

Studies on Monostomes from the Winter Migratory Birds in Kashmir

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ABSTRACT

Though the earliest account of monostomes was recorded by Zeder (1800) but earlier to that there are several scattered contributions by Goeze (1782) and Schrank (1788). Beginning with the early nineteenth century, monostomes have attracted the attention of several helminthologists worldwide. The detailed study of monostomes harbouring migratory birds in Kashmir is not extensive despite the fact that these birds visit Kashmir in large numbers during winter months. Apart from a preliminary account of *Notocotylus attenuatus* (Rud. 1809) recorded by Fotedar and Kaw (1965), *Paramonostomum kashmirensis* has also been described by Fotedar et Khan (1977). The present study is a contribution towards additional information regarding distribution of these trematodes in migratory birds in Kashmir. Besides presenting a brief history of monostomes, two genera with three species are also reported.

Key Words: Trematode, Monostome, Notocotylidae, *Notocotylus*, *Paramonostomum*.

INTRODUCTION

The earliest account of monostomes can be traced back to that of Goeze (1782) who described two species which he believed to have one sucker (mouth). This was followed by publication of a catalogue of species by Schrank (1788) and thereafter Gmelin (1790) changed the nomenclature of certain genera proposed by Schrank. The first of the monostomes were described in the early nineteenth century by Zeder (1800, 1803) who also established this group by creating the genus *Monostoma*. The publication of *Synopsis Entozooram* by Rudolphi helped in early organization of this group though classification of a large number of species was not perfect and therefore not accepted. Von Siebold (1835) published anatomy of *Monostoma mutabile* (Zeder) along with the early stages of life history through development of egg. Thereafter, Diesing (1850), Van Beneden (1861) Brandes (1892) and Monticelli (1892) also contributed to the knowledge of this group by describing the genera *Cyclocoelium*, *Notocotylus* and *Monostomum*. In the beginning of 20th century the works of Stossich (1902), Odhner (1905, 1907) and Kossack (1911) stand out as important contributions within this group though the studies carried out by Looss (1899) and Luhe (1909) have proved as milestones for future helminthologists. During the first quarter of the twentieth century three comparative studies were made first by Stossich (1902) based on European material, the second by Kossack (1911) on the same material and a comprehensive work on monostomes by Ward (1917) and Harrah (1922) respectively.

Harrah (1922) accepted the validity of four families within Monostomata as Cyclocoelidae Kossack 1911 Notocotylidae Luhe 1909, Collyriclidae Ward, 1917 and Heronimidae Ward, 1917. Of the four families Notocotylidae has attracted maximum attention and has been studied thoroughly. The earliest record of monostomes within this family is *Catartropis verrucosa* (Frolich, 1789) Odhner, 1905 which were later classified as *Fasciola* by Frolich et Gmelin. Though Zeder (1800) placed them in the genus *Monostoma* but Diesing (1839) removed them to a new genus *Notocotylus* to include *Fasciola verrucosa* Frohlich (1789), *Fasciola anseris* (Gmelin, 1790), *Festucaria pedata* (Schrank, 1788) and *Monostoma verrucosum* Zeder (1800, 1803), all of which are synonyms of type species *Notocotylus attenuatus* Rudolphi, 1809 (*N. triserialis*, Diesing, 1839). Diesing (1850) subsequently changed the generic name of *Notocotylus* to *Notocotyle* Diesing without assigning any reason. Though some helminthologists have accepted the new generic name but the author, according to article 32 of International rules of Zoological nomenclature agrees with Kossack, Ward and Harrah in retaining the original name *Notocotylus*. Odhner (1905) while disagreeing with Diesing thought it different from Diesing type species, *Notocotylus triserialis* and accordingly shifted it to the new genus *Catartropis*. The other genera described in the family in the earlier part of twentieth century are *Notocotylus quinqueserialis* (Barker et Laughlin, 1911), *Notocotylus urbanensis* (Cort, 1914), *Catartropis filamentis*

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(Barker,1915,1916) and *Paramonostomum echinum* (Harrah,1922). Although the work on monostomes in India is not very extensive yet whatever little accomplishment, is due to the contributions of Moghe (1932), Bhalerao (1935), Srivastava (1935), Khan (1935), Lal (1935) Fotedar and Kaw (1965) and Kharoo (1974). The author has restricted his studies to only two genera *Notocotylus* and *Paramonostomum* during the present investigation due to the availability of the parasites from these genera only.

