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Neoechinorhynchus (*Neoechinorhynchus*) *zabensis* sp. n. (Acanthocephala: Neoechinorhynchidae) from freshwater fish in northern Iraq

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Abstract. *Neoechinorhynchus* (*Neoechinorhynchus*) *zabensis* sp. n. (Acanthocephala: Neoechinorhynchidae) is described from *Capoeta damascina* (Valenciennes, 1842) (type host) and *Capoeta trutta* (Heckel, 1843) in the Greater and Lesser Zab Rivers, northern Iraq. The new species is unique among all other species of the genus by its characteristic paired para-vaginal muscular appendage and fragmented giant nuclei in the lemnisci. Eleven of the other 88 valid species of *Neoechinorhynchus* and *N. zabensis* have middle and posterior hooks of equal length. However, *N. zabensis* is distinguished from the others by size of trunk, proboscis, proboscis hooks and lemnisci, number of giant nuclei, position of female gonopore, and geographical and host distribution. It is also distinguished from six other species of *Neoechinorhynchus* previously reported from Iraq. Other distinguishing features are also included.

Amin (2002) studied 107 species of *Neoechinorhynchus*, recognised 88 to be valid, and created 2 subgenera, *Hebesoma* Van Cleave, 1928 and *Neoechinorhynchus* Stiles et Hassall, 1905 that differ in egg anatomy. The new species, *Neoechinorhynchus zabensis* sp. n., belongs in the latter subgenus. It is the 89th species of the genus and second species of *Neoechinorhynchus* recorded in northern Iraq. The other species is *N. rutili* (Müller, 1780) found in the Tigris River at Mosul City (Fattohy 1975) and in Dokan Lake (Abdullah 1990). It is the seventh freshwater species of the genus reported in Iraq (Amin et al. 2001). It is herein described and distinguished from other species of the genus.

MATERIALS AND METHODS

A total of 691 cyprinid fishes of two species were collected from the Lesser Zab River near Alton Kupri City (34°36'0"N, 43°46'0"E) 45 km south of Erbil City, and from the Greater Zab River near Iski-kalik City (36°37'0"N, 43°44'0"E) 40 km west of Erbil City in northern Iraq (Table 1). Fish were collected by gill netting, cast netting, or electrofishing twice monthly between November 2000 and October 2001. Freshly collected fish were examined for parasites in the laboratory shortly after capture. The names of fishes are according to Froese and Pauly (2003).

Acanthocephalans recovered were first washed in saline solution, refrigerated in cold water for 12 h, then fixed in 70% ethanol. Worms were stained in Mayer's acid carmine, dehydrated in ascending concentrations of ethanol, cleared in graduated concentrations of terpineol in 100% ethanol and whole-mounted in Canada balsam. The measurements (in micrometres unless otherwise stated) are given as range followed by mean (in parentheses). Width measurements refer to maximum width. Body (= trunk) length does not include neck, proboscis or bursa. Egg measurements were made of fully developed ripe eggs artificially released from female body cavity. Drawings were made using a Ken-A-Vision microprojector. Type specimens were deposited in the United States National Parasite Collection (USNPC), Beltsville, MD, USA and in the Institute of Parasitology, Academy of Sciences of the Czech Republic (IP), in České Budějovice, Czech Republic.

RESULTS

The prevalence of acanthocephalan infections in *Capoeta damascina* (Valenciennes, 1842) from both collecting sites was about twice as high as that in *Capoeta trutta* (Heckel, 1843) but the intensity was about the same (Table 1). Over 10,000 worms were collected from both host species in both localities of which 113 sexually mature specimens (52 males and 61 females) were used for this study.

Neoechinorhynchus zabensis sp. n. Figs. 1–7

General. Neoechinorhynchidae, Neoechinorhynchinae with characters of the genus and subgenus *Neoechinorhynchus*. Trunk medium, cylindrical with sexual dimorphism in size of all common structures. Trunk with thick walls not dorso-ventrally distinguished

