Ecological morphotaxometry of trematodes of garfish (Teleostomi: Belonidae) from Gangetic riverine ecosystem in India. I. Morphology and taxometric assessment of *Cephalogonimus yamunii* n.sp.

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Received: 26 May 2012 / Accepted: 17 August 2012 / Published online: 18 September 2012
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Abstract A new endoparasitic fluke, *Cephalogonimus yamunii* n.sp. is described from the intestine of freshwater fish *Xenentodon cancilla* (Belonidae). The worms could be differentiated from *C. amphiumae* (Chandler 1932), *C. apognichthysi* (Gupta and Puri 1982), *C. hanumanthai* (Agrawal and Agarwal 1984), *C. salamandrus* (Dronen and Lang 1974), *C. simhai* (Singh 2010) and *C. vesicaudus* (Nickerson 1912) in a unipartite seminal vesicle, genital pore subterminal anteriorly, opening at the hind end of oral sucker, equatorial or sub-equatorial testes, besides other morphological attributes of shorter body and pharynx, larger oesophagus and oral sucker, smaller ventral sucker, testes, cirrus sac and ovary, and a terminal excretory pore. Taxometric substantiation has been presented by using Polythetic Divisive Classificatory System, and ecological attributes have been evaluated to validate specific distribution patterns in population dynamics of the new species in simultaneous contributions.

Keywords *Cephalogonimus yamunii* · *Xenentodon cancilla* · Polythetic Divisive Classificatory System · Unipartite seminal vesicle · Taxometric · Ecological

Introduction

Cephalogonimus (Poirier 1886) is a parasite of family Cephalogonimidae, reported initially from amphibians. Several species of this genus were known from fishes in various parts of the world namely *C. hanumanthai* (Agrawal and Agarwal) from *Mystus vittatus*, *C. heteropneustus* (Gupta) from *Heteropneustes fossilis*, *C. indicus* (Gupta) from *Lissemys punctata*, *C. japonicus* (Ogata) from *Amyda japonica*, *C. lenoiri* (Poirier) from *Tetrathya vaillanti*, *C. magnus* (Sinha), *C. mehri* (Pande) and *C. mukerjius* (Rai) from *Trionyx gangeticus*, *T. nilotica* and *T. hurum*, respectively, *C. minutum* (Mehra) from *L. punctata*, *C. seenghalus* (Kakaji) from *Mystus seenghala*, *C. simhai* (Singh) from *Clarias batrachus*, *C. sireni* (Premvati) from Florida mud eels, *C. trachysauri* (MacCallum) from *Trachisaurus rugosus* and *C. vesicaudus* (Nickerson) from *Aspidonectes* sp. The morphological features of the newer worms being described herein as *C. yamunii* n.sp. were subjected to taxometric analysis using Polythetic Divisive Classificatory System (Malhotra et al. 1981).

Materials and methods

The flukes were collected from the intestine of garfish, *Xenentodon cancilla* (N = 1,063), from River Yamuna (Kakraha Ghat), Allahabad, U.P. (81°49'06.28" (Lon), 25°24'53.24" (Lat), 74 m (Alt)). The collected worms

Sushil K. Upadhyay—Part of D.Phil. thesis awarded by the Allahabad Central University, U.P., India.

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were processed for morphometric analysis after Malhotra et al. (2011). Photomicrographs were taken by “MOTIC” Image Analyzer unit using Biovis Image Plus software and Nikon Trinocular Computerized photomicrography unit. Drawings of helminth parasites were prepared with Camera Lucida (SIPCON SP-14). GPS measurement of the site of investigation was done with MapmyIndia Satellite Based Navigation System Model S350. Polythetic Divisive Classificatory System (Malhotra et al. 1981) was applied to conduct taxometric analysis for substantiating biostatistical differentiation.

