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**ORIGINAL ARTICLE**

# NEW RECORDS OF SOME DIGENETIC TREMATODES IN SOME MARINE FISHES FROM IRAQ

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## ABSTRACT

A parasitological investigation of diagenetic trematodes in three fish species from Iraqi marine territorial waters was conducted from December 2021 to December 2022. The study identified five trematode species belonging to the families Hemiuridae, Acanthocolpidae, and Opecoelidae. *Lecithocladium angustiovum* Yamaguti, 1953, found in the intestines of the black pomfret *Parastromateus niger* (Bloch, 1795) (Hemiuridae). Three species of acanthocolpid trematodes, *Monostephanostomum loossi* (Pandey & Tewari, 1984), *Stephanostomum ditrematis* (Yamaguti, 1939), and *Stephanostomum* sp., were recorded in the greater amberjack *Seriola dumerili* (Risso, 1810) Additionally, *Pseudopecoeloides tenuis* Yamaguti, 1940 (Opecoelidae) was recorded in the purple-spotted bigeyes *Priacanthus tayenus* Richardson, 1810. Except for *L. angustiovum*, all of these parasites were recorded for the first time in Iraq and the Arabian Gulf.

Keywords: Arabian Gulf, Fish, Iraq, Marine, Monogenoidea, Parasite.

## INTRODUCTION

Black pomfret *Parastromateus niger* (Bloch, 1795) is commercially important fish species in the Arabian Gulf region. It feeds on phytoplankton, zooplanktons, crustaceans and annelids (Dadzie, 2007). The Greater Amberjack *Seriola dumerili* (Risso, 1810), a large predatory fish of commercial significance, is distributed globally, inhabiting tropical and warm temperate seas. Its range includes the Indo-West Pacificfrom South Africa to the Arabian Gulf, southern Japan, the Hawaiian Islands, and south to New Caledonia as well as the Western and Eastern Atlantic. Purple-spotted bigeyes *Priacanthus tayenus* Richardson, 1846 which feeds on a variety of benthic organisms, is considered a minor commercial species (Froese and Pauly, 2024).

In Iraq research on parasites in the fish species targeted in the current study has been limited; *P. niger* has been to be only infected with *Lecithocladium bulbolabrum* Reid, Coil & Kuntz, 1966 (=*Lecithocladium angustiovum* Yamaguti, 1953) by Mohammad (2010); *P. tayenus* has been found to host a cestode plerocercus of *Callitetrarhynchus* sp. (Al-Hajjaj, 2021), fourth larval nematode *Hysterothylacium* sp. type BI (Al-Hajjaj, 2021; Ali and Mizher, 2023) and a diplectanid monogenoid *Oliveriplectanum robustitubum* (Wu & Li, 2003) (Kritsky *et al*., 2024). However, for parasitological report (s) detected on *S. dumerili*.

*Lecithocladium* Lühe, 1901 comprises 50 valid species (WoRMS, 2024); although seven species are known from Pakistan: *L. arii* Bilqees, Khatoon, Shabbir, Shaukat, Muti-ur-Rehman & Khan, 2005, *L. cybii* Shaukat & Bilqees, 2011, *L. karachiense* Shaukat & Bilqees, 2010; *L. lateropharyngium* Shaukat, Bilqees, Haseeb & Matiur-Rehman, 2008, *L. magnasoma* Shaukat & Bilqees, 2007, *L. olivacae* Bilqees, Khatoon, Khan & Mutiur-Rehman, 2006 and *L. thynense* Bilqees & Nighat, 1985; only *L. karachiense* has been described from the stomach of the black pomfret *P. niger* (Shaukat and Bilqees, 2010). *L. unibulborum* Fischthal & Thomas, 1971 has been isolated from the stomach of the Malabar travelly *Platycaranx malabaricus* (Bloch & Schneider, 1801) from the UAE coast (Kardousha, 2003).

According to Cribb *et al*. (2002), the genus *Stephanostomum* Looss, 1899 is ranked the second richest genus of Digenea that infect fishes, with 108 valid species belonging to this genus, including six species isolated from *S. dumerili* (Saoud *et al*., 2002; Cribb *et al*., 2003; WoRMS, 2024). In contrast, the genus *Monostephanostomum* Kruse, 1979 is characterised by a single row of large oral spines, compared to the species *Stephanostomum*, which have two rows of large oral spines (Madhavi and Bray, 2018).

The Opecoelidae Ozaki 1925 comprises over 800 species and 85 genera, including *Pseudopecoeloides* Yamaguti, 1940, which contains 25 valid species (Cribb, 2005; Martin *et al.*, 2018). Species this genus are categorized into two phenotypic groups based on the ratio of the ventral sucker to the oral sucker. Group A includes species in which the oral sucker is larger than the ventral sucker, while Group B includes species in which the ventral sucker is equal to or greater than the oral sucker (Aken'Ova *et al*., 2009).

This study aims to describe some trematode species recorded from commercial fishes for the first time in Iraq and the Arabian Gulf to enhance understanding of the diversity of these parasites in marine fish populations in the region.

## MATERIALS AND METHODS

Fishes were collected from Iraqi marine waters by fishermen during the period from December 2021 to December 2022. The fish were kept in a cool box filled with crushed ice and transported to the Fish diseases and parasites laboratory at the Department of Fisheries and Marine Resources, College of Agriculture, University of Basrah. The targeted fishes were identified according to Carpenter *et al*. (1997) and verified using Fricke *et al*. (2024). The fish species examined 39 *Parastromateus niger* (Bloch, 1795) and three *Seriola dumerili*

Richardson, 1846 (both Carangidae) as well as 240 *Pricanthus tayenus* Richardson, 1846 (Priacanthidae). The fish were dissected, examined for parasites and the isolated specimens were then, washed and fixed in hot 5% formalin (Justine *et al*., 2012), stained in Mayer-Schuberg's Aceto carmine and mounted in Canada balsam. All morphometric measurements were taken in micrometers. The ecological terms used in the current study followed the guidelines set by Bush *et al*. (1997).

## RESULTS AND DISCUSSION

Family **Hemiuridae** Looss, 1899
Genus ***Lecithocladium*** Lühe, 1901
***Lecithocladium angustiovum*** Yamaguti, 1953
Host: *Parastromateus niger* (Bloch)
Prevalence and intensity: 38.46%, 4. 53
Site of infection: Stomach**.**
Description and measurements based on 17 specimens (Fig. 1, Tab. 1): These trematodes have a thick, muscular body with a smooth tegument, reproductive organs present and located behind the large ventral sucker and hind body elongated. Oral sucker terminal, deep, and funnel-shaped. Pharynx cylindrical in shape, thick and elongated. Seminal vesicle typically elongated and oval sometime bulbous in shape**.** Ovary postesticular separated by a distance of 0-312 (unit 138 micrometer) sometimes overlaps with posterior testis. Uterus occupies the area between ventral sucker and posterior ovary and reaches the tail (ecosoma). Seminal vesicle cylindrical to tubular shape. The genital pore opens at the base of oral sucker. The vitellarium is follicular, formed in 3-4 tubes on each side posterior to the ovary (Tab.1).

**Remark:** The measurement and biometric characteristics of current specimens were compared with six species that has been isolated mainly from the black pomfret which contains an oral sucker larger than the ventral one (Group A, see Aken'Ova *et al*., 2009); *L. annulatum* Chauhan, 1945 from the intestine of *Apolectus niger* (=*P. niger*) from Calicut, Indian waters, *L. apolecti* Velasquez, 1962 from the intestine of *A. niger* (=*P. niger*) from the island of Luzon, Philippines, *L. angustiovum* Yamaguti, 1953 from the intestine of Indian mackerel *Scomber kanagurta* [=*Rastrilleger kanagurta* (Cuvier, 1816)] from Macassar, South Africa; *L. excisum* (Rudolphi, 1819) Lühe, 1901 from the intestine of butterfly perch *Caesioperca lepidoptera* (Forster, 1801) and the stomach of New Zealand blue cod *Parapercis colias* (Forster, 1801) from Wellington In New Zealand; *L. excisiforme* Cohn, 1902 from the intestine of *Stromateus niger* (=*P. niger*) from the coasts of the Arabian Sea and Bombay, India; *L. karachiense* Shaukat & Bilqees, 2010 from the stomach of *P. niger* from coast of Karachi, Pakistan (Cohn, 1902; Velasque, 1962; Shaukat and Bilqees, 2010; Madhavi and Lakshmi, 2011; Indaryanto *et al*., 2015; Madhavi and Bray, 2018) (Tab. 2).

The extension of the uterus to the middle of the tail, the placement of the ovary at the end of the soma, the some tubular vitellaria extending to the ecsoma; and the eggs measurement, funnel-shaped oral sucker and other biometric characteristics (as shown in Table (1)), confirm that the current specimens agree with *L. angustiovum*, including the proportion of the

ecsoma to the total length of the body, suckers ratio, and the ratio of ventral sucker to body width (Yamaguti, 1953; Indaryanto *et al*., 2015; Madhavi and Bray, 2018) (Tab. 1).

The current specimens differ from *L. annulatum*, where the uterus in the latter species extends only to the end of the soma rather than reaching the to the ecsoma and it has smaller eggs and the ventral sucker is located in the first sixth of the body (Compared to its position at the beginning of the second sixth of the body), the seminal vesicle in *L. annulatum* is wider than length (Chauhan, 1954).

