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On the *Homoptera-Cicadinea* of Kamchatka

[With 14 Tables and 42 Text-figures]

The *Cicadinea* fauna of Kamchatka has up to the present time been rather insufficiently known, although the first species list was published as early as in 1858 by STÅL. In his paper he presented 6 species collected by F. W. SAHLBERG[1]:

Delphax dispar
Deltocephalus abdominalis
D. ocellaris
Deltocephalus striatus
Thamnotettix sexnotatus
Athysanus striatulus

In 1876 UHLER wrote that he had seen specimens of *Philaenus lineatus* from Kamchatka.

In 1899 ASHMEAD published a description of a new species — *Delphax stejnegeri*, collected by an American expedition on Commander Islands.

In 1925 LINDBERG published a list of the *Cicadinea* collected in Kamchatka by a Swedish expedition (E. HULTÉN, R. MALAISE, S. BERGMAN and E. HEDSTRÖM) in 1920–22. His list comprises 11 species:

[1] There must be an error. Apparently the person referred to was not F. W. SAHLBERG, but Reinhold Ferdinand SAHLBERG, who collected insects on his voyage round the world in the years 1839–1843 and visited among other places all localities noted in STÅL's paper (l.c.). In the biography of R. F. SAHLBERG (SAALAS, 1958) it is said that on the way from Atka to Okhotsk only one halt was made — on Atka Island (probably Atta I. — the westernmost island of the Aleutians). Therefore, it is plausible that all the finds from Kamchatka mentioned in STÅL's paper must be referred to Okhotsk (situated in the northern part of Khabarovsk Territory, on the western coast of the Okhotsk Sea).

Philaenus spumarius	*Th. torneellus*
P. albipennis var. *albosellatus*	*Limotettix intermedius*
Euacanthus interruptus	*Cicadula Dahlbomi*
Oncopsis flavicollis	*C. 6-notata*
Macropsis cerea	*Liburnia pellucida*
Thamnotettix subfusculus	

Some years later the same author (LINDBERG, 1929) published a list of the *Homoptera* collected by Y. WUORENTAUS in East Asia in 1917. This list also contains 3 species found in Kamchatka:

Euscelis grisescens	*Delphax pellucida*
Thamnotettix subfusculus	

In addition to these, only a short notice has been published by the present author (VILBASTE, 1965) about a find of *Verdanus evansi* in Kamchatka.

According to NAST (1972), altogether 17 species have been found in Kam-

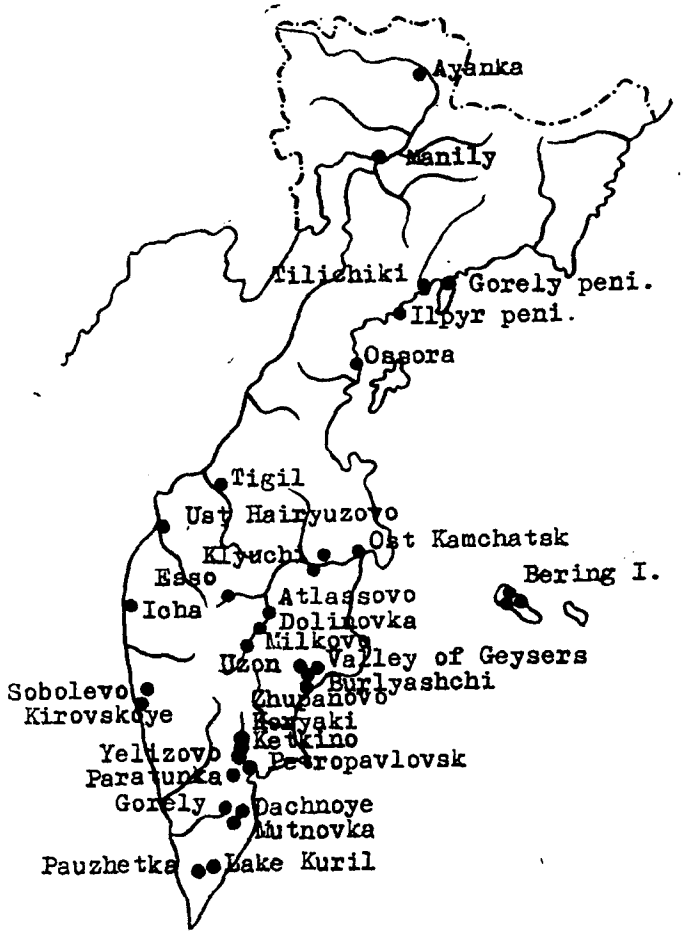

Fig. 1. Map of sampling sites.

Kamchatka. As the older contributors used old systematics, some of the species recorded do not live in the area and must be replaced by other species:

Deltocephalus abdominalis	= *Verdanus evansi*
Thamnotettix 6-notata	= *Macrosteles* spp.
Athysanus striateulus	= *Scleroracus* spp.
Philaenus lineatus	= *Neophilaenus sachalinensis*
Oncopsis flavicollis	= *O. planiscuta*

and the corresponding species should be omitted from the species list of Kamchatka.

The materials for this survey have been collected mainly by the author in two expeditions (in 1974 and 1977). In addition the materials collected by K. ELBERG (in the text abbreviated K. E.) and by A. KOPPEL (abbrev. A. K.) of the Institute of Zoology and Botany and by L. LUPKOVA (abbrev. L. L.) of the Kronoki Nature Reserve have been used. The collecting sites are indicated in Fig. 1. The whole Kamchatka Region was considered as an area under investigation, i.e. besides the peninsula areas on the Asiatic mainland and on the Commander Islands were also included.

Samples have been collected in almost all the geobotanical regions (REUTT, 1970) (cf. Fig. 10) of Kamchatka. Numbers of the sampling sites (further noted also as localities), number of the samples collected and the specimens collected are presented in Table 1.

Table 1. Number of sampling sites, samples and specimens collected in various regions.

	Geobotanical regions	Sites	Samples	Specimens
I	Plain tundra-forest-marshland region of western coast of Kamchatka	4	50	4990
II	Mountainous alpine tundra-subalpine bush region of the Central Mountain Ridge	1	3	62
III	Plain birch-conifer forest region of the Central Kamchatkan Depression	6	78	2780
IV	Eastern alpine stony desert - subalpine bush mountainous volcanic region of Kamchatka	5	83	5130
V	Coastal forest-bush and tundra-marshland region of East Kamchatka	7	89	6573
VI	Alpine stony desert region of Karachinsk Island	—	—	—
VII	Mountainous region of Siberian dwarf pine elfin woods, tundras and birch forests of the Coast of the Okhotsk Sea	1	5	156
VIII	Mountainous region of alpine arctic and Siberian dwarf pine elfin wood tundras of Koryak (and Chukotka) Mountains	1	29	1445
IX	Region of the lake-marshland complex of the Depression of Pendzhina River	1	8	558

Altogether about 22 000 specimens have been collected, which belong to 76 species.

The fauna is presumably somewhat richer. So in most localities it was collected only once. There are especially few samples taken in springtime (when most imagines of the *Delphacidae* occur). For example during the investigation one *Delphacidae* female was found which has not been determined yet.

LIST OF SPECIES

Cixiidae

Cixius (Ussuricixius) elbergi n. sp. A small dark species. Vertex short (much shorter than its width), blackish-brown, with whitish hind angles. Frons blackish brown between somewhat lighter keels, postclypeus slightly lighter. Basal joints of antennae dirty light-brown. Eyes reddish to blackish brown.

Pronotum, incl. side lobes, predominantly light brown, usually with a small dark dot on each side of the median keel. Fore margin infuscated below eyes. Mesonotum blackish-brown, the middle keel sometimes (especially in females) ± lightened. Light is also the proximal part of the hind margin. Fore wings slightly milky. Veins, except brownish cross-veins, whitish. On the veins there are numerous dark brown bristle-points. Points on costa are considerably larger than on other veins. In males there exist some brownish patches proximal to the middle (in the middle of hind margin of clavus, at fork of *Cu*, etc.). Also the surroundings of apical cross-veins are darkened. In females the patches are larger and usually form a slightly oblique band from hind margin to costal cell. Stigma distally brown. Hind wings also milky, with brownish veins. Legs dirty light-brown, fore- and middle femora dark.

Abdomen dark with narrow light hind margins of segments.

For male genitalia see Fig. 2–11; for the apical end of female see Fig. 12 and 13.

The male genitalia are characterized by a strong sclerotisation of the apical part of aedeagus, by the presence of an additional lobe in the latter. The under margin of phallosoma is wavy, the upper margin ± straight.

Size in millimetres: ♂ (2): Length to the end of fore wings — 4.85–4.90; to the end of abdomen — 3.65–3.70; length of vertex — 0.14; width of head — 0.91–0.96; width of vertex between eyes — 0.37–0.38; length of pronotum — 0.10–0.13; width of pronotum 1.22–1.23; length of mesonotum — 1.09; length of fore wing — 4.05–4.10; width of fore wing — 1.44–1.46; length of hind femur — 1.78–1.79.

♀ (3): Length to the end of fore wings — 5.45–5.90 (5.72); to the end of abdomen — 4.50–4.95 (4.68); length of vertex — 0.16–0.17 (0.16); width of head — 1.00–1.07 (1.04); width of vertex between eyes — 0.43; length of pronotum — 0.14; width of pronotum — 1.47–1.56 (1.50); length of mesonotum — 1.10–1.23 (1.19); length of fore wing — 4.65–5.00 (4.85); width of fore wing — 1.56–1.72 (1.63); length of hind femur — 2.01–2.17 (2.08).

Holotype ♂; Kamchatka, Pauzhetka, thermal areas, 1.07.75 (K.E.). 1♂ and 3 ♀ paratypes, in the same locality, 14.07.75 (K.E.).

Similar to the only known species of the subgenus – *C.* (*U.*) *remmi* VB., but is considerably smaller, the dark pattern of the fore wing is less developed. The male genitalia are rather different.

Fig. 2–13. *Cixius elbergi* n. sp. 2 – male genital segment, lateral view (magnification 52 ×); 3 – same, ventral view (52 ×); 4 – aedeagus, from right (82 ×); 5 – same, from left (82 ×); 6 – same, ventral view (82 ×); 7 – styles, ventral view (52 ×); 8 – style, lateral view (82 ×); 9 – anal tube, lateral view (63 ×); 10 – same dorsal view (63 ×); 11 – same, caudal view (63 ×); 12 – female abdomen end (13 ×); 13 – end of the same, caudal view (13 ×).

Pentastiridius leporinus (LINNÉ, 1761) has been found only in the Valley of Geysers, where it feeds probably on rushes, sometimes lives in rather great populations. Collected 33 ♂, 45 ♀.

A Transpalaearctic species. Occurrence of this species in the area was very unexpected, as the nearest known locality where it is found is Mongolia.

Delphacidae

Kelisia ribauti WAGNER, 1938. Tigil, fen, 1 ♂, 2 ♀, 10.08.77.[1]

A Transpalaearctic species. The nearest known locality is the Altai.

Paradelphacodes paludosus (FLOR, 1861). Zhupanovo, fen, 15.07.74, 1 ♀; Dolinovka, fen, 1 ♂, 04.08.74; Sobolevo, bog, 29.07.77, 2 ♂.

A Transpalaearctic species. Nearest known localities — Sakhalin and Kuril Islands.

Unkanodes excisus (MELICHAR, 1898). Zhupanovo, dunes on the seashore, 15. and 28.07.74, 13 ♂, 27 ♀, 1 N.

A Transpalaearctic species. It is surely more widely distributed, but as adults occur only in early spring it has not been found.

Achorotile transbaicalica KUSNEZOV, 1929, SW slope of the Avacha Volcano, 29.07.77, 1 ♀ (K.E.).

An Asiatic species. Its range extends from Mongolia to Kuril Islands.

Achorotile sp. Uzon, western solfatara field, 1 ♀, 23.07.74. Most probably to this species belong also nymphs collected in Ossora, Manily and Tilichiki. I am unable to refer the female specimen to any known East Asiatic species, as it is almost dull, whereas all known East Asiatic species (*A. transbaicalica* KSN., *A. caeciantha* EM.) are strongly lustrous. *A. subarctica* SCD. which is somewhat duller, has a broad white midline in the fore part of the body.

Dicranotropis tenellula DLABOLA, 1965 (= *D. montana* VB., 1965). Petropavlovsk, tall vegetation on the bank of a brook, 8 ♂, 20 ♀ (among them 1 ♀ f. macroptera), 12.07.74; dry slope, 1 ♂, 1 ♀; Valley of Geysers, *Pinus pumila* elfin wood, 1 ♀, 24.07.74; Uzon, mountain tundra, 1 ♂, 11 ♀, 1 N, 21. 07. 74; Tilichiki, tundra, 27.07.75, 2 ♀ (K.E.).

An Asiatic species. Previously known from the Altai Mts., Mongolia and Tuva.

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[1] Here and later on individual samples are separated from each other by a semicolon. In quantitative samples (100 sweepnet strokes), the number of specimens stands before the date, in qualitative samples behind it.

Criomorphus borealis (J. SAHLBERG, 1871). Petropavlovsk, tall vegetation, 1 ♀, 12.07.74; Zhupanovo, willow stand, 1 ♂, 2 ♀, 15.07.74; *Abies gracilis* coppice, 1 N; birch forest, 1 ♂, 2 ♀; Uzon, western solfatara field, 23.07.74, 1 ♀.

A Transpalaearctic species.

Hyledelphax elegantulus (BOHEMAN, 1847). Zhupanovo, willow thicket, 1 ♂, 2 ♀, 15.07.74; coastal barrier, 1 ♀, 28.07.74; Milkovo, birch forest, 1 ♀, 03.08.74; Dolinovka, margin of a birch forest, 1 ♀, 04.08.74; Klyuchi, birch forest, 1 ♂, 1 ♀, 12.08.74; dry margin of a road, 1 ♀, 12.08.74; Koryaki, birch forest, 1 ♂, 19.08.74; Paratunka, 23.07.78, 2 ♂ (K.E.).

A Transpalaearctic species.

Javesella dubia (KIRSCHBAUM, 1868). Zhupanovo, thermal fen, 1 ♂, 3 ♀, 28. 07. 74; Macrocaricetum, 2 ♀. 29.07.74.

A Transpalaearctic species. The nearest known locality where it is found are the Kuril Is.

Javesella pellucida (FABRICIUS, 1790) (= *Delphax stejnegeri* ASHMEAD, 1899, **n. syn.**)[1]. Occurs in almost all collecting sites (Petropavlovsk, Yelizovo, Paratunka, Zhupanovo, Uzon, Valley of Geysers, Milkovo, Dolinovka, Klyuchi, Ust-Kamchatsk, Sobolevo, Icha, Ust-Hairyuzovo, Tigil, Ossora, Tilichiki, Pauzhetka, Ketkino, Lake Kuril, Teplichnoye, Dachnoye, Mutnovka). It is lacking only in the northernmost localities. Lives mainly in marshy habitats. Collected 83 ♂, 155 ♀ f. brachyptera, 44 ♂, 52 ♀ f. macroptera and 19 N.

A Holarctic species. Previously known also from the Commander Islands (ASHMEAD, 1899), but not found there during the present investigation.

Aphrophoridae

Philaenus spumarius (LINNÉ, 1758). Was found in almost all localities, being absent only in the northern part of the area (north of 58° N. L.) (Petropavlovsk, Yelizovo, Paratunka, Zhupanovo, Valley of Geysers, Milkovo, Dolinovka, Atlassovo, Esso, Klyuchi, Koryaki, Sobolevo, Icha, Tigil, Pauzhetka, Tachiki, Ketkino). Occurs in very different habitats. Collected 370 ♂, 391 ♀, 15 N. It is very interesting to note that all the specimens collected belong to f. typica.

A Holarctic species.

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[1] Through the courtesy of Dr. J. P. KRAMER and D. R. DAVIS, to whom he expresses his sincerest thanks, the present author could examine the holotype of *D. stejnegeri*. A very careful comparison of it with the specimens of *J. pellucida* from Kamchatka indicated that the first specimen is a short-winged form of *J. pellucida*. DOZIER (1926), too, has drawn attention to the similarity of D. *stejnegeri* to this species.

Neophilaenus sachalinensis (MATSUMURA, 1915). Occurs in all the same localities as the preceding species, with an exception of Zhupanovo, but the absence in this locality is probably due to the early time of sampling. Collected 273 ♂, 308 ♀. The find of a male in the Caldera of Uzon on 26.09.74 probably points to the presence of a second generation there.

An East-Asiatic species known from Kamchatka, Sakhalin, Kuril Islands, Khabarovsk Territory, Primorye Territory and Korean Peninsula.

