Neotropical Helminthology, 2026, vol. 20 (2), XX-XX.

DOI: https://doi.org/10.62429/rnh20262022184

ORIGINAL ARTICLE / ARTÍCULO ORIGINAL

COMMUNITY ECOLOGY OF THE METAZOAN PARASITES OF THE TOMTATE GRUNT *HAEMULON AUROLINEATUM* CUVIER, 1830 OFF RIO DE JANEIRO, SOUTHEASTERN BRAZIL

ECOLOGÍA DE LA COMUNIDAD DE PARÁSITOS METAZOARIOS DEL PEZ CUJÍ *HAEMULON AUROLINEATUM* CUVIER, 1830 EN LA COSTA DE RÍO DE JANEIRO, SURESTE DE BRASIL

Taíssa Casanova[1], Arthur Bessi Machado[1]* & José Luis Luque[2]

[1] Programa de Pós-Graduação em Biologia Animal, Universidade Federal Rural do Rio de Janeiro, Seropédica, Brazil.
[2] Departamento de Parasitologia Animal, Universidade Federal Rural do Rio de Janeiro, Seropédica, Brazil.

*Corresponding author: bessiarthur@gmail.com

Running Head: Parasite community of *Haemulon aurolineatum*.
Casanova *et al.*

Taíssa Casanova: https://orcid.org/0000-0001-7348-2010

Arthur Bessi Machado: https://orcid.org/0009-0003-8793-7380

José Luis Luque: https://orcid.org/0000-0003-3515-1127

ABSTRACT

The present study provides the first ecological assessment of the metazoan parasite community of the tomtate grunt, *Haemulon aurolineatum* Cuvier, 1830 (Actinopterygii: Haemulidae), from the southeastern Brazilian coast. Between May 2022 and February 2023, 100 specimens were collected from Angra dos Reis, Rio de Janeiro, Brazil, and examined for metazoan parasites. A total of 284 parasite specimens belonging to 19 species were recovered, including digeneans, monogeneans, nematodes, copepods, and acanthocephalans. Adult endoparasites predominated in the parasite community, accounting for 91.54% of all collected specimens. The nematode *Procamallanus* sp. was the most prevalent, abundant, and dominant parasite species, whereas the copepod *Ceratocolax tavaresi* Casanova, Paschoal & Luque, 2023 showed the highest mean relative dominance. Three parasitic species exhibited an aggregated distribution pattern. The abundance of *Procamallanus* sp. was positively correlated with host total length, while no significant relationship was observed between host size and overall parasite abundance, richness, or diversity. Significant differences in parasite diversity were detected between male and female hosts. Interspecific association analyses revealed a tendency toward a positive association between *Procamallanus* sp. and *Genolopa ampullacea* Linton, 1910, although without statistical significance. The parasite fauna recorded herein expands the known host range of several taxa, including *Ceratocolax tavaresi*, *Dichelyne* sp., *Monorchis* sp., and *Prosorhynchus ozakii* Manter, 1934. These findings provide baseline ecological data for future comparative and monitoring studies involving haemulid fishes and marine environmental quality along the Brazilian coast.

Keywords: haemulids – host-parasite relationships – marine fish – parasite ecology

Resumen

El presente estudio proporciona la primera evaluación ecológica de la comunidad de parásitos metazoarios del pez cují *Haemulon aurolineatum* Cuvier, 1830 (Actinopterygii: Haemulidae) en la costa del sureste de Brasil. Entre mayo de 2022 y febrero de 2023, se recolectaron 100 ejemplares en Angra dos Reis, Río de Janeiro, Brasil, los cuales fueron examinados en busca de parásitos metazoarios. Se recuperó un total de 284 especímenes parasitarios pertenecientes a 19 especies, incluyendo digéneos, monogéneos, nematodos, copépodos y acantocéfalos. Los endoparásitos adultos predominaron en la comunidad parasitaria, representando el 91,54 % de todos

los especímenes recolectados. El nematodo *Procamallanus* sp. fue la especie parasitaria más prevalente, abundante y dominante, mientras que el copépodo *Ceratocolax tavaresi* Casanova, Paschoal & Luque, 2023 presentó la mayor dominancia relativa media. Tres especies parasitarias exhibieron un patrón de distribución agregada. La abundancia de *Procamallanus* sp. se correlacionó positivamente con la longitud total del hospedador, mientras que no se observó una relación significativa entre el tamaño del hospedador y la abundancia total, riqueza o diversidad parasitaria. Se detectaron diferencias significativas en la diversidad parasitaria entre hospedadores machos y hembras. Los análisis de asociación interespecífica revelaron una tendencia hacia una asociación positiva entre *Procamallanus* sp. y *Genolopa ampullacea* Linton, 1910, aunque sin significancia estadística. La fauna parasitaria registrada en este estudio amplía el rango de hospedadores conocido para varios taxones, incluidos *C. tavaresi*, *Dichelyne* sp., *Monorchis* sp. y *Prosorhynchus ozakii* Manter, 1934. Estos hallazgos proporcionan datos ecológicos de referencia para futuros estudios comparativos y de monitoreo que involucren peces haemúlidos y la calidad ambiental marina a lo largo de la costa brasileña.
Palabras clave: ecología parasitaria – haemúlidos – peces marinos – relaciones hospedador-parásito

INTRODUCTION

The Brazilian Atlantic coast harbors a high diversity of marine environments and extends for more than 8,000 km, supporting approximately 1,310 fish species, including 26 species of the family Haemulidae (Actinopterygii: Haemulidae) distributed among 11 genera (Froese & Pauly, 2026). Within this context, the coast of Rio de Janeiro State represents an important marine ecosystem characterized by elevated biological diversity and a wide variety of marine and estuarine habitats (Paschoal *et al.*, 2024). However, anthropogenic pressures such as urban expansion, industrial development, and diffuse pollution have increasingly affected biodiversity and ecosystem integrity along this coastal region (Araújo *et al.*, 2017; Benicio *et al.*, 2022; Paschoal *et al.*, 2024).

