ZOOGEOGRAPHY OF THE AUCHENORRHYNCHA OF THE USSR AND ADJOINING TERRITORIES

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ABSTRACT

In the last 10 years the number of known Auchenorrhyncha has risen in the Palaearctic region by 500 species. The number of species is highest in southern countries and decreases towards the north. A simplified system of range types is presented. The connections of the Palaearctic fauna with the faunas of other regions are discussed. Species with limited ranges prevail in the southernmost countries of the Palaearctic Region. In the northern countries, widely distributed species prevail. In the Soviet Union about 2000 species have been recorded. Central Asiatic species are most numerous. Using some better investigated areas as a basis, the fauna of various parts of the USSR is characterised according to their origin and formation. In the USSR there are no major Auchenorrhyncha pests.

INTRODUCTION

As the Soviet Union covers more than 60% of the territory of the Palaearctic region, it is justified to analyse first some problems common to the whole region.

In 1972 Nast catalogued 4080 species from this region. The actual number, however, was somewhat smaller because he included also numerous species of "uncertain position", the majority of which are without any doubt synonyms. In addition, there are many species whose types have not been investigated.

According to my rather inaccurate estimates, there were at least 4523 species at the end of 1981, which means that the number of known species has increased in the last 10 years by about 500. The number of new species is somewhat higher, and during recent investigations many new synonyms have been established. Thus in my survey of the Auchenorrhyncha of Tuva I described 40 new species and simultaneously discovered 23 new synonyms. An increase in the number of species has been noticed in almost all families, except the Aphrophoridae where many described species proved to be synonyms (e.g. out of the 12 described species of the genus Sinophora, only 4 are valid).

The Auchenorrhyncha are in general a southern group. If one compares the number of species in various countries, one notices a continuous increase in species from north to south: Finland - 311, Estonian SSR - 304, Latvian SSR - 322, Poland - 488, Czechoslovakia - 560, Italy - 687.

The exact geographical distribution of many species is very inadequately known. For example, my investigations in Kamchatka have "extended" the ranges of 12 species, believed to be Eurasiatic or Eurosiberian up to the Pacific coast. Therefore I can refer to only very wide areal types, which do not reflect exact ranges of individual species but merely their presence or absence in larger areas. The following areal types are distinguished:

1. European (E) (or more precisely West-Palaearctic, since their ranges also include North Africa, Caucasian and Transcaucasian areas and Anatolia),
2. Eurasiatic (EA) (includes Europe and the Western part of Asia, including Central Asia),
3. Euro-Siberian (ES) (the same without Central Asia),
4. Transpalaearctic (TP),
5. Central-Asiatic (CA),
6. Transasiatic (TA) (throughout the continent, including Central Asia),
7. Transsiberian (TS) (the same without Central Asia),
8. Central Siberian (CS) (living in Central Siberia, mostly species originating from the so-called Angara distribution centre),
9. East-Asiatic (EaA).

These range types include species of various origin. The European species are descendants from various distribution centres in South Europe and North Africa. According to the Auchenorrhyncha, it seems that the connection between the faunas of South Europe and North Africa is not so close as earlier believed: although there exist about 300 common species, there also exist 232 species endemic to North Africa. Furthermore, it seems that the so-called refugial areas of various authors (Reinig, de Lattin, etc.) are in fact centres of origin, since such areas are very rich in endemic species. These areas could act as refugial areas only for South and Central European species. As indicated by various malacological investigations, most species living now in Northern Europe survived the maximum glaciation not far from the ice margin.

The existence of such species which now live only in the area north of the Alps, indicates that there also exist species of northern origin, viz. descendants of so-called Fenno-Sarmatian or Palaeeuropean Platforms. They were driven to the south during the glaciations and returned after the retreat of the ice cover. Eurasiatic species are partly of European and partly of Central Asiatic origin. Apparently the first group is greater, because the Turanian Lowland was for a long time covered by the Thethis Sea and the occupation of the area was possible only after it had dried out. Euro-Siberian species are also partly of European origin, and partly descendants of the Angara centre. Most Asiatic species are of Central Siberian or East Asiatic origin.

The Palaearctic Region is not very sharply delimited from other zoogeographical regions. An estimate demonstrated that about 10% of all the species found are common to other regions. Most numerous are the species common to the Oriental region - 234 species. Almost 80% of them belong to the East-Asiatic range type. It is quite understandable as there is no real dispersal barrier between the Palaearctic and Oriental regions, and also the exact position of their borderline is ill-defined. The presence of 3 species common to the Oriental Region in the Palaearctic Region of the European range type (Empoasca affinis Nast, E. punjabensis Singh-Pruthi and E. signatus Haupt) refers to the dispersal of those species by man. The ranges of 11 species extend through the Oriental Region into the Australian Region. They are mostly widely distributed species - probably species transported there by man (tree-living species, pests, etc.).

