

***Fagivorina arenaria* (Geometridae, Lepidoptera) endangered species of preserved mountain beech forests: new records from the Czech Republic**

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Abstract: We summarize the published data on occurrence of *Fagivorina arenaria* (Hufnagel, 1767) in the Czech Republic. The species belongs to the European endangered moths. It occurs only very locally and rarely in the Czech Republic. Published records come mainly from the border mountain ranges. Newly we present records from the Beskydy Mts. and the Hrubý Jeseník Mts. On the basis of our observations and published data, *F. arenaria* can be considered as a representative species of preserved mountain herb-rich beech forests. Due to the very local occurrence of the species, particular associations with mountain primeval forest and decline from some former localities, we argue that the species should be listed in the Red List of Invertebrates of the Czech Republic in the higher categories of threat, i.e. endangered or critically endangered.

Key words: conservation status, faunistic, Moravia, primeval forest, Silesia

Introduction

Fagivorina arenaria (Hufnagel, 1767) (Lepidoptera: Geometridae) belongs to species with a European range of distribution, extending from southern Scandinavia to Italy (incl. Sicily) and from southern England to the Balkan Peninsula (incl. parts of Greece and Albania). Throughout its quite wide range, *F. arenaria* is an endangered species. It is disappearing from many previously known localities, especially in the northern and northwestern parts of its areal (Müller et al. 2019). It is therefore included in a number of European red lists, e.g. Poland (Głowaciński 2002), Austria (Huemer et al. 1994), Germany (Trusch et al. 2011), Scandinavia (Tingstad et al. 2017), Romania (Rákossy et al. 2003), and is extinct in England (Fox et al. 2006). In the Czech Republic, it is considered a very local and rare species. It is listed in the Red List of Invertebrates of the Czech Republic (Hejda et al. 2017) in the category “near threatened”.

The species has a single generation during a year (bivoltine in the southern part of its range; Müller et al. 2019). It inhabits mainly primeval moist beech forests or mixed mountain forests with old beeches (Macek 2012), occasionally also old light lowland oak forests (Mack 1985). The forests habitats are typically sparse, over-aged, age-differentiated, with a moist microclimate, tree lichens and often on north-facing slopes (Wegener 2013). Young leaves of beech (*Fagus sylvatica*), oak (*Quercus petraea* and *Q. robur*) and birch (*Betula pendula*) are reported as the host plants (Urbahn 1941; Wegner 2013). According to records from Baden-Württemberg (Germany), *F. arenaria* inhabits forests at altitudes of about 200 to 1000 m a.s.l., in the Alps up to the 1500 m and in Italy it can exceptionally reach 2000 m (Müller et al. 2019). Most of the registered records from Central Europe are from montane areas above 500 m a.s.l. (Ebert 2003).

The aim of the study is to summarize the existing papers recording the occurrence of *F. arenaria* in the Czech Republic, and provide new information on the distribution of the species in northern Moravia and Silesia. At the same time, we try to characterize the typical habitat and the conservation status of the species in the Czech Republic.



Fig. 1: Male of *Fagivorina arenaria* (Hufnagel, 1767), Dolní Bečva, Radhošť Mt., 3.vi.1983 (photo J. Sitek).

Distribution of the species in the Czech Republic

In the Czech Republic, the species is recorded mainly from the Czech border mountains. The first records from Bohemia are summarized in Sterneck (1929). During the late 19th and early 20th century, the species is listed from Mníšek pod Brdy, Trocnov, Sobotka, Frýdlant, Karlovy Vary and Mariánské Lázně (Sterneck 1929). More recent records originate from the Slepíčí hory Mts. (Jaroš 1984), Jizerské hory Mts. (e.g. Jizerskohorské bučiny National Nature Reserve: Soffner 1924; Krampl & Marek 1999, 2003), Novohradské hory Mts. (Žofínský prales National Nature Reserve, Myslivna Nature Reserve: Jaroš & Spitzer 2004; Šumpich 2011), Šumava Mts. (e.g. Smrčina Mt., Stožec Mt., Strážný Mt.: Novák & Spitzer 1972; Krampl 1973; Šumpich & Černý 2010) and the Blanský les Mts. (Klet' Mt.: Krampl 1973). From the Polish part of the Krkonoše Mts. (Jagniątkow env.), the species was recently recorded by Chrzanowski (2002).

There are considerably fewer published records from Moravia. During the late 19th and early 20th century, the species was reported from Brno (Skala 1912–1913), Dražanská vrchovina Highlands (Ferdinandsko: Skala 1931) and the Moravian Karst (Křtiny: Skala 1931; cf. Laštůvka & Marek 2002). In the 1980s, *F. arenaria* was reported from the Chřiby Mts. (Salaš: Králíček & Gottwald, 1987) and the Beskydy Mts. (Radhošť Mt.: Sitek 1984). Recent records came only from the Českomoravská vrchovina Highlands (Rožtnýnská obora Nature Reserve: Šumpich et al. 1999; Žákova hora National Nature Reserve: Šumpich 2017).

