

Notes and Comments

***Lernaea cyprinacea* Linnaeus, 1758 (Cyclopoida: Lernaeidae) in ornamental fish from a commercial fish farm in the state of Pará, Brazilian Amazon**

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Brazil is on the rise in terms of ornamental fish farming (aquarism) (Brasil, 2019). Among the most important species cultivated in the country, those of the species *Carassius auratus* Linnaeus, 1758 (popularly known as goldfish) and *Xiphophorus hellerii* Heckel, 1848 (known as green swordtail) stand out because of the uniqueness in their color pattern as well as the characteristics of sexual dimorphism (Florindo, 2016).

The intensification in the breeding of ornamental fish may favor the loss of balance between the host-parasite environment, resulting in a higher manifestation and transmission of disease (Garcia et al., 2009; Martins et al., 2012). Among these, stand out those related to macroparasites such as *Lernaea cyprinacea* Linnaeus, 1758, a copepod crustacean of a cosmopolitan character, which was introduced in Brazil through carp originating from Hungary. The clinical signs involved in parasitism are imbalance, wandering swimming, lethargy, apathy, opacity in the eyes, hemorrhages in the body, cavitation areas on the fins, itching, and consequently, change in behavior (Florindo, 2016). The present work report the infestation by *L. cyprinacea* in ornamental fish of the species *X. hellerii* and *C. auratus* from a commercial farm in the state of Pará, Brazilian Amazon.

The animals evaluated in this study come from a commercial property dedicated to the creation of ornamental fish, located in the municipality of Santa Izabel do Pará, a municipality located in the metropolitan mesoregion of the state of Pará, Eastern Amazon, Brazil. In this property, an outbreak of ectoparasitism occurred in fish of the species *X. hellerii* (green swordtail) and *C. auratus* (Goldfish) that were kept in mixed cultivation in a 1m³ asbestos tank, which held a total of 50 fish. According to the person responsible for the creation, the outbreak occurred after the acquisition of a male goldfish originating from the municipality of Ananindeua, Pará, Brazil. The animal was introduced in the fish stock of the property that was free of infestation, without respecting a quarantine

period. For ectoparasite research, a random sampling of fish from both species was carried out, undergoing individual examinations through visual and physical inspection, biometrics, and sexing. The identification was based on morphology using the dichotomous key for genera and species of post-metamorphic females of the Lernaeidae family in South America, as proposed by Thatcher (2006).

A sampling of 40 individuals was carried out, being 28 *X. hellerii*. The individuals of this species were 12 males and 16 females, and presented a varied color pattern between albino, lyre and common. Through biometrics of this species, it was observed that the analyzed fish had an average total length of 8.53 cm (± 2.95 ; 5.5-11.5 cm). The species *C. auratus* was composed of 12 specimens, being two females, six males, and four young individuals of unidentified sex. The color pattern corresponded to pearl, oranda and telescope, and its average total length was 8.79 cm (± 1.54 ; 4-15.5 cm).

The parasites had morphological characteristics corresponding to the species *L. cyprinacea*: head with four large anchors, frequently branched; genital pore near posterior extremity; and fourth legs on hindbody (Figure 1). Regarding the prevalence rate, 75% (30/40) of the fish from both species were infested, from which 59 parasites were recovered (Table 1). The lesions were distributed in the vicinity of the pectoral fins, caudal, in the dorsal and ventral regions of the body, and in one animal, parasitism was observed in the region of the nostrils. The clinical signs of the fish of both species were anorexia, lethargy, and erratic swimming.

The present work presents important data on the infestation by *L. cyprinacea* in two species of exotic ornamental fish kept in a commercial farm in the state of Pará. Through this work, we highlight the importance of carrying out prophylactic measures to introduce new animals, such as quarantine and other hygienic-sanitary self-control measures to prevent disease outbreaks, like the one described in this research.

