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Mediterranean Marine Science

Vol 5, No 2 (2004)

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doi: 10.12681/mms.200

To cite this article:

CLARK, P., DIONISIO, M., & COSTA, A. (2004). Microcassiope minor (Dana, 1852): a description of the first stage zoea (Crustacea: Decapoda: Brachyura: Xanthidae). *Mediterranean Marine Science*, *5*(2), 23–34. https://doi.org/10.12681/mms.200

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Mediterranean Marine Science
Vol. 5/2, 2004, 23-33

Microcassiope minor (Dana, 1852): a description of the first stage zoea (Crustacea: Decapoda: Brachyura: Xanthidae)

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Abstract

The first stage zoea of Microcassiope minor (Dana, 1852) is described, illustrated and compared with thirteen other known Xanthinae. This comparison suggests that M. minor is closely related to another Atlantic Ocean xanthid, Nanocassiope melanodactyla (A. Milne-Edwards, 1867). Such an affinity may indicate that the genus Nanocassiope Guinot, 1967) is not a homogenous taxon.

Keywords: *Microcassiope minor* (Dana, 1852); First stage zoeal description; Comparative morphology; Xanthinae.

Introduction

SERÈNE (1984:21, 172) listed 13 Xanthinae genera, but the larvae are only known for *Leptodius exaratus* (H. Milne Edwards, 1834) by AIKAWA (1929) as *Xantho exaratus* [ZI], CHHAPGAR (1956) [ZI], TUFAIL & HASHMI (1964) as *L. exeratus* [ZI-II], SABA (1976) [ZI-IV, Meg.], FIELDER *et al.* (1979) [ZI-IV, Meg.], TERADA (1980) [ZI-IV], AMIR (1989, publication not seen during this present study), SIDDIQUI & TIRMIZI (1998) [ZI-IV], KO & CLARK (2002) [ZI], and CLARK & PAULA (2003) [ZI]; *Macromedaeus distinguendus* (de HAAN, 1835) by TERADA (1980) [ZI-IV]; *Nanocassiope granulipes* (SAKAI, 1939) by KO & CLARK (2002) [Z1-IV, Meg.]; *Nanocassiope melanodactyla* (A. Milne-Edwards, 1867) by DORNELAS *et al.* (2004) [ZI-IV, Meg.] and *Paraxanthias elegans* (Stimpson, 1858) by TERADA (1990) [ZI-IV]. Xantho is also assigned to this subfamily and the larvae of a number of species are known e.g. *Xantho* incisus Leach, 1814 by LEBOUR (1928) [ZI-IV, Meg.], BOURDILLON-CASANOVA (1960) as *Xantho incisus granulicarpus* [ZI-IV],

and INGLE (1983) [ZI-IV, Meg.], (1991) [ZI-IV, Meg.]; *Xantho pilipes* A. Milne Edwards, 1867 by LEBOUR (1928) as *Xantho hydrophilus* [ZI], INGLE (1992) [ZI] and PAULA & dos SANTOS (2001) [ZI-IV, Meg], and *Xantho poressa* (Olivi, 1792) by GOURETT (1884) as *Xantho rivulosus* [ZI], BOURDILLON-CASANOVA (1960) [ZI], RODRIGUEZ & MARTIN (1997) [ZI-IV, Meg.], and KO & CLARK (2002) [ZI]. Other genera may also be referred to the Xanthinae for which the larval morphology is reported for *Cataleptodius floridius* (Gibbes, 1850) by KURATA (1970, publication not seen during this present study) as *Leptodius floridius* and INGLE (1987) [ZI]; *Cycloxanthops novemdentatus* (LOCKINGTON, 1877) by KNUDSEN (1960) [ZI-IV, Meg.]; *C. truncatus* (de HAAN, 1837) by HONG (1977) [ZI-IV, Meg], SUZUKI (1979) [ZI-IV] and TERADA (1980) [ZI-IV] and *Pseudomedaeus agassizii* (A. Milne Edwards, 1880) by COSTLOW & BOOKHOUT (1968) as *Leptodius agassizii* [ZI-IV, Meg.].

