

Ecology

New records of crustaceans infesting *Phractocephalus hemioliopus* (Siluriformes: Pimelodidae), the large catfish from the Amazon

Nuevos registros de crustáceos que infestan Phractocephalus hemioliopus (Siluriformes: Pimelodidae), el gran bagre del Amazonas

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Abstract

The aim of the present study was to investigate the infracommunities of ectoparasitic crustaceans in *Phractocephalus hemioliopus* Bloch and Schneider, 1801, a catfish from the lower Amazon River, in the state of Pará, eastern Amazon region, Brazil. From 12 hosts examined, a total of 45 specimens of crustacean ectoparasites from 5 species were found in the tegument, oral cavity or dorsal fins. The species were: *Argulus multicolor*, *Argulus violaceus*, *Dolops nana*, *Dolops discoidalis*, and *Braga patagonica*. *Dolops discoidalis* was the dominant ectoparasite, while *D. nana* had the highest mean intensity in the tegument, which was the most infested host site. This is the first record of *A. multicolor*, *A. violaceus*, *D. nana* and *B. patagonica* parasiting *P. hemioliopus*.

Keywords: Amazon; Freshwater fish; Parasites; Pimelodidae

Resumen

El objetivo del presente estudio fue investigar las infracomunidades de crustáceos ectoparásitos en *Phractocephalus hemioliopus* Bloch y Schneider, 1801, un bagre de la parte baja del río Amazonas, en el estado de Pará, en la Amazonía oriental, Brasil. A partir de 12 hospederos examinados, se encontraron un total de 45 ejemplares de

crustáceos ectoparásitos de 5 especies en el tegumento, cavidad o aletas dorsales orales. Las especies fueron: *Argulus multicolor*, *Argulus violaceus*, *Dolops nana*, *Dolops discoidalis* y *Braga patagonica*. *Dolops discoidalis* fue el ectoparásito dominante, mientras que *D. nana* tuvo la intensidad media más alta en el tegumento, que fue el sitio más infestado. Este es el primer registro de *A. multicolor*, *A. violaceus*, *D. nana* y *B. patagonica* parasitando *P. hemioliopeterus*.

Palabras clave: Amazonía; Peces de agua dulce; Parásitos; Pimelodidae

Introduction

The Siluriformes genus *Phractocephalus* Agassiz described by Spix and Agassiz (1829) (Pimelodidae) has 3 species, but only 1 remains alive, the *Phractocephalus hemioliopeterus* Bloch and Schneider, 1801, the larger catfish from the Amazon. The 2 extinct species are: *Phractocephalus nassi* Lundberg and Aguilera, 2003, and *Phractocephalus acreornatus* Aguilera, Bocquentin, Branco, Lundberg and Maciente, 2008. In Venezuela and Colombia, *P. hemioliopeterus* is known as “cajaro” while in Brazil it is known as “pirarara” tailed catfish.

Phractocephalus hemioliopeterus is widely distributed throughout the Amazon River and its major tributaries in white, clear and black water. This Siluriformes can be found on beaches and river channels, rapids and flooded forests, and can grow up to 1.3 m in length (Barbarino-Duque & Winemiller, 2003; Goulding, 1980; Santos et al., 2006). This catfish supports large commercial fisheries in the Amazon River system (Barbarino-Duque & Winemiller, 2003). This catfish is omnivorous, with carnivorous tendencies, and feeds on several species of fish including other Pimelodidae, Prochilodontidae, Cetopidae, Synbranchidae, Serrasalminidae species, as well as reptiles, amphibians, some vegetables (Barbarino-Duque & Winemiller, 2003), crabs, fruits and seeds (Goulding, 1980; Maia & Chalco, 2002). Its reproduction occurs during the seasonal floodings of the Amazon (Ferreira et al., 1998).

Among the crustacean parasites of fish, there are species of Branchiura Thorell, 1818; Copepoda Milne-Edwards, 1940, and Isopoda Latreille, 1871 (Luque et al., 2013). Species of these crustaceans infest freshwater, saltwater and brackish water fish around the world and can be found in the integument, fins, mouth, lid, nostrils, gills, anus and abdominal cavity (Luque et al., 2013; Mamani et al., 2004; Oda et al., 2015; Tavares-Dias et al., 2015; Thatcher, 2006). In the Brazilian Amazon, branchiurans, copepods and isopods infest fish of the Characiformes, Perciformes, Siluriformes, Osteoglossiformes, and Rajiformes orders (Luque et al., 2013; Tavares-Dias et al., 2015; Oliveira et al., 2017). Characiform fish of the Serrasalminidae family have been the most infested, mainly

by species of *Argulus* and *Dolops* (Tavares-Dias et al., 2015). Yet little is known about the parasitic fauna of *P. hemioliopeterus*, especially crustacean species known to infest this host, being recorded only *Dolops discoidalis* Bouvier, 1899 of the Solimões River (central Amazon) (Malta, 1984) and Jari River (eastern Amazon) (Oliveira et al., 2017).