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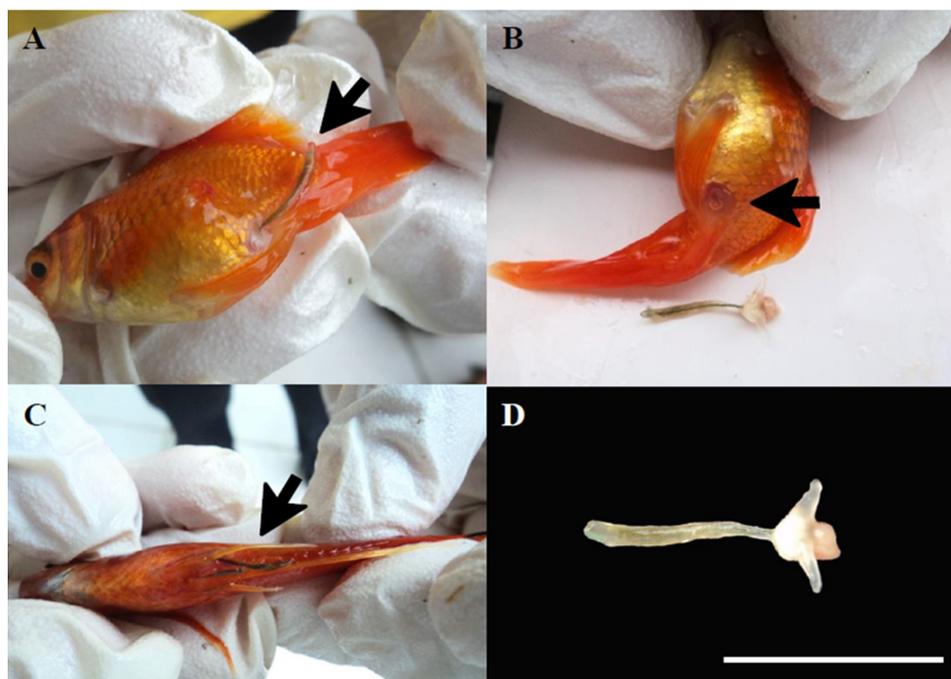


Figure 1. Parasitism by *Lernaean cyprinacea* in fish evaluated in the present study. (A) *Carassius auratus* fish presenting *L. cyprinacea* fixed anteriorly to the caudal fin (arrow); (B) Same specimen showing deep skin lesion (arrow) after removing the parasite; (C) *Xiphophorus hellerii* in prone position, presenting multiple specimens of *L. cyprinacea* fixed between the spine dorsal and soft dorsal fins; (D) Female *L. cyprinacea* (scale bar: 1 cm).

Table 1. Parasitic ecology indexes obtained for *Lernaean cyprinacea* in *Carassius auratus* and *Xiphophorus hellerii* from the present work.

Species	Prevalence rate	Prevalence rate - males	Prevalence rate - females	Mean intensity \pm SD*	Mean abundance \pm SD
<i>Xiphophorus hellerii</i>	85.7% (24/28)	100% (12/12)	75% (12/16)	2.45 \pm 1.54	2.10 \pm 1.58
<i>Carassius auratus</i>	50% (6/12)	33% (2/6)	50% (1/2)	1.16 \pm 0.40	0.58 \pm 0.66
Total	75% (30/40)	78% (14/18)	72% (13/18)	1.96 \pm 1.40	1.47 \pm 1.48

*SD: Standard deviation.

Freshwater fish specimens are grown in large proportions in shops spread across the world (Zuanon et al., 2011). Some of the most common ones are those of the species *X. hellerii* (green swordtail) and *C. auratus* (goldfish), as evaluated in this work (Zuanon et al., 2011; Florindo, 2016). According to Martins et al. (2007), the introduction of ornamental fish imported from several countries culminated in the spread of parasite infections, including Brazil, due to the growing trade in fishkeeping. Therefore, it can be said that the introduction of invasive species through this market has become an increasing risk worldwide (Peeler et al., 2011; Whittington and Chong, 2007).

The copepod *L. cyprinacea* parasite is a non-native species that was first cataloged in Brazil in the 1960s, being disseminated from then on to all Brazilian regions (Brasil, 2019). A study by Assis et al. (2014), confirmed the presence of *Lernaean cyprinacea* in four aquarium establishments in Aracaju, northeastern Brazil, including *C. auratus* and *X. hellerii*, corroborating the data obtained from the present study. The authors report that measures such as adopting quarantine and not disposing of waste

water in common sewage are actions that prevent the spread and establishment of the parasite, including from the point of view of environmental contamination and the possibility of infestation in native species. Other findings of *L. cyprinacea* in these hosts are also presented in Table 2.

