Acta zool. cracov., 36(1): 45-52, Kraków, 15 Nov. 1993

Zoogeographical relations of the northern parts of the Carpathians, the Caucasus and Altai. The faunas and the communities of *Orthoptera*

Michael G. SERGEEV

Received: 17 May 1992
Accepted for publication: 4 May 1993

SERGEEV M. G. 1993. Zoogeographical relations of the northern parts of the Carpathians, the Caucasus and Altai. The faunas and the communities of *Orthoptera*. Acta zool. cracov., 36(1): 45-52.

Abstract. Common and distinguishing features of the orthopteran faunas and communities of the northern parts of the Carpathians, the Caucasus, and Altai are described in connection with their historical roots. Altitudinal types of communities are characterized.

Key words: *Orthoptera*, fauna, community, Carpathians, Caucasus, Altai.

Michael G. SERGEEV, Biological Institute, Siberian Branch of Russian Academy of Sciences, 11, Frunze Str., Novosibirsk 630091, Russia, and Department of General Biology, Novosibirsk State University, 2, Pyrogova Str., Novosibirsk 630090, Russia

I. INTRODUCTION

The orthopteran faunas of the northern parts of the Carpathians, the Caucasus and Altai have been comparatively well studied (BARANOV, BEY-BIENKO 1926; KOPANEVA 1963; BAZYLUK 1971, 1978; CEJCHAN 1986; SERGEEV et al. 1988). Each of them includes about 45-70 species. Their species compositions suggest their belonging to the Palaearctic (SERGEEV 1986, 1991). But certainly all the three faunas have some peculiar features each, which are connected with distance and history. That shows their being representatives of different parts of the Palaearctic. On the other hand, these three regions are fairly similar in their natural conditions: well marked altitudinal zonality (belting), heavy precipitation, comparatively warm summer, prevalence of forests. As a result the structure of orthopteran communities may be of the same sort not only in each region but also in similar biotopes of different regions. In this connection, it is interesting to discuss the problems of zoogeographical relations of these palaearctic regions.

II. MATERIALS AND METHODS

Grassland and similar anthropogenic biotopes were mainly investigated considering their specificity for the palaearctic *Orthoptera*. Catches were carried out during definite time periods in every biotope under study (GAUSE et al. 1930).

According to this method, insects were caught using a standard net during a definite period of time. Then the results obtained in one hour. Simultaneously orthopteran density is usually estimated on 25 square meters (RIEGERT 1968; ONSAGER 1977). It will be noted, according to our data, these methods allow to obtain stable results including in the time of perennial observations.

This survey was carried out from 1977 to 1990. During this period some trips were made to Altai (1977, 1979, 1988-1990), the one – to the Caucasus (1988), and another – to the Carpathians (1990). The species abundance and the communities composition were determined during 89 catching during definite time.

I investigated about 3 000 specimens of *Orthoptera* which were being of 66 species.

III. FAUNISTIC RELATIONS

The general composition of each fauna is characterized by its nomerous widely distributed palaearctic species. But I intend to describe some peculiarities of each investigated region.

The orthopteran fauna of the northern part of the Carpathians includes some European species. A few of them should be determined as subendemics in the mountains of Central Europe (*Isophya* sp., *Miramella* (*Kisella*) *alpina*, *M.* (*Capraiuscula*) *ebneri* GALVAGNI, *Pseudopodisma fieberi* (SCUDD.)). Other species are distributed widely all over the plains and the low-mountains of Europe (*Leptophyes albovittata*, *Meconema thalassinum* (DEG.), *Pholidoptera griseoaptera*, *Nemobius sylvestris* (BOSC.), *Tetrix undulata* (SOW.), *Stenobothrus stigmaticus* (RAMB.),*Chorthippus pullus* (PHIL.)). The majority of local species are known from Asia, partly as far as the Pacific coast (*Phaneroptera falcata*, *Conocephalus discolor*, *Tettigonia viridissima*, *Metrioptera brachyptera*, *Tetrix subulata*, *T. bipunctata*, *Chrysochraon dispar*, *Stenobothrus lineatus*, *Omocestus viridulus*, *Gomphocerus rufus*, *Chorthippus albomarginatus*, *Ch. dorsatus*). The main zone of habitation of these species are steppes and forest-steppes of the Palaearctic. A few grasshoppers are connected with the central and even southern parts of Eurasia (*Oedipoda caerulescens*, *Aiolopus thalassinus* (F.)).

