IBOY Activity in Russia and Insect Diversity of the Russian Far East

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IBOY Activity in Russia and Insect Diversity of the Russian Far East

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Abstract – The insect fauna of Russian Far East is represented by about 31500 species. The richest insect fauna associated with mixed broad-leaved-coniferous forests in Primorskii krai. A one hectare plot has been established in the mixed forest in Primorskii krai in 2001. The 33619 specimens of arthropods from 118 samples have been collected. The most abundant orders are Diptera and Lepidoptera. The number of insect families in plot amounts to 30-40% of the total number of families in Primorskii krai. The species diversity in plot varied from 5-8% (Coleoptera, Orthoptera) to 39% (Diptera: Drosophilidae) of the fauna of Primorskii krai.

I. Introduction

The problem of biodiversity of the World and its regions is widely discussed now. Insects are much more abundant than other living organisms together. Excellent arguments have been made for 5-15 million [1], 12.5 million [2], but estimated number even may be up to 30 millions extant insect species [3].

The International Network for DIWESITAS in the Western Pacific and Asia (DIWPA) was established in 1993 with a series of biodiversity focussed goals including the inventoring and monitoring of boidiversity and ecosystem function of biodiversity. DIWPA has led to much improved collaboration between biodiversity researches and has organised in 2001 the "International Biodiversity Observation Year" (IBOY). The forest IBOY program was focus on the biodiversity of the sites in the region from Russia to Australia.

The main aim of this paper is to discuss the first results of the IBOY activity in the site at Ussuriiskii Reserve. A special attempt is made in comparison of the insect diversity of the studied plot with the biodiversity of the Primorskii krai and Russian Far East.

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II. Insect diversity of the Russian Far East

Russian Far East (Fig. 1) occupies the square 3016 thousand sq. km. and extends from Wrangel Il. (71° N) southwards to Khasan Lake (42° N) and from Dezhnev Cape (170° W) westwards to Stanovoj Range (120° E). The forests occupy 39% of this square and dominate in Primorskii krai, Amurskaya oblast, Sakhalin Il. and Khabarovskii krai. The insect fauna of Russian Far East is represented by about 31500 estimated species from 629 recorded families of 31 orders [4]. The largest orders are Hymenoptera (72 families, 9000 estimated species), Diptera (119 families, 8000 species), Coleoptera (114 families, 5500 species), Lepidoptera (81 families, 5000 species). The most insects orders are well represented in each region except Chukotka.

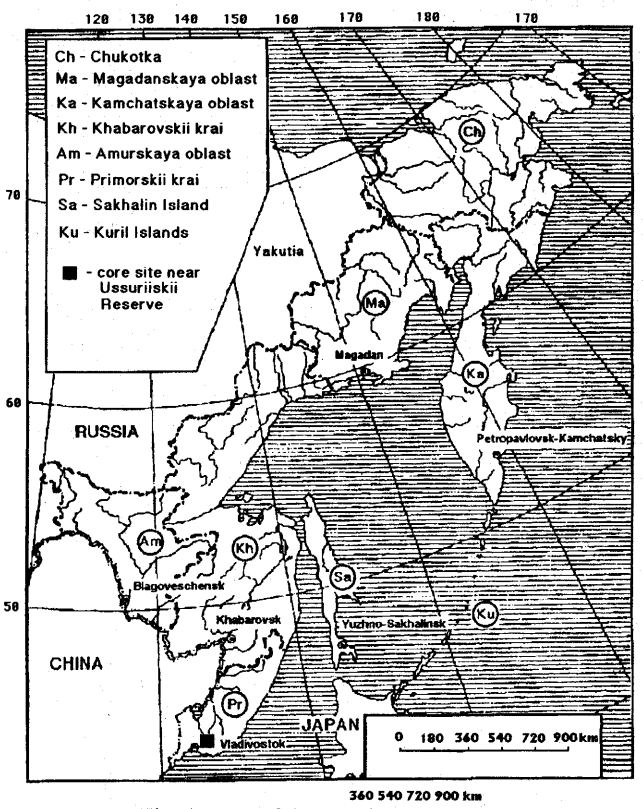

Fig. 1. Map of the Russian Far East.

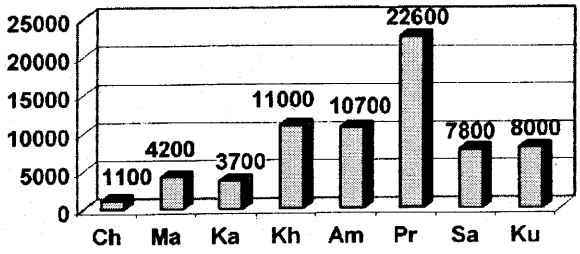

Fig. 2. Number of estimated species in the Russian Far East. Abbreviations of regions as in Fig. 1.

