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Phenology, distribution and first observation of the larva of the rare stink bug *Dybowskyia reticulata* (Hemiptera: Heteroptera: Pentatomidae) in Europe

Fenológia, rozšírenie a prvý nález larvy bzdochy svarínskej (*Dybowskyia reticulata*) (Hemiptera: Heteroptera: Pentatomidae) v Európe

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Central Europe, Slovakia, Podopinae, phenology, distribution modelling, Red List

Abstract. A new and remarkable record of a 5th instar larva of the extremely rare stink bug *Dybowskyia reticulata* (Dallas, 1851) is presented from Europe. A chronological overview of all European records of the species is provided and discussed in the context of its Palaearctic distribution, together with an evaluation of the species' phenology, notes on its biology and modelling of its potential area of current occurrence in Europe. Additionally, an update to the current Slovakian Red List is suggested.

INTRODUCTION

The stink bug *Dybowskyia reticulata* (Dallas, 1851) (Hemiptera: Heteroptera: Pentatomidae: Podopinae: Tarisini) is considered a Palaearctic species, which is common in the eastern parts of the region, specifically in Northeast China, the Korean Peninsula, Japan and the Russian Far East (Dallas 1851; Scott 1874; Horváth 1879a,b, 1917; Distant 1883; Uhler 1897; Schouteden 1905; Mitsuhashi 1915; Hoffmann 1932; Ookubo 1937; Kiritshenko 1951; Yang 1962; Miyamoto 1970; Miyamoto & Yasunaga 1989; Ren 1992; Hua 2000; Kwon et al. 2001; Hayashi & Ozaki 2004; Rider & Zheng 2005; Rider 2006; Vinokurov et al. 2010; Lim & Lee 2012; Lee et al. 2013; Shen et al. 2014; Hayashi et al. 2016). However, it is one of the rarest true bugs in Europe, with only a limited number of records from the western part of its range, all based on adult specimens. Records from European Russia (Stark 1926, Kiritshenko 1951) represent the first known European records of the species. In Central Europe, the species was recorded for the first time from the vicinity of the Slovak village of Svarín (Nízke Tatry Mts.) by Balthasar (1937). He described the specimen as a new genus and species *Svarinella inexspectata*, which was later synonymised with *D. reticulata* by Leston (1955). The second published record from Central Europe was also from Slovakia. Stehlík (1970) reported *D. reticulata* from the vicinity of Šumivý prameň (Belianske Tatry Mts.).

Subsequently, the species was also observed in other European countries: Austria in 1971 (Rabitsch 2000), Bulgaria in 1972 (Štusák 1976), Estonia in 1987 (Coulianos 2003), Slovenia

in 1989 (Gogala 1991) and Finland in 2001, 2003 and 2005 (Albrecht et al. 2003, Rietschel 2006), always as single specimens. Very few records are known from the central parts of the Palaearctic region, specifically from Kazakhstan (Esenbekova 2013), West Siberia (Balakhonova 1998), and East Siberia (Kiritshenko 1951, Kanyukova & Vinokurov 2009). There is even one isolated record from Yunnan Province (Southwest China) (Zhang 2011). Due to the small number of records of *D. reticulata* from Europe relative to its common occurrence in the north-eastern Palaearctic Region, the vast majority of information about its biology and development is from Japan, where the species is univoltine or bivoltine and overwinters as an imago (Kobayashi 1951, 1965; Nakamura & Numata 1997, 1998; Numata 2004). Larvae of *D. reticulata* feed on seeds of plants from the family Apiaceae (Stichel 1962), in Japan especially on *Torilis japonica* and *T. scabra* (Kobayashi 1957, Nakamura & Numata 1997).

Our study provides the third record of this rare species from Slovakia and the first documented record of a larva from Europe, together with an evaluation of the distribution, phenology of the species and modelling of its area of current occurrence in Europe.

MATERIAL AND METHODS

Material. The material was collected using a sweep net. After killing, it was mounted by gluing onto a card, and deposited in the private collection of Vladimír Hemala. Later, it was identified based on literature (Josifov 1981, Kobayashi 1951) and compared with older material from the Moravian Museum (MMBC). Photographs of selected specimens were taken using a Canon MP-E 65 mm macro lens attached to a Canon EOS 6D camera and stacked from multiple layers using the Helicon Focus 5.1 Pro software.

Collecting site. The Svarínska dolina Valley is a long valley (ca. 10 km) situated on the northern slopes of the Kráľovohoľské Tatry Mts., in the eastern part of the Nízke Tatry Mts. The altitude in the valley ranges from 700 m a.s.l. at the beginning (Svarín village) up to 1727 m a.s.l. at the end of the valley (Veľký bok Mt.) (Krištof et al. 1996). After World War I, a road was built there, which is now asphalted (Krištof et al. 1996). The Svarínka stream flows through the entire length of the valley. Our specimens were only collected in its initial part in the herbaceous vegetation near the edge of the forest and near the Svarínka stream. The forests in the valley are mostly coniferous (ca. 94% conifers, among them 74% spruce) (Krištof et al. 1996), the deciduous trees are more abundant only along both sides of the Svarínka stream (V. Hemala observ.). The herbaceous vegetation is more-less ruderal (probably a successional stage of the formerly pastured/mown non-forest vegetation) with a relatively rich representation of Apiaceae, e.g. *Aegopodium podagraria*, *Heracleum sphondylium*, *Pimpinella major*, *Chaerophyllum aromaticum*, *Anthriscus sylvestris* and *Daucus carota* (P. Veselý det.). [*Torilis japonica* was not observed]. Some plants from other families were also common, e.g. *Filipendula ulmaria* (Rosaceae), *Achillea millefolium* (Asteraceae), *Artemisia vulgaris* (Asteraceae) and *Tanacetum vulgare* (Asteraceae) (P. Veselý det.). We have on one occasion observed inappropriate landscape management (mulching of herbaceous vegetation ca. 0.5–1.0 m along both sides of the road) at the locality. Despite the fact that we visited the locality several times during August and September 2017 and during September 2018, our specimens of *Dybowskyia reticulata* were only collected during the first visit and we did not find further specimens during later visits.

