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*Ecdyonurus silvaegabretae* n. sp., a new representative of the  
*E. helveticus* species-group from the Šumava Mountains, Czech  
Republic  
(Ephemeroptera: Heptageniidae)

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ABSTRACT. *Ecdyonurus silvaegabretae* n. sp. (male and female imagines and subimagines, mature larva, egg) belonging to the *E. helveticus* species-group is described from the Czech Republic part of the Šumava Mountains (type locality in a small unnamed right tributary of the Vydra River near Čeňkova Pila, 49°05'31" N, 13°29'58" E, elevation of 740 m). The species, actually known for a long time, has been currently confused with *E. austriacus austriacus* Kimmins, 1958 and *E. picteti* (MEYER-DÜR, 1864) in regional and local references, full synonymy is presented. Critical diagnostic characters distinguishing this species from related *E. subalpinus* (KLAPÁLEK, 1907) and other species of the respective species-group are illustrated and discussed. Fundamental data on its distribution, ecological range, habitat preference, and life cycle are presented.

Key words: entomology, taxonomy, Ephemeroptera, Heptageniidae, *Ecdyonurus helveticus* species-group, Czech Republic, distribution, biology.

#### INTRODUCTION

The *Ecdyonurus helveticus* species-group as defined by KIMMINS (1958) and re-defined by HEFTI & TOMKA (1988), HEFTI et al. (1986, 1987, 1989) GODUNKO & SOLDÁN (2003), GODUNKO & KLONOWSKA-OLEJNIK (2004) and GODUNKO et al. (2004) now consists of 13 European mountain or submontane species. Within the

genus *Ecdyonurus*, this group is well defined by the arrangement of male external genitalia and numerous larval characters. For a long time, widely distributed and abundant species *E. subalpinus* (KLAPÁLEK, 1907), although originally described from the Ukrainian Carpathians, remained the only representative of the *E. helveticus* species-group known from Central Europe. The only note on other species of this group found in this area is that by ŠÁMAL (1941) who identified a specimen collected near Horská Kvilda in the Šumava Mountains as *E. helveticus* (EATON, 1885). Although this material is not preserved and thus cannot be checked, this determination is not likely since the area of this submediterranean species is restricted to the Alps, Iberian and Apennine Peninsula, and the Balkan's (BOGOESCU 1958, PUTHZ 1978, BAUERNFEIND 1990, HAYBACH 1998, BAUERNFEIND & HUMPESCH 2001). Most probably, ŠÁMAL's (1941) specimen belonged either to the new species described in the present paper or to *E. cf. austriacus* living in the same area and showing some different morphological characters from *E. austriacus austriacus* KIMMINS, 1958 populations from the Alps.

A good many years ago, LANDA (1968, 1969) first presented a description, illustrations and life cycle data of an *Ecdyonurus* species, which he had found in the Šumava and Novohradské hory Mountains, Czech Republic in the 1950s. Since he had originally identified this species as *E. austriacus*, this opinion was followed in numerous subsequent taxonomic and faunistic treatments of the Czech Republic fauna (e.g., LANDA & SOLDÁN 1981, 1985 or SOLDÁN et al., 1996, 1998, 1999, 2000). For many years, *E. austriacus* remained the only other representative of the *E. helveticus* species-group identified in the Labe river-basin of the Czech Republic.

However, PUTHZ (1975) considering the species *E. austriacus* and *E. picteti* (MEYER-DÜR, 1864) conspecific, synonymized these species under the name *E. picteti*. Following this opinion, some material collected in the Czech Republic during the 1970s and 1980s containing the same species was treated also as *E. picteti*, e.g., by SOLDÁN (1981) or LANDA & SOLDÁN (1989). Nevertheless, a subsequent revision by JACOB & BRAASCH (1984) showed these species to actually represent two very good and quite separated taxa. This opinion was later proved also by HEFTI et al. (1982, 1985) on the basis of both classical taxonomic and some biochemical (isoenzyme) data.

This was the reason compelling us to re-examine all the material ever collected in the Labe basin within the Czech Republic. Detailed examination of both larval and adult stages revealed that there are actually two species of the *Ecdyonurus helveticus* species-group usually identified as *E. austriacus* being evidently different in their morphological characters from both the nominative subspecies *E. austriacus austriacus* and true *E. picteti*, the material of which we had a possibility to compare.

The aim of the present paper is to (i) make a revision of the earlier occurrence data of the original *Ecdyonurus* "austriacus" in LANDA's (1968, 1969) sense in order to establish full synonymy, taking into account all regional and local

references, (ii) describe a new species from the Šumava Mountains and determine critical diagnostic characters to distinguish it from other species of *E. helveticus* species-group and (iii) present fundamental data on its distribution, ecological range, habitat preference, and life cycle.

***Ecdyonurus silvaegabretae* n. sp.**

?*Ecdyonurus helveticus* partim, nec EATON, 1883: ŠÁMAL 1941: 5.

*Ecdyonurus austriacus* partim, nec KIMMINS, 1957: LANDA 1962: 252; 1968: 278; 1969: 220; 1977: 24; LANDA & SOLDÁN 1981: 58; SOLDÁN 1981: 19; LANDA & SOLDÁN 1985: 243; LANDA et al. 1997: 220; SOLDÁN et al. 1996: 180; 1998: 38; 1999: 103; 2000: 172; SOLDÁN & ZAHŘÁDKOVÁ 2000: 229; SOLDÁN & LANDA 2002: 217; SOLDÁN 2003: 123.

*Ecdyonurus* cf. *austriacus*: PAPÁČEK & SOLDÁN 1995: 43.

*Ecdyonurus picteti*: partim, nec MEYER-DÜR, 1864, nec PUTHZ 1975; 1978: 256; LANDA & SOLDÁN 1989: 67.

ETYMOLOGY

The species is named after Silva Gabreta, an ancient Roman name of the Šumava Mountains in Central Europe (Böhmerwald or Bohemian Forest in German and English, respectively).

DESCRIPTION

Male imago

Size: body length: 11.4-14.2 mm; fore wings length: 11.7-13.6 mm; cerci length: 23.6-28.3 mm.