**Table (1):** Measurements and biometric characters of *Lecithocladium angustiovum* from *Parastromateus niger*.

| Character | Min-Max (Mean± Standard deviation) |
|---|---|
| Body size | 6615-12096 (9132± 1488.655)×800–1210(983±142.637) |
| Ratio body width to length | 1: 5.6-11.5 (9.47±1.823) |
| Ecsoma length | 2703–5765(4065±978.471) |
| Forebody | 820–1840(1399±264.845) |
| Hindbody | 4838–9242(6593±1338.588) |
| Oral sucker L ×W | 546–945(759±86.981) × 546 – 780(692±62.065) |
| Pharynx L ×W | 515–983(773±152.167) × 234– 462(385±64.586) |
| Ventral sucker L ×W | 413–680(541±70.048)×350– 671(478±94.546) |
| Sucker width ratio L ×W | 1: 0.63-0.81(0.80±0.12) |
| Seminal vesicle L ×W | 218-1201(566±246.737)–133 × 390(264±69.894) |
| Anterior testis L ×W | 270–499(369±67.385) × 164-499(309±91.818) |
| Posterior testis L ×W | 200–507(335±77.743) × 133– 486(291±94.168) |
| Distance between posterior testis and ovary | 0–328(138±128.548) |
| Ovary L ×W | 164–390(253±74.411) ×125–390(261±85.001) |
| Eggs L ×W | 14–19.5(16.272±1.967) × 8–10(9.2) |
| Body length without ecsoma | 3693 - 6331.0 (5169±922.965) |

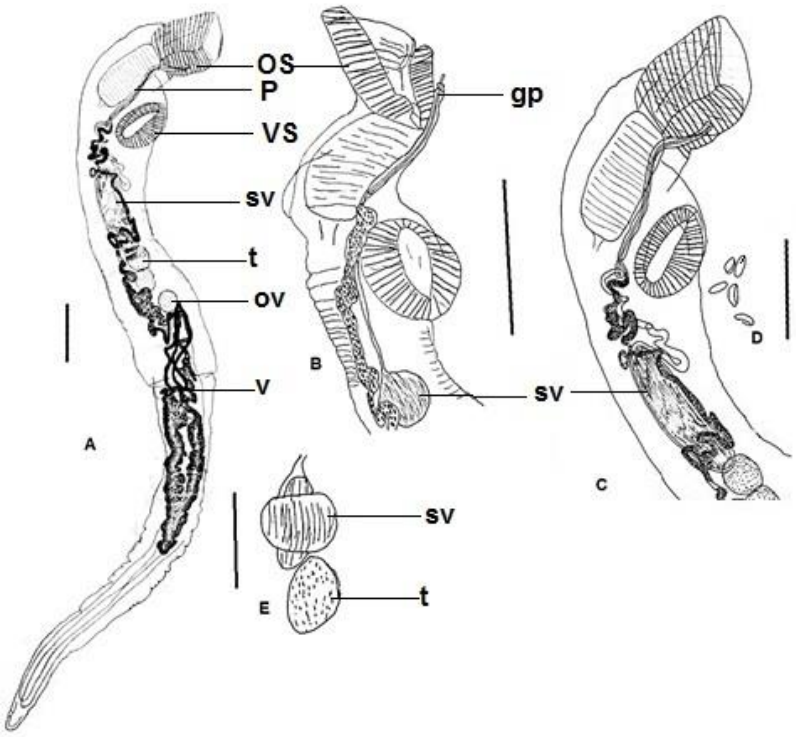


**Figure (1):** *Lecithocladium angustiovum* Yamaguti, 1953 from intestine of *Parastromateus niger*. (A) Ventral view, (B) Anterior part with protruded cirrus and globular seminal vesicle, (C) Terminal genitalia, (D) Eggs, (E) The shape of seminal vesicle of globular seminal vesicle. [Abbreviations: gp: Gonopore, OS: Oral sucker, Ov: Ovary, P: Pharynx, SV: Seminal vesicle, t: Testis, V: Vitellaria, VS: Ventral sucker. Scale bars, A-C= 770µm, D=190 µm, E=385 µm].

The current specimens differ from *L. apolecti* in the location of the testes, ovary, and the extension of the vitellaria, the testes are located in the middle of body, and the overy is located at the end of soma and beginning of ecsoma, and vitellaria do not extend to the tail area. In contrast, vitellaria extend beyond ecsoma, and slightly have smaller eggs. The soma in the current specimens is longer than the ecsoma whereas in *L. apolecti* soma is shorter than ecsoma (Velasquez, 1962; Madhavi and Bray, 2018).

**Table (2):** Comparative measurements and biometric characters of *Lecithocladium* spp. mainly from the black pomfret which possessing an oral sucker larger than the ventral one.

| **Species** | ***L. annulatum*** | ***L. apolecti*** | ***L. angustiovum*** | ***L. excisum*** | ***L. excisiforme*** | ***L. karachiense*** | ***L. angustiovum*** |
|---|---|---|---|---|---|---|---|
| **Reference** | Chauhan (1945) | Velasquez (1962) | Yamaguti (1953) | Gibson and Bray (1986) | Cohn (1902) | Shaukat and Bilqees (2010) | Current study |
| **Host** | *Apolectus niger* (=*P. niger*) | *A. niger* (=*P. niger*) | *Scomber kanagurta* (=*Rastrilleger kanagurta*) | *Scomber scombrus* Linnaeus, 1758 | *Stromateus niger* (=*P. niger*) | *P. niger* | *P. niger* |
| **Locality** | BOM, Calicut AS | The island of Luzon, Philippines | Macassar, South Africa | Hugli Estuary | BOM, AS | Arabian Sea, Pakistan | Arabian Gulf, Iraq |
| **Body length (TL)** | 9870 | 10090-15370 | (3800–6528) | 3500-7200 | 3700 | 8800-8980 | 6615-12096 (9132) |
| **Body width** | 1100 | 730-1040 | 0.171-0.257 | 600-1200 | 420-780 | 1330-1390 | 800-1210 (983) |
| **Fore body: Soma length** | 20.75% | 25% | 28% | 17.9-20% | - | - | 19-41 (28)% |
| **Fore body** | 1137.9 | 428.5 | 785.71 | 600-1100 | 600-1100 | 1430-1450 | 820-1840 (1399) |
| **Ecsoma Length** | 3610 | 3820-6910 | 231- 975 | 150-400 | 1300 | 4100-4230 | 2703-5765 (4065) |
| **Oral sucker L.** | 425 | 170-260 | 200-300 | 350-650 | 420 | 490-500 | 546-945 (759) |
| **Suckers ratio** | 1: 0.76 | 1:0.91–0.99 | 1:0.63-0.95 | 1: 0.72-0.95 | 1:0.33 | 1: 0.64-0.65 | 1:0.63-0.81 (0.80) |
| **Oral sucker width** | 325 | 180-451 | 210-300 | 380-600 | 300 | 750-770 | 546-780 (692) |
| **Pharynx L.** | 379 | 230-160 | 200- 300 | 500 | 480 | 490-500 | 515-983 (773) |
| **Pharynx. W.** | 172.4 | 69-104 | 110-150 | 250 | 250 | 380-400 | 234-462 (385) |
| **Ventral Sucker L.** | 350 | 364-418 (140-250) | 175-220 | 300-470 | 300 | 480-490 | 413-680 (541) |
| **Vent. Sucker width** | 344 | 120-459 | 102-120 | 350-500 | 100 | 490-500 | 35-671 (478) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Ovary L.** | 350 | 46-210 | 100-130 | 150-300 | - | 210-220 | 164-390 (253) |
| **Ovary W.** | 250 | 69-230 | 150-210 | 280-390 | - | 240-250 | 125-390 (261) |
| **Anterior testis L.** | 413.7 | 69-280 | 65-87 | 230-420 | 230-420 | 200-210 | 270-499(369) |
| **Anterior testis W.** | 241 | 70-320 | 57-81 | 230-430 | 230-430 | 180-190 | 164-499 (309) |
| **Posterior testis L.** | 413.7 | 71- 370 | 57-94 | 243.2 | - | 140-150 | 200-507 (335) |
| **Posterior testis W.** | 206.8 | 69-320 | 61-86 | 324.32 | - | 160-163 | 133-486 (291) |
| **Seminal vesicle L.** | 250 | 69-690 | 120-300 | 513.5 | - | 500-510 | 218-1201 (566) |
| **Seminal vesicle W.** | 425 | 69-240 | 110-130 | 189.1 | - | 210-220 | 133-390 (264) |
| **Egg length** | 12 | 18-20 (9-13 | 15-19 | 21-24 | - | 28-34 | 14-19.5 (16) |
| **Egg width** | 4.8 | 11-12 (5-6) | 7-9 | 11-14 | - | 16-20 | 8-10 (9.2) |

The species under current study differs from *L. excisum* in the distribution of the vitellaria (in the current species, all vitellaria lobes extend back towards the tail, whereas in *L.excisum* some lobes extend to the anterior of the ovary; Additionally, the uterus in the current species extends near the end of the tail, whereas in *L. excisum* uterus does not reach the tail (Manter, 1954; Gibson and Bray, 1986; Indaryanto *et al*., 2015). The current specimens differ from *L. excisiforme* by having shorter tail, larger body, pharynx, oral sucker, ventral sucker, and ratio of sucker. Some of vitellaria lobes in the current specimens enter the tail area, whereas in *L. excisiforme*, the vitellaria lobes do not reach the tail. The pharynx is elongated in the current specimen, reaching the ventral sucker with part of it extending beyond, whereas in *L. excisiforme*, the pharynx reaches a distance before the ventral sucker (Cohn, 1902). The current specimens differ from *L. karachiensis* as they have larger testes relative to the than the ovary, and smaller eggs (Shaukat and Bilqees, 2010).

Mohammad (2010) recorded *L. bulbolabrum* (= *L. angustiovum*) from the intestine of black pomfret from Khor Abdullah, Iraq. The author mentioned that the species was recorded for the first time in Iraq and the Arabian Gulf, despite having been previously previously recorded in the Arabian Gulf specifically in Kuwaiti waters by Al-Yamani (1981) from the Donkey croaker *Johnius aneus* [=*Pennahia aneus* (Bloch, 1793)]. Al-Kuwari *et al*. (2001) recorded *L. angustiovum* from milkfish, *Chanos chanos* (Fabricius, 1775), in Qatari waters. Nahhas and Sey (2002) isolated the parasite from shrimp scad *Caranax kalla* [=*Alepes djedaba* (Fabricius, 1775)] in Kuwaiti waters and they found differences in the location and distribution of the vitellaria. Although the current species of parasite was isolated from the same host and sharesa synonymous name, the current study provides

additional morphological data and characteristics which are necessary for accurately distinguishing closely related species, especially those that infect the same hosts.

