

Research Article

***Paramonostomum bubaki* n. sp. (Digenea: Notocotylidae) from the Black Coot, *Fulica atra* (Gruiformes: Rallidae), in South Central Pakistan**

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Received 18 January 2013; Accepted 13 February 2013

Academic Editors: M. Cucco, P. V. Lindeman, M. Paolucci, T. H. Struck, and S. E. Walker

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During a helminthological survey of black coot, *Fulica atra* (Gruiformes: Rallidae), in Sindh Province of Pakistan, eight specimens of undescribed species of trematode belonging to genus *Paramonostomum* Lühe, 1909 were recovered from large intestine of the single host bird. *Paramonostomum bubaki* n. sp. differs from its congeners except *P. macrovesiculum* Dharejo et al., 2006 by having less attenuated anterior end, a pharynx, a bifurcal genital pore, a longer posttesticular space, a Y-shaped excretory vesicle, number of uterine loops (16), and large size of filamentous eggs. *P. bubaki* n. sp. resembles *P. macrovesiculum* Dharejo et al., 2006 collected from *Fulica atra* from Pakistan by having a pharynx but differs in larger body, smaller esophagus, a bifurcal genital pore, shape of cirrus sac, seminal vesicle and gonads, ceca reaching posterior extremity, and a longer posttesticular space.

1. Introduction

Pakistan exhibits a certain cohesion of physical geography and climate which has a great bearing upon the distribution and habits of its bird fauna. Pakistan gets a large number of migrant birds from Europe and Central Asian countries every year. Birds from the North spend winters in different wetlands and have also been found living in the manmade ponds in Pakistan [1]. These habitats provide favorable environment for breeding as well as the development of populations of snails, crustaceans, and insect fauna, which enhances likelihood of acquiring parasitic infection [2]. Reports of *Paramonostomum* species in Pakistan are limited to those of Dharejo et al. [2] and Bhutta and Khan [3]. Other trematodes reported from *Fulica atra* in Pakistan are *Cotylurus sindhense* Birmani et al., 2009 [4], *Echinostoma atrae* Birmani et al., 2008 [5], and *Paramonostomum macrovesiculum* Dharejo et al., 2006 [2]. Snail species *Thiara riquetti*, *Hydrobia vulva*, *Hydrobia ventrosa*, *Hydrobia salsa*, and *Peringia ulvae* have been reported to be an intermediate hosts in life cycle of

Paramonostomum species [6]. *Fulica atra*, a migratory game bird, is a popular food item in Sindh Province. Therefore, the interest was developed to investigate this bird for the presence of helminth parasites.

2. Materials and Methods

Live one hundred and one black coot, *Fulica atra* Linnaeus (Gruiformes: Rallidae), collected from different water bodies of Sindh Province, Pakistan, during winter season (2007–2010) were examined for endohelminths. Trematodes were put into 0.9% saline, relaxed in hot water, fixed under slight cover glass pressure in alcohol-formalin-acetic acid (AFA), stained with borax carmine, dehydrated in a graded series of ethanol solutions, then cleared in clove oil and xylol, and mounted in Canada balsam. Illustrations were made with aid of camera lucida. All measurements are given in micrometer (μm) unless otherwise stated, as holotype is followed by range in parenthesis. Specimens were identified and compared with the literature available.

