

ZOOGEOGRAPHICAL ANALYSIS OF NEUROPTERA IN BULGARIA

A. POPOV

*National Museum of Natural History, Blvd Tsar Osvoboditel 1, BG-1000 Sofia, Bulgaria,
E-mail: nmhnd@bgcict.acad.bg*

The Bulgarian species of Neuroptera have been analysed according to origin, not on the basis of chorology. In Bulgaria, the more cold-loving of the Siberian elements inhabit the mountains only (*Symphorobius fuscescens*, *Micromus paganus*) and some ubiquitous from the same category occur in the whole country (*Chrysopa perla*, *Myrmeleon formicarius*). Most of the Siberian–Mediterranean species have a broad ecological plasticity (*Coniopteryx pygmaea*, *Chrysopa formosa*). Only species with a typical Holarctic distribution in North America, but not Siberian and Holomediterranean elements that are probably casually introduced in the Nearctic, are interpreted as Siberian–Nearctic. The Central European and the Central European–Mediterranean species are rare components in the Bulgarian fauna. Holomediterranean elements are about twice as numerous as the Pontomediterranean ones. The expansive Holomediterranean species prevail considerably over the stationary ones. Among the Pontomediterranean elements both groups are equally represented in the fauna of Bulgaria. They have a Balkan (*Dilar turcicus*, *Nedroledon anatolicus*) or an Anatolian (*Isoscelipteron fulvum*, *Hemerobius zernyi*) origin. The species of southern origin (the Mediterranean elements) comprise 52% of the Bulgarian fauna of Neuroptera and predominate slightly over the species of northern origin (originated from the Central European and from the Siberian centres).

Key words: Neuroptera, Bulgaria, zoogeography, arboreal, oreotundral, eremial

INTRODUCTION

Bulgaria belongs entirely to the Eurosiberian Zoogeographical Subregion, but its southern border coincides in some places with the border of the Mediterranean Zoogeographical Subregion (Fig. 1). Thus, there is a small zone, inhabited by a typical stationary Mediterranean fauna (but except for the most typical Mediterranean vegetation) and of a wider transitional zone, inhabited by a slightly expansive Mediterranean or the so called Submediterranean fauna.

The Bulgarian species of Neuroptera have been analysed in this review according to origin, not on the basis of chorology. On the one hand, this has been done in order to avoid the gaps caused by insufficient exploration of some areas in their ranges, as for instance European and especially Asiatic Russia notwithstanding the intensive studies during the last 15 years. On the other hand, chorological data take no account of the influence of anthropogenic factor in habitat changes

and passive transport of species, such as deforestation or accidental introduction of European species to America.

ZOOGEOGRAPHICAL CATEGORIES

The zoogeographical categories proposed by DE LATTIN (1967), ASPÖCK, ASPÖCK & RAUSCH (1977), ASPÖCK, ASPÖCK & HÖLZEL (1980) and MALICKY *et al.* (1983) were used in the determination of origin. All 113 species occurring in Bulgaria originated in the Holarctic Region including those whose present ranges extend across the boundaries of the latter. All three large ecological-zoogeographical complexes (biochores or biomes) of the Holarctic are represented in the Bulgarian fauna of Neuroptera, but with varying proportions. The eremial fauna and the orotundral fauna have one representative each in the country and all the other species are part of the arboreal fauna.

