2011	Heteropterus Revista de Entomología **Heteropterus Rev. Entomol.**	**11(2):** 351-358

ISSN: 1579-0681

True bugs collected on snow in Vitosha Mt., Bulgaria. A proposed method for investigation of flight activity and dispersal ability of Heteroptera (Hemiptera)(*)

N. SIMOV

National Museum of Natural History; 1 Tsar Osvoboditel Blvd.; 1000 Sofia; Bulgaria; E-mail: myrmedobia@gmail.com

Abstract

Ninety-eight Heteroptera species were found on snow in the subalpine zone (*i.e.*, 1830-2290 m) of Vitosha Mountain (Bulgaria) during the spring and early summer. However, only 24 of these species inhabit this altitude, whereas the ranges of the remaining species are in the lower parts of the mountain. Four species inhabit southern localities in Bulgaria or the Balkan Peninsula, more than 200 km away from the investigated area. Insects of the species inhabiting the subalpine zone presumably fall on the snow after an active flight, whereas those of the species inhabiting lower elevations are probably transported by ascending winds. The species known from distant southern localities may have been transported by Mediterranean cyclones. The finding, using our method, of so a large number of Heteroptera species suggests that regular collections on snow during the spring and early summer may be a productive approach to investigating the flight activity and dispersal ability of Heteroptera.

Key words: Heteroptera, insects on snow, spring, summer, mountains.

Resumen

Chinches recolectadas sobre la nieve en la Montaña Vitosha, Bulgaria. Propuesta de un método para investigar la actividad de vuelo y la capacidad dispersiva en Heteroptera (Hemiptera)

En la zona subalpina (*i.e.*, 1830-2290 m) de la Montaña Vitosha se han encontrado 98 especies de heterópteros sobre la nieve durante la primavera y el verano temprano. Solo 24 de dichas especies habitan esas altitudes, mientras que el resto se encuentran en las partes más bajas de la montaña. Cuatro especies son conocidas de hábitats más meridionales en Bulgaria o en la Península Balcánica, a una distancia de, al menos, 200 km de la región investigada. Para las especies habitantes de la zona subalpina se puede suponer que se han hallado sobre la nieve después de un vuelo activo. El resto probablemente hayan sido elevadas por vientos ascendentes. Las especies que hasta la actualidad sólo se conocían de localidades lejanas al sur de la montaña probablemente hayan sido llevadas por masas aéreas ciclónicas mediterráneas. El hallazgo de tantas especies de heterópteros de esta manera nos hace pensar que el muestreo periódico en la nieve de las montañas durante primavera y verano constituye un buen método para investigar tanto su actividad de vuelo como su capacidad dispersiva.

Palabras clave: Heteroptera, insectos sobre nieve, primavera, verano, montañas.

Laburpena

Elur gainean bildutako zimitzak Vitosha Mendian, Bulgaria. Heteropteroen (Hemiptera) hegaldi--jarduera eta sakabanatze-gaitasuna ikertzeko metodo baten proposamena

Vitosha Mendiaren eremu subalpetarrean (*i.e.*, 1830-2290 m) 98 heteroptero espezie aurkitu dira elurraren gainean udaberrian eta uda goiztiarrean zehar. Horietatik 24 baino ez dira altitude horietan bizi, gainontzeko guztiak mendiaren alde baxuagoetakoak direlarik. Lau espezie Bulgariako edo Balkandar Penintsulako hegoalderagoko habitatetan dira ezagunak, ikerketa-eremutik 200 km-ra gutxienez. Eremu subalpetarrean bizi diren espezieen kasuan, badago

(*) Dedico este trabajo a mi colega y amigo Prof. Jordi Ribes en ocasión de su 80 cumpleaños y como reconocimiento de su valiosa contribución al conocimiento de los Heteroptera de la Región Mediterránea.

pentsatzea hegaldi aktibo baten ondorioa dela elurraren gainean aurkitzea. Beste espezieen kasuan, baliteke goranzko haizeek haraino igo izana. Izan ere, orain arte mendi honetatik urrutiko (hegoalderantz, alegia) lekuetan besterik ezagutzen ez ziren espezieak mediterranear aire-masa ziklonikoek garraiatuko zituzten bertara. Hainbeste zimitz espezie modu honetan aurkitu izanak hurrengo ondoriora garamatza: Mendietako elurretan udaberri eta udan garatu daitekeen heteropteroen laginketa metodo egokia dela ikertzeko bai haien hegaldi-jarduera bai eta haien sakabanatze-gaitasuna ere.