According to MANNING & HOLTHUIS (1981) *Microcassiope minor* (Dana, 1852) lives inter-tidally down to a depth of ca. 220 m with a reported distribution from the Eastern Atlantic including the Açores, Madeira, the Cape Verde Islands, the Canary Islands, the Spanish Sahara, the Ivory Coast, Ghana, the Gulf of Guinea (Principe and São Tomé) to Annobon and Saint Helena. LEWINSOHN & HOLTHUIS (1964) provide records for the Eastern Mediteranean and Chace (1966) for the Western Atlantic (the Bahamas, Cuba, Curaçao and Islas Los Roques). CHACE (1966) recorded ovigerous crabs from Saint Helena in January and April and off West Africa during June (FOREST & GUINOT, 1966). Recently an ovigerous crab of *M. minor* was collected from São Miguel, Açores in August and the first stage zoeas were hatched in the laboratory. The purpose of this present study is to describe the morphology in detail and compare it with other known Xanthinae first stage zoeas in an attempt to establish the relationship of *M. minor* within this subfamily.

Materials and Methods

An ovigerous *Microcassiope minor* was collected by hand on the lower shore from Ponta Delgada, São Miguel, Açores, on 5 August 2002. The first stage zoeas hatched on 13 August 2002 and were fixed and preserved in 4% buffered formalin. Zoeas were dissected using a Wild M5 and an Olympus BH-2 microscope equipped with Nomarski interference contrast. Setal ambiguities were resolved using a Zeiss Axioskop differential interference contrast microscope. Appendages were mounted on slides in polyvinyl lactophenol and allowed to clear for 24 h. Cover slips were sealed with clear nail varnish and drawings were made with the aid of camera lucida. Five zoeal specimens were examined. The sequence of the zoeal descriptions is based on the malacostracan somite plan and described from anterior to posterior. Setal armature of appendages is described from proximal to distal segments and in order of endopod to exopod (CLARK *et al.*, 1998). The first stage zoea and the spent female are deposited in The Natural History Museum, London, registration number NHM 2002.2006. The first stage zoea is described and fully illustrated. The long plumose natatory setae of the first and second maxillipeds, and the long antennular aesthetascs, were drawn truncated. The approximate measurement of the antennal exopod (for its ratio with the protopod) was taken from the base to the tip excluding the terminal setae.

Description

Microcassiope minor (Dana, 1852)

Zoea I

Carapace (Figs 1a, b). Dorsal spine long, distally curved and spinulate and longer than rostral spine; rostral spine straight with prominent spines distally and equal in size to the antennal protopod; lateral spines present with spinulations on anterior margin;

anterodorsal setae absent; one pair of posterodorsal setae present; each ventral margin without setae; eyes sessile.

Antennule (Fig. 1c). Uniramous; endopod absent; exopod unsegmented with three long (two stout + one thinner) aesthetascs, one short, slender aesthetasc and one small seta, all terminal.

Antenna (Fig. 1d). Protopod equal in length to rostral spine and distally spinulate; with a minute protopodal spine; exopod ca. 17% length of protopod with one long subterminal seta and two terminal setae of unequal length.

Mandible. Mandibular palp absent.

Maxillule (Fig. 2a). Epipod absent, coxal endite with seven setae; basial endite with five setal processes; endopod two-segmented, proximal segment with one seta, distal segment with six (two subterminal + four terminal) setae; exopod seta absent.

