

New records of Coccinellidae (Coleoptera) from the Republic of North Macedonia

Sami Karjalainen

Neidonpuistontie 6 D 8, FIN-02400 Kirkkonummi, Finland; E-mail: sk@korento.net

Abstract: The fauna of the family Coccinellidae (Coleoptera) in the Republic of North Macedonia is poorly studied; only 44 species have been reported so far. The present study provides data on 48 species of the family Coccinellidae recorded during short trips in North Macedonia in 2018 and 2019. Ten species are recorded for the first time in the Republic of North Macedonia: *Aphidecta obliterata* (L., 1758), *Coccidula rufa* (Herbst, 1783), *Hyperaspis campestris* (Herbst, 1783), *Myrrha octodecimguttata* (L., 1758), *Myzia oblongoguttata* (L., 1758), *Nephus bisignatus* (Boheman, 1850), *N. quadrimaculatus* (Herbst, 1783), *Scymnus impexus* Mulsant, 1850, *Sospita vigintiguttata* (L., 1758) and *Stethorus gilvifrons* (Mulsant, 1850).

Key words: faunistics, ladybirds, ladybugs, insects, Balkan Peninsula

Introduction

JORDANOVA (2002) compiled literature records and new data in a list of 32 species of the family Coccinellidae from the Republic of North Macedonia. JADWISZCZAK et al. (2011) studied ladybirds in the neighbourhood of Ohrid and Prespa Lakes and added two further species. KULJER (2016) reported *Harmonia axyridis* (Pallas, 1773) from Macedonia. CVETKOVSKA-GJORGIEVSKA et al. (2019) reported one more individual of *H. axyridis*. In addition, records of Coccinellidae from Macedonia have been published in the Catalogue of Palaearctic Coleoptera (KOVÁŘ 2007). In total, these publications listed 44 species of the family Coccinellidae from North Macedonia. However, most of the published records were without information about the studied areas and habitats.

The present study reports data on the species diversity and distribution of ladybirds (Coccinelli-

dae) sampled in the Republic of North Macedonia in 2018 and 2019.

Materials and Methods

A group of Finnish entomologists made two short trips to North Macedonia to study Coleoptera, Hemiptera and other insects and spiders. The first trip took place on 14–22 May 2018 and the second trip on 7–12 July 2019. Most of the collecting was performed in the Pelister National Park and areas near Lake Prespa, both located in the southwestern part of the country. A visit was made to Ohrid area on 19th May 2018. Sampling was performed also during the short stops when driving from Lake Prespa to Skopje on 12th July 2019.

Ladybirds were collected mainly with sweep or clap nets. No traps were used to capture ladybirds. The identification of ladybirds was performed by the author. Sampling was carried out