Haemulids are marine actinopterygian fishes widely distributed in tropical and subtropical regions. Although most species inhabit marine environments, some may occur in estuarine and, less frequently, freshwater habitats (Froese & Pauly, 2026).

Ecologically, haemulids play an important role in reef ecosystems by influencing benthic invertebrate populations and contributing to nutrient transfer among habitats. In addition, several species have commercial and subsistence value for coastal communities (Melo *et al.,* 2020).

The genus *Haemulon* Cuvier, 1829 comprises 21 valid species, among which *Haemulon aurolineatum* Cuvier, 1830 is widely distributed along the western Atlantic Ocean, occurring from Massachusetts, USA, to southern Brazil. This species inhabits reef-associated coastal environments and feeds mainly on small crustaceans, mollusks, benthic invertebrates, planktonic organisms, and algae (Froese & Pauly, 2026). In addition, *H. aurolineatum* occupies an important trophic position in marine food webs, serving as prey for several predatory fish species (Menezes, 1969, 1970; Menezes & Aragão, 1977; Ximenes-Carvalho & Fonteles-Filho, 1996).

To date, studies investigating the parasite community of *H. aurolineatum* have been restricted to Venezuela and Mexico (Centeno & Bashirullah, 2003; Bashirullah & Díaz, 2015; López-Zacarías *et al.*, 2021; García-Teh *et al.*, 2022). No ecological parasitological studies have been conducted for this host species in Brazilian waters.

Approximately 67 species of metazoan parasites have been reported in haemulid fishes from the Brazilian coast (Paschoal *et al*., 2015; Camargo *et al*., 2017; Keidel *et al*., 2019; Casanova *et al*., 2023). Previous ecological studies have evaluated parasite communities in haemulids from Rio de Janeiro State, including *Orthopristis rubra* (Cuvier, 1830), *Haemulon steindachneri* (Jordan & Gilbert, 1882), *Conodon nobilis* (Linnaeus, 1758), and *Anisotremus virginicus* (Linnaeus, 1758) (Luque *et al.,* 1996; Paschoal *et al*., 2023; Paschoal *et al*., 2024; Mainenti *et al*., 2026).

Therefore, the present study aimed to characterize, for the first time, the structure of the metazoan parasite community of *H. aurolineatum* from the southeastern Brazilian coast, providing baseline data for future comparative and temporal studies involving marine parasite communities.

MATERIALS AND METHODS

Host collection, processing, and parasitological procedures

Between May 2022 and February 2023, 100 specimens of *H. aurolineatum* were obtained from the coastal zone of Angra dos Reis (23°01′21"S, 44°19′13"W), Rio de Janeiro State, Brazil. Fish were purchased from local fishermen at a local market. Sixty specimens were examined fresh, whereas the remaining were stored frozen at -20 °C until analysis. Host identification followed Menezes & Figueiredo (1985), and nomenclature and taxonomic classification were updated according to FishBase (Froese & Pauly, 2026).

Each fish specimen was measured for total length, weighed, and sexed. Possible differences in host total length between males and females were evaluated using the Mann-Whitney test, since parasite burden may be associated with host size (Zar, 2010).

The body surface, nostrils, gills, body cavity, stomach, intestine, and gonads of each specimen were individually examined under a stereomicroscope for parasite collection. Parasites were collected, fixed, and processed according to the procedures described by Eiras *et al.* (2006). Taxonomic identification followed the specialized literature for each species and/or parasite group (Anderson *et al.*, 2009; Casanova *et al.*, 2023; Hesse, 1873; Kohn & Macedo, 1984; Linton, 1910; Manter, 1934; Manter, 1947; Monticelli, 1888; Mosquera *et al.*, 2014a; Mosquera *et al.*, 2014b; Nahhas & Cable, 1964; Paradižnik & Radujković, 2007; Pinto *et al.*, 1974; Roberto *et* al., 2013; Siddiqi & Cable, 1960; Yamaguti, 1963; Youssef-Dridi *et al.*, 2023).

Ecological and statistical analyses

Prevalence, mean intensity, and mean abundance were calculated as descriptors of parasite populations according to Bush *et al.* (1997). The variance-to-mean ratio (index of dispersion, ID) and discrepancy index (D) were used to evaluate parasite distribution patterns within the host population (Poulin, 1993). Frequency of dominance and relative dominance were calculated according to Rohde *et al.* (1995).

Parasite diversity was estimated using the Brillouin diversity index (*HB*), since each host specimen was considered a fully censused infracommunity (Magurran, 2004; Zar, 2010). Differences in parasite prevalence and abundance between male and female hosts were evaluated using Fisher's exact test (*F*) and the Mann-Whitney test with corrected normal approximation (*Zc*), respectively. Differences in parasite diversity according to host sex were also analyzed using the Mann-Whitney test (Magurran, 2004; Zar, 2010). Spearman's rank correlation coefficient (rs) was used to evaluate possible associations between host total length and parasite abundance, richness, and diversity (Magurran, 2004; Zar, 2010).

To investigate potential effects of concurrent infection (endoparasites) and infestation (ectoparasites), parasite species were grouped into three spatial guilds: adult endoparasites, helminth larval stages, and adult ectoparasites. Possible interspecific associations involving parasite presence/absence were evaluated using logistic regression models, whereas associations involving parasite abundance were analyzed using Poisson regression models (Dohoo *et al*., 2003; Zar, 2010).