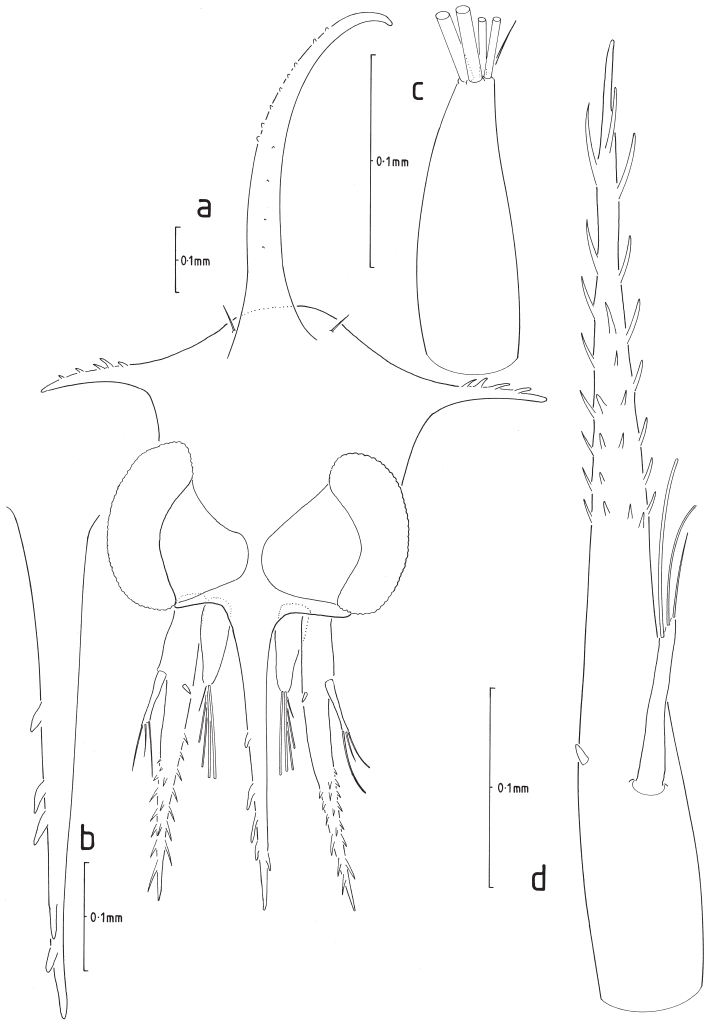

Fig. 1: *Microcassiope minor* (Dana, 1852) first stage zoea; a) anterior view of carapace; b) rostral spine; c) antennute; d) antenna.

Maxilla (Fig. 2b). Coxal endite bilobed with 4 + 4 setae; basial endite bilobed with 5 + 4 setae; endopod bilobed with 3 + 5 (two subterminal + three terminal) setae; exopod (scaphognathite) margin with four plumose setae plus distal stout plumose process.

First maxilliped (Fig. 3a). Coxa with 1 seta; basis with ten setae arranged 2, 2, 3, 3; endopod five-segmented with 3, 2, 1, 2, 5 (one subterminal + four terminal) setae respectively; exopod two-segmented, distal segment with four terminal natatory plumose setae.

Second maxilliped (Fig. 3b). Coxa without seta; basis with four setae arranged 1, 1, 1, 1; endopod three-segmented, with 1, 1, 6 (three subterminal + three terminal) setae respectively; exopod two-segmented, distal segment with four terminal natatory plumose setae.

