Zoosymposia 18: 135–142 (2020)
https://www.mapress.com/j/zs

ISSN 1178-9905 (print edition)
ZOOSYMPOSIA
ISSN 1178-9913 (online edition)
https://doi.org/10.11646/zoosymposia.18.1.17
http://zoobank.org/urn:lsid:zoobank.org:pub:4D03B572-B828-4EC1-BA36-75FB19F258A3

Expected and unexpected areas of distribution of caddisflies (Trichoptera)

HANS MALICKY
Sonnengasse 13, A-3293 Lunz am See, Austria.
tatarin.kyselak@gmail.com; https://orcid.org/0000-0003-1305-8378

Abstract

The area of distribution of a species is the result of range expansions and regressions in the past. If the fauna of a region is reasonably well known (e.g., in Europe), certain patterns of distribution are easily recognised. New findings may readily be placed, but sometimes unexpected patterns may appear which are difficult to explain. Several examples are given.

Key words: Distribution pattern, Zoogeography

Introduction

The recent distribution of species is the result of range expansions and regressions in the past (De Lattin 1967; Malicky 2000, 2006). In faunistically well known regions such as Europe, the presently known areas show particular patterns which allow conclusions concerning the expansion/regression cycles in the past, in some cases even going back to four of these events, e.g. in *Rhyacophila dorsalis* Curtis 1834 (Malicky 2002).

Characteristic patterns of areas

1. Some endemics inhabit relatively small, sometimes very small areas, and have survived the last regression period (which in Europe usually was the Würm = Weichsel glaciation) in these small refuge areas and have not, or only slightly expanded their ranges since then, despite favourable conditions. Numerous examples may be seen in the book by Neu *et al*. (2018), e.g., *Metanoea rhaetica* Schmid 1955, *Rhyacophila aurata* Brauer 1857, *Crunoecia kempnyi* Morton 1901, *Anabolia lombarda* Ris 1897, and many more.

2. Many species had their refuges during the Würm glaciation somewhere in the Mediterranean Region and have since expanded more or less long distances northwards (De Lattin 1967), such as *Odontocerum albicorne* Scopoli 1763, *Chimarra marginata* Linnaeus 1767, *Diplectrona felix* McLachlan 1878. However, other species had refuges in this period, in particular regions in Central Europe: Malicky (2006) found about a dozen refuges in Europe well north of the Mediterranean Region.

3. Some of these regression areas may even go back to earlier glaciations (of which there were about 20 during the Pleistocene). If distant refuges of a species were isolated long enough, their populations may have developed into more than one separate species (e.g., the group of *Rhyacophila rougemonti* McLachlan 1880, *R. italica* Moretti 1981, *R. pallida* Mosely 1930, *R. tarda* Giudicelli 1968, *R. trifasciata* Mosely 1930, *R. vallei* Moretti 1997, *R. gudrunae* Malicky 1972, and *R. aphrodite* Malicky 1975; or *Helicopsyche*, see below). In a few other species, the partial areas are geographically widely separated from each other, but they are considered to remain one and the same species, e.g. *Silo graellsi* E. Pictet 1865 (Fig. 1).

4. Some of these groups of species are systematically isolated within Europe and have their closer relatives (species or genera) in tropical regions where these groups may be very diverse and abundant. They may be regarded as tertiary relics, e.g., *Helicopsyche* (Fig. 2), *Ptilocolepus, Thremma, Calamoceras,* etc. (Malicky 2005), and *Larcasia* (Malicky 2014, Fig. 3). Recent discoveries, such as *Nyctiophylax gaditana* (Ruiz *et al*. 2013) in southern Spain, fit well into this pattern, where the genus was known from Europe only in Baltic Amber of the Eocene.

Submitted: 10 Aug. 2019; Accepted by Pongsak Laudee: 4 Feb. 2020; published: 12 Jun. 2020

5. Contrary to all of these, other groups are presently in a regression situation and may have their refuges in northern regions as well as in isolated spots in Central or Southern Europe (Malicky 1990). In most cases, they are the same species (e.g., *Asynarchus lapponicus* Zetterstedt 1840: Fig. 4) but if they are a group of closely related species which are separated over very long distances [e.g. *Apataniana* ssp.: Fig. 5, (Malicky 2005) or *Apatania volscorum* (Moretti *et al*. 1988)], they are probably relics from earlier glaciations. These may be distinguished from the others under nos. 1–4 by the general distribution of the relatives of these species: Helicopsychidae, Calamoceratidae, Rhyacophilidae, etc. are mainly found in southern regions including the tropics, but Apataniinae, Limnephilini, etc. occur mainly in northern regions including the Holarctic.

However, a few cases of distribution in Europe as well as worldwide are hard to explain. The so-called Gondwana distribution over South America, Africa and Australia is well known and has been often discussed. The same can be said about the "holarctic" distribution over Europe, northern Asia and North America.

