DOI: 10.2478/s11686-010-0050-2

Acta Parasitologica, 2010, 55(4), 419–423; ISSN 1230-2821

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RESEARCH NOTE

Critically endangered *Pristis microdon* (Elasmobranchii), as a host for the Indian parasitic copepod, *Caligus furcisetifer* Redkar, Rangnekar et Murti, 1949 (Siphonostomatoida): New records from northern Australia

David L. Morgan[1]*, Danny Tang[2,3] and Stirling C. Peverell[4]

[1]Freshwater Fish Group and Fish Health Unit, Centre for Fish and Fisheries Research, Murdoch University, South St Murdoch, Western Australia, 6150, Australia; [2]Department of Zoology (M092), The University of Western Australia, 35 Stirling Highway, Crawley, Western Australia 6009, Australia; [3]Present address: Laboratory of Aquaculture, Department of Bioresource Science, Hiroshima University, 1-4-4 Kagamiyama, Higashi-Hiroshima 739-8528, Japan; [4]Delivery Animal Science Sustainable Fisheries, Queensland Department of Primary Industries and Fisheries, Cairns, Queensland 4811, Australia

Abstract

This paper presents the first records of the parasitic copepod *Caligus furcisetifer* Redkar, Rangnekar et Murti, 1949 beyond Indian waters, specifically, on the body surface and head of the critically endangered largetooth sawfish (commonly referred to as the freshwater sawfish in Australia), *Pristis microdon* Latham, 1794 (Elasmobranchii, Pristidae), in brackish tidal waters of the Fitzroy River in the Kimberley region of Western Australia and the Leichhardt River in the Gulf of Carpentaria in northern Queensland. This represents a geographic range extension of ~8000 km for this parasite. Further, it is only the second member of the genus *Caligus* to be found on an elasmobranch host in Western Australia and it is the first time this species has been reported from the Southern Hemisphere. Male biased dispersal of *P. microdon* may be the vector in which the parasite has dispersed from India across to northern Australia, or *vice versa*. A decline in populations of the critically endangered *P. microdon* (and possibly other pristid species) in these regions may lead to a concomitant decline in their parasite fauna.

Keywords

Sea lice, Fitzroy River, Leichhardt River, northern Australia, India

The copepod genus *Caligus* Müller, 1785, which contains well over 220 species within the Caligidae Burmeister, 1835 (Boxshall and El-Rashidy 2009), is relatively poorly represented in tropical northern Australia. This is due in large part to the lack of specific investigations into the copepod fauna infecting fishes in northern Australia. Indeed, only 22 valid *Caligus* species have been reported from this region thus far (Beumer *et al*. 1982, Byrnes 1987, Lester and Sewell 1989, Tang and Newbound 2004). In sharp contrast, more than 50 species of *Caligus* have been found on fishes inhabiting the comparatively smaller coastal regions of Taiwan (Ho *et al*. 2007). While the majority of members of the genus are parasitic on teleosts, 17 species have been recorded from elasmobranchs, but only four of them are known to occur solely on elasmobranch hosts (Tang and Newbound 2004). The only records of *Caligus* sp. from sawfishes (Elasmobranchii, Pristidae) are those of *Caligus dasyaticus* Rangnekar, 1957 and *Caligus furcisetifer* Redkar, Rangnekar et Murti, 1949 from an unidentified *Pristis* sp. caught in south-western Indian waters (Pillai 1985). This paper describes the first record of a species of *Caligus* parasitising the critically endangered (IUCN Red List) largetooth sawfish, *Pristis microdon* Latham, 1794, in Australian waters.