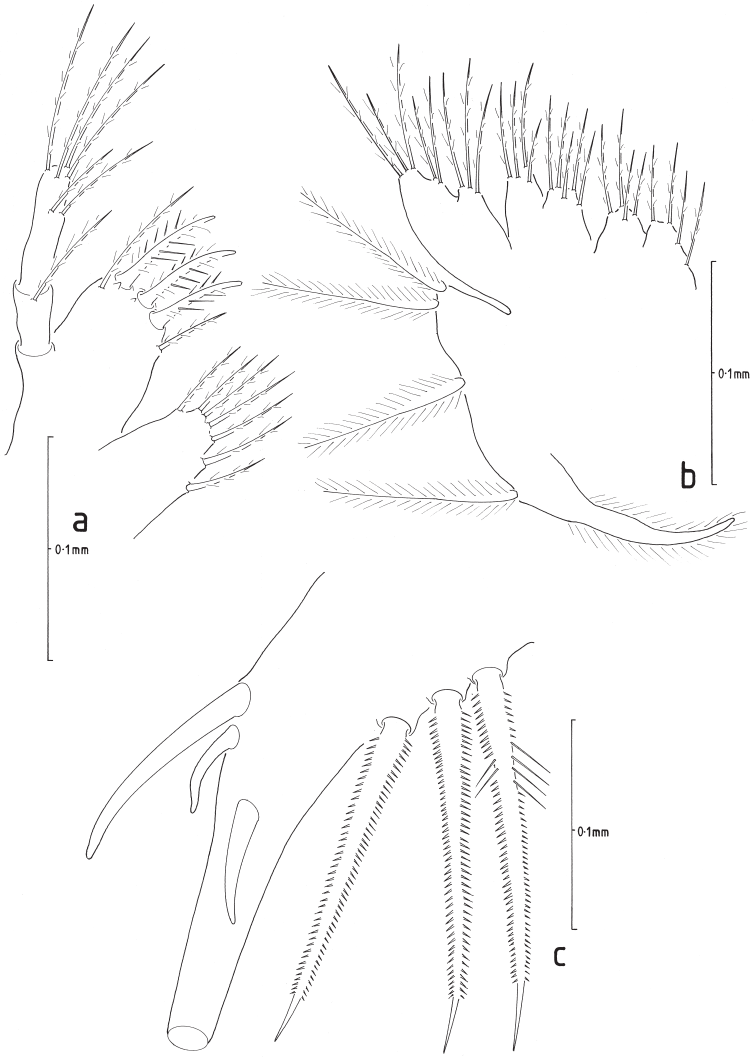

Fig. 2: *Microcassiope minor* (Dana, 1852) first stage zoea; a) maxillule; b) maxilla; c) telson.

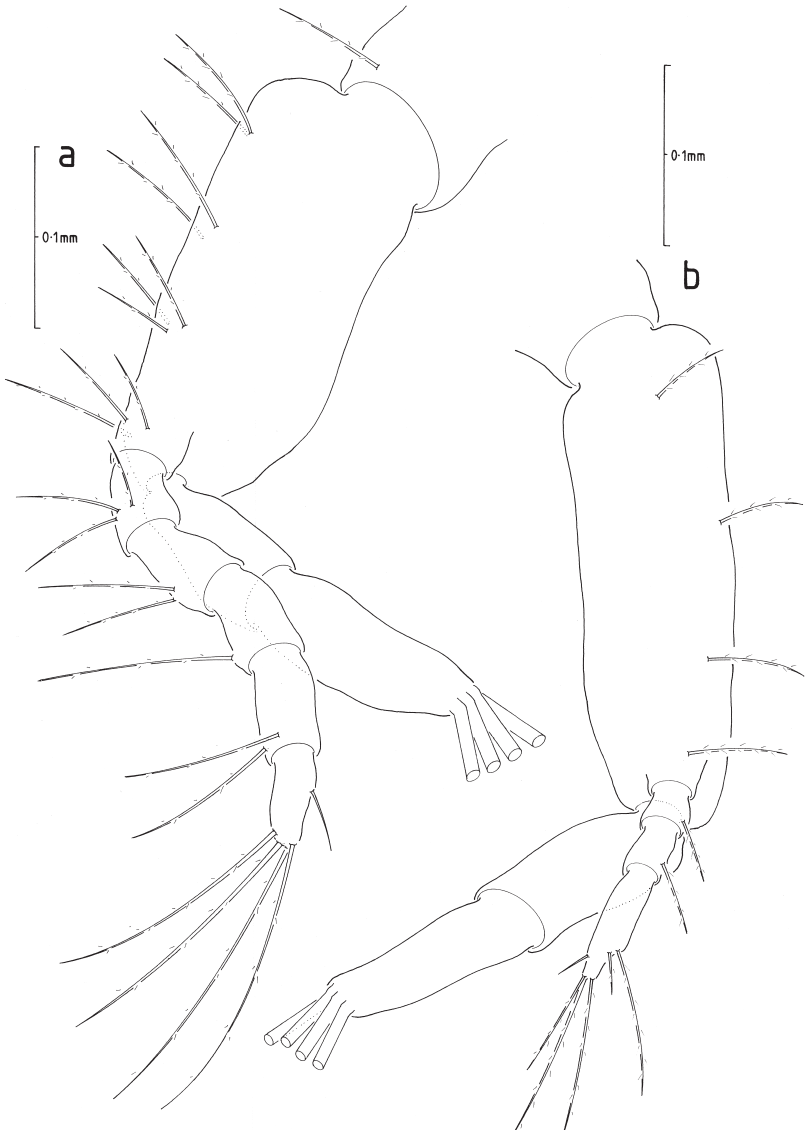

Fig. 3: *Microcassiope minor* (Dana, 1852) first stage zoea; a) first maxilliped; b) second maxilliped.