Family **Acanthocolpidae** Lühe, 1906
Genus ***Monostephanostomum*** Kruse, 1979
***Monostephanostomum loossi*** (Pandey & Tewari, 1984) Saoud, Nahhas, Al Kuwari & Ramadan, 2002
Host: *Seriola dumerili* (Risso, 1810)
Prevalence and intensity: 66.6%, 5
Site of infection: Stomach
Description and measurements (Based on 5 specimens, Fig. 2, Tab. 3): The worms are cylindrical, with their maximum width at the level of the testes. The tissue area directly posterior, ventral sucker is non-spinous, unlike the rest of body parts, especially the area of pharynx and esophagus which reach up to the ventral sucker, which spines extend to the level of seminal vesicle. The oral sucker is vascular in shape and surrounded by a single ring of 31-32 blunt, cylindrical spines. The ventral sucker is large, circular and located in the first sixth of body. The caeca bifurcated anteriorly before the ventral sucker. Two oval-shaped testes are located near the end of body. The overy is spherical and pretesticular situated in the last quarter the hindbody. The preovarian uterus is located between the ovary and the posterior end of the seminal vesicle. The eggs are large but few in numbers. The vitellaria fill the posttesticular space covering the testes, the posterior region of the body, and the lateral margin of the seminal vesicle (Tab. 3).

**Table (3):** Measurement and biometric characters of *Monostephanostomum loossi* from *Seriola dumerili*.

| Character | Min-Max (Mean± Standard deviation) |
|---|---|
| Body size | 3270-5046 (4547±726.563) ×359-397 (378±13.400) |
| Ratio body width: length | 8.65-13.53 (12.04) |
| Spines number | 31-32 |
| Forebody (FB) | 1285–1512 (1413.74±97.700) |
| Hindbody (HB) | 1796–3308 (2786±576.687) |
| Prepharynx length | 680-945 (810±112.311) |
| Pharynx | 123-179 (160±19.198) × 94.5-132 (118±18.954) |
| Oral sucker | 78-170 (110±37.757) × 78-359 (201±110.681) |
| Ventral sucker (VS) | 204-289 (226±35.909)× 179-265 (207±34.222) |
| Suckers ratio | 1:1.28-2.60 (2.18±0.515) |
| VS length / body length % | 4.02-8.84 (5.23±2.030)% |
| Ventral sucker: Fore body | 13.43-22.49. (16.17±3.632)% |
| Anterior testis | 312-320 (314±3.900) × 179-250 (224±33.525) |
| Posterior testis | 312-343 (323.7±14.936) ×179-250 (230±34.221) |
| Ratio anterior testis: fore body | 1:4.12-4.85 (4.43±1.527) |
| Ratio anterior testis: hind body | 1:5.76-9.57 (8.45) |
| Ovary | 125-156 (146±18.013) ×140-156 (151±9.238) |
| Eggs | 61-74 (68.78±4.853)× 47-55 (52±3.311) |

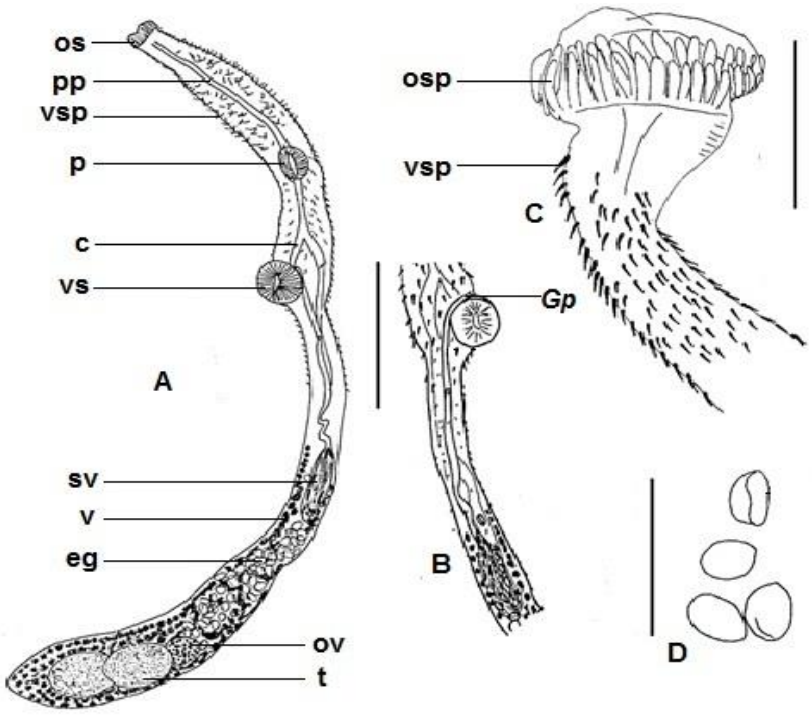


**Figure (2):** *Monostephanostomum loossi* (Pandey & Tewari, 1984) from *Seriola dumerili;* (A) Ventral view, (B) Terminal genitalia, (C) Oral sucker, (D) Eggs. [Abbreviation: C: caecum, eg: egg, Gp: gonopore, OS: oral sucker, OSP: Oral spines, Ov: ovary, P: pharynx, PP: prepharynx, SV: seminal vesicle, t: testis, V: vitellaria, VS: ventral sucker, VSP: Ventral spines. Scale bars: A-B= 770µm, C-D=190 µm].

There are nine valid species belonging to *Monostephanostomum* Kruse, 1979 (WoRMS, 2024): *M. gazzae* (Shen, 1990) Bray & Cribb, 2002, from the toothpony *Gazza minuta* (Bloch, 1795) in the waters near Hainan Island, China; *M. georgianum* Bray & Cribb, 2002, from the intestine and caeca of *Arripis georgianus* (Valenciennes, 1831) off Kangaroo island, southern Australia, *M. krusei* Reimer, 1983 from the intestine of the white trevally *Pseudocaranx dentex* (Bloch & Schneider, 1801) along the Ningaloo coast in Australia, *M. loossi* (Pandey & Tewari, 1984), Saoud *et al*. (2002) from *Euthynnus* sp. in the Arabian Sea and the Bay of Bengal, *M. manteri* Kruse, 1979 from the intestine and rectum of *A. georgianus* off the coast of Kangaroo Island in southern Australia.

**Table (4):** Comparative measurements of and biometric characters of *Monostephanostomum* spp. with *M. loossi* from *Seriola dumerili*.

| Species | Reference | Total length (TL) | Body width | Oral sucker L. | Oral sucker W | Prepharynx L | Prepharynx : TL |
|---|---|---|---|---|---|---|---|
| ***M. gazzae*** | Bray and Cribb (2002) | - | - | - | - | - | - |
| ***M. georgianum*** | Bray and Cribb (2002) | 2398-2904 (2638) | 182-197 (192) | 52-55 (54) | 73-79 (76) | 390-421 (401) | - |
| ***M. krusei*** | Bray and Cribb (2002) | 2504-2708 (2596) | 273-295 (287) | 51-64 (58) | 115-126 (120) | 549-808 (668) | 21.9-29.8 (25.6) |
| ***M. manteri*** | Bray and Cribb (2002) | 1255-2576 (1864) | 192-349 (271) | 49-73 (59) | 69-98 (81) | 163-397 (283) | - |
| ***M. mesospinosum*** | Abdel-Gaber *et al.* (2023) | 6102-7923 (6870) | 201-243 (231) | 70-79 (75) | 91-103 (98) | 590-721 (611) | - |
| ***M. nolani*** | Bray and Cribb (2007) | 2072-2963 (2602) | 293-437 (343) | 43-102 (76) | 81-134 (109) | 389-921 (701) | 17.4-35.2 (26.9) |
| ***M. roytmani*** | Saoud *et al.* (2002) | - | - | - | - | - | - |
| ***M. yamagutii*** | Ramadan (1984) | 2580-3370 | 640-690 | 120-150 | 150-200 | 200-300 | - |
| ***M. loossi*** | Current study | 3270-5046 (4547) | 359-397 (378) | 78-170 (110) | 78-359 (201) | 680-945 (810) | 14-22.6 (18) |

| Spines number | Ovary W. | Ovary L. | OSW:VSW | Ventral sucker W. | Ventral sucker L. | Prepharynx /TL % | Pharynx. W. | Pharynx L. |
|---|---|---|---|---|---|---|---|---|
| 23 | - | - | 1:2.0-2.5 | - | - | - | - | - |
| 18-20 (19) | 107-115 (111) | 108-114 (111) | 1:1.6-1.7 | 120-132 (124) | 125-138 (133) | - | 57-62 (59) | 67-86 (78) |
| 17-20 | 97-116 (106) | 92-104 (98) | 1:1.8-2.7 (2.2) | 120-132 (127) | 115-138 (124) | 6.1-6.3 (6.2) | 74-87 (80) | 152-168 (161) |
| 14-18 (16) | 71-125 (103) | 72-136 (110) | - | 102-169 (133) | 101-156 (130) | - | 49-72 (62) | 51-102 (73) |
| 18 | 113-125 (119) | 115-124 (119) | 1:1.2-1.4 | 124-168 (141) | 118-147(128) | - | 82-94 (86) | 163-184 (172) |
| 17-20 (17.9) | 93-141 (111) | 85-142 (123) | - | 126-187 (159) | 121-215 (160) | 4.7-9.9 (6.9) | 55-79 (68) | 101-253 (179) |
| 17-20 | - | - | - | - | - | - | - | - |
| 12-16 | 160-200 | 120-200 | 1:0.31-0.42 | 360-410 | 360-420 | - | 170-210 | 220-230 |
| 31-32 | 140-156 (151) | 125-156 (146) | 1:1.28-2.60 (2.18) | 179-265 (207) | 204-289 (226) | 2.7-4.5 (3.58) | 94.5-132 (118) | 123-179 (160) |

| Body width : TL | Hind Body: TL % | Fore Body/TL % | Hind Body L. | Fore Body L | Egg W. | Egg L | Posterior testis W | Posterior testis L | Anterior testis W | Anterior testis L |
|---|---|---|---|---|---|---|---|---|---|---|
| - | - | 11% | - | - | 27-30 | 42-45 | - | - | - | - |
| 6.8-8.3 (7.3) | - | 25-32 | - | 668-752 (724) | 39-50 (45) | 75-86 (81) | 152-173 (163) | 225-260 (242) | 143-175 (155) | 191-239 (210) |
| 10.6-11.5 (11.1) | 51.3-58.6 (54.9) | 35.9-44.3 (40.3) | 1389-1468 (1423) | 898-1199 (1048) | 39-44 (41) | 62-64 (63) | 171-191 (178) | 229-237 (234) | 164-168 (167) | 190-21 (200) |
| 12-18 (15) | - | - | - | 478-801 (634) | 24-48 (37) | 63-91 (76) | 115-218 (182) | 220-542 (376) | 117-235 (181) | 196-397 (294) |
| - | - | 10% | - | - | 39-50 | 75-86 | 189-184 (184) | 291-371 (311) | 173-185 (170) | 267-351 (298) |
| 10.3-17 (13.3) | 45.1-60.5 (52.5) | 32.4-48.6 (41.3) | 935-1605 (1366) | 724-1302 (1075) | 30-40 (34) | 52-62 (56) | 169-242 (208) | 271-386 (330) | 153-236 (207) | 203-310 (266) |
| - | - | - | - | - | 33-46 | 46-60 | - | - | - | - |
| 3.78-5.07 | - | - | - | - | 30-52 | 68-74 | 160-270 | 300-510 | 200-270 | 260-410 |
| 1:8.65-13.53 (12.04) | 54.92-65.56 (60.82) | 28.41-39.30 (31.62) | 1796-2986 (2786.12) | 1285-1512 (1413.74) | 47-55 (52) | 61-74 (68.78) | 179-250 (230) | 312-343 (323.7) | 179-250 (224) | 312-320 (314) |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **% Body width / TL** | 4.70% | - | - | - | 3.1-3.4% | - | - | - | 7.39- 11.56 (8.53)% |

