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Two 'new' renicolid trematodes (Trematoda: Digenea: Renicolidae) from the California horn snail, *Cerithidea californica* (Haldeman, 1840) (Gastropoda: Potamididae)

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Abstract

This manuscript describes the daughter parthenitae (sporocysts) and cercariae of two species of renicolid xiphidiocercaria that infect the California horn snail, *Cerithidea californica*, which serves as first intermediate host for a diverse and ecologically important guild of digenean trematode parasitic castrators. The two species described here have previously been considered to be a single morphospecies in ecological and evolutionary research. We provide provisional species names to respect that digenean alpha taxonomy is currently focused on sexual (adult) stages, while simultaneously respecting the spirit and utility of formal nomenclature in providing unambiguously unique, species-level names that also clarify to the extent possible species' taxonomic affiliations. The first species, *Renicola* sp. "polychaetophila" is most readily distinguishable from previously described renicolid xiphidiocercariae by a combination of (1) having a penetration gland duct arrangement of 2[(1+3+1)+1], (2) having one pair of penetration glands positioned anteriorly to the main gland cluster, (3) lacking tegmental spines, and (4) infecting *Cerithidea californica.* The second species, *Renicola* sp. "martini", is most readily distinguishable from other renicolid xiphidiocercariae that also have tegmental spines by a combination of (1) having a simple, bullet-shaped oral stylet sclerotized for 50–80% of its length, (2) having a cystogenous-gland field with an anterior-most extent about half way between the oral and ventral suckers, and (3) in infecting *Cerithidea californica*. Phylogenetic analyses using DNA (COI and ITS1) sequence data support that these two trematodes represent distinct species of *Renicola.* We also (1) provide an emended diagnosis for renicolid cercariae, (2) highlight a few morphological characters that may be useful for future taxonomic work involving renicolid xiphidiocercariae, and (3) suggest that future descriptive work involving trematode parthenitae include more information pertaining to the group of parthenitae as a whole.

Key words: parthenitae, colony, first intermediate host, cercariae, parasites, parasitic castrators, *Renicola*, estuary

Introduction

Dr. Walter Martin appears to have never seen the two renicolid xiphidiocercaria species described in this manuscript. This is noteworthy because, for over two decades, Martin studied the digenean trematodes that infect the California horn snail, *Cerithidea californica* (Haldeman, 1940) (e.g., see Martin 1950;1955;1972). This snail serves as first intermediate host for a diverse and ecologically important guild of trematode parasitic castrators (e.g., see Kuris *et al.* 2008; Martin 1972) and resides in coastal estuaries from central California (USA) to Peru (Keen 1971; Miura *et al.* 2010). Martin's studies took place in several localities in southern California, and he created an identification key for these trematodes (Martin 1972). The key included species that he had described, and those that he had encountered but not thoroughly described. However, the key did not include any renicolid xiphidiocercariae. This is odd, as researchers, both before and after that time, have regularly encountered renicolid xiphidiocercariae from the California horn snail. For instance, in an unpublished thesis, Hunter (1942), also working in southern California, included what appear to be two renicolid xiphidiocercariae. More recently, ecological and evolutionary research involving this trematode guild has included what was considered to be a

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of the entire group of parthenitae in a host (that is, colony characteristics). At a minimum, this could involve brief, general notes, such as those included in this manuscript, on the distribution and density of the parthenitae within the host, including any obvious seasonal variation in colony attributes. Such observations are often readily obtained during the normal descriptive process and could easily be included in descriptions. Going further, some obvious, additional information on parthenitae could include (1) the total numbers in infected hosts, (2) the proportion of the host mass or volume taken up by the colony, and (3) evidence for different morphs and their frequencies. Such attention is warranted because, as noted in the introduction, the mass of parthenitae in their first intermediate host is comprised of individuals that cooperatively live together to reproduce and operate the castrated host phenotype. Hence, they can be understood as comprising a colony or society (Hechinger *et al.* 2011b). The degree of sociality can be developed so far as to involve a reproductive division of labor among parthenitae including the formation of a non-reproducing soldier caste (Hechinger *et al.* 2011b; Leung & Poulin 2011; Miura 2012). Whether one adopts this basic zoological/sociobiological perspective (see Oster & Wilson 1978; Wilson 1975) concerning trematode parthenitae, it is clear that it is the entire group of clonally produced parthenitae that is the functional unit of interaction with the host. Hence, information on parthenita colony attributes, including that which is often readily available to workers describing parthenitae and cercariae, will shed light on trematode biology, ecology, and evolution, and may also reveal taxonomically informative traits.

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