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Studies on hold-fast organs of piscean cestode parasites from Maharashtra State, India

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Abstract

Present study deals with hold-fast organs of some Piscean tapeworms collected from Maharashtra State India. Hold-fast organs of tapeworms are important for attachment and adhesion. These organs of attachment are in the form of muscular suckers, rostellum, spines, hooks, tentacles etc. The work on hold-fast organs of Piscean tapeworms is very essential for research in taxonomy and histopathology. Hence, the present study was undertaken on the role and status of diversity of holdfast organs with special reference to histopathology of Piscean tapeworms collected from Maharashtra State, India. Tapeworms were collected and studied from certain fishes and localities.

Key Words: Hold-fast organs, Maharashtra, Piscean Cestodes

Introduction

Cestodes are endoparasites of vertebrates from fishes to mammals. Infection of Piscean cestodes leads to anemia complications and protracted illness. Parasitic diseases are major public health problems of tropical countries including India. Parasitic diseases of Fish seem to be one of the major problems confronting fish culturists. Fishes are important components of ecosystem from ecological, medicinal, nutritional and economical point of view.

Materials and Methods

Study Area: Maharashtra State, India.

Taxonomy:-Cestode parasites were collected from intestine of fishes from Maharashtra State, India during January, 2010 to December, 2013. Cestodes are preserved in hot 4% formalin, stained in Haematoxylin and Borax carmine, mounted in D.P.X, microphotograph were taken with digital camera and identification is done with the help of standard protocol (Yamaguti,1959).

Histopathology:-The fixed materials from Bouins fluid were removed, washed, dehydrated through alcoholic grades, cleared in xylene and embedded in paraffin wax (58-62°C). The sections were taken at 7µ and slides were stained with Haematoxylin-Eosin double staining method.

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Results and Discussion

The present study focus the diversity of hold-fast organs of some Piscean tapeworms collected from Maharashtra State, India includes sixteen genera of Nine families (Table 1 and Figure 1).

In course of study the collected Piscean tapeworm possessing following morphological featuresin their scolex.

1. ***MARSIPOMETRA*** **CAPOOR, 1917-** Scolex pyramidal, arrow shaped, divided into two region. Anterior region is represented by a pyramidal arrow shaped apical disk. Posterior region represents suckers, which are oval to rounded in shape, arranged in two groups.
   Host- *Carcharhinus laticaudus*.

2. ***PHOREIOBOTHRIUM*** **LINTON, 1889-** Scolex quadrangular. Narrow anteriorly and broad posteriorly. Bothridia sessile, rectangular, four in number. Each bothridium armed with a pair of hooks. The hooks are trifurcated i.e. having three prongs, the middle prong is longer than the adjacent prongs.
   Host:- *Carcharias acutus.*

3. ***UNCIBILOCULARIS*** **SOUTHWELL, 1925-** Scolex rounded, oval, triangular. The bothridia are sessile, four in number, balloon shaped.Each bothridium is divided into two oval locula of which the anterior locula is larger than the posterior one. Accessory sucker absent. Each bothridium having bifurcated hooks.
Host: - *Aetomylaecus nichoffii*, *Dasyatis zugei*.

4. ***PHYLLOBOTHRIUM*** **BENEDEN, 1849-** Scolex oval, China rose shaped. Bothridia sessile,four, leaf like. Loculia 40-50 on each bothridium. The powerful longitudinal muscle fibers are attached to each bothridium.
Host- *Carharhinus macloti*.