The northern part of the West and Central Caucasus has comparatively heavy precipitation. It is characterized by a well developed altitudinal belt of forest. All that provides conditions of some European species (*L. albovittata*, *Ph. griseoaptera*) and the widely distributed palaearctic forms (14 species – *T. viridissima*, *Decticus verrucivorus*, *C. discolor*, *Tetrix tenuicornis*, *Euthystira brachyptera*, *Arcyptera fusca*, *S. lineatus*, *O. haemorrhoidalis*, *Chorthippus parallelus*, *Stethophyma grossum*, *Psophus stridulus* etc.). Among these last there is a typical boreo-montane species (*Aeropus sibiricus*). At the same time, the local fauna includes a number of steppe (*Tessellana vittata*, *Celes variabilis*,

Stenobothrus nigromaculatus (H.-S.), *S. fischeri* (EV.), *Dociostaurus brevicollis* (EV.), *Omocestus petraeus* (BRIS.)) and Mediterranean taxa (more than 10 species – *Poecilimon* sp.sp., *Calliptamus* sp.sp., *Oedaleus decorus*). It is interesting that there are a few species mainly settled in Central Asia (*Paratettix uvarovi*, *Docuostaurustartarus* (STSHELK.)).

Some forms (*A. thalassinus*, *Mecostethus alliaceus*) are widely distributed throughout the tropical regions of the Old World. The Caucasian fauna comprises many endemics and subendemics (more than 10 species in the study region: *Poecilimon* sp.sp., *Isophya* sp.sp., *Parapholidoptera noxia*, *Psorodonotus* sp.sp., *Montana decticiformis*, *Nocaracris cyanipes*, *Podisma* sp.sp., *Chorthippus elbrusianus* B.-BIEN.). They include a number of katydids and forms connected with arid mountains of the East Mediterranean (*N. cyanipes* from Pamphagidae) and with forest regions of the Palaearctic (*Podisma* sp.sp, *Ch. elbrusianus*). Thus, the orthopteran fauna of the North Caucasus is really analogous with the other faunas of the Palaearctic forest only that it differs in‘ some peculiar features, especially Mediterranean and steppe relations.

In general, the orthopteran fauna of North Altai should be also characterized as a typical palaearctic one. It is composed of transpalaearctic species (about 50%, i.e. 22 species *D. verrucivorus*, *Roeseliana roeselii*, *Bicolorana bicolor*, *T. tenuicornis*, *S. lineatus*, *Ae. sibiricus*, *Ch. montanus*, *Ch. albomarginatus*, *Bryodema tuberculatum* etc.). Almost all of them are found in the Carpathians and many – in the Caucasus. Some southern forms are also common to the Caucasus and Altai: *M. alliaceus* is distributed widely all over the tropical zone and *Oe. decorus* – in the Mediterranean and Central Asia. Six species may be defined as west-palaearctic (*Tettigonia caudata*, *T. cantans*, *Stauroderus scalaris*, *Glyptobothrus biguttulus* s.str., *Chorthippus apricarius*). All of them are known from other study regions. At the same time, theeastpalaearctic forms are typical of the Altaian fauna, e.g. *Gampsocleis sedakovii*, *Podismopsis poppiusi*, *Megaulacobothrus aethalinus*, *Chorthippus intermedius*, *Ch. hammarstroemi*, *Celes skalozubovi*. Only *Isophya altaica* and *Podismopsis altaica* should be regarded as subendemic in North Altai.

Thus, all the faunas compared, are relatively well distinguished. Their features correspond with their geographical location in different parts of Eurasia. The Carpathian fauna belongs to the western (European) part of the Palaearctic. The Altaian one is a typical component of the Scythian (steppe) Subregion. And the Caucasian fauna is transitional from the steppe and desert subregions to the West Mediterranean. All of them have a common feature – they show a remarkable influence of the boreal fauna of *Orthoptera* represented by widely distributed (usually transpalaearctic) species. In this connection, it is interesting to study how these common and peculiar features are expressed in the community compositions of the local *Orthoptera*.