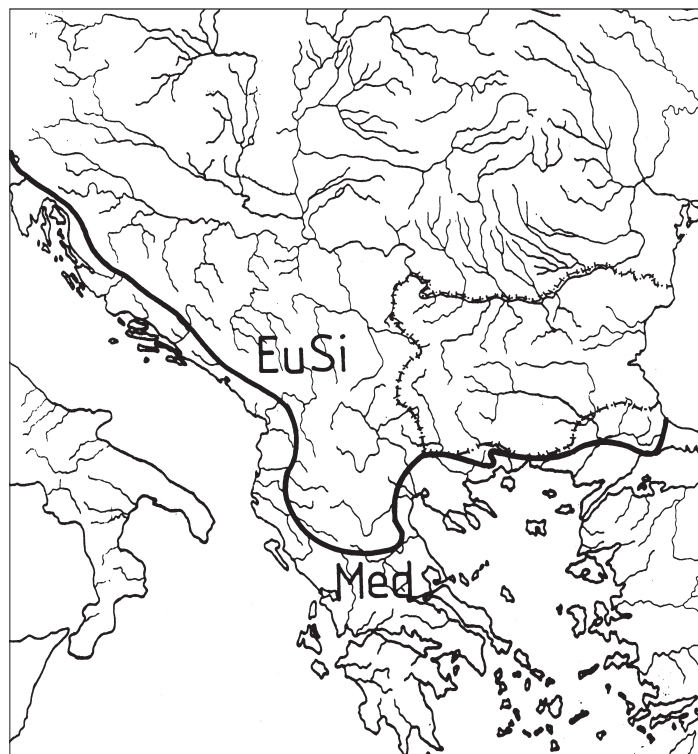


Fig. 1. Bulgaria (dashed line) and the border between the Eurosiberian (EuSi) and the Mediterranean (Med) zoogeographical subregions (solid line) on the Balkan Peninsula

Non-arboreal fauna

The only eremial species is the Bulgarian coniopterygid of the genus *Hemisemidalis* MEINANDER (Fig. 2), known by a unique unidentifiable female from Southwest Bulgaria (POPOV 1986). It is one of the few animal species occupying a borderline position between the arboreal fauna and the eremial fauna according to their present ranges. They inhabit both desert and semidesert territories in the Southern Palearctic and some arid and hot habitats in the Mediterranean Subregion.

The oreotundral fauna is also represented by a unique species – *Wesmaelius malladai* (NAVÁS). It can be put together (with some reservation) with the taxa with oreotundral, i.e. arctoalpine distribution, as well as with the oreal taxa on the basis of their origin. Concerning its range, *W. malladai* corresponds to the species