Distribution and distribution modelling. We have combined all known distribution records based on published literature (Dallas 1851; Scott 1874; Horváth 1879a,b, 1917; Distant 1883; Uhler 1897; Schouteden 1905; Mitsuhashi 1915; Stark 1926; Hoffmann 1932; Balthasar 1937; Ookubo 1937; Kiritshenko 1951; Yang 1962; Miyamoto 1970; Stehlík 1970; Štusák 1976; Miyamoto & Yasunaga 1989; Gogala 1991; Nakamura & Numata 1997; Hayashi & Kishi 1998; Hua 2000; Kwon et al. 2001; Albrecht et al. 2003; Coulianos 2003; Hayashi & Ozaki 2004; Rider & Zheng 2005; Rider 2006; Rietschel 2006; Tomokuni & Hayashi 2006; Zhang 2011; Lim & Lee 2012; Esenbekova 2013; Lee et al. 2013; Shen et al. 2014; Ishikawa et al. 2015; Hosokawa et al. 2016; Hayashi et al. 2016). We geo-referenced the localities using Google maps and constructed complete distribution maps in ArcGIS v. 10.2 (ESRI 2017). The possible area of distribution of *D. reticulata* in Europe was calculated by BIOCLIM modelling in DIVA-GIS (Hijmans et al. 2001) using two bioclimatic variables, Temperature Seasonality [STD x 100] (BIO4) and Annual Precipitation (BIO12), which were selected as the best predictors of an Envelope analysis and high values in Outliers.

Phenology. The differences in phenology between Europe and Asia was calculated from the time (e.g. day and month) and distribution data (e.g. locality and GPS coordinates) extracted from literature (Stark 1926, Ookubo 1937, Kiritshenko 1951, Miyamoto 1970, Stehlík 1970, Štusák 1976, Gogala 1991, Nakamura & Numata 1997, Hayashi & Kishi 1998, Rabitsch 2000, Kwon et al. 2001, Albrecht et al. 2003, Coulianos 2003, Hayashi & Ozaki 2004, Rietschel 2006, Tomokuni & Hayashi 2006, Lim & Lee 2012, Ishikawa et al. 2015, Hosokawa et al. 2016) and museum material (MMBC, NMPC) using the Analysis of variance (ANOVA) in R v. 3.3.3. to test dependence of distribution on latitude or longitude.

Abbreviations. The following abbreviations are used in this article: coll. – collection; L5 – fifth instar larva; spec. – unsexed adult; MMBC – Moravian Museum, Brno, Czech Republic; NMPC – National Museum, Prague, Czech Republic; VHJS – Vladimír Hemala private collection, Jalovec, Slovakia.

REVIEW OF THE RECORDS FROM SLOVAKIA

All the available records of *Dybowskyia reticulata* are reviewed below. For a map of the distribution see Fig. 5.

1. Nízke Tatry Mts., Svarín, 1937, 1 spec., F. Šlégl lgt., coll. NMPC (Balthasar 1937, holotype of *Svarinella inexspectata*; not examined).
2. Belianske Tatry Mts., Šumivý prameň near Tatranská Kotlina village, 850–950 m a.s.l., 7.ix.1967, 1 ♀, P. Lauterer lgt., ex coll. J. L. Stehlík, coll. MMBC (Stehlík 1970; Fig. 1).
3. Nízke Tatry Mts., Svarín, initial part of Svarínska dolina Valley, vegetation with Apiaceae near the Svarínka stream, 700–720 m a.s.l., 9.viii.2017, 1 ♀ (collected dead) 1 L5 (alive), V. Hemala lgt. et det., coll. VHJS (Figs 2–4).

