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# *Haemopis caeca* (Annelida: Hirudinea: Arhynchobdellida: Haemopidae), a new species of troglobitic leech from a chemoautotrophically based groundwater ecosystem in Romania

Dan G. Manoleli, Donald J. Klemm, and Serban M. Sarbu

(DGM) Department of Ecology, University of Bucharest, 91-95, Splaiul Independent, ei, 76201 Bucharest, Romania;
(DJK) U.S. Environmental Protection Agency, National Exposure Research Laboratory, Ecological Exposure Research Division, Ecosystems Research Branch, Cincinnati, Ohio 45268-1642, U.S.A.;
(SMS) Department of Biological Sciences (ML-6), University of Cincinnati, Cincinnati, Ohio 45221-0006, U.S.A.

*Abstract.*—A new species of leech, *Haemopis caeca*, is described from a unique chemoautotrophically based groundwater ecosystem, in southern Dobruja, Romania, containing thermomineral $H_2S$ rich water. Fifty invertebrate species have been identified from the cave, 33 of which are endemic species. *Haemopis caeca* is the second species in the genus recorded from Europe, and the other Palearctic Region is *H. sanguisuga*. *Haemopis caeca*, a cave adapted species, was observed exhibiting macrophagous feeding on the earthworm, *Allolobophora* sp., an undescribed species.

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The new species, *Haemopis caeca*, belongs to the Order Arhynchobdellida Blanchard 1894; Family Haemopidae Richardson 1969, Sawyer 1986b. The genus *Haemopis* Savigny 1822 contains nine recognized species of which eight are endemic to the Nearctic Region (Richardson 1969, Soos 1969, Klemm 1985, Sawyer 1986b, Davies 1991). The species are *H. caballeroi* (Richardson 1971), *H. grandis* (Verrill 1874), *H. kingi* Mathers 1954, *H. lateromaculata* Mathers 1963, *H. marmorata* (Say 1824), *H. plumbea* Moore 1912, *H. septagon* Sawyer & Shelley 1976, and *H. terrestris* (Forbes 1890). Until now, the type species, *H. sanguisuga* (Linnaeus 1758), has been the only species of *Haemopis* reported to occur in the Palearctic Region (Mann 1961, Soos 1970). However, *H. sanguisuga* has been reported from the Sino-Japanese Region of the Amur River Basin, in eastern Siberia, (Lukin 1955).

The three genera of Arhynchobdellida reported from Europe, *Hirudo* Linnaeus 1758; *Haemopis* Savigny 1822; and *Limnatis* Moquin-Tandon 1826, are also present in Romania (Cristea & Manoleli 1977, Manoleli 1972, 1974, Ruckert 1985, Soos 1969). However, none of these genera has been reported specifically in caves. The Natural History Museum of Oradea, Romania contains three specimens of *H. sanguisuga*, which were collected in 1892 in the Western Carpathians (Apuseni Mountains). The label mentions "cave habitat" with no further details. Scriban & Autrum (1934) examined the three specimens and found five pairs of eyes, and they all resembled morphologically the classic description of the (type) species, *H. sanguisuga*.

## Materials and Methods

Fifteen leeches were collected by hand from the shoreline or near shoreline (0–20 cm) of the sulfidic lake in Movile Cave,

southern Romania (location in Sarbu 1996, Sarbu & Kane 1995). Nine specimens were observed while alive in the field and laboratory. Leeches to be preserved were first anesthetized by adding 70% ethanol slowly to a small amount of water containing the specimens until they no longer responded to stimulation. They were then preserved in either 70% ethyl alcohol or fixed overnight in 10% formalin and later stored in 70% alcohol. All drawings were made using either a IOR-MC1 dissecting microscope or a Zeiss Stemi SV6 dissecting microscope.

