

TINODES ATLASENSIS IBRAHIMI, MABROUKI & TAYBI, SP. NOV. (TRICHOPTERA: PSYCHOMYIIDAE), A NEW SPECIES FROM ATLAS MOUNTAINS, MOROCCO

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The caddisfly fauna of North Africa and Morocco is still poorly known, with only a few historical and recent investigations, carried out sporadically. In this paper we describe a new species, *Tinodes atlasensis* Ibrahimi, Mabrouki & Taybi, sp. nov. from the Atlas Mountains in Morocco. The new species is closest to *Tinodes baenai* Gonzales & Otero, 1984, known from the Iberian Peninsula and mainly differs by the shape of segment IX, coxopodites, harpago and the process of basal plate.

Tinodes atlasensis Ibrahimi, Mabrouki & Taybi, sp. nov. is the seventh known species of the genus *Tinodes* Curtis, 1834 from Morocco. Future caddisfly investigations in this North African country will most certainly increase the number of the known species and reveal other new ones.

Keywords: North Africa, caddisfly diversity, new insect species, *Tinodes baenai*

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Fauna tulara sjeverne Afrike i Maroka je još uvijek slabo poznata, sa samo nekoliko povijesnih i novijih sporadičnih istraživanja. U ovom radu opisujemo novu vrstu *Tinodes atlasensis* Ibrahimi, Mabrouki & Taybi, sp. nov., s gorja Atlas u Maroku. Nova vrsta najbliža je vrsti *Tinodes baenai* Gonzales & Otero, 1984, poznatij s Iberskog poluotoka, a uglavnom se razlikuju oblikom segmenta IX, koksopodita, kopolaturnog aparata i nastavka bazalne ploče.

Tinodes atlasensis Ibrahimi, Mabrouki & Taybi, sp. nov. sedma je poznata vrsta roda *Tinodes* Curtis, 1834 iz Maroka. Buduća istraživanja ove sjevernoafričke zemlje sigurno će povećati broj poznatih vrsta te otkriti nove vrste.

Ključne riječi: sjeverna Afrika, raznolikost, tulari, nova vrsta kukaca, *Tinodes baenai*

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INTRODUCTION

Caddisflies are an important order of aquatic insects which are crucial in ecosystem functioning, because of their significant role in food webs and the processing of organic matter. In this regard, baseline biodiversity studies are decisive in recognizing and using caddisflies as a crucial indicator component in freshwater ecosystems.

Caddisfly investigations in North Africa related to taxonomy, ecology, biomonitoring and molecular analysis are still insufficient, as compared to some adjacent areas, such as Europe and Asia Minor (e.g. CERJANEC *et al.*, 2020; IBRAHIMI *et al.*, 2015, 2016; KUČINIĆ *et al.*, 2020; MARTINEZ *et al.*, 2016; OLÁH *et al.*, 2017; VITECEK *et al.*, 2017; SIPAHILER, 2014). Although Morocco is the most investigated country of North Africa, in many areas of this country only a few caddisfly taxa are known. Several historical and recent investigations have been carried out sporadically and have revealed out that the country harbours a rich and interesting caddisfly fauna (e.g. BOTOSANEANU, 1975, 1983, 1999; DAKKI, 1978, 1979, 1982; DAKKI & MALICKY, 1980; NAVAS, 1917, 1928, 1932 1936; MABROUKI *et al.*, 2020; MALICKY & LOUNACI, 1987; MEY, 2018; MOSELY, 1938; HAJJI, 2017; NEU & MALICKY, 2017). Beside several species that are widespread in Europe, North Africa and nearby areas, several low-scale endemics are reported from Morocco, such as: *Tinodes akrimensis* Mey, 2018, *Tinodes igmir* Neu & Malicky, 2017, *Pseudoneureclipsis maroccanus* Dakki and Malicky, 1980, *Rhyacophila fonticola* Giudicelli & Dakki, 1984, *Agapetus dakki* Malicky & Lounaci, 1987, *Agapetus dolichopterus* Dakki & Giudicelli, 1980 and *Philopotamus ketama* Giudicelli & Dakki, 1984. However, most of the recent investigations in Morocco are based on larval material only and mainly intended for biomonitoring purposes (e.g. BERRAHOUI *et al.*, 2001; BONADA *et al.*, 2008; LAMRI *et al.*, 2016; MABROUKI *et al.*, 2019; SOULIMI *et al.*, 2019). Currently, 82 species from 41 genera and 14 families are known from Morocco (HAJJI, 2017; MABROUKI *et al.*, 2020).

