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VALVE SURFACE STRUCTURE OF *Candona neglecta* Sars, 1887 (CRUSTACEA, OSTRACODA)

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Abstract

The valves of *Candona neglecta* Sars, 1887, a common freshwater ostracod occurring throughout the Holarctic, were formerly described to bear tiny tubercles and spinules. It is here shown with the help of the scanning electron microscope that the valves of this species actually appear to be smooth. The tubercles and spinules described by previous authors correspond to conspicuously wide pore canals that mimic tiny surface structures when observed in the stereomicroscope. The taxonomic importance of this character is briefly discussed and a diagnosis of the *neglecta*-group of *Candona* Baird, 1845 is given. The genus name *Neglecandona,* which was introduced in 2001, is unavailable in the sense of the International Code of Zoological Nomenclature.

Key words: Crustacea, freshwater Ostracoda, *Candona neglecta* Sars, 1887, taxonomy, valve surface structure

INTRODUCTION

Candoninae, the subfamily to which *Candona neglecta* Sars, 1887 belongs, is a large family of freshwater ostracods with world-wide distribution. The valves of all species appear either whitish, often with a pearly lustre, or more or less translucent. The eyes are reduced and lack any pigment. Additionally, candonines have totally reduced the natatory setae on their second antennae and are therefore devoid of any swimming ability. These animals spend their lives crawling and digging on and in the bottom mud of their aquatic habitat.

While the majority of extant candonines possess smooth valves, those of a number of species appear more or less densely pitted. Valve pits are sometimes restricted to the juvenile stages, as for instance in most species of *Pseudocandona* s.str. Kaufmann, 1900 (see Meisch 2000). Conspicuous valve ornamentations, such as large projections, are found in a small number of Candoninae, mostly known from the fossil record only (Krstić, Shao-zeng 2001).

Within *Candona* s.str., the type genus of Candoninae, both juveniles and adults usually possess carapaces with smooth surfaces. Only the valves of the species around *Candona neglecta* Sars, 1887 were repeatedly described to bear tiny tubercles and spinules (Lindner 1923, Petkovski 1969, Meisch 2000).

Initially, the present work aimed at describing the structure of these tubercles and spinules on the valves of *C. neglecta* with the help of the scanning electron microscope (SEM). The finding, in the SEM, of smooth valves was a surprise and needs to be explained (see below). Additionally, the taxonomic significance of the results is briefly discussed.

THE GENUS *Candona* Baird, 1845 AND THE *neglecta*-GROUP OF SPECIES

Candona neglecta Sars, 1887 belongs to the genus *Candona* s.str. Baird, 1845 – type species: *Candona candida* (Müller, 1776) – which is classified as follows (classification above superfamily level follows Horne *et al.* 2002).

Subphylum Crustacea Pennant, 1777
Class Ostracoda Latreille, 1806
Subclass Podocopa Sars, 1866
Order Podocopida Sars, 1866
Suborder Cypridocopina Jones, 1901
Superfamily Cypridoidea Baird, 1845
Family Candonidae Kaufmann, 1900
Subfamily Candoninae Kaufmann, 1900
Tribe Candonini Kaufmann, 1900
Genus *Candona* s.str. Baird, 1845

Ecology

Candona neglecta Sars, 1887 is widespread in springs, brooks and ponds connected to springs, and lakes, where it is found from the shallow littoral zone down to great depths. The species is distributed throughout the Holarctic (Meisch 2000).

Taxonomy

In his most influential monograph, Klie (1938), relying mainly on the work of Hartwig (1901), subdivided the genus *Candona* s.l., which at that time already had become an un-

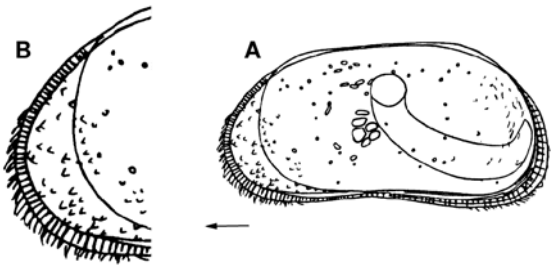

Fig. 1. *Candona neglecta* Sars, 1887. Female. A, LV, external view. B, detail of A. Reproduced from Lindner (1923).

usually large genus (Kempf 1980, 1997), into seven groups of species. *Candona neglecta* Sars, 1887 and its relatives were grouped with the species around *Candona candida* (Müller, 1776), the type species of *Candona*, to form the *candida*-group.

