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# *Ecdyonurus bimaculatus* n. sp., a new species of mayfly from Turkey (Ephemeroptera, Heptageniidae, Ecdyonurinae)

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With 22 figures

**Keywords**: Ecdyonurus, Heptageniidae, Ephemeroptera, Insecta, Turkey, Anatolia, Asia Minor, morphology, taxonomy, first description, distribution, ecology, egg, nymph, subimago, imago
**Schlagwörter**: Ecdyonurus, Heptageniidae, Ephemeroptera, Insecta, Morphologie, Taxonomie, Türkei, Anatolien, Kleinasien, Erstbeschreibung, Verbreitung, Ökologie, Ei, Larve, Subimago, Imago

***Ecdyonurus bimaculatus* n. sp. is described based on all stages from material collected in north-western Anatolia (Turkey). The imago of the new species shows a peculiar coloration pattern of the abdomen, which consists of two brownish to violet quadratic spots on each tergum. The structure of the penis resembles those of other pristine species of the subfamily Ecdyonurinae especially of *Afghanurus* Demoulin, 1964. However special characters of the penis, as well as the maxillary structure of the nymph indicate its systematic placement near to *Thamnodontus* Kluge, 2004. The nymph possesses, amongst other characters, 7 pairs of plate like gills, each with a separate tuft of filaments. The new species prefers sand and gravel in beta-mesosaprobic streams. It is widely distributed throughout the north-western Anatolia region of Turkey and its flight period is between June and September.**

## 1 Introduction

During research by the senior author on the Ephemeroptera fauna of the North-West Anatolia region since 1996, many nymphs belonging to the genus *Ecdyonurus* Eaton, 1868 sensu lato (or Ecdyonurini sensu Braasch, 1990 = *Ecdyonurus*/fg1 sensu Kluge, 2004 = Ecdyonurinae Ulmer sensu Wang & McCafferty, 2004) have been encountered. After obtaining adults and subimagines, it became clear that the collected specimens belong to a new species which can be easily separated from all other species of *Ecdyonurus* s. l. in the stages of male imago and nymph.

In this study all stages (egg, nymph, subimago, imago) of both sexes are described. Further, notes on its tentative systematic placement, as well as on its ecology and zoogeographical affinities are given.

## 2 Material

Holotype (1 ♂ imago), Turkey, South-East of Balıkesir, Harmancık – Dursunbey Road 24.km, Hopanlar Village, Emet Stream (39°37′ N; 28°49′ E) at 360 m, on 2.IX.2000, leg Mustafa Tanatmış. Paratypes: Turkey: the same locality and date as the holotype, 13 ♂ imagines, 15 ♀ imagines, 4 ♂ subimagines with larval exuviae, 9 ♀ subimagines with larval exuviae, 10 nymphs; the same locality; 3.VII.1996, 32 nymphs; 28.VIII.1997, 7 nymphs; 29.VII.1998, 46 nymphs; 15.VIII.1998, 19 nymphs; Bursa Kestelek, Orhaneli Stream (39°58′ N; 28°31′ E), 120 m, 26.VII.1996, 4 nymphs; Bursa (Mustafakemalpaşa) Mustafakemalpaşa Stream (40°04′ N; 28°26′ E), 110 m,19.V.1997,13 nymphs; Kütahya (Değirmisaz), Emet Stream (39°25′ N; 29°15′ E), 19.VII.1997, 44 nymphs; 18.VII.2004, 18 nymphs; Karabük (Kayabogazı Village), Araç Stream (41°14′ N; 33° 02′ E), 520 m, 3.VI.1999, 7 nymphs; 8.VIII.2000, 3 nymphs; Karabük (Aşağı Kızılcaören Village), Soğanlı Stream (41°51′ N; 35°04′ E), 350 m, 25.VI.1999, 8 nymphs; Zonguldak (Devrek-Bakacakkadı), Filyos Stream (41°14′ N; 31°58′ E), 80m, 29.VII.1999, 8 nymphs; Zonguldak (Devrek- Özpınar Village), Karasu Stream (41°09′ N; 31°54′ E), 160 m, 6.VIII.2000, 12 nymphs. Sinop (Kabalı), Kabalı Stream (41°51′ N; 35°04′ E), 110 m, 1.VI.1999, 3 nymphs; 27. VII. 1999, 5 nymphs.