A case in Europe is *Mesophylax impunctatus* McLachlan 1884 (Fig. 6). Its area is divided into three widely separated parts: ssp. *zetlandicus* McLachlan 1884 inhabits the northern part of the British Isles and Ireland, ssp. *impunctatus* McLachlan 1884 lives in the southern part of Central Europe, and ssp. *aduncus* Navas, 1923 in the Balkan Peninsula and in Anatolia. The areas in Central Europe and in the Aegean Region are easily explained by the above patterns, but how could the species arrive in northern Great Britain and Ireland, an area which was more or less completely covered by ice during the Würm glaciation? And if it arrived from a southern refuge, why are wide areas in southern England, the Netherlands, France, etc. now empty? Did the populations there become extinct, and if yes, why? Molecular genetics may help to explain this enigma.

Another, but worldwide case is the distribution of *Pseudoneureclipsis* and the very similar genus *Antillopsyche* (between which there is only a minor difference in the wing venation). *Pseudoneureclipsis* inhabits large southern parts of the Old World including southeastern, eastern, and southern Asia; the Bismarck Archipelago; Central Africa and Madagascar; and the Mediterranean Region (Malicky 2009). *Antillopsyche* has been found only on the islands of Central America: Cuba, Hispaniola, and Puerto Rico (Flint *et al*. 1999; Fig. 7).

A parallel, but even more enigmatic case is the genus *Campsiophora*. Three species are known from the Central American islands of Jamaica, Cuba, and Hispaniola, but not from the adjacent continent (Flint *et al.* 1999). Recently a fourth species was found in northern Thailand (Malicky 2014; Fig. 8). Again, there is no indication of a Holarctic or Gondwanan distribution.

A third, similar case is the genus *Paduniella*. Many species are known from the southern part of Asia including Indonesia and the Philippines, Africa, Madagascar, and southwestern Europe. In addition to this, one species, *P. nearctica* Flint, 1967 was found widely isolated in southeastern North America (Fig. 9).

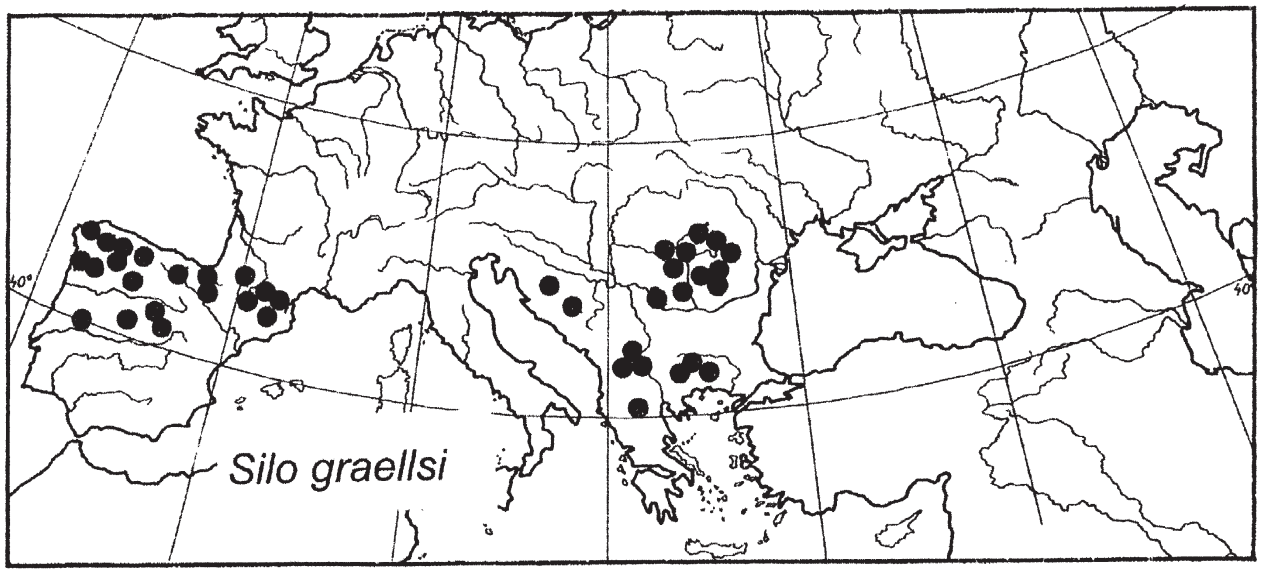

Figure 1

FIGURE 1. Separate areas of *Silo graellsi* Pictet 1865.

