

The taxonomy of some Poecilacanthoidea (Eucestoda: Trypanorhyncha) from elasmobranchs off the southern coast of Brazil

R.M. Pinto^{1*}, M. Knoff¹, S.C. São Clemente², R.M. Lanfredi³ and D.C. Gomes¹

¹Departamento de Helminthologia do Instituto Oswaldo Cruz, Avenida Brasil 4365, 21045-900 Rio de Janeiro, RJ, Brazil: ²Departamento de Inspeção e Tecnologia de Alimentos, Faculdade de Veterinária da Universidade Federal Fluminense, Rua Vital Brazil Filho 64, 24230-340 Niterói, RJ, Brazil: ³Programa de Biologia Celular e Parasitologia do Instituto de Biofísica Carlos Chagas Filho da Universidade Federal do Rio de Janeiro, 21949-900 Rio de Janeiro, RJ, Brazil

Abstract

Specimens of elasmobranchs, collected in the State of Santa Catarina, Brazil, were parasitized with Poecilacanthoidea trypanorhynch cestodes. Sharks of the species *Prionace glauca* harboured *Callitetrarhynchus gracilis* and *Floriceps saccatus*, and those of the species *Sphyrna zygaena* were infected with *Callitetrarhynchus speciosus*. Details of the proglottids of *F. saccatus*, provided by bright-field, and/or scanning electron microscopy, are described. Adults of *F. saccatus* are reported for the first time in the Brazilian coast.

Introduction

During an extensive parasitological survey of 90 elasmobranch fishes off the southern coast of Brazil, many parasite specimens were collected. Recently, several taxonomic and parasitological studies on these parasites have been published: Knoff *et al.* (2001a) on nematodes, Knoff *et al.* (2001b) on digeneans and acanthocephalans, Knoff *et al.* (2002) on prevalences and intensities of infections of trypanorhynch cestodes, and Knoff *et al.* (2004a,b), and Gomes *et al.* (2005) on Homeacanthoidea and Obothrioidea trypanorhynch cestodes. The present paper continues these taxonomic approaches related to Poecilacanthoidea trypanorhynchs from elasmobranchs, with particular reference to species recovered off the coast of the State of Santa Catarina.

Over the past 20 years in Brazil, species of this group have mainly been reported from teleost hosts, including

the studies of Carvajal & Rego (1985), Carvajal *et al.* (1987), São Clemente (1986a,b, 1987), São Clemente *et al.* (1991a, 1993, 1995, 1997, 2004), Pereira Jr. (1993, 1998), Palm (1997), Alves & Luque (1999, 2000, 2001a,b), Luque *et al.* (2000), Luque & Alves (2001), Silva *et al.* (2000a,b), Silva & São Clemente (2001) and Alves *et al.* (2002). In elasmobranchs, data were provided by São Clemente & Gomes (1989) and São Clemente *et al.* (1991b).

Floriceps saccatus Cuvier (Lacistorhynchidae, Guiart), found in the shark *Prionace glauca* (Linnaeus), was originally described from the teleost *Mola mola* (Linnaeus). Adult worms have been recovered from the spiral valve of several elasmobranchs worldwide: *Carcharhinus obscurus* (Lesueur) on the Atlantic coast of the USA; *Carcharias glaucus* (Linnaeus) (= *P. glauca*) in Aranuka, Gilbert Islands, Kiribati; *P. glauca* and *Carcharhinus japonicus* (Temminck & Schelegel) (= *C. plumbeus* (Nardo)) in Japan; *Carcharias glaucus* in Concarneau, France; *Notorhynchus maculatus* Ayres (= *N. cepedianus* (Péron)) and *Negaprion brevirostris* (Poey) in Mexico; *Carcharhinus limbatus* (Müller & Henle) in southern

*Fax: 55 21 2598 4363
E-mail: rmpinto@ioc.fiocruz.br

California, USA, and *Carcharias* sp. on the coast of Madras, India (Dollfus, 1942; Bates, 1990). Silva & São Clemente (2001) referred to the prevalence and intensity of infection with *F. saccatus* plerocerci in the muscle of 596 *Coryphaena hippurus* Linnaeus collected in the State of Rio de Janeiro, reporting the species for the first time in Brazil.

