

Studies on the Family Plagiorchiidae Luhe, 1901 with Redescription of *Plagiorchis Bulbulii* Mehra, 1937 A Digenetic Trematode Collected From Two Different Hosts In Kashmir, India

VK Kharoo

Department of Zoology, University of Allahabad, Allahabad. U.P., India.

Author for Correspondence: E-mail: kharoolg@gmail.com

ABSTRACT

The plagiorchiidae is a large group of digenetic trematodes parasitizing tetrapod hosts world wide in all parts of digestive system as well as lungs, ureters and kidneys. Plagiorchiids have the most complex and controversial taxonomic history because of disagreements between researchers from time to time. Notwithstanding the availability of enormous literature on the family, the systematic position of several genera is still imperfect despite useful contributions by several workers from time to time. The history and classification of the family has been thoroughly discussed. A redescription of *Plagiorchis bulbulii* (Mehra, 1937) based on newly collected specimens from the small intestine of two different hosts *Hirundo rustica rustica* (Linn.) and *Passer domesticus griseigularis* (Sharpe) is also given.

Key Words: Trematode, Plagiorchiidae, *Plagiorchis*, *Katij*, *Tcher*

INTRODUCTION

The family Plagiorchiidae Luhe, 1901 consists of a large number of digenetic trematodes found in amphibians, reptiles, birds and also in mammals world wide. These parasites have been located in mouth, cloaca, bile duct, gall bladder, liver, lungs, ureter and kidney. Despite enormous work done on the Plagiorchiidae, the systematic position of a number of genera and the classification of the family is still controversial due to complex taxonomic history. Since its creation, over 150 genera have been included in the family (Tkach, 2008), majority of which have either been synonymized or transferred to other families. Notwithstanding availability of enormous literature on the family, these Plagiorchiids have, perhaps, not been studied thoroughly and it appears that the survey work of this group is far from complete. This could probably be due to complexities arising from difference of opinion among authors and conspicuous morphological variations in these parasites. Among the notable researchers who have studied this family at different times and contributed to the knowledge of this group are Stiles (1901), Baer (1924), Fuhrman (1928), Talbot (1934), Mehra (1937), Skrjabin and Antipin (1958, 1960, 1961), Sharpilo and Iskova (1989) and Tkach (2008). The important contributions which have stood as milestones in the systematics of plagiorchiids have been made by Looss (1899), (Luhe, 1899, 1909), Baer (1924), Poche (1925), McMullen (1937),

Mehra (1937), Olsen (1937), Byrd *et al.*, (1940), Skrjabin and Antipin (1958, 1960, 1961), Yamaguti (1958, 1971), Odening (1959, 1964), Prudhoe and Bray (1982), Sharpilo and Iskova (1989) and Tkach (2008).

The controversy concerning the status of the Plagiorchiidae has arisen from the nomenclature of the most central and typical genera *Lepoderma* Looss, 1899 and *Plagiorchis* Luhe, 1899 which were later synonymized and published in different journals on the same date in the same year. This led to difference of opinion and arguing with different authors regarding priority of the one over the other. Luhe published the name of his genus *Plagiorchis* including two species on Dec. 28, 1899 and Looss published the description of his genus *Lepoderma* with the type species *L. Ramlianum* Looss with a subfamily Lepodermatinae on the same date. Brown (1900) who first pointed out the synonymy of these genera as well as that of *Prosthogonimus* Luhe with *Prymnoprion* Looss on account of the priority by one day of “versendungsdatum” (date of posting) of Luhe’s work accepted the genus erected by Luhe. Stiles (1901) reviewed the question of synonymy of these two genera, also adopted Luhe’s denomination giving preference to the date of issue. He clarified that the issue no. 604 of *Zoologischer Anzeiger* with the erection of *Plagiorchis* Luhe, 1899 was published on 28 December, 1899 and sent to subscribers on 29 Dec., while the issue of *Zoologischer Jahrbucher* with the erection of

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Lepoderma Looss, 1899 though published on the same date was sent to distribution on 30 Dec. He therefore, concluded that the name *Plagiorchis* has priority and the family name should accordingly be Plagiorchiidae. Poche (1926), Fuhrman (1928), Skrjabin and Antipin (1958) and majority of other researchers accepted stiles' conclusion in taking "versendungsdatum" to settle the controversy and to recognize the priority of *Plagiorchis* Luhe, 1899 over *Lepoderma* Looss, 1899. Talbot (1934) also accepted the validity of the the genus *Plagiorchis* and the family name Plagiorchiidae. This view was also accepted by Tkach, 2008.