The genus *Notocotylus* 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. Harrah (1922) while working upon monostomes commented that “this group of parasites has served as a dumping ground for inaccurately studied species ...” There is still a lot of confusion regarding the validity of the species described so far. Odening(1964) after synonymizing a number of species accepted the validity of only 26 species. Lal (1935) characterized the genus thus : Presence of several rows of protusible glands on the ventral surface of body; absence of pharynx; extracaecal testes at the posterior body end; ovary intercaecal; shell gland pre-ovarian; uterine coils confined to intercaecal region behind cirrus sac; receptaculum seminis absent; eggs with polar filament at both ends.

The other genus *paramonostomum* was created by Luhe (1909) with *Monostomum alveatum* (Mehli's in Creplin,1846) as type species. Earlier, this species was included by Monticelli (1892) in the genus *Notocotylus* (Diesing,1839) but Luhe (1909) said that it is not congeneric with *Notocotylus*. Luhe characterized the genus as : Body compressed, egg shaped, greatest breadth a little caudad from middle of body, posterior end broad, anterior tapering and pointed; anterior half of ventral surface thickly set with short spines; ventral glands absent; cirrus pouch weakly muscular; vagina usually one half of cirrus pouch (Harrah,1922). The presence or absence of minute spines on the cuticle was not given much preference by subsequent workers because of their disappearance in the prepared slides. Barker (1916) criticized the erection of a new genus on the basis of the absence of ventral glands but Harrah (1922) accepted its validity.

Lal (1936) subdivided the genus into two genera, *Paramonostomum* and *Neoparamonostomum* but Harwood (1939) did not accept the validity of Lal's

genus. Yamaguti (1971) recognized two subgenera, *Paramonostomum* and *Paramonostomoides* but Gtoschaft and Tenora (1981) did not accept these as valid which was also supported by Barton et Blair, 2005. Of the several species described in the genus *Paramonostomum* worldwide, Yamaguti (1958) recognized only twelve but Stunkard (1967) raised the number to twenty though he was also very critical of erecting new species without valid grounds, especially, when the distinctions between them are tenuous. He did not commend the creation of a new species from a single specimen but laid emphasis upon the fact that “final determination of specific identity in the genus *Paramonostomum* may depend on discovery of life cycles and description of larval stages.”

The present work, besides presenting a brief history of monostomes, embodies the investigations undertaken by the author during the period 1971-1972 to secure data relating to the infestation of trematode parasites in migratory birds visiting Kashmir during winter months.

MATERIAL AND METHODS

Indian subcontinent plays host to a number of migratory birds in summer as well as in winters. It is estimated that over hundred species of migratory birds fly to India either in search of feeding grounds or to escape severe winter in their natural habitat and the numerous wildlife sanctuaries set up in the country serve as their temporary habitat. Prominent amongst the migratory birds are Pintail, Siberian Cranes, Greater flamingo, Ruff, Black winged stilt, Common Teal, Greenshank, Wagtails, Shoveler, Pelicans, Sandpipers, starling, Blue throat, Pipit etc. (Ind.wildlife mom.). Bird migration in Kashmir is similarly a regular seasonal journey undertaken by many species of birds in response to changes in food availability, habitat or weather, though the primary motivation appears to be food. At least 15-20 species of migratory birds visit Kashmir in flocks with the onset of winter, arriving from Siberia, Afghanistan, China, Central Asia and North Europe. The birds particularly visiting Kashmir are Goose, Mallard, Pintail, Pochards, Shoveler, Common Teal, Eurasian Wigeon, Geese, Ducks, Waterfowls, Grey Heron, Grebe, Common Snipe etc. Their favoured destinations at or around Srinagar, Kashmir are Hoksar, wetlands at Mirgund, Narabal, Shalabug and Hygam which they flock in large numbers and this higher concentration of the migratory birds at stopover sites makes them prone to parasites and pathogens. During the course of survey of the endohelminth parasites of the migratory birds in

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Kashmir, birds belonging to the species *Casarca ferruginea*, *Anser anser* and *Aythya rufa* were examined for any trematode infestation. The birds were caught from Narabal area on the outskirts of Srinagar 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 movements and changes in shape and position of various organs. The excretory and reproductive systems were particularly studied. The monostomes 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. Holotype and paratypes were deposited in the helminthological collection of the said department.