Results

Cephalogonimus yamunii n.sp. (Figs. 1, 2, 3, 4, 5, 6, 7, 8, 9, Tables 1, 2, 3)

Body ovoid, flattened, widest at two-third of body length, tapering towards anterior end which was bluntly rounded, measure, $0.825\text{--}1.224$ (1.061 ± 0.028) $\times$ $0.378\text{--}0.756$ (0.556 ± 0.024). Cuticle covered with minute and sparsely distributed spines all over the body. Oral sucker, $0.036\text{--}0.162$ (0.124 ± 0.029) $\times$ $0.045\text{--}0.216$ (0.167 ± 0.041),

Figs. 1–3 Camera lucida drawings of *Cephalogonimus yamunii* n.sp. (scale bar = 0.10 mm); **1** whole body of worm, **2** anterior end of body of worm to show common genital pore, and **3** posterior part of body to show muscular excretory sac and excretory pore

Figs. 4–9 Photomicrographs of *Cephalogonimus yamunii* n.sp. (not to scale) **4** whole body of worm ($\times 100$), **5** anterior part of body of worm to show location of genital pore in relation to acetabulum ($\times 400$), **6** common genital pore in the post-pharyngeal region ($\times 400$),

7 muscular excretory sac (magnified) ($\times 400$), **8** extension of vitellaria up to nearer to excretory sac in the posterior part of body ($\times 100$), and **9** terminally placed excretory pore connected to the inner cavity of sac ($\times 400$)

comparatively larger than ventral sucker, $0.082\text{--}0.099$ (0.091 ± 0.009) $\times$ $0.063\text{--}0.108$ (0.079 ± 0.014). Ventral sucker pre-equatorial, $0.657\text{--}0.774$ (0.717 ± 0.031) from the posterior end of body. Pharynx highly muscular, measure, $0.018\text{--}0.045$ (0.030 ± 0.006) $\times$ $0.031\text{--}0.063$ (0.042 ± 0.005), followed by short oesophagus, $0.054\text{--}0.090$ (0.072 ± 0.008) $\times$ $0.039\text{--}0.090$ (0.053 ± 0.007) that is bifurcated into intestinal caecae. Left intestinal caeca, $0.351\text{--}0.630$ (0.473 ± 0.082) $\times$ $0.008\text{--}0.028$ (0.014 ± 0.002), longer than the right one that measure, $0.234\text{--}0.509$ (0.382 ± 0.080) $\times$ $0.004\text{--}0.014$ (0.009 ± 0.002), and extend beyond the posterior testis. Genital pore sub-terminal, near the oral sucker in a common genital atrium. Ovary, $0.144\text{--}0.230$ (0.187 ± 0.017) $\times$ $0.139\text{--}0.270$ (0.195 ± 0.014), post-ventral sucker, $0.504\text{--}0.738$ (0.639 ± 0.042) distant from posterior extremity. An oval or polygonal receptaculum seminis, measure, $0.107\text{--}0.126$ (0.113 ± 0.003) $\times$ $0.107\text{--}0.135$ (0.123 ± 0.005), antero-dextral to ovary. Receptaculum seminis, measure, $0.609\text{--}0.774$ (0.690 ± 0.042) from posterior end of body, occupying the space between ventral sucker and ovary. Ootype and shell gland not clearly visible. Transverse vitelline duct, $0.004\text{--}0.007$ (0.005 ± 0.0004) in dia, received anterior and posterior forks on either side of the intestinal caecae. Vitelline glands of the left side more compactly arranged than

the right, measure, $0.027\text{--}0.045$ (0.036 ± 0.002) $\times$ $0.029\text{--}0.051$ (0.041 ± 0.006), and extend from the level of just behind the posterior border of ventral sucker to either side of muscular excretory sac, at posterior extremity of body. Uterus irregularly coiled and filled with the very numerous yellow eggs, measure, $0.010\text{--}0.045$ (0.028 ± 0.04) $\times$ $0.012\text{--}0.045$ (0.029 ± 0.003). Testes nearly rounded, anterior testis smaller than the posterior testis, measure, $0.101\text{--}0.156$ (0.134 ± 0.007) $\times$ $0.103\text{--}0.203$ (0.149 ± 0.009) while posterior, measure, $0.117\text{--}0.203$ (0.169 ± 0.008) $\times$ $0.144\text{--}0.207$ (0.185 ± 0.009). The anterior testis $0.414\text{--}0.666$ (0.516 ± 0.040), however, posterior testis $0.360\text{--}0.540$ (0.426 ± 0.028) from the posterior extremity, therefore, the posterior border of anterior testis partially overlapped with the anterior border of posterior testis. Cirrus sac long, flask shaped, measure, $0.230\text{--}0.454$ (0.347 ± 0.026) $\times$ $0.052\text{--}0.106$ (0.082 ± 0.027), with posterior extremity at the level of ventral sucker, sometimes crosses ventral sucker. Unipartite internal vesicula seminalis, measure, $0.039\text{--}0.079$ (0.059 ± 0.020) $\times$ $0.055\text{--}0.125$ (0.099 ± 0.035) laterally placed in the cirrus sac. Cirrus sac surrounded by highly muscular prostatic muscles, $0.417\text{--}0.666$ (0.516 ± 0.028) $\times$ $0.078\text{--}0.162$ (0.090 ± 0.009) extending up to the level of ovary, but sometimes partially overlapped it laterally. Excretory system with