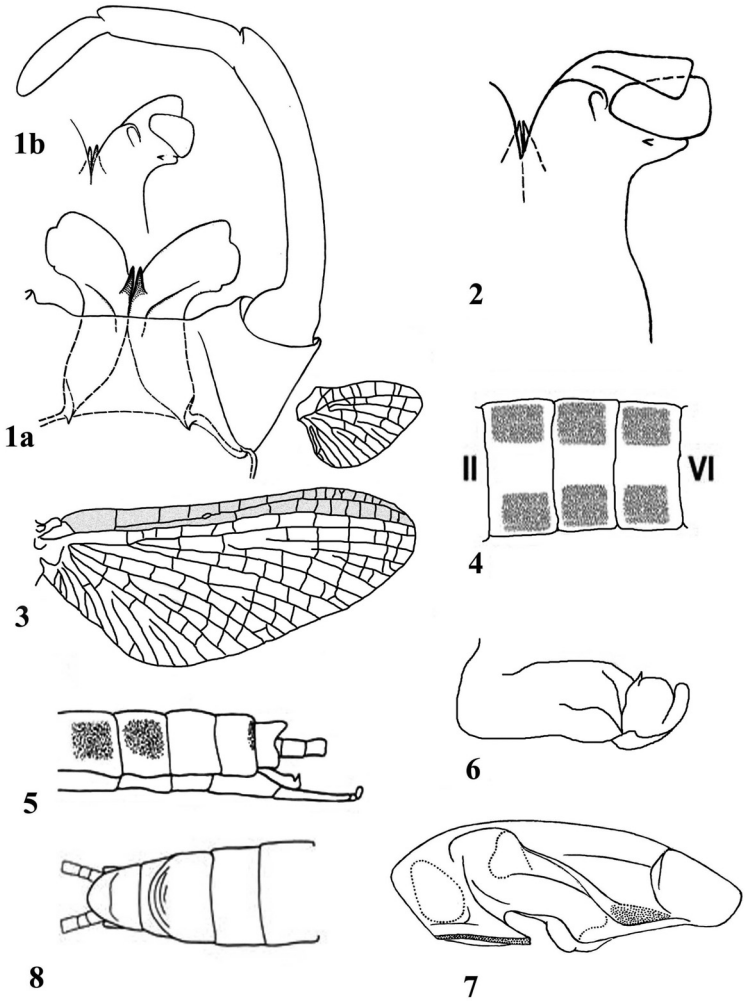
Association of nymphs and adults: At the type locality subimagines were reared from full grown nymphs, and were associated with swarming males (collected at the same locality and date) by colour pattern of the abdomen. Larvae were identified by comparison with larval exuviae of the reared subimagines.

The material is preserved in 75 % ethanol alcohol solution. The holotype and part of paratypes are deposited in the Zoology Museum of Biology Department, Anadolu University, Eskişehir Turkey. Other paratypes are in the collection of the authors and in the collection of the Zoological Institute of the Russian Academy of Sciences, St. Petersburg.

## 3 Description

*Ecdyonurus bimaculatus* **Tanatmış & Haybach, sp. nov. (Figs. 1–22)**

Male-Imago (in alcohol): Body-length: 6.6 mm, cerci 11.0 mm, forewing 6.9 mm. General coloration yellowish-brown. Head: Eyes large, globular, in dorsal view touching medially. Thorax: Yellowish-brown, without conspicuous spots; terga and sterna darker, pleura paler. Fore legs yellowish-brown, darker at femoro-tibial articulation and apex of tibia. Middle and hind legs pale yellowish, unicoloured. Fore tarsus subequal to tibia; 1st tarsal segment half the length of 2nd, 2nd–4th segments subequal. On middle and hind legs 1st tarsal segment longer than 2nd. Wings (Fig. 3): hyaline; pterostigmatic area, especially its tip, more whitish, with simple non-anastomosed cross veins. Abdomen (Fig. 4): Yellowish, terga with two dark brown to violet paramedian quadrate spots conspicuous on tergites 2–7 but inconspicuous on others. Penis (Figs 1a-b, 2, 5, 6) with laterally expanded lobes, latero-dorsal spines small (Fig. 6); Penis lobes with distinct ventral and outer sclerites and well-developed titillators contiguous medially. Cerci yellowish, unicoloured.