For statistically significant models, odds ratios (OR) and their respective 95% confidence intervals (CI) were calculated to evaluate the direction and strength of associations among parasite species. Values of $0 < OR < 1$ indicated a negative association, OR = 1 indicated absence of association, and OR > 1 indicated positive association (Dohoo *et al.*, 2003). Ecological terminology followed Bush *et al.* (1997), and only parasite species with prevalence higher than 10% were included in the analyses (Bush *et al.,* 1990). Statistical significance was established at $p \leq 0.05$. All analyses were performed using Quantitative Parasitology software (QPweb version) (Reiczigel *et al*., 2019) and R software (R Core Team, 2020).

Ethical Approval

All applicable institutional, national, and international guidelines for animal care and use were followed. Because no live animals were used and all fish specimens were obtained from a local market, approval by an ethics committee was not required, according to Brazilian Law No. 11,794, Article 3, Item III.

RESULTS

Host samples

The examined specimens of *H. aurolineatum* had a mean total length of 19.23 ± 1.84 cm (14.5–23.1 cm) and a mean body weight of 103.79 ± 25.22 g (45–152 g). Females (n = 36) presented a mean total length of 18.88 ± 1.37 cm, whereas males (n = 64) showed a mean total length of 19.42 ± 2.04 cm. No significant difference in body length was observed between sexes (U = 918, $p = 0.09$).

Parasite component community

The parasite community of *H. aurolineatum* comprised 19 metazoan parasite species (Table 1). The nematode *Procamallanus* sp. was the most prevalent, abundant, and dominant species (Table 1), accounting for approximately 40% of all collected parasite specimens and exhibiting the highest frequency of dominance (Table 2). In contrast, the copepod *Ceratocolax tavaresi* Casanova, Paschoal & Luque, 2023 presented the highest mean relative dominance.

Table 1. Prevalence (P), mean intensity (MI), mean abundance (MA), total number of individuals (TNI), and site of infection/infestation of metazoan parasites of *Haemulon aurolineatum* from Angra dos Reis, Rio de Janeiro, Brazil (SD: standard deviation, IC: confidence interval).

Parasite species	P% (IC)	MI ± SD (IC)	MA ± SD (IC)	TNI	Site
Digenea					
Aponurus pyriformis (Linton, 1910) Overstreet, 1973	7 (3.10–14.38)	1	0.07 ± 0.26 (0.02–0.12)	7	Stomach
Prosorhynchus ozakii Manter, 1934	8 (3.77–15.61)	1.38 ± 0.52 (0.94–1.81)	0.11 ± 0.40 (0.03–0.19)	11	Stomach
Genolopa pritchardae (Nahhas & Cable, 1964) Fischthal, 1977	4 (1.29–10.51)	1	0.04 ± 0.20 (0.00–0.08)	4	Stomach
Diphterostomum brusinae (Stossich, 1888) Stossich, 1904	7 (3.10–14.38)	1.57 ± 1.51 (0.17–2.97)	0.11 ± 0.55 (0.00–0.22)	11	Stomach
Monorchis sp.	7 (3.10–14.38)	2.29 ± 1.38 (1.01–3.56)	0.16 ± 0.68 (0.03–0.29)	16	Intestine
Genolopa ampullacea Linton, 1910	22 (14.58–31.61)	2.14 ± 1.55 (1.45–2.82)	0.47 ± 1.14 (0.24–0.70)	47	Stomach
Homalometron foliatum Siddiqi & Cable, 1960	3 (0.78–9.15)	1	0.03 ± 0.17 (0.00–0.06)	3	Stomach
Infundiburictus longovatus (Hopkins, 1941) Wee, Cutmore, Pérez-del-Olmo & Cribb, 2020	5 (1.86–11.83)	1	0.05 ± 0.22 (0.01–0.09)	5	Stomach
Leurodera decora Linton, 1910	3 (0.78–9.15)	1	0.03 ± 0.17 (0.00–0.06)	3	Stomach
Lecithochirium	1 (0.05–6.24)	1	0.01 ± 0.10	1	Stomach

musculus (Looss, 1907) Nasir & Diaz, 1971					
Cainocreadium oscitans (Linton, 1910) Cribb, 2005	1 (0.05–6.24)	1	0.01 ± 0.10	1	Stomach
Diplangus paxillus Linton, 1910	1 (0.05–6.24)	2	0.02 ± 0.20	2	Stomach
Didymozoidae	2 (0.35–7.74)	1	0.02 ± 0.14	2	Body cavity
Copepoda					
Ceratocolax tavaresi Casanova, Paschoal & Luque, 2023	15 (8.91–23.85)	1.33 ± 0.82 (0.88–1.79)	0.20 ± 0.57 (0.09–0.31)	20	Nostril
Colobomatus sp.	1(0.05–6.24)	1	0.01 ± 0.10	1	Mandibular canal
Monogenea					
Choricotyle sp.	1(0.05–6.24)	1	0.01 ± 0.10	1	Gills
Nematoda					
Procamallanus sp.	53 (42.80–62.96)	2.62 ± 1.75 (2.14–3.10)	1.39 ± 1.83 (1.03–1.75)	139	Intestine
Dichelyne sp.	9 (4.46–16.83)	1	0.09 ± 0.29 (0.03–0.15)	9	Intestine
Acanthocephala					
Dollfusentis chandleri Golvan, 1969	1 (0.05–6.24)	1	0.01 ± 0.10	1	Intestine

Table 2. Frequency of dominance and mean relative dominance of metazoan parasites of *Haemulon aurolineatum* from Angra dos Reis, Rio de Janeiro, Brazil.