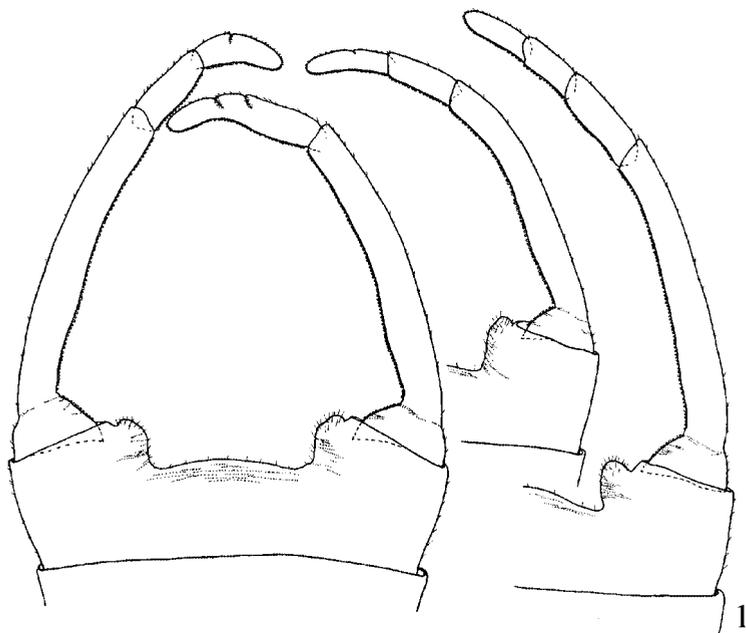
General coloration of body light yellow or yellowish-brown to brown.

Head yellowish-brown to light brown with unclear dark smudge and reflections on facial keel. Antennae light brown, unicolorous. Basal part of eyes black, apical part clearly paler, gray. Ocelli white apically, their basal part light brown rounded.

Thorax yellow to light brown (nomenclature of thoracic structures used here follows that by KLUGE 1994, 2004). Pronotum with diffused brownish smudges laterally. Mesonotum with longitudinal brownish bands between medial longitudinal and medioparapsidal sutures. Metanotum darker than pro- and mesonotum, light brown to brown. Thorax yellow in lateral view, posterior phragma and anterior paracoxal suture brown to dark brown. Prosternum, basisternum and furcasternal protuberances clearly brown to dark brown. Fore legs dark, light to dark brown, except yellow colored coxae and trochanters. Femora light brown to dark brown, darker distally, with diffuse spots. Tibiae darker than femora and tarsi, clearly dark brown. Tarsi pale, light brown and unicolorous. Middle and hind legs unicolorous as well, light brown, tarsi slightly darker. Femora distally with diffuse brownish-red maculation. Fore wings hyaline and transparent. Venation yellowish-brown to dark brown, paler at base. Stigmatic area opaque with some yellowish reflection. Hind wings of the same color as fore ones.

Abdomen yellowish-brown to brown. Posterior part of terga I-IX with narrow reddish-brown band. Lateral sides of terga II-VIII with broad triangular reddish-brown spots surrounded with a typical L-shaped drawing characteristic for most species of the *Ecdyonurus helveticus* species-group. Terga IX-X without lateral spots. Tergum X with two small brown to dark brown spots near the posterior margin. Sterna paler than terga, yellow to light brown. Sterna I-VIII with distinct longitudinal brownish spot in the central part of segment and two small light spots. Nerve ganglia well visible. Cerci yellowish-white to dark brown. Basal portion of cerci (1/4 or 1/3 of their length) clearly darker in distal portion.

Genitalia. Styli ger pale, yellow to yellowish-brown. Forceps segments slightly darker, light brown to brown. Forceps base with two strongly asymmetrical and brown colored protuberances. The arrangement of forceps variable from 4 clearly separated segments to segment 4 (occasionally also segment 3) separated from previous segment by more or less deep incision (Fig. 1). Penis lobes pale, yellowish-brown, clearly divergent laterally and spherical, not stretched laterally with evidently rounded external part (Fig. 6) and conspicuous protuberances. Apical sclerite robust, with bluntly pointed apical part directed perpendicularly to the axis of symmetry of penis lobes. Inner denticulation well developed, with 1-2 strong teeth directed towards the middle of the lobe or perpendicular to the axis of symmetry. Lateral sclerite relatively large, with nearly sub-parallel margins, deep narrowing in its external part not apparent (contrary to *E. subalpinus*). Distal part



1. *Ecdyonurus silvaegabretae* n. sp., male imagines (paratypes): variability in forceps structure, ventral view

of lateral sclerite almost rounded. Basal sclerite massive, with a single strong tooth directed towards the middle of the lobes or perpendicular to the axis of their symmetry (Figs 2, 3, 6). Lobes surface covered with numerous small spines. Penis stem without hump. Titilators light brown, pointed at apex.

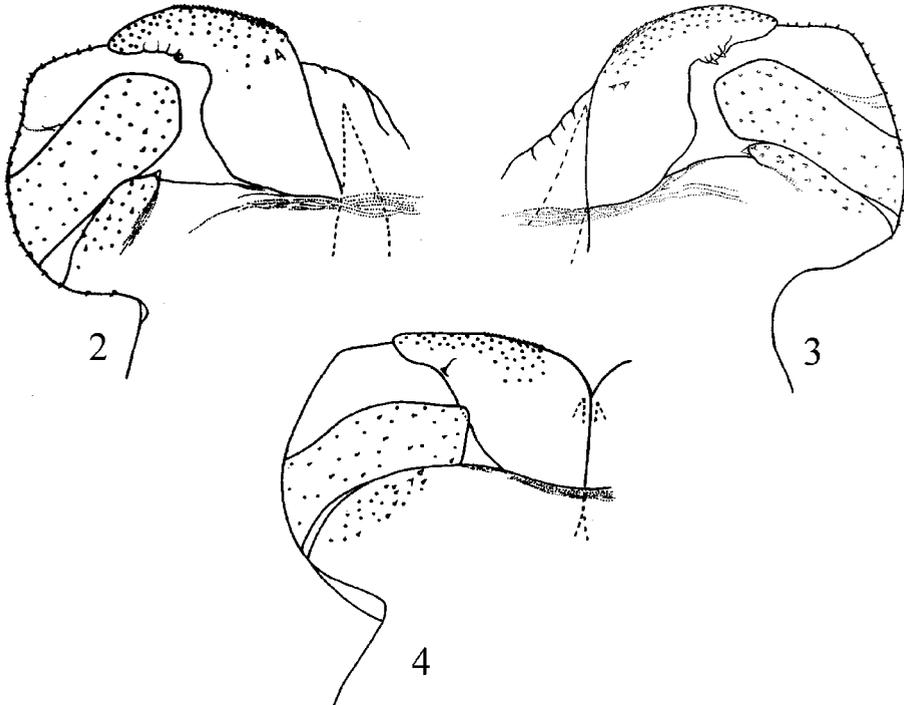
Male subimago

Size: body length: 9.9-10.7 mm; fore wings length: 11.0-12.4 mm; cerci length: 11.2-11.7 mm.