In a subsequent publication, Klie (1939) suggested *C. neglecta* and its relatives to be lodged in a separate subgroup within the *candida*-group, "a subgroup that might be designated as that of the neglectoids". However, Klie never formally published that subdivision.

Klie's (1938) subdivision of the genus *Candona* s.l. was generally accepted until the 1970s (*e.g.* Löffler, Danielopol 1978). In the third quarter of the 20th century, however, most of Klie's (1938) species-groups were extracted from *Candona* s.l. to be elevated to the genus rank. Consequently, the genus *Candona* was progressively restricted to the *candida* and *neglecta* groups of species (Meisch 2000).

Recently, Krstić (1993, 1995) proposed to elevate the *neglecta*-group to the rank of a subgenus: *Candona* (*Neglecandona*). Subsequently, the same researcher co-authored a contribution in which the subgenus *Neglecandona* was elevated to the genus rank (Krstić, Shao-zeng 2001). It must be stressed, however, that no type species was designated, although from the context of the three mentioned papers it can be deduced that *Candona neglecta* was most likely intended to assigned as such. Nonetheless, because of the missing formal designation of a type species, the International Code of Zoological Nomenclature (1999) stipulates that *Neglecandona* is not available as a subgeneric or generic name.

Finally, Petkovski *et al.* (2002) subdivided the *neglecta*-group into three subgroups based on differences in the shape of the M-process of the penis. The characterization of these subgroups is not discussed here as this goes beyond the scope of the present work.

Fossil record

The first representatives of the *neglecta*-group are recorded from the Upper Cretaceous of Mongolia (Szczechura 1978; fide Krstić, Shao-zeng 2001). Species of the *neglecta*-group are abundantly recorded from deposits of both the Cenozoic and Quaternary.

MATERIAL AND METHODS

The animals illustrated here were collected in April 1994 from a spring located in meadowland near the village of Dahlem situated about 12 km to the west of Luxembourg City. Photos of the valves were taken in the SEM laboratory of the Royal Belgian Institute of Natural Sciences in Brussels. The SEM-pictures were exclusively stored and handled as electronic files.

RESULTS (Figs 1–2)

In contrast to what was expected from the descriptions in the literature and also from our own observations in the light microscope, the SEM shows the valve surface of *Candona neglecta* to be rather perfectly smooth (Fig. 2A, B, C): no traces of tubercles, spinules or similar structures are visible. Only the openings of the pore canals and the associated setae are present (Fig. 2B, C). Both the pore openings and the lips surrounding those openings appear 'normally' built, untransformed, and therefore similar to those found in the other candonines. In the SEM, the internal view of the valves shows the presence of relatively wide pore openings (Fig. 2E, F, G). From these findings it must be concluded that the presumed external surface structures seen in both stereo- and light microscopes (Fig. 1A, B) are actually situated within the outer lamella of the valve. No sexual dimorphism was seen in the number and structure of the pore canals.

DISCUSSION

Early descriptions mention the valve surface of *Candona neglecta* to be smooth (Sars 1887, 1925, Müller 1900, Kaufmann 1900). Lindner (1923) first described and illustrated the presence of tiny tubercles and spinules on the valves of his *neglecta*-specimens from Upper Swabia, Germany (Fig. 1A, B). Following Lindner (*op. cit.*), the tubercles are most dense in the anterior valve area where they are transformed into spinules that point anteriorly. Also, that author suggested the tubercles and spinules to arise from the openings of the valve pore canals. The presence of these tiny structures led Lindner (*op. cit.*) to assign his animals to a new variety, *C. neglecta* var. *tuberculata* Lindner, 1923. Petkovski (1969) recognized the *tuberculata*-variety to belong to a separate species – *Candona lindneri* Petkovski, 1969 – and stressed that the tubercles described by Lindner (1923) are found in both *C. neglecta* and *C. lindneri*.

