Gussevia spiralocirra (Monogenea: Dactylogyridae) in farmed *Pterophyllum scalare*

Gussevia spiralocirra *(Monogenea: Dactylogyridae) em cultivo de* Pterophyllum scalare

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Abstract

The monogenean parasites are one of the most important pathogens causing economic losses in fish farming worldwide. This study aimed to evaluate parasitological indexes of *Gussevia spiralocirra* in juvenile *Pterophyllum scalare*, in the warm and cool season. A total of 34 fish were examined for parasitological analysis and the water quality was measured during the experimental period. The gills were fixed in 5% formalin solution for quantification and the parasites were mounted in Hoyer´s medium for identification. The parasitic species was identified as *Gussevia spiralocirra*, and presented a prevalence of 100%. The mean abundance and mean intensity of infestation were significantly higher in fish during the warm season (784.0 ± 393.9) than that observed in the cool season (418.0 ± 111.2). Temperature did influence the biology of *G. spiralocirra* possibly by increasing the oviposition rate. This study presents important data that can be used for implementation of best management practices in ornamental *P. scalare* farming, especially in the hottest seasons of the year.

Keywords: *Cichlidae*. Ectoparasite. Monogenean. Temperature.

Resumo

Os parasitos monogenéticos são um dos patógenos mais importantes que implicam em perdas econômicas na piscicultura em todo o mundo. Este estudo teve como objetivo avaliar os índices parasitológicos de Gussevia spiralocirra *em juvenis de* Pterophyllum scalare*, nas* *estações quente e fria. Um total de 34 peixes foi examinado para análise parasitológica e a qualidade da água foi mensurada durante o período experimental. As brânquias foram fixadas em solução de formalina 5% para quantificação e os parasitos montados em Hoyer's para identificação. A espécie parasitária foi identificada como* Gussevia spiralocirra*, e apresentou prevalência de 100 %. A abundância média e a intensidade média de infestação foram significativamente maiores nos peixes durante a estação quente (784,0 ± 393,9) do que na estação fria (418,0 ± 111,2). A temperatura influenciou a biologia de* G. spiralocirra*, possivelmente aumentando a taxa de oviposição. Este estudo apresenta dados importantes que podem ser usados para a implementação de boas práticas de manejo na produção de* P. Scalare*, especialmente nas estações mais quentes do ano.*

Palavras-chave: Cichlidae. *Ectoparasito. Monogenéticos. Temperatura.*

Introduction

The angelfish *Pterophyllum scalare* (Schultze, 1823) from the Amazon basin is one of the most popular ornamental freshwater fish species in the world (Fujimoto et al., 2006). It has high commercial value and it's among the eight most commercialized species of ornamental fish worldwide (Chapman et al., 1997). Despite the great potential for growth and development, one of the production bottlenecks is the lack of understanding of the different diseases that affect ornamental fish breeding (Hoshino et al., 2018), that associated to inadequate management can lead to economic losses (Klesius and Rogers, 1995; Martins et al., 2015).

Parasitic diseases constitute a significant cause of fish mortality in fish farms and depending on the region they can spread rapidly (Pavanelli et al., 2008). Among them, the ectoparasite monogenean helminthes present rapid dissemination in favorable environment in global aquaculture (Jerônimo et al., 2011; Cohen, 2013) especially due to their monoxenic life cycle (Goldstein, 2001). Besides, they present high host specificity when compared to other helminthes (Poulin, 1992; Boeger and Viana, 2006; Tavares-Dias et al., 2009) and some present seasonal pattern (Boeger and Viana, 2006; Neves et al., 2013; Tavares-Dias et al., 2014) related to water temperature and conductivity, as observed in the oviposition of *Aphanoblastella mastigatus* (Suriano, 1986; Marchiori et al., 2015).

The genus *Gussevia* includes parasite species of cichlid fishes (Kritsky et al., 1989; Pantoja et al., 2015), being a concern to fish farmers by the fact that they reproduce rapidly in both tropical and subtropical regions favored by the abiotic conditions such as temperature (Flores-Crespo and Flores, 2003). According to Jackson and Tinsley (1998), the egg production of monogeneans might be influenced by environmental changes. In fact, studies have indicated the influence of temperature on the dynamic of monogenean population (Buchmann, 1988; Ernst et al., 2005; Tubbs et al., 2005).

This study evaluated the monogenean infestation by *Gussevia spiralocirra* (Monogenea, Dactylogyridae) in the gills of fingerlings of *P. scalare* farmed during the warm and cool season.

Methods

In December 2008, 24 angel fishes (*P. scalare*), used in this study, were captured in rio Tapajós (Amazon Basin) and acquired from an ornamental fish shop in Joinville (Santa Catarina). Males and females (12 of each) were maintained in six 1,000 L tanks (provided with constant water renewal), with two couples per tank, fed daily *ad libitum* with commercially available fish food. All tanks were cleaned and disinfected (quaternary ammonia) before use. Dissolved oxygen was maintained at 5.10 mgL^{-1}, pH values ranged from 6.5 to 6.9 and water temperature between 27 and 32°C. After reproduction, the broodstock were removed to perform the nursery.

