

A candiru, *Paracanthopoma* sp. (Siluriformes: Trichomycteridae), associated with a thorny catfish, *Doras phlyzakion* (Siluriformes: Doradidae), in a tributary of the middle Rio Negro, Brazilian Amazon

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Abstract

Amazonian vampire catfish, known regionally as “candiru”, are recognized as hematophagous fishes, but information on their ecology remains limited. We provide the first report of *Paracanthopoma* sp. (Vandelliinae) found attached to the body surface of a thorny catfish, *Doras phlyzakion* Sabaj Pérez et Birindelli, 2008, below the lateral bony plates, rather than at the gills where they have usually been found. The specimens had not recently ingested blood or other identifiable fish remains (flesh, skin, or mucus), which could be an indication they have been using this host for protection or as a phoretic association, rather than for feeding. Thus, the interaction of vampire fish with the host catfish may be more complex than previously understood.

Keywords

candiru, vampire fish, interspecific fish relations, Actinopterygii, Siluriformes, Vandelliinae

Introduction

Although predation has often been considered the main interspecific relation structuring ecological communities (Menge and Sutherland 1987; Rodríguez and Lewis 1997; Okada et al. 2003; Piana et al. 2006; Petry et al. 2010), there are other biotic interactions that can be important to regulate the abundance of some species, such as parasitism, mutualism, and commensalism.

Candiru is the common name of Vandelliinae catfishes (Trichomycteridae) that are known to be para-

sites of other fish (de Pinna and Wosiacki 2003; Zuanon and Sazima 2004a, 2005) and sometimes humans (Spotte 2002). However, only species in the subfamily Vandelliinae are considered truly hematophagous parasites, feeding on blood extracted from the gill arteries of host fish (de Pinna and Wosiacki 2003; Zuanon and Sazima 2004a).

Some species of parasitic catfishes, such as those of the genus *Paracanthopoma* (Vandelliinae), seem to exhibit behavior of long-lasting attachment to their host fish, which may relieve them of the time and energy

