Nature, particularly the insect fauna of Ladoga and Olonets Karelia

Antti Pekkarinen & Larry Huldén

Pekkarinen, A. & Huldén, L. 1995: Nature, particularly the insect fauna of Ladoga and Olonets Karelia. — Entomol. Fennica 6:57–64.

The geology, vegetation, entomological studies, postglacial immigration of insects and characteristics of the insect fauna in southern Russian Karelia are reviewed, with examples of eastern and southern plant and insect species recorded in Russian Karelia, but not recorded or recorded to very limited extent in southern Finland. The management of forests and agriculture in Russian Karelia have been, during the Soviet period much less effective, and thus habitats have retained more diversity than in southern Finland. Recent studies indicate that many species considered threatened in Finland occur abundantly in Russian Karelia.

Antti Pekkarinen, Department of Ecology and Systematics, P.O. Box 17, FIN-00014 University of Helsinki, Finland
Larry Huldén, Zoological Museum, P.O. Box 17, FIN-00014 University of Helsinki, Finland

1. Bedrock

Ladoga (Laatokka in Finnish) and Olonets (Aunus in Finnish) Karelia comprises the biogeographic provinces of Karelia ladogensis (Kl) and Karelia olonetsensis (Kol) in the western, northern and northeastern side of Lake Ladoga in Russia (Fig. 1). The area belongs largely to the basement rock area of Fennoscandia (Fig. 2). The border between the areas of basement rock and sedimentary rocks extends to a little north of the River Svir (Eskola 1942, Gorbunov & Papunen 1985). In the western part of Ladoga Karelia, migmatites are the dominant rock. The area around Sortavala is connected to a large mica schist zone of the ancient Karelidic mountains. In addition, rich dolomite and calcite deposits exist near Sortavala, especially in Kirjavalahti, Ruskeala and Pitkäranta (Karhu 1993). In the eastern part of Ladoga Karelia (in the Salmi area), rapakivi granite, and on the southwestern coast of Lake Onega, Jotnian sandstone form fairly large and continuous areas of bedrock. On the northwestern coast of Lake Onega (which belongs to Karelia onegensis) is a large area of diabases and greenstones, also rich in dolomite and phyllite.

Heavy glacial sand and gravel deposits, locally perhaps over 200 m thick (Kotilainen 1944a), cover the bedrock all over the southwestern part of Olonets Karelia (as well as the Karelian Isthmus between Lake Ladoga and the Gulf of Finland). A zone of Cambro-Silurian deposits covering northern Estonia and the islands of Gotland and Öland reaches to the River Svir (Sederholm 1931) and occurs also on most of the Karelian Isthmus under the glacial deposits. Devonian deposits are also suggested as occurring locally in Olonets Karelia (Kotilainen 1944a,b).

Fig. 1. Biogeographical provinces of south-eastern Fennoscandia. Kb = Karelia borealis; Sa = Savonia australis; Ka = Karelia australis; Kl = Karelia ladogensis; Ik = Isthmus karelicus; Kon = Karelia onegensis; Kol = Karelia olonetsensis; Kton = Karelia transonegensis.