Gako-hitzak: Heteroptera, intsektuak elurretan, udaberria, uda, mendiak.

Introduction

Heteroptera found on snow in the late autumn or early spring is a known phenomenon (Hågvar, 2007). However, these observations are less frequent in the late spring and summer. This is probably because heteropterists tend to not expect to find representatives of this thermophilic insect group in snow habitats. Some of the few reported observations of true bugs on snow were published by Josifov (1990) (4 species) and Simov and Antonov (2006) (1 species).

The goal of this paper is to present and discuss the results from a study of Heteroptera species found on snow in the subalpine zone of Vitosha Mountain (Mt.) during the spring and summer. The possibility of using these observations as a method of investigation of the flight activity and dispersal ability of Heteroptera is also discussed.

Materials and methods

Vitosha is a dome-shaped mountain in western Bulgaria. Its average height is 1400 m above the surroundings. The highest point of the mountain is Cherni Vrah Peak (2290 m a.s.l.). All vegetation belts that are characteristic of Bulgarian mountains are also present on Vitosha Mountain (Fig. 1), except for the alpine belt. The highest parts of Vitosha are typically covered by snow until April, with big snow patches still present in May (Fig. 2). The size of these patches decrease substantially by the end of May. In years with cool springs, isolated snow patches remain in the northeastern part of the mountain until June.

Compared to other mountains in Bulgaria, the Heteroptera of Vitosha Mt. are relatively well studied. Data about the distribution of 315 Heteroptera species across vegetation belts, as well as about the trophic specialization and zoogeographical characteristics of species found above the belt of mixed deciduous forests were published by Josifov (1990).

The present material was collected in the subalpine zone of Vitosha Mt. (*i.e.*, from 1830 to 2290 m) during 2006-2010. While on snow, true bugs lose their ability to move but remain alive for a considerable period of time (*e.g.*, 1–2 days). Because of the darker colour of their bodies, true bugs warm up more than the surrounding snow, which melts and encases them, making their movement even more difficult. The collection was performed by careful observation of the snow surface of different snow patches and fields in northeastern and southwestern parts of the mountain. Nine sample plots, each with an area of 25 m^2, were established in some of the investigated snow patches and fields in order to gain information about the density of some heteropterans. Sample plots were surveyed once in the first decade of May. The collection time per snow patch or sample plot was 1.5–2 h. Materials collected by M. Josifov in 1947 and 1958 (16 species) and M. Langourov in 2000 and 2003 (5 species) were also included.

Results

Ninety-eight species of Heteroptera were found on snow in the subalpine zone of Vitosha Mt (*i.e.*, 1830-2290 m) during the spring and early summer (Table 1). The ranges of only 24 of these species extend to this altitude, whereas the remaining 74 species inhabit lower parts of the mountain. Twenty-five species inhabit only the belt of mixed oak forests located below 1200 m a.s.l., and 45 species inhabit the beech and spruce belts. Nine species of the latter group had not been found previously above the boundaries of the beech belt. Four of the species we observed (*Myrmecoris gracilis*, *Nabis* (*Tropiconabis*) *capsiformis*, *Caenocoris nerii* and *Spilostethus pandurus*) inhabit distant