Cicadellidae

Macropsis cerea (GERMAR, 1837). The only species of the genus in Kamchatka. Occurs usually in localities remote from the sea (Petropavlovsk, Yelizovo, Milkovo, Dolinovka, Atlassovo, Klyuchi, Koryaki, Ust-Hairyuzovo, Tigil, Ketkino). On willows. Collected 45 ♂, 64 ♀, 4 N.

A Transpalaearctic species mentioned already by LINDBERG (1925) from Kamchatka.

Oncopsis planiscuta (THOMSON, 1870). Occurs throughout the area where only alders grow. (Petropavlovsk, Yelizovo, Zhupanovo, Valley of Geysers, Atlassovo, Klyuchi, Ust-Kamchatsk, Tigil, Ossora, Manily, Tilichiki, Dachnoye). Collected 25 ♂, 72 ♀, 34 N.

A boreal Transpalaearctic species.

Notus sitka DE LONG & CALDWELL, 1937. Widely distributed over all the area (Petropavlovsk, Paratunka, Zhupanovo, Uzon, Klyuchi, Ust-Kamchatsk, Sobolevo, Icha, Tigil, Ossora, Ayanka, Tilichiki). Occurs sometimes in very large populations (e.g. 165 specimens in a sample of 50 strokes — Tigil, flooded meadow of a brook). Collected 324 ♂, 347 ♀, 50 N.

A Holarctic species. In the eastern part of Palaearctic Region its range extends to the Altai Mountains.

Forcipata citrinella (ZETTERSTEDT, 1828). Also widely distributed in the area (Yelizovo, Uzon, Valley of Geysers, Milkovo, Dolinovka, Atlassovo, Esso, Klyuchi, Koryaki, Sobolevo, Tigil, Ayanka). Collected 56 ♂, 79 ♀, 3 N.

According to NAST (1972), a Holarctic species.

Forcipata major (WAGNER, 1947). Valley of Geysers, tall vegetation, 2 ♂, 25.07.74; Manily, moist tundra, 1 ♂, 23.08.77.

A Transpalaearctic species.

Micantulina pseudomicantula (KNIGHT, 1966). Milkovo, tall vegetation, 2 ♂, 1 ♀, 04.08.74; Yelizovo, birch forest, 21.08.78, 5 ♂, 3 ♀ (K.E.). A female collected in a birch forest in Koryaki 19.08.74 probably also belongs to this species.

A Transpalaearctic species. The nearest known locality is in Mongolia.

Kybos butleri (EDWARDS, 1908). Atlassovo, on willows on the side of the Kamchatka River, 06.08.74, 1 ♂, 4 ♀; Klyuchi, on willows, 12–13.08.74, 3 ♂ 12 ♀; ? Tilichiki, 26.08.77, 1 ♀.

A Transpalaearctic species. The nearest known locality is in Tuva.

Kybos rufescens MELICHAR, 1896. Milkovo, on willows, 04.08.74, 1 ♂, 3 ♀; Yelizovo, thicket near airport, 26.07.77, 3 ♂, 2 ♀.

A Transpalaearctic species. The nearest place where it is found is Mongolia.

Kybos betulicola (WAGNER, 1955). Klyuchi, on the shore of Lake Kurazyc, 12.08.74, 29 ♂, 46 ♀; on birches on the S margin of the village, 13.08.74, 1 ♂, 7 ♀; 17 km NNE of the village, 14.08.74, 7 ♀; Paratunka, 23.07.78, 1 ♀ (K.E.).

A Transpalaearctic species. The nearest known locality where it is found is Mongolia.

Edwardsiana ussurica VILBASTE, 1968. Occurs almost throughout the area (Petropavlovsk, Yelizovo, Paratunka, Milkovo, Dolinovka, Atlassovo, Klyuchi, Koryaki, Tigil, Ossora, Tilichiki). Lives usually on alders and birches, but also on willows, hawthorns and briers. Sometimes the species was very numerous, especiality on alders, so that the leaves were quite light from sucking. Collected 418 ♂, 594 ♀, 2 N.

An East Asiatic species. Previously found only in the Primorye Region[1].

Edwardsiana singularis ANUFRIEV, 1977. Milkovo, on *Crataegus*, 03.08. 74, 4 ♂, 9 ♀; tall vegetation, 04.08.74, 2 ♂; Klyuchi, mixed larch-birch forest, 14.08.74, 1 ♂.

An East Asiatic species. Hitherto known in the Amur Region in two specimens.

Edwardsiana bergmani (TULLGREN, 1916). Kronok Nature Reserve, River Novy Zayachik, 03.10.73, 1 ♂, 2 ♀ (L. L.); Klyuchi, mixed larch-birch forest, 14.08.74, 4 ♂; dry roadside, 3 ♂; Tigil, birch thicket, 10.08.77, 4 ♂; Manily, on alders, 23.08.77, 1 ♂, 4 ♀.

A Transpalaearctic species. Nearest find — in Mongolia.

Evacanthus interruptus (LINNÉ, 1758). One of the most widely distributed and numerous species in the area (Petropavlovsk, Yelizovo, Paratunka, Zhupanovo, Valley of Geysers, Milkovo, Dolinovka, Klyuchi, Ust-Kamchatsk, Koryaki, Sobolevo, Kirovskoye, Icha, Tigil, Ayanka, Pauzhetka, Lake Kuril, Ketkino, Zhirovskie thermal springs). Lives in shady places. Collected 163 ♂, 261 ♀, 337 N.

A Holarctic species.

[1] ANUFRIEV (1978) has synonymized this species with *E. lanternae* WG. It is clearly a mistake. The differencies have been given in the original description (VILBASTE, 1968).

Aphrodes montanus VILBASTE, 1965. Pauzhetka, thermal areas, 30.06.75, 1 ♂ (K. E.); Sobolevo, dry tundra, 1 ♂, 29.07.77, 1 ♀; moister area in tundra, 1 ♂, 1 ♀; Kozherevsk, aerodrome, 27.07.77, 1 ♀ (K.E.).

An Asiatic species. Previously konwn from the Altai and Tuva. Trophically connected with *Empetrum nigrum*.

Sorhoanus xanthoneurus (FIEBER, 1869). Occurred in almost all the localities visited (Petropavlovsk, Yelizovo, Zhupanovo, Uzon, Milkovo, Dolinovka, Atlassovo, Esso, Klyuchi, Koryaki, Sobolevo, Ust-Hairyuzovo, Tigil, Ossora, Manily, Ayanka, Tilichiki). In marshy habitats (fens, bogs, moist tundras) but also in tall vegetation, in forests, etc. Collected 380 ♂, 616 ♀, 67 N.

A Holarctic species.

Rosenus abiskoensis (LINDBERG, 1926) (= *R. transarcticus* HM. & RS., 1975). Manily, stony tundra, 1 ♂, 11 ♀, 23. 08. 77; 3 ♂, 5 ♀; Tilichiki, *Pinus pumila* elfin wood, 3 ♀, 26.08.77; Goven peninsula, tundra, 9 ♀; 27.08.77, 2 ♀.

A Holarctic boreal species which lives on *Dryas* spp.

Lebradea flavovirens (GILLETTE & BAKER, 1895) (= *L. karafutonis* MATSUMURA, 1911). Found throughout the territory (Valley of Geysers, Milkovo, Dolinovka, Atlassovo, Krapivnoye, Esso, Klyuchi, Yelizovo, Sobolevo, Tigil, Ayanka, Kozherevsk). Lives on *Calamagrostis* spp. and is threfore found in dry as well as in marshy habitats. Collected 63 ♂, 140 ♀.

A Holarctic species. To this species belongs also *L. icarus* described recently by OSSIANNILSSON (1976) from Finland since the main distinguishing feature — a membranous projection — occurs also in *L. flavovirens* but was not drawn in the figures published earlier by the present author (VILBASTE, 1968).

Boreotettix ribauti EMELJANOV, 1966. Throughout the area (Yelizovo, Valley of Geysers, Milkovo, Dolinovka, Atlassovo, Klyuchi, Tigil, Ayanka, Tilichiki). Lives also on *Calamagrostis*. Sometimes occurs in very large populations (e.g. in the Valley of Geysers or in Tigil — up to 45 specimens in a sample of 50 strokes). Collected 141 ♂, 296 ♀, 1 N.

An East Asiatic species. Hitherto found only in Chita Region and Primorye Territory.

Cosmotettix paludosus (BALL, 1899) (= *C. multinotatus* VB. 1965). Tigil, fen, 1 ♀, 10.08.77; Ayanka, Caricetum, 25.08.77, 2 ♀.

A Holarctic species. In the Palaearctic its range extends as far as the Altai only.

Cosmotettix milkovoensis n. sp. Light ochraceus, a female often whitish ochraceus. On the crowm there exist two small elongated spots on the tip, which also extend to the frons. Behind these small spots there are two larger dark spots of irregular shape. Their hind angles lie somewhat backwards from

the midpoint of the vertex, their fore angles are usually connected with the fore spot by a brownish shade. In the single male this connection is dark, almost black. The lateral foreangles form a triangle along the frontal suture. Two light-brown bands emerge from the hind spots and continue on pronotum and on scutellum (on the last-named they are sometimes darkened). In the male these bands are quite indistinct. In some specimens the face is almost unicoloured, in others there exist brownish remains of arch-lines in the lower parts (in male they are more distinct). The outer sutures of lora and of anteclypeus are here and there darkened. In the male there exist two dark semicircular spots in an ocello-ocular area, along the frontal sutures. Basal joints of antennae light, with a black stripe on the median side. Flagellum darkens towards the tip. Eyes (reddish) brown.

Pronotum besides the two above-mentioned longitudinal bands with two additional ones behind the eyes. Lateral margin whitish, side lobe of the ground-colour. Scutellum in the male almost unicoloured, in the female provided

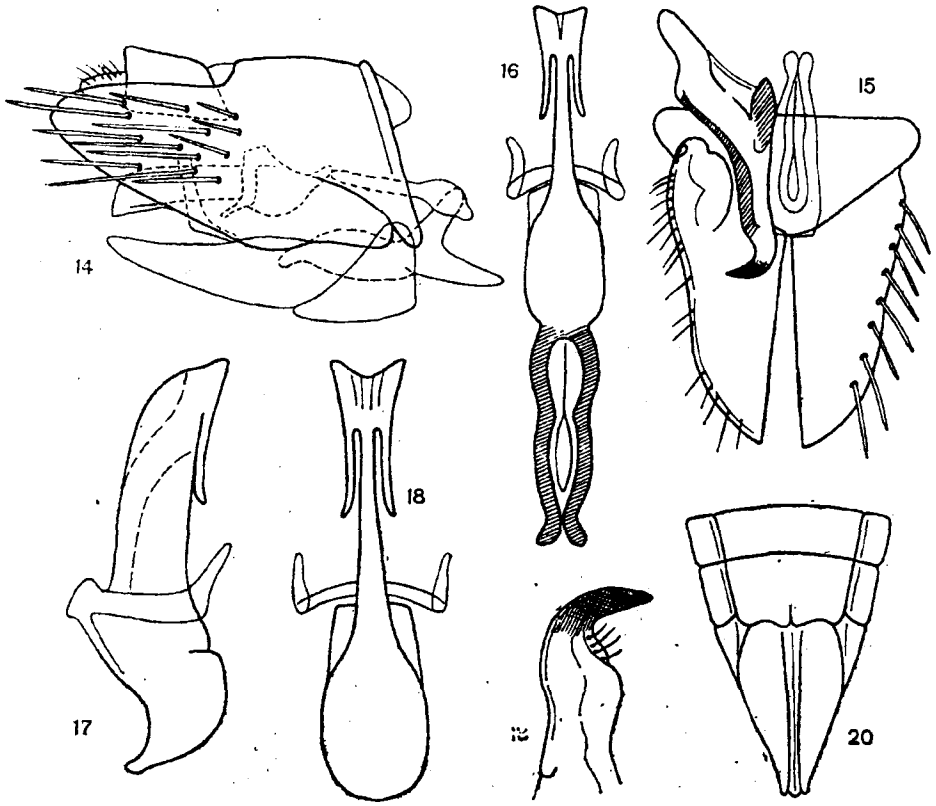

Fig. 14–20. *Cosmotettix milkovoensis* n. sp. 14 – male genital segment, lateral view (95 ×); 15 – genital valve and plates (right ventral, left dorsal view (95 ×); 16 – aedeagus and connective, ventral view (150 ×); 17 – aedeagus, lateral view (150 ×); 18 – same, ventral view (150 ×); 19 – tip of style, dorsal view (150 ×); 20 – female abdomen end (26 ×).

with two above-mentioned ends of longitudinal bands. Fore wings of the ground colour, the veins in females whitish. Hind wings whitish. Legs of the ground colour, fore and middle femora with remains of preapical rings. Tibiae with dark points.

Abdomen dorsally dark in male, in females with four dark longitudinal bands. Underside predominantly light like the genital segment. Sheath of ovipositor black.

For the male genitalia see Fig. 14–19; for the hind part of the abdomen of a female see Fig. 20.

Size in millimetres: ♂ (1) – Length to the end of fore wings – 3.20; to the end of abdomen – 2.85; length of vertex – 0.33; width of head – 0.92; width of vertex between the eyes – 0.40; length of pronotum – 0.43; width of pronotum – 0.83; length of fore wing – 2.56; width of fore wing – 0.78; length of hind femur – 1.64.

♀ (3) – Length to the end of fore wings – 3.60–4.12 (3.79); to the end of abdomen – 3.90–3.95 (3.92); length of vertex – 0.42–0.43 (0.42); width of head – 1.09–1.11 (1.10); width of vertex between the eyes – 0.52–0.53 (0.53); length of pronotum – 0.48–0.53 (0.51); width of pronotum – 0.99–1.01 (1.00); length of fore wing – 2.78–3.12 (2.90); width of fore wing – 0.91–0.97 (0.94); length of hind femur – 2.09–2.21 (2.17).

Holotype ♂: Kamchatka, Reg. Dolinovka, fen, 04.08.74. Paratypes: Milkovo, fen, 03.08.74, 1 ♀; tall vegetation, 2 ♀; Tigil, fen, 10.08.77, 1 ♀.

The new species is rather similar to *C. pyrifer* (Em.), but there is no black cross-band on the frons below the transit to the vertex, the hind spots of the vertex are smaller, etc. Also the male genitalia are similar, but the under margin of the aedeagus before the tip is almost straight, the apical appendages are more apart from each other, so that there is a free space between the stem and the appendages, etc.

Verdanus evansi (ASHMEAD, 1904). One of the most widely distributed species in Kamchatka, found in all sampling sites (excl. Manily). In all kinds of open habitats in dry as well as in wet ones. It was especially abundant in some thermal areas (e.g. in solfatara fields in the craters of Burlyashchi and Uzon) but was absent in the Valley of Geysers. Collected 533 ♂, 871 ♀, 436 N.

A Holarctic species. When treated as a separate species (cf. WAGNER, 1968, DLABOLA, 1970), its range in the Palaearctic is restricted to the Soviet Far East (Kamchatka, Kuril Islands).

Verdanus limbatellus (ZETTERSTEDT, 1828). Valley of Geysers, *Pinus pumila* elfin wood, 1 ♂, 1 ♀, 1 N, 24.07.74; Mutnovka, a small meadow in the mountains, 14.08.76, 22 ♂, 44 ♀ (K.E.).

A Transpalaearctic boreomontane species.

Errastunus ocellaris (FALLÉN, 1806). Found in almost all localities where collected (excl. Manily). In all kinds of drier habitats. Collected 308 ♂, 519 ♀, 112 N.

A Holarctic species.

Jassargus repletus (FIEBER, 1869). Milkovo, tall vegetation in a birch forest, 1 ♂, 1 ♀, 03.08.74; Krapivnoye, 02.08.78, 1 ♂ (K.E.); Atlassovo, felled area, 5 ♂, 1 ♀, 05.08.74; 3 ♂, 1 ♀, 1 N, 07.08.74; small fen, 1 ♀; Esso, 04.08.78, 4 ♂, 1 ♀ (K.E.); Klyuchi, margin of the village, 1 ♂, 13.08.74; brushwood, 3 ♂, 2 ♀; roadside, 1 ♂, 1 ♀, 14.08.74; Koryaki, *Agropyron* — meadow, 4 ♂, 3 ♀, 19.08.74; birch forest, 18 ♂, 29 ♀; Tigil, among willows, 2 ♂, 10.08.77.

A Transpalaearctic species.