RESULTS AND DISCUSSION

Family: Notocotylidae Luhe, 1909

Sub-family: Notocotylinae Kossack, 1911

Genus: *Paramonostomum* Luhe, 1909

(I) Species: *P. microstomum* Moghe, 1932 (Fig 1: Table 2)

Description

Redescription based on three mature specimens; measurements are in mm.; mean followed by range appear within brackets. *Casarca ferruginea* (syn. *Tadorna ferruginea*) Pallas, 1764 commonly known as Brahmany Duck, Red Duck or Rudy Shelduck is a member of the Duck, Goose and Swan family Anatidae. It is a breeding bird of south-eastern Europe and further eastwards in Asia as far as Tibet, western China and Mangolia , arriving in Kashmir towards fag end of October to November. During the course of

survey of the parasites of these birds, only ten mature specimens of a monostome belonging to the genus *Paramonostomum* Luhe, 1909 were recovered from the intestinal contents of one out of the three *Casarca ferruginea* examined. On closer examination the collection turned out to be *Paramonostomum microstomum* Moghe, 1932.

Sexually mature specimens of the worms are elongated in shape with parallel sides except at the posterior end where it tapers slightly; anterior end blunt, posterior flattened, (1.55) 1.52-1.58 long and (0.47) 0.43-0.51 broad in the region of cirrus sac. Oral sucker (0.106) .096-0.128 x (0.128) 0.112- 0.144 in size. Cuticle completely devoid of spines. Oesophagus small, (0.069) 0.048-0.096 long; caeca narrow, reaching almost up to the posterior end of body. Testes extracaecal at hinder body end, slightly overlapping caeca, opposite to each other at the same level of ovary, lobed, right testis (0.181) 0.16-0.192 x 0.08, left (0.186) 0.16-0.208 x (0.083) 0.08-0.09 in size. Cirrus sac flask shaped, (0.46) 0.43-0.49 x (0.69)0.064-0.080 in size with a long vesicula seminalis externa reaching up to the anterior level of vitellaria; vesicula seminalis interna small, pars prostatica pear shaped, terminating into a long ductus ejaculatorius; cirrus long and curved. Ovary median, partially lobed, situated in the intercaecal space between testes, (0.096) 0.08-0.112 x (0.112) 0.096-0.128 in size.

Mehli’s gland immediately anterior to ovary, 0.112 x (0.15) 0.14-0.16 in size. Vitellaria extracaecal, commence immediately in front of testes on the lateral sides to terminate far behind the middle of body. Uterus pre-ovarian consisting of characteristic transversely arranged coils lying intercaecally up to the base of cirrus sac. Metraterm long, slightly muscular extending up to the bulb of cirrus sac and opens through the common genital pore situated immediately behind the intestinal bifurcation. Eggs 0.012- 0.015 long and 0.006-0.009 broad.

Table 1: General distribution of Entozoa in the hosts examined

Name of host	Number of hosts				
	Examined	With Trematodes	With Cestodes	With Nematodes	With Acanthocephala
<i>Casarca ferruginea</i>	3	1	2	-	-
<i>Anser anser</i>	3	1	1	-	-
<i>Aythya rufa</i>	2	1	-	-	-

Monostomes obtained, their harbouring hosts, classification and redescriptions along with the comparative tables are given below:

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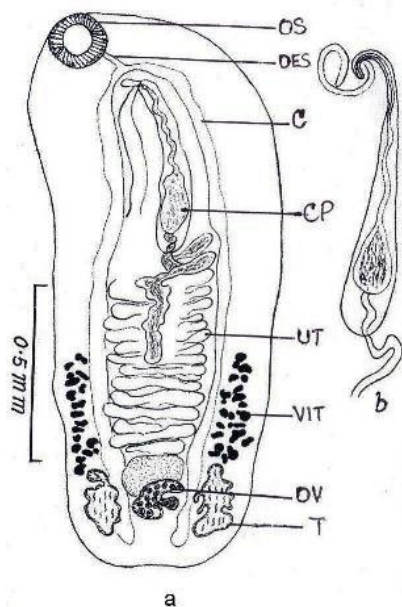


Fig.1 (a). *Paramonostomum microstomum* Holotype, entire worm (b). Enlarged view of cirrus pouch.

