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On the biology of *Symbiocladius rhithrogenae* (ZAVŘEL, 1924) (Diptera: Chironomidae) from the Chornohora Mts., Ukraine

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ABSTRACT. A metamorphosis of a parasitic chironomid *Symbiocladius rhithrogenae* (ZAVŘEL, 1924) infesting nymphs of mayflies of the genera *Rhithrogena* EATON, 1881 and *Ecdyonurus* EATON, 1868 in a stream of the Ukrainian Carpathians, is described and illustrated.

KEY WORDS: Diptera, Chironomidae, *Symbiocladius rhithrogenae*, Ephemeroptera, *Ecdyonurus*, *Rhithrogena*, biology, Ukraine.

INTRODUCTION

Symbiocladius KIEFFER, 1925 is the only genus within the family Chironomidae including exclusively parasitic species, which feed on nymphs of mayflies of selected genera (*Atalophlebioides* PHILLIPS, 1930, *Australophlebioides* CAMPBELL et SUTER, 1988, *Ecdyonurus*

EATON, 1868, *Electrogena* ZURWERRA et TOMKA, 1985, *Epeorus* EATON, 1881, *Habroleptoides* SCHOENEMUND, 1929, *Heptagenia* WALSH, 1863, *Meridialaris* PETERS & EDMUNDS, 1972 *Rhithrogena* EATON, 1881 and *Thraulodes* ULMER, 1920) (CODREANU 1939, ARVY & PETERS 1973, WIENS et al. 1975, HYNES 1976, SOLDÁN 1978, 1979, MATĚNA & SOLDÁN 1982, MOUBAYED 1991, PETERS & CAMPBELL 1991, JACOBSEN 1995, GONSER & SPIES 1997). *Symbiocladius* is a widely distributed genus including 6 species known from the Nearctic: S*ymbiocladius chattahoocheensis* CALDWELL, 1984, *Symbiocladius equitans* (CLASSEN, 1922); Neotropics: *Symbiocladius wygodzinskyi* ROBACK, 1965, *Symbiocladius renatae* SPIES, 1997; the Australasian Region: *Symbiocladius aurifodinae* HYNES, 1976) and the Palearctic: *Symbiocladius rhithrogenae* (ZAVŘEL, 1924). The latter species has been so far recorded from Austria, Czech Republic, France, Germany, Hungary, Poland, Romania, Slovakia, Spain, Swiss and Ukraine, northern and central European part of Russia, Near East and eastern Palaearctic (ARVY & PETERS 1973, CORDEANU & CORDEANU-BALCESCU 1979, SOLDÁN 1978, JACOBSEN 1995, GODUNKO 1998, KRISKA et al. 1999, 2000, KRISKA & ANDRIKOVICS 2003, SÆTHER & SPIES 2004).

Presently we observed the metamorphosis of *S. rhithrogenae* in the Chornohora Mts., Ukraine. This allowed us to describe and illustrate a life history of this species in detail.

MATERIALS AND METHODS

The material was collected in Ukraine, Zakarpattia Region, Carpathian Biosphere Reserve, the Chornohora Range, Polonyna Brebeneska district, mountain valley between SW slope of Gutyn Tomnatek Mt. and NW slope of Brebeneskul Mt., upper section of the Brebeneskul stream (width 2-4 m, depth 0.3-0.8 m, current velocity higher than 1 m/s, water temperature in summer months 7-11 °C; pH 7.0-7.5; bottom covered with boulders and cobbles and shaded by subalpine forest; 1400-1450 m a. s. l., Long. E48°04'37" - 48°04'32", Lat. N24°33'16" - 24°32'54"). Mayflies were collected by M. KŁONOWSKA-OLEJNIK and R. J. GODUNKO on 20-27 July 2002 (26 nymphs infested with 4 larvae of lower instar, 4 larvae of 4th instar, 2 larvae during pupation, 16 pupae including 9 fully developed adults: 7 males, 2 females). The material (partly slide-mounted) is housed in the collection of the Department of Zoology, University of Gdańsk, Poland, the Institute of Environmental Sciences, Jagiellonian University, Kraków, Poland and the State Museum of Natural History, National Academy of Sciences of Ukraine, L'viv, Ukraine.

The nymphs of mayflies of the genera *Rhithrogena* and *Ecdyonurus*, carrying larvae and pupae of the parasite were collected using a Surber sample (0.25 m x 0. 25 m, 250 µm mesh size) mostly by means of "kicking techniques", i.e. by digging of stones within the whole profile of watercourse. Same specimens were sampled by direct stone picking with forceps.