Callitetrarhynchus gracilis (Rudolphi) Pintner, also found parasitizing *P. glauca*, has been frequently reported in teleosts and elasmobranchs, mainly from tropical and subtropical seas and also occurring in temperate waters (Dollfus, 1942; Bates, 1990). The first report of *C. gracilis* in Brazil was that of Dollfus (1942) in *Centropomus undecimalis* (Bloch) from Marajó Island, in the State of Pará. Other accounts of this species in Brazilian hosts were given by Carvajal & Rego (1985), São Clemente (1986a,b, 1987), São Clemente *et al.* (1991a, 1995, 1997, 2004), and Silva & São Clemente (2001) in *Micropogonias furnieri* (Desmarest), *Pomatomus saltatrix* (Linnaeus), *Netuma barba* (Lacepède), *Balistes vetula* Linnaeus, *Genypterus brasiliensis* Regan and *Lutjanus synagris* (Linnaeus) in the State of Rio de Janeiro; by São Clemente *et al.* (1991b), Pereira Jr. (1993, 1998) in *Mustelus canis*, *M. furnieri*, *Cynoscion guatucupa* (Cuvier) and *Macrondon ancylodon* (Bloch & Schneider) from the littoral of the State of Rio Grande do Sul; and by Palm (1997) in *Caranx crysos* (Mitchill), *Chloroscombrus chrysurus* (Linnaeus), *Oligoplites palometa* (Cuvier), *Selene vomer* (Linnaeus), *Harengula clupeiola* (Cuvier), *Opisthonema oglinum* (Lesuer), *Haemulon aeorlineatum* Cuvier, *Larimus breviceps* (Cuvier), *Scomberomorus maculatus* (Mitchill) and *Sphyrna guachancho* Cuvier from the littoral of the State of Pernambuco. In addition to the occurrence of *C. gracilis* in Brazilian elasmobranchs referred to by São Clemente *et al.* (1991b) there are reports of the species in *Hypoprion brevirostris* Poey (= *Negaprion brevirostris*) from Florida, USA; *Carcharias* sp., from the coast of Madras, India; *Prionace glauca*, from California, USA, and *Carcharhinus leucas*, from Nicaragua (Heinz & Dailey, 1974; Bates, 1990).

Earlier, records of *Callitetrarhynchus speciosus* (Linton) Carvajal & Rego from *Sphyrna zygaena* (Linnaeus), refer to teleost fishes only from the Brazilian coast. Carvajal & Rego (1985) and São Clemente *et al.* (1997) reported *C. speciosus* in *P. saltatrix*, from the littoral of the State of Rio de Janeiro and Pereira Jr. (1993) reported it in *M. furnieri* from the littoral of the State of Rio Grande do Sul. Furthermore, scanning electron microscopy (SEM) has been used as an auxiliary tool for the identification of *C. gracilis* and *C. speciosus* by Carvajal & Rego (1985) and Carvajal *et al.* (1987), of *F. saccatus* by Andersen (1987) and of *F. minnacanthus* Campbell & Beveridge, a very close species to *F. saccatus*, by Richmond & Caira (1991).