Jassargus neglectus (THEN, 1896). Ayanka, sparse larch forest, 46 ♂, 65 ♀, 5 N, 24.08.77; 8 ♂, 16 ♀; roadside, 1 ♂, 2 ♀; *Calamagrostis* stand, 1 ♀, 25.08.77; Tilichiki, *Calamagrostis* stand, 5 ♂, 8 ♀, 26.08.77; tundra, 1 ♂, 1 N; willow-alder thicket, 18 ♂, 34 ♀; *Calamagrostis* stand, 10 ♂, 8 ♀.

A Transpalaearctic species. The nearest localities where found — Altai and Tuva.

Psammotettix confinis (DAHLBOM, 1850). Distributed throughout the area (Petropavlovsk, Yelizovo, Paratunka, Uzon, Valley of Geysers, Atlassovo, Krapivnoye, Klyuchi, Ust-Hairyuzovo, Ossora, Ayanka, Tilichiki, Pauzhetka). Occurs on dry slopes, in dry meadows, etc. Was very numerous in the Valley of Geysers in the *Deschampsia* belt (up to 57 specimens per sample). Collected 52 ♂, 111 ♀, 14 N.

A Holarctic species.

Psammotettix kamtshaticus n. sp. Pronotum in males 1.07–1.2 times as long as vertex, in females subequal. The ground colour dirty ochraceus, with a light-brown pattern. The pattern of the vertex is sometimes indistinct, but usually it covers the major part of the vertex. Fore triangles are great and they usually constitute the darkest part of vertex. Middle patches are in the shape of elongated triangles whose shortest side is situated along the light middle band around the coronal suture. Sometimes the triangle is connected with a dark patch on the fore margin of the head forming so an oblique trapezoid patch. Often indistinct hind patches consist of two somewhat oblique longitudinal patches of which the lateral one is longer, but it may also be absent. Frons has 8 to 9 brown archlines, which, beginning from the 4th pair fuse in the middle, thus forming a great brown patch. The lower lines become wider underneath but may also vanish. The remainder of the face is light, only in cheeks there is sometimes a brownish spot immediately below the eyes.

Pronotum with six brownish longitudinal bands, of which the middle ones are broadest and most sharply defined. Fore wings of males and in part of females are slightly longer; in one part of females shorter than abdomen. They are of the ground colour with somewhat lighter veins. Cross-veins (except the apical ones) are white like their surroundings. Cells are here and there brownlined, especially at the end of clavus and in the apical part of the wing. Larger

dark patches exist also behind claval cross-veins and in hind subapical cell. Hind wings are whitish. Legs are of the ground colour with a brown pattern proper to the genus.

Upper side of abdomen dark with narrow hind margins of tergites. In females the last tergites are lightened. Underside of abdomen predominantly light. Sheath of ovipositor black.

For male genitalia see Fig. 21–27, for the hind part of abdomen of female see Fig. 28.

Size in millimetres: ♂ (5) — Length to the end of the fore wing — 3.45–3.67 (3.50); to the end of abdomen — 3.17–3.30 (3.00); length of vertex — 0.38–0.41 (0.39); width of head — 0.95–1.05 (1.00); width of vertex — 0.45–0.50 (0.47); length of pronotum — 0.42–0.46 (0.42); width of pronotum — 0.89–0.97 (0.92); length of fore wing — 2.50–2.95 (2.77); width of fore wing — 0.84–0.89 (0.87); length of hind femur — 1.93–2.07 (1.96).

♀ (3): Length to the end of fore wings — 3.10–3.30 (3.21); to the end of abdomen — 3.20–4.00 (3.67); length of vertex — 0.40–0.43 (0.41); width of head — 1.01–1.05 (1.02); width of vertex — 0.47–0.50 (0.48); length of pronotum — 0.42–0.43 (0.42); width of pronotum — 0.92–0.96 (0.93); length of fore wing — 2.48–2.58 (2.53); width of fore wing — 0.86–0.87 (0.87); length of hind femur — 1.86–1.88.

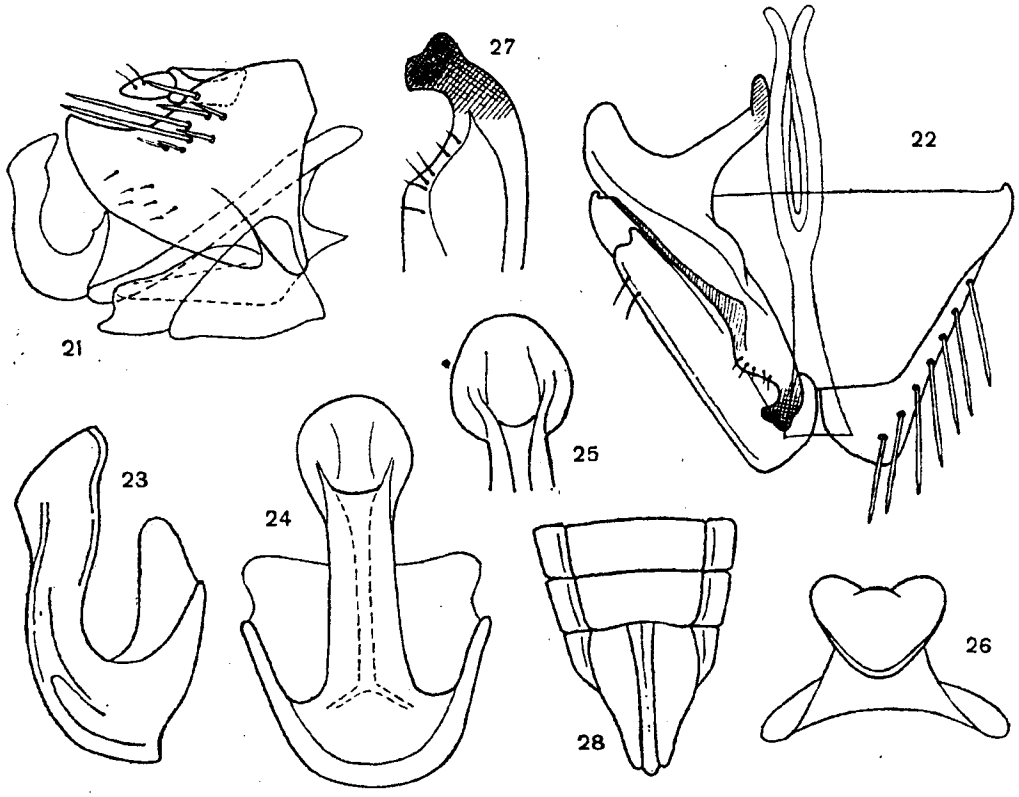

Fig. 21–28. *Psammotettix kamtshaticus* n. sp. 21 — male genital segment, lateral view (95 ×); 22 — same, ventral view (112 ×); 23 — aedeagus, lateral view (180 ×); 24 — same, caudal view (180 ×); 25 — tip of aedeagus, dorsocaudal view (180 ×); 26 — same, dorsal view (180 ×); 27 — style, dorsal view (250 ×); 28 — female abdomen end (26 ×).

Holotype ♂: Kamchatka, Atlassovo, on the bank of the Kamchatka River, 06.08.74. Paratypes: Klyuchi, roadside (in a fen), 1 ♂, 1 ♀, 19.08.74; Tigil, tall vegetation 2 ♂, 4 ♀, 1 N, 10.08.77; marshy meadow, 1 ♀; Pauzhetka, thermal areas, 1 ♂, 30.05.75 (K.E.).

The size and coloration are the same as in other species of the *P. striatus*-group. The aedeagus is very similar to that of the Nearctic *P. beirnei* GREENE, 1971, but the stem is shorter and stouter. In females the hind margin of the 7th sternite is almost straight, not trapezoidally prominent as in *P. beirnei*.

Psammotettix alienus (DAHLBOM, 1850) was found only in Icha, where it lived on a dry meadow on the bank of a river and on a dry beach barrier, 06.08.77, 6 ♂, 14 ♀, 5 n.

A Holarctic species.

Psammotettix alienulus n. sp. Length of the pronotum is subequal to that of vertex. The ground colour dirty ochraceous. The pattern of the vertex is very variable, usually brown. In the most complete case there exist apical triangles (almost equilateral), large quadrangular middle spots and behind them two hind patches on each side, at the side of the eyes. Around the coronal suture is a light band. On the fore angle of the middle spots is a quadrangular lobe, which sometimes is connected with the fore margin of the apical triangle, so that there forms a slightly concave dark stripe between the tip of the head and the field around the ocellus. Often the pattern is ± lightened (especially in females), so that in some specimens there exist only darker oblique lines along the fore margin and two small points before the hind margin of the vertex. The frons has distinct dark archlines (7–8), which are much broader than the light areas between them, and grow broader downwards. In the middle they are fused with those of the opposite side, but leave between them a light longitudinal band. The under margin of the frons is light, as are also the side margins at the ends of three under archlines. Anteclypeus darkened in the middle. On the under part of lora there are dark spots as also on the genae opposite the lora. Genae have some additional dark streaks and spots. Eyes reddish or dark brown, ocelli pinkish.

Pronotum is of the ground colour, with usual darker bands. Scutellum has small dark basal triangles, two darker points before the cicatrix and a darkening behind it. Fore wings are longer than abdomen, brownish or grayish, with somewhat lighter veins. Fore margin widely whitish, as are also the surroundings of the cross-veins and the tip of the hind claval vein. Cells are here and there lined with brown, especially in clavus, in medial and cubital cells and in the apical part of the wing. In costal and radial cells they are always distinct. Often the brown pigment is entirely lacking. Hind wings whitish. Legs are of the ground colour, with dark brown rings and points.

Abdomen is dorsally black-brown, with narrow light margins of segments.

Hind parts are sometimes ± lightened (especially in females). Underside is light, sheath of ovipositor black.

For male genitalia see Fig. 29–35, for the hind part of the abdomen of a female see Fig. 36.

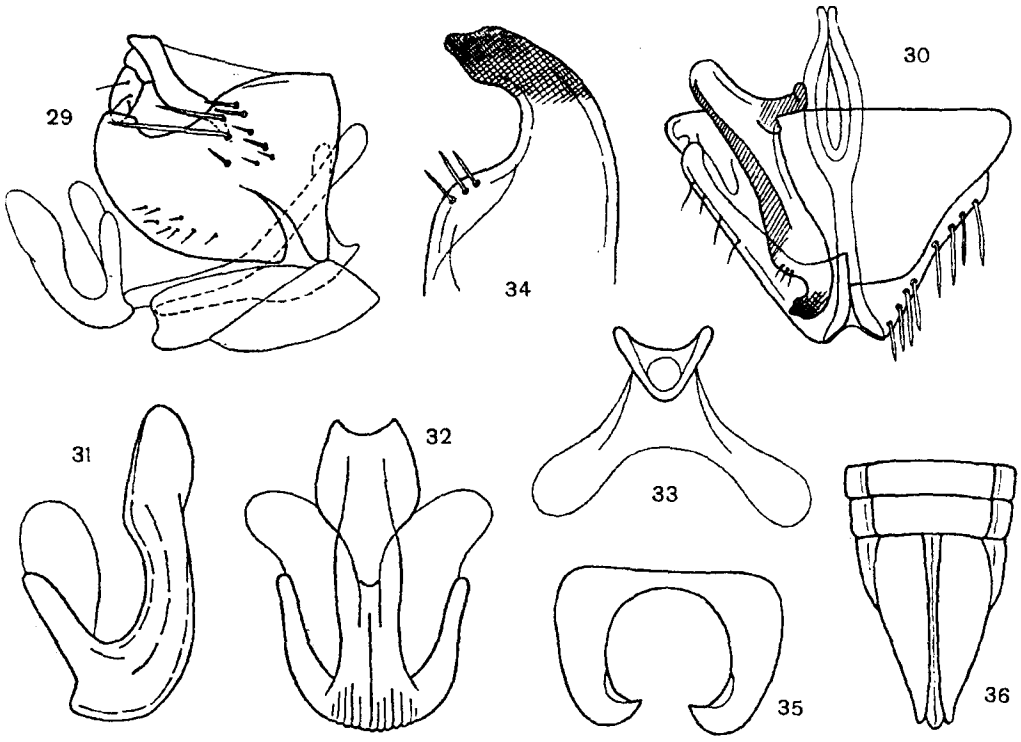

Fig. 29–36. *Psammotettix alienulus* n. sp. 29 — male genital segment, lateral view (95 ×); 30 — same, ventral view (95 ×); 31 — aedeagus, lateral view (180 ×); 32 — same, caudal view (180 ×); 33 — tip of aedeagus, dorsal view (180 ×); 34 — style, dorsal view (375 ×); 35 — pygofer, dorsal view (63 ×); 36 — female abdomen end (30 ×).

Size in millimetres: ♂ (5) — Length to the end of fore wings — 3.05–3.25 (3.18); to the end of the abdomen — 2.55–2.70 (2.61); length of vertex — 0.36–0.42 (0.40); width of head — 0.98–1.00 (0.99); width of vertex — 0.48–0.50 (0.50); length of pronotum — 0.40–0.43 (0.42); width of pronotum — 0.89–0.90 (0.90); length of fore wing — 2.37–2.55 (2.49); width of fore wing — 0.83–0.90 (0.86); length of hind femur — 1.64–1.78 (1.71).

♀ (4) — Length to the end of fore wings — 3.15–3.77 (3.25); to the end of the abdomen — 2.72–3.20 (3.00); length of vertex — 0.42–0.47 (0.43); width of head — 1.03–1.05 (1.04); width of vertex — 0.53–0.54; length of pronotum — 0.43–0.44; width of pronotum — 0.93–0.97 (0.96); length of fore wing — 2.48–2.60 (2.53); width of fore wing — 0.89–0.93 (0.91); length of hind femur — 1.81–1.92 (1.85).

Holotype ♂, 5 ♂ and 4 ♀ paratypes: Kamchatka, caldera of Volcano Gorely, mountain tundra, 01. 08. 76 (K. E.).

Externally similar to other species of the *Ps. striatus*-group, but is more stocky. Also the aedeagus is similar to that of *Ps. alienus*, but the spoon is almost

as long as the stem underneath and the gonopore opens in the middle of the height of the aedeagus. Basal arms of the aedeagus are only slightly diverging. Side lobe of pygofer is short and blunt, its tip is turned inwards.

Psammotettix koreanus (MATSUMURA, 1915). It was found on the seashore, almost everywhere where *Elymus* grew (Zhupanovo, Ust-Kamchatsk, Icha, Ossora, Goven Peninsula, Ilpyr Peninsula). Collected 31 ♂, 50 ♀, 8 N.

An Asiatic species. It is widely distributed on the coasts of the Pacific and of the seas surrounding it, where it feeds on *Elymus*. On the other hand, if the synonymisation of ANUFRIEV (1976) is correct, the same species occurs in Central Siberia and Kazakhstan (previously known under the name *Ps. calamagrostidis* MORAVSKAJA, 1952) where it feeds on *Calamagrostis* and other grasses.

Deltocephalus pulicaris (FALLÉN, 1806). Klyuchi, dry roadside, 2 ♂, 14.09.74; Manily, stony tundra, 1 ♂, 23.08.77; Ayanka, dry road, 1 ♀, 24.08.77; dry meadow, 1 ♂; Tilichiki, *Pinus pumila* elfin wood, 26.08.77, 2 ♂, 1 ♀; Govan Peninsula, tundra, 1 ♂, 27.08.77.

A Holarctic species.

Amplicephalus nebulosus (BALL, 1900). Atlassovo, on the bottom of a dry tributary of the Kamchatka River, 1 ♂ f. *macroptera*, 06.08.74.

A Holarctic species.

Hardya taimyrica VILBASTE, 1969. Volcano Burlyashchi, mountain tundra, 3 ♂, 2 ♀, 2 N.

An Asiatic boreal species. Hitherto found only in Taimyr.

Limotettix striola (FALLÉN, 1806). In all parts of the territory (Volcano Burlyashchi, Uzon, Valley of Geysers, Zhupanovo, Pauzhetka, Ayanka). It was especially numerous in thermal areas (e.g. in the caldera of Uzon, in a narrow belt of *Eleocharis* on the banks of the Komariynaya River were collected 361 specimens, in the Valley of Geysers 299 specimens, etc.). Collected 884 ♂, 459 ♀, 86 N.

A Holarctic species.

Scleroracus decumanus (KONTKANEN, 1949). Milkovo, tall vegetation in birch forest, 1 ♂, 03.08.74; Atlassovo, on *Artemisia*, 06.08.74, 3 ♂, 10 ♀; ruderal vegetation, 07.08.74, 4 ♂, 9 ♀; Yelizovo, dry meadow, 1 ♀, 26.07.77; Kozherevsk, aerodrome, 24–27.07.77, 1 ♀ (K.E.).

