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Taxonomic Description and Morphological Differentiation of *Pallisentis armatai* SP. NOV. (Acanthocephala: Quadrigyridae) from a Freshwater Fish Host in Sindh, Pakistan

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Abstract

The present study describes a new species of acanthocephalan parasite, *Pallisentis armatai* sp. nov. (Acanthocephala: Quadrigyridae), recovered from the intestine of the freshwater fish *Mastacembelus armatus* collected from Chotiary Reservoir, Sanghar District, Sindh, Pakistan. Out of fifty examined hosts, seven were found infected, yielding ten adult specimens. An elongated, spinose body characterises the new species; a globular proboscis armed with four circular rows, each bearing sixteen hooks; a short neck; unequal lemnisci; unequal testes with the anterior testis larger than the posterior; cylindrical cement glands; an elongated cement reservoir; a pyriform Saeftigen's pouch; and a well-developed bursa in males. Females possess thirteen collar spine rows, forty-four trunk spine rows, numerous ovarian balls, and elongated eggs containing fully developed embryos. Detailed morphometric analysis and comparative evaluation with all known congeners reveal distinct differences in proboscis armature, collar and trunk spine arrangement, reproductive structures, and egg dimensions. The combination of these diagnostic features clearly distinguishes *Pallisentis armatai* sp. nov. from previously described species of the genus, including those reported from Pakistan and neighbouring regions. The present finding also represents a new host record for the genus *Pallisentis*. This study contributes to the growing knowledge of acanthocephalan diversity in South Asia and emphasises the importance of continued parasitological surveys in freshwater ecosystems.

Keywords: *Pallisentis armatai* sp. nov, Freshwater fish, Tire-track Eel *Mastacembelus armatus*, Pakistan

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Introduction

Tire-track Eel *Mastacembelus armatus*, a freshwater fish, is a good source of food in Pakistan as well as Bangladesh, India, Indonesia, Malaysia, Nepal, Southern China, Sri Lanka, Thailand and other parts of South East Asia. *M. armatus* harbours different types of ectoparasites as well as endoparasites. Generally infected with helminths, including acanthocephalan, monogens, digeneans, round worms, tapeworms and crustaceans, especially *Ergasilus*. Acanthocephala of the genus *Pallisentis* Van Cleave, 1928, are found to infect the intestine of freshwater fishes. Various species of the genus *Pallisentis* Van Cleave, 1928, are reported from many freshwater fish species in India, China, Jammu, Kashmir, and Pakistan. The species of genus *Pallisentis* Van Cleave, 1928 reported from freshwater fishes of Pakistan include *P. magnum* Saeed et Bilquees, 1971 from *Wallago attu*; *P. kalriai* Khan et Bilquees, 1985 from *Labeo rohita*; *P. sindhensis* Khan & Bilquees, 1987 from the unknown fish host; *P. munifi* Naqvi et al., 2015 from *Cirrhinus mrigala* and *Pallisentis* sp. from piscivore avian host *Phalacrocorax niger*.

The purpose of the present research is to describe and formally establish a new species of *Pallisentis* based on adult morphological characteristics. Present findings provide detailed morphometric data for male and female specimens and their comparison with all valid congeners reported globally, particularly from South Asia.

Materials and Methods

A total of 50 live *M. armatus* hosts were captured with the help of fishermen, from August 2019 to July 2022, from Chotiary reservoir, in Sanghar, Sindh, Pakistan. Host fishes were transported to the Parasitology laboratory, Department of Zoology, University of Sindh, Jamshoro,

Sindh, Pakistan. After examination of gut contents and visceral organs under an AmScope Trinocular Stereo Zoom Microscope, only seven host fishes out of 50 were found harbouring acanthocephala. After recovery, acanthocephala were fixed in Alcohol-Formalin-Acetic Acid (AFA) solution, stained in borax carmine, dehydrated in a graded series of ethanol, cleared in clove oil and xylene and mounted in Canada balsam permanently. All measurements are taken in micrometres. Holotype and paratypes are deposited in the Department of Zoology, University of Sindh, Jamshoro. Drawings are made with the help of the Olympus BH2-DA drawing tube attachment, and photographs were taken with the OMAX Digital Trinocular LED Microscope with 10MP Digital USB Microscope Camera.

Taxonomic summary

Number of hosts examined:	50
Number of hosts found positive:	07
Site of infection:	Intestine
No. of specimens recovered:	10
Locality:	Chotiary reservoir, Sanghar, Sindh, Pakistan 26.1641° N, 69.0374° E
Etymology:	The name of the new species, <i>Pallisentis armatai</i> , refers to the species name of the host fish.

