

Parasitic copepods on *Oligoplites* spp. (Osteichthyes, Carangidae) from the Brazilian coastal zone, with the redescription of *Tuxophorus caligodes* Wilson, 1908 (Siphonostomatoida, Tuxophoridae)

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ABSTRACT. Four species of caligid copepods, parasites of *Oligoplites palometa* (Cuvier, 1833), *O. saurus* (Bloch & Schneider, 1801) and *O. saliens* (Bloch, 1793) (Osteichthyes: Carangidae) from the Sepetiba Bay, coast of the state of Rio de Janeiro, Brazil, are presented. New geographical and host records for *Caligus robustus* Bassett-Smith, 1898, *C. rufimaculatus* Wilson, 1905, *C. bonito* Wilson, 1905 and *Metacaligus rufus* (Wilson, 1908) are given. *Caligus oligoplitisi* Carvalho, 1954 is considered a new junior synonym of *C. robustus*. Fishes of the genus *Oligoplites* are new host records for this species of copepod. Redescription and illustration of *Tuxophorus caligodes* Wilson, 1908, collected on the body surface of *Oligoplites saliens*, *O. palometa* and *O. saurus*, are provided.

Key words: Copepod, Caligidae, *Tuxophorus caligodes*, *Oligoplites*, Carangidae, South Atlantic.

RESUMO. Copépodes parasitos de *Oligoplites* spp. (Osteichthyes, Carangidae) da costa brasileira, com a redescricao de *Tuxophorus caligodes* Wilson, 1908 (Siphonostomatoida, Tuxophoridae). Quatro espécies de copépodes caligídeos, parasitos de *Oligoplites palometa* (Cuvier, 1833), *O. saurus* (Bloch & Schneider, 1801) e *O. saliens* (Bloch, 1793) (Osteichthyes, Carangidae) da Baía de Sepetiba, litoral do Estado do Rio de Janeiro, Brasil, são descritos. São apresentados o registro de novo hospedeiro e nova distribuição geográfica para *Caligus robustus* Bassett-Smith, 1898, *C. rufimaculatus* Wilson, 1905, *C. bonito* Wilson, 1905 e *Metacaligus rufus* (Wilson, 1908). *Caligus oligoplitisi* Carvalho, 1954, é considerado novo sinônimo júnior de *C. robustus*. *Tuxophorus caligodes* Wilson, 1908, coletado na superfície do corpo de *Oligoplites saliens*, *O. palometa* e *O. saurus* é redescrito e ilustrado. Peixes do gênero *Oligoplites* são novos hospedeiros para estas espécies de copépodes.

Palavras-chave: Copepoda, Caligidae, *Tuxophorus caligodes*, *Oligoplites*, Carangidae, Atlântico Sul.

Introduction

Studies about copepods parasitic on marine fishes from the Brazilian coast are scanty. Hitherto, only two species of the family Caligidae have been recorded parasitizing fishes of the genus *Oligoplites* Gill, 1863 in Brazil, both from the coast of São Paulo State (Carvalho, 1956; Rohde, 1991). During a parasitological survey in the coast of Rio de Janeiro state, Brazil, specimens of *Tuxophorus caligodes* Wilson, 1908, were collected from the body surface of *Oligoplites saliens* (Bloch), *O. palometa* (Cuvier) and *O. saurus* (Bloch & Schneider). The parasite is

described and illustrated. This is the first record of the genus *Tuxophorus* parasitic on these hosts and from the South American Atlantic Ocean.

Material and methods

From March 1991 to November 1992, 84 specimens of *O. palometa*, 37 specimens of *O. saurus*, and 36 specimens of *O. saliens* were collected monthly by local fishermen from Itacuruçá (22°51'S, 43°56'W), Sepetiba Bay, coast of Rio de Janeiro state, Brazil. The fishes were sent to the Seção de Peixes do Museu de Zoologia da Universidade de São Paulo (MZUSP) for

identification. The copepods were fixed in 70° GL ethyl alcohol and their appendages were dissected and cleared in lactic acid and mounted in Hoyer's medium (Eiras *et al.*, 2000). The figures were made with the aid of a drawing tube. All measurements are given in millimeters (mm) while the ranges follow

the mean within parentheses. The nomenclature used for the description of the appendages follows Kabata (1979). The terms prevalence and mean intensity are used according to Margolis *et al.* (1982) revisited by Bush *et al.* (1997).