Third maxilliped. Absent.

Pereiopods. Absent.

Abdomen (Figs 4a, b). Five somites; somite 2 with a pair of lateral processes directed laterally; somite 3 with a pair of lateral processes directed posteriorly; somites 3-5 with posterolateral processes; somites 2-5 with one pair of posterodorsal setae; pleopods absent.

Telson (Figs 4a, b; 2c). Each fork long and not spinulate, with two lateral spines (one stout and one smaller) and one dorsomedial spine; posterior margin with three pairs of stout spinulate setae.

Discussion

The first stage zoeas of nine genera and thirteen species which may have affinites within the Xanthinae MacLeay, 1838, are tabulated (Table 1) with respect to six larval characters. These are the antennal ratio of the exopod length to protopod length, the presence of the antennal endopod spine, the terminal setation of the antennal exopod, the presence or absence of spinulation on the anterior margin of the lateral carapace spines, the setation of the distal endopod segment of the second maxilliped and the lateral armature of the telson. One character that appears to have been overlooked in the past by a number of Xanthidae (*sensu* SERÈNE, 1984) zoeal descriptions is the small endopod spine on the antenna (Fig. 1d) and this is probably due to

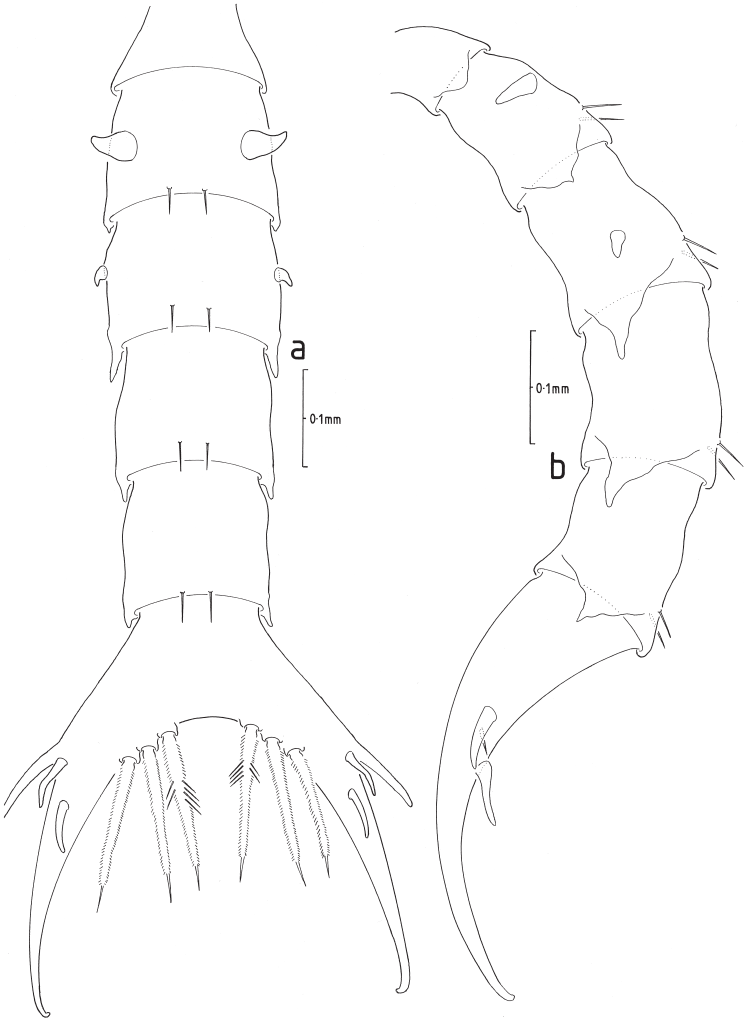

Fig. 4: *Microcassiope minor* (Dana, 1852) first stage zoea; a) dorsal view of abdomen; b) lateral view of abdomen.