Table 1 Taxometric analysis of observations of *C. americanus* (Stafford 1902), *C. amphiumae* (Chandler 1932) vis-à-vis *C. yamunii* n.sp.

Character		<i>C. americanus</i>			<i>C. amphiumae</i>		
		C.D.	C.Dis.	M.C.D.	C.D.	C.Dis.	M.C.D.
Body	L	–	0.207*	–	2.641	0.288*	0.248*
	W	–	0.422	0.332	2.380	0.365	0.281*
Oral sucker	L	2.235*	–	–	2.548	0.648	0.506
	W	–	–	–	2.436	0.667	0.408
Pharynx	L	–	–	–	2.539	0.679	0.500
	W	–	–	–	2.641	–	–
Oesophagus	L	2.465	0.406	0.335	–	–	–
	W	2.284*	0.454	0.338	2.290*	0.475	0.357
Intestinal caeca left	L	2.590	0.360	0.293	2.306	–	–
	W	2.563	0.676	0.464	2.817	0.635	0.431
Intestinal caeca right	L	–	0.405	0.304	–	–	–
	W	2.700	0.803	0.556	2.872	0.647	0.441
Ventral sucker	L	2.226*	–	–	2.609	0.110*	0.169*
	W	2.248*	–	–	2.651	0.279*	0.224*
Testis anterior	L	–	–	–	2.537	0.293*	0.249*
	W	–	–	–	2.498	0.406	0.319
Testis posterior	L	–	–	–	2.436	0.362	0.297*
	W	–	–	–	2.399	0.273*	0.237*
Cirrus sac	L	–	–	–	2.267*	–	–
	W	–	0.766	0.553	–	–	–
Seminal vesicle	L	–	–	–	2.258*	–	–
	W	2.529	–	–	2.533	–	–
Ovary	L	2.247*	–	–	2.290*	0.274*	0.231*
	W	2.230*	0.345	0.267*	2.271*	0.379	0.422
Egg	L	–	0.773	0.509	–	0.843	0.560
	W	2.224*	0.652	0.435	2.326	0.694	0.470
Vittellaria	L	–	0.442	0.361	2.408	–	–
	W	2.379	0.380	0.311	2.224*	–	–
Anterior testis from posterior end		–	–	–	2.594	–	–
Posterior testis from posterior end		–	–	–	2.590	–	–
Ovary from posterior end		–	–	–	2.554	–	–
Ventral sucker from posterior end		–	–	–	2.533	–	–

C.D. coefficient of divergence, C.Dis. coefficient of dissimilarity, M.C.D. mean character difference

* Non-significant; –, observations not available

highly muscular broad reservoir or sac, measure, 0.108–0.207 (0.164 ± 0.005) $\times$ 0.187–0.288 (0.240 ± 0.007), with an excretory canal extending up to the ventral sucker and terminated into excretory pore at the posterior extremity of body.

Family Cephalogonimidae (Nicoll); syn. Plagiorchidae (Poirier)
 Subfamily Cephalogoniminae (Loos)
 Genus *Cephalogonimus* (Poirier)

Taxonomic summary

Systematic position

Phylum Platyhelminthes
 Class Trematoda Yamaguti 1961
 Subclass Digenia Yamaguti 1961
 Order Allocreodoidea (Nicoll)

Type material *Cephalogonimus yamunii* n.sp.
 Type host *Xenentodon cancella*
 Type locality River Yamuna (81°49'06.28"E (Lon), 25°24'53.2"N (Lat), 74 m (Alt)), Allahabad, U.P

Table 2 Taxometric analysis of observations of *C. hanumanthai* (Agrawal and Agarwal 1984), *C. lenoiri* (Poirier 1886) vis-à-vis *C. yamunii* n.sp.

