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Gill parasites from *Caranx latus* (Perciformes, Carangidae) from Northeastern Coast of Brazil and a new host record to the monogenoid *Protomicrocotyle mirabilis* (Monogenoidea, Protomicrocotylidae) and *Caligus chorinemi* (Copepoda, Caligidae)

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Abstract. On the Brazilian coast, five species of *Caranx* are known - *C. crysos*, *C. hippos*, *C. latus*, *C. lugubris* and *C. ruber* - all of them of high commercial value. In the Northeastern region, *C. hippos* and *C. latus* have been registered, the latter being frequent from the north to the south coast of Brazil, but available knowledge about their gill parasites is scarce. In Brazil, only two species of Crustacea, *Caligus robustus* (Caligidae) and *Lernanthropus giganteus* (Lernanthropidae), and two species of Monogenoidea, *Cemocotyle carangis* (Pseudomazocraeidae) and *Pseuddomazocraes selene* (Pseudomazocraeidae), are known to parasitize *C. latus*. In this study, 12 specimens of *C. latus* obtained on the coast of Salvador, Bahia, were analyzed for the presence of gill parasites. The gills were removed and the parasites separated for identification. The permanent slides were prepared to monogenoids and crustacean, which were identified as *Protomicrocotyle mirabilis* (Protomicrocotylidae), and *Caligus chorinemi* (Caligidae) and *Lernanthropus giganteus* (Lernanthropidae), respectively. The parasitological indexes of prevalence, mean intensity of infestation and mean abundance were evaluated. This study comprises the first records of *P. mirabilis* and *C. chorinemi* parasitizing *C. latus* on the Brazilian coast.

Key words: horse-eye jack, ectoparasites, Salvador, Bahia.

Resumo: **Parasitas brânquiais de *Caranx latus* (Perciformes, Carangidae) da costa Nordeste do Brasil e um novo relato do monogenóideo *Protomicrocotyle mirabilis* (Monogenoidea, Protomicrocotylidae) e *Caligus chorinemi* (Copepoda, Caligidae).** Na costa brasileira cinco espécies de *Caranx* são conhecidas e todas elas possuem valor comercial, e são elas: *C. crysos*, *C. hippos*, *C. latus*, *C. lugubris* e *C. ruber*. Na região nordeste, *C. hippos* e *C. latus* foram registradas; a última sendo frequente até a costa sul do Brasil, mas o conhecimento disponível sobre seus parasitos de brânquias é escasso. No Brasil, somente duas espécies de

Crustacea, *Caligus robustus* (Caligidae) e *Lernanthropus giganteus* (Lernanthropidae), e duas espécies de Monogenoidea, *Cemocotyle carangis* (Pseudomazocraeidae) e *Pseuddomazocraes selene* (Pseudomazocraeidae) são conhecidas por parasitar *C. latus*. Neste estudo, 12 espécimes de *C. latus* obtidos na costa de Salvador, Bahia, foram analisadas para a presença de parasitas de brânquias. As brânquias foram removidas e os parasitas separados para identificação. Lâminas permanentes foram preparadas para monogenéticos e crustáceos, os quais foram identificados como *Protomicrocotyle mirabilis* (Protomicrocotylidae), e *Caligus chorinemi* (Caligidae) e *L. giganteus*, respectivamente. Os índices parasitológicos de prevalência, intensidade media de infestação e abundância media foram avaliados. Este estudo compreende o primeiro registro de *P. mirabilis* e *C. chorinemi* parasitando *C. latus* da costa brasileira.

Palavras-chave: Xerelete, ectoparasitas, Salvador, Bahia.

Introduction

Carangidae is composed of 32 genera and 140 tropical or subtropical pelagic species, which form shoals close to the surf (Nelson 1984, Luque & Alves 2001). They are common species on the Brazilian coast and have high economic (Menezes & Figueiredo 1980) and ecological value, composing the ichthyofauna of the Brazilian West Atlantic reefs (Floeter *et al*. 2003).

On the Brazilian northeastern coast species of 10 genera of Carangidae are known: *Alectis* Lacepede, 1802, *Carangoides* Bleeker, 1851, *Caranx* Lacepede, 1801, *Chloroscombrus* Girard, 1858, *Elagatis* (Quoy & Gaimard, 1825), *Oligoplites* Gill, 1863, *Selar* Bleeker, 1851, *Selene* Lacepede, 1802, *Seriola* Cuvier, 1816, and *Trachinotus* Lacepede, 1801 (Lessa *et al*. 2000, Feitosa *et al*. 2003, Lima Filho *et al*. 2006).

Eighteen valid species of *Caranx* are registered in the world, of which five have been recorded on the coast of Brazil: *Caranx latus* Agassiz, 1831, *C. hippos* (Linnaeus, 1766), *C. crysos* (Mitchill, 1815), *C. lugubris* Poye, 1860, and *C. ruber* (Bloch, 1793) (Froese & Pauly 2019). In Todos os Santos Bay (TSB), in the Bahia State, only *C. latus* and *C. hippos* have been recorded (Reis-Filho *et al*. 2010). *Caranx latus* is a species that occurs in shoals in the pelagic zone and in reefs (Froese & Pauly 2019) and is very frequent from the northeast coast to the south of Brazil (Paiva *et al*. 2013). Although *Caranx* species are common and commercially important, studies on the gill ectoparasites of these hosts on the Brazilian coast are scarce, especially for *C. latus* (Luque & Alves 2001, Kohn *et al*. 2013).

