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Héctor Flores, María Fernanda Gómez & Héctor Basaure

Universidad Católica del Nort

INTRODUCTION

Seriolella violacea Guichenot, 1848 (Centrolophidae), commonly known as the palm ruff, is a commercially important endemic fish species in the Eastern South Pacific, the capture of which has significantly decreased in recent decades (Oliva, Parker, Miranda & Martínez 1996; Chirichingo & Velez 1998). This epipelagic resource is vital to small scale fishery activities and is one of the most consumed fish, by regional human populations. Providing alternative production methods and studying the factors that affect the health of this species are important for achieving its successful maintenance under reared conditions.

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Héctor Flores[α], María Fernanda Gómez[σ], Héctor Basaure[ρ]

Author α: Departamento de Acuicultura, Facultad de Ciencias del Mar, Universidad Católica del Norte, Chile.
σ ρ: Departamento de Biología Marina, Facultad de Ciencias del Mar, Universidad Católica del Norte, Chile.
α: Centro de Innovación Acuícola Aquapacífico, CORFO 15 PCTI-46284 Aquapacifico, Chile
α: Red CYTED LARVAplus

I. INTRODUCTION

Seriolella violacea Guichenot, 1848 (Centrolophidae), commonly known as the palm ruff, is a commercially important endemic fish species in the Eastern South Pacific, the capture of which has significantly decreased in recent decades (Oliva, Parker, Miranda & Martínez 1996; Chirichingo & Velez 1998). This epipelagic resource is vital to small scale fishery activities and is one of the most consumed fish, by regional human populations. Providing alternative production methods and studying the factors that affect the health of this species are important for achieving its successful maintenance under reared conditions.

Close to 18 parasite species have been reported for *S. violacea* (Tantalean, 1974; Castro & Baeza 1985; Escalante & Miranda 1986; Luque, Iannacone & Farfán 1991; Avdeev 1992; Tantaleán & Huiza 1994; Ruelas & Córdova 1997a,b; Iannacone 2003; Valdebenito 2008). Several of these parasites can affect humans (Escalante & Miranda, 1986), mainly when *S. violacea* is consumed raw (Quijada, Lima & Avsalov 2005; Valdebenito 2008). Pathologies such as diphyllobothriasis and anisakiasis can develop, both of which are worldwide problems for human populations (Ferre 2001; Ogawa 1996; Quijada *et al.* 2005).

Considering the health concerns triggered by the parasites that affect *S. violacea*, together with the lack of knowledge regarding the incidence of parasites in this fish species under reared conditions, the aim of this study was to determine the incidence of parasitic fauna (ecto-and endoparasites) in cultivated palm ruffs over one year in a cage culture system.

Seriolella violacea were obtained from broodstock maintained by the Universidad Católica del Norte that spontaneously spawn in the winter. *S. violacea* eggs, larvae, and juveniles were incubated for 10 months in circular, land-based tanks. Fish were fed with a formulated diet developed by BioMar from the first feeding. Once the fish reached a total approximate weight of 200 g, they were transferred to the sea (May 2012) where they were maintained for one year in a cage culture system in the Bay of La Herradura, Coquimbo, Chile until harvest (April 2013). Fish were kept at a culture density of 3 kg/m^3, an average temperature of 15.5°C, and an oxygen concentration of 7.2 mg/L. During the harvest, 22 *S. violacea* individuals were collected and transported to the Zoology Laboratory of the Faculty of Marine Sciences at the Universidad Católica del Norte. The total weight, fork length, and total length were recorded for each fish. Following this, each sample was externally and internally examined for the presence of parasites following the methods described by Salgado (2007) and González, Vásquez, Farfán, Villalobos & Turis (2013).

To identify and quantify ectoparasites, the fins, the gill arches, and the buccal cavity were assessed

under a stereoscopic microscope. To identify endoparasites, the gonads, mesentery, and coelomic cavity were assessed under a stereoscopic microscope. The stomach and intestines were opened, and the gastrointestinal contents were collected in a seawater solution, filtered through a 278 µm sieve, and observed under a stereoscopic microscope. To analyze the muscle, a left- or right-side tissue sample was randomly selected and extracted. The extracted tissue was compressed between two slides (Salgado 2007) and analyzed under a stereoscopic microscope. To identify the collected parasites, the catalogs of Tantalean (1974) and Brusca (1981) were used.

Based on the collected, identified, and quantified parasites, the prevalence for each recorded parasite was determined. The collected parasites were stored in the Biological Collections Archive of the Faculty of Marine Sciences at the Universidad Católica del Norte under registries SCBUCN 4757 and 4758.

After one year in a cage culture system, fish had an average total weight of 803.2 ± 215.3 g, fork length of 33.7 ± 3.4 cm, and total length of 36.6 ± 3.8 cm (Table 1). Next, the parasites found in the different tissues of palm ruffs were analyzed under a stereoscopic microscope. Two ectoparasite species were identified, each in a different host sample. No endoparasites were found.