*M. mesospinosum* (Madhavi, 1976), Bray & Cribb, 2002 from the intestine of coastal trevally *Carangoides caeruleopinnatus* (= *Turum caeruleopinnatus* [Rüppell, 1830]) in the Red Sea, Saudi Arabia; *M. nolani* Bray & Cribb, 2007 from the intestine of Barcheek trevally *C. plagiotaenia* (= *Craterognathus plagiotaenia* [Bleeker, 1857]) from Australian Great Barrier Reef, *M. roytmani* (Parukhin, 1974) Reimer, 1983 from bigeye trevally *Caranx sexfasciatus* Quoy & Gaimard, 1825 in the Red Sea, and *M. yamagutii* Ramadan 1984 from the small intestine of sky emperor *Lethrinus mahsena* (Fabricius, 1775) in the Red Sea. (Ramadan 1984; Bray and Gribb, 2002, 2007; Madhavi and Bray 2018; Abdel-Gaber *et al.*, 2023). The current specimens match *M. loossi* in distinctive characteristics that can be classified as *M. loossi*. The most important feature is the number of oral spines, as they both have 32 spines. All other species of this genus have 14-23 mouth spines, except *M. loossi*, which has 32. The body shape is also club-shaped and the vitellaria are limited to the posterior of the body and spread between the gonads (Tab. 4).

The general characteristics of the species under the current study differ from *M. gazzae* and *M. georgianum* in body shape, and number of oral spines, the ratio of suckers and eggs measurement. *M. manteri* and *M. nolani* differ from the current species in the distribution of the vitellaria which reach to the fore body or even to the ventral sucker, whereas in the current species, the vitellaria distribution is in the hind body. They also differ in the number of oral spines (Bray and Cribb 2007). *M. loossi* differ from *M. mesospinosum* in the number of oral spines. These two species are aslo vary in the distribution of the vitelline as well as eggs measurements, the ratio of the body width to body length and the ratio of fore body length to total body length (Bray and Cribb, 2002, 2007). *Monostephanostomum krusei* differs from *M. loossi* in the number of oral spines, the percentage ratio of both the pre-pharyngeal and pharynx length to the body length, the ratio of suckers and the presence or absence of the uroproct (Bray and Cribb 2007). The *M. roytmani* differs from *M. loossi* in the number of oral spines and the eggs measurement. *M. yamagutii* differs from *M. loossi* in the number of oral spines and the ratio of body width to length.

Genus ***Stephanostomum*** Looss, 1899
***Stephanostomum ditrematis*** (Yamaguti, 1939) Manter, 1947
Host: *Seriola dumerili* (Risso)
Prevalence and intensity: 66.6%, 12.5
Site of infection: Stomach.

Description and measurements (12 specimens, Fig. 3, Tab. 5): The worms are cylindrical. The area behind ventral sucker is non spined, unlike the rest of the body especially between pharynx and esophagus extending to the ventral sucker which is spiny. The oral sucker is vascular in shape, surrounded by a double ring of alternating spines. The ventral sucker is large and protrudes forward from the body. It is circular in shape, and is located in the second sixth of body. The pre-pharyngeal is very long, while the pharynx short. The testes are oval, either contagious or well separated from each other, are located near the posterior end of the body. The seminal vesicle is elongate, and tubular. The overy is spherical located in the last quarter of hind body, and is pretesticular. The uterus is preovarian and located between the ovary and the seminal vesicle.

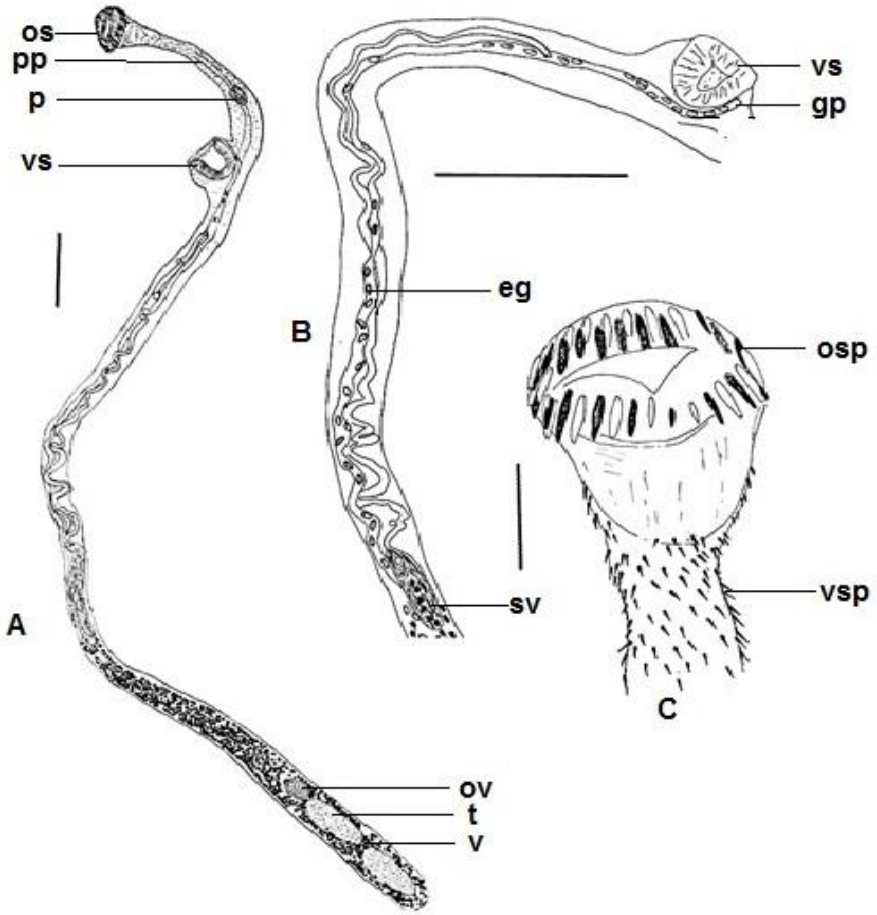


**Figure (3):** *Stephanostomum ditrematis* (Yamaguti, 1939) from *Seriola dumerili*; (A) Ventral view, (B) Terminal genitalia, (C) Oral sucker area. [Abbreviations: eg: Egg, gp: Gonopore, OS: Oral sucker, OSP: Oral spines, Ov: Ovary, P: Pharynx, PP: Prepharynx, SV: Seminal vesicle, t: Testis, V: Vitellaria, VS: ventral sucker, VSP: Ventral spines. Scale bars, A-B= 770µm, C=190 µm].

**Table (5):** Principal measurements of *Stephanostomum ditrematis*.

| Character | Min-Max (Mean± Standard deviation) |
|---|---|
| Body size L×W | 9412-18147 (12151±2552.223) ×236-564 (463±91.645) |
| Ratio body width to length | 1: 18-39 (27±6.430) |
| body width to length % | 2.51- 5.56 (3.90)% |
| Number of spines | 36-40 (38±1.379) |
| Forebody | 1480–2268 (1763.50±221.509) |
| Hindbody | 7163–15979 (10018.92±2460.055) |
| Forebody/ Total length % | 9.24-19.88(15±2.592)% |
| Hindbody/ Total length | 76-88(82±2.961)% |
| Prepharynx length (pp) | 800-1193 (1023±105.014) |
| Prepharynx length: Forebody | 53-68 (58±5.790)% |
| Prepharynx length: Hindbody | 6.62-15.83 (10.67±2.417)% |
| Prepharynx length: Total length | 5.83-12(8.69±1.679)% |
| Pharynx L×W | 160-289 (212±41.716) × 101-125 (113±7.336) |
| Oral sucker L×W | 110-321 (178±54.037) × 240-473 (348±58.300) |
| Prepharynx: Pharynx | 1:3.60-6.94 (5.01±1.125) |
| Ventral sucker L×W | 320-491 (369±44.262)× 290-454 (361±42.259) |
| Suckers ratio | 1: 1.53-2.91 (2.17±0.412) |
| Ventral sucker length/total length | 2.31-4.00 (3±0.522)% |
| Ventral Sucker: Fore Body | 13.43-22.49 (16.17±3.477)% |
| Anterior testis (AT) L×W | 523-920 (719±106.657) × 150-400 (259±70.702) |
| Posterior testis (PT) L×W | 530-991 (759±133.698) ×195-360 (278±52.855) |
| Seminal vesicle L×W | 867-1640 (1264±263.372) ×100-190 (147±22.725) |
| Ratio Anterior testis: Fore body | 1:5.76-9.57 (8.45±7.258) |
| Ovary L×W | 234-370 (30645.811) ×187-420 (229±63.899) |
| Eggs L×W | 47-66 (60±4.745) × 29-49 (42±5.573) |

The eggs are large and few. Vitellaria fill the area between seminal vesicle to posterior end of the body (Tab. 5).