Kritsky *et al*. (2011) listed 20 species of Monogenoidea parasitizing *C. hippos* in different locations around the world. In Brazil, only five species were recorded in the same host: *Allopyragraphorus* sp., *Allopyragraphorus hippos* (Hargis, 1956) Yamaguti, 1963 (Allopyragraphoridae), *Cemocotyllela elongata* (Meserve, 1938) Price, 1962 and *Cemocotyle noveboracensis* (MacCallum, 1919) (Cemocotylidae), and *Protomicrocotyle mirabilis* (MacCallum, 1918) Johnston & Tiegs, 1922 (Protomicrocotylidae), all in Rio de Janeiro. *Cemocotyle carangis* (MacCallum, 1913) Sproton, 1946 and *Pseudomazocraes selene* Hargis, 1957 (Pseudomazocraeidae) parasitize *C. latus* from Rio de Janeiro (Luque & Alves 2001, Kohn *et al*. 2013).

Monogenoids in other carangids have been recorded for *Oligoplites palometa* (Cuvier), *O. saurus* (Bloch & Schneider, 1801), and *O. saliens* (Bloch, 1793) from the coast of Rio de Janeiro, among which are *Metacamopia oligoplites* Takemoto, Amato and Luque, 1996 and *Hargicola oligoplites* (Hargis, 1957) Lebedev, 1970 (Takemoto *et al*. 1996) (Allodiscocotylidae); *Benedenia* sp., *Encotyllabe* sp. (Capsalidae), and *P. selene* (Hargis, 1957) (Cordeiro & Luque 2004) were recorded in *Selene setapinnis*. *Trachurus lathami* Nichols, 1920, from the coast of Rio de Janeiro, are parasitized by *Gastrocotyle trachuri* Dillon & Hargis, 1965 and *Pseudaxine trachuri* Parona & Perugia, 1889 (Braicovich *et al*. 2012, Gonçalves & Alves 2012) (Gastrocotylidae). *Trachinotus goodei* Jordan and Evermann, 1896 from Rio de Janeiro, are parasitized by *Cemocotyle* sp., *Pseudobicotylophora atlantica* (Amato, 1994), *P. selene* (Discocotylidae), and *Pyragraphorus pyragraphorus* (MacCallum and MacCallum, 1913) (Pyragraphoridae) (Luque & Cezar 2004).

Protomicrocotylidae is the family with the highest degree of host specificity and the one that contains the lowest rate of registration among carangids of the Brazilian coast (see Kohn *et al*. 2013). Nine species of *Protomicrocotyle* Johnston and Tiegs, 1922 are known all over the world, and all of them occur in species of Carangidae. These are

Protomicrocotyle carangis Sivasankar Pillai & Krishna Pillai, 1978; *Protomicrocotyle celebesensis* Yamaguti, 1953; *Protomicrocotyle ivoriensis* Wahl, 1972; *Protomicrocotyle madrasensis* Ramalingam, 1960; *Protomicrocotyle mannarensis* Ramalingam, 1960; *Protomicrocotyle manteri* Bravo-Hollis, 1966; *Protomicrocotyle minuta* Ramalingam, 1960; *P. mirabilis* ; and *Protomicrocotyle nayaritensis* Bravo-Hollis, 1979.

All nine species of *Protomicrocotyle* occur in the Atlantic and Pacific Oceans, but just *P. nayaritensis* was reported in the Pacific Ocean (Kritsky *et al*. 2011). All species of *Protomicrocotyle* have been recorded only in two *Caranx* species (Kritsky *et al*. 2011). *Protomicrocotyle carangis* and *P. celebesensis* were recorded parasitizing *Caranx* sp. (Kritsky *et al*. 2011); *P. ivoriensis*, *P. madrasensis*, *P. mannarensis*, *P. manteri*, *P. minuta*, *P. mirabilis* and *P. nayaritensis* were recorded parasitizing *C. hippos* (Wahl 1972, Luque & Alves 2001, Kritsky *et al*. 2011); and *P. nayaritensis* was reported only in the Pacific Ocean (Kritsky *et al*. 2011).

Another group of very common gill parasites in pelagic fish are Copepoda (Crustacea) (Kabata 1979). On the Brazilian coast, the records of Crustacean gill parasites of the species of *Caranx* are still incipient, containing records only of species of Caligidae, Lernanthropidae, and Cymothoidae (Luque & Tavares 2007).

Caligus (Caligidae) contains 268 known species (WoRMS 2019), and of these, 24 have been recorded in Brazil, 11 of them in carangids and three parasitizing species of *Caranx*: *C. chorinemi* Krøyer 1863, parasitizing *Carangoides bartholomaei*, *Caranx crysos*, and *C. hippos* (Cressey 1991); *Caligus robustus* Bassett-Smith, 1898 (Caligidae) of *C. hippos*, *C. latus*, *Oligoplites palometa*, *O. saliens*, *O. saurus*, *S. setapinnis*, *Selene vomer* (Takemoto *et al*. 1996, Cezar *et al*. 2000, Luque *et al*. 2000, Luque & Alves 2001, Takemoto & Luque 2002, Cordeiro & Luque 2004); and *Caligus tenax* (syn. of *C. chorinemi*) of *C. hippos* (Cressey 1991, Luque & Tavares 2007, Morales-Serna *et al*. 2016).