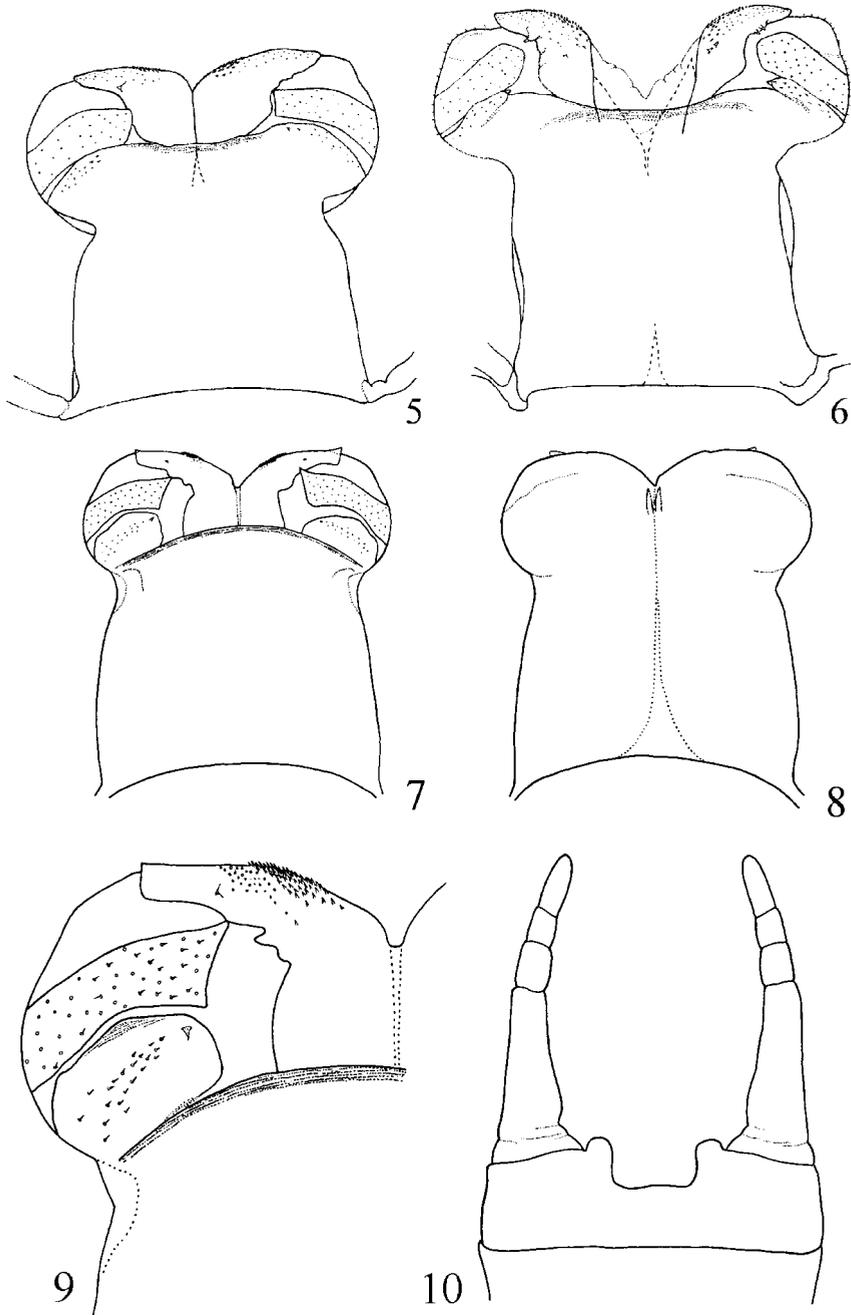
General coloration of body pale, yellow to yellowish-brown.

Head. Head and facial keel pale, yellowish, with grayish smudge and reflections. Antennae brown, unicolorous. Eyes black with light grayish reflections. Ocelli white in their apical part, black band at the basis well visible.

Thorax. General coloration pale, yellowish to yellowish-brown with grayish reflections and light brown spots. Fore legs darker than middle and hind ones. Coxae and trochanters unicolorous, yellowish-brown, femora yellowish-brown with brown-castaneous spots distally, tibiae and tarsi darker, unicolorous, dark brown. Middle and hind legs paler, yellowish-brown to brown. Femora unicolorous, yellowish-brown with light brownish reflections distally, tibiae yellowish brown



2-4. *Ecdyonurus silvaegabretae* n. sp., male imagines and subimago (paratypes): 2, 4 - detail of the right penis lobe, dorsal view; 3 - detail of the left penis lobe, dorsal view



5-10. *Ecdyonurus silvaegabretae* n. sp., male imago (5, 6) and subimago (7-10, paratypes): 5 - imaginal penis, dorsal view; 6 - submaginal penis, dorsal view; 7 - penis, dorsal view; 8 - penis, ventral view; 9 - detail of the right penis lobe, dorsal view; 10 - forceps, ventral view

to light brown with darker proximal area, tarsi unicolorous, brown with paler yellowish-brown area at a half of the first article length. Fore wings unicolorous, opaque, yellowish-grey, without drawings. Venation generally darker, dark brown in costal and subcostal fields. Pterostigmatic area slightly milky. Hind wings similar to fore ones in coloration.

