

## Large Heath (*Coenonympha tullia* (Müller, 1764)) in Šumava National Park, Czech Republic

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### Abstract

The large heath *Coenonympha tullia* (Müller, 1764) (Lepidoptera, Nymphalidae, Satyrinae) is widespread in large parts of Holarctic region. The species is not considered as being under serious threat on a scale of a whole Europe (Vulnerable, VU) or near threatened (NT) for EU27 (MAES et al. 2019). The species disappeared from a vast area in NE Europe (SOMMER et al. 2022). In the Czech Republic, it used to be locally distributed in all regions of the country. After the 1960s, the species underwent a rapid decline and now it can only be found in two parts of South Bohemia. In 2021, we, therefore, investigated 33 of its formerly known as well as potential localities in Šumava National Park. We confirmed the species from 10 sites, yet only four sites host populations larger than 20 individuals.

*Key words:* butterfly, faunistics, habitat management, insect conservation, peat bog, wetland

### INTRODUCTION

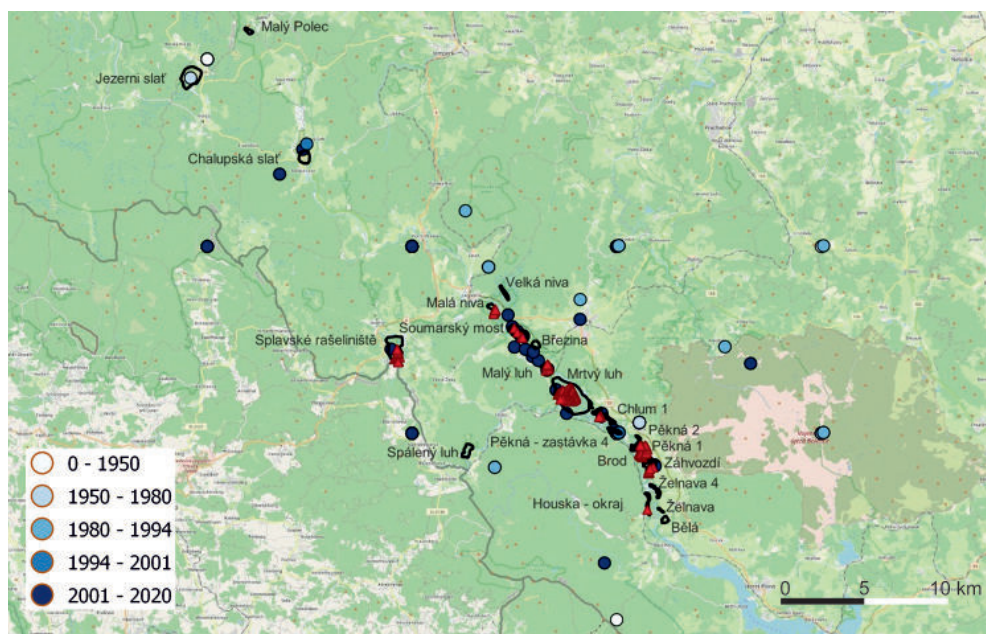
The large heath *Coenonympha tullia* (Müller, 1764) (Lepidoptera, Nymphalidae, Satyrinae), is a butterfly of a vast distribution spanning from Ireland to Chukotka in Eurasia, and from Alaska to Newfoundland in North America (BOZANO 1999). Even though the species is considered as not under serious threat (vulnerable, VU) on the scale of the whole Europe, and near threatened (NT) for EU27 (VAN SWAAY et al. 2011, MAES et al. 2019), it is listed as the highest priority species (SPEC1) (VAN SWAAY et al. 2011) for its rapid decrease, especially in the Northwest and Central Europe. It also disappeared from a vast area in Northeast Europe (SOMMER et al. 2022).

*C. tullia* mostly inhabits peatlands, but is not strictly tyrphobiontic and can be found in other types of poor fens (for instance MIKKOLA & SPITZER 1983, DENNIS & EALES 1997, PAVLÍČKO & KONVIČKA 2002, HUEMER 2004, SETTELE et al. 2009). E.g., in pre-alps the species prefers managed fens rather than adjoining transition and raised bogs (WEKING et al. 2013). The most important larval hostplants are *Eriophorum vaginatum* L. and other species of *Eriophorum* (*E. angustifolium* L.), it was also reported from other plant genera like *Juncus articulatus* L., *Rhynchospora* spp., *Carex lasiocarpa* Ehrh., *C. canescens* L., *C. limosa* L.,