Parasite species	Frequency of dominance (%)	Frequency of dominance shared with one or more species	Mean relative dominance
Procamallanus sp.	40	5	0.80 ± 0.23
Genolopa ampullacea	10	5	0.72 ± 0.24
Ceratocolax tavaresi	7	3	0.93 ± 0.16
Dichelyne sp.	2	3	1
Prosorhynchus ozakii	2	-	1
Choricotyle sp.	1	-	1
Diphterostomum brusinae	1	-	1
Infundiburictus longovatus	1	-	1

Adult ectoparasites accounted for 7.74% of all collected parasite specimens, whereas adult endoparasites represented 91.54% and larval endoparasites 0.70% of the parasite community. *Aponurus pyriformis* (Linton, 1910), *Procamallanus* sp., and *Genolopa ampullacea* Linton, 1910 exhibited aggregated distribution patterns, with index of dispersion (ID) values higher than 1.60 and discrepancy index (D) values exceeding 0.60 (Table 3).

Table 3. Values of variance to mean ratio of parasite abundance (ID) and index of Discrepancy (D) of metazoan parasites of *Haemulon aurolineatum* from Angra dos Reis, Rio de Janeiro, Brazil.

Parasite species	ID	D	Type of dispersion
Aponurus pyriformis	1.62	0.87	Aggregate
Procamallanus sp.	2.4	0.65	Aggregate
Genolopa ampullacea	2.77	0.85	Aggregate

The abundance of *Procamallanus* sp. showed a significant positive correlation with host total length (rs = 0.23, p = 0.01). In contrast, *G. ampullacea* exhibited a negative, although non-significant, correlation with host total length (rs = -0.09, p = 0.33).

Parasite infracommunities

A total of 74 specimens (74%) of *H. aurolineatum* were infected by at least one metazoan parasite species. Overall, 284 parasite specimens were collected, with a mean abundance of 2.84 ± 3.48 parasites per host. Host total length was not significantly correlated with parasite abundance (rs = 0.17, p = 0.08).

Mean parasite species richness was 1.51 ± 1.50 species per host and was not correlated with host total length (rs = 0.17, p = 0.09). Likewise, mean parasite diversity (HB = 0.21 ± 0.33) showed no significant correlation with host body length (rs = 0.13, p = 0.18). However, significant differences in parasite diversity were observed between male (HB = 0.25 ± 0.36) and female hosts (HB = 0.15 ± 0.27) (Zc = 2.02, p = 0.03).

Regarding infracommunity structure, 39 host specimens (39%) harbored a single parasite species, 12 (12%) harbored two species, 11 (11%) harbored three species, 9 (9%) harbored four species, 1 (1%) harbored five species, and 2 (2%) harbored seven parasite species.

Pairwise interspecific associations involving the copepod *C. tavaresi*, the nematode *Procamallanus* sp., and the digenean *G. ampullacea* were also evaluated. No significant association was detected between *C. tavaresi* and *Procamallanus* sp., either for presence/absence or abundance data (p = 0.58 and p = 0.76, respectively). Similarly, no significant association was observed between *C. tavaresi* and *G. ampullacea* (p = 0.73 and p = 0.42, respectively). In contrast, the association between *Procamallanus* sp. and *G. ampullacea* indicated a tendency toward a positive interaction (p = 0.05; OR = 2.92; CI = 0.960–10.12), although this relationship was not statistically significant.

DISCUSSION

The present study provides the first ecological parasitological assessment of *H. aurolineatum* from the southeastern Brazilian coast. A total of 284 parasite specimens belonging to 19 species were recovered, including digeneans, monogeneans, nematodes, copepods, and acanthocephalans. Adult endoparasites predominated in the parasite community, and the nematode *Procamallanus* sp. was the most prevalent, abundant, and dominant species. Similar predominance of nematodes has been reported in marine fishes from the southeastern Brazilian coast (Alves & Luque, 2001; Paraguassú *et al*., 2002; Luque *et al.*, 2003; Soares *et al*., 2014; Casanova *et al.,* 2025).

The predominance of endoparasites may be associated with the demersal feeding habits of haemulids and the diversity of intermediate hosts available in marine environments (Alves & Luque, 2001). Species of *Haemulon* feed mainly on benthic prey (Limeira *et al*., 2022), and *H. aurolineatum* commonly consumes crustaceans, mollusks, and benthic invertebrates (Froese & Pauly, 2026), which may facilitate infection by *Procamallanus* sp., whose life cycle involves crustacean intermediate hosts (Santos et al., 1999).

Previous studies on the parasite fauna of *H. aurolineatum* have been conducted in Venezuela (Centeno & Bashirullah, 2003; Bashirullah & Díaz, 2015) and Mexico (López-Zacarías *et al*., 2021; García-Teh *et al*., 2022). Several parasite taxa found herein, including *A. pyriformis* (Linton, 1910), *Choricotyle* sp., *Dichelyne chandleri* Golvan, 1969, *Diplangus paxillus* Linton, 1910, *G. ampullacea* Linton, 1910, *Infundiburictus longovatus* (Hopkins, 1941) Wee, Cutmore, Pérez-del-Olmo & Cribb, 2020, *Leurodera decora* Linton, 1910, and *Procamallanus* sp., had previously been reported in this host species. Considering both Nearctic and Neotropical regions, 25 parasite species have already been recorded in *H. aurolineatum* (Paschoal *et al*., 2015). In addition, the present study reports *H. aurolineatum* for the first time as a host for *Ceratocolax tavaresi* Casanova, Paschoal & Luque, 2023, *Dichelyne* sp., *Monorchis* sp., and *Prosorhynchus ozakii* Manter, 1934.

Compared with previous studies, the present investigation revealed relatively higher diversity of digeneans and nematodes, whereas monogenean richness was lower than that reported by Bashirullah & Díaz (2015) and García-Teh *et al.* (2022). Digeneans generally represented the parasite group with the highest parasitological indices in previous studies, partially corroborating the pattern observed herein. However, García-Teh *et al.* (2022) reported a prevalence of 100% for *Haliotrematoides* sp. (a monogenean), highlighting marked variation among localities and sampling conditions.