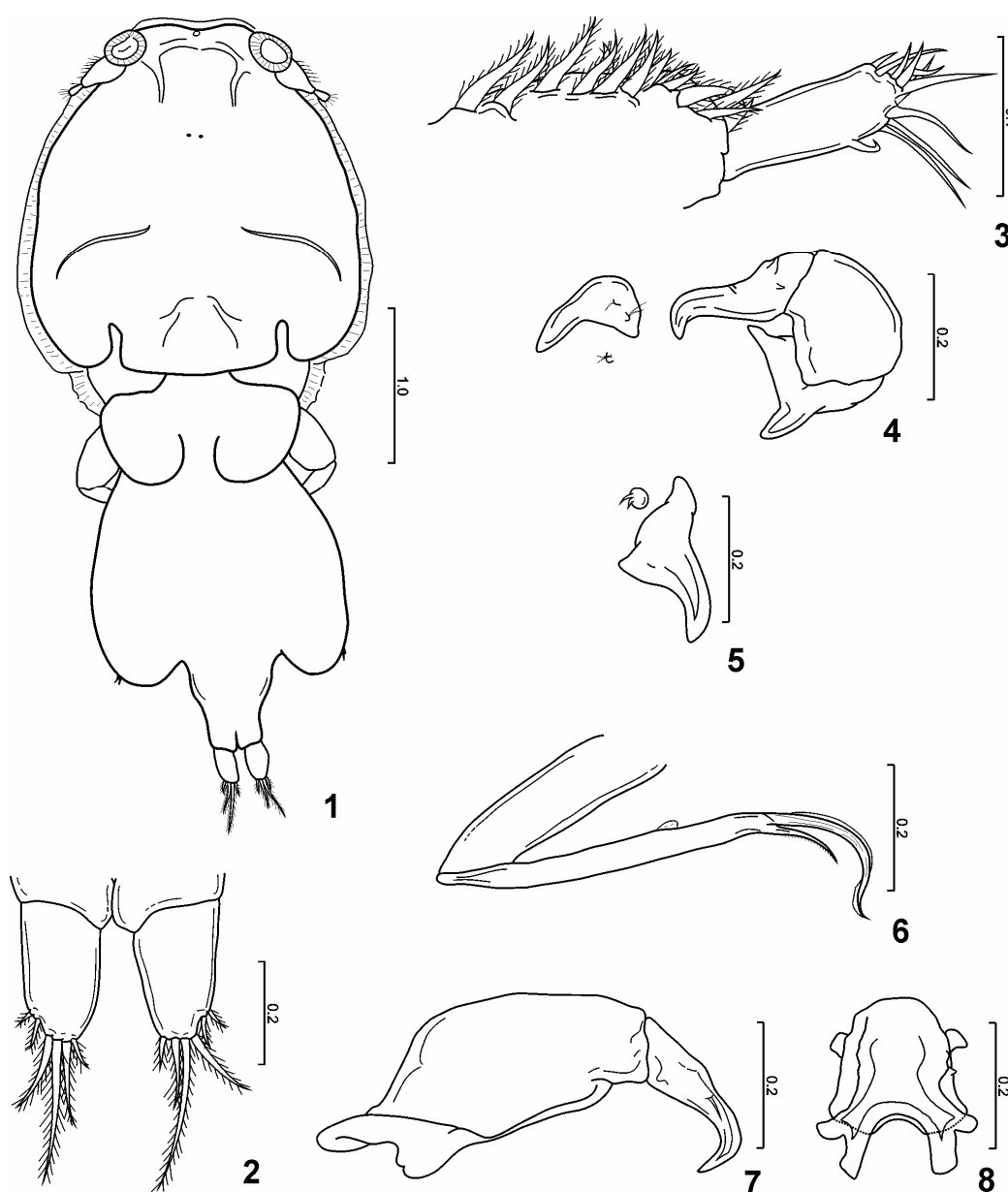
Results

Copepoda

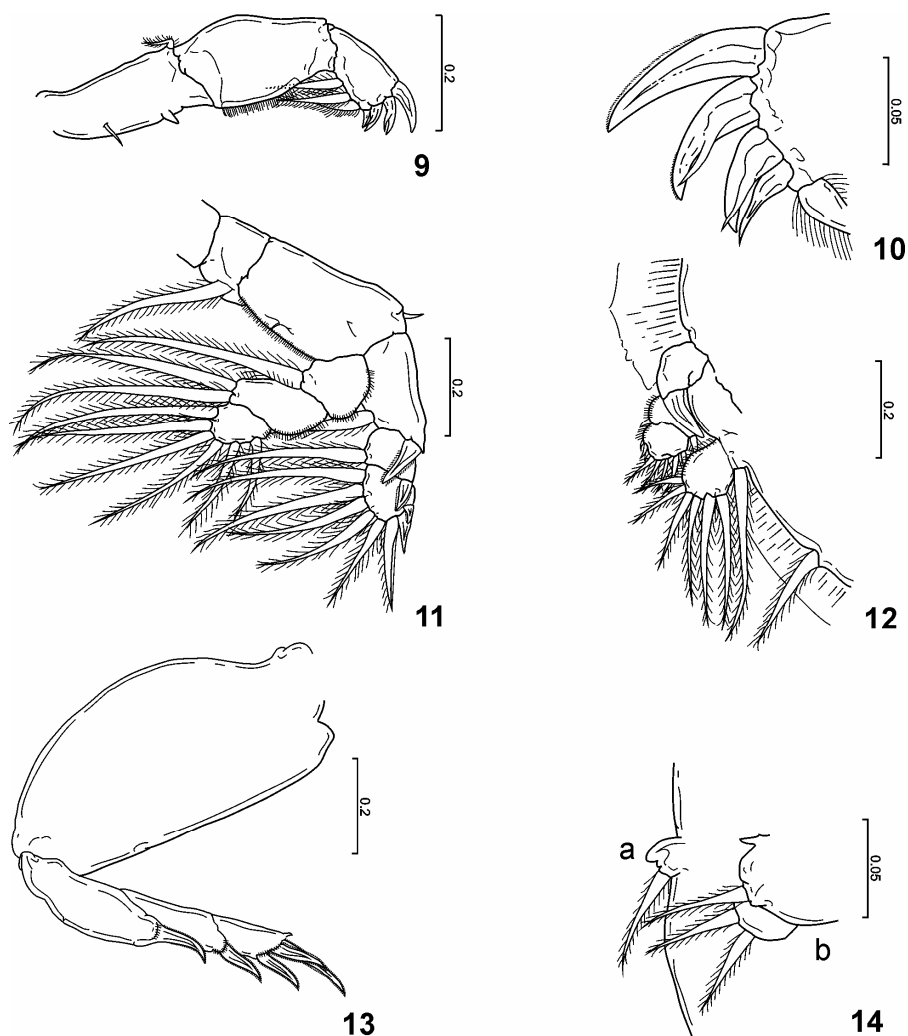
Siphonostomatoida

Euryphoridae

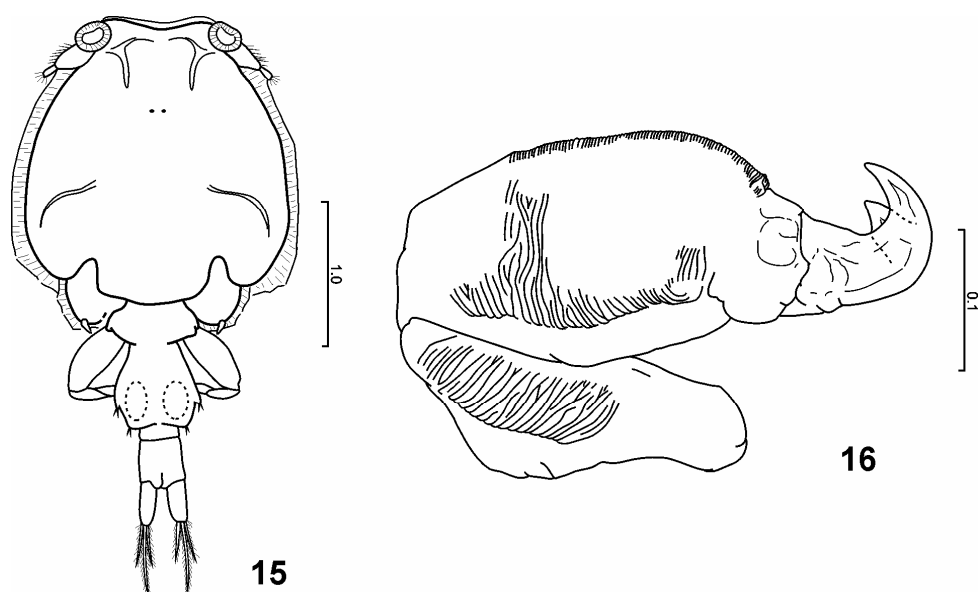
Tuxophorus caligodes Wilson, 1908.



Figures 1-8. *Tuxophorus caligodes* Wilson, 1908. Female: Figure 1, dorsal view; Figure 2, uropods; Figure 3, first antenna; Figure 4, second antenna; Figure 5, first maxilla; Figure 6, second maxilla; Figure 7, maxilliped; Figure 8, sternal furca



Figures 9-14. *Tuxophorus caligodes* Wilson, 1908. Female: Figure 9, first leg; Figure 10, distal segment of first leg; Figure 11, second leg; Figure 12, third leg; Figure 13, Fourth leg; Figure 14a, fifth leg; Figure 14b, sixth leg



Figures 15-16. *Tuxophorus caligodes* Wilson, 1908. male: Figure 15, dorsal view; Figure 16, second antenna

Redescription: Female (based on five specimens collected on *Oligoplites saliens* and two on *O. palometa*, all measured): Total length (to uropods), 2.85 - 5.16 (4.38). Maximum width 1.79 - 2.52 (2.27). Cephalotorax total length 1.73 - 2.37 (2.18), with pair of aliform plates arising from sides of fourth leg-bearing segment, anterior margin straight, inclined