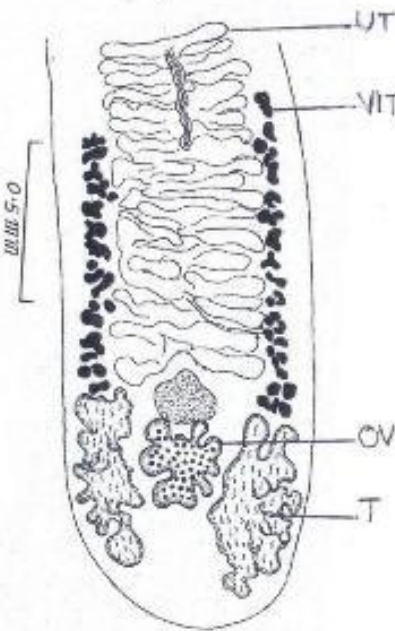
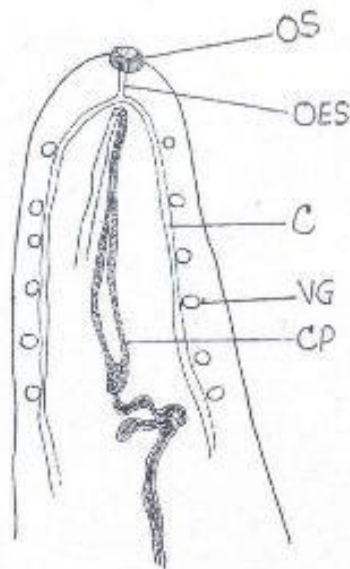


Fig. 2. *Notocotylus intestinalis*. Holotype, entire worm

Fig. 3. *Notocotylus babai*. Holotype, entire worm.

Abbrev: OS-Oral sucker; OES-oesophagus; C-Caecum; VG-Ventral gland; CP-Cirrus pouch; UT-Uterus; VIT-Vitellaria; OV-Ovary; T-Testes

Remarks

The above description is in agreement with the description given by Moghe, 1932 for *Paramonostomum microstomum*. However, the specimens under study show certain variations from the original description (Table-2). Oral sucker is comparatively larger and vitellaria terminate far behind the equatorial line in the author's collection. Cuticular spines were also not

visible and the size of ova also differs in the present collection.

Host: *Casarca ferruginea*

Site: Intestine

Locality: Narabal, Srinagar, Kashmir, India.

No. of specimens obtained: Ten.

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Table 2: Comparison of the specimens of *Paramonostomum microstomum*. All dimensions are in mm.

	S	P	E	C	I	M	E	N	S	
	Moghe, 1932					Author's collection				
Host	<i>Philomachus pugnax</i> ; India					<i>Casarca ferruginea</i> ; Kashmir, India				
Body length	1.348-1.624					1.52-1.584				
Body width	0.375-0.409					0.432- 0.516				
Oral sucker	0.063 in diam					0.096- 0.128 x 0.112- 0.144				
Oesophagus	-					0.048-0.096 long				
Testes	0.13- 0.15 long					0.16-0.208 x 0.08- 0.09				
Cirrus pouch	0.413 long					0.432-0.496 long				
Ovary	-					0.080-0.11 x 0.096-0.128				
Vitellaria	Extend upto equatorial line					Terminate far behind equatorial line				
Eggs	0.015 long					0.012-0.015 x 0.006-0.009				

Family: Notocotyliidae Luhe, 1909

Sub-family: Notocotylineae Kossack, 1911

Genus: *Notocotylus* Diesing, 1839

(II) Species: *Notocotylus intestinalis* Tubangui, 1932

(Fig. 2; Table-3)

Description

Redescription based on three mature specimens; all dimensions are in mm. *Anser anser* (Linnaeus, 1758) commonly known as Rajhans in India and Greylag Goose elsewhere is a member of the family Anatidae. A bird with a wide range in the old world, it is the largest and bulkiest of the Grey Anser Geese extending across Asia to China. Last to migrate towards south or west in winter, it arrives in Kashmir during November. During the course of survey of any parasitic infestation in these birds, only three mature specimens of a trematode belonging to the genus *Notocotylus* Diesing, 1839 were collected from the intestine of one out of the three birds examined. On closer examination the collection turned out to be *Notocotylus intestinalis* Tubangui, 1932.