At the infracommunity level, the total abundance of parasites recorded herein was higher than that reported by Centeno & Bashirullah (2003) and López-Zacarías *et al.* (2021), but species richness was lower than that observed by Bashirullah & Díaz (2015) and García-Teh *et al.* (2022). Such differences may be associated with variation in sampling effort, collection period, host population structure, and environmental conditions.

Comparisons with other haemulids from Rio de Janeiro State, including *H. steindachneri*, *C. nobilis*, *O. rubra*, and *A. virginicus* (Luque *et al*., 1996; Paschoal *et al*., 2023; Paschoal et al., 2024), revealed similar ecological patterns, particularly regarding the predominance of digeneans, copepods, and nematodes. More recently, Mainenti *et al*. (2026) reported higher prevalence and abundance values for digeneans and monogeneans in *O. rubra*, whereas *H. aurolineatum* in the present study showed higher parasitological values mainly for nematodes. The occurrence of shared parasite taxa among related hosts collected from nearby localities suggests persistence of these species within the marine ecosystem and may reflect similarities in trophic ecology among haemulids.

Host body length showed no significant correlation with parasite abundance, richness, or mean diversity, corroborating the results of Centeno & Bashirullah (2003). In marine fish parasite systems, relationships between host size and parasitism are often weak or inconsistent (Poulin, 2000; Luque *et al*., 2003). Ontogenetic variation in feeding habits and differences in the environmental availability of infective stages may therefore exert greater influence on parasite community structure than host size alone.

Host sex also influenced parasite diversity in the present study. Similar sex-related differences have been reported in haemulids, including higher prevalence and intensity of *Diplangus paxillus* in male *O. rubra* (Luque *et al*., 1996) and higher abundance of *Caligus haemulonis* Krøyer, 1863 in male *C. nobilis* (Paschoal *et al.,* 2024). Such differences may be associated with sex-related variation in feeding behavior, habitat use, physiology, and hormonal condition (Rohde, 1993; Lizama *et al*., 2005). However, Bashirullah & Díaz (2015) did not detect significant sex-related differences in *H. aurolineatum*, suggesting that these effects may vary among host populations and environmental contexts.

Aponurus pyriformis, *Procamallanus* sp., and *G. ampullacea* exhibited aggregated distribution patterns, a common feature in host-parasite systems (Crofton, 1971). Similar patterns have also been reported in haemulid fishes (Luque *et al*., 1996; Bashirullah & Díaz, 2015; Paschoal *et al.,* 2023), reflecting heterogeneity in host susceptibility and exposure to infective stages.

The abundance of *Procamallanus* sp. showed a positive correlation with host body length, possibly because larger fish exploit a broader diversity of prey and intermediate hosts (Karpouzi & Stergiou, 2003; Marques & Alves, 2011). Conversely, *Genolopa ampullacea* showed a negative correlation with host size, potentially associated with environmental disturbances affecting molluscan intermediate hosts and transmission dynamics (Marcogliese, 2005; Sures *et al*., 2023; Mainenti *et al*., 2026). Similar negative relationships between parasite abundance and host size were also reported for copepods infecting *C. nobilis* (Paschoal *et al*., 2024).

Although previous studies employed different parasitological descriptors, some recurrent patterns are evident among haemulids. Positive and negative relationships between host size and parasitological parameters have been reported for several digenean species in *H. steindachneri*, *H. aurolineatum*, and *O. rubra* (Luque *et al*., 1996; Bashirullah & Díaz, 2015), indicating that the influence of host size on parasite dynamics may vary among taxa and ecological conditions.

The possible positive association observed between *Procamallanus* sp. and *G. ampullacea* may indicate interspecific interaction patterns within the parasite community. Similar associations have been reported in haemulids (Paschoal *et al*., 2024), although experimental evidence is still necessary to confirm biological interactions among parasite species (Poulin, 2001).

Overall, differences in the predominant parasite groups among related haemulid species collected from nearby localities reinforce the influence of trophic ecology and environmental conditions on parasite community structure. Despite previous studies on *H. aurolineatum* from other Atlantic regions (Centeno & Bashirullah, 2003; Bashirullah & Díaz, 2015; López-Zacarías *et al*., 2021), the present investigation represents the first ecological parasitological study of this host species in Brazilian waters and provides baseline data for future comparative, temporal, and environmental studies in the southwestern Atlantic Ocean.

This study represents the first ecological investigation of the metazoan parasite community of *H. aurolineatum* from the Brazilian coast and expands current knowledge of parasite diversity in haemulid fishes from the southwestern Atlantic Ocean. The parasite community was characterized by a predominance of adult endoparasites and by the dominance of the nematode *Procamallanus* sp., reinforcing previously observed patterns in marine demersal fishes from southeastern Brazil. Although host body length was not associated with overall parasite abundance, richness, or diversity, significant relationships were observed for specific parasite taxa, indicating that ecological and trophic factors may influence parasite transmission dynamics differently among species. The significant difference in parasite diversity between male and female hosts also suggests that host biological traits may contribute to structuring parasite infracommunities. In addition, the new host records reported herein increase the known distribution and host range of several parasite taxa. Overall, the present data provide an important baseline for future temporal, biogeographical, and environmental monitoring studies involving marine parasite communities along the Brazilian coast.

Acknowledgments

Taíssa Casanova and Arthur Bessi were supported by a student fellowship from the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES), Brazil (Finance Code 001). José Luis Luque received support from a research grant provided by the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), Brazil.