5. ***POLYPOCEPHALUS*** **BRAUN, 1878**-Scolex oval, rectangular. Anterior region represented by a crown of 10-20 tentacles. Posterior region with 4 suckers.
Host :- *Dasyatis walga, Dasyatis uarnak.*

6. ***TYLOCEPHALUM LINTON, 1890***- Scolex divided into two region. Anterior region oval, globular. Posterior region quadrangular with four sucker.
Host*:-Dasyatis walga, D. sephen.*

7. CEPHALOBOTHRIUM SHIPLEY ET HORNELL, 1906- Scolex squarish, rectangular, quadrangular divided into two region. Anterior region bears four, cuplike suckers. Posterior region bears large central disc.
Host *:- Dasyatis sephen,Dasyatis uarnak.*

8. ***CALYCOBOTHRIUM*** **SOUTHWELL, 1911-** Scolex quadrangular, rectangular, divided into two region Anterior region bears four suckers. Posterior region bears 10-16 finger like tentacles.
Host :- *Chiloscyllium plagiosum, Carcharhinus bleekeri.*

9. ***HEXACANALIS*** **SOUTHWELL, 1911-** Scolex rectangular, square in shape. Anterior region is highly muscular and bears large protrusible sucker. Posterior region bears four small suckers at corner.
Host : *Dasyatis bleekeri*.

10. ***NYBELINA*** **POCHE, 1926**- Scolex tubular part consist pores bulbosa. Hooks three in numbers.
Host :- C*archarlinus dussumieri.*

11.***GYMNORHYNCHUS*** **CUVIER *1817-*** Scolex Tubular, cylindrical in shape. Bothredia sessile and divided into four parts.
Host: *Carcharhinus dissumeri.*

12.***TETRAGONOCEPHALUM*** **SHIPLEY ET HORNELL, 1905-** Scolex divided into two region. Anterior region globular, muscular. Posterior region cushion like with four suckers. Host :- *Dasyatis bleekeri, Dasyatis walga*.

13***.SENGA*** **DOLLFUS, 1934-** Scolex triangular, conical, pear shaped, tapering anteriorly and broad posteriorly, having pair of sessile bothria, rostellum oval to rounded, armed with circled or semi circled hooks.
Host :- *Mastacembelus armatus, Channa sp.*

14***.GANGESIA*** **WOODLAND, 1924-** Scolex globular with marked rosetellum, rostellum armed with hooks, suckers four, muscular.
Host :- *Channa sp., Wallago attu, Macrones seenghala, Barbus ticto.*

15.***PROTEOCEPHALUS*** **WEINLAND, 1858-** Scolex large, suckers four to five in numbers, muscular.
Host :- *Channa sp., Wallago attu*.

16***.SILUROTAENIA*** **NYBELIN, 1942-** Scolex large, pear shaped, suckers four, muscular, rostellum oval to rounded, armed with 'V' shaped hooks.
Host :- *Macrones seenghala, Barbus ticto, Mystus seenghala*.

The scolex (pl. scolices), located at the anterior end, is the attachment portion, the morphology and dimensions of which are key features in identification of these worms. To facilitate attachment to the host's intestinal wall, tapeworms utilize several types of structures on their scolices, the most common of which are suckers. In most of the tapeworms of present study possessing suckers.

Table 1.Piscean Tapeworms collected from Maharashtra State, India

S	Family	Name of Genera
1.	Amphicotyllidae Ariola,1899	*Marcipometra* Capoor,1917
2.	Onchobothriidae Braun,1900	*Phoreiobothrium* Linton,1899, *Uncibilocularis* Southwell,1925
3.	Phyllobothriidae Braun,1900	*Phyllobothrium*, Beneden,1849
4.	Lecanocephallidae Braun,1900	*Polypocephalus* Braun,1878, *Tylocephalum* Linton,1890, *Cephalobothrium* Shipley et Hornell,1906, *Calycobothrium* Southwell, 1911, *Hexacanalis* Southwell,1911
5.	Tentaculariidae Poche,1926	*Nybelina* Poche,1926
6.	Gmnnorhynchidae Dollfus,1935	*Gymnorhynchus* Cuiver,1817 Rudolphi,1819
7.	Tetragonocephalidae Yamaguti, 1959	*Tetragonocephalum* Shipley et Hornell,1905
8.	Ptychobothridae Luhe, 1902	*Senga* Dollfus, 1934
9.	Proteocephalidae La Rue, 1911	*Gangesia* Woodland, 1924, *Proteocephalus* Weinland, 1858, *Silurotaenia* Nybelin, 1942

