

## Distribution and habitat requirements of *Arcyptera microptera* (Fischer von Waldheim, 1833) in Hungary

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### Abstract

*Arcyptera microptera* is a transpalaeartic grasshopper species, which occurs sporadically in Middle Europe. There are only a limited number of historic records from this species from Hungary. More intensive research has revealed new data from the Hungarian Middle Mountains, from the Eastern- and Southern Bakony (Hungary, Transdanubia). *Arcyptera microptera* has been found mainly between 200 and 350 metres height above sea-level. In the study region the species occurs sporadically with robust, but regularly distributed populations. Our publication summarizes the current knowledge from Hungary and depicts some habitat requirements.

### Zusammenfassung

*Arcyptera microptera* ist eine transpaläarktische Feldheuschrecke, die in Mitteleuropa nur sporadisch vorkommt. Aus Ungarn sind nur eine kleine Anzahl historischer Funde bekannt. Während neuer Untersuchungen in den Ungarischen Mittelgebirgen der östlichen und südlichen Bakony-Region (Ungarn, Transdanubien) konnte *Arcyptera microptera* mehrfach nachgewiesen werden. In der Untersuchungsregion kommt die Art ebenfalls nur sporadisch zwischen 200 und 350 m NN vor, teilweise aber mit robuster Populationsgröße. In unserer Mitteilung charakterisieren wir die neu entdeckten Vorkommen und die Habitate der Art in Ungarn.

### Introduction

*Arcyptera* (*Pararcyptera*) *microptera* (Fischer von Waldheim, 1833) is a widespread thermo- and xerophytic (INGRISCH & KÖHLER 1998a) locust species, with a northern-steppe, transpalaeartic distribution (Fig. 1). Several subspecies have been described, but were subsequently all transferred to synonyms. Even so, *Arcyptera carpentieri* Azam 1907 and *Arcyptera kheili* Azam 1900 had been described from France, these taxa are regarded as synonyms of *Arcyptera microptera* by some authors (RAGGE & REYNOLDS 1998).

Habitats of *Arcyptera microptera* are situated in the Eurasian steppe zone (SERGEEV 1986). In Russia it is known as a damaging but not gregarin species, which sometimes (usually during droughts) brings agricultural harm to cultivated fields (SHUROVENKOV 1963, STOROZHENKO 1991, LATCHININSKY et al. 2002). On the contrary in Central-Europe and towards the west *Arcyptera microptera* is a rare species characterized by isolated occurrences.



Fig. 1: Distribution of *Arcyptera microptera* (corrected map after SERGEEV 1986).

*Arcyptera microptera* exists typically on plan and collin grasslands (STEBAEV & MOLODTSOV 2001) of the steppe and forest-steppe areas (STOROZHENKO 1991), but it also occurs in high-mountainous regions (WILLEMSE 1984). Both larvae and imagos consume leaves of grass species (STOROZHENKO 1991). Phenologically *Arcyptera microptera* is a spring species, reaching adulthood earlier than most other grasshoppers of our region. The first instar larvae are present in April or mid-May. After 25-30 days, and 4 (TZYPLENKOV 1970) or 5 (BEREZHKO 1956) instars the specimen turn into imago and/or adult. Dying of the adults is significant already in mid-July (STOROZHENKO 1991).

A few published data are known from Central-Europe and many of them have not been confirmed for a long time. In Germany mainly old data are known (Brandenburg, Mecklenburg, Thuringia, Muggendorf, Darmstadt) (HARZ 1960). According to INGRISCH & KÖHLER (1998a) the species is extinct, but DETZEL (2001) put it in his checklist. *Arcyptera microptera* can also be found in the list of German protected species (INGRISCH & KÖHLER 1998b). In Austria many occurrences (Marchfeld, Bisamberg, Eichkogel bei Mödling, Vöslau, Neusiedler See) were known from dry grasslands (EBNER 1951), nevertheless NAGY (2002) presumed that part of them became extinct. The description of new Austrian occurrences has been rare recently [e.g. Sonnenberg (Südtirol), 29.05.1997, Markus Schwibinger (2007) in <http://www.tagschmetterlinge.de/>]. In Slovenia *Arcyptera microptera* exists in the eastern part of the country and also in the coastal region (US 1992, NAGY 2005). In Croatia it also occurs in the coastal region (US 1967), but accurate and published data are unknown [collected specimen from Opatija in Zoologisches Forschungsinstitut und Museum Alexander Koenig (see <http://www.biologie.uni-ulm.de/systax/>)]. KALTENBACH (1970) depicted *Arcyptera microptera* as a widespread species in the former Yugoslavia, but the current distribution of the species in this region is unknown. In Bohemia *Arcyptera microptera* occurs in the region of Poudrany, Plain of Brno (OBENBERGER 1926, HARZ 1957, ČEJCHAN 1985). PODPERA (1928) mentioned the species (under the name of *Arcyptera flavicosta*) from this region as well (Pausramer foothills) as an example of the species dominant in the Great Hungarian Plain and which reached the northern area of the above mentioned region. In contradiction with this statement later