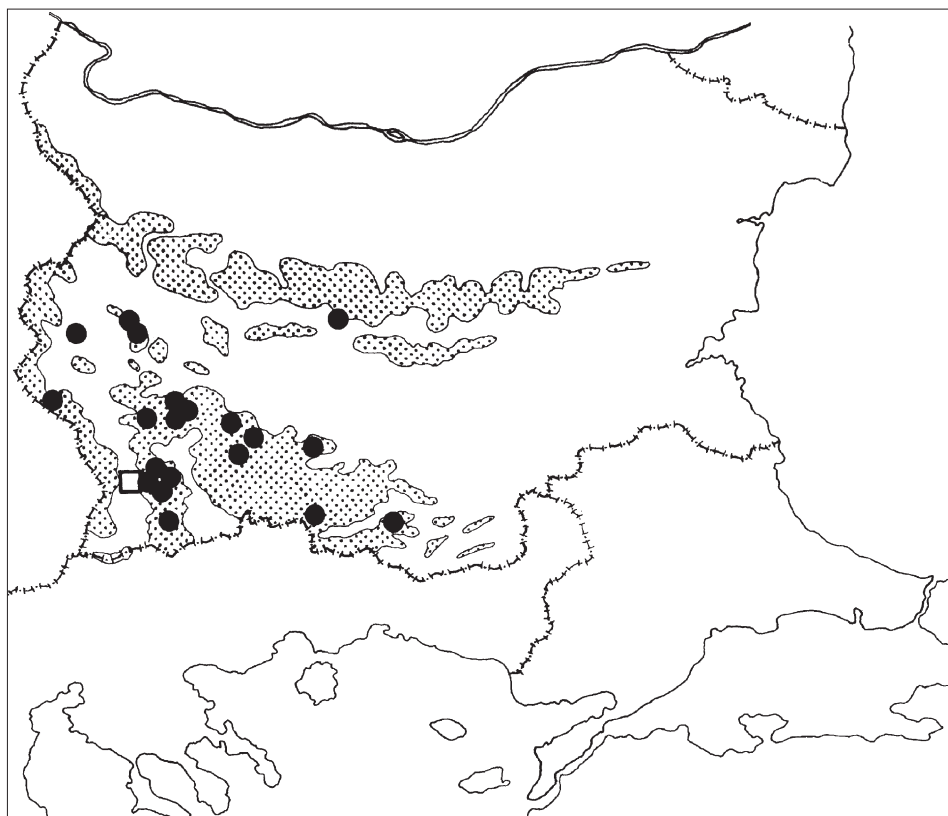


Fig. 2. Distribution of the eremial species *Hemisemidalis* sp. (□) and the oreotundral species *Wesmaelius malladai* (●) in Bulgaria. Areas above 1000 m altitude are shaded

with arctoalpine disjunction. The uncertainty arises from the fact that in Bulgaria (Fig. 2) it is typical for the coniferous belt with only a small part of its populations occurring above the timberline (POPOV 1997). Hence the conclusion that this hemerobiid probably occupies an intermediate position between the oreotundral arctoalpine and the arboreal boreomontane species (both terms confused and incorrectly united as “boreoalpine” in the past and sometimes also nowadays).

Siberian and Central European fauna

The remaining 98% of the Bulgarian species are arboreal. Their classification according to zoogeographical categories on the basis of origin is given on Table 1.

Part of the Siberian faunal elements consists of more cold-loving Neuroptera which inhabit only the mountains in Bulgaria, e.g. *Symphorobius fuscescens* (WALLENGREN), *Hemerobius pini* STEPHENS (Fig. 3). Others are ubiquitous and occur in the whole country, e.g. *Chrysopa perla* (LINNAEUS), *Myrmeleon formicarius* LINNAEUS. The Siberian fauna has penetrated into the Balkan Peninsula in two directions: along the Dinaric Alps (southward and eastward) and along the Carpathians (southward). The expansive Siberian elements are often incorrectly named “Eurosiberian faunal elements”. There are no such elements but only species with Eurosiberian distribution.

Most of the Siberian-Mediterranean species have a broad ecological plasticity and are widely spread in Bulgaria (*Coniopteryx pygmaea* ENDERLEIN, *Chrysopa formosa* BRAUER).

Table 1. Zoogeographical categories of Neuroptera in Bulgaria according to their origin

Categories	Species	%
Oreal	1	1
Siberian	22	19
Siberian–Mediterranean	10	9
Siberian–Nearctic	8	7
Central European	8	7
Central European–Mediterranean	5	4
Holomediterranean	38	34
Pontomediterranean	20	18
Eremial	1	1
Total	113	100

The species with Holarctic distribution are polycentric. They have an initial centre of dispersal in the Siberian Subregion (and a centre of development in the Manchurian Subregion) and an additional centre of dispersal in the Nearctic. Therefore, on the analogy of the Siberian-Mediterranean and the Central European-Mediterranean species, I propose for them the term Siberian-Nearctic. Only species with a typical Holarctic distribution in North America have been interpreted here as Siberian-Nearctic. Such are for instance the mountain species in Bulgaria *Helicoconis lutea* (WALLENGREN) and *Coniopteryx tineiformis* CURTIS as well as *Hemerobius humulinus* LINNAEUS, distributed mostly in the lowlands. Six Siberian and Holomediterranean elements have not been interpreted as Holarctic. Most likely they are casually introduced in the Nearctic, e.g. *Wesmaelius subnebulosus* (STEPHENS), *Psectra diptera* (BURMEISTER) and both *Conwentzia* ENDERLEIN.

