



**REDISCOVERY AND DISTRIBUTION OF THOR'S FRITILLARY  
*BOLORIA THORE* (HÜBNER, 1803) (LEPIDOPTERA: NYMPHALIDAE)  
IN SLOVENIA**

Rudi VEROVNIK<sup>1</sup>, Primož GLOGOVČAN<sup>2</sup>, Stanislav GOMBOC<sup>3</sup>

<sup>1</sup>Univerza v Ljubljani, Biotehniška Fakulteta, Oddelek za biologijo, Jamnikarjeva  
101, 1000 Ljubljana; e-mail: rudi.verovnik@bf.uni-lj.si

<sup>2</sup>Čirče 63, 4000 Kranj; e-mail: primoz.glogo@gmail.com

<sup>3</sup>Gančani 110, 9231 Beltinci, e-mail: stanislav.gomboc@siol.net

**Abstract** Thor's Fritillary (*Boloria thore*) has been considered extremely rare and localised at the south-eastern edge of its distribution in the Alps, especially in Slovenia. Despite surveys focused on sites with historical records (Julian Alps, Karavanke Mts.), there is almost a century long gap with no observations. Its discovery on the south-eastern slopes of Mt. Košuta (Karavanke Mts.) in 2004 was therefore unexpected, however within the known historical range of the species in the region. Since its re-discovery, the species has been observed at several new localities in the Karavanke Mts. and Julian Alps. These records are presented and habitat requirements as well as potential threats for the species are discussed.

**KEY WORDS:** Papilionoidea, montane species, habitat, endangerment

**Izvleček** PONOVRNO ODKRITJE TEMNEGA TRATARJA *BOLORIA THORE* (HÜBNER, 1803) (LEPIDOPTERA: NYMPHALIDAE) IN NJEGOVA RAZŠIRJENOST V SLOVENIJI

Temni tratar (*Boloria thore*) velja na jugovzhodnem robu svoje razširjenosti v Alpah, zlasti v Sloveniji, za izredno redko in lokalno razširjeno vrsto. Kljub načrtnemu pregledu znanih zgodovinskih lokacij (Julijske Alpe, Karavanke) ga pri nas skoraj 100 let nismo našli. Njegovo ponovno odkritje na jugovzhodnih pobočjih Košute (Karavanke) leta 2004 je bilo nepričakovano, pa čeprav znotraj znanega zgodovinskega območja razširjenosti vrste v regiji. Od ponovnega odkritja je bila vrsta potrjena na več novih lokacijah v Karavankah in Julijskih Alpah. Te najdbe predstavljamo v prispevku, kjer razpravljamo še o habitatu in potencialni ogroženosti te vrste.

**KLJUČNE BESEDE:** Papilionoidea, montanske vrste, življenjski prostor, ogroženost

## Introduction

Thor's fritillary is a boreo-alpine species distributed in the northern Palaearctic region from Japan in the east (Tuzov & Bozano 2006), throughout northern Asia to boreal northern Europe with a disjunct range in the Alps (Tolman & Lewington 2008). Here it is distributed mainly in the Central and Eastern Alps, reaching the northern Piedmont region at the south-western edge of the distribution (Mérit & Manil 2016). It is more widespread in the northern part of the Alps (e.g. Bavaria - Nunner 2013), becoming much scarcer towards south (e.g. South Tyrol – Huemer 2004, Dolomites - Bonato et al. 2014).

It is a predominantly woodland species favouring coniferous forest clearing or open coniferous or mixed woods in the montane belt in the Alps (Pro Natura 1987, Weidemann 1995). It is often found on shaded clearings, along dump forest edges, ravines and mountain streams with abundance of nectar sources (Pro Natura 1987, Tolman & Lewington 2008, Nunner 2013). Adults have a slower and more gliding flight compared to other species in the genus and are often visiting flowers, or perching on low bushes and young firs (Gorbunov & Kosterin 2007). Flight period in the Alps is from mid-June to beginning of August depending on altitude and season (Tolman & Lewington 2008). Due to large fluctuations in numbers of adults a biannual lifecycle has been anticipated (Pro Natura 1987), however not confirmed (Huemer 2004). The larvae feed on different *Viola* spp., in the Alps most commonly on *Viola biflora* L. (Pro Natura 1987). The species in general is not considered threatened in Europe (van Swaay et al. 2010), however local populations at the edge of the distribution can be affected by afforestation of clearings, intensive forest management, overgrowing of open forest areas or development of infrastructure (ski pists, etc.) (Nunner 2013).