Character		<i>C. hanumanthai</i>			<i>C. lenoiri</i>		
		C.D.	C.Dis.	M.C.D.	C.D.	C.Dis.	M.C.D.
Body	L	–	0.309	0.265*	2.188*	0.227*	–
	W	–	0.619	0.472	–	0.384	0.300
Oral sucker	L	–	0.767	0.466	–	0.807	0.534
	W	2.206*	0.746	0.479	–	0.797	0.520
Pharynx	L	2.250*	0.629	0.467	2.429	0.535	0.400
	W	–	0.452	0.255*	2.254*	0.661	0.500
Oesophagus	L	–	0.313	0.266	2.352	0.363	0.302
	W	2.293*	0.553	0.420	–	0.541	0.410
Intestinal caeca left	L	–	0.304	0.243	2.343	0.295*	0.234
	W	2.482	0.746	0.517	2.617	0.636	0.484
Intestinal caeca right	L	2.535	0.401	0.300	2.459	0.438	0.333
	W	2.455	0.764	0.359	2.649	0.896	0.611
Ventral sucker	L	–	0.294*	0.253*	2.185*	0.154*	–
	W	2.279*	0.335	0.275*	2.310	0.377	0.310
Testis anterior	L	–	0.325	0.276*	2.068*	0.356	0.301
	W	–	0.414	0.362	–	0.451	0.356
Testis posterior	L	–	0.412	0.337	–	0.393	0.327
	W	–	0.439	0.358	–	0.233	0.203*
Cirrus Sac	L	–	0.380	0.297*	2.293*	0.381	0.297*
	W	2.464	0.675	0.505	–	0.846	0.590
Seminal vesicle	L	2.255*	0.772	0.555	2.219*	0.432	0.338
	W	–	0.439	0.328	2.221*	0.453	0.340
Ovary	L	2.281*	0.358	0.301	2.199*	0.279*	0.236*
	W	2.219*	0.419	0.405	2.322	0.549	0.512
Egg	L	–	0.779	0.514	–	–	–
	W	–	0.690	0.467	–	–	–
Vittellaria	L	–	0.393	0.213*	–	–	–
	W	–	0.334	0.271*	–	–	–

C.D. coefficient of divergence, C.Dis. coefficient of dissimilarity, M.C.D. mean character difference

* Non-significant; –, observations not available

Habitat Small intestine
Type specimen Holotype-PTLS08/2008 and Paratype-PTLS09/2008; deposited with the Parasitology Laboratory, Department of Zoology, University of Allahabad, Allahabad, U.P.
Etymology The worms of the newer species *C. yamunii* n.sp. were named after habitat of its fish host in river Yamuna

Discussion

The worms of new species differed from *C. americanus* (Stafford 1902) in possessing narrower oral sucker, smaller oesophagus, larger acetabulum, right intestinal caecae

longer but narrower intestinal caecae, location of genital pore a short distance behind anterior end vis-à-vis terminal, testes equatorial vis-à-vis in anterior half of body, testes overlapping anterior vis-à-vis in anterior half of body, longer cirrus pouch, vitellaria extending from pharynx to 2/3rd of body vis-à-vis extending up to acetabulum from posterior end, cirrus pouch extends beyond acetabulum vis-à-vis reaching up to acetabulum, shorter seminal vesicle, larger ovary, smaller eggs and the excretory sac distinctly heavily muscular. Further differentiation could be established from *C. amphiumae* (Chandler 1932) in possessing smaller worms with uniformly distributed spines all over the body vis-à-vis aspinose posterior 3rd of body, smaller oral sucker, pharynx, in having narrower intestinal caecae with diameter of intestinal caecae that was 3/10th of the oesophagus vis-à-vis located at about 5/7th of body length

Table 3 Taxometric analysis of observations of *C. salamandrus* (Dronen and Lang 1974) *C. simhai* (Singh 2010) vis-à-vis *C. yamunii* n.sp.