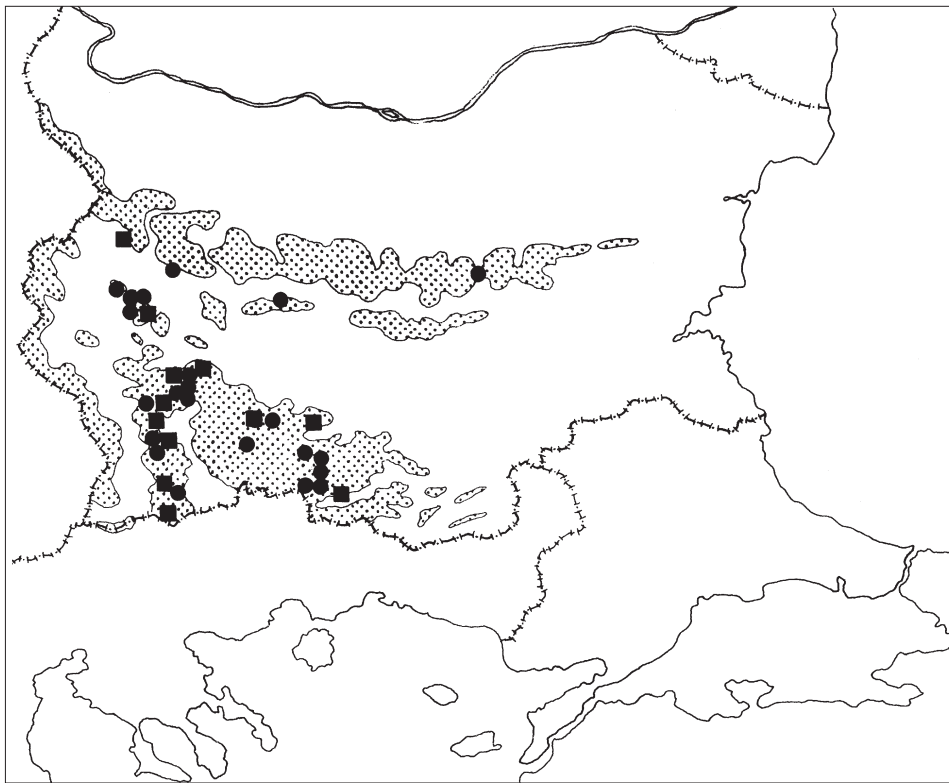


Fig. 3. Distribution of cold-stenothermic Siberian elements in Bulgaria: ● = *Hemerobius pini*, ■ = *Sympherobius fuscescens*. Areas above 1000 m altitude are shaded

The Central European species, e.g. *Hemerobius schedli* HÖLZEL, *Wesmaelius fassnidgei* (KILLINGTON), and the Central European–Mediterranean species, e.g. *Nothochrysa capitata* (FABRICIUS), *Euroleon nostras* (FOURCROY), are rare components in the Bulgarian fauna. Not one of them is among the first 45 most abundant species in Bulgaria. The category “Central European faunal elements” is often erroneously used in the faunistic and zoogeographical literature for the expansive Holomediterranean species. Another term, “European elements”, is also used for the same purpose, but such a group exists actually only as a chorological category and not as a group of faunal elements.

Mediterranean fauna

Nearly all the Mediterranean species in the Bulgarian fauna originated from the northern part of the Mediterranean Subregion. The Holomediterranean elements are about twice as numerous as the Pontomediterranean ones (Table 1).

The expansive (according to their chorology) Holomediterranean species prevail considerably over the stationary ones (Table 2). Their postglacial ranges have been extended northwards, e.g. *Coniopteryx borealis* TJEDER, *Osmylus fulvicephalus* (SCOPOLI), *Wesmaelius ravus* (WITHYCOMBE), *Dichochrysa flavifrons* (BRAUER), or eastwards, e.g. *Mantispa aphavexelte* ASPÖCK et ASPÖCK, *Chrysopa viridana* SCHNEIDER, *Myrmecaelurus trigrammus* (PALLAS). Few species have been dispersed in both directions, e.g. *Chrysopa nigricostata* BRAUER, *Acanthaclisis occitanica* (VILLERS).