RESULTS AND DISCUSSION

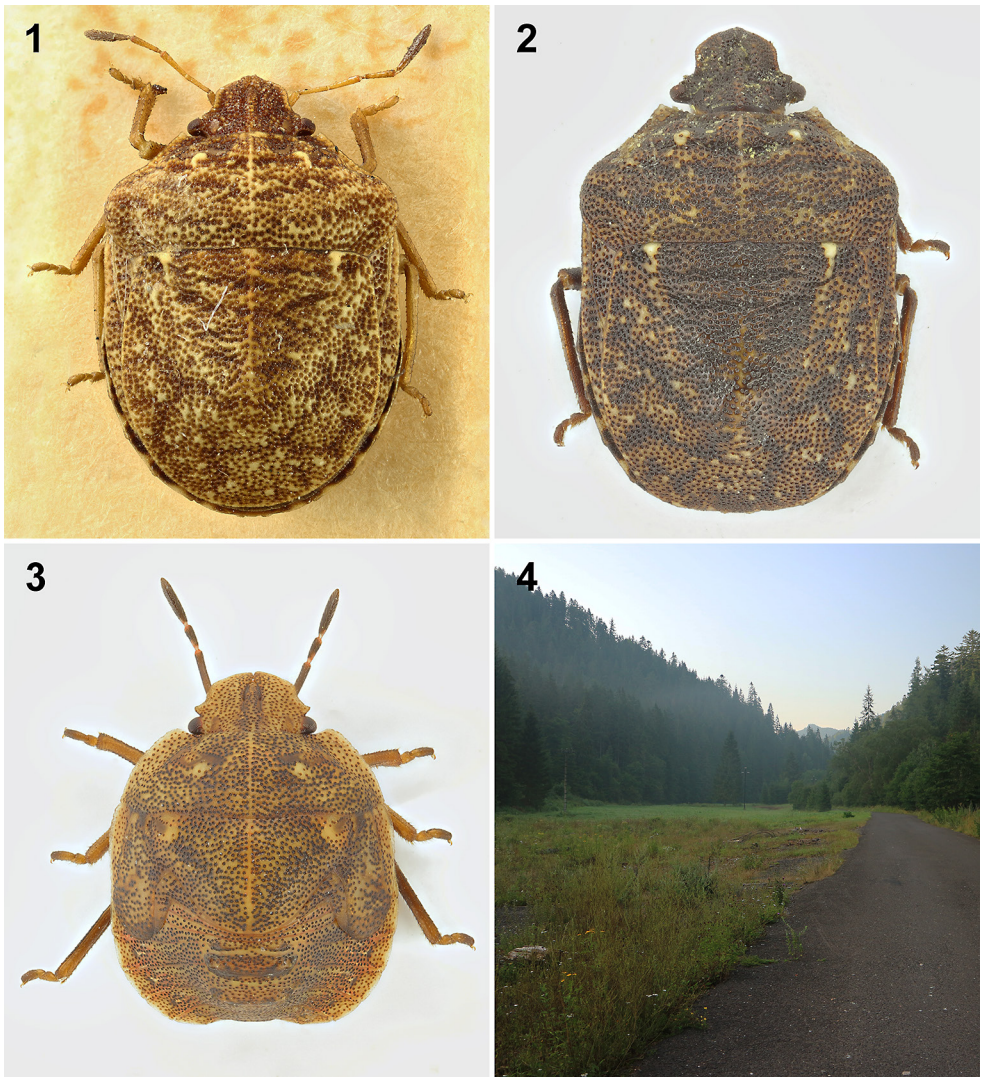
A chronological overview of records of *Dybowskyia reticulata* from Europe is provided (Tab. 1) together with maps of its distribution in Europe and the studied location in Svarín (Figs 5–6). The history of records of *Dybowskyia reticulata* from Slovakia began 80 years ago, when a single adult specimen was found for the first time in Central Europe. At this time it was described as a new genus and species, *Svarinella inexspectata* Balthasar, 1937. Our new record represents the confirmation of occurrence of the species in Slovakia after 50 years (at the same locality even after 80 years) and shows that the Svarín population still exists, despite significant habitat changes and some inappropriate landscape management (mulching, etc.) in the region. This record is very interesting, as *D. reticulata* has only been recorded in seven European countries until now, always from a single adult specimen. However, we assume that the reasons for such rare findings may be: 1) unknown biology (host plants are known only from East Asia) and development (length of ontogenesis as well as period are also known only from East Asia) of the species in Europe, 2) random collection of material where the species was overlooked by collectors who primarily targeted other insect groups, and the specimens remained unrecognized in collections until they were rediscovered later by a specialist, 3) the species may survive in Europe only in relatively small, isolated, climatically suitable refugia, and at low abundance.

Dybowskyia reticulata has a disjunct European-East Asian distribution, with several localities also in Central Asia. From results based on BIOCLIM analysis and all available records it is possible to deduce that the distribution of the species corresponds with the occurrence of closed temperate forests in Europe during the Holocene (Fig. 7). However, values

of Model evaluation results (AUC = 0.585) were not significant because of the low number of distribution records included in the analysis, the Envelope analysis incorporated only 86% of observations as suitable for BIOCLIM analysis. Furthermore, the species could be considered as a boreo-montane element (P. Kment, pers. comm.) with shifts in its altitudinal distribution – e.g. occurrence at low altitudes (sea drifts, dry meadows) in Northern Europe, in contrast to its occurrence at higher altitudes (700–1300 m a.s.l.) in Central Europe and on the Balkan Peninsula. A similar European–East Asian disjunctive distribution as is observed in *D. reticulata* is also found in other rare European true bugs, e.g. the mirid *Polymerus* (*Pachycentrum*) *carpathicus* (Horváth, 1882) (Gapon 2014) or the acanthosomatid *Elasmostethus brevis* Lindberg, 1934 (Kment et al. 2005, Hebda & Gutowski 2017).

Results of the Analysis of variance (ANOVA) highlighted no significant latitudinal (F = 0.2923; Pr (>F) = 0.5915) or longitudinal (F = 0.175; Pr (>F) = 0.8953) patterns in the phenology of *D. reticulata* in the Palaearctic Region, and also no difference between individuals from Europe and Asia (Fig. 8). Most of the records are of adults active from May to August in Europe as well as in Asia, only very few records are known from later in the season (Fig. 8). This corresponds with the findings of Nakamura & Numata (1998), who reported the occurrence of adults from June to the end of August in Japan. Relatively similar patterns of seasonal occurrence are also known in other species of Heteroptera occurring in Europe or/and in Eastern Asia, e.g. in a number of Miridae in Inner Mongolia, China (Shi et al. 2016); in *Palomena prasina* (Linnaeus, 1758) (Pentatomidae) (Saulich & Musolin 1996, 2014a) or in *Coptosoma mucronatum* Seidenstücker, 1963 and *C. scutellatum* (Geoffroy, 1785) (Plataspidae) (Saulich & Musolin 2014b).

