

Proterebia phegea (Lepidoptera: Nymphalidae: Satyrinae): building bridges between the relic populations of Croatia, Bosnia-Herzegovina, Greece, and a new record from northern Albania

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Abstract. *Proterebia phegea* (Borkhausen, 1788) (Lepidoptera: Nymphalidae: Satyrinae) is a butterfly with a restricted and fragmented distribution in the Balkan Peninsula. During a field trip on 26.iv.2022, within the area of the artificial Vau-Dejës Lake in northern Albania, the first author observed one female of *P. phegea*. The butterfly was found in a forest habitat on sandy, dark-reddish ophiolite rocky substrate. Twenty butterfly species were recorded in that area during the field trips, between March 2021 to September 2022, including *Hipparchia fagi* (Scopoli, 1763) occurring together with *Hipparchia syriaca* (Staudinger, 1871), *Hipparchia statilinus* (Hufnagel, 1766), and ten species of Odonata. This is only the second locality in Albania where *P. phegea* has been found. These two distant localities form a bridge between the well-documented populations of Croatia, Bosnia-Herzegovina, and Greece. The dragonfly, *Trithemis annulata* (Palisot de Beauvois, 1807) is new for northern Albania. The known and potential distribution, phenology and conservation status of *P. phegea* in Albania are discussed.

Samenvatting. *Proterebia phegea* (Borkhausen, 1788) (Lepidoptera: Nymphalidae: Satyrinae) is een dagvlinder met een beperkte en gefragmenteerde verspreiding op het Balkan schiereiland. Tijdens veldwerk op 26.iv.2022 vond de eerste auteur één wijfje *P. phegea* in de omgeving van het Vau-Dejës stuwwaard. De vlinder werd gevonden in een bosbiotoop met een zanderige, donkerrode ofioliet rotsondergrond. Tijdens veldwerk van maart 2021 tot september 2022 werden er twintig soorten dagvlinders gevonden waaronder *Hipparchia fagi* (Scopoli, 1763) die er samen voorkomt met *Hipparchia syriaca* (Staudinger, 1871) en *Hipparchia statilinus* (Hufnagel, 1766) alsook tien soorten Odonata. Dit is pas de tweede plaats in Albanië waar *P. phegea* werd gevonden. Deze twee verafgelegen plaatsen vormen een brug tussen de goed gedocumenteerde populaties van Kroatië, Bosnië-Herzegovina en Griekenland. De libel, *Trithemis annulata* (Palisot de Beauvois, 1807) is nieuw voor het Noorden van Albanië. De gekende en potentiële verspreiding, fenologie en status van *P. phegea* in Albanië worden besproken.

Përmbledhje. *Proterebia phegea* (Borkhausen, 1788) (Lepidoptera: Nymphalidae: Satyrinae) është një flutur me një shpërndarje të kufizuar dhe të fragmentuar. Gjatë një udhëtimi në terren më 26.iv.2022, në zonën e liqenit artificial të Vau-Dejës në veri të Shqipërisë, autori i parë vëzhgoi në terren dhe koleksionoi një femër *P. phegea*. Flutura u gjet në një habitat pyjor në një substrat shkëmbor me rërë të kuqërremtë të errët ofioliti. Njëzet lloje fluturash u regjistruan në atë zonë gjatë udhëtimeve në terren, nga marsi 2021 deri në shtator 2022, duke përfshirë *Hipparchia fagi* (Scopoli, 1763) që është bashkëgjetur me *Hipparchia syriaca* (Staudinger, 1871) dhe *Hipparchia statilinus* (Hufnagel 1766) dhe dhjetë lloje Odonata. Ky është lokaliteti i dytë në Shqipëri ku është gjetur *P. phegea*. Këto dy lokalitete të largëta formojnë një urë lidhëse midis popullatave të mirë dokumentuara të Kroacisë, Bosnje-Hercegovinës dhe Greqisë. Piliveza, *Trithemis annulata* (Palisot de Beauvois, 1807) është një lloj tjetër i ri për Shqipërinë e Veriut. Në këtë artikull diskutohet shpërndarja e njohur dhe e mundshme, fenologjia dhe statusi i ruajtjes së *P. phegea* në Shqipëri.