As per the literature available on Plagiorchiids and the different views expressed by another school of thought, Odhner, 1911 gave priority to the name *Lepoderma*. Mehra, 1931 also preferred the name *Lepoderma*, considering it arbitrary to attach importance to the date of issue of the journal from the press. The name *Lepoderma* and Lepodermatidae were also accepted by Baer (1924) without assigning any reason.

The family plagiorchiidae is the largest of the digenetic trematodes. Looss in 1899 considered it as subfamily Lepodermatinae. Odhner, 1911 while characterizing Lepodermatinae Looss, included it in his new family Lepodermatidae which he raised by adding to it a large number of other genera, the systematic position of which was not certain. Baer (1924) divided this family into two, Lepodermatidae Odhner (1911) e.p. Baer and Reniferidae (Pratt,1902) e.p. Baer on the basis of the presence and absence of the lateral branches of excretory bladder. He divided Lepodermatidae further into five subfamilies, Saphederinae Baer, Lepodermatinae Looss e.p. Baer, Cymatocarpinae Baer, Brachycoeliinae Looss and Astiotrematinae Baer. The family Reniferidae was also divided by him into three subfamilies, Enodiotrematinae Baer, Reniferinae Pratt e.p. Baer and Styplotrematinae Baer.

While Poche, 1925 criticized the creation of the family Reniferidae, Odhner also denounced it. Following Odhner's rejection, Fuhrman, 1928 dropped Baer's subfamilies. Travassos, 1928 gave a tentative classification without any indication of the characters on which it was based. He divided the subfamily Lepodermatinae into four sections and included the genera of all the five subfamilies, Lepodermatinae Looss, Astiotrematinae Baer, Styplotrematinae Baer, Cymatocarpinae Baer and Endodiotrematinae Baer. Mehra, 1931, while discussing the relationship of the genera, dropped the family Reniferidae, amended the subfamilies Styplotrematinae and Reniferinae and created additional

genera. While accepting the validity of the family Lepodermatidae Odhner, 1910, he included in it ten subfamilies: Lepodermatinae Looss, Saphederinae Baer, Brachycoelinae Looss amended by Odhner, Styplotrematinae Baer (amended by Mehra), Reniferinae (Pratt, 1902) amended by Mehra, Endiotrematinae Baer, Opisthognominae Travassos, Encyclometriinae Mehra, Prosthognominae Luhe and Telorchiinae Looss,1899. Schulz and Skworzov,1931 further added to the confusion by creating two sub-genera for the genus *Plagiorchis*: (a) *Plagiorchis* Luhe,1899, on account of the vitellaria not uniting mesially in front of acetabulum and (b) *Multiglandularis* Schulz et Skworzov,1931 on account of the vitellaria uniting in front of acetabulum so as to form the anterior commissure. They also gave a list of fifty species, according to their hosts and the sub-genus to which they belong.

Thapar, 1933 retained the subfamily Astiotrematinae Baer, 1924. Mehra, 1937 revised the family Lepodermatidae on account of certain points raised by some researchers after the publication of his previous work in 1931. He did not agree with Thapar (1933) with regard to the retention of the subfamily Astiotrematinae Baer, 1924. He raised certain new genera for the already known species, dropped the subfamily Saphederinae Baer and created a new subfamily Pneumonoecesinae. He also supported Pande (1932) for the retention of Cephalogoniminae as sub family instead of the family Cephalogonimidae. He retained Prosthognominae, provisionally accepted the family Stomylotrematidae Poche but expressed the opinion that it should be reduced to the rank of a subfamily as created by Travassos within Lepodermatidae. Skrjabin, 1958 in his publication of "Trematodes of animals and man" Vol.XIV recognized the classification given by Mehra (1931).