We have not detected specimens feeding or even resting on any particular plant species, because our specimens of *D. reticulata* were collected using a sweep net. All the available papers from Europe (Stark 1926, Balthasar 1937, Kiritshenko 1951, Stehlík 1970, Štusák 1976, Gogala 1991, Rabitsch 2000, Coulianos 2003, Albrecht et al. 2003, Rietschel 2006) also lack plant associations. Although, the host plants of *D. reticulata* are unknown in Europe, it is very probable that the species feeds on seeds of Apiaceae as documented in East Asia (e.g. Kobayashi 1957, Stichel 1962, Nakamura & Numata 1997), though only two species of Apiaceae are mentioned as host plants there: *Torilis japonica* and *T. scabra* (Kobayashi 1957, Nakamura & Numata 1997). *Torilis japonica* has a Palaearctic distribution (e.g. Hrouda 1997) similar to *D. reticulata*, but *T. japonica* is present particularly in lowlands and only rarely in cold mountains and higher altitudes of Central Europe (Hlavaček et al. 1984, Hrouda 1997). We did not observe any specimens of *T. japonica* in the Svarínska dolina Valley despite intensive observation of all umbellifer plants at the locality during our visits in 2017 and 2018. *Torilis japonica* has been rarely documented from the surroundings of the High Tatra Mts. and Belianske Tatry Mts. from two localities in the Subtatra Basin (Poprad-Matejovce and Podolínec) (Májeková & Limánek 2016) at altitudes around 560 and 650 m a.s.l. and only ca. 14 and 17 km from the Šumivý prameň locality (Belianske Tatry Mts.) where *D. reticulata* was recorded in 1967 (see Stehlík 1970). Further interesting records of *T. japonica* are also known from Majerova skala Rock in Veľká Fatra Mts. (Slovakia) at an altitude around 1200 m a.s.l. (Lengyel 1915) and from Jizerské hory Mts. (Czech Republic) at an altitude of 840 m a.s.l. (Hrouda 1997). In view of these facts, *Torilis japonica* is a possible host plant of *D. reticulata* in Europe, but this plant, with few exceptions, occurs in other habitats. This situation, when the host plant is rare in suitable habitats, may be one of the important reasons



Figs 1–4. Examined specimens of *Dybowskyia reticulata* (Dallas, 1851) from Slovakia. 1 – adult female from Šumivý prameň in Belianske Tatry Mts. published in Stehlík (1970). 2–3 – adult female (2) and 5th instar larva (3) from Svarínska dolina Valley. 4 – initial part of the Svarínska dolina valley in Nízke Tatry Mts. (Photographs: Luboš Dembický (1), Jiří Procházka (2–3), Vladimír Hemala (4)).

Obr. 1–4. Študované jedince bzdochy svarínskej (*Dybowskyia reticulata* (Dallas, 1851)) zo Slovenska. 1 – dospelá samica z lokality Šumivý prameň v Belianskych Tatrách, údaj publikovaný v práci Stehlíka (1970). 2–3 – dospelá samica (2) a larva piateho instaru (3) zo Svarínskej doliny. 4 – ústie Svarínskej doliny v Nízkych Tatrách. (Fotografie: Luboš Dembický (1), Jiří Procházka (2–3), Vladimír Hemala (4)).

for *D. reticulata* being so rarely collected in Europe. However, it is also possible that the species uses some other host plant in Europe.

Additionally, *D. reticulata* was listed by Štepanovičová & Bianchi (2001) as vulnerable (VU) in the Red List of Heteroptera of Slovakia, despite a complete lack of knowledge about the biology and distribution of the species in the country. Based on the fact that only four specimens from two localities are currently known, we propose to change the status of the species to endangered (EN). This status could also be applicable for the future European Red List of Heteroptera.