The presence of two rows of enlarged spines surrounding the oral sucker indicates that these worms belong to the genus *Stephanostomum*, within the Acanthocolpidae Lühe, 1906. It is widespread and represents the largest genus that removes many aquatic organisms, especially marine fishes. There are 19 species of this genus have been reported from the Indian subcontinent. The classification of these dioecious worms are is challenging, and determineing the species depends on a set of characteristics, including the number and arrangement of the spines surrounding the mouth, the size of the oral and ventral suckers, the size of the seminal vesicle, the distance between the gonads, and the presence or absence of a uroproct, and eggs measurements (Madhavi and Bray, 2018).

Six species of this genus have been isolated from *Seriola dumerili*. These species are: *S. cesticillum* (Molin, 1858) Looss, 1899 from the intestine of angler *Lophius piscatorius*

Linnaeus, 1758 in Mediterranean waters. *S. ditrematis* (Yamaguti, 1939) Manter, 1947 initially described as *Echinostephanus ditrematis* from *Ditrema temminckii* Bleeker, 1853 off Japan. *S. euzeti* Bartoli and Bray, 2004 isolated from the rectum of *S. dumerili* in Corsica in France, *S. hispidum* (Yamaguti, 1934) Manter, 1940 originally described as *Echinostephanus hispidus* Yamaguti, 1934 from the Japanese amberjack *Seriola quinqueradiata* Temminck & Schlegel, 1845 along the Pacific coast, Japan, *S. filiforme* Linton, 1940 from the yellowtail amberjack *Seriola lalandi* Valenciennes, 1833 in the north-western Atlantic and *S. petimba* Yamaguti, 1970 from *Fistularia petimba* (=*F. commersonii* Rüppell, 1838), off Hawaii Island (Manter, 1940; Bartoli and Bray, 2001, 2004; Bray and Cribb, 2003, 2008).

The current specimens can be identified as *S. ditrematis*, depending on the following characteristics: i-The absence of spines in the area located directly below the oral sucker, while the rest of the body is spiny both dorsally and ventrally, especially in the anterior region up to the ventral sucker, ii-The average number of oral spines is 36-40 (average 38), iii-The oral sucker is funnel-shaped, iv- The dorsal spines on the body are longer than the abdominal spines, v-The ventral sucker is prominent, circular and located at the end of the second sixth of the body length, and the vitellarium follicular fill the space between the seminal vesicle and the posterior end of body, and vi- large eggs are present (Tab. 7).

The current species (*S. ditrematis*) differs from *S. cesticillum* in the placement of the ventral sucker, a longer percentage ratio of the pre-pharynx to the length of the fore body, a pharynx smaller than the ventral sucker, the vitellarium follicular distribution forming more than 50% of the length of the hindbody vs only 5% of the length of the hindbody, number of oral spines and the suckers ratio (Bartoli and Bray, 2001; Saoud *et al.*, 2002). *S. ditrematis* differs from *S. euzeti* in the number of spines around the oral sucker, the spines interrupted in the ventral region of the sucker. The ratio of hindbody to forebody is larger than in *S. euzetii*. The testes are oblique vs tandem, and the ovary is far from the anterior testis vs contiguous to the anterior testis (Bartoli and Bray, 2004). *S. ditrematis* differs from *S. filiforme* in the number of spines around the oral sucker, the location of the ventral sucker; the ratio of the length of the pre-pharyngeal part to the length of the forebody which is smaller in *S. ditrematis* (Bartoli and Bray, 2004). Furthermore, *S. ditrematis* differs from *S. petimba* in total length; number of spines on the oral sucker, the pharynx is longer than the ventral sucker (Bray and Cribb, 2003, Bartoli and Bray, 2004).

Finally, *S. ditrematis* differs from *S. hispidum* in the number of oral spines; the location of the seminal vesicle; the ratio of suckers. The testes are contiguous in *S. ditrematis* whereas in *S. hispidum*, the testes are well separated from each other. Additionally, the vitellarium follicular are absent from the space between ovary to the seminal vesicle in *S. ditrematis*, whereas in *S. hispidum* the vitellarium follicular fill the space between ovary and the level of the seminal vesicle (Manter, 1940; Ohnish *et al*., 1991).

***Stephanostomum*** sp.
Host: *Seriola dumerili* (Risso)
Prevalence and intensity: 66.6%, 7.5
Site of infection: Stomach and pyloric caeca.

Description and measurements (8 specimens, Fig. 4, Tab. 6): The worms are cylindrical in shape. The area behind ventral sucker is non spinous, unlike the rest of the body parts, especially the area around the pharynx and esophagus, extending to the ventral sucker. The oral sucker vascular in shape, surrounded by a double ring of alternating cylindrical and blunt spines. The ventral sucker is circular and large, protruding forward from the body and located in the second sixth of the body length, the pre-pharynx is very long. The testes are oval-shaped either contiguous or well separated from each other and located near the end of body. The ovary is semi-spherical (pyriform) and situated in the last quarter of hind body. The uterus is unclear, while the seminal vesicle is distinct in some specimens (Fig.4A), and eggs are small, fewin number, and absent in most specimens; vitellarium not present (Tab. 6).

**Table (6):** Measurements and biometric character of *Stephanostomum* sp. from *Seriola dumerili*.

| Character | Min-Max (Mean± Standard deviation) |
|---|---|
| Body size Length × Width (L×W) | 4631-6350 (5788±595.494) ×378-491 (429±39.073) |
| Ratio of body width to total length | 1: 11.86-16 (13.54±1.535) |
| Body width to length % | 6.25- 8.43 (7.46) |
| Spines number | 36-41 (38) |
| Forebody | 1115-1701 (1477±202.883) |
| Hindbody | 3062-4328 (3858±427.014) |
| Forebody/ Total length % | 18-29 (26±3.768)% |
| Hindbody/ Total length% | 64-70 (67±2.111)% |
| Prepharynx length | 819-1053 (922±80.490) |
| Prepharynx length/ Forebody% | 56-73 (63±6.114)% |
| Prepharynx length/Hindbody% | 20-30 (24±3.237)% |
| Prepharynx length/Total length% | 13-20 (16±2.101)% |
| Pharynx L×W | 94-180 (130±27.712) × 63-110 (89±14.441) |
| Oral sucker (OS) | 109-187 (150±23.512) × 218-328 (279±40.259) |
| Ventral sucker L×W | 250-343(285±33.994)× 234-296 (264±23.377) |
| Sucker ratio | 1: 1.50-2.31 (1.93±0.328) |
| % VS length/body length | 4.29-5.85 (5±0.496)% |
| Ventral sucker: Forebody | 1: 15-28 (19.61±3.799) |
| Anterior testis L×W | 117-289 (215±60.121)× 101-195 (158±31.979) |
| Posterior testis L×W | 156-289 (219±50.053) ×94-187 (155±31.351) |
| Ovary L×W | 62-78 (70±5.617) × 49-78 (73) |
| Eggs L×W | 31×16 |

*Stephanostomum* sp. is similar to *S. ditrematis*; however, the latter differs from the former in total length, in the ratio of both hind body and fore body to the total length. Although the two closely related species are similar in the length of the prepharynx, they differ in the ratio

of the ratio of the pre-pharyngeal length to the body length, pre-pharyngeal length ratio to the hindbody, the ratio of the ventral sucker length to body length and the eggs size. *Stephanostomum* sp. also differs from *S. ditrematis* in the maximum width of the body, the ratio of the the pre-pharyngeal length to the length of the hind body, the ratio of pharynx length, and the length ratio of the pharynx to its width, the ratio of the fore body to the total length. *Stephanostomum* sp. possesses more oral spines than *S. cesticillum*; the location of the ventral sucker, the percentage of pre-pharyngeal part to the forebody and the percentage of pre-pharynx part to the hind body. *Stephanostomum* sp. differs from *S. euzeti* in the number of oral spines. The shape of mouth opening; and the degree of isolation between the testes and ovary (Bartoli and Bray, 2004). *Stephanostomum* sp. has fewer oral spines than the *S. filiforme*; the location of the ventral sucker at the second sixth of the body while it is located at the end of the first sixth of the body in *S. filiforme* and in the ratio of width to length ratio (Bartoli and Bray, 2004).

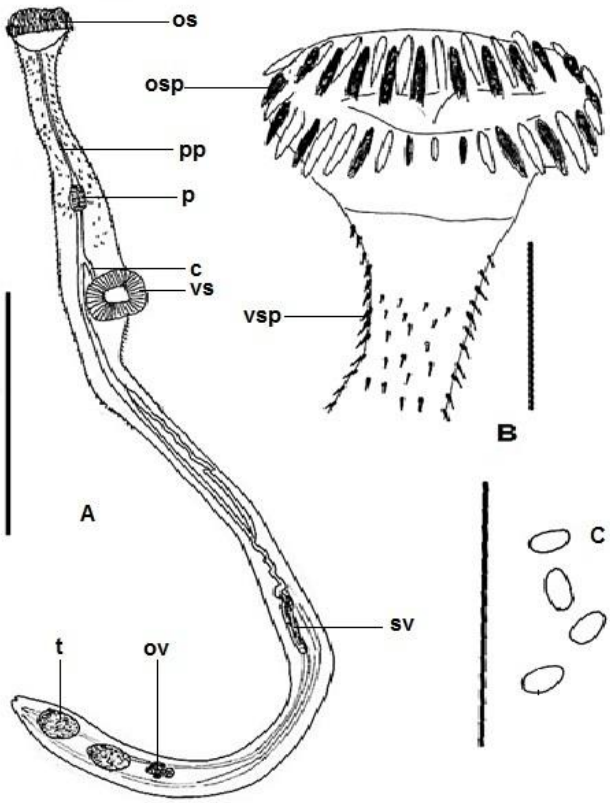


**Figure (4):** *Stephanostomum* sp. from *Seriola dumerili*; (A) Ventral view, (B) Oral sucker, (C) Eggs. [Abbreviations: C: Caecum, OS: Oral sucker, OSP: Oral spines, OV: Ovary, P: Pharynx, PP: Prepharynx, t: Testis, SV: Seminal vesicle, VS: Ventral sucker, VSP: Ventral spines]. Scale bars, A= 770µm, B=190 µm.