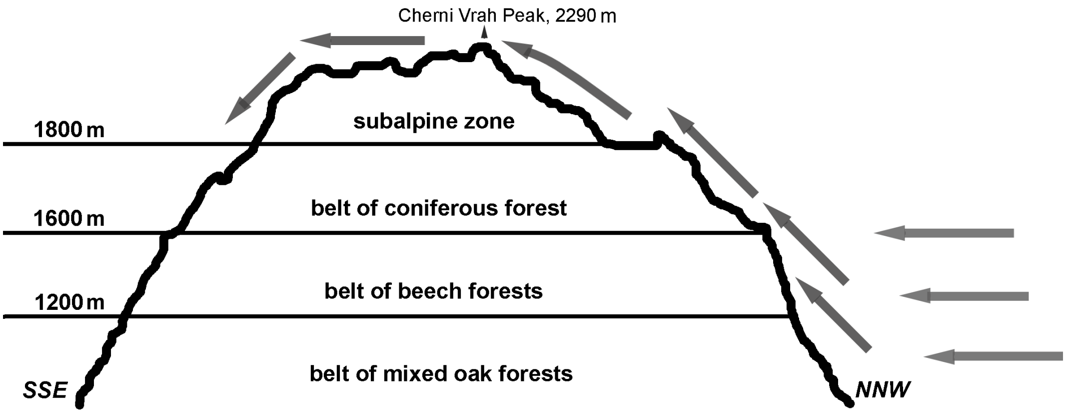

FIGURE 1. Silhouette of Vitosha Mt. with vegetation belts and sketch of the generation of ascending winds.

FIGURE 2. Snow cover on Vitosha Mt. in the first decade of May. Photograph taken from the city center of Sofia.

(in some cases, more than 200 km away) southern localities in Bulgaria or the Balkan Peninsula. *Spilostethus pandurus* is rarely found in the lowlands in the southern part of the country (Josifov, 1986, 1990). *Myrmecoris gracilis* and *Nabis* (*Tropiconabis*) *capsiformis* are known by single specimens from southwestern Bulgaria and the southern Black Sea coast (Josifov, 1990, 1999; Strawiński, 1959).

The observation of *Caenocoris nerii*, which is trophically associated with the plant *Nerium oleander* L., is particularly interesting. The closest localities of *C. nerii* on the Balkan Peninsula are on the Aegean Sea coast and on the North Aegean islands (Thasos) in Greece, where *N. oleander* is also distributed (pers. obs.). *C. nerii* had only been found once in Bulgaria (Josifov, 1999): A single specimen was observed in aggregation of *Tropidothorax leucopterus* in Rupite, 180 km south of Vitosha Mt.

Discussion

The species inhabiting the subalpine zone of Vitosha Mt. presumably fell on the snow after an active flight. Active transport of the remaining species we observed, however, seems unlikely. In some cases, the likely transport was over more than 1000 m of elevation. For example, *Dryophilocoris* (*Camarocyphus*) *luteus*, *Dryophilocoris* (*Dryophilocoris*) *flavoquadrimaculatus*, *Harpocera hellenica* and *H. thoracica* are trophically associated with oaks (Josifov, 1978), which occur at elevations up to 1250 m, predominantly in the western part of the mountain. Western winds are predominant in this part of the mountain (Fig. 3). Thus, Heteroptera were probably transported from their normal habitats to higher-elevation snow fields or patches by ascending winds, caused by the contact of the air currents against the mountain dome elevated above

