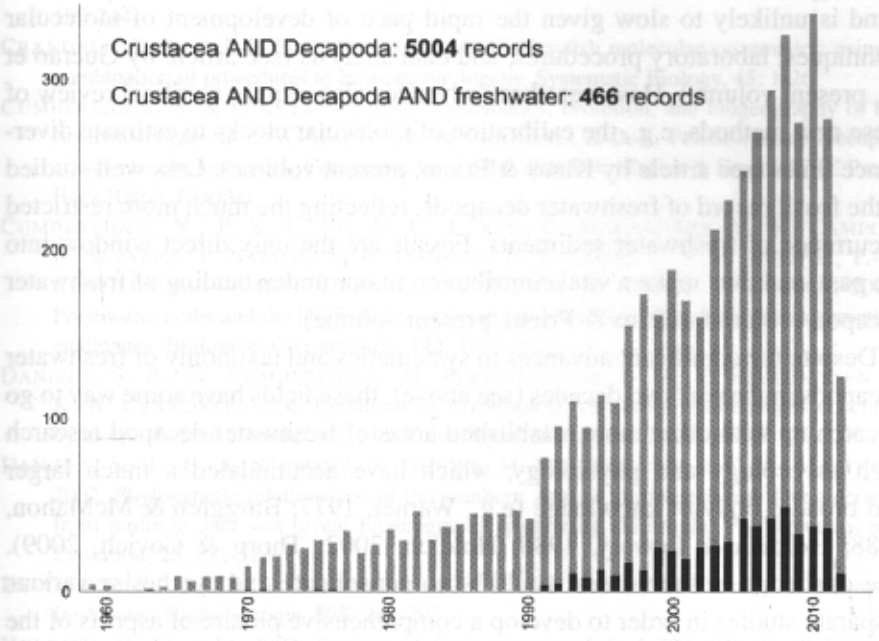

Fig. 1. Increase in publications on freshwater decapod Crustacea (black bars) in relation to articles on decapod Crustacea in general (grey bars) during the last 50 years (citations retrieved from Web of Science®, 1899 to 2012; records prior to 1959 not shown).

the work of earlier researchers (see article by Klaus & Türkay, present volume). A total of seven new taxa are described in this volume: two new atyid species from Hainan, China (see Cai, present volume), one new aeglid species from Uruguay (see Santos et al., present volume); one new pseudothelphusid species from Brazil (see Magalhães et al., present volume); two new potamid species — one from Iran (Keikhosravi & Schubart, present volume) and one from Philippines (Mendoza & Yeo, present volume); and one new sesarmid subspecies (Schubart & Santl, present volume). Conventional morphological approaches (see articles by Cai, Mendoza & Yeo, Santos et al., all present volume) still play a major role alongside diverse new methodological approaches that employ a combination of molecular, morphometric, and histological tools (see articles by Keikhosravi & Schubart, Magalhães et al., Schubart & Santl, all present volume).

Since the mid-1990s to mid-2000s, molecular phylogenetic and phylogeographic studies have been conducted on various groups of freshwater decapods (e.g., crayfish: Crandall & Fitzpatrick, 1996; Crandall et al., 1999, 2000; crabs: Segawa, 2000; Daniels et al., 2002, 2006; Shih et al., 2004; Klaus et al., 2006; aeglids: Pérez-Losada et al., 2004; prawns: Murphy & Austin, 2005). This trend is unlikely to slow given the rapid pace of development of molecular techniques, laboratory procedures, and data analysis (see article by Guerao et al., present volume). However, these advances also require a critical review of these new methods, e.g., the calibration of molecular clocks to estimate divergence times (see article by Klaus & Prieto, present volume). Less well studied is the fossil record of freshwater decapods, reflecting the much more restricted occurrence of freshwater sediments. Fossils are the only direct window into the past, and thus make a vital contribution to our understanding of freshwater decapod evolution (Klaus & Prieto, present volume).

Despite the significant advances in systematics and taxonomy of freshwater decapods in the past two decades (see above), these fields have some way to go to catch up with other more established areas of freshwater decapod research such as ecology and physiology, which have accumulated a much larger and broader body of knowledge (e.g., Warner, 1977; Burggren & McMahon, 1988; Holdich & Lowery, 1988; Holdich, 2002; Thorp & Covich, 2009). The challenge in such cases would be to consolidate and synthesise various disparate studies in order to develop a comprehensive picture of aspects of the life history of these animals (see article by Vogt, present volume).

In our rapidly changing world, perhaps the most urgent topic in freshwater decapod research is the growing realization that there are large numbers

of species of freshwater crabs, crayfish, freshwater shrimp, and freshwater aeglids that are threatened with extinction, and that there is an urgent need for the effective implementation of conservation measures (see articles by Cumberlidge, Furse, present volume). The fact that all groups of freshwater decapods include high numbers of endemic species that have a restricted distribution makes them more likely to be strongly affected by a range of human activities that are seriously impacting vulnerable freshwater habitats throughout the inland waters in most parts of the world.

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