A Transpalaearctic species. It is highly probable that this species is conspecific with some North-American species (e.g. *Scl. plutonius* UHL. or *Scl. cheolus* BLL.).

Scleroracus russeolus (FALLÉN, 1826). In the whole area (Uzon, Dolinovka, Atlassovo, Klyuchi, Sobolevo, Ossora, Manily, Ayanka, Tilichiki, Goven

Penisula, Gorely). Lives in bogs, in *Pinus pumila* elfin woods, on solfatara fields, rarely in forests. Feeds probably on *Ledum* spp. Collected 33 ♂, 44 ♀, 19 N.

A Transpalaearctic species. It is probable that this species, too, is conspecific with some North-American species (e.g. *Scl. osborni* BLL. s. BEIRNE).

Paluda praecursor ANUFRIEV, 1971. In the southern part of the peninsula (Petropavlovsk, Yelizovo, Milkovo, Dolinovka, Atlassovo, Klyuchi, Koryaki Tigil). Lives in marshy habitats, also in forests. Collected 36 ♂, 44 ♀.

An East-Asiatic species. Up to the present time found only in Primorye Territory and on the Kuril Islands.

Cicadula quadrinotata (FABRICIUS, 1794). Occurs throughout the area (Petropavlovsk, Yelizovo, Zhupanovo, Dolinovka, Atlassovo, Klyuchi, Koryaki, Tigil, Ossora, Ayanka, Pauzhetka, Esso). Lives in marshy habitats. Collected 135 ♂, 129 ♀ and many nymphs which probably belong here.

A Transpalaearctic species.

Cicadula intermedia (BOHEMAN, 1845). Also widely distributed in the area (Petropavlovsk, Yelizovo, Zhupanovo, Uzon, Klyuchi, Ust-Hairyuzovo, Tigil, Ossora, Manily, Ayanka, Tilichiki, Ilpyr Peninsula). Lives in marshy habitats. Sometimes lives in very dense populations (up to 325 specimens per sweepnet sample, in a small fen near Ossora, 21.08.77). Collected 309 ♂, 291 ♀.

A Holarctic species.

Cicadula ornata (MELICHAR, 1900). In a fen near Petropavlovsk, 09.08.75, 1 ♂ (K.E.).

A Holarctic species.

Cicadula ciliata (OSBORN, 1898). Widely distributed in the northern part of the area (Tigil, Ossora, Manily, Ayanka, Tilichiki, Ilpyr Peninsula). Lives in marshy habitats and tundras. Up to 43 specimens per sweepnet sample (Ossora, Caricetum, 21.08.77). Collected 226 ♂, 165 ♀.

A Holarctic species. In the Palaearctic area found only in Mongolia and Tuva.

In addition to the above-mentioned specimens 511 nymphs of the same genus were collected. But up to now the author has been unable to determine them.

Doliotettix lunulatus (ZETTERSTEDT, 1840). Klyuchi, at the foot of Volcano Klyuchevskaya Sopka, at a height of about 900 m., in a subalpine meadow, 1 ♀, 13.08.74; birch forest, 4 ♀ (K.E.); ca 53 km NE of Klyuchi, larch-birch forest, 1 ♂, 14.08.74; Ossora, birch forest, 21.08.77, 1 ♂, 2 ♀; *Calamagrostis* stand, 3 ♀; *Calamagrostis* belt, 5 ♀, 22. 08. 77.

A Holarctic species.

Thamnotettix confinis (ZETTERSTEDT, 1828). In forests (Petropavlovsk, Dolinovka, Zhupanovo, Atlassovo, Klyuchi, Sobolevo, Yagodnoye). Collected 6 ♂, 12 ♀, 2 N.

A Holarctic species.

Speudotettix subfusculus (FALLÉN, 1806). In the southern part of the area (Zhupanovo, Valley of Geysers, Dolinovka, Klyuchi, Petropavlovsk). Lives in birch and spruce forests. Collected 8 ♂, 13 ♀, 1 N.

A Transpalaearctic species.

Speudotettix minor EMELJANOV, 1962. Koryaki, birch forest, 1 ♀, 19.08.74; Sobolevo, dry hill on the margin of a fen, 2 ♀, 29.07.77.

An Asiatic species.

Idiodonus cruentatus (PANZER, 1799). Throughout the area (Dolinovka, Atlassovo, Esso, Klyuchi, Koryaki, Sobolevo, Tigil, Ossora, Manily, Ayanka, Tilichiki). Lives in marshy habitats (bogs, fens, birch forests, tundras, etc.). Collected 29 ♂, 15 ♀, 80 N.

Probably a Holarctic species. The author is convinced that some of the North-American species or even several of them are conspecific with this species (especially *I. aurantiacus* and *I. morsei*). Coloration of the species is rather variable and specimens with dark spots and without markings occur often in the same locality.

Colladonus torneellus (ZETTERSTEDT, 1828). Caldera Uzon, western solfatara field, 3 ♀, 23.07.74; Klyuchi, on the shore of Lake Kurazhye, 2 ♀, 12.08.74; ca 50 km NE of the village, larch-birch forest, 1 ♀, 14.08.74; Manily, moist tundra, 1 ♀, 23.08.77; Koryaki, 25.06.77, 1 ♀ (K.E.).

A Holarctic species.

Macustus grisescens (ZETTERSTEDT, 1828). Zhupanovo, willow stand, 1 ♂, 15.07.74; fen, 1 ♂; Milkovo, tall vegetation, 1 ♀, 03.08.74; Sobolevo, bog, 1 ♂, 2 ♀, 29.07.77; 5 ♂, 4 ♀; 3 ♂, 1 ♀; fen, 1 ♂; Ossora, *Pinus pumila* elfin wood, 2 ♂, 21.08.77; tundras and fens, 1 ♂, 2 ♀.

A Holarctic species.

Streptanus aemulans (KIRSCHBAUM, 1868). Yelizovo, willow stand, 07.07.75, 1 ♂, 1 ♀ (K.E.); Uzon, thermal areas, 1 ♂, 22.07.74; 24.09.75, 1 ♂ (A.K.); Dolinovka (Kimitino), 28.07.78, 3 ♀ (K.E.); Atlassovo, felled area, 1 ♂, 05.08.74; Sobolevo, moist area, 1 ♂, 2 ♀, 13 N, 28.07.77; Tigil, roadside, 2 ♀, 10.08.77; Tilichiki, *Calamagrostis* stand, 2 ♂, 8 ♀, 26.08.77; 1 ♀; tundra, 1 ♀.

A Holarctic species.

Euscelis incisus (KIRSCHBAUM, 1858). Males were found in the Valley of Geysers only, where it inhabits thermal areas covered with *Artemisia*. Col-

lected 31 ♂, 23 ♀, 9 N. In addition, females and nymphs of the genus have been also found in Paratunka, Dolinovka and at the Zhirovskie Springs.

A Transpalaearctic species.

Morinda sibirica (EMELJANOV, 1962). Caldera of Uzon, western solfatara field, 1 ♂, 2 ♀, 23.07.74.

An East-Asiatic species. Up to date known from Yakutia only.

Balclutha lineolata HORVATH, 1904. The only *Balclutha* species in the area (Uzon, Dolinovka, Atlassovo, Klyuchi, Ayanka). Lives in bogs and fens, but also in dry meadows and elfin woods. It was lacking in the sourthern part of the peninsula. Collected 19 ♂, 7 ♀, 28 N.

A Transpalaearctic or even a Holarctic species.

Macrosteles alpinus (ZETTERSTEDT, 1828). The taxonomy of this species is rather confusing. If the species is considered in such a very wide sense as the *M. fascifrons* complex of BEIRNE (1952), this species is undoubtedly conspecific with the latter. The differences mentioned by MOORE and ROSS (1957) are not essential or are erroneous. The tips of the apical appendages of the eadeagus, which must "tend to curve back slightly mesad" (p. 112) in *M. alpinus* vary also within one local population, and the form of the second sternal apodemes (second abdominal sterna of MOORE and ROSS) depends on the position of figuring and on the circumstance if a cover glass is used. Thus, e.g., if we compare Fig. 18 in MOORE and ROSS (l. c.) and Fig. 810 in LE QUESNE (1969), there really exist no essential differences. Also the character used by LINNAVUORI (1969) — the aedeagus stem narrows toward the tip in *M. fascifrons* — is also not reliable. In this paper under *M. alpinus* is regarded a small (less than 4 mm) relatively dark boreomontane form with a relatively long and pointed vertex. It is rather uniform in all parts of the Palaearctic Region. It is apparently also distributed in boreal and montane areas of North America. *M. fascifrons* s. str. is a younger synonym for this species. The problem requires further examination. It seems that there exists a group of species in which the genitalia are quite similar, but they vary in size, in proportions of the body and in coloration. The American species of economic importance should apparently be called *M. quadrilineata* (FORBES, 1885).

This is one of the most widely distributed *Cicadinea* species in Kamchatka. It was found in all localities, where the author sampled (except the Commander Islands). Lives mostly in moist habitats — fens, bogs, flooded, coastal and moist meadows, tall vegetation, birch forests, etc. Sometimes it lives in very dense populations (e.g. in a flooded meadow of a small river near Ossora were found 2603 specimens per sample, in a flooded meadow near Tilichiki 393 specimens per sample, in a bog near Dolinovka 112 specimens, etc.). Collected 1638 ♂, 2974 ♀, 597 N.

A Holarctic species.

Macrosteles lineatifrons (STÅL, 1858). To this species have been referred robust specimens (♂ about 4, ♀ about 4.5 mm) with a vertex in the middle only slightly longer than at the sides. That was apparently the same insect presented by BEIRNE (1952, p. 226) as a "robust form [of *M. fascifrons*] with a short round vertex and yellow-veined hyaline fore wings in coastal marshes of Alaska". It corresponds well also with the original description of STÅL "capite valde obtuse triangulari ...♀. Long. $4^1/_3$, Lat. $1^1/_5$ Millim". (STÅL, l. c., p. 195). The pattern of the vertex is also rather characteristic (Fig. 37). It was abundantly found in a fen near Sobolevo, 29. 07. 77., 28 ♂, 7 ♀, 67 N, and near Tilichiki, 27. 07. 75, 2 ♂ (K. E.) and 26. 08. 77, 2 ♀. In southern Kamchatka the specimens were somewhat smaller than in the northern part of the peninsula.

A Holarctic species.

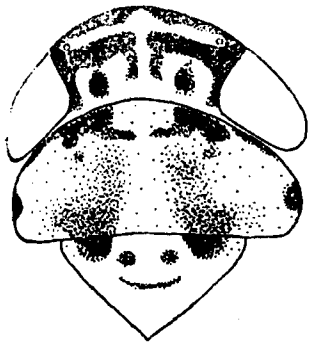

Fig. 37. *Macrosteles lineatifrons* (ST.). Head and pronotum.

Macrosteles cristatus (RIBAUT, 1927). Kirovskoye, flooded meadow, 30.07.77, 2 ♂, 3 ♀, 1 N; Sobolevo, potato field, 1 ♂, 2 ♀, 01.08.77; meadow in a willow thicket 2 ♂; tall vegetation, 2 ♀; Icha, riverside slope, 06.08.77, 2 ♂; old felled area, 6 ♂, 1 ♀, 07.08.77; Ust-Hairyusovo, meadow, 54 ♂, 76 ♀, 08.08.77; Tigil, tall vegetation, 10.08.77, 2 ♂, 2 ♀; Petropavlovsk, cultivated meadow, 08.07.77, 1 ♂ (K.E.); 21.07.77, 1 ♂ (K.E.); 21.07.77, 1 ♂, 1 ♀, 1 N. In addition, this species occurred very abundantly in Icha in a dry meadow on the beach barrier, together with *M. laevis*. They were not determined separately (674♂, 493 ♀, 33 N).

A Holarctic species. The crest on the dorsal side of the aedeagus is in Kamchatka specimens very small.

Macrosteles laevis (RIBAUT, 1927). Was found in Icha in a meadow on the beach barrier, 06.08.77, 7 ♂, 4 ♀, and in the above-mentioned sample together with *M. cristatus*. The pattern of the vertex is in the Kamchatka specimens not lightened at all in the middle part, as e.g. in Estonian specimens.

A Holarctic species.

Macrosteles fieberi (EDWARDS, 1889). Tigil, a wet meadow near a brook, 2 ♂, 6 ♀, 10.08.77. The specimens from the Far East are somewhat larger than those from Europe and the keels on the aedeagus stem are smaller or absent altogether.

Probably a Holarctic species. The American records need checking, as the figures published e.g. by BEIRNE (1952, Fig. 91) indicate that species brought by American investigators belongs merely to *M. lividus*.

Macrosteles frontalis (SCOTT, 1875). Atlassovo, felled area, 9 ♂, 6 ♀, 05.08.74; Klyuchi, fens, 14.08.74, 5 ♀; Pauzhetka, on the bank of a thermal brook, 01.07.75, 6 ♀ (K.E.).

A Transpalaearctic species.

Macrosteles osborni (DORST, 1931). Widely distributed in the eastern part of the southern peninsula (Paratunka, Zhupanovo, Uzon, Ust-Kamchatsk, Pauzhetka, Lake Kuril, Dachnoye, volc. Mutnovskoye, Milkovo, Esso). Found in fens where it feeds on *Juncus* species. Especially abundant in thermal areas. Collected 162 ♂, 45 ♀, 68 N.

A Holarctic species. In the Palaearctic Region it is distributed only in the eastern part. The westernmost sampling locality where it has been previously found lies in Irkutsk Region.

Macrosteles variatus (FALLÉN, 1806). Klyuchi, on the shore of Lake Kurazhye, 12.08.74, 4 ♂; Koryaki, in tall vegetation on the bank of a brook, 19.08.74, 1 ♂; Yelizovo, on the bank of a ditch, 1 ♂, 26.07.77.

A Holarctic species.

Sonronius dahlbomi (ZETTERSTEDT, 1840). Widely distributed in the southern part of the area (Petropavlovsk, Paratunka, Yelizovo, Milkovo, Dolinovka, Esso, Atlassovo, Klyuchi, Koryaki, Sobolevo, Icha, Tigil, Lake Kuril, Ketkino). Lives in both moist habitats (in tall vegetation, forests, meadows, etc.) and also in dry ones (ruderal areas, dry meadows, etc.). Collected 40 ♂, 78 ♀, 4 N.

A Holarctic species.

Sonronius binotatus (J. SAHLBERG, 1871). Occurs throughout the peninsula (Yelizovo, Pauzhetka, Milkovo, Atlassovo, Esso, Klyuchi, Sobolevo, Ossora, Manily). Lives usually in dry habitats. Collected 71 ♂, 41 ♀, 20 N.

Probably a Holarctic species, as it is surely conspecific with American *S. arcuatus* GILLETTE & BAKER, 1895. The similarity of both species was noted already by DORST (1937). Later on revising American species of the genus BEIRNE (1952) did not agree with the synonymization, as "*arcuata* does not seem to have been found in Europe". In the same year RIBAUT (1952) synonymized them. The same standpoint was supported by METCALF (1968).

COMPOSITION OF THE FAUNA AND ABUNDANCE OF THE SPECIES

As already stated, hitherto 76 species have been found in the Kamchatka Region. They belong to various families as follows:

Cixiidae – 2 spp. (2.6%)
Delphacidae – 10 spp. (13.2%)
Aphrophoridae – 2 spp. (2.6%)
Cicadellidae – 62 spp. (81.6%)
  Macropsinae – 2 spp. (2.6%)
  Typhlocybinae – 10 spp. (13.2%)
  Cicadellinae – 1 sp. (1.3%)
  Aphrodinae – 1 sp. (1.3%)
  Deltocephalinae – 48 spp. (63.2%)

These percentages are very near to those noticed in Altai (VILBASTE, 1965), Mongolia (DLABOLA, 1970) and Tuva (VILBASTE, 1980)[1]. Maybe the share of *Delphacidae* is in Mongolia somewhat greater.

When the collected specimens[2] are taken into consideration, the picture is only slightly different (in square brackets the mean abundance of one species in the corresponding families is given):

Cixiidae – 83 ex. (0.4%) [41.5]
Delphacidae – 473 ex (2.4%) [52.5]
Aphrophoridae – 1328 ex. (6.6%) [664.0]
Cicadellidae – 18 259 ex. (90.6%) [294.5]
  Macropsinae – 233 ex. (1.2%) [116.5]
  Typhlocybinae – 2017 ex. (10.0%) [201.7]
  Cicadellinae – 750 ex. (3.7%) [750]
  Aphrodinae – 4 ex. (0.01%) [4.0]
  Deltocephalinae – 15 255 ex. (75.7%) [317.8]

As can be seen, the prevalence of leafhoppers is still greater. A comparison of the percentages of species and specimens is given in Fig. 38. When the mean abundance of one species is considered, it is greatest in froghoppers, i.e. in a family in which only two species were found, but both of them were exceedingly abundant. This number was exceeded only by the subfamily *Cicadellinae* with its sole but abundant species *Evacanthus interruptus*.