Materials and methods

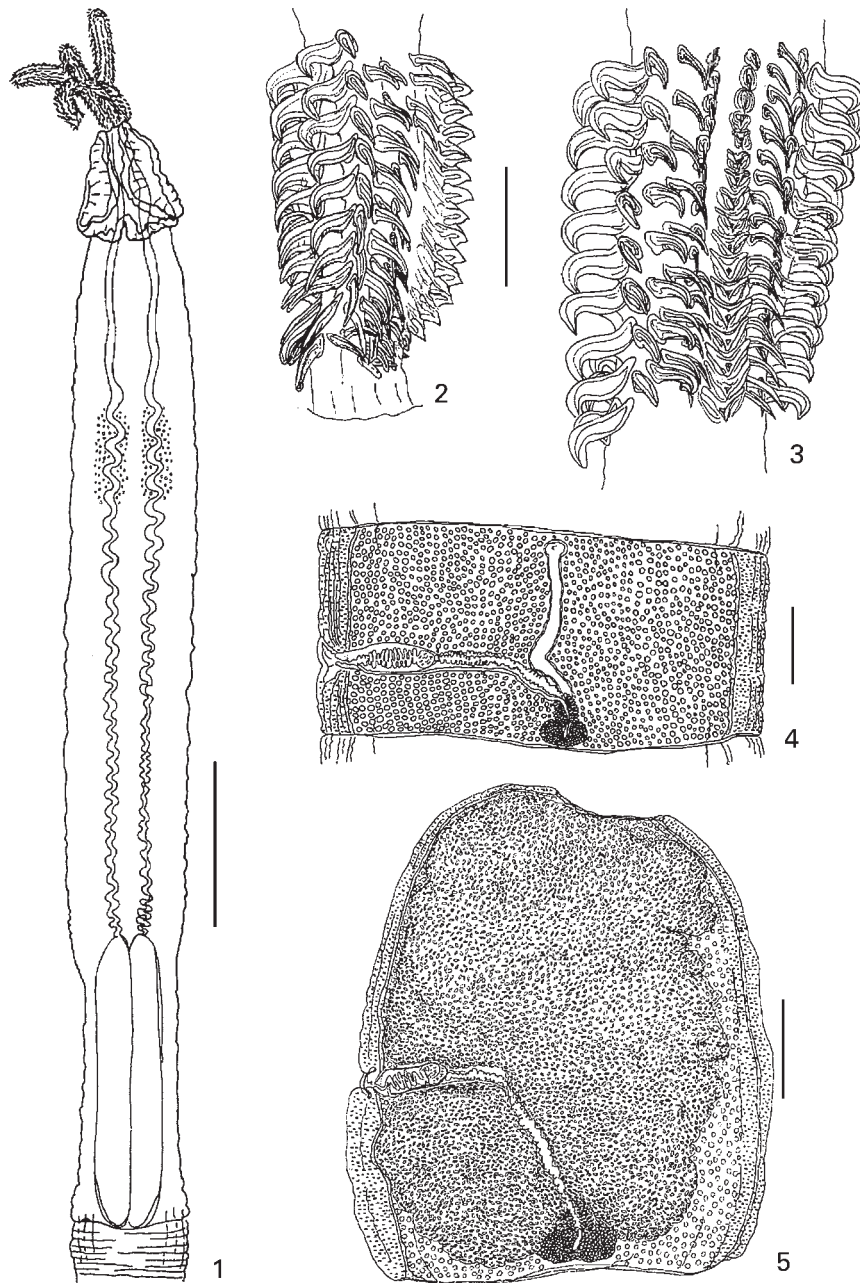
In March 1999, one of the authors (M. Knoff) was officially authorized by the Instituto de Pesca, Santos, São Paulo, to join the crew of professional fishermen of the Kiyomã tuna fish boat to examine fish for helminth parasites. Thirty-five elasmobranchs, comprising 12 males and 18 females of *Prionace glauca*, 206–287 cm total length, and 1 male and 4 females of *Sphyrna zygaena*,

190–250 cm total length, were collected about 190 miles off the coast of the State of Santa Catarina (27°08'S–28°38'S; 45°30'W–46°53'W; ~25–50 m in depth). On board, the stomachs and spiral valves were collected, labelled and preserved on ice before examination. Cestodes were recovered, fixed, stained and mounted according to the technique of Amato *et al.* (1991). Taxonomic classification is in accordance with Campbell & Beveridge (1994). Measurements and terminology follow Dollfus (1942) and Campbell & Beveridge (1994). Measurements are in millimetres (mm) unless otherwise indicated; means are followed by the range in parentheses and NH refers to a new host. Drawings were made with the aid of a drawing tube connected to a brightfield Olympus BH-2 microscope (BM). Some specimens were observed under a Variable Pressure Scanning Electron Microscope (VPSEM) – LEO 435; other samples were routinely prepared and were examined using a scanning electron microscope JEOL. Representative specimens were deposited in the Coleção Helmintológica do Instituto Oswaldo Cruz, (CHIOC), Rio de Janeiro, Brazil; samples for comparison were also obtained from the CHIOC, Musée National d'Histoire Naturelle, Paris, France (MNHN), the United States National Parasite Collection, Beltsville, USA (USNPC) and from the private collection of Dr S.C. de São Clemente (SCSC). At least one host specimen of each investigated fish species was deposited as symbiotypes *sensu* Brooks (1993), in the collection of the Instituto de Pesca, Santos, São Paulo, Brazil and listed by Knoff *et al.* (2001b).