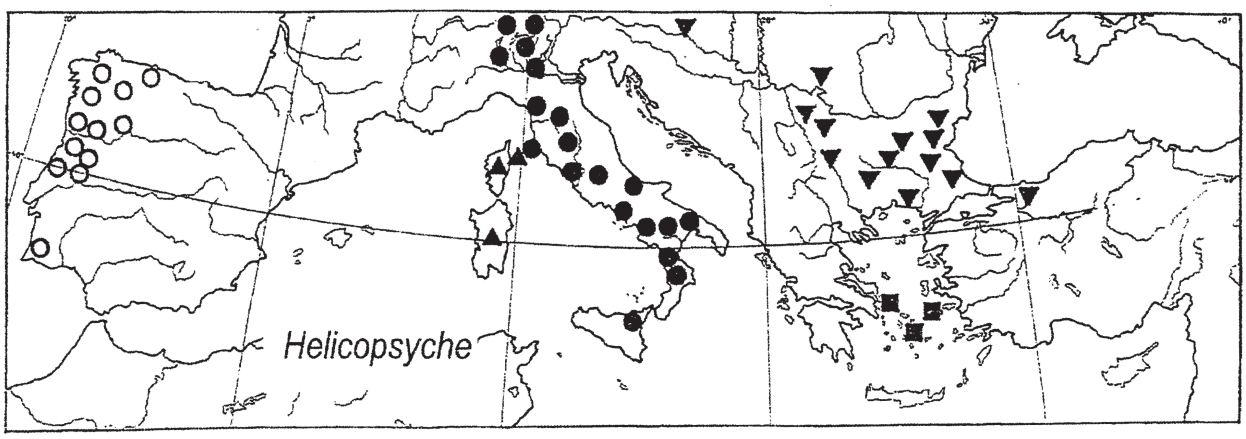

Figure 2

FIGURE 2. Distribution of *Helicopsyche* species in the Mediterranean area: Open circles = *H. lusitanica* McLachlan 1884; dorsally acute triangles = *H. revelieri* McLachlan 1884; black circles = *H. sperata* McLachlan 1876; ventrally acute triangles = *H. bacescui* Orghidan & Botosaneanu, 1953; squares = *H. megalochari* Malicky 1974.

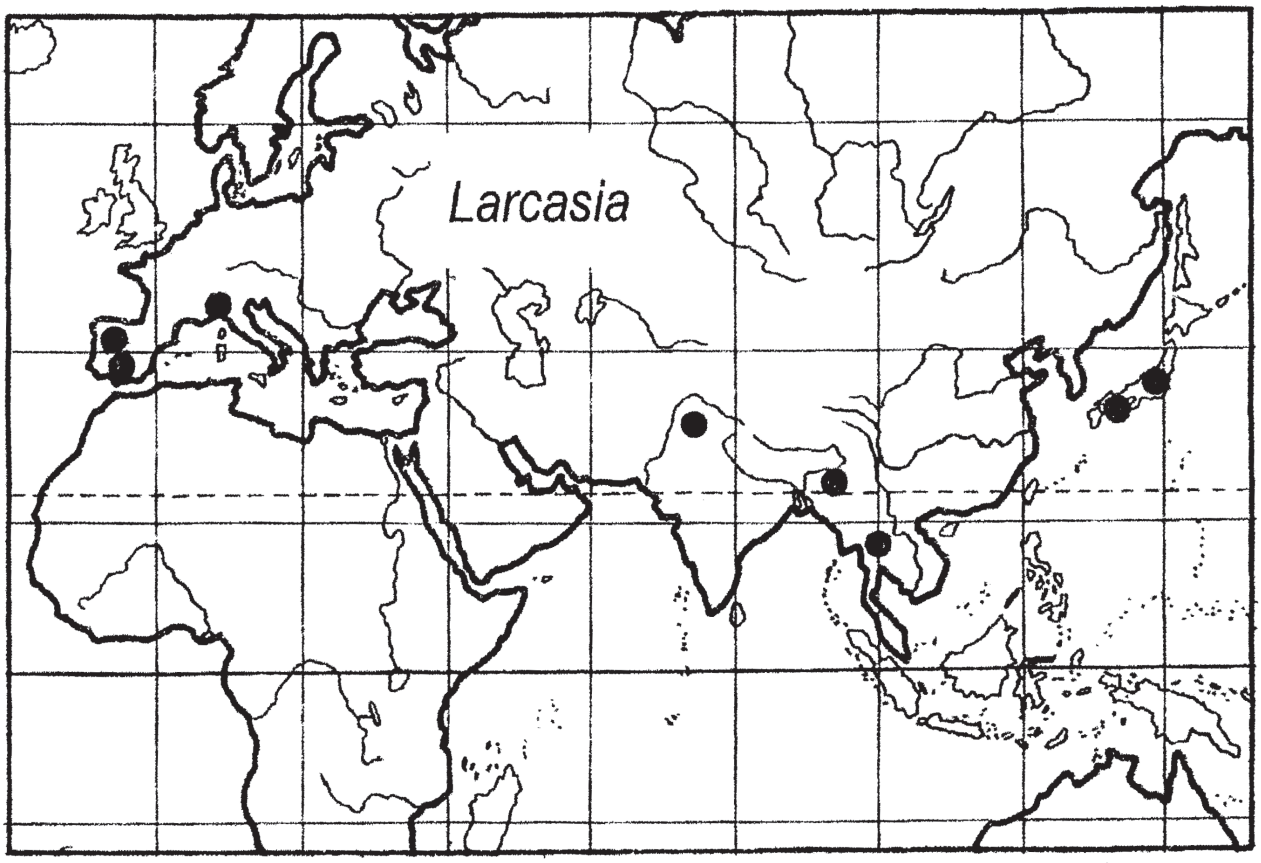

Figure 3

FIGURE 3. Worldwide distribution of *Larcasia* species.

