

# A SURPRISING FINDING OF THE SPECIES *STENOPHYLAX MALASPINA* (SCHMID, 1957) (INSECTA, TRICHOPTERA) IN CROATIA

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This paper reports on the first finding of the species *Stenophylax malaspina* (Schmid, 1957) in the Croatian fauna, also providing a brief review of the history of Trichoptera research in Croatia. The distribution of *S. malaspina* is discussed, indicating the highly isolated nature of its occurrence in Croatia. Although the new finding of *S. malaspina* in Croatia was made in the Mediterranean region, which corresponds to the biology of this Asian-Mediterranean species, the location was almost 400 kilometres away from the western border of its range in southern Italy. On the Balkan Peninsula, the nearest previously known record of this species is situated to the east, approximately 500 km from the site in Croatia.

**Keywords:** aquatic insects, caddisflies, south Croatia

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Rad donosi prvi nalaz vrste *Stenophylax malaspina* (Schmid, 1957) u hrvatskoj fauni, uz kratki pregled povijesti istraživanja Trichoptera research u Hrvatskoj. Raspravlja se o rasprostranjenosti *S. malaspina*, naglašavajući veliku izoliranost ovog nalaza i Hrvatskoj. Iako je *S. malaspina* pronađena u Mediteranskoj regiji Hrvatske, što odgovara biologiji te azijsko-mediteranske vrste, lokacija se nalazi skoro 400 km od zapadne granice njene rasprostranjenosti u južnoj Italiji. Na Balkanu se najbliži prethodno poznati nalaz ove vrste nalazi oko 500 km istočno od našeg nalaza u Hrvatskoj.

**Ključne riječi:** vodeni kukci, tulari, južna Hrvatska

## INTRODUCTION

Trichoptera is an order of aquatic insects (CHINERY, 2012; FRANSEN *et al.*, 2025; HICKIN, 1967; HOLZENTHAL *et al.*, 2007; MCGAVIN, 2011) that, along with two other orders, Ephemeroptera and Plecoptera, forms the so-called EPT group. This group is important not only for study of the biodiversity of insects in aquatic habitats (O'CONNOR, 2015; MCGAVIN, 2011; MORSE *et al.*, 2019; SOLE & GULLEFORS, 1996; SOUZA *et al.*, 2024; WALLACE *et al.*, 2003), but also for the biomonitoring of water quality (HAMID & RAWI, 2017). In addition to these three orders, two more – Odonata (dragonflies) and Megaloptera (alderflies, dobsonflies and fishflies and dobsonflies) – belong to the aquatic insect orders. The life cycles of all or almost all of these species are related to different types of aquatic habitats, with larvae usually inhabiting aquatic biotopes. A large number of aquatic species from other insect orders, e.g., Diptera or Coleoptera, have also been recorded. Regarding the number of species, they are dominant in these habitats, but in relation to the entire order to which they belong, this number of species makes a smaller percentage (up to 20%), i.e., the majority of species live in terrestrial habitat types.

Where diversity of fauna is concerned, the analysis of caddisfly larvae does not always provide enough information because many species (50% or more) cannot be distinguished at this stage of development (WARINGER & GRAF, 2011). Nevertheless, it is interesting and can result in the finding of new species for the fauna of a given area, in this case, Croatia. This applies especially when classical morphological methods of larval identification are combined with DNA barcoding, which enables highly accurate species level identification based on molecular analysis of the COI gene using the BOLD Systems database (e.g., ČUK *et al.*, 2021; KLADARIĆ *et al.*, 2021). Trichoptera currently encompasses 65 extant families and 17,279 described species, with approximately 300 fossil species from 22 families (TRICHOPTERA WORLD CHECKLIST, 2025).

The first faunistically significant data resulting from into Croatian Trichoptera adults can be found in the work of František Klapálek, a Czech entomologist who also worked on the collection of caddisflies in the Zoological Museum in Zagreb (KLAPÁLEK, 1906). His work can be considered the first and, in many respects, the defining research into Trichoptera in Croatia. Research on Trichoptera has continued to the present day, with greater or lesser interruptions. After the publication of Klapálek's work, there was a period during which caddisflies were scarcely studied in Croatia, with the exception of two papers on cave organisms that included Trichoptera. The first paper was published by a professor of the University of Zagreb, August Langhoffer (LANGHOFFER, 1912, 1915), and the second by the biologist from Belgrade and university professor, Milutin Radovanović, who published the work "Trichoptera of Yugoslavia" (RADOVANOVIĆ, 1935), in which he mentioned approximately 20 recorded species for the fauna of Croatia. A significant phase in the study of the Trichoptera of Croatia began with limnological research in the middle of the 20<sup>th</sup> century (MATONIČKIN, 1959; MATONIČKIN & PAVLETIĆ, 1960; MATONIČKIN *et al.*, 1971). This type of research has continued to the present day (SVIBEN *et al.*, 2024; VILENICA *et al.*, 2025). During this period, the activity of Professor Mara Marinković-Gospodnetić from Sarajevo University was also important. Over a period of 70 years, she studied the large springs in the Dinarides of the former Yugoslavia (MARINKOVIĆ-GOSPODNETIĆ, 1977, 1979) and in 1971 she described the species *Drusus croaticus* Marinković-Gospodnetić, 1971 from the area of Plitvice Lakes National Park