**Table (7):** Comparative measurements of *Stephanostomum ditrematis* and *Stephanostomum* sp. parasite *Seriola dumerili* with other *Stephanostomum* species.

| Species | *S. ditrematis* | *S. cesticillum* | *S. euzeti* | *S. hispidum* | *S. filiforme* | *S. petimba* | *S. ditrematis* | *Stephanostomum* sp. |
|---|---|---|---|---|---|---|---|---|
| **Reference** | Partoli and Bray (2004) | Partoli and Bray (2001) | Partoli and Bray (2004) | Yamaguti (1934) | Partoli and Bray (2004) | Bartoli and Bray (2004) | Current study | Current study |
| **Total length (TL)** | 3279-8540 (5872) | 3250-9393 (5060) | 2370-7094 (4793) | 6800-9800 | 5265-10424 (7035) | 6194-7394 (6438) | 9412-18147 (12151) | 4631-6350 (5788) |
| **Maximum width** | 75-152 (101) | 470-850 (569) | 108-254 (164) | 520-620 | 127-171 (146) | 121-237 (176) | 236-564 (463) | 378-491 (429) |
| **Body width: Body length** | - | - | - | - | 1:41.4-60.9 (48) | - | 1:18-39.88 (27.06) | 1:11.8-16 (13.5) |
| **Body width / TL%** | 4.4–8.0 (5.7) | - | 7.1–14.0 (9.6) | 6.32-7.64 | 4.7–6.6 (5.5) | 7.7–11.7 (9.4) | 2.51-5.56 (3.90) | 6.25-8.43 (7.46) |
| **Hindbody: Forebody** | 1:3.8-6.5 (5.4) | 1: 1.83-3.37 (2.56) | 1:1.84-2.72 (3.33) | - | - | - | 1:3.83-9.53 (5.72) | 1:2.27-3.63 (2.65) |
| **Oral sucker L.** | 88-126 (110) | 155-309 (198) | 121-292 (210) | 170-220 | 138-203 (174) | 225-273 (249) | 110-321 (178) | 109-187 (150) |
| **Oral sucker W** | 144-184 (166) | 197-373 (268) | 198-546 (374) | 360-450 | 206-224 (217) | 426-521 (472) | 240-473 (348) | 218-328 (279) |
| **Prepharynx** | 378-592 (476) | 245-959 (556) | 298-1152 (709) | 710-910 | 400-646 (542) | 896-1270 (1161) | 800-1193 (1023) | 819-1053 (922) |
| **Pharynx L.** | 170-224 (194) | 245-437 (323) | 203-323 (267) | 300-360 | 166-256 (206) | 356-457 (400) | 160-289 (212) | 94-180 (130) |
| **Pharynx. W.** | 53-122 (76) | 240-368 (305) | 70-163 (131) | 170-190 | 80-144 (105) | 144-206 (144) | 101-125 (113) | 63-110 (89) |
| **Prepharynx : Pharynx** | - | - | 1:1.4-3.5 (2.6) | - | - | - | 1:3.60-6.94 (5.01) | 1:5.8-8.7 (7.29) |
| **Ventral sucker L.** | 196-310 (258) | 245-453 (319) | 192-300 (246) | 260-280 | 218-337 (256) | 270-356 (305) | 320-491 (369) | 250-343 (285) |
| **% VS length/TL** | - | - | - | - | - | - | 2.31-4.00 (3)% | 4.29-5.85 (5)% |
| **Ventral sucker W.** | 189-307 (244) | 256-469 (323) | 179-279 (236) | 330-390 | 211-304 (243) | 241-356 (300) | 290-454 (361) | 234-296 (264) |
| **Oral s: Ventral s** | 1:1.9-2.7 (2.4) | 1: 1.43-1.99 (1.63) | 1: 1.4-2 (1.7) | - | 1:1.2–1.7 (1.5) | | 1:1.53-2.91 (2.17) | 1: 1.50-2.31 (1.93) |
| **Ovary L.** | 118-256 (191) | 123-346 (179) | 122-272 (184) | 84 | 165-286 (197) | 149-305 (227) | 234-370 (306) | 62-78 (70) |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Ovary W** | 125-185 (177) | 75-288 (171) | 106-222 (160) | 63 | 134-254 (184) | 190-320 (241) | 187-420 (229) | 49-78 (73) |
| **Buccal spines number** | 34-37 (35, 36) | 35-36 | 49-51 (50) | 40-42 | 43-46 | (40-46 ) 42 | 36-40 (38.08) | 36-41 (38.2) |
| **Anterior testis L** | 256-720 (478) | 266-826 (393) | 195-749 (473) | 640-1100 | 406–1,067 (658) | 540-857 (647) | 523-920 (719) | 117-289 (215) |
| **Anterior testis W** | 144-286 (202) | 165-474 (266) | 150-394 (266) | 240-470 | 160–317 (241) | 279-540 (385) | 150-400 (259) | 101-195 (158) |
| **Posterior testis L** | 288-688 (498) | 341-959 (507) | 272-933 (574) | 640-1100 | 438-1080 (630) | 667-1079 (800) | 530-991 (759) | 156-289 (219) |
| **Posterior testis W** | 160-273 (208) | 187-506 (259) | 144-406 (271) | 240-470 | 160-317 (241) | 317-527 (382) | 195-360 (278) | 94-187 (155) |
| **Seminal vesicle L.** | 165-233 | 123-346 (179 | - | - | - | - | 867-1640 (1264) | Not observed |
| **Seminal vesicle W.** | | 75-288 (171) | - | - | - | - | 100-190 (147) | Not observed |
| **Egg length** | 48-62 (55) | 65-85 (77) | 62-76 (68) | 68-75 | 54-73 (59) | 62-76 (70) | 47-66 (60) | 31 |
| **Egg width** | 21-33 (27) | 65-85×28-43 (77× 37) | 26-40 (32) | 50-60 | 25-32 (28) | 25-43(35) | 29-49 (42) | 16 |
| **Forebody length** | 608-1092 (871) | 850-2061 | 781-1872 (1304) | - | 902-1388 (1060) | 1722-2386 (1970) | 1480-2268 (1764) | 1115-1701 (1477) |
| **Hindbody length** | 2352-7143 (4755) | 1,998-6,864 (3,391) | 1442-5103 (4351) | - | 3890-8758 (5705) | 3666-5500 (4351) | 7163-15979 (10019) | 3062-4328 (3858) |
| **Prepharynx / Forebody %** | 54-62 (55) | 40% | 38-71 (54) | - | 44-56 (51) | - | 53-68 (58)% | 56-73 (63)% |
| **Prepharynx : Hindbody %** | 8.2-16 (10) | 12-13.97 | 20-22.5 (16) | - | - | - | 6.62-15.83 (10.67) | 20-30 (24) |
| **Forebody: total length %** | 8.6–22.7 (15.6) | - | 19.6–34.8 (28.0) | - | 12.6-21.7 (15.7) | 27.2–32.3 (30.6) | 9.24-19.88(14.91) | 17.56-28.90(25.69) |
| **Hindbody: total length %** | - | - | - | - | - | - | 76-88 (82) % | 64-70 (67)% |

The number of oral spines in *Stephanostomum* sp. is less than that in *S. hispidum*. They differ in the ratio of both testes length to body length and the ratio of the pre-pharyngeal part to the pharynx (Manter, 1940; Ohnish *et al*., 1991) (Tab. 7).

*Stephanostomum* sp. has fewer oral spines than *S. petimba*; the ventral sucker is longer than the pharynx. Whereas in *S. petimba*. The ventral sucker is shorter than the pharynx; the reproductive organs are contiguous in most individuals whereas in *S. petimba*. They are separated; the ratio between the body width and length is different (Bartoli and Bray, 2004). According to above results, it is clear that the current specimens are considered an

undescribed species, however as all specimens lack eggs (except one with single egg) and vitellaria, they are considered juveniles.

***Pseudopecoeloides tenuis*** Yamaguti, 1940
Host: *Priacanthus tayenus* Richardson
Prevalence and intensity: 7.91%, 3.63.
Site of infection: Intestine.
Description and measurements (13 specimens, Fig. 5, Tab. 8): Elongated worms, maximum width at the gonads and three constrictions posterior to the gonads. Oral sucker large compared to the smaller ventral sucker. The ventral sucker is carried on a peduncle. The pharynx is distinct, circular, or semi-circular. The caeca are long and reach the posterior end of body. The testes are spindle-shaped, tandem, and separate, located in the middle of last third of body. The seminal vesicle is long and sinous. The genital pore opens at the posterior level of pharynx. The ovary is oval, pretesticular. The uterus occupies the area between the seminal vesicle and ovary. Eggs are relatively small and oval. Vitellaria extend from the ventral sucker to the posterior end of the body, reaching the gonads area.

*Pseudopecoeloides* Yamaguti, 1940 compromises 25 valid species recorded from many hosts and different regions of the world (Aken'Ova *et al*., 2009; WoRMS, 2024). Species of this genus are divided into two groups, group A is characterized by a larger oral sucker in comparison with the ventral sucker, whereas group B is characterized by a smaller oral sucker or one equal in size to the ventral sucker. Based on measurements, it seems that the current species belongs to the first group, accordingly the comparison is limited to the 14 species; *P. arripi* Aken'Ova, Cribb & Bray, 2009 from the intestine of Australian herring *Arripis georgianus* (Val.) in Australian marine waters, *P. boops* Yamaguti, 1970 from the intestine of glasseye *Priacanthus boops* [=*Heteropriacanthus cruentatus* (Lacepède, 1801)] and Champsodontidae from Hawaii and Mozambique, *P. buckleyi* (Saoud & Ramadan, 1984) Martin, Cutmore & Cribb, 2018 from Atlantic bigeye *Priacanthus arenatus* Cuvier, 1829 from Red Sea, Egypt, *P. capucini* Toman, 1992 from the intestine of *Pseudupeneus* sp. from Africa off Seychelles, *P. chloroscombri* (Fischthal & Thomas, 1970) Bartoli, Bray & Gibson, 2003 from Atlantic bumper *Chloroscombrus chrysurus* (Linnaeus, 1766) and *Trachurus* spp. from the Mediterranean and Atlantic waters, *P. hafeezullahi* Aken'Ova, Cribb & Bray, 2009 from the intestine of the yellowtail horse mackerel *Trachurus novaezealandiae* Richardson, 1843 along Coogee Beach Jetty, Australia, *P. hickmani* Aken'Ova, Cribb & Bray, 2009 from the intestine, cecum and rectum of skipjack trevally *Pseudocaranx wrighti* (Whitley, 1931) from Western Australia, *P. opelu* Yamaguti, 1970 from the intestine of mackerel scad *Decapterus macarellus* (Cuvier, 1833) from Hawaii, USA, *P. orientalis* Gupta & Ahmad, 1978 from the intestine of long-barbel goatfish *Parupeneus macronemus* (Lacepède, 1810) from Bay of Bengal, India, *P. parviacetabulatus* Yamaguti, 1970 from the intestine of bigeye scad *Selar crumenophthalmus* (Bloch, 1793) off Hawaii, *P. psettodi* Parukhin, 1983 from Indian halibut *Psettodes erumei* (Bloch & Schneider, 1801) in the Mozambique canal, *P. tenuis* Yamaguti, 1940 from the pyloric caeca and intestine of *Pseudopriacanthus nipponicus* (=*P. niphonia* Cuvier, 1829) from Moreton Bay, Australia, *P. tenuoides* Martin, 1960, from *Priacanthus cruentatus* (=*Heteropriacanthus cruentatus* [Lacepède, 1801]) from Kaneohe