During monitoring of *P. microdon* in the lower tidal reaches of both the Fitzroy River (Kimberley region of Western Australia) in October 2006 and the Leichhardt River (Gulf of Carpentaria in Queensland) in September 2008, caligid copepods were observed on the external surfaces of 1 and 5

*Corresponding author: D.Morgan@murdoch.edu.au

P. microdon, respectively (Figs 1A, 2). No other ectoparasites were observed on these six host individuals. The *P. microdon* host captured in the Fitzroy River was a juvenile female of 2487 mm TL, with a rostrum length of 567 mm and 21 teeth on each rostral margin. A total of 12 female caligid copepods was recorded on the dorsal surface of the head anterior to the eyes and proximal to the first rostral tooth. A second large female *P. microdon* (2750 mm TL) was captured at the same locality a few hours later but did not harbour any ectoparasites. Since that time, the senior author recorded a further 80 captures of juvenile *P. microdon* in very close proximity to the capture site of the infected fish, with no additional records of ectoparasites. From a total of eight immature *P. microdon* captured in the Leichhardt River, three female and two male specimens were observed to be infected with caligid copepods. The total length of the host specimens ranged in size from 910–1650 mm and had an average tooth count of 20 on the left rostrum margin. Of these host specimens, caligid copepods were located on the dorsal and ventral surfaces of the pectoral fins and rostrum, and ventral surface of the body extending down towards the caudal fin. Total counts of caligid copepods was only conducted on two host specimens; one infected sawfish possessed 13 female copepods, while the other host had one male and 35 female copepods.

Both sites are tidal and moderately saline, but receive high volumes of freshwater discharge particularly between January and June in each year from monsoonal weather patterns (see Whitty *et al*. 2009). At the time of capture in the Fitzroy River site, mean salinities ranged from 10 to 15 ppt and water temperatures from ~25 to 31°C were recorded (see Whitty *et al*. 2009). Similarly the Leichhardt River in September has mean salinities of 24 to 29 ppt and water temperatures from ~25 to 28°C were recorded. The Leichhardt River also has a 14 m high natural rock barrier located 82 km upstream of the river mouth that limits the migratory behaviour of *P. microdon* to periods when the river is in flood only. The riverine habitat below the rock barrier is tidal and during September is heavily influenced by salt water.

A sample of 12 copepods was removed from the single host in the Fitzroy River and preserved in 100% ETOH, while 13 and 3 copepods, respectively, were removed from two of the five hosts in the Leichhardt River and preserved in 100% ETOH. A subsample of copepods was later immersed in lactic acid for several minutes prior to examination using an Olympus SZ60 stereomicroscope and Olympus BX51 compound microscope. All specimens (subsamples) were identified to species level using Redkar *et al*. (1949) and Pillai (1968, 1985). Photographs of an intact specimen and various appendages were taken using an Olympus DP20 digital camera fitted on an Olympus SZX10 stereomicroscope and Olympus BX51 compound microscope, respectively. Voucher specimens (Fitzroy River, WAM C45267: Leichhardt River, WAM C45268, WAM C45269) are deposited in the Crustacea section of the Western Australian Museum (WAM), Perth, Australia.

Parasitic copepods found on *P. microdon* in brackish waters of both Western Australia and Queensland were identified as *Caligus furcisetifer* based on the following salient morphological features: (1) similar body size (5.02 mm mean body length (n = 4)); (2) similar shape of the cephalothorax, genital complex, and abdomen (Fig. 1B); (3) the relatively minute lunules (arrowed in Fig. 1C) shifted laterally on the frontal plate; (4) the presence of a small, triangular sclerite (arrowed in Fig. 1D) on the ventral surface of the cephalothorax, which distally projects over the base of the dentiform process of the maxillule; (5) the relatively elongated flabellum (arrowed in Fig. 1E) on the maxillary basis; (6) the presence of an accessory process on the middle and inner terminal spines on the terminal exopodal segment of leg 1 (Fig. 1F), (7) the reduced apical seta on the terminal exopodal segment of leg 1 (Fig. 1F); (8) same leg 4 exopod armature of I–0, III (Fig. 1G); and (9) the subequal outer and middle spines on the terminal exopodal segment of leg 4 (Fig. 1G). Our specimens differ slightly, however, from those of Redkar *et al*. (1949) and Pillai (1968, 1985) in having relatively narrower and longer tines on the sternal furca.