There are four levels of insect family diversity: around 200 families (Chukotka), around 300 (Magadanskaya oblast and Kamchtskaya oblast), around 450 (Amurskaya oblast, southern part of Khabarovskii krai, Sakhalin and Kuril Islands), and 600 families (Primorskii krai). Insects are best and well represented at the species level in Primorskii krai, mostly in its extremal southern part (Fig. 2). The species number per square unit considerably differs in the different regions of the Russian Far East. In spite of relativity of this index it is adequate to species richness degree of separate zonal landscapes: less than 10 species/1000 sq. km indicates zonal and mountain tundras of Chukotka (1.5), Magadanskaya oblast (9.1) and Kamchatskaya oblast (7.8), less than 100 species/1000 sq. km – taiga landscapes of Khabarovskii krai (13.3) and Amurskaya oblast (29.4), more than 100 species/1000 sq. km – the nemoral cenoses of Primorskii krai (136.2), Sakhalin (108.9) and Kuril Islands (512.8).

Three regions in Holarctic have almost the same number of species: Russian Far East [4], Japan [5] and Canada [6]. Russian Far East and Canada belong to temperate zone of Holarctic. Southern borders of these vast regions have the same latitude (42° N), which result in similarity of climatic and vegetation belts. These factors have strong influence for distribution and diversity of insects. Therefore total number of insect species in both regions is almost equal, and percentages of Lepidoptera (16% of total species) and Diptera (24-25%) are the same, but the beetles are more numerous in Canada. The number of recorded insect species for Japan in spite of it rather small square is approximately the same as for Russian Far East and Canada. The reason of such similarity depends on more southern position of Japan (up to 23° N). Coleoptera represented in Japanese fauna much better (32% of total insect species) than in Canada (25%) or Russian Far East (17%), probably it results of the increasing of beetle percentage for subtropical faunas.

III. IBOY site in the Russian Far East

The core site in Russia has been established in Primorskii krai near Ussuriiskii Natural Reserve (Fig. 1). A one hectare plot have been selected in the vicinity of Kamenushka village on the top of the hill (200 m above sea level) on left side of Volkha River (43°36.63' N, 132°14.18' E) in mixed coniferous-broad-leaved forest. A plot was established according recommendations of DIWPA-IBOY [9].

The plant diversity of the mixed coniferous-broad-leaved forest at plot is characterised by follow. There are 91 recorded species of vascular plants: trees, bushes and lianas are represent by 34 species, the herbs - by 57 species. The number of herb species at plot will be increased after studying of ephemeral spring herbs and sedges (Carex). The three layer at plot consist of 3 sub-layers: highest (at a height of 23-27 m, with *Abies holophylla*, *Pinus koraiensis*, *Quercus mongolica*, *Tilia amurensis*, *Betula platyphylla* and other trees with mean diameter about 40-60 cm), median (at a height of 16-20 m, the same species plus *Acer mono* with mean diameter about 20-25 cm), and lower (at a height of 8-12 m, composing by *Acer pseudosieboldianum*, *Carpinus cordata* and young trees with mean diameter about 10-12 cm). The shrub layer is mosaic and composing by 14 plant species. *Corylus mandshurica* is dominant here. The herb layer (about 60 species) at plot is not uniform. The forb and graminoids are dominant in the half of plot, in other half the cryptogams are most abundant.

TABLE I

Number of specimens of arthropod orders collected by different types of traps in plot at Ussuriiskii Reserve in 2001

Taxa	Trapping methods							Total
	PT	LS	BS	BT	LT	MT	WT	
Archeognatha			18					18
Collembola	522	27	163	7			27	746
Diplura							1	1
Thysanura	12						3	15
Ephemeroptera					6			6
Orthoptera	17		5		7		1	30
Dermaptera	6	1		1	1	4	1	14
Psocoptera			6		98	7	12	123
Thysanoptera	1		3				11	15
Homoptera	17		16	1	588	28	36	686
Heteroptera			7		393	7	4	411
Coleoptera	231	9	35	143	1592	58	60	2128
Strepsiptera	3							3
Neuroptera					46			46
Hymenoptera	292	1	84	14	409	455	77	1332
Thrichoptera					278	1		279
Lepidoptera	3		12		8740	123	10	8888
Diptera	493	41	235	162	6988	9336	224	17479
Acari	132	159	322	3	434	7	20	1077
Araneae	75	2	130	19	17	11	13	267
Pseudo-scorpiones		2				1		3
Myriapoda	1							1
Diplopoda	7	1	1					9
Chilopoda	29	7	3			1		40
Isopoda					1		1	2
Total	1841	250	1040	350	19598	10039	501	33619

Abbreviations. PT – pitfall traps; LS – litter samples; BS – bark spraing; BT – banana traps; LT – light traps; MT – Malaise traps; WT – window traps.

