

Survival of the endemic Hemiptera species in Slovenia during the Holocene *

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ABSTRACT

The endemic Hemiptera species of Slovenia are found in the karstic south-west of the country. Three endemic Heteroptera and one Auchenorrhyncha species are distributed only in karstic mountains and the Kras plateau. As they live in grassland habitats, but the prevailing vegetation in the past was shown to be forest, a question of their survival during Holocene comes into mind. The existence of small grassland refuges in the south slopes at the peaks and ridges of the mountains is proposed. Such small grassland refuges could not be detected by the pollen analysis in distant deposits. In these refuges, endemic species could survive and evolve from the times of glaciations and soon after, when steppes were widely distributed for the last time, to the present.

Keywords: endemic species, relicts, Hemiptera, Heteroptera, Auchenorrhyncha, Slovenia.

INTRODUCTION

Slovenia is a relatively small country, but its biodiversity is high due to very diverse geographic regions converging in it. There are Alps in the North and Dinaric mountains to the South, Pannonian influences in the East, and Mediterranean influences in the South-West. The submediterranean region is especially reach as 95% of all of Slovenian species live in the southwestern part of Slovenia, mainly in the karst region covering some 10,000 km² (MRŠIĆ

* This paper is dedicated to Michail Josifov, a prominent expert on the Balkan Heteroptera, on the occasion of his 80th birthday.

1997). Most of the endemic insect species found in Slovenia are underground dwellers of karst caves and other underground habitats. The majority of these species are beetles of the families Carabidae and Cholevidae. Among the insect groups which do not penetrate into underground habitats, however, endemic species are rare as all surface habitat types continue across borders. We know only three endemic Heteroptera species, one of them lives also in the neighboring territory of Italy. All three of them live in the Kras (Karst) plateau and/or the karstic mountains nearby. The endemic Auchenorrhyncha species are also confined to the SW part of Slovenia with submediterranean climate and vegetation. They are part of the larger east Adriatic endemism, rich in unique species, and live also in neighboring areas of Croatia or Italy. One species, *Jassargus bicorniger* (THEN) seems to be limited to an area between the Karst edge in the South and the southern slopes of the Trnovski Gozd mountains in the North (SELJAK 2004), just like the endemic Heteroptera species. The Kras (Karst) is a calcareous plateau near the Gulf of Trieste, which gave the name to all karst phenomena in the world. It was largely deforested in early history by people who raised sheep and goats and was long known as a windy, stony desert. Nowadays the land is largely left unmanaged, so that the region is in a natural process of reforestation.

ENDEMIC HETEROPTERA SPECIES



Fig. 1: *Halticus henschii* REUTER, 1888

Halticus henschii REUTER, 1888

Described by REUTER (1888) on basis of the material from Gorica (Gorizia), it is species with the widest distribution of the three endemics. It is present at the edge of the Trnovski Gozd and Nanos mountains, the Kras plateau and at the Karst edge in Slovene Istria (GOGALA 2006). Its foodplant is *Genista sericea*, where I collected and observed it. Its closest relative, *Halticus puncticollis* FIEBER, is distributed in the Balkans, Ukraine, Caucasus and Kazakhstan (KERZHNER & JOSIFOV 1999).

Dimorphocoris saulii WAGNER, 1965

This brachypterous species was collected first by Luciano Sauli in the mountain Vremščica (1027 m), mentioned in the descriptions by WAGNER (1965, 1969) by its Italian name Mt. Auremiano. This karstic mountain is still the only place where it is known from. It can be found there (800 – 930