In order to advance the knowledge of caddisfly fauna in Morocco, several field expeditions have been conducted since 2014 (and are ongoing) in the northern part of the country, with a focus on its great geographical barriers such as the Middle Atlas massif. More than 150 localities have been investigated and most of these sampling sites were visited at least three times (e.g., TAYBI *et al.*, 2017, 2020; MABROUKI *et al.*, 2020 for more details on the localities).

In this paper, we describe a new species of *Tinodes* from the Atlas Mountains in Morocco and give an overview of the known species of this genus in Morocco.

MATERIAL AND METHODS

Fieldwork and laboratory processing. We collected adult caddisflies with entomological nets and handpicking from the riparian vegetation nearby the streams. Specimens were stored directly in 80% ethanol. Abdomen of the holotype was macerated in KOH and is kept in glycerin. The rest of the specimen is kept in 70% alcohol. The holotype is deposited in the collection of Halil Ibrahimi, Faculty of Mathematics and Natural Sciences, Hasan Prishtina University of Prishtina, Morocco Collection.

Morphological features of genitalia of *Tinodes atlasensis* Ibrahimi, Mabrouki & Taybi, sp. nov. were analyzed from 1 male specimen. For comparative assessments of morphological features we used drawings of *Tinodes baenai* and other species of this genus from MALICKY (2004), NEU & MALICKY (2017) and MEY (2018).

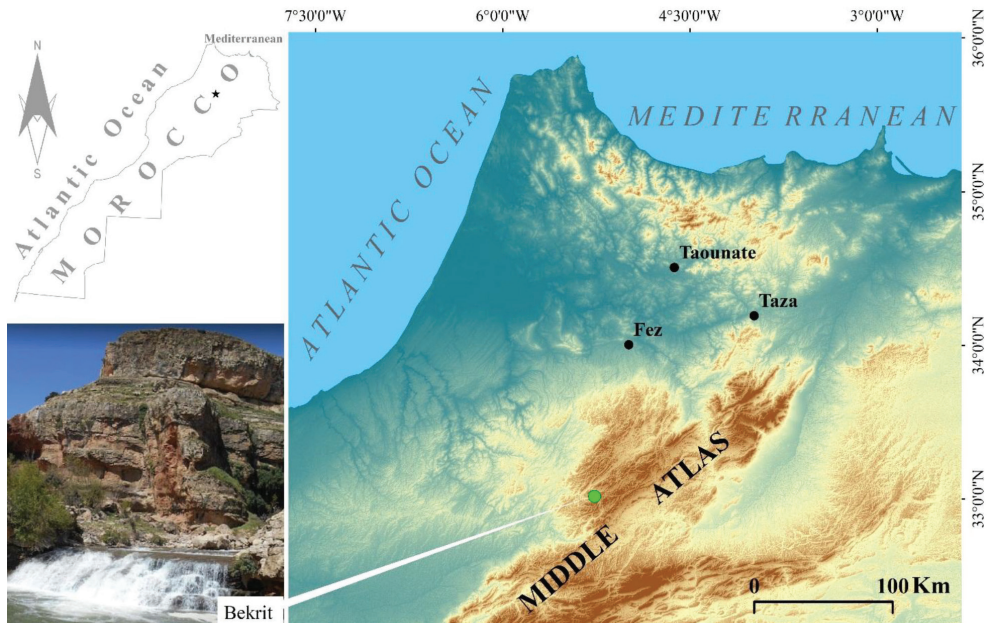


Fig. 1. Type locality of *Tinodes atlasensis* Ibrahimi, Mabrouki & Taybi, sp. nov. and position of Bekrit in the Middle Atlas, Morocco.

Illustrations were prepared in Adobe Illustrator (version Creative Cloud 2018) by digitizing pencil templates made with a camera lucida. Systematic nomenclature follows MORSE (2020).