The immatures were reared in their natural habitat. We put plastic rearing cages into the stream with mayfly nymphs inside (EDMUNDS et al. 1976). All specimens were pre-

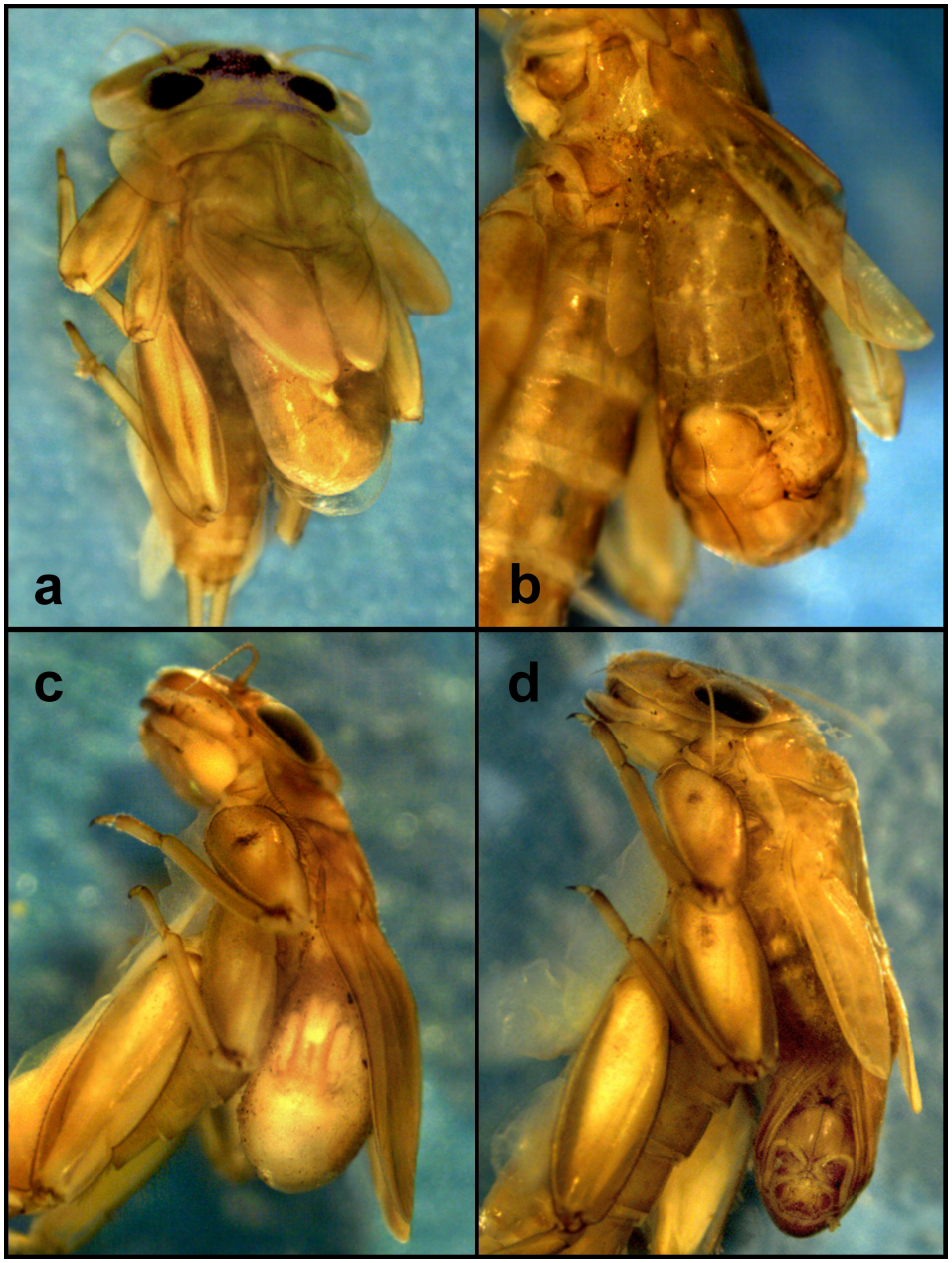
served in 70% ethanol in the field. We were taking photographs in the laboratory by using the Olympus SZX7 with camera (Olympus SZX-DA) and GHG 12345/X700.