There are records of over 100 (104 according to WoRMS 2019, Boxshall & Montú 1997) species of *Lernanthropus* Blainville, 1822, all of them gill parasites of the teleost fishes, mainly in seas and oceans of low latitude regions (FAO 1999), such as the Atlantic, Indian, and Pacific oceans (Kabata 1979, Luque & Farfán 1990). However, records of species of this genus are rare on the Pacific coast of the Americas, where only four species have been reported (Oliva & Duran 1982, Castro & Baeza 1985). *Lernanthropus giganteus* Kroyer, 1863 (Lernanthropidae) has records only for species of Carangidae: *Carangoides ferdau* (Forsskål, 1775) and *Carangoides praeustus* (Bennett, 1830); *Caranx hippos* (Linnaeus, 1766), *Caranx ignobilis* (Forsskål, 1775), *Caranx melampygus* Cuvier, 1833, *Caranx senegallus* Cuvier, 1833 and *Caranx sexfaciatus* Quoy and Gaimard, 1825); and *Selaroides leptolepis* (Cuvier, 1833) (FAO 1999). In Brazil, *L. giganteus* has been recorded in *C. hippos* and *C. latus* from Rio de Janeiro (Takemoto *et al*. 1996, Cezar *et al*. 2000, Luque *et al*. 2000, Luque & Alves 2001, Takemoto & Luque 2002).

Caranx species from Brazil are also parasitized by other crustaceans such as *Cymothoa oestrum* (Linnaeus, 1758) (Cymothoidae), recorded only on *C. latus* from Pernambuco and from Santa Catarina States (Thatcher 2000, Thatcher *et al.* 2003), and *Cymothoa brasiliensis* Schiödte and Meinert, 1884 (Cymothoidae) of *Caranx* sp. from Rio de Janeiro (Thatcher *et al.* 2003, Luque *et al.* 2013).

During studies on *C. latus*, two known species of crustaceans and one of monogenoid were found parasitizing this fish host and these new records are presented herein.

Materials and Methods

Twelve *C. latus* specimens (Fig. 1) were obtained from fishermen from the Rio Vermelho fishing colony (13º 00’45.5” S, 38º 29’ 41.6”W), Salvador, Bahia State, to investigate the presence of gill parasites. The gills were removed and the parasites separated. The monogenoids were fixed in 5% formalin and prepared in Hoyer’s medium (Humason 1979). Crustaceans samples were fixed in 70% glycerinated ethanol and mounted in Hoyer's medium (Thatcher 2006). The pictures were obtained in microscopy Olympus CX41 with phase contrast and camera Olympus DP73.

The minimum and maximum numbers of parasites per gill branch, followed by values of abundance of parasites (N), are presented between parentheses. The parasitological indexes of prevalence, mean intensity of infestation and mean abundance were evaluated according Bush *et al*. (1997). Vouchers of parasite specimens were deposited in the helminthological collection of Museu de Zoologia da Universidade de São Paulo (MZUSP), São Paulo Brazil, as presented in the results.

Figure 1. *Caranx latus* from Salvador coast, Bahia State, Brazil. **Scale bar** = 10 cm.

Results

Specimens of *C. latus* presented a mean total length of 29.5 ± 4.06 cm (24.8–36.0; N = 12) and a mean standard length of 24.0 ± 3.57 cm (20.4–29.0; N = 12).

The gills of horse-eye jack were parasitized by *Protomicrocotyle mirabilis* (9–145; N = 697) (Fig. 2), *L. giganteus* (1–17; N = 48;) (Fig. 3 – 4) and *C. chorinemi* (Fig. 5). All the specimens of *C. latus* this study were parasitized by at least one parasite; only four hosts presented the five specimens of *C. robustus*, and only one host was not parasitized by *P. mirabilis*, while all hosts were parasitized by *L. giganteus*, albeit with few parasites per host (a mean of 4 per fish). The parasitological indexes are presented in Table I.

Protomicrocotyle mirabilis occur in greater numbers (697 parasites) in the gills of *C. latus* but with a prevalence of 91.7% and containing about 63 parasites per positive host. The total length of host between 27 cm and 31.5 cm presented the biggest number of *P. mirabilis*, 145 and 93 parasites, respectively. The second most abundant species was *L. giganteus*, with 48 parasites in total, which the biggest number of parasites (17), was found on the host with total length of 31.5. The remaining fishes with values of total size, larger or smaller than 31.5 cm, presented a range of number of *L. giganteus* between 1 and 5.

Voucher specimens of *C. chorinemi* MZUSP 41111, *L. giganteus* MZUSP 41110 and *P. mirabilis* MZUSP 7972a-j, and were deposited in the helminthological collection of Museu de Zoologia da Universidade de São Paulo (MZUSP), São Paulo Brazil.

Discussion

Caranx species have a circumtropical distribution and occur in estuarine environments when they are young and in pelagic zones when they are adults (Briggs 1960, FAO 1999). Besides having great commercial importance, the largest species of *Caranx* are appreciated in the practice of sport fishing (FAO 1999).