Résumé. *Proterebia phegea* (Borkhausen, 1788) (Lepidoptera : Nymphalidae : Satyrinae) est un papillon dont la distribution est restreinte et fragmentée dans la péninsule balkanique. Lors d'une sortie sur le terrain le 26.iv.2022, dans la zone du lac artificiel Vau-Dejës dans le nord de l'Albanie, le premier auteur y a observé une femelle de *P. phegea*. Le papillon a été trouvé dans un habitat forestier sur un substrat rocheux sableux d'ophiolite rouge foncé. Vingt espèces de papillons ont été enregistrées dans cette zone lors des sorties sur le terrain, entre mars 2021 et septembre 2022, y compris *Hipparchia fagi* (Scopoli, 1763) se trouvant avec *Hipparchia syriaca* (Staudinger, 1871), *Hipparchia statilinus* (Hufnagel, 1766) et dix espèces d'Odonata. Ce n'est que la deuxième localité en Albanie où *P. phegea* a été trouvé. Ces deux localités éloignées forment un pont entre les populations bien documentées de Croatie, de Bosnie-Herzégovine et de la Grèce. L'espèce de libellule, *Trithemis annulata* (Palisot de Beauvois, 1807) est nouvelle pour le nord de l'Albanie. La distribution connue et potentielle, la phénologie et le statut de conservation de *P. phegea* en Albanie sont discutés.

Key words: *Proterebia phegea* — Lepidoptera — Papilionoidea — *Trithemis annulata* — Odonata — Albania — Shkodër — Vau-Dejës — Faunistics — Habitat — Conservation.

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Introduction

Albania is located on the western edge of the Balkan Peninsula, with a mostly mountainous relief. The region of the Vau-Dejës Lake has a Mediterranean climate with 14.7°C average annual temperature and an average precipitation of 1528 mm per year. The study area is

characterized by a variety of ecosystems, including aquatic ecosystems, Mediterranean evergreen and deciduous shrubs, coniferous and mixed broad-leaved forests, meadows and pastures. Typical for the area are: *Pinus pinea* L., *P. halepensis* Mill., *P. nigra* J.F.Arnold, *Quercus cerris* L., *Q. ilex* L., *Carpinus betulus* L., *Fraxinus angustifolia* Vahl, *Satureja montana* L., *Achillea mille-*

