



Taxonomic notes on *Nemoura banatica* Kis, 1965 and *Nemoura marginata* Pictet, 1836 (Plecoptera: Nemouridae) from the Jura Mountains

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Originally described from the Banat region, which is presently divided between Hungary, Romania and Serbia, *Nemoura banatica* Kis, 1965 had been considered as a synonym of *Nemoura marginata* Pictet, 1836 ever since the study of Zwick (1970), but was recently reinstated as a valid species by Vinçon *et al.* (2024) after the discovery of this species in several headwater regions in Austria, Italy, Slovenia, and the Jura Mountains of France and Switzerland. For establishing the synonymy, Zwick (1970) had relied on microscopic preparations of the apical sclerite of the epiproct of adult males (Fig. 9), which have become the standard method of taxonomic studies of *Nemoura*. By placing side-by-side fresh microscopic preparations of *N. banatica* (Figs 1–3) and *N. marginata* (Figs 4–6) from the Jura Mountains, it appears that the drawings of the apical sclerite of *N. marginata* provided by Zwick (1970, his Fig. 1m) show characteristics that are somewhat intermediate between both species (Fig. 9). The tip of the apical sclerite of *N. marginata*, as drawn by Zwick (Fig. 9), is less protruding than it is in freshly prepared specimens (Figs 4–6, 8) and thus appears close to *N. banatica* (Figs 1–3, 7), which might explain why Zwick (1970) could consider the latter as being a synonym of *N. marginata*.

Given the succinct original description of *N. marginata* by Pictet (1836, pg. 181), as well as the absence of type material, Zwick (1970) had undertaken to designate a neotype based on a specimen collected in May 1943 from River Flon, located on the foothills of the Jura Mountains in the Lausanne region, though the original description of Pictet (1836, pg. 182) reports the species from the “Vallée de Chamounix [i.e. Chamonix]” and from the Salève region (Pictet 1841, pg. 398), both located in the Savoy Prealps. In defense of Zwick (1970) it may be invoked that the neotype for *N. marginata* chosen by this author had been based on older material preserved in ethanol, with subsided epiprocts. Specimens from this same locality (05.07.1942, River Flon near Lausanne, leg. Jacques Aubert, GBIFCH01219423) are still extant in the collections of the MZL (State Museum of Natural Sciences (Naturéum), Department of Zoology, Lausanne, Switzerland) and can be identified morphologically by the present author as corresponding to *N. marginata*. However, having been collected > 80 years ago, the apical sclerite of the epiproct of these specimens is also far less protruding than it is in fresh specimens (Fig. 8) and looks close to the one of *N. banatica* (Fig. 7).

It should be noted that microscopic preparations of the apical sclerite of the epiproct of adult males of *N. marginata* are very delicate to perform, given that care must be taken not to crush or dislocate this small sclerite, which is attached perpendicularly to its base (Figs 7–8). It is recommended to first soak the abdomen of specimens preserved in ethanol overnight in 10% room-temperature NaOH before separating and cleaning the epiproct with a dissection needle (Figs 3, 6). The cleaned structures can then be prepared as microscope slides and are best studied by phase-contrast microscopy (Figs 1–2, 4–5). In some figures of *N. marginata* found in the literature, this apical sclerite is compressed, making the tip of the sclerite nearly invisible. The illustrations of *N. marginata*, found in Koesé (2008), represent an intact tip (his figs 151, 161), whereas the tip of the left apical sclerite is compressed (his fig. 160). The microscopic preparation of *N. marginata* found in Enting (2003, his Fig. 14) also shows a crushed apical sclerite, provided that it is not a misidentified specimen of *Nemoura erratica* Claassen, 1936. The problem arising from incorrectly prepared samples is that the differences between *N. banatica* and *N. marginata* become blurred. The distal edge of the apical sclerite of the epiproct of *N. marginata* has a long, arched lateral extension ending in a well-marked blunt tip (Figs 4–6, 8), whereas this tip is much less prominent in *N. banatica* (Figs 1–3, 7).

In macroscopic view, the separation of adult males of *N. marginata* and *N. banatica* from the Jura Mountains is possible only with specimens having well sclerotized cerci and epiprocts. In dorsal and ventral view, the membranous part of the tip of the cercus of *N. banatica* is long and distinctly swollen and the sclerotization of the cercus does not reach to its apex (Fig. 10). On *N. marginata*, in contrast, the membranous part is shorter, straight, and narrow, and the sclerotization

of the cercus continues right to its pointed apex (Fig. 13; Ris 1902, his plate 4, fig. 25; Vinçon *et al.* 2024, pg. 39, their fig. 5). Upon closer scrutiny, this difference is also visible in the original description of *N. banatica* in Kis (1965) and Kis (1974, pg. 148, his fig. 83, *sub nom. Nemoura marginata fide* Zwick 1970). Moreover, in dorsal view, the apical sclerite of the epiproct is triangle-shaped in *N. marginata* (Zwick 1970, his fig. 11), whereas it is elongated and nearly rectangular on *N. banatica* (Kis 1974, pg. 148, his fig. 83C).

