



# Diversity of Monogenoidea parasitizing scombrid fishes from Rio de Janeiro coast, Brazil

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**Abstract:** Eleven known species of Monogenoidea were found parasitizing six different species of scombrid fishes collected from Rio de Janeiro coast, Southwestern Atlantic Ocean: *Capsala biparasitica*, *Capsala katsuwoni*, *Capsala notosinense*, *Nasicola brasiliensis*, *Nasicola klawei*, *Alloposeudaxinoides euthynni*, *Sibitrema poonui*, *Hexostoma albsmithi*, *Hexostoma euthynni*, *Hexostoma keokeo* and *Hexostoma sibi*. *Katsuwonus pelamis* is reported as a new host to *A. euthynni* and *Thunnus obesus* to *H. albsmithi*. *Capsala notosinense*, *A. euthynni*, *H. albsmithi* and *H. sibi* are referred for the first time in Brazil, Southwestern Atlantic Ocean. Morphological and morphometric features are presented for each species.

**Key words:** Axinidae, Capsalidae, Hexostomatidae, Gastrocotylidae, Monogenoidea, Scombridae

## INTRODUCTION

During a survey of helminth parasites of Scombridae from the coast of the Rio de Janeiro, Brazil, Southwestern Atlantic Ocean, species of Monogenoidea were found parasitizing *Auxis thazard* (Lacepède, 1800), *Euthynnus alletteratus* (Rafinesque, 1810), *Katsuwonus pelamis* (Linnaeus, 1758), *Thunnus albacares* (Bonnaterre, 1788), *Thunnus atlanticus* (Lesson, 1831) and *Thunnus obesus* (Lowe, 1839). These fishes support very important commercial and recreational fisheries as well as substantial artisanal fisheries throughout the tropical and temperate waters of the world (Collette and Nauen 1983). Considering that Brazil has a large canned-fish industry, these species are very important economically.

In South America monogenean parasites of scombrid fishes are represented by 16 genera (see Cohen et al. 2013). Research on monogenoidean parasites of scombrid fishes from Brazil had been conducted by Abdallah et al. (2002), Alves and Luque (2006), Kohn and Justo (2006), Kohn et al. (2003), Kohn et al. (2004), Mogrovejo and Santos (2002), Mogrovejo et al. (2004), Oliva et al.

(2008), Price (1938), Rego and Santos (1983), Rohde (1986), Rohde and Hayward (1999) and Rohde and Watson (1985). The aim of this study is to contribute to the increase of the knowledge and expansion of the geographical distribution of monogenoidean parasites in different species of Scombridae in the area of the Southwestern Atlantic Ocean.

## MATERIAL AND METHODS

A total of 230 specimens of scombrid fishes were examined between January 2004 to April 2007: 20 *Auxis thazard* (29–54 cm in total body length and 0.65–2.5 kg in weight), 31 *Euthynnus alletteratus* (27–71 cm in total body length and 0.50–4.0 kg in weight), 61 *Katsuwonus pelamis* (26–73 cm in total body length and 1.0–9.0 kg in weight), 38 *Thunnus albacares* (34–76 cm in total body length and 0.55–7.8 kg in weight), 45 *Thunnus atlanticus* (38–61 cm in total body length and 1.2–5.5 kg in weight) and 35 *Thunnus obesus* (39–67 cm in total body length and 1.2–6.3 kg in weight).

The fishes were obtained by local fishermen from the coastal zone of the state of Rio de Janeiro, Brazil (22°52'46" S, 042°01'07" W). The parasites collected were fixed under light cover-glass pressure in 5% formaldehyde, stained with Langeron's alcoholic-acid carmine, dehydrated in an ethyl alcohol series, cleared in beechwood creosote and mounted in Canada balsam as permanent slides. Measurements are in micrometers, unless otherwise specified, with the mean in parentheses followed by the number of specimens measured in brackets, where applicable. The material studied was deposited in the Helminthological Collection of the "Instituto Oswaldo Cruz" (CHIOC), Rio de Janeiro, Brazil.