In the general list of the collected specimens there exists 1 species (1.3%) with more than 5000 specimens, 2 species (5.3%) with more than 1000 specimens, 11 species (14.7%) with more than 500 specimens, 26 species (34.7%) with more than 100 specimens, 36 species (48%) with more than 50 specimens and 45 species (60%) with more than 20 specimens. It means that 40% of the species occurred in 1 to 20 specimens. Among them only four species were collected

[1] A review of these data see in the last-named paper.
[2] Only the specimens collected before the year 1978 have been taken into consideration.

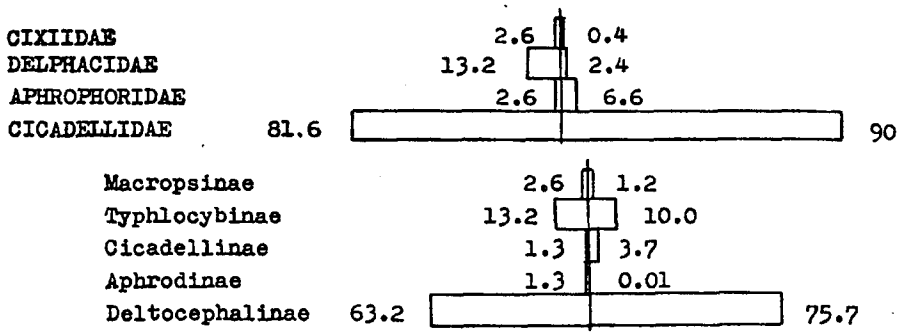

Fig. 38. Comparison of the percentages of species (left) and specimens (right) belonging to various families and subfamilies.

in one specimen (*Amplicephalus nebulosus*, *Cicadula ornata*, *Achorotile transbaicalica*, *Achorotile* sp.).

The following species were most abundant:

Macrosteles alpinus	5172 ex. (25.7% of all specimens collected)
Verdanus evansi	1810 ex. (9.0%)
Limotettix striola	1229 ex. (6.1%)
Sorhoanus xanthoneurus	1057 ex. (5.2)%
Errastunus ocellaris	898 ex. (4.5%)
Philaenus spumarius	755 ex. (3.7%)
Evacanthus interruptus	750 ex. (3.7%)
Notus sitka	721 ex. (3.6%)
Edwardsiana ussurica	613 ex. (3.0%)
Cicadula intermedia	599 ex. (3.0%)
Neophilaenus sachalinensis	573 ex. (2.8%)
Boreotettix ribauti	406 ex. (2.0%)
Cicadula ciliata	391 ex. (1.9%)
Javesella pellucida	353 ex. (1.8%)
Macrosteles osborni	263 ex. (1.3%)
Cicadula quadrinotata	262 ex. (1.3%)
Jassargus neglectus	229 ex. (1.1%)

These are mainly the species which usually live together in large populations as well as the species which live in small populations but are met with very frequently. It would, therefore, by very interesting to calculate the mean number of specimens per sample (Table 2).

As seen below, the results are only slightly different. It is interesting to note that the first place is occupied by *Limotettix striola*, a species which occurred only in a few localities and samples but was there (especially in thermal areas) very abundant. The same situation is valid for species which occupy 3rd and 4th places — *Verdanus limbatellus* and *Jassargus neglectus*, species which stand in the general list of collected specimens correspondingly in the 33rd and 17th places. On the other hand, *Verdanus evansi*, which occupied the 2nd place in

Table 2. Mean abundance of species per sample.

Species	Number of samples	Abundance per sample
Limotettix striola	19 (5.8)[1]	64.7
Macrosteles alpinus	108 (33.0)	47.9
Verdanus limbatellus	2 (0.6)	34.5
Jassargus neglectus	9 (2.8)	33.2
Cicadula intermedia	27 (8.3)	22.2
Euscelis incisus	3 (0.9)	21.0
Notus sitka	35 (10.7)	20.6
Cicadula ciliata	19 (5.8)	20.6
Verdanus evansi	97 (29.7)	18.6
Macrosteles osborni	15 (4.6)	17.5
Boreotettix ribauti	25 (7.6)	16.2
Macrosteles cristatus	10 (3.1)	16.1
Macrosteles lineatifrons	7 (2.1)	15.1
Sorhoanus xanthoneurus	77 (23.5)	13.7
Dicranotropis tenellula	4 (1.2)	13.7
Edwardsiana ussurica	48 (14.7)	12.7
Psammotettix alienus	2 (0.6)	12.5
Eracanthus interruptus	70 (21.4)	10.7
Unkanodes excisus	4 (1.2)	10.2
Sonronius binotatus	13 (4.0)	10.0
Psammotettix alienulus	1 (0.3)	10.0
Philaenus spumarius	76 (23.2)	9.9
Neophilaenus sachalinensis	60 (18.3)	9.5
Cicadula quadrinotata	28 (8.6)	9.4
Errastunus ocellaris	101 (30.9)	8.9

[1] In brackets percentages of total samples.

the general list of collected specimens stands in Table 2 in the 9th place, and *Errastunus ocellaris* (5th in the general list) stands in the 25th place.

At the end of this chapter some data will be given about the maximum abundance of species per sweepnet sample. In several cases it was not possible to take a sample of 100 strokes, since the area of sampling was too small. Such areas were usually connected with thermal areas, especially on the banks of thermal springs. Those non-quantitative samples are presented in brackets. If the number is extrapolated to 100 strokes, the abundance will be considerably higher. To such species belong also arboricolous species.

Macrosteles alpinus	2603 Ossora, flood-plain meadow, 27.07.77.
Verdanus evansi	(450) Burlyashchi, solfatara field, 20.07.74.
Limotettix striola	(361) Uzon, bank of thermal brook, 22.07.74.
Cicadula intermedia	325 Ossora, fen, 27.08.77.
Boreotettix ribauti	(262) Valley of Geysers, *Calamagrostis*, 24.07.74.
Notus sitka	185 Sobolevo, fen, 29.07.77.
Edwardsiana ussurica	(167) Tilichiki, on alders, 26.08.77.

Macrosteles cristatus	130 (50 x) Ust Hairyuzovo, meadow, 8.06.77.
Sorhoanus xanthoneurus	121 Tilichiki, tundra, 26.08.77.
Jassargus neglectus	116 Ayanka, sparse larch forest, 24.08.77.
Macrosteles lineatifrons	109 Tigil, marshy meadow, 10.08.77.
Evacanthus interruptus	101 Sobolevo, birch forest, 28.07.77.
Cicadula quadrinotata	90 Dolinovka, fen, 04.08.74.
Philaenus spumarius	82 Sobolevo, moist meadow, 26.07.77.
Errastunus ocellaris	75 Ossora, beach barrier, 21.08.77.
Lebradea flavovirens	(72) Valley of Geysers, *Calamagrostis*, 24.07.74.
Verdanus limbatellus	(68) Mutnovka, small meadow, 13.08.76.
Neophilaenus sachalinensis	62 Milkovo, fen, 31.08.74.
Sonronius binotatus	(60) Sobolevo, dry meadow, 28.07.77.
Psamnotettix confinis	(57) Valley of Geysers, *Deschampsia*, 24.07.74.

They are all species which can yield large or very large populations whenever they find suitable conditions. It is very characteristic that in several cases such conditions exist in thermal areas. Thus, *Verdanus evansi* was found under normal conditions in only up to 45 specimens per sample (100 ×), *Boreotettix ribauti* also up to 45 specimens, *Lebradea flavovirens* up to 12 specimens, *Psammotettix confinis* up to 9 specimens. *Limotettix striola* was found exclusively in thermal areas.

Other species, such as *Macrosteles alpinus*, *Cicadula* species, etc., live in several places at high densities.

ECOLOGICAL ZOOGEOGRAPHY OF KAMCHATKAN *CICADINEA*

In this part an attempt will be made to shortly characterize the *Cicadinea* fauna of different habitats and to compare the abundance of species in them. As a great part of collections were carried out as quantitative sweepnet samples (100 strokes), some examples will be given for each habitat on the basis of such samples. Further species found in this habitat are discussed and their zoogeographical spectra are presented.

Fauna of forests

Kamchatka Region, at least its southern part, is a densely forested area. About 68 % of the whole territory is covered with forests (incl. elfin woods).

About 71.6 % of all forests belong to birch forests (mainly of *Betula ermani*) (KABANOV, 1963). In the southern part of the peninsula they cover almost all the areas from sealevel to a height of about 500 m. In the north they extend to about 60° N. L. Usually they are rather sparse, parklike and therefore their undergrowth is often very luxurious, forming so-called tall herbaceous vegetation (composed mostly of *Filipendula kamtshatica*, *Angelica ursina*, *Senecio palmatus*, *Cacalia hastata*, *Veratrum oxysepalum*, *Aconitum maximum*, *Thalictrum minus*, etc.). Materials have been collected from birch forests in various parts of the area (Tab. 3).

Table 3. Composition of the herb-layer fauna in some birch forests

Species	Klyuchi 13.08.74	Sobolevo 28.07.77	Ossora 21.08.77
Edwardsiana ussurica	28		
Kybos betulicola	3		
Philaenus spumarius	1	3	
Idiodonus cruentatus	1		
Evacanthus interruptus		101	
Forcipata citrinella		8	
Errastunus ocellaris		5	2
Lebradea flavovirens		1	
Sorhoanus xanthoneurus			1
Oncopsis planiscuta			1
Achorotile sp. (nympha)			1
	33	117	5

Additional species found in other samples are the following: *Criomorphus borealis*, *Hyledelphax elegantulus*, *Javesella pellucida*, *Neophilaenus sachalinensis*, *Macropsis cerea*, *Forcipata major*, *Micantulina pseudomicantula*, *Edwardsiana singularis*, *Kybos rufescens*, *Boreotettix ribauti*, *Paluda praecursor*, *Verdanus evansi*, *Jassargus repletus*, *Psammotettix confinis*, *Doliotettix lunulatus*, *Scleroracus russeolus*, *Speudotettix subfusculus*, *S. minor*, *Thamnotettix confinis*, *Cicadula quadrinotata*, *C. intermedia*, *Macrosteles alpinus* and *Sonronius dahlbomi*. Thus the total number of species is 34 (it is 44.7 % of all the species found).

As one can see from the Table, the fauna of birch forests is rather heterogeneous. There existed no species common to all the areas. The quotients of similarity (after SØRENSEN) are below 25 %. If all samples from birch forests (26) are taken into consideration, there existed only two species present in half of the forests studied: *Errastunus ocellaris* (65.4 %) and *Philaenus spumarius* (61.5 %). Three further species were present in more than 25 % of the samples — *Evacanthus interruptus* (42.3 %), *Edwardsiana ussurica* (30.8 %) and *Macrosteles alpinus* (27.0 %). The presence of all other species was smaller, among them such characteristic forest species as *Hyledelphax elegantulus* (19.2 %), *Criomorphus borealis* (3.8 %), *Micantulina pseudomicantula* (11.5) %, *Thamnotettix confinis* (3.8 %) and *Speudotettix subfusculus* (11.5 %).

The high number of species in the herb layer is due to the floral diversity of the luxurious undergrowth, which in its turn depends on good insolation conditions. Many *Cicadinea* species follow their food species: *Calamagrostis langsdorffi* (*Boreotettix ribauti*, *Paluda praecursor*, *Lebradea flavovirens*), willows (*Macropsis cerea*), alders (*Oncopsis planiscuta*), etc. Since insolation conditions are relatively good, many species which are usually confined to open habitats can live there.

Of the species found, 47 % are Holarctic, 32.4 % Transpalaearctic and 20.6 % Asiatic species[1].

Larch forests were studied in two different areas. Firstly, there is a large "island" (about 9794 km²) in the Central Kamchatkan depression. This area, consisting of *Larix kurilensis*, makes up about 9.1 % of all the forested territories (KABANOV, 1963). In one sample taken in a dry larch forest near Atlassovo (05.08.74) the following species were found:

Neophilaenus sachalinensis	5 ex.
Idiodonus cruentatus	4 ex.
Errastunus ocellaris	1 ex.
Thamnotettix confinis	1 ex.
Forcipata citrinella	1 ex.

In additional, unquantitative samples were still found *Philaenus spumarius*, *Edwardsiana ussurica*, *Sorhoanus xanthoneurus*, *Jassargus repletus*, *Scleroracus russeolus* and *Macrosteles alpinus*. Thus the total number of species was 11. More insolated places (felled areas) may be invaded by more photophilous species — *Lebradea flavovirens*, *Boreotettix ribauti*, *Cicadula quadrinotata*, *Streptanus aemulans*, *Balclutha lineolata* and *Macrosteles frontalis* — species, which are trophically connected mainly with reedgrass (*Calamagrostis langsdorffi*).

The same species were found in a larch-birch forest about 50 km NE of Klyuchi. In addition, there were found *Oncopsis planiscuta* (an alder inhabiting species), *Verdanus evansi*, *Paluda praecursor*, *Colladonus torneellus* and two birch-inhabiting species — *Edwardsiana singularis* and *E. bergmani*.

It must be stated that almost all species (excl. *Edwardsiana bergmani*, *Colladonus torneellus*, *Streptanus aemulans*, *Macrosteles frontalis*) were also found in birch forests. It once more confirms an earlier statement (VILBASTE, 1965, 1968, 1971) that in forests the specific composition of *Cicadinea* fauna is considerably uniform and does not depend on the forest type.

The chorological structure of the fauna is also almost identical with that of birch forests (47.8 %, 30.4 % and 21.8 % respectively).

Somewhat different was the fauna of the larch forests in the northern part of Kamchatka Region. They are rather sparse and consist of *Larix dahurica* ssp. *cajanderii*. A sample taken near the village Ayanka (24.08.77) contained

Jassargus neglectus	116 ex.
Verdanus evansi	24 ex.
Cicadula quadrinotata	13 ex.
Balclutha lineolata	4 ex.
Macrosteles alpinus	1 ex.
Forcipata citrinella	1 ex.

In moister areas there also occurred *Sorhoanus xanthoneurus*. Characteristic is the very abundant presence of the Transpalaearctic *Jassargus neglectus*

[1] A comparison of the chorological spectra of various habitats is given in Table 1

of the 8 species found, a half are Holarctic, another half Transpalaearctic species.

Spruce forests of *Picea jezoensis* (= *P. ajanensis*) have a very restricted distribution in the Central Kamchatkan Depression. Very few samples were collected in the area (near Dolinovka, 4.08.74). In a very densely forested small area only one specimen of *Speudotettix subfusculus* was found, whereas in a moist birch-spruce forest 19 specimens of *Macrosteles alpinus* and 1 specimen of the Holarctic *Forcipata citrinella* and the East-Asiatic *Edwardsiana ussurica* were present. Apparently the fauna is somewhat richer, especially in respect of spring species (e.g. *Hyledelphax elegantulus* and *Criomorphus borealis*).

Few samples were taken also in the small (22 ha) but famous graceful fir (*Abies gracilis*) forest, which is the only one of its kind in the world. In one sample taken by the author only 1 specimen of *Criomorphus borealis* was found, whereas L. LUPKOVA had collected *Oncopsis planiscuta* there.

Especially in the northern part of the region, but also high in the mountains large areas are covered with the Siberian dwarf pine (*Pinus pumila*) elfin woods. In more sparse stands the area among the pine patches is covered with *Ledum* spp., *Empetrum nigrum*, *Arctous alpinus*, *Vaccinium vitis idaea*, sedges and grasses. Samples were collected just from such areas. Some examples are presented in Table 4.

Table 4. The *Cicadinea* Fauna among Siberian dwarf pine elfin woods.

Species	Tigil 17.08.77	Ossora 21.08.77	Ossora 22.08.77	Tilichiki 26.08.77	Ayanka 25.08.77
Sorhoanus xanthoneurus	19	51		1	
Forcipata citrinella	3				
Cicadula quadrinotata	2				
Paluda praecursor	1				
Macustus grisescens		2			
Scleroracus russeolus		2	4	2	2
Errastunus ocellaris		1			
Sonronius binotatus			3		
Idiodonus cruentatus			1		1
Rosenus abiskoensis				3	
Oncopsis planiscuta				1	
	25	56	8	7	3

These species almost exhaust the fauna in such areas. Only in the Caldera of Uzon there was additionally found *Verdanus evansi*. The most characteristic species are *Sorhoanus xanthoneurus* in moister areas and *Scleroracus russeolus* (a *Ledum* inhabiting species) in drier ones.