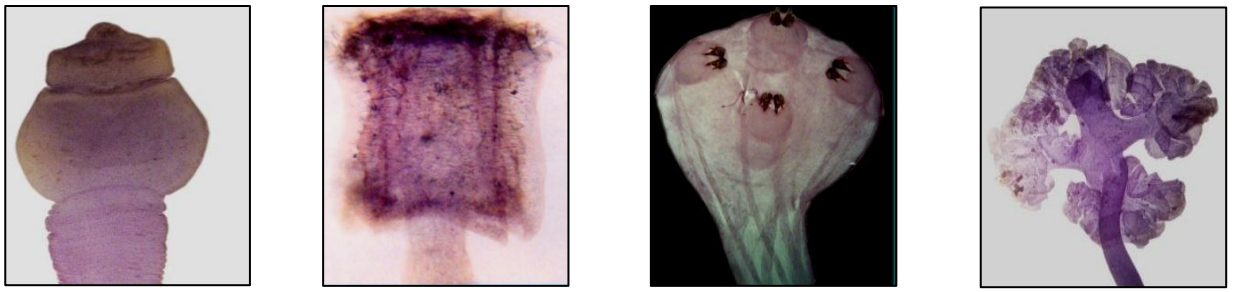
In some groups, the holdfast function of the scolex is lost early in life, and the anterior end of the stroblia becomes distorted into a pseudoscolex to function as a holdfast Muscles in the scolex make possible the holdfast action of this organ. The scolices of tapeworms are typically categorized as either acetabulate or bothriate, depending on the type of sucker present. An acetabulate scolex is characterized by the presence of 4 muscular cups sunk into the equatorial surface of the scolex. In addition to muscular cups, there may be accessory holdfast structures, such as hooks to help anchor the scolox to the host's intestinal wall. In this case, the scolex is called an armed scolex.

These hooks are usually grouped at the apical end of the scolex on a protrusible Rostellum. A bothriate scolex is characterized by the presence of 2, or rarely 4 to 6, longitudinally arranged, shallow depressions called bothria (sing. bothrium). Various types of glandular secretions are associated with the scolex of many tapeworms; they are proteolytic, adhesive, and/or stimulatory, depending on the species. Results of present study are in agreement with those conducted by Jadhav *et al*., (2006) described diversity of hold fast organs of Lecanicephalidean tapeworms are importance for taxonomic observation and parasitic association.

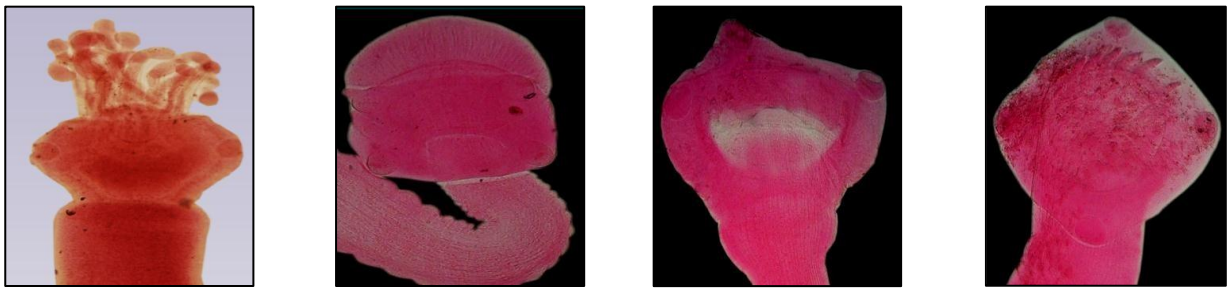
Hiscock, (1954); described comparative morphological and functional information on scolex structures for use of systematic and phylogenetic investigation of *Trypanrhyncha*. Palm, (1997) uses number of bothridia, presence or absence of bothridial pits and bulbular organs to distinguish major *Trypanorhyncha* taxa. Campbell and Beveridge, (1994) classified the *Trypanorhynchs* largely on arrangements of tentacular hooks, structure of scolex, mature proglottids. Hence the present study is also important for taxonomic identification of Piscean tapeworm.