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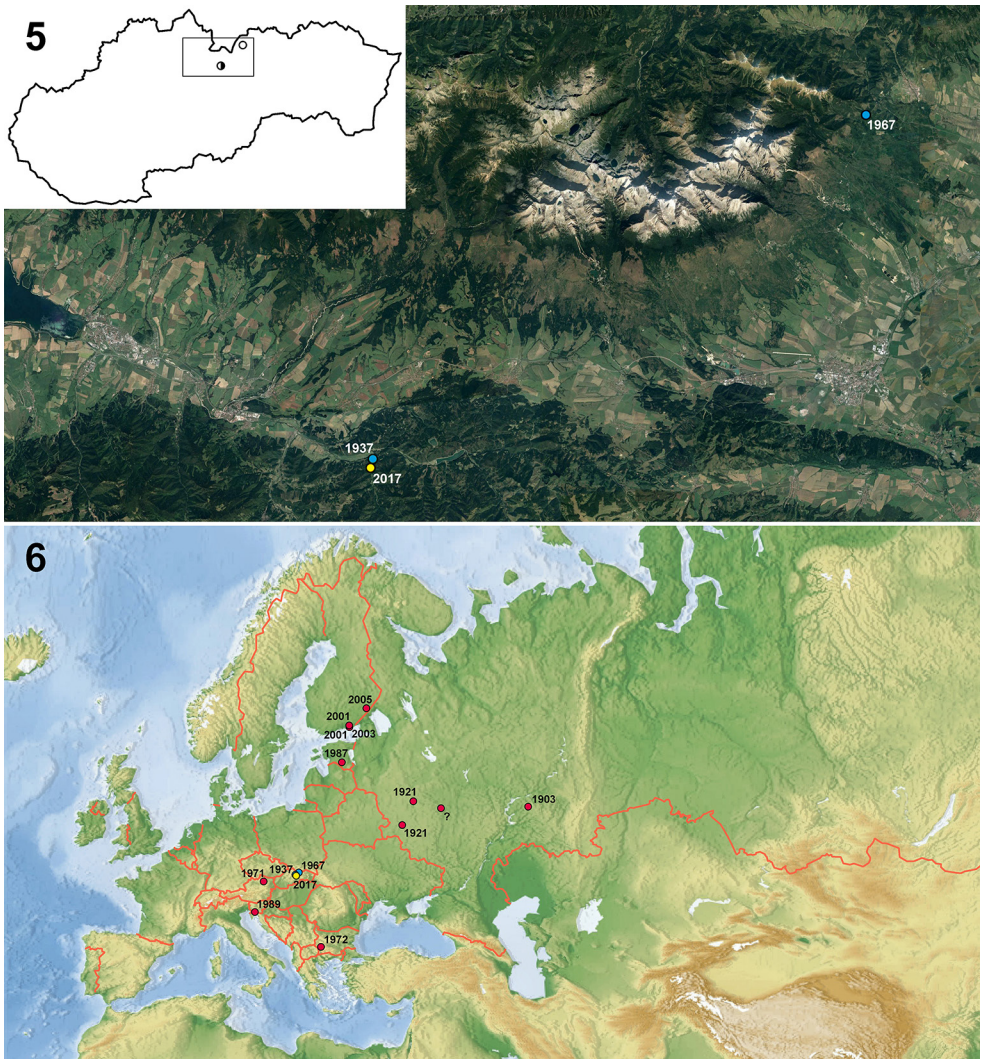
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Figs 5–6. A chronological overview of distribution of *Dybowskyia reticulata* (Dallas, 1851) in Slovakia (Fig. 5) and Europe (Fig. 6) [*yellow* – our records from Svarín, *blue* – previously published records from Slovakia, *red* – previously published records from Europe].
Obr. 5–6. Chronologická mapa rozšírenia bzdochy svarínskej (*Dybowskyia reticulata* (Dallas, 1851)) na Slovensku (Obr. 5) a v Európe (Obr. 6). [*žltá* – náš nález zo Svarína, *modrá* – predtým publikované nálezy zo Slovenska, *červená* – doteraz publikované údaje z Európy].

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SÚHRN

Bzdocha svarínska (*Dybowskyia reticulata* (Dallas, 1851)) predstavuje palearktický druh s ťažiskom rozšírenia vo východnej časti areálu (severovýchodná Čína, Kórejský polostrov, Japonsko a ruský Ďaleký východ) (napr. Mitsuhashi 1915, Hoffmann 1932, Kiritshenko 1951, Miyamoto & Yasunaga 1989, Hua 2000, Rider & Zheng 2005, Rider 2006, Vinokurov et al. 2010, Lee et al. 2013, Hayashi et al. 2016). Niekoľko nálezov druhu však pochádza aj zo strednej časti Palearktu (Kazachstan, Západná i Východná Sibír) (Kiritshenko 1951, Esenbekova 2013) a z Európy. Jeden izolovaný nález je dokonca uvádzaný aj z provincie Jün-nan v juhozápadnej Číne (Zhang 2011). V Európe bzdocha svarínska patrí medzi najvzácnejšie druhy bzdôch, pričom do roku 2017 bola známa len v štrnástich zbierkových kusoch zo siedmych krajín. Úplne prvými nálezmi v Európe sú štyri nálezy z európskej časti Ruska (Stark 1926, Kiritshenko 1951), z ktorých je jeden z roku 1903, druhý bez známeho dátumu nálezu (môže byť ešte starší od prvého, ale aj mladší; najneskôr však z roku 1909) a ostatné dva z roku 1921. Ruské nálezy boli v roku 1937 nasledované úplne prvým nálezom tohto druhu zo Slovenska, ktorý zároveň predstavoval aj prvý nález druhu v strednej Európe (Balthasar 1937). Jednalo sa o jediný čerstvo vypreparovaný zbierkový kus označený lokalitou „Nízke Tatry, Svarín", ktorý si v muzeálnych zbierkach všimol Dr. Vladimír Balthasar a následne podľa neho popísal nový rod aj druh s pomenovaním *Svarinella inexspectata*, zdôrazňujúcim lokalitu a nezvyčajnosť tohto nálezu (lat. *inexspectata* = neočakávaná). Autor síce vedel o existencii druhu *D. reticulata* vyskytujúceho sa vo východnej Ázii (vo svojom popise ho dokonca so *S. inexspectata* porovnával), v tej dobe však bol z Európy publikovaný len jediný nález z Briansku v Rusku z roku 1921 (publikovaný V. N. Starkom v roku 1926; ostatné nálezy z Ruska, hoci sú staršie, boli publikované A. N. Kiritshenkom až v roku 1951). Celkom istotne vzhľadom na už spomenuté nálezy z Ruska publikované v roku 1951, ako aj na príliš malé a málo signifikantné rozdiely uvádzané v Balthasarovej diagnóze, Leston (1955) synonymizoval meno *Svarinella inexspectata* s *Dybowskyia reticulata*. Až celé tri desaťročia po náleze zo Svarína sa v Európe našiel ďalší jedinec bzdochy svarínskej, a to prekvapivo znovu na Slovensku – v roku 1967 ho totiž pri Šumivom prameni v Belianskych Tatrách odchytil P. Lauterer (Stehlík 1970). Následne bol druh objavený aj v ďalších európskych krajinách, a to v Rakúsku v roku 1971 (Rabitsch 2000), v Bulharsku v roku 1972 (Štusák 1976), v Estónsku v roku 1987 (Coulianos 2003), v Slovinsku v roku 1989 (Gogala 1991) a vo Fínsku v rokoch 2001, 2003 a 2005 (Albrecht et al. 2003, Rietschel 2006).