Species	*Altitude of records* (*m*)			*Months of records*				*Vegetation belts inhabited*				
	1800-1950	**1950-2100**	**2100-2290**	**III**	**IV**	**V**	**VI**	**BQF**	**BFF**	**BPF**	**SAZ**	**OUT**
Saldidae												
Chartoscirta cocksii (Curtis, 1835)	●					●			●	●		
Tingidae												
Catoplatus carthusianus (Goeze, 1835)	●					●		●				
Copium clavicorne (Linnaeus, 1758)	●					●		●				
Dictyla rotundata (Herrich-Schäffer, 1835)			●			●		●				
Tingis (*Tingis*) *auriculata* (A. Costa, 1847)	●					●		●				
Miridae												
Deraeocoris (*Deraeocoris*) *ventralis* Reuter, 1904	●						●	●				
Capsus ater (Linnaeus, 1758)		●	●			●	●	●	●	●		
Polymerus (*Poeciloscytus*) *unifasciatus* (Fabricius, 1794)	●						●	●				
Leptopterna dolabrata (Linnaeus, 1758)	●						●	●	●	●		
Myrmecoris gracilis (R.F. Sahlberg, 1848)	●						●					●
Stenodema (*Stenodema*) *holsata* (Fabricius, 1787)	●						●	●	●	●	●	
Stenodema (*Stenodema*) *laevigata* (Linnaeus, 1758)	●	●				●	●	●	●	●	●	
Stenodema (*Stenodema*) *virens* (Linnaeus, 1767)		●				●			●	●	●	
Dryophilocoris (*Camarocyphus*) *luteus* (Herrich-Schäffer, 1835)		●					●	●				
Dryophilocoris (*Dryophilocoris*) *flavoquadrimaculatus* (De Geer, 1773)	●	●				●		●				
Systellonotus triguttatus (Linnaeus, 1767)	●						●	●	●			
Amblytylus nasutus (Kirschbaum, 1856)	●						●	●	●			
Chlamydatus (*Euattus*) *pulicarius* (Fallén, 1807)			●			●		●	●	●	●	
Chlamydatus (*Euattus*) *pullus* (Reuter, 1870)	●					●		●	●	●	●	
Harpocera hellenica Reuter, 1876		●				●		●				
Harpocera thoracica (Fallén, 1807)	●	●				●	●	●				
Hoplomachus thunbergii (Fallén, 1807)	●						●	●	●			
Plagiognathus (*Plagiognathus*) *chrysanthemi* (Wolff, 1804)	●						●	●	●	●		
Psallus (*Psallus*) *varians* (Herrich-Schäffer, 1841)	●						●	●	●	●		
Nabidae												
Nabis (*Nabis*) *pseudoferus* Remane, 1949	●					●		●	●	●	●	
Nabis (*Nabis*) *punctatus* A. Costa, 1847	●				●			●	●	●		
Nabis (*Tropiconabis*) *capsiformis* Germar, 1838		●				●						●
Anthocoridae												
Acompocoris alpinus Reuter, 1875	●					●				●		
Acompocoris pygmaeus (Fallén, 1807)	●						●			●		
Anthocoris nemoralis (Fabricius, 1794)	●						●	●	●			
Aradidae												
Aneurus (*Aneurodes*) *avenius avenius* (Dufour, 1833)	●	●				●	●	●				
Aradus aterrimus Fieber, 1864		●				●				●		
Berytidae												
Berytinus (*Berytinus*) *clavipes* (Fabricius, 1775)	●	●				●	●	●				
Berytinus (*Berytinus*) *minor* (Herrich-Schäffer, 1835)	●						●	●	●	●	●	
Berytinus (*Lizinus*) *montivagus* (Meyer-Dür, 1841)	●					●		●	●	●		
Berytinus (*Lizinus*) *striola* (Ferrari, 1874)		●				●		●				
Lygaeidae *sensu lato*												
Caenocoris nerii (Germar, 1847)	●	●				●						●
Lygaeus equestris (Linnaeus, 1758)		●				●		●	●	●	●	
Spilostethus pandurus (Scopoli, 1763)	●					●						●
Nysius cymoides (Spinola, 1837)		●				●		●	●	●		
Nysius senecionis (Schilling, 1829)	●					●		●				
Cymus claviculus (Fallén, 1807)			●			●		●	●	●		
Macroplax preyssleri (Fieber, 1837)	●		●			●	●	●	●	●		
Metopoplax origani (Kolenati, 1845)	●	●					●	●	●	●		
Oxycarenus (*Euoxycarenus*) *pallens* (Herrich-Schäffer, 1850)	●						●	●	●			
Kleidocerys resedae (Panzer, 1797)	●	●				●	●	●	●	●		
Tropistethus holosericus (Scholtz, 1846)	●						●	●	●	●		

TABLE 1 (1/2). List of Heteroptera species found on snow in the spring and early summer on Vitosha Mt. (BQF: Belt of mixed oak forests; BFF: Belt of beech forests; BPF: Belt of coniferous forests; SAZ: Subalpine zone; OUT: Distributed outside Vitosha Mt.).