Among the Pontomediterranean elements both groups (stationary and expansive species) are equally represented in the fauna of Bulgaria (Table 2). Their dispersal has been also directed northwards (*Chrysopa dorsalis* BURMEISTER, *Chrysopa commata* KIS et ÚJHELYI), eastwards, e.g. *Creoleon plumbeus* (OLIVIER), or in both directions, e.g. *Libelloides macaronius* (SCOPOLI). The expansion of some species westwards has reached the Adriatomediterranean secondary centre, e.g. *Dichochrysa clathrata* (SCHNEIDER), *Nicarinus poecilopterus* (STEIN), *Deleproc-*

Table 2. Mediterranean categories of Neuroptera in Bulgaria

Zoogeographical categories	Species	% of all Mediterranean species	% of all species
Expansive Holomediterranean	24	42	21
Stationary Holomediterranean	14	24	12
Expansive Pontomediterranean	10	17	9
Stationary Pontomediterranean	10	17	9
Total	58	100	51

tophylla australis (FABRICIUS). The Pontomediterranean elements have a Balkan origin (*Dilar turcicus* HAGEN, *Nedroledon anaticus* NAVÁS – Fig. 4), or an Anatolian origin (*Hemerobius zernyi* ESBEN-PETERSEN, *Isoscelipteron fulvum* COSTA – Fig. 5).

The strictly stationary Holomediterranean and Pontomediterranean elements inhabit only the warmest and driest arid habitats in Bulgaria, e.g. *Coniopteryx loipetsederi* ASPÖCK, *Helicoconis aptera* MESSNER, *Isoscelipteron fulvum* COSTA, *Hemerobius zernyi* ESBEN-PETERSEN, *Dichochrysa zelleri* (SCHNEIDER), *Myrmeleon noacki* OHM, *Nedroledon anaticus* NAVÁS (Fig. 6). They have penetrated into Bulgaria along three routes: along the valley of Struma River, along the Arda River Valley in East Rhodopes and along the southern part of the Bulgarian Black Sea Coast. Other stationary species occur as well in the Submediterranean territories (with less strong Mediterranean influence), i.e. the Thracian Lowland and the Subbalkan kettles in South Bulgaria, the northern part of the Bulgarian Black Sea