Author contributions: CRediT (Contributor Roles Taxonomy)

TCA = Taíssa Casanova
ABM = Arthur Bessi Machado
JLL = José Luis Luque

Conceptualization: TCA, ABM, JLL
Data curation: TCA, ABM, JLL
Formal Analysis: TCA, JLL
Funding acquisition: TCA, ABM, JLL
Investigation: TCA, ABM, JLL
Methodology: TCA, JLL
Project administration: JLL
Resources: TCA, JLL
Software: TCA, ABM, JLL
Supervision: JLL
Validation: TCA, ABM, JLL
Visualization: TCA, ABM, JLL
Writing – original draft: TCA, JLL
Writing – review & editing: TCA, ABM, JLL

BIBLIOGRAPHIC REFERENCES

Alves, D.R., & Luque, J.L. (2001). *Community ecology of the metazoan parasites of white croaker, Micropogonias furnieri (Osteichthyes: Sciaenidae), from the coastal zone of the state of Rio de Janeiro, Brazil. Memórias do Instituto Oswaldo Cruz, 96*, 145–153.

Anderson, R.C., Chabaud, A.G., & Willmott, S. (2009). *Keys to the nematode parasites of vertebrates.* CAB International.

Araújo, D.F., Peres, L.G.M., Yepez, S., Mulholland, D.S., Machado, W., Tonhá, M., *et al.* (2017). *Assessing man-induced environmental changes in the Sepetiba Bay (Southeastern Brazil) with geochemical and satellite data. Comptes Rendus Geoscience, 349*, 290–298.

Bashirullah, A.K., & Díaz, M.T. (2015). *Helminth infracommunity of Haemulon aurolineatum Cuvier, 1830 (Haemulidae) from the Gulf of Cariaco, Venezuela. Revista Científica, 25*, 167–172.

Benicio, L., Moreira, J., & Paschoal, F. (2022). *Community ecology of the metazoan parasites of the Atlantic anchoveta, Cetengraulis edentulus (Actinopterygii: Engraulidae) from the Sepetiba Bay, Rio de Janeiro, Brazil. Zoologia, 39*, e21034.

Biswal, D.D., & Chatterjee, S. (2020). *Fish parasites as biological indicators: A systematic review. Bioscience Biotechnology Research Communications, 13*, 1743-1755.

Bush, A.O., Aho, J.M., & Kennedy, C.R. (1990). *Ecological versus phylogenetic determinants of helminth parasite community richness. Evolutionary Ecology, 4*, 1–20.

Bush, A.O., Lafferty, K.D., Lotz, J.M., & Shostak, A.W. (1997). *Parasitology meets ecology on its own terms: Margolis et al. revisited. The Journal of Parasitology, 83*, 575–583.

Camargo, A.C.A., Luque, J.L., & Santos, C.P. (2017). *Mexicana rubra sp. nov. and Encotyllabe cf. spari Yamaguti, 1934 (Monogenea) of Orthopristis ruber (Cuvier, 1830) from the Brazilian Coast off Rio de Janeiro. Helminthologia*, *54*, 336–347.

Casanova, T., Cardoso, T.S., Simões, R.O., Paschoal, F., & Luque, J.L. (2025). *Changes in parasite communities of Paralonchurus brasiliensis (Sciaenidae) in southeastern Brazil across a two-decade interval. Acta Parasitologica*, *71* (10), 2–8.

Centeno, L., & Bashirullah, A. (2003). *Comunidades de parásitos metazoos en ocho especies de peces del género Haemulon (Fam: Haemulidae) del Golfo de Cariaco, Venezuela. Ciencia, 11*, 119–124.

Crofton, H.D. (1971). *A quantitative approach to parasitism*. *Parasitology, 62*, 179–193.

Cribb, T.H., Bray, R.A., & Littlewood, D.T.J. (2001). *The nature and evolution of the association among digeneans, molluscs and fishes. International Journal for Parasitology, 31*, 997–1011.

Cribb, T.H., Bray, R.A., Olson, P.D., & Littlewood, D.T.J. (2003). *Life cycle evolution in the Digenea: A new perspective from phylogeny. Advances in Parasitology, 54*, 197–254.

Dohoo, I., Martin, W., & Stryhn, H. (2003). Veterinary epidemiologic research. AVC Inc.

Eiras, J.C., Takemoto, R.M., & Pavanelli, G.C. (2006). *Métodos de estudo e técnicas laboratoriais em parasitologia de peixes* (2nd ed.). Eduem.

Froese, R., & Pauly, D. (2026). *FishBase* [online]. http://www.fishbase.org

García-Teh, J.G., Vidal-Martínez, V.M., Mariño-Tapia, I., Árcega-Cabrera, F., Ordoñez-López, U., & Aguirre-Macedo, M.L. (2022). *Metazoan parasite infracommunities of the tomtate grunt (Haemulon aurolineatum) as potential bioindicators of environmental conditions in the Yucatan continental shelf, Mexico. Bulletin of Environmental Contamination and Toxicology, 108*, 49–54.

Hesse, M. (1873). *Mémoire sur des crustacés rares ou nouveaux des cotes de France. Annales des Sciences Naturelles, 5*, 1–17.

Karpouzi, V.S., & Stergiou, K.I. (2003). *The relationships between mouth size and shape and body length for 18 species of marine fishes and their trophic implications. Journal of Fish Biology, 62*, 1353–1365.

Keidel, L., García-Varela, M., Brener, B., León, G.P.P., & Santos, C.P. (2019). *Integrative taxonomy reveals a new species of Dollfusentis (Acanthocephala: Illiosentidae), in Orthopristis ruber (Osteichthyes: Haemulidae) from Rio de Janeiro, Brazil. Parasitology International*, *71*, 132–142.