Results

Family Quadrigyridae

Genus *Pallisentis* Van Cleave, 1928

Pallisentis armatai sp. nov. (Figure 1-4)

General description:

Present species belongs to genus *Pallisentis* based on following characteristics: body spinose, elongated, small globular proboscis with arm 4 circles each consists of 16 hooks; having collar spine rows 14, each with 14-26 spines in male and 13 rows each with 18 spine in female; after a non-spiny area having trunk spine rows, 29 rows each with 6-22 spines

in male and 44 rows each with 18 spines in female; proboscis receptacle is cylindrical saccate with single layered muscular wall, ganglion near proboscis receptacles, lemnisci long, tubular, slender, testes oval to cylindrical, contiguous. The cement gland is long and cylindrical, the cement reservoir is longer than the cement gland, and the Bursa is well developed.

Male:

(based on 1 holotype and 6 paratype specimens) Figure 1 & 3: Body spinose, long, elongated, armed with collar spines and trunk spines; maximum with at shoulders; proboscis globular, armed with 4 circles of 16 hook; each circle has different size of hook and each hook consists of curved blade, horizontal directed root, handle sunk in proboscis wall and posterior directly embedded in proboscis wall; top hooks at 1st circle are biggest and wider than hooks of lower three circles; length of top hook is 0.110 and has wider roots (0.069) than blade (0.027); basal hooks are smallest in compression of three upper circles; basal hook are smaller than upper hooks, with slightly wider root than blade; neck shorter, wider than long, having groove at mid lateral sides; proboscis receptacle cylindrical, saccate, single layered muscular wall, started from last row of the collar spines up to neck; lemnisci two in number, cylindrical, tubular, longer, located laterally to proboscis receptacle; left lemnisci longer than right lemnisci; collar region started at the end of neck; there are 14 transverse rows of spines at collar with 14-26 spines in each row; collar spines thicker and shorter. Trunk spines are longer and slightly thinner, arranged in 29 spiny rows, each of which contains 6-22 spines; the distance between trunk spines is greater than that between collar spines. Male reproductive system started from post equatorial region; anterior testis oval shaped, contiguous to

the posterior testis which is cylindrical shaped, and smaller than anterior testis; cement glands cylindrical, located behind posterior testis, larger than posterior testis; cement reservoir cylindrical, located bellow the cement gland, biggest within all reproductive parts; Saeffitigen pouch pyriform in shape, located between cement reservoir and bursa; bursa is well developed.

Female:

(based on 1 holotype and 2 paratype specimens) Figure 2 & 4: Body spinose, elongated, longer and slightly wider than male. Proboscis globular, wider than long, armed with 4 circles of hooks with 16 hooks in each circle; shape of hooks is similar to the hooks of male proboscis, but differ in size and sharper blades of hooks; largest hooks are located in 1st circle which is situated at top of proboscis; these hooks have three times broadest roots than blade; basal hooks are attached in 4th circle having wider roots. The neck is smaller than that of males. Proboscis receptacle is saccate, cylindrical, single-layered with a muscular wall; in comparison to the male proboscis receptacle, the female has smaller sized proboscis receptacle. Lemnisci long, slender; right lemnisci longer than left lemnisci in the female, which is opposite in male specimen where left lemnisci are longer than right lemnisci. There are 13 rows of collar spines; each row consists of 18 spines; collar spines are shorter and thicker; the distance between collar spines is slightly greater than in males; the non-spiny area between the collar spine and trunk spines is shorter than the male non-spiny area. There are 44 rows of trunk spines; each row consists of 18 spines. There are 22-24 rounded ovarian balls. Eggs are numerous in number, oval to elongated, filling the entire area up to the end of the uterine bell. Embryos are in dark colour with a dumbbell or crescent.

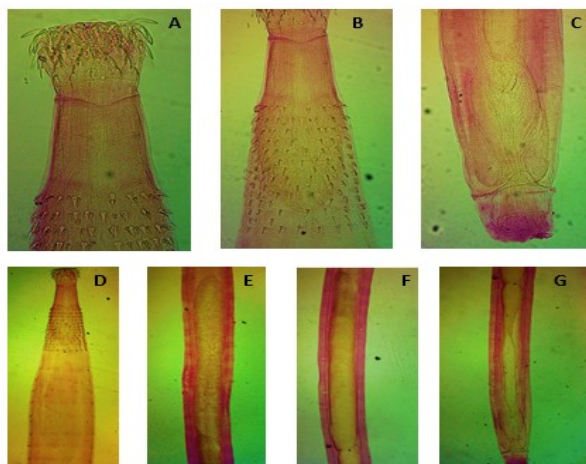


Figure-1: *Pallisentis armatai* (♂) sp. nov. A- proboscis with neck, B- proboscis receptacle and trunk spines, C- bursa, D- Anterior portion of specimen, E- testes, F- cement gland and cement reservoir and G- posterior portion of specimen.

