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A northernmost European record of the alien black soldier fly *Hermetia illucens* (Linnaeus, 1758) (Diptera: Stratiomyidae)

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Abstract: The black soldier fly *Hermetia illucens* (Linnaeus, 1758) is recorded from Bohumín in Czech Silesia (Czech Republic). This finding represents not only the first record from the Czech Republic but also the northernmost occurrence (at 49°55'N) of this species in Europe. *H. illucens* is a non-indigenous fly in Europe that was introduced from the New World and is now distributed in the tropical and subtropical regions all over the world. The first Czech record is documented in detail and the causalities of the occurrence of *H. illucens* at so high a latitude is discussed. An updated distribution of the species in Europe is mapped.

Key words: Diptera, Stratiomyidae, *Hermetia illucens*, alien species, new record, habitat, Czech Republic

Introduction

The black soldier fly *Hermetia illucens* (Linnaeus, 1758) belongs to the subfamily Hermetiinae of the family Stratiomyidae. Of the five known genera of this subfamily three are restricted to the Neotropical Region and one is Australasian. The remaining genus *Hermetia* Latreille, 1804, is by far the most speciose with 76 species, and more widely distributed, having representatives in the Nearctic (12), Neotropical (52), Afrotropical (3), Australasian (10) and Oriental Regions (14)* (Woodley 2001). However, *Hermetia illucens*, originating likely from the tropics and subtropics of both Americas (very likely South America) became widespread all over the world (excluding colder areas), thus reaching also the Nearctic, Palaearctic, Oriental, Australasian and Afrotropical Regions where it was largely introduced by man's activities. The black soldier fly is a very adaptable saprophagous species with larvae scavenging in various decayed organic matter of both plant and animal origin, including rotten fruits, vegetables, corn and other foodstuffs, accumulated remains of vegetation, compost, manure, carrion etc. (Rozkošný 1983). The ability to utilize such a wide range of decaying matter enabled the species to penetrate into new and remote regions. However, its spread was also accelerated by commerce, particularly when the species had come to be bred with the aim of using its larvae in composting, waste decontamination and as food for animals, for example as fishing bait or pet reptile food (see e.g. Newton et al. 1977; Sheppard 1992; Sheppard et al. 1994; Diener et al. 2011). In addition, it seems to be spreading accidentally, with waste and rotting commercial goods. The species has also been introduced to southern Europe (for review of records see Rozkošný 1983 and Üstüner et al. 2003) where it was first recorded from Malta in 1926 (Lindner 1936) and after World War II it became widespread in the western part of the Mediterranean Subregion. Interestingly, there seems to be no record from the mediterranean areas of North Africa. More recently, *H. illucens* expanded to the eastern Mediterranean (Balkan peninsula: Beschovski & Manassieva 1996; Ssymank & Doczkal 2010; Turkey: Üstüner et al. 2003) and also reached northwestern France (Chevin 1986), Switzerland (Sauter 1989; Tóth 1994; Üstüner et al. 2003) and even southern Germany (Ssymank & Doczkal 2010) where it seems to have established the northernmost population in Europe. According to Üstüner et al. (2003) the Alps are the natural barrier

* Numbers of species in all regions are bigger than the number of species in the genus, because several species occur in several regions.

hampering its further penetration to the north. The recent discovery of black soldier fly in the NE part of the Czech Republic (see below) is therefore very surprising in this context.

Material and methods

All the material examined has been reared by the junior author from larvae found in livestock manure (ca 90 l) used by him as medium for breeding earthworms (Lumbricidae: *Eisenia fetida*). The manure used for rearing was collected in spring 2010 and placed into plastic containers in a heated room (26°C, relative air humidity 80%). All emerged adult flies were captured; only the first observed puparium was killed and dissected (not preserved). Originally the reared adults were put in ethanol but were subsequently dry mounted and are now deposited in the Slezské zemské muzeum, Opava, Czech Republic (SMOC). The site where the manure with black soldier fly larvae was taken has been re-visited in 2013 and documented by photography. Macrophotographs of the voucher specimens were taken by means of digital camera Sony NEX-7.