Kohn, A., & Macedo, B. (1984). *First record of Aspiculuris tetraptera (Nitzsch, 1821) (Nematoda: Oxyuroidea) and Dollfusentis chandleri (Golvan, 1969) (Acanthocephala: Illiosentidae) in Haemulon sciurus (Shaw, 1803) (Pisces: Pomadasyidae). Annales de Parasitologie Humaine et Comparée, 59*, 477–482.

Lafferty, K.D. (2008). *Ecosystem consequences of fish parasites. Journal of Fish Biology, 73*, 2083–2093.

Limeira, A.G.C., Frédou, T., Soares, A.P.C., Lira, A.S., Le Loc'h, F., Viana, G.F.S., Rosa-Filho, J.S., Munaron, J.M., & Lucena-Frédou, F. (2022). *Trophic ecology and resource partitioning of Haemulidae species along the Northeastern Brazilian continental shelf. Neotropical Ichthyology, 20*, e220001.

Linton, E. (1910). *Helminth fauna of the Dry Tortugas. II. Trematodes. Papers from the Tortugas Laboratory of the Carnegie Institute of Washington, 4*, 11–98.

Lizama, M.L.A.P., Takemoto, R.M., Pavanelli, G.C. (2005). *Influence of host sex and age on infracommunities of metazoan parasites of Prochilodus lineatus (Valenciennes, 1836) (Prochilodontidae) of the Upper Paraná River floodplain, Brazil. Parasite, 12*, 299–304.

López-Zacarías, M.N., Herrerías-Diego, Y., Tafolla-Venegas, D., Domínguez-Domínguez, O., & Pérez-Ponce de León, G. (2021). *Community structure of intestinal adult trematodes (Platyhelminthes) in six species of Haemulon (Osteichthyes) in Puerto Morelos Reef National Park, Quintana Roo, Mexico. Revista Mexicana de Biodiversidad, 92*, e923602.

Luque, J.L., Amato, J.F.R., & Takemoto, R.M. (1996). *Comparative analysis of the communities of metazoan parasites of Orthopristis ruber and Haemulon steindachneri (Osteichthyes: Haemulidae) from the southeastern Brazilian littoral: I. Structure and influence of the size and sex of hosts. Revista Brasileira de Biologia, 56*, 279–292.

Luque, J.L., Alves, D.R., & Ribeiro, R.S. (2003). *Community ecology of the metazoan parasites of banded croaker, Paralonchurus brasiliensis (Osteichthyes: Sciaenidae), from the coastal zone of the state of Rio de Janeiro, Brazil. Acta Scientiarum. Biological Sciences, 25*, 273–278.

Magurran, A.E. (2004). *Measuring biological diversity*. Blackwell Publishing.

Mainenti, A.R., Paschoal, F., Cardoso, T.S., Simões, R.O., & Luque, J.L. (2026). *Temporal dynamics in the parasite communities of corocoro grunt Orthopristis rubra (Actinopterygii: Haemulidae) from Sepetiba Bay, southeastern Brazil: A comparative study from 1991 to 2024. Revista Brasileira de Parasitologia Veterinária, 35*(2), e016925.

Manter, H.W. (1934). *Some digenetic trematodes from deep-water fish of Tortugas, Florida. Papers from Tortugas Laboratory, 28*, 257–345.

Manter, H.W. (1947). *The Digenetic Trematodes of Marine Fishes of Tortugas, Florida. The American Midland Naturalist, 38*, 257–414.

Marcogliese, D.J. (2005). *Parasites of the superorganism: Are they indicators of ecosystem health? International Journal for Parasitology, 35*, 705–716.

Marques, L.C., & Alves, D.R. (2017). *Ecologia da comunidade de metazoários parasitos do dourado, Coryphaena hippurus Linnaeus, 1758 (Osteichthyes: Coryphaenidae) do litoral do Estado do Rio de Janeiro, Brasil. Cadernos UniFOA, 6*, 111–122.

Melo, C.C., Soares, A.P.C., Pelage, L., Eduardo, L.N., Frédou, T., Lira, A.S., Ferreira, B.P., Bertrand, A., & Lucena-Frédou, F. (2020). *Haemulidae distribution patterns along the Northeastern Brazilian continental shelf and size at first maturity of the most abundant species. Regional Studies in Marine Science, 35*, 101226.

Menezes, M.F. (1969). *Alimentação da cavala, Scomberomorus cavalla (Cuvier), em águas costeiras do Estado do Ceará*. *Arquivos de Ciências do Mar, 9*, 15–20.

Menezes, M.F. (1970). *Alimentação da serra, Scomberomorus maculatus (Mitchill), em águas costeiras do Estado do Ceará*. *Arquivos de Ciências do Mar, 10*, 171–176.

Menezes, M.F., & Aragão, L.P. (1977). *Aspectos da biometria e biologia do bonito, Euthynnus alleteratus (Rafinesque), no Estado do Ceará, Brasil. Arquivos de Ciências do Mar, 17*, 96–100.

Menezes, N.A., & Figueiredo, J.L. (1985). *Manual de peixes marinhos do Sudeste do Brasil V. Teleostei (4)*. Museu de Zoologia USP.

Monticelli, F.S. (1888). *Saggio di una morfologia del trematodi. Stabilimento Tipografico Fili*. Ferrante.

Mosquera, O., Mago, Y., & Chinchilla, O. (2014a). *Finding of Genolopa ampullacea Linton, 1910 (Digenea: Monorchiidae, Monorchiinae) in Haemulon bonariense Cuvier, 1830 from Mochima Bay, Sucre State, Venezuela. Saber, 26*, 121–126.

Mosquera, O., Mago, Y., & Chinchilla, O. (2014b). *Hallazgo de Lasiotocus longovatus (Hopkins, 1941) Thomas, 1959 (Digenea: Monorchiidae: Monorchiinae) en Haemulon bonariense Cuvier, 1830 de la Bahía de Mochima, Estado Sucre, Venezuela. Boletín del Instituto Oceanográfico de Venezuela, 53*, 205–210.