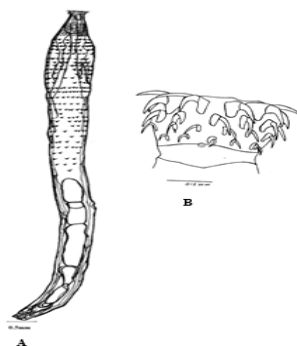


Figure-2: *Pallisentis armatai* (♂) sp. nov. A- Line diagram of entire specimen, B- proboscis



Figure-3: *Pallisentis armatai* (♀) sp. nov. A- Photograph of proboscis and trunk spines, B- reproductive region, C- anterior portion of specimen, D- posterior portion of specimen.

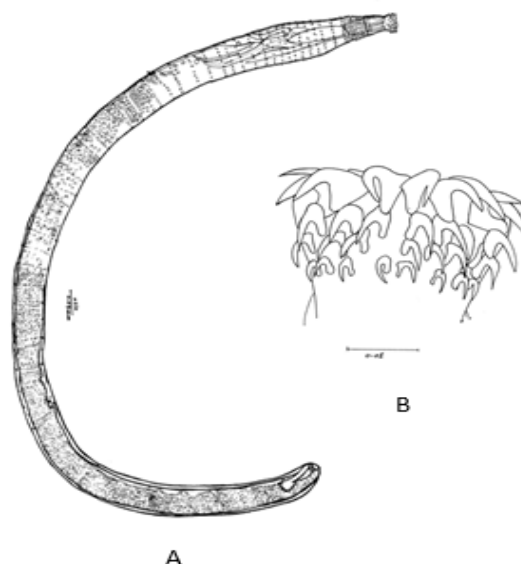


Figure-4: *Pallisentis armatai* (♀) sp. nov. A- Line diagram of entire specimen, B – proboscis.

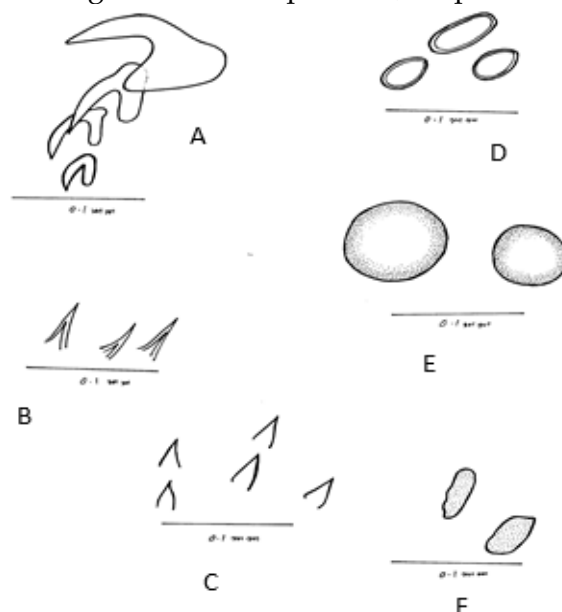


Figure-5: *Pallisentis armatai* (♀) sp. nov. A- proboscis hooks, B- collar spines, C- trunk spines, D- eggs, E- ovarian balls and F- embryo.

Discussion

Species of the genus *Pallisentis* are mostly intestinal parasites of freshwater fishes, occasionally found in marine water. These parasites are generally found in members of the genus *Channa* (*Channidae*), such as *Channa marulius*, *Ophiocephalus* (*Channa*) *striatus*, *Ophiocephalus argus*, *Channa punctatus*, but also found in *Monopterus javanensis*, *Nandas nandas*,

Rhynchobdella aculeata, *Lepidocephalichthysguntea*, *Clupisoma garua*, *Wallago attu*, *Clupea longiceps*, *Nandas nandas*, *Labeo rohita*, *Caranx kalla*, *Cirrhinus mrigala*, *Glossogobius giuris*, *Glossogobius giuris*. *Mastacembelus armatus* is the new host addition in the present study.