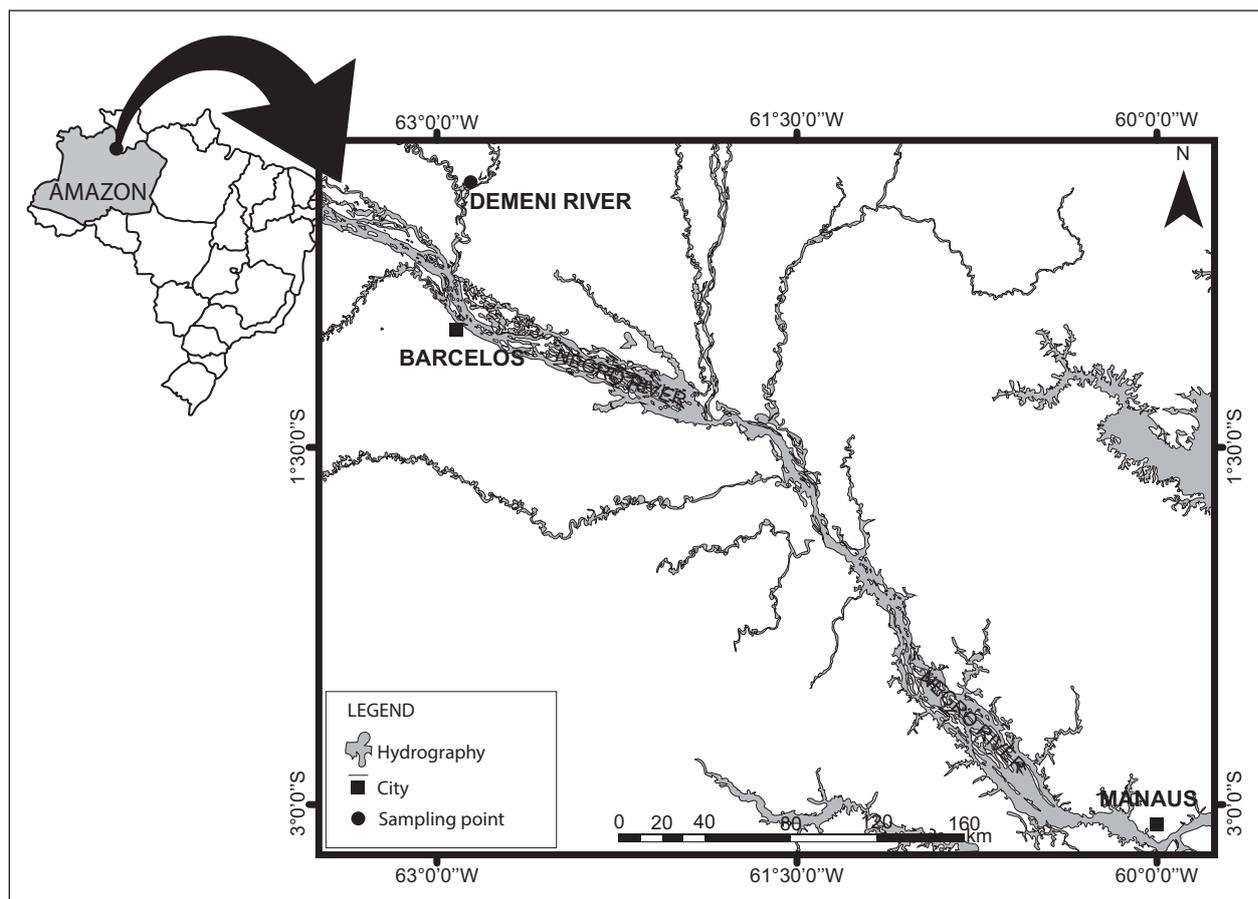


Figure 1. Location of the new occurrence of vampire fish (*Paracanthopoma* sp.) in the Demeni River, left bank tributary of the Negro River, Amazonas State, Brazil.

required to search for prey (de Pinna 2013). Attachment to a larger fish host may also offer a certain amount of protection against predation, especially since candirus are tiny and transparent, and therefore can avoid being noticed by visual predators while attached to their hosts (de Pinna 2013).

Zuanon and Sazima (2005) already reported an occurrence of individuals of *Paracanthopoma* sp. found attached to a large pimelodid catfish—*Zungaro zungaro* (Humboldt, 1821)—landed by a small-scale commercial fisherman. Here we present the first report of the occurrence of *Paracanthopoma* sp. attached to the body surface of a doradid thorny catfish, *Doras phlyzakion* Sabaj Pérez et Birindelli, 2008, a non-migratory species that was caught in a blackwater floodplain lake of the Negro River in Brazilian central Amazon.

Material and methods

The catch sample we examined was part of a study on the fish assemblages done on 7 April 2019, at a lake of the Demeni River basin ($0^{\circ}23'36.2''S$, $62^{\circ}51'43.4''W$), a left-bank tributary of the Negro River (Fig. 1). We used gillnets of 30, 40, and 60 mm mesh sizes, which remained in the water from 1700 h to 2100 h. All the

fish caught were identified, weighed [g], and measured (standard length, SL) [mm]. The collected fish were euthanized with benzocaine hydrochloride and fixed in 10% formalin. Subsequently, the samples were transferred to 70% ethanol and voucher specimens were deposited in the Fish Collection of the Instituto Nacional de Pesquisas da Amazônia (INPA, Manaus, Amazonas State; deposit number #59058). Fish samples were collected under the license SISBIO 22121.

A regression was performed to evaluate the host length vs. the number of parasites. The regression was performed using the software R version 4.0.2 (R Core Team 2020).