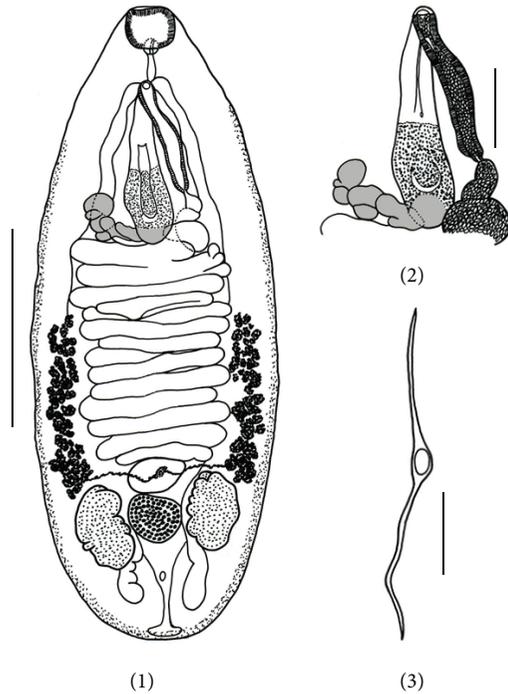


FIGURE 1: *Paramonostomum bubaki* n. sp. (1) entire worm; (2) cirrus sac; (3) egg. Scale bar: (1) 1000 μm ; (2) 300 μm ; (3) 50 μm .

3. Results

Family Notocotyliidae Lühe, 1909

Genus *Paramonostomum* Lühe, 1909

Paramonostomum bubaki n. sp. (Figure 1)

Description (based on 8 specimens): Body elongate, attenuated anteriorly, rounded posteriorly, 3.20 mm (2.24–3.26) long by 1.22 (0.80–1.22) wide. Tegument roughly outlined. Oral sucker rounded, 200 (160–210) long by 250 (170–250) wide. Pharynx 80 (40–110) long by 60 (30–90) wide. Esophagus short, 130 (30–130) long. Intestinal caeca terminate 150 (140–160) from posterior extremity and are greatly concealed before its termination by compact uterine coils and testes.

Testes side by side, irregular, slightly lobed, extracecal, in last quarter of body; right testis 400 (290–510) long by 260 (120–260) wide; left testis 440 (270–450) long by 260 (170–260) wide; posttesticular space 370 (280–370) long (11.34%–12.5% of body length). Cirrus sac club-shaped, containing cirrus, prostate glands and seminal vesicle, 820 (740–870) long by 220 (130–220) wide (25%–33% of body length) extending from level of cecal bifurcation. External seminal vesicle convoluted. Genital pore receives both male system and female uterus, situated at level of cecal bifurcation, 380 (220–400) from anterior extremity.

Ovary, intercecal, intertesticular, 250 (170–250) long by 260 (160–300) wide; seminal receptacle preovarian, 180 (80–210) long by 300 (120–300) wide; metraterm smaller than cirrus sac, 600 (430–610) long. Transverse vitelline ducts from either side meet to form a common vitelline duct to

open at ootype. Uterine loops compact 16 in number mostly intercecal, partly overlapping ceca extending up to posterior end of cirrus sac. Eggs with long polar filaments, 190–210 long. Eggs exclusive of polar filaments 15–19 long by 9–11 wide. Vitellaria follicular, extending from middle of body reaching up to anterior margin of testes. Excretory vesicle Y-shaped.

Taxonomic Summary

Type Host: black coot, *Fulica atra* (Gruiformes: Rallidae).

Type locality: manchar Lake (26°24'N, 67°38'E), Bubak City, Sindh Province, Pakistan

Site of infection: large intestine

Type specimens: a specimen is to be deposited in Natural History Museum London.

Prevalence: 0.99%

Etymology: specific name refers to locality of host.

4. Discussion

Genus *Paramonostomum* and subgenus *Paramonostomum* Lühe, 1909 were erected to accommodate trematodes from several orders of birds including Anseriformes, Charadriiformes, Ciconiiformes, Galliformes, and Gruiformes [7]. The type species is *Paramonostomum alveatum* (Mehlis in Creplin, 1846) Lühe, 1909 from *Actitis macularia*, *Anas penelope*, *Anser anser*, *Branta* sp., *Charadrius wilsonia*, *Charadrius hiaticula semipalmatus*, *Clangula hyemalis*, *Cygnus* sp., *Nyroca marila*, *Oedemia* sp., and *Somateria mollissima* [8]. *Paramonostomum alveatum* (Mehlis in Creplin, 1846) Lühe, 1909 differs from *Paramonostomum bubaki* in body shape, absence of a pharynx, postbifurcal genital pore, smaller and wider testes, deeply lobed ovary, very short posttesticular space, and uterine loops 6–11.