The family Plagiorchiidae Luhe, 1901, as it stands is a very large group containing hundreds of described species. As would be expected in such a large group, the divergence of species is exceptionally noticeable and because of these deviations in adult characters it is difficult to arrive at a definite conclusion to determine the criteria to be used for obtaining a natural classification. The work on classification undertaken by several researchers has been counterproductive due to lack of coordination between any two helminthologists as a result of which several subfamilies were raised without justifying the characters assigned to each subfamily. This confusion was illustrated by mcmullen, 1935 in a paper published with certain trematodes which were placed in Allocreadiidae on the basis of characteristics of the

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excretory bladder in adults. McMullen, 1937 selected ten subfamilies with sixty genera and revised only those groups with sufficient knowledge of the life history and excretory system. While discussing the taxonomy of the Plagiorchiidae he gave a comparative review of the known life cycles of Xiphidiocercarie Luhe, 1909. Based upon this study he concluded that the comparison provides sufficient evidence to accept the recognition of the super family Plagiorchioidea (Luhe, 1901) Plagiorchioidea Dollfus, 1930. On the basis of the evidence found by him, he amended the diagnosis of the super family and included within it all trematodes which develop from Xiphidiocercarie. He accordingly included four families within Plagiorchioidea: Plagiorchiidae Luhe, 1901 (emend.); syn. of Plagiorchiidae Ward, 1917; Macroderoididae n. Fam.; Reniferidae Baer, 1925 (emend.) And Haplometridae n. fam. Prudhoe and Bray (1982) criticized the family diagnosis of McMullen (1937) besides pointing out the inconsistency in the shape of excretory bladder. This was also supported by Tkach, 2008 who clarified that the shape of excretory vesicle, although a “very important character in the systematics of Plagiorchiidae Luhe, 1901 is strongly dependant on fixation and age of parasite”. Accordingly he did not use this character in distinguishing morphological factors while reviewing the Plagiorchiidae.

Yamaguti, 1958 added seven more new subfamilies to the list, emended Encyclometriinae Mehra, 1931 and Haematoloecinae Freitas et Lent, 1939, recognized and accepted the validity of other ten subfamilies and presented a list of a total of nineteen subfamilies under the family Plagiorchiidae thus: Protenterinae Yamaguti, 1958; Astiotrematinae Baer, 1924; Styphlodoridae Dollfus, 1937; Omphalometrinae Looss, 1899; Haematoloecinae nom. Emend. For Haematoloecinae Teixeira de Freitas et Lent, 1939; Plagiorchiinae Pratt, 1902; Alloglyptinae Yamaguti, 1958; Aporchiinae Yamaguti, 1958; Macroderinae Yamaguti, 1958; Bieriinae Freitas, 1956; Oistosominae Yamaguti, 1958; Leptophallinae Dayal, 1958; Stomatrematinae Yamaguti, 1958; Enodiotrematinae Baer, 1924; Sticholecithinae Freitas, 1916; Opisthogoniminae Travassos, 1928; Doliochoperioidinae Johnson et Angel, 1940; Natrioderinae Yamaguti, 1958; Encyclometrinae Yamaguti, 1958 nom. Emend. For Encyclometriinae Mehra, 1931. Earlier Baer (1924) had given a family status to the subfamily Reniferinae (Baer, 1924) which was turned down by the subsequent authors. Yamaguti, 1971 considered it a tribe Ochetosomatini Leao, 1945 under the subfamily Styphlodoridae Dollfus, 1937.