Species of the genus *Pallisentis* are mostly distributed in India, Pakistan, Jammu Kashmir and China. There are 35 valid species of genus *Pallisentis* which are *P. umbellatus* Van Cleave, 1928; *P. cleatus* Van Cleave, 1928; *P. ophicephali* Thapar, 1930; *P. nagpurensis* Bhalerao, 1931; *P. nandai* Sarkar, 1953; *P. colisai* Sarkar, 1956; *P. allahabadii* Agrawal, 1958; *P. basiri* Farooqi, 1958; *P. buckeye* Tadross, 1966; *P. guntei* Sahay et al., 1967; *P. pandei* Rai, 1967; *P. garuai* Sahay et al., 1971; *P. magnum* Saeed et Bilquees, 1971; *P. clupei* Gupta and Gupta, 1979; *P. guptai* Gupta and Fatima, 1985; *P. kalriai* Khan et Bilquees, 1985; *P. mehrai* Gupta and Fatima, 1985; *P. sindhensis* Khan & Bilquees, 1987; *P. fotedari* Gupta and Sinha, 1991; *P. jagani* Koul et al., 1991; *P. channai* Rahul Gupta et al., 2015; *P. munifi* Naqvi et al., 2015; *P. punctati* Neelima Gupta et al., 2015; *P. vinodai* Rahul Gupta et al., 2015; *P. chauhani* Saxena et al., 2013-14; *P. giuris* Saxena et al., 2015; *P. lucknowensis* Gautam et al., 2019; *P. amini* Gautam et al., 2019; *P. meyeri* Gautam et al., 2019; *P. unnaoensis* Gautam et al., 2019; *P. thapari* Gautam et al., 2020; *P. paranandai* Amin et al., 2021. *P. heingangyensis* Pengki and Gambhir, 2021; *P. roparensis* Rana and Kaur, 2021; *P. himachalensis* Rana and Kaur, 2023 and *P. longus* Rana and Kaur, 2023.

Present species differs from its congeners in having 16 hooks in each row of proboscis, whereas, *P. allahbadi* have (9-10 hooks), *P. basiri* (9 hooks), *P. buckleyi* (10 hooks), *P. clupei* (8 hooks), *P. colisai* (10 hooks), *P. guntei* (8-10 hooks), *P. mehrai* (10-12 hooks), *P. ophiocephali* (8 hooks), *P. nagpurensis* (8-10 hooks), *P. pandei* (10

hooks), *P. fotedari* (10 hooks), *P. garuai* (6 hooks), *P. guptai* (8 hooks), *P. channai* (10 hooks), *P. vinodai* (8 hooks), *P. punctate* (10 hooks), *P. chauhani* (10 hooks), *P. giuris* (6-10 hooks), *P. heingangyensis* (9), *P. roparensis* (10), *P. hemachalensis* (8-10) and *P. longus* (9-10).

Present species differs from its congeners in Pakistan, including *P. kalriai*, *P. munifi* and *Pallisentis* sp. recorded from the bird *Phalacrocorax niger* in several morphological characteristics. *P. kalriai* differs in having a medium body, short proboscis consisting of 10 hooks per row, collar spines with 15 rows, each row contains 20 spines, uterine bell poorly developed, eggs sizes 0.032-0.036 by 0.012-0.016;

P. munifi has medium sized body with a cylindrical to globular proboscis with 14-15 rows of spines, 06 hooks in each row, 14-15 rows of spines at the collar with 54-56 hooks in each row, anterior testis smaller than posterior testis, and eggs elongated 0.045-0.068 by 0.024-0.028.

Pallisentis sp. recorded from the bird *Phalacrocorax niger* has a cylindrical body, proboscis globular containing 8-10 hooks in each circle, lemnisci equal in size, trunk spines arranged in 11 rows, each row contains 14 spines, and cement glands are cylindrical, 2-3 in number and well developed.

The present species has a proboscis armed with 4 circles of hooks, with 16 hooks in each circle. It has 14 collar rows like *P. vinodai*, *P. munifi*, *P. pandei*, *P. nagpurensis* and *P. basiri* but differs in collar spines, which are 14-26 in each row. It differs from all in trunk rows and number of spines, anterior and posterior testes size, cement gland size, cement reservoir (which is absent in some species and differs in size from other species), saefitigen pouch size, which is absent in

some species and differs in size from other species. Hence present species refers to a new species, and the name is taken from its host.

Based on these differences between present and previously known species of the genus *Pallisentis* (table-1), a new species, *P. armatai*, is proposed. The name of the new species refers to the species name of the host fish, *M. armatus*.