Histopathology

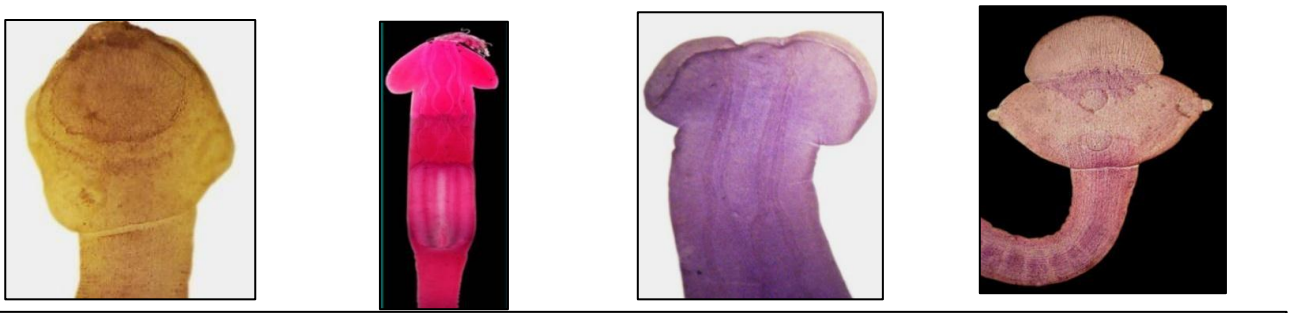
Histopathology is the microscopic study of tissues affected by disease. The procedures adopted for preparation of material for such studies are known as histological or histopathological techniques. Fish diseases constitute one of the most important problems and challenges confronting fish culturists. In host parasite relationship, host provides a suitable environment to parasite and in turn parasite either directly or indirectly gave injury to host and also deprives host by getting required nutrition. Host parasites relationship results in gain of one organism and loss of another. It leads to various diseases and disorders. The microscopic study of tissues affected by the cestode parasites revealed different pathological conditions.The normal histological structure (Healthy intestine) of the host showed that the healthy villi and all layers i.e. serosa, muscularis mucosa, submucosa and mucosa are clearly observed (Fig.2), where as infected intestine (Fig.3) has been observed that worm attached to the mucosal layer of intestine and slowly invades the deeper layers of host tissue.



Marcipometra Capoor, 1917 | *Phoreiobothrium* Linton, 1899 | *Uncibilocularis* Southwell,1925 | *Phyllobothrium*,



Polypocephalus Braun, 1878 | *Tylocephalum* Linton, 1890 | *Cephalobothrium* Shipley et Hornell, 1906 | *Calycobothrium*

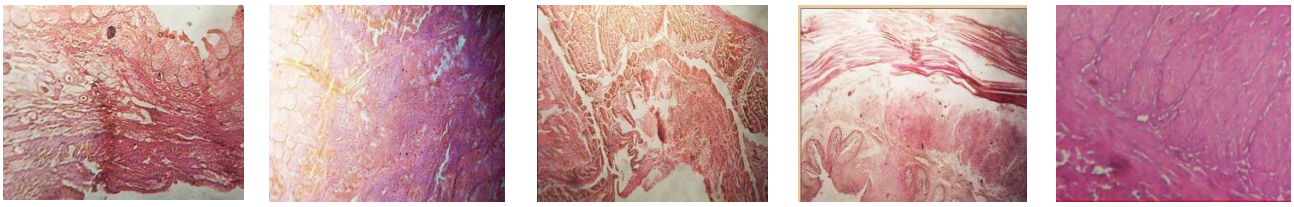


Hexacanalis Southwell,1911 | *Nybelina* Poche,1926 | *Gymnorhynchus* Cuiver,1817 Rudolphi,1819 | *Tetragonocephalum*