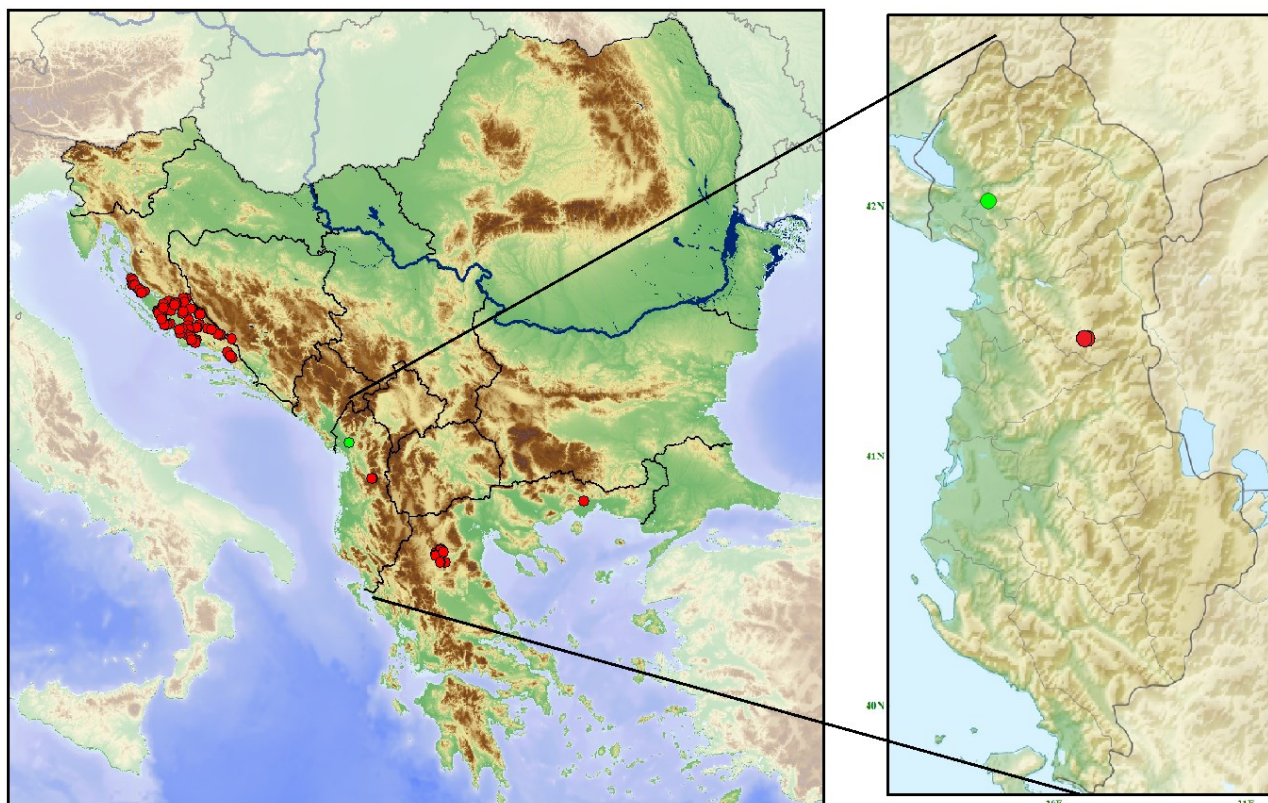


Fig. 1. Left: distribution of *Proterebia phegea* in the Balkan Peninsula. Right: distribution of *Proterebia phegea* in Albania. ● Records including coordinates from three sources: literature, own surveys and those kindly provided by other entomologists. ● New record of *P. phegea* (this paper).

folium L., *Juniperus oxycedrus* L. etc. (Vau-Dejës 2017). The first comprehensive overview of the butterfly fauna for Albania was compiled by Rebel & Zerny (1931), and during the long period of isolation only a few publications focused on Albania. The publication by Misja (2005) represented the first time that distribution maps for all known species were available. The most recent checklist (Cuvelier *et al.* 2018) presents 196 confirmed butterfly species. *Proterebia phegea* (Borkhausen, 1788) was never listed or mentioned as a potential target for research in Albania. In July 2022, Verovnik & Verovnik provided the first information concerning the unexpected discovery on 27.iv.2022: *P. phegea* was flying in good numbers on south-facing slopes near Bulqizë (Dibër County).

Proterebia phegea is a species whose adults tolerate harsh continental conditions (Bartoňová 2017), is single brooded and flies in early spring. It has been found from sea level up to almost 1500 m a.s.l. Until recently, *P. phegea* was only documented in the Balkans from disjunct, relict populations in Croatia, Bosnia-Herzegovina, and Greece (Fig. 1). In recent years, Albania has received more attention from butterfly researchers, but the area of Vau-Dejës in North Albania remained unexplored. Comprehensive data on the distribution and conservation status of *P. phegea* in Albania is still poor as the species has only recently been documented. The goal of this article is to improve the knowledge on the potential distribution of *P. phegea* in Albania, to tentatively assess its conservation status, and to document the diversity of the Vau-Dejës region. The most remarkable data from the surveys for the Papilionoidea and Odonata are briefly analysed and summarised as supplementary material.

Material and methods

Six sites (S1) with varied biotopes were selected within the Vau-Dejës region. Collecting was done using the insect net. Captured specimens were killed and placed in paper envelopes, marked with the date and coordinates. For preparation for the entomological reference collection, individuals were softened with water vapour in plastic boxes for 24 hours and then set on polystyrene using entomological pins. Each individual was labelled with the scientific name, date of collection and coordinates according to Misja (2005) and Paparisto *et al.* (2005). Identification was based on external (Tolman & Lewington 1997; Dijkstra & Lewington 2006) and genital characters (Beshkov 1995). The identifications of *Hipparchia fagi* (Scopoli, 1763) and *Hipparchia syriaca* (Staudinger, 1871) are based on genitalia dissections, as these two species are externally indistinguishable. Observational data of *P. phegea*, with precise coordinates, were compiled from the literature and from information kindly provided by other researchers. The distribution maps were created with DMAP, distribution mapping software.