Paramonostomum species reported from Pakistan include *P. macrovesiculum* Dharejo et al., 2006 [2] from *Fulica atra* which resembles *P. bubaki* only in presence of pharynx but differs in having a smaller body, longer esophagus, voluminous seminal vesicle, bulb-shaped cirrus sac, postbifurcal genital pore, testes more elongated broadly flattened anteriorly and tapering posteriorly, elongated and lobed ovary, poorly developed metraterm, and ceca not reaching posterior extremity; *P. kuntzi* Bhutta and Khan, 1975 [3] from *Gallinula chloropus* differs in having an oval body, pharynx absent, short esophagus, longer cirrus sac, postbifurcal genital pore, uterine loops 13–14, and smaller eggs.

Paramonostomum species reported from *Fulica atra* outside of Pakistan include *Paramonostomum* sp. Foronda et al., 2003 [9] and *P. fulicai* Baugh, 1958 [10]. *Paramonostomum* sp. Foronda et al., 2003 [9] differ from *Paramonostomum bubaki* in having a smaller body, pharynx absent, short esophagus, termination of ceca at posterior level of testes, postbifurcal genital pore, vitellaria extended up to posterior level of testes, and posterior half of uterus without coils; *P. fulicai* Tanveer and Chishti, 2001 [10], reported by Tanveer and Chishti, 2001 [10] from *Fulica atra* differs in shape and size of body,

absence of pharynx, short esophagus, postbifurcal genital pore, cirrus sac and metraterm of almost same size, shape of the ovary, and seminal receptacle and has more elongated testes (Table 1).

Other *Paramonostomum* species: *P. pseudalveatum* Price, 1931 reported by Drago et al., 2007 [11] from *Anas georgica* differs in having a smaller ovoid body, pharynx absent, shape of testes, ovary irregularly outlined and located at posterior level of testes, very short posttesticular space, vitelline glands reaching up to cirrus sac anteriorly, 4–7 uterine loops, and smaller eggs.

P. himantopodis (Harwood, 1939) Cribb, 1991 illustrated by Jones et al., 2005 [7] differs in body shape, pharynx absent, postbifurcal genital pore, gonads situated near posterior end of body, elongated lobed ovary, and very short posttesticular space.

P. galli Tanveer and Chishti, 2001 [10] from *Gallus gallus domesticus* differs in shape and has a larger body, pharynx absent, larger cirrus sac, ceca terminate before posterior margins of testes, more elongated deeply lobed testes, lobed ovary notched posteriorly, and smaller eggs.

P. kherai Gupta and Singh, 1985 [12] from *Casarca ferruginea* and *Dafila acuta* differs in smooth and larger body, pharynx absent, genital pore at posterior half of oral sucker, elongated deeply lobed testes and ovary, termination of ceca at posterior level of testes, uterine loops 20–23, and smaller eggs.

P. makundi Gupta and Singh, 1985 [12] from *Anser indicus* differs in smooth and wider body, pharynx absent, genital pore at posterior border of oral sucker, pear-shaped cirrus sac, presence of cecal diverticulae, termination of ceca before posterior level of testes, larger and deeply lobed testes, ovary lobed and bifid posteriorly, uterine loops 16–19, and smaller eggs.

P. salimi Gupta and Singh, 1985 [12] from *Anas poecilorhyncha* and *Anas platyrhyncha* differs in smooth and wider body, pharynx absent, genital pore immediately behind oral sucker, pear-shaped cirrus sac with wavy margins, ceca with diverticulae terminate before posterior level of testes, deeply lobed testes and ovary, uterine loops 17–23, and smaller eggs.

P. antarcticum Graefe, 1968 reported by Odening, 1982 [13] from *Larus dominicanus* differs in having an oval body, pharynx absent, ceca with diverticulae, smaller cirrus sac, genital pore at posterior border of oral sucker, much lobed testes and ovary, and ovary extended beyond caudal margins of testes.