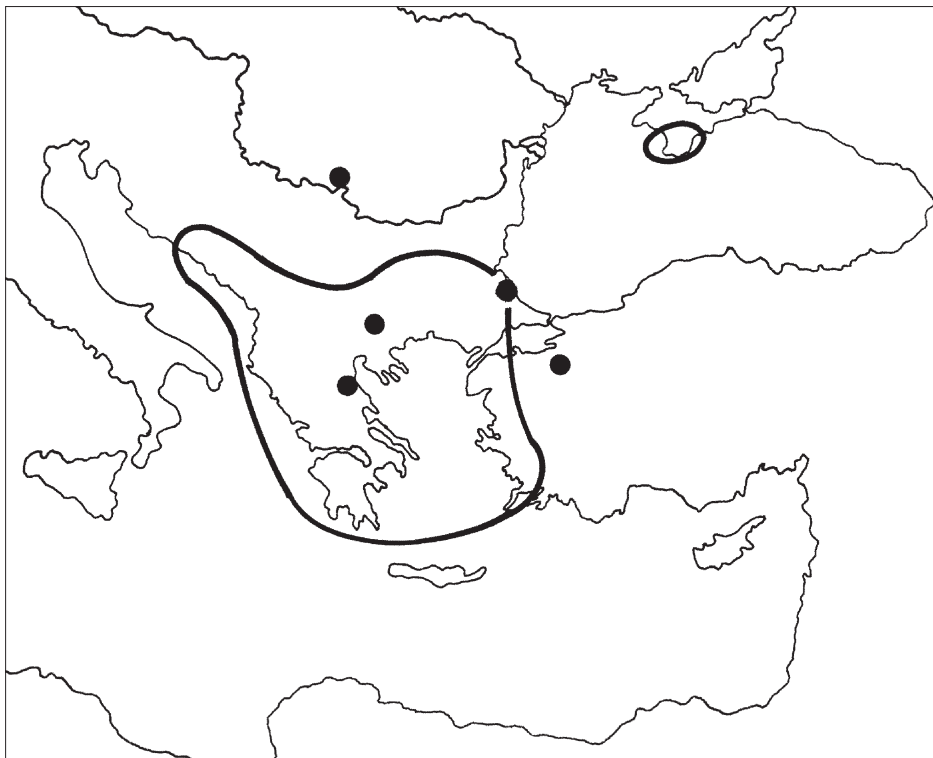


Fig. 4. Distribution of Pontomediterranean elements with a Balkan origin: encircled areas = *Dilar turcicus*, dots = *Nedroledon anaticus*

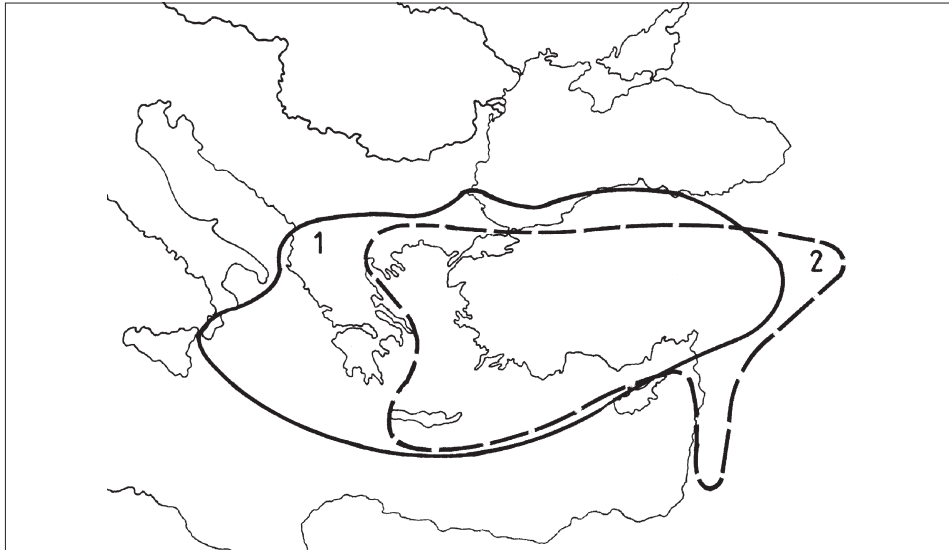


Fig. 5. Ranges of Pontomediterranean elements with an Anatolian origin: 1 = *Isoscelipteron fulvum*, 2 = *Hemerobius zernyi*