Sampling area. The species was captured in the Bakrit region ($33^{\circ}02'59.7''\text{N}$ $5^{\circ}16'21.2''\text{W}$) (Fig. 1), belonging to the Middle Atlas, a mountain range stretching over some 350 km, from southwest to northeast of northern Morocco, located between the Rif and the High Atlas, and covering an area of 2.3 million hectares, i.e. 18% of Morocco's high altitude-mountain domain. This chain belongs to the Atlas massif, and more precisely, to one of the three elements of the Moroccan Atlas, the other two being the High Atlas and the Anti-Atlas. The heavy rainfall gives the Middle Atlas massif the form of "a water tower", from both hydrogeological and the hydrographic perspectives, and as such it serves as the main water supply for median and low reaches. The scientific and socio-economic interests of the included aquatic ecosystems are no longer perceived as an area with rich and varied natural resources, which generally support the presence of an interesting aquatic biodiversity with high rates of endemism (TAYBI *et al.*, 2020; MABROUKI *et al.*, 2021).

RESULTS

Tinodes atlasensis Ibrahimi, Mabrouki & Taybi, sp. nov.

(Figs. 2, 3 and 4).

Type material. Holotype (1 male): 16.05.2021. $33^{\circ}02'59.7''\text{N}$ $5^{\circ}16'21.2''\text{W}$, Bakrit Region, Middle Atlas, Morocco, leg. Youness Mabrouki and Abdelkhaleq Fouzi Taybi.

