



Observations on parasite fauna of *Centropomus undecimalis* and *C. parallelus* (Perciformes) bred in southern Brazil, and its possible influence on the welfare of fishes

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Abstract The metazoan parasite fauna of snooks, *Centropomus parallelus* and *Centropomus undecimalis*, cultured in southern Brazil and parasite's influence on the relative condition factor (Kn), are investigated. Snooks were parasitized by two species of gill monogeneans belonging to *Rhabdosynochus* (Diplectanidae) genus and by one endoparasitic digenean species *Acanthocolaritrema umbilicatum* (Acanthocolaritremitidae). *Centropomus parallelus* and *C. undecimalis* showed similar prevalence rates of *Rhabdosynochus* spp., but greater mean intensity and abundance rates were found in *C. parallelus*. On the other hand, there was no significant difference on prevalence, mean intensity and abundance of *A. umbilicatum* for both hosts. The mean abundance of *Rhabdosynochus* spp. decreased as the hosts' length and weight increased. Since the most parasitized fish species, *C. parallelus*, had lower weight than expected (Kn<1.0), the fact suggested that gill monogeneans might alter fish welfare. Current analysis reports a new host and a new locality for *A. umbilicatum*.

Key words: snook, body condition, parasitology, Monogenea, Digenea, health

Resumen. Observaciones sobre la fauna de parásitos de *Centropomus undecimalis* y *C. parallelus* (Perciformes) cultivado en el sur de Brasil, y su posible influencia en el bienestar de los peces. En este estudio se investigó la fauna de parásitos metazoos de robalos *Centropomus parallelus* y *Centropomus undecimalis* cultivados en el sur de Brasil, así como la influencia de los parásitos en el factor de condición relativa (Kn). Los robalos estaban parasitados por dos especies de monogéneos branquiales pertenecientes al género *Rhabdosynochus* spp. (Diplectanidae) y uno endoparásito digéneo *Acanthocolaritrema umbilicatum* (Acanthocolaritremitidae). *Centropomus parallelus* y *C. undecimalis* mostraron tasas de prevalencia similares de *Rhabdosynochus* spp., sin embargo mayores intensidad y abundancia media fueron observadas en *C. parallelus*. Además, ninguna diferencia significativa en la prevalencia, la intensidad y la abundancia media de *A. umbilicatum* para ambos hospederos fue observada. La abundancia media de *Rhabdosynochus* spp. disminuyó con el

aumento de la longitud y del peso en ambos los hospederos. La especie más parasitada, *C. parallelus*, tenía peso inferior a lo esperado ($Kn < 1,0$), lo que sugiere que los monogéneos branquiales pueden alterar el bienestar de los peces. Este estudio reporta un nuevo hospedero y una nueva localidad para *A. umbilicatum*.

Palabras clave: robalo, factor de condición, parasitología, Monogenea, Digenea, salud

Introduction

Species of *Centropomus* Lacépède, 1802 (Centropomidae) are widely distributed in the American Atlantic and Pacific tropical and subtropical waters (Rivas, 1986). In Brazil, the centropomid common snook *Centropomus undecimalis* (Bloch, 1792) and fat snook *Centropomus parallelus* (Poey, 1860) may be found along the coast of the northern states of Pará and Amapá and extend southward towards the state of Rio de Janeiro (Cerqueira, 2010). These fish species are considered potentially important and economically valuable for Brazilian marine aquaculture due to the quality of their meat, sport fishing and larvae obtainment by induced spawning (Temple *et al.*, 2004; Cerqueira, 2010).

Intensive breeding of snooks, however, may lead to the occurrence of infectious and non-infectious diseases. According to Cerqueira (2010), snooks are sensitive to low environmental quality, which conditions them to stress and diseases (Barbosa *et al.*, 2011). It is therefore important to understand how to detect diseases early and their effects on fish host so that decisions for management or control may be taken.

In the field of fisheries science, several studies have been devoted to the understanding of the relation between host's body condition and parasitism (eg. Ranzani-Paiva & Silva-Souza, 2004; Lizama *et al.*, 2006; Yamada *et al.*, 2008). The basic assumption underlying the use of such relation is that parasitic interaction with the host may negatively affect its welfare. In addition, the relative condition factor (Kn) is also a quantitative indicator of fish's health, both acting as interesting tools for the study of host-parasite relationship (Lizama *et al.*, 2006).