IV. COMMUNITIES

A community is a group of individuals of animals and/or plants (perhaps of one taxon) which inhabit an ecosystem. A comparison of the communities investigated in different regions makes it possible to determine the main ways of their formation and to estimate

the role of the *Orthoptera* in herbaceous ecosystems. Moreover, we can evaluate the probable change induced in them by man's activities.

I also characterize the main types of communities, i.e. these of altitudinal belts and river flood-plains. Since the palaearctic *Orthoptera* are chiefly linked with herbaceous biotopes, I confine myself to examining them only.

The Carpathian communities (Table 1) include a few orthopteran species. Their abundance is small. The alpine and subalpine meadows are inhabited by the only species – *M. alpina*. The communities of forest meadows characterize themselves by a number of widely distributed *Orthoptera* (*G. rufus*, *Ch. parallelus*, *G. biguttulus*) and a few subendemics (*M. alpina*, *I. brevipennis*). As a rule, the total number of the *Orthoptera* increases. *O. viridulus* is obviously connected with flood-plain meadows. That grasshopper is a common dominant.

Table 1

Abundance of *Orthoptera* (individuals/hour) in the meadow biotopes in the northern part of the Carpathians

Species	Altitudinal belts			Flood-plain meadows
	Under timber-line	Forest belt		
		Upper part	Lower part	
Isophya brevipennis BRUNNER VON WATTENWYL	–	+	–	–
Decticus verrucivorus (LINNEUS, 1758)	–	–	3	–
Roeseliana roeselii (HAGENBACH, 1882)	–	+	+	–
Tetrix bipunctata (LINNEUS, 1758)	–	+	+	–
Miramella alpina (KOLLAR, 1833)	+	18	–	+
Stenobothrus lineatus (PANZER, 1796)		–	+	–
Omocestus viridulus (LINNEUS, 1758)	–	+	6	30
Gomphocerus rufus (LINNEUS, 1758)	–	96	–	–
Glyptobothrus biguttulus (LINNEUS, 1758)	–	–	21	–
Chorthippus parallelus (ZETTERSTEDT, 1821)	–	+	36	–
Ch. albomarginatus (DE GEER, 1773)	–	–	+	–
Total	~0	114	66	30

The Caucasian communities (Table 2) differ largely from the Carpathians in species composition and in the level of abundance. The alpine, subalpine and forest meadows are characterized by the dominance of the rather xerophilous, almost transpalaearctic, grasshopper *Ch. apricarius*. There are a few mountain subendemics (*N. cyanipes*) and a single boreomontane species (*Ae. sibiricus*). The orthopteran abundance is great.

Table 2

Abundance of *Orthoptera* (individuals/hour) in the meadow and steppe biotopes in the northern part of the Caucasus

Species	Altitudinal belts				Flood-plain meadows
		Under timber-line	Forest belt		
			Upper part	Lower part	
Leptophyes albovittata KOLLAR, 1833	–	–	32	8	30
Poecilimon scythicus STSHELKANOVTZEV, 1911	–	–	16	–	–
P. heroicus STSHELKANOVTZEV, 1911	–	–	8	–	–
Tettigonia caudata (CHARPENTIER, 1845)	–	+	8	–	–
Decticus verrucivorus (LINNAEUS, 1758))	4	+	+	20	–
Gampsocleis glabra (HERBST, 1786)	–	–	–	+	–
Pholidoptera griseoaptera (DE GEER, 1773)	–	–	104	+	10
Parapholidoptera noxia (RAMME, 1930)	–	–	–	+	–
Psorodonotus specularis (FISCHER DE WALDHEIM, 1939)	–	–	–	–	+
Montana decticiformis (STSHELKANOVTZEV, 1914)	–	–	–	+	–
Tessellana vittata (CHARPENTIER, 1825)	–	–	–	8	20
Bicolorana bicolor (PHILIPPI, 1830)	–	–	+	+	–
Conocephalus discolor THUNBERG, 1815	–	–	–	+	70
Gryllus campestris LINNAEUS, 1758	–	–	+	+	+
Tetrix tenuicornis (SAHLBERG, 1891)	–	–	+	+	+
Paratettix uvarovi SEMENOV, 1915	–	–	–	–	10
Nocaracris cyanipes (FISCHER DE WALDHEIM)	4	–	–	–	–
Euthystira brachyptera (OCSKAY, 1826)	–	–	+	+	–
Arcyptera fusca (PALLAS, 1773)	–	–	+	–	–
Stenobothrus lineatus (PANZER, 1796)	–	–	+	8	–
Omocestus viridulus (LINNEUS, 1758)	–	–	8	–	–
O. haemorrhoidalis (CHARPENTIER, 1825)	4	12	+	+	–
Myrmeleotettix maculatus (THUNBERG, 1815)	+	+	–	–	–
Aeropus sibiricus (LINNEUS, 1767)	12	–	–	–	–
Glyptobothrus biguttulus (LINNEUS, 1758)	+	+	–	–	+
G. brunneus (THUNBERG, 1815)	–	–	+	56	10
G. mollis (CHARPENTIER, 1825)	–	–	–	+	–
Chorthippus apricarius (LINNEUS, 1758)	752	252	–	+	+
Ch. macrocerus (FISCHER DE WALDHEIM, 1846)	–	–	52	636	70
Ch. parallelus (ZETTERSTEDT, 1821)	–	–	368	92	800
Ch. loratus (FISCHER DE WALDHEIM)	–	–	4	–	–
Stethophyma grossum (LINNEUS, 1758)	–	–	–	–	+
Mecostethus alliaceus (GERMAR, 1817)	–	–	+	–	10
Psophus stridulus (LINNEUS, 1758)	+	+	+	+	–
Oedipoda caerulescens (LINNEUS, 1758)	–	–	–	+	–
Celes variabilis (PALLAS, 1774)	–	+	–	–	–
TOTAL NUMBER	776	264	592	832	1030