Floriceps saccatus Cuvier, 1817

(figs 1–14)

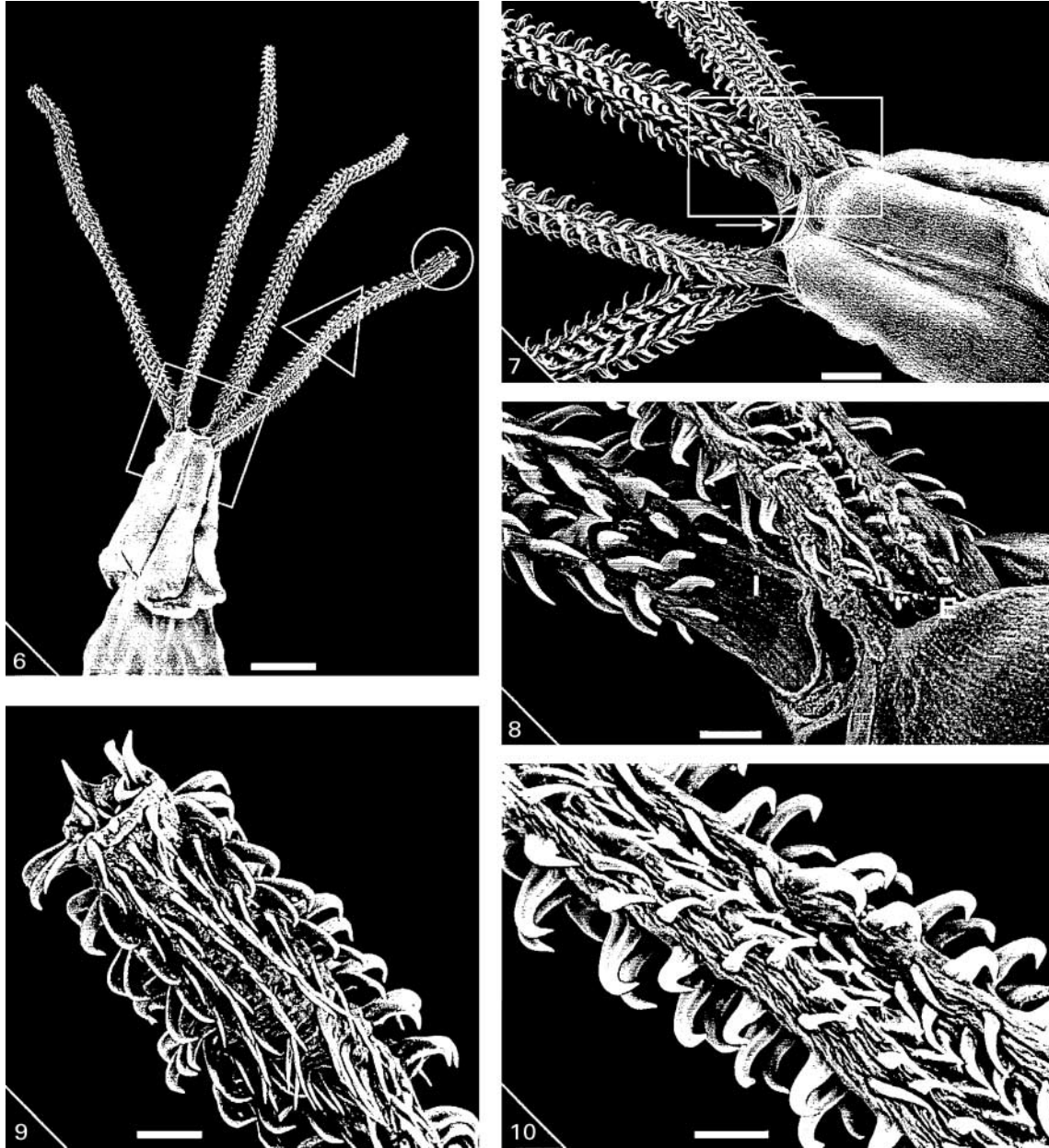
Description. Based on 8 adults, 5 mounted and measured, 1 observed under SEM, 2 observed under VPSEM, uncompressed. Scolex large, long, craspedote, 10.19 (9.68–10.64) long, 1.26 (1.20–1.34) wide (not considering the width of the pars bothridialis). Greatest width not always at the bothridial region. Pars bothridialis with two cordiform reverse bothridia, 1.20 (1.12–1.38) long, 1.17 (1.04–1.40) wide, with a notch in the posterior region. Pars vaginalis, with shields and spiralled tentacles, surrounded by numerous glandular cells at the beginning of the anterior two thirds, 7.25 (6.88–7.70) long. Pars bulbosa 2.94 (2.80–3.08) long, 0.73 (0.66–0.90) wide; the retractor muscle begins at the bulbar anterior middle region. Pars post-bulbosa absent. By VPSEM a naked tegumentary quadrangular area, at the internal bases of the tentacles, in the apical bothridial region, is observed. Tentacular armature pocilacanthous, with alternate half-spiralled ascending rows with 8 main hooks, intercalary at the external face with a row of double-winged chainette, with the hooks 7(7') and 8(8') appearing as satellites adjacent to the chainette. Tentacles ribbon-like, 0.120 (0.112–0.136) wide, the longest tentacle not totally extroverted, 1.68 long. Hooks 1(1') stout with wide basis at the internal face, basal 0.037 (0.032–0.048) long, 0.018 (0.012–0.034) wide, metabasal 0.067 (0.050–0.076) long, 0.051 (0.048–0.054) wide; hooks 2(2') with narrower basis, 0.41 (0.026–0.056) long, 0.023 (0.014–0.034) wide, metabasal 0.070 (0.060–0.078) long, 0.053