The discovery of *C. furcisetifer* in northern Australia represents the first record of the species from outside of Indian waters, is only the second species of *Caligus* recorded on an elasmobranch host in Western Australia and is the first *Caligus* sp. recorded from *P. microdon*, noting that the host reported in Redkar *et al*. (1949) and Pillai (1968, 1985) is given as only *Pristis* sp. It is thus also the first record of the parasite in the Southern Hemisphere and extends the known range of the species by some 8000 km. *Pristis microdon* is known to occur in India (Last and Stevens 2009) so it is plausible that *C. furcisetifer* is also associated with this fish species over there. The only other host known of *C. furcisetifer* is the winghead shark, *Eusphyra blochii* (Cuvier, 1816) (see Margolis *et al*. 1975), the type host of *C. furcisetifer* reported originally from India and a species that has been recorded from near the Fitzroy River mouth (Morgan *et al*. 2004) and inshore foreshore and riverine habitats of the Gulf of Carpentaria (Halliday *et al*. 2001). Examination of *E. blochii* (and other elasmobranchs) in northern Australia is needed to determine the degree of host specificity of this parasite in the Southern Hemisphere and whether the potential exists for this parasite to be transmitted from *E. blochii* to *P. microdon*, or *vice versa*.

The low infection rate recorded in brackish tidal waters of the Fitzroy River (i.e. <1%) may simply be an artefact of the sampling bias towards juveniles of *P. microdon*. In northern Australia *P. microdon* are believed to be pupped near the mouths of rivers during the monsoonal wet season, then migrate upstream into freshwater habitats (Peverell 2005, Thorburn *et al*. 2007, Whitty *et al*. 2009) where they are often found large distances inland (Morgan *et al*. 2004, Peverell 2008). The upstream movement of juvenile *P. microdon* from saline to fresh waters has been identified by the above authors as a possible behavioural mechanism to cleanse the body of unwanted parasites; although new born pups have been found