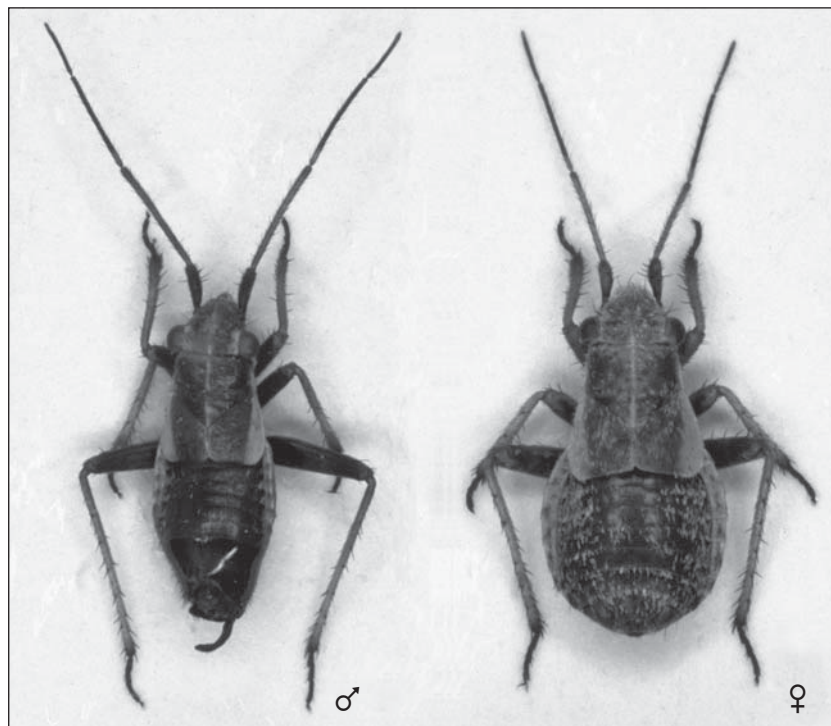


Fig. 2: A couple of *Dimorphocoris saulii* WAGNER, 1965

m a.s.l.) only for a few weeks in June or July, on grass which was identified as *Bromus erectus condensatus* (GOGALA 1992). It is possible that other grass species are also its foodplants. Related species were later described from Italy and the closest locality where one of them (*Dimorphocoris servadeii* TAMANINI) was found, is Mt. Catria on the other side of the Adriatic (TAMANINI 1982). Another Italian species (*D. marci*), found in the central Appennins, was described by RIZZOTTI VLACH (1998). A related species was discovered also in Greece: *Dimorphocoris sari* was found on Mt. Taigetos on Peloponnese and described by LINNAVUORI (1992). All of these species are restricted to a single or a few mountain habitats.

Platycranus boreae GOGALA, 2002

I found this species approximately 800 m a.s.l. in the mountain ridge of Lipnik above the Karst edge in Slovene Istria (GOGALA 2002). This is still its only known locality, although the same ridge continues across the border to Croatia and I am sure the species lives also there. The locality is one of the largest remains of grasslands in the Slovene karst, but *P. boreae* lives only at the top of the exposed ridge, where its foodplant, *Genista sericea*, grows in large aggregations. The closest relative of this small species is probably *P. jurineae* PUTSHKOV from the Ukraine.



Fig. 3: A couple of *Platycranus boreae* GOGALA, 2002

ECOLOGICAL DEMANDS OF THE ENDEMIC

The endemic Hemiptera species live in the open, steppe-like habitats, on grasses or other plants. This type of habitat is endangered today because of natural reforestation as a consequence of diminishing use of the land for pastures. Largest grassland remains exist in the south-exposed slopes of the mountains, where strong bora wind potentiates the effects of summer drought and physiological drought in winter when the ground is frozen. Trees grow also there, but much more slowly and many die or grow only at the side opposite to the prevailing wind.

According to the prevailing view all grasslands in the karstic region are man-made and forest is the natural vegetation of the area. How could then the endemic species survive as they cannot live in the forest? A hypothesis was postulated by botanists that seeds of steppe plants were transported in animal fur from the South during migrations of livestock to new grazing lands. The insect species could follow, but what about the endemics? We do not know of their populations in the South, although they could still exist unnoticed. Much more credible is a hypothesis which states that small refuges for grassland flora and fauna existed in the karstic mountains also before people came to the area. Two of the endemic Heteroptera species live on *Genista sericea* which grows in the

most stony, exposed ridges, in the plant association *Genisto sericeae-Seslerietum juncifoliae*, together with the grass *Sesleria juncifolia* (= *S. tenuifolia*) and other thermophilous and xerophilous plant species of Illyrian or Mediterranean distribution (KALIGARIČ 1997). The areas where this plant association grows were probably never overgrown by forest due to the stony calcareous ground, inclination to the south and windy conditions (the bora wind).

HISTORY OF THE VEGETATION

Sediments older than 500 years, useful for pollen analyses, did not accumulate on the karstic ground. The nearest localities where such investigations were done are at the Adriatic coast in Slovene Istria. The investigations in the Škocjanski zatok near Koper and the Sečovlje salt pans showed the development of the Holocene forest vegetation from approximately 7000 to 500 years b.p. (CULIBERG 2005). In the oldest sediments pollens of *Fagus*, *Abies*, *Quercus* and *Carpinus* were found. Such forests thrive today in much higher elevations in the interior. Soon the degradation of the forest began by people. Pollen of tree species became rarer around the year 1000 a.d. when herbaceous and grassland vegetation proliferated. The Karst was deforested in the 15th and 16th century and at the end of the 18th century only bare rock remained in many places.

Investigations showed that the natural vegetation in the area was forest of the associations *Abieto-Fagetum* and *Quercus-Carpinetum*. What we do not know, however, is the situation at the peaks and ridges of the karstic mountains. Is it possible that small grassland refuges remained there from the times when whole area was covered by steppe vegetation? The existence of relict endemic species in meadows at the karstic peaks speaks in favor of this hypothesis. Such situation is also indicated by names of many peaks in the karstic area like Golič (the naked) and



Fig. 4: The meadows on Mt. Vremščica (1027 m) are home to the endemic heteropteran bug *Dimorphocoris saulii*, which is wingless and thus cannot fly. The nearest location where a related species, *D. servadeii*, was discovered, is Mt. Catria in the Italian Apennines, on the other side of the Adriatic sea. The shallow northern part of the Adriatic (in lighter color) was dry during the glaciations and a common ancestor of both species probably also lived in the dry northern Adriatic sea bed during the glaciation periods of the Pleistocene, when the steppes were much more widely distributed.



