

FIRST RECORD OF *ANTHOCHARIS DAMONE* BOISDUVAL, 1836 IN BOSNIA AND HERZEGOVINA WITH A SIGNIFICANT RANGE EXTENSION IN SERBIA (LEPIDOPTERA: PIERIDAE)

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Abstract

Anthocharis damone Boisduval, 1836 is a rare Ponto-Mediterranean butterfly with a fragmented distribution and high conservation priority. This study presents new data that significantly expand the known range of the species at its northern limit. We report new localities in western Serbia (Uvac Gorge, Mt. Zlatibor) and provide the first documented records for Bosnia and Herzegovina (Cikote and Masali villages). Field surveys conducted between 2023 and 2025 confirmed breeding populations through the observation of all life stages. All new records were strictly limited to xeric, south-facing slopes on ophiolitic substrates, despite the widespread availability of the host plant, *Isatis tinctoria* L., on other geological formations. Our findings suggest that the Drina River drainage basin serves as an important population stronghold. Given its endangered status in Europe, these newly discovered populations warrant a reassessment of regional conservation priorities and highlight the role of ophiolite massifs as thermal refugia for xerothermic species at high latitudes.

KEYWORDS: Balkan Peninsula, Drina River basin, species conservation, faunistics

Introduction

Anthocharis damone Boisduval, 1836 is a Ponto-Mediterranean butterfly species with a fragmented distribution, extending from southern Italy and the Balkan Peninsula through Turkey and the Caucasus to the Levant and Middle East (Tshikolovets, 2011). As a monovoltine species, its flight period is closely linked to the flowering phenology of its host plants, primarily species of the genus *Isatis*. The species inhabits xeric, rocky habitats where its host plants thrive under high solar exposure (Nekrutenko, 1990; Jutzeler *et al.*, 1998).

In the Balkans, the species was historically known only from western Greece, Treska Gorge, and western parts of North Macedonia (Schneider & Jakšić, 1989; Pamperis, 2009). Recent surveys have expanded its known range to Albania, with records from the central region near Elbasan (Micevski *et al.*, 2015) and southern parts of the country (Sachanowicz *et al.*, 2016), as well as to Serbia (Drndić *et al.*, 2017). While the Albanian records represent a contiguous northward range extension, the Serbian records were unexpected, occurring approximately 170 km north of the previously known core range. In 2023, this species was discovered in the Uvac Gorge, an isolated locality further north than its previously known range. The record was documented on the Biologer biodiversity platform (Popović *et al.*, 2020). These disjunct and peripheral populations raise questions about the habitat requirements and environmental factors that enable the species to persist at its northern range limit. Furthermore, the complex topography and diverse geology of the Central Balkans suggest that many suitable habitat patches remain insufficiently explored.

This study aims to clarify the northern distribution limit of *A. damone* in the Central Balkans by combining targeted field surveys with existing occurrence records. Specifically, we report new localities that extend the species' range further north in Serbia and provide the first records for Bosnia and Herzegovina. We also discuss the ophiolitic (ultramafic, serpentinite) substrates in facilitating the species' persistence and northward range expansion.

Materials and Methods

Field surveys were conducted in 2024 and 2025. In Serbia, surveys took place in May 2024 and focused on the Uvac Monastery locality in the Uvac Gorge, where the species had been originally reported. In Bosnia and Herzegovina, targeted fieldwork took place in May 2024 with extended monitoring during the "Dobrun" Biologer research camp (31 May – 5 July 2024). Follow-up surveys were conducted in May 2025 in the same area. Given that the nearest recent Serbian records of *A. damone* were located only 7 km from the state border and that suitable habitat in the Uvac River Gorge extends directly into Bosnia and Herzegovina, the presence of the species in the latter country was considered highly probable. The surveys were designed to investigate the geographical continuity of the species' distribution in the Drina River drainage basin.