Our explanation for the absence of the tubercles and spinules seen in the light microscope is as follows. The putative tubercles and spinules correspond to enlarged pore canals that cross the outer lamella of the valve. In reflected and transmitted light of stereo- and light microscopes, respectively, these canals mimic external surface structures. This is consistent with the following observations made in the stereo- microscope: the putative tubercles and spinules are only seen in those individuals that possess at least partly transparent valves. By contrast, carapaces with opaque valves – those of animals approaching the moulting process? – appear perfectly smooth in the light microscopes.

It is suggested here that these striking pore canals are a characteristic feature of the members of the *neglecta*-group. Future studies should confirm their presence in the remaining species of that group. If present in all the species, this very peculiar feature would be an important diagnostic character of

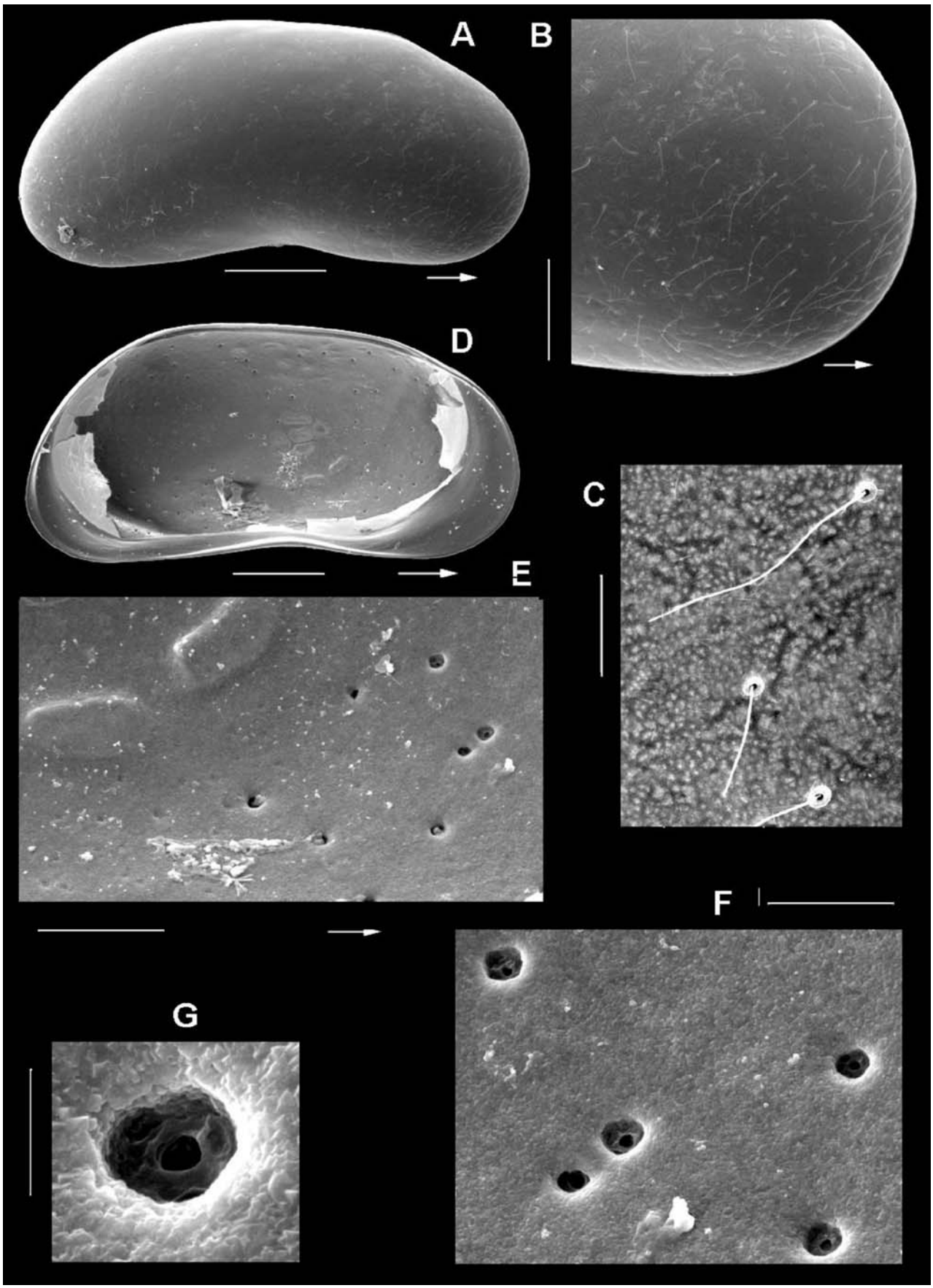

Fig. 2. *Candona neglecta* Sars, 1887. Female. A, right valve, external. B, anterior valve area, detail of A. C, detail of B, see 'normal' pores and pore lips. D, left valve, internal. E, internal view, pores below and anteriorly to the mandibular muscle scars. F, detail of E. G, internal pore, detail of F. Arrows point anteriorly. Scale bars: 200 μm for A and D; 100 μm for B; 50 μm for E; 20 μm for C and F; 5 μm for G.

the *neglecta*-group and also a valuable argument for the erection of a separate genus for this group of species.

The 'neglectoids' bear the following diagnostic characters (for details on the characters used, see Meisch 2000):

(1) valves of females usually relatively elongate in lateral view, with a straight dorsal margin;

(2) mandibular palp: (a) setal group of the second segment with 4 setae (except *Candona paionica* Petkovski, 1958: 5 setae, see Petkovski *et al.* 2002) (always 5 setae in the *candida*-group); (b) externodistal seta of the penultimate segment (=gamma-seta) feathered (not smooth);