slightly backward, posterior margin strongly curved, not reaching midline. Genital complex, 0.67 - 2.19 (1.59) long, 0.62 - 1.68 (1.28) wide. Egg sacs 2.47 (n=1) long, 0.51 (n=1) wide. Abdomen unsegmented, 0.36 - 0.71 (0.59) long, 0.34 - 0.56 (0.43) wide. Caudal rami, 0.15 - 0.26 (0.23) long, 0.11 - 0.15 (0.13) wide, with six terminal pinnate setae, largest 0.16 - 0.29 (0.26) long. Frontal lunules 0.20 - 0.29 (0.27) in diameter, spaced 0.52 - 0.70 (0.65). Antenna bisegmented, basal segment with 15 pinnate setae, distal segment with 11 naked setae. Antennule with curved claw and one spine on the internal margin, spatulate process on the external extremity of the basal segment. Postantennal process somewhat curved, subtriangular base, with two pairs of setulae. Maxilla subtriangular, with inferior extremity slightly curved. Maxillule bisegmented, with small external membrane on the distal segment. Maxilliped corpus robust, curved claw, with one seta, near the curvature. Sternal furca double, with base rounded, small, rami bifurcate. First leg sympod, with one naked, one pinnate seta; endopod reduced to small digitiform process; exopod bisegmented, basal segment with plumose inferior edge, outer angle with one setule; distal segment with four terminal setae, largest with delicate outer membrane, two medial setae with spiniform secondary processes, inferior seta smaller than the others, three pinnate setae at the inferior edge. Second leg, sympod segmented; coxopod with long pinnate seta, basipod with two small naked setae, one on the external superior corner, other on the external margin, inferior edge plumose; trisegmented rami; first two segments of exopod with sclerotized spine in the distal outer corner and one pinnate seta each, spines with thin external membrane; distal segment with two terminal spines of unequal size, smaller with thin outer membrane, longer naked, one semipinnate seta with outer membrane and five pinnate setae; endopod with outer edge plumose, basal segment with long pinnate seta, medial segment with two long pinnate setae, distal segment with six pinnate setae. Third leg, sympod with long pinnate seta near to endopod; endopod bisegmented, basal segment with pinnate seta and distal segment with six pinnate setae of unequal size; exopod with heavily sclerotized spine

