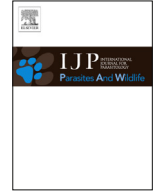




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Invited Review

Global diversity of fish parasitic isopod crustaceans of the family Cymothoidae

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ABSTRACT

Of the 95 known families of Isopoda only a few are parasitic namely, Bopyridae, Cryptoniscidae, Cymothoidae, Dajidae, Entoniscidae, Gnathiidae and Tridentellidae. Representatives from the family Cymothoidae are obligate parasites of both marine and freshwater fishes and there are currently 40 recognised cymothoid genera worldwide. These isopods are large (>6 mm) parasites, thus easy to observe and collect, yet many aspects of their biodiversity and biology are still unknown. They are widely distributed around the world and occur in many different habitats, but mostly in shallow waters in tropical or subtropical areas. A number of adaptations to an obligatory parasitic existence have been observed, such as the body shape, which is influenced by the attachment site on the host. Cymothoids generally have a long, slender body tapering towards the ends and the efficient contour of the body offers minimum resistance to the water flow and can withstand the forces of this particular habitat. Other adaptations to this lifestyle include small sensory antennae and eyes; a very heavily thickened and calcified cuticle for protection; and sharply curved hooks on the ends of the pereopods which allows these parasites to attach to the host. Most cymothoids are highly site and host specific. Some of these parasitic cymothoids have been reported to parasitise the same host fish species for over 100 years, showing this species specificity. The site of attachment on the host (gills, mouth, external surfaces or inside the host flesh) can also be genus or species specific. This paper aims to provide a summary of our current knowledge of cymothoid biodiversity and will highlight their history of discovery, morphology, relationships and classification, taxonomic diversity and ecology.

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1. Introduction

Cymothoid isopods are obligate fish parasites, occurring in all oceans with the exception of polar waters. The family is primarily marine, with limited occurrence in African and Asian freshwaters, but a moderate diversity in tropical South American river systems, notably the Amazon and its tributaries. Most cymothoids occur on hosts within the 200 m bathymetric, with fewer than 10 species extending beyond 500 m in depth. The family is among the larger of the isopod families comprising some 40 genera and more than 380 species (Ahyong et al., 2011). Greatest diversity occurs within the tropics, with a rapid attenuation in diversity towards high latitudes.

The Cymothoidea belongs within the suborder Cymothoidea Wägele, 1989, and the superfamily Cymothoidea Wägele, 1989. This superfamily forms a clade of families that show a gradient from commensal and micropredation in the families Corallanidae, Aegidae and Tridontellidae to obligate parasitism in the Cymothoidea (Brandt and Poore, 2003). Cymothoids are large isopods, with few species below 10 mm in length or more than 50 mm in length. Characteristic of the family is that the females are far larger than the males, this trait being most strongly expressed in the buccal and gill attaching genera.

Cymothoids are one of the best-known groups of isopod among the general public. They are familiar to fishers and anglers as sea lice (incorrectly – not to be confused with arguloid or caligoid copepods), tongue-biters and fish doctors, and are of interest to fish biologists and to the aquaculture industry as potential pests or disease vectors. The account of the tongue-replacing isopod (Brusca and Gilligan, 1983) achieved widespread and sustained publicity.

2. History of discovery

The family Cymothoidea is unique in being among the first isopods described and being the first isopod family subjected to a comprehensive world revision (Schioedte and Meinert, 1881, 1883, 1884). Cymothoids, being relatively large (10–50 mm), came to the attention of taxonomists early in the history of crustacean taxonomy, in large part through the work of the early fish taxonomists, notably Pieter Bleeker, who would have seen and collected this ‘by-catch’. Fish collections today are still a source for undescribed cymothoids.

The Cymothoidea differ significantly from all other free-living isopod families in the large number of genera and species described before 1900 and before 1950. As Poore and Bruce (2012) showed, there was a spike in the documentation of isopod species in the period 1970–1990. The Cirolanidae are typical of free-living families with 12% and 28% of species described by 1900 and 1950, respectively. In contrast approximately 42% of Cymothoidea (depending on accepted synonymies) were described by 1900, 55% by 1950 (Fig. 1).