Abdomen. General coloration of terga yellowish brown to brown with reddish reflections and spots, darker than thorax. Surface of terga with V-shaped reddish spots near anterior margins of segments II-VIII and two elongated paler spots at the central part of segments II-X. Posterior margins of terga I-IX with brown-castaneous or blackish band. Lateral sides of terga with reddish-brown to castaneous spots around L-shape drawing. Sterna paler, yellowish-brown with distinct reddish-brown longitudinal spot on segments I-VII, reddish reflections and small spots on segments VIII and IX (consequently, well distinguished central longitudinal reddish-brown stripe apparent on abdomen in ventral view). Sterna I-VI with two pairs of central paler spots and elongated paler spots laterally. Caudal filaments brown to dark brown, slightly paler distally.

Genitalia. Styli and forceps segments light brown to brown. Forceps consisting of 4 more or less clearly separated segments (Fig. 10). Forceps segments 3-4 slightly paler, yellowish-brown, their base with two strong asymmetrical lateral protuberances. Penis lobes paler, yellowish, not divergent and stretched laterally in both ventral and dorsal views. Lobes apparently spherical with evidently rounded external margin. Well visible external rounded protuberance at a half of the lobe length (Figs 5, 7, 8). Apical sclerite bluntly pointed or not pointed at the apex, robust, external denticulation and a single strong tooth on sclerite body well visible. Lateral sclerite relatively large, with sub-parallel margins, slightly or clearly divergent distally, without deep narrowing. Basal sclerite massive, generally with some small spines and a single tooth directed towards the lobes center. Small spines present also on the forceps surface and external proximal part of penis lobes (Fig. 4, 9). Penis stem without hump. Titilators yellowish, small and bluntly pointed at apex.

#### Female imago

Size: body length: 13.5-15.3 mm; fore wings length: 13.2-14.7 mm; cerci length: 18.9-20.8 mm.

General coloration of body paler, yellowish-brown with some reddish reflections.

Head. General coloration pale, yellowish, with diffuse reddish smudges on facial keel. Antennae brown. Eyes black, slightly yellowish with black band at the border and reddish central transversal stripe. Ocelli whitish yellow at the apical part and black band at base.

Thorax. General coloration yellowish-brown with slightly grayish reflections and small brown to reddish-brown spots. Thorax paler than abdominal terga. Fore legs dark brown. Femora with black smudges distally, tibiae paler than femora and

tarsi, slightly brownish proximally, tarsi brown, unicolorous. Middle and hind legs paler, yellowish-brown to brown. Femora yellowish brown with brown smudge distally, tibiae unicolorous yellowish, tarsi unicolorous, brown. Fore wings hyaline, transparent, slightly yellowish, unicolorous, wing venation brown to dark brown. Pterostigmatic area opaque, milky with some light brown reflections. Proximal part of costal and subcostal fields transparent. Hind wings of the same color as fore ones.

Abdomen. General coloration yellowish-brown to brown with reddish spots at lateral sides of terga around *L*-shape drawing. Terga surface with hardly visible small paler spots. Sterna yellowish-brown with two pairs of central and laterally elongated paler spots. Nerve ganglia dark. Subgenital plate relatively wide, posterior margin with smooth rectangular contour, similar to *E. austriacus*. Distal margin of subanal plate clearly pointed. Caudal filaments darker at base, yellowish-brown distally.

#### Female subimago

Size: body length: 10.5-13.3 mm; fore wings length: 12.4-15.1 mm; cerci length: 12.9-14.6 mm.

General coloration similar to male subimago. Shape and color patterns of subgenital and subanal plates similar to female imago.

#### Mature larva

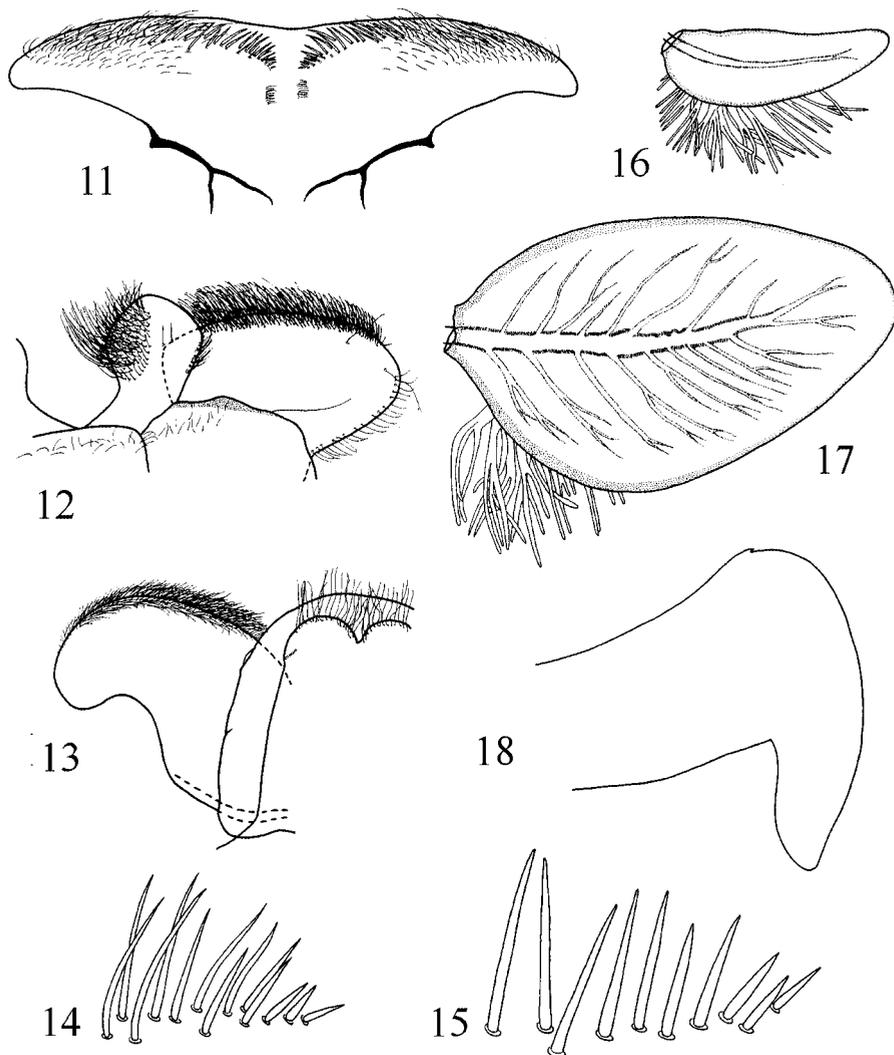
Size: body length: 12.3-16.7 mm; cerci length: 8.4-11.6 mm.