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Table-1: Measurement of different body parts of *Pallisentis armatai* sp. nov.

Body part	Male (♂) mm	Female (♀) mm
Body size (length X width)	13.4 X 0.6	18.5 X 0.65
Proboscis size	0.183 X 0.292	0.217 X 0.306
Proboscis no. of circle	4	4
No. of p. hooks in each circle	16	16
Top hook blade size	0.083 X 0.029	0.091 X 0.022
Top hook root size	0.028 X 0.069	0.042 X 0.075
Basal hook blade size	0.039 X 0.005	0.053 X 0.009
Basal hook Root size	0.005 X 0.006	0.027 X 0.011
Neck size	0.089 X 0.220	0.058 X 0.222
Proboscis receptacle size	0.856 X 0.311	0.733 X 0.3
Left lemnisci	3.6 X 0.15	3.7 X 0.1
Right lemnisci	3.55 X 0.1	3.9 X 0.1
No. of collar rows	14	13
No. of spines in a collar row	14-26	18
Collar spine (length X width)	0.038-0.033 X 0.019-0.014	0.042-0.033 X 0.014-0.020
Distance b/w collar spines	0.011	0.017
Non-spiny area	0.233 X 0.566	0.144 X 0.478
Trunk rows	29	44
No. of spines in each trunk row	6-22	18
Trunk spine (length X width)	0.05-0.04 X 0.02-0.008	0.041 X 0.019-0.008
Distance b/w trunk spines	0.111-0.1333	0.1
Anterior testis	1.05 X 0.3	--
Posterior testis	0.3 X 0.25	--
Cement gland	0.65 X 0.3	--
Cement reservoir	1.8 X 0.3	--
Saeftigen's pouch	0.75 X 0.275	-
Bursa	0.85 X 0.4	--
Egg size	--	0.052-0.04 X 0.027-0.025
Ovarian ball	-	0.069
Embryo	-	0.051-0.042 X 0.017-0.012

Table-2: Comparative table of species of genus *Pallisentis*.

Species	<i>P. allahbadi</i>	<i>P. basiri</i>	<i>P. buckleyi</i>	<i>P. clupei</i>	<i>P. guntei</i>	<i>P. guptai</i>	<i>P. mehrai</i>	<i>P. ophiocephali</i>	<i>P. nagpurensis</i>	<i>P. nandai</i>
Total body size ♂	3.45-5.97 X 0.309-0.424	8.28 X 0.24	3.5-6.4 X 0.24-0.381	8.27-8.64 X 0.60-0.63	1.75-1.95	5.54-6.86 X 0.50-0.55	5.72-6.68 X 0.50-0.56	5.5-6.0 X 0.32	2.4-19.0 X 0.43-0.9	5.6-9.9 X 0.37-0.63
Proboscis circle	4	4	4	4	4	4	4	4	4	4
Proboscis hooks /circle	9-10	9	10	8	8-10	8	10-12	8	8-10	-
Collar circle	15-16	15-14	16-18	12-13	16-17	-	10-12	11	12-14	18-20 X 16-20
Collar spines/row	12-16	-	12-14	14-20	-	13-14	-	-	-	-
Trunk rows	20-26	26	26-28	28-30 ♀ 61♂	-	-	-	Till the end of the body	30-63	28-34
Trunk spine per row	2-14	-	10-12	-	-	16-20	20-30	-	18-14	-
Anterior testis	0.44-0.962X 0.146-0.212	0.95 X 0.35	0.35-0.65 X 0.15-0.2	0.61-0.74 X 0.18-0.20	0.2-0.3 X 0.10-0.11	0.48-0.50 X 0.18-0.22	0.60-0.65 X 0.10-0.12	0.65	0.63-1.82 X 0.16-0.37	0.57 X 0.14
Posterior testis	0.424-0.718 X 0.16-0.22	0.7 X 0.35	0.36-0.46 X 0.15-0.2	0.71-0.75 X 0.18-0.19	0.175-0.25 X 0.10-0.11	0.52-0.58 X 0.18-0.23	0.62-0.68 X 10.0-15.0	0.65	0.49-1.28 X 0.17-0.36	0.53 X 0.14
Cement gland	0.538-0.718 X 0.146-0.22	0.9 X 0.34	0.3-0.73 X 0.088-0.227	1.39-1.5 X 0.16-0.20	0.125-0.18	0.50-0.58 X 0.20-0.25	0.60-0.68 X 0.15-0.16	Nucleus 4-5	1.15-1.18 Nuclei 20-30	0.77 X 0.14
Cement reservoir	0.293-0.55 X 0.146-0.228	-	0.175-0.59 X 0.085-0.236	0.46-0.50 X 0.17-0.18	-	-	-	-	-	0.32 X 0.13
Saeffitigen pouch	0.309-0.456 X 0.049-0.065	0.78 pyriform	0.25-0.71 X 0.075-0.15	0.58-0.60 X 0.11-0.16	-	-	0.50-0.65	-	-	-
Female body	7.351-11.954 X 0.57-0.799	10.00X 0.4-0.5	-	11.30 X 0.70	4.15-4.5	14.26-20.50 X 0.45-0.66	8.6-10.5 X 0.45-0.58	-	-	6.3-10.4 X 0.35-0.56
Egg size	0.057-0.082 X 0.02-0.037	0.036 X 0.021	-	-	-	0.055-0.057 X 0.030-0.031	0.055-0.07 X 0.030-0.035	Embryo- 0.01 X 0.03	0.116-0.214 X 0.083-0.115	-
Host	<i>Ophiocephalus marulius</i>	<i>Rhynchobdella aculeate</i>	Unidentified fish	<i>Clupea longiceps</i>	<i>Lepidocephala lithysguntea</i>	<i>Nandas nandas</i>	<i>Caranx kalla</i>	<i>Channa marulius</i>	<i>Ophiocephalus striatus</i>	<i>Nandas nandas</i>
Locality	India	India	India	India	India	India	India	India	India	India