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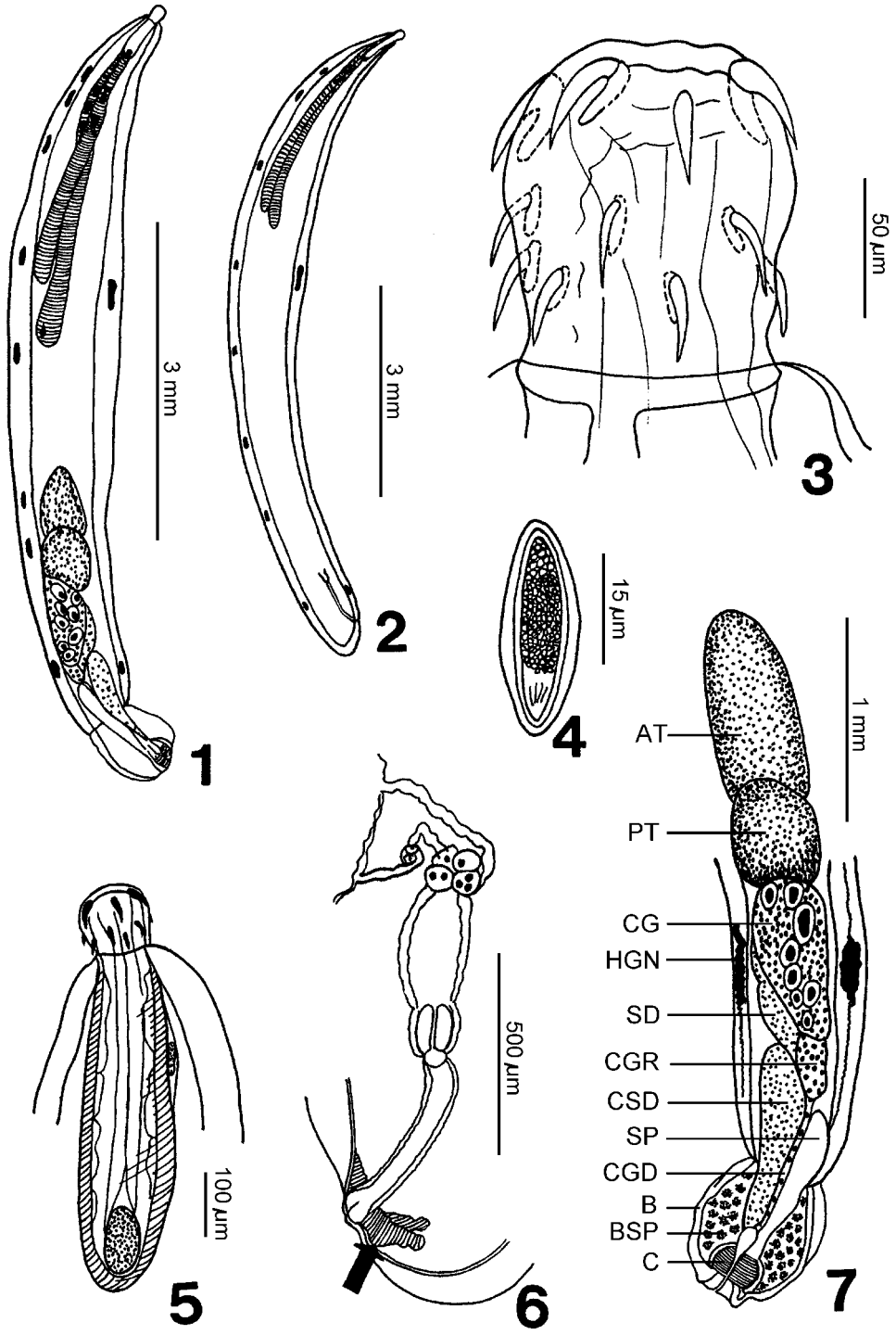

Figs. 1–7. *Neoechinorhynchus* (*N.*) *zabensis* sp. n. from *Capoeta damascina*. **Fig. 1.** Holotype male. Note nuclear fragments in lemnisci. **Fig. 2.** Allotype female. **Fig. 3.** Proboscis of a paratype female. Note two alternating levels of largest hooks in anterior circle. **Fig. 4.** Mature egg. **Fig. 5.** Proboscis and receptacle of a paratype female. Note oblong structure trapped under outer cell layer of proboscis receptacle. **Fig. 6.** Reproductive system of a paratype female with bent uterine bell. Note the paired muscular para-vaginal appendage (arrow) and the sinuate nature of membranes. **Fig. 7.** Reproductive system of a paratype male. AT – anterior testis; B – bursa; BSP – bursal sensory papillae; C – cirrus; CG – cement gland; CGD – cement gland duct; CGR – cement gland reservoir; CSD – common sperm duct; HGN – hypodermal giant nuclei; PT – posterior testis; SD – sperm duct; SP – Saefftigen's pouch.

Table 1. Parameters of infection of *Neoechinorhynchus zabensis* sp. n. in *Capoeta damascina* and *C. trutta* from the Zab River, between November 2000 and October 2001.