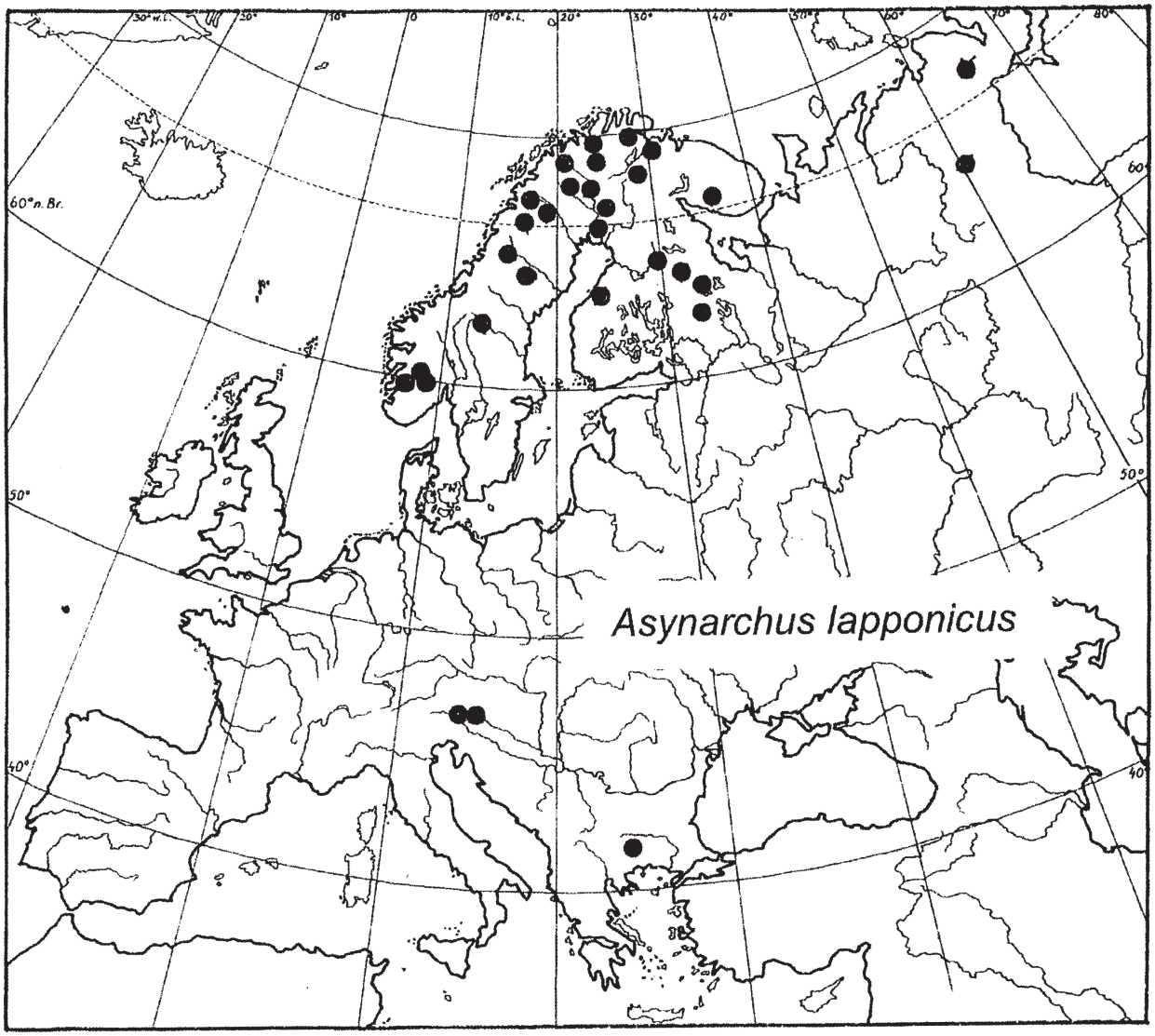

Figure 4

FIGURE 4. Areas of *Asynarchus lapponicus* Zetterstedt 1840.

Large regions of tropical countries are still poorly investigated for the systematics and faunistics of caddisflies. We have to expect the discovery of thousands of unknown species, but a "fine-meshed" faunist study in these regions, as it is now underway, e.g., in Thailand, may help to explain these and other enigmas, as well as to find out the location of possible refuges.