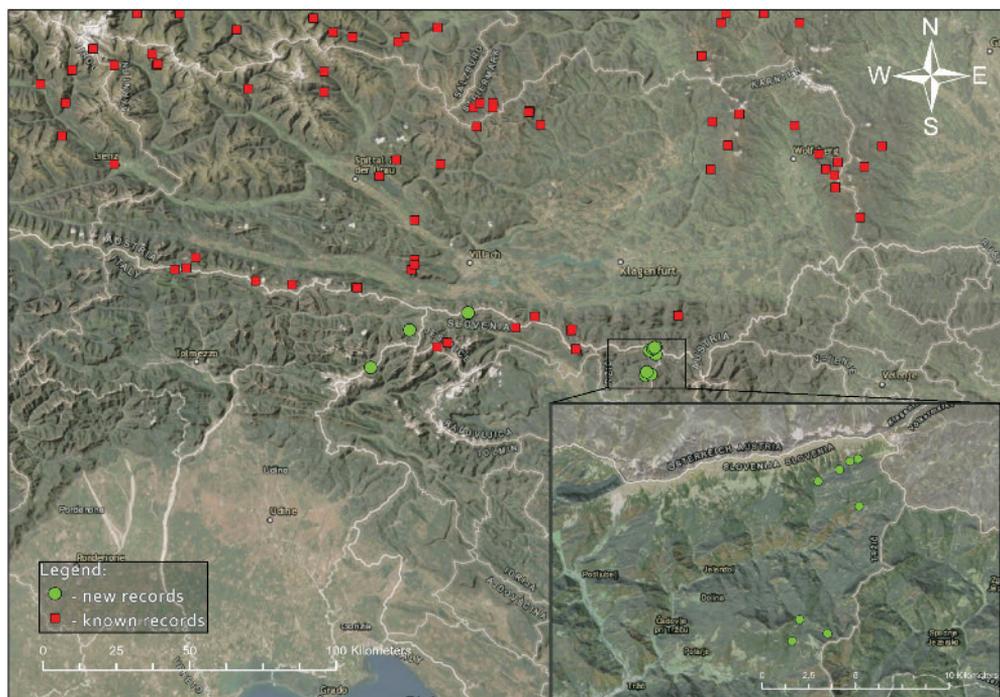
Only three historical records were published for Thor's Fritillary in Slovenia. It was first reported by Hafner (1909) in his comprehensive overview of the fauna of the Krain region based on specimens collected by Hans Kautz in the northern Julian Alps in Pišnica Valley (18.6.1908) and at Erjavčeva hut near Vršič Pass (9.7.1908) (also mentioned in Rebel 1910). Additionally, it was reported from Mt. Baba in Karavanke Mts. (18.7.1906) (Galvagni 1910), however without precise information on the locality. It is likely, that the species was found on the southern side of the mountain (in Slovenia) as Galvagni mentions Mojstrana town as a starting point of his explorations (Galvagni 1910). There is also an additional record for Mt. Stol in the same range based on a specimen in Vienna Natural History Museum (Verovnik et al. 2005), however it is likely that the specimen was collected on the northern (Austrian) side of the mountain where the species is known to occur in nearby Bärenthal (Thurner 1948). Thurner (1948) also mentions the species from Quadia Alm in close proximity of the Slovenian border near Mt. Golica, and several other mountain ranges in Carinthia (Koralpe, Saualpe, Dobratsch, Carnic Alps). In Koralpe, just north of the Slovenian border near Drava River, the species was reported from both the Carinthian and Styrian part of the range (Höfner 1885, 1903, 1911, Kühnert 1966, 1978). No published

records from Friuli region could be retrieved, but species was known to occur near Fužine Lakes close to Slovenian border (Štanta Radovan, pers. observ.).