Of the 12 species, 66.7 % belong to Holarctic species, 25 % to Transpalaearctic and only 8.3 % to Asiatic species.

Externally somewhat similar subalpine alder (*Duschenia fruticosa*) elfin woods are still more sparsely inhabited by leafhoppers. Only two species were found in the field layer of such areas – *Verdanus evansi* and *Oncopsis planiscuta*, the latter being a species feeding predominantly on alders.

However, when reedgrass grows under such woods the fauna is much richer. For example in one sample taken in such an alder elfin wood near Tilichiki, the following species were found:

Jassargus neglectus	13 ex.
Errastunus ocellaris	10 ex.
Streptanus aemulans	10 ex.
Edwardsiana spp. (♀♀)	5 ex.
Verdanus evansi	3 ex.
Macrosteles alpinus	2 ex.
Oncopsis planiscuta	2 ex.
Sorhoanus xanthoneurus	1 ex.

The *Cicadinea* fauna is considerably richer under willow thickets (Table 5). These usually grow on the banks of rivers and brooks and their undergrowth is rather rich.

Table 5. The *Cicadinea* fauna under some willow thickets.

Species	Sobolevo 01.08.77	Tigil 10.08.77[1]
Philaenus spumarius	53	29
Evacanthus interruptus	66	7
Errastunus ocellaris	54	
Cicadula quadrinotata	29	
Verdanus evansi	27	3
Macrosteles cristatus	2	
Sonronius dahlbomi	1	
Javesella pellucida	1	
Neophilaenus sachalinensis		9
Idiodonus cruentatus		3
Jassargus repletus		2
Sorhoanus xanthoneurus		2
Paluda praecursor		1
Forcipata citrinella		1
	233	57

[1] 50 strokes only.

In additional samples *Criomorphus borealis*, *Unkanodes excisus*, *Hyledelphax elegantulus*, *Macropsis cerea*, *Lebradea flavovirens*, *Psammotettix koreanus*, *Macustus grisescens* and *Macrosteles alpinus* were found. The total number of species was 22. It is worth noting that 17 of them were present in birch forest. Of the remaining 5 species, two (*Unkanodes excisus* and *Psammotettix koreanus*

are obviously accidental (they were found only in Zhupanovo, in the neighbourhood of coastal dunes, on which their food plant – *Elymus mollis* – grows.

Of these species, 59.1 % are Holarctic, 27.3 % Transpalaearctic and 13.6 % Asiatic ones.

Very characteristic was a sparse hawthorn – honeysuckle bush in the vicinity of the village Klyuchi. It is probably distributed in areas in which forests have been destroyed by man or by volcanic sediments. The fauna was also similar to that of the other forests and bushes. In one sample (collected on 13.08.74) were present:

Philaenus spumarius	60 ex.
Neophilaenus sachalinensis	4 ex.
Edwardsiana ussurica	7 ex.
Verdanus evansi	5 ex.
Idiodonus cruentatus	4 ex.
Jassargus repletus	4 ex.
Sonronius binotatus	1 ex.

In qualitative samples *Evacanthus interruptus*, *Sorhoanus xanthoneurus* and *Forcipata citrinella* were found.

Of the species found 70 %, 10 % and 20 % respectively belong to areal types.

*
* *

To summarize all data about the fauna of forests and bushes, we can state that altogether 45 species were found, which is more than a half (61.3 %) of all the species found in Kamchatka. This is undoubtedly the result of a high degree of insolation in Kamchatkan forests, which enables species of open habitats to invade there. One must once more stress the former statement (p. 394) about the uniformity of the forest fauna.

When the quotients of similarity between different habitats were calculated (Fig. 39), they were found to be rather high. In three cases (out of 15 possibilities) they exceeded 70 %. Lower quotients were often caused by an uneven number of species found in the corresponding forest types. The latter in its turn may be the result of small numbers of samples taken in them.

When the species composition in various forest types was compared, then two species (*Forcipata citrinella* and *Sorhoanus xanthoneurus*) were found in all (6) habitats with tree growth. Three species (*Verdanus evansi*, *Cicadula quadrinotata* and *Idiodonus cruentatus*) occurred in 5 forest types, and 6 species (*Philaenus spumarius*, *Neophilaenus sachalinensis*, *Errastunus ocellaris*, *Jassargus repletus*, *Paluda praecursor* and *Macrosteles alpinus*) in 4 ones. It must be stated that all these species are not real forest species, but merely species of

open habitats. Proper umbriphilous forest species (*Criomorphus borealis*, *Hyledelphax elegantulus*, *Speudotettix subfusculus*) were relatively rare and were present only in few specimens. Such umbriphilous species as *Evacanthus interruptus* and *Errastunus ocellaris* occurred in forests also in large populations.

B	Lk	Ld	Pp	RL	
63.1	24.4	35.5	60.7	31.8	B
	40.0	47.0	53.3	48.5	Lk
		33.3	34.5	35.3	Ld
			42.4	28.6	Pp
				50.0	S

Fig. 39. Quotients of similarity between various forest types. B — birch forests; Lk — *Larix kurilensis* forests; Ld — *Larix dahurica* forests; Pp — *Pinus pumila* elfin woods; S — willow thickets; hawthorn honeysucle bush.

Fauna of different kinds of trees and shrubs

Like the fauna of *Cicadinea* as a whole, so also the fauna of trees and shrubs is very poor in Kamchatka.

No species were found on coniferous trees. On various birch species (*Betula* spp.) were found: *Edwardsiana ussurica*, *E. bergmani*, *E. singularis* and *Kybos betulicola*. Occasionally some specimens of *Oncopsis planiscuta* were found. On alders (*Duschenia fruticosa*) *Oncopsis planiscuta* is very characteristic but locally *Edwardsiana ussurica* was very abundant, occasionally also *E. bergmani*. On willows (*Salix* spp.) the fauna was found to be somewhat richer. Most characteristic were *Kybos rufescens*, *K. butleri* and also *K. betulicola*, but also *Edwardsiana ussurica* was locally very abundant. On briers (*Rosa* spp.) *Edwardsiana ussurica*, on hawthorns (*Crataegus* spp.) *Kybos betulicola*, *Edwardsiana ussurica* and *E. singularis*, and on spiraeas (*Spiraea* spp.) *Edwardsiana ussurica* were established. As can be seen from the list, there exists one species, which was found on all deciduous trees (*Edwardsiana ussurica*). At the same time this species may give very large populations on all of them.

It is may be of interest to point out that among the above-mentioned species there are no Holarctic ones. Four species (71.4 %) belong to Transpalaearctic species, the remaining two (28.6 %) are Asiatic ones.

Fauna of the tundra areas

Tundras cover enormous areas in the northern part of Kamchatka. In the southern part they are confined to higher areas of the Central Mountain Ridge and to the Central Volcanic Plateau.

Below only the fauna of open sedge-cotton gras tundras will be discussed since the fauna of tundras with Siberian dwarf pine and subalpine alder elfin woods has been treated already under forests.

Northern tundras are generally situated north of the timberline, which lies approximately at the level where the peninsula is narrowest. It extends southwards only locally along the western coast of Kamchatka, due to the very high degree of air moisture and to low temperatures.

In such areas the fauna is rather poor, especially in the number of species. In contrast, the abundance of some individual species may be rather high.

In the quantitative samples taken near Icha no specimens were found. In the qualitative samples single specimens of *Javesella pellucida*, *Verdanus evansi*, *Errastunus ocellaris* and *Evacanthus interruptus* were collected (all of them being Holarctic species). In the northern parts of the Region the fauna is somewhat richer. Some examples are given in Table 6.

Table 6. The composition of the fauna in some tundra areas.

Species	Tilichiki 26.08.77	Tilichiki 26.08.77	Goven p.i. 27.08.77	Goven p.i. 27.08.77
Sorhoanus xanthoneurus	50	121	80	
Achorotile sp. (nympha)	1			
Macrosteles alpinus		4		
Jassargus neglectus		2		
Idiodonus cruentatus		2		
Streptanus aemulans		1		
Scleroracus russeolus			2	5
Rosenus abiskoensis				9
	51	130	82	14

In qualitative samples were found in addition the species: *Verdanus evansi*, *Cicadula ciliata*, *C. quadrinotata* and *Boreotettix ribauti*. The most characteristic species seems to be *Sorhoanus xanthoneurus*, which in some cases give rather large populations. The species is widely distributed in all marshy habitats.

Zoogeographically most species, with the exception of the Transpalaearctic *Jassargus neglectus*, *Cicadula quadrinotata* and *Scleroracus russeolus* and the Asiatic *Boreotettix ribauti*, are Holarctic ones (63.6 %).

Somewhat different is the *Cicadinea* fauna of mountainous stony tundras. A sample taken in such a tundra near Manily is given by way of an example:

Sorhoanus xanthoneurus	28 ex.
Rosenus abiskoensis	12 ex.
Macrosteles alpinus	3 ex.
Cicadula ciliata	1 ex.
Deltocephalus pulicaris	1 ex.
Idiodonus cruentatus	1 ex.
Achorotile sp. (nymph)	1 ex.

In the southern areas no quantitative samples were taken. In qualitative samples in addition the species *Verdanus evansi*, *Hardya taimyrica*, *Dicranotropis tenellula*, *Javesella pellucida*, *Errastunus ocellaris*, *Scleroracus russeolus* and *Psammotettix alienulus* were found.

Among the species found, Holarctic species predominate (69.2 %). Then follow Asiatic species (23.1 %), whereas the role of Transpalaearctic species is very small.

Fauna of peatlands

Peatlands are distributed in Kamchatka Region mainly in the valleys of larger rivers, but large areas are covered with them on the western coast of the peninsula. Most mires belong to fens, while *Sphagnum* bogs are of limited distribution.

Fens were studied almost in all parts of the peninsula. Some examples of the fauna will be given in Table 7.

As can be seen from the Table, the fauna as a whole is rather rich in species, but in individual samples there are usually few of them. It can also be seen that the populations of some species are rather large. On the other hand, if we compare the faunas of different fens, then there appear great differencies.

Table 7. Composition of the Cicadinea fauna in some fens.

Species	Zhupanovo 15.07.74	Dolinovka 04.08.74	Klyuchi 14.08.74	Sobolevo 29.07.77	Tigil 10.08.77	Ossora 22.08.77	Ossora 21.08.77
Javesella pellucida	7						
Macustus grisescens	1						
Cicadula quadrinotata		90	16				1
Sorhoanus xanthoneurus		30	83		73		
Neophilanus sachalinensis		15	42				
Verdanus evansi		1		1			
Idiodonus cruentatus		1					
Cosmotettix milkovoensis		1					
Paradelphax paludosus		1					
Macrosteles lineatifrons				97			
Notus sitka				43		88	
Cicadula spp. (nymphae)				18			
Cicadula intermedia					10	22	9
Cicadula ciliata					39	54	325
Paluda praecursor					1	39	20
Kelisia ribauti					3		
Macrosteles alpinus						50	45
	8	139	141	159	126	253	402

In rare cases the quotients of similarity exceed 60 %. Moreover, it can be seen that such great similarities occur in particular areas. One of such areas lies in the Central Depression (Dolinovka, Klyuchi), another is on the western coast (Sobolevo), a third one is located in the middle of the peninsula (Tigil, Ossora).

As already earlier pointed out by the author (VILBASTE, 1955) the marginal areas of fens are usually more densely inhabited by the *Cicadinea*. Thus, in a sample from the margin of a fen the following species were found (cf. with sample No. 5 in Table 7):

Cicadula ciliata	48 ex.
C. intermedia	40 ex.
C. quadrinotata	21 ex.
C. spp. (nymphae)	11 ex.
Sorhoanus xanthoneurus	26 ex.
Macrosteles alpinus	10 ex.
Neophilaenus sachalinensis	5 ex.
Verdanus evansi	4 ex.
Paluda praecursor	3 ex.
Lebradea flavovirens	2 ex.
Macropsis cerea	2 ex.
Notus sitka	2 ex.
Philaenus spumarius	1 ex.
Cosmotettix paludosus	1 ex.
C. milkovoensis	1 ex.
Macrosteles osborni	1 ex.
Javesella pellucida	1 ex.

Besides the species noted above, some additional species were found: *Evacanthus interruptus*, *Errastunus ocellaris*, *Boreotettix ribauti*, *Jassargus reple-*

Table 8. The fauna of *Cicadinea* in some sphagnum bogs.

Species	Sobolevo 29.07.77			Dolinovka 04.08.74
	1	2	3	
Macrosteles alpinus	58	22	14	112
Neophilaenus sachalinensis	21	29		2
Notus sitka	18			
Javesella pellucida	18		2	
Cicadula spp. (nymphae)	14	2	3	
Macustus grisescens	9	3	4	
Sorhoanus xanthoneurus	6	9	2	2
Paradelphax paludosus	2			
Errastunus ocellaris	1			
Balclutha lineolata				1
Idiodonus cruentatus				37
Scleroracus russeolus				4
	147	65	25	158

tus, Cicadula ornata, Balclutha lineolata and *Macrosteles cristatus*. Thus the total number of species found in fens amounts to 28.

18 species (64.3 %) belong to Holarctic species, 6 species (21.4 %) are Transpalaearctic and only 4 species (14.3 %) are Asiatic ones.

As already stated, sphagnum bogs are of very limited distribution in Kamchatka. They are confined mostly to the West Kamchatkan Lowland, but some isolated bogs are also in the Central Kamchatkan Depression. The fauna of sphagnum bogs greatly resembles that of fens (Table 8).

One can at once notice a great similarity between different samples from Sobolevo (quotients of similarity range between 71–80 %). At the same time the quotients between the samples of Sobolevo with those of Dolinovka vary only between 36–54 %. All the species that were found in bogs were also established in fens (with the exception of *Scleroracus russeolus*).

Also the chorological structure of the fauna is quite similar to that of the fens. The role of Holarctic species is slightly smaller (63.6 %), that of the Transpalaearctic species being somewhat larger (27.7 %).

Fauna of meadows

Meadows are of minor importance in Kamchatka. According to REUTT (1970), meadows cover 4030 square kilometres only. Their vegetation is very variable and they can be divided into several types.

Most characteristic of southern Kamchatka is so-called tall herbaceous vegetation. It is distributed in river valleys, on the lower parts of mountain slopes, and, as already indicated, it is often connected with birch forests. The vegetation is very luxurious and consists of *Filipendula kamtschatica, Angelica ursina, A. genuflexa, Heracleum dulce, Cacalia kamtschatica, C. hastata, Thalictrum cotortum*, etc.

Although many such areas were studied, no quantitative samples were taken. Altogether 18 species were established: *Dicranotropis tenellula, Criomophus borealis, Javesella pellucida, Philaenus spumarius, Neophilaenus sachalinensis, Evacanthus interruptus, Sorhoanus xanthoneurus, Cosmotettix milkovoensis, Verdanus evansi, Errastunus ocellaris, Paluda praecursor, Cicadula quadrinotata, Speudotettix subfusculus, Macustus grisescens, Macrosteles alpinus, M. osborni, M. variatus* and *Sonronius dahlbomi*. If one compares this fauna with that of birch forests, then 13 species are common to both habitats (QS = 50 %). Moreover, the fauna is similar to the ombrogenic fauna of forests in general. The very high and dense vegetation creates conditions similar to those in forests.

As far as chorology is concerned, 12 species (66.7 %) are Holarctic, 2 species (11.1 %) Transpalaearctic and 4 species (22.2 %) Asiatic.

Reedgrass meadows are widely distributed in the flooded areas of the West Kamchatkan Lowland. They are usual also in anthropogenic habitats, where man has destroyed natural vegetation (e.g. on roadsides, etc.). In the

northern part of the Region they also occur on the banks of rivers and brooks, forming there uniform associations or are mixed with sedges or cotton grasses. The areas in which *Calamagrostis langsdorffi* dominates were studied in almost all parts of the territory (Table 9).

Table 9. Composition of the *Cicadinea* fauna in some reedgrass meadows.

