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New species of *Centroderes* (Kinorhyncha: Cyclorhagida) from the Northwest Atlantic Ocean, life cycle, and ground pattern of the genus

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Abstract

Four new species of *Centroderes* are described from the Northwest Atlantic Ocean based on light microscopical observations of 153 adult and 26 juvenile specimens and on SEM investigations of 54 adult and 3 juvenile specimens. *Centroderes barbanigra* n. sp. and *C. bonnyae* n. sp. can be distinguished from all other species by the existence of a short lateroventral tube on segment 7. The latter species can be separated from the former by an acicular spine in the lateral accessory position on segment 8. The female of both *C. readae* n. sp. and *C. spinosus* possesses a female-specific, modified gland cell outlet on segments 7–9, but such an outlet is missing on segment 7 of all other species. The latter species is distinguished from the former by its robust lateroventral spine on segment 8 and by its lack of a laterodorsal sensory spot on segment 4, whereas the former species shows a midlateral sensory spot on segment 8. *Centroderes drakei* n. sp. agrees with the remaining American species in the possession of a laterodorsal sensory spot on segment 4; the former species can be distinguished from *C. readae* n. sp. by the lack of a sensory spot sublaterally on segment 1 and midlaterally on segment 8 as well as by the lack of a female-specific, modified gland cell outlet on segment 7; *C. drakei* n. sp. can be separated from *C. barbanigra* n. sp. and *C. bonnyae* n. sp. by its lack of a lateroventral tube on segment 7.

We report anomalies rarely noticed for Kinorhyncha, such as different developmental artifacts in several specimens and a potential tumour in one individual. Evidence is provided that species of *Centroderes* develop via at least two adult life history stages, but three or more adult stages exist in *C. drakei* n. sp.; this represents the first record of a more complicated life cycle in Kinorhyncha. This paper also contains the first report of spermatophores in cyclorhagid Kinorhyncha and in both female and male specimens. In addition, characters in the ground pattern of *Centroderes* are summarized.

Key words: *Centroderes barbanigra* n. sp., *C. bonnyae* n. sp., *C. drakei* n. sp., *C. readae* n. sp., taxonomy, tumour, spermatophore, development

Introduction

The first known species of *Centroderes* reveals a confusing history that was unveilled only recently (Neuhaus *et al.* 2013). Reinhard (1881) briefly describes and a few years later redescribes more extensively and also illustrates (Reinhard 1885, 1887) a new species, *Echinoderes spinosus* Reinhard, 1881. A couple of years later, Zelinka (1896) suggests a new family Centroderidae Zelinka, 1896 without assigning any species to this taxon. It takes another 11 years until Zelinka (1907) assigns a new genus name, *Centroderes*, to his family Centroderidae, and it is not before 1928, that *E. spinosus* is formally renamed *Centroderes spinosus* (Reinhard, 1881) in Zelinka's monography of the Kinorhyncha (Zelinka 1928). In this important compilation, he also describes *C. eisigii* Zelinka, 1928 as new to science. The latter species differs from *C. spinosus* only by its lack of three dorsal acicular spines on segment 10 and by its smaller size, and it takes 85 years before Neuhaus *et al.* (2013) show that *C. eisigii* is actually the female, and hence a junior synonym, of *C. spinosus*. Unfortunately, Zelinka (1928) collects and describes not only species known from adult life history stages in his family Centroderidae, but also a range of

TABLE 10. Characters in the ground pattern of *Centroderes*. Features appearing exclusively in stage-1, stage-2, or unspecified females are marked in bold and put in [ ]. Characters existing only in stage-1, stage-2, or unspecified males are highlighted in italics and bold.

position segment	**md**	**pd**	**sd**	**ld**	**ml**	**sl**	**la**	**lv**	**vl**	**vm**
1	ac	ssp		ssp					long ac	ssp
2	ac	ssp			ssp				short tube	
3	ac	ssp		ssp		ssp				ssp
4	ac	ssp				ssp				ssp
5	ac	ssp		ssp				short tube		
6	ac	ssp		ssp		ssp				ssp
7	ac	ssp		ssp		ssp				ssp
8	ac	ssp		ssp		ssp		ac; **[gc]** [1]		ssp
9	ac	ssp		ssp		ssp		ac	**[gc]** [1]	ssp
10	**[ac** or –]; ♂$_{2:}$ ***cr***		ssp	**[ac** or –]; ♂$_{2:}$ ***cr***						pa
11	ac + mts		3x ssp				ssp; ltas	lts	ssp; gc	

[1] The position of the female-specific modified gland cell outlets is located more midventrally in *C. spinosus* than in the American species, so the table does not intend to mention the exact position of these gland cell outlets.

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