on basal segment, medial segment with spine and pinnate seta, distal segment with three spines and five pinnate setae. Fourth leg, robust sympod, unarmed; exopod trisegmented, first two segments with one spine with outer membrane each, with pecten on the base; distal segment with three terminal spines with outer delicate membrane, all spines with pecten at base. Fifth leg represented by papilla with pinnate seta and one sclerotized process. Sixth leg, represented by two papilla, one with two pinnate setae, other with one pinnate seta and small acute process.

Male (based on five specimens collected on *Oligoplites saliens*, five on *O. palometa* and one on *O. saurus*, three specimens measured): Total length 3.44 - 4.20 (3.73). Maximum width 2.08 - 2.28 (2.19). Cephalotorax total length 1.97 - 2.92 (2.32), without aliform plates. Genital complex 0.84 - 0.91 (0.87) long, 0.60 - 0.62 (0.61) wide. Abdomen bisegmented, first segment 0.08 - 0.11 (0.09) long, 0.29 - 0.32 (0.31) wide; second segment 0.29 - 0.34 (0.32) long, 0.30 - 0.33 (0.32) wide. Uropods, 0.29 - 0.32 (0.31) long, 0.12 - 0.13 (0.13) wide; longest seta, 0.43 - 0.46 (0.45) long. Frontal lunules 0.24 - 0.27 (0.25) in diameter, spaced 0.68 - 0.69 (0.68). The appendages are similar to that of females, with exception of second antenna bisegmented, modified, with short bifid claw, two adhesive zones.

Taxonomic summary

Hosts: *Oligoplites saliens* (Bloch, 1793), *O. saurus* (Bloch & Schneider, 1801) and *O. palometa* (Cuvier, 1833)

Site of infestation: Body surface

Locality: Itacuruçá, Sepetiba Bay, state of Rio de Janeiro, Brazil

Prevalence: 13.89% on *O. saliens*, 5.59% on *O. palometa* and 2.70% on *O. saurus*

Intensity of infestation: 10 on 5 *O. saliens*, 7 on 5 *O. palometa* and 1 on 1 *O. saliens*

Mean intensity of infestation: 2.0 on *O. saliens*, 1.4 on *O. palometa* and 1.0 on *O. saurus*

Remarks: The genus *Tuxophorus* has wide geographical distribution, with records in the Indian, Atlantic and Pacific Oceans (Yamaguti, 1963; Cressey *et al.*, 1983). *Tuxophorus* was proposed by Wilson (1908), with the type species, *T. caligodes* collected on *Rachycentron canadus* Linnaeus and *Echeneis naucrates* (Cuvier) at the North Carolina, USA. The characteristics of the specimens now studied are in agreement with the original description of *T. caligodes*, however, in the Wilson's description some characters of the appendages are insufficiently described. The armature of the distal exopod segment of the first leg was illustrated with

three spines only in the Wilson's specimens, while in our specimens it was possible to detect the presence of secondary processes in the setae and the presence of fourth smaller seta. Also, the first antenna and other buccal appendages are described and illustrated in detail by the first time.

