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The discovery of progenetic *Allocreadium neotenicum* Peters, 1957 (Digenea: Allocreadiidae) in water beetles (Coleoptera: Dytiscidae) in Great Britain

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Abstract

Progenetic specimens of *Allocreadium neotenicum* Peters, 1957 are described from water beetles, *Hydroporus rufifrons*, an endangered species, and *Agabus paludosus* from northern England and Scotland, and as non-ovigerous metacercariae from *Agabus melanarius* from southern England. Morphologically, the worms are identical to *A. neotenicum* described from water beetles in North America. Molecular phylogenetic estimates based on 28S rDNA sequences show these British specimens as more closely related to the North American freshwater fish parasite *Allocreadium lobatum* Wallin, 1909 than to the European species *A. isoporum* (Looss, 1894). *A. lobatum* shows a predilection for progenesis and may be a senior synonym of *A. neotenicum*. Based on the molecular phylogeny, the genus *Pseudallocreadium* Yamaguti, 1971 is considered synonymous with *Allocreadium* and the two species assigned to that genus, *P. neotenicum* and *P. alloneotenicum* (Wootton, 1957) are returned to *Allocreadium*.

Key words: *Pseudallocreadium*, *Hydroporus*, *Agabus*, England, Scotland

Introduction

We have discovered ovigerous digeneans in the haemocoel of water beetles from sites in England and Scotland. The development of eggs in Digenea in organisms that would usually be considered intermediate hosts has been considered as an example of neoteny or progenesis. According to Gould (1977), these are distinct categories of paedomorphosis, neoteny being the 'retention of young features' produced by retardation of somatic development. The situation we have found is closer to progenesis, which is produced by the 'acceleration of maturation'. Nevertheless, these definitions have not been universally applied, such that this situation has often been called neoteny. In fact, our specimens are indistinguishable morphologically from the species named *Allocreadium neotenicum* Peters, 1957, named for the 'neoteny' it exhibits. Recent studies relating to 'precocious egg production' in digeneans have followed Gould in using the term 'progenesis' (e.g. Lefebvre & Poulin 2005; Herrmann & Poulin 2012).

Material and methods

Collection: The water beetles in Westmorland were found as part of an ongoing survey of potential sites for the water beetle *Hydroporus rufifrons* (Müller, 1776) (Dytiscidae) in the south of the Lake District, which appears to provide the major centre for this species in Britain (Foster *et al*. 2008). Ponds and small tarns are typically surveyed by working five roughly one square metres of flooded vegetation with a D-shaped pond net fitted with a 1 mm mesh. For "inventory samples" the netted debris is sorted until no further species can be detected, with most material returned alive to the water, retaining only a few vouchers. However, the fluke infection was detected when dissecting a subsample from the specimens of *H. rufifrons* captured for translocation; the dissections were intended to assess the state of gonad development so only the main body cavity was examined. Infections were first detected

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