(MARINKOVIĆ-GOSPODNETIĆ, 1971). Systematic research on the Croatian Trichoptera fauna, in a way after Klapálek, began at the end of the last century with research on the diversity and distribution of Trichoptera in the area of Plitvice National Park and resulted in continuous research that is still active. Among its outcomes are six doctoral dissertations dealing with biodiversity of the Croatian Trichoptera (e.g., ČUKUŠIĆ, 2019; PREVIŠIĆ, 2009; ŽALAC, 2022), including certain molecular aspects (e.g., ČUKUŠIĆ, 2019; PREVIŠIĆ, 2009). There are also large number of scientific studies (e.g., CERJANEC 2020; MALICKÝ 2014; KUČINIĆ *et al.*, 2011, 2017a, 2017b; PREVIŠIĆ *et al.*, 2009, 2014) that make this group one of the most studied insect groups in the fauna of Croatia. During these activities the Trichoptera collections at the Faculty of Science of the University of Zagreb and at the Croatian Natural History Museum in Zagreb were formed, as were several private collections. These studies were based on data gathered from adult specimens within the local fauna.

A particularly significant contribution to the study of Croatian Trichoptera was made by Prof. Hans Malicky from Lunz am See (Austria), who spent time in the Croatian Natural History Museum in 1995 and helped the first author of this paper in the preparation of his doctoral dissertation on the diversity of Trichoptera in the Plitvice Lakes, by verifying the identification of all species collected in the area of the National Park (KUČINIĆ, 2002). Professor Malicky described one subspecies from Croatia, *Rhyacophila dorsalis plitvicensis* Kučinić & Malicky, 2002, and two species, *Athripsodes dalmatinus* Malicky, 1980 and *Rhyacophila cabrankensis* Malicky, Previšić & Kučinić, 2007 (KUČINIĆ & MALICKÝ, 2002; MALICKÝ, 1980; MALICKÝ *et al.*, 2007), and also worked on the small collection of Trichoptera of the Varaždin City Museum. That material was collected by the high school teacher Franjo Košćec at the beginning of the 20th century in Varaždin and its surroundings, and contains 39 species, 10 of which were new to the fauna of Croatia (MALICKÝ, 2009).

This paper reports the finding of the newly identified Trichoptera species of the genus *Stenophylax* Kolenati, 1848 from Croatia, describes the unusual method by which it was collected, and provides information on its biological characteristics and distribution.

## MATERIALS AND METHODS

Two adult Trichoptera specimens of the genus *Stenophylax* were extracted from a spider's web on the window of a family house in the village of Ružić near the town of Drniš in the Mediterranean part of Croatia (43.82742N, 16.25253E). The specimens were collected on 3 November 2013 (leg. Josip Skejo), preserved in 80% ethanol and stored in the Trichoptera collection of the Faculty of Science, University of Zagreb. Morphological identification of specimens was done according to KUMANSKI (1988), MALICKÝ (1983, 2004) and SCHMID (1957). The systematic presentation follows the TRICHOPTERA WORLD CHECKLIST (2025).