Tuxophorus caligodes already was registered in Brazil by Knoff *et al.* (1994) on *Mugil platanus* and by Luque *et al.* (1998) on *Scomberomorus* sp., both in the coast of Rio de Janeiro state.

Oligoplites saliens, *O. palometa* and *O. saurus* are new host records for *Tuxophorus caligodes*.

CALIGIDAE

Caligus robustus Bassett-Smith, 1898

Female: (based on eight specimens) Total length (including caudal rami) 4.92 - 6.58 (5.53). Maximum width 2.27 - 2.94 (2.66). Cephalotorax total length 2.10 - 2.56 (2.37). Genital complex 1.51 - 1.73 (1.58) long, 0.91 - 1.46 (1.16) wide. Egg sacs 2.19 long, 0.45 wide (in one specimen only). Caudal rami 0.21 - 0.30 (0.26) long, 0.13 - 0.19 (0.15) wide. Frontal lunules 0.23 - 0.27 (0.25) in diameter 0.60 - 0.71 (0.66) apart.

Male: (based on eight specimens) Total length (including caudal rami) 3.23 - 5.67 (4.02). Maximum width 1.93 - 3.07 (2.31). Cephalotorax total length 1.90 - 3.16 (2.32). Genital complex 0.53 - 0.93 (0.68) long. First segment of abdomen 0.11 - 0.22 (0.16) long, 0.31 - 0.57 (0.42) wide; second segment 0.38 - 0.68 (0.49) long, 0.38 - 0.73 (0.51) wide. Caudal rami 0.23 - 0.35 (0.27) long, 0.16 - 0.27 (0.19) wide, largest seta 0.24 - 0.37 (0.19) long. Frontal lunules 0.18 - 0.30 (0.24) in diameter 0.49 - 0.72 (0.59) apart.

Taxonomic summary

Synonym: *Caligus oligoplitis* Carvalho, 1956

Hosts: *Oligoplites saliens* (Bloch, 1793), *O. saurus* (Bloch & Schneider, 1801) and *O. palometa* (Cuvier, 1833)

Site of infestation: Gills

Locality: Sepetiba Bay, state of Rio de Janeiro, Brazil

Prevalence: 30.95% on *O. palometa*, 37.80% on *O. saurus* and 63.89% on *O. saliens*

Intensity of infestation: 65 on 26 *O. palometa*, 30 on 15 *O. saurus* and 41 on 23 *O. saliens*

Mean intensity of infestation: 2.5 on *O. palometa*, 2.0 on *O. saurus* and 1.8 on *O. saliens*

Remarks: *Caligus robustus* has wide geographical distribution, and was recorded in many host species, mainly in fishes of the family Carangidae (Margolis *et al.* 1975; Cressey, 1991). The specimens studied right now was very similar to *Caligus oligoplitis* Carvalho, 1956, parasite of *Oligoplites saurus* which is

from littoral of São Paulo state. The author differentiate *C. oligoplitis* from *C. robustus* by its differences in the body size, the armature of appendix, and by the bisegmented abdomen. Although the specimens from Rio de Janeiro was collected from fishes of the genus *Oligoplites*, they have the body size and appendix armature similar to *C. robustus* but the abdomen has only one little constriction, not constituting one segment, with is demonstrated on the illustration of *Caligus robustus*. It was not possible to obtain the types of *Caligus oligoplitis* for analysis and to confirm the validate of this specie. An analysis of the description and illustration presented by Carvalho (1956) make us consider *C. oligoplitis* as a new synonym junior of *C. robustus*. The specimens of *Caligus robustus* now collected differs from the description of Cressey (1991) by the absence of little spines on the ventral surface of basal segment of the first leg.

Caligus bonito Wilson, 1905.