*C. ovalis* Good., *C. diandra* Schrank, and *Molinia caerulea* (L.) Moench (ASHER et al. 2001, ELIASSON et al. 2005, AARVIK et al. 2009). In a study from Slovenia, ČELIK & VREŠ (2018) found the caterpillars solely on *Trichophorum alpinum*, and in a lesser scale on *Carex lasiocarpa* Ehrh., *C. limosa* L., *C. panicea* L., *C. lepidocarpa* Tausch, and *C. elata* All. PAVLÍČKO (2002) studied habitat preferences of *C. tullia* in the Czech Republic, he mentioned *E. vaginatum* L., as the only host plant of this species from the area, however, other *Eriophorum* species are mentioned in BENEŠ et al. (2002) and all of them also occur there.

The species was in the past known from all major regions in the Czech Republic (BENEŠ et al. 2002). In Southwest Bohemia, the species was reported from these localities before 1950: Mrtvý luh, Pěkná, Peckov, Říhov (Stachy), Vacov (Vlkonice) (VOLDŘICH 1963, HAVEL 1967, KUDRNA 1969, 1971). According to the database “Mapping of Czech Republic butterflies” [“Mapování motýlů České republiky”] run by Biology Centre Czech Academy of Sciences, the species was known also from these sites: Blažejovice, Borová Lada, Čábuze, Černý Kříž, Dobrá, Chalupská slat, Chlum, Jezerní slat, Kapličky u Vyššího Brodu, Klenovice, Knížecí Pláně, Knížecí Stolec, Křišťanov, Křišťanovice, Lenora, Milíkov, Pěkná and Stožec. However, after 1960, the species strongly declined so that it is now only known from two isolated populations in the Třeboň basin (Borkovická blata and Ruda National nature reserve) and several localities in Šumava National Park and Šumava Protected Landscape Area.

The aim of this work was to revise the current distribution of *Coenonympha tullia* in Šumava Mountains and the status of its populations.



**Fig. 1.** Map of the area with old records of *Coenonympha tullia* (circles), our explored areas (black polygons), and recorded individuals of *C. tullia* (red triangles).

## METHODS

### Study area

During the main flight season of the focal species (June 22–July 5, 2021) and ideal butterfly weather and time (sunny or partly cloudy, no wind, 15–25°C, between 10:00–16:00), we visited all potential sites as well as other surrounding marshes and fens in Šumava National Park, from where either *C. tullia* or its main host plant, *Eriophorum vaginatum* L., were reported in the past (BENEŠ et al. 2002, AOPK ČR 2022), or the habitat suitable for the butterfly was present. In total, we investigated 33 sites (Table 1, Fig. 1). We thoroughly searched each site for the presence or absence of *C. tullia*, and if the species was present, we counted the amount of seen individuals. Furthermore, we recorded other species of Lepidoptera, i.e. butterflies and day-flying moths (Lepidoptera: Papilionoidea, Geometroidea, Noctuoidea).

## RESULTS AND DISCUSSION

We recorded the presence of *Coenonympha tullia* at 10 sites out of 33 surveyed localities (Table 1, Fig 2.). In total, we encountered 200 individuals, 162 males and 38 females. All positive records were from the raised bogs of Vltavský luh (i.e., Teplá Vltava valley) with one exception – Splavské rašeliniště near Strážný. The highest amount of *C. tullia* (>50) was found in Mrtvý luh and Záhvozdí 4, followed by Splavské rašeliniště, Malý luh and Malá Niva (exceeding >10 individuals). All these sites were characterized by a high presence of *E. vaginatum*, but also a high amount of shrubby vegetation (*Vaccinium uliginosum*, *Erica vulgaris*) and small to middle-sized shrubs or trees of *Pinus rotundata*. Contrarily, the species was not recorded at the localities with open water surfaces. The absence of open water surfaces agrees with the findings by JOY & PULLIN (1997). It is obvious that the complexity of habitat plays the crucial role in survival not only for *C. tullia* (WEKING et al. 2013) but also for other species of threatened butterflies (for instance KONVIČKA et al. 2003, or more generally DENNIS 2020). In the case of Šumava as suitable biotopes were evaluated open raised bogs and *Pinus rotundata* bog (CHYTRÝ et al. 2001) with a relatively high shrub cover. River floodplains of Vltavský luh are important ecotones between terrestrial and freshwater ecosystems (HOLLAND et al. 1991), moreover, they represent a suitable habitat not only for threatened plants (BUFKOVÁ et al. 2005) but also for invertebrates (JAROŠ et al. 2014).