Thor's Fritillary was rediscovered in Slovenia in 2004 at Dolge Njive pastures below Mt. Košutnik in the eastern part of Karavanke Mts. (Gomboc, pers. observ.) and at several nearby sites in the subsequent years (Verovnik et al. 2012). A more detailed account of these records and additional records from western Karavanke Mts. and Julian Alps are discussed in our overview.

## Methods

Focused species surveys for Thor's fritillary were based on historical records and presence of the potentially suitable habitat, mainly along streams and forest roads since the year 2000. Maps with orthophoto images, such as Geopedia (<http://www.geopedia.si/>) and Atlas okolja (<http://gis.arso.gov.si/atlasokolja/>) were also used for detection of the potential habitats. Butterflies were netted and released after examination,



**Fig. 1:** The distribution of the Thor's fritillary (*Boloria thore*) in south eastern Alps. New records (green dots) are added to the known locations (red squares) based on literature data and database queries (see methods).

**Sl. 1:** Razširjenost temnega tratarja (*Boloria thore*) v jugovzhodnih Alpah. Novi podatki (zelene točke) so dodani k znanim lokacijam (rdeči kvadrati) iz literature in baz podatkov (glej metode).

or were observed without disturbance. Adults and habitats were documented by photographing.

Distribution map (Fig. 1) was prepared in ESRI ArcGIS Pro software, based on observation presented in this contribution, the literature data, and records from databases ZOBODAT (<https://www.zobodat.at/>), GBIF (<https://www.gbif.org/>), and Observation (<https://observation.org/>).

## Results

Since the year 2000, which marks the large scale faunistic surveys for the butterfly atlas of Slovenia (Verovnik et al. 2012), but also earlier, the first author visited all three historical sites (Velika and Mala Pišnica Valleys, Vršič pass, Mt. Baba) with the former presence of Thor's fritillary on several occasions, however without any success. Apart from the open forest and small streams on the northern side of the Vršič pass, no potentially suitable habitat was found. The known site at nearby Lago di Fusine in Italy was also visited with a single observation in 1999 (see Table 1). In the last decade the open forests near the lake were greatly reduced and large intensive pastures have been established, so no additional observations were made.



**Fig. 2:** Thor's fritillary (*Boloria thore*) underside. Photographed at the quarry below Mt. Košutnik. (photo: Rudi Verovnik)

**Sl. 2:** Temni tratar (*Boloria thore*), spodnja stran. Fotografiran pri kamnolomu pod Košutnikom. (foto: Rudi Verovnik)

**Table 1:** List of localities and dates of the recent observations of Thor's fritillary (*Boloria thore*) in south-eastern Alps.

**Tabela 1:** Seznam lokalitet in datumov novejših najdb temnega tratarja (*Boloria thore*) v jugovzhodnih Alpah.

date	locality	Lat (WGS84)	Lon (WGS84)	Altitude (m)
31.7.2004	SI, Tržič, Mt. Košuta, upper part of the Dolge njive pastures along the dry stream in the woods	46°26'18"	14°25'10"	1465
12.7.2006	SI, Tržič, Mt. Veliki Javornik, along the road 500 m Gaberčev rovt pastures	46° 22' 38"	14° 23' 16"	1440
12.7.2006	SI, Tržič, Mt. Veliki Javornik, glades and pastures at the saddle N of the mountain	46° 22' 47"	14° 24' 17"	1470
12.7.2006, 4.7.2014, 19.6.2018, 7.7.2018	SI, Tržič, Mt. Veliki Javornik, along a small stream in the valley E of Konjščica peak	46° 23' 04"	14° 23' 29"	1380
6.7.2006	SI, Tržič, Mt. Košuta, clearings along the road south east of the Črna Peč peak	46° 25' 21"	14° 25' 12"	1210
19.6.2018	SI, Tržič, Mt. Košuta, along the stream and road in the valley N of Košutnik hut	46° 25' 51"	14° 24' 01"	1140
6.7.2006, 2.7.2007, 15.6.2011, 11.7.2015, 19.6.2018	SI, Tržič, Mt. Košuta, along the road near the small abandoned quarry	46° 26' 05"	14° 24' 38"	1290
6.7.2006	SI, Tržič, Mt. Košuta, lower part of the Dolge njive pastures and along the dry stream	46° 26' 15"	14° 24' 56"	1380
24.7.2018, 25.6.2019, 9.7.2020	SI, Kranjska Gora, Mt. Trupejevo Poldne, first part of the Železnica valley	46° 30' 43"	13° 50' 37"	1500
27.6.1999	IT, Fusine in Valromana, Lago di Fusine, small glade south-west of the upper lake	46° 28' 29"	13° 39' 54"	930
29.6.2019	IT, Mt. Jerebica, clearing along the track W of Jezerski pass	46° 23' 39"	13° 32' 45"	1610