The works of Tkach, 2008 stand out as important and valuable contribution towards this group. While revising the family Plagiorchiidae, Tkach, 2008 separated a number of genera and shifted them to their original families viz., Leptophallidae Dayal, 1938, Haematoloecidae Freitas et Lent, 1939, Glyphthelminthidae Cheng, 1959, Omphalometridae Looss, 1899, Encyclometridae Mehra, 1931, Opisthogonimidae Travassos, 1928, Reniferidae (Baer, 1924) and Styphlotrematidae Baer, 1924. He retained only non-monophyletic genera within the Plagiorchiidae. His efforts towards studying molecular phylogeny of the Plagiorchiids proved futile due to the non availability of important taxa from Africa, Asia and South America. Further, while accepting the previously proposed synonymies of certain genera, he too synonymised a number of genera besides assigning new systematic allocations. In this key, he dropped all the subfamilies except for those that were raised to the rank of family and clarified that due to nonavailability of sufficient data, the remaining genera in the Plagiorchiidae cannot be separated confidently into monophyletic lineages. He further suggested that: “In my opinion, the family Plagiorchiidae (*sensu stricto*) should include only digeneans from tetrapods possessing a well developed cirrus sac containing a bipartite seminal vesicle, a uterus that passes between testes or partly overlap them, a “y” shaped excretory vesicle with short arms, a protonephridial formula of $2[(3+3+3) + (3+3+3)]=36$ and arthropods as intermediate hosts.” After synonymizing several genera with *Plagiorchis*, the main diagnostic features which he chose and recorded for the genus are: *Plagiorchis* Luhe, 1899 (syn. *Lopoderma* Looss, 1899; *Cercolecithus* Perkins, 1928; *Multiglandularis* Schulz et Skvortsov, 1931; *Neolepoderma* Mehra, 1937; *Plagiorchoides* Olsen, 1937; *Choristogonoporus* Stunkard, 1938; *Paralepidauchen* Brinkman, 1956; *Metaplagiorchis* Timofeeva, 1962.

Body oval to fusiform, elliptical or elongated; cuticle covered with spines. Oral sucker subterminal. Ventral sucker located at one third of body length or more from anterior end, usually smaller than oral sucker. Prepharynx and oesophagus present or absent; pharynx present; intestinal caeca bifurcate in forebody to terminate at or near posterior extremity. Testes oblique, usually in middle, rarely in posterior third of body. Cirrus sac containing bipartite seminal vesicle and pars prostatica extends usually beyond ventral sucker; cirrus smooth. Genital pore immediately anterior to ventral sucker, median or slightly submedian. Ovary posterior or

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posterolateral to ventral sucker or near base of cirrus sac. Seminal receptacle absent. Laurer's canal present. Uterus passes between ovary and anterior testis, reaching near posterior extremity. Eggs numerous. Vitellaria form fields commencing from level of intestinal bifurcation into hind body, extending to posterior extremity, usually confluent in post-testicular region and may be confluent in fore body. Excretory vesicle Y shaped. In intestine of tetrapods. Cosmopolitan. Type species: *Plagiorchis lima* (Rudolphy, 1809) Luhe, 1899. (Junior synonym of *P. vespertilionis* (Muller, 1780) Braun, 1900)

The genus *Plagiorchis* as it stands today consists of a large number of species described from various parts of the world but unfortunately the descriptions in many instances are inadequate, indefinite or confused due to inaccurately studied species within the group. The author is therefore, of the opinion that as our knowledge accumulates, the existing classification obviously seems to be confused or superficial due to sharp divisions on the composition of the family Plagiorchiidae. There seems to be no justification in erecting new species without valid grounds, especially, when the distinctions between them are tenuous. The author also does not commend the creation of new species from a single specimen. The final determination of specific identity should be left to the further studies on anatomy, discovery of life cycles and description of larval stages by future helminthologists.

The genus *Plagiorchis* was established by Luhe in 1899 and assigned to the family Plagiorchiidae Luhe in 1901. Out of a total of 190 species described from various parts of the World (ITIS standard report, 2011), twelve species have been recorded from India which are : *P. casarcii* Mehra, 1937 in *Casarca ferruginea*; *P. bulbuli* Mehra, 1937 in *Molpastes haemorrhous intermedius*; *P. ferruginus* Mehra, 1937 in *Casarca ferruginea* (Skrjabin and Antipin, 1959); *P. funambulusi* Gupta et Jahan, 1980 in *Funambulus palmarum*; *P. himalaya* (Jordan, 1939) in *Bufo* sps. (Common toad); *P. guptai* Khan et Das, 1986 in *Herpestes edwardsii*; *P. horridus* (Leidy, 1850) Stossich, 1904 from U.S.A.; *P. orientalis* Jha, 1944 in *Nycticejus kuhli*; *P. pipistrellicola* Fotedar and Khan, 1974; *P. stunkardi* Dwidi and Chauhan, 1971 in reptilian host; *P. kashmiriensis* Mehra and Kharoo, 1974 in *Vesperugo serotinus* and *P. tcheri* Khan and Chisti, 1983 in *Passer domesticus*. *P. vespertilionis* which is a bat parasite has also been reported in a 34 year old man in republic of Korea by Guk, S.M. et al (2007) (Jour.Parasit. 2007).