Results

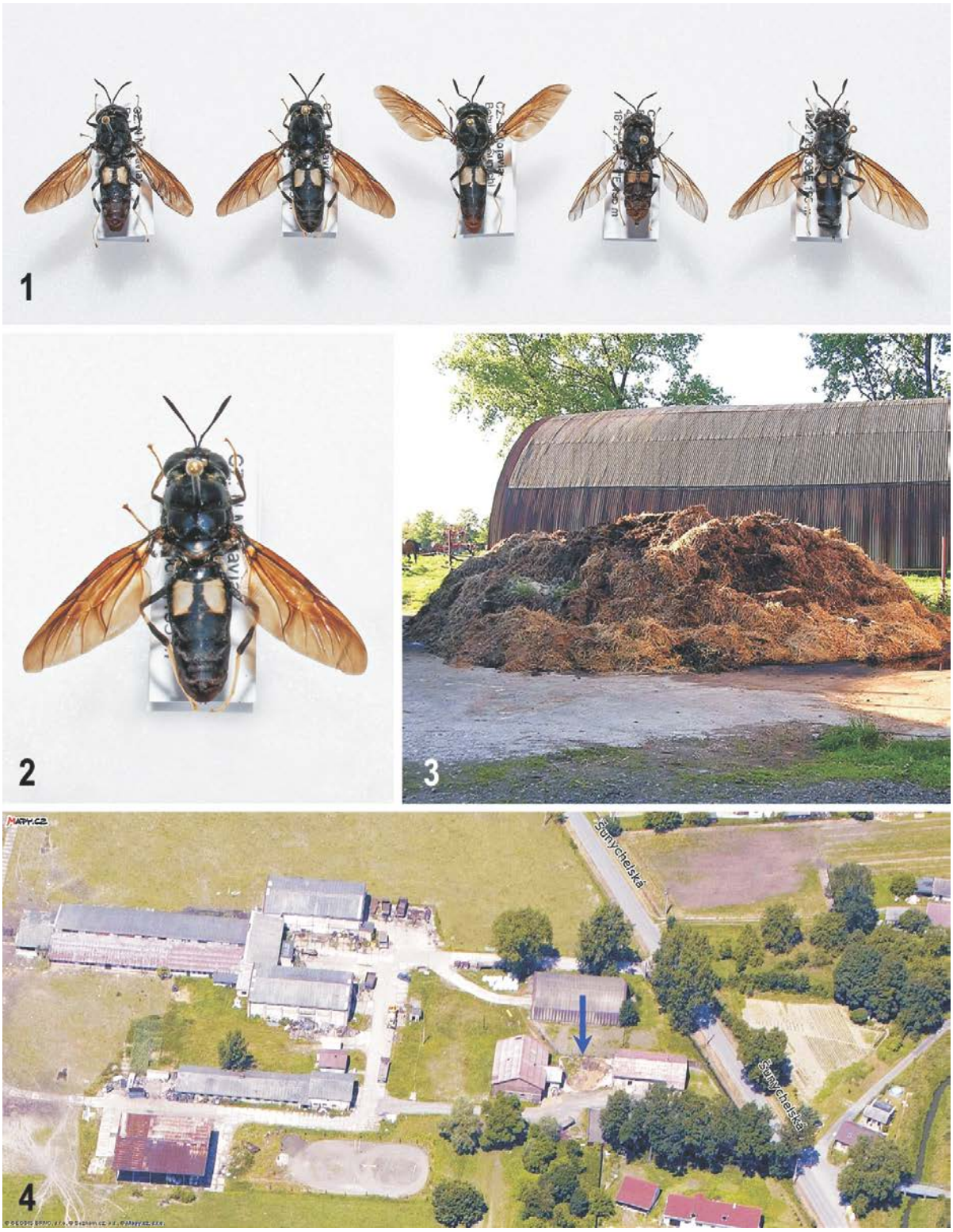
Hermetia illucens (Linnaeus, 1758)

(Figs 1, 2)

Material examined: CZECH REPUBLIC: N Moravia (Silesia): Bohumín-Šunychl, 49°55'29.254"N, 18°21'26.136"E, 195 m (locality of manure heap with larvae), reared ex larvae in manure, adults emerged vi.2010, 4♂1♀, M. Hora leg., J. Roháček det. (SMOC).

Habitat of larvae: The manure heap (largely consisting of cow and horse dung) was situated within a small farm (Fig. 4) on the margin of Šunychl (part of Bohumín city, Fig. 6). This dung heap had remained in the same place for years (Fig. 3, from 14.v.2013) but, unfortunately, since the finding of black soldier fly larvae in 2010 it was emptied several times because the manure was used by farmers in the fields in the vicinity of the site. The larvae probably lived here only in 2009-2010 inasmuch as the species has only one generation in the temperate belt (Rozkošný 1983), with larvae overwintering and adults emerging in spring. According to information by owners of the farm the dung heap was entirely taken to fields in autumn 2010 so that the loss of breeding substrate has probably led to the extinction of this population. Also our attempts to find larvae or adults of *H. illucens* in the site in 2013 were not successful.