IV. Results of arthropod collecting in plot

To collect arthropods in canopy and ground zones of plot the follow seven techniques and traps recommend by DIWPA-IBOY [9] are used: light traps, Malaise traps, window traps, pitfall traps, banana traps, litter sampling, and bark spraying. All types of traps were concurrently used periodically from 25 June to 12 September 2001. After collecting and fixation of the entomological materials all samples have been sorted to ordinal or families levels. A part of arthropods is fixed in alcohol (mainly from window traps, pitfall traps, banana traps, bark spraying, and litter sampling), the specimens from light traps and Malaise traps are kept mainly in cotton layers in dry condition. All data are storied in database using Excel. The 33619 specimens of arthropods from 118 samples in plot have been collected totally (Table I). The most abundant orders are Diptera and Lepidoptera. The orders Coleoptera, Hymenoptera, Collembola, Homoptera and Acari are well represented too. Other insect orders and arthropod groups are represented by about 1300 specimens (4%).

A. Light traps. The standard Pennsylvania trap with 8W daylight fluorescent tube and 12v battery is used. We operate 2 traps, one at ground level and one in the canopy. The 20 samples are made at randomly determined points (10 at ground level and 10 at canopy). The 19598 specimens of insects and other arthropod have been collected totally. The orders Lepidoptera, Coleoptera and Hymenoptera are represent in canopy zone slightly better than in ground. On the contrary the number of specimens of Diptera, Homoptera and Heteroptera in the ground zone are about twice greater than in canopy (Fig. 3).

B. Malaise traps. We use two standard Malaise traps. The 25 samples (13 at ground level and 12 at canopy) are made. The 10039 specimens arthropod have been collected. All large orders (Diptera, Hymenoptera, Lepidoptera, Coleoptera, Homoptera) are represent in ground zone considerably (2-10 times) better than in canopy (Fig. 4).

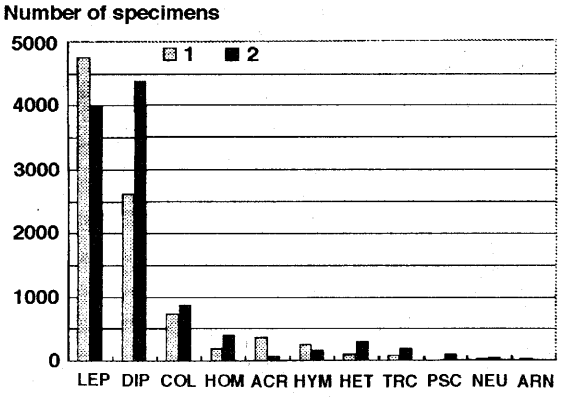

Fig. 3. The number of specimens of large arthropod taxa from ground (1) and canopy (2) zones collected by light traps in plot. Abbreviations: ACR – Acari, ARN – Araneae, COL – Coleoptera, DIP – Diptera, HET – Heteroptera, HOM – Homoptera, HYM – Hymenoptera, LEP – Lepidoptera, NEU – Neuroptera, PSC – Psocoptera, TRC – Trichoptera.

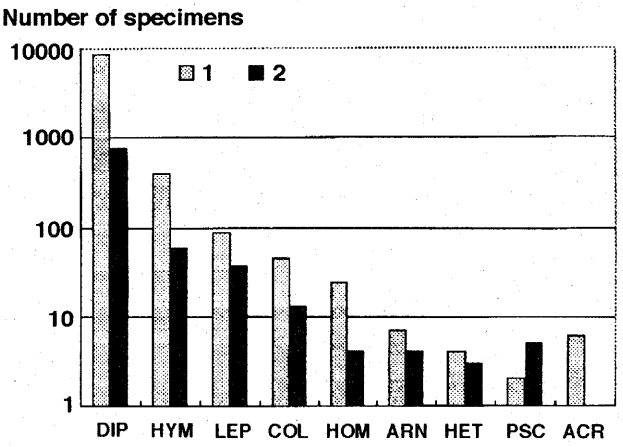

Fig. 4. The number of specimens of large arthropod taxa from ground (1) and canopy (2) zones collected by Malaise traps in plot. Abbreviations as in Fig. 3.