Helminth parasites registered in *C. undecimalis* from the coast of Rio de Janeiro were the digenea *Acanthocolaritrema umbilicatum* Travassos, Freitas & Bürhheim, 1965 (Gomes *et al.*, 1972; Wallet & Kohn, 1987; Tavares & Luque, 2001; Tavares & Luque, 2004), the monogeneans *Rhabdosynochus hargisi* (Tavares & Luque, 2004) and *R. guanduensis* (Abdallah *et al.*, 2012), the acantocephalan *Corynosoma* sp. and the larvae of *Contracaecum* sp. (Tavares & Luque, 2004). On the

other hand, in the case of *C. parallelus* from Itamaracá, PE, Brazil, the occurrence of *A. umbilicatum* (Robaldo & Padovan, 1998), *R. rhabdosynochus* (Mizelle & Blatz, 1941), *R. hargisi*, *R. hudsoni* (Kritsky, Boeger & Robaldo, 2001) and *Rhabdosynochus* sp. (Kritsky *et al.*, 2001) was reported. In Florida (USA), *C. undecimalis* was found to be parasitized by *R. rhabdosynochus*, *R. hargisi* and *R. hudsoni*, while *C. parallelus* was infested by *R. rhabdosynochus* and *R. hudsoni* (Kritsky *et al.*, 2010).

The metazoan parasite fauna of *C. parallelus* and *C. undecimalis*, bred in southern Brazil, and its influence on the Kn of hosts, are investigated.

Materials and Methods

Specimens of *C. parallelus* and *C. undecimalis* were obtained from the Yakult pisciculture farm (26° 32' 21" S; 48° 39' 14" W) in the municipality of Barra do Sul, state of Santa Catarina, southern Brazil, between November 2011 and May 2012. Fish were maintained separated per species in 1.2-hectare ponds, fed twice a day with a commercial diet (extruded, 45% protein) and were up to a year and a half old by the time of their capture.

Immediately after collection, fish were transported in plastic bags with oxygen to the laboratory, where they were examined. After anesthetized with eugenol (75mg/L), forty-four specimens of *C. parallelus* and twenty specimens of *C. undecimalis* were weighed and measured (total length). Next, they were euthanized by deepening the anaesthetized condition for parasitological analysis. Methods of parasite collection and preparation were used following Eiras *et al.* (2006) and parasitological descriptors were performed as recommended by Rohde *et al.* (1995) and Bush *et al.* (1997).

The relative condition factor (Kn) (Le Cren, 1951; Ranzani-Paiva & Silva-Souza, 2004) was calculated by using total weight and total length rates of the examined specimens.

Statistical analysis

Mean intensity and abundance were tested for normality by Kolmogorov-Smirnov's test.

Prevalence rates of each parasite species for *C. parallelus* and *C. undecimalis* were submitted to the chi-square test (χ^2) (with Yates continuity correction). Differences in weight, length, intensity of infection and abundance between the two fish species were evaluated with Mann-Whitney's (U) test. The Spearman's rank correlation coefficient (rs) was calculated to investigate correlation of parasite abundance with host length, weight, and relative condition factor (Kn) (Zar, 2010). Mean Kn rates of the two fish hosts were compared to standard Kn = 1.0 by Student's *t* test. All statistical analyses were carried out with Sigma Stat 3.5.

Results

C. parallelus and *C. undecimalis* differed in mean weight ($U=178.0$, $p=0.001$) and length ($U=108.5$, $p=0.0001$) rates (Table I). Relative condition factor (Kn) of *C. parallelus* was lower than standard Kn ($t=-11.913$; $p=0.001$) and that of *C. undecimalis* ($U=45.0$, $p=0.001$) (Table I). Conversely, Kn value for *C. undecimalis* ($t=0.0925$, $p=0.927$) did not differ from standard Kn rate (Kn=1.0).

A negative correlation between monogenean abundance and length (Lt), weight (Wt) and HSI was reported in *C. parallelus*, ($rs=-0.6117$, $p<0.0001$; $rs=-0.6197$, $p<0.0001$; $rs=-0.4482$, $p=0.0023$). In the case of *C. undecimalis*, a negative correlation

between monogenean abundance and fish length and weight was also observed ($rs=-0.6993$, $p=0.0006$; $rs=-0.7140$, $p=0.0004$), except for the non-significant positive correlation between abundance and HSI ($rs=0.1912$; $p=0.4192$).