The species common to the Aethiopian Region are less numerous - 62. The large Sahara Desert proves to be a good dispersal barrier. Most species have European or Eurasiatic range types in the Palaearctic Region. It is difficult to understand why common species include also 5 central Asiatic and 4 Transasiatic species.

Most interesting are the connections with the Nearctic Region. About 100 common species have been established. It is interesting that there are very few species of Fulgoroidea among them (3 species of Delphacidae, 1 species of Derbidae, and 2 species of Issidae). It clearly refers to the southern origin of those groups. The present author is convinced that only the species which have passed the Bering Land Bridge and consequently at present live on both sides of the Bering Strait or in the vicinity of it should be regarded as "real" Holarctic species. The Bering Land Bridge existed several times. Of particular importance was the Oligocene-Miocene period, when temperate deciduous forests extended across the whole northern parts of Eurasia and North America. The millions of years that have passed since then have been sufficient for those species to reach the Atlantic coast in Europe. About a half of all species belong to such species. About 3/4 of the species have apparently used the direction from Asia to America.

Only 9 (or 13) species probably crossed the Bering Land Bridge during the last (Würm, New Drift, Valday or Wisconsin) glaciation. These are species whose ranges extend westwards up to Central Siberia (Notus sitka DeLong & Caldwell, Cosmotettix paludosus (Ball), Cicadula ciliata (Osborn)) or which have relatively recently intruded into Europe: Boreotettix bidentatus (DeLong & Davidson) (first recorded in Finland 1942), Cicadula ornata (Melichar) (Sweden 1939 and Finland 1942), and Lebradea flavovirens (Gillette & Baker) (Sweden 1970). All these species are inhabitants of moist meadows or bogs, which indicates that during the existence of the Land Bridge (at least in its southern part) such vegetation also existed. The climate was then presumably somewhat milder, as the ranges of some species do not now extend up to the Chukchi Peninsula or Alaska.

Some species live only on both sides of the Bering Strait, e.g. Macrosteles guttatus (Matsumura) (= M. osborni (Dorst)), M. lineatifrons (Stal) and Verdanus evansi (Ashmead).

There also exists a small group of Transarctic species: Achorotile subarctica Scudder, Javesella simillima (Linnavuori) (= J. saileri (Beamer), Hardya youngi Beirne, Coulinus usnus Beirne, Rosenus abiskoensis (Lindberg) (= R. transarcticus Hamilton & Ross) and Psammotettix lapponicus (Ossiannilsson). It is very difficult to establish the time of their passage across the Land Bridge, but as the first four species do not occur in Europe, one can conclude that they also passed it during the last glaciation.

All other species, I assume, have been introduced into America (and vice versa) by man. The introduction of 4 species from North America to Europe is well documented: Stictocephala bisonia Kopp & Yonke (first recorded from Hungary in 1912), Scaphoideus littoralis Ball (recorded in France 1960), Graphocephala fennahi Young, and Metcalfa pruinosa Say (in recent years in Italy). Two species were introduced to North America from Japan (Japanus hyalinus (Osborn) and Orientus ishidae (Matsumura)). All the remaining North American immigrants originate from Europe. There are 31 arboricolous species among them, which were transported to America probably with planting material. This assumption was confirmed by the fact of finding Typhlocyba quercus (Fabricius) in 1948. Quite recently also some herbaceous species were introduced into America (e.g. Doratura stylata (Boheman), Allygus mixtus (Fabricius)). The mechanism of the transport of such species is still unclear. In some cases (e.g. Arthaldeus pascuellus (Fallén), some Aphrodes species, Macrosteles viridigriseus (Edwards) they could have been brought to America by ballast material, as it was demonstrated very ingeniously for many beetle species by Lindroth. It is also quite unknown in which way Neoaliturus tenellus (Baker) was transported to America and is now a serious pest there.

I would like to draw attention to a small southern group of 4 Balclutha species, which besides the Holarctic region occur also in the Neotropical region. I regard this group as a very ancient one, which apparently was present already before the continental drift.

If we now calculate the proportion of different areal types (Fig. 1) we see that the largest group is European (viz. Westpalaearctic) - 35%.

