

**The first observation of *Euphydryas aurinia* (Lepidoptera,  
Nymphalidae) developing on *Gentiana cruciata* in Lithuania**

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**ABSTRACT.** A population of the endangered butterfly Marsh Fritillary *Euphydryas aurinia*, using exclusively *Gentiana cruciata* as a larval food plant, was recorded for the first time in the valley of the Dūkšta river (Vilnius administrative district) in Lithuania. Caterpillars were observed both in summer when they lived gregariously in numerous webs spun on gentians, and in spring when they were feeding on new shoots or basking in the sun. The butterfly is considered as dependent on *Succisa pratensis* in Central and Northern Europe, therefore our finding is unexpected. Other plants including other *Gentiana* species are reported as locally used only in Southern Germany, Switzerland and Spain. *Phengaris 'rebeli'* a well known butterfly related to *G. cruciata* occurred sympatrically with *E. aurinia* at the Lithuanian site.

**KEY WORDS:** *Euphydryas aurinia*, *Gentiana cruciata*, Lithuania, endangered species, host use.

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INTRODUCTION

Marsh Fritillary *Euphydryas aurinia* (ROTTEMBURG, 1775) is a threatened butterfly species, also included in Annexes II and IV of the Habitats Directive, and in Appendix II of the Bern Convention (VAN SWAAY & WARREN 1999). The distribution range of *E. aurinia* encompasses most of Europe, temperate Asia and North Africa (TOLMAN & LEWINGTON 1997). It is declining in many countries and has become extinct in Belgium and in the Netherlands (KUDRNA 2002). Because of morphological and ecological variability several

subspecies are recognized e.g. the most widespread ssp. *aurinia*, ssp. *debilis*, ssp. *beckeri*, which in the past were even raised to the species level. Several different kinds of biotopes are used. In Central and Northern Europe *E. aurinia* is considered as a hygrophilous butterfly. To the south it is increasingly encountered on dry, calcareous grasslands. Open woodland is also mentioned (WARREN 1996).

The butterfly is univoltine and imagines are on the wing between May and August depending on latitude, altitude and micro-habitat (WARREN 1996). Females lay their eggs in batches on the underside of the leaves of host plants. After hatching, larvae feed gregariously within a communal web and in the fourth instar they overwinter in a small hibernaculum, usually close to the ground. In early spring caterpillars can be observed basking communally, which enables them to raise the temperature of their bodies and therefore accelerate development (PORTER 1984). They disperse in their fifth instar and feed solitarily by their sixth (final) instar. Finally they pupate close to the ground, usually on plant stems (WARREN 1996).

*Succisa pratensis* (Dipsacaceae) is the most important food plant of the butterfly across the European species range. In western and southern Europe some other plants were also recorded, especially: *Knautia*, *Scabiosa*, *Cephalaria* (Dipsacaceae), *Lonicera*, *Symphoricarpos* (Caprifoliaceae) and *Gentiana* (Gentianaceae). *Centaurea* (Asteraceae), *Plantago* (Plantaginaceae), *Veronica*, *Digitalis* (Scrophulariaceae), *Viola* (Violaceae), *Teucrium* (Lamiaceae) and *Primula* (Primulaceae) are also mentioned (WARREN 1996, MUNGUIRA et al. 1997, TOLMANN & LEWINGTON 1997, VAN SWAAY & WARREN 1999, ANTHES et al. 2003, SAARINEN et al. 2005, STEFANESCU et al. 2006). However particular populations are usually monophagous. For instance, in Catalonia (north-east Spain) most populations in typical Mediterranean habitats develop on *Lonicera implexa* (STEFANESCU et al. 2006).

WAHLBERG (2001) found out that plants belonging to Dipsacaceae, Caprifoliaceae, and Gentianaceae families contain secondary compounds known as seco-iridoid glycosides. It was also observed that leaves bearing eggs have greater concentrations of those chemicals than other leaves - this was probably induced by oviposition. It may suggest that iridoids are either sequestered by larvae for their own defence or are helpful in avoiding competition from generalist herbivores (PEÑUELAS et al. 2006).