	Capoeta damascina		*Capoeta trutta*	
	Greater Zab River	Lesser Zab River	Greater Zab River	Lesser Zab River
Fish length (cm)	7–42 (28)	6–33 (25)	7–45 (26)	9–45 (25)
No. fish examined	300	192	21	178
No. fish infected	280	179	7	85
Prevalence (%)	93.3	93.2	33.3	47.7
Parasites/fish (mean)	0–42 (20)	0–28 (16)	0–30 (14)	0–30 (18)

having 7–11 (usually 8–10) dorsal and 1–3 (usually 2) ventral hypodermal giant nuclei (Figs. 1, 2). Proboscis as long as wide; apical organ not prominent. Proboscis hooks in all circles rooted. Anterior hooks largest alternating at two levels, with somewhat curved simple roots without manubria. Hooks in second and third circles slightly shorter than anterior hooks and have roots with reduced anterior manubria. Hooks in second circle as long as hooks in third circle but more slender (Fig. 3). Neck unremarkable. Proboscis receptacle about 6 times as long as proboscis, with single muscular wall having usually two small oblong structures "trapped" just under its outer cell layer in its anterior half. Cerebral ganglion (brain) large, oval, about as long as proboscis, at base of receptacle (Fig. 5). Lemnisci subequal, ribbon-shaped, widest posteriorly, distant from anterior testis and corresponding distance in females, 5 or 6 times as long as proboscis receptacle, with 2–4 (usually 3) and 1–3 (usually 2) giant nuclei in the longer and shorter lemniscus, respectively; one or more nuclear fragments also present in posterior half of either lemniscus (Figs. 1, 2).

Male (based on 18 mature specimens with sperm). Trunk 5.07–10.12 (7.42) mm long by 0.85–1.50 (1.12) mm wide. Proboscis 88–125 (107) long by 100–112 (106) wide. Proboscis hooks in anterior circle 37–45 (42) long; in middle circle 30–35 (33) long; in posterior circle 30–35 (33) long. Proboscis receptacle 426–728 (566) long by 125–187 (150) wide. Longer lemniscus 2.00–3.75 (2.97) mm long by 0.12–0.27 (0.20) mm wide posteriorly; shorter lemniscus 1.55–3.30 (2.63) mm long by 0.15–0.27 (0.18) mm wide posteriorly. Reproductive system in posterior half of trunk and extends to posterior end of bursa (Fig. 7). Testes oblong, approximately equal in size, usually slightly overlapping with each other and contiguous with cement gland. Anterior testis 0.50–1.32 (0.88) mm long by 0.40–0.75 (0.54) mm wide; posterior testis 0.50–1.30 (0.88) mm long by 0.35–0.75 (0.49) mm wide. Cement gland large, tapering posteriorly, 0.35–1.20 (0.73) mm long by 0.27–0.65 (0.40) mm wide anteriorly, with 8 vesicular giant nuclei, contiguous to cement gland reservoir 175–400 (278) long by 125–250 (179) wide. Cement gland duct runs between Saefftigen's pouch 0.52–1.02 (0.73) mm long by 0.10–0.21 (0.15) mm wide and large common sperm duct 0.60–1.25 (0.90) mm long and 0.10–0.35 (0.25) mm wide. Bursa 375–925 (648) long by 350–825 (570) wide, with many sensory papillae, designed to accommodate posterior reproductive structures including prominent cirrus (Fig. 7).

Female (based on 18 gravid specimens). Trunk 8.82–14.87 (10.87) mm long by 0.97–2.12 (1.46) mm wide. Proboscis 100–125 (112) long by 100–122 (112) wide. Proboscis hooks in anterior circle 37–46 (42) long, in middle circle 30–40 (35) long, in posterior circle 30–40 (35) long. Proboscis receptacle 510–728 (593) long by 135–198 (170) wide. Longer lemniscus 3.10–4.35 (3.67) mm long by 0.10–0.31 (0.25) mm wide; shorter lemniscus 2.90–4.12 (3.37) mm long by 0.10–0.31 (0.23) mm wide. Reproductive system with sinuate membranes, distal vaginal swelling, markedly subterminal gonopore, uterus and uterine bell as long as vagina, and one paired muscular para-vaginal appendage (Fig. 1). Eggs ovoid-elongate with concentric shells 28–35 (30) long by 10–17 (14) wide (Fig. 4).

Type host: *Capoeta damascina* (Valenciennes, 1842) (Cyprinidae).

Other host: *Capoeta trutta* (Heckel, 1843) (Cyprinidae).

Site of infection: Intestine.

Type locality: Greater Zab River near Iski-kalik City (36°37'0"N, 43°44'0"E) 40 km west of Erbil City, northern Iraq.

Other locality: Lesser Zab River near Alton Kupri City (34°36'0"N, 43°46'0"E) 45 km south of Erbil City, northern Iraq.

Specimens deposited: USNPC 92390 (holotype male), 92391 (allotype female), 92392 (paratypes on 14 slides); IP A-77 (paratypes on 3 slides).

Etymology: The new species is named for the Zab River in which it is found.