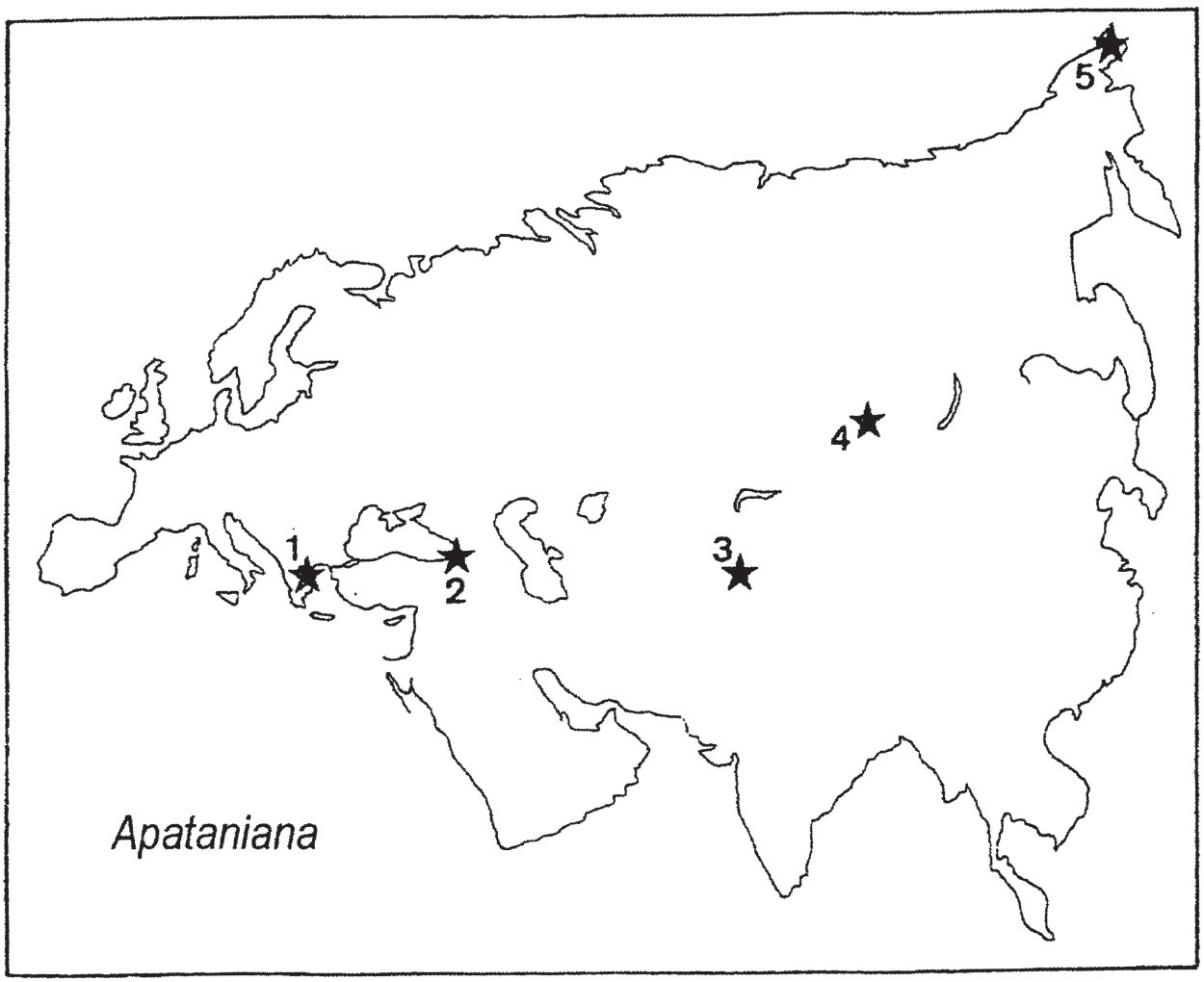

Figure 5

FIGURE 5. Worldwide distribution of *Apataniana* species: 1, *A. hellenica* Malicky 1987; *A. stropones* Malicky 1993; and *A. vardusia* Malicky 1992; 2, *A. borcka* Sipahiler 1996; 3, *A. rauschorum* Malicky 1999; 4, *A. bulbosa* Martynov 1918; 5, *A. tschuktschorum* Levanidova 1979.