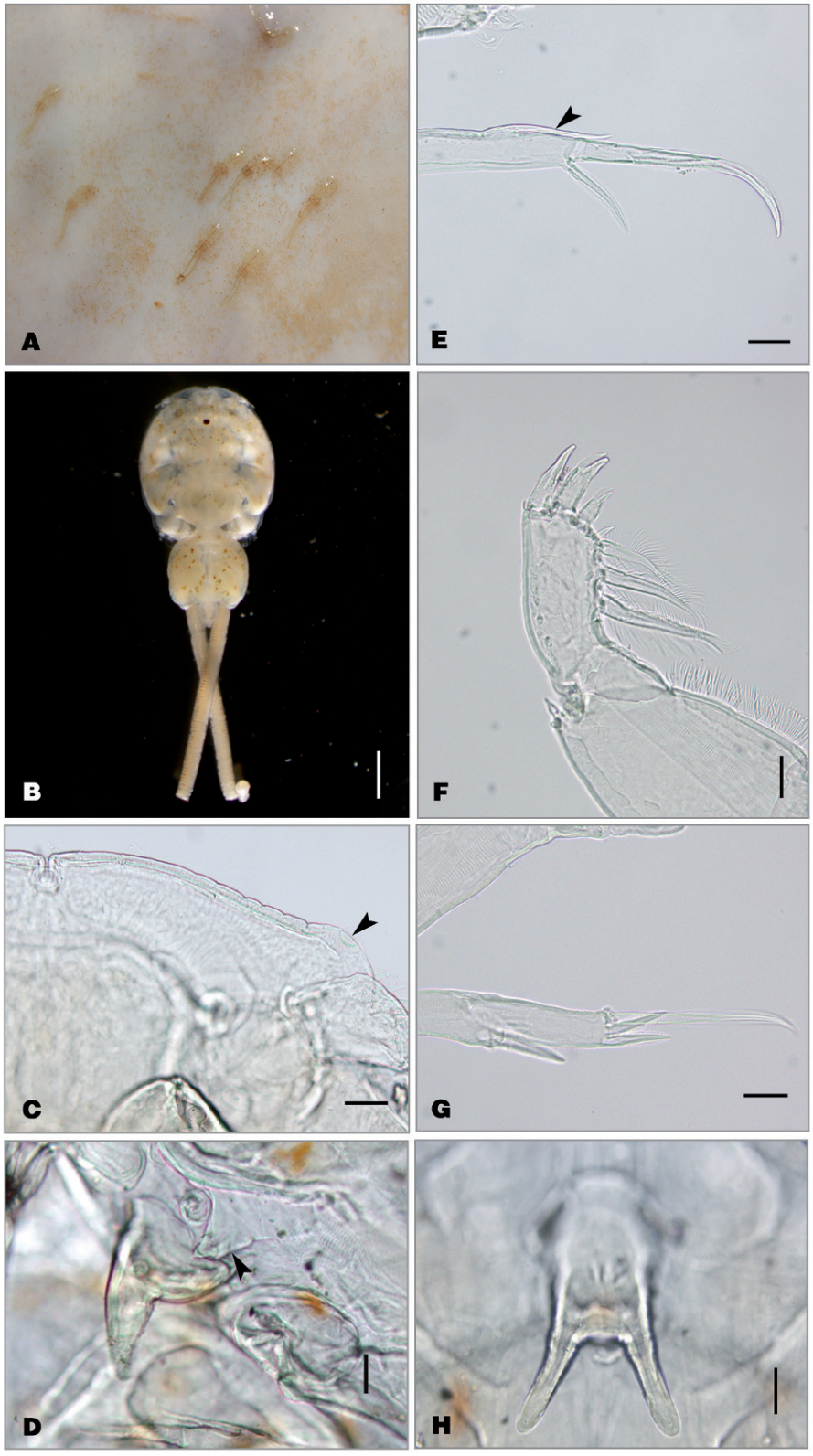

Fig. 1. Digital images of adult female of *Caligus furcisetifer* Redkar, Rangnekar et Murti, 1949: **A.** Nine individuals attached on the ventral body surface of *Pristis microdon* Latham, 1794 captured in the Leichhardt River, Queensland, Australia. **B.** Habitus, dorsal. **C.** Left-side of frontal plate, ventral. **D.** Left maxillule, ventral. **E.** Distal end of right maxillary basis, anterior. **F.** Left leg 1 exopod, anterior. **G.** Right leg 4 exopod, anterior. **H.** Sternal furca, anterior. Scale bars: B = 900 μm; C = 100 μm; D-H = 50 μm