The monogeneans *Rhabdosynochus rhabdosynochus* Mizelle & Blatz, 1941 and *Rhabdosynochus hudsoni* Kritsky, Boeger & Robaldo, 2001 (Diplectanidae) were registered in the gills of *C. parallelus* and *C. undecimalis*, whereas in the digestive tract the digenean *Acanthocollaritrema umbilicatum* Travassos, Freitas & Bürhheim, 1965 (Acanthocollaritrematidae) was reported. Prevalence of *Rhabdosynochus* spp. was high, with the same rates in the two fish species. Contrastingly, mean intensity ($U=228.0$, $p=0.0021$) and abundance ($U=228.0$, $p=0.0021$) were higher in *C. parallelus* (Table II).

Prevalence ($\chi^2=0.051$, $p=0.940$), mean intensity ($U=33.0$, $p=0.446$) and mean abundance ($U=431.0$, $p=0.896$) of *A. umbilicatum* were found to be similar for *C. parallelus* and *C. undecimalis* (Table III). Conversely, parasite's site of infection varied: while in *C. parallelus* the parasite was reported in the intestine (prevalence=18.2%, mean intensity=3.5) and in the stomach (prevalence=13.6%, mean intensity=1.2), the intestine of *C. undecimalis* was the only locus of the parasite (prevalence = 30.0%).

Table I. Biometry, and relative condition factor (Kn) of *Centropomus parallelus* and *Centropomus undecimalis* cultured in south Brazil. Mean rates \pm standard deviations are followed by minimum and maximum values between parentheses.

Parameters	<i>C. parallelus</i> (n=44)	<i>C. undecimalis</i> (n=20)
Total weight (g)	58.2 \pm 39.14 ^b (13.0-116.0)	148.6 \pm 83.9 ^a (20.4-264.2)
Total length (cm)	17.8 \pm 4.0 ^b (11.5-23.2)	25.8 \pm 5.3 ^a (14.3-32.3)
Kn	0.781 \pm 0.121 ^b (0.650-1.053)	1.001 \pm 0.014 ^a (0.934-1.039)

Different letters indicate significant difference between fish species by Mann-Whitney's test (U) ($p < 0.05$)

Table II. Infection by *Rhabdosynochus* spp. in the gills, and by *Acanthocollaritrema umbilicatum* in the intestine of *Centropomus* spp. cultured in south Brazil. PF: parasitized fish, EF: examined fish, P: prevalence (%), MA: mean abundance, MI: mean intensity.

Parasites	<i>Centropomus parallelus</i>			
	PF/EF	P	MA	MI
<i>Rhabdosynochus</i> spp.	44/44	100	105.0 \pm 90.4 ^a	105.0 \pm 90.4 ^a
<i>A. umbilicatum</i>	15/44	34.9 ^a	4.6 \pm 10.39 ^a	13.66 \pm 14.15 ^a
Parasites	<i>Centropomus undecimalis</i>			
	PF/EF	P	MA	MI
<i>Rhabdosynochus</i> spp.	20/20	100	45.1 \pm 44.2 ^b	47.4 \pm 45.4 ^b
<i>A. umbilicatum</i>	6/20	30.0 ^a	4.1 \pm 21.59 ^a	13.7 \pm 32.56 ^a

Different letters indicate significant difference between fish species by Mann-Whitney's test (U) ($p < 0.05$).

Table III. Spearman's rank correlation coefficient (r_s) between mean abundance of *Rhabdosynochus* spp. and biometric data in *Centropomus* spp. cultured in south Brazil. L: length (cm), W: weight (g)

Host species	Abundance x L		Abundance x W	
	R_s	p	r_s	p
<i>C. parallelus</i>	-0.725	<0.0001	-0.6572	<0.0001
<i>C. undecimalis</i>	-0.701	0.0006	-0.6998	0.0006

Mean abundance of *Rhabdosynochus* spp. was negatively correlated with weight and length of hosts (Table III). There was no correlation between abundance of *A. umbilicatum* and *C. parallelus*'s length ($r_s = 0.0726$, $p = 0.4717$) and weight ($r_s = 0.1317$, $p = 0.3941$), as well as between the abundance of *A. umbilicatum* and *C. undecimalis*'s length ($r_s = -0.170$, $p = 0.4737$) and weight ($r_s = -0.1466$, $p = 0.5373$) (Table IV).