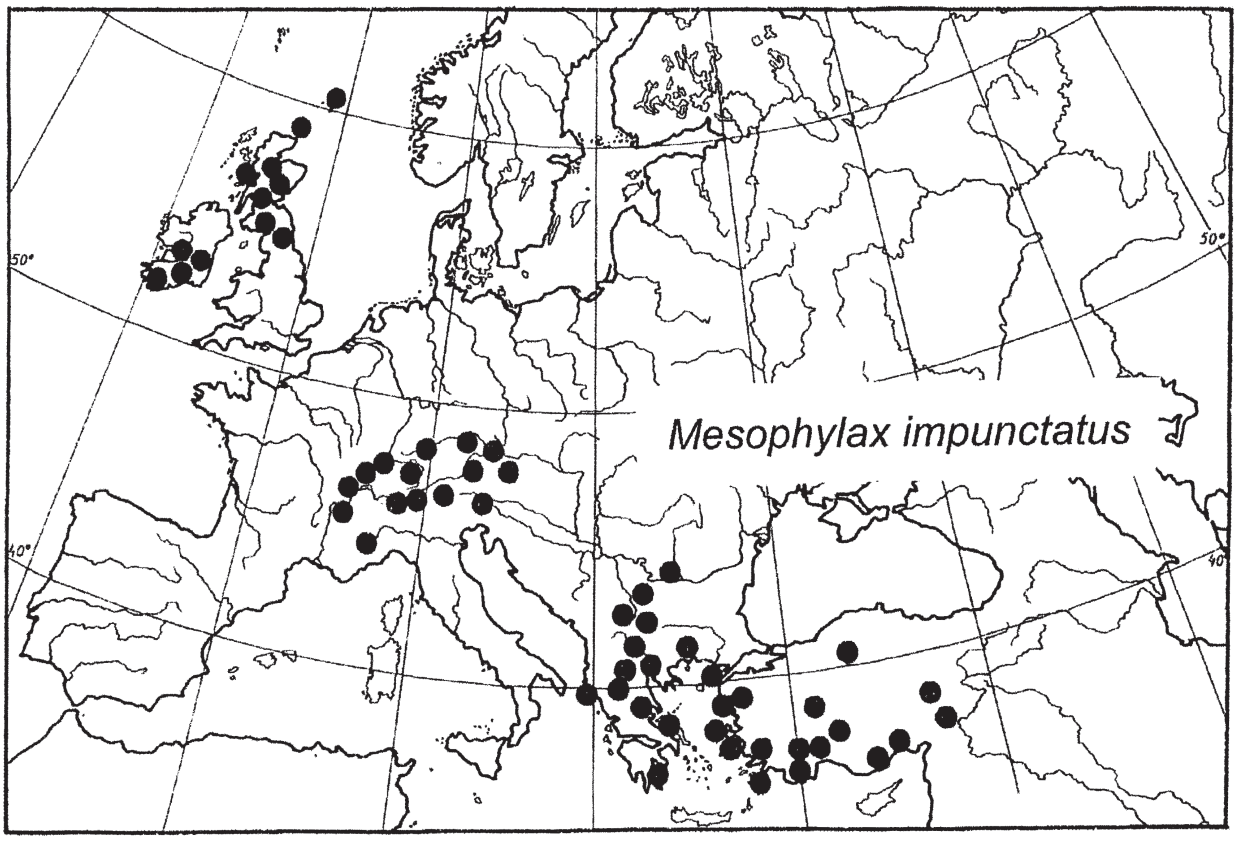

Figure 6

FIGURE 6. Separate areas of *Mesophylax impunctatus* Mclachlan 1884.

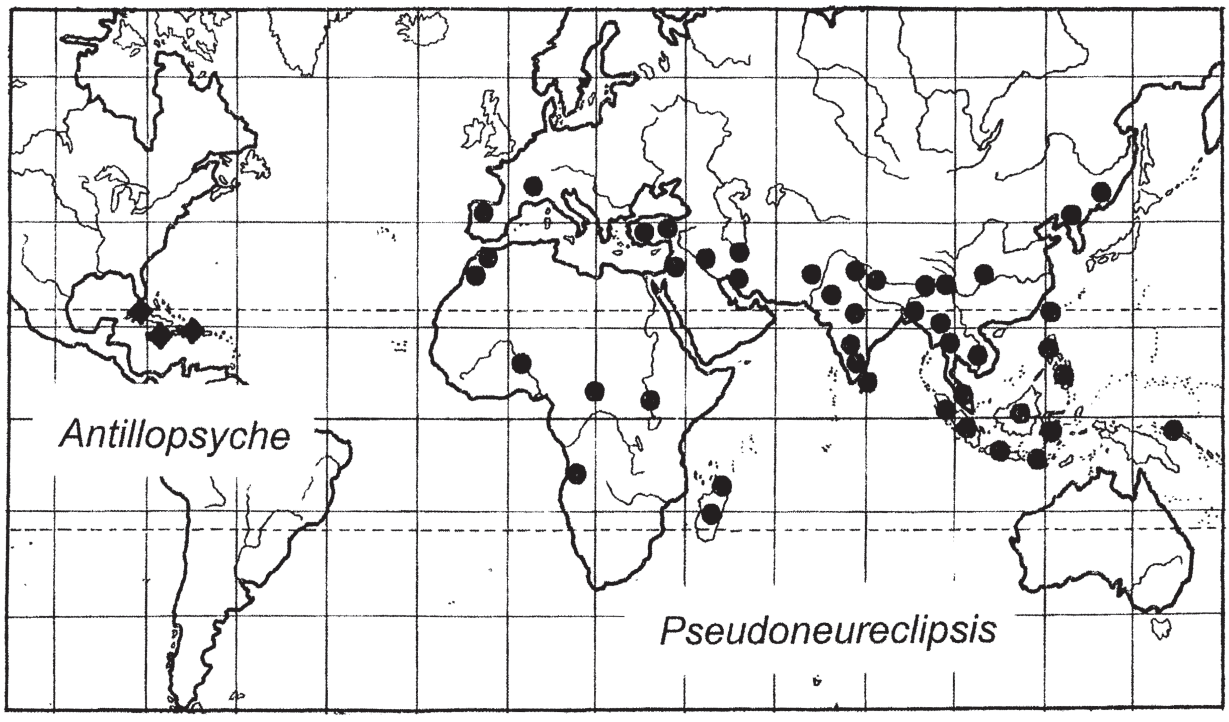

Figure 7

FIGURE 7. Worldwide distribution of *Pseudoneureclipsis* (black circles) and *Antillopsyche* (black diamonds). Not all the known sites are shown here.