The occurrence of *C. tullia* was accompanied by several species, whereas dominated species are, namely *Callophrys rubi* (Linnaeus, 1758) and *Agriades optilete* (Knoch, 1781). However these species usually occur on sites with older stages of the vegetation succession or in open pine forests with large covers of *Vaccinium* spp., possibly indicating successive degradation of the *C. tullia* habitats in Šumava (see BENEŠ et al. 2002). The co-occurrence of these species therefore can rather be seen as warning sign and not as typical assemblage for indicating suitable *C. tullia* habitats.

As a species of humid habitats, *C. tullia* is threatened by landscape changes like wetland drainages, land abandonment, or even afforestation (HANČ et al. 2019). Habitat degradation is the main driver of the species decline also on the European level (VAN SWAAY et al. 2006) and habitat loss caused the extinction of the species along the northern margin of the species distribution (FRANCO et al. 2006). On the other hand, the larval stages suffer from increasing

**Table 1.** Overview of localities surveyed for the presence of *Coenonympha tullia*. We show the actual number of recorded individuals.

Locality name	Presence of <i>C. tullia</i>	Latitude	Longitude
Bělá	0	48.801876	13.953196
Brod	0	48.840570	13.927400
Březina	0	48.897794	13.847788
Houska - okraj	1	48.810498	13.940521
Chalupská slat'	0	48.997150	13.658900
Chlum 1	0	48.856950	13.908921
Chlum 1b	0	48.859448	13.905460
Chlum 3	4	48.859000	13.902393
Chlum 4	0	48.861079	13.901361
Chlum 5	0	48.864990	13.893878
Jezerní slat'	0	49.040855	13.571615
Malá Niva	12	48.915758	13.815752
Malý luh	20	48.884772	13.858603
Malý luh env.	1	48.886444	13.858088
Malý Polec	0	49.065495	13.613559
Mrtvý luh	61	48.867696	13.879331
Pěkná – zastávka 2	0	48.808843	13.940210
Pěkná – zastávka 4	0	48.850806	13.913714
Pěkná 1	0	48.843031	13.929851
Pěkná 2	0	48.847149	13.932241
Pěkná 3	0	48.855489	13.912181
Soumarský most	5	48.902282	13.837758
Spálený luh	0	48.843810	13.791490
Splavské rašeliniště	29	48.893610	13.737000
Velká Niva	0	48.925382	13.823071
Záhvozdí	13	48.828759	13.940151
Záhvozdí 2	0	48.834981	13.944206
Záhvozdí 3	0	48.834810	13.940350
Záhvozdí 4	55	48.839300	13.933650
Želnavá	0	48.807750	13.952769
Želnavá 2	0	48.808671	13.950391
Želnavá 3	0	48.817951	13.949276
Želnavá 4	0	48.819206	13.948998



**Fig. 1.** A) Large heath (*Coenonympha tullia*) and B) the Mrtvý luh (photo: Z.F. Fric).

water levels, which is frequently used for wetland restoration, and the larvae are unable to survive water submergence (JOY & PULLIN 1997). In general, habitat quality seems to be more important than its isolation for the species survival (DENNIS & EALES 1997), which can be documented also by long-term persistence in completely isolated localities, in our case in the Třeboň basin. On the other hand, due to the low mobility of the species (EBENHARD 1995) isolated populations in the Třeboň basin and several other localities in Šumava National Park are more likely than others to be extinct.

## CONCLUSIONS AND MANAGEMENT RECOMMENDATIONS

*Coenonympha tullia* still survives in Šumava National Park in several populations including likely viable ones (especially Mrtvý luh, Malý luh, Záhvozdí 4 and Splavské rašelině). Other populations are small. Many past populations apparently disappeared due to succession or afforestation. From a long-term perspective, the situation is critical – one local disaster (drought, windstorm, flood) may deteriorate the whole population. The vegetation succession could act as the most serious threat, together with the effects of low water level either due to drought or high water level caused by nearby beaver activities. Thus, it is urgent to conduct a detailed study of the species' preferred habitat structure, behavior, individual movements, and spontaneous dispersal abilities. This will help us to elaborate a proper species support strategy and restore remaining occupied habitats to save the species from local extinction.

The present study is a first step for a following detailed research about *C. tullia* population structures, dispersal abilities and other species' performances.

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