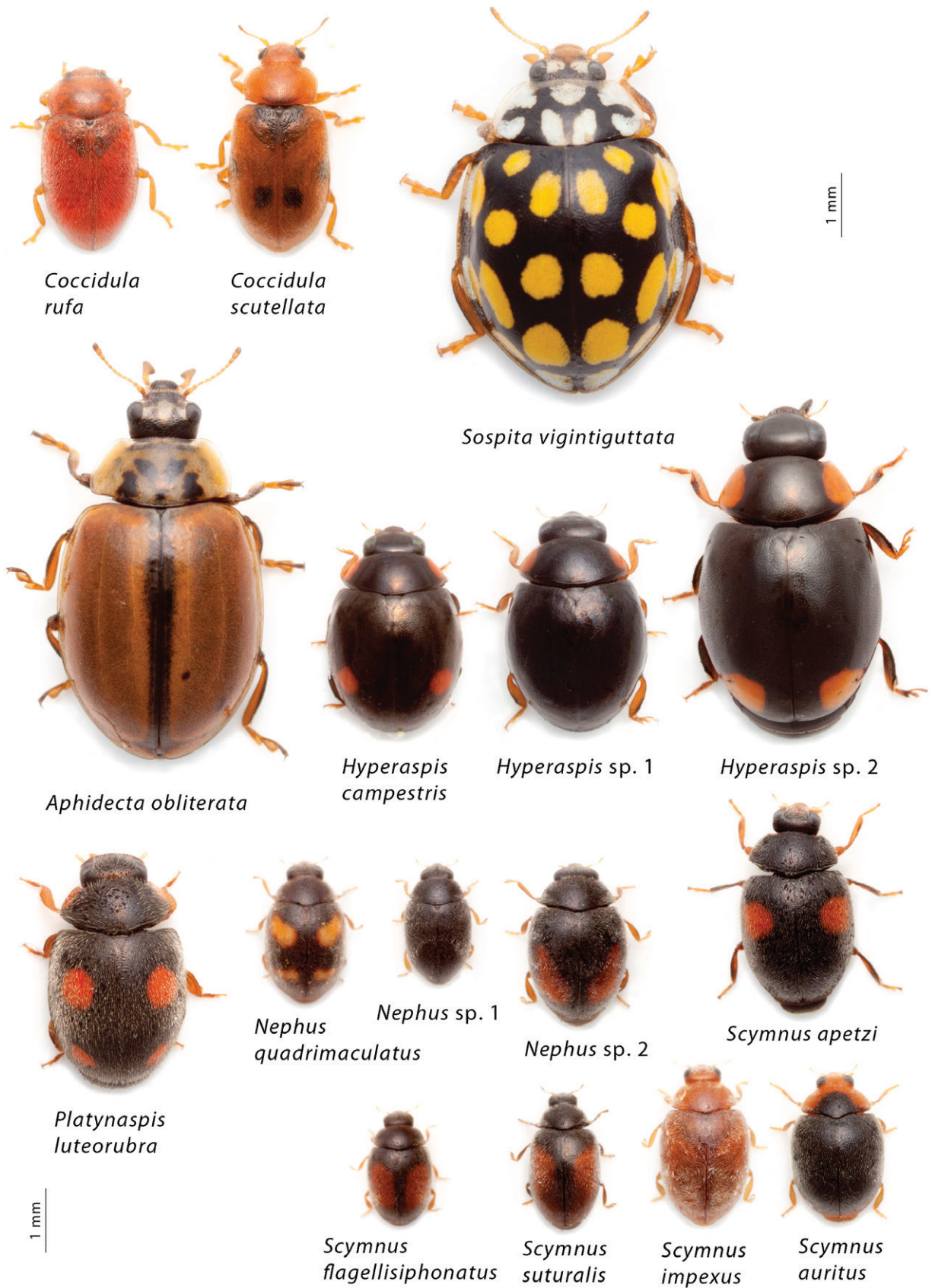


Fig. 1. Species of the family Coccinellidae collected in the Republic of North Macedonia during the present study. All specimens were photographed alive and are presented here with the same scale. Photos: Sami Karjalainen.

from grasslands as well as from broad-leaved trees, conifers and shrubs. There was a small difference between the methods used during the first and the second visit. During the second trip, less efforts were applied to sample from conifers and more work was done for sampling from grasslands and broad-leaved trees.

The most interesting specimens found were photographed alive in the studio and then placed in the collection. Other specimens were identified in the field and released after the identification. Many specimens of the subfamily Scymninae were identified based on genital dissection, while others were identified based on their general appearance and external characteristics.

A few individuals were sent for DNA barcoding to confirm identification. These belonged to the genera *Hyperaspis*, *Nephus*, *Scymnus* and *Stethorus*. The barcoding of ladybirds was a part of our study, in which we aimed to create a comprehensive reference library of DNA barcodes for the arthropods of Finland (ROSLIN et al. 2022). The reference library contains mtDNA COI barcodes. The barcoded ladybirds were deposited in the entomological collection of Oulu University. The remaining collected ladybirds are in the collection of the author.

Results

During the short trips in 2018 and 2019, a total of 894 specimens of the family Coccinellidae of 48 species were found. Ten of the recorded species were new to the fauna of North Macedonia. Other three or perhaps four ladybird species (belonging to *Hyperaspis* and *Nephus*) were recorded for the first time but they could not be identified at the species level. All the species found are presented in Table 1, with information from earlier publications. Some of the recorded species are shown in Fig. 1. The illustrated individuals are the actual specimens from the Republic of North Macedonia.