V každej zo spomenutých krajín Európy s výnimkou Ruska, Slovenska a Fínska je dosiaľ známa iba jedna jediná lokalita nálezu s jedným jediným odchyteným exemplárom. Predpokladáme, že príčiny takto ojedinelých nálezov môžu byť nasledovné: 1) neznáma biológia (hostiteľské rastliny sú známe iba z východnej Ázie) a vývoj druhu v Európe; 2) náhodný zber materiálu, pričom bol druh často zberateľmi prehliadnutý a iba odložený do zbierok; 3) prežívanie druhu len v izolovaných refúgiách alebo v relatívne malých izolovaných oblastiach v Európe s relatívne nízkou abundanciou na jednotlivých lokalitách. Vzhľadom na takto

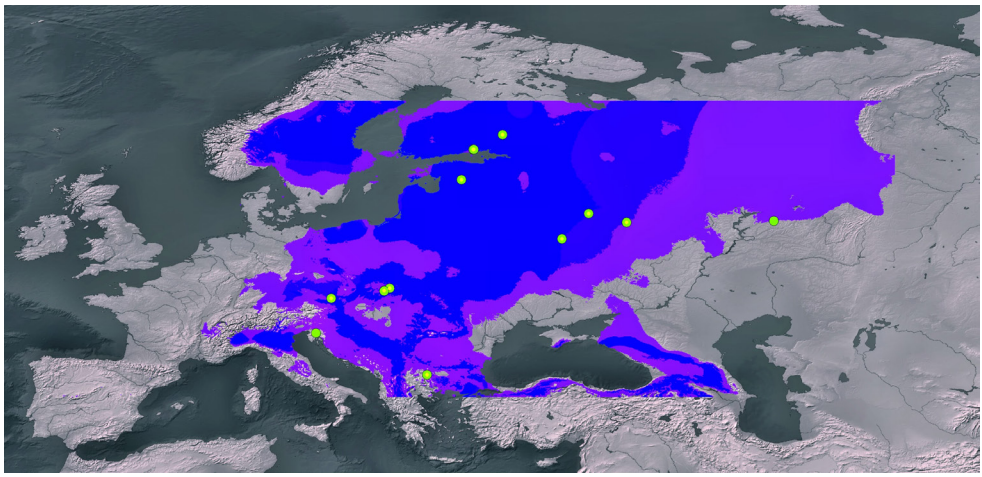


Fig. 7. BIOCLIM model of the possible occurrence of *Dybowskyia reticulata* (Dallas, 1851) in Europe [– Medium (2.5–5.0 percentile), – High (5–10 percentile), – Very High (10–20 percentile), – Excellent (20–47 percentile)].
Obr. 7. BIOCLIM model pravdepodobného rozšírenia bzdochy svarínskej (*Dybowskyia reticulata* (Dallas, 1851)) v Európe [miera pravdepodobnosti: – stredná (percentil 2,5–5,0), – vysoká (percentil 5–10), – veľmi vysoká (percentil 10–20), – najvyššia (percentil 20–47)].

nízky počet nálezov v Európe, ktorý je v ostrom kontraste s relatívne početnými nálezmi z východných častí Palearktického regiónu, sú aj všetky informácie o biológii a vývoji druhu známe práve vďaka výskumom z východnej Ázie, a to najmä z Japonska (napr. Nakamura & Numata 1997, 1998), kde má druh do roka jednu až dve generácie a prezimúva v štádiu imága. Larvy tohto druhu sa živia semenami rastlín z čeľade mrkvovité (Apiaceae) (Stichel 1962), v Japonsku konkrétne semenami torice japonskej (*Torilis japonica*) a torice *Torilis scabra* (Kobayashi 1957, Nakamura & Numata 1997).

Počas návštevy Svarínskej doliny v Nízkych Tatrách, ktorá sa uskutočnila v auguste roku 2017, sa pomocou smýkacej siete podarilo odchytiť dva jedince bzdochy svarínskej (*Dybowskyia reticulata*), jednu mŕtvu a poškodenú dospelú samicu a jednu živú larvu piateho instaru, čím sa podarilo potvrdiť prítomnosť druhu na Slovensku po 50 rokoch a v okolí osady Svarín dokonca po 80 rokoch. Nález larvy zároveň predstavuje vôbec prvý známy nález larvy druhu v Európe. Nález druhu po tak dlhej dobe na tej istej lokalite, ako aj nález samice a živej larvy, indikuje dodnes prežívajúcu populáciu.