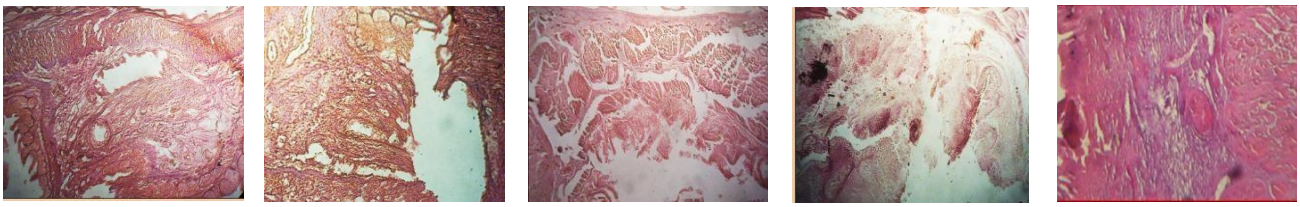
Senga Dollfus, 1934 | *Gangesia* Woodland, 1924 | *Proteocephalus* Weinland, 1858 | *Silurotaenia*

0.125 mm

Fig.1: Diversity of Hold fast organs of Piscean Cestode



A B C D E
Fig.2: T.S. of Non-infected intestines of A- *Carcharhinus bleekeri* B- *Dasyatis zugei* C-*Dasyatis sephen* D- *Dasyatis walga* E- *Mastacembelus armatus*



A B C D E
Fig.3: T.S. of infected intestines of A- *Carcharhinus bleekeri* B- *Dasyatis zugei* C-*Dasyatis sephen* D- *Dasyatis walga* E- *Mastacembelus armatus*

A) *Calycobothrium Sp.-* The worm *Calycobothrium* sp. having non-penetrative scolex, and have close intimate contact with intestinal tissue of host *Carcharhinus bleekeri*. In T.S. of intestine it shows *Carcharhinus bleekeri* cestodes attached to mucosal, submucosal and muscularis mucosa of intestine and slowly damaged the host intestinal tissue.

B) Uncibilocularis Sp. -The worms *Unicibilocularis* sp. is having penetrative scolex, and have close contact with the intestinal tissue of the host *Dasyatis zugei*. In T.S. of intestine of *Dasyatis zugei*, cestode attached to mucosal, sub- mucosal and muscularis mucosa of intestine are damaged and destroys the intestinal Villi by penetrative scolex.

C) *Tylocephalum Sp.* - In *Tylocephalum sp.* Scolex is Penetrative, it adhere with intestinal wall causing damage to intestinal epithelim of Villi, Destruction of epithelium at the point of attachment was also observed and large connective tissue origin in paramucosal lumen of *Dasyatis sephen.*

D) Tetragonocephalum Sp. -*Tetrgonocephalum Sp.* Scolex is non penetrative, easily adhere itself tohost tissue and suck nourishment with the help of muscular pad and suckers. T.S. of host *Dasyatis walga* intestine showing damaged intestinal wall, villi of crypts of liberkuhn are ruptured and destructed by adhering scolex. Destruction of the epithelium of the point of attachment was also observed.

E) *Senga Sp.-* The worm *Senga Sp.* is having scolex with rostellum, which is medium, rounded, with 40-44 hooks which are used for attachment of worm to the intestine of host *Mastacembelus armatus*. In T.S. of intestine of *Mastacembelus armatus* it has been observed that cestode attached to mucosal, sub-mucosal and muscularis mucosa of intestine and slowly damaged hosts intestinal villi, invaded deep and forming the cyst like structure and pad formation took place for invading and sucking the content in the region of villi.