The most commonly-found ladybirds in the studied areas were *Coccinula quatuordecimpustulata* (L., 1758), *Hippodamia variegata* (Goeze, 1777), *Coccinella septempunctata* L., 1758, *Parexochomus nigromaculatus* (Goeze, 1777) and *Harmonia axyridis* in no particular order.

Three species of *Hyperaspis* were found (Fig. 1) but most of the individuals were females, which cannot usually be identified. The findings of *Hyperaspis campestris* were confirmed based on the male genitalia. The other two species remain uni-

identified (for comments, see Table 1). It was not possible to identify all specimens of *Nephus* (Fig. 1, see comments in Table 1). All the unidentified specimens of *Hyperaspis* and *Nephus* were DNA-barcoded but conclusive identifications were not obtained because the species were absent from the BOLD Systems Database. For future identification using DNA-barcoding, process ids of the specimens in BOLD Systems Database are included in Table 1.

Discussion

During two short trips to the Republic of North Macedonia, 48 species of the family Coccinellidae were found. These included several species new to the fauna of the Republic of North Macedonia. Some of these new species to the country belonged to the tribe Scymnini and may have been overlooked earlier because of their small size and expert knowledge needed for the identification. The list of new species, however, also includes large-sized species easy to identify, such as *Myrrha octodecimguttata*, *Myzia oblongogutta* and *Sospita vigintiguttata*. It can be assumed that many more species of the family Coccinellidae are still very likely to be found in the country.

The first known records of *Harmonia axyridis* from North Macedonia were made in 2015 (KULIJER 2016). This does not necessarily mean that *H. axyridis* was not present in the country before that. However, it seems that the species has become common in this country within few years. This species, native to Asia, is considered to be a threat to the biodiversity through competition and predation (ROY et al. 2016).

Acknowledgments: The collecting was accomplished by our group of entomologists: Petri Ahlroth, Nina Kiljunen, Erkkä Laine, Jaakko Mattila, Olli Pihlajamaa, Pekka Raukko and Heli Vainio. The collection permits were provided by the Ministry of Environment and Physical Planning of the Republic of North Macedonia (issued on 3rd May 2018). We thank the staff of the Pelister National Park for their help and cooperation, as well as the EU project “Strengthening the capacities for effective implementation of the acquis in the field of nature protection in the North Macedonia”. A grant from Helsingin hyönteistieteellinen yhdistys was received for travelling. DNA barcoding was possible with the help of Marko Mutanen, University of Oulu and FinBOL project. Piotr Ceryngier gave useful comments on the identification of the specimens. I thank the anonymous reviewers for their relevant comments and suggestions. Thanks are also due to Brian Nelson for helpful suggestions for improving the paper.

Table 1. Species of the family Coccinellidae recorded in the Republic of North Macedonia based on literature and the present study. The species new to the fauna of the Republic of North Macedonia are in bold. The comments refer to the present study. Some of the individuals are shown in Fig. 1.