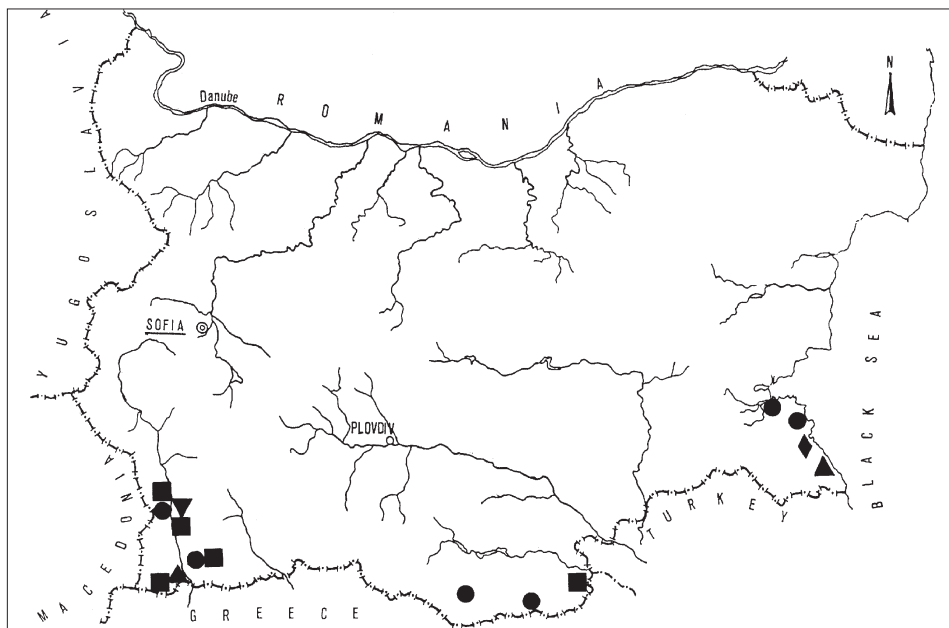


Fig. 6. Distribution of strictly stationary Mediterranean elements in Bulgaria, inhabiting only areas with strong Mediterranean influence in the country: ◆ = *Coniopteryx loipetsederi*, ● = *Isoscelipteron fulvum*, ▼ = *Hemerobius zernyi*, ■ = *Dichochrysa zelleri*, ▲ = *Nedroledon anatolicus*

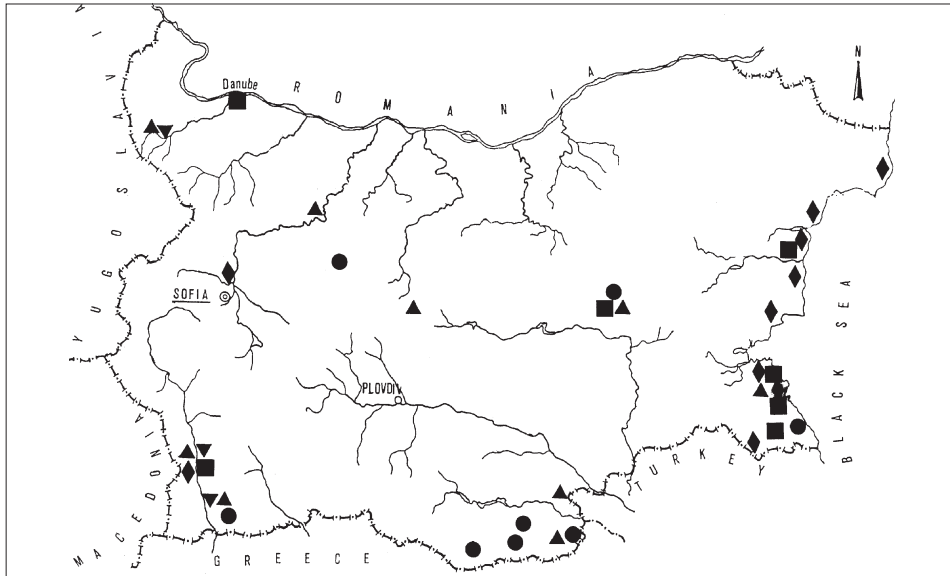


Fig. 7. Distribution of stationary Mediterranean elements in Bulgaria, inhabiting areas with Mediterranean and Submediterranean influence in the country: ● = *Coniopteryx drammonti*, ■ = *Mantispa aphavexelte*, ▲ = *Italochrysa italica*, ◆ = *Acanthaclisis baetica*, ▼ = *Delfimeus irroratus*