## Systematics

### Family Haemopidae Richardson, 1969; (Sawyer 1986b, revised)
### Genus *Haemopis* Savigny, 1822
### *Haemopis caeca*, new species

*Type material.*—Holotype, deposited in the Muzeul de Istorie Naturala Bucuresti (MINB-49.999), Bucharest, Romania, and 2 representative paratypes (MINB-50.000), (collected 15 Jun 1992, sulfidic lake in Movile Cave, collector Serban M. Sarbu). Three additional paratypes, United States National Museum (USNM 178821), deposited in the National Museum of Natural History, Division of Worms, Smithsonian Institution, Washington, D.C.), collected 18 Jun 1996, sulfidic lake in Movile Cave, collector Serban M. Sarbu; 1 specimen, collected 20 Dec 1991, same locality, collector and collection Serban M. Sarbu; and 9 Oct 1994; 18 Jun 1996, same locality, collector Serban M. Sarbu, five specimens in the collection of Donald J. Klemm.

*Type locality.*—Movile Cave, southern Dobrogea, Romania.

*Diagnosis.*—without body pigment and eyes; body firm and muscular; annuli VIIa3 and VIIIa1 not subdivided ventrally; 25 annuli from oral cavity to annulus XIa2 bearing the male gonopore. Gonopores separated by 4 ½ annuli; jaws absent or vestigial (agnathous), denticles (teeth) absent; entrance to mouth and lumen of pharynx not strongly reduced; pharynx with 12 internal ridges; testisac 8–10 pairs (8 in holotype); anterior edge of prostate at XII; penis sheath long, extends back to annuli XIIa2; penis has knot in its proximal end; vagina shaped like a bagpipe, proximal portion is thin; vaginal duct connects to the vagina subapically; vaginal duct exhibits a bifid shape in profile view; anus small, not prominent; macrophagous feeding (predaceous carnivore and scavenger); aquatic to semi-aquatic (amphibious).

### Description of Holotype (Fig. 1B–E)

*External anatomy* (Fig. 1A, B).—Body firm, muscular (living and preserved), size medium, never large, body elongate, slender; length 50–63 mm, body-width 5–6 mm, depth 2–3 mm, body smooth, very contractile; the central portion with parallel or nearly parallel margins, usually terete anteriorly, pigment absent. Epidermis, transparent, and lacking chromatophores. Live animals red-brownish due to visible vascularization of muscle tissue. Annuli VIIa3 and VIIIa1 slightly enlarged, and faintly subdivided or not divided at all; 25 distinct annuli from oral cavity to annulus XIa2, bearing male gonopore; male and female gonopores separated by 4 ½ annuli. Anterior rim of mouth lip-like; one paratype exhibited a slight "emarginate" of the prostomium (Fig. 1A) and slight pigmentation strictly limited to this "emarginate," other paratypes mouth more lip-like. Eyes absent in living and preserved specimens. Segment annuli I = 1, II = 1, II = 1, IV = 2, V = 2, VI = 3, VII = 3, VIII = 4, IX–XXIII-5, XXIV = 3, XXV = 2, XXVI = 1, XXVII = 2. Anus small, not prominent on segment XXVII with no post-anal annuli; caudal sucker circular (width 3–4 mm), broadly and centrally attached to posterior end of body; nephridiopores 17, located paramedially on posterior portion of b2 annulus from segment VIII to XXIV; body with 15 complete (five annulate) segments from IX to XXIV; male genital pore located on segment XIa2; female genital pore lo-