General coloration of body yellowish-brown to brown with paler color patterns.

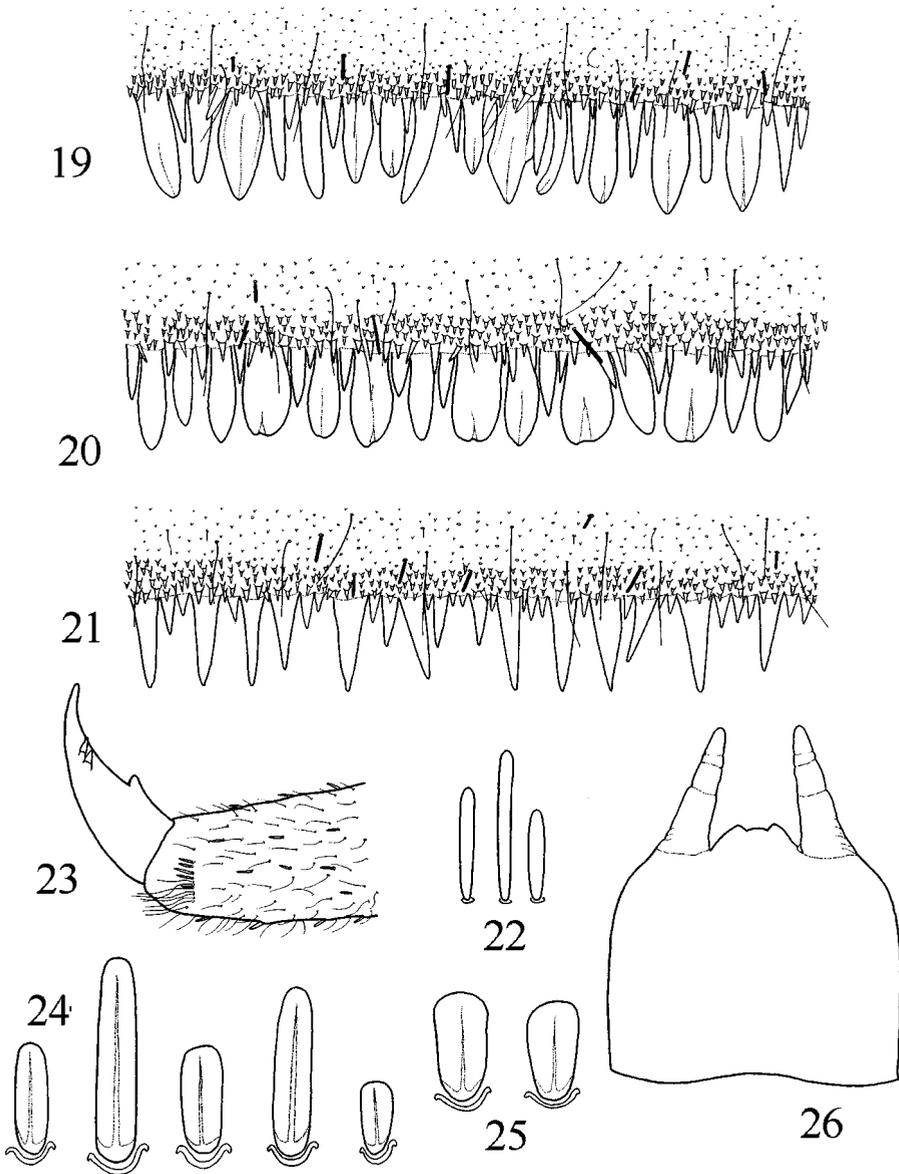
Head generally uniformly light brown. Antennae light brown, eyes and ocelli black. Labrum (Fig. 11) relatively narrow with slightly curved lateral lobes. A pair of rows of bristles apparent on ventral surface (Fig. 14), first three bristles more robust than the others (only a single row of robust bristles occurs in *E. subalpinus*, Fig. 15). First segment of maxillary palps with more than 5 long bristles at the fore margin, more than 30 long bristles along the outer margin. More than 16 long bristles on the dorsal part of galea-lacinia anterolateral area. Hypopharyngeal superlinguae (Fig. 13) massive, distinctly stretched laterally. Glossae and paraglossae as in Fig. 12, glossae not produced laterally, slightly rounded.

Thorax. General coloration yellowish-brown to brown. Posterolateral pronotal expansion (Fig. 18) asymmetrical, pointed at the apex, evidently directed towards the body axis, with curved inner margins and apical part clearly directed outwards (Fig. 18). General coloration of legs yellowish-brown with slightly darker femora and tarsi. Tibiae and trochanters yellowish-brown. Femora with cross shaped yellowish spots on yellowish-brown background. Femora relatively broad. Length/width ratio of metafemora 2.30 (mean,  $\sigma = 0.128$ ;  $n = 10$ ). Spatulas on dorsal surface in their central and distal area apically rounded, with slightly expanded

lateral margins (Fig. 25). Elongated, apically rounded spatulas with parallel margins (Fig. 24) present only in proximal part of femora. External margin of femora with long setae and short spines (more than 20 bluntly pointed spines present). Trochanters with spatulas similar to femoral ones. Tarsal claws with 1-2 teeth, usually with 2 teeth (Fig. 23).