(3) Cleaning leg (third thoracopod): (a) this leg 5-segmented, *i.e.* penultimate segment subdivided (that segment undivided in the *candida*-group); (b) basal segment with two setae (d1 and dp);

(4) (hemi)penis: M process characteristically shaped (see Meisch 2000, Petkovski *et al.* 2002);

(5) valves smooth, (always?) with conspicuous pore canals that mimic tiny tubercles and spinules in the reflected light of the stereomicroscope (40–100 X).

This is not the first time that internal valve structures of ostracods are reported to mimic external surface structures under the transmitted light microscope. When describing *Tanganyikacypris matthesi* (type species of the genus *Tanganyikacypris*) Kiss (1961) reports the presence of two protuberances, visible in dorsal view and situated antero-dorsally, between the eyes and muscle scars. When redescribing this species De Deckker & Wouters (1983) could not see these protuberances on the external side of the valves. In transmitted light and in dorsal view, however, the two deep fulcral points appeared as they were protuberances. This feature is only visible in translucent specimens. In opaque specimens this type of optical illusion is not present.

Finally, it should be noticed that the valves of *C. neglecta* and those of at least part of the remaining species of the *neglecta*-group – *e.g. Candona angulata* Müller, 1900 – are known to posses another sort of faint ornamentation: a reticulate pattern of striations found in the posterior valve area. In the stereomicroscope, the lines of that reticulation consist of inconspicuous, linear, small shallow pits arranged perpendicularly to the lines of the reticulation (Müller 1900). This peculiar pattern was first described by Müller (*op. cit.*), who found it on the *neglecta* animals from one single locality and in part of the individuals only. This ornamentation, which so far has not been illustrated with the SEM, was not seen by the present authors in any of the specimens of *C. neglecta* examined.

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