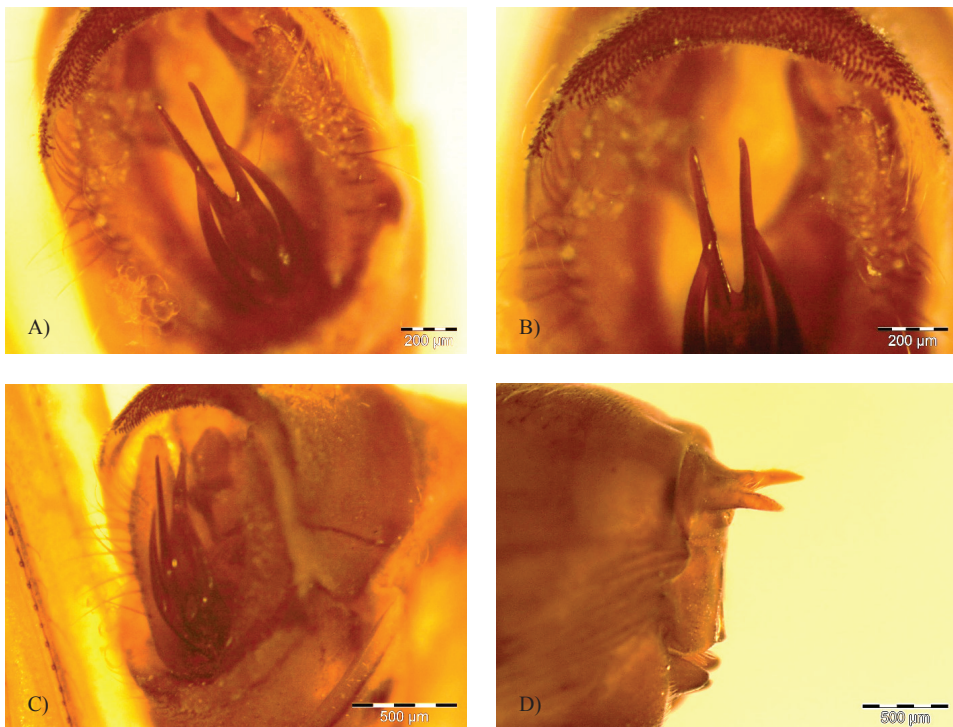
The specimens were photographed under a motorized stereo microscope, Carl Zeiss Discovery V12 equipped with an Olympus LC20 Digital Microscope Camera, in the Laboratory for Zoology of Centre for Plant Protection (CAAF).

Distribution of the species is given according to the literature data: CIANFICCONI (2002); DARILMAZ & SALUR (2015); KUMANSKI (1988), MALICKÝ (2005), NEU *et al.*, (2018), SCHMID (1957), SIPAHILER (2005).

## RESULTS AND DISCUSSION

Analysis of the genital morphology of the two specimens collected (one male and one female) deposited in the Trichoptera collection of the Faculty of Science, University of Zagreb, showed that both specimens belong to the species *Stenophylax malaspina* (Schmid, 1957) (Fig. 1A-D), recorded for the first time in Croatia. It is not known how long they were in the spider's web, but their state of preservation suggests that they had been trapped for a relatively long period. The collected specimens show low morphological variability and resemble some other species of the genus *Stenophylax*, e.g., *S. mitis* McLachlan, 1875 or *S. fissus* (McLachlan, 1875), but we think that according to the morphological features of male and female genitalia (Fig. 1A-D), the collected specimens belong to the *S. malaspina* species. According to KUMANSKI (1988) and MALICKY (1983, 2004) the aedeagus is typical of *S. malaspina* with apices longer than in *S. fissus*; inferior appendages are also of the typical form of *S. malaspina* with their apices not extending inwardly as they do in *S. fissus* (Figs 1A-C). According to KUMANSKI (1988), MALICKY (1983) and SCHMID (1957) morphological characters of female genitalia (terminal abdominal segments 8-10; e.g., vulvar scale, supragenital plate, segment X) are typical of *S. malaspina* (Fig. 1D).

The species *S. malaspina* is a typical member of the genus *Stenophylax* in terms of morphological features, and these species usually have a relatively large adult body