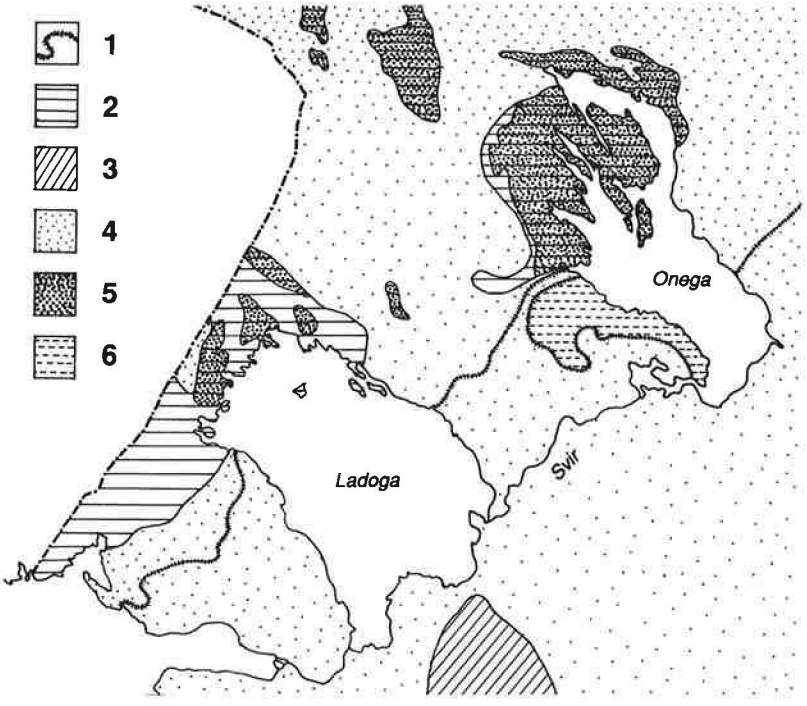

Fig. 2. Simplified outline of exposed geology of south-eastern Fennoscandia. 1 = NW borderline of sedimentary rocks (Cambro-Silurian deposits); 2 = Basement rock or varved clay and silt; 3 = Homogeneous clay and silt; 4 = Quaternary moraine and sand; 5 = Outstanding calciferous deposits; 6 = Jotnian sandstone (partly covered by moraine). Main sources: Gorbunov & Papunen (1985) and Niemelä, Ekman & Lukashov (1993).

2. The southeastern border of Fennoscandia in Olonets Karelia

The geologist W. Ramsay (1898:4) originally proposed the name "Fennoscandia" for the area comprising Scandinavia, Finland, eastern Karelia and Kola. Furthermore, the geologist P. Eskola (1942) emphasized that the geological border on western side of the River Onega is the most abrupt in the whole of Europe. As early as 1837 Wirzén suggested that the southeastern border of "natural-history Finland" should follow the River Svir, and the founder of Finnish plantgeography J. P. Norrlin (1871) held the same opinion. The border was, however, later drawn north of the Svir mainly according to the proposal of Cajander (1900). Later, Kotilainen especially (1943a,b,c) (see also Hiitonen 1961) presented strong, mainly botanical arguments placing the border of Fennoscandia along the Svir. On modern maps the southeastern border of the biogeographic province of Olonets Karelia follows the River Svir.

3. Vegetation

The vegetation in Ladoga and Olonets Karelia is in broad outline similar to that of southern Finland, and the area belongs (like most of southern Finland) to the southern boreal vegetational zone (Ahti et al. 1968). The Sortavala area in the northwestern corner of Ladoga is well known for the richness of its vegetation which is dependent upon the calciferous deposits of the area (Linkola 1916, 1931, 1932). The northwestern coast of Ladoga is rugged, with many rocky isles and and fjord-like bays. The coast between Salmi and the River Svir is covered by glacial sand and gravel; even dyne biotopes are typical here. The vegetation is generally fairly poor in the large glacial sand and gravel area of the Olonets Isthmus between the lakes Ladoga and Onega, but distinctly more rich in the sandstone area of the southwestern side of Lake Onega (Linkola 1918, 1932). The vegetation on the western coast of Lake Onega has been studied already in the last century by Norrlin (1871) and Cajander & Lindroth (1900) and that of the riverside of Svir by Elfving (1878). Afterwards, the vegetation in the Gumbaritza and Kuuttilahti areas near the mouth of Svir has been described by Palmén (1943) and Hustich (1943), that of in the Kuujärvi area near the middle course of Svir by Hustich (1945) and in the the sandstone or Devonian area in Juksova by Perttula (1944). The northwestern coast of Lake Onega (in Karelia onegensis) is vegetationally possibly the richest area in eastern Karelia (Linkola 1918, Kalela 1943:46) (description of the vegetation, see Fagerström 1944). Linkola (1932) describes the luxuriant nature of the northwestern Onega coast with its fjord-like slender bays, many lakes and rich slopes as "paradisal"! However, there is local eutrophic vegetation even in the area of the glacial deposits on the Olonets Isthmus; Kotilainen (1944a,b) supposed that locally spring water brings nutrients from the Cambro-Devonian rock through the moraine and sand deposits in so-called primeval valleys, "Urstromhäler", worn by ancient rivers. Further, a remarkable character is the coexistence of southern and northern plant species (Kotilainen 1944a).