Among the five *Caranx* species recorded in Brazil, only *C. latus* and *C. hippos* have been reported in Todos os Santos Bay (BTS) in the Bahia State (Northeast Brazil) (Reis-Filho *et al*. 2010).

Caranx latus is a species found in the pelagic zone and in reefs (Froese & Pauly 2019), which form schools and capture gregarious prey, features that enables greater proximity among the hosts and potentiate the monoxenic cycle ectoparasites transmission, as monogenetic and copepods, influencing in the parasitological indices (Carvalho Filho 1999, Boada *et al*. 2012). Additionally, morphological characteristics such as host length also can be influence in the parasitological indices (Luque & Alves 2001).

Parasitological indices of *P. mirabilis* from the gills of *C. hippos* from Rio de Janeiro (Southeast Brazil) were prevalence of 31.7%, mean intensity of 2.7 and mean abundance of 0.90, and present positive correlated with the total length of the host, while that on *C. latus* the parasite was not observed (Luque & Alves 2001). Two localities from Venezuela were sampled, presenting significant differences of parasitological indices. In Santa Cruz the prevalence values of *P. mirabilis* from the gills of *C. hippos* was of 77.5%, while in Carúpano the

Table I. Parasitological indexes of assembly of gill parasites of *Caranx latus* from Salvador coast, BA. N – Total number of parasites; P(%) – Prevalence; MII – Mean infestation intensity; MA– Mean abundance.

Species	N	Range	P (%)	MII	MA
Protomicrocotyle mirabilis	697	0 - 145	91.7	63.4	58.1
Caligus chorinemi	05	0 - 2	41.7	1.3	0.4
Lernanthropus giganteus	48	1 - 17	100	4.0	4.0

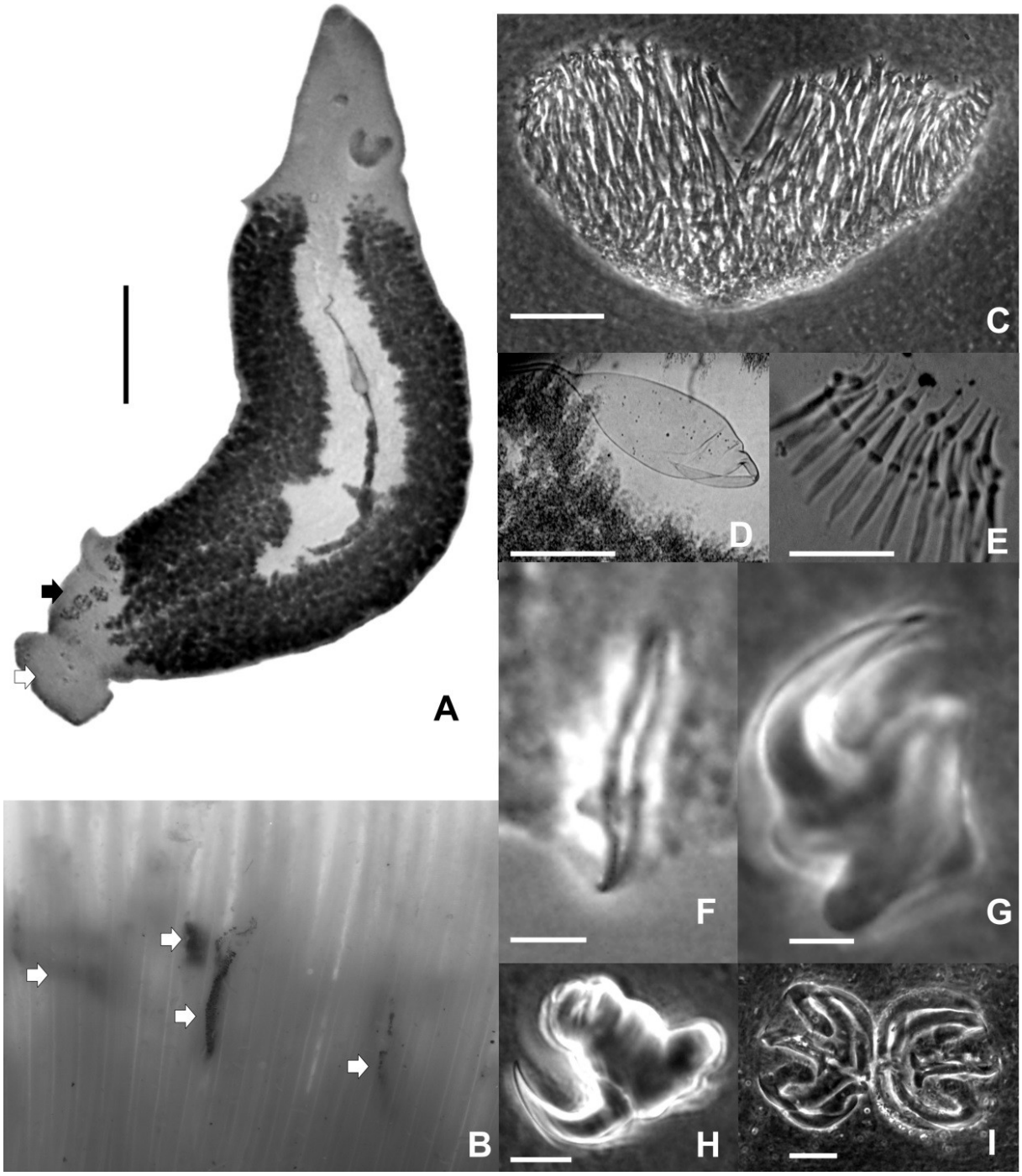

Figure 2. *Protomicrocotyle mirabilis* from gill of *Caranx latus* from Salvador coast, Bahia State, Brazil. **A**. Parasite *in toto*. Black arrow indicates the clamps. **B**. Specimens of *Protomicrocotyle mirabilis* (*in loco*) attached in the gill