## RESULTS AND DISCUSSION

Eleven cosmopolitan species of four families of monogenoideans, already referred in different fish and oceans were found. *Alloposeudaxinoides euthynni*

Yamaguti, 1966 (Axinidae); *Capsala biparasitica* (Goto, 1894), *Capsala katsuwoni* (Ishii, 1936), *Capsala notosinense* (Mamaev, 1968), *Hexostoma albsmithi* Dollfus, 1962, *Nasicola brasiliensis* Kohn, Baptista-Farias, Santos & Gibson, 2004, *Nasicola klawei* (Stunkard, 1962) (Capsalidae); *Hexostoma euthynni* Meserve, 1938, *Hexostoma keokeo* Yamaguti, 1968, *Hexostoma sibi* Yamaguti, 1968 (Hexostomatidae) and *Sibitrema poonui* Yamaguti, 1966 (Gastrocotylidae).

The most prevalent species were *N. klawei* parasitizing *T. albacares* (81.6%) and *N. brasiliensis* parasitizing *T. obesus* (77.1%) and *T. atlanticus* (68.9%). New host records are reported: *K. pelamis* to *A. euthynni* and *T. obesus* to *H. albsmithi*. *C. notosinense*, *A. euthynni*, *H. albsmithi* and *H. sibi* are reported for the first time in the Rio de Janeiro coast, Southwestern Atlantic Ocean.

### Lists of parasite species

Phylum Platyhelminthes Gegenbaur, 1859

Class Monogenoidea Bychowsky, 1937

Subclass Polyonchoinea Bychowsky, 1937

Family Capsalidae Baird, 1853

Subfamily Capsalinae Baird, 1853

*Capsala* Bosc, 1811

#### ***Capsala biparasitica*** (Goto, 1894) Price, 1938

Synonyms: *Caballerocotyla abidjani* Bussi eras & Baudin-Laurencin, 1970; *Caballerocotyla neothunni* Yamaguti, 1968

Hosts: *T. albacares*, *T. atlanticus* and *T. obesus*

Site: Gills

Prevalence: *T. albacares* (21.1%); *T. atlanticus* (4.4%); *T. obesus* (5.7%)

Mean intensity: *T. albacares* (2.0 ± 1.23); *T. atlanticus* (0.07 ± 0.07); *T. obesus* (1.50 ± 0.98)

Material studied: CHIOC 36612 a-c, 36613, 37976, 37977

Main measurements (based on six adults and one immature specimens). Adult specimens: Body elongate, 8.0–9.4 (8.7) mm × 3.6–4.8 (4.4) mm with two pairs of eye spots; single longitudinal row of dorsolateral spines, 57–73 on right side and 57–74 on left side in number, with 9–12 cuspids each. Cephalic suckers 600–800 (703) × 1.00–1.04 (1.03) mm, concave ventrally. Haptor sessile 2.5–3.0 (2.7) mm × 2.5–2.8 (2.6) mm, surrounded by delicate marginal membrane 140–150 wide. One pair of anchors, 65–135 (84) long. Pharynx muscular, composed of two unequal bulbs, the posterior smaller than the anterior, 780–1.04 (900) total length by 920–1.16 (1.03) largest wide. Mouth opening ventrally at anterior end of pharynx. Testes about 60, rounded, 195–370 (248) × 100–250 (133), confined to the intercecal field. Seminal receptacle 230 × 155. Ovary, 600–700 (658) × 700–900 (820), immediately pretesticular. Copulatory organ papillate, near to vaginal pore. Egg tetrahedral, with 4

filaments.

Immature specimen: Body elongate, 4.2 mm × 1.3 mm, with two pairs of eye spots; single longitudinal row of dorsolateral spines, 57 on right side and 62 on left side in number, with 9–12 cuspids each. Cephalic sucker 480 × 580, concave ventrally. Haptor sessile measuring 1.2 mm × 1.1 mm. One pair of anchors measuring 85 long. Pharynx muscular, composed of two unequal bulbs, the posterior smaller than anterior, 440 total length by 420 largest wide. Testes rounded, 75 × 65 confined to the intercaecal field. Seminal receptacle 170 × 95. Ovary 240 × 150, immediately pretesticular.