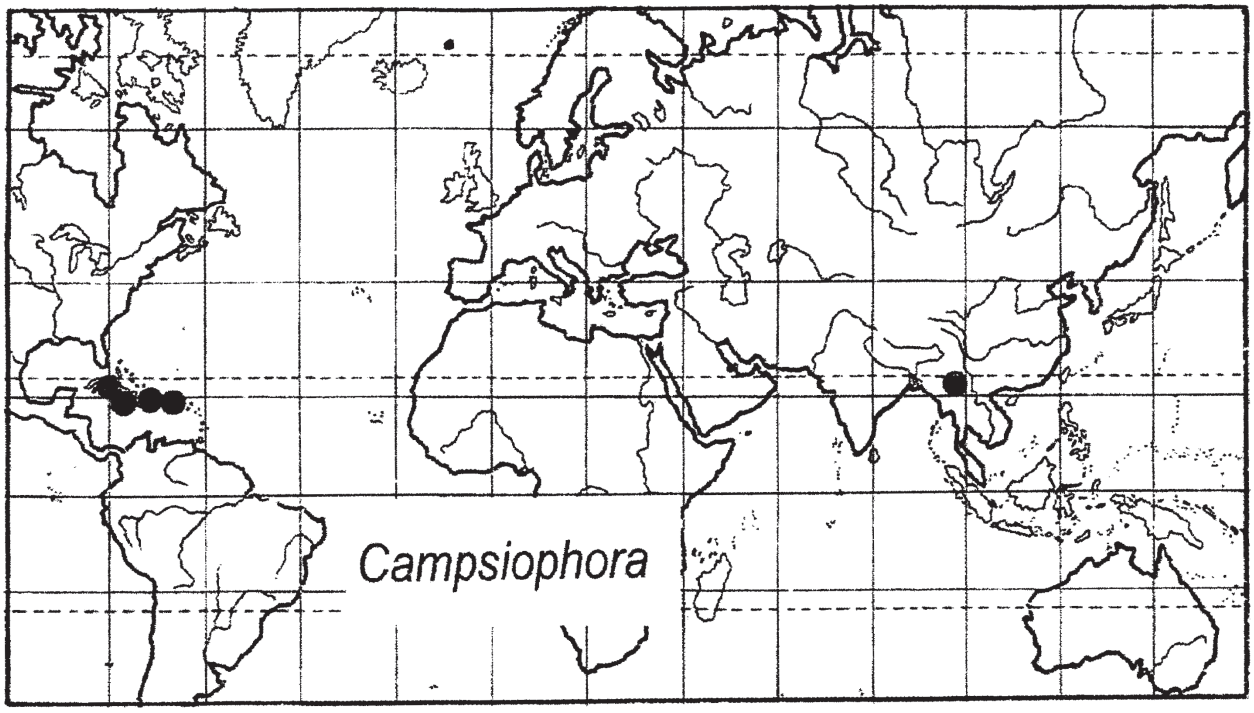

Figure 8

FIGURE 8. Worldwide distribution of *Campsiophora*.