Table 1
A comparison of first stage zoeal characters from some known Xanthinae descriptions. ? = character may require re-examination (continued)

Species	Antenna: ratio of exopod length to protopod length	Small antennal endopod spine	Terminal setation of the antennal exopod	Spinulation on anterior margin of lateral carapace spines	Setation of distal endopod segment of 2nd maxilliped	Lateral armature of the telson
Microcassiope minor	***17%*** *(this study: Fig. 1d)*	***present*** *(this study: Fig. 1c)*	***3*** *(this study: Fig. 1d)*	***present*** *(this study: Fig. 1a)*	***6*** *(this study: Fig. 3b)*	***1 spine + 1 smaller spine*** *(this study: Figs 2c, 4a, b)*
Nanocassiope melanodactyla	***19%*** *(Dornelas et al., 2004: Fig. 5A)*	***present*** *(Dornelas et al., 2004: Fig. 5A)*	***3*** *(Dornelas et al., 2004: Fig. 5A)*	***present*** *(Dornelas et al., 2004: Fig. 1A)*	***6*** *(Dornelas et al., 2004: Fig. 10A)*	***1 spine + 1 smaller spine*** *(Dornelas et al., 2004: Figs 11A, 12A, 13A)*
Paraxanthias elegans	***26%*** *(Terada, 1990: Fig. 3CI)*	***absent?*** *(Terada, 1990: Fig. 3CI)*	***3*** *(Terada, 1990: Fig. 3CI)*	***absent*** *(Terada, 1990: Fig. 3AI)*	***5?*** *(Terada, 1990: Fig. 3GI)*	***1 spine + 1 seta*** *(Terada, 1990: Fig. 3HI)*
Xantho poressa	***2.5%*** *(Ko & Clark, 2002)*	***present*** *(Ko & Clark, 2002)*	***2*** *(Rodriguez & Martin, 1997: Fig. 2F)*	***absent*** *(Rodriguez & Martin 1997: Fig. 1A)*	***6*** *(Rodriguez & Martin, 1997: Fig. 5H)*	***1 spine + 1 smaller spine*** *(Rodriguez & Martin, 1997: Fig. 6A)*
Xantho incisus	***3%*** *(Ko & Clark, 2002)*	***present*** *(Ko & Clark, 2002)*	***2*** *(Ko & Clark, 2002)*	***absent*** *(Ingle, 1983: Fig. 7a)*	***6*** *(Ko & Clark, 2002)*	***1 spine + 1 smaller spine*** *(Ko & Clark, 2002)*
Xantho pilipes	***6%*** *(Dornelas et al., 2004)*	***present*** *(Dornelas et al., 2004)*	***2*** *(Paula & dos Santos, 2001: Fig. 1D)*	***absent*** *(Paula & dos Santos, 2001: Fig. 1A, B)*	***5?*** *(Paula & dos Santos, 2001: Fig. 1A, J)*	***1 spine + 1 smaller spine*** *(Paula & dos Santos, 2001: Fig. 1A, J)*
Cycloxanthops truncatus	***13%*** *(Terada, 1980: Fig. 2B'1)*	***present*** *(Terada, 1980: Fig. 2B'1)*	***2*** *(Terada, 1980: Fig. 2B'1)*	***absent*** *(Terada, 1980: Fig. 1 B1)*	***5*** *(Terada, 1980: 138)*	***1 spine + 1 smaller spine*** *(Terada, 1980: Fig. 3 B1)*
Cataleptodius floridanus	***10%*** *(Ingle, 1987: Fig. 4c)*	***present*** *(Ko & Clark, 2002)*	***2*** *(Ingle, 1987: Fig.4c)*	***absent*** *(Ingle, 1987: Fig. 4a)*	***5*** *(Ingle, 1987: Fig. 4g)*	***1 spine + 1 smaller spine*** *(Ingle,1987: Fig. 4h)*
Pseudomedaeus agassizii	***10%*** *(Costlow & Bookhout, 1968: Fig. 1D)*	***absent?*** *(Costlow & Bookhout, 1968: Fig. 1D)*	***2*** *(Costlow & Bookhou, 1968: Fig. 1D)*	***absent*** *(Costlow & Bookhout, 1968: Fig. 1B)*	***5*** *(Costlow & Bookhout, 1968: Fig. 1I)*	***1 spine + 1 smaller spine*** *(Costlow & Bookhout, 1968: Fig. 1B)*
Nanocassiope granulipes	***12%*** *(Ko & Clark, 2002: Fig. 5a)*	***present*** *(Ko & Clark, 2002: Fig. Fig. 5a)*	***1*** *(Ko & Clark, 2002: Fig. 5a,b)*	***absent*** *(Ko & Clark, 2002: Fig. 1a)*	***5*** *(Ko & Clark, 2002: Fig. 9a)*	***1 spine + 1 seta*** *(Ko & Clark, 2002: Figs 11a, 12a, 13a)*