P. querquedula Lal, 1936 reported by McDonald (1981) [14] from *Querquedula circa* differs in absence of pharynx, postbifurcal genital pore, larger cirrus sac, more elongated testes, much lobed ovary, ceca with diverticulae not extending beyond testes, very short posttesticular space, and uterine loops 17–18.

P. indica Gupta and Gupta, 1976 [15] from *Anser indicus* differs in having smooth and larger body, absence of pharynx and seminal receptacle, genital pore behind oral sucker, metraterm longer than cirrus sac, lobed testes and ovary, and testes very close to posterior extremity.

P. poecilorhynchai Gupta and Gupta, 1976 [15] from *Anas poecilorhyncha* differs in having smooth and larger body, absence of pharynx and seminal receptacle, genital pore just behind oral sucker, metraterm longer than cirrus sac, testes large very close to posterior extremity, lobed ovary, uterine loops 17–18, and smaller eggs.

P. thapari Gupta and Gupta, 1976 [15] from *Nettapus coromandelianus* and *Anser indicus* differs in having smooth and smaller body, absence of pharynx and seminal receptacle, esophagus short, genital pore immediately behind oral sucker, metraterm longer than cirrus sac, more elongated posteriorly tapering testes, uterine loops 17–19, and smaller eggs.

P. kanpurensis Gupta and Gupta, 1976 [15] from *Anser anser* differs in having smooth body, pharynx absent, short esophagus, metraterm longer than cirrus sac, ceca with diverticulae, postbifurcal genital pore, larger and lobed testes and ovary, seminal receptacle absent, uterine loops 19, and smaller eggs.

P. philippinensis Velasquez, 1969 [16] from chicks and ducks differs in having a smaller body, pharynx absent, prebifurcal genital pore, more elongated lobed testes, intestinal ceca terminate at posterior margins of testes, number of uterine loops 10–12, and smaller eggs.

P. signiensis Jones and Williams, 1969 [17] from *Chionis alba* differs in having spinose body, pharynx absent, short esophagus, genital pore immediately behind oral sucker, ceca with diverticulae, smaller cirrus sac, metraterm and cirrus sac of equal length, ovary elongated and posteriorly notched, seminal receptacle with conspicuous transverse loops in forward course of uterus, excretory bladder very broad, and uterine loops 13–14.

P. histrionici Ching, 1961 [18] from *Histrionicus histrionicus pacificus* differs in having a smaller body, pharynx absent, postbifurcal genital pore, longer cirrus sac, ceca with small diverticula, lobed ovary, and short posttesticular space.

P. nettioni Baugh, 1958 [8] from *Nettion creca* differs in having smaller body, pharynx absent, prebifurcal genital pore, longer cirrus sac, lobed ovary, termination of ceca before posterior margins of testes, short posttesticular space, and uterine loops 12–14.

P. malarischi Dunagan, 1957 [19] from *Philacte canagica* differs in having a more elongated larger body, pharynx absent, prebifurcal genital pore, longer cirrus sac and metraterm, deeply lobed testes, slightly lobed ovary, very short posttesticular space, and uterine loops 12–15.

P. brantae Bullock 1952 [20] from *Branta canadensis* differs in having a smaller and oval body, pharynx absent, postbifurcal genital pore, twisted cirrus sac, broad and oval testes touching posterior extremity of body, and uterine loops 8–11.

P. casarcum Lal, 1936 [8] from *Casarca rutila* differs in having a larger body, pharynx absent, genital pore at rear edge of oral sucker, very lobed and branched testes, elongated and lobed ovary, cylindrical ceca terminate before posterior margins of testes, and short posttesticular space.

P. bucephala Yamaguti, 1935 [8] from *Anas clypeata*, *Bucephala clangula*, *Cygnus olor*, *Netta rufina*, *Nyroca ferina*,

TABLE 1: Comparative morphological features and measurements of *Paramonostomum* species closely related to present species.