One of the ectoparasites was the isopod *Ceratothoa gaudichaudii* (H. Milne Edwards, 1840), found in the buccal cavity of one fish. The other ectoparasite was *Paraeurysorchis sarmientoi* of the Monogenea class (Tantalean, 1974), found in the gill filaments (Table 2). Each of these parasites had a prevalence of 4.5%.

Low indexes of ectoparasite prevalence (4.5%) and no endoparasite prevalence were observed in juvenile *Seriolella violacea* cultivated for one year under a cage culture system. This recorded ectoparasite incidence is lower than the prevalence of *P. sarmientoi* found for wild fish in Peru (14%) (Iannacone 2003) and Chile (80 and 45%; Antofagasta 23°38'S and Talcahuano 36°43'S, respectively) (Valdebenito 2008).

Paraeurysorchis sarmientoi belongs to the Monogenea (Platyhelminthes) class of flatworms and negatively affects economically important fish species worldwide (Sitjà-Bobadilla & Álvarez-Pellitero, 2009; Sitjà-Bobadilla, Redondo & Álvarez-Pellitero 2010). These high-risk parasites are the cause of epizootic diseases that, in turn, result in significant losses for the aquaculture industry (González *et al.* 2013). Specifically, Monogenea species damage gill lamellae, leading to hemorrhages and anemia, obstructed water flow, and decreased feed consumption by the affected host (Sitjà-Bobadilla & Álvarez-Pellitero, 2009; Sitjà-Bobadilla *et al.*, 2006). These parasites have a greater impact on cultures, where fish are kept at high densities and where Monogenea species can rapidly propagate and easily transfer between fish hosts (Thoney & Hargis Jr. 1991).

The other ectoparasite, *Ceratothoa gaudichaudii*, has not been reported in *S. violacea* in Peru, but in Chile, prevalence is 5% (Antofagasta) and 45% (Talcahuano) for wild fish (Valdebenito 2008). Infestation prevalence in Antofagasta (5%) is close to that reported for cultivated *S. violacea* in Coquimbo (4.5%). This seems to indicate that prevalence of this ectoparasite increases with latitude. The geographical distribution of *C. gaudichaudii* is extensive, reaching from the Gulf of California until Cape Horn. Related to this, *C. gaudichaudii* is frequently reported in the coastal fish populations of Ecuador, Peru, and Chile (Sievers, Lobos, Inostroza & Ernst 1997; Molina & Manrique 1996). In Chile, *C. gaudichaudii* has been reported in 12 fish species, both wild and cultivated (Muñoz & Olmos 2007). Moreover, this parasite affects a diverse range of pelagic species, including the Chilean jack mackerel (*Trachurus murphyi*), Pacific bonito (*Sarda chilensis*), and yellowtail kingfish (*S. lalandi*), in addition to coastal species such as the grape-eyed seabass (*Hemilutjanus macrophthalmo*) and Peruvian rock seabass (*Paralabrax humeralis*) (Jaramillo

1977; Molina & Manrique 1996; González *et al.* 2013). This parasite has also been reported in a number of cultured species, such as the Atlantic salmon *Salmo salar* (Inostroza, Sievers, Roa & Aguirrebeña 1993, Sievers, Lobos & Inostroza 1997), Coho salmon *Oncorhynchus kisutch* (Bravo, 1987), and rainbow trout *Oncorhynchus mykiss* (González, Carvajal & Medina 1997). *Ceratothoa gaudichaudii* represents a high risk for the aquiculture industry as infestations can reduce the total weight of fish by 15%, translating into significant economic losses (Sievers *et al.* 1996). Altogether these data suggest a positive outcome for the cage culture system in Coquimbo, as specifically supported by the low parasite prevalence index observed for *S. violacea*.

In wild individuals of *S. violacea* from Chile, nine endoparasite species have been reported (Talcahuano 6 species; Antofagasta 7 species; and 4 species for both locations). Prevalence rates of these endoparasites vary from 5 to 100% for the different reported species (Valdebenito 2008). The lack of endoparsites in cultivated *S. violacea* is probably the result of fish feeding on a formulated diet instead of natural resources, which is the principal entry path of distinct endoparasitic species. This is a favorable observation in terms of food safety, providing a guarantee of health for the consumer. Moreover, cultivated *S. violacea* could be consumed raw with a lower risk of ingesting parasite larvae that could provoke diphyllobothriasis or anisakiasis, as occurs with wild fish. The prevalence of parasite infestation in *S. violacea* using a cage culture system is low (4.5%), with a singl *C. gaudichaudii* found in the buccal cavity and a single *P. sarmientoi* found in the gill filaments. No endoparasites were observed. This represents the first parasitological study in cultivated palm ruffs and provides relevant parasitological information for this commercially important fish. The results of this study also indicate that cultured *S. violacea* could be a safer option for human consumption, with a decreased risk for contracting diseases such as diphyllobothriasis or anisakiasis. Further epidemiological studies assessing the effects of cultivated palm ruffs on human health would provide important insight regarding this subject.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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