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THE RIVER FISH COMMUNITIES STRUCTURE- RESULTS OF BIODIVERSITY MONITORING

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In 2006 62 stream sites in 32 different size rivers of Latvia were sampled using electrofishing. All of the sites were originally sampled as a part of state Biodiversity Monitoring Program. The sampling sites were chosen using 50*50 km grid map to cover all country territory as far regular. In total, 29 fish and 2 lamprey species were found. Among these species 6 were occasional, with few sampled individuals in one or two sampling sites. Most of the sampling sites were presented with 5- 8 species. The 5 of them- stone loach, minnow, roach, trout (sedentary and migratory forms) and riffle minnow were widely distributed and made largest part (75%) of the total catch. Local species richness (LSR), the number of fish and the fish biomass are related mostly by local habitat conditions (bottom substrate, temperature and oxygen conditions, average depth) and stream spatial characteristics (watershed area, order). Environmental variables explained a great part of the density and distribution patterns of the fish species. From the other side, rough analysis of anthropogenic impact on fish communities structure demonstrated that large part country territory with according rivers is inaccessible for migratory fish species. It means that fish communities structure and LSR would be affected by the far- away (out of the watershed) factors impact. The data on fish communityÿs structure and abundance of fish are the basis for elaboration of further rivers ecological classification system for the contribution of WFD requirements. At present the data of biodiversity monitoring is used for Latvia report regarding distribution and population dynamics (trends) characterization for the regulation 97/62/EK species.

Key words: fish communities structure, biodiversity monitoring, Latvia

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Introduction

This study would be the first evaluation of fish community᾽s structure in the rivers of Latvia in relation with streams spatial position and local environmental conditions. Until now the main effort of research on river fish distribution and abundance was connected with economically important species, mainly diadroms- Baltic salmon, sea trout and river lamprey, primarily in the rivers entering directly the Baltic Sea or these streams tributaries.

Since 2006 the fish monitoring program in rivers was reorganized accordingly to the background monitoring principles. The monitoring sites network should cover the country territory as regular as possible, the selection of the rivers to be random or partly random. The objectives of this monitoring program are:

-to assess the species richness and fish abundance in the rivers of Latvia;

-to assess the ranges of species distribution, suitable habitats and future prospects with special emphasis on regulation 97/96/EK species.

The stream fish assessment has been placed to answer the questions of the fish community's structure determined by biotic or abiotic, regional or local environmental factors. From the other side, antrophogenic impacts play significant role on formation of fish distribution and abundance. The aim of this study therefore is (i) describe the fish community's structure and fish abundance in the rivers of Latvia based on 2006 monitoring results, (ii) analyze the fish community's parameters in relation with selected large scale (within-basin and within- river) and local (within- site) environmental factors and human impacts, especially rivers damming.

Material and methods

Study area

In this study research data from 34 Latvia rivers sampled in 62 reaches in July- August of 2006 have used. Fish sampling is carried out under the state biodiversity monitoring program.

Sampling sites were selected using grid map 1: 200000 to square the all country territory in 31 sections. In every section one river (2 reaches) was selected for sampling. To divide the sampling sites in country territory as far regularly the total rivers length allocation between river basin districts (RBD) was taking into account (table 1).

Table 1. The allocation of sampling sites between river basin districts (RBD)

River basin district	Total area of RBD (km^2)	River length in RBD (km)	Sampling sites
Daugava	27041	8323	22
Gauja	13039	4235	14
Lielupe	8841	3144	8
Venta	15633	4973	18

Table 2. Environmental variables registered in monitoring

Environmental variables	Classification of environmental variables			
	1	2	3	4
Stream velocity range	pool	glide	riffle	
Dominating bottom substrate type	sand	cobble/pebble	rocks	
Temperature type	Warmwater >17°C	Coldwater<17°C		
Depth class	<0.2 m	0.2- 0.3m	0.3- 0.4m	0.4- 0.5m
Oxygen type	low (<7 mg/l)	high (>7 mg/l)		
Accessibility of the river	Accessible	Blocked		

Habitat surveys

In each river site average width (m), maximal and average depth (m), section length and width (m) measured. Stream velocity range (pool, glide, riffle), dominating and sub-dominating bottom substrate (boulder, cobble, pebble, gravel, sand, silt) registered (table 2). Dissolved oxygen (mg/l), temperature (°C), pH and conductivity (ġS/cm) measured using WTW Multi340i meter.

Stream segments order calculated according Strahler (1957) from confluence to confluence. The watershed area (concerning sampling site) determined using maps 1: 50000.