Fig. 5: Stony grassland on Mt. Lipnik, the habitat of *Platycranus boreae*.

years b.p.) when the steppes thrived again in much of southern Europe for the last time. Then the forest reoccured but was more open than at present until about 8000 years b.p. The clearing of the forests for agriculture began soon after 7000 years b. p. Only for about 1000 years the steppe flora and fauna had to survive in the supposed refuges in the mountains to spread again to the man-made pastures. Some endemic Heteroptera species, however, never spread out of their mountain refuges and can be found today only there.

The mountains of Trnovski Gozd, Nanos and Vremščica form a barrier today for the warm air from the coast and are dividing the submediterranean vegetation on their south-orienting slopes from the Central European-type vegetation in the interior. During the last glaciation the same barrier was a southern limit for the arctic fauna. North of this barrier in Postojna the remains of marmots, arctic hares and reindeer, animals which live in the tundra, were found. South of this barrier, only cave bears, cave lions, deer and roe lived (POHAR 1992). We can conclude that tundra-type vegetation thrived North of this mountain barrier and steppe-like vegetation to the South. That is the cause for the endemic Hemiptera species, relics of the old Mediterranean steppe fauna, not to appear North of this mountain barrier, where they could not survive the glaciations. They are found only in the Kras and surrounding mountains.

Pleša (bald one), although we do not know how old these names are. Small grassland refuges could not be detected by the pollen analysis in distant deposits.

During the last glaciation period (22,000 – 14,000 years b.p.) cold and dry climate caused that much of southern Europe was covered by dry, almost semi-desert steppe vegetation (ADAMS 1997). The sea level was much lower than today and the shallow northern Adriatic was dry during that time. There was no barrier between the mountains Vremščica and Catria, where related *Dimorphocoris* species live today. In that time a common ancestor of both species could live in a broad area where steppe vegetation was distributed. When ice caps melted after warming of the climate around 13,000 years b.p., steppes replaced tundra in a great part of Europe as the trees needed much more time for spread and regrowth. Colder climate returned again in younger dryas (11,000 – 10,000

CONCLUSIONS

The endemic Hemiptera species of Slovenia live in grassland habitats and are confined to the south-western part of Slovenia with submediterranean vegetation. The three endemic Heteroptera and one Auchenorrhyncha species are found only in the Kras plateau and mountains in its fringe. They are bound to the limestone ground which does not keep moisture well and is prone to summer droughts. The pollinological research showed that forest is a natural vegetation in the area. The endemic species are relics from the times before the glaciations, probably from the tertiary. When the climate was cooler and drier and when steppes covered much of South Europe, they could spread wider and populate new territories. When forests spread to their habitats, however, they survived only in the mountain refuges. They could not populate man-made pastures later from anywhere else than from these grassland refuges, which were most probably situated at the southern slopes at the top of mountain peaks and ridges and the majority of the endemic species never left their mountains. They are still found only there.

The grassland refuges were probably maintained by the prevailing bora wind, which blows in the Kras especially strong in winter, desiccates ground and potentiates physiological drought for plants when the ground is frozen as well as summer drought which usually appears in the area. We should not overlook also the potential role of fire. It is a common feature in the summer today, but is usually stopped soon by firemen. In the times before people populated the area fire did not broke out so often, but when it did, nothing stopped its spread. The bora wind successfully accelerates the spread of fire. Fire burns trees and soil which is then eroded away. In such a way, the vegetation is returned to an earlier successive phase.

The habitats of endemic species and the species themselves are endangered today by spread of the forest vegetation and by plans for wind power plants which would be build in the mountain ridges, exact places where the endemic species live.

РЕЗЮМЕ

Ендемичните за Словения видове Hemiptera са намерени в югозападната карстова част на страната. Три ендемични вида Heteroptera и един вид Auchenorrhyncha са описани само за карстовите планини и платото Крас. Тъй като тези видове живеят в тревисти хабитати, появили се на места с преобладаващи в миналото гори, възниква въпросът как те са оцелели през Холоцена. Допуска се съществуването на малки тревни рефугиуми по южните склонове на върховете и по билата на планините. Наличието на такива малки тревни рефугиуми е невъзможно да бъде уловено чрез поленов анализ на гревни отложения. В такива рефугиуми ендемичните видове биха могли да оцелеят и еволюират по времето на заледряванията, скоро след това, когато степите са били широко разпространени за последен път в района, и чак до наши дни.

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