Species	<i>P. parvum</i> Stunkard and Dunihue, 1931	<i>P. galli</i> Tanveer and Chishti, 2001	<i>P. elongatum</i> Yamaguti, 1971	<i>P. alveatum</i> (Mehlis in Creplin, 1846) Lühe, 1909	<i>Paramonostomum</i> sp. Foronda et al., 2003	<i>P. macrovesiculum</i> Dharejo et al., 2006
Body size	2.24–3.26 × 0.80–1.22	4.35–4.45 × 1.1–1.25	2.99–3.0 × 0.8–0.9	0.78–0.90 × 0.5–0.56	1.44 × 0.51	1.88–1.98 × 0.71–0.74
Oral sucker	160–210 × 170–250	0.19–0.2 × 0.16–0.19	0.10–0.11 × 0.12–0.13	0.05–0.11	0.10	0.018–0.019
Pharynx	40–110 × 30–90	—	—	—	—	Present
Esophagus	30–130	0.1–0.15	—	—	0.04	0.23–0.25
Cirrus sac	740–870 × 130–220	1.13–1.15 × 0.25–0.27	0.02–0.04 × 0.08–0.10	0.18–0.24	0.36	0.23–0.26 × 0.11–0.13
Right testis	290–510 × 120–260	0.9–0.99 × 0.25	0.32–0.47 × 0.16–0.19	0.11–0.14	0.154 × 0.07	0.43–0.50 × 0.26
Left testis	270–450 × 170–260	0.75–1.0	—	—	0.15 × 0.07	0.45–0.50 × 0.23–0.25
Ovary	170–250 × 160–300	0.35–0.4 × 0.2–0.3	0.15–0.16 × 0.2–0.4	0.08–0.67	0.10 × 0.11	0.25–0.27 × 0.13–0.15
Seminal receptacle	80–210 × 120–300	Present	—	—	Present	Present
Vitellaria	From anterior margin of testes up to middle of body	From middle of uterus up to anterior end of testes	From termination of uterine coils up to anterior margins of testes	From anterior margin of testes up to cirrus sac	From middle of body up to posterior end of testes	From anterior margin of testes up to level of last loop of uterus
Genital pore	Bifurcal	Bifurcal	Postbifurcal	Postbifurcal	Postbifurcal	Postbifurcal
Uterine loops	16	16–18	—	10–12	—	9–10
Eggs	190–210 × 9–11	20–25 × 10–15	22–23 × 12–13	21 × 10	20 × 10	75–148 × 10–13
Host	<i>Fulica atra</i>	Long Island duck	<i>Gallus domesticus</i>	<i>Anas</i> sp.	<i>Fulica atra</i>	<i>Fulica atra</i>
Locality	Pakistan	New York, USA	Kashmir, India	New York, USA	Canary Island, West Africa	Pakistan

Nyroca marila mariloides, *Nyroca nyroca*, *Spatula clypeata*, and *Tadorna tadorna* differs in absence of pharynx, longer esophagus, postbifurcal genital pore, longer cirrus sac and metraterm, ceca terminate before posterior margins of testes, and short posttesticular space.

P. elongatum Yamaguti, 1934 [8] from *Olor bewickii jankowskii* reported by McDonald [14] differs in absence of pharynx, short esophagus, postbifurcal genital pore, longer cirrus sac, more elongated deeply lobed testes, lobed ovary, ceca terminate at posterior margins of testes, and smaller eggs.

P. microstomum Moghe, 1932 [21] from *Philomachus pugnax* differs in having a smaller and elongated body, pharynx absent, very short esophagus, postbifurcal genital pore, an elliptical ovary, very short posttesticular space, transparent uterine loops 13–15, and smaller and wider eggs.

P. parvum Stunkard and Dunihue, 1931 [22] from *Anas platyrhynchos domestica* differs in having smaller oval body, pharynx absent, smaller and curved cirrus sac, short metraterm, much lobed ovary located at posterior level of testes, vitellaria reaching up to level of seminal vesicle anteriorly, ceca that terminate at caudal margins of ovary, and larger eggs.

The name of new species refers to Bubak City where Manchhar Lake is located and from where the host birds were collected.

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