*Arcyptera microptera* was published from Poland, also from a plain region (Torun) (HARZ 1957). From Slovakia KOCAREK et al. (1999) did not report *Arcyptera microptera*, NAGY (2005) regarded the species extinct. In Romania most data of the species are originated from lower regions of high-mountains (e.g. Retezat Mts.; Eastern-Carpathians: Tusnád, Vlahita; Southern-Carpathians: Slimnic; Bihar Mts.: Cluj-Napoca, Turda), but the species is also known from the region of Dobrudza (Mangalia) (KNECHTEL & POPOVICI-BIZNOSANU 1959). According to the opinion of KIS & VASILIU (1970) many earlier Transylvanian data are doubtful.

In Hungary just a few occurrences were known before our tendential studies. FRIVALDSZKY (1867) gave the first data (sub *Arcyptera flavicosta*) without any exact habitat information [circumference of Pest, and in the Bánság (presently Bánság belongs to Serbia and Romania)]. Later the species was published from some further Hungarian localities, nevertheless confirmed or newly published (in last ten years) occurrences are the following: Tarcal, Kopasz Hill (communication: NAGY 1991, confirmation: NAGY et al. 1998, NAGY 2002); Pécel, Comb of Isaszeg (NAGY 2003); Nagyvázsony, Nőzsér (NAGY 2002). The further occurrences are regarded as approaching extinction (Pomáz, NAGY 1991, NAGY 2003), or are already extinct (Budapest, Hármashatár Hill, NAGY 1987, 1991, 1997, 2002, 2003). Before our study further 4 data became known in Hungary. "Márkó" (27 July 1980, leg. Barnabás Nagy, unpublished) has not been confirmed for almost three decades. The localization of data "Near Sóskút" (in: NAGY 2002) is doubtful. Old data of the Hungarian Natural History Museum (Budapest) are also not confirmed ["Szigetmonostor" (25 May 1960) and "Tard" (22 May 1957) in RÁCZ et al. (2005)].

Our aim was to map systematically the distribution of *Arcyptera microptera* in the Bakony Region (Transdanubia) based on the study of the above mentioned two habitats ("Márkó", "Nagyvázsony") which were not described precisely (Table 1).

Table 1: Historic distribution data of *Arcyptera microptera* in Hungary

Settlement	Locality	Author and published date	Notes
"Pest"	?	FRIVALDSZKY (1867)	
?	Bánság	FRIVALDSZKY (1867)	
Budapest	Hármashatár Hill	NAGY 1987	extinct
Tard		RÁCZ et al. (2005)	coll. 22 May 1957 by Sándor Tóth
Szigetmonostor		RÁCZ et al. (2005)	coll. 25 May 1960 by H. Steinmann
Márkó		Unpubl.	coll. 27 July 1980 by Barnabás Nagy
Tarcal	Kopasz Hill	NAGY 1991	
Pomáz		NAGY 1991	
Nagyvázsony	Nőzsér	NAGY 2002	
Sóskút		NAGY 2002	doubtful
Pécel	Comb of Isaszeg	NAGY 2003	

*Arcyptera microptera* is enlisted in Red Books and Red Lists of several European countries (e.g. Bohemia: GULIČKA 1992, FARKAÉ et al. 2005; France: SARDET & DEFAUT 2004; Hungary: RAKONCZAY 1990, KISBENEDEK 1997; Germany: INGRISCH & KÖHLER 1998b).

We were motivated by the fact that in the Bakony Region many large grasslands exist, potential functioning as habitats for *Arcyptera microptera*. A further necessity of systematic mapping was given by the European nature conservation interest and the many doubtful old data for this species.

