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Redescription and molecular characterisation of *Dujardinascaris madagascariensis* and a note on *D. dujardini* (Nematoda: Heterocheilidae), parasites of *Crocodylus niloticus*, with a key to *Dujardinascaris* spp. in crocodilians

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Abstract

An examination of one specimen of Nile crocodile, *Crocodylus niloticus* (Laurenti, 1768), from Lake Turkana (Kenya), revealed the presence of two ascaridoid nematodes belonging to the genus *Dujardinascaris* Baylis, 1947. *Dujardinascaris madagascariensis* Chabaud & Caballero, 1966 was studied by scanning electron microscopy, redescribed, and differentiated from *D. dujardini* (Travassos, 1920). *Dujardinascaris madagascariencsis* is the second of the genus to be sequenced. An internal fragment of the small ribosomal subunit and nuclear ribosomal DNA internal transcribed spacer 2 region were amplified—the slowly evolving 18S gene region was used for phylogenetic analysis. Molecular data confirmed affinity of *D. madagascariensis* to the family Heterocheilidae and revealed its closest relationship with *D. waltoni*. A key to the species of *Dujardinascaris* parasitizing crocodiles is provided.

Key words: Lake Turkana, Omo River delta, Kenya, Africa, bar-coding, 18S rDNA, ITS2

Introduction

The Nile crocodile, *Crocodylus niloticus* (Laurenti, 1768), is one of 25 species of extant representatives of the order Crocodilia (Uetz & Hošek 2013). It is a nocturnal, carnivorous and opportunistic predator and its diet is dependent on its developmental stage and potential prey diversity (Magnusson *et al.* 1987). It is widely distributed in the eastern half of Africa (from the Nile delta to the very south) and Madagascar, with only patchy distribution in Central and West Africa, where it is mostly replaced by a cryptic species *Crocodylus suchus* Geoffroy, 1807 (Hekkala *et al.* 2011).

The genus *Dujardinascaris* Baylis, 1947 includes a total of 20 species. All *Dujardinascaris* spp. are host specific; 18 species parasitize exclusively crocodilians and two (Afrotropical) species parasitize fish (Sprent 1977; Sprent *et al.* 1998; Machida *et al.* 1992, Moravec & Jirků 2014). In Africa and Madagascar, Sprent (1977), Sprent *et al.* (1998) and Junker *et al.* (2006) listed five *Dujardinascaris* spp. in the Nile crocodile *C. niloticus* (including cryptic *C. suchus*), African slender snouted crocodile *Mecistops cataphractus* (Cuvier, 1825) and the African dwarf crocodile *Osteolaemus tetraspis* Cope, 1861: *D. dujardini* (Travassos, 1920); *D. gedoelsti* Sprent, 1977; *D. puylaerti* Sprent, 1977; *D. petterae* Sprent, McKeown & Cremin, 1998 and *D. madagascariensis* Chabaud & Caballero, 1966. Among these, *D. madagascariensis* was originally described by Chabaud & Caballero (1966) as the subspecies *D. dujardini madagascariensis* but Sprent (1977) gave it species status. Sprent *et al.* (1998) emphasised that the current descriptions of the crocodilian ascaridoids needed to be completed with respect to some morphological details, preferably by scanning electron microscopy (SEM). In our opinion, morphometric variability data, as well as molecular-genetic characteristics should be added as well. To date, only females of four

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6b. Tail conical, 1.38% of body length; interlabia 40% of lips length, caecum 44.1% of oesophagus length; caecum 7.14% of body length. . . . . *D. puylaerti*
7a. Parasites in crocodilians of Oriental region. 8
7b. Parasites in crocodilians of Australian region. 9
8a. Tail conical with rounded terminal knob; vulva with corrugated lips and conspicuous striated area; tail 1.00–1.16% of body length; oesophagus 4.1–5.0% of body length, caecum 63.4–69.2% of oesophagus length; caecum 3.0–3.2% of body length, distance of vulva from anterior extremity 28.3% of body length. . . . . *D. woodlandi*
8b. Tail conical with sharp pointed tip; (vulva not described); tail 1.93–2.1% of body length; oesophagus 15.9–18.0% of body length, caecum 69.8–73.5% of oesophagus length; caecum 11.0–13.2% of body length, distance of vulva from anterior extremity 42–49% of body length. . . . . *D. philippinensis*
9a. Tail conical with sharply pointed tip or tip with indistinct mucron; vulval papilla present. 10
9b. Tail conical with sharply pointed tip; vulval papilla absent. 11
10a. Interlabia short (40–41% of lip length), caecum 70–73% of oesophagus length; caecum 10.0–14.0% of body length, vulva (laterally) with anterior and posterior lips, situated at 23–39% of body length from anterior end. . . . . *D. harrisae*
10b. Interlabia longer (50% of lip length), caecum 62.5% of oesophagus length; caecum 6.8% of body length, vulva (laterally) with conspicuous anterior and posterior lips, situated at 58–62% of body length from anterior end. . . . . *D. mawsonae*
11a. Interlabia reached behind half of lip (58%); caecum 55% of oesophagus length; caecum 5.8% of body length, vulva flanked by flaps arranged so that opening is S-shaped, situated at 32–53% of body length from anterior end . . . . . *D. taylorae*
11b. Interlabia reach to half of lip (50%); caecum 65% of oesophagus length; caecum 7% of body length, vulva between two indistinct lips in shallow cuticular striated depression, situated at 30–48% of body length from anterior end, vulva surrounded by spherical mass of striated tissue in the lateral view. . . . . *D. blairii*
12a. Vulval papilla present 13
12b. Vulval papilla absent 15
13a. Tail conical, sharply pointed tip, 1.25–1.92% of body length; oesophagus 13–16% of body length; caecum 9–11% of body length, vulva from anterior extremity 37–45% of body length; vulva with conspicuous cuticular fold on anterior aspect; in cleared specimens, coarse striations visible in base of groove between cuticular expansions of vulva. 14
13b. Tail long conical, pointed tip, 0.98–1.38% of body length; oesophagus 10–18% of body length; caecum 5–14% of body length, vulva from anterior extremity 32–54% of body length; vulva with large salient lips (in same height). . . . . *D. helicina*
14a. Tail long, 1.25–1.27% of body length, oesophagus 15–16% of body length, caecum 54–70% of oesophagus length; caecum 9–11% of body length; vulva with salient lips in form of thickened cuticle forming folds . . . . . *D. paulista*
14b. Tail long, 1.92% of body length, oesophagus 13.7% of body length, caecum 80% of oesophagus length; caecum 10–11% of body length; vulva with conspicuous cuticular fold on anterior aspect (upper lip), and smaller (narrower) lower lip . . . . . *D. chabaudi*
15a. Oesophagus 25–30% of body length, caecum 63% of oesophagus length; caecum 15–16% of body length, vulva from anterior extremity 32–54% of body length; vulva striated in fold cuticle, and no salient vulval lips. Parasite of North American alligators. . . . . *D. waltoni*
15b. Oesophagus 19–20% of body length, caecum 66–67% of oesophagus length; caecum 13% of body length, vulva from anterior extremity 48–50% of body length; vulva in grove with prominent anterior fold of cuticle over vulva. Parasite of South American crocodiles. . . . . *D. longispicula*

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