Nachev, M., & Sures, B. (2015). *Environmental parasitology: Parasites as accumulation bioindicators in the marine environment. Journal of Sea Research, 113*, 45–50.

Nahhas, F.M., & Cable, R.M. (1964). *Digenetic and aspidogastrid trematodes from marine fishes of Curacao and Jamaica. Tulane Studies in Zoology, 11*, 169–228.

Paradižnik, V., & Radujković, B. (2007). *Digenea trematodes in fish of the North Adriatic Sea. Acta Adriatica, 48*, 115– 129.

Paraguassú, A.R., Luque, J.L., & Alves, D.R. (2002). *Community ecology of the metazoan parasites of red porgy, Pagrus pagrus (L., 1758) (Osteichthyes, Sparidae), from the coastal zone of the state of Rio de Janeiro, Brazil*. *Acta Scientiarum, 24*, 461–467.

Paschoal, F., Cezar, A., & Luque, J.L. (2015). *Checklist of metazoan associated with grunts (Perciformes, Haemulidae) from the Nearctic and Neotropical regions. Check List, 11*, 1–23.

Paschoal, F., Cezar, A.D., Pereira, F.B., & Luque, J.L. (2023). *Structure of the metazoan parasite communities of haemulid fish (Actinopterygii: Perciformes) in the South Atlantic Ocean: A comparative approach. Anais da Academia Brasileira de Ciências, 95*, e20220205.

Paschoal, F., Nunes, J.L., Cezar, A., Pereira, F., & Luque, J.L. (2024). *The metazoan parasite community of the barred grunt Conodon nobilis (Actinopterygii: Haemulidae) from the coast off Rio de Janeiro, southeastern Brazil. Brazilian Journal of Veterinary Parasitology, 33*, e010724.

Pickering, A.D. (1977). *Seasonal changes in the epidermis of the brown trout Salmo trutta (L.).* Journal of *Fish Biology, 10*, 561–566.

Pinto, R.M., Fabio, S.P., Noronha, D., & Rolas, F.J.T. (1974). *Procamallanus brasileiros – parte I (Nematoda, Camallanoidea). Memórias do Instituto Oswaldo Cruz, 72*, 205–211.

Poulin, R. (1993). *The disparity between observed and uniform distributions: A new look at parasite aggregation. International Journal for Parasitology, 23*, 937–944.

Poulin, R. (2000). *Variation in the intraspecific relationship between fish length and intensity of parasitic infection: Biological and statistical causes. Journal of Fish Biology, 56*, 123–137.

Poulin, R. (2001). *Interactions between species and the structure of helminth communities. Parasitology, 122*(Suppl. S1), S3–S11.

R Core Team. (2020). *R: A language and environment for statistical computing* [software]. Vienna, AT: R Foundation for Statistical Computing. https://www.r-project.org/

Reiczigel, J., Marozzi, M., Fábián, I., & Rózsa, L. (2019). *Biostatistics for parasitologists: A primer to quantitative parasitology. Trends in Parasitology, 35*(4), 277–281.

Rohde, K. (1993). *Ecology of marine parasites. An introduction to marine parasitology* (2nd ed.).CAB International.

Rohde, K., Hayward, C., & Heap, M. (1995). *Aspects of the ecology of metazoan ectoparasites of marine fishes. International Journal for Parasitology, 25*, 945–970.

Roberto, M.S., Martín, M., Paula, M., & Pilar, A. (2013). *Primer registro de Diphterostomum brusinae (Digenea, Zoogonidae) parasitando a la corvina Micropogonias furnieri con datos sobre su ciclo biológico. Revista Argentina de Parasitologia, 2*, 22–27.

Santos, C.P., Cárdenas, M.Q., & Lent, H. (1999). *Studies on Procamallanus (Spirocamallanus) pereirai Annereaux, 1946 (Nematoda: Camallanidae), with new host records and new morphological data on the larval stages. Memórias do Instituto Oswaldo Cruz, 94*, 635–640.

Siddiqi, A.H., & Cable, R.M. (1960). *Digenetic trematodes of marine fishes of Puerto Rico (Volume XVII- Part 3)*. The New Academy of Sciences.

Soares, I.A., Vieira, F.M., & Luque, J.L. (2014). *Parasite community of Pagrus pagrus (Sparidae) from Rio de Janeiro, Brazil: Evidence of temporal stability. Revista Brasileira de Parasitologia Veterinária, 23*, 216–223.

Sures, B., Nachev, M., Schwelm, J., Grabner, D., & Selbach, C. (2023). *Environmental parasitology: Stressor effects on aquatic parasites. Trends in Parasitology, 39*, 461–474.

Ximenes-Carvalho, M.O., & Fonteles-Filho, A.A. (1996). *Estudo da idade e crescimento da xira, Haemulon aurolineatum Cuvier (Pisces: Pomadasyidae), no estado do Ceará, Brasil. Arquivos de Ciências do Mar, 30*, 73–77.

Yamaguti, S. (1963). *Systema Helminthum. Volume IV. Monogenea and Aspidocotylea.* Interscience Publishers.

Youssef-Dridi, S.B., Antar, R., Gey, D., Justine, J.L., & Gargouri, L. (2023). *Morphological and molecular studies of the life-cycle stages of the monorchiid Monorchis parvus (Looss, 1902) (Digenea) from the Southern Mediterranean coast (Tunisia). Parasitology Research, 122*, 2819–2833.

Zar, J.H. (2010). *Biostatistical analysis* (5th ed.). Prentice Hall.

Received June 254, 2026.

Accepted July 10, 2026.