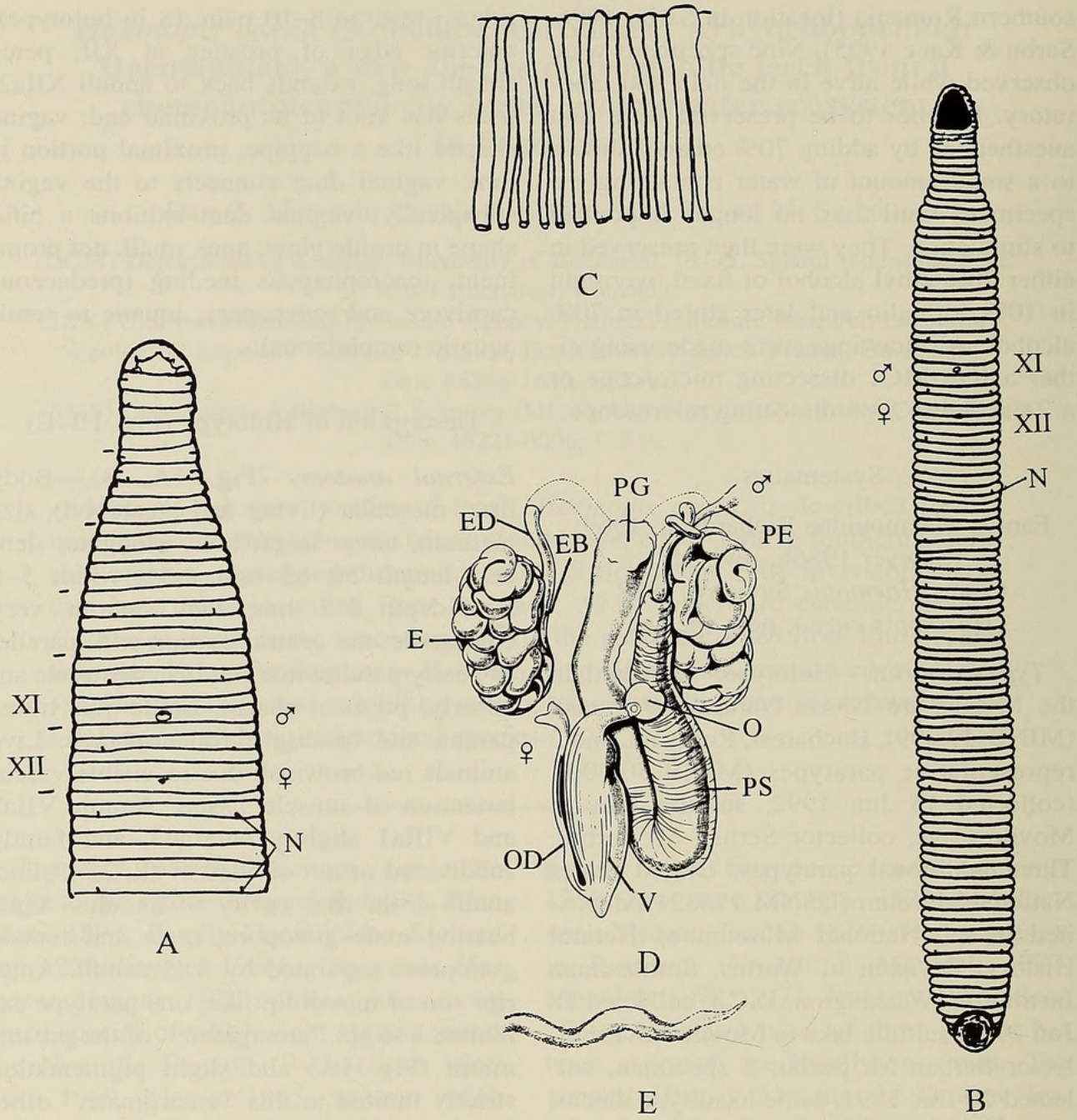


Fig. 1. *Haemopis caeca*. A, Ventral view: Annuli VIIa3 and VIIIa1 not subdivided, 25 distinct annuli from oral cavity to segment XIa2, bearing the male gonopore; and male and female gonopores separated by 4 ½ annuli; B, Ventral view of *Haemopis caeca*; C, Pharynx, opened the mid-ventral line; D, Dorsal view of male and female reproduction systems; E, Distal end of the penis. Abbreviations: N, nephridiopore; Segments XI and XII; E, epididymis; EB, ejaculatory bulb; ED, ejaculatory duct; O, ovary; OD, oviduct; PG, prostate gland; PE, Penis; PS, penis sheath; V, vagina.

cated on segment XIIb2/a2; penis when fully extended, moderately long, small diameter (filamentous) proximal end, and distal end with a corkscrew-like tip (Fig. 1E).