Distribution: The black soldier fly (*H. illucens*) is now a subcosmopolitan species that has been spread by man to all tropical and subtropical areas of the world (see above). Having been of New World origin it is a non-indigenous (alien) species in the Palaearctic Region. Its distribution in Europe has hitherto been limited to warm subtropical areas of southern Europe (Portugal, Spain, France, Sardinia, Italy, Malta, Croatia, Montenegro, Albania) but also reaching Switzerland (Sauter 1989; Tóth 1994; Üstüner et al. 2003) as summarised by Rozkošný (2012). According to Üstüner et al. (2003) the occurrence of *H. illucens* in Europe appeared to be restricted between 46°N and 42°S latitudes, with northernmost known records from southern Switzerland at Locarno (46°09'N) and Gorgola (46°10'N). However, in 2008 the species was first found north of Alps in Granzach-Wyhlen (47°33'N), southern Germany (Ssymank & Doczkal 2010). The above new record from the northeastern part of the Czech Republic is therefore rather unexpected, with the breeding site situated far more northerly, at 49°55'N. The current distribution of black soldier fly in Europe and the Near East of Asia is displayed in a map (Fig. 5). Besides the published records (most of them listed by Üstüner et al. 2003; for others see references cited above) several unpublished records are also included in this map: FRANCE: 2 km E Aureille, 43°41.78'N 4°57.66'E, 8.vi.1997, 1♂, O. Niehuis leg.



Figs 1–4: *Hermetia illucens* (Linnaeus, 1758) and its habitat in Bohumín-Šunychl. 1 – series of reared adults (4 males, 1 female – the latter on extreme right); 2 – male (body length 17 mm) ; 3 – manure heap within a farm in Bohumín-Šunychl in 2013; 4 – aerial view of the farm with manure heap situation (blue arrow). Photo by J. Roháček. (Figs 1, 2), M. Hora (Fig. 3) and www.mapy.cz (Fig. 4).

(M. Hauser coll.). ITALY: W Calabria, 3 km NW Santa Maria del Cedro, Abatemarco river, sweeping riverside vegetation, 4.vi.1997, 1♂, J. Roháček leg. (SMOC). CROATIA: Istria, 6 km SE Pula, 44°50'N 13°54"E, 1♂, C. Schmid-Egger leg. (M. Hauser coll.); Primošten, Bilo, 10.-12.vii.2013, 1♂ photographed plus several specimens observed by N. Rahmé, see http://www.flickr.com/photos/ eurythyrea/9850536755/.

Remarks. The occurrence of *H. illucens* in Czech Silesia (based on the above record) has recently been mentioned in the chapter on Diptera in the popular book Příroda Slezska (Roháček & Ševčík 2013). In addition, P. J. Chandler and R. D. Hawkins exhibited *H. illucens* at the 2012 BENHS Exhibition (Chandler 2013) reporting about its occurrence in Srí Lanka and SW France (at Haumont, Tarn-et-Garonne) respectively. More interestingly, P. J. Chandler also reported here information he had received from Tim Cahill about the larvae found in a compost bin in Ireland. However, the latter record (precise data missing) remains unconfirmed as no voucher specimens are available.

Discussion and conclusions

(1) The occurrence of *H. illucens* in the NE part of the Czech Republic is certainly interesting, mainly because the species clearly developed in the manure in the above locality in 2010. According to our personal investigation in the site nobody could have intentionally introduced larvae into this dung heap (e.g. for breeding of black soldier larvae as food for animals or using them for waste composting). However, it cannot be excluded that some adult flies escaped from some more distant captive breeding in 2009, reached the locality Šunychl and oviposited into the manure where the larvae subsequently developed, overwintered and metamorphosed to adults emerging in June 2010. However, the winter 2009-2010 was rather cold, with frost in most days of December, January and February; on the other hand there was a snow cover during these months, isolating the manure from frosty air. Moreover, manure produces heat from bacterial activity and is therefore warmer than the environment; this could prevent the larvae in dung from freezing if the heap was large enough. Nevertheless, the population of *H. illucens* in the locality obviously did not survive to the next year, particularly because the dung was entirely dispersed to fields in autumn 2010. It is probable that the occurrence of *H. illucens* in Bohumín-Šunychl was only temporary although the species could survive in other manure piles or land fills and garbage dumps in the neighbouring region, without being noticed.

(2) Despite the occurrence of *H. illucens* in the NE part of the Czech Republic not having been confirmed in subsequent years, the propagation of black soldier flies at such a high latitude demonstrates again that *H. illucens* is an extremely temperature- and habitat-tolerant animal which has great potential to inhabit new territories at more northern situations than it has formerly been presumed. It is therefore probable that it could occur outdoor also in other parts of the Central Europe although forming only temporary populations.

