



<http://dx.doi.org/10.11646/zootaxa.3717.1.2>

<http://zoobank.org/urn:lsid:zoobank.org:pub:FF5A940A-FAA1-440F-A815-FD954E3283BD>

## Novel techniques for biodiversity studies of gordiids and description of a new species of *Chordodes* (Gordiida, Nematomorpha) from Kenya, Africa

MATTHEW G. BOLEK<sup>1</sup>, CLEO SZMYGIEL<sup>1</sup>, AUSTIN KUBAT<sup>1</sup>,  
ANDREAS SCHMIDT-RHAESA<sup>2</sup> & BEN HANELT<sup>3</sup>

<sup>1</sup>Department of Zoology, 501 Life Sciences West, Oklahoma State University, Stillwater, Oklahoma 74078, U.S.A.  
E-mail: [bolek@okstate.edu](mailto:bolek@okstate.edu)

<sup>2</sup>Zoological Museum and Institute, Biocenter Grindel, Martin-Luther-King-Platz 3, 20146 Hamburg, Germany.  
E-mail: [andreas.schmidt-rhaesa@uni-hamburg.de](mailto:andreas.schmidt-rhaesa@uni-hamburg.de)

<sup>3</sup>Center for Evolutionary and Theoretical Immunology, Department of Biology, 163 Castetter Hall, University of New Mexico, Albuquerque, New Mexico 87131-0001, U.S.A. E-mail: [bhanelt@unm.edu](mailto:bhanelt@unm.edu)

### Abstract

We review recent advances in the use of non-adult gordiid cyst stages to locate gordiids over large geographical regions and new culturing techniques which can help overcome current difficulties in nematomorph biodiversity studies. Using these techniques, we collected a new species of gordiid as cysts in aquatic snails (*Biomphalaria pfeifferi*) from the Lake Victoria Basin, western Kenya, Africa and cultured them in the laboratory. We describe the adult free-living male and female worms using morphological (light and scanning electron microscopy) and molecular data as well as the life cycle, mating and oviposition behavior, egg strings, eggs, larvae, and cysts of this new species. *Chordodes kenyaensis* n. sp. belongs to a large group of African *Chordodes* in which simple areoles are smooth or superficially structured less so than “blackberry” areoles but contain filamentous projections. Present among the simple areoles are clusters of bulging areoles, crowned and circumcluster areoles along with thorn and tubercle areoles. In the laboratory, worms developed and emerged within 53–78 days from three species of laboratory-reared crickets exposed to cysts of this species. Adult male and female *C. kenyaensis* n. sp. initiated typical Gordian knots within hours to days of being placed together and males deposited masses of sperm on the cloacal region of females. Females began oviposition within a week of copulating and attached egg strings in a continuous zigzag pattern on small branches or air-hoses but never free in the water column. Larvae hatched within two to three weeks, and cysts developed in laboratory-reared and exposed snails within 14–24 days. Morphological characteristics of egg strings, eggs, larvae and cysts of *C. kenyaensis* were most similar to other gordiids in the genus *Chordodes* but differed morphologically from other gordiid genera for which similar information is available.

**Key words:** Gordiida, gordiid, hairworm, Gordian worm, Nematomorpha, Africa, scanning electron microscopy, Nomarski interference contrast microscopy, molecular data, life cycle, oviposition behavior, non-adult life stages, *Chordodes kenyaensis*

### Introduction

Our lack of knowledge of the biodiversity of gordiids stems from the fact that most hairworm species have been described based on random collections of single worms for which life cycles are unknown. In fact, it has been estimated that only 18% of hairworm species have been described globally (Poinar 2008). However, recent studies from our laboratories indicate that non-adult stages of gordiids, such as cysts, are the most commonly encountered life stages of hairworms in the environment and may be useful for discovering the hidden biodiversity of this group (Hanelt *et al.* 2001; Szymgiel 2012). In a 3-year study of 50 streams in a 2,000 km<sup>2</sup> prairie ecosystem in Nebraska (USA), free-living adult gordiids were found at one stream, whereas cysts were recovered from aquatic snails at 35 streams (Hanelt *et al.* 2001). In a similar study, Szymgiel (2012) examined 46 streams in a 1,810 km<sup>2</sup> central Great Plains ecosystem of Oklahoma (USA). Over a one year sampling period no adult worms were found at any streams but cysts of three different types were recovered from aquatic snails from 32 of those streams. Additional studies