11-18. *Ecdyonurus silvaegabretae* n. sp., mature larva (paratype) (Figs 11-14, 16-18); *E. subalpinus* (KLAPÁLEK, 1907), mature larva (Fig. 15): 11 - labrum; 12 - glossa and paraglossa of labium; 13 - lingua and superlingua of hypopharynx; 14 - oblique submedial bristles of labrum arranged into 2 rows; 15 - oblique submedial bristles of labrum arranged into a single row; 16 - gill 1; 17 - gill 4; 18 - pronotal posterolateral projection



19-26. *Ecdyonurus silvaegabretae* n. sp., mature larva (paratype): 19-21 - variability in arrangement of posterior margin of tergum 4; 22 - setae on the surface of tergum 4; 23 - tarsal claw; 24 - elongated spatulas rounded at the apex with parallel margins (only in the proximal part of femora); 25 - expanded spatulas with slightly divergent margins (in central and distal part of femora); 26 - sternum 9 with the forceps anlagen of male larva

Abdomen. General coloration of abdominal terga darker than head and thorax, brown with yellowish-brown to yellowish spots. Surface of terga with more or less visible drawing in dorsal view. Segment I paler with central smudge, segment II with a pair of central paler spots and two paler spots laterally, segments III-IV uniformly colored with a pair of central paler small spots, small spots near posterior margin of terga and two elongated paler spots laterally, V-shaped central pale spot and two spots lateral on segment V, segments VI-VII uniformly colored with a pair of central paler spots, small spot near posterior margin of terga and a pair of elongated paler lateral spots; segments VIII-IX unicolorous, yellowish with V-shaped central paler spot around smaller V-shaped dark spot, segment X unicolorous, brown, sometimes with two small paler central spots and paler stripe near the posterior margin of terga. Lateral sides of terga with color patterns characteristic for *Ecdyonurus helveticus* species-group. Posterior margin of terga with several patterns of spine arrangement as in Figs 19-21. There are large spines, spines expanded and rounded at apex (Fig. 20), combined narrower and usually bluntly pointed spines and large spines pointed at apex (Fig. 19) as well as narrow pointed spines (Fig. 21). Surface of terga with small spines and spatulas, long spatulas (Fig. 22) and long fine setae. Tracheal gills yellowish-violet to brownish-grey. Gill 1 (Fig. 16) relatively long. Gill 4 (Fig. 17) strong, asymmetric and wide, with blunt distal margin. Length/width ratio of the fourth gills 1.73 (mean  $\sigma = 0.193$ ;  $n = 10$ ). Sterna yellowish to yellowish-brown with large central reddish-brown longitudinal spot on sterna I-VII or I-IX thus forming well visible central longitudinal reddish-brown stripe on abdomen in ventral view. Abdominal nerve ganglia dark pigmented. Caudal filaments unicolorous, yellowish-brown.

Nymphal male genitalia. Styliger, forceps and penis lobes yellowish-brown. Forceps with at least three well distinguishable segments. Third forceps segment with hardly visible hollows on lateral margins (Fig. 26). Subimaginal forceps with more or less visible border of 3 and 4 segments. Penis lobes distinctly spherically shaped, not divergent and not stretched laterally. Details of penis lobes sclerotisation hardly visible, and still not differentiated. Apical sclerite robust, bluntly pointed at apex with a single well visible tooth on sclerite body. External denticulation of apical sclerite similar to male subimago. Lateral sclerite clearly widened distally. Form and denticulation of basal sclerite similar to male subimago.

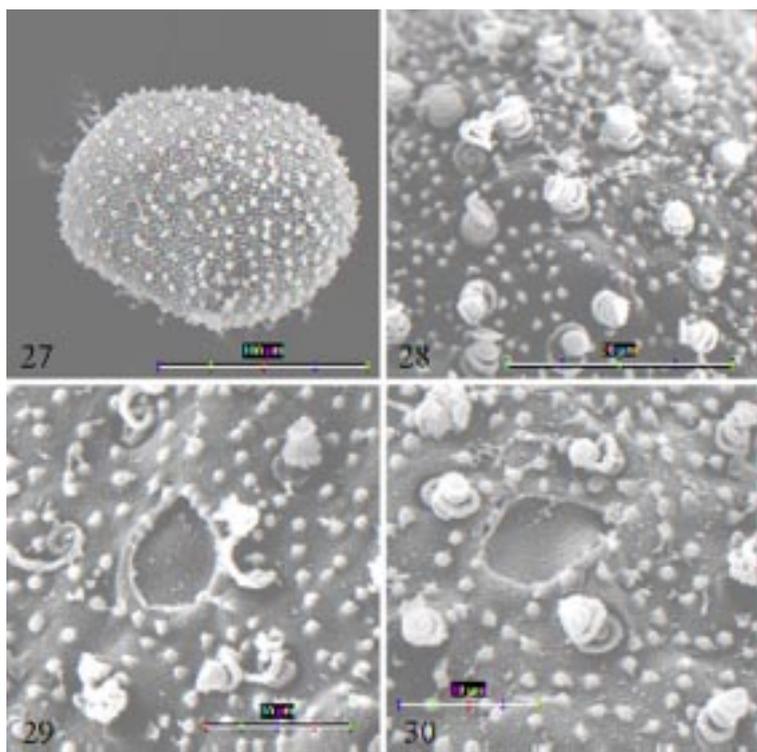
#### Egg

Dimensions of eggs: 142-158  $\mu\text{m}$  in length and 89-106  $\mu\text{m}$  in width. Eggs usually ovoid and evidently longer than wide (Fig. 27). Surface of exochorion covered with large knob-terminated coiled thread (KTC) attachment structures (Figs 27-29) all over its area. The KTC apparently larger 1.5-2.5 times in size on one of hemispheres measuring 2.5-3.2  $\mu\text{m}$  in diameter (Fig. 28). Those on the other hemisphere measure 1.3-1.6  $\mu\text{m}$  in diameter on average. Large KTC apparent also in the subequatorial and equatorial area, distances between them are 4.2-10.4  $\mu\text{m}$ . Among them, there are small delicate granules (about 0.8-1.2  $\mu\text{m}$  in diameter), irregularly and relatively sparsely (in comparison, e.g., with *E. austriacus*

*nataliae*) scattered all over the exochorion surface. Average distances between them are approximately 8.3-13.2  $\mu\text{m}$ . Some (usually 3-5) micropyles situated in the equatorial and subequatorial areas, measuring about 7.7-9.9  $\mu\text{m}$  in length and 5.5-6.3  $\mu\text{m}$  in width. Micropyle (Fig. 30) drop-shaped, usually apparently bluntly pointed at one side, sperm guide not distinguishable. Micropylar rim always developed but smooth, sometimes very thin and hardly distinguishable (only about 0.3-0.5  $\mu\text{m}$  in width) and almost without tubercles, sometimes smooth again but well visible (about 2.0-2.5  $\mu\text{m}$  in width) and bearing from 3 to 8 granular subunits identical in shape and size to small delicate granules covering the egg surface (Figs 29, 30) These microgranules are always well separated, not touching each other (in contrast to other *Ecdyonurus helveticus* species-group eggs).

