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FOREWORD
TO THE SPECIAL ISSUE
“NEW FRONTIERS FOR MONITORING EUROPEAN BIODIVERSITY:
THE ROLE AND IMPORTANCE OF AMPHIPOD CRUSTACEANS”

The MEB Conference (“New frontiers for Monitoring European Biodiversity: the role and importance of amphipod crustaceans”), sponsored by the University of Palermo (<http://portale.unipa.it/>) and by the Ateneo Italo-Tedesco (<http://www.ait-dih.org/>), took place in Palermo, Italy, between 27 and 29 September 2011. In this Special Issue of “Crustaceana — International Journal of Crustacean Research”, the Proceedings of that conference are published; the articles contained herein represent part of the papers delivered at said meeting.

AIMS AND SCOPE

The aim of the conference was to highlight the importance of amphipod crustaceans as a model group for monitoring biodiversity at different levels, from molecules to communities. Amphipods colonize a great number of different ecosystems, from the aquatic to the semi-terrestrial (Pavesi & Ketmaier, 2013). As a consequence, they have radiated into an astonishing diversity of kinds of morphology, ecology and behaviour (Scapini et al., 2013; Scipione, 2013). In spite of this diversity, which would make the group an ideal candidate to address a variety of research avenues, the European scientific community suffers from a slow turnover of generations, with a limited number of young researchers being involved in amphipod taxonomy. This is even more surprising, considering that in Europe some of the most renowned experts of the group have been working (see Ruffo, 1982-1998), or are still working currently. It seems evident that the process of passing on their vast and valuable legacy to the next generations, must have been hampered by a number of difficulties.

We believe those difficulties originate from different levels. First, there is a general lack of awareness in the scientific community of the ecological importance of amphipods. Second, and perhaps even more important, an effective network among the total of amphipod specialists and/or potential specialists is still lacking.

This adds to the fact that biologists of the younger generations are only rarely attracted to the classical taxonomy of a given group, because they do not consider

this a scientific topic that would offer them chances to access funding, or to publish in top-ranked international journals. The MEB meeting aimed to focus on current and prospective research lines on amphipods and to lay foundations for future research projects on the taxon that would meet the needs of the scientific community.

Biodiversity is a term widely used in scientific circles and beyond. The study and monitoring of biodiversity at all taxonomic and ecological levels are now considered a fundamental part of any proper conservation and management scheme of natural resources. Obviously, this also holds true for European aquatic ecosystems, which are of prime importance to total biodiversity but which also require a distinct, specific approach.

In particular the southern part of Europe hosts a great wealth of endemic lineages as a consequence of its long and complex history. Unfortunately, this unique biodiversity is currently threatened by recent, and often human-induced, developments including climate warming and invasion of alien species (Rossano et al., 2013). In this context, certain groups better than others could be helpful in detecting such changes at an early stage and would, thus, deserve proper scientific attention as fundamental tools in monitoring biodiversity. It goes without saying that a detailed knowledge of what we wish to protect (at whatever level) is crucial to implement plans with chances of succeeding.

Hence, taxonomy, the science that identifies living beings, makes a crucial prerequisite to successful biodiversity management. However, in recent years there has been a decrease in interest in this discipline, although we inhabit a biologically diverse world. As an example, Costello et al. (2010) recently provided a global perspective on what is known and what are the major scientific gaps in marine species diversity. These authors proposed a state-of-knowledge index, on which they could base a reliable ranking of geographical areas and taxonomic groups according to the extent of the information available on each of them. Southern Mediterranean regions (i.e., the northern African coasts and the eastern Mediterranean Sea) and amphipods (Coll et al., 2010) turned out to be ranked among the less investigated regions and taxonomic groups, respectively.

This lack of detailed knowledge, even for areas and groups that are certainly neither remote nor elusive, can be traced back to a number of real taxonomic impediments as listed by Ebach et al. (2011). These are: insufficient funding, insufficient expertise, insufficient education of experts, lack of understanding how much taxonomic research is yet to be done, a general perception among experimental investigators that taxonomy is not (hard) science, a lack of appreciation of how taxonomic hypotheses are tested, and general impediments of sufficiently mastering a (foreign) language. All (or at least most) of the above-mentioned impediments

could be overcome if an efficient network of researchers, sharing interest on the same taxon would exist.

Considering the above, it becomes essential to establish a strong, multidisciplinary link aimed at understanding the principles governing the diversity of a specific taxon (in our case, of course, Amphipoda). Given their ecological diversity, amphipods could easily be envisioned as a model group to (better) understand how the natural processes from which the current biodiversity originated, have unfolded in a variety of environments, and how and to what extent biodiversity is influenced and altered by human activities.

The MEB meeting thus aimed to focus on current and prospective research lines in amphipods and to lay foundations for future research projects on this taxon that would allegedly meet (most of) the current needs of the scientific community in the realm of biodiversity.