Remarks: Chisholm and Whittington (2007) published a revision of the subfamily Capsalinae Baird, 1853 based on literature and examination of type-material and considered only 36 valid species. These authors proposed *Caballerocotyla* Price, 1960 as synonymous of *Capsala* Bosc, 1811 and considered *Caballerocotyla abidjani* and *Caballerocotyla neothunni* synonymous of *Capsala biparasitica*. *Capsala biparasitica* was originally described from a copepod parasitizing *T. albacares* from Pacific Ocean. In 1960, Price revised Capsalinae and proposed *Caballerocotyla* for the type species *C. biparasitica*. Yamaguti (1968) described and figured this species as *Capsala (Caballerocotyla) biparasitica*. Also from the Pacific, Egorova (2000) referred it as *Caballerocotyla neothunni*. From the Atlantic Ocean, *Capsala biparasitica* was described as *Caballerocotyla abidjani* by Bussi eras and Baudin-Laurencin (1970) and by Bussi eras (1972) and as *Caballerocotyla neothunni* by Kohn and Justo (2006).

#### ***Capsala katsuwoni*** (Ishii, 1936) Price, 1938

Synonym: *Caballerocotyla llewelyni* Kohn & Justo, 2006 [sic]

Hosts: *K. pelamis* and *T. atlanticus* (new host record)

Site: Gills

Prevalence: *K. pelamis* (11.4%) and *T. atlanticus* (6.6%)

Mean intensity: *K. pelamis* (3.0 ± 1.64); *T. atlanticus* (one parasitized by one parasite)

Material studied: CHIOC 36611 a-b, 37975

Main measurements (based on one adult specimen parasitizing *T. atlanticus*): Body 6.2 long, excluding haptor by 6.0 in maximum width. Haptor 1.9 × 1.7 mm. Anchors 150 long. Anterior end of body with pair of cephalic lobes and a pair of sucker-like attachment organs, 800 in diameter. Pharynx muscular, 600 in total length by 920 wide. Testes rounded, 37 in number 210 × 150. Few Goto's glands scattered among testes. Ovary subglobular, pre-equatorial, median, 740 by 800. Seminal receptacle round, 240 by 200. Vitelline reservoir 300 by 400, immediately preovarian.

Remarks: *Capsala katsuwoni* was described by Ishii (1936) as *Tristoma katsuwonum* from Pacific. This species was included by Price (1938) in the genus *Capsala* and later in the new genus *Caballerocotyla* proposed by the

same author in 1960, but not recognized by Chisholm and Whittington (2007). Kohn and Justo (2006) described the new species *Caballerocotyla llewelyni* from the Atlantic Ocean, which was considered as synonym of *Capsala katsuwoni* by Chisholm and Whittington (2007). We present only the main measurements of the specimen from *T. atlanticus*, which is comparative larger than those found in *K. pelamis* reported by Ishii (1936), Muruges (1995) and Kohn and Justo (2006).

***Capsala notosinense*** (Mamaev, 1968) Chisholm & Whittington 2007

Synonyms: *Capsala andhraensis* Raju & Rao, 1980; *Caballerocotyla chilensis* Pillai & Pillai, 1976; *Capsala katuo* Iwata, 1990; *Capsala naffari* Kardousha, 2002

Hosts: *A. thazard* and *K. pelamis*

Site: Gills

Prevalence: *A. thazard* (20%); *K. pelamis* (4.5%)

Mean intensity: *A. thazard* ( $2.75 \pm 3.01$ ); *K. pelamis* (one parasitized by one parasite)

Material studied: CHIOC 37057 a-b; 37058 a-h.

Main measurements (based on 10 adult specimens parasitizing *A. thazard*): Body oval to elliptical, 2.2–4.2 (3.3) mm  $\times$  0.9–2.2 (1.6) mm. Dorsomarginal body sclerites comprise 2–3 rows of unicuspid sclerites, extending to posterior part of the body, except at to the posterior end near the haptor. Haptor discoid, without papillae, 460–960 (745) mm  $\times$  520–920 (763) mm, with anchors 48–77 (61) long and 14 marginal hooklets. Cephalic ellipsoid lobes, 220–400 (329)  $\times$  340–480 (406). Pharynx muscular, 260–480 (386)  $\times$  260–440 (353), with a conspicuous equatorial constriction. Testes oval to rounded, 22–40 in number, 88–270 (135)  $\times$  60–180 (113). Ovary subglobular, situated at the anterior third of body, 200–370 (274)  $\times$  225–400 (308). Vitelline with small follicles in cephalic, cecal, diverticular and testicular regions. Vitelline reservoir, 105–140 (125)  $\times$  80–120 (99). Egg tetrahedral.