Sampling sites were selected based on geological maps, primarily focusing on ophiolitic substrates characterized by xeric, rocky slopes. The vegetation at these sites typically consists of scattered pine trees (*Pinus sylvestris*, *P. nigra*) and stunted deciduous shrubs (*Carpinus orientalis*, *Quercus* spp.). To assess habitat specificity, comparative surveys were performed on nearby calcareous terrains where the host plant, *Isatis tinctoria*, was abundant.

All life stages (eggs, larvae, and adults) were recorded. To confirm species identification, two larvae were collected in 2024 and reared under laboratory conditions until pupation. All records were georeferenced and archived in the Biologer database (Popović *et al.*, 2020).

Results and Discussion

Our surveys reconfirmed the presence of *A. damone* at Uvac Monastery (Serbia) and yielded records at two previously undocumented localities in Bosnia and Herzegovina (Table I). These findings substantially extend the known distribution of the species toward the north and northwest (Fig. 1). The documentation of all life stages confirms the presence of established breeding populations rather than incidental occurrences.

Table I. New records of *Anthocharis damone* Boisduval, 1836 in Serbia and Bosnia and Herzegovina. Full details of the records are available in the Biologer database.

Observer	Locality	Date	Coordinates
Ivana Stevanoski, Nevena Kuzmanović	Uvac Monastery	30.04.2023	43.615984, 19.589425
Iva Stojanović, Miloš Popović	Uvac Monastery	09.05.2024	43.618362, 19.588888; 43.618385, 19.588872; 43.615493, 19.589340; 43.615401, 19.589776
Iva Stojanović, Miloš Popović, Branislava Đukić, Dejan Kulijer	Donje Cikote – Rudo	10.05.2024	43.592433, 19.393632
Iva Stojanović, Miloš Popović, Branislava Đukić, Dejan Kulijer	Donje Cikote – Rudo	11.05.2024	43.598804, 19.411302; 43.598192, 19.409802; 43.597058, 19.407567; 43.598191, 19.409828
Dejan Kulijer	Donje Cikote – Rudo	18.05.2025	43.596832, 19.407588; 43.596935, 19.407860; 43.596926, 19.407916; 43.591158, 19.403406; 43.592669, 19.396199
Dejan Kulijer	Masali	18.05.2025	43.719063, 19.491101

Range extension in Serbia

In Serbia, *A. damone* was previously known only from a limited area of Mt. Giljeva (Drndić *et al.*, 2017). On 30.04.2023, the species was unexpectedly recorded during a botanical field survey at a locality on Mt. Zlatibor, in the Uvac Gorge near the Uvac Monastery (Table I). Several males were observed, notable for their vivid yellow coloration (Fig. 2a). This finding represents a northward extension of the species' previously known distribution. The population was reconfirmed during our survey on 09.05.2024. Owing to adverse weather conditions, numerous females and several larvae were found in a state of torpor on *I. tinctoria* (Figs. 2b-d). A subsequent visit on 09.05.2025 by other authors confirmed the continued presence of the species at this locality and additionally yielded the first Serbian record of *Papilio alexanor* (Vukajlović *et al.*, 2025).