The aim of the present paper is presentation of a brief history of Plagiorchiidae, besides embodying the

investigations undertaken by the author of the trematodes parasitizing birds in Kashmir, India.

MATERIAL AND METHODS

For more than fifty years the helminth fauna of vertebrates in Kashmir has been studied though the survey work seems far from complete. The extraordinary biological richness of Kashmir has attracted the attention of several prominent parasitologists both from India and abroad who have contributed to increase the amount of information about the helminth parasites of Kashmir. However, a survey of the available literature shows dearth of information on the helminth parasites harbouring birds in Kashmir notwithstanding the fact that this state has a rich and vast Avifauna and their parasites might have a special interest from taxonomic and zoogeographical point of view. During the course of survey of the endohelminth parasites of birds in Kashmir, two mature specimens of the trematodes referable to *Plagiorchis bulbulli* Mehra, 1937 were obtained, one each, from the small intestines of *Hirundo rustica rustica* (Linn. 1758), commonly known as Barn Swallow (local name 'Katij') and *Passer domesticus griseigularis* (Sharpe), known as Kashmir house sparrow (local name 'Tcher'). The birds were caught in Srinagar through bird catchers and necropsied in accordance with ethical procedures. The dissected organs were kept in Petri dishes with 0.85 NaCl solution and examined under high power of microscope. The worms as far as possible, were examined in living conditions to study changes in shape and position of various organs. The trematodes were mounted in toto, compressed-fixed in Bouin's fluid, stained in Ehrlich's haematoxylin, dehydrated in graded series of alcohol, cleared in xylol and kept as whole mounts in Canada balsom. Drawings were made with the help of camera lucida. Identification of the parasites was done at Zoology Department, university of Allahabad. Holotypes were deposited in the helminthological collections of the said department.

RESULTS AND DISCUSSION

Family: Plagiorchiidae Luhe, 1901

Sub-family: Plagiorchinae Pratt, 1902

Genus: *Plagiorchis* Luhe, 1899

Species: *Plagiorchis bulbulli* Mehra, 1937 (Nov. Comb.) (Figs. 1-2 and Table-1).

Description

Redescription based on two mature specimens is given in Table 1.

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A description is given of *Plagiorchis bulbulii* Mehra, 1937 based on newly collected specimens from the small intestines of *Hirundo rustica rustica* (Linn.1758) and *Passer domesticus griseigularis* (Sharpe) in Srinagar, Kashmir. This material as well as re-examination of the original description made possible a detailed study and redescription of the morphology of this inadequately described species.

Body elongated, sides parallel from acetabular level to a little behind posterior testis, measuring 2.31-2.8 in length and 0.64-0.95 in maximum width which lies in the testicular region. Tegument covered with numerous small triangular spines which are distinctly larger and denser on fore body except at the posterior extremity are

visible in the specimen collected from *Hirundo r. rustica* whereas they are not visible in the permanent mount of the specimen found in *Passer d. Griseigularis*. Oral sucker subterminal, large, more or less rounded, 0.224-0.378 x 0.21-0.378 with distinct ventral groove. Ventral sucker also nearly rounded, almost of the same size as oral sucker; situated in the anterior half of the body- the position is slightly variable in the two specimens, 0.224-0.35 in length and 0.196-0.35 broad. Pharynx oval muscular, 0.098-0.112 x 0.112-0.154 in size. Oesophagus very short or practically absent. Intestinal bifurcation just posterior to pharynx, caeca lateral, throughout uniform in breadth and extend posteriorly to terminate a little in front of the hinder body end.