**Fig.3:** Habitat of Thor's fritillary (*Boloria thore*) in the lower part of the Železnica Valley, western Karavanke Mts. (photo: Primož Glogovčan)

**Sl. 3:** Življenjski prostor temnega tratarja (*Boloria thore*) v spodnjem delu doline Železnica, zahodne Karavanke. (foto: Primož Glogovčan)

The rediscovery of Thor's Fritillary in 2004 was completely coincidental, during an inventory of grasshoppers and butterflies. Only a single worn individual was observed in open spruce forest near dry stream at Dolge njive pastures. A more detailed survey of the wider region between Mt. Košuta and Mt. Storžič followed in 2006 when the species was recorded at six additional sites. Main common characteristics of the localities are the presence of open coniferous woods with open areas along roads and in most cases also small streams. Abundance of flowering plants was noted along the streams and on road verges providing the necessary nectar sources for the adults. We noticed different *Cirsium* sp., *Knautia* sp., and *Thymus* sp. as the main nectar source of the adults. The males commonly perched on small spruces or bushes 2 to 3 meters above the ground, sometimes returning to the same perch when disturbed. They were also observed patrolling along streams or roads, while females were busier visiting the flowers. Mostly, they were present in low numbers from 1 to 5 specimens per site, however in 2006 they were common near the small abandoned quarry below Mt. Košuta (Fig. 2). Closely related, montane woodland habitat specialist, Titania's fritillary (*Boloria titania* (Esper, 1793)) has been found cohabiting at most of these sites.

In 2018 the species has finally been discovered also in the western Karavanke Mts., much closer to the historical Mt. Baba locality, in Železnica Valley. The first

author visited the valley on two previous occasions, but possibly too late in the season, as only Titania's fritillary was recorded. The habitat is otherwise ideal for both fritillaries with open fir and larch woods on both slopes and glades along the stream and the narrow road meandering through the valley (Fig 3). The presence of the species was confirmed also in both consecutive years, with largest abundance of about a dozen of specimens seen in 2020.

The discovery of the species at the Mt. Jerebica (Jezerški pass) in the western Julian Alps just across the border in Italy was a bigger surprise, as the habitat there is steep grassy slope with dwarf pine and small fir trees near the ridge surrounded by otherwise dense montane forest with no stream in vicinity. Such habitat combination is widespread throughout Julian Alps in particularly on the eastern and northern edge of the range. Approximately ten adults were observed, some feeding on thistles *Adenostyles alliariae* (Gouan) A.Kern. (Fig. 4).

### Discussion

Given the recent records, the Thor's fritillary is obviously not that extremely rare in south-eastern Alps as adjudging from the long gap between historical and recent



**Fig.4:** Thor's fritillary (*Boloria thore*) feeding on *Adenostyles alliariae* near Jezerški pass, Mt. Jerebica in western Julian Alps. (photo: Primož Glogovčan)

**Sl. 4:** Temni tratar (*Boloria thore*) se hrani na *Adenostyles alliariae* v bližini Jezerskega prelaza pri Jerebici v zahodnih Julijskih Alpah. (foto: Primož Glogovčan)

observations (Verovnik et al. 2012). This could be explained by its low detectability due to short flight period, low adult abundance (possibly due to biannual life cycle (Pro Natura 1987)), and extremely localised distribution linked to availability of suitable open coniferous forest habitat. Our records span from mid-June to end of July, which is in line with observations elsewhere in the Alps (Pro Natura 1987, Tolman & Lewington 2008), however locally the adults are on the wing not more than three weeks with a peak of occurrence in Slovenia at the beginning of July.