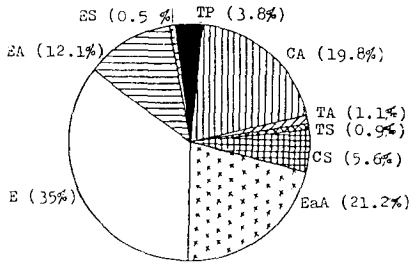

Fig. 1 Areological spectrum of the Palaearctic Auchenorrhyncha fauna

One must note that the number is especially high in Fulgoroidea - comprising 46.5% of all species. The families of Fulgoroidea especially rich in European species are Issidae (69.5%), Flatidae (54%), Tettigometridae (53.4%) and Cixiidae (51.5%). Also in the Cicadellidae, the family richest in species (about 60% of all species), European species are predominant (31.5%). The proportion of the European species is low only in Membracidae (13.1%) and Cercopoidea (11.7%).

East-Asiatic species occupy the second place - 21.2%. The richest East Asiatic families are Aphrophoridae (75.5%), Membracidae (71.1%) and Derbidae (57.2%). Central Asiatic species take up the third place - 19.8%. Of the families richest in Central Asiatic species are Dictyopharidae (44.6%), Flatidae (28.4%) and Cixiidae (22.1%). All the other areal types are represented by low percentages. Only for the Eurasiatic species does the proportion slightly exceed 10%, the proportion of other types is much lower.

This discussion seemingly demonstrates that among Auchenorrhyncha in general, species with limited ranges are most prevalent.

Quite a different result is obtained when we compare the areological spectra of different areas, viz. countries. European species prevail only in the southernmost European countries, e.g. 48.9% in Italy and 55.2% in the Iberian Peninsula. The proportion is highest in North Africa, where 63.9% of all species are European. This is quite understandable, since 40.4% of the species are endemic to that area. The number of endemic species is high also on the islands of the Atlantic Ocean (Madeira Archipelago, Azores, Canary Islands, Selvagens Islands), where there exist at least 98 endemic species.

Further north widely distributed species prevail. Although 34.6% of European species occur in Czechoslovakia, this number is exceeded by Eurasiatic species (41.6%). In Poland the ratio is 33:38.3%, in England 31.7:37.4, in Estonia 17.4:40.8 and in Finland 18.3:38.3. At the same time one notices an increase in Transpalaearctic species (accordingly Italy - 14.7%, Iberian Peninsula - 13.8%, Czechoslovakia - 21.1%, Poland - 25%, England - 28.7%, Estonia - 37.2% and Finland - 38.3%).

Such a distribution of range types has doubtless been influenced also by Pleistocene glaciations. After the retreat of the ice the freed areas were occupied by these species with a wider ecological tolerance.

A somewhat different picture is seen in the Central Asiatic area. Central Asiatic species prevail only in Turanian Lowland. In Kazakhstan there are 44.6% Central-Asiatic species against 36.7% of Eurasiatic and 12.4% of Transpalaearctic species. In Tadjikistan the prevalence of Central-Asiatic species is still greater (53.6% against 33.7% and 11.2%). In contrast, in Iran there are more Eurasiatic species (53.7%) than Central-Asiatic ones (39.9%), and in Afghanistan 51.6% and 35.3%.

It demonstrates that the area freed from the Thethis Sea also served as a place of intensive speciation. At present there are several endemic groups (e.g. subfamily Orgeriinae, tribe Adelungiini, and many genera and species) which live exclusively or predominantly here.

In East Asia the relationships are similar to those of Europe. In the northern part of the area widely distributed species are prevalent. In Kamchatka 70.7% of the species are Transpalaearctic and 17.3% East Asiatic. In Soviet Primorye Territory (Maritime Territory) there are 63.8% East Asiatic species against 25.4% Transpalaearctic ones. In the Korean Peninsula the numbers are 79% and 15.8%, respectively, and in Japan 90.4% and 8.3%.

If we now consider the characterisation of the fauna of the Soviet Union, I would like to start with the number of recorded species. By the end of 1981 about 2000 species (according to my rather rough estimates - 1975 species) had been recorded from the USSR. It is somewhat less than half of the Palaearctic fauna (ca 44%). The true number is doubtless larger since large areas are still uninvestigated and every new investigation adds some more species. Thus during my incomplete investigations on Sakhalin I found more than 10 new species, not included in this survey.

Of great interest is the areological spectrum of the fauna (Fig. 2). Central Asiatic species (31.5%) greatly predominate, followed by European (21%), East Asiatic (16.9%), Eurasiatic (8.7%) and Transpalaearctic (8.6%) species.