Body elongated, rounded at both the extremities, narrowing towards the anterior extremity. It measures 2.74-2.94 in length and 0.72-0.798 in maximum breadth at the region of vitellaria. Spines absent. Ventral glands are arranged in three longitudinal rows, the two lateral rows are extracaecal and comprise of 20 glands each whereas the median row consists of 18 glands. Oral sucker terminal, 0.08-0.096 x 0.122-0.128 in size, leads into a short oesophagus 0.08 long which bifurcates into intestinal caeca at 0.176 from the anterior end of the body. Caeca bend inwards in the region of

gonads and terminate at the posterior end of testes. Testes are deeply indented, symmetrically placed on either side of the ovary at the posterior extremity of body, measuring 0.48-0.55 x 0.176-0.256 in size. Cirrus sac median, more or less club shaped, 0.896 long and 0.08 broad at the base. Vesicula seminalis externa extends upto the middle of body and anteriorly it enters the cirrus sac as a short vesicula seminalis interna which continues into pars prostatica; ductus ejaculatorius long and tubular. Ovary deeply multilobed situated in the intertesticular space in between caeca and measures 0.256-0.276 x 0.24 in size. Vitellaria commence from the anterior margin of testes and extend upto the middle of body length; vitelline glands 0.8-1.056 long. Shell gland mass placed immediately in front of ovary. Transverse uterine coils nineteen in number are confined to the intercaecal space anterior to ovary. Muscular metraterm opens at the common genital pore situated immediately behind intestinal bifurcation. Eggs numerous, 0.015 x 0.009 in size.

Remarks

The measurements of the specimens under description are given in Table-2 along with the original description given by Tubangui, 1932 for comparison. The description tallies with that given by Tubangui for *Notocotylus intestinalis* though there are a few minor variations. Oral sucker is terminal in my collection but subterminal in earlier description. Cuticular spines were not observed in specimens collected by me. The number of ventral glands in all the three rows is larger than mentioned by Tubangui. There are also variations in the size of gonads and ova.

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Table 3: Comparison of the specimens of *Notocotylus intestinalis* (All dimensions are in mm)

	S	P	E	C	I	M	E	N	S	
	Tubangui, 1932					Author's collection				
Host	<i>Anas platyrhynchos</i>					<i>Anser anser</i> ; Kashmir, India.				
Body length	2.30-3.25					2.744-2.94				
Body width	0.54-0.75					0.72-0.798				
Oral sucker	0.12 in diam					0.08-0.096 x 0.122-0.128				
Oesophagus	0.08-0.1					0.08				
Testes	0.14-0.64 x 0.16-0.22					0.48-0.55 x 0.176-0.256				
Cirrus pouch	0.62-0.88 x 0.07-0.08					0.896 x 0.08				
Ovary	0.17-0.24 x 0.16-0.18					0.256-0.276 x 0.24				
Ova	0.018-0.025 x 0.013-0.014					0.015 x 0.009				
No. of ventral glands:										
Total	47-49					58				
Centre	15					18				
Sides	16-17					20				

Family: Notocotylidae

Sub-family: Notocotylinae

Genus: *Notocotylus*

(III) Species: *Notocotylus babai* Bhalerao,1935 (syn. *N. indicus* Lal,1935) (Fig. 3; Table 4)