Most of the flora in Ladoga and Olonets Karelia is shared with southern Finland. There are, however, about forty phanerogame species recorded in the area and which do not occur in southern Finland or occur only in a very limited area in southeastern Finland. Following are some examples (data mainly from Hultén 1971):

1. Eastern species not recorded in southern Scandinavia or southern Finland: *Scirpus ovatus*, *Rumex rossicus*, *Sempervivum soboliferum*, *Allium strictum* (a completely isolated occurrence in Ladoga Karelia), *Rubus humulifolius* (an isolated but later extinct occurrence in central Finland), *Potentilla strigosa*, *Conioselum vaginatum*, *Lonicera coerulea* (a few isolated records in central and northern Sweden), *Ligularia sibirica* and *Crepis sibirica*.
2. Mainly southern species recorded in the southern part of eastern Karelia and Scandinavia but not in Finland or only in a very limited area in the southeastern part of the country (the latter marked with an asterisk): *Polygonum bistortatum* (hemerochorous in some localities in southern Finland), **Thalictrum aquilegiifolium*, *Rubus nessensis*, *Cotoneaster melanocarpus*, *Cnidium dubium*, *Gentiana pneumonanthe*, *Dracocephalum ruyschiana* and *Cirsium oleraceum* (hemerochorous in southern Finland).
3. A species whith a large, but isolated range in central and northern Scandinavia and a continuous distribution over eastern Eurasia, but occurring in Finland only in a very limited area near the southeastern border of the country: *Aconitum septentrionale* (see also Fries 1949).
4. Northern species: *Salix myrsinites*, *Cerastium alpinum*, *Minuartia verna* and *Saxifraga groenlandica*.

4. Entomological studies in the area

Research on insect fauna in eastern Karelia began in the second half of the last century. From that period the name of Alexander Günther is especially worth mentioning. He was an apothecary in Petrozavodsk who collected insects during the years 1859–1899. He maintained lively contacts with many Finnish biologists and published lists and reports on Lepidoptera, Coleoptera and plants from Olonets and Onega Karelia (e.g. 1896a,b). Among other entomologists who studied insects in Ladoga and Olonets Karelia in the last century were J. M. J. af Tengström, J. Sahlberg, K. J. Ehnberg, B. Poppius and A. Westerlund (see also Saalas 1942, 1960, Kaisila 1947). Remarkable studies were those of Sahlberg (1871), Westerlund (1893), Poppius (1899) and Blöcker (1909).

John Sahlberg made an expedition to Olonets, Onega and Pomoria Karelia during the three summer months in 1869 and Günther helped him much during the expedition. After Sahlberg's return home, he wrote to the Swedish entomologists C. G. Thomson in Lund (originally in Swedish; the translation from Finnish in Saalas 1960):

> "My travel was unfavorable since the weather was often very rainy and inconvenient for collecting insects. However, I am very satisfied for the results. The insect fauna in Russian Karelia is very interesting and richly compensates to an entomologist all the pains and repulsiveness, which he has to endure when staying in the company of savage and squalid inhabitants. — The most interesting characteristic in the fauna of the district was the occurrence of arctic species together with those actually belonging to more southern districts."

After the First World War the whole Russian Karelia was inaccessible for Finnish entomologists. However, because Ladoga Karelia was part of Finland until the Second World War, many Finnish entomologists collected insects in that area, such as A. J. Silfvenius (by the beginning of this century), J. Kaisila, M. Kononen, J. Koponen, S. Platonoff and L. Tiensuu. Notable entomofaunistic studies were those of Silfvenius (1902, 1906), Tiensuu (1933, 1935) and Platonoff (1938). Finland lost Ladoga Karelia to the Soviet Union in the Moscow peace of 1940, but later during the Second World War the Finnish troops occupied former Finnish Karelia and most of Russian Karelia. Despite the war, many Finnish entomologists collected and studied insects in various areas of eastern Karelia (mainly during the two summers 1942–43); e.g. J. Carpelan, W. Hellén, W. Hackman, O. Heikinheimo, D. Hemdahl, J. Kaisila, E. Kangas, J. Kangas, V. Karvonen, M. Kononen, T. Kontuniemi, H. Krogerus, P. Niemelä, E. Palmén, O. Peltonen, S. Platonoff, M. Pohjola, O. Renkonen, U. Saalas, E. Thuneberg, O. Vaartaja, L. Tiensuu and T. Äyräpää. The most remarkable studies based on insect material collected in eastern Karelia during that war were those of Palmén & Platonoff (1943), Karvonen (1945), Palmén (1946), Kaisila (1944, 1947), Peltonen (1947) and Kontuniemi (1965). Lauri Tiensuu wrote a large manuscript about Diptera of Karelia olonetsensis and onegensis. Regrettably, Tiensuu never completed this valuable work, which is largely based on his own collections and observations (during 1941–44) and in which he identified 1280 dipteran species from the area. The manuscript is preserved in the Zoological Museum of the University of Helsinki.