Table 1 (continued)

Species	Antenna: ratio of exopod length to protopod length	Small antennal endopod spine	Terminal setation of the antennal exopod	Spinulation on anterior margin of lateral carapace spines	Setation of distal endopod segment of 2nd maxilliped	Lateral armature of the telson
Leptodius exaratus	*7%* (*Clark & Paula, 2003*)	***present*** (*Clark & Paula, 2003*)	*1* (*Clark & Paula, 2003*)	***absent*** (*Clark & Paula, 2003*)	*5* (*Clark & Paula, 2003*)	***1 spine + 1 small spine*** (*Clark & Paula, 2003*)
Cycloxanthops novemdentatus	***11%*** (*Knudsen, 1960: pl. 2 Fig. 3*)	***absent?*** (*Knudsen, 1960: pl. 2 Fig. 3*)	*1* (*Knudsen, 1960: pl. 2 Fig. 3*)	***present*** (*Knudsen, 1960: pl. 2 Fig. 1*)	*5* (*Knudsen, 1960: pl. 2 Fig. 1*)	***1 spine + 1 smaller spine*** (*Knudsen, 1960: pl. 2 Fig. 2*)
Macromedaeus distinguendus	***9%*** (*Terada, 1980: Fig. 2 C'1*)	***absent?*** (*Terada, 1980: Fig. 2 C'1*)	*1* (*Terada, 1980: Fig. 2 C'1*)	***absent*** (*Terada, 1980: Fig. C 1*)	*5* (*Terada, 1980: Fig. 2 C''4*)	***1 spine + 1 seta*** (*Terada, 1980: Fig. 2 C1*)

the use of an inadequate microscope. This small endopod spine may be a diagnostic zoeal character of the family.

DORNELAS *et al.* (2004) suggested that *Nanocassiope* was not a homogenous taxon and could be divided into separate Atlantic and Indo-Pacific genera. They concluded that the larval study of another Indo-Pacific species would be needed to clarify further the generic status of *Nanocassiope*, and adult characters will also have to be reappraised. However, this present larval study appears to support their hypothesis because *Microcassiope minor*, with an Atlantic distribution, appears to show close affinites with *N. melanodactyla*. Four zoeal characters (Table 1) distinguish these two Atlantic species from *N. granulipes* as described by KO & CLARK (2002) and include: the number of terminal setae on the antennal exopod (three versus one respectively), the number of setae on the distal endopod segment of the second maxilliped (six versus five respectively), the presence or absence of spinulation on the anterior margin of the lateral carapace spines and the lateral armature of the telson fork (one spine and one smaller spine versus one spine and one seta respectively). Zoeal evidence seems to suggest that adult characters within *Nanocassiope* Guinot, 1967 will have to be reappraised.

Acknowledgements

The authors wish to thank Maria Thessalou-Legaki and the organising committee of the 8th Colloquium Crustacea Decapoda Mediterranea for an extremely successful meeting.

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