The communities of coniferous forest meadows are fairly similar. But the endemic, subendemic and boreo-montane forms disappear, and the steppe species (*Celes variabilis* etc.) occur. The diversity of orthopterans increases in the deciduous forest (nemoral) altitudinal belt. Some European species (*L. albovittata*, *Ph. griseoaptera*) appear. Some of them have a very local distribution (*Poecilimon scythicus*, *P. heroicus* etc.). The dominant species (*Ch. parallelus*) is a sort of forest-steppe form. It is replaced by *Ch. macrocerus* in the steppe belt. The presence Caucasian endemics (*P. noxia*, *M. decticiformis*) is also interesting. The species diversity is the greatest in tlocal steppe landscapes.

The flood-plain communities are generally characterized by similar features, but endemic *Psorodonotus specularis* is found in the upper part of the Baksan valley, while of boreal (*S. grossum*) and southern species (*M. alliaceus*, *P. uvarovi*) occur in its lower part.

The Caucasian meadow communities have generally a xeromorphic character. This is very typical of the lower belt, where steppe and similar species dominate. As far as endemics are concerned, they are found in most local communities, but their abundance is usually not great.

The Altaian communities of *Orthoptera* are conspicuous by the great diversity of species. This seems to result from the comparatively goog knowledge of the region. The level of orthopteran abundance is similar to that in the Caucasus. The alpine and subalpine communities are very interesting (BARANOV, BEY-BIENKO, 1926). Besides endemic *P. altaica*) typical steppe forms (*Stenobothrus eurasius*, *Angaracris barabensis*) live in the mountains of South Siberia, although such species are not known from the lower belts of North Altai. That is due to the penetration of steppe elements into the meadows situated below the under timber-line. It is connected with the very high continentality of this region. *Ae. sibiricus* is a typical form of such meadows.

The communities of meadows in the coniferous forest belt consist of mesophilous species: east-palaearctic *P. poppiusi* and boreal transpalaearctic *R. roeselii*, *Ch. montanus*, *O. viridulus*. Below that belt the diversity and abundance of orthopterans crease. In the deciduous forest belt the widely distributed forest-steppe grasshoppers (*A. fusca*, *Ch. dorsatus*) generally predominate. There are many east-palaearctic and typical steppe forms.

The greatest abundance and diversity are observed the steppe altitudinal belt. *Ch. apricarius* is the dominant species of local communities which are similar to the under-timber-line communities of the North Caucasus. But the Altaian communities of this type are characterized by the considerable participation of thermophilous forms, including steppe-inhabitations: *Poecilimon intermedius*, *Montana montana*, and *Pararcyptera microptera*. There are also some east-palaearctic mesoxerophilous grasshoppers (*Ch. hammarstroemi*, *C. skalozubovi*).