**Figs 1-8:** ***Ecdyonurus bimaculatus*** **n. sp.: male imago: (1a) ventral view of genitals; (1b) dorsal view of a half penis of the same specimen; (2) dorsal view of a half penis of a specimen whose ventral sclerite is strongly bent; (3) wings; (4) abdominal segments 3-5 in dorsal view; (5) abdomen and genital apparatus in lateral view; (6) penis from lateral; (7) subimagos mesonotum right half; (8) female imago: abdomen in ventral view**

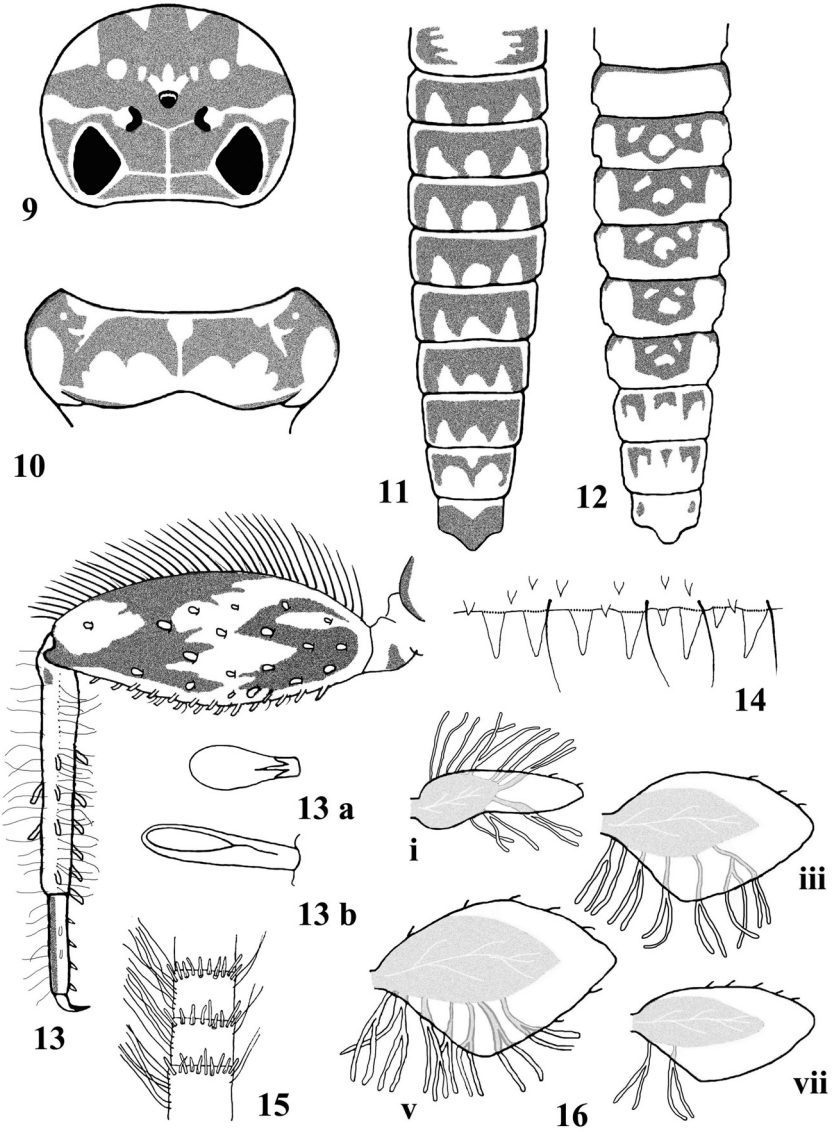
Male-Subimago (in alcohol): Similar to imago, especially with respect to abdominal pattern. Differences: Eyes not as globular as in imago, separated. Thorax brownish; subimaginal mesonotal cuticle nearly colorless, with two pairs of contrasting brown stripes (Fig. 7). Wings uniformly greyish.