In Lithuania *E. aurinia* is a very local species, though sometimes its populations can consist of hundreds of individuals. In many localities populations suffer a high level of fragmentation. *E. aurinia* is usually found in natural and semi-natural moist or wet oligotrophic grasslands (purple moorgrass and heath rush meadows), and alkaline fens, mostly in Eastern, North-Western and Central Lithuania, where *S. pratensis* is abundant. Inhabited patches are frequently situated along woodland edges or surrounded by bushes. Good insolation of habitat is preferable. The species is not found in Southern Lithuania where sandy soils predominate or in South-Western Lithuania where agriculture is very intensive. Up to 150 localities in which *E. aurinia* was found are registered in Lithuania, but some of the information is outdated (ŠVITRA 2009). Knowledge on the distribution of the species is insufficient, and many populations probably are remain undetected.

In this contribution we describe observations carried out on one newly discovered Lithuanian population, which turned out to be very unusual as far as larval food plant was concerned.

## RESULTS

The site is localised in the Dūkšta river valley near Rusėnai, in the Dūkštos environs, Vilnius administrative district (54°49'59"N, 24°58'09"E). The habitat can be described as gentle clay based dry slopes exposed to south, southeast and east with meso-thermophile grasslands (Fig. 1a). The slopes are in close vicinity to wet tall-grass meadows of different types.

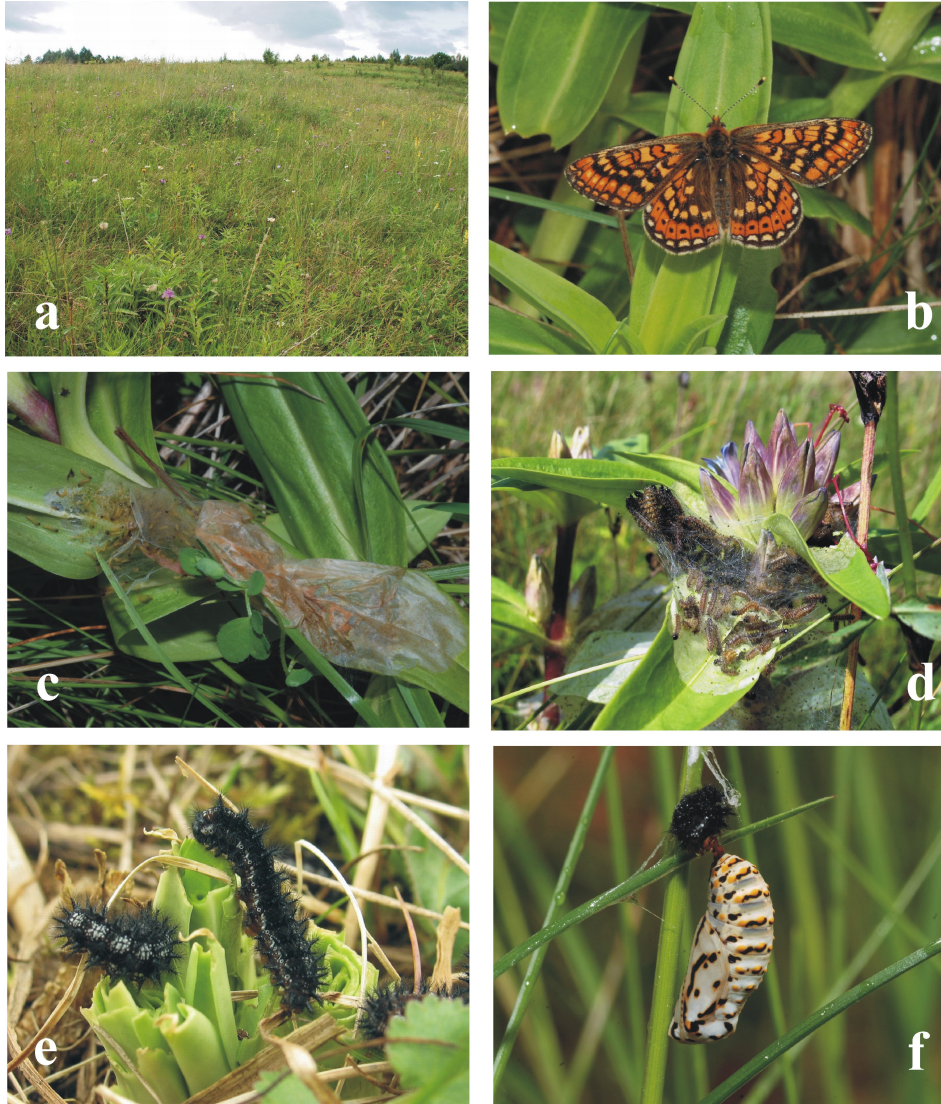
The population of *E. aurinia* was discovered accidentally during inventory work on another rare butterfly species *Phengaris 'rebeli'* (ecotype of *P. alcon*), whose females oviposit on the flowerheads of *Gentiana cruciata* growing numerously at this locality. On 3 August 2007 when gentians were searched for eggshells of *P. 'rebeli'*, several silken webs were found with hundreds of young caterpillars of *E. aurinia* inside, entirely covering the shoots (Fig. 1d). Checking the site on 19 April 2008, about 30 third instar larvae of *E. aurinia* were observed over an area of about 800 m<sup>2</sup>. They were basking in the sun in small groups of 2-8 or grazing the young shoots of gentians (Fig. 1e). Nearby individuals of *G. cruciata* were strongly gnawed or grazed to ground level. On 9 June 2008 several imagines were observed at the site.