Remarks: *Capsala notosinense* was described by Mamaev (1968) from gills from *Euthynnus affinis* (Cantor, 1850) in South China as *Caballerocotyla notosinense*. Chisholm and Whittington (2007) considered *Capsala andhraensis*, *Caballerocotyla chilensis*, *Capsala naffari* and *Capsala katuo* as synonymous of *Caballerocotyla notosinense*. In this opportunity, *Capsala notosinense* is reported by the first time in Brazil, Southwestern Atlantic Ocean.

*Nasicola* (Stunkard, 1962) Yamaguti, 1968

***Nasicola brasiliensis*** Kohn, Baptista-Farias, Santos & Gibson, 2004

Hosts: *T. atlanticus* (new host record) and *T. obesus*

Site: Nasal cavity

Prevalence: *T. atlanticus* (68.9%); *T. obesus* (77.1%)

Mean intensity: *T. atlanticus* ( $3.03 \pm 0.34$ ); *T. obesus* ( $2.85 \pm 0.36$ )

Material studied: CHIOC 37036, 37973, 37974

Main measurements (based on three adult specimens from *T. atlanticus*): Body 11.9–17.5 (15.5) mm  $\times$  11.2–15.5 (13.6) mm. Body surface smooth, except for dorsolateral margins which have outer, irregular row of small spines formed by a broad base, and 1–5 cuspid teeth and inner row of large spines formed by a broad base, and 1–2 cuspid teeth. Haptor 3.2–4.1 (3.6) mm  $\times$  3.0–3.9 (3.5) mm. Cephalic lobe with pair of sucker-like attachment organs, each 590–640 (617)  $\times$  660–790 (727). Eye-spots present. Pharynx with postequatorial constriction wider in the anterior portion, with papillae distributed over inner surface, 0.82–1.16 (0.99) mm  $\times$  1.3–1.8 (1.5) mm in anterior region, 0.5–0.6 (0.5) mm  $\times$  1.0–1.3 (1.2) mm in smaller posterior region. Testes spherical to oval, 90–135 in number, in intercecal field. Cirrus muscular, covered with small papillae. Ovary lobate. Vitellaria formed by many thousands of small follicles, which extend throughout body except in regions of marginal spines, pharynx, gonads, terminal genitalia and attachment organs; vitelline ducts coextensive with intestinal diverticula. Egg tetrahedral, with 4 filaments.

Remarks: This species was originally described by Kohn et al. (2004) from the nasal cavity of *T. obesus* from Rio de Janeiro coast. The specimens recovered from the new host *T. atlanticus*, are morphometrically similar to those from the type host.

***Nasicola klawei*** (Stunkard, 1962) Yamaguti, 1968

Synonym: *Caballerocotyla klawei* Stunkard, 1962.

Host: *T. albacares*

Site: Nasal cavity

Prevalence: 81.6%

Mean intensity:  $2.87 \pm 0.37$

Material studied: CHIOC 37037 a–e

Main measurements (based on five adult specimens): Body 9.0–14.2 (13.0) long mm  $\times$  9.0–13.0 (11.0) mm in maximum width. Row of spines close to margin on each side of body, small, irregularly disposed, with broad base and 2–5 digitiform cusps inner; row of larger spines, on each side of body, with broad base and conical tip with 1–2 digitiform points. Haptor 2.5–3.3 mm (3.0) in diameter, divided by 7 septa forming central polygonal loculus and 7 subtriangular loculi, with 2 similar accessory sclerites and 14 small peripheral marginal hooklets. Cephalic lobe with pair of sucker-like attachment organs, 440–640 (540)  $\times$  500–680 (595). Mouth opening at level of eyespots; pharynx with papillae distributed over inner surface, anterior region 0.70–0.84 (0.77) mm  $\times$  1.02–1.44 (1.23) mm and posterior region, 0.44–0.60 (0.53) mm  $\times$  0.73–1.14 (0.94) mm. Intestinal ceca ramified. Testes 28–33 in number, 140  $\times$  80. Cirrus-sac flask-shaped. Vaginal pore opens immediately posterior to genital



pore. Ovary lobate. Vitelline follicles dispersed throughout body. Egg tetrahedral, with 4 filaments.