Bay, Oahu, Hawaii, USA, and *P. wekeula* Yamaguti, 1970, from Mullidae and Chaetodontidae, and Yellowstrip goatfish *Mulloidichthys samoensis* (=*M. flavolineatus* [Lacepède, 1801]), from Hawaii, USA. The relative positions of the ovary, testes and the post-testicular area are important for identifying and distinguishing *Pseudopecoeloides* species according to the description of Yamaguti (1970) and Aken'Ova *et al*. (2009). *P. tenuis* differs from *P. arripi* in body length, maximum of width, and the ratio of width: length. Additional differences include the percentage of the ventral sucker to oral sucker width, the ratio of peduncle length to body length and the ratio of the ventral sucker to the pharynx (Tab. 9).

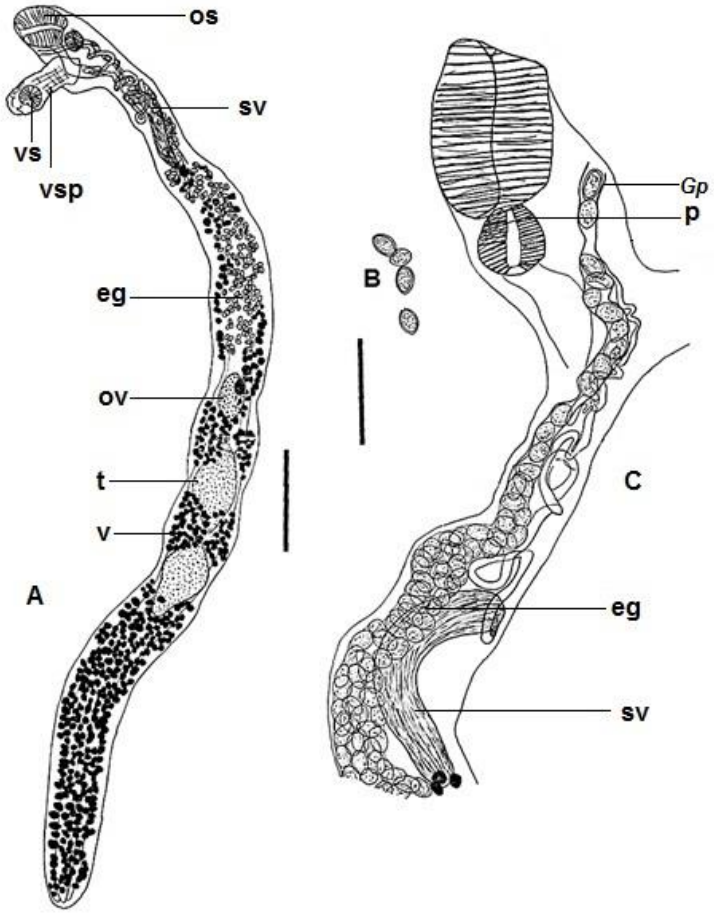


**Figure (5):** *Pseudocoeloides tenuis* Yamaguti, 1940 from *Priacanthus tayenus*; (A) Ventral view, (B) Eggs, (C) Anterior part of body with terminal genitalia. [Abbreviations: eg: Egg, Gp: Gonopore, OS: Oral sucker, Ov: Ovary, SV: Seminal vesicle, t: Testis, v: Vitellaria, VS: Ventral sucker, VSP: Ventral sucker peduncle. Scale bars, A= 770µm, B, C=190 µm].

**Table (8):** Principal measurements of *Pseudopecoeloides tenuis* from *Priacanthus tayenus*.

| Character | Min-Max (Mean± Standard deviation) |
|---|---|
| Body size L×W | 4385-9488 (7302±1736.684) ×340-502 (447±54.805) |
| Ratio body width (W): length (L) | 1:13-21 (16±2.734) |
| Forebody | 335-702 (509±130.606) |
| Hindbody | 4165-8978 (6560±2710.474) |
| Forebody: Total length | 1:10.2-20.4 (13.98±3.525) |
| Pharynx L×W | 94-164 (124±21.810) × 102-156 (128±18.581) |
| Oral sucker | 242-390 (334±47.615) × 187-359 (271±43.612) |
| Ventral sucker L×W | 117-160 (140±15.262)× 78-225 (161±23.844) |
| Suckers width ratio | 1:0.40-0.67 (0.53±0.077) |
| Peduncle L×W | 395-780 (579±114.116)× 78-225 (161±40.795) |
| Peduncle width: Peduncle length | 1: 2.41-6.50 (3.82) |
| Length of peduncle/ Total length | 6.8-11 (8.5±)% |
| Forebody: Peduncle length | 1: 0.61-1.11(0.86±1.275) |
| Seminal vesicle L×W | 220-601 (379±123.209)× 70-220 (122±49.568) |
| Anterior testis L×W | 335-780 (571±142.087)× 187-330 (258±50.754) |
| Posterior testis L×W | 374-780 (588±128.598) ×172-360 (274±62.957) |
| Ovary L×W | 120-351 (223±75.980) ×86-179 (138±31.718) |
| Eggs L×W | 43-59 (53±4.812) x 28-47 (38±5.246) |

**Table (9):** Comparative measurements and biometric character of *Pseudopecoeloides tenuis* with eight closely species.

| **Species** | ***P. arripi*** | ***P. boops*** | ***P. buckleyi*** | ***P. hickmani*** | ***P. orientalis*** | ***P. parviacetabulatus*** | ***P. psettodi*** | ***P. tenuoides*** | ***P. tenuis*** |
|---|---|---|---|---|---|---|---|---|---|
| **Reference** | Aken'Ova *et al*. (2009) | Yamaguti (1970) | Saoud and Ramadan (1984) | Aken' Ova *et al*. (2009) | Madhavi and Bray (2018) | Yamaguti (1970) | Aken' Ova *et al*. (2009) | Martin (1960); Yamaguti (1970)* | Current study |
| **Total length** | 1596-2798 (2138) | 4500-7500 | 4750-8000 | 3204-4929 (4213) | 3328 | 2400-3300 | 3100 | 2550-5040 (3470) | 4385-9488 (7302) |
| **Maximum width** | 156-213 (182) | 280-470 | 200-400 | 205-301 (249) | 320 | 340-400 | 220 | 160-500 (300) | 340-502 (447) |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **MW: TL** | 1:8.7-16 (11.8) | - | 1:23.9-32 | 1:15.6-19.2 (17) | - | - | 1: 9.5-14.1 | - | 1:13-21 (16) |
| **Oral sucker length** | 91-143 (112) | 160-240 | 280-520 | 131-175 (159) | 220 | 140-160 | - | 220-280 (243) | 242-390 (334) |
| **Oral sucker Width** | 88-120 (103) | 120-240 | 280-380 | 112-155 (134) | 240 | 150-130 | - | 180-230 (193) | 187-359 (271) |
| **OS: Pharynx W.** | 1:1.3-1.6 (1.4) | - | - | 1:1.4-1.6 (1.5) | - | - | 1:2.9 | - | 1:1.66-2.65 (2.18) |
| **Pharynx length** | 59-82 (68) | 60-120 | 40 | 66-89 (79) | - | 90-130 | - | 87-124 (100) | 94-164 (124) |
| **Pharynx Width** | 67-81 (73) | 90-140 | - | 71-101 (87) | - | 100-130 | - | 65-81 (68) | 102-156 (128) |
| **Ventral sucker L** | 75-96 (88) | 100-150 | 100-160 | 71-79 (73) | - | 100-120 | - | 68-118 (98) | 117-160 (140) |
| **Ventral sucker W** | 83-108 (98) | 100-160 | 120-160 | 78-92 (85) | - | - | - | 87-109 (96) | 94-172 (144) |
| **VS:O.S W** | 1:0.7-1.1 (1) | - | 1:3.3-3.6 | 1:0.6-0.8 (0.6) | - | 1:1.3-1.5 | 1:0.6 | - | 1:0.40-0.67 (0.53) |
| Peduncle L | 271-458 | - | 310-880 | 425-863 (650) | - | | - | 250-450* | 395-780 (579) |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Peduncle W | 98-156 (124) | - | - | 97-109 (102) | - | - | - | - | 78-225 (161) |
| %Peduncle: TL | 10.3-16.7 (14.4) | - | 4-6 | 13.3-17.5 (15.3) | - | - | - | - | 6.8-11 (8.5) |
| Ovary L. | 50-120 (89) | 140-260 | 130-320 | 116-197 (163) | - | 110-150 | - | 131-211 (180) | 120-351 (223) |
| Ovary W | 46-102 (77) | 90-220 | 100-190 | 129-168 (142) | - | 130-160 | - | 62-243 (96) | 86-179 (138) |
| Anterior testis L | 152-233 (190) | 200-700 | 360-800 | 273-396 (335) | | 200-500 | - | 187-336 (267) | 335-780 (571) |
| Anterior testis W | 120-177 (146) | 180-370 | 190-260 | 169-246 (210) | - | 150-240 | - | 93-146 (115) | 187-330 (258) |
| Posterior testis L | 154-249 (198) | - | 390-730 | 298-383 (350) | - | - | - | 218-348 (292) | 374-780 (588) |
| Posterior testis W | 137-183 (156) | - | 190-280 | 164-257 (203) | - | - | - | 93-124 (111) | 172-360 (274) |
| Seminal vesicle L. | 69-190 (135) | 400-650 | - | - | - | 60-100 | - | 40-50* | 220-601 (379) |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Seminal vesicle W. | 27-87 (58) | 30-70 | - | - | - | - | - | - | 70-220 (122) |
| Egg L | 47-67 (56) | 55-63 | 46-54 | 44-71 (55) | 32-46 | - | 46-53 | 40-50 (44) | 43-59 (53) |
| Egg W | 21-36 (28) | 32-37 | 28-31 | 20-42 (26) | 15-27 | 46-56 | 26 | 25-37 (30) | 28-47 (38) |
| Forebody L | 248-337 (285) | - | - | 337-399 (362) | - | 32-39 | - | - | 335-702 (509) |
| Forebody : TL | 1:9.6-17 (13.9) | - | - | 1:7.7-10.5 (8.7) | - | - | 1:7.3 | - | 1:10.2-20.4 (13.98) |
| Forebody:.peduncle | 1:0.59-1 (0.87) | - | - | 1:0.4-0.8 (0.6) | - | - | - | - | 1:0.61-1.11 (1.03) |
| Post testicular area | - | - | - | 1005-1639 (1472) | - | - | - | - | 1232-3081 (2162) |
| Post testicular area: TL % | - | - | - | 31.4-37.1 (34.9) | - | - | - | - | 15-36 (30) |