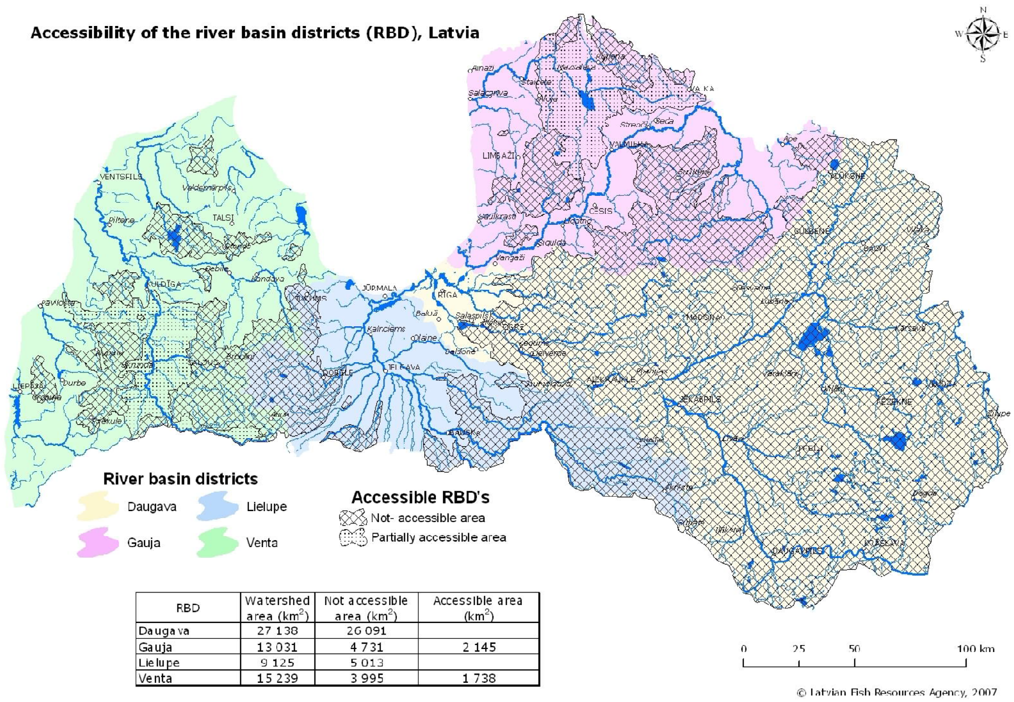
Fish sampling

Fish were caught using electrofishing gear (direct current 300V) supplied by 2 kW generator. Fish sampling in small and medium size rivers had provided by wading in upstream direction. The size of sampled area fluctuated from 120- 300 m^2. Three successive removals carried out in each sampling site with intervals of 30 minutes. In large and deep rivers single pass electrofishing provided near the shore in 50m long stream section. Fishes caught in one sampling site were separated according removal and species. For every individual length (L or Ls for salmonids, mm), weight (Q, g) were measured. Fishes were examined according diseases, parasites and abnormities.

The density (n/ha) and biomass (kg/ha) of fish was calculated by the Zippin method modified by Bohlin (Bohlin at al, 1989).

Analysis

The number of species (N), fish abundance (n/ha), fish communities functional guilds characterized by feeding habitat preference (benthic and water column species, reophilic, limnophilic,



RBD	Watershed area (km^2)	Not accessible area (km^2)	Accessible area (km^2)
Daugava	27 138	26 091	
Gauja	13 031	4 731	2 145
Lielupe	9 125	5 013	
Venta	15 239	3 995	1 738

Fig. 1. Accessibility of the river basin districts (RBD), Latvia.