The present study aimed to investigate the parasitic crustacean fauna infesting *P. hemioliopeterus* in the lower Amazon River, state of Pará, northern Brazil, to contribute to the knowledge of the host-parasite relationship and increase knowledge about the biodiversity in the region.

Materials and methods

Twelve specimens of *P. hemioliopeterus* were collected in October 2012, during the dry season, off the left bank of the Amazon River, in the state of Pará, Brazil (Fig. 1). The Amazon River system and its tributaries are responsible for the formation of large areas that are periodically flooded due to high rainfall and tidal surges. In the rainy season, the waters invade the plains, creating favorable conditions that allow the majority of fish species to reproduce. According to the Macapá-AP Meteorology rainfall volume was 23.17 mm, with a maximum temperature of 45 °C and a minimum of 32 °C and relative humidity 45.48%, at the time of collection. This is the main period for feeding, growth and energy accumulation for several species of fish, especially during the dry season (Braga et al., 2011; Maia & Chalco, 2002).

The fish were caught using hooks and lines during 9 hours, with the freshwater prawn *Macrobrachium amazonicum* Heller, 1862, used as bait. Immediately after collection, the integument, fins, mouth, anus, operculum, eyes and nostrils of each *P. hemioliopeterus* were examined in search of crustacean parasites. When found, the parasites were collected and quantified. Then, each fish was measured for total weight (g) and standard length (cm). The present study was carried out according to the principles adopted by the Brazilian College of Animal Experimentation - COBEA.

The crustacean collection procedures were performed at the site of fish collection, with crustaceans being collected

from one fish at a time. This procedure lasted around 3.5 minutes for each fish, and the fish were immediately returned to the Amazon River.

All the crustaceans collected were fixed in 70% alcohol for 24 hours and then stored in 70% ethanol containing 10% glycerin and processed for identification. The identification of the crustacean species followed Lemos de Castro (1959, 1986) and Thatcher (2006). The ecological descriptors used were those proposed by Bush et al. (1997) and Rohde et al. (1995).

The length-weight relationship was calculated using the equation $W = aL^b$, where W is the total weight in grams, L is the standard length in cm, and a and b are constants (Le-Cren, 1951). The type of growth was verified using the t-test where: $H_0: b = 3$ (isometric growth) and $H_1: b \neq 3$ (allometric growth) ($p = 0.05$). Spearman's correlation coefficient (r_s) was used to determine possible correlations between the abundance of parasitic crustaceans and the standard length and body weight of the host (Zar, 1996).