Species	JORDANOVA (2002)	JADWISZCZAK et al. (2011)	KOVÁŘ (2007)	Present study	Comments
<i>Adalia bipunctata</i> (Linnaeus, 1758)	X	X		X	
<i>Adalia decempunctata</i> (Linnaeus, 1758)	X		X	X	
<i>Anatis ocellata</i> (Linnaeus, 1758)	X			X	
<i>Aphidecta obliterata</i> (Linnaeus, 1758)				X	New; Pelister NP 2018; Prespa 2019
<i>Bulaea lichatschovii</i> (Hummel, 1827)	X				
<i>Calvia quatuordecimguttata</i> (Linnaeus, 1758)	X		X	X	
<i>Calvia quindecimguttata</i> (Fabricius, 1777)	X	X			
<i>Ceratomegilla alpina redtenbacheri</i> (Capra, 1928)	X				
<i>Ceratomegilla notata</i> (Laicharting, 1781)	X			X	
<i>Ceratomegilla undecimnotata</i> (Schneider, 1792)	X	X	X	X	
<i>Chilocorus bipustulatus</i> (Linnaeus, 1758)			X	X	
<i>Coccidula rufa</i> (Herbst, 1783)				X	New; Ohrid 2018; Prsepa 2018
<i>Coccidula scutellata</i> (Herbst, 1783)		X		X	
<i>Coccinella septempunctata</i> Linnaeus, 1758	X	X	X	X	
<i>Coccinula quatuordecimpustulata</i> (Linnaeus, 1758)	X	X	X	X	
<i>Coccinula sinuatomarginata</i> (Faldermann, 1837)			X	X	
<i>Exochomus quadripustulatus</i> (Linnaeus, 1758)	X		X	X	In addition to normally-coloured individuals of <i>E. quadripustulatus</i> , individuals with yellowish spots in the fore parts of pronotum were found. These individuals collected from oak trees (Pelister NP 2019; Prespa 2019) either belong to <i>E. quadripustulatus</i> or <i>E. cedri</i> J. Sahlberg, 1913.
<i>Halyzia sedecimguttata</i> (Linnaeus, 1758)	X		X	X	
<i>Harmonia axyridis</i> (Pallas, 1773)				X	Pelister NP 2018, 2019; Ohrid area 2018; Prespa 2018, 2019
<i>Harmonia quadripunctata</i> (Pontoppidan, 1763)	X			X	
<i>Henosepilachna argus</i> (Fourcroy, 1785)	X				
<i>Hippodamia tredecimpunctata</i> (Linnaeus, 1758)			X		
<i>Hippodamia variegata</i> (Goeze, 1777)	X	X	X	X	
<i>Hyperaspis campestris</i> (Herbst, 1783)				X	New; Pelister NP 2018; Prespa 2018

Species	JORDANOVA (2002)	JADWISZCZAK et al. (2011)	KOVÁŘ (2007)	Present study	Comments
<i>Hyperaspis quadrimaculata</i> Redtenbacher, 1843	X				
<i>Hyperaspis reppensis</i> (Herbst, 1783)	X				
<i>Hyperaspis</i> sp. 1				X	New ; Pelister NP 2018. This female (Fig. 1) may belong to <i>Hyperaspis concolor</i> Suffrian, 1843. Process id in BOLD Systems database: LEFIJ8006-19.
<i>Hyperaspis</i> sp. 2				X	New ; Pelister NP 2018. This large female (Fig. 1) may belong to <i>Hyperaspis reppensis</i> but DNA barcoding did not confirm that. Another possibility is perhaps <i>Hyperaspis hoffmannseggi</i> (Gravenhorst, 1809). Process id in BOLD Systems database: LEFIJ8008-19.
<i>Myrrha octodecimguttata</i> (Linnaeus, 1758)				X	New ; Pelister NP 2018
<i>Myzia oblongoguttata</i> (Linnaeus, 1758)				X	New ; Pelister NP 2018
<i>Nephus bisignatus</i> (Boheman, 1850)				X	New ; Pelister NP 2019
<i>Nephus quadrimaculatus</i> (Herbst, 1783)				X	New ; Skopje 2019. No collection efforts were performed in Skopje except sweeping a <i>Hedera</i> plant in the small garden of a hotel. The single individual found turned out to be a male of this species.
<i>Nephus</i> sp. 1				X	New ; Pelister NP 2018. Process id in BOLD Systems database: LEFIJ8013-19.
<i>Nephus</i> sp. 2				X	New ; Pelister NP 2018. The shape of spermatheca is rather similar with <i>Nephus ludyi</i> (J. Weise, 1879) but the colouration of elytra differs (Fig. 1). Process id in BOLD Systems database: LEFIJ8012-19.
<i>Oenopia conglobata</i> (Linnaeus, 1758)	X	X		X	
<i>Oenopia lyncea agnate</i> (Rosenhauer, 1847)	X				
<i>Parexochomus nigromaculatus</i> (Goeze, 1777)	X		X	X	
<i>Platynaspis luteorubra</i> (Goeze, 1777)			X	X	
<i>Propylea quatuordecimpunctata</i> (Linnaeus, 1758)	X	X	X	X	
<i>Psyllobora vigintiduopunctata</i> (Linnaeus, 1758)	X		X	X	
<i>Rhyzobius litura</i> (Fabricius, 1787)		X			
<i>Scymnus apetzi</i> Mulsant, 1846	X		X	X	
<i>Scymnus auritus</i> Thunberg, 1795			X	X	
<i>Scymnus flagellisiphonatus</i> (Fürsch, 1970)			X	X	
<i>Scymnus frontalis</i> (Fabricius, 1787)	X	X		X	