*Internal anatomy, male genitalia* (Fig. 1D).—Epididymis occupying the space between the two genital pores; ejaculatory ducts short; sheath of penis extends back reaching segment XIVb1; penis has a knot in its proximal end; testisacs 8–10 pairs. Female genitalia (Fig. 1D).—vagina has shape of a bagpipe; proximal portion of vagina is thin; vaginal oviduct connects to vagina subapically; proximal end of oviduct exhibits a bifid-shape in profile view. Digestive system.—pharynx euthylaematous, without

jaws (agnathous) and denticles, no salivary papillae; wall of pharynx intimately associated with muscles of body-wall; entrance to, and lumen of pharynx unrestricted with some 12 internal ridges, with four single ridges and four paired ridges, all terminating on the margin of the entrance to the pharynx (Fig. 1C); pharynx ending at X; crop tubular acaecate, thin wall, elongate posterior crop caeca extending from XIX to XXIV; medium intertine, extending from XIX to XXIX; rectum, extending from XXIII to anus; anus small, not prominent.

*Additional observations of paratypes.*—The paratypes agree with the holotype externally and internally except for the "emarginate" of the prostomium (Fig. 1A) in a few specimens (this may be due to preservation); none of the specimens examined have eyes and all specimens have the same number of annuli between gonopores, 4 ½ annuli.

*Remarks.*—The structure of the reproductive system shows that this species belongs to the genus *Haemopis*.

*Habitat and ecology.*—A unique chemoautotrophically based groundwater ecosystem was discovered in Movile Cave, at Mangalia, Dobrogea, Romania, near the Black Sea (Sarbu and Kane 1995). The cave was opened by an artificial shaft in 1986, and it represents a window to a vast network of fissures and cave passages of phreatic origin, associated with the thermomineral sulfidic waters present in the Mangalia region (Constantinescu 1989, Lascu 1989, Sarbu & Kane 1995). The lower level of the cave is flooded by mesothermal waters (21°C) with a high content of $H_2S$ (0.3 mMol/L).

The cave contains rich aquatic and terrestrial troglobitic invertebrate communities (Lascu et al. 1993, Sarbu & Kane 1995). Thirty-three new invertebrate species, including *H. caeca*, have been discovered so far, and other discoveries are expected (Decu et al. 1994, Gruia et al. 1994, Weiss & Sarbu 1994). The food base of both the aquatic and terrestrial communities is produced *in situ* by a rich chemoautotrophic microbiota. These microbiota fix the carbon using the energy that results from the oxidation of $H_2S$ at the surface of the water in the cave in aerobic conditions (Sarbu & Kane 1995). The Movile Cave ecosystem appears to be the first known subterranean ecosystem existing independently of the photoautotrophic carbon fixation in green plants at the surface. The cave ecosystem relies entirely on the *in situ* chemoautotrophically produced food base (Sarbu & Kane 1995, Sarbu et al. 1996).

*Haemopis caeca* and another recently described endemic species, *Nepa anophthalma* (Decu et al. 1994), (Heteroptera: Nepidae), are the only known predators in the aquatic and semi-aquatic community and are thus far the largest animals found inhabiting the cave (Decu et al. 1994). Fifteen *H. cacea* have been observed above the shoreline displaying macrophagous feeding on earthworms (*Allolobophora* sp., an undescribed species). This aquatic and semi-aquatic leech was also observed in the cave creeping along the shores of the sufidic lake. Specimens of the leech have often been seen swimming in the sufidic lake, always in shallow water (0–15 cm deep).

## Discussion

The genus *Haemopis* was subdivided in North America by Richardson (1969, 1971) into three genera, *Percymoorensis*, *Mollibdella*, and *Bdellarogatis*. The revision was followed by Soos (1969) Davies (1971, 1991), and Klemm (1972). Sawyer (1972, 1986b, 1986c) and Sawyer & Shelley (1976) rejected this revision based on additional anatomical information and the description of a new species, *Haemopis. septagon* (Sawyer & Shelley 1976). Klemm (1977, 1982, 1985, 1990) later also followed their recommendations for the genus *Haemopis*, which are followed by the authors of this paper.