## Study area and methods

The study area covers more than half of the western part of the Hungarian Middle Mountains. Two *Arcyptera microptera* specimens were collected from the Bakony Region previously (detailed data of the earlier mentioned occurrences are: Nagyvázsony, Nőzsér, 5 July 2001, leg. B. Nagy and Márkó, 27 July 1980, leg. B. Nagy). Our screening of potential habitats was carried out between May and August 2007.

The study area is very adaptable for the study of *Arcyptera microptera* habitat requirements. It is on the western border of the Eurasian forest-steppe zone, which is the main area of the species. Main habitat types of the steppe vegetation, like steppe grasslands (*Chrysopogono-Caricetum humilis*, *Cleistogenes-Festucetum rupicolae*) in deep soil and open rocky grasslands in fleet soil are widely spread in the Bakony Region. The examinations were taken in the most potential part of the Bakony Region, in the Eastern- and Southern-Bakony.

We started the field work early (11 May 2007) since most of the known Hungarian data are reported from May (it is not a typical time for acridological studies). We found old larvae in one of the earliest known locations (Nagyvázsony, Nőzsér) on 11 May 2007. Due to this founding and the general early records from the literature, we started the systematic mapping the following week.

## Results

### Distribution of *Arcyptera microptera* in Hungary

During our screening of potential habitats, we were able to considerably increase our knowledge about the distribution of *Arcyptera microptera* in Hungary (Fig. 2). Six records from the Bakony Region were unknown before. Two previous records from the Bakony Region were confirmed by our study. Further three confirmed spots lay outside the Bakony Region (Table 2).

Populations are quite isolated, with an average distance of 6.7 kilometres between the localities studied by us. In conclusion *Arcyptera microptera* is found in 15 UTM-quadrates (10 x 10 km) from Hungary. The Bakony Mountains can be considered as a rich in potential *Arcyptera microptera* habitats, awaiting further records in the future. Records are restricted between 202 and 342 metres height above sea-level, mostly on dolomite bedrock and black turf soil. The size of the area suitable for the *Arcyptera microptera* to colonize was between 0.5 and 7 square-kilometres, the average was 2.05 square-kilometres (data estimated by

geoprocessing method: ArcGIS 9.1 (1999-2004) and ArcPad 7.0 (2000-2005) softwares and RGB aerial photographs were used for the determination of the geographical coordinates and for the manual interpretation). The number of observed specimens was in all cases very low, ranging from 1–31 individuals per population (see Table 2). Population size was estimated less than 100 specimens in six cases, between 100 and 1.000 specimens in three and more than 1.000 specimens in just two cases. Records were in a short time period, with the earliest finding on 11<sup>th</sup> of May and the latest one on the 17<sup>th</sup> of June 2007.

Table 2: Distribution and habitat parameters for *Arcyptera microptera* from Southern- and Western Bakony Mountains (Hungary). Disturbance: GAD=grazing on an average degree; IG= intensive grazing; FMP=former military place, has not been disturbed recently, MPA= military place, disturbance on an average degree recently, MPI= military place, with intensive disturbance recently. Estimated (based on sweep-netting samples and area size) population size: a=<100 specimens; b=100–1000 specimens; c=>1000 specimens.)

Settlement	Geographical name	Time of first detection	Altitude (m asl)	Veg. cover	Dist	Area size	N - obs. spec.	Pop. size
<b>Sothern-Bakony</b>								
Sáska	Kecskevár	2007.05.31.	215,0	50-70%	FM P	~7 km <sup>2</sup>	8♂, 11♀	c
Nagyvázsony	Nőzsér	2007.05.11.	292,0	60-80%	GA D	~1 km <sup>2</sup>	4♂, 3♀	a
Tótvázsony	Öreg-Kátyó	2007.05.29.	322,5	50-70%	IG	~0,7 km <sup>2</sup>	1♂, 1♀	a
Nemesvámos	Cinege-hegy	2007.06.01.	334,0	70-80%	–	~0,8 km <sup>2</sup>	1♂	a
<b>Eastern-Bakony</b>								
Márkó	Peres Nagy-mező	2007.05.21.	270,0	40-60%	MP A	~2,5 km <sup>2</sup>	1♂, 2♀	b
Veszprém	Füzes	2007.05.22.	212,0	50-70%	MP A	~3,6km <sup>2</sup>	1♂, 1♀	a
Hajmáskér	Nagy-mező	2007.05.23.	232,0	40-60%	MPI	~4,0 km <sup>2</sup>	12♂, 19♀	c
Öskü	Hosszú-völgy	2007.06.17.	202,0	50-70%	–	~0,5 km <sup>2</sup>	1♂, 2♀	a
Várpalota	Nyugati-Nagy-mező	2007.06.17.	260,0	40-50%	–	~1 km <sup>2</sup>	2♀	b
Várpalota	Baglyas-hegy	2007.06.17.	342,0	40-60%	–	~0,5 km <sup>2</sup>	1♀	a
Csór	Mandulás	2007.06.01.	272,0	50-70%	–	~0,5 km <sup>2</sup>	1♂, 1♀	b