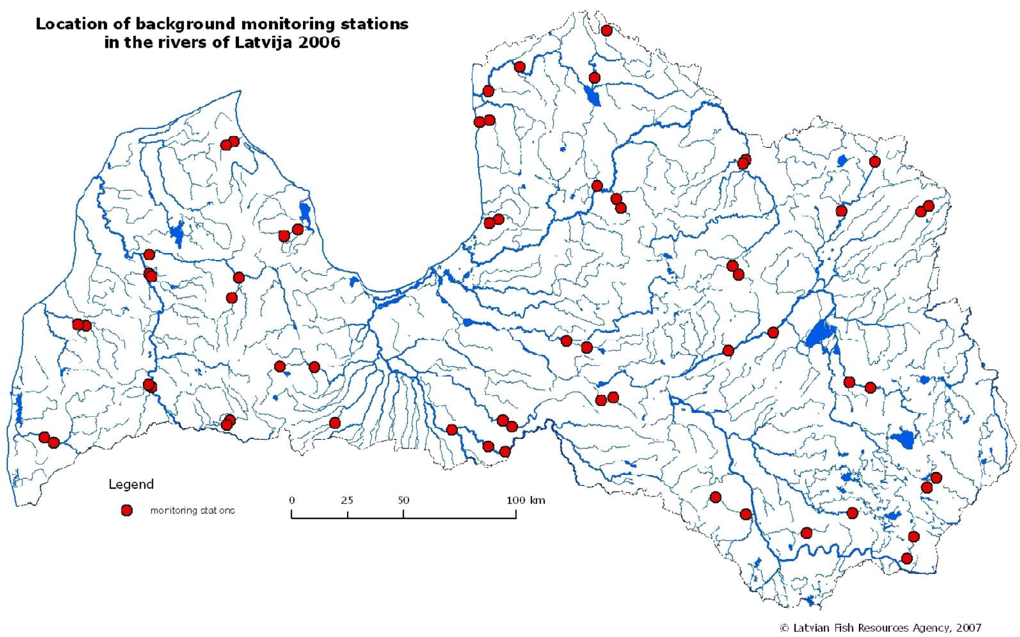


Fig. 2. Location of background monitoring stations in the rivers of Latvia 2006.

eurytopic), reproduction mode (lithophilic, phytream silic), feeding type (piscivorous, insectivorous, omnivorous) and more common species stone loach *(Noemacheilus barbatulus),* minnow *(Phoxinus phoxinus),* roach *(Rutilus rutilus),* trout *(Salmo trutta)* and riffle minnow *(Alburnoides bipunctatus)* abundance were analyzed.

We evaluated the differences in fish communities metrics in relation with stream spatial characteristics (watershed area and stream order), within- river environmental variables: temperature type of stream (cold or warm water), oxygen saturation (low <7 mg/l, high >7 mg/l) and within-site (local) environmental variables: bottom substrate type (rocks, pebble/cobble, sand), type of habitat (pool, glide, riffle), average depth class (<0.2m, 0.2- 0.3m, >0.3- 0.4m, >0.4m- 0.5m).

Before the analyses, a log and log (x+1) transformation was applied for separate metrics to minimize the effects of extremes and get the numerical values in case when initial data is 0.

The simple and conservative ANOVA was used to test whether fish metrics differed among the different environmental factors. The descriptive statistics, ANOVA and correlations between fish and environmental metrics calculated using standard software packages.

Results

Habitat surveys

Glides (characterized by uniform depth and flow) were the most common habitat type 36 of 62 fish sampling sites. Pools (low gradient, non uniform depth) were the next most common habitat type, being found primarily in the largest rivers. Riffles (faster flow and higher gradient) were the less widespread habitat type in the river of Latvia.

Table 3. Mean values for habitat characteristics sampled in 2006

	Stream order			
Variables	1	2	3	4
Watershed area (km^2)	74	196	1560	3062
Average depth (m)	0.19	0.30	0.30	0.38
Maximum depth (m)	0.39	0.52	0.55	0.68
Dissolved oxygen (mg/l)	6.9	7.2	7.7	8.9
T (°C)	17.9	19.0	22.2	19.9
Conductivity (µS/cm)	461	480	513	483
pH	7.6	7.7	7.9	8.0

The most frequent bottom substrate was sand (28 sites) with some addition of silt or organic material. Hard river bottom substrate as rocks and rocks in combination with pebble, cobble and gravel was most common in small and medium size rivers and separate large rivers stages. As low and medium gradient habitat type dominates in the observed rivers, the predominant water current classes estimated to be a slow (18 sites) and medium (33 sites). Rapid stream flow was found only in 11 of sampling sites.

According to the water temperature in summer, the rivers divide in to coldwater (<17 °C) and warmwater (>17° C) streams. The proportion of coldwater sites were 14 (7 rivers) contrary the 48 sites (29 rivers) defined as warmwater.

Dissolved oxygen concentration was highest in coldwater streams and stream reaches with open and light river stretch and riparian zone. Contrary, in small, slow flowing lowland rivers with highly shading dissolved oxygen levels decreased down to 2- 3 mg/l.

The variables "stream order" and "watershed area" characterized stream size and spatial position of sampling site. These two variables showed significant correlation. The variables "depth" and "average depth" diversify respectively from 0.1 to 0.5 and 0.3 to 1.0m. Both this variables correlated significantly, as well as similarly increase with stream order and watershed area (table 4). The water temperature tends to increase with the increasing of watershed area and stream order.