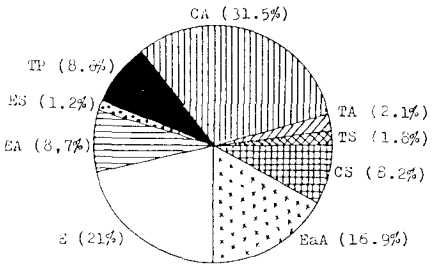

Fig. 2. Areological spectrum of the Auchenorrhyncha fauna of the USSR

As stated above, all parts of the Soviet Union have not been investigated with equal completeness. Therefore an attempt will be made to characterise the fauna, its origin and formation on the basis of a few better-investigated areas.

In the European part of the Soviet Union the relations are similar to those described above. In its northern part the fauna has been repeatedly changed by Pleistocene glaciations - the fauna was destroyed and after the retreat of the ice cover the area was newly colonised by immigrants from the south and partly also from the east. Moreover, the post-glacial climate also underwent great changes - warmer periods alternated with colder ones. Each of them had its influence on the fauna. Thus, for example, several xerothermic species exist in the Estonian fauna (Tettigometra atrata Fieber, Neophilaenus albipennis (Fabricius), Adarrus bellevoyei (Puton)), which are probably remnants of the Atlantic period. The main parts of their ranges lie far southwards. They do not occur in the southern Soviet Baltic Republics and therefore one must suppose that their occurrence in Estonia is connected with the limestone basic rock in North Estonia. To this group probably also belong Anaceratagallia estonica Vilbaste and Mongolojassus bicuspidatus (J. Sahlberg) - species whose main range is situated in Central Asia. On the other hand, some Estonian species are regarded as glacial relicts.

The conditions in the other Soviet Baltic republics are quite similar. In Latvia 322 species have been recorded so far, and in Lithuania 299. The proportion of European species is increasing steadily, mainly at the expense of Eurasiatic species.

The fauna of the Ukrainian SSR is also rather well known, due to the activities of Dr. V. Logvinenko: 559 species have been reported, of which 48.8% are Eurasiatic, 30.8% European, 18.8% Transpalaearctic and 1.6% Euro-Siberian.

The area is covered mainly by steppes and therefore the fauna is almost the same as in all the plain areas of South Europe. As is known, xerophication and formation of steppes was a relatively recent phenomenon (in the Miocene the area was still covered with forests) and accordingly these must have been settled by immigrants from other areas.

An exception is the Crimean Peninsula (at least in its southern part) where very many southern species live. It is quite normal as the Crimea, during the whole Miocene, was a part of the so-called Aegean Land, which according to many scientists served as a major speciation centre.

From the Caucasian area 479 species have been recorded. The number is undoubtedly greater since no list of the current species is available. Although Eurasiatic species (45.1%) prevail, very many European species (40.5%) also exist of which at least 94 species (19.6%) are endemic to the area. This circumstance is very understandable as the Caucasus during the whole Palaeogene was an island with a subtropical climate in the common basin of the Black and the Caspian Sea. It became connected with Asia Minor through the elevation of land in the southern part, in the Middle Pliocene.

Of the Central Asian republics, Kazakhstan is best known. Due to the activities of Dr. A. Emelyanov and Dr. I. Mityayev, 823 species have been recorded. The great number of species is in accord with the magnitude of the republic. Its area is more than 10 times larger than that of Great Britain and it occupies various vegetational zones from deserts and steppes to mountain areas. Central Asiatic species prevail (44.6%), very many are also Eurasiatic ones (36.7%), whereas the number of Transpalaearctic species is rather low (12.4%).

The formation of such a fauna was strongly affected by orogenetic processes. Especially in the Pliocene the mountain ridges in the south achieved such a height that they acted as barriers to moist air masses from the Indian Ocean. Those species which remained beyond the barrier had to accommodate themselves or change.

In Tadjikistan, which is about 20 times smaller, only 338 species have been recorded. This area does not extend very far in the northern direction and therefore lacks many widely distributed species. In addition, in the southern part of the republic marked elevation of land has taken place. As a result, 53.6% of all the species are of Central Asiatic origin.

The fauna of the Soviet Altay (Mountainous Altay A.O.) is poorly known: 254 species have been recorded. The area is intermediate between taiga forests, steppes and semideserts. This circumstance determines also the composition of the fauna; 38.2% of all the species are Transpalaearctic, 27% Eurasiatic and 18.1% Central Siberian ones. The last figure is unexpectedly small, in view of the fact that the area lies quite near to the Angara distribution centre. During the glaciation some northern or even arctic species invaded here (Verdanus limbatellus (Zetterstedt), Rosenus abissoensis J.K. Lindberg). On the other hand, the presence of the so-called insular steppes enabled Central-Asiatic steppe or desert species to invade the area. Although the area is separated from Central Asia by high mountains, about 7.5% of the species are common to this area.