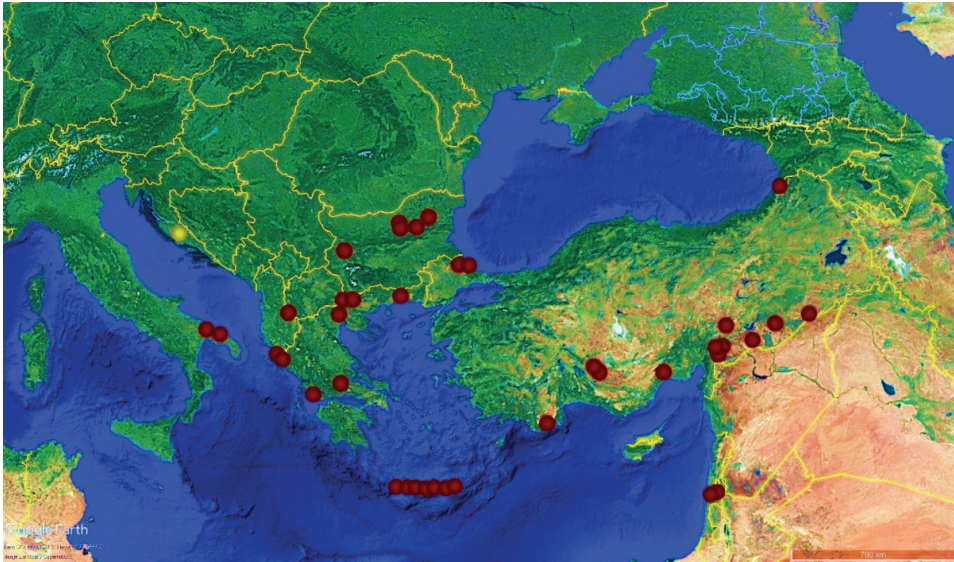
**Fig. 1** A-D. *Stenophylax malaspina* (Schmid, 1975), A-C: male genitalia; A-B: caudal view; C: caudo-lateral view (right); D - female genitalia, lateral view (left).

size: forewing length 17-20 mm for females and 14-19 mm for males (KUMANSKI, 1988; MALICKY, 2004), and coloration ranging from yellowish-brown to brown tones.

The family Limnephilidae is the most numerous family in Europe and the Western Palearctic, with several hundred species and several dozen genera (MALICKY, 2004), including the genus *Stenophylax* Kolenati, 1848. The genus *Stenophylax* is represented in the European fauna with about 35 species (MALICKY, 2004).. The number of species within this genus has increased significantly because it was merged with the very numerous genus *Micropterna* Stein, 1874 (TRICHOPTERA WORLD CHECKLIST, 2025) into one genus, *Stenophylax*. The first data on the genus *Stenophylax* from the territory of Croatia can be found in the study by Klapálek of the early 20<sup>th</sup> century (KLAPÁLEK, 1906). The present findings represent the first record of *S. malaspina* for the Croatian fauna, as this species has not been recorded in any previous faunistic surveys in Croatia (e.g., CERJANEC *et al.*, 2020; KLAPÁLEK, 1906; PREVIŠIĆ *et al.*, 2014). In the last 10 years, two new species of the genus *Stenophylax* have been identified in the Mediterranean region of Croatia: *S. mitis* McLachlan, 1880 (KUČINIĆ *et al.*, 2019) and *S. wagneri* (Malicky, 1971) (KUČINIĆ *et al.*, 2017a). The species *Stenophylax mucroantus* McLachlan, 1880, previously listed for the cave fauna of Croatia, has not been confirmed in our fauna so far and this information is not valid (GOTTSTEIN MATOČEC *et al.*, 2002). According to these data, 11 species of the genus *Stenophylax* have been identified in the fauna of Croatia.

The finding of the species *S. malaspina* in central Dalmatia is somewhat unexpected, as is the way the specimens were collected - by accidental observation in a spider's web on the window of a family house. Both female and male specimens were well preserved, although already dead. The finding at the beginning of November is not so surprising, because the genus *Stenophylax* can be collected in the autumn period after aestivation, and for the species *S. malaspina* the period of emergence is stated to be throughout the year, including all 4 seasons (GRAF *et al.*, 2008). The exact time at which the specimens entered the window and became trapped in the web cannot be determined, although it can cover the period from September or October (or earlier) to the date of collection on 3 November 2013. The state of preservation of the specimens indicates that the specimens were most probably captured shortly before being collected. This is the first example of the collection and identification of a new species of Trichoptera in the Croatian fauna in this very interesting and unusual way.

Previous research has identified more than 220 species in the fauna of Croatia, which most likely represents approximately 90 to 95% of its potential Trichopteran fauna (it is very difficult to give a more accurate percentage). The finding of each new species is therefore faunistically very interesting (e.g., ČUK *et al.*, 2021; KLADARIĆ *et al.*, 2021). In addition to being new for the fauna of Croatia, and collected in a very particular manner, the species *S. malaspina* in Croatia discussed here is also interesting because of its distribution range. The species was described by the Canadian entomologist Fernand Schmid in 1957 from Turkey (Mardin, the Taurus Mountains) (SCHMID, 1957). The range of this species was later expanded, especially toward the west, with the westernmost boundary documented in the southern part of Italy (e.g., Apulia region), and towards the south, where, in addition to the island of Crete, the species has been recorded in Lebanon (MALICKY, 2005; NEU *et al.*, 2018) (Fig. 2). To the north, *S. malaspina* was found at several localities in Bulgaria (KUMANSKI, 1988) (Fig. 2). The record of *S. malaspina* from the Mediterranean region in Croatia, is consistent with the biology of this Asian-Mediterranean species, but it is almost 400 kilometres away from the western border of its range in southern Italy (e.g., Apulia region) and signifi-