Results

Twelve specimens of the vampire catfish, *Paracanthopoma* sp. (Trichomycteridae, Vandelliinae), measuring 10.1–18.0 mm SL (15.7 ± 2.5 mm) were found attached to the body of nine adult specimens of *Doras phlyzakion* weighing 30–106 g (69.11 ± 25.40 g) and measuring 110–160 mm (141.9 ± 17.6 cm). Each specimen of *D. phlyzakion* hosted one or two specimens of *Paracanthopoma* sp. attached to the outside of the body near the lateral bone plates (Fig. 2), where several reddish wounds

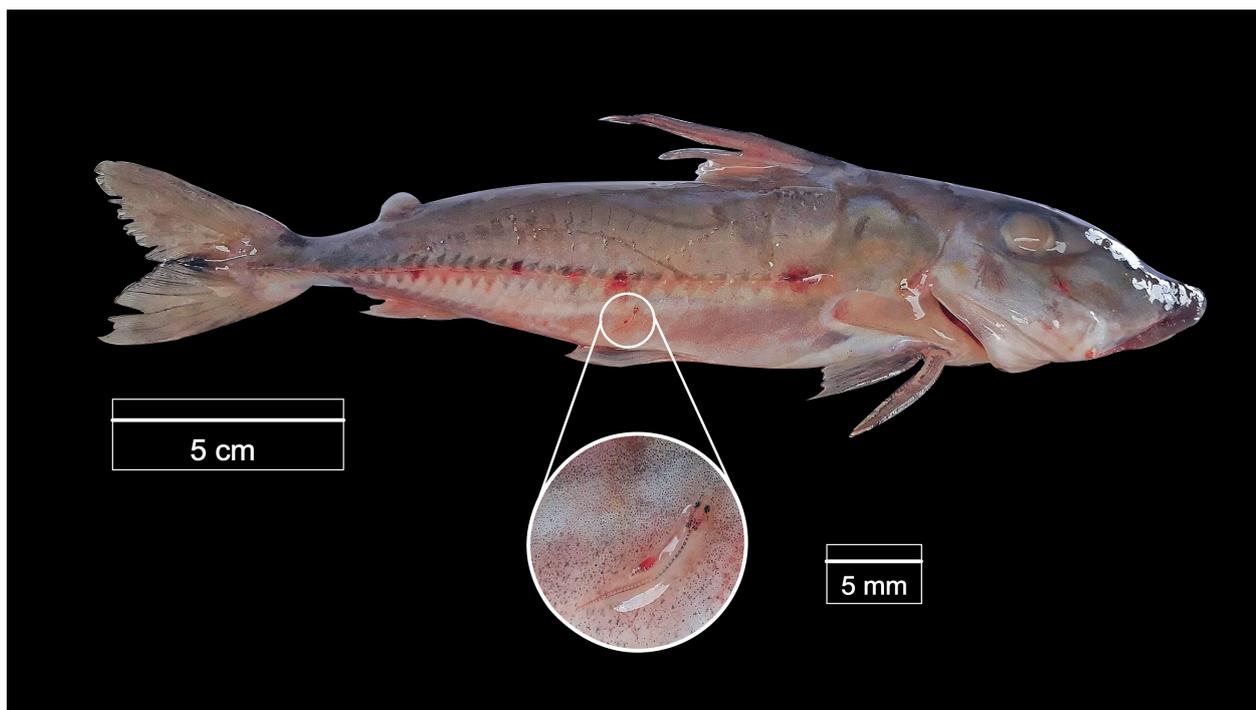


Figure 2. *Doras phlyszakion* with vampire fish (*Paracanthopoma* sp.) fixed into its epidermis close to the bony plates of the lateral line. Collected from the Demeni River, left bank tributary of the Negro River, Amazonas State, Brazil.

(small holes) were also observed. According to the values obtained from the regression, the length of the hosts explains approximately 50% the variation in the number of parasites (residual standard error = 0.6582, $r^2 = 0.4969$, $F = 8.901$, P -value = 0.02042). Therefore, larger fishes hosted more parasites.