*Continues table*

| Species | *P. capucini* | *P. chloroscombri* | *P. hafeezullahi* | *P. opelu* | *P. wekeula* | *P. tenuis* |
|---|---|---|---|---|---|---|
| Reference | Aken'Ova *et al.*, 2009 | Bartoli *et al.*, 2003 | Aken'Ova *et al.*, 2009 | Aken'Ova et *al.*, 2009 | Yamguti, 1970 | Current study |
| Total length | 5250-6780 | 2907-7060(4470) | 2452-3564(3026) | 1400-3600 | 1500-4800 | 4385-9488 (7302) |
| Maximum width | 530-730 | 253-514 (374) | 226-321 (274) | 140-400 | 180-500 | 340-502 (447) |
| MW: TL | 1:8.6 | 1:11.95 | 1:8.9-12.6 (11) | 60-190 | 100-210 | 1:13-21 (16) |
| Oral sucker length | 180-200 | 163-266 (220) | 128-163 (147) | 60-200 | 100-200 | 242-390 (334) |
| Oral sucker Width | 170-210 | 173-262 (210) | 110-169 (141) | 1:1.8 | 1:2 | 187-359 (271) |
| OS: Pharynx W. | 1:1.7 | 1:1.18 | 1:1.1-1.4 (1.3) | 50-150 | 50-150 | 1:1.66-2.65 (2.18) |
| Pharynx length | 130-150 | 131-173 (154) | 85-115 (99) | 50-140 | 50-40 | 94-164 (124) |
| Pharynx Width | 110-140 | 106-166 (131) | 99-122 (111) | - | 70-130 | 102-156 (128) |
| Ventral sucker L | 130-140 | 100-138 (124) | 85-111 (96) | 60-150 | 95-160 | 117-160 (140) |
| Ventral sucker W | 130-170 | 122-176 (154) | 96-110 (105) | 1:0.6 | 1:0.7 | 94-172 (144) |
| VS:OS W | 1:0.6 | 1:0.54-0.86 (0.73) | 1:0.6-0.9 (0.7) | - | - | 1:0.40-0.67 (0.53) |
| Peduncle L | - | - | 289-382 (330) | - | - | 395-780 (579) |
| Peduncle W | - | - | 129-161 (140) | - | - | 78-225 (161) |
| % Peduncle / TL | - | 8.3 | 10.1-11.8 (10.9) | - | - | 6.8-11 (8.5) |
| Ovary L. | - | - | 85-134 (104) | - | - | 120-351 (223) |

| | | | | | | |
|---|---|---|---|---|---|---|
| Ovary W | - | - | 76-123 (94) | - | - | 86-179 (138) |
| Anterior testis L | - | - | 183-284 (226) | - | - | 335-780 (571) |
| Anterior testis W | - | - | 122-205 (162) | - | - | 187-330 (258) |
| Posterior testis L | - | - | 197-295 (235) | - | - | 374-780 (588) |
| Posterior testis W | - | - | 130-202 (160) | - | - | 172-360 (274) |
| Seminal vesicle L. | - | - | - | - | - | 220-601 (379) |
| Seminal vesicle W. | - | - | - | 46-63 | 51-70 | 70-220 (122) |
| Egg L | 52-62 | 51-68 (61) | 40-60 (52) | 30-46 | 32-49 | 43-59 (53) |
| Egg W | 37-48 | 28-39 (30) | 20-37 (26) | - | - | 28-47 (38) |
| Forebody L | - | 270-616 (442) | 299-465 (384) | 1:11.8 | 1:14.6 | 335-702 (509) |
| Forebody : T L | 1:12.3 | - | 1:11-15.3 (12.9) | - | - | 1:10.2-20.4 (13.98) |
| Forebody: peduncle | - | - | - | 1:11 | 1:8.5 | 1:0.61-1.11 (1.03) |
| Post testicular area | - | 1092-2203 (1618) | 797-1159 (971) | - | - | 1232-3081 (2162) |
| %Post testicular area: TL | 28.4 | 36.2 | 28-34.2 (32.1) | 1:21.3 | 25.7 | 15-36 (30) |

The general measurements of current specimens match those of *P. tenuis* and *P. boops* in many characteristics; but the former differs by having forebody Similar in length to ventral sucker peduncle Whereas *P. boops* has a shorter forebody than to ventral sucker peduncle, the position of both ovary (pre-eaquatorial vs posequatorial) and testes (located in the third quarter of body vs the forth quarter of body in *P. boops*).

*P. tenuis* differs from *P. buckleyi* in the ratio of body width to length, the ratio of suckers, and the ratio of peduncle length to the body length (Saoud and Ramadan, 1984). *P. tenuis* is

distinguished from *P. capucini*, *P. chloroscombri*, *P. hafeezullahi*, *P. opelu*, and *P. wekeula* by the ratio of body width to length (Bartoli *et al*., 2003; Aken'Ova *et al*., 2009).

*P. tenuis* differs from *P. hickmani* in the ratio of ventral sucker peduncle length to the body length, the ratio of forebody to body length, the ratio of forebody to peduncle length and the ratio of oral sucker to pharynx length (Aken'Ova *et al*., 2009). *P. tenuis* differs from *P. orientalis* in the total body length, body width, oral sucker length and larger eggs (Madhavi and Bray, 2018). *P. tenuis* differs from *P. parviacetabulus* in body length, oral sucker, ventral sucker length, suckers ratio and seminal vesicle length (Yamagujti, 1970). *P. tenuis* differs from *P. psettodi* in body length, the ratio forebody to body length and the ratio of the ventral sucker to Pharynx (Aken'Ova *et al*., 2009). *P. tenuis* is very similar to *P. tenuoides*; however Martin (1960) distinguished between the two species based on eggs size and presence of pads on the ventral sucker which are present in the former and absent in the latter; but Bartoli *et al.* (2003) prepared keys to diagnosis all species of *Pseudopecoeloides* and placed *P. tenuis* and *P. boops* in the same group which is characterised by forebody length shorter than peduncle length, while *P. tenuoides* the forebody length is similar to peduncle length. Aken'Ova *et al.* (2009) redescribed *P. tenuis* from the intestine of the red bigeye *Priacanthus macracanthus* Cuvier from Queensland, Australia and discussed the measurements and verification of *P. tenuoides* as reported by Yamaguti (1970) and considered the differences in eggs size between *P. tenuis* and *P. tenuoides* are no significant, this is due to the fact that Yamaguti (1970) used live eggs in compared with Martin's description; however, the pads on the ventral sucker were not observed in the Australian specimens and they predicted from the idea that most australian specimens were mounted laterally. The only difference in the current specimens from original description and redescription is the ratio of forebody to total length (Yamaguti, 1940; Aken'Ova *et al*., 2009).

## CONCLUSIONS

The current study has identified four trematodes that are new additions to the parasitic fauna of Iraq. Three of these belonging to Acanthocolpidae increasing the number of species in this family to seven in Iraq distributed across three genera *Pleorchis* Railliet, 1896, *Monostephanostomum* Kruse, 1979 and *Stephanostomum* Looss, 1899, as well as one opecoelid trematode was identified, increasing the number of species in this family to six species in Iraq belonging to the genera *Helicometrina* Linton, 1910, *Macvicaria* Gibson & Bray, 1982 and *Pseudopecoeloides* Yamaguti, 1940.

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## CONFLICT OF INTEREST STATMENT

"The authors have no conflicts of interest to declare."

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# تسجيل جديد لبعض المخرمات ثنائية المنشأ من بعض الاسماك البحرية من العراق

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الخلاصة

اجريت فحوصات طفيلية للمخرمات ثنائية المنشأ في ثلاثة انواع من الاسماك في المياه البحرية العراقية للفترة من كانون الاول 2021 ولغاية كانون الاول 2022. بينت الدراسة تسجيل خمسة انواع من المخرمات تعود الى العوائل هيميوريدي واكانثوكولبيدي وابيكوليدي.

عزل المخرم *Lecithocadium angustiovum* Yamaguti, 1953 (عائلة هيميوريدي) من امعاء اسماك الحلوائي *Parastromateus niger* (Bloch, 1795). عزل كل من النوع *Monostephanostomum loossi* و *Stephanostomum ditrematis* و *Stephanostomum* sp. (عائلة اكانثوكوليدي) من اسماك الديايوه *Seriola dumerili* بالاضافة الى عزل النوع *Pseudocoeloides tenuis* Yamaguti, 1940 من امعاء السمك كبير العين *Priacanthus tayenus* كانت جميع الطفيليات المسجلة ماعدا النوع *L. angustiovum* في هذه الدراسة توصوف وتسجل لاول مرة في العراق والخليج العربي.