Figs 1–5. *Floriceps saccatus*. 1. Scolex. 2. Tentacle, basal armature, with chainette on external face. 3. Tentacle, metabasal armature, external face, transition zone of the chainette shape. 4. Mature proglottid. 5. Gravid proglottid. Scale bars = 3.0 mm (1), 0.1 mm (2–3), 0.5 mm (4), and 1.0 mm (5).

(0.044–0.064) wide; hooks 3(3') basal, 0.049 (0.028–0.066) long, 0.017 (0.010–0.024) wide, metabasal 0.058 (0.034–0.070) long, 0.035 (0.026–0.042) wide; hooks 4(4') basal 0.046 (0.024–0.062) long, 0.015 (0.010–0.022) wide, metabasal 0.051 (0.044–0.070) long, 0.031 (0.018–0.042) wide; hooks 5(5') basal, 0.043 (0.034–0.054) long, 0.012 (0.010–0.016) wide, metabasal 0.042 (0.032–0.050) long, 0.018 (0.016–0.024) wide; from these hooks on, they become slender and filiform; hooks 6(6') basal, 0.037

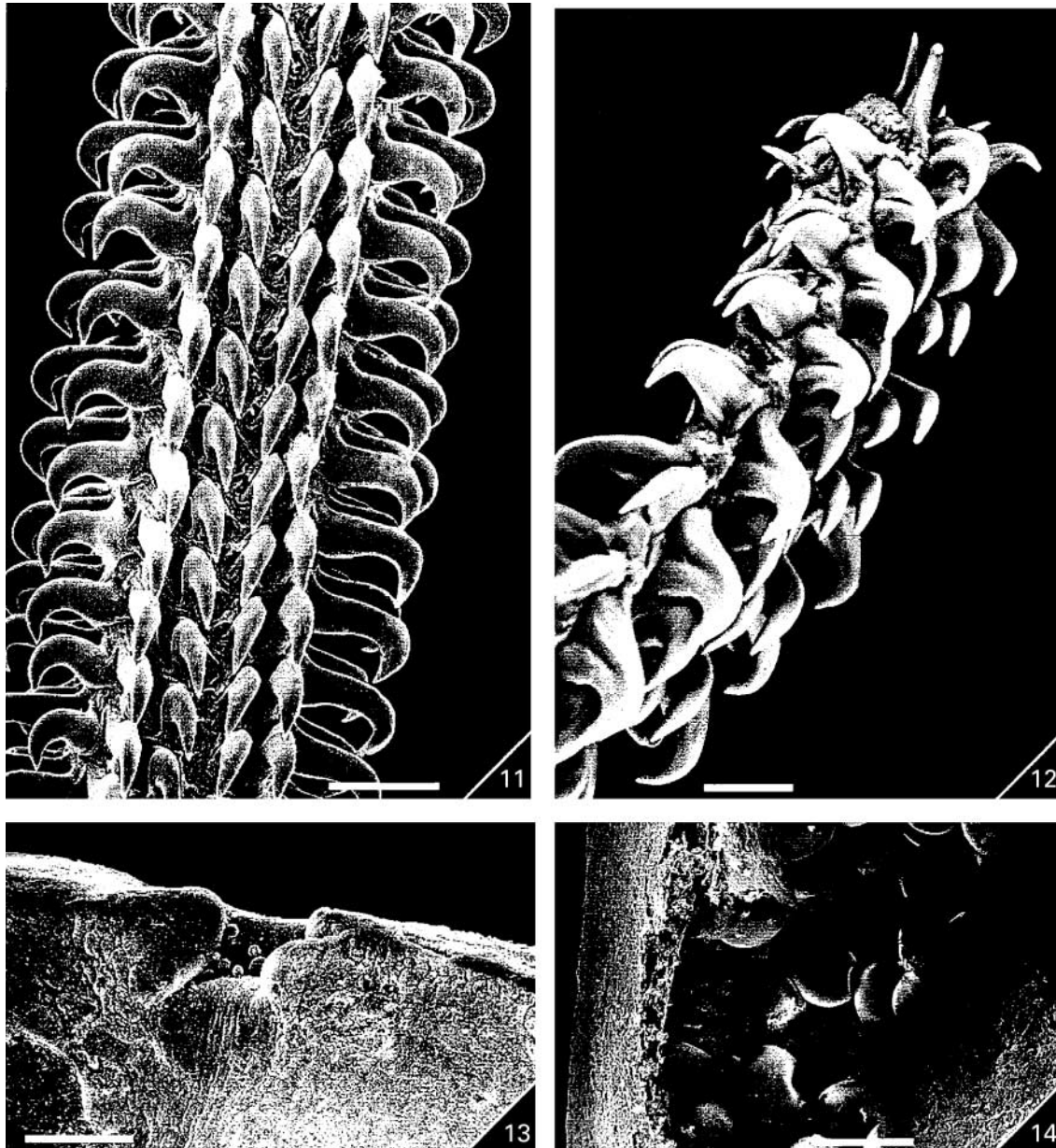
(0.024–0.042) long, 0.010 (0.008–0.012) wide, metabasal 0.044 (0.036–0.050) long, 0.012 (0.010–0.014) wide; hooks 7(7') basal 0.027 (0.012–0.040) long, 0.010 (0.008–0.012) wide, metabasal 0.044 (0.028–0.056) long, 0.014 (0.010–0.020) wide; hooks 8(8') basal 0.025 (0.012–0.042) long, 0.009 (0.008–0.010) wide, metabasal 0.045 (0.034–0.056) long, 0.013 (0.010–0.016) wide. On the external face, between the rows of principal hooks, there is a chainette of double-winged hooks arranged as 9(9') one after the