The flood-plain communities are distinguished by the dominance of boreal species: hydrophilous *S. grossum* and mesohydrophilous *Ch. montanus*. They are accompanied by other widely distributed forms.

On the whole, the Altaian communities include mainly the comparatively xerophilous species. Such forms are common to both under timber-line meadows and steppe vegetation. As a rule, they occur rather locally. Widely distributed species inhabit the forest meadows which are of the same type as in the Carpathians and Caucasus.

Table 3

Abundance of *Orthoptera* (individuals/hour) in the meadow and steppe biotopes in the northern part of Altai

Species	Altitudinal belts			Flood-plain meadows
	Under timber-line	Forest belt		
		Upper part	Lower part	
Phaneroptera falcata (PODA, 1761)	–	–	–	+	–
Isophya altaica (BEY-BIENKO, 1926)	–	12	–	+	–
Poecilimon intermedius (FIEBER, 1853)	–	–	4	+	–
Tettigonia viridissima (LINNEUS, 1758)	–	–	–	+	–
T. caudata (CHARPENTIER, 1845)	–	–	8	+	6
T. cantans (FUESSLY, 1775)	–	–	+	–	–
Decticus verrucivorus (LINNEUS, 1758)	–	–	+	–	–
Gampsocleis sedakovii FISCHER DE WALDHEIM, 1846)	+	–	+	+	–
Montana montana (KOLLAR, 1833)	–	–	4	+	–
Metrioptera brachyptera (LINNEUS, 1761)	–	–	–	+	–
Roeseliana roeselii (HAGENBACH, 1882)	–	18	+	6	–
Bicolorana bicolor (PHILIPPI, 1830)	–	–	–	60	36
Tetrix subulata (LINNEUS, 1761)	–	–	–	+	+
T. bipunctata (LINNEUS, 1758)	–	–	–	–	–
T. tenuicornis (SAHLBERG, 1891)	–	–	–	6	6
Chrysochraon dispar (GERMAR, 1831)	–	–	–	+	–
Euthystira brachyptera (OCSKAY, 1826)	–	+	8	+	–
Podismopsis altaica ZUBOVSKY, 1900	+	–	–	–	–
P. poppiusi (MIRAM, 1907)	+	36	+	–	12
Arcyptera fusca (PALLAS, 1773)	–	+	32	+	6
Pararcyptera microptera (FISCHER DE WALDHEIM, 1833)	–		–	+	–
Stenobothrus lineatus (PANZER, 1796)	–		+	+	–
S. eurasius ZUBOVSKY, 1898	+		–	–	–
Omocestus viridulus (LINNEUS, 1758)	–	+	4	–	+
O. haemorrhoidalis (CHARPENTIER, 1825)	–		–	+	+
Aeropus sibiricus (LINNEUS, 1767)	+		–	–	–
Gomphocerus rufus (LINNEUS, 1758)	–		12	–	–
Stauroderus scalaris (FISCHER DE WALDHEIM, 1846)	–		–	+	–
Megaulacobothrus aethalinus (ZUBOVSKY, 1899)	–	+	–	+	–
Glyptobothrus biguttulus (LINNEUS, 1758)	+		–	+	–
Chorthippus apricarius (LINNEUS, 1758)	–	+	+	672	36
Ch. intermedius (BEY-BIENKO, 1926)	–		+	+	12
Ch. hammarstroemi (MIRAM, 1907)	+	+	–	24	–
Ch. montanus (CHARPENTIER, 1825)	+	12	20	72	96
Ch. parallelus (ZETTERSTEDT, 1821)	–	–	–	+	–
Ch. dorsatus (ZETTERSTEDT, 1821)	–	–	36	+	30
Ch. albomarginatus (DE GEER, 1773)	–	–	–	+	–
Stethophyma grossum (LINNEUS, 1758)	–	–	–	+	114
Mecostethus alliaceus (GERMAR, 1817)	–	–	–	+	–
Oedaleus decorus (GERMAR, 1817)	+	–	–	–	–
Psophus stridulus (LINNEUS, 1758)	+	–	–	6	–
Celes skalozubovi ADELUNG, 1906	–	–	–	6	–
Bryodema tuberculatum (FABRICIUS, 1775)	+	–	–	+	–
Angaracris barabensis (PALLAS, 1773)	+	–	–	–	–
TOTAL NUMBER	7	78	132	852	354