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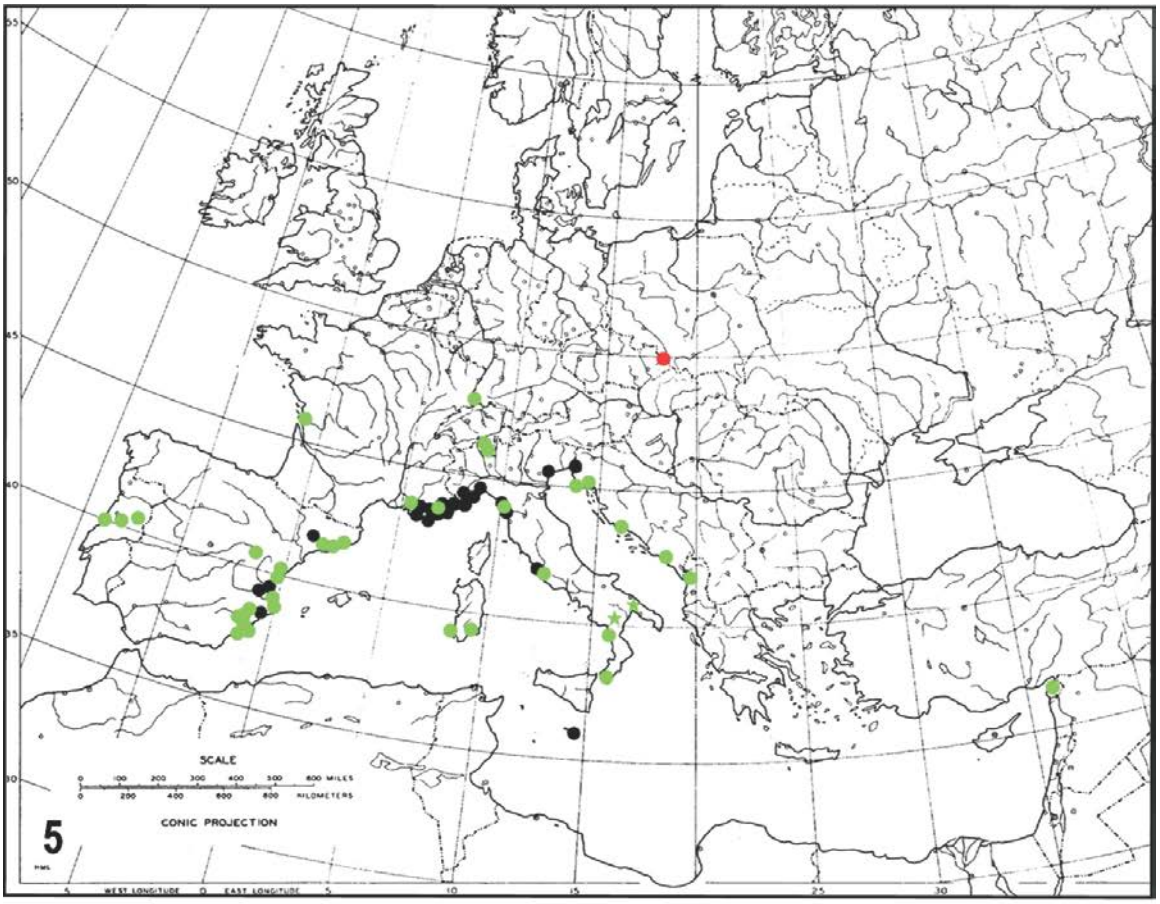

Figs 5–6: Maps. 5 – distribution of *Hermetia illucens* in Europe and Near East (black circles – according to Rozkošný 1983; green circles – additions published and/or obtained up to 2013; red circle – new northernmost record from the Czech Republic; green asterisks – province records where the particular localities were not published); 6 – position of the locality of *H. illucens* in Bohumín-Šunychl (blue arrow). Source: www.mapy.cz (Fig. 6).

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Nejsevernější evropský výskyt nepůvodní bráněnky *Hermetia illucens* (Linnaeus, 1758) (Diptera: Stratiomyidae)

Bráněnka *Hermetia illucens* (Linnaeus, 1758) je hlášena z Bohumína-Šunychlu v Českém Slezsku (Česká republika). Tento nález je nejen prvním záznamem o výskytu tohoto nápadného druhu v České republice, ale zároveň také představuje nejsevernější lokalitu této bráněnky v Evropě. *H. illucens* je v Evropě nepůvodním druhem, který byl zavlečen z (patrně jižní) Ameriky do celého světa, takže je nyní subkosmopolitně rozšířen ve všech tropických a subtropických oblastech, včetně jižní Evropy. První nález bráněnky *H. illucens* z České republiky, který je založen na kusech vychovaných z larev nalezených v hnoji, je podrobně zdokumentován a diskutovány možné příčiny výskytu tohoto druhu v tak vysoké zeměpisné šířce. Současné rozšíření bráněnky *H. illucens* v Evropě a na Blízkém Východě je znázorněno na mapce (Fig. 5).

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