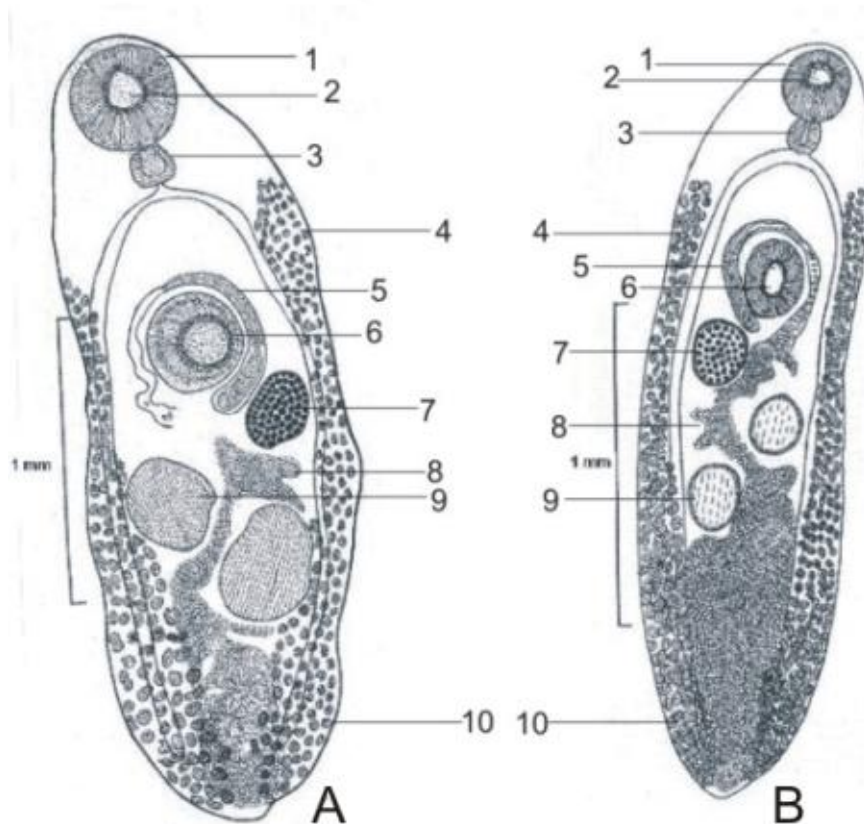


Figure 1. Diagrams showing *Plagiorchis bulbulii* Mehra, 1931 obtained from *Hirundo rustica rustica* and *Passer domesticus griseigularis* respectively. **A *Plagiorchis bulbulii* Holotype; Entire worm; obtained from *Hirundo rustica rustica*; **B** *Plagiorchis bulbulii* Holotype; Entire worm; obtained from *Passer domesticus griseigularis*. (Abbrev. 1&2 - Oral suckers; 3 - Pharynx; 4 - Vitellaria; 5 - Cirrus sac; 6 - Ventral sucker; 7 - Ovary; 8 - Uterus; 9 - Anterior and Posterior Testes)**

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Testes oval, entire, subequal in size, obliquely placed and separated from each other by uterine coils; anterior testis equatorial or slightly post-equatorial, 0.246-0.252 behind acetabulum, 0.196-0.35 in length and 0.154-0.308 in breadth; posterior testis comparatively larger, 0.21-0.42 x 0.154-0.308 in size, 0.182-0.252 behind ovary and 0.714-0.826 in front of the hinder body end. Cirrus sac well developed, semilunar, encircling the right of ventral sucker and its basal part almost filling the entire space between acetabulum and ovary, 0.544-0.672 in length and 0.064-0.096 in maximum width. Voluminous vesicula seminalis well developed, 0.224-0.272 long; pars prostatica small, bulb like; ductus ejaculatorius long and tubular, opening at the genital pore which lies slightly to left in front of acetabulum.

Ovary dextral, oval in shape with entire margin, equatorial or pre-equatorial, 0.196-0.304 in length and 0.168-0.24 in width. Vitellarium composed of numerous follicles, confined to lateral fields but also encroaching towards median line at the posterior end, fields commencing from just behind intestinal bifurcation but not at the same level to terminate at hinder body end beyond blind caecal ends. Uterus mostly occupying the intercaecal space behind posterior testis. Eggs numerous, yellow, 0.027-0.036 x 0.012-0.021 in size.