Character		<i>C. salamandrus</i>			<i>C. simhai</i>		
		C.D.	C.Dis.	M.C.D.	C.D.	C.Dis.	M.C.D.
Body	L	2.500*	0.364	0.308	2.522	0.297*	0.256*
	W	2.246*	0.622	0.474	2.452	0.400	0.313
Oral sucker	L	2.223*	0.825	0.547	2.471	0.767	0.504
	W	2.029*	0.867	0.571	2.372	0.724	0.460
Pharynx	L	2.302	0.709	0.519	2.234*	0.601	0.447
	W	2.300	0.417	0.326	2.573	0.366	0.279*
Intestinal caeca left	L	2.377	0.350	0.285*	2.616	0.289*	0.229*
	W	2.588	0.889	0.607	2.617	0.749	0.519
Intestinal caeca right	L	2.545	0.407	0.306	2.643	0.507	0.284*
	W	2.714	0.889	0.607	2.805	0.700	0.484
Ventral sucker	L	2.329	0.365	0.299*	2.644	0.285*	0.246*
	W	–	0.426	0.349	2.747	0.529	0.419
Testis anterior	L	–	0.507	0.403	2.404	0.294	0.250*
	W	–	0.617	0.443	2.712	0.558	0.434
Testis posterior	L	–	0.517	0.411	2.221*	0.363	0.298*
	W	–	0.423	0.348	2.654	0.287*	0.249*
Cirrus Sac	L	–	–	–	2.634	0.463	0.366
	W	–	0.656	0.505	–	–	–
Seminal vesicle	L	2.419	–	–	–	0.440	0.345
	W	–	0.825	0.584	–	0.429	0.319
Ovary	L	–	0.483	0.387	–	0.264*	0.222*
	W	–	0.601	0.548	2.206*	0.359	0.280*
Egg	L	2.200*	0.779	0.514	–	0.779	0.514
	W	2.301	0.690	0.467	–	0.779	0.533
Seminal receptacle	L	–	–	–	2.354	–	–
	W	–	–	–	2.657	–	–
Vittellaria	L	2.218*	–	–	–	0.583	0.450
	W	2.155*	0.392	0.329	2.268*	0.597	0.463
Anterior testis from posterior end		2.583	–	–	2.576	0.473	0.328
Posterior testis from posterior end		2.631	–	–	2.518	0.252*	0.216*
Ovary from posterior end		–	–	–	2.742	0.387	0.280*
Ventral sucker from posterior end		2.464	–	–	2.580	0.150*	–

C.D. coefficient of divergence, C.Dis. coefficient of dissimilarity, M.C.D. mean character difference

* Non-significant; –, observations not available

from posterior end, smaller testes and seminal, vesicle, testes, ovary and ventral sucker being more closer to posterior extremity, smaller, post-equatorial ovary, larger eggs and cirrus pouch utmost reaching acetabulum vis-à-vis extending beyond it; from *C. apognichthysi* (Gupta and Puri 1982) in having similar sub-terminal opening of genital pore at the end of oral sucker and differed in extension of intestinal caeca beyond the posterior testis and larger posterior testis; from *C. europeus* (Blaizot 1910) in possessing shorter vitellaria (C.D., L = 2.662; W = 2.782); from *C. hanumanthai* (Agrawal and Agarwal 1984) in having a shorter oral sucker, wider pharynx, wider

oesophagus, an equatorial ventral sucker vis-à-vis pre-equatorial, ventral sucker being more closer to posterior extremity, equal sized oral and ventral sucker vis-à-vis larger ventral sucker than oral sucker, wider testes, larger cirrus sac that cross well beyond ventral sucker vis-à-vis utmost overlap ventral sucker and heavily muscular excretory sac at posterior extremity, larger ovary and eggs; from *C. lenoiri* (Poirier 1886) in having smaller worms and left as well as right intestinal caecae, larger oral sucker, anterior and posterior testes and ovary; shorter oesophagus and shorter but wider pharynx, and acetabulum as well as ovary at a closer distance from posterior end of body; from