Species	<i>P. pandei</i>	<i>P. fotedari</i>	<i>P. garuai</i>	<i>P. channai</i>	<i>P. vinodai</i>	<i>P. munifi</i>	<i>P. punctati</i>	<i>P. giuris</i>	<i>P. chauhani</i>	<i>P. armatai</i> sp.nov
Total body size ♂	5.07-6.0 X 0.30-0.35	12.48-12.60 X 0.55-0.66	8.97-10.49X 0.58-0.78	4.14X 0.35	4.15 X 0.38	6.45-7.09 X 0.38-0.42	0.226 X 0.013	4.10 X 0.3	3.92 X 0.22	13.4 X 0.6
Proboscis circle	4	4	4	4	4	4	4	4	4	4
Proboscis hooks/ circle	10	10	6	10	8	6	10	10	10	16
Collar circle	14- 16	-	13-15	16	14	14-15	16	14	13	14 (♂) 13 (♀)
Collar spines per row	16	-	-	16	16	-	14	12-14	16-18	14-26 (♂) 18 (♀)
Trunk rows	20-28	-	28-32	21	27	54	20-26	20	20	29 (♂) 44 (♀)
Trunk spine per row	-	-	-	14-18	16-18	56	12	14-16	14	6-22 (♂) 18 (♀)
Anterior testis	0.58-0.62 X 0.13-0.15	1.40-1.75 X 0.30-0.35	0.729-0.748 X 0.09-0.20	0.36 X 0.15	0.49 X 0.18	0.78-0.89 X 0.15-0.16	0.374-0.684 X 0.133-0.216	0.46 X 0.11	0.36 X 0.13	1.05 X 0.3
Posterior testis	0.52-0.56 X 0.13-0.14	1.05-1.35 X 0.30-0.40	0.654-0.841 X 0.09-0.39	0.32 X 0.15	0.47 X 0.19	0.84-0.86 X 0.15-0.16	0.393±0.041	0.53 X 0.13	0.24 X 0.12	0.3 X 0.25
Cement gland	0.47-0.63 X 0.12-0.14	-	1.683-2.47 X 0.132-0.34	0.34 X 0.14	0.52 X 0.19	0.60 X 0.21	0.370-0.648 X 40-0.141	0.234-0.918 X 0.108-0.252	0.51 X 0.13	0.65 X 0.3
Cement reservoir	-	-	-	0.28 X 0.11	0.42 X 0.14	0.62-0.82 X 0.21-0.22	-	0.36 X 0.16	0.33 X 0.11	1.8 X 0.3
Bursa	-	-	-	0.22 X 0.06	0.18 X 0.05	0.45 X 0.21	0.27-0.56 X 0.19	0.26 X 0.14	Absent	0.85 X 0.4
Female body size	6.1-13.24 X 0.61-0.76	13.3-14.6X 0.55-0.64	14-28 X 0.43-0.59	-	-	7.20-7.36 X 0.39-0.42	5.472-14.791 X 0.461-0.820	16.3 X 0.9	-	18.5 X 0.65
Egg size	0.08-0.10 X 0.04	0.03-0.07 X 0.03-0.06	0.05-0.067 X 0.018-0.08	-	-	0.045-0.068 X 0.02	0.028-0.061 X 0.010-0.025	0.035-0.045 X 0.02-0.025	-	0.052-0.044 X 0.027-0.025
Host	<i>Channa punctatus</i>	<i>Clupea longiceps</i>	<i>Clupiso magarua</i>	<i>Channa punctatus</i>	<i>Channa punctatus</i>	<i>Cirrhinus mrigala</i>	<i>Channa punctatus</i>	<i>Glossogobius giuris</i>	<i>Channa punctatus</i>	<i>Mastacembelus armatus</i>
Locality	India	India	India	India	India	Pakistan	India	India	India	Pakistan