#### MATERIAL EXAMINED

Holotype: mature larva, Czech Republic, Šumava Mountains, unnamed small forest brook (right-bank tributary of the Vydra River) about 2.4 km south of



27-30. *Ecdyonurus silvaegabretae* n. sp., egg exochorionic structures; 27 - the egg, general view; 28 - detail of larger KTC concentrated on one of the egg hemispheres; 29 - variability of micropyle, example of thin, hardly apparent rim with almost indistinguishable microgranular units; 30 - variability of micropyle, example of well developed and relatively thick rim with apparent and separated granular subunits

Čeňkova Pila, 49° 05' 31" N, 13° 29' 58" E, altitude of 740 m, coordinates according to the uniform grid system 6947, 6.IV.1999, leg. T. Soldán and M. Putz.

Paratypes: 38 half grown and older larvae, same locality and collection date as holotype; 2 younger larvae, same locality as holotype, 28.XI.1968, leg. V. Landa; 2 male subimagines (reared), 3 female subimagines (reared), 7 mature larvae, same locality as holotype, 30.V. 2002, leg. T. Soldán; 1 female imago (reared), 5 mature larvae, same locality as holotype, 5. VI. 2002, leg. T. Soldán; 10 larvae ready to emerge, same locality as holotype, 7.VI. 2003, leg. T. Soldán; 7 male imagines (some reared from larvae with subimaginal skins), 3 male subimagines, 8 female imagines, 3 larvae ready to emerge, same locality as holotype, 15.-16.V.2004, leg. T. Soldán; 10 larvae ready to emerge, unnamed small forest brook (right-bank tributary of the Vydra River) about 1.7 km south of Čeňkova Pila; 49° 05' 17" N, 13° 30' 20" E, altitude of 720 m, 6947, 7.VII. 2003, leg T. Soldán; 1 younger larva, small unnamed forest brook (right-bank tributary of the Hamerský brook), Horská Kvilda, about 5.2 km northwest of Kvilda, 49° 05' 17" N, 13° 30' 20" E, altitude of 1, 050 m, 6947, 4.VIII. 1976, leg. V. Landa; 30 younger larvae, Zhůřský brook (right-bank tributary of the Vydra River), Turnerova chata, about 3.4 km southeast of Čeňkova Pila; 49° 05' 00" N, 13° 33' 04" E, altitude of 850 m, 6947, 23.VIII.1977, leg. T. Soldán; 2 larvae ready to emerge, Popelný brook (right-bank tributary of the Vydra River), Turnerova chata, about 4.8 km southeast of Čeňkova Pila; 49° 04' 28" N, 13° 32' 00" E, altitude of 920 m, 6947, 23.VIII.1977, leg. T. Soldán; 2 larvae ready to emerge, unnamed small forest brook (right-bank tributary of the Vydra River), Buchingrův Dvůr, about 2.5 km southeast of Čeňkova Pila; 49° 05' 37" N, 13° 31' 14" E, altitude of 910 m, 6947, 8.VI.2003, leg. T. Soldán; 1 larva, Hrádecký brook (left-bank tributary of the Vydra River) about 1.0 km southeast of Srní, 49° 05' 05" N, 13° 32' 00" E, altitude of 780 m, 6947, 6.IV.1999, leg. T. Soldán; 2 larvae ready to emerge, unnamed small forest brook (right-bank tributary of the Řezná-Regen River), Pamflerova Hut', about 2.5 km northeast of Zelezná Ruda-Eisenstein; 49° 09' 02" N, 13° 29' 39" E, altitude of 800 m, 6845, 25.V.2004, leg. E. Zelenková.

Other material studied (no types): 8 mature larvae (18.V.1955, leg. V. Landa), 35 younger larvae (12.I.1998, leg T. Soldán), 9 older larvae (15.IV.1998 leg. T. Soldán and M. Putz), 15 half-grown larvae (17.III.1998, leg. T. Soldán and M. Putz), unnamed small forest brook (right-bank tributary of the Vydra River) about 1.7 km south of Čeňkova Pila; 49° 05' 17" N, 13° 30' 20" E, altitude of 720 m, 6947; 32 mature larvae, 4 larval exuviae (30.V.2002, leg. T. Soldán) 4 older larvae (15-16.V.2004, leg. T. Soldán), the same locality as holotype; 11 half-grown larvae, 21 mature larvae, 1 larval exuvia, Zhůřský brook (right-bank tributary of the Vydra River), Turnerova chata, about 3.4 km southeast of Čeňkova Pila; 49° 05' 00" N, 13° 33' 04" E, altitude of 850 m, 6947, 6.VI.2002, leg. T. Soldán; 16 larvae, unnamed small forest brook (right-bank tributary of the Řezná-Regen River), Pamflerova Hut', about 2.5 km northeast of Zelezná Ruda-Eisenstein; 49°09'02" N, 13°29'39" E, altitude of 800 m, 6845, 25.V.2004, leg. E. Zelenková.

Parts of paratypes on slides. Holotype and most paratypes deposited in collection of the Institute of Entomology, Academy of Sciences Czech Republic, České Budějovice, Czech Republic, some paratypes (1 male imago, 1 male subimago, 1 female imago, 1 male subimago, 14 larvae) deposited also in the State Museum of Natural History, National Academy of Sciences of Ukraine, Lviv, Ukraine.

#### CRITICAL DISTINGUISHING CHARACTERS AND AFFINITIES

*E. silvaegabretae* n. sp. belongs to the *Ecdyonurus helveticus* species-group which can be distinguished from other *Ecdyonurus* species by the combination of the following characters: distal part of larval hypopharynx without long and dense setae; posterolateral extensions of larval abdominal segments (abdominal spines) short and directed parallel to the body axis; apical sclerite of penis lobes of imago laterally elongated.