Results and discussion

During the weekly field surveys (March 2021–September 2022) for the master thesis of the first author, 20 species of butterflies and 10 species of Odonata (S1) were recorded in the six selected sites (S1) of the Vau-Dejës region. In site 5, 100 m a.s.l., the first author



Fig. 2. Female of *Proterebia phegea*, Vau-Dejës, 26.iv.2022 (Coll. and © M. Prendi); a, upperside, b, underside.

sampled a female *P. phegea* (Fig. 2) on 26.iv.2022 near the road (42.0197N 19.6625E) in a forest habitat (Fig. 3a) on sandy, dark-reddish, ophiolite rocky substrate (Fig. 3b) with *Juniperus* spp., *Pinus* spp. and typical undergrowth of *Festuca* spp. The locality is 144 km NE of the first published records (Verovnik *et al.* 2022) from the Bulqizë area, +/- 750 m a.s.l., and represents an important extension for the Albanian range of *P. phegea* (Fig. 1). Most of the known localities in Croatia, the adjacent locality in Bosnia-Herzegovina and Greece are open, well-exposed habitats on grey-whitish limestone. Typical habitats are found on dry, rocky karstic meadows with sparse vegetation. In the Dalmatian part of its range *P. phegea* also occurs in more overgrown sites with similar vegetation.

This observation confirms the occurrence of *P. phegea* in localities with a similar habitat, structure and vegetation on ophiolite substrate. Two of the three localities known to us are located within the large ophiolite zone of Albania and belong to two different tectonic zones. The habitat near Bulqizë is located in the Inner Albanides and the area around Vau-Dejës Lake is situated in the Outer Albanides. Both these areas have a rather similar lithological composition. In Greece, *P. phegea* is also present on ophiolites in scattered localities on the south-western slopes of Mt. Vourinos (personal observation third author).

P. phegea has a rather continuous range in the Pontic steppes and northern parts of the Irano-Turanian biogeographic region. The phylogeography of *P. phegea*

(Bartoňová *et al.* 2018) shows that the Balkan populations are distinct but were repeatedly connected in between the glacial cycles to the rest of the range. The Dalmatian lineage is closely related to Turkish haplotypes; the Greek haplotypes are closely related to butterflies north of the Greater Caucasus.

In Europe, *P. phegea* has disjunct populations. It was first discovered in Croatia and is known from 60 sites in total, including the island of Pag in the northwest, to the Biokovo Mts. in the south (Koren *et al.* 2010; Bartoňová 2019). In 1984, *P. phegea* was discovered in Greece by the late Simos Ichtiaroglou (De Louker & Dils 1987) and is recorded in western Greek Macedonia on Mt. Siniátsiko, on the hills just north of the town of Siatista, and on Mt. Vourinos near Kozani (Pamperis, oral communication). More recently *P. phegea* has also been recorded by Lazaros Pamperis in the Rhodopi Mts. in north-eastern Greece (Pamperis 2011). *P. phegea* is very local in Greece though quite common where found. On April 2011 *P. phegea* was also confirmed from Bosnia-Herzegovina, near the Croatian border, only a marginal extension inland of its range in Dalmatia (Koren & Trkov 2011). The recent Albanian discoveries near Bulqizë and at the Vau-Dejës Lake form a bridge between the well-documented populations found in Croatia, Bosnia-Herzegovina, and Greece. The butterfly is not only present in open and exposed localities on grey-whitish limestone substrate but also in more overgrown sites on limestone and ophiolite substrates.



Fig. 3. Vau-Dejës, 26.iv.2022, a, Forest habitat b, ophiolite substrate. © M. Prendi.

The altitude of the two Albanian localities is in line with the European range: from sea level up to almost 1500 m a.s.l. (Koren *et al.* 2010; Bartoňová 2017). *P. phegea* is a species of the early spring: adults have been observed from the beginning of March till the end of May (Koren *et al.* 2010). The single female, not perfectly fresh, observed at +/-100 m a.s.l. in the Vau-Dejës area is a potential indication that the species was at the end of its flight time on 26.iv.2022 in this lowland locality. In Bulqizë, the majority of the specimens were mostly fresh males and newly emerged females on 27.iv.2022, indicating that this was more or less in the middle of the flight time at 750 m a.s.l. (Verovnik & Verovnik 2022).

According to the Red List Status of the European butterflies (van Swaay *et al.* 2010) and the Red List of Mediterranean butterflies (Numa *et al.* 2016) based on the IUCN categories and criteria, *P. phegea* is classified in the category LC (Least Concern). For Albania the Red List category is NE (not evaluated).