After the Second World War, eastern Karelia was again closed to Finnish entomologists for almost forty years. However, Russian entomologists gradually began their research at the Karelian Branch of the Academy of Sciences in Petrozavodsk. During the last fifteen years Finnish and Russian entomologists in Karelia have maintained contacts which have produced fruitful joint work in various areas of entomology. In this joint work Dr. E. B. Jakovlev has been the leader on the Russian side. The studies made by Russian entomologists in eastern Karelia during the last few decades will possibly be reviewed in another context.

5. Postglacial immigration of insects to Karelia

Large areas of eastern Karelia from the Karelian Isthmus to the White Sea were already deglaciated about 12000–11000 years B.P. during the mild Alleröd period (Hyvärinen 1973, 1975). The main part of deglaciated eastern Karelia was dry land, whereas southern Finland was largely covered by water. Most of the Karelian Isthmus was also submerged during the Baltic Ice Lake (12000–10200 years B.P.) and a wide former outlet of Ladoga in the northern part of the Istmus closed the land connection during the transgression of the Ancylus Lake (9500–8500 years B.P.). Thus the Olonets

Isthmus has for a long time been an important immigration route for fauna and flora dispersing after deglaciation from the southeast to Finland (see also Kalela 1943:40, 1961). Coexistent occurrence of boreal and southern elements of the biota in Ladoga, Olonets and Onega Karelia are at least partly due to this early dispersion (Kotilainen 1944c, Kaisila 1947).

Subfossil remains of beetles and some other insects living in arctic environments have been found on the Karelian Isthmus (Lindberg 1908, Poppius 1911) and in the Salpausselkä foreland in Finnish Karelia (Bondestam et al. 1994). These remains have been dated to the Younger Dryas period about 10000 years B.P. and indicate arctic conditions in an open tundra-like environment. Bondestam et al. (1994) demonstrated that arctic and subarctic insect and plant species disappeared after about 9500 B.P., and new more southern species dispersed to southern Karelia. This change in fauna was fairly sudden and connected with a great and rapid climatic amelioration somewhat after 10000 B.P. However, Lindroth (1949:721) suggested (mainly on the basis of the arguments of Hyyppä 1933 and Kalela 1943; see also Kalela 1961) that the arctic and subarctic insect species recorded in southern Karelia could not reach the fjeld-region of Finland by means of immigration from the southeast. Lindroth assumed that many of them immigrated either from western (or northern) refugia or from northern Russia through the Kola Peninsula or possibly even from a glacial refuge near the western (present) White sea. According to calculations by Sauramo (1958:432), the land connection between the Kola and Kanin Penisulas has really existed in the beginning of the Bölling period about 13000 years B.P., and according to Hyvärinen (1975) (see also Eronen & Haila 1992) as late as in the Younger Dryas period about 10500 years B.P. Several plant and insect species recorded in Fennoscandia only on the Kola Penisula also indicate the Kanin-Kola dispersal route. However, the main portion of the fauna in Finland has dispersed through Karelia, and Palmén & Platonoff (1943) separated two different postglacial Karelian immigration elements from the southeast:

1. Karelian: species which have dispersed from the southeast (a) only to Karelia, (b) also to Finland or (c) also to Scandinavia around the Gulf of Bothnia.
2. Southern Scandinavian and Karelian: species which have dispersed to Fennoscandia both from the south to Scandinavia and from the southeast to Karelia and possibly also to Finland.

6. Insect fauna in southern Russian Karelia

Like the vegetation, also the insect fauna in Ladoga and Olonets Karelia is fairly similar to that of southern Finland, yet, some characteristics of the fauna differ from those of more western parts of Fennoscandia. Concerning the Macrolepidoptera of the Olonets area (Karelia olonetsensis and onegensis), Kaisila (1947) gave the following special features (compared with those of southern Finland):

1. Several northern species occur in more southern localities and southern species in more northern localities.
2. The proportion of the species with a Boreo-continental distribution is greater.
3. Species with an Atlantic distribution are almost lacking.
4. The proportion of the species living in habitats influenced by man is lower.

As reasons for these features Kaisila (1947) suggested (1) poor habitats in large glacial sand and gravel areas (favorable for northern species) but, on the other hand, very rich habitats especially in calciferous areas (favorable for southern species), (2) a more continental climate, (3) the distributional history and (4) scattered human settlement.