V. CONCLUSIONS

The composition of the faunas and communities of the northern parts of the Carpathians, the Caucasus, and Altai shows univocally that they have a common historical origin – in the ancient palaearctic meadow-steppe fauna. But the distances between the investigated regions results in considerable differences. They are a distinctive characteristic of the orthopteran fauna of the North Caucasus. There are distinct influences of the Mediterranean, steppe and Central-Asian faunas. The steppe and east-palaearctic species are well represented in the Altaian fauna. In addition, the detached mountains situated further to the more southern and separated south of the Caucasus are inhabited by many endemics and subendemics. That was all observed for community compositions. But distinctions are more sharply. The transpalaearctic species prevail in the meadow communities of the forest altitudinal belts only. Under the timber-line the orthopteran communities are characterized by the dominance of subendemics (the Carpathians, Altai) and/or steppe and forest-steppe species (the Caucasus, Altai). The mesophilous and mesoxerophilous forms are usual inhabitants of the steppe altitudinal belts of the Caucasus and Altai. That means that considerable differences between the investigated faunas arose comparatively long ago, during the Pliocene at latest. The published results of investigations in the Mediterranean mountains (DREUX, 1961; CLARIDGE, SINGHRAO, 1978) show a similar pattern. These differences should be taken into account if the role of *Orthoptera* delt with and the changes caused in their communities by man's activities are estimated.

REFERENCES

BARANOV V. I., BEY-BIENKO G. J. 1926. An experience of phytoecological description of biotopes of *Orthoptera Saltatoria* in Altai. Izv. Zap.-Sib. otd. Russk. geogr. obstsh., **5**: 179-198.

BAZYLUK W. 1971. Prostoskrzydłe (*Orthoptera*) Bieszczadów Zachodnich wraz z opisem *Isophya posthumoides* n.sp. Fragm. faun., **17**: 127-159.

BAZYLUK W. 1978. Karaczany (Blattodea), prostoskrzydle (*Orthoptera*) i skorki (*Dermaptera*) Pienin oraz góry Wżar. Fragm. faun., **22**: 7-50.

CEJCHAN A. 1986. K poznani orthopteroidniho hmyzu (s.l.) Bilych Karpat. II. (*Grylloptera*, *Orthoptera* s.str.,*Dermaptera*, *Dictuoptera*). Sb. Nar. mus. Praze. B **42**: 141-148.

CLARIDGE M. F., SINGHRAO J. S. 1978. Diversity and altitudinal distribution of grasshoppers (*Acridoidea*) on a Mediterranean mountain. J. Biogeogr., **5**: 239-250.

DREUX P. 1961. Recherches écologiques et biogéographiques sur les Orthopteres des Alpes Françaises. Ann. Sci. Nat., Zool., **3**: 323-766.

GAUSE G. F. 1930. Studies on the ecology of the *Orthoptera*. Ecology, **11**: 307-325.

KOPANEVA L. M. 1963. *Orthoptera* of the Upper Teberda basin (The Great Caucasian Ringe) and patterns of their distribution through biotopes. Avtor. diss. kand. biol. nauk, Leningrad, 18 pp.

ONSAGER J. A. 1977. Comparison of five methods for estimating density of rangeland grasshoppers. J. Econ. Ent., **70**: 187-190.

OTTE D. 1979. Biogeographic patterns in flight capacity of nearctic grasshoppers (*Orthoptera*: *Acrididae*). Ent. News, **90**: 153-158.

RIEGERT P. M. 1968. A history of grasshopper abundance surveys and forecast of outbreaks in Saskatchewan. Mem. Ent.Soc. Can., **52**: 3-99.

SERGEEV M. G. 1986. Patterns of *Orthoptera* distribution in North Asia. Nauka Publ., Novosibirsk, 237 pp.

SERGEEV M. G. 1988 *Orthoptera* communities of main landscapes of North Altai and attempt of their classification. In: Landshaftaja ecologia nasekomych. Nauka Publ., Novosibirsk: 15-26.

SERGEEV M. G. 1991. Distribution patterns of *Orthoptera* in the Asian part of the USSR. Avtoref. diss. dokt. biol. nauk. Sankt-Petersburgh, 37 pp.