The fauna of Tuva has been somewhat better studied: 351 species have been established. Of these, 28.8% are Central-Siberian, 27.9% Transpalaearctic and 19.7% Eurasiatic species. The high number of the Central-Siberian species is understandable as Tuva belongs to the oldest part of Asia, existing in the Palaeozoic era and therefore believed to be one of the main places of origin of the Eurasiatic fauna. The Pleistocene glaciation also exerted its influence on the fauna. Although the margin of the continuous ice cover was separated from Tuva by more than 1 thousand km, local glaciations took place. The original fauna was forced southwards and was replaced by a more hygrophilous fauna which after the melting of the ice remained high in the mountains. At the same time the area was invaded by some species which had just passed the Bering Land Bridge.

The Primorye (Maritime) Territory is also a very old part of the Eurasian continent. Its fauna must therefore be regarded as mainly autochthonous; 390 species have been recorded. Of them as many as 63.8% belong to the East-Asiatic species. Of the total

species, 22.5% are common with Japan. In this phenomenon also one can see the influence of the Pleistocene glaciations, because it is believed that during the maximum glaciation the sea level was about 200 m lower than today, and consequently Japan was connected with the Asian mainland.

About 10% of all species also occur in the Oriental region. The majority now inhabit broad-leaved forests. Transpalaearctic species (25.4%), however, live in moist meadows and bogs. The fauna of the Primorye Territory is also connected with the so-called Manchurian fauna - through dry meadows and East Asian steppes.

In the Kamchatka Peninsula only 75 (+ 2 undetermined) species have been found; 70.7% of them belong to Transpalaearctic forms, of which about a half (44.7%) are Holarctic. This is quite natural as the neighbouring area, the Chukchi Peninsula, served as a place of species exchange; 17.3% of species are of East-Asiatic origin, while 10.7% are Transsiberian.

Kamchatka is of relatively recent origin. It was present in the late Miocene as a row of small islands. The main invasion of that area, occurred somewhat later, mainly from the north. The very small number of species on the Middle Kuril Islands indicate that it could not have occurred from the south. During the last glaciation the established fauna was destroyed or concentrated into the southern part of the peninsula. After the retreat of the ice cover, the peninsula was settled anew from north and south.

It is quite interesting to observe how far north the Auchenorrhyncha have gone. Material for the study has been collected from Taimyr Peninsula (from my own studies and those of Dr. J.I. Chernov). No Auchenorrhyncha are found in the so-called Arctic tundra. I could not find any specimens in the vicinity of Port Dickson (at the mouth of Yenisei River). Three or four species live in the so-called typical tundra: Javesella simillima (Linnavuori), Streptanus arctuosus Emeljanov, Hardya taimyrica Vilbaste and H. youngi Beirne. The latter species is the northernmost one which can maintain its populations, due to the fact that the species can hibernate in all stages and accordingly can reproduce throughout the year. In the so-called southern tundra the number of species suddenly rises together with the appearance of shrubs and trees. Penetration of the southern species into the north is greatly facilitated by large river valleys, which create favourable climatic conditions for invasions.

In conclusion I should like to give some information about pest species. There are no major Auchenorrhyncha pests in the Soviet Union. Even in general textbooks of economic entomology no such species are mentioned. It seems that the most serious pests live chiefly in southern (mostly in tropical or subtropical) countries, where constantly high temperatures create conditions for the continuous development of the subsequent generations.

On the other hand, as Auchenorrhyncha species do not leave any clear feeding marks, it is rather difficult to estimate yield losses. An exception is species of the subfamily Typhlocybinae, whose members suck individual plant cells, leaving chlorotic spots at the feeding sites. Many species injure plants by oviposition. These wounds, in their turn, enable various diseases to penetrate into plants. Many species transmit serious plant diseases (viruses and mycoplasma-like organisms). Taking all these circumstances into account, I think that the economical significance of Auchenorrhyncha is much greater than recognised so far.

A handbook on "Insects and mites as agricultural pests" was published in 1972. Its first part contains a list of the pest species of Auchenorrhyncha (compiled by Dr. A. Emelyanov): 194 species are cited. However, the greater part of them are species which have been observed feeding on various agricultural plants or which are pest species of neighbouring countries. Only 49 species have caused some loss to agriculture. It turned out that the majority of them are widely distributed species with a wide ecological preference. It means that the pest fauna of the temperate climate consists mainly of polyphagous species which have found especially good conditions for survival among the monocultures created by man.

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