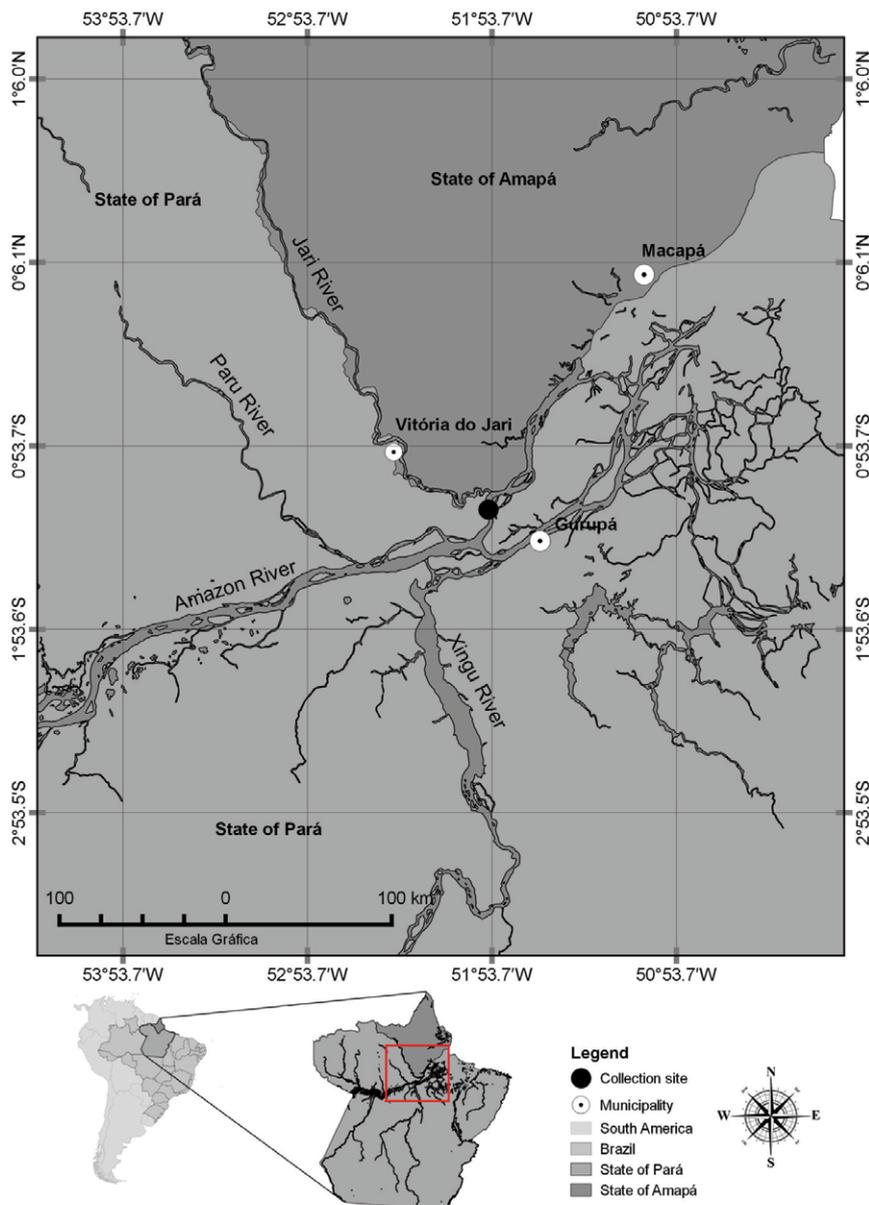


Figure 1. Geographic localization of area of collection of *Phractocephalus hemiliopterus* in the lower Amazon River, state of Pará, Brazil.

Results

A total of 12 specimens of *P. hemiiopterus* measuring 39.0 ± 13.2 cm and weighing $1,830 \pm 1,974.5$ g were collected and examined for the collection of parasitic crustaceans. A total of 91.7% of the fish examined were parasitized by 1 or more species of crustaceans. From the integument, dorsal fin or mouth of the hosts, 45 parasites were collected, such as: *Argulus multicolor* Stekhoven, 1937, *Argulus violaceus* Thomsen, 1925, *Dolops nana* Lemos de Castro, 1950, *D. discoidalis* (Branchiura: Argulidae), and *Braga patagonica* Schiödte and Meinert, 1884 (Isopoda: Cymothoidae). *Dolops discoidalis* was the dominant parasite, while *D. nana* had the greatest intensity of infestation. The tegument was the most infested host site (Table 1).

A positive correlation was observed between the abundance of *D. discoidalis* and the length and body weight of the hosts (Table 2). For *P. hemiiopterus*, the equation that described the length-weight relationship was: $W = 0.041x^{2.8369}$; $r^2 = 0.985$, which demonstrated an isometric type growth ($t < t_{2(0.05) 11}$; $p < 0.05$), indicating proportional growth of both the body weight and length of the hosts.

Discussion

Dolops discoidalis was the dominant parasitic species in *P. hemiiopterus*, while *D. nana* exhibited the highest average intensity. Other studies related to the occurrence of these crustaceans parasitize *P. hemiioptera* of Solimões River (central Amazon) (Malta, 1982) and Jari River (eastern Amazon) (Oliveira et al., 2017), however, it is not possible to compare infection levels because of the low number of fish examined in these other studies. However, infestation levels were higher than those of *Pseudoplatystoma fasciatum* (Linnaeus, 1766) and *Pseudoplatystoma tigrinum* (Valenciennes, 1840) from the Ichilo and Beni River basins in Bolivia (Mamani et al., 2004). *Argulus multicolor* and *A. violaceus* occurred only in the oral cavity of *P. hemiiopterus*, while *D. nana* and *D. discoidalis*, and *B. patagonica* were found in the tegument and fins, respectively. Species of *Argulus* fixed themselves to the hosts via suction cups, a method that appears to be less efficient than the modified jaws terminating in strong claws of species of *Dolops*, as well as *B. patagonica*, which fixes to its host using its legs with strong claws, which also seem to be effective for fixing. Furthermore, the choice of fixation site of the crustaceans may be mainly related to food availability (Thatcher, 2006).

Table 1

Crustacean parasites of *Phractocephalus hemiiopterus* (N = 12) from the lower Amazon River, state of Pará, Brazil. P: Prevalence, MI: mean intensity, MA: mean abundance, FD: frequency of dominance, IS: infestation site, TNP: total number of parasites.