Pretože naše jedince bzdochy svarínskej boli odchytené pomocou smýkacej siete, nemáme zaznamenané satie ani posedávanie druhu na akejkoľvek konkrétnej rastline. Všetky dostupné práce uvádzajúce bzdochu svarínsku z Európy (Stark 1926, Balthasar 1937, Kiritshenko 1951, Stehlík 1970, Štusák 1976, Gogala 1991, Rabitsch 2000, Coulianos 2003, Albrecht et al. 2003, Rietschel 2006) taktiež postrádajú akýkoľvek podobný údaj či pozorovanie. Hoci živné rastliny druhu nie sú v Európe známe, je veľmi pravdepodobné, že bzdocha svarínska sa tu živí semenami mrkvovitých rastlín podobne ako vo východnej Ázii (napr. Kobayashi 1957, Stichel 1962, Nakamura & Numata 1997), kde sú však zaznamenané len dva druhy živných rastlín: *Torilis japonica* a *T. scabra*. Torica japonská

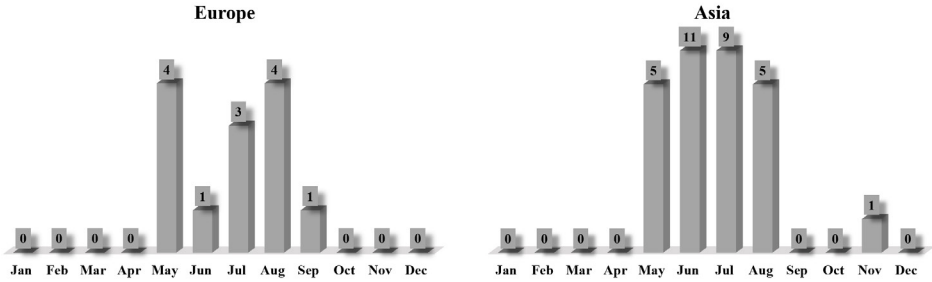


Fig. 8. Seasonal occurrence of *Dybowskyia reticulata* (Dallas, 1851) in Europe and Asia (number of records per month).
Obr. 8. Sezónny výskyt bzdochy svarínskej (*Dybowskyia reticulata* (Dallas, 1851)) v Európe a Ázii (počet nálezov za mesiac).

(*T. japonica*) má palearktický areál (napr. Hrouda 1997) a teda sa okrem východnej Ázie vyskytuje aj v Európe, čím jej areál korešponduje s areálom bzdochy svarínskej. Avšak torica japonská v Európe oveľa častejšie rastie v nížinách a nižších polohách, v chladných podmienkach vyšších polôh je veľmi zriedkavá (Hlavaček et al. 1984, Hrouda 1997). Toricu japonskú sme vo Svarínskej doline zatiaľ nepozorovali ani napriek intenzívnym obhliadkam mrkvovitých rastlín počas našich návštev v rokoch 2017 a 2018. Rastlina však bola zaznamenaná v relatívnej blízkosti Vysokých aj Belianskych Tatier, konkrétne na dvoch lokalitách v Podtatranskej kotline (Poprad-Matejovce a Podolínec) (Májeková & Limánek 2016) vzdialených len 14 a 17 km od Šumivého prameňa (Belianske Tatry), kde bola bzdocha svarínska nájdená v roku 1967 (Stehlík 1970). Ďalšie zaujímavé nálezy torice japonskej sú udávané aj z vyšších nadmorských výšok, napr. Majerova skala vo Veľkej Fatre (cca 1200 m n. m.) (Lengyel 1915) alebo Jizerské hory v Českej republike vo výške 840 m n. m. (Hrouda 1997). Vzhľadom k týmto skutočnostiam možno toricu japonskú do istej miery považovať za možnú živnú rastlinu bzdochy svarínskej v Európe, avšak táto rastlina sa až na výnimky vyskytuje v iných habitatoch. Táto situácia, kedy živná rastlina je vzácna v habitatoch preferovaných hostiteľom, môže byť jedným z hlavných dôvodov prečo bola bzdocha svarínska tak mimoriadne vzácne nachádzaná v Európe. Avšak je nutné zdôrazniť aj druhú rovnako pravdepodobnú možnosť, že bzdocha svarínska môže v Európe prežívať aj na nejakom inom druhu živnej rastliny.

V našej práci je taktiež diskutovaná pravdepodobná oblasť rozšírenia druhu pomocou BIOCLIM modelovania v programe DIVA-GIS (Hijmans et al. 2001) s použitím dvoch bioklimatických premenných – sezonality v miernom pásme a premenných zrážok. Z výsledkov tohto modelovania možno vyvodiť, že rozšírenie druhu zodpovedá výskytu mierneho zapojeného lesa v Európe počas holocénu (obr. 7). Avšak hodnoty testu jednotlivých modelov (AUC = 0,585) neboli štatisticky významné z dôvodu nízkeho počtu distribučných záznamov zahrnutých v analýze; zahrnutých bolo iba 86 % pozorovaní ako vhodných pre BIOCLIM analýzu. Navyše, druh je považovaný za boreo-montánny element (P. Kment, pers. comm.) s prítomnosťou altitudinálneho posunu v závislosti od zemepisnej šírky – napr. nízke nadmorské výšky v severnej Európe (20–200 m n. m.) v kontraste s vyššími nadmorskými výškami v strednej Európe a na Balkáne (700–1300 m n. m.). Podobný euro-východoázijský disjunktívny areál ako u *D. reticulata* možno nájsť aj u niektorých ďalších vzácnych druhov bzdôch, napr. *Polymerus* (*Polymerus*) *carpathicus* (Horváth, 1882) z čeľade Miridae (Gapon

2014) alebo *Elasmostethus brevis* Lindberg, 1934 z čeľade Acanthosomatidae (Kment et al. 2005, Hebda & Gutowski 2017).