For the moment the threats in the two localities are low but not non-existent. Road works, building and quarrying along the SH6 road near Bulqizë could have a dramatic effect on the current known localities of *P. phegea*. The Vau-Dejës population probably has declined due to the damming. Deforestation and urbanization may pose additional threats in the future.



Fig. 4. *Trithemis annulata*, Vau-Dejës, 05.iv.2021. © M. Prendi.

Intermediate grazing pressure (Bartoňová 2019), suppressing shrubs and trees and keeping enough dry grass litter, is present in Croatian and Greek habitats

where thriving populations of *P. phegea* are present. Increased grazing is a serious threat. In the same locality, during the summer months, *H. fagi*, *H. syriaca* and *Hipparchia statilinus* (Hufnagel, 1766) are syntopic, further underlying the natural value of the area of the Vau-Dejës region. Vau-Dejës is speaking through its biodiversity. Ten species of Odonata were recorded in the Vau-Dejës region belonging to eight genera and four families (S1). *Trithemis annulata* (Palisot de Beauvois, 1807) (Fig. 4) is recorded for the first time for North Albania and this dragonfly species was only recorded for the first time in South Albania (Shkëmbi 2019) in 2018.

Conclusion

Further efforts are needed to estimate the status of the *P. phegea* population in the Vau-Dejës Lake region where more open habitats also have potential for the species, and to survey other localities with suitable ophiolite habitat from north-eastern Albania, near the Republic of Kosovo, to the county of Korçë in south-eastern Albania, near Greece. Other surveys that might bring new evidence can focus on the karst habitats between Dalmatia to North Albania and the ophiolite zones in the Republic of Northern Macedonia.

Also, future molecular research is needed to elucidate the biogeography of these recently found Albanian populations of *P. phegea*. The Vau-Dejës region is home to important butterfly and dragonfly species. Further research is expected to document its full potential, as is the case in many more localities in North Albania.

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Supplementary material. Study sites and results of the field surveys for Papilionoidea and Odonata in the Vau-Dejës region



Fig. S1. Map of the study sites (source: Google Earth and adapted by Marko Prendi)

Table S1. Study sites.

Site number	Site name	Latitude	Longitude	Altitude (m)
1	Mjedë	42.0023	19.6353	21
2	Zadejë	42.0058	19.3742	40
3	Rragam	42.0145	19.3745	100
4	Qersaq	42.0106	19.3839	90
5	Vau-Dejës	42.0114	19.3938	75
6	Gomsiqe	42.0123	19.4053	75

Table S2. Study results.

Lepidoptera	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Papilionoidea						
<i>Iphiclides podalirius</i>	*	*	*	*	*	*
<i>Papilio machaon</i>	*	*	*	*	*	*
<i>Colias crocea</i>	*					
<i>Gonepteryx rhamni</i>	*					
<i>Pieris brassicae</i>	*	*			*	*
<i>Pieris rapae</i>	*					
<i>Pontia edusa</i>	*					
<i>Lycaena phlaeas</i>					*	*
<i>Polyommatus icarus</i>	*	*	*	*	*	*
<i>Argynnis paphia</i>					*	
<i>Melitaea cinxia</i>					*	
<i>Melitaea trivia</i>					*	
<i>Polygonia egea</i>	*					
<i>Vanessa atalanta</i>	*	*			*	
<i>Vanessa cardui</i>	*	*			*	
<i>Coenonympha pamphilus</i>	*	*	*	*	*	*
<i>Hipparchia fagi</i>					*	
<i>Hipparchia statilinus</i>					*	
<i>Hipparchia syriaca</i>					*	
<i>Proterebia phegea</i>					*	
Odonata						
<i>Ischnura elegans</i>	*					

<i>Enallagma cyathigerum</i>	*	*			*	*
<i>Anax imperator</i>					*	
<i>Lindenia tetraphylla</i>	*					
<i>Orthetrum brunneum</i>		*				
<i>Orthetrum cancellatum</i>	*	*	*	*	*	*
<i>Orthetrum coerulescens</i>		*				
<i>Sympetrum fonscolombii</i>					*	*
<i>Crocothemis erythraea</i>	*	*			*	
<i>Trithemis annulata</i>	*				*	

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