filaments of *Caranx latus* (white arrows). **C**. Vagina. **D**. Egg. **E**. Male copulatory organ. **F**. Hook. **G**. Medial anchor. **H**. Lateral anchor. **I**. Clamp. **Scale bars** – **A-C** = 500 µm. **D-E** = 20 µm. **F-I** = 100 µm.

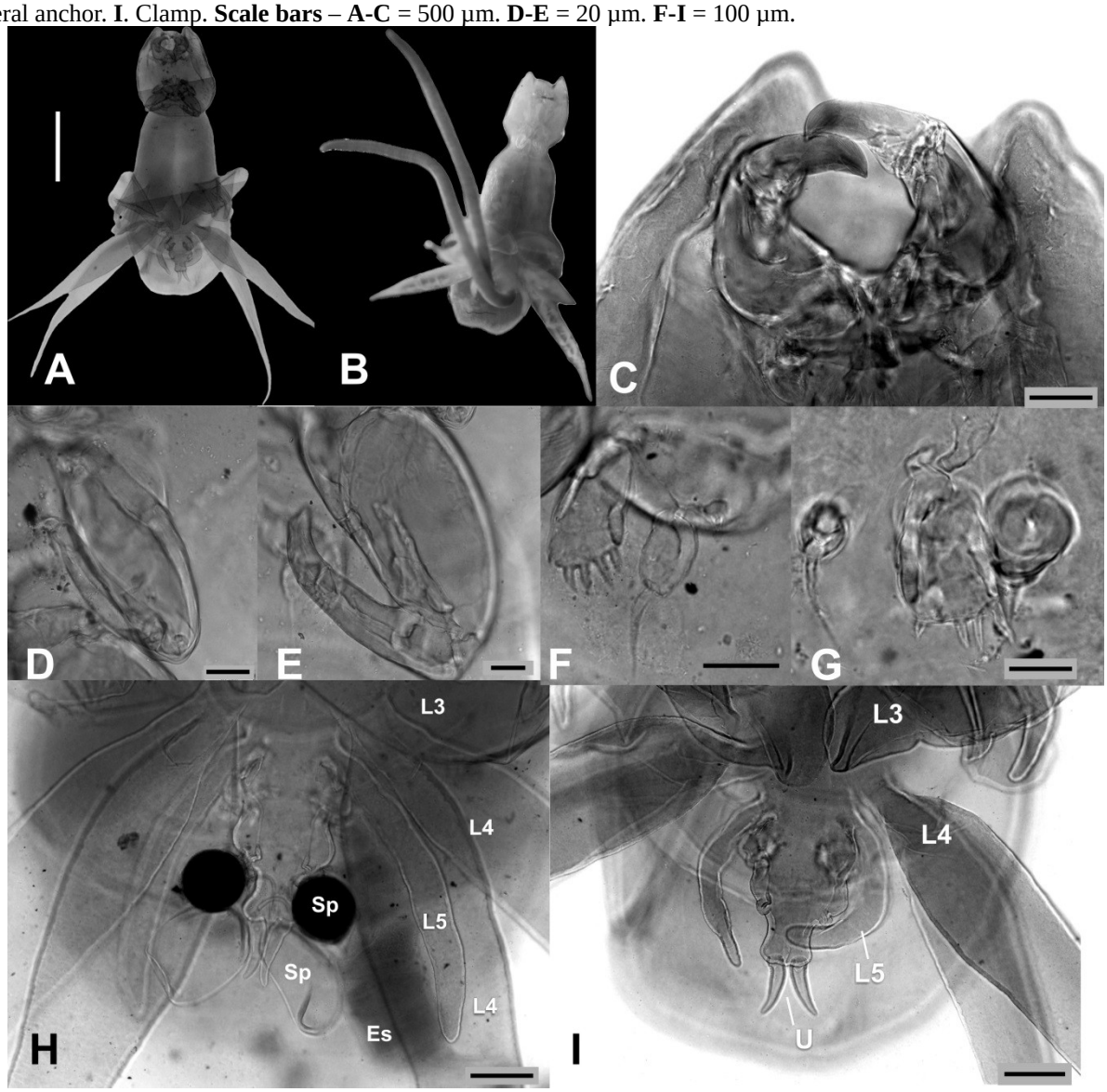

Figure 3. *Lernanthropus giganteus* (female) from gill of *Caranx latus* from Salvador coast, Bahia State, Brazil. **A-B**. Female *in toto*; **A**. Composite prepared with Hoyer's medium. **B**. Picture without preparation (*in natura*). **C**. Second antenna. **D.** First maxilla. **E**. Second maxilla. **F**. Leg 1. **G**. Leg 2. **H**. Posterior portion of body. **L3** – Leg 3; **L4** - Leg 4; **L5** - Leg 5; **Es** - Egg sac; **Sp** - Spermatophore. **I**. Posterior portion of body showing the genital segment. **L3** – Leg 3; **L4** - Leg 4; **L5** - Leg 5; **U** - Uropod. **Scale bars** – **A-C** = 500 µm. **D-E** = 20 µm. **F-I** = 100 µm.