Figs 6–10. *Floriceps saccatus*, by VPSEM. 6. Scolex, apical region and tentacles. Square, circle and triangle indicate the regions from which figs 7, 9 and 10 were respectively obtained. 7. Apical bothridial region, arrow indicates the rectangular naked area on the internal base of the tentacles. Rectangle indicates the region from which fig. 8 was obtained. 8. Tentacles, basal armature: external face (E) and internal face (I). 9. Tentacle, apical metabasal armature, external, note the chainette is filiform. 10. Tentacle, metabasal armature, external, transition zone of the chainette shape. Scale bars = 1.0 mm (6), 300 μ m (7), and 90 μ m (8–10).

other, the first two hooks of the chainette appearing quite distorted, rounded; from the third hook up to the 44th, with two lateral wings; basal, including the third, 0.012 (0.006–0.020) long, 0.017 (0.010–0.028) wide; metabasal 0.036 (0.024–0.040) long, 0.043 (0.034–0.050) wide; from the 34th hook the wings become narrower and are absent at the distal portion of the metabasal, similar in shape to the hooks 6(6'), 7(7') and 8(8'), and just after the 45th hook,

0.041 (0.032–0.050) long, 0.014 (0.010–0.018) wide. Strobila acraspedote, apolytical, the larger 26 cm long. Proglottids at first wider than long, increasing gradually in length; generally, the mature proglottids are 1.00 (0.50–1.91) long, 1.48 (1.12–3.15) wide; nevertheless, some were longer than wide; gravid proglottids with at least one egg were 1.19 (1.00–1.38) long, 2.57 (1.94–3.19) wide; the last bigger gravid proglottid was 5.28 long and 5.02



Figs 11–14. *Floriceps saccatus*, by SEM* and VPSEM. 11*. Tentacle, metabasal armature, internal face. 12. Tentacle, apical metabasal armature, internal face. 13*. Tegumental surface around the genital pore, showing the bifid projection on the both extremities. 14*. Damaged proglottid showing eggs inside. Scale bars = 50 μm (11 and 14), 60 μm (12), and 200 μm (13).

wide. Genital pore, marginal, irregularly alternating, post-equatorial. Under SEM, each of the anterior and posterior margins of the pore has a bifid projection with rounded margins. Eggs in proglottids with at least one egg, 0.016 in diameter; eggs in the terminal gravid proglottid, 0.028–0.030 long, 0.020–0.022 wide, with smooth shell, as observed under SEM. Testes numerous, more than 1000, intervascular, irregular, varying in size from the mature proglottids to the terminal gravid proglottid and are 0.016–0.048 long, 0.016–0.048 wide. Hermaphroditic bursa elongate oval and from the mature

proglottids to the terminal gravid proglottid, is 0.21–0.56 long, 0.06–0.19 wide, with internal seminal vesicle, 0.04–0.14 long, 0.14 wide. Ovary small, just in front of the posterior margin of the proglottid, tetralobate (bilobate in ventral view), varying, from the mature proglottids to the terminal gravid, from 0.10–0.34 in length and 0.19–1.08 in width. Ootype well defined, with Mehlis's gland cells conspicuous, anterior to the ovary. The vagina joins the ejaculatory duct, to become a hermaphroditic duct. Uterus simple, median, tubular, longitudinal, extending to the anterior extremity of the proglottid. Uterine

pore ventral. Vitelline follicles circumcortical, dorsally interrupted, around the ovary and ootype. Smaller eggs 0.016 long, 0.16 wide, larger 0.030 long, 0.022 wide, not collapsed.

Number of cestodes/host/number of infected hosts/site of infection. 12/*Prionace glauca*/6/spiral valve.

Locality. Coast of State of Santa Catarina, Brazil.

Material deposited. CHIOC no. 34511 and 34512 a–c.

Material examined. Metacestodes, from *Diodon holacanthus* Linnaeus, Guadeloupe (MNHN no. BD 28).