William Elford Leach (1813–1814, 1815, 1818) was the first significant contributor naming nine cymothoid species and establishing the family name Cymothoidea Leach, 1818. Earlier described species such as *Cymothoa ichtiola* (Brünnich, 1764), the first post-Linnaeus species to be described and *Ceratothoa imbricata* (Fabricius, 1775) predate the family and its genera. Leach achieved particular fame through naming eight genera based on the name Caroline and Carolina (after Queen Caroline of Britain, 1768–1821; see Bruce, 1995). Milne Edwards’ (1840) *Histoire naturelle des crustacés comprennent l’anatomie, la physiologie et la classification de ces animaux* can be taken as the practical start to the discovery for the Isopoda including the Cymothoidea as that publication was the first world-wide review of the Crustacea, at which point 30

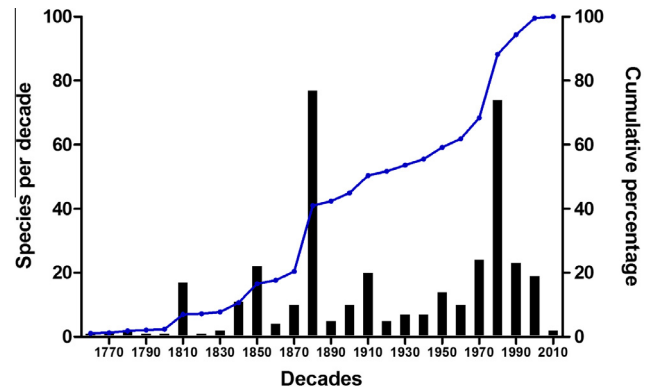


Fig. 1. Absolute numbers and cumulative percentage of species of Cymothoidea (373) published per decade since Linnaeus (1758). Data from the World List of Marine, Freshwater and Terrestrial Isopod Crustaceans hosted by the Smithsonian and at the WoRMS database (Schotte et al., 1995 onwards).

species names of Cymothoidea had been proposed. Others from that era made individual contributions such as Risso (1816), Say (1818), Otto (1828) and Perty (1833).

The period following Milne Edwards’ (1840) work saw several taxa described, but the most significant contribution was a single work by the fish taxonomist Pieter Bleeker (1857) describing 14 species; both Edward John Miers (1877, 1880) and G. Haller (1880) each described five species.

The great work of the Danish co-authors Jørgen Christian Schioedte and Frederik Vilhelm August Meinert fixed the concept of the family that stands today, and provided a largely unambiguous concept for the Cymothoidea. This work is an outstanding contribution by the standards of the day and nothing since has come close to that breadth of coverage. Schioedte and Meinert undertook a comprehensive world revision of what is now the superfamily Cymothoidea, including the families Corallanidae, Aegidae (Schioedte and Meinert 1879a,b) and Cymothoidea (Schioedte and Meinert 1881, 1883, 1884) in an age that had no ‘rapid communication’, no rapid shipping and no rapid international travel. Schioedte and Meinert borrowed specimens from the major museums of the western world of Europe and the USA. Again, ahead of their time, they specified both the provenance and the holding institutions of the specimens that they examined. Schioedte and Meinert also offered a detailed classification for the family, proposing several sub-family and tribe names. Some of these reflected perceptible differences in the morphology of the species and genera, but their classification caused some subsequent confusion, and these family group names have subsequently been largely ignored. Although the descriptions and drawings may be regarded as too brief and simple by the standards of today, this does not detract from their outstanding contribution. The completion of their body of work brought the total number of species proposed to 146 in 33 genera. The comprehensive nature of their monographs is demonstrated by the fact that of the genera accepted today 35% are attributed to Schioedte and Meinert. Since 1884 only 17 genera have been described, and 16 genera are junior synonyms or otherwise invalid.

The decades following Schioedte and Meinert’s work saw little sustained activity, the most significant contribution being the accumulated works of Carl Bovallius [1855–1887] describing seven cymothoid species (among other taxa). The early Twentieth Century in contrast saw considerable activity with contributions from the major isopod taxonomists of the period such as the Reverend Thomas Roscoe Rede Stebbing [1893–1923; two species], Harriet Richardson [1884–1914; 24 species], Hugo Frederik Nierstrasz [1915–1931; five species], and Herbert Matthew Hale

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