Species	<i>Pallisentis</i> sp.	<i>P. kalrai</i>	<i>P. lucknownsis</i>	<i>P. amini</i>	<i>P. unnaoensis</i>	<i>P. heingangyensis</i>	<i>P. roparensis</i>	<i>P. hemachalensis</i>	<i>P. armatai</i> sp.nov.
Total body size ♂	3.45 X 0.32	medium body size	2.55-4.47 X 0.19-0.28	1.83-5.8 X 0.15-0.27	3.4-4.4 X 0.2-0.26	8.19-9.35 X 0.13-0.28	5.5-9 X 0.304-0.427	9.0-14.0 X 0.4-0.5	13.4 X 0.6
Proboscis circle	4	4	4	4	4	4	4	4	4
Proboscis hooks /circle	8-10	10	8-10	-	8	9	10	8-10	16
Collar circle	11	15	15-16	14-16	15	15	15-16	15-16	14 (♂), 13 (♀)
Collar spines per row	14	20	12-24	14-18	16-18	8-10	-	-	14-26 (♂), 18 (♀)
Trunk rows	21	-	19-25	21-40	28-33	15	32-35	27-37	29 (♂), 44 (♀)
Trunk spine per row	-	-	14-19	14-18	16-18	8 - 10	16-18	10-15	6-22 (♂), 18 (♀)
Anterior testis	0.205 X 0.088	-	0.2-0.5 X 0.08-0.19	0.27-0.48 X 0.08 -0.16	0.37-0.42 X 0.13	0.41-0.81 X 0.30	0.45-0.5 X 0.1-0.14	0.90-1.06 X 0.26-0.28	1.05 X 0.3
Posterior testis	0.235 X 0.088	-	0.2-0.48 X 0.08-0.2	0.26-0.44 X 0.08-0.16	0.34-0.45 X 13	0.32-1.35 X 0.27	0.43-0.45 X 0.13-0.16	0.713-0.99 X 0.256-0.301	0.3 X 0.25
Cement gland	0.22 X 0.102	-	0.32-0.59 X 0.11-0.2	0.26-0.66 X 0.08-0.2	0.38-0.52 X 0.1-0.16	0.32-1.35 X 0.38	0.88-0.89 X 0.06-0.07	1.704-2.179 X 0.222-0.227	0.65 X 0.3
Cement reservoir	-	-	0.33-0.64 X 0.11-0.2	0.31-0.62 X 0.1-0.2	0.45-0.47 X 0.11-0.19	0.5	0.33-0.35 X 0.08-0.09	0.575-0.603 X 0.221-0.226	1.8 X 0.3
Bursa	-	-	-	-	0.06-0.16 X 0.05-0.1	0.10-0.63	0.083-0.087	0.524-0.550 X 0.371-0.490	0.85 X 0.4
Female body size	-		4.45-4.46 X 0.28-0.45	4.20-8.12 X 0.38-0.44	3.40-5.7 X 0.19-0.45	7.62-12.27 X 0.23-0.65	7.0-10.5 X 0.38-0.552	13.0-018.0 X 0.5-0.6	18.5 X 0.65
Egg size	-	0.032 X 0.012-0.016	0.036-0.05 X 0.02	0.06 X 0.006	0.035-0.040 X 0.015-0.020	0.06-0.15 X 0.09	0.02-0.03 X 0.01	0.066-0.078 X 0.034-0.037	0.052-0.044 X 0.027-0.025
Host	<i>Phalacrocorax niger</i>	<i>Labeo rohita</i>	<i>Channa punctatus</i>	<i>Channa striatus</i>	<i>Glossogobius giuris</i>	<i>Channa striatus</i>	<i>Wallago attu</i>	<i>Channa punctata</i>	<i>Mastacembelus armatus</i>
Locality	Pakistan	Pakistan	India	India	India	India	India	India	Pakistan