Remarks: *N. klawei* was originally described by Stunkard (1962) as a species of *Caballerocotyla* Price, 1960, from the nasal cavity of *T. albacares* (as *Neot-hunnus macropterus*) from the Pacific Ocean. In 1968, Yamaguti studied specimens from the same host and from *T. obesus* (as *Parathunnus sibi*) from off Hawaii and erected *Nasicola* to accommodate this species. In the Pacific Ocean it was reported by Egorova (2000) from an unidentified scombrid fish. *N. klawei* was referred in the Atlantic Ocean parasitizing *T. albacares* by Bussi eras and Baudin-Laurencin (1967, 1973), Bussi eras (1972), Williams Jr. and Bunkley-Williams (1996) and redescribed by Kohn et al. (2004). Ours specimens correspond to the description presented by Kohn et al. (2004) from same host and locality.

Subclass Oligonchoinea Bychowsky, 1937

Family Axinidae Monticelli, 1903

Subfamily Alloposeudaxininae Yamaguti, 1963

*Alloposeudaxinoides* Yamaguti, 1965

***Alloposeudaxinoides euthynni*** Yamaguti, 1965

Host: *K. pelamis* (new host record).

Site: Gills

Prevalence: 4.5%

Mean intensity: Only one specimen was infected

Material studied: CHIOC 37059, 37060

Main measurements (based on two adult specimens):

Body large, 8.2 and 8.6 mm by 2.6 and 2.8 mm. Haptor unilateral, extending obliquely in the posterior half of the body, with a row of 14-15 clamps and a prominent digitiform caudal appendage which is provided at its blunt end with two pairs of anchors; outer anchor 55 long, inner 25. Clamps 220 and 240 in diameter, constituted by two valves. Rounded anterior end of body, 175 and 205 wide, with two paired oral suckers, 50-51 × 42; pharynx pyriform, 87 × 37. Testes 20 in number, irregular in shape. Genital atrium spherical, 52 and 55 in diameter, with thick wall of radial muscle fibers, armed inside with a corona about 20 spines long and bifid. Genital pore midventral. Ovary 2.04 mm by 0.40 mm, in midregion of body, with both ends directed backwards. Vitellaria co-extensive with intestine and its branches. Vitelline reservoir Y-shaped. Eggs not visualized.

Remarks: *Alloposeudaxinoides euthynni* was described by Yamaguti (1965) from gills of *Euthynnus affinis* (as *Euthynnus yaito*) from Hawaii and redescribed in 1968 in the same host and locality. In this opportunity, it is referred for the first time in Southwestern Atlantic Ocean and in a new host, *K. pelamis*.

Family Gastrocotylidae Price, 1943

Subfamily Gastrocotylinae Sproston, 1946

*Sibitrema* Yamaguti, 1966

***Sibitrema poonui*** Yamaguti, 1966

Synonym: *Metapseudaxine ventrosicula* Mamaev, 1967

Host: *T. obesus*

Site: Gills

Prevalence: 5.7%

Mean intensity: Only one specimen was infected

Material studied: CHIOC 37038, 37039

Main measurements (based on one adult specimen):

Total body measuring 9.20 mm by 1.10 mm in the region of the ovary and testes. Haptor long, 1.60 mm × 0.54 mm, with single row of 49 clamps, and terminal appendices with two pairs of anchors of different sizes. Two buccal suckers, 35 × 30; pharynx larger than suckers, 54 × 38. Testes rounded, about 70 in number. Vas deferens strongly winding. Muscular genital atrium with single circle of curved terminally bifurcated spines. Ovary tubular. Vitelline follicles small, co-extensive with intestinal branches. Vitelline reservoir Y-shaped. Egg fusiform, 210 × 90, with one filament at each pole.

Remarks: *Sibitrema poonui* was originally described by Yamaguti (1966) from gills of *T. albacares* (as *N. macropterus*) and *T. obesus* (as *P. sibi*) in the Pacific Ocean, Hawaii and redescribed by Rohde (1978) from *Cybiosarda elegans* (Whitley, 1935) and *E. alletteratus* from Australia. Bussi eras and Baudin-Laurencin (1973) also referred this species parasitizing *T. albacares* from Antilles Islands. In Brazil, *S. poonui* was reported by Kohn et al. (2003) from *T. albacares* and *T. obesus* and by Alves and Luque (2006) as *M. ventrosicula*, parasitizing *E. alletteratus* and *Sarda sarda* (Bloch, 1793).