Male imago of *E. silvaegabretae* n. sp. can be distinguished from all other species of *Ecdyonurus helveticus* species-group by the following combination of characters: (1) forceps compounds with 4 more or less apparently separated segments (unique character within the whole genus *Ecdyonurus*); (2) penis lobes not stretched laterally, spherical with evidently rounded outer margins; (3) apical sclerite robust, bluntly pointed at apex; (4) lateral sclerite relatively large with almost sub-parallel margins and without deep narrowing in the external part; (5) massive basal sclerite with 1 strong tooth only; (6) coloration of body, legs and wings (as described above).

Larva of *E. silvaegabretae* n. sp. can be easily distinguished by the following combination of characters from all species of this group, and especially from *E. subalpinus*: (1) position and shape of bristles on ventral side of labrum; (2) position and number of setae and bristles on the first segment of maxillary palps and dorsal part of anterolateral area of galea-lacinia; (3) shape of pronotum posterolateral extensions (here asymmetrical, pointed at apex, directed distinctly outwards with external outline slightly curved distally); (4) position, different types and shape of spines of abdominal terga and femoral spatulas (see the above description for details); (5) numerous smaller and long spatulas present on the surface of terga

The eggs of *Ecdyonurus silvaegabretae* n. sp. can be compared only with *E. subalpinus*, *E. cf. austriacus* and *E. austriacus nataliae* GODUNKO et KLONOWSKA-OLEJNIK, 2004 and, *E. rizuni* GODUNKO, KLONOWSKA-OLEJNIK et SOLDÁN, 2004 recently described according to electronmicrograms. Contrary to *Ecdyonurus silvaegabretae* n. sp., the eggs of all these species are evenly covered with KTC of the same size and there are 2-4 differently shaped and sized and more densely spread microgranula among them. Micropylar rim rough, micropyle is always surrounded with a large number of well differentiated microgranular units.

## DISTRIBUTION AND BIOLOGY

The area of *E. silvaegabretae* n. sp. (altogether only 8 localities) seems to be very small and restricted to the upper reaches of the river Otava, a part of the Labe basin, and Řežná (Regen) belonging to the Danube basin. *E. silvaegabretae* n. sp. thus seems to be the Central European species (SOWA 1975a, LANDA & SOLDÁN 1985). Such a small area shows to some degree endemism but this phenomenon seems to be very rare in mayflies and new localities might be discovered soon. For instance, larvae of *E. helveticus* species-group that could not be determined according to the existing keys (e.g. HEFTI et al. 1989) have been collected at the Bavarian side of the Šumava-Böhmerwald Mountains (DORN, pers. comm. 2001).

At the localities of its occurrence, *E. silvaegabretae* n. sp. is fairly numerous, subdominant (A3 category by SOLDÁN & ZAHŘÁDKOVÁ 2000). Larvae have been still found at two types of habitats. First of them (including the type locality) comprises small shaded spruce stand forest books of the first order evidently belonging predominantly to the hypocrrenal zone, about 1-2 km long and 0.1-0.5 m broad with a relatively high slope. Larvae evidently prefer stony places with cobble, pebble and granules, small larvae were collected also from coarse sand bottom, and other substrates are usually not inhabited. Current speed is low at these localities (0.1-0.3 m.s<sup>-1</sup>). In these habitats, the mayfly taxocenes usually consisting of *Baetis alpinus* (PICTET, 1843), *B. rhodani* (PICTET, 1843), *B. vernus* CURTIS, 1834, *Rhithrogena iridina* (KOLENATI, 1859), *Ephemerella mucronata* (BENGTSSON, 1909), and *Serratella ignita* (PODA, 1761) prevail. This type of habitat is evidently preferred. Second type of localities is represented by larger brooks or streams of the second or third order evidently belonging mostly to the epirhithral, partly to mesorhithral (e.g., Zhůřský brook near Turnerova chata). Larvae evidently prefer stony places again, they are rarely found on coarse sand bottom but never occur on fine sand, silt or organic debris substrates. They are only exceptionally distributed in the streamline or at places with maximal current velocity, preferring stones situated at slow to moderate current expositions. However, larvae are very rare (A1 category by SOLDÁN & ZAHŘÁDKOVÁ 2000) at these places.

The oviposition follows immediately mating flight of adults that takes place from the end of May to the beginning of July. Larvae of the first instar hatch from the eggs about 6 weeks to 2 months after the oviposition, there is obviously no egg diapause or quiescence. Larvae grow slowly during the end of autumn and in winter reaching only about 3-5 mm in body length in January, i.e. about a third of their ultimate body length. While the larval growth is very slow and approximately linear during winter, exponential growth period occurs approximately from the end of March or beginning of April after spring increase of water temperature. The half-grown and older larvae (wing pads apparently developed) measure about 5-7 mm in mid March and about 8-10 mm in mid April in body length, respectively. First mature larvae (i.e. those of the ultimate instar with black wing pads) start to appear in mid May. Larvae of the same population of

*E. silvaegabretae* n. sp. are always approximately of the same length at the same moment. This is contrary to *Ecdyonurus* cf. *austriacus*, the mature larvae of which occur at the same localities much longer approximately from mid May to early October, usually together with older and even half-grown ones at the same time. Similar life cycle has been described also in *E. austriacus austriacus* populations from its terra typica (BAUERNFEIND & HUMPESCH 2001). In related species, namely *E. austriacus nataliae* and *E. rizuni*, there are monovoltine winter life cycles (GODUNKO & KŁONOWSKA-OLEJNIK 2004, GODUNKO et al. 2004). On the other hand, *E. subalpinus* has bivoltine winter life cycle in its western subarea (Central Bohemia) or monovoltine cycle with extremely long flight period in its eastern subarea in the Carpathians (SOWA 1974b, GODUNKO & SOLDÁN 2003). Under the laboratory conditions subimagines of *E. silvaegabretae* n. sp. always emerged in early afternoon (about 11.30 a.m.-2.00 p.m.) and the subimaginal stage lasted for approximately one day. To conclude, *E. silvaegabretae* n. sp. shows a typical seasonal univoltine “winter” life cycle belonging to the category Uw as defined by CLIFFORD (1972). At least at our localities, there are no alternative life cycle types within this species; all larvae from the same egg cohort develop approximately in the same way.

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