Contributions to Zoology, 72 (2-3) 95-96 (2003)
SPB Academic Publishing bv, The Hague

Morphometric analysis of extant *Nephrops norvegicus* (Linné, 1758) and *Solenocera membranacea* (Risso, 1826) applied to systematic palaeontology of fossil decapod crustaceans

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Keywords: Crustacea, Decapoda, morphometric analysis

Abstract

The study of fossil decapods have shown the need for reliable statistics to document the value of the characters considered. Morphometric data, however, are usually absent in scientific papers on living decapod crustaceans since neontological systematists normally analyze internal organs and tissues not available in fossils. A series of morphometric data for two extant species have been processed statistically in order to obtain numerical models that could be applied to fossil species showing morphological affinities.

Introduction

For over twenty years, the Dipartimento di Paleontologia degli Invertebrati (Museo civico di Storia naturale, Milano), has been carrying out systematic studies of Mesozoic and Cenozoic decapod crustaceans, both from Italy and abroad. We have encountered difficulties in the study of highly diverse faunal assemblages, such as the ones recorded from Solnhofen or Lebanon, and problems experienced in highlighting morphological features useful in species discrimination have shown the need for statistics to document the value of the characters considered. For this reason we have initiated a research program on extant decapod crustaceans that have morphological traits in common with many fossil species, such as *Solenocera* and *Nephrops*, in order to find out whether morphological characters, e.g., carapace grooves or rostral spines, are diagnostically valid in samples of fossils, or not, but also to integrate into systematic paleontology new elements, e.g., sexual dimorphism and ontogenetic stages, that are rarely evident in fossil specimens.

The vagaries of preservation of decapod crustaceans, above all fragile characters such as spines, cephalic appendages, and/or thoracic and abdominal appendages, make systematic assignment of such animals occasionally difficult. Paleontological studies based exclusively on morphologically discriminant criteria often lead to arbitrary choices, e.g., what characters to use to classify any particular species.

The present study considers extant species so as to obtain a large data set of significant morphometric data that can be used to elaborate a systematic paleontology at the lower levels of classification (genera, species). Suitable morphometric data are usually absent in scientific papers on living decapod crustaceans since neontological systematics normally analyses internal organs and tissues not available in fossils (Holthuis, 1991, 1993). A series of morphometric data for extant species have been processed statistically in order to obtain numerical models which could be applied to fossil species showing morphological affinities.

Methods

The sample used for the present study comprises 274 specimens of *N. norvegicus* and 302 specimens of *S. membranacea* from the central Adriatic Sea. Fossils considered are all housed in the Museo di Storia naturale (Milano), and include twenty specimens of *Ifasia madagascariensis* (van Straelen,

1933) from the Lower Triassic of Madagascar, and six species of decapod crustaceans from Hakel and Hadjula (Lower-Middle Cenomanian, Lebanon), viz., *Eryma cretacea* Roger, 1946, *Homarus hakelensis* (Fraas, 1878), *Odontochelion cretaceum* (Roger, 1946), *Microchela rostrata* Garassino, 1994, *Carpopenaeus callirostris* Glaessner, 1945 and *Hakelocaris vavassorii* Garassino, 1994.

All morphometric data have been analyzed statistically (descriptive, discriminant and principal components analyses).

Results

The morphometric analyses of *N. norvegicus* and *S. membranacea* confirm the occurrence of sexual dimorphism, while descriptive analyses of *N. norvegicus* and the U test of Mann-Whitney highlight that males are larger than females, while the reverse is true for *S. membranacea*. In an earlier study we compared *S. membranacea* with *I. madagascariensis*; significant morphological differences were found. In particular, the length of the rostrum and the length of the chelae of the first pereiopods are greater in the juvenile stages of *I. madagascariensis* than in *S. membranacea*. Discriminant analysis of *S. membranacea* has confirmed the importance of five characters to discriminate the sexes. The same analysis isolated ten characters to discriminate the sexes in *I. madagascariensis*.

We subsequently compared *N. norvegicus* and Late Cretaceous macruran decapod crustaceans from the Lebanon. Principal components analysis applied to all Lebanese species grouped these in Natantia and Reptantia, according to their morphological characteristics, thus confirming customary paleontological classification. Principal components and discriminant analyses applied to *H. hakelensis* and *E. cretacea* showed the importance of the length of the carapace and that of the cutting chela for discrimination between the sexes. This statistic analysis also enabled us to highlight ontogenetic stages in these two fossil decapod species.

The statistical analyses applied to the fossil samples have proved highly efficient for keeping species apart and for documenting sexual dimorphism and ontogenetic stages. However, their application to fossil samples presupposes a certain sample size (should consist of at least twenty specimens), and rests on the importance of comparison between fossil species and extant ones that share morphological affinities.

In future, this program will analyze other Recent species that show morphological affinities with fossil taxa so as to create a data base which is as complete as possible. This should then become a valid tool in our study of fossil decapods.

References

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Received: 2 March 2003