Species	JORDANOVA (2002)	JADWISZCZAK et al. (2011)	KOVÁŘ (2007)	Present study	Comments
<i>Scymnus impexus</i> Mulsant, 1850				X	New; Pelister NP 2018, 2019. Recorded in 2018 and 2019 on the same spruces inside the Pelister National Park. No other records.
<i>Scymnus interruptus</i> (Goeze, 1777)	X			X	
<i>Scymnus limbatus</i> Stephens, 1832	X		X	X	
<i>Scymnus magnomaculatus</i> Fürsch, 1958			X		
<i>Scymnus rubromaculatus</i> (Goeze, 1777)	X	X	X	X	
<i>Scymnus subvillosus</i> (Goeze, 1777)	X		X	X	
<i>Scymnus suturalis</i> Thunberg, 1795			X	X	
<i>Sospita vigintiguttata</i> (Linnaeus, 1758)				X	New; Pelister NP 2018
<i>Stethorus gilvifrons</i> (Mulsant, 1850)				X	New; Pelister NP 2018; Prespa 2018
<i>Stethorus pusillus</i> (Herbst, 1797)			X	X	
<i>Subcoccinella vigintiquatuorpunctata</i> (Linnaeus, 1758)	X	X	X	X	
<i>Tytthaspis sedecimpunctata</i> (Linnæus, 1761)	X	X	X	X	
<i>Vibidia duodecimguttata</i> (Poda, 1761)	X	X		X	
Total	32	15	26	48	

References

- CVETKOVSKA-GJORGIEVSKA A., DEDOV I., HRISTOVSKI S. & LANGOUROV M. 2019. New records of allochthonous, invasive and pest invertebrate species from the Republic of Macedonia. *Ecologica Montenegrina* 20: 56–70.
- JADWISZCZAK A., PIETRZAK L., ZAWAL A., STOJANOVSKI S., SMILJKOV S. & KOSTOSKI G. 2011. Ladybirds (Coccinellidae) from neighbourhood of Ohrid and Prespa lakes (Republic of Macedonia). *Natura Montenegrina* 10: 87–92.
- JORDANOVA V. 2002. Neue Angaben über Marienkafer (Coleoptera: Coccinellidae) aus Republik Mazedonien, Albanien, Griechenland und Türkei, mit eine Revisionsliste der Arten der Balkanhalbinsel. *Historia Naturalis Bulgarica* 15: 113–126.
- KOVÁŘ I. 2007. Family Coccinellidae Latreille, 1807. Pp. 568–631. In: LÖBL I. & SMETANA A. (Eds.) *Catalogue of Palaearctic Coleoptera. Volume 4: Elateroidea, Derodontoidea, Bostrichoidea, Lymexyloidea, Cleroidea and Cucujoidea*. Apollo Books, Strenstrup.
- KULJER D. 2016. *Leptoglossus occidentalis* (Heteroptera: Coreidae) and *Harmonia axyridis* (Coleoptera: Coccinellidae), two new invasive alien species for insect fauna of Macedonia. *Ecologica Montenegrina* 5: 22–25.
- ROSLIN T., SOMERVUO P., PENTINSAARI M., HEBERT B. D. N., AGDA J., AHLROTH P., ANTONEN P., ASPI J., BLAGOEV G., BLANCO S., CHAN D. et al. 2022. A molecular-based identification resource for the arthropods of Finland. *Molecular Ecology Resources* 22: 803–822.
- ROY H. E., BROWN P. M. J., ADRIAENS T., BERKVEN N., BORGES I., CLUSELLA-TRULLAS S., COMONT R. F., DE CLERCQ P., ESCHEN R., ESTOUP A., EVANS E. W. et al. 2016. The harlequin ladybird, *Harmonia axyridis*: global perspectives on invasion history and ecology. *Biological Invasions* 18: 997–1044.

Received: 19.04.2021
Accepted: 01.09.2021