C. salamandrus (Dronen and Lang 1974) in possessing a wholly spinous smaller body, narrower oral and ventral suckers, small pharynx, larger oesophagus, smaller right and left intestinal caecae, acetabulum equatorial vis-à-vis 1/3rd of body from anterior end, ventral sucker and testes closer to posterior extremity of body, larger cirrus pouch extending beyond acetabulum vis-à-vis overlap, genital pore a short distance behind anterior end vis-à-vis terminal above oral sucker, larger testes, equatorial vis-à-vis 2/3rd of body, ovary larger, smaller eggs and vitellaria extending up to acetabulum from posterior end vis-à-vis from level of pharynx to posterior testes and from *C. simhai* (Singh 2010) in possessing shorter body, shorter pharynx, larger oesophagus, larger oral and smaller ventral sucker, smaller testes and ovary, seminal vesicle smaller and unipartite, genital pore subterminal anteriorly, smaller cirrus sac and excretory sac opens by terminal excretory pore posteriorly, equatorial or subequatorial testes, ovary rounded, seminal receptacle placed anteriorly than the ovary. The newer worms could finally be differentiated from *C. vesicaudus* (Nickerson 1912) in having a shorter, elliptical and vitellaria restricted in post-acetabular region.

The high level of biostatistical significance at varied levels (Tables 1, 2, 3), worked out by Polythetic Divisive Classificatory System, substantiated different morphological variations between organs of the newer and closer species, mentioned as above. In addition, the ecological distribution patterns worked out for the new species, being published simultaneously (Upadhyay et al. 2012), provide convincing evidence to establish the newer worms as a new species, *C. yamunii* n.sp. named after the habitat of its fish host.

Acknowledgments SKM is thankful to Department of Biotechnology for a research project grant no. BT/PR9651/SPD/09/818/2007, and SKU is grateful for a fellowship under the DBT project.

References

- Agrawal SC, Agarwal GP (1984) On *Cephalogonimus hanumanthai* (Digenea: Cephalogonimidae, Nicoll) from the intestine of a freshwater fish *Mystus vittatus* (BI). Ind J Helminthol 1:115–117
- Blaizot I (1910) In nouveau trematode *Cephalogonimus europeus* parasite intestinal de *Rana esculenta* L. Bull Soc Zool France 35:34–38
- Chandler AC (1932) Three new trematodes from *Amphiuma* means. Proc US Nat Mus 63:4–7
- Dronen DO Jr, Lang BZ (1974) The life cycle of *Cephalogonimus salamandrus* sp.n. (Digenea: Cephalogonimidae) from *Ambystoma tigrinum* (green) from eastern Washington. J Parasitol 60:75–79
- Gupta V, Puri M (1982) Studies on digenetic trematodes of marine fishes of Puri, Orissa, families: Maseniidae, Cephalogonimidae and Hemiuridae. Ind J Helminthol 34:1–14
- Malhotra SK, Dixit S, Capoor VN (1981) A contribution to the study of taxa differentiation in cestode taxonomy. Proc Ind Acad Sci (Animal Sci) 90:343–349
- Malhotra A, Jaiswal N, Malakar AK, Verma MS, Singh HR, Lakra WS, Malhotra SK, Shamsi S (2011) The morphology and genetic characterization of *Iheringascaris goaii* n.sp. (Nematoda: Raphidascarididae) from the intestine of the silver whiting and spotted catfish of the central west coast of India. J Helminthol. doi: 10.1017/S0022149x11000472
- Nickerson WS (1912) On *Cephalogonimus vesicaudus* n.sp. Zool Jahrb Syst 33:249
- Poirier J (1886) Trematodes nouveaux ou peu connus. Bull Soc Philomat Paris 10:20–40
- Singh A (2010) Studies on some digeneans and cestode parasites of vertebrates in eastern-middle Gangetic plains of U.P. Unpubl. Ph.D. Thesis, Dr. R. M. L. Avadh University, U.P.
- Stafford J (1902) *Cephalogonimus americanus* (new species). Centralbl Bakt 32:719–725
- Upadhyay SK, Jaiswal N, Malhotra A, Malhotra SK (2012) Ecological morphotaxometry of trematodes of garfish (Teleostomi: Belontiidae) from Gangetic riverine ecosystem in India. II. Correlation of seasonality and host biology with distribution pattern of *Cephalogonimus yamunii* n.sp. J Parasit Dis. doi: 10.1007/s12639-012-0168-2
- Yamaguti S (1961) Systema helminthum. In: The trematode of vertebrates, vol 1 (Parts I & II). Inter Science NY