Female-Imago (in alcohol): Length 7.3 mm, cerci 10.2 mm, forewing 8.5 mm. Thorax as in male. Abdomen unicoloured yellowish, without dark quadrate spots. Subgenital plate (Fig. 8) short, approximately half width of sternite 8. Subanal plate also short and regularly rounded.

Female-Subimago (in alcohol): Similar to ♀-imago. Thorax with the same patterns as in male subimago (see above). Wings uniformly greyish.

Eggs (in alcohol): Oval, length: 190–225 μm, width: 120–140 μm. Attachment structures, characterized by knob-terminated coiled threads (KCT) (Koss & Edmunds 1974). KCT spread over surface, but concentrated on one pole. On this pole KCT larger (~3.2 μm). On the remaining surface KCT smaller (~ 1.9 μm) and subequal in size to rounded macrogranulae spread more or less evenly over egg. Probably only one micropyle in subequatorial area, ovoidal, 12–15 μm in length and 10–12,5 μm in width (micropylar opening situated at the side). Micropylar rim thin, surrounded by small tubercles.

Mature nymph (in alcohol): Length of body 7–8 mm; cerci and paracercus subequal, 3–4 mm. General body colour from light brown to yellowish brown. Head pigmentation (Fig. 9): conspicuous white spots close to anterior margin. Anterior margin of head capsule not thickened. Antennae: Scapus whitish, pedicellus and flagellum light brown. Compound eyes and ocelli black. Mouthparts: Labrum broad (Fig. 17), with slightly concave notch distally. In ventral view inner median row of bristles consists of single row of stout bristles (Fig. 17 a). Mandibles (Fig. 18): Incisor of right mandible with 7 teeth along inner margin; inner incisor apically with two teeth. Incisor of left mandible with 12 teeth along inner margin; inner incisor apically widened, with 3 teeth. Prostheca of each mandible consists of 3 bristles. Maxilla (Fig. 19) with 12 pectinate bristles. Distal dentiseta divided into several branches diverging nearly from base (Fig. 20). Ventral surface of galea lacinia with scattered setae, those near apex fimbriate. Superlinguae with long hairs on outermost apex (Fig. 22). Glossae rhomboid (Fig. 21), separated from each other by U-shaped gap, ventrally with 3 stout setae. Apical segment of labial palps acutely pointed. Pronotum: pigmentation as in figure 10. Legs (Fig. 13): All legs similar in shape. Femora relatively broad, dorsal surface with pigmentation as in figure 13. Stout bristles on dorsal surface oval (Fig. 13a). Area close to inner margin of femur with