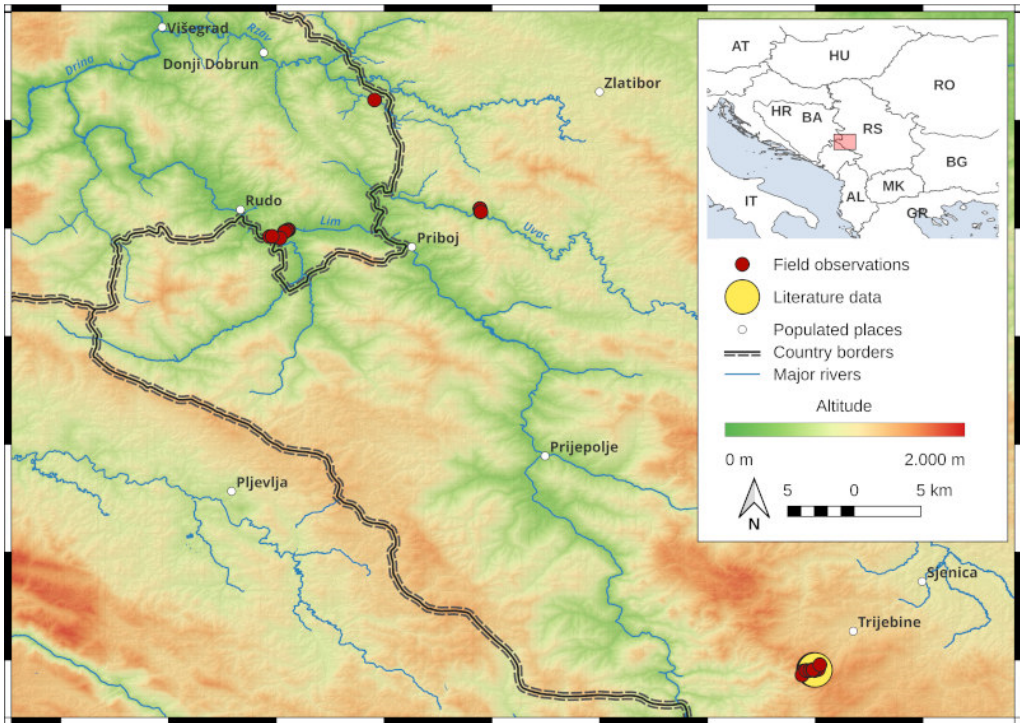


Figure 1. Records of *Anthocharis damone* Boisduval, 1836 from the border region between Serbia and Bosnia and Herzegovina, including newly documented localities that extend the species' known distribution towards the northwest. ISO 2 country codes are shown on the overview map.

First records in Bosnia and Herzegovina

Our targeted field survey in May 2024 yielded the first records of *A. damone* for Bosnia and Herzegovina. While northern sites in the Uvac Gorge initially exhibited delayed phenology, with only emerging shoots of *I. tinctoria*, flowering host plants, and *A. damone* larvae were discovered on 10.05.2024 at a lower-elevation site between Donje Cikote and Rudo (Fig. 2e). On 11.05.2024, adults of both sexes, eggs, and larvae were recorded at the same site (Figs. 2f, g). Reared larvae reached the pupal stage on 17.05.2024 (Fig. 2k). By early June 2024, the species was no longer active at the Cikote site (authors, pers. obs.). Furthermore, intensive surveys in early June along the Bosnian section of the Uvac Gorge yielded no records despite suitable weather conditions and flowering host plants (Fig. 2j). On 18.05.2025, only larvae were found at the Cikote area, suggesting that the flight season had already ended at lower altitudes. However, a single adult was recorded the same day further north, near the village of Masali (Fig. 2l). All recorded individuals were found on ophiolitic substrates, despite the widespread presence of *I. tinctoria* on adjacent calcareous formations.