SUMMARY OF THE MEETING

The Conference was opened by T. Krapp-Schickel; she reported on her fifty years of activity dedicated to marine amphipods during which she witnessed the revolution of taxonomy with the advent of molecular techniques that are now complementing the traditional morphological approach.

From the very first contributions, it has been pointed out explicitly that our knowledge of amphipod diversity is still far from being exhaustive (C. d'Udekem d'Acoz, oral commun.). F. Stoch attempted to present concepts describing “taxonomic gaps”; the “Linnaean shortfall” refers to our lack of knowledge of how many species exist, the “Wallacean shortfall” refers to our inadequate knowledge of species distribution. Several lectures, however, demonstrated that quite a scientific effort has been put on certain groups of amphipods. We nowadays have detailed knowledge on the systematics and evolutionary relationships within *Niphargus*, the largest genus of Eurasian freshwater amphipods, and on the family Caprellidae. The caprellids, slender-bodied amphipods, have been presented as a model group suitable for different purposes. They proved informative as bio-indicators of environmental quality in marine habitats, i.e., to detect tributyltin (TBT) and heavy metals (J. M. Guerra-García, oral commun.), as well as to describe the invasion processes of non-native species (M. Ros & J. M. Guerra-García, oral commun.).

Amphipod assemblages have been shown to often be the dominant component of communities regardless of the kind of substrate considered. They dominate the hydrothermal fields in the twilight zone (S. Giacobbe et al., oral commun.) and the communities of marine caves where changes in granulometry influence their composition and abundance (Navarro-Barranco et al., 2012).

The interaction between abiotic and biotic factors plays a fundamental role in determining the species diversity of amphipod benthic communities (Targusi et al., 2013); less well known is the capability of amphipods to establish interactions with other species to their benefit. *Gammarus fossarum* and *G. pulex* are capable of using ducks and muskrats as biological vectors for dispersal (M. Drees et al., oral commun.), whereas several marine amphipods live in strict association with the bio-constructions of bryozoans, serpulids, or barnacles. Vader & Tandberg (2013) showed an interesting, regular association between amphipods and bivalve mollusks; in some circumstances the interaction is temporary but some species entertain a tighter association with their host.

Various case studies demonstrated that amphipods respond actively to environmental changes, rendering the group an ideal tool for environmental monitoring of biodiversity (Beerman & Franke, oral commun.). In contrast, some invasive species of amphipods are altering autochthonous communities (e.g., *Gammarus varsoviensis*, cf. M. Grabowski et al., oral commun.; or *Dikerogammarus* spp., A. Jążdżewska et al., oral commun.).

Many contributions highlighted the use of amphipods in eco-toxicological monitoring (Berezina et al., 2013; Strode & Balode, 2013; M. Bloor, oral commun.; R. Mansergh et al., oral commun.; P. Sormon et al., oral commun.; B. Sundelin et al., oral commun.). Amphipods have also been proposed to supplement the feed base for commercially cultured marine species (Baeza-Rojano et al., 2013), stressing the potential economic importance of this group of crustaceans.

A large number of contributions helped us better understand evolutionary processes at the molecular level. The study of chromosomes shed light on genome evolution in amphipods (M. Rampin, oral commun.). The so-called DNA barcode approach (i.e., the use of a short DNA marker to correctly assign individuals to a given species) is extremely advantageous in amphipods, a group where taxon-specific expertise sometimes is not available (M. S. Ferreira et al., oral commun.). The constant dwindling of costs of DNA sequencing, moreover, has made large-scale phylogeographic studies increasingly popular in amphipods. These have unveiled processes at the population level both in freshwater (T. Mamos et al., oral commun.) and semi-terrestrial species (L. Pavesi, oral commun.).

CONCLUSIONS

The MEB meeting, in spite of the difficulties that amphipodologists are faced with, has shown that this is an active and promising field of research. About 100 delegates participated in the meeting, representing 45 universities and research institutes and 20 countries, including a few non-European (Brazil, Iran, Tunisia).

The 13 studies gathered in this Special Issue of *Crustaceana* represent an overview of the current research lines in amphipods, as well as their most important results. The diversity of these studies, in terms of the subjects covered, accurately reflects the vast diversity of the taxon they are centred upon. The studies cover topics as diverse as classical taxonomy (Bueno et al., 2013; Krapp-Schickel, 2013), community ecology (Lattanzi et al., 2013), behaviour of aquatic and semi-terrestrial species, DNA barcoding (Marusso et al., 2013), population genetics and morphometrics (Curatolo et al., 2013).

In assembling the Special Issue, we, as Guest Editors, have done our best to emphasize this diversity in keeping up with the ultimate aim of the MEB conference, i.e., promoting amphipods as organisms that can be central in the study of the biodiversity we need to understand in order to ultimately preserve it for future generations to depend on as well as to enjoy. We are convinced that the compilation of studies presented herein is still far from being a concluding point in the research on Amphipoda. Rather, we see it as a foundation upon which new research ideas and avenues should be built. We also hope this Special Issue will offer to the young generations of amphipodologists, who attended the conference in large numbers, some of the means required to reinforce their respective research networks.