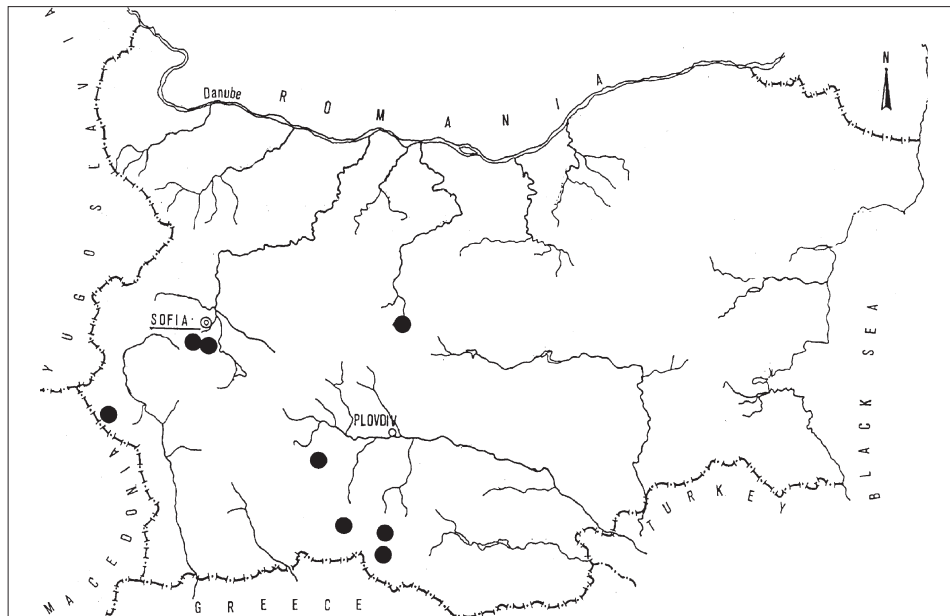


Fig. 8. Distribution of *Nevrothrus apatelios* in Bulgaria

Coast and some warm areas in North Bulgaria. Such species are *Coniopteryx drammonti* ROUSSET, *Mantispa aphavexelte* ASPÖCK et ASPÖCK, *Symphorobius klapaleki* ZELENÝ, *Italochrysa italica* (ROSSI), *Libelloides ottomanus* (GERMAR), *Delfimeus irroratus* (OLIVIER), *Acanthaclisis baetica* RAMBUR (Fig. 7). The only Balkan endemic species in Bulgaria is *Nevrorthus apatelios* ASPÖCK, ASPÖCK et HÖLZEL (Fig. 8). In contrast to the thermophilous Pontomediterranean species, it is a unique stenotopic inhabitant of cold mountain rivers at an altitude of 900–1000 m.

CONCLUSION

The species of Neuroptera occurring in Bulgaria can be divided into groups that originated, respectively, to the north and the south of the country. The species of southern origin are the Mediterranean elements and the eremial species. The species of northern origin are all the remaining categories originating from the Central European and the Siberian centres. The species of southern origin comprise 52% of the Bulgarian fauna of Neuroptera and slightly predominate over the species of northern origin.

REFERENCES

- ASPÖCK, H., ASPÖCK, U. & HÖLZEL, H. (1980) *Die Neuropteren Europas*. I. Goecke & Evers, Krefeld, 495 pp.
- ASPÖCK, H., ASPÖCK, U. & RAUSCH, H. (1977) Polyzentrische Ausbreitung eines "sibirisch-mediterranen" Faunenelements am Beispiel der polytypischen Kamelhalsfliege *Raphidia ophiopsis* L. (Neuroptera, Raphidioptera, Raphidiidae). *Z. Arbeitsgem. Österr. Ent.* **28**: 89–105.
- LATTIN, G. DE (1967) *Grundriss der Zoogeographie*. Hochschullehrbücher für Biologie 12. G. Fischer Verlag, Stuttgart, 602 pp.
- MALICKY, H., ANT, H., ASPÖCK, H., JONG, R. DE, THALER, K. & VARGA, Z. (1983) Argumente zur Existenz und Chorologie mitteleuropäischer (extramediterran-europäischer) Faunen-Elemente. *Entom. Gener.* **9**: 101–119.
- POPOV, A. (1986) Coniopterygiden aus Bulgarien (Neuroptera). *Ent. Nachr. Berichte* **30**: 167–171.
- POPOV, A. (1997) Neuroptera. Pp. 43–44. In SAKALIAN, V. (ed.) *Endemic and relict insects in the Pirin National Park, Bulgaria*. Pensoft Publ., Sofia, Moscow.

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