prevalence was of 68.1%, being this species of parasite dominant numerically. Moreover, was observed the existence of an accumulation of parasite as the host increases in size, indicating a correlation with host size in both localities (Boada *et al*. 2012). In the present study, the parasitological indices evaluated were higher than observed to *C. hippos* from Rio de Janeiro and of two localities from Venezuela, presenting values of prevalence (91.7%), mean infestation intensity (63.4) and mean abundance (58.1). However, at Bahia coast, the higher number of specimens of *P. mirabilis* on *C. latus* was observed between the lengths of 27.4 cm (145 parasites) and 31.5 cm (93 parasites), decreasing as the length increased. These values indicate that the host size have a weak influence with parasite distribution.

Host specificity may potentiate the parasite transmission process (Boada *et al*. 2012). Among the monogenoids, *Protomicrocotyle* species appear to have morphological and phylogenetic specificity for *Caranx* species (Boada *et al*. 2012). The

morphological specificity of *P. mirabilis* for *C. hippos* may be due to the position (and symmetry) of the haptor in the gill arcs of its hosts (Kritsky *et al*. 2011).

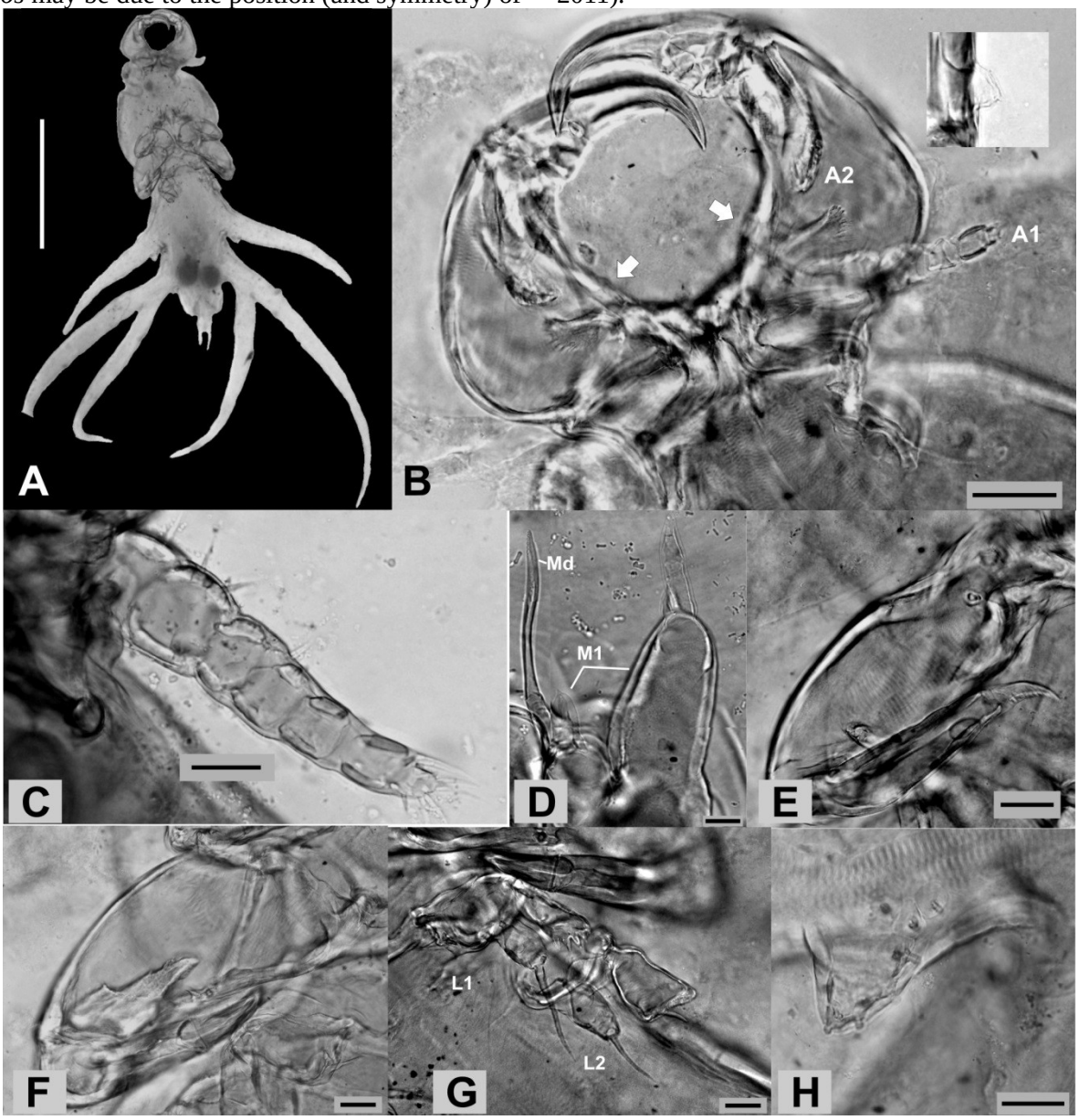

Figure 4. *Lernanthropus giganteus* (male) from gill of *Caranx latus* from Salvador coast, Bahia State, Brazil. **A**. Male prepared with Hoyer's medium. **B**. Second atenna with sensorial spines (arrows, detail); First antenna (**A1**); Second antenna (**A2**). **C**. First antenna. **D**. Mandibule (**Md**) and maxilulla (**M1**). **E**. First maxila. **F**. Second maxila. **G**. First and second legs. **H**. Segment of leg 4. **Scale bars** – **A-C** = 500 µm. **D-E** = 20 µm. **F-I** = 100 µm.

In contrast to the specificity presented by monogenoids, species of parasitic crustaceans such as *Caligus* and *Lernanthropus* are considered generalists (Paraguassú *et al*. 2002, Sabas & Luque 2003, Isbert *et al*. 2018), parasitizing hosts of different families.

In Brazil, studies developed at State of Rio de Janeiro (Southeast Brazil) reported *L. giganteus* on *C. hippos* (Luque & Alves 2001), *Lernanthropus gisleri* of *Centropomus undecimalis* (Centropomidae) (Tavares & Luque 2004), *L. leidyi* Wilson, 1922 on *Umbrina canosai* (Sciaenidae) (Luque & Paraguassú 2003), and *Lernanthropus caudatus* Wilson, 1922 on *Pagrus pagrus* (Sparidae) (Sabas & Luque 2003); *Lernanthropinus trachuri* (Brian, 1903) on the gills of *Trachurus lathami* (Carangidae) (Braicovich *et al*. 2012, Luque *et al*. 2013) and *Lernanthropinus cynoscicola* of the gills of *Cynoscion guatucupa* (Sciaenidae) (Sabas & Luque 2003). One single report of *Lernanthropus* sp.

was made at State of Rio Grande do Norte (Northeast Brazil) of the gills of *Lutjanus synagris* (Lutjanidae) (Cavalcanti *et al*. 2013).