Table IV. Spearman's rank correlation coefficient (r_s) between mean abundance of *Acanthoecoliaritrema umbilicatum* in the intestine of *Centropomus* spp. cultured in south Brazil. L: length (cm), W: weight (g)

Host species	Abundance x L		Abundance x W	
	R_s	p	r_s	p
<i>C. parallelus</i>	0.0726	0.4717	0.1317	0.3941
<i>C. undecimalis</i>	-0.170	0.4737	-0.1466	0.5373

Discussion

The relationship between the quantitative indicators of fish welfare and parasitism has been recently studied by several authors to better comprehend the effects of parasites on their hosts. Findings vary throughout the different studies. While some suggested that parasitism reduced the condition factor of the hosts (Silva-Souza, 1998; Tavares-Dias *et al.*, 2000; Ranzani-Paiva & Silva-Souza, 2004), others showed no such relationship (Ranzani-Paiva *et al.*, 2000, Yamada *et al.*, 2008; Velloso & Pereira Jr., 2010).

The relative condition factor (Kn) corresponds to the ratio between observed and theoretically expected weight for a given length (Le Cren, 1951; Ranzani-Paiva & Silva-Souza, 2004). Further, it is frequently used to compare two or more co-specific populations living in similar or different food or density conditions, and in the determination of the period and duration of gonadal maturation (Weatherley & Gill, 1987).

Snooks are protandrous hermaphrodites, or rather, they become sexually mature first as males and later undergo a sex conversion into female as they become larger (Alvarez-Lajonchère & Tsuzuki, 2008). All analyzed specimens in current study were immature and indicated that neither gonadal

maturation was likely to have a major influence on the observed Kn rates nor food availability, since all fish were fed on the same diet and at the same feeding ratio.

Aspects of the biology of common snook *C. undecimalis* include a larger body size when compared to that of *C. parallelus*, although this species was reported to have faster growth rates (Ximenes-Carvalho *et al.*, 2007). This datum corroborates our observations on biometrics of the two fish species under analysis, since we also observed larger body sizes for the former.

Similarly to current study, Tavares & Luque (2001), observing the ecological aspects of *Caligus praetextus* Bere, 1936 (Copepoda: Caligidae) in *C. undecimalis*, found no relationship between the length neither with abundance nor with prevalence. On the other hand, in *M. platanus*, Ranzani-Paiva & Silva-Souza (2004) observed that monogenean gill parasites affected fish weight especially in those specimens parasitized by *Trichodina* sp. and copepods. Nevertheless, since several other factors admittedly able to influence Kn rate were kept relatively stable in current study (as for example, food availability, feeding ratio, gonadal development and stress), it may be assumed that ectoparasitism by monogeneans may have had an impact on their host, since Kn value of the most parasitized host species (fat snook) were lower than expected ($Kn < 1.0$). Further, the high rates of mean infection intensity and mean abundance in *C. parallelus* may have been influenced by the host's lower Kn rate (increased susceptibility) and by the greater parasite abundance in smaller fish.

Parasite fauna of common wild snooks from Brazil includes several taxonomic groups such as digeneans (*A. umbilicatum*), monogeneans (*R. hargisi*), acanthocephalans (*Corynosoma* sp.), nematodes (*Contraecaecum* sp.), copepods (*Acantholochus unisagittatus*, *Caligus praetextus*, *Ergasilus* sp., *Lernanthropus gisleri*) and isopods (Cymothoid not identified) (Tavares & Luque, 2004). Low parasite diversity was reported in current study since only the monogeneans *Rhabdosynochus* spp. and *A. umbilicatum* were registered. Regarding the latter, previous studies had only reported *A. umbilicatum* parasitizing common snook (Travassos & Freitas, 1965; Gomes *et al.*, 1972; Robaldo & Padovan, 1998; Tavares & Luque, 2001, 2004). Fat snook is therefore herein considered a new host and the state of Santa Catarina, Brazil, as a new locality for *A. umbilicatum*.

A similar level of infection by *A. umbilicatum* was observed in *C. parallelus* and *C. undecimalis*.

As expected, infection levels were lower than those observed in the wild *C. undecimalis* (Tavares & Luque, 2001, 2004). Contrastingly to current investigation, in natural environment, the fish are frequently in contact with infectious stages of *A. umbilicatum* (Tavares & Luque, 2004). In the wild *C. undecimalis*, a positive co-relationship between abundance of *A. umbilicatum* and host length was observed by Tavares & Luque (2001) and by Tavares & Luque (2004), possibly due to the cumulative effect of intestinal parasites. Nevertheless, no correlation between abundance of *A. umbilicatum* and length of cultured *C. undecimalis* and *C. parallelus* was found owing to low parasitic prevalence in the hosts from the state of Santa Catarina.

Further studies should be undertaken on the parasite fauna of cultured snooks especially for the rearing system to avoid the negative effects of parasitism and to better understand host-parasite relationship.

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