Species	*Altitude of records (m)* 1800--1950	1950--2100	2100--2290	*Months of records* III	IV	V	VI	*Vegetation belts inhabited* BQF	BFF	BPF	SAZ	OUT
Drymus (*Sylvadrymus*) *sylvaticus* (Fabricius, 1775)	●					●		●	●	●		
Eremocoris fenestratus (Herrich-Schäffer, 1839)		●		●				●	●			
Gastrodes abietum Bergroth, 1914	●	●	●	●	●	●	●			●		
Gastrodes grossipes (De Geer, 1773)			●		●	●		●	●	●		
Scolopostethus thomsoni Reuter, 1875	●		●			●	●	●	●	●		
Taphropeltus contractus (Herrich-Schäffer, 1835)	●					●		●	●	●	●	
Emblethis griseus (Wolff, 1802)	●						●	●	●	●		
Emblethis verbasci (Fabricius, 1803)	●						●	●				
Trapezonotus (*Trapezonotus*) *arenarius* (Linnaeus, 1758)	●					●		●	●			
Trapezonotus (*Trapezonotus*) *desertus* Seidenstücker 1951			●			●					●	
Icus angularis Fieber, 1861	●					●		●				
Megalonotus chiragra (Fabricius, 1794)			●		●			●	●	●	●	
Megalonotus dilatatus (Herrich-Schäffer, 1840)	●						●			●	●	
Megalonotus emarginatus (Rey, 1888)	●					●		●	●			
Megalonotus sabulicola (Thomson, 1870)			●			●			●	●	●	
Sphragisticus nebulosus (Fallén, 1807)			●			●				●		
Raglius alboacuminatus (Goeze, 1778)			●		●			●	●	●		
Rhyparochromus pini (Linnaeus, 1758)	●					●		●	●	●	●	
Stygnocoris fuligineus (Geoffroy, 1785)			●			●		●	●	●		
Rhopalidae												
Corizus hyoscyami (Linnaeus, 1758)	●					●		●	●	●	●	
Rhopalus (*Rhopalus*) *parumpunctatus* Schilling, 1829			●		●			●	●	●	●	
Coreidae												
Bathysolen nubilus (Fallén, 1807)	●						●	●	●	●	●	
Ceraleptus gracilicornis (Herrich-Schäffer, 1835)	●	●				●	●	●				
Spathocera laticornis (Schilling, 1829)	●					●		●	●	●		
Spathocera lobata (Herrich-Schäffer, 1840)	●					●		●	●	●		
Ulmicola spinipes (Fallén, 1807)	●					●				●	●	
Alydidae												
Camptopus lateralis (Germar, 1817)		●				●		●	●	●		
Cydnidae												
Sehirus morio (Linnaeus, 1761)	●						●	●				
Microporus nigrita (Fabricius, 1794)	●					●		●				
Thyreocoridae												
Thyreocoris fulvipennis (Dallas, 1851)	●					●	●	●	●	●		
Thyreocoris scarabaeoides (Linnaeus, 1758)	●						●	●	●	●		
Acanthosomatidae												
Acanthosoma haemorrhoidale (Linnaeus, 1758)	●	●	●			●	●	●	●			
Elasmostethus interstinctus (Linnaeus, 1758)	●						●			●		
Elasmucha fieberi (Jakovlev, 1865)	●	●				●	●			●		
Elasmucha grisea (Linnaeus, 1758)	●						●		●	●		
Scutelleridae												
Odontoscelis (*Odontoscelis*) *fuliginosa* (Linnaeus, 1761)	●						●	●				
Eurygaster austriaca (Schrank, 1776)	●	●				●	●	●				
Pentatomidae												
Jalla dumosa (Linnaeus, 1758)	●					●		●				
Rhacognatus punctatus (Linnaeus, 1758)	●					●				●	●	
Troilus luridus (Fabricius, 1775)	●	●	●		●	●	●		●	●		
Zicrona caerulea (Linnaeus, 1758)	●					●		●	●	●		
Aelia acuminata (Linnaeus, 1758)	●				●		●	●	●	●	●	
Aelia rostrata Boheman, 1852	●					●	●	●	●	●	●	
Aelia sibirica Reuter, 1884	●					●				●	●	
Palomena prasina (Linnaeus, 1761)			●		●			●	●	●		
Pentatoma rufipes (Linnaeus, 1758)			●			●		●	●	●		
Sciocoris (*Aposciocoris*) *homalonotus* Fieber, 1851	●						●	●				
Sciocoris (*Aposciocoris*) *umbrinus* (Wolff, 1804)	●						●	●				
Sciocoris (*Sciocoris*) *cursitans* (Fabricius, 1794)	●						●	●	●	●	●	
Eurydema (*Eurydema*) *oleracea* (Linnaeus, 1758)	●	●				●		●	●	●	●	
Eurydema (*Rubrodorsalium*) *ventralis* Kolenati, 1846			●			●		●				