Family Hexostomatidae Price, 1936

*Hexostoma* Rafinesque, 1815

***Hexostoma albsmithi*** Dollfus, 1962

Host: *T. obesus* (new host record).

Site: Gill

Prevalence: 5.7%

Mean intensity: 16.5 ± 30.38

Material studied: CHIOC 37056 a-j

Main measurements (based on 10 adult specimens):

Body elongated, tapered anteriorly 9.24-17 (14.2) mm × 2.30-3.50 (2.80) mm, containing two small suckers 40-62 (51) × 30-47 (40); pharynx 65-110 (86) × 40-87 (66). Intestinal caeca form network of thin canals in dorsal and ventral region of the body. Numerous testes, 60-80 in number. Ovary located in the middle portion of the body. Vagina 100-160 (133) × 95-150 (116). Vitelline follicles dispersed throughout the body, except in the anterior region and the haptor region. Haptor 3.30-5.70 (4.40) mm long, containing 4 pairs of oval clamps: 3 larger pairs with similar size, 420-610 (520) × 370-540 (450), including a delicate membrane that surrounds the

clamps, measuring 35–62 (43) wide; one pair of clamps median, 130–250 (207) × 120–260 (170) including the membrane that measures 20–40 (28). Each clamp present 3 muscular sclerites: 2 lateral small sclerites and one median sclerite X-shaped, with 3–6 perforations. Two pairs of similar anchors: one pair 72–96 (87) long and one small pair 15–38 (21) long. Eggs 200–275 (233) × 95–175 (131), with two polar filaments: opercular filament, 100–155 (130) long and posterior filament, 105–162 (148) long. Uterus containing 2–16 eggs.

Remarks: *Hexostoma albsmithi* was described by Dollfus (1962) from gills of the *Thunnus thynnus* (Linnaeus, 1758) (as *Thynnus saliens*) from California, Pacific Ocean. In this paper, this specie is reported by the first time from Brazil, Southwestern Atlantic Ocean and in a new host record *T. obesus*.

### ***Hexostoma euthynni* Meserve, 1938**

Synonyms: *Hexostoma macracanthum* Fujii, 1944; *Neohexostoma euthynni* (Meserve, 1938) Price, 1961; *Neohexostoma kawakawa* Yamaguti, 1968; *Neohexostoma pricei* (Koratha, 1955) Price, 1961

Hosts: *A. thazard* and *E. alletteratus*

Site: Gills

Prevalence: *A. thazard* (25%); *E. alletteratus* (16.1%)

Mean intensity: *A. thazard* (1.4 ± 0.51); *E. alletteratus* (4.8 ± 3.64)

Material studied: CHIOC 37050, 37051, 37052, 37053

Main measurements (based on four adult specimens): Body elongate, 4.3–7.3 (6.1) mm × 1.2–1.5 (1.3) mm, presenting a constriction in pretesticular region, tapering from level of ovary to anterior end. Haptor continuous with body proper, each side with four sessile clamps decreasing in size; clamps of uniform structure sucker-like, larger clamps 190–350 (303) × 160–250 (210) and smaller clamps 175–245 (214) × 165–175 (167); each clamp encloses three sclerites, the middle one X-shaped, while the two lateral ones are straight; one pair of large and one pair of small terminal hooks. Two buccal elliptical suckers, 40 and 47 × 35; small pharynx; short esophagus bifurcating anterior to genital pore. Genital pore ventral, median. Testes post-ovarian, 22–26 in number. Ovary median, U-shaped. Vagina opens dorsal, 75–90 (82) × 60–87 (71), immediately posterior to genital atrium, provided with pair of denticulate bodies. Vitelline consist of irregular follicles. Uterus near midline of body. Eggs fusiform, 200–260 (220) × 100–180 (130) [*n*=3], with one filament at each pole, measuring 150–230 long.