Species	Yelizovo 26.07.77	Sobolevo 28.07.77	Tigil 10.08.77	Ossora 21.08.77	Tilichiki 26.08.77	Tilichiki 26.08.77	Ayanka 25.08.77
Errastunus ocellaris	23	31	40	41	3		3
Macrosteles alpinus	16	2	1		14	28	
Lebradea flavovirens	15	2	6				
Neophilaenus sachalinensis	13	1	1				
Javesella pellucida	12	1					
Boreotettix ribauti	11		45		1		1
Verdanus evansi	6	9		63	5	6	
Cicadula quadrinotata	3	2		5			
Sonronius dahlbomi	2	2					
Philaenus spumarius	1	13	2				
Scleroracus decumanus	1						
Paluda praecursor	1						
Psammotettix confinis	1			2			
Streptanus aemulans		16	2				
Evacanthus interruptus		36					
Notus sitka		2			3	5	11
Sorhoanus xanthoneurus				1	4	6	2
Cicadula ciliata					13	11	27
C. intermedia					14	1	1
Jassargus neglectus						1	1
	105	112	97	112	57	58	46

One can at once notice that there exist two distinct groups of localities of great similarities: one is located in the southern part of the peninsula (Yelizovo, Sobolevo, QS = 54.5 %), the other — in the northern part of the Region (Tilichiki, Ayanka, QS = 66–80 %). Samples from Central Kamchatka take in an intermediate position.

In qualitative samples *Forcipata citrinella* and *Psammotettix kamtschaticus* were collected. The total number of species is 22. As can be seen, the number of the species found is rather high. This is partly due to the number of species which live as monophags on reedgrass or feed predominantly on it (*Lebradea flavivirens*, *Boreotettix ribauti*, *Paluda praecursor*, possibly also *Streptanus aemulans*). The remaining species are mostly polyphagous, which can develop on different plants.

In reedgrass meadows the role of Holarctic species is still greater — 69.5%, somewhat greater is also the role of Transpalaearctic species — 13%. Asiatic species constitute only 17.4%.

To forb meadows have in this report been referred drier meadows with low but speciesrich vegetation. This group has a rather heterogeneous specific composition and is of various origin. Natural forb meadows are distributed mainly among birch forests. Partly they grow in areas in which the forest has been felled or in areas where the growth of other plant communities has been prevented by man (e.g. aerodromes, etc.). Such areas were studied in all parts of the Region (Table 10).

Table 10. Composition of the fauna in some forb meadows.

Species	Yelizovo 26.07.77	Zhupanovo 17.07.74	Koryaki 19.08.74	Sobolevo 28.07.77	Ttcha 07.08.77	Ust-Hairyuzovo 08.08.77	Ayanka 24.08.77	Ayanka 24.08.77
Javesella pellucida	21				2	1		
Macrosteles alpinus	15			7			15	14
Errastunus ocellaris	14	4			3			
Lebradea flavovirens	12						2	
Neophilaenus sachalinensis	9	5	10	1	30	20		
Verdanus evansi	4	45	31	5	62	25		
Psammotettix confinis	4			6		3	8	6
Boreotettix ribauti	3							
Philaenus spumarius	2		17	9	15			
Forcipata citrinella	2							
Sonronius dahlbomi	1				4			
Macropsis cerea	1					1		
Cicadula sp. (nymphae)	53				7			
Evacanthus interruptus		7			100			
Jassargus repletus			7					
Paluda praecursor			1					
Idiodonus cruentatus				5				
Sonronius binotatus				60				
Thamnotettix confinis				2				
Aphrodes montanus				1				
Macrosteles cristatus					7	130		
Cicadula intermedia						6		2
Sorhoanus xanthoneurus						1		4
Balclutha lineolata							26	1
Deltocephalus pulicaris							1	1
Cicadula ciliata								3
Jassargus neglectus								31
	141	61	66	96	230	187	52	

As can be seen from the Table, the fauna of forb meadows is also rather rich in species. The richness is undoubtedly due to the presence of numerous umbriphilous forest species, which have remained there after the felling of the forests. Also the QS with birch forests is as high as 62.3 %. On the other hand, there exist no species which occur in all the meadows studied. Most characteristic are such genuine meadow species as *Neophilaenus sachalinensis*, *Verdanus evansi* (frequency 75 %), *Psammotettix confinis* (62.5 %), *Macrosteles alpinus* and *Philaenus spumarius* (50 %).

Of the 27 species found, 19 (70.4 %) are Holarctic, 4 (14.8 %) Transpalaearctic and 4 Asiatic ones.

Coastal meadows were studied in several places on the coast of the Pacific, where they are distributed mainly around the mouths of rivers. As they usually grow on sandy soil, the vegetation consists mainly of *Elymus mollis* together with *Senecio pseudoarnica* and some other gramineous plants. *Lathyrus maritimus* grows usually on the ground.

The fauna of such areas is rather uniform. In almost all cases *Psammotettix koreanus* (a monophag on *Elymus* species) was present. In springtime there existed another monophag on *Elymus* — *Unkanodes excisa*. All the other species found were invaders from the surrounding areas. They are species of a wide ecological range: *Verdanus evansi*, *Sorhoanus xanthoneurus*, *Macrosteles laevis* (in Icha only), *Errastunus ocellaris*, *Neophilaenus sachalinensis* and occasionally also *Evacanthus interruptus*.

Somewhat different was the fauna on the beach barrier at Icha, on the side which was turned landwards, towards the coastal lagoon. In one sample the fauna consisted of a huge population of *Macrosteles laevis* and *M. cristatus* (1103 ex.) in addition to several (22) specimens of *Psammotettix alienus*. In another nearly sample of the fauna was almost of the same composition but the number of specimens was only 100.

Thus the total number of species amounts to 10. Out of them all additional species are Holarctic ones (80 %). *Unkanodes excisa* is a Transpalaearctic species, *Psammotettix koreanus* being a Transasiatic one.

Flood-plain meadows are distributed on the banks of fresh water bodies. They are also of very different floral composition, but the dominant plants are always sedges and rushes. Some examples of the *Cicadinea* fauna in such areas are given in Table 11.

In qualitative samples were found: *Javesella pellucida*, *Philaenus spumarius*, *Neophilaenus sachalinensis*, *Evacanthus interruptus*, *Verdanus evansi*, *Boreotettix ribauti*, *Cosmotettix paludosus*, *Limotettix striola*, *Balclutha lineolata* and *Macrosteles osborni*. They belong to the same species which were already established in all the other types of meadows. As we calculate the quotients of similarity between the fauna of the flood-plain meadows and other meadow types, the quotients will range between 55–65.3 % except for the coastal meadows with which the quotient is only 31.3 %.

Table 11. Composition of *Cicadinea* fauna in some flood-plain meadows.

Species	Tigil 10.08.77	Ossora 22.08.77	Ilpyr p.i. 28.08.77	Manily 23.08.77
Notus sitka	166		2	
Cicadula intermedia	45		14	1
C. quadrinotata	3			
Cicadula spp. (nymphae)	28			
Macrosteles fieberi	8			
Lebradea flavovirens	1			
Sorhoanus xanthoneurus	1			4
Macropsis cerea	1			
Sonronius dahlbomi	1			
Macrosteles alpinus	1	2603		48
Cicadula ciliata			7	9
Oncopsis planiscuta			1	
Errastunus ocellaris			1	
	255	2603	25	62

72.8 % of the species found are Holarctic, 18.2 % are Transpalaearctic and 9.0 % are Asiatic ones.

Very few samples were taken in subalpine meadows. These occur in mountains at a height of 850–1100 m and usually alternate with subalpine elfin woods. At the foot of the Volcano Klyuchevskaya (at a height of ca 850 m) *Verdanus evansi*, *Doliotettix lunulatus* and *Scleroracus russeolus* were found, on the slope of Volcano Mutnovka (ca 960 m) *Verdanus limbatellus* was very abundant.

Fauna of anthropogenic habitats

The anthropogenic influence in Kamchatka is comparatively small. It is also very small on the composition of the *Cicadinea* fauna. By laying ways and roads by cutting forests and by founding settlements man enable new species to invade such areas from neighbouring areas and settle there. The remote location of the peninsula (the tundra areas in the northern part of the peninsula acting as an ecological barrier) prevents new species to penetrate there. And indeed, no species has been found there which are characteristic of only anthropogenic habitats.

For instance, while in the fens near Klyuchi only 2–7 species per sample were collected, on the sides of the road passing through these areas the number of species was 17. Also in the areas of settlements covered by vegetation the fauna was that of the adjacent areas. Of course, in case some plant species

have found especially good conditions in settlements one can find there such aggregations of *Cicadinea* species which never exist in undisturbed nature. Thus in a patch of a tall *Artemisia* species in Atlassovo a qualitative sample contained:

Scleroracus decumanus	13 ex.
Sonronius binotatus	2 ex.
Sonronius dahlbomi	1 ex.
Macrosteles alpinus	2 ex.

Fields, too, are inhabited by the species of adjacent areas. E.g. in an oat field (cultivated for silage) near Tilichiki were found 1 specimen of *Sorhoanus xanthoneurus* and 3 specimens of *Macrosteles alpinus* and in a small potato field near Sobolevo 6 ex. of *Evacanthus interruptus*, 4 ex. *Sonronius dahlbomi* and 3 ex. of *Macrosteles cristatus* were established.

Fauna of thermal areas

Kamchatka is extraordinarily rich in volcanic phenomena. There exist many active and inactive volcanoes as well as several other types of thermal areas. Therefore during this investigation an attempt was made to collect *Cicadinea* also in those areas with the aim of estblishing if there existed a fauna which would be characteristic of thermal areas only. The principal areas of collecting were calderas of the Volcanoes Burlyashchi and Uzon and the Valley of Geysers.

In general, on the banks of thermal water bodies the vegetation (sedges and rushes) is more dense and therefore (and due to a higher temperature) the populations of several leafhopper species are large or even very large. As those areas were usually rather small, it was impossible to take complete samples (100 strokes) and no comparative data can be given. One can only list more numerous species on the basis of qualitative samples: *Limotettix striola* (361 ex.), *Macrosteles alpinus* (190 ex.), *Macrosteles osborni* (62 ex.), *Verdanus evansi* (150 ex.). At the same time *Limotettix striola* occurred predominantly in thermal areas. Outside of them only 1 specimen was found. On the banks of thermal water bodies the only Kamchatkan specimen of *Javesella dubia* was captured. In thermal areas lay the only locality where a new species — *Cixius elbergi* — was found.

The conditions were somewhat different in the Valley of Geysers. It is a small (8×2–3 km) area in a volcanically active region and is connected with a belt of tectonic deformations. Numerous geysers and other volcanic phenomena give the valley unique appearance. Around the geysers and other thermal water bodies the fauna is similar to that described above.

Around thermal areas (geysers, hot water springs and also hot patches of earth) there existed distinct microzones (cf. TRASS, 1963) on which different

Cicadinea species were living. These microzones are especially distinct around hot spots.

The nearest zone where higher plants grow consists of *Fimbrostylis ochotensis* (of the family *Cyperaceae*). No *Cicadinea* have been found on it. The second zone consists of the grass *Deschampsia caespitosa*. This zone is usually quite narrow, but sometimes on steep slopes it may cover rather large areas. In the zone *Psammotettix confinis* is very abundant (up to 57 specimens in a sample of 100 strokes).

The next zone, the zone of *Calamagrostis langsdorffi* is rich in leafhoppers. The zone occurs only locally, being often lacking. More rarely it forms large patches such an area. In a sample of 100 strokes the following species were found:

Boreotettix ribauti	263 ex.
Lebradea flavovirens	72 ex.
Errastunus ocellaris	23 ex.
Pentastiridius leporinus	2 ex.
Psammotettix confinis	1 ex.

In the zone of *Artemisia vulgaris* var. *kamtshatica* the leafhopper *Euscelis incisus* was very abundant. Occasionally here also lives *Pentastridius leporinus*. Sometimes in this zone there also grows *Lycopus uniflorus*, but no leafhopper species were found on it. In some cases *Lycopus* forms a distinct zone between the zones of *Deschampsia* and *Artemisia*.

Around hotwater springs there grow dense stands of *Eleocharis afflata*. On it live *Javesella pellucida*, *Limotettix striola* and *Pentastiridius leporinus*.

As can be seen from this review, in the Valley of Geysers live some *Cicadinea* species which are lacking in the other parts of Kamchatka, namely *Pentastiridius leporinus* and probably also *Euscelis incisus* (in other places were found females and nymphs). In many cases the abundance of species is considerably higher than elsewhere.

ON THE GEOGRAPHICAL DISTRIBUTION OF KAMCHATKAN CICADINEA

Density of the species. Kamchatka is very sparsely inhabited by *Cicadinea* species. If we calculate the number of species per 1000 km² (cf. DLABOLA, 1970, VILBASTE, 1980), we get a rather low number — 0.22. It is the lowest number established so far. If we calculate the logarithmic ratio (number of species/log of territory in 1 000 km²) (cf. Vilbaste, 1980), the number is only 29.87, which is also several times lower than the lowest known index.

Comparison with faunas of adjacent and some remote areas. The comparison has been carried out only with territories the fauna of which is sufficiently known. Corresponding data are given in Table 12.

Table 12. Numbers of common species in Kamchatka and in some territories.

Area	Numbers of common species	% of Kamchatkan fauna
Alaska	30	39.5
Whole Nearctic Region	34	44.7
Kuril Islands	24	35.5
Primorye Territory	32	42.1
Central Siberia	58	76.1
Central Asia	32	42.1
Europe	53	69.7

The table clearly demonstrates the boreal character of the fauna. The low number of species common with Kuril Islands depends probably on insufficient data, at least in the northern islands, on the fauna[1]. The number of species common with Primorye Territory (Maritime Territories) is somewhat larger. But only 13 species of them occur in South Primorye (VILBASTE, 1968).

As expected, there were many species common with North America[2]. Of them, 4 species are not found in Alaska.

The largest number of common species is with Central Siberia (Tuva, Altai, environs of Lake Baikal, Taimyr peninsula) and only a somewhat smaller with Europe.

Distribution within Kamchatka Region. Data about the number of species found on different collecting sites is given in Fig. 40. As can be seen, the greatest number of species was found in the middle part of the peninsula — at Klyuchi (38 species) and at Tigil (34 species). But when the species composition is compared, there are only two species which were found only in these localities — *Kybos betulicola* (at Klyuchi) and *Macrosteles fieberi* (at Tigil). There arises an impression that the number of species in a locality depends directly on the number of samples taken in it. And, indeed, the largest number of samples has been taken at Klyuchi and in its environs (and at the same time in very various habitats), but the number of samples at Tigil occupies only the 11th place. Probably the reason for such a high number is that these localities are situated in an area where both northern and southern species occur simultaneously. In many cases (e.g. Ust-Hairyuzovo, Esso, Natshiki, Burl-

[1] For instance, in very few samples taken by K. ELBERG in Paramushir, the northernmost island of the Kurils, 10 species were present (against 5 in ANUFRIEV's list) of which 3 were unknown for the Kurils at all.

[2] It is interesting to note that already in 1870 Russian hemipterologist V. OSHANIN wrote (original in Russian) "... as for Kamchatka, it would be very desirable to have from it large collections, to be convinced if its *Hemiptera* represent such a mixture of American forms, as was established by HAGEN for *Odonata*" (OSHANIN, 1870, p. 98–99).

yashchi, etc.) the low number of species is due to the few samples taken in that locality.

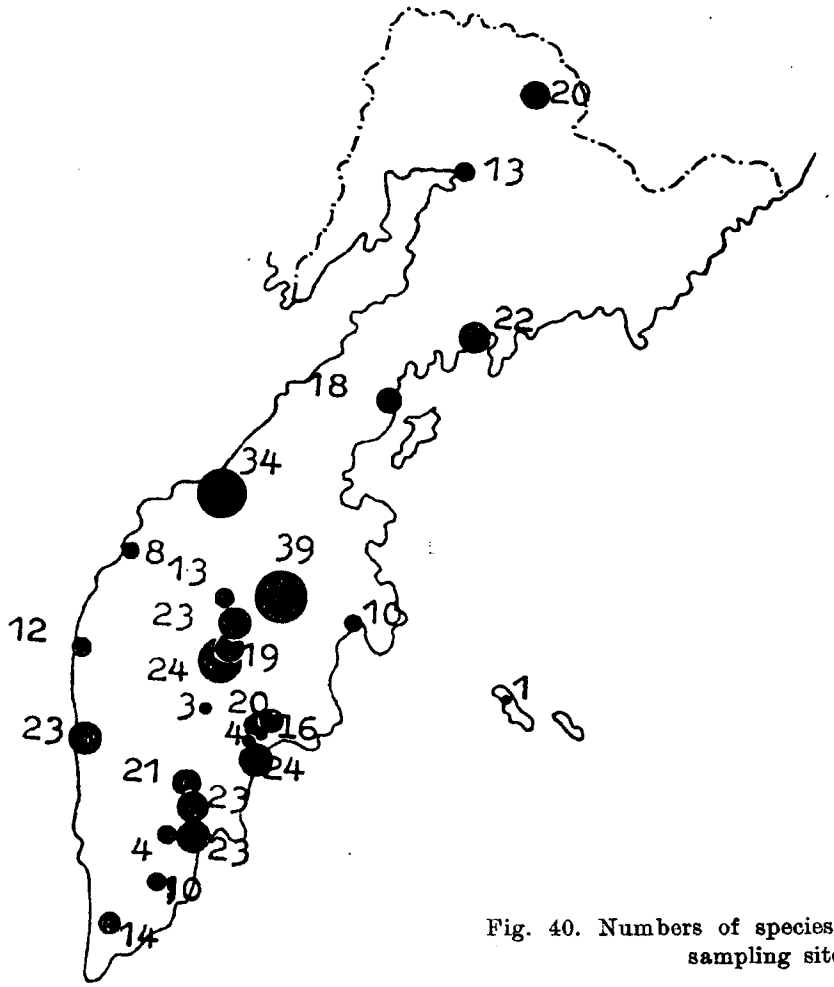

Fig. 40. Numbers of species found on various sampling sites.