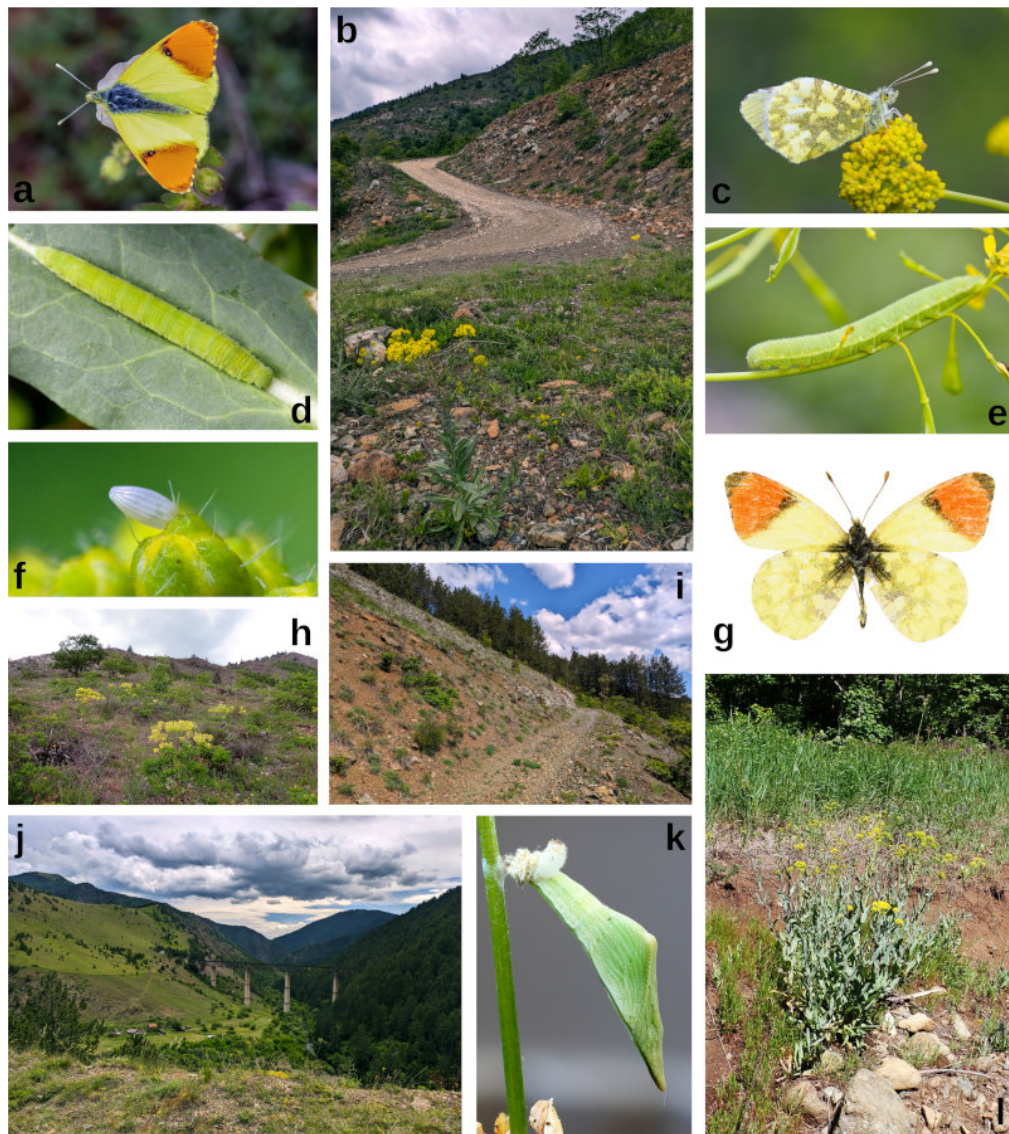


Figure 2. Findings of *Anthocharis damone* Boisduval, 1836 in the border region between Serbia and Bosnia and Herzegovina: a – male specimen from Serbia, 2023 (photo: I. Stevanoski); b – habitat along the road to the Uvac Monastery, Serbia (photo: M. Popović); c – female and d – larva from the Uvac Monastery vicinity, 2024 (photo: M. Popović); e – larva, f – egg, and g – adult specimen from the Cikote-Rudo area, Bosnia and Herzegovina, 2024 (photo: M. Popović); h – habitat with *Isatis tinctoria* L. host plants at Cikote-Rudo area, 2025 (photo: D. Kulijer); i – ophiolitic slope at the first recording site in Bosnia and Herzegovina (photo: M. Popović); j – landscape of the Uvac River gorge (photo: M. Popović); k – pupa reared in laboratory conditions (photo: B. Dukić); l – host plant stand near Masali village, 2025 (photo: D. Kulijer).