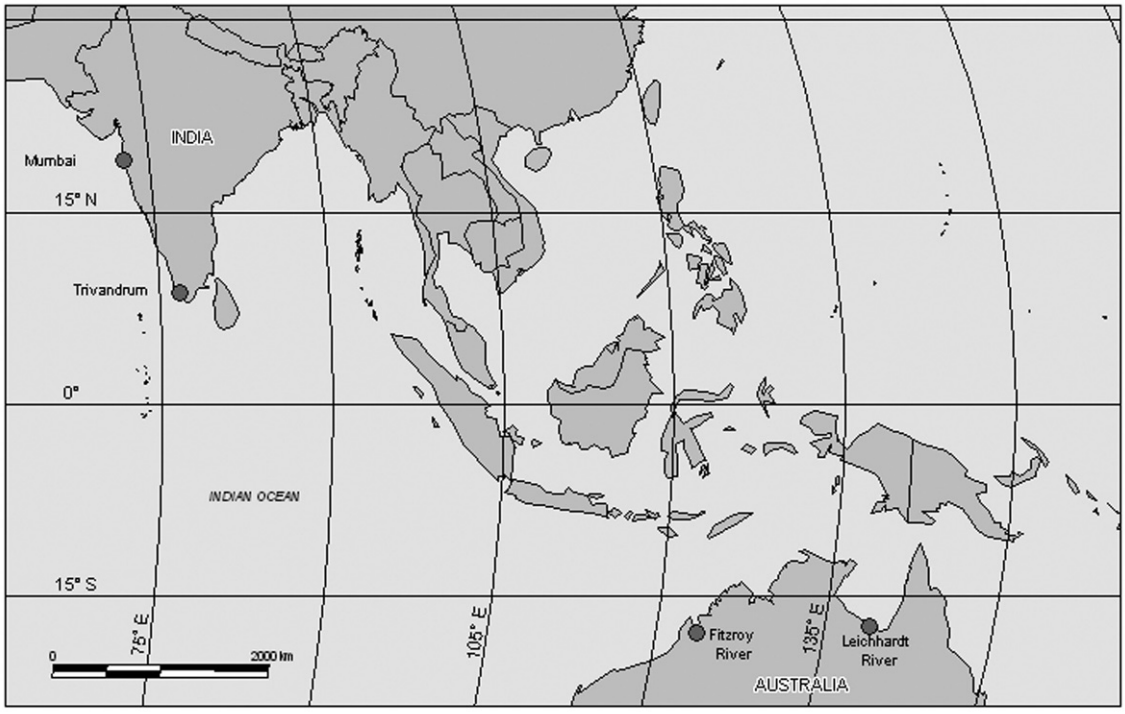

Fig. 2. Known locations (closed circles) of *Caligus furcisetifer* Redkar, Rangnekar et Murti, 1949 (N.B. the Fitzroy and Leichhardt Rivers are latitudinal equivalents to Mumbai)

a long distance from river mouths in the marine environment. This behaviour may in part lead to a loss of *C. furcisetifer*, which belongs to an almost exclusively marine group and has not been recorded on juvenile *P. microdon* in fresh waters of the Fitzroy and Leichhardt Rivers nor the Daly River, Northern Territory, Australia, and Sepik River and Lake Murray, Papua New Guinea (Ogawa 1991, present study). It is likely that *C. furcisetifer* would be more prevalent on the obligate marine adults of *P. microdon*, which are generally rarely encountered. Many individuals of *P. microdon* remain in estuarine waters throughout life, however, and are often sympatric with a number of other pristids in northern Australia (see Peverell 2005, Thorburn *et al*. 2008) which thereby potentially offer the parasite host continuity; yet the authors have not observed *C. furcisetifer* on dwarf sawfish (*Pristis clavata* Garman, 1906) or longcomb sawfish (*Pristis zijsron* Bleeker, 1851), despite the capture of numerous individuals.

At least within Australia, the results of Phillips *et al*. (2009) suggest that *P. microdon* exhibit sex biased dispersal, with females being philopatric and males being wide ranging. Thus, if *P. microdon* dispersal is male biased, this may be the vector that has allowed the parasite to disperse between Western Australia and the Gulf of Carpentaria (Queensland) and possibly to, or from, India. Future studies should examine the morphological and genetic differences between Indian, Western Australian, and Queensland specimens of *C. furcisetifer* to ascertain the level of structure and divergence within the population. The loss of pristid populations worldwide may lead to a concomitant decline in *C. furcisetifer*. Furthermore, if the infection prevalence is low, as observed in the Fitzroy River *P. microdon* population, this suggests that the occurrence of this parasite may be even more vulnerable to decline and like pristid populations around the world would also qualify for conservation listing. As far as we are aware, the pygmy hog sucking louse *Haematopinus oliveri* Mishra et Singh, 1978 (Insecta: Haematopinidae) is the only parasite species presently listed on the IUCN Red List of Threatened Species (Whiteman and Parker 2005).

Acknowledgements. We thank the Australian Government (Threatened Species Network, National Heritage Trust, Department of the Environment, Water, Heritage and the Arts) for funding the Freshwater Sawfish studies in northern Australia. Thanks to Jeff Whitty, Brendan Ebner, Dillon Ebner and Zach Duff for field assistance in Queensland, to staff from Armraynald and Flouraville Stations for logistical support, to Brenton Knott for providing laboratory support and to Geoffrey A. Boxshall and an anonymous reviewer for their constructive comments.

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(Accepted July 12, 2010)