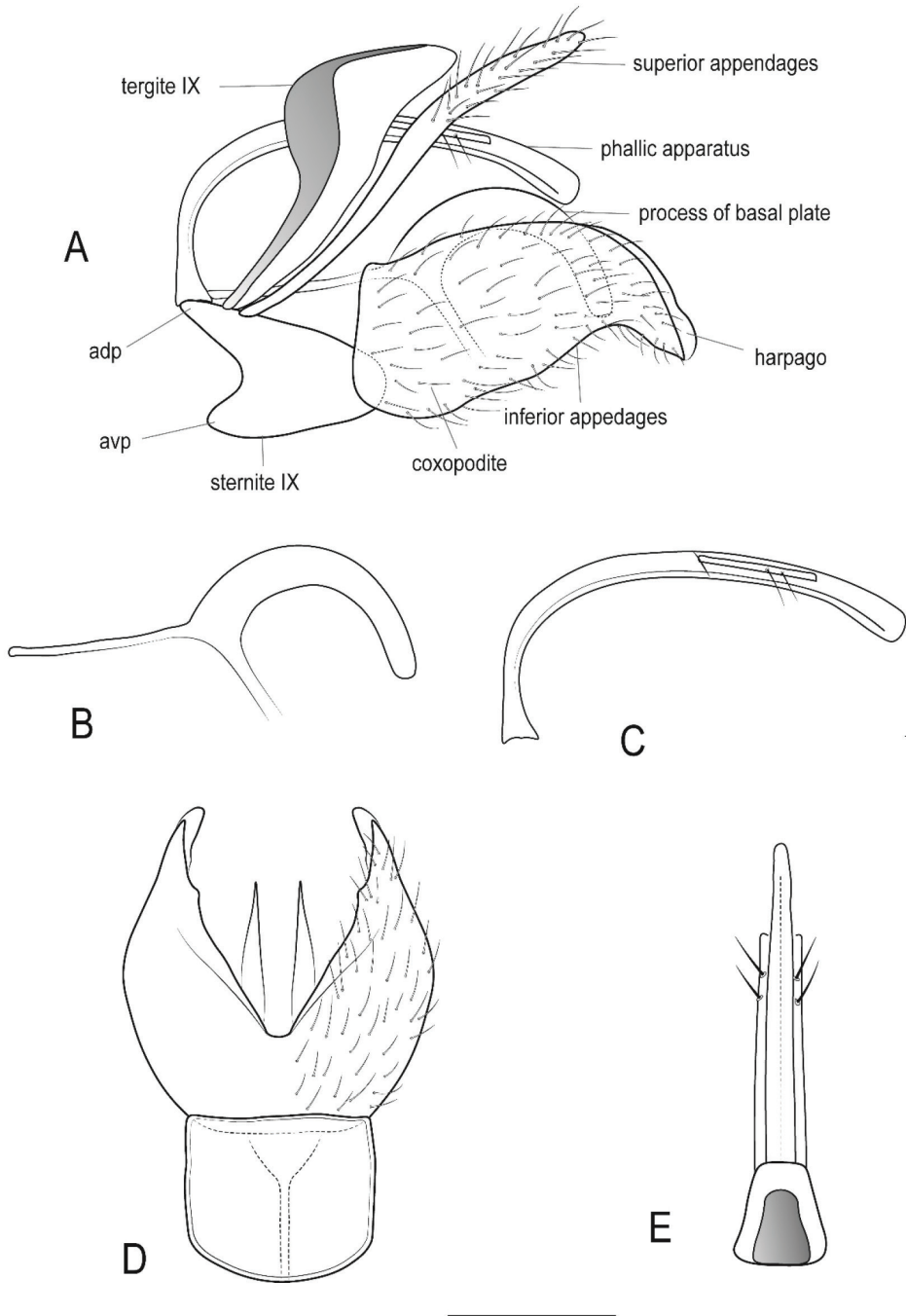


Fig. 2. *Tinodes atlasensis* Ibrahimi, Mabrouki & Taybi, sp. nov. male genitalia: A. lateral view, B. process of basal plate, lateral view, C. phallus and paraproctal processes, lateral view, D. ventral view, E. tergite IX, phallus and paraproctal processes, dorsal view. avp – anteroventral process of sternite IX, adp – anterodorsal process of sternite IX. Scalebar 0.2 mm.

Distribution. Morocco: Middle Atlas.

Diagnosis. Male of *Tinodes atlasensis* Ibrahim, Mabrouki & Taybi sp. nov., is most similar to *Tinodes baenai* (in GONZALES & OTERO, 1984) but differs mainly by the shape of segment IX, coxopodite, harpago as well as the process of basal plate. *Tinodes baenai* has coxopodites extending apically into a long, thin tooth, slightly curved downwards, and pointed at the apex, with another supplemental tiny denticle at the base of the teeth; while in the new species the supplemental denticle is missing and also the apical teeth are smaller and blunt. In *Tinodes baenai* the harpago is several times longer than the apex of coxopodites, both laterally and ventrally, while in *T. atlasensis* harpago is only slightly longer than the apex of coxopodites, and is differently shaped. In *T. baenai* the distal half of the process of basal plate in lateral view has a characteristic shape, reminiscent of the silhouette of a hawk's head, while in the new species the distal half of the process of basal plate is uniformly broad (Figs 2B, 3). *Tinodes atlasensis* Ibrahim, Mabrouki & Taybi, sp. nov. differs from *Tinodes baenai* in several other minor characteristics as well, such as the shape, width and length of tergite IX, sternite IX and shape of superior appendages.

Description. Male (in alcohol). Forewing length 4.5 mm; head light brown, antennae brown, with lighter nuances at the articulations of the flagellomeres; maxillary palps brown; thorax light brown; legs yellow-brown, number of spurs 2.4.4.; abdomen dark brown, external genital apparatus light brown to brown.

Genitalia. Ventral part of segment IX (sternite IX) in lateral view with slightly concave ventral margin, antero-ventral process large triangular with rounded edges, posterior end rounded, antero-dorsal process triangular and larger and wider than antero-ventral process (Fig. 2A). In ventral view, segment IX roughly quadratic in shape, with straight margins except the ventral one which is concave. Tergite IX sclerotized dorsally, membranous ventrally. Superior appendages of medium length, thin, sinuate, not reaching the apex of inferior appendages, dilating in distal third, slightly tapering apically and bearing long setae on the surface (Figs 2A, 3). Coxopodites of inferior appendages relatively long, widest basally, with sinuous dorsal and ventral margins which are roughly convex, expanded into ventro-apical process directed downwards, all in lateral view (Fig. 2A); in ventral view fused mesoventrally near the base, inner margin wide and V shaped (Figs 2D, 4). Harpago robust and finger like, relatively long, in lateral view almost entirely covered by apical process of coxopodite. The basal plate of inferior appendages with long proximal apodeme and paired distal process, curved and with rounded apex (Fig. 2B), in lateral view uniformly broad along the entire length, with the exception of the segment after basal third which is slightly wider; in ventral view with pointed apices. Aedeagus long and curved in lateral view, tapering apically in dorsal view; parameres shorter, bearing two short spines each.