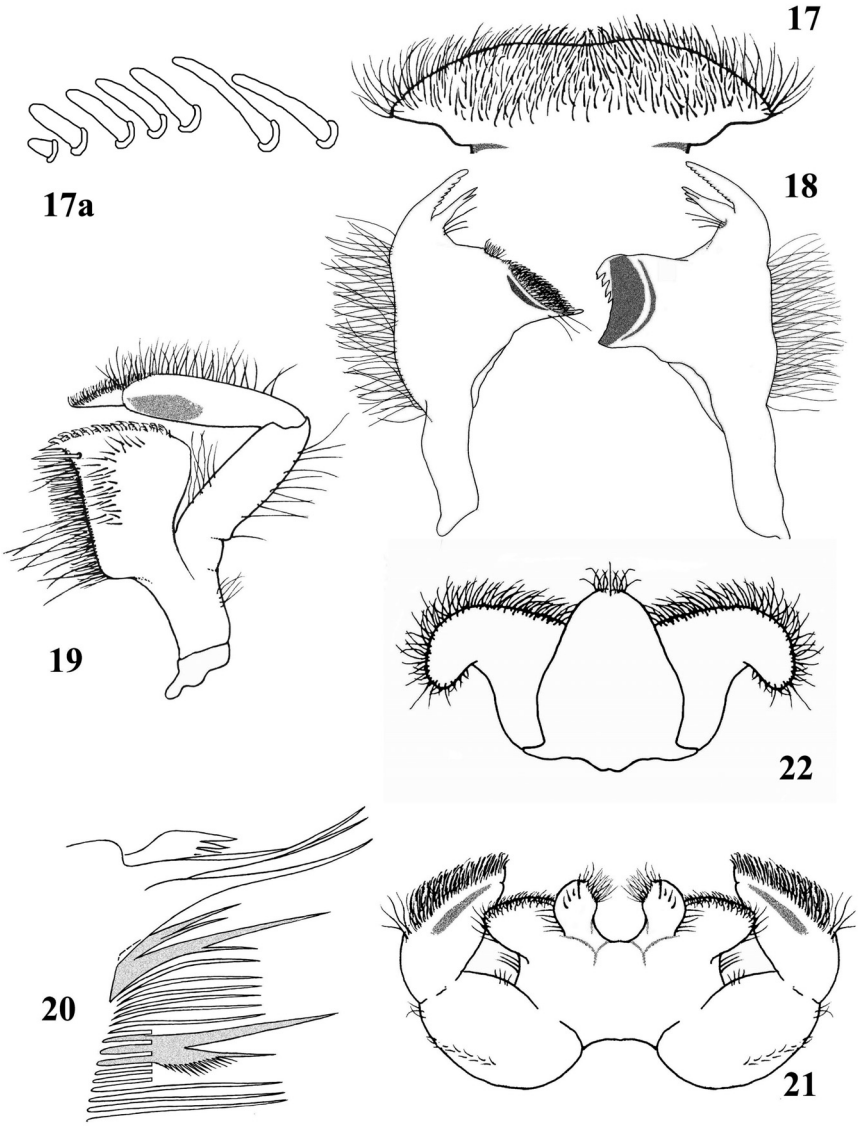

**Figs 9-16:** ***Ecdyonurus bimaculatus*** **n. sp.: Nymph: (9) head capsule (without antennae); (10) pronotum; (11) abdominal tergites; (12) abdominal sternites; (13) hind leg; (13a) bristle from the dorsal surface of femur; (13b) bristle from the lower femoral edge; (14) posterior margin of the 7th abdominal tergite; (15) segments from the middle of the cercus; (16) gills 1,3,5,7 in dorsal view**

double line of irregularly arranged bristles (Fig. 13b), which are longer and thinner than stout bristles on dorsal surface. Tibiae with scattered long, thin hairs along outer margin and along dorsal inner margin. Outer margin of tarsi and tip of claws dark brown. Claws with 2–3 teeth. Supracoxal sclerites rounded. Cerci and paracercus pale, with primary swimming hairs (Fig. 15). Gills (Fig. 16): Tufts of filaments and central part of lamella milky-white, outer parts more or less transparent. Gill 1 (Fig. 16 i) narrow and bent gently dorsally. Gills 2–6 (Figs 16 iii–v) tetragonal. Gill 7 (Fig. 16 vii) smaller, with tuft of filamentous gills. Dorsal margins of gills with some hairs. Abdomen: Tergites, especially 3–7, with conspicuous pigment pattern as in figure 11. Hind margin of tergites as in figure 14. Pigmentation of sternites (Fig. 12): 1st and 2nd abdominal sternites more or less whitish, sternites 3–7 with three or four whitish spots on brown background. In young nymphs sternite colour pattern is not so clear.

## 4 Systematic placement and diagnosis

*Ecdyonurus bimaculatus* nov. sp. differentiated from all other known *Ecdyonurus* s.l. species in the male imago and male subimago stages by its peculiar colouration pattern of the abdomen. The shape of its penis in the male imago is similar to those of *Afghanurus* Demoulin, 1964. However it differs from *Afghanurus* in the lack of spines on the ventral sclerite of the penis dorsad-laterad of tittillators. Kluge (2004) defined two systematic subgroups in *Ecdyonurus* s.l. based on larval characters. In the first subgroup which includes *Ecdyonurus* Eaton, 1868, *Afghanurus* Demoulin, 1964, *Leucrocuta* Flowers, 1980 and subgen. *Ecdyogymnurus* Kluge, 2004 the maxillae of the nymphs have distal dentisetae that are either simple, or distally bifurcate, which is interpreted as the plesiomorphic condition by Kluge. In the other genus group, which consists of *Atopopus* Eaton, 1881, *Notacanthurus* Tshernova, 1974, *Ecdyonuroides* Dang, 1967, *Electrogena* Zurwerra & Tomka, 1985, *Afronurus* s.l. Lestage 1924, and subgen. *Thamnodontus* Kluge, 2004 (= genus *Thamnodontus* after Webb & McCafferty, 2008) the nymphs have distal dentiseta of the maxillae that divides into several branches diverging nearly from base (Fig. 20), while in some other oriental and ethiopian subgenera of uncertain systematic position this feature is still unknown.