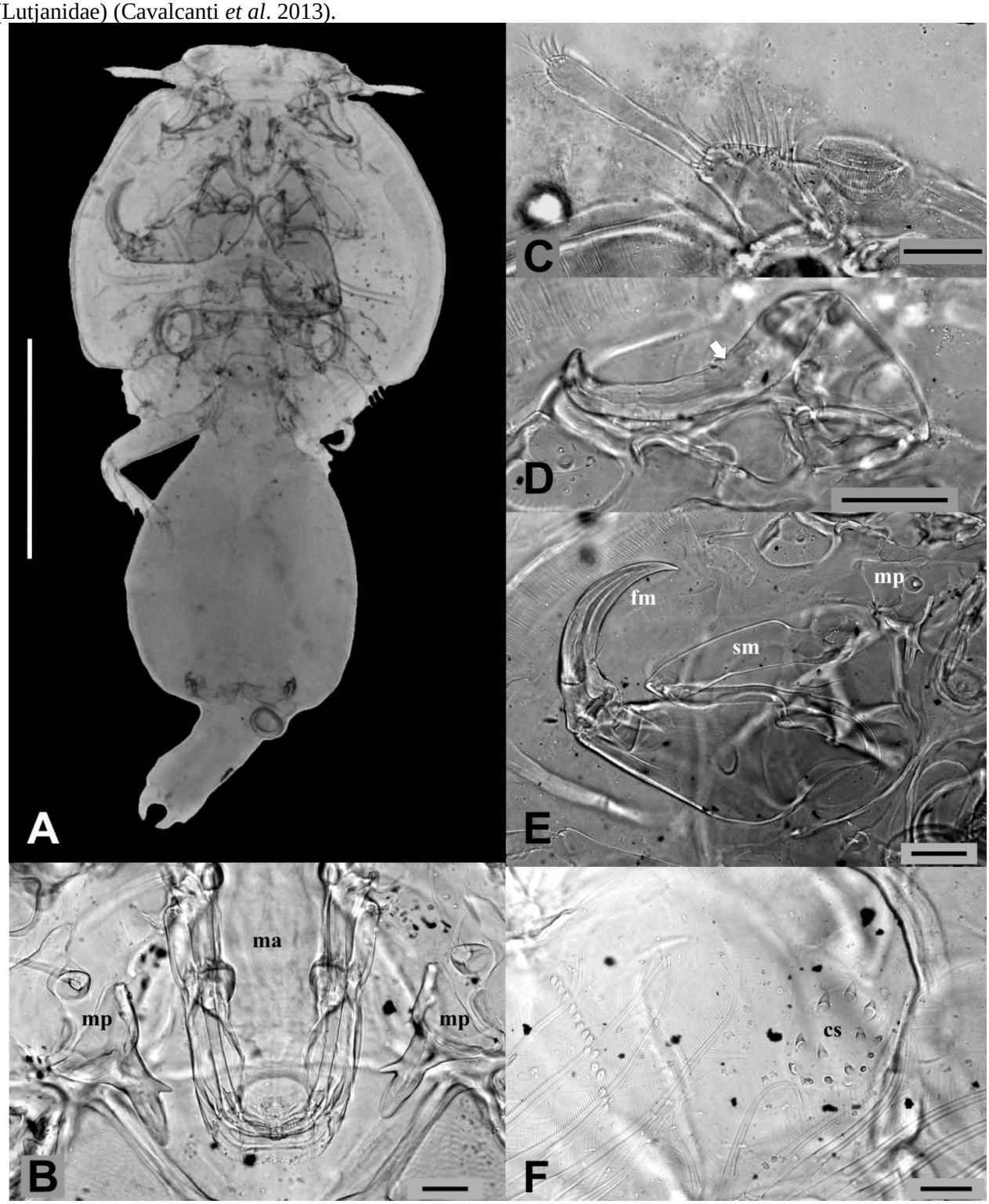

Figure 5. *Caligus chorinemi* (male) from gill of *Caranx latus* from Salvador coast, Bahia State, Brazil. **A**. Male *in toto*. **B**. Mandibule (**ma**) and maxilulla process (**mp**). **C**. First atenna. **D**. Second antenna. **E**. First and second maxila (**fm**, **sm**), maxilulla process (**mp**). **F**. Fourth leg, basecoxa with concentric spines (**cs**). **Scales bar**: **A** = 500 µm. **B and F**= 20 µm. **C**-**E** = 50 µm.

Due to this diversity of hosts, *Lernanthropus* species present different infestation strategies and, as a consequence, different values of parasitological indices. In *L. synagris* from State of Rio Grande do Norte, *Lernanthropus* sp. presented a prevalence of 4%, a mean infestation intensity of 2.75, and a mean abundance of 0.11 (Cavalcanti *et al*. 2013). Infestation by *L. giganteus*, given by the prevalence and abundance values, was positively correlated with the total length of *C. hippos* (Luque & Alves 2001). *Lernanthropus giganteus* was considered a generalist when parasitizing carangids from Mexico, of which *Oligopletes altus* showed prevalence/abundance values of 29.76% / 0.65; *O. saurus* 1.6% / 0.05; and *O. refugens* 2.6% / 0.03, respectively (Santos-Bustos *et al*. 2018).

All specimens of *C. latus* from Bahia investigated in this study contained, on average, four specimens of *L. giganteus* in their gills (MII and MA = 4 and P = 100%), values higher than those for hosts in Mexico. The prevalence of *L. giganteus* in *C. latus* indicates a well-supported association, although this parasite is considered a generalist. In addition, only one specimen of *C. latus* contained more than five parasites in its gills (17) and was not the largest captured host (31.5 cm), indicating the possible absence of a relationship between infestation and host size.

Species of *Caligus* reported for State of Rio de Janeiro were found parasitizing different species of carangids fishes. *Caligus chorinemi* was registered parasitizing *C. hippos* and *C. crysos*, while *C. robustus* was found on *C. hippos*, *C. latus* and *C. tenax* (Luque & Alves 2001, Luque & Tavares 2007). Additionally, *C. robustus* was reported parasitizing *Selene setapinnis* in the same locality (Cordeiro & Luque 2004).