**Fig. 2.** Distribution of *Stenophylax malaspina* (Schmid, 1957). Red points - literature data according to NEU *et al.* (2018), yellow point – locality of finding in Croatia.

cantly shifts the westernmost point in the distribution of *S. malaspina*. On the Balkan Peninsula, the first nearest finding of this species is in the east, approximately 500 km from the locality in Croatia (Fig. 2; NEU *et al.*, 2018). There is always a possibility of finding a species outside its known range. In Croatia, this was the case, for example, with the species *Hydropsyche mostarensis* Klapálek, 1898 and *Rhyacophila balcanica* Radovanović, 1953 (KARAOUZAS *et al.*, 2015; KUĆINIĆ *et al.*, 2011), which is not so strange. But in this case *S. malaspina* was found in the Mediterranean part of Croatia, where intensive research has been carried out in the last 20 years without any previous records of this species being made (e.g., ČUKUŠIĆ, 2019; KUĆINIĆ *et al.*, 2011; MALICKY, 2014; VUČKOVIĆ *et al.*, 2021; WARINGER *et al.*, 2009). The same is the case with the southern parts of Bosnia and Herzegovina, which have also been the subject of systematic Trichoptera studies. This species has not been recorded in Bosnia and Herzegovina (e.g., MARINKOVIĆ-GOSPODNETIĆ, 1970, 1977, 1978, 1979; STANIĆ-KOŠTROMAN *et al.*, 2012, 2015), although its occurrence in the southern parts of the country might be expected. These data indicate that the Croatian population of *S. malaspina* is isolated, although we can expect it in other localities in the Mediterranean part of Croatia, especially in some streams or rivers near the town of Drniš. It is interesting that no aquatic habitats are present in the immediate vicinity of the collection site in the village Ružić, so these collected specimens probably flew in from a nearby stream, such as the Čikola River, located two kilometres away, or from another watercourse in the surrounding area.

In future research, it will be very interesting to collect additional specimens of *S. malaspina* from the territory of Croatia and to determine whether there are any differences in relation to the three DNA barcoded specimens of *S. malaspina* collected in Crete (Greece), Lebanon and Turkey, whose DNA barcoding data are deposited in the BOLD Systems database under the same BIN (BOLD:AAJ5192). In addition, by conducting this research, the identification and presence of this species in the fauna of

Croatia will be further confirmed. So far, more than 590 DNA barcoded Trichoptera specimens collected in Croatia have been deposited in the BOLD Systems database.

Some species of the genus *Stenophylax* emerge from aquatic biotopes in the spring period, after which they have a period of summer dormancy (aestivation) during which they take refuge in higher mountain areas, such as the species *Stenophylax wagneri* (Malicky, 1971), recorded at higher altitudes of Mt Biokovo (KUČINIĆ *et al.*, 2017a). One of the interesting features of genus *Stenophylax* is that some species spend the summer period in pits and caves, where air temperatures are lower (GOTTSTEIN MATOČEC *et al.*, 2002; KUČINIĆ & ILIĆ 1993). According to KUMANSKI (1988), *S. malaspina* has been recorded at approximately ten localities in Bulgaria, occurring at elevations from 100 to 2100 meters above sea level, with the flight period from April to October. The larva of *S. malaspina* has not yet been described, and its morphological features and feeding ecology are unknown.

## CONCLUSION

Future research on the Trichoptera of Croatia will focus on areas where collecting efforts have so far been absent or very sporadic. Findings like this one indicate the need for such research on one hand, and enable a better understanding of the diversity and distribution of Trichoptera fauna in Croatia on the other. Also, DNA barcoding of Trichoptera will continue, focusing especially on species from Croatia that have not yet been DNA barcoded (about 50 species; ČUKUŠIĆ *et al.*, 2019), including the species that was the subject of this study, *S. malaspina*.

It should be noted that the collected specimens of the species *S. malaspina* show certain morphological variability and resemble some other species of the genus *Stenophylax*, e.g., *S. mitis* or *S. fissus*. Therefore, in future research it will be necessary to collect new specimens from Croatia and perform a detailed molecular analysis in addition to the morphological ones. For now, *S. malaspina* can be considered a confirmed member of the Croatian Trichoptera fauna.

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