Remarks: *Hexostoma euthynni* was described by Meserve (1938) from the gills of *E. alletteratus* from Galapagos Island, Pacific Ocean. It was also referred from the same ocean as *H. macracanthum* by Fujii (1944) from *E. alletteratus*; as *Neohexostoma pricei* by Koratha (1955) from *Sarda sarda* and as *N. euthynni* from *A. thazard* and *E. affinis* by Mamaev (1968). *H. euthynni* was redescribed

from *Euthynnus lineatus* Kishinouye, 1920 from Pacific Ocean by Millemann (1956), who considered *H. macracanthum* as synonym. In 1978, Rohde studied this species from *Euthynnus alletteratus affinis* (Cantor, 1849) from Australia and considered *Neohexostoma* synonymous of *Hexostoma*. In the Atlantic Ocean this species was referred by Williams Jr. and Bunkley-Williams (1996) and by Alves and Luque (2006) from gills of *E. alletteratus* in the genus *Neohexostoma*.

### ***Hexostoma keokeo* Yamaguti, 1968**

Host: *A. thazard*

Site: Gills

Prevalence: 15%

Mean intensity: 1.33 ± 0.70

Material studied: CHIOC 37054 e 37055

Main measurements (based on two adult specimens): Body elongate, anterior region tapered, 3.6 and 5.7 mm; greatest at width ovary level, 1.1 and 2.2mm. Haptor papillate, 1 and 1.8 mm, with two lateral papillate lobes; four pairs of clamps 210–225 (217) × 160–230 (195), arranged horizontally, similar, sessile, sucker-like, each clamp presenting three sclerites enclosed in two muscular and oval bands. Two pairs of terminal anchors, outer anchors large, 110 long. Mouth subterminal, surrounded by spherical buccal suckers, 35 × 37. Pharynx small, esophagus long, caeca with lateral diverticula reaching to haptor. Testes 18 in number, post-ovarian. Bulbous muscular cirrus. Ovary anterior to mid half of body, U-shaped. Vitelline follicular. Vagina with two symmetrical elongate pads densely covered with conical teeth, 75 and 100 × 60 and 90. Uterus midventral. Egg fusiform 200 × 90, filaments on each pole, equal in size, 192 long.

Remarks: *Hexostoma keokeo* was described by Yamaguti (1968) from gills of *A. thazard* off Hawaii, Pacific Ocean. In 1995, Murugesu proposed that *H. keokeo* should be considered a synonym of *Hexostoma auxisi* Palombi, 1943. However, Mogrovejo et al. (2004), based on scanning electron microscopy studies of specimens of *H. keokeo* from Rio de Janeiro coast, did not considered the validity of the synonymy.

### ***Hexostoma sibi* Yamaguti, 1968**

Hosts: *T. albacares* and *T. obesus*

Site: Gills

Prevalence: *T. albacares* (10.5%); *T. obesus* (22.9%)

Mean intensity: *T. albacares* (5.00±3.39); *T. obesus* (12.75±4.44)

Material studied: CHIOC 37040, 37041, 37042, 37043, 37044, 37045, 37046, 37047, 37048, 37049

Main measurements (based on ten adult specimens): Body 15.2–22.4 (18.2) mm × 4.1–6.4 (5.6) mm, divided into four regions of different width: the first region is very narrow and pointed, 80–170 (125) in the greatest

width, comprising a pair of cephalic suckers, 38–50 (44) × 28–50 (36), pharynx and anterior part of esophagus. The second region is nearly uniform in width, between the first region and the genital pore, 210–500 (400) wide; the third region occupies the greater middle portion of the body; the fourth region comprises the haptor, 4.1–6.1 (5.2) mm wide, with four pairs of ventral haptor suckers: three major pairs, 520–790 (650) × 480–630 (540) and two small pairs 200–330 (270) × 200–220 (210); two pairs of median external anchors, 70–100 (82) long and two pairs of median internal anchors 20–40 (23) long. Testes rounded, 110 in number. Ovary tubular. Vitelline follicles extend along from region of intestinal bifurcation to constriction, between third and fourth region. Eggs oval to elliptical, 200–250 (220) × 80–190 (130) [ $n=10$ ]; filament, 110–170 (140) of opercular pole and 110–210 (160) long of opposite pole.

Remarks: *Hexostoma sibi* was originally described by Yamaguti (1968) from the gills of *T. albacares* (as *N. macropterus*), *T. obesus* (as *P. sibi*) and *T. alalunga* from Hawaii, Pacific Ocean. In this opportunity this species is referred by the first time in Brazil, Southwestern Atlantic Ocean.

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