Remarks. The morphology of the specimens studied is in agreement with the description of *Floriceps saccatus* by Dollfus (1942) and Palm (2004). This is the first report of adults of this species in Brazil. The previous report is of plerocerci in the teleost *Coryphaena hippurus* (see Silva & São Clemente, 2001). Most of the records in elasmobranchs are from species of Carcharhinidae. This is the second report of the occurrence in *P. glauca*, previously having been found in Japan (Iwata, 1939; Bates, 1990). SEM and VPSEM observations show that the tentacular armature appears the same as originally described by Dollfus (1942). Data obtained by VPSEM improve the knowledge of the proglottid surface in the surrounding area of the genital pore, as well as the shape of the eggs.

Callitetrarhynchus gracilis (Rudolphi, 1819) Pintner, 1931

Number of cestodes/host/number of infected hosts/ site of infection. 2 plerocerci/ *P. glauca*/1/spiral valve.

Locality. Coast of the State of Santa Catarina, Brazil.

Material deposited. CHIOC no. 34509.

Material examined. Plerocerci, from *Micropogonias furnieri*, Venezuela Gulf, Venezuela (CHIOC no. 32496); Cabo Frio, Rio de Janeiro, Brazil (CHIOC no. 31924 a–b); from *Mustelus canis*, Rio Grande do Sul, Brazil (CHIOC no. 32564); from *M. furnieri*, Cabo Frio, Rio de Janeiro, Brazil (4 specimens of SCSC).

Remarks. The morphology of the specimens from *P. glauca* in the littoral of the State of Paraná, is in agreement with the description given by Dollfus (1942) and Palm (2004). Observation of the armature, either by brightfield microscopy or by SEM, showed the chainette and satellite hooks with different sizes, confirming the specific diagnosis, as already reported by Carvajal & Rego (1985). Neither in the specimen preserved in balsam, examined under bright-field microscopy, nor in the specimen studied under VPSEM and SEM, was it possible to properly examine the pattern of the microtriches that are present on several areas on the surface of the scolex, as observed by Carvajal & Rego (1985) and Carvajal *et al.* (1987). In Brazil, this species has been reported in several teleost hosts in the States of Pará, Pernambuco, Rio de Janeiro and Rio Grande do Sul (Dollfus, 1942; Carvajal & Rego, 1985; São Clemente, 1986a,b, 1987; São Clemente, *et al.*, 1991a, 1995, 1997, 2004; Pereira Jr., 1993, 1998; Palm, 1997; Silva & São Clemente, 2001). The only report of this species parasitizing a Brazilian elasmobranch, *Mustelus canis*, from the littoral of the State of Rio Grande do Sul, is that of São Clemente *et al.* (1991b). Thus, this is the second report of the species in elasmobranchs in Brazil and also,

the second report of the parasitism of *P. glauca* by this cestode (Heinz & Dailey, 1974; Bates, 1990).

Callitetrarhynchus speciosus (Linton, 1897) Carvajal & Rego, 1985

Synonym: *Rhynchobothrium speciosum* Linton, 1897.

Number of cestodes /host/number of infected hosts/site of infection. 1 plerocercus/ *Sphyrna zygaena* (NH)/1/ spiral valve.

Locality. Coast of State of Santa Catarina, Brazil.

Material deposited. CHIOC no. 34510.

Material examined. Plerocerci, from *Cynoscion guatucupa* (Cuvier), Rio Grande do Sul, Brazil (CHIOC no. 33905–7); from *M. furnieri*, Cabo Frio, Rio de Janeiro, Brazil (4 specimens of SCSC).

Remarks. The morphology of the single specimen from *S. zygaena*, in the littoral of the State of Santa Catarina is in accordance with the descriptions given by Carvajal & Rego (1985) and Palm (2004). The study of the onchotaxy, using bright-field microscopy, showing a chainette and satellite hooks similar in size, confirms the specific identification as reported by Carvajal & Rego (1985). This is the first report of *C. speciosus* in an elasmobranch host, previously found only in teleosts (Carvajal & Rego, 1985; Pereira Jr., 1993; São Clemente *et al.*, 1997).

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