Table-32: Species of genus *Pallisentis* reported from fish hosts

Species	Host	Locality	Reference
<i>P. umbellatus</i>	<i>Ophiocephalus argus</i>	China	Yamaguti, 1963
<i>P. cleatus</i>	<i>Monopterus javanensis</i>	China	Yamaguti, 1963
<i>P. ophicephali</i>	<i>Channa marulius</i>	India	Bhattacharya, 2007
<i>P. nagpurensis</i>	<i>Ophiocephalus striatus</i>	India	Bhattacharya, 2007
<i>P. nandai</i>	<i>Nandas nandas</i>	India	Bhattacharya, 2007
<i>P. colisai</i>	<i>Channa punctatus</i>	India	Bhattacharya, 2007
<i>P. allahabadii</i>	<i>Ophiocephalus marulius</i>	India	Agrawal, 1958
<i>P. basiri</i>	<i>Rhynchobdella aculeate</i>	India	Farooqi, 1958
<i>P. buckeyi</i>	Unidentified fish	India	Tadross, 1966
<i>P. guntei</i>	<i>Lepidocephalus ichthyoguntea</i>	India	Sahay <i>et al.</i> , 1967
<i>P. pandei</i>	<i>Channa punctatus</i>	India	Rai, 1967
<i>P. garuai</i>	<i>Clupiso magarua</i>	India	Sahay <i>et al.</i> , 1967
<i>P. magnum</i>	<i>Wallago attu</i>	Pakistan	Saeed et Bilqees, 1971
<i>P. clupei</i>	<i>Clupea longiceps</i>	India	Gupta and Gupta, 1979
<i>P. guptai</i>	<i>Nandas nandas</i>	India	Gupta and Fatma, 1985
<i>P. kalriai</i>	<i>Labeo rohita</i>	Pakistan	Khan et Bilqees, 1985
<i>P. mehrai</i>	<i>Caranx kalla</i>	India	Gupta and Fatma, 1985
<i>P. sindhensis</i>	Fishes	Pakistan	Khan et Bilqees, 1985
<i>P. fotedari</i>	<i>Clupea longiceps</i>	India	Gupta and Sinha, 1991
<i>P. jagani</i>	<i>Channa channa</i>	Jammu Kashmir	Koul <i>et al.</i> , 1991
<i>P. channai</i>	<i>Channa punctatus</i>	India	Gupta <i>et al.</i> , 2015
<i>P. munifi</i>	<i>Cirrhinus mrigala</i>	Pakistan	Naqvi <i>et al.</i> , 2015
<i>P. punctati</i>	<i>Channa punctatus</i>	India	Gupta <i>et al.</i> , 2015
<i>P. vinodai</i>	<i>Channa punctatus</i>	India	Gupta <i>et al.</i> , 2015
<i>P. chauhani</i>	<i>Channa punctatus</i>	India	Saxena <i>et al.</i> , 2013
<i>P. giuris</i>	<i>Glossogobius giuris</i>	India	Saxena <i>et al.</i> , 2015
<i>Pallisentis</i> sp.	<i>Phalacrocorax niger</i>	Pakistan	Abro <i>et al.</i> , 2017
<i>P. lucknowensis</i>	<i>Channa punctatus</i>	India	Gupta, 2024
<i>P. amini</i>	<i>Channa striatus</i>	India	Gautam, Misra and Saxena, 2019
<i>P. meyeri</i>	<i>Channa punctatus</i>	India	Gautam, Misra and Saxena, 2019
<i>P. unnaoensis</i>	<i>Glossogobius giuris</i>	India	Gautam, Misra and Saxena, 2019
<i>P. thapari</i>	<i>Channa punctatus</i>	India	Gautam, Misra and Saxena, 2019
<i>P. paranandai</i>	<i>Channa marulius</i>	India	Amin <i>et al.</i> ,
<i>P. heingangyensis</i>	<i>Channa striatus</i>	India	Devi and Gambhir, 2021
<i>P. roparensis</i>	<i>Wallago attu</i>	India	Rana and Kaur, 2021
<i>P. himachalensis</i>	<i>Channa punctata</i>	India	Rana and Kaur, 2023
<i>P. longus</i>	<i>Channa marulius</i>	India	Rana and Kaur, 2023
<i>P. armatai</i> sp.nov.	<i>Mastacembelus armatus</i>	Pakistan	Present work