C. Window traps. We operate two window traps. The 501 specimens of insects and other arthropod have been collected from 18 samples (9 at ground level and 9 at canopy). The orders Diptera, Hymenoptera and Collembola are represent in ground zone 2-3 times better than in canopy. On the contrary the number of specimens of Homoptera and Coleoptera in canopy zone are about twice greater than in ground.

E. Banana traps. Twenty-four samples have been made using banana traps (6 samples at ground, 6 - at 1.3 m, 6 - at 2.5 m and 6 – at 6 m above ground level). Drosophilidae (Diptera) is dominate here (144 specimens).

F. Litter sampling. We collect 2 samples from random points in the plot. Each comprises about a litre of moist leaf scraped up from around the selected point. The Acari, Diptera, and Collembolla are most abundant here.

G. Bark spraying. The bark spraying was made on square unit (1x0.5 m) of 5 tree species: oak (*Quercus mongolica*), birch (*Betula platyphylla*), ashwood (*Fraxinus mandshurica*), fir (*Abies holophylla*), pine (*Pinus koraiensis*), and in hollow of old oak tree. The arthropod fauna of the bark surface of trees quite different from fauna of hollow, mainly by increasing of the Dipteran family Phoridae, and order Orthoptera in hollow. The number of specimens of different orders on bark surface is similar for all tree species, except Collembola and Acari, which are more numerous on the *Fraxinus mandshurica* bark.

V. Preliminary analysis of insect diversity of the plot

For a few groups of insects, such as orders Coleoptera, Orthoptera, and family Drosophilidae (Diptera) all collected in plot specimens were determinate up to species [7]. It give possibility to compare the biodiversity in plot (0.01 sq. km) with diversity of local (Ussuriiskii Reserve, 405 sq. km) and regional (Primorskii krai, 169900 sq. km) faunas.

In Primorskii krai the number of the species of family Drosophilidae (Diptera) and order Orthoptera are almost the same (114 and 102 species respectively). But the fauna of plot is quite different in both groups. Drosophilidae are well represent in studied forest ecosystem (58% of local fauna of Ussuriiskii Reserve, and 39% of regional fauna of Primorskii krai), while Orthoptera occupied mainly open areas and are pure represent in plot (8% and 4% respectively).

The fauna of Coleoptera of Primorskii krai is represented by 3800 species from 104 families [4]. Only 212 species from 51 families were collected by all types of traps in plot, which consist 49% of families and 5.6% species of the fauna of Primorskii krai [7]. The most diverse families in plot are Staphylinidae (38 species from 22 genera), Carabidae (28 species from 16 genera) and Nitidulidae (17 species from 10 genera), each other family is represent by 1-8 species.

The fauna of Primorskii krai consists of 117 families of Diptera, but only 39 families (33.3%) are mentioned from the plot. There are three large groups of the families in the plot: most abundant families (more than 100 collected specimens), common families (10-100 specimens totally), and rare families (less than 10 specimens). Beside must abundant Diptera the families Muscidae, Tabanidae and Sciaroid flies are dominant in Malaise traps, Ceratopigonidae, Tipulidae and Sciaroid flies very common in light traps, and Drosophilidae were collected mainly in banana and light traps. Seventeen families of Diptera are common, the majority of them well represent in Malaise and light traps. The Sphaeroceridae and Antomiidae were collected mainly in pitfall traps. Empididae are dominant in window traps. Eleven families of Diptera are rare and represented by 1-5 specimens in all types of traps totally.

In satisfactory studied insects, such as orders Coleoptera, Orthoptera and family Drosophilidae, all collected in plot specimens belong to known species [7]. New species will be found beside insects poorly studied in Russian Far East. For example, 15 new species of gall midges (Diptera, Cecidomyiidae) have been described based on material collected in plot [8].

VI. Conclusions

The insect fauna of Russian Far East is represented by about 31500 species. The richest insect fauna associated with mixed broad-leaved-coniferous forests in south part of the Russian Far East.

A one hectare plot has been established in the forest near Ussuriiskii Natural Reserve in Primorskii krai in 2001. The 33619 specimens of arthropods from 118 samples have been collected totally in plot using 7 trapping methods. Beside 31 recorded from Primorskii krai insect orders only 19 were found in the plot. The most abundant orders are Diptera (52% of specimens) and Lepidoptera (26%). In plot the number of families of the large orders, such as Coleoptera and Diptera, amounts to 30-40% of the total number of families in Primorskii krai. The number of species in plot varied from 5-8% (Coleoptera, Orthoptera) to 39% (Diptera: Drosophilidae) of the fauna of Primorskii krai.

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