In the Rio de Janeiro State, the values of prevalence and mean intensity of species of *C. robustus* were low. In *C. hippos* the prevalence was 16.7%, and the mean intensity was 1.8 parasites per fish, while in *C. latus* the prevalence and mean intensity were 1.8% and 1.0, respectively (Luque & Alves 2001, Luque & Tavares 2007). The prevalence value found for *C. chorinemi* (41.7%) parasitizing *C. latus* from Bahia was higher than those found to *C. robustus* from Rio de Janeiro; however, the mean intensity was close (1.3). These data indicate that species of *Caligus* use the different host populations, maintaining a low number of individuals per host, even with different prevalence values, which reinforces the generalist character of these copepods.

Just one report of the co-occurrence of *C. chorinemi*, *L. giganteus* and *P. mirabilis* at Brazil coast was made on gills of *C. hippos* (Luque & Alves 2001). The co-occurrence of these three parasite species was also observed in *C. latus* of the coast of Bahia, with a numerical predominance of *P. mirabilis* (N = 697), followed by *L. giganteus* (N = 48) and *C. chorinemi* (N = 5).

These numerical differences can be given due to the form of fixation of parasites in the host, distinctly observed for each parasite species of *C. latus*. *Protomicrocotyle mirabilis* has its attachment site in the secondary lamellae, with the body extended between the primary lamellae, generally keeping the anterior region directed to the distal portion of the lamella (Fig. 2A), while the copepods were observed attached near the base of the primary gill filament, occupying the same site. This behavior of fixation can explain the low number of copepods in contrast with higher number of *P. mirabilis*. Ramasamy *et al*. (1985) observed difference among fixation site to monogenoids and copepods, which showed preference of fixation site (microhabitat) at gill filaments according with the water flow, without interference of one under others species.

This study reports the first parasitic record for *P. mirabilis* and contributes new information on the geographical distribution of *C. chorinemi* and *L. giganteus* in *C. latus* from the coast of Brazil.

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