Discussion

Paracanthopoma is a monophyletic genus of vampire catfish (Ochoa et al. 2020) that contain one described (*Paracanthopoma parva* Giltay, 1935) and several undescribed species (e.g., Pedroza et al. 2012). Fishes of the genus *Paracanthopoma* have long and robust snouts, with strong dentary teeth (Spotte 2002) that help them to attach to the epidermis of their hosts. However, a macroscopic analysis of the stomach contents of the preserved specimens of *Paracanthopoma* failed to detect coagulated blood or other fish remains such as flesh, skin, or mucus. Machado and Sazima (1983) hypothesize that the presence of vampire catfish attached to a host may be related to its inability to swim long distances by itself, which could indicate a phoretic relation. In that study, an individual of *Pseudoplatystoma fasciatum* (Linnaeus, 1766) (in fact, *Pseudoplatystoma reticulatum* Eigenmann et Eigenmann, 1889; see Buitrago Suárez and Burr 2007) was trapped on the river bank, and when removed from the water, individuals of a vampire catfish (*Paravandellia oxyptera* Miranda Ribeiro, 1912; Siluriformes: Trichomycteridae) left the body of the host. Vandelliinae and Stegophilinae species may perceive occasions when

a host is injured or at a disadvantageous situation, and take advantage to attach and feed on them (Machado and Sazima 1983).

Previously it has been reported that Vandelliinae species attach to the gills of their hosts for feeding (Machado and Sazima 1983; Spotte 2002; Zuanon and Sazima 2004b), which allows them to passively intake of blood pumped by the host's heart through gills arteries. During an ichthyological survey on the Orinoco River, Lasso et al. (2015) found two individuals of *Vandellia beccarii* Di Caporiacco, 1935 in the branchial chamber of two mature females of *Potamotrygon orbignyi* (Castelnau, 1855), as well as one individual of *Paracanthopoma* sp. on an adult male of *Potamotrygon scobina* Garman, 1913. Judging by the location of the vampire catfish, they would possibly be feeding on the hosts' blood, since species of Vandelliinae can be considered truly hematophagous parasites, feeding on blood extracted from the gill arteries of host fish (de Pinna and Wosiacki 2003; Zuanon and Sazima 2004a).

The absence of blood or other food remains in the stomach of the *Paracanthopoma* specimens apparently weakens the hypothesis of a parasitic relation with *D. phlyszakion*. However, such kind of relation cannot be discarded, since empty stomachs are a common fact among carnivorous fish and may reflect a momentaneous condition related to the time of collection of the candiru catfishes, as well as to a fast digestion rate of the ingested food. Despite this uncertainty, our finding of several *Paracanthopoma* individuals attached to the 9 collected individuals of *D. phlyszakion* suggests the existence of some strong interspecific association. For instance, the

association could provide some form of protection from predators to the candiru catfish (de Pinna and Wosiacki 2003; Zuanon and Sazima 2005). The candirus are tiny and nearly transparent, so they might pass unnoticed by predators while attached to the host catfish (de Pinna 2013). Moreover, the attachment near the sharp hooks of the lateral bony plates of the catfish host could strengthen the protective effect to the small candirus, which remains to be tested.

In addition to feeding and protection, riding on the host can greatly extend the movement capabilities of small candirus. Zuanon and Sazima (2005) found specimens of an undescribed species of *Paracanthopoma* attached to the body surface of *Zungaro zungaro*, a giant pimelodid catfish, and hypothesized that this could facilitate the dispersal of the candiru over the long migrations across the Amazon basin of their host. Enhanced dispersal does not seem to be the case of the association described here, since *D. phlyzakion* is not a migratory catfish. However,

the candirus may still benefit from short-distance movements by the host catfish by saving energy, while moving unnoticed to predators.

Conclusion

In conclusion, the observed interspecific association may combine elements of parasitism, protection from predators and a phoretic association between *Paracanthopoma* sp. and *D. phlyzakion*.

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