Butterfly ecology in the study region

Our observations suggest that *A. damone* is well established along the ridges of the Zlatibor, Stari Vlah, and Varda mountains, occupying suitable habitats in the Drina River drainage basin. Beyond its conservation significance, this population represents the northern range margin of *A. damone* on the Balkan Peninsula. Although the newly discovered populations appear isolated from the previously known populations in southern Serbia (Drndić *et al.*, 2017), additional “stepping-stone” populations may exist on isolated ophiolitic outcrops within the predominantly calcareous landscape. These records refine our understanding of the species’ distribution in the Central Balkans, effectively bridging the gap between southern core populations and their fragmented northern outposts. Recent phylogenetic analyses have revealed a complex population structure within *A. damone*, characterized by several geographically differentiated subspecies (Naderi *et al.*, 2025). Populations from North Macedonia, Serbia, and Bosnia and Herzegovina belong to the subspecies *A. damone hollaenderi* Seyer, 1980 and are considered genetically distinct from lineages described from Italy, Greece and Turkey. This taxonomic and genetic structuring suggests that the current distribution of the species cannot be explained solely by recent range expansion but may instead reflect a more complex biogeographical history and the refugial character of these populations. Although *A. d. hollaenderi* in North Macedonia occurs on calcareous substrates, the populations in Serbia and Bosnia and Herzegovina are associated with ophiolitic geology, which may provide suitable habitat conditions at the species’ northern range limit.

The locations where *A. damone* was recorded in western Serbia, particularly the Zlatibor-Maljen region, are well known for the presence of extensive ophiolitic rock complexes (Chiari *et al.*, 2011). These ophiolitic formations are part of the broader Dinaric-Hellenic belt, a continuous system extending approximately 1000 km from Bosnia and Herzegovina to southern Greece (Nirta *et al.*, 2010). A similar, although less continuous, pattern of ophiolite distribution occurs further east in the Balkans, including northeastern Greece and adjacent regions of Turkey (Yılmaz & Yılmaz, 2013; Plissart *et al.*, 2017). At a finer spatial scale, this connectivity is likely facilitated by the fragmented distribution of ophiolitic substrates across the region (Bani *et al.*, 2010), which creates an “archipelago” of suitable xeric habitats that promotes persistence and dispersal across an otherwise inhospitable terrain. Such habitat networks are known to function as vital stepping stones (MacArthur & Wilson, 1967), allowing specialized butterflies to persist and disperse through an otherwise unsuitable landscape matrix (Thomas *et al.*, 1992). If the distribution of *A. damone* is indeed constrained by the occurrence of ophiolitic substrates, additional populations may exist along these geological formations, and future surveys should focus on such regions.

At the local scale, the importance of these geological “islands” lies not only in their physical presence but in the specific microclimatic conditions they provide at this latitude. Near the species’ northern range limit, the open, rocky massifs of the Drina basin likely act as thermal refugia. Butterfly species specialized for rocky habitats have been shown to warm most effectively under low ambient temperatures by utilizing conductive heating from preferred basking substrates, such as stones and bare ground (Klečková *et al.*, 2014). The dark coloration of ophiolitic rocks, combined with the sparse vegetation cover typical of ophiolitic soils, likely creates a significantly warmer microclimate than that of the surrounding forested landscape. This effect is attributable to the low albedo of the dark substrate, which promotes greater absorption of solar radiation and higher surface temperatures than those of lighter-colored rock types (Hall *et al.*, 2005). Such enhanced heat accumulation likely facilitates earlier larval development and adult emergence, thereby providing a phenological advantage at the species’ northern range limit (Moradinour *et al.*, 2023). However, it is important to emphasize that *A. damone* is not a strict ophiolitic specialist but rather a xeric habitat specialist. This is evidenced by its occurrence on volcanic lava beds in Italy (Jutzeler *et al.*, 1998) and limestone formations in the southern Balkans (Schaidler & Jakšić, 1989; Tolman & Bernhard, 1994; Sachanowicz *et al.*, 2016). Consequently, although current observations in this region are restricted to ophiolite rock formations, *A. damone* may also occur on other geological substrates that provide suitable thermal and xeric conditions. A

