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## New *Sensiava* species (Copepoda: Calanoida: Diaixidae) from the deep South Atlantic and first description of the female

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### Abstract

Females are described for the first time in the genus *Sensiava* Markhaseva & Schulz, 2006, that was known previously only from males. Four species of this genus are identified from samples collected in the vicinity of the abyssal sea bed. Two species, *Sensiava secunda* sp. nov. and *S. peculiaris* sp. nov. are named, and two species are not given names due to a poor condition of the examined specimens and their incomplete descriptions. *Sensiava* males have also been found in the samples. They share with their male congener *Sensiava longiseta* Markhaseva & Schulz, 2006 a geniculate right antennule, which is a plesiomorphy observed only in the benthopelagic Clausocalanoidea Giesbrecht, 1893. A differential diagnosis for the genus is given, based on both sexes. *Sensiava* was previously known only from the Antarctic waters between 63–64°S, but its distributional range now can be extended significantly further to the north, up to the Equator in the South Atlantic.

**Key words:** Clausocalanoidea, calanoids, taxonomy, benthopelagic, biogeography

### Introduction

The near-bottom dwelling calanoid copepod *Sensiava* was described from abyssal depths (4742–4975 m) in the Weddell Sea (63–64°S). Subsequently, four species of *Sensiava* have been sorted from near-bottom samples collected by the German expeditions DIVA–I–III (Latitudinal Gradients of Deep-Sea Biodiversity in the Atlantic Ocean) at abyssal depths (4602 to 5175m) in the years 2000, 2005, and 2009. These are the first records of this genus in the South Atlantic north of 36 °S, and they show that *Sensiava* is widespread in the benthopelagic habitat. Up to now *Sensiava* was monotypic, known only from males of *Sensiava longiseta* Markhaseva & Schulz, 2006. Four new species of the genus represented by their females have been identified in the DIVA samples. Two species are named here, while the other two are not because of their poor condition. Several *Sensiava* males were also found in the samples and are currently attributed to one new species.

*Sensiava* belongs to the family Diaixidae Sars, 1902, which presently includes 15 valid genera (see Markhaseva *et al.* 2014): *Anawekia* Othman & Greenwood, 1994, *Byrathis* Markhaseva & Ferrari, 2005, *Cenognatha* Bradford-Grieve, 2001, *Diaixis* Sars, 1902, *Falsilandrumius* Vyshkvartzeva, 2001, *Grievella* Ferrari & Markhaseva, 2000, *Landrumius* Park, 1983, *Neoscolecithrix* Canu, 1896, *Paraxantharus* Schulz, 2006, *Procenognatha* Markhaseva & Schulz, 2010, *Ranthaxus* Markhaseva & Schulz, 2010, *Sensiava* Markhaseva & Schulz, 2006, *Xancithrix* Markhaseva, 2012, *Xantharus* Andronov, 1981, and *Thoxancalanus* Markhaseva, Laakmann & Renz, 2013.

### Material and methods

Specimens of several *Sensiava* species were collected during the RV Meteor expeditions DIVA–I–III in 2000, 2005 and 2009 close to the sea bed in the abyss of the tropical Atlantic, at depths between 4602 and 5390 m by a closing epibenthic sledge (Brenke 2005).

## Discussion

A right geniculate antennule in *S. longiseta* and in males of other Clausocalanoidea has been recently discussed as a striking example of the plesiomorphic condition of the antennule of males of this superfamily (Markhaseva & Schulz 2006). A similarly modified right antennule has been described for *Procenognatha* (Markhaseva & Schulz 2010), and here for *Sensiava cf. secunda*.

In *Procenognatha* and *Sensiava* ancestral segments XVII–XXIII of the right antennule are modified in shape (Fig. 15A–C) compared to the corresponding segments of the left antennule (see Fig. 3B–C in Markhaseva & Schulz 2006, Fig. 6C–D in Markhaseva & Schulz 2010, and Fig. 7A–B herein). In both genera the ancestral segments XVIII and XXI of the left and right antennules share an identical setation formula ( $2s + 1ae$  and  $1s + 1ae$  respectively), but in *Procenognatha* the middle seta of the right segment XVIII is stronger. Ancestral segments XVII, XIX and XX of the right antennule differ from the corresponding segments of the left antennule not only in shape but also in armament; the right one possesses an additional setal element. This setal element is the middle seta at each of ancestral segments XVII, XIX and XX in *Procenognatha* (Fig. 15A), and in *Sensiava* it is the middle seta on ancestral segment XVII and the robust spine on ancestral segments XIX and XX (Fig. 15B–C). Additionally, the middle setal element on fused ancestral segments XXII–XXIII of *Sensiava* is also modified into a robust spine.

In the ancestral calanoid copepod, the primary antennular geniculation is hypothesized to be located between the ancestral segments XX and XXI (Huys & Boxshall 1991, Bradford-Grieve *et al.* 2010). However, this is not the case for Ryocalanoidea and for those species of Clausocalanoidea described with a modified right antennule. For some of Ryocalanoidea the primary geniculation appears to be located between ancestral segments XXII and XXIII – XXIV (see Fig. 2 in Ohtsuka & Huys 2001). Furthermore, several additional secondary geniculations are found both proximal and distal to ancestral segments XXII and XXIII – XXIV (Ohtsuka & Huys 2001). For the other members of Ryocalanoidea the location of the primary geniculation is not as clear (Renz *et al.* 2013). The species of Clausocalanoidea with a modified right antennule share an inconsistency in the location of the primary geniculation with the latter group of ryocalanoideans. The presence of several secondary geniculations in some Ryocalanoidea and Clausocalanoidea could be a plesiomorphy inherited from their common ancestor. However, segmental fusions of ancestral segments of the right antennule in representatives of these superfamilies are not homologous: ancestral segments XXII–XXIII are fused in Clausocalanoidea, but ancestral segments XXIII–XXIV or XXIV–XXV are fused in Ryocalanoidea (Ohtsuka & Huys 2001; Renz *et al.* 2012, 2013). This difference demonstrates the subsequent evolutionary divergence of these two groups.

Both *Procenognatha* and *Sensiava*, with their unusual features of the right antennule morphology, are clausocalanoideans living in the vicinity of the sea bed. Specimens of *Sensiava* described here increase the number of species possessing the plesiomorphic character states of the antennule that appear to be restricted to the benthopelagic representatives of the superfamily.

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