### Habitats of *Arcyptera microptera*

In Hungary the habitats of *Arcyptera microptera* can be found in a middle mountain-boundary zone, where the xerotherm forest-steppe forests were originally dominated by several Pannonian elements (ZÓLYOMI 1957, 1964, FEKETE 1955, 1965, BORHIDI 1961). These habitats occur in the most xerophytic part of the studied area, with average annual rainfall of 600 mm a year. Former xerophytic forest-steppe forests showed both middle-mountainous and plainy features, and had a heterogeneous vegetation structure with large natural open grasslands and steppe slopes. The habitats became repressed caused by the human activity

(mostly because of agricultural activity). The Hungarian habitats of *Arcyptera microptera* reveal considerable similarities with the occurrences in Lower-Austria and in the Vienna Basin – equally in biogeographical, plant coenological and land use aspects (WENDELBERGER 1953, NIKLFELD 1964, ZÓLYOMI 1964). The cover of grasslands increased, forests can not renew on xerophytic soil distressed by erosion. Presently the hilly dolomite areas of the Bakony Mountains are characterized by open and closed rocky and dry steppe grasslands, with small bushy (*Crataegus monogyna*, *Prunus spinosa*, *Rosa* spp., *Prunus fruticosa*, *P. tenella*) and xerophyllous oak-forest (*Quercus pubescens*, *Acer campestre*, *Fraxinus ornus* etc.) patches. The studied rocky grasslands (*Festuca pallens*, *Stipa eriocalis*, *Thymus praecox*, *Scorzonera austriaca*, *Erysimum diffusum* etc.) and steppe slopes (*Carex humilis*, *Chrysopogon gryllus*, *Stipa pennata*, *Anthyllis vulnearia* subsp. *polyphylla*, *Pseudolysimachion spicatum* etc.) are widely distributed in the Bakony Mountains. The characteristic plant species of these grasslands are pannonian, pannonian-balkanic (*Seseli leucospermum*, *Dianthus plumarius* subsp. *regis-stephani*, *Dianthus pontederiae*, *Euphorbia glareosa*, *Jurinea mollis*, *Onosma arenaria* etc.) and sub-mediterranean elements (*Reseda phyteuma*, *Aethionema saxatile*, *Ononis pusilla*, *Convolvulus cantabrica*, *Fumana procumbens*, *Trinia glauca*, *Medicago prostrata*, *Artemisia alba* etc.). In these grasslands *Arcyptera microptera* occurs only with small populations.