similar pattern has been reported for *Proterebia phegea* Borkhausen, 1788, and *Anthocharis gruneri* Herrich-Schäffer, 1851, which are typically associated with karstic limestone habitats (Tolman & Lewington, 2008; Koren *et al.*, 2010). However, both species have also been recorded on ophiolitic substrates in Serbia, Albania and Greece, indicating that similar environmental conditions can be maintained across different geological settings (Popović & Milenković, 2012; Verovnik & Verovnik, 2022; Prendi *et al.*, 2023).

These findings are of considerable conservation importance, especially as the species has recently been assessed as Endangered (EN) in Europe (Van Swaay *et al.*, 2025), Critically Endangered (CR) in Serbia (Popović *et al.*, in press), and Vulnerable (VU) in North Macedonia (Krpach, 2024). The discovery of these previously unknown populations suggests that the national Red List status for Serbia may warrant reassessment and could potentially result in a less severe threat category under IUCN criteria. Given the extensive area of potentially suitable terrain in the region, the species may be more widespread than currently documented and may support a larger population than previously assumed. Following the substantial biodiversity data collected during the Biologer research camp, the Dobrun area is now being considered for designation as a protected area in Bosnia and Herzegovina and should include the newly discovered *A. damone* populations. As suitable geological substrates are more fragmented and isolated in Bosnia and Herzegovina, the species could potentially be assessed as Vulnerable (VU° B2ab), taking into account possible rescue effects from populations in western Serbia and the ongoing decline in habitat quality associated with vegetation encroachment and rural depopulation. In contrast, the Serbian populations are already located in the “Zlatibor” Nature Park, where targeted habitat management measures could be implemented if necessary. Protecting these northern populations is vital, as peripheral populations often harbor unique ecological adaptations that contribute to species resilience and long-term survival (Lesica & Allendorf, 1995). This importance is further underscored by the distinct genetic lineage present in this part of the species’ range (Naderi *et al.*, 2025).

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ПРВИ НАЛАЗ ВРСТЕ *ANTHOCHARIS DAMONE* BOISDUVAL, 1836 У БОСНИ И ХЕРЦЕГОВИНИ СА ЗНАЧАЈНИМ ПРОШИРЕЊЕМ АРЕАЛА У СРБИЈИ (LEPIDOPTERA: PIERIDAE)

ИВА СТОЈАНОВИЋ, ДЕЈАН КУЛИЈЕР, БРАНИСЛАВА ДУКИЋ, МАРТИНА ШАШИЋ,
ТОНИ КОРЕН, РУДИ ВЕРОВНИК И МИЛОШ ПОПОВИЋ

Извод

Anthocharis damone Boisduval, 1836 је ретка понто-медитеранска врста лептира са фрагментисаним ареалом и високим приоритетом заштите. Ова студија представља нове податке који значајно употпуњују познати ареал врсте на њеној северној граници распрострањења. Забележени су нови локалитети у западној Србији (кањон Увца, планина Златибор) као и први потврђени налази за Босну и Херцеговину (села Цикоте и Масали). Теренска истраживања спроведена између 2023. и 2025. године потврдила су присуство репродуктивних популација кроз забележена сва развојна стадијума врсте. Сви нови налази били су строго ограничени на ксеротермне јужне падине на серпентинитној подлози, упркос широкој распрострањености хранитељске биљке *Isatis tinctoria* L. на другим геолошким подлогама. Наши резултати указују да слив реке Дрине представља значајно упориште популација ове врсте. Имајући у виду њен статус угрожености у Европи, новооткривене популације захтевају преиспитивање регионалних приоритета заштите и наглашавају улогу серпентинитних масива као термалних рефугијума за ксеротермне врсте на у севернијим деловима ареала.

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