Výsledky analýzy rozptylu (ANOVA) nezaznamenali žiadne významné latitudinálne ($F = 0{,}2923$; $Pr (> F) = 0{,}5915$) ani longitudinálne ($F = 0{,}175$; $Pr (> F) = 0{,}8953$) vzory vo fenológii *D. reticulata* v Palearktickom regióne a taktiež žiadny rozdiel medzi jedincami z Európy a Ázie (obr. 8). Väčšina údajov patrí dospelcom aktívnym od mája do augusta v Európe aj Ázii, z neskoršej sezóny je známych len veľmi málo údajov (obr. 8). Tento výsledok zodpovedá zisteniam v práci Nakamuru & Numatu (1998), ktorí udávali výskyt dospelých jedincov od júna do konca augusta v Japonsku. Relatívne podobné vzory sezónneho výskytu imág sú známe aj u iných druhov bzdôch vyskytujúcich sa v Európe alebo vo východnej Ázii, napr. u množstva druhov čeľade bzdôškovitých (Miridae) vo Vnútornom Mongolsku v Číne (Shi et al. 2016), u bzdochy zelenej (*Palomena prasina* (Linnaeus, 1758)) (čeľaď Pentatomidae) (Saulich & Musolin 1996, 2014a) alebo u okrúhličky čiernej (*Coptosoma scutellatum* (Geoffroy, 1785)) či okrúhličky *Coptosoma mucronatum* Seidenstücker, 1963 (čeľaď Plataspidae) (Saulich & Musolin 2014b).

Bzdocha svarínska (*D. reticulata*) bola v Červenom zozname bzdôch (Heteroptera) Slovenska (Štepanovičová & Bianchi 2001) zaradená do kategórie „zraniteľný" (VU) napriek nedostatočnému poznaniu jej biológie a rozšírenia na území Slovenska. Na základe skutočnosti, že v súčasnosti sú známe iba štyri zbierkové jedince z dvoch lokalít, navrhujeme zmeniť status druhu do kategórie „ohrozený" (EN).

Tabulka 1. A chronological overview of records of *Dybowskyia reticulata* (Dallas, 1851) from Europe.
Table 1. Chronologický prehľad nálezov bzdochy svarínskej (*Dybowskyia reticulata* (Dallas, 1851)) z Európy.

Year	Country	Details of record	Publication
unknown	**European Russia**	Ryazan, coll. A. I. Jakovlev [*1863–†1909].	Kiritshenko (1951)
1903	**European Russia**	Pavlovka, north from Bugulma, 19.–25.vii.1903, Elachich lgt.	Kiritshenko (1951)
1921	**European Russia**	Bryansk, 26.vi.1921, Karachizh-Krylovskaya forestry, spruce forest margin, at the old tree stump, V. Stark lgt.	Stark (1926)
1921	**European Russia**	Moscow district, Kuzminka, 5.viii.1921, E. Smirnov lgt.	Kiritshenko (1951)
1937	**Slovakia**	Nízke Tatry Mts., Svarín, 1 spec., F. Šlégl lgt. [holotype of *Svarinella inexspectata*].	Balthasar (1937)
1967	**Slovakia**	Belianske Tatry Mts., Šumivý prameň near Tatranská Kotlina village, 850–950 m a.s.l., 7.ix.1967, 1 ♀, P. Lauterer lgt.	Stehlík (1970)
1971	**Austria**	Dürnstein-Wachau, 14.v.1971, 1 ♂, H. Bergmayer lgt., coll. Oberösterreichisches Landesmuseum.	Rabitsch (2000)
1972	**Bulgaria**	Rila Mts., slope of Mt. Maljovica near Rilski Manastir, 1300 m a.s.l., 3.viii.1972, 1 ♂, Z. Jindra lgt.	Štusák (1976)
1987	**Estonia**	Aakre, 1.vii.1987, 1 spec. swept on a dry meadow, M. Marits lgt., coll. Zoological Museum of University of Tartu.	Coulianos (2003)
1989	**Slovenia**	Ilirska Bistrica, Štanga [1101 m a.s.l.], 8.vii.1989, Brelih lgt.	Gogala (1991)
2001	**Finland**	Hamina Vilniemi, sea drift, 23.v.2001, 1 spec., S. Karjalainen lgt.	Albrecht et al. (2003)

2001	**Finland**	Vehkalahti Matinsaari, sea drift, 23.v.2001, 1 spec., S. Karjalainen lgt.	Albrecht et al. (2003)
2003	**Finland**	Hamina Vilniemi, sea drift, 15.v.2003, 1 spec., S. Karjalainen lgt.	Albrecht et al. (2003)
2005	**Finland**	Hiukkajoki near Punkaharju, Mikkeli district, 9.viii.2005, 1 ♂, S. Rietschel lgt. et coll.	Rietschel (2006)
2017	**Slovakia**	Nízke Tatry Mts., Svarínska dolina valley, 700–720 m a.s.l., 9.viii.2017, 1 ♀ 1 L, V. Hemala lgt. et coll.	this paper