Female. Unknown.

Etymology. Named after the Atlas Mountains of Morocco where the new species was found.

Habitat. Bakrit River is a fast-flowing stream, fed by numerous springs that rise on the banks. The type locality belongs to the Oum Errabiâ River basin. The banks are natural, with sparse herb-lined vegetation on the banks, subjected to strong anthropic pressure by excessive pastoralism. The bottom consists of blocks, stones, pebbles and a lot of plant debris.

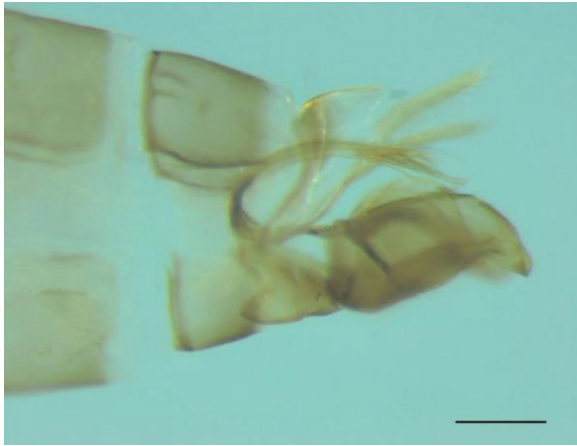


Fig. 3. *Tinodes atlasensis* Ibrahimi, Mabrouki & Taybi, sp. nov. male genitalia, lateral view. Scalebar 0.2 mm.



Fig. 4. *Tinodes atlasensis* Ibrahimi, Mabrouki & Taybi, sp. nov. male genitalia, ventral view. Scalebar 0.2 mm.

DISCUSSION

Thanks to its geographical position, Morocco is one of the most interesting biogeographical regions in the Mediterranean, representing a contact area between Europe and Africa and a compulsory passage for much of the fauna between the Palaearctic and Afrotropical region and between the Mediterranean Sea and the Atlantic Ocean.

Tinodes is a species-rich genus with many taxa that are endemics of certain areas. Currently only six taxa are known from Morocco: *Tinodes algiricus* McLachlan, 1880, *Tinodes assimilis rifensis* Botosaneanu and Gonzalez, 2001, *Tinodes waeneri* (Linnaeus, 1758), *T. maroccanus* Mosely, 1938, *T. igmir* Neu and Malicky, 2017 and *T. ankrimensis* Mey, 2018. The last two species are known from Morocco only. Description of three new species (including *T. atlasensis* Ibrahimi, Mabrouki & Taybi, sp. nov.) from Morocco during the past five years demonstrates that the country harbours a rich

fauna of this genus and most certainly many new species are waiting to be described. For comparison, in the Iberian Peninsula several endemic species of this genus are known.

Tinodes atlasensis Ibrahim, Mabrouki & Taybi, sp. nov. belongs to the *Tinodes unicolor* species group and can be easily differentiated from all species of this group, as well as from all other known species of the genus *Tinodes*, by its uniquely shaped appendages, segment IX and other structures. Generally it shares the same morphological patterns of male genitalia with *Tinodes baenai*, which is reasonable since this species is geographically the closest one. Previously larvae resembling *Tinodes unicolor* Pictet, 1834 were found in Oued Berkine in Guercif Province and Bni Waklane in Jerada Province of Morocco (MABROUKI *et al.*, 2020). These larvae were reported to have a uniformly pale labrum as mentioned for *Tinodes unicolor*. However, other characters of these larvae did not correspond to those of the larvae of *T. unicolor*. Geographically these larvae were collected far away from the type locality of *T. atlasensis* Ibrahim, Mabrouki & Taybi, sp. nov.; however, this shows that most probably *Tinodes unicolor* group is present in Morocco with more species.

Description of the new species from Morocco documents that this country harbours interesting, yet still not completely known caddisfly fauna. Future caddisfly investigations in this North African country will most certainly increase the number of the known and reveal other new species.

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