Table 1 (2/2). List of Heteroptera species found on snow in the spring and early summer on Vitosha Mt. (BQF: Belt of mixed oak forests; BFF: Belt of beech forests; BPF: Belt of coniferous forests; SAZ: Subalpine zone; OUT: Distributed outside Vitosha Mt.).

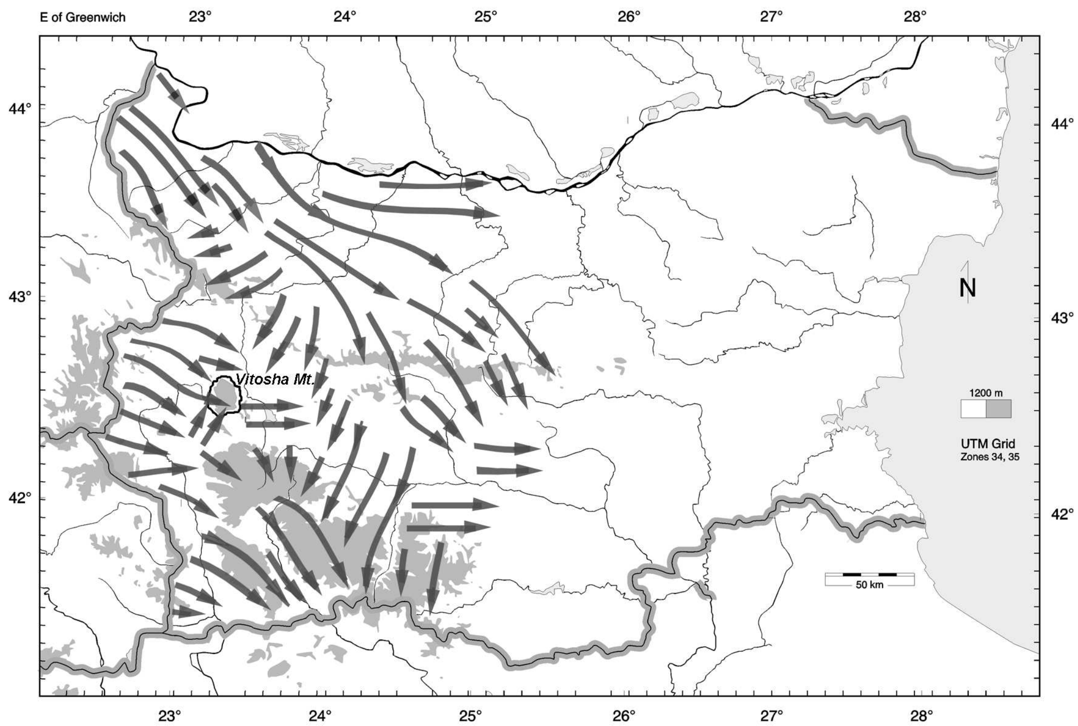

FIGURE 3. Map of prevailing winds in western Bulgaria (based on Velev, 2002b).

the adjacent territories (Fig. 1). This wind-mediated transport would explain the abundant presence (*e.g.*, up to 3 *H. thoracica* individuals per m^2; 24.05.2006; 1830 m a.s.l.) of oak-associated and other lower-elevation Heteroptera on snow fields and patches.