Certainly many eastern insect species are more common in Russian Karelia than in Finland. Many species have also been recorded in the southern part of Russian Karelia, but not in southern Finland or in only a very limited area in southeastern Finland (the latter marked with asterisk). The following are some examples:

1. Eastern or southern species not recorded in Scandinavia (the Karelian immigration): *Erebia euryale euryaloides* Tengström, *Charadrina grisea* (Eversmann), **Autographa excelsa* (Kretschmar), *Bombus patagiatus* Nylander, **B. semenoviellus* Skorikov (see also Elfving 1965), *Polistes nimpha* (Christ), *Carabus menetriesi* Hummel, *Elaphrus angusticollis* F. Sahlberg, *Hephathus nanus* (Herrich-Schäffer), *Neoliturus fenestratus* (Herrich-Schäffer), *Mongolajassus bicuspidatus* (J. Sahlberg), *Chorthippus pullus* (Philippi).

2. Southern species recorded also in southern Scandinavia (the southern Scandinavian and Karelian immigration): **Araschnia levana* (Linnaeus), **Deltote bankiana* (Fabricius), *Empis punctata* (Meigen), *Pterocheilus phaleratus* (Panzer) (see also Erlandsson 1968), *Halictus quadricinctus* (Fabricius), *Pemphredon mortifer* Valkeila, *Dyschirius intermedius* Putzeys, *Bledius filipes* Sharp, *Eupteryx aurata* (Linnaeus) and *Bryodema tuberculata* (Fabricius) (an isolated population was recently recorded in southwestern Finland, Väisänen et al. 1991).
3. Species which have isolated range in central and northern Scandinavia: **Clossiana thore* (Hübner) (see also Pekkarinen 1977), **Bombus consobrinus* Dahlbom (oligolectic on *Aconitum septentrionale*, see also Löken 1973, Pekkarinen 1979).
4. Northern species: *Colostygia turbata* (Hübner), *Hydropsyche Silfvenii* Ulmer, *Psammotettix frigidus* (Boheman).

During the Soviet period, forestry and agriculture in eastern Karelia were quite different from and not at all as intensive as in Finland or Scandinavia. Large old primeval forests in Russian Karelia and managed forests were not subjected to repeated intermediate cuttings. Plenty of decaying wood remained in forests, and large dead aspens are common in old mixed forests. In agriculture, stock-raising and growing of root plants and vegetables were dominant, and cultivation of bread grain minute. Uncultivated and often pastured dry grasslands, meadows and forest meadows are still common in settled areas. Thus, forest and agricultural habitats are for the present much more diversified in Russian Karelia than the same habitats in southern Finland. In consequence, several insect species considered threatened or even extinct in Finland may show a considerably rich occurrence in Russian Karelia.

Nearly 50% of all terrestrial insect species considered threatened in Finland are living in forests and especially high proportion of threatened Diptera (64%), Coleoptera (53%) and Heteroptera (52%) are living in forests (Rassi et al. 1992). Recently Siitonen and Martikainen (1994) have studied beetles and flat bugs living on decaying aspen wood in Finnish and the southern part of Russian Karelia. A total of 21 rare species were found on the Russian side but only five on the Finnish side of the border. Among the species found only on Russian side was *Hylochares cruentatus* (Gyllenhal), which is considered extinct in Finland and six species considered endangered or vulnerable in Finland, e.g. *Cucujus cinnaberinus* (Scopoli) and *Aradus truncatus* Fieber. On the other hand, 55% of Hymenoptera (mainly sawlies and aculeates) and 40% of Lepidoptera considered threatened in Finland are living in various grassland and other man-made habitats (Rassi et al. 1992). Consequently, change of agricultural habitats, especially the disappearance of dry meadows and the general decrease of flowering fields are considered the most important reason for the decline and disappearance of several lepidopteran species in Finland (Mikkola 1987). In all probability, also many of these species occur more abundantly in Russian Karelia than in Finland.

In the future, forestry and agriculture in Russian Karelia will certainly become more effective, and diversity in Nature will diminish. For example, large logging projects are already in operation. However, the great difference in human influence on Nature in Russian and in Finnish Karelia will for a long time give extraordinarily good possibilities for comparative studies of the impoverishment process in Nature caused by the modern forestry and agriculture.

Acknowledgements. We are grateful for advice or other help to the following persons: Mrs. Sirkka-Liisa Nyéki, Mrs. Marjatta Rautiala, Dr. Antti Jansson, Mr. Paavo Koponen, Mr. Ilpo Mannerkoski and Dr. Hans Silfverberg.

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