RESULTS AND DISCUSSION

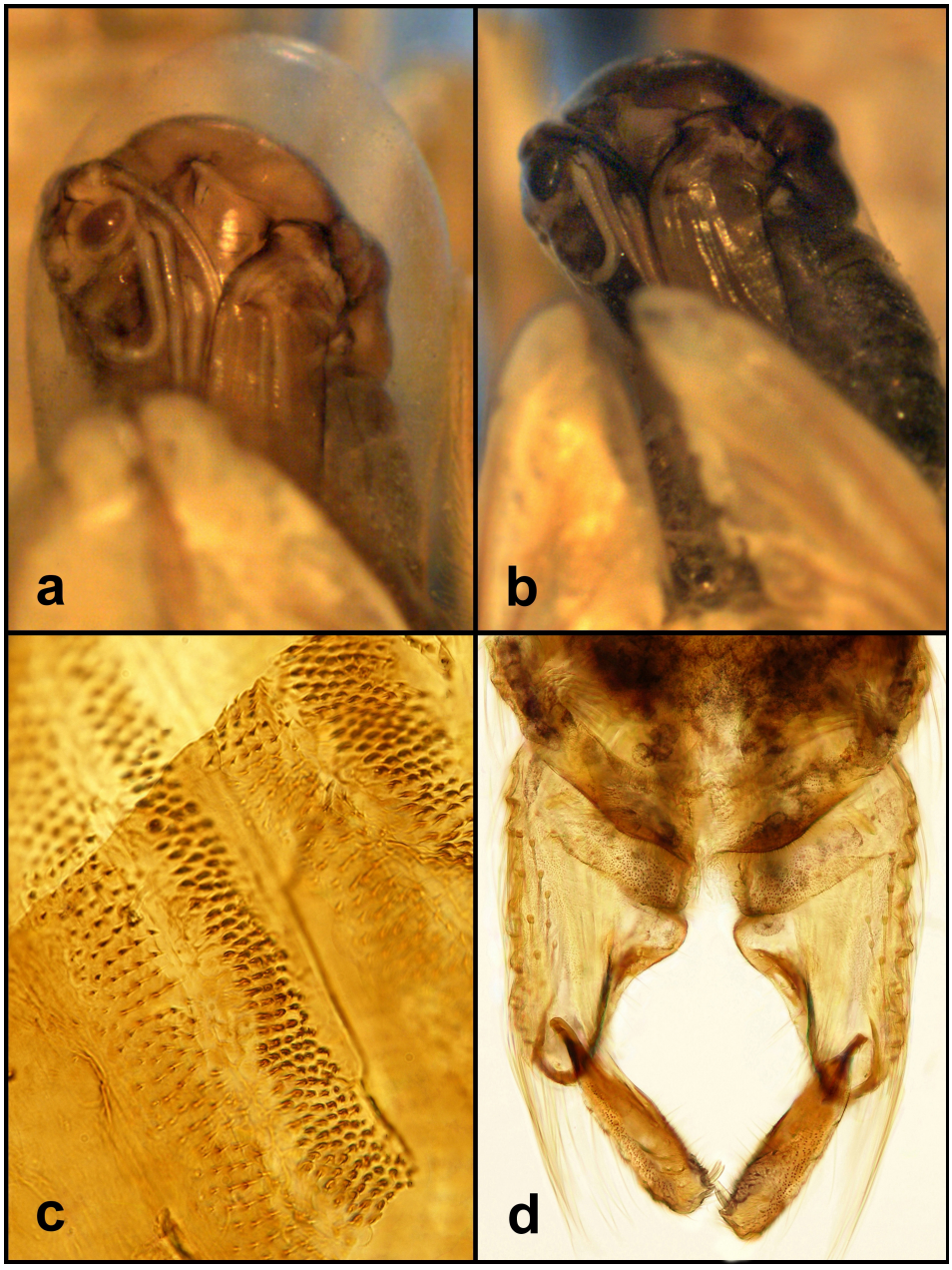
Symbiocladius rhithrogenae is an aquatic parasite associated with lotic habitats at high elevations of its hosting mayflies. We recorded the species only in one cold-water mountain stream of Zakarpattia Region, the Chornohora Range, i.e. Brebeneskul stream. Despite regular collecting conducted on nearby sites *S. rhithrogenae* was only found in a relatively narrow partition of altitude between 1400-1450 m a.s.l. Up to 40 % of larvae of *Rhithrogena iridina* (KOLENATI, 1859) and *Ecdyonurus* sp. (*E. helveticus* species-group), were infested with the larvae and pupae of *S. rhithrogenae*.