The observed species that inhabit distant southern localities were probably transported by Mediterranean cyclones, which are characteristic of this time of the year. Before reaching Bulgaria, Mediterranean cyclones pass over the southern Balkan Peninsula (Fig. 4), where these Heteroptera species can be found. Although this long-distance transport creates opportunities for migration and colonization of new habitats by low-elevation and/or southern species of Heteroptera, their survival in the harsh subalpine habitats is probably rare.

Low-elevation and southern true bugs are probably captured by wind currents during active flight. Except for the majority of species in the Miridae family, the species we observed were represented by overwintered individuals. During the warmer spring days, overwintered individuals migrate actively. Similar behaviour was observed for some of these species during the autumn, when, while actively flying, they were fed on by the pallid swift (*Apus pallidus*) (Simov and Antonov, 2006).

In contrast, true bugs from dendrobiont species might have been blown away from the trees they inhabit and then uplifted by ascending wind currents. However, this hypothesis is inconsistent with the observation that these species were not found in greater abundance following strong wind storms.

It is possible that the reflecting snow patches act as big light traps and attract insects. This hypothesis was assessed by a survey of lacewings and their relatives (*i.e.*, because they are large and easy to observe). Like true bugs, lacewings and their relatives are attracted by light. However, similar numbers of these insects were found on and outside of snow patches, within each site. Therefore, Heteroptera are probably found preferentially on snow surfaces in the subalpine zone because they can be seen more easily on a white background.

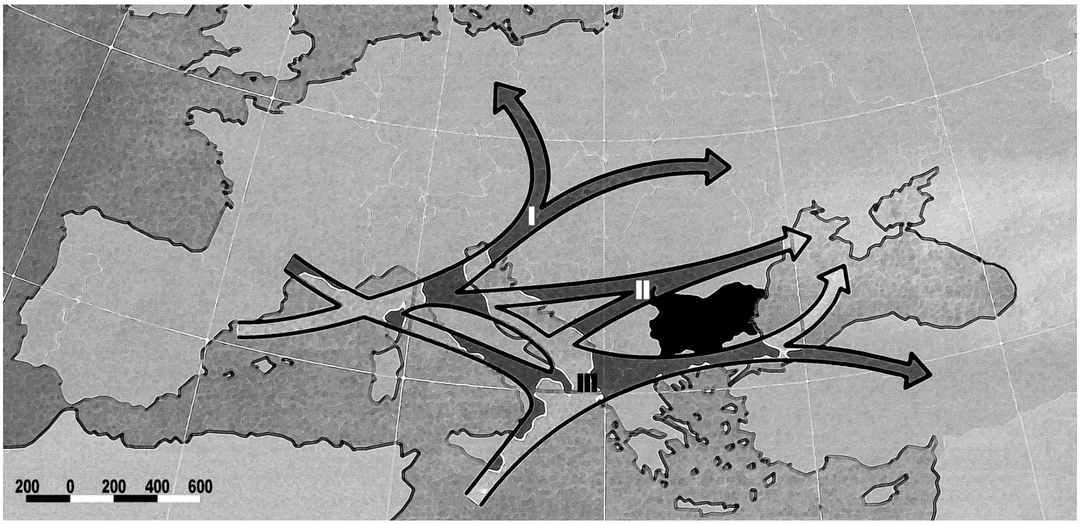

FIGURE 4. Schematic diagram of the tracks of Mediterranean cyclons (based on Velev, 2002a).

Several problems were encountered with collecting insects on snow. First, snow cover is very dynamic in the spring and early summer. In cooler springs there are enough snow patches suitable for collection of insects. However, because of warm spells and the foehn wind (also called «snow eater»), which is characteristic of Vitosha Mt., snow patches can be melted within 3–4 days. When these conditions occur, there are only 2-3 isolated snow patches in the northeastern part of the mountain. This makes investigating the dynamics of Heteroptera on snow in different parts of the mountain practically impossible. Second, the investigation was affected by the presence of bird species. The water pipit (*Anthus spinoletta*) and black redstart (*Phoenicurus ochruros*), for example, are common in the subalpine zone of Vitosha Mt. and often feed on insects on snow. The presence of a single pair of birds caused a significant reduction in the numbers of true bugs, cicadas, lacewings and their relatives, and butterflies on a substantial area of snow. Birds probably prefer these insects to beetles, the abundance of which did not appear to be affected by the presence of birds. Finally, because of their soft exoskeleton, Heteroptera do not remain on the snow after being exposed to frequent and prolonged rains.