Female: (based on three specimens) Total length (including caudal rami) 4.57 - 4.81 (4.69). Maximum width 1.68 - 1.77 (1.72). Cephalotorax total length 1.72 - 1.75 (1.73); genital complex 1.68 - 1.95 (1.82) long, 1.26 - 1.29 (1.28) wide. Egg sacs 1.62 long, 0.32 wide (in one specimen only) Abdomen 1.04 - 1.17 (1.10) long, 0.38 - 0.53 (0.45) wide. Caudal rami 0.13 long, 0.10 wide, largest seta 0.37 long. Frontal lunules 0.28 - 0.29 (0.28) in diameter 0.22 - 0.25 (0.24) apart.

Male: Not collected.

Taxonomic summary

Synonym: *Caligus sarda* Pearse, 1952; *C. productus* Causey, 1953; and *C. kuroshio* Shiino, 1959.

Host: *Oligoplites palometa* (Cuvier, 1833)

Site of infestation: Gills

Locality: Sepetiba Bay, Rio de Janeiro state, Brazil

Prevalence: 3.57 %

Intensity of infestation: 3 on 3

Mean intensity of infestation: 1

Remarks: *Caligus bonito*, described originally by Wilson (1905), has low specificity by hosts, it was registered in many species of fishes, mainly Scombridae, and in many locality (Margolis *et al.*, 1975). Bere (1936) made the unique record of *C. bonito* in fishes of the genus *Oligoplites*, collected from *O. saurus* from Gulf of Mexico (Florida). In Brazil this species was collected by Carvalho (1951) who provided from gills of *Katsuwonus pelamis* from the shore of São Paulo state, and by Cressey and Cressey (1980) on *Sarda sarda* from littoral of Rio de Janeiro state.

The specimens collected on *O. palometa* on the shore of Rio de Janeiro state, differs only in the size from the description presented by Cressey (1991), that found in hot water smaller specimens than those specimens collected in cold water. The specimens of the present work are smaller.

***Caligus rufimaculatus* Wilson, 1905.**

Female: (based on seven specimens) Total length (including caudal rami) 3.27 - 5.12 (4.00). Maximum width 1.84 - 2.43 (2.05). Cephalotorax total length 1.70 - 2.78 (2.03). Genital complex 1.04 - 2.01 (1.36) long, 0.93 - 1.62 (1.13) wide. Egg sacs 3.98 long, 0.42 wide (in one specimen only). Abdomen 0.51 - 0.68 (0.58) long, 0.37 - 0.38 (0.37) wide. Caudal rami 0.15 - 0.33 (0.20) long, 0.10 - 0.14 (0.12) wide. Frontal lunules 0.19 - 0.29 (0.22) in diameter 0.41 - 0.74 (0.51) apart.

Male: (based on six specimens) Total length (including caudal rami) 2.61 - 2.76 (2.69). Maximum width 1.53 - 1.70 (1.61). Cephalotorax total length 1.48 - 1.62 (1.55). Genital complex 0.51 - 0.52 (0.51) long. First segment of abdomen 0.14 - 0.18 (0.16) long, 0.29 - 0.30 (0.29) wide; second segment 0.29 long, 0.29 wide. Caudal rami 0.14 - 0.17 (0.16) long, 0.09 - 0.10 (0.09) wide, largest seta 0.52 - 0.60 (0.56) long. Frontal lunules 0.16 - 0.18 (0.17) in diameter 0.37 - 0.41 (0.39) apart.

Taxonomic summary

Hosts: *Oligoplites palometa* (Cuvier, 1833) and *O. saliens* (Bloch, 1793)

Site of infestation: Gills

Locality: Sepetiba Bay, Rio de Janeiro state, Brazil

Prevalence: 35.71% on *O. palometa* and 8.33% on *O. saliens*

Intensity of infestation: 71 on 30 *O. palometa* and 6 on 3 *O. saliens*

Mean intensity of infestation: 2.4 on *O. palometa* and 2 on *O. saliens*

Remarks: Wilson (1905) described this species on *Fundulus* and *Mugil* which are from Woods Hole and North Carolina, USA. Later, Bere (1936) registered this parasite on 10 species of hosts including *Oligoplites saurus* from Gulf of Mexico, and Cressey (1991) in the same locality, registered this parasite on fishes of eight different family, showing its low specificity.