Parasite species	P (%)	MI	MA	FD (%)	IS	TNP
<i>Argulus multicolor</i>	8.3	6.0	0.50	0.133	Oral cavity	6
<i>Argulus violaceus</i>	8.3	4.0	0.33	0.089	Oral cavity	4
<i>Braga patagonica</i>	8.3	1.0	0.08	0.022	Dorsal fin	1
<i>Dolops nana</i>	8.3	16.0	1.33	0.356	Integument	16
<i>Dolops discoidalis</i>	58.3	2.5	1.50	0.40	Integument	18

Table 2

Spearman's correlation coefficient (rs) between abundance of parasites and standard length and body weight for infracommunities of parasite crustaceans of *Phractocephalus hemiiopterus* (N = 12) from the lower Amazon River, state of Pará, Brazil.

Parasites	Length		Weight	
	rs	p	rs	p
<i>Argulus multicolor</i>	-0.2191	0.493	-0.219	0.492
<i>Argulus violaceus</i>	-0.438	0.154	-0.395	0.202
<i>Dolops discoidalis</i>	0.767	0.003*	0.744	0.005*
<i>Dolops nana</i>	-	-	0.131	0.682
<i>Braga patagonica</i>	-	-	-0.004	0.892

A positive correlation was observed between the abundance of *D. discoidalis* with host size, due to the larger area available in the integument for these ectoparasites (Malta, 1984; Mamani et al., 2004; Walker et al., 2008). As *D. discoidalis* infests fish from different families, it shows no host specificity (Luque et al., 2013; Tavares-Dias et al., 2014; Thatcher, 2006). *Dolops nana* has been described as mainly parasitizing fish from the family Anostomidae such as *Leporinus* spp. from the Paraná River basin (Luque et al., 2013), but has not been recorded for Pimelodidae species from the Amazon basin. Therefore, this is the first report of *D. nana* for *P. hemioliopus*.

Argulus violaceus, a parasite of *Hoplias malabaricus*, *Hypostomus commersonii*, *Loricaria anus*, *Basilichthy bonariensis*, *Pimelodus albicans*, *Rhamdia quelen*, and *Rhamdia sapo* from South America (Thatcher, 2006), exhibited low levels of infestation for *P. hemioliopus*. However, there have been no reports of this crustacean infesting fish in Brazil until now. As such, this is the first record of *A. violaceus* both for a host in Brazil and for *P. hemioliopus*.

The infestation of *A. multicolor* in *P. hemioliopus* was low, similar to a report for *P. tigrinum*, but inferior to the infestation documented for *Pseudoplatystoma punctifer* (Castelnau, 1855) in the central Amazon (Lopes et al., 2009). In Brazil, *A. multicolor* infests fish from the Amazon River (Bittencourt et al., 2014; Lopes et al., 2009; Malta, 1984; Thatcher, 2006), Pantanal basin (Fontana et al., 2012), and Tocantins River (Yamada & Takemoto, 2013) and Jari River (Oliveira et al., 2017). However, this is the first record of *A. multicolor* for *P. hemioliopus*.

Only one specimen of *B. patagonica* was found in the dorsal fin of *P. hemioliopus*. This species of isopod with no host specificity was found causing severe lesions in a region near the dorsal fin of *Colossoma macropomum* (Cuvier 1816), due to the strong claws used for attachment (Tavares-Dias et al., 2014). However, no macroscopic lesions in *P. hemioliopus* were found in the present study. Among isopod parasites of fish, *B. patagonica* has been recorded in fish in the Brazilian Amazon, infesting species in the Acestrorhynchidae, Erythrinidae, Cichlid, Curimatidae, Characidae, Cynodontidae, Loricaridae, Serrasalminidae and Sciaenidae (Luque et al., 2013; Tavares-Dias et al., 2014; Tavares-Dias et al., 2015; Oliveira et al., 2017). However, this is the first record of *B. patagonica* for *P. hemioliopus*.

The length-weight relationship is used to estimate the weight of fish when their length is known, and provides relevant information for fisheries (Ruffino & Isaac, 1995). In the present study, this relationship is representative of the growth of young and adult fish, which may have influenced isometric growth ($b = 2.8369$), which was

within the range expected for fish (Froese, 2006). However, there are no other growth records for *P. hemioliopus*. Isometric growth is the most desirable for fish cultivation and has also been recorded for other Pimelodidae such as *P. fasciatum* and *P. tigrinum* from a natural environment (Mateus & Penha, 2007). This seems to be characteristic for species whose feeding occurs at higher trophic levels (Barbieri, 1989). Moreover, such growth is an indication that the environment provides suitable food conditions for the development of *P. hemioliopus*, which exhibited proportional weight and body length growth.

Finally, the diversity of parasitic crustacean species was high in *P. hemioliopus*, with 5 species from 2 families and 3 genera. In general, the community of parasitic crustaceans was characterized by mixed infestation, low prevalence and low abundance, but with dominance of *D. discoidalis*.

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