Description

Redescription based on eight mature specimens; All dimensions are in mm. *Aythya rufa* or White Eyed Pochard is one of the characteristic ducks of Palearctic region, breeding throughout much of Europe and western Asia. As a transit camp it winters in small numbers in Kashmir. Though in Kashmir this species seems to be quite rare (Baker,1921) but in other parts of India it is common enough throughout northern part. Hume and Marshall(1879) describe it rare in India but has been sighted in Hyderabad, Gujarat , Kutch upto Madras. In regard to the migration in Asia, the information is very meager. The only testimony is by Hume and Marshal, Baker (1921) and other naturalists, that in India they arrive by the end of October and November. They feed chiefly on roots and seeds of various species of water weeds (Nauman 1896-1905),

besides vegetation, pebbles and sand, insects, grubs, worms and tiny frogs (Hume and Marshall,1879). During the routine examination of the birds, eight mature specimens of a monostome belonging to the genus *Notocotylus* were located in the intestinal

caeca of one out of the two birds dissected. The trematodes recovered there from turned out to be *Notocotylus babai* Bhalerao,1935 (syn. *N. indicus*, Lal, 1935). Body elongated, much wider in the anterior half, measuring 1.92-3.056 in length, 0.656-1.104 in breadth in posterior body half and 0.72-1.312 in anterior body region. Spines not visible in mounted specimens. Ventral glands in three rows – lateral rows contain 15 glands each and 14 glands in the middle row. Oral sucker subterminal, usually rounded, 0.096-0.144 x 0.112-0.176 in size. Oesophagus 0.08- 0.128 long; caeca terminate slightly beyond the posterior margin of testes. Testes lobed, symmetrical, extracaecal, situated at the posterior end of body, 0.224-0.4 in length and 0.128-0.192 in breadth. Cirrus sac well developed, 0.528-0.784 long and 0.064-0.128 in maximum breadth ; vesicula seminalis externa long, commencing a little in front of vitellaria; vesicula seminalis interna short and coiled within the base of cirrus sac, continues anteriorly as a small pars prostatica which is further prolonged into a tubular ductus ejaculatorius; cirrus small. Ovary 3-5 lobed, intercaecal in testicular zone, 0.096-0.16 long and 0.16-0.27 broad. Shell gland complex immediately in front of ovary, 0.08-0.16 x 0.144-0.256 in size. Uterine coils 14-19 in number, usually intercaecal, though, a few anterior coils overlap caeca. Metraterm long, opening at the common genital pore behind intestinal bifurcation. Ova numerous, 0.018 x 0.006-0.009 in size. Vitellaria follicular, extracaecal,

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Table 4: Comparison of the specimens of *Notocotylus babai* (All dimensions are in mm)

	S	P	E	C	I	M	E	N	S
	Bhalerao, 1935			Lal, 1935			Author's collection		
Host	<i>Milvus migrans</i> ; Rangoon			<i>Mareca Penelope</i> ; India			<i>Aythya rufa</i> ; Kashmir, India		
Body length	3.83			2.18			1.92-3.056		
Body width	0.93			0.63			0.656-1.104		Post. half
							0.72-1.312		Ant. half
Oral sucker	0.2 x 0.16			0.12-0.13 long			0.096-0.144 x 0.112-0.176		
Oesophagus	0.12			0.075 long			0.08-0.128 long		
Testes	0.535-0.545 x 0.24-0.275			0.36-0.38 long			0.224- 0.4 x 0.128-0.192		
Cirrus sac	1.09 long			0.58 long			0.528-0.78 x 0.064-0.128		
Ovary	0.3-0.31			0.18 x 0.16			0.096-0.16 x 0.16-0.272		
Vitellaria	Terminate behind middle Line of body.			Terminate behind Middle body level.			Terminate far behind middle of body length		
Ova	0.014-0.017 x 0.008-0.011			0.018 x 0.011			0.018 x 0.006-0.009		
No. of ventral glands									
Total	47			49			44		
Centre	15			16			14		
Sides	17			17			15		

commencing immediately in front of testes and terminate far behind the middle of body length.

Remarks

The specimens under study resemble with the descriptions given by Bhalerao, 1935 and Lal, 1935 in all major characters except some minor variations in sizes (Table-4). The number of ventral glands in the author's collection is comparatively less and ovary is only 3-5 lobed.

Host: *Aythya rufa*

Site: Intestinal caeca

Locality: Srinagar, Kashmir

No. Of specimens Obtained: 8

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reviewed, emended and updated by incorporating the contributions of subsequent workers through their published records and original data on the group/family/genus wherever necessary as on date. Certain details concerning bird nomenclature, habit/habitat is also added to the previous description.

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