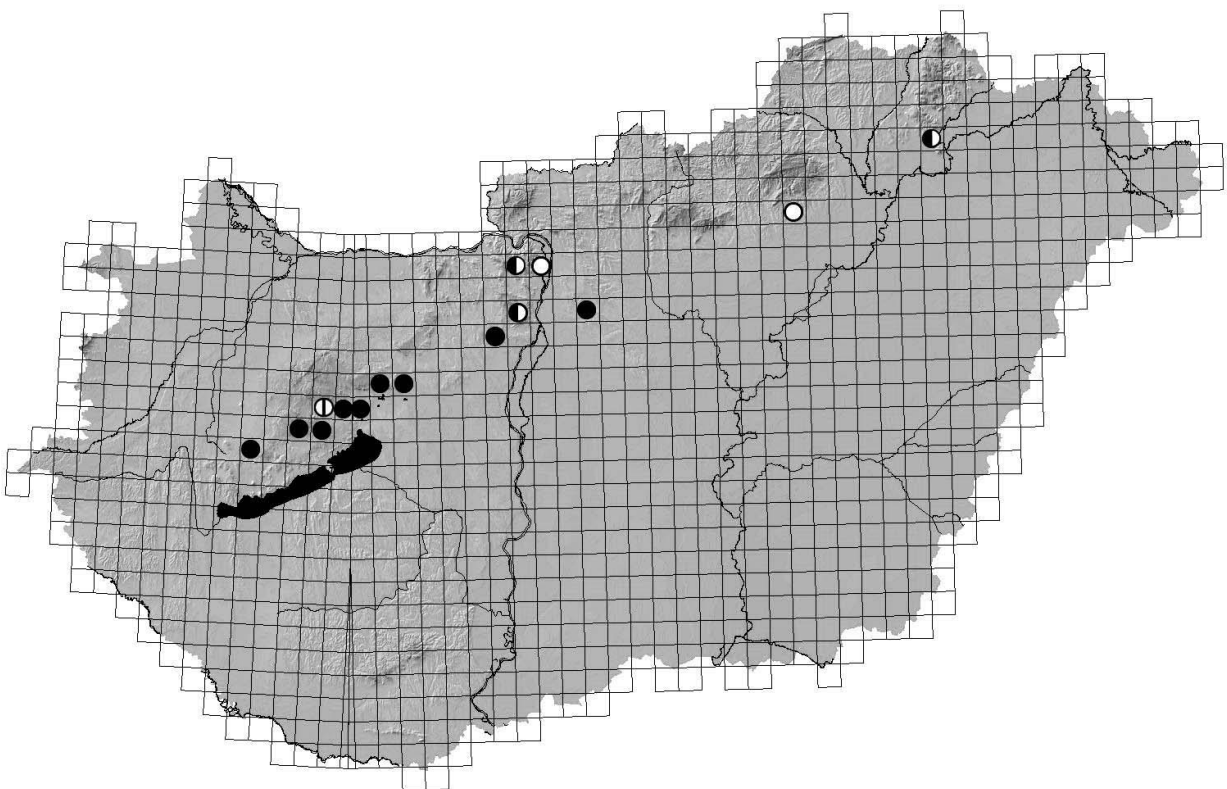


Fig. 2: Chronology of *Arcyptera microptera* occurrences knowing in Hungary (empty circle: until 1950; crossed circle: 1951–1980; black and white circle: 1981–2000; black circle: 2001–)

The habitats of *Arcyptera microptera* in the Bakony Region are restricted to such open dry grasslands. The most robust populations were observed in grasslands characterized by heterogenous vegetation structure. These grassland type is characterized by outcrops, patches of fleet soil, and patches of deep soil with dense vegetation in a balanced contingent. Within this habitat type, the presence of the species was not typical neither in closed grasslands (vegetation cover more than 80%), nor in open grasslands (vegetation cover below 40%). Even so, the occurrence of *Arcyptera microptera* was not characteristic on very fleet (<1 cm) soil.

Typical habitats in the region were plain-like areas, where in small patches the dolomite bedrock is slim layered by loess (Márkó, Veszprém, Nagyvázsony, Öskü, Csór), or gravel (Öskü, Hajmáskér, Márkó), or sand (Sáska). Because of this covering the soil layer is deeper. On these patches the vegetation is reduced variably, and such grasslands can be found which are at least moderately closed (vegetation cover is 60-80%) and characterised by steppe grass species, like *Festuca valesica* agg., *Stipa capillata*, *Poa angustifolia*. Because of the aridity and disturbances (land use by army, grazing etc.) the grassland is characterized by typically open soil surfaces (in 20-40%) (typically between grass stocks). Further recorded plant species in the studied habitats of *Arcyptera microptera* are: *Medicago minima*, *Astragalus austriacus*, *Cerinth minor*, *Marrubium peregrinum*, *Reseda lutea*, *Berteroa incana*, *Achillea collina*, *Asperula cynanchica*, *Eryngium campestre*, *Teucrium chamaedrys*, *Artemisia campestris*, *Elymus hispidus*, *Euphorbia pannonica*, *Echium italicum*, *Salvia austriaca*, *Seseli annuum*, *Stachys recta*, *Salvia aethiops*, *Trifolium arvense*, *Thesium arvense*, *Verbascum speciosum*, *Chondrilla juncea*, *Xeranthemum annuum* etc. Habitats are characterized by a number of rare or local loess-preferent, steppe and forest-steppe plant species (with plant geographical relevance), like *Vinca herbacea*, *Hesperis tristis*, *Aegilops cylindrica* [Márkó, Öskü, Várpalota], *Taraxacum serotinum* [Márkó, Öskü, Várpalota, Csór], *Prospero elisae* [Nagyvázsony, Márkó, Hajmáskér, Várpalota], *Silene bupleuroides* [Hajmáskér, Öskü, Várpalota, Csór] and *Scorzonera laciniata* [Öskü].