In the Czech part of Silesia, only one old unspecified record of the species can be found from the Hrubý Jeseník Mts. (= Altvatergebirge, Wocke 1872). There are no more recent published records from this area.

Here we present new records of *F. arenaria* from Moravia and the Czech part of Silesia:

Moravia

Dolní Bečva (6575a), 3.vi.1983, on light, 1 ♂, J. Sitek leg. et coll.; 3.vii.1992, on light, 2 ♂♂, J. Sitek leg. et coll.; 10.vii.1993, on light, 3 ex., J. Sitek observ.

Note: southern slope of the Radhošť Mt. (49°28'30"N, 18°13'8"E), ca. 670 m a. s. l., birch forest and adjacent herb-rich beech forest (habitat L5.1, *sensu* Chytrý et al. 2010).

Silesia

Ludvíkov pod Pradědem (5869d), 8.vii.2023, UV light trap, 1 ♂, J. Beneš & L. Spitzer leg., J. Beneš det. et coll.

Note: Jelení bučina Nature Reserve (50°6'42"N, 17°17'56"E), 910 m a. s. l., herb-rich beech and ravine forests (habitat L4 and L5.1).

Loučná nad Desnou – Rejhotice (5969a), 24.vi.2022, UV light trap, 1 ♂, J. Kašák leg., J. Beneš det. et coll.

Note: Bučina pod Františkovou myslivnou Nature Reserve (50°3'23"N, 17°11'47"E), 1150 m a. s. l., montane sycamore-beech forests (habitat L5.2).

Dolní Lomná (6477d), 10.vi.1993, on light, 3 ex., J. Sitek observ.

Note: Mionší National Nature Reserve (49°32'19"N, 18°39'44"E), ca. 780 m a. s. l., herb-rich beech primeval forest (habitat L5.1).



Fig. 2: Habitat of *Fagivorina arenaria*, beech forest in the Jelení bučina Nature Reserve (photo L. Spitzer, 8.vii.2023).

Discussion

The recent (after 2000) occurrence of *F. arenaria* in the Czech Republic is restricted to the Jizerské hory Mts., Šumava Mts., Novohradské hory Mts., Českomoravská vrchovina Highl., and Hrubý Jeseník Mts. Individuals of the species have always been recorded only sporadically (see Krامل & Marek 2003; Jaroš & Spitzer 2004; Šumpich & Černý 2010; Šumpich 2017; *pers. observ.*). The species is more widespread in the western half of the country (especially in the southern and northern Bohemia), whilst published records from Moravia are absent after 2000. In Silesia the species has been recently found only in the Hrubý Jeseník Mts. The occurrence in the Moravian Karst, Chřibý Mts. and the Bílé Karpaty Mts. has not been documented again, although entomological surveys have been conducted there (cf. Laštůvka &

Marek 2002; Gottwald & Bělin 2001; Spitzer & Beneš 2023; *pers. observ.*). The last records from the Beskydy Mts. date back to the end of the 20th century. Therefore, we assume that this species became locally extinct in some Moravian localities during the last century.

The localities where *F. arenaria* was sampled belong to montane deciduous forests. In the majority, it was the herb-rich beech forest (L5.1; *sensu* Chytrý et al. 2010). Most of these are areas of high natural importance and protected as primeval forest nature reserves. However, the association of the species to the habitat will be more complex. Not only the host plants, but also the different age structure of the forest and the general quality of the environment will be drivers of the species' occurrence (see Ebert 2003; Weggener 2013). For example, some authors suggest a significant relationship between *F. arenaria* and the presence of tree lichens as resting sites for imagoes. Due to their wing coloration pattern, cryptic on the background of lichens, imagoes can escape the attention of the visually oriented predators (Bergmann 1955; Lechner 1999; Wegener 2013). Laboratory breeding experiments indicate that *F. arenaria* caterpillars require a higher humidity during their development (Wegener 2013). Such conditions occur particularly in primeval forests.

We can conclude that *F. arenaria* belongs to the rare species of the Czech Republic. Its presence indicates mainly preserved mountain deciduous forests of the primeval nature. Unfortunately, it seems that the species has been declining from the Czech Republic during the 20th century, especially from the regions at lower elevations. The reasons for the local extinction of *F. arenaria* are definitely related to intensive forest management, clear-cutting of primeval deciduous forests and their replacement by monocultures of mainly conifers (da Silva et al. 2019). Nor we can exclude the negative effects of climate changes on isolated populations of the species, in recent decades (see Linder et al. 2010). Therefore, we suggest that *F. arenaria* should be considered endangered and declining species in the Czech Republic. Hence, we recommend changing the conservation status of the species in the red List of Invertebrates of the Czech Republic (Hejda et al. 2017) from current “near threatened” to “endangered” or “critically endangered”.

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