During nursery the fish were kept in a polyethylene tank with 1,000 L capacity, provided with a continuous flow of water and fed powder dry diet Guabi 55% of crude protein at the Aquaculture Laboratory of Instituto Federal Catarinense (IFC), in Araquari (26° 22' 12" S e 48° 43' 20" W), SC, Brazil. Water temperature and dissolved oxygen were measured with YSI Pro 20 (Yellow Springs, USA) and pH was measured with Hach pH test kit 17-N (USA); warm season (temperature 30.2 ± 1.34 °C, dissolved oxygen 4.4 ± 1.74 $mg.L^{-1}$, pH 6.9 ± 0.10), cool season (temperature 21.3 ±

0.83 °C, dissolved oxygen 4.5 ± 1.65 mg.L^{-1}, pH 7.0 ± 0.10). During the nursery period, 34 fingerlings (14 fish in 2009 March at the warm season and 20 fish in 2009 May at the cool season) of angelfish (*P. scalare*) with 1.05 ± 0.56 g were collected for parasitological analysis.

After capture, the fish were quickly anesthetized in eugenol solution (75 mg.L^{-1}), euthanized by transection of the spinal column and the gills were removed, bathed in hot water 55 °C, shaken and fixed in 5% formalin solution for posterior counting. Parasites were mounted in Hoyer´s medium (Humason, 1979) and identified according to Kritsky et al. (1986). Prevalence, mean abundance and mean of infection were calculated according to Bush et al. (1997). Descriptive statistics to observe the normality and variance homogeneity were calculated using the software Statistic to posterior assessment with T-Student test with 5% of significance.

Results and discussion

Water temperature was significantly higher ($p < 0.05$) in the warm season than the cool season (Figure 1). Parasites were identified as *Gussevia spiralocirra,* based on Kritsky et al. (1986) morphological description. The parasitological indexes of *P. scalare* parasitized by *G. spiralocirra* were 100% prevalence, and the mean intensity and mean abundance of parasites were significantly ($p < 0.05$) higher in warm season (784.0 ± 393.9) than that found in cool season (418.0 ± 111.18) (Table 1).

Table 1 - Parasitological indices of *Pterophyllum scalare* parsasitized by *Gussevia spiralocirra*

Parasitological indices	Warm season	Cold season
Prevalence (%)	100.0 ± 0.0*	100.0 ± 0.0*
Mean intensity (n)	784.0 ± 393.9*	418.0 ± 111.2
Mean abundance (n)	784.0 ± 393.9*	418.0 ± 111.2

Note: *It indicates significant difference between warm and cool season ($p < 0.05$) by t-Student test.

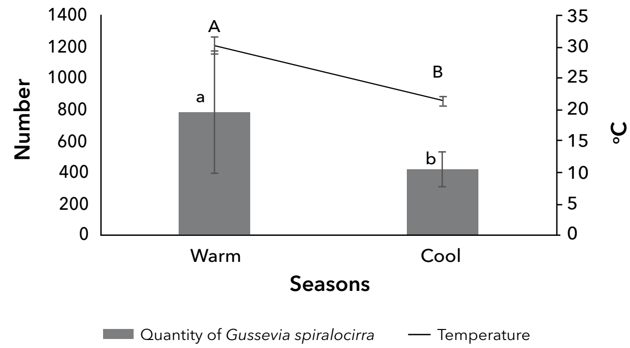

Figure 1 - Quantity of *Gussevia spiralocirra* in *Pterophyllum scalare*. Uppercase letters indicate significant difference in temperature, and lowercase letters indicate significant difference in the number of parasites between the hot and cold season ($p < 0.05$) by the t-Student test.

Water quality parameters were kept within the range for tropical species (Baldisserotto and Gomes, 2010). Some studies have related the parasitism by Gussevia genus in cichlid fishes (Kritsky et al., 1989; Vidal-Martinez et al., 2001; Mendoza-Franco et al., 2010; Yamada et al., 2011; Mathews-Delgado et al., 2012), including angelfish from a river in the Amazon basin (Ferreira-Sobrinho and Tavares-Dias, 2016). In South America, 13 species of the genus *Gussevia* were described (Kritsky et al., 1986, 1989), showing its host specificity and easy dissemination (Mathews-Delgado et al., 2013).

Environmental alterations can influence not only the biology of the hosts but also the parasite life cycle and in its reproduction (Takemoto et al., 2009; Silva et al., 2011; Tavares-Dias et al., 2014). Similar to that, observed in this study, increased water temperature contributed to development and egg production of *Diplectanum aequans* parasite of European seabass, *Dicentrarchus labrax* (Cecchini et al., 1998). Positive correlation between temperature and oviposition in monogenean parasites was also reported with *Pseudodactylogyrus bini* in European eel (*Anguilla anguilla)* (Buchmann, 1988), *Protopolystoma xenopodis* in African clawed toad (Jackson and Tinsley, 1998), *Benedenia seriolae* and *Zeuxapta seriolae* in yellowtail kingfish (*Seriola lalandi)* (Tubbs et al., 2005), *Dactylogyrus extensus* in carp (*Cyprinus carpio)* (Turgut, 2012), and with *Aphanoblastella mastigatus* in jundiá (*Rhamdia quelen)* (Marchiori et al., 2015).

Conclusion

Based on these results, we suggest a constant parasitological monitoring in fish at ornamental fish farms,and the implementation of good production practices. As well, preventive baths can be evaluated to reduce economic losses, especially in the hottest seasons of the year.

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