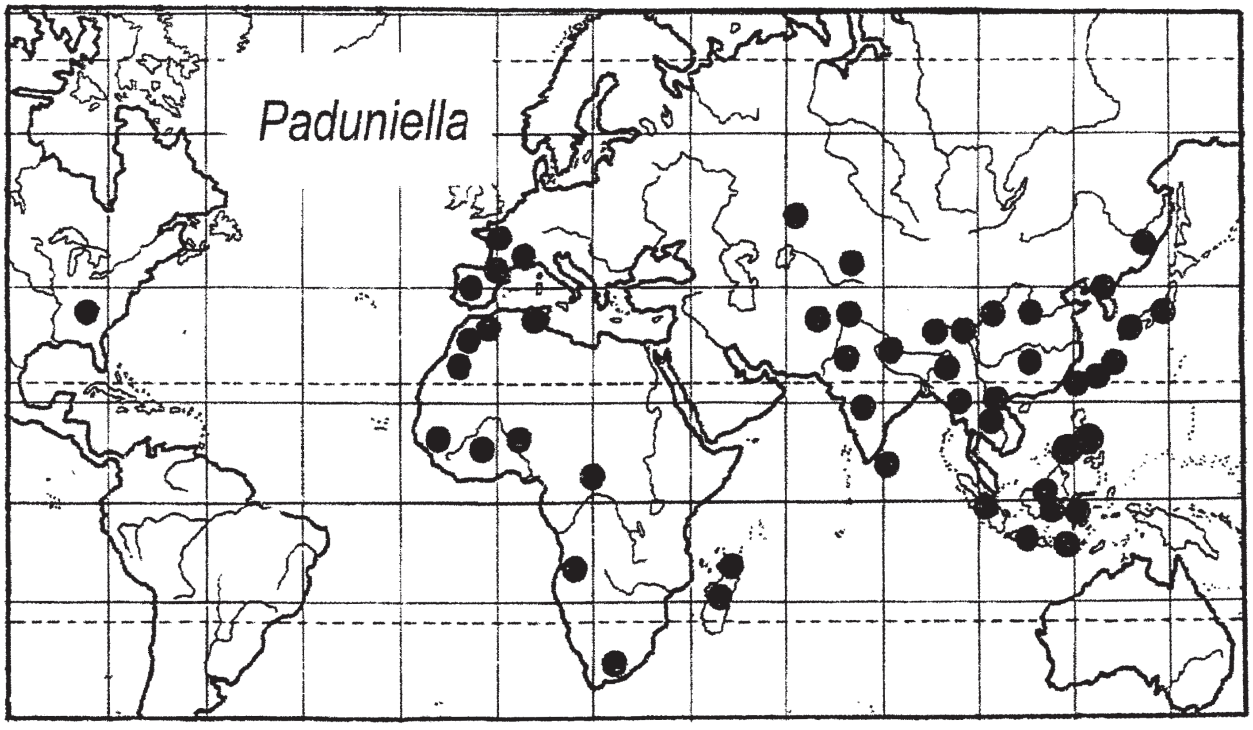

Figure 9

FIGURE 9. Worldwide distribution of *Paduniella*. Not all the known sites are shown here.

Acknowledgement

James P. O'Connor has corrected the English text.

References

Flint, O.S. (1967) The first record of the Paduniellini in the New World. *Proceedings of the Entomological Society of Washington*, 69, 310–311.

Flint, O.S., Holzenthal, R.W. & Harris, S.C. (1999) *Catalog of the Neotropical caddisflies* (*Insecta: Trichoptera*). Ohio Biological Survey, Columbus, OH, USA, 239 pp.

De Lattin, G. (1967) *Grundriß der Zoogeographie*. Fischer, Stuttgart, 602 pp.

Malicky, H., Ant, H., Aspöck, H., De Jong, R., Thaler, K. & Varga, Z. (1983) Argumente zur Existenz und Chorologie mitteleuropäischer (extramediterran—europäischer) Faunen-Elemente. *Entomologia Generalis*, 9, 101–119. https://doi.org/10.1127/entom.gen/9/1983/101

Malicky, H. (1990) Spuren der Eiszeit in der Trichopterenfauna Europas (Insecta, Trichoptera). *Rivista di Idrobiologia*, 27 (1988), 247–297.

Malicky, H. (2000) Arealdynamik und Biomgrundtypen am Beispiel der Köcherfliegen (Trichoptera). *Entomologia Basiliensia*, 22, 235–259.

Malicky, H. (2002) The sub-specific division of *Rhyacophila dorsalis* Curtis, 1834, and its transitions to *R. nubila* Zetterstedt, 1840. *Nova Supplementa Entomologica*, 15, 149–166.

Malicky, H. (2005) *Die Köcherfliegen Griechenlands* (*Trichoptera*). *Denisia*, 17, 1–240. https://doi.org/10.1007/978-1-4020-3026-0_1

Malicky, H. (2006) Mitteleuropäische (extra-mediterrane) Arealkerne des Dinodal am Beispiel von Köcherfliegen. *Beiträge zur Entomologie*, 56, 347–359.

Malicky, H. (2009) Übersicht über die Gattung *Pseudoneureclipsis* (Trichoptera, Polycentropodidae), mit Beschreibung von neuen Arten. *Linzer biologische Beiträge*, 41, 709–735.

Malicky, H. (2014) Neue Beiträge zur Kenntnis asiatischer und mediterraner Köcherfliegen (Trichoptera). *Braueria*, 41, 43–50.

Moretti, G.P., Cianficconi, F. & Papagno, F. (1988) *Apatania volscorum* sp. n. (Trichoptera, Apataniinae): Morfologia, Tassonomia, ciclo biologico e geonemia. *Atti 15 Congresso Nazionale Italiana di Entomologia*, *L'Aquila*, 1988, 145–152.

Neu, P.J., Malicky, H., Graf, W. & Schmidt-Kloiber, A. (2018) Distribution Atlas of European Trichoptera. *Die Tierwelt Deutschlands*, 84, 1–891.

Ruiz-García, A., Márquez-Rodríguez, J. & Ferreras-Romero, M. (2013) Discovery of *Nyctiophylax* (Trichoptera: Polycentropodidae) in Europe, with the description of a new species. *Freshwater Science*, 32, 169–175. https://doi.org/10.1899/12-014.1