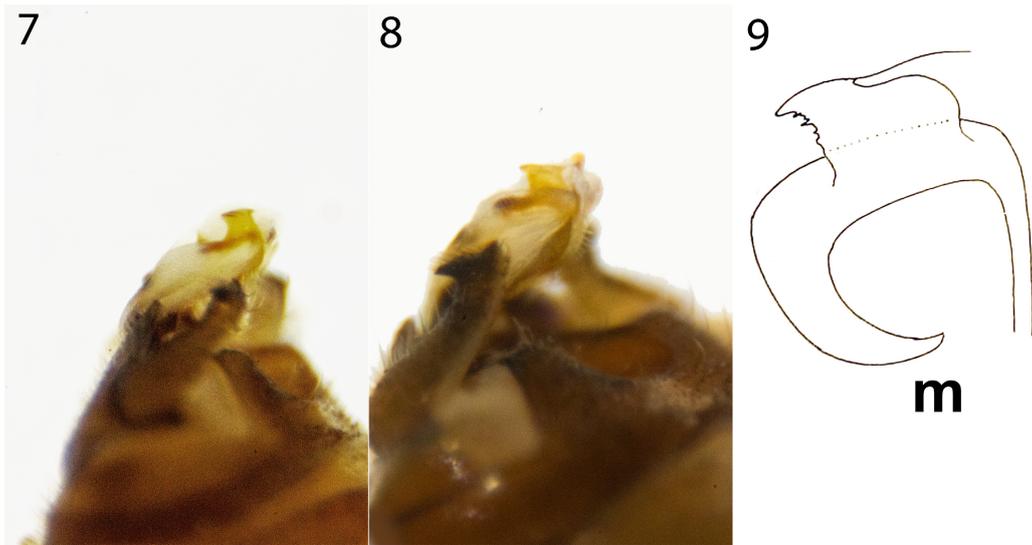
Nymphs of *N. banatica* from the Jura Mountains are also separable from those of *N. marginata*. The basal antennal segments of *N. banatica* bear a tuft of mediadorsal setae (Fig. 11), which is absent on *N. marginata* (Fig. 14). In dorsal view, the forelegs of the nymphs of both species have a median, glabrous area, delimited distally by a group of stiff setae (Figs 12, 15), which separates them from other *Nemoura* nymphs in the Jura Mountains, but not from each other.

Due to numerous nomenclatural confusions throughout the *N. marginata* species complex (*sensu* Murányi *et al.* 2023) likely present in current barcoding catalogues (i.e., Barcode of Life Database (BOLD), Ratnasingham & Hebert 2007), identification to species level of specimens solely by means of their mitochondrial cytochrome c oxidase subunit I gene (COI or barcode gene; Hebert *et al.* 2003) is presently unreliable. Overall, COI sequences of *N. banatica* are likely present under at least two different species names and do not necessarily correspond to this species.

Nemoura banatica is a very rare species in the French and Swiss Jura Mountains and is collected only from the highly specialized biotope of temporary springs (Figs 16–17) fed by upwelling groundwater, and hygropetric temporary habitats, that dry out from early May to late September. Being out of scope of standardized sampling protocols, this kind of biotope, disconnected from any larger watercourse, has received little attention from hydrobiologists, and is also difficult to spot, except in winter (Fig. 17).



FIGURES 1–6. 1–3, *Nemoura banatica*, 4–6, *Nemoura marginata*. 1: epiproct, apical sclerites (400x, phase-contrast); 2: epiproct, left apical sclerite (400x, phase-contrast); 3: epiproct, apical sclerites (after NaOH treatment); 4: epiproct, apical sclerites (400x, phase-contrast); 5: epiproct, left apical sclerite (400x, phase-contrast); 6: epiproct, apical sclerites (after NaOH treatment).



FIGURES 7–9. 7, *Nemoura banatica*, 8–9, *Nemoura marginata*. 7: epiproct, apical sclerite (lateral view); 8: epiproct, apical sclerite (lateral view); 9: epiproct, left apical sclerite (reproduced from Zwick 1970, Fig. 1m).



FIGURES 10–15. 10–12, *Nemoura banatica*, 13–15, *Nemoura marginata*. 10: cerci, adult male (dorsal view); 11: nymph, basal antennal segments; 12: nymph, head, pronotum and forelegs; 13: adult male, cerci (dorsal view); 14: nymph, basal antennal segments; 15: nymph, pronotum and foreleg.



FIGURES 16–17. Temporary spring in the Jura Mountains harboring *Nemoura banatica*. 16: autumn; 17: winter.

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