This species was registered for the first time in the South Atlantic by Luque *et al.* (1998).

The specimens collected from Rio de Janeiro on *O. saliens* and *O. palometa* are new host record.

***Metacaligus rufus* (Wilson, 1908)**

Female: (based on seven specimens) Total length (including caudal rami) 4.94 - 5.81 (5.36). Maximum width 1.99 - 2.32 (2.11). Cephalotorax total length 2.26 - 2.86 (2.42). Genital complex 1.77 - 1.83 (1.79) long, 1.04 - 1.22 (1.11) wide. Egg sacs 2.83 long, 0.42 wide (in one specimen only). Abdomen 0.62 - 0.73 (0.68) long 0.38 - 0.49 (0.44) wide. Caudal rami 0.18 - 0.29 (0.23) long, 0.08 - 0.13 (0.11) wide. Frontal lunules 0.30 - 0.34 (0.32) in diameter 0.35 - 0.40 (0.37) apart.

Male: (based on four specimens) Total length (including caudal rami) 3.84 - 4.04 (3.94). Maximum width 1.77 - 1.92 (1.82). Cephalotorax total length 2.12 - 2.26 (2.20). Genital complex 0.93 - 0.96 (0.94) long. First segment of abdomen 0.23 - 0.29 (0.26) long, 0.40 - 0.43 (0.42) wide; second segment 0.36 - 0.38 (0.37) long, 0.31 - 0.36 (0.34) wide. Caudal rami 0.18 - 0.22 (0.20) long, 0.08 wide, largest seta 0.64 - 0.66 (0.65) long. Frontal lunules 0.26 - 0.27 (0.27) in diameter 0.31 - 0.38 (0.34) apart.

Taxonomic summary

Synonym: *Caligus* (*Metacaligus*) *uruguayensis* Thomsen, 1949; *Caligus longicervicis* Gnanamuthu, 1950.

Hosts: *Oligoplites palometa* (Cuvier, 1833) and *O. saliens* (Bloch, 1793)

Site of infestation: Gills

Locality: Sepetiba Bay, Rio de Janeiro state, Brazil

Prevalence: 20.23% on *O. palometa* and 13.89% on *O. saliens*

Intensity of infestation: 24 on 14 *O. palometa* and 9 on 5 *O. saliens*

Mean intensity of infestation: 1.8 on *O. palometa* and 1.9 on *O. saliens*

Remarks: This species was originally described how *Caligus rufus* by Wilson (1908). Thomsen (1949) proposed the subgenus *Metacaligus* for a group of species of this genus which doesn't have the sternal furca but presents the first maxilla. The taxonomic position of this subgenus could be situated among *Anchicaligus* Stebbing (1901), which doesn't have the sternal furca nor the first maxilla, and *Caligus* which has sternal furca and first maxilla. Four species present this characteristics: *C. (M.) rufus* Wilson, 1908; *C. (M.) afurcatus* Wilson, 1913; *C. (M.) enormis* Wilson 1913 and *C. (M.) uruguayensis* Thomsen, 1949. Ho and Bashirullah (1977) studying the copepods parasites of marine fishes from Venezuela, elevated the subgenus *Metacaligus* at the level of genus, due the absence of the sternal furca and other characteristics that differ from the *Caligus* and that have generic level. According to these authors, there

are differences between *Metacaligus* and *Caligus* on the armature of the first and second leg. On the first leg of the *Metacaligus* the spines of distal segments of exopod are denticulate and none are ramified, as in many species of *Caligus*. At the second leg of *Metacaligus* there is only one spine on the sternal margin of the distal segment of exopod. On the species of *Caligus* there is more than one spine. With this new organization, only two species show this feature: *Metacaligus uruguayensis* (Type specie) and *M. rufus*. *Oligoplites saliens* is a new host record for *Metacaligus rufus*.

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