DISCUSSION

Neoechinorhynchus (*N.*) *zabensis* is distinguished from all other species of the genus by having a paired muscular para-vaginal appendage. We found no records of nuclear fragments in the lemnisci or the structure present in the proboscis receptacle wall in the description of any of the other 88 species of the genus.

Table 2. Comparison between *Neoechinorhynchus zabensis* sp. n. and the 11 other species of *Neoechinorhynchus* with equal middle and posterior proboscis hooks, based on Amin (2002).

Species*	Trunk L (mm) MM, FF	Proboscis L × W	Proboscis hooks L	Lemnisci	Para-vaginal appendage	Giant nuclei			Female gonopore	Distribution
						hypodermal	lemniscal	cement gland		
N. armenicus Mikailov, 1975	9–25	160–200 × 130–180	60–74 33–41 33–41	equal	absent	NG	NG	NG	NG	Armenia
N. bangoni Tripathi, 1956	9–12, 15-20	76–118 × 89–106	26–38 19–23 19–21	markedly unequal	absent	NG	NG	NG	NG	India
N. golvani Salgado-Maldonado, 1978	1, 1–3	56–75 × 56–75	45–78 18 18	subequal	absent	5, 1	NG	NG	terminal	Mexico, Brazil
N. hutchinsoni Datta, 1936	8, 19 constricted	70–100 × 99–110	50 37 35	subequal	absent	5, 2	NG	NG	NG	India
N. ichthyobori Saoud, El Naffar et Abu Sinna, 1974	30–42	100 × 100	68–84 30–42 30–42	subequal	absent	2–3, 3–4	1, 1	21–24	terminal	Sudan
N. ovalis Tripathi, 1956	0.725, 0.652	114 × 91	60–68 53 53	equal	absent	4, 2	NG	NG	NG	India
N. plagiognathopitis Wang et Zhang, 1987	16	210 × 175	66–70 28–35 28–35	equal	absent	NG	NG	no males	subterminal	China
N. prolixus Van Cleave et Timmons, 1952	5–12, 7–16	84–112 × 98–140	42–56 28 28	markedly unequal	absent	5, 1	2, 1	8	subterminal	North America
N. quinghaiensis Liu, Yang et Yang, 1981	2–4, 3–5	69–114 × 63–137	35–60 17–27 17–27	subequal	absent	5, 1	2, 1	few	terminal	China
N. simansularis Roitman, 1961	9–25	80–108 × 84–104	44–60 20–28 20–28	subequal	absent	3+, 1	2, 1	NG	NG	Russia
N. tylosuri Yamaguti, 1939	16–24, 21–70	100–160 × 120–150	63–75 30–35 30–35	markedly unequal	absent	5, 1	2, 1	20	subterminal	Japan, North Pacific
N. zabensis sp. n.	5–10, 9–15	107–112 × 106–112	37–45 30–35 30–35	subequal	present	8–10, 2–3	3, 2	8	subterminal	Iraq

*All species are from freshwater fish except *N. golvani* from estuarine/marine fish, see Amin (2002); MM – male; FF – female; NG – not given.

Only 11 other species of *Neoechinorhynchus* have the middle and posterior proboscis hooks of similar length like *N. zabensis*. Distinguishing diagnostic features are summarised in Table 2.

Amin et al. (2001) described *N. iraqensis* Amin, Al-Sady, Mhaisen et Bassat, 2001 and Mhaisen (unpublished data) observed five other species of *Neoechinorhynchus* from freshwater fishes in Iraq: *N. australis* Van Cleave, 1931; *N. cristatus* Lynch, 1936; *N. dimorphospinus* Amin et Sey, 1996; *N. macronucleatus* Machado, 1954; and *N. rutili* (Müller, 1780). None of these six species has para-vaginal appendage, lemniscal nuclear fragments, cellular structures in the proboscis receptacle wall, or proboscis hooks in second and third circles of equal length as the case is in *N. zabensis*. Other distinguishing differences include: specimens of *N. iraqensis* are very long with laterally constricted proboscis, markedly unequal lemnisci, and terminal female gonopore. Specimens of *N. australis* and *N. cristatus* have markedly unequal lemnisci and a terminal female gonopore with the latter species having proboscis hook roots with anterior manubria, and large eggs. Specimens of *N. dimorphospinus* have proboscides markedly wider than long with unequal hooks in anterior circles and terminal female gonopore, and rounded eggs. Hypodermal giant nuclei of *N. macronucleatus* are bead-like in body wall swelling with anterior four dorsal nuclei being adjacent, lemnisci are equal and female gonopore terminal. Anterior proboscis hooks of *N. rutili* are about twice as long as middle hooks and female gonopore is also terminal. All six species have the usual number of hypodermal giant nuclei (4–6 dorsal, 1–2 ventral; usually 5, 1) compared to the usual greater number found in *N. zabensis* of 8–10 dorsal, and 2–3 ventral.

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