The contamination that occurs in tanks/aquariums is believed to be due to cross-contamination, such as the insertion of different species in the same environment, management failures like breaking the quarantine period as well as the lack of technification and supervision of trained professionals who adequately guide the producer (Cardoso et al., 2017). These problems were also observed in this work, especially in relation to quarantine, which was not established when introducing an animal, resulting in harm to the squad, as reported by Cardoso et al. (2017). These authors emphasize that the isolation of these fish is mandatory, and it is essential to apply it in a period of time necessary for possible manifestation of signs and changes in illnesses, which is also reinforced by the present study.

Tavares-Dias et al. (2011) stated that diseases caused by parasites of the family Lernaecidae in fish populations have

Table 2. Comparative prevalence rate of *Lernaea cyprinacea* infestation in *Carassius auratus* and *Xiphophorus hellerii*.

Species	Prevalence rate	Location	Reference
<i>Carassius auratus</i>	50%	Pará, Brazil	Present study
	Absence	Santa Catarina, Brazil	Lami (2009)
	54*	Sergipe, Brazil	Assis et al. (2014)
	30%	Mazandaran, Iran	Adel et al. (2015)
<i>Xiphophorus hellerii</i>	85.7%	Pará, Brazil	Present study
	Absence	Santa Catarina, Brazil	Lami (2009)
	9*	Sergipe, Brazil	Assis et al. (2014)
	10.7%	Kerman, Iran	Mirzaei (2015)
	2.2%	Peradeniya, Sri Lanka	Thilakaratne et al. (2003)

*Absolute number of cases. The prevalence rate was not informed.

high and rapid capacity for dissemination and proliferation, mainly in captive animals (kept in tanks/aquariums), due to the closed breeding system. The author also states that normally in small fish, it is possible to visualize a more intense infestation by parasites, as was observed in the present study, where the fish presented up to seven parasites adhered to the surface of the body. In a study conducted in São Paulo on the fauna of ectoparasites in several species of ornamental fish, including *C. auratus* (n = 31) and *X. hellerii* (n = 8), Cardoso et al. (2019) reported that 80% (215/268) of all fish sampled were infested with parasites, although only 4.5% (10/215) of these were infested with *Lernaea* spp.. The study showed a low prevalence rate compared to the percentages obtained in this study, in which the prevalence was 75% (30/40).

Fernandes (2003) reported that infestation by *Lernaea* spp. leads to high mortality rates, reaching up to 100% of a squad, if there is no adequate treatment in a timely manner and also depending on the parasitic intensity. In addition, the consequences revolve around the damage done to the appearance of the fish, due to injuries caused by copepod hooks when adhering to the skin and musculature, as evidenced in the animals of the present study.

The parasitized animals showed a higher frequency of ectoparasite in the dorsal and caudal regions, especially in the fins, findings similar to those previously described by Gallio et al. (2007). The injuries caused in these regions can evolve into ulcerations and deep injuries, providing secondary infections, according to Cardoso and Balian (2016). Regarding clinical signs, Florindo (2016) described that the infested animals show, among other signs, weight loss, anorexia, erratic and lateralized swimming, lethargy, and reduced growth rate. Some of these signs were also observed in the animals in the present study, which had anorexia, lethargy, and erratic swimming.

As described by Cardoso and Balian (2016), and reinforced by the present work, monitoring by veterinarians in these establishments is essential, in order to plan and establish preventive measures, hygienic-sanitary control, and treatment of animals to safeguard the squad's health.

The present study detected a high prevalence of infestation by *L. cyprinacea* in ornamental fish of the species *C. auratus* and *X. hellerii* in a commercial farm

in Santa Izabel do Pará, Brazil. The data found reinforce the importance of using quarantine to introduce newly acquired animals, for the prevention of disease outbreaks as the one described in this research.

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