Records of true bugs on snow during the spring and early summer are not unique to Vitosha Mt. There are data (although currently scarce) about Heteroptera found on snow during the spring and summer in the Alps (E. Heiss *in litt.*) and Tatra Mountains (P. Kment *in litt.*). The results of this study suggest that regular collections on snow during the spring and summer in different high mountains could provide information about the dispersal ability and flight activity of many true bug species. These collections may also help elucidate the mechanisms of rapid dispersal of some invasive alien species (*e.g.*, *Leptoglossus occidentalis* Heidemann, 1910 (Lis *et al.*, 2008; Rabitsch, 2008)). Indirectly, these studies would also give an indication about the likely speed of response of Heteroptera to past and ongoing climate change and provide insights into the dynamics of local fauna.

Acknowledgements

I thank the late Dr. M. Josifov for his encouragement of heteropteran research and of this project. I would also like to thank E. Heiss, H. Günther, P. Kment and M. Langourov for valuable comments on an earlier version of this manuscript and for providing material and data. The gentle language editing by G. Slavov and S. Pagola-Carte is gratefully acknowledged. This study was partly supported by grant DO-02-259/08 of the Bulgarian Ministry of Education and Science.

References

HÅGVAR S. 2007. Why do some Psylloidea and Heteroptera occur regularly on snow? *Norwegian Journal of Entomology* **54**: 3-9.

JOSIFOV M. 1978. Dendrobionte und dendrophile Halbflugler (Heteroptera) an der Eiche in Bulgarien. *Acta Zoologica Bulgarica* **9**: 3-12. [In Bulgarian, with German summary]

JOSIFOV M. 1986. Verzeichnis der von der Balkanhalbinsel bekannten Heteropterenarten (Insecta, Heteroptera). *Faunistische Abhandlungen Staatliches Museum für Tierkunde in Dresden* **14(6)**: 61-93.

JOSIFOV M. 1990. Heteroptera (Insecta, Heteroptera) in the belts of the beech, spruce and the subalpine belt of Vitoša. *Fauna of Southwestern Bulgaria* **3**: 88-101. [In Bulgarian, with English Summary]

JOSIFOV M. 1999. Heteropterous insects in the Sandanski-Petrich Kettle, southwestern Bulgaria. *Historia Naturalis Bulgarica* **10**: 35-66.

LIS JA, LIS B, GUBERNATOR J. 2008. Will the invasive western conifer seed bug *Leptoglossus occidentalis* Heidemann (Hemiptera: Heteroptera: Coreidae) seize all of Europe? *Zootaxa* **1740**: 66-68.

RABITSCH W. 2008. Alien true bugs of Europe (Insecta: Hemiptera: Heteroptera). *Zootaxa* **1827**: 1-44.

SIMOV N, ANTONOV A. 2006. First data of the true bugs (Heteroptera) in the diet of the second brood of pallid swift (*Apus pallidus*) in Bulgaria. *Entomologist's Monthly Magazine* **142**: 243-245.

STRAWIŃSKI K. 1959. Heteroptera for the fauna of Bulgaria. *Bulletin de l'Institut de Zoologie et Musée* **8**: 77-82.

VELEV S. 2002a. Atmosphaeric circulation (pp.: 141-142, 169). In: Kopralev I (Ed.). *Geography of Bulgaria. Physical geography and socio-economic geography*. Institut of Geography – BAS and ForKom Publishing House. Sofia. [In Bulgarian]

VELEV S. 2002b. Atmosphaeric pressure and wind (pp.: 149-150, 172). In: Kopralev I (Ed.). *Geography of Bulgaria. Physical geography and socio-economic geography*. Institut of Geography – BAS and ForKom Publishing House. Sofia. [In Bulgarian]

Received / Recibido / Hartua: 24/01/2011
Accepted / Aceptado / Onartua: 26/04/2011
Published / Publicado / Argitaratua: 15/12/2011