It must be stated that in the Commander Islands during this investigation no species were found, despite intensive sampling. Previously *Javesella pellucida* had been found (ASHMEAD, 1899).

Data about the number of species found in different geobotanical regions is given in Fig. 41.

When the area under study is divided into Southern (roughly as far as 54° NL), Middle (as far as 58° NL) and Northern Kamchatka and when the corresponding faunas are compared, we see that in Southern Kamchatka there occur 44 species (57.9 % of all the species found), in Middle Kamchatka 70 species (92.1 %) and in North Kamchatka 35 species (46.0 %). Apparently the number of species is somewhat greater in Southern and Northern Kamchatka

since from these areas are lacking samples of springtime, when the majority of adult *Delphacidae* occur. When quotients of similarity between the faunas

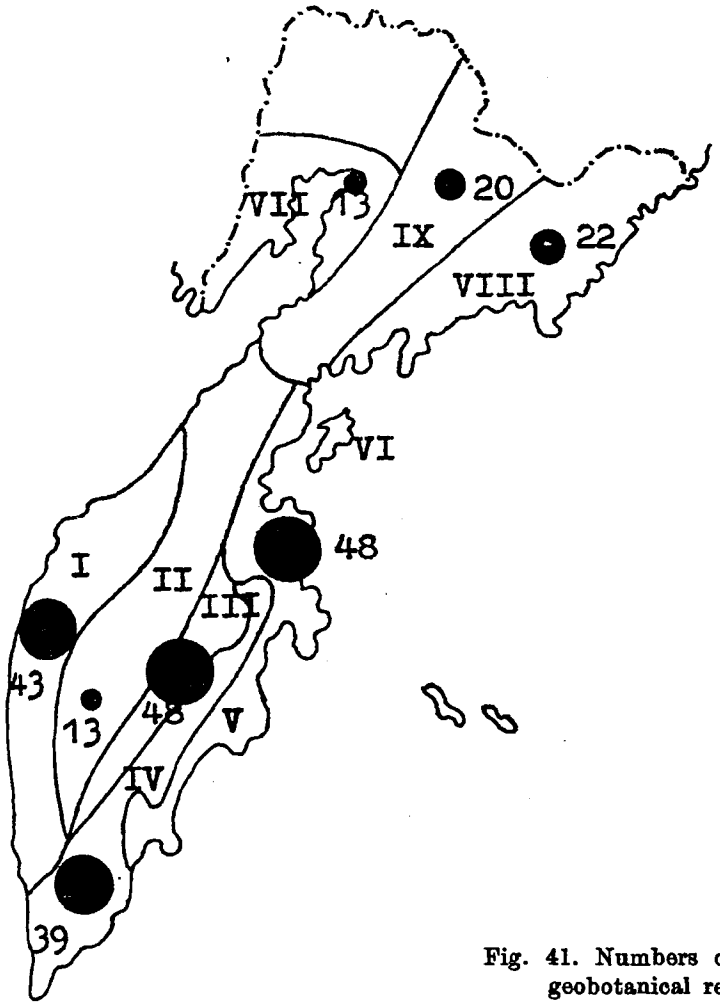

Fig. 41. Numbers of species found in various geobotanical regions listed in Table 1.

of different zones are calculated, they are rather high — 50–70 %. They are higher when one of them is the Middle zone. The high percentages may suggest that there are very many species which are distributed in all the zones. In reality there are only 20 such species (26.3 % of total species). In two zones there exist 33 species (43.4 %) and in one zone 23 species (30.3 %). Of the species found in one zone, there exist only 4 species (*Cixius elbergi*, *Achorotile transbaicalica*, *Psammotettix alienulus* and *Cicadula ornata*) which are present in the Southern zone and two species (*Rosenus abiskoensis* and *Jassargus neglectus*) which are confined to the Northern zone. All the remaining 17 live in the Middle zone. Of the bizonal species, 20 occur in the South and Middle zones. They are partly forest species, partly southern species. It is interesting to note that also

both two *Aphrophoridae* species (*Philaenus spumarius* and *Neophilaenus sachalinensis*) and 4 *Macrosteles* species belong to them.

13 species are common to the Middle and Northern zones but there exist no species common to Southern and Northern zones.

When we compare in how many localities individual species have been found, then 1 species (*Macrosteles alpinus*) was established in 25 localities (96.2 %), 1 species (*Verdanus evansi*) in 23 (88.5 %), 1 species (*Errastunus ocellaris*) in 21 localities (80.3 %). The frequency of further 5 species was higher than 50 % and that of 18 species was higher than 25 %. 17 species were established only in one locality. It must be noted that some of them live there in rather large populations (e.g. *Pentastiridius leporinus*, *Unkanodes excisus*, *Kybos betulicola*, *Euscelis incisus*, etc.).

The belonging of Kamchatkan species to areal types is given in Table 13.

Table 13. Belonging of Kamchatkan species to areal types.

Areal type	Number of species	%
Holarctic	34	44.7
Transpalaearctic	25	32.9
Asiatic	16	21.1
Transasiatic	1	1.3
common with Central Siberia	4	5.3
East-Asiatic	11	14.5
unknown[1]	1	1.3

[1] *Achorotile* sp.

As can be seen from the table, the majority of species are those of very wide distribution. To them belong 77.6 % of all species.

When the belonging to areal types is calulated for the specimens collected (Fig. 42), the picture is rather different — the prevalence of the specimens of Holarctic species is almost overwhelming — 82.4 %. And, indeed, when we compare the total numbers of collected species, then the first 9 places are occupied

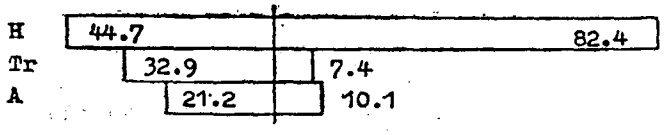

Fig. 42. Comparison of percentages of species (left) and specimens (right) belonging to various areal types.

by Holarctic species. Of the first 25 most abundant species, 19 are Holarctic ones.

The great number of Holarctic species was not unexpected. Most of them are distributed as far as Europe and only the ranges of 6 species (*Notus sitka*, *Cosmotettix paludosus*, *Verdanus evansi*, *Cicadula ciliata*, *Macrostele lineatifrons* and *M. osborni*) extend in an extreme case up to Central Siberia only. On the other hand, 3 species (*Psammotettix confinis*, *Doliotettix lunulatus* and *Macrosteles laevis*) are found in the Nearctic Region only in Alaska, 8 further species (*Notus sitka*, *Sorhoanus xanthoneurus*, *Rosenus abiskoensis*, *Lebradea flavovirens*, *Verdanus evansi*, *Macrosteles fieberi* and *M. osborni*) are distributed in Alaska and Canada, but have not been found in the main territory of the U.S.A. To them can be added *Macrosteles lineatifrons*, which in addition to Alaska was found in Michigan. Two species — *Macrosteles cristatus* and *Evacanthus interruptus* — are lacking both in Alaska and in Canada, and one species — *Deltocephalus pulicaris* — lives only in the eastern provinces of Canada and in the eastern states of the U.S.A. The remaining 18 species are widely distributed all over the Nearctic Region. The exact distribution of *Forcipata citrinella* is unknown up to date.

It can be presumed that the number of Holarctic species is somewhat larger, as there exist some species in which synonymy has not yet been established (e.g. *Scleroracus* species).

It is interesting to note that out of 10 species of *Delphacidae* only one is Holarctic. The same ratio is valid of *Typhlocybinae*. In contrast, out of 16 species of *Deltocephalini* 10 are Holarctic, out of 19 species of *Euscelini* 10 are Holarctic, and out of 10 species of *Macrostelini* even 9 are Holarctic.

Also the number of Transpalaearctic species is very great. It must be stated that the present investigation has in several cases extended the known ranges considerably eastwards. Such species are:

Pentastiridius leporinus	*Micantulina pseudomicantula*
Kelisia ribauti	*Kybos butleri*
Javesella dubia	*K. betulicola*
Macropsis cerea	*Edwardsiana bergmani*

The role of Transpalaearctic species is especially great in the family *Delphacidae* (10 : 6) and in the subfamily *Typhlocybinae* (10 : 6) while it is small in *Euscelini* (19 : 5) and very small in *Deltocephalini* (18 : 3) and *Macrostelini* (10 : 1).

The number of Asiatic species was unexpectedly small. Out of the 16 species one species is transasiatic, its range extending from Central Asia to the Far East. 5 species live also in Central Siberia (*Achorotile transbaicalica*, *Dicranotropis tenellula*, *Aphrodes montanus*, *Boreotettix ribauti* and *Hardya taimyrica*. The remaining 10 species are East-Asiatic ones. Here belong all the new species (*Cixius elbergi*, *Cosmotettix milkovoensis*, *Psammotettix kamtshatica*, *Psammotettix alienulus*). *Morinda sibirica* is a boreal species hitherto found in Eastern

Table 14. Zoogeographical spectra of Kamchatkan habitats.
H. — Holarctic, Tr. — Transpalaearctic, A. — Asiatic, tr. — Transasiatic, cs.-ea. — Central-Siberian — East-Asiatic, ea. — East-Asiatic.

	Forests							Trees	Tundras	Peatlands		Meadows				
	Birch f.	*Larix kurilensis* f.	*Larix dahurica* f.	*Picea jezoensis* f.	*Pinus pumila* elfin woods	Willow thickets	Hawthorn-honeysuckle th.			Fens	Sphagnum bogs	Tall herbaceous vegetation	Reedgrass m.	Forb m.	Coastal m.	Flood-plaine m.
H.	47.0	47.8	50.0	75.0	66.7	59.1	70.0	—	63.6	64.3	63.6	66.7	69.6	70.4	81.8	72.8
Tr.	32.4	30.4	50.0	—	25.0	27.3	10.0	71.4	36.4	21.4	27.3	11.1	13.0	14.8	9.1	18.2
A.	20.6	21.8	—	25.0	8.3	13.6	20.0	28.6	—	14.3	9.1	22.2	17.4	14.8	9.1	9.0
tr.	—	—	—	—	—	4.5	—	—	—	—	—	—	—	—	9.1	—
cs.-ea.	11.8	13.1	—	—	—	—	—	—	—	3.5	—	5.5	4.4	7.4	—	4.5
ea.	8.8	8.7	—	25.0	8.3	9.1	20.0	28.6	—	10.7	9.1	16.7	13.0	7.4	—	4.5
No. of species	34	22	8	4	12	22	10	6	11	28	11	18	22	27	11	22

Yakutia only, *Edwardsiana singularis* was found in Amur Region, 4 species (*Neophilaenus sachalinensis*, *Edwardsiana ussurica*, *Paluda praecursor*, *Speudokttix minor*) in Primorye Territory.

It is of great interest to compare the zoogeographical spectra of various habitats (Table 14).

It can be seen that the role of the Holarctic species is greatest in coastal and flood-plain meadows. In general the role is greater in meadows and peatlands than in forests (excl. spruce forests but here the high percentage is due to the low number of species found in it). It is very interesting that no Holarctic species was found on trees. On trees prevail Transpalaearctic species.

The role of Asiatic species is greatest in tall herbaceous vegetation and in forests in which the latter grows.

At the end of this chapter, on the basis of the materials described above, some speculations are expressed about the formation of the contemporary Kamchatkan fauna. As is known, North East Asia has undergone very extensive changes during its prehistory. Thus, e.g. in the Middle Miocene there obtained a warm temperate climate in the area (cf. BISKE & BARANOVA, 1976) and correspondingly there prevailed deciduous or coniferous (in mountains) forests. Presumably the fauna of these forests has not been preserved in Kamchatka, since the peninsula was still covered by the sea. The Bering Land Bridge was present again in the early and middle Pliocene, when it was covered, however, with coniferous forests and forest tundras. At this time the Kamchatkan Peninsula was already present (it was present also in the late Miocene as a row of small islands in the place of the Central Mountain Ridge). Presumably this time-gap was the main time for the Holarctic element to invade the Palaearctic Region as well as the Kamchatka Peninsula. They are widely distributed species which are at present time distributed as far as the coast of the Atlantic Ocean. The Northern part of Kamchatka was then covered mainly with boreal coniferous forests, which have been preserved now in the Central Kamchatkan Depression. Apparently in this time (when there prevailed a temperate climate) and also in the late Pliocene took place the main invasion of species which now have a Transpalaearctic and Asiatic distribution. This immigration occurred mainly from the north (along the coast of the Okhotsk Sea). Immigration from the south was probably rather small. This is indicated by a very small number of species in the Middle Kuril Islands (cf. ANUFRIEV, 1970, 1978).

During the pleistocene glaciations in the mountainous areas the established fauna was destroyed or pressed together into the southern part of the peninsula. After the retreat of the ice cover, the fauna once more occupied areas which were released from the ice. This immigration again took place from the north and partly from southern Kamchatka.

In this time Kamchatka was invaded by some species which had recently crossed the Bering Land Bridge. To them belong such species as *Notus sitka*, *Cosmotettix paludosus*, *Cicadula ciliata* and *Macrosteles osborni* – that is the

species whose ranges do not extend westward of Central Siberia. To this group also belongs probably *Lebradea flavovirens*, a species which has invaded Europe only in recent years (OSSIANNILSSON, 1976, ALBERCHT, 1977). It is notable that all these species are inhabitants of marshy habitats. *Verdanus evansi* and maybe also *Macrosteles osborni* are presumably boreal forms which live only in the vicinity of the Bering Strait. It must be stated that according to some investigators *Verdanus evansi* is only an Eastern ecological form of the Palaearctic *V. abdominalis* (cf. DLABOLA, 1970).

It is quite unclear at which point of time the Valley of Geysers was intruded by such thermophilous species as *Pentastiridius leporinus* and *Euscelis incisus*, which could be preserved there only due to a considerably warmer local climate caused by numerous geysers and hot springs.

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STRESZCZENIE

[Tytuł: O piewikach (*Homoptera-Cicadinea*) Kamczatki]

Według danych z piśmiennictwa, znanych było dotychczas z Kamczatki 17 gatunków piewików. Zbiory autora i innych entomologów z Instytutu Zoologii i Botaniki Akademii Nauk Estońskiej SRR (około 22.000 okazów) ujawniły

występowanie na Kamczatce 76 gatunków, z których 4 opisano jako nowe dla nauki. W pierwszej części pracy zamieszczono szczegółowe dane o znalezionych gatunkach. Następnie zamieszczono wiadomości o składzie fauny i liczebności gatunków, rozkładzie ich w poszczególnych środowiskach, przynależności gatunków do typów rozmieszczenia oraz podano rozważania dotyczące zagadnienia pochodzenia i kształtowania się współczesnej fauny piewików Kamczatki.

РЕЗЮМЕ

[Заглавие: О цикадовых (*Homoptera-Cicadinea*) Камчатки]

По литературным источникам из Камчатки было известно 17 видов цикадок. По сборам автора и других энтомологов Института зоологии и ботаники Академии наук Эстонской ССР (около 22 000 особей), в Камчатке встречаются 76 видов. Из них 4 описываются как новые для науки. В первой части даны подробные данные о найденных видах. Далее даются некоторые сведения о составе фауны и численности видов, данные об их стациональном распределении, о заселенности области цикадовыми, о распространении цикадовых внутри области, о принадлежности видов к типам ареалов и даются некоторые соображения об образовании современной фауны.

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