Judging from this larval feature of the maxilla our new species belongs to the second subgroup, and is not closely related to *Afghanurus* or *Ecdyonurus* s.str., in spite of superficial similarities of the penis shape. The new species is especially close to *Thamnodontus* based on the following features, defined by Kluge (2004): Nymphs with "normal" proportions of head and legs (in contrast to *Atopopus*, whose larvae have a very wide head with a laterally expanded shield and relatively short legs). Larval abdomen without median ridge or spines (in contrast




**Figs 17-22: *Ecdyonurus bimaculatus* n. sp.: Nymph: Mouthparts; (17) labrum; (17a) Bristles on the ventral surface of labrum (left side); (18) mandibles; (19) left maxilla, (20) apex of left maxilla (dentisetae grey); (21) labium; (22) Hypopharynx. Figs. 18, 19, 21, 22 in ventral view; figs. 17, 20 in dorsal view**

to *Notacanthurus*) and with posterolateral spines not enlarged (in contrast to *Ecdyonuroides*). Penis lobes with distinct ventral and outer sclerites (in contrast to *Electrogena*) and well-developed titillators contiguous medially (in contrast to *Afronurus* s.l.).

The new species shows the following differences to *Thamnodontus*: So far only three species are described, all from Eastern Asia. They all have larvae that have lost their primary swimming hairs of cerci and paracercus, present in our species. Kluge, 2004 designates this feature as a "character of unclear phylogenetic status", however this character may be subject to further phylogenetic studies by Kluge (pers. comm.).

Because of this different systematic feature as well as the different distribution area far from all other known *Thamnodontus* species and because we like to avoid to erect a new genus for our species based on a single plesiomorphic character in a complicated family where better justified genera are now treated as synonym to *Ecdyonurus* by Webb & McCafferty (2008) we decide to place it tentatively into *Ecdyonurus* Eaton, 1868 in the broadest sense.

The nymph of the new species can be most easily recognized by having a tuft of filaments on each of all 7 pairs of gills. This feature is within *Ecdyonurus* s.l. only known in two species of *Ecdyonurus* s. str., *E. insignis* Eaton, 1870 and *E. asiaeminoris* Demoulin, 1973, both with the typical form of pronotum having backward projections on each side. Besides there is an unnamed species from Japan *Ecdyonurus* sp. EA. of uncertain systematic position, which differs in the lack of primary swimming hairs of cerci and paracercus (Tsuda 1983: Fig. 9a).

Our species is therefore most probable identical with *Afronurus*? sp. 1 of Demoulin (1963: p. 37, larva only) having also tufts of filaments on each of all pairs of gills described also from Anatolia.

## 5 Etymology

The new species is named after the peculiar pattern of the abdomen in male imagoes, bimaculatus lat. = having two spots.

## 6 Ecology

Nymphs were collected from sand and gravel in the current of broad beta-mesosaprobic streams. Imagines were collected at the beginning of October, but the presence of fully mature nymphs with black wing pads suggests that the flight period is between June and September.

## 7 Zoogeographical notes

The new species is widely distributed in the whole north-western Anatolia region in Turkey. This area, part of the glacial Ponto-Mediterranean refugium sensu de Lattin 1967 is situated at the crossing of two important post glacial immigration routes, one from the Macedonian-Thrace (Balkans) refugium and the other from the Irano-Caspian refugium (de Lattin 1967, Demirsoy 1999). The whole region is therefore expected to hold a rich mayfly fauna from different zoogeographic regions (Kazancı 1991, 2001).

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