More than 50 percent of the studied grasslands are characterized by disturbances (2 robust populations also exist in disturbed grasslands). The disturbance type is mostly connected to former or current military training. The effects of this land use can obviously be seen on vegetation cover and species composition.

### **Nature protection aspects**

Two historically reported populations from Budapest (NAGY 1987) and Pomáz (NAGY 1991, NAGY 2003) obviously have become extinct in the last few decades. In these areas the land use has changed drastically (intensive treading, erosion, planting of fruit-trees, inbuilding etc.). The population of Tokaj Hill is endangered by vineyard planting and chemicalization. However, the majority of *Arcyptera microptera* populations are scattered over Hungary in habitats not likely to be changed drastically in the near future. Extensively used and variably reduced military training places in a patchy-like way seems to help the species to occur in stable and reasonable large populations.

## Discussion

*Arcyptera microptera* has been known as a typical species of the steppe, forest steppe areas (PRAVDIN & MISHCHENKO 1980, STOROZHENKO 1991), occurring in grasslands of piedmonts and plains (STEBAEV & MOLODTSOV 2001). The results of our study confirmed these statements and revealed that the species occurs sporadically with robust, but regularly distributed populations abroad of its area-centre in the survived fragments of the Eurasian forest-steppe zone in the Carpathian Basin.

The structure of the grasslands found in the Bakony Region shows analogy with the Asian steppe areas. Short-grass steppe grassland patches with open soil surfaces are suitable for the *Arcyptera microptera* to colonize. In Central-Asia habitats of *Arcyptera microptera* are diverse steppe and forest steppe habitats (STOROZHENKO 1991), covered by 60–70 percent plant species (PRAVDIN 1978). Similar, in Central-Europe the species from dry grassland (EBNER 1951), loess grassland (NAGY 2003) and dry forest-steppe vegetation with Corneto-Quercetum and secondary loess meadows (NAGY et al. 1998).

Sand (HARZ 1960 INGRISCH & KÖHLER 1998a) bedrock, loamy and loamy-sandy soil (STOROZHENKO 1991), loamy loess soil (NAGY 2003) are known in the habitats of *Arcyptera microptera*. The requirement of incompact soil is probably originated from the fact that females lay their eggs deeper in the soil than other locusts (INGRISCH & KÖHLER 1998a). In the Bakony Region the species can be found on stony-rocky soils and dolomite black turf, but mostly occurs on colluviosols covered slightly by quaternary sediment (mostly loess). In these areas the depth of the soil is suitable for egg-laying.

Habitats studied in this project are affected by disturbances (mainly military training). Presence of the species in anthropogenic habitats is known, mainly on coasts and in harbours (e.g. US 1967, KNECHTEL & POPOVICI-BIZNOSANU 1959). The rate of several occurrences in anthropogenic habitats can presume anthropochor dispersion of the species, especially when knowing the fact that *Arcyptera microptera* belongs to species with low mobility (ZHONGCHENG & YONGLIN 1998). In our opinion the connection to anthropogenic disturbances is caused by other facts. Grasslands on deep soil (suitable for *Arcyptera microptera* laying) are usually closed. This is unfavourable for the xerophytic, geochortobiont (RÁCZ 1998) species. The short-term and intensive military use creates open soil surfaces and patchy, heterogeneous habitat-structure, which meets *Arcyptera microptera* requirements.

Based on our results we can presume that *Arcyptera microptera* presented with stable populations in the following areas of the Carpathian Basin is doubtful, became extinct or has a few data: Wiener Basin–Lower Moravian Plain, foreland of the North-western-Carpathians, regions of the North-eastern-Carpathians, Eastern-Carpathians and Transylvanian Middle Mts. in low height above sea-level. Western to the Carpathian Basin the steppe vegetation (and its character species) is presented decreasingly as far as the Bohemian Basin.



Despite our systematic study, further examination of xerotherm grasslands with open soil surfaces in low altitude could reveal additional data. Because of the early hatching of the species, intensive field work in May and June is proposed (further advantage that larvae of other locust species are not present, or present in early stage in May). Sound signalling (can be heard with human ears) helps the recognition of the presence of adult males.

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