The first instar larva of *S. rhithrogenae* is most likely the only free-living stage, seeking the host (GONSER & SPIES 1997). It attaches itself to sites under wing sheaths of the mayfly, breaks its integument, feeds on haemolymph and associated tissues and often causes a discontinuation of the moulting process (CODREANU 1939, SOLDÁN 1978, 1979). In the reared material we mostly observed larvae of higher instars, including those during pupation, as well as the pupae and the adults enclosed in their pupal exuviae. The fully grown larva of 4th instar has its body strongly curved, with the head located under the base of one wing sheath of the mayfly, with distal part of the body attached under the adverse sheath (Fig. 1b). The head of the prepupal or pupating larva (Fig. 1a), is located under right (4 examined specimens) or left (2 specimens) wing sheath. The pupa is attached as shown in Figs 1c, d, with the head directed to the posterior of the host abdomen, with the body placed in lateral position and the face directed to right (6 specimens) or left side (10 specimens). The prepupal larvae and the pupae are enclosed in a thin gelatinous membrane (Fig. 2a), which shrinks during maturation of the pupa (Fig. 2b). The infested mayfly nymphs were reared up to their emergence, however, we have not observed emerging of *Symbiocladius rhithrogenae*. The adults, remaining in their pupal exuviae (Figs 2b,c), were completely developed and well determinable (Fig. 2d).

The species of the genera *Rhithrogena* and *Ecdyonurus* in Europe are viewed as the host species of *S. rhithrogenae* (SOLDÁN 1979, MATĚNA & SOLDÁN 1982). SOLDÁN (1978, 1979) mentioned some species of the family Heptageniidae from Central Europe, infected by *S. rhithrogenae*: *Rhithrogena alpestris* EATON, 1885, *R. beskidensis* ALBA-TERCEDOR et SOWA, 1987, *R. carpatoalpina* KŁONOWSKA, OLECHOWSKA, SARTORI et WEICHSELBAUMER 1987, *R. circumtatrica* SOWA et SOLDÁN, 1986, *R. iridina* (KOLENATI, 1859), *R. puytoraci* SOWA et DEGRANGE, 1987, *R. semicolorata* (CURTIS, 1834); *Ecdyonurus dispar* (CURTIS, 1834), *E. starmachi* SOWA, 1971, *E. subalpinus* (KLAPÁLEK, 1907), *E. sabmontanus* LANDA, 1969, *E. torrentis* KIMMINS, 1942, *E. venosus* (FABRICIUS, 1775); *Electrogena affinis* (EATON, 1883), *E. lateralis* (CURTIS, 1834) and one species of the family Leptophlebiidae: *Habroleptoides confusa* SARTORI et JACOB, 1986. Within Heptageniidae family the



Figs 1a-d. Metamorphosis of *Symbiocladius rhithrogenae*: a - larva of 4th instar, b - pupation, c - young pupa, d - fully developed pupa.



Figs 2a-d. Pupa and male adult of *Symbiocladius rhithrogenae*: a - pupa enclosed in gelatinous membrane, b - adult male in pupal exuvium, c - pupal exuvium, pattern of spinulae of 5th and 6th tergite, d - male hypopygium.

most frequently infected are *Rhithrogena semicolorata*, *R. carpatoalpina* and *R. puytoraci*. Populations of R. *semicolorata* are infected in 19-29%, *E. lateralis* - in 5-16%, while *E. subalpinus* populations only in 4-5%. *H. confusa* was parasited occasionally (0.5% of nymphs population) (SOLDÁN 1979). *S. rhithrogenae* is distributed in cold streams and rivers at altitudes 250-800 m a.s.l. (SOLDÁN 1979, MATĚNA & SOLDÁN 1982). MOUBAYED (1991) found this species in Pyrenees, at altitude 900-1100 m a.s.l. Our investigations showed that *S. rhithrogenae* in Chornohora Range occur in the altitude between 1400-1450 m a.s.l and it is the higest altitude reported for this species. *S. rhithrogenae* in Chornohora Range was found only in the upper part of just one stream (Brebeneskul stream), while in other similar streams examined in this region and inhabited by potential host mayflies, we did not observe the parasite.

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