Remarks

Plagiorchis bulbulii was reported by Mehra in 1937 for the first time in *Molpastes haemorrhous intermedius*, commonly known as Red vented Bulbul from Srinagar, Kashmir in India. The present collection though collected from the same locality but from different hosts belong undoubtedly to *P. bulbulii* Mehra, 1937. It coincides very much in morphological and anatomical features with the description given by Mehra. However, there are conspicuous variations in certain characters between the specimens collected by the author and the original collection which are described below:

- (i) The dimensions of the body show a definite variation, the present specimens being larger.
- (ii) The situation of acetabulum in the original description is at about anterior one third body length, but it is slightly anterior in the specimen obtained from *Hirundo r. rustica* where it lies at about one fourth of body length from anterior end.
- (iii) Testes as described by Mehra in his original description are post-equatorial while in my specimen collected from *Passer d. Griseigularis*, the anterior testis is equatorial though post-equatorial in the worm collected from *Hirundo r. Rustica*.

- (iv) Situation of the ovary in the specimen collected from *Hirundo r. rustica* is almost the same but it is entirely different in the worm collected from *Passer d. Griseigularis* where it is pre-equatorial.
- (v) Vitellaria commence from the level of intestinal bifurcation and extend upto the posterior end of body quite beyond the blind ends of caeca in the present collection, whereas in the original description vitellaria extend from the anterior margin of acetabulum.

The author is confident that these differences are sufficient for redescription of this species with new combinations, if not significant for creation of a new species. These characters appear to be too minor to sustain a specific distinction. These variations could be due to several factors like contraction of the specimens, pressure applied to cover glass and other environmental factors.

Specific Diagnosis (emended): Body elongated, sides parallel from acetabular level to a little behind posterior testis; cuticle beset with minute spines all over body except posterior extremity; oral sucker subterminal, usually rounded; ventral sucker situated in anterior half of body; oesophagus very small or nearly absent; testes rounded to oval, oblique, anterior testis equatorial or post-equatorial; ovary rounded to oval in shape, equatorial or pre-equatorial; receptaculum seminis absent; vitellaria commencing from just behind intestinal bifurcation but not at the same level to terminate at hinder body end; uterus intercaecal, usually behind posterior testis.

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Table 1: Comparative dimensions of *plagiorchis bulbulii*, Mehra, 1937 from different hosts.

	SPECIMENS		
	Mehra, 1931	Author's Collection	
Host	<i>Molpastes h. Intermedius</i>	<i>Hirundo rustica rustica</i>	<i>Passer d. Griseigularis</i>
Locality	Srinagar	Srinagar	Srinagar
Body	1.3-1.9 x 0.38-0.64	2.8 x 0.952	2.31 x 0.644
Cuticle	Beset with spines in front of acetabulum	Spines throughout body except at hinder end	Spines not observed
Oral sucker	0.175-0.2 (diam.)	0.378 (diam.)	0.224 x 0.21
V. Sucker	0.14-0.18(diam.)	0.35(diam.)	0.224 x 0.196
Pharynx	0.07 x 0.077-0.087	0.12 x 0.154	0.098 x 0.112
Oesophagus	Much smaller	Very small	Absent
Ant. Testis	Post-equatorial 0.21(diam.)	Post-equatorial 0.35 x 0.308	Equatorial 0.196 x 0.154
Post. Testis	0.198(diam.)	0.42 x 0.308	0.21 x 0.154
Cirrus sac	-	0.672 x 0.096	0.544 x 0.064
Ves. Seminalis	-	0.272 long	0.224 long
Ovary	Equatorial 0.17(diam.)	Equatorial 0.304 x 0.24	Pre-equatorial 0.196 x 0.168
Vitellaria	Extend from anterior margin of acetabulum to end a little in front of blind ends of caeca	Extend from level of intestinal bifurcation upto hinder end of body	Extend from level of intestinal bifurcation upto hinder end of
Eggs	0.0315- 0.035 x 0.175-0.21	0.027-0.033 x 0.012-0.015	0.036 x 0.021

(All measurements are in mm.)

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