In order to prove that feeding on gentians was not an accidental case for *E. aurinia* in this location we checked the site on 9 July 2008. As expected, we found tens of new, not very conspicuous, silky webs on gentians containing hundreds of caterpillars (Fig. 1c), over an even more vast area than in the previous year. On 24 May 2009, after some attempts, we found several last instar caterpillars, two pre-pupae, two pupae (Fig. 1f) and about 10 newly emerged imago butterflies of *E. aurinia* (Fig. 1b), covering almost all the area with *G. cruciata*.

## DISCUSSION

Though in Lithuanian publications besides *S. pratensis* there are references to *Scabiosa columbaria*, *Knautia arvensis*, *Plantago* and *Veronica* as the foodplants for *E. aurinia* (KAZLAUSKAS 1984, IVINSKIS & AUGUSTAUSKAS 2004, IVINSKIS 2004, RAŠOMAVIČIUS 2007), these should be treated as citations from foreign bibliographic sources, for no direct observations of caterpillars feeding on these plants in Lithuania have ever been published.

The fact that *E. aurinia* in some localities can use plants other than *S. pratensis* is interesting and new for Lithuania and for a large part of central and northern Europe. *S. pratensis* is recorded as the only food-plant for caterpillars in Poland (BUSZKO & MASŁOWSKI



**Fig. 1.** The site of *Euphydryas aurinia* in the Dūkšta river valley in Lithuania where *Gentiana cruciata* is used exclusively as a host plant: **a)** general view (9 July 2008), **b)** a female basking on its larval food plant (late May 2009), **c)** and **d)** larvae (9 July 2008 and 3 August 2007 respectively) feeding in common webs on leaves of *G. cruciata*, **e)** larvae feeding on young shoots of host-plant (19 April 2008), **f)** a pupa found in the neighbourhood of gentians (24 May 2009).