The present findings are more or less similar to the observations made by Bose and Sinha (1983) who reported the pathological changes mainly enhanced mucus secretion in *Heteropneustes fossilis* infected by nematode, *Procamallanus spiculogubernaculus*. Satpute and Agrawal (1974) also noticed shortening of villous processes and inflammatory response in the submucosa and serosa of *C. batrachus* infected with *Lytocestus indicus* and

Diphyllobothrium penetram. Ruhela *et al*. (2006) also revealed pyknotic epithelial cells in mucosa, vacuolization, separation of muscular layers, rupturation of serosa and shortening and truncated villi in the intestine of *C. batrachus* experimentally infected by *Procamallanus*. Banhawy *et al, (*1975) as degenerative changes in gut wall, liver and pancreas of *Synodontis schall* as a result of *Wenyonia virilis* infection and also reported histopathology of the fish tissues shows different pathological conditions. There was mucosal oedema, haemorrhage with haemosiderosis in some tissues examined while there was moderate focal lymphocytic infilterations of myocardium of heart in some fish species. Jadhav B.V.*et al.,* (2008) reported intestinal pathology of *Gallus gallus domesticus* parasitized by *Davainea* sp. Nanware *et al*., (2005) reported intestinal infilammation and vasodilation of intestinal tissue of *Carcharias acutus* by *Phoreobothrium* sp. and destruction of intestinal villi by invasion of Scolex of *Moniezia sp.* inhabiting intestinal tract of *Capra hircus* L. Nanware and Bhure, (2011) studied intestinal histopathology of *Capra hircus* L. infected with *Stilesia jadahave*, and their results shows, that the worm is not having very close contact but it has developed very weak contact and attached loosly to crypts of Liberkuhn. Pathan *et al*., (2011) studied infected intestinal tissue gets broken due to penetration of hooks and formed ulcer from intestine *Aetomylaeus nichoffii* parasitized by *Uncibilocularis* sp. Laxma Reddy and Benarjee (2014) observed that the stomach is highly effected due to helminth infestation which was evidenced by total eruption of villi from the mucous membrane which resulted to a major disruption of the structural organization of the organ which might have profound influence on the nutrition and digestion process of the fish. Rezaei *et al*. (2013) studied histo-pathological changes in the intestinal wall of *Neogobius bathybius* infected by *D. minutus* and revealed mucosal erosion, increased number of goblet cells, hyperplastic changes in the epithelial cells, and remarkable hyperplasia that formed nodule-like structures with hyperemia in the submucosa. Khatoon,(2004) studied the total destruction and necrosis of all layers of intestinal wall and severe destruction occurs in mucosa and sub-mucosa *Nesokia indica* parasitized by *Syphacia* sp. Such types of changes were also observed in fishes parasitized by *Anisakis* larvae (Bilqees and Parveen, 1996). Destruction of the epithelium at the point of attachment was observed by some workers and large numbers of detached cells of epithelial and connective tissue origin in the paramucosal lumen (Chaicharn and Bullock,1967). Kapustina, (1978) noted damage to intestinal mucosa adjacent to the strobila of *K. sinensis*, which was attributed to cestode feeding strategies, migration of the parasite in the gut, and previous sites of attachment. Gupta and Srivastava, (2007) observed heavy infection of *Fasciolopsis buski* damaging lamina propria, submucosa and mucosa with profuse infiltration of eosinophils, lymphocytes and plasma cells of pig intestinal tissue. Ahuwalia, (1960) studied the histopathology of *Gastrodicoides hominis* a digenean trematode of pig and reported leucocytic infiltration and mucosal epithelium destruction. Haque and Siddiqui, (1978) reported infection of *Fasciolopsis buski* causing surface desquamation and destruction of mucosal epithelium, infiltration of eosinophils and plasma cells. Khadap, (2009) reported plug formation at ruptured epithelial portion which may have formed from lymphocytes and eosinophilic cells of intestinal tissue of *Gallus domesticus* parasitized by *Cotugnia*.

Conclusion

It reveals that, the tapeworms are successful in surviving and growing well until its reproduction. The worms are attached to the tissues of the intestine, the villi of crypts of liberkuhn are ruptured, destructed the mucosal, sub mucosal layer of intestine and shifted apart by the penetrating the worm. The host is in loss, not able to drive away the parasite or to kill it by secreting toxins in the cavity formed by the encircling villi**.**

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