The species is possibly more widespread in the south-eastern Alps and we expect its wider distribution in the Karavanke Mts., northern Julian Alps, and anticipate its possible occurrence also in the Pohorje Mts. further eastwards. Namely, the Thor's fritillary has been recorded from nearby Koralpe (Höfner 1885, 1903, 1911, Kühnert 1966, 1978) and both ranges share at least one boreo-alpine butterfly species *Argiades optilete* (Knoch, 1781) (Kühnert 1978, Jež 1983). Potentially suitable habitats for Thor's fritillary are present on the northern side of the Pohorje Mts. but so far no focused search has been undertaken. The geographically even closer to Koralpe are Kozjak Mts. at the border with Austria, but they are probably too low and with a predominantly southern exposition, therefore not likely to have any suitable habitat for the species.

The Thor's fritillary is listed as vulnerable in the Alpine region in the first published Red list of butterflies of Slovenia (Carnelutti 1992) with a note, that it has not been observed for a 'while'. In the Atlas of threatened butterflies of Slovenia (Čelik & Rebeušek 1996) it is considered extinct and was therefore not evaluated for the official red list of the Lepidoptera of Slovenia (Official Gazette 2004). The status of a vulnerable species has been proposed also in the Slovenian butterfly atlas (Verovnik et al. 2012) due to extreme localised distribution. Taking into consideration our recent findings we are inclined to lower its extinction risk to near threatened, as we show that the Thor's fritillary has a wider distribution in Slovenia and is predominantly distributed in areas with low human impact. Still majority of the populations are highly localised and possibly isolated, thus vulnerable to local habitat change (e.g. road construction, logging, afforestation) and over-collecting. Although climate change could also be considered a long term threat for such montane butterflies (Settele et al. 2008), a much more detailed survey and a longer time span would be required to substantiate this.

The current forest management, particularly in the Karavanke Mts., is suitable for long term maintenance of the habitat for the Thor's fritillary with large areas of open spruce woods, clearings, and fellings. Pasturing, to a smaller extent, is also important for maintenance of open habitat structures below the treeline, which are prerequisite for flower rich areas required by the species. We hope our publication will trigger further surveys and research of this interesting species at its southern edge of the distribution in Europe.

### Acknowledgment

The field work of Rudi Verovnik was partially funded by the Slovenian Research agency (program P1-0184).

## Bibliography

- Bonato, L., Uliana, M., Beretta, S.,** 2014: *Farfalle del Veneto: atlante distributivo*. Regione del Veneto, Fondazione Musei Civici di Venezia, Marsilio Editori, Venezia, pp. 408.
- Carnelutti, J.,** 1992: Rdeči seznam ogroženih metuljev (Macrolepidoptera) v Sloveniji. *Varstvo narave, Ljubljana*, 17: 61-104.
- Čelik, T., Rebeušek, F.,** 1996: *Atlas ogroženih vrst dnevnih metuljev Slovenije*. Slovensko entomološko društvo Štefana Michielija, Ljubljana, pp. 102.
- Galvagni, E.,** 1910: Sammeltage in den Karawanken und Steiner-Alpen. *XX. Jahres-Bericht des Wiener entomologischen Vereines, Wien*, 20: 147-162.
- Gorbunov, P., Kosterin, O.,** 2007: *The Butterflies (Hesperioidea and Papilionoidea) of North Asia (Asian part of Russia) in Nature*. Vol. 2. Rodina & Fodio, Moscow, pp. 408.
- Hafner, J.,** 1909: Verzeichnis der bisher in Krain beobachteten Großschmetterlinge I. *Carniola (Mitteilungen des Musealvereins für Krain), Ljubljana*, 2: 77-108.
- Höfner, G.,** 1885: Die Schmetterlinge des Lavantthales und der beiden Alpen „Kor-u. Saualpe“, IV nachtrag. *Jahrbuch des naturhistorischen Landes-Museums von Kärnten*, 17: 217-226.
- Höfner, G.,** 1904: Die Schmetterlinge Kärntens. *Jahrbuch des Naturhistorischen Landesmuseums von Kärnten*, 27: 179-416.
- Höfner, G.,** 1911: I. Nachtrag zur Schmetterlings-Fana Kärntens. *Carinthia II*, 101: 18-46.
- Huemer, P.,** 2004: *Die Tagfalter Südtirols*. Veröffentlichungen des Naturmuseums Südtirol, 2, Folio Verlag, Bozen, pp. 232.
- Jež, M.,** 1983: Osnovne karakteristike favne dnevnih metuljev (Lepidoptera, Diurna) Slovenskega Podravja. *Biološki vestnik, Ljubljana*, 31(1): 83-106.
- Kühnert, H.,** 1966: Verbreitung der Tagfalter im Bezirk Deutschlandsberg nach ökologischen Gesichtspunkten. *Zeitschrift der Arbeitsgemeinschaft Österreichischer Entomologen* 18:51-67.
- Kühnert, H.,** 1978: Über die Verbreitung einiger interessanter Tagfalterarten in der Südsteiermark. *Zeitschrift der Arbeitsgemeinschaft Österreichischer Entomologen*, 30: 49-61.
- Mérit, X., Manil, L.,** 2016: Contribution à la connaissance de la faune lépidoptérique du Val d'Ossola (Piémont, Italie): 5. - Une espèce très rare dans la région: *Boloria (Clossiana) thore thore* (Hübner, [1803]) (Lepidoptera: Nymphalidae). *Lépidoptères - Revue de l' Association des Lépidoptéristes de France*, 25(65): 94-96.
- Nunner, A.,** 2013: Alpen-Perlmutterfalter — *Boloria thore* (Hübner, 1803). Pp. 215–217 in: **Bräu, M., Bolz, R., Kolbeck, H., Nunner, A., Voith, J., Wolf, W. (Eds.),** 2013: Tagfalter in Bayern. Eugen Ulmer, Stuttgart: pp.784.
- Official Gazette RS,** 2004: Uredba o zavarovanih prostoživečih živalskih vrstah v Sloveniji. Uradni list Republike Slovenije, 46/2004: 5963-6017 in 109/04, 84/05, 115/07, 32/08 – odl. US, 96/08, 36/09, 102/11, 15/14, 64/16 in 62/19.