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Fig. 1a. Most of the participants of the conference “New Frontiers for Monitoring European Biodiversity: the Role and Importance of Amphipod Crustaceans” – Palermo, Italy, 27-29 September 2011, gathered together; see fig. 1b for further explanation. This figure is published in colour in the online edition of this journal, which can be accessed via <http://booksandjournals.brillonline.com/content/15685403>.

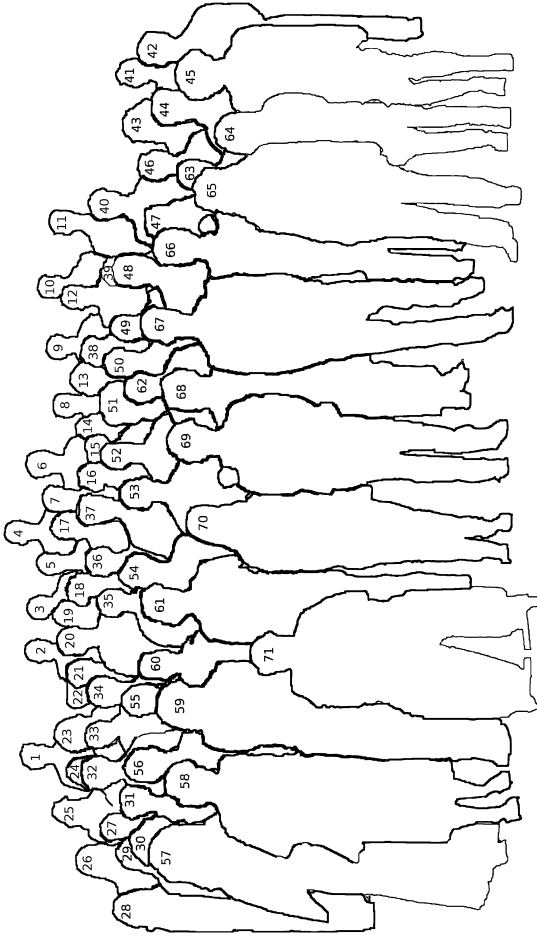


Fig. 1b. Identification of the participants shown in fig. 1a: 1, Tomasz Mamos; 2, Krzysztof Jazdzewski; 3, Mykola Ovcharenko; 4, Vasilij Pavlichenko; 5, Jorge Lobo Arteaga; 6, Wim Vader; 7, Christophe Piscart; 8, Franz Krapp; 9, Filipe Costa; 10, Martin Reutgard; 11, [not identified]; 12, [not identified]; 13, Rym Zakhama-Sraieb; 14, Raja Jelassi; 15, Randa Mejri; 16, Charles Oliver Coleman; 17, Dirk Platvoet; 18, Victoria Fernandez-Gonzalez; 19, Maria Sara Ferreira; 20, Cédric d'Udekem d'Acoz; 21, [not identified]; 22, Bibiana Kaiser Dutra; 23, Silvia Torres; 24, Felipe Amorim Fernandes; 25, Paula Beatriz Araujo; 26, Elena Baeza-Rojano Págeo; 27, María del Pilar Cabezas Rodríguez; 28, Maité Vázquez-Luis; 29, Macarena Ros Clemente; 30, Evita Strode; 31, Lucia Fanini; 32, [not identified]; 33, Guendalina Turcato Oliveira; 34, Michael Drees; 35, Remi Wattier; 36, Jose Antonio de-la-Ossa-Carretero; 37, Jan Beermann; 38, Amel Ayari; 39, Valentina Iannilli; 40, Ronald Vonk; 41, Fišer Cene; 42, Maxim Timofeyev; 43, Brita Sundelin; 44, Davide Iacofano; 45, Claudia Rossano; 46, Salvo Napoli; 47, [not identified]; 48, Gordan Karaman; 49, Maria Beatrice Scipione; 50, [not identified]; 51, Elvira De Matthaëis; 52, José Manuel Guerra García; 53, Carlos Navarro Barranco; 54, Monica Targusi; 55, [not identified]; 56, Pierluigi Strafella; 57, Maija Balode; 58, Felicitia Scapini; 59, Nadezhda Berezina; 60, Angela Santelli; 61, Veronica Marusso; 62, Massimiliano Rampin; 63, Teresa Maggio; 64, Radha Santonocito; 65, Tiziana Curatolo; 66, Bozana Karaman; 67, Valerio Ketmaier; 68, Traudl Krapp-Schickel; 69, Sabrina Lo Brutto; 70, Laura Pavesi; 71, Loretta Lattanzi. Colleagues either not identified or not present on fig. 1a: Michelle Bloor; Giovanna Cardoso; Robert Mansergh; Teresa Romeo; Lucilla Ronci; Pascal Sornom. [Photo taken by Anna Jazdzewska and Wanda Plaiti.]