2008), Denmark (SIGAARD et al. 2008), Estonia (T. TAMMARU, pers. comm), Latvia (N. SAVENKOV, pers. comm.), Finland (WAHLBERG et al. 2002) and in the Czech Republic as well (HULA et al. 2004). In the UK *K. arvensis* and *S. columbaria* are also occasionally used (ASHER et al. 2001). In Sweden *S. pratensis* is the only plant on which oviposition was observed. There are some indications that caterpillars can feed temporarily on other plants after hibernation while waiting for fresh *Succisa* foliage, especially *Valeriana sambucifolia* (ELIASSON et al. 2005). It is possible that some literature records of plants belonging to various families eaten by larvae relate only to spring feeding (and not to oviposition).

Moreover the observation of *G. cruciata* as a larval food plant of the butterfly is novel on a global scale, as this gentian to our knowledge has never been recorded as a host of *E. aurinia*. The nearest records of *Gentiana* species used by the butterfly concern the northern pre-alpine region of south-west Germany where *G. asclepiadea* is eaten by caterpillars besides *S. pratensis* (ANTHES et al. 2004). The Alpine subspecies *E. aurinia debilis* uses exclusively *G. clusii* and *G. acaulis* in Switzerland. However, *G. lutea* is mentioned as a host along with *S. pratensis* and *S. columbaria* for *E. aurinia aurinia* in the same country (SBN 1987). Other gentians i.e. *G. kochiana* and *G. alpina* are also reported by WARREN (1996) as far as *E. a. debilis* is concerned.

Use of *G. cruciata* as a local host suggests the existence of races of *E. aurinia* in Lithuania and northern Europe with different host plant preferences. However it remains unknown whether gentians would be preferred in the case of the simultaneous presence of *G. cruciata* and *S. pratensis*. *E. aurinia* using *Cephalaria*, *Lonicera* and *Gentiana* strongly preferred the 'foreign' *Succisa* over their own hosts (SINGER et al. 2002). Sympatricity of *G. cruciata* and *S. pratensis* is generally a rare phenomenon because of different habitat preferences i.e. damp versus dry calcareous grasslands. This kind of coincidence is observed for instance in Poland in the Brzeźno natural reserve near Chełm (Polesie region), where *G. cruciata* overgrows patches of raised dry land surrounded by *Molinion* meadows and fens (SIELEZNIEW & STANKIEWICZ 2004). However we have never observed *E. aurinia* developing on any plant species other than *S. pratensis* there.

There are at least two hypotheses on the origin of the presently studied Lithuanian population. 1) In the past some individuals shifted to *G. cruciata* because of the disappearance of *S. pratensis* from nearby damp areas because of overgrowing or other habitat changes. 2) The site was successfully colonised from a more distant population, which originally used *S. pratensis*. To our knowledge there are no other populations of *E. aurinia* nearby at the moment. However it should be mentioned that the history of detailed lepidopterological studies in Lithuania is relatively short and inventory gaps still exist. In future research it would be interesting amongst other things to analyse the genetic differentiation of *E. aurinia* populations which use *S. pratensis* or *G. cruciata* e.g. with the application of microsatellite markers, which were recently successfully implemented in studies of the butterfly (SIGAARD et al. 2008). It may also shed light on the issue of the origin of this regionally atypical butterfly-plant relationship.

There are also important conservation issues related to *E. aurinia*. The species is declining in Lithuania due to natural succession of their habitats after the change of agricultural policy in 1990 when traditional extensive haymaking and grazing decreased or stopped. Some of the habitats were destroyed during the change of land use, e.g. ploughing up or afforestation of meadows.

KONVIČKA et al. (2003) found out that at *S. pratensis* stands, nests of *E. aurinia* (thus also oviposition places) were positively associated with a high cover of the host-plant and of short grasses. Short sward facilitates larval basking and therefore the warm Lithuanian locality favours the development of *E. aurinia*. Light grazing is optimum management for *E. aurinia* (SAARINEN et al. 2005) and small scale sod disturbance facilitates germination of the larval food plant (KONVIČKA et al. 2003). Interestingly this kind of management also promotes *G. cruciata* (and *P. 'rebeli'*). However we have no data about the oviposition preferences of *E. aurinia* at this unique site and therefore any possible future intensifications should be introduced very carefully.

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