- Pro Natura**, 1987: Tagfalter und ihre Lebensräume. Lepidopterologen-Arbeitsgruppe / SBN Pro Natura, Basel, pp. 516.
- Rebel, H.**, 191: Lepidopteren aus dem Gebiete des Triglav und der Črna Prst in Krain: III. Nachtrag. Jahresbericht des Wiener entomologischen Vereines, Wien, 21: 1-37.
- Settele, J., Kudrna, O., Harpke, A., Kuehn, I., van Swaay, C., Verovnik, R., Warren, M., Wiemers, M., Hanspach, J., Hickler, T., Kuehn, E., van Halder, I., Veling, K., Vliegenthart, A., Wynhoff, I., Schweiger, O.**, 2008: Climatic risk atlas of European butterflies. Biorisk 1, pp. 710.
- Thurner, J.**, 1948: Die Schmetterlinge Kärntens und Osttirols. Carinthia II: X. Sonderheft pp. 200.
- Tolman, T., Lewington, R., (ill.)**, 2008: Collins butterfly guide: the most complete field guide to the butterflies of Britain and Europe. Collins guide – HarperCollins Publishers, London, pp. 384.
- Tuzov, V.K., Bozano, G.C.**, 2006: Guide to the Butterflies of the Palearctic Region - Nymphalidae part II - Tribe Argynnini - Genus *Boloria*, *Proclossiana*, *Clossiana*. Bozano G. C. Ed., Omnes Artes, Milano, Italia, pp. 72.
- van Swaay, C., Cuttelod, A., Collins, S., Maes, D., López Munguira, M., Šašić, M., Settele, J., Verovnik, R., Verstrael, T., Warren, M., Wiemers, M., Wynhoff, I.**, 2010: European Red List of Butterflies. Luxembourg: Publications Office of the European Union, pp. 47.
- Verovnik, R., Rebeušek, F., Jež, M.**, 2012: Atlas dnevnih metuljev (Lepidoptera: Rhopalocera) Slovenije. Center za kartografijo favne in flore, Miklavž na Dravskem polju, pp. 456.
- Wiedemann, H.J.**, 1995: Tagfalter: beobachten, bestimmen. Naturbuch Verlag, Augsburg: pp. 659.

*Received / Prejeto:* 6. 10. 2020