The absence of eyes, body pigment, jaws, and denticles are four characteristics that

distinguish *H. caeca* from *H. sanguisuga*, the only other Palearctic Region species of the genus (Sawyer 1986b, Soos 1969). The anatomical examination of the two closely related Palearctic Region species reveals specific differences between *H. caeca*, the subterranean form, and the surface form of *H. sanguisuga*: the absence of eyes, epidermal chromatophores, jaws, and teeth; separation of the gonopores by 4 ½ annuli (*H. caeca*) rather than by 5–5 ½ annuli (*H. sanguisuga*). The male pore is located on XIa2 rather than XIb6, while the female pore is located on XIIb2/a2 rather than XIIb6. The body color of *H. caeca* is red-brownish dorsally and ventrally, but in *H. sanguisuga* the dorsal color varies from dark grey-green, to pale yellow-green, to almost black, and paler ventrally, with variable amounts of black flecking. The anus is small, less prominent in *H. caeca*, but is very conspicuous in *H. sanguisuga*. The examination of the paleogeographic data regarding the Mangalia region indicates that *H. caeca* may have been isolated underground for a considerable period of time, suggesting that the characteristics found in this stygobiotic species are genetically determined. All specimens of *H. caeca*, living and preserved, that have been examined thus far were found with eyes absent. All the other nine species of *Haemopis*, including *H. sanguisuga*, have five pairs of eyes, and they have never been reported in the literature without eyes or variable number of eyes when collected and studied. All specimens of *H. caeca* examined internally were found with jaws and denticles absent. Seven species of *Haemopis* possess low and rounded jaws with two distinct rows of large, course, blunt distichodont denticles, and the distichous denticles vary in numbers from 9–25. The other two Nearctic Region *Haemopis* species, *H. grandis* (Verrill 1874) and *H. plumbea* Moore 1912, have vestigial or absent jaws and denticles. The total length of all *H. caeca* collected so far are also shorter (80–83 mm) and thinner (5–9 mm) than *H. sanguisuga*. The pharynx and related structures are haemopisoid but are less prominent than in *H. sanguisuga*. Also, Segment VI and Segment VII have three annuli each in *H. caeca*, but in *H. sanguisuga* Segment VI has three annuli and Segment VII has four.

Turquin (1984) stated that several species belonging to the Order Arhynchobdellida and the Family Haemopidae may exhibit a certain degree of troglophylly and can be found in dark places such as sewage systems where they seem to be attracted by the abundance of food such as aquatic worms and insect larvae. However, none of these troglophilic invertebrate populations exhibit any morphological modifications compared to the populations living in surface waters. Agtelek Cave in Hungary is inhabited by *Typhlobdella kavatsi* Deising 1850 (a junior synonym of *H. sanguisuga*), which exhibits all of the external characteristics found in *H. sanguisuga* (Lukin 1976, Soos 1969). Peck (1988) reported *H. terrestris* (Nearctic Region) from mines in Ontario, Canada. *Haemopis terrestris* occurs in North America in two forms, either found living in freshwater or living in semi-aquatic to moist terrestrial habitats (Miller 1929, Klemm 1985, Sawyer 1986b).

In Erpobdellidae, a different family of leeches, Sawyer (1986a) reported that most troglophilic leech species (e.g., *Trocheta bykowskii* Gedroyc (1915), of southeastern Europe), reported in caves and other subterranean habitats, are only migrants from outside the cave area and are indistinguishable from the surface-dwelling forms. However, Sawyer (1986a) stated that some truly cave-adapted aquatic erpobdellid species and closely related forms of uncertain taxonomic standing of *Dina lineata* (Muller 1774) live in caves in southern Europe and southwest Asia. For example, *D. absoloni* Johansson (1913), an unpigmented species, lives in caves of Yugoslavia and Bulgaria, and the subspecies, *D. absoloni ratschaensis* Kobakhidze (1958), lives in caves of western Georgian. Soos (1966) reported that a few truly unpigmented cave dwelling forms of *D. absoloni* have been reported

from Yugoslavia and Bulgaria with and without pigmented eyes and the integument unpigmented.

*Haemopis caeca*, discovered in the Movile Cave and collected later from a sulfidic spring in the same aquifer, about 4 km north of the cave, appears to be the only truly known cave-adapted species of *Haemopis* (Family Haemopidae). The spring also contains other blind and unpigmented troglobitic animals, such as *Asellus aquaticus* (Isopoda: Asellidae); *Niphargus* sp., an undescribed species, and *Pontoniphargus racovitzai* (Amphipoda: Gammaridae). All of these species also are present in Movile Cave.

*Etymology.*—From the Latin adjective *Caecus*, *—a*, *—um* meaning blind.

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