Table 4. Matrix of correlation between environmental variables

	Stream order	Watershed area	Average depth	Maximum depth	Dissolved oxygen	T	Conductivity	pH
Stream order	1							
Watershed area[a]	**0.60**	1						
Average depth	**0.54**	0.28	1					
Maximum depth	**0.41**	0.31	**0.83**	1				
Dissolved oxygen	0.23	0.26	-0.11	-0.05	1			
T	**0.39**	**0.49**	0.15	0.2	0.07	1		
Conductivity	0.16	0.09	0.04	-0.02	0.07	0.01	1	
pH	**0.45**	**0.45**	0.05	0.03	0.78	**0.36**	**0.36**	1

Notes: Pearson˙s correlation coefficients (n=62, į=0.001), significant values in Bold, a- variables expressed in logarithmic values

In light exposed river conditions dense helophytes vegetation produces extra oxygen which concentrations exceeded 100% of saturation.

Fish surveys
Fish number and abundance

In total 62 sites in 32 rivers were sampled using electrofishing. All together 6813 individuals were caught representing 29 fish and 2 lamprey species (table 5).

Stone loach (*Noemacheilus barbatula*), minnow (*Phoxinus phoxinus*), roach (*Rutilus rutilus*), one summer old trout (*Salmo trutta*) and riffle minnow (*Alburnoides bipunctatus*) comprised the 75% of total catch.

Least numerous in the total catch were eel (*Anguilla anguilla*), bream (*Abramis brama*), ide (*Leuciscus idus*), crucian carp (*Carassius carassius*), pond loach (*Misgurnus fossilis*), pikepearch (*Stizostedion lucioperca*) and ruff (*Gymnocephalus cernua*). The individuals of all these 7 species made only 0.2% from the catch. Water column fish species dominate - 55% of species and individuals were represented by this ecological guild. The reophilic and eryphilic fish species dominated in the rivers, contrary the species lakes specialists. Species gravel spawners were more abundant in our study in comparison with fishes phythophils. Insectivors amount 57%, omnivors- 39% and piscivors- 4% from the total catch.

The number of fish species varied from 2- 12 per sampling site or 2- 15 per river. The average

Table 5. Fish species found in the rivers and their ecological guilds

	Catch (% of catch)	Number of streams (reaches)	Tolerance	Feeding habitat	Habitat type	Repro-duction mode	Feeding type
River lamprey ***Lampetra fluviatilis****	*	8 (14)	Intolerant	B	RH	LITH	
Brook lamprey ***Lampetra planeri****	*	23 (34)	Intolerant	B	RH	LITH	
Salmon ***Salmo salar***	187 (2.7)	4 (7)	Intolerant	WC	RH	LITH	INSV
Trout ***Salmo trutta spp.***	590 (8.7)	9 (17)	Intolerant	WC	RH	LITH	INSV
Grayling ***Thymallus thymallus***	24 (0.4)	3 (3)	Intolerant	WC	RH	LITH	INSV
Pike ***Esox lucius***	57 (0.8)	19 (21)		WC	EURY	PHYT	PISC
Eel ***Anguilla anguilla***	1 (0.0)	1 (1)		B	EURY		
Silver bream ***Blicca bjoerkna***	92 (1.4)	3 (3)	Tolerant	B	EURY		OMNI
Bream ***Abramis brama***	3 (0.0)	1 (2)	Tolerant	B	EURY		OMNI
Roach ***Rutilus rutilus***	689 (10.1)	25 (35)	Tolerant	WC	EURY		OMNI
Rudd ***Scardinius erythrophthalmus***	16 (0.2)	4 (4)		WC	EURY	PHYT	OMNI
Dace ***Leuciscus leuciscus***	125 (1.8)	14 (21)		WC	RH	LITH	OMNI
Chub ***Leuciscus cephalus***	120 (1.8)	13 (21)		WC	RH	LITH	OMNI
Ide ***Leuciscus idus***	1 (0.0)	1 (1)		WC	RH		OMNI
Gudgeon ***Gobio gobio***	509 (7.5)	21 (31)		B	RH		
Minnow ***Phoxinus phoxinus***	1083 (15.9)	27 (43)		WC	RH	LITH	
Riffle minnow ***Alburnoides bipunctatus***	517 (7.6)	15 (22)	Intolerant	WC	RH	LITH	INSV
Bleak ***Alburnus alburnus***	13 (0.2)	7 (7)	Tolerant	WC	EURY		OMNI
Bitterling ***Rhodeus sericeus***	10 (0.1)	3 (3)	Intolerant	WC	LI		
Tench ***Tinca tinca***	5 (0.1)	3 (4)	Tolerant	B	LI	PHYT	OMNI
Crucian carp ***Carassius carassius***	3 (0.0)	2 (2)	Tolerant	B	LI	PHYT	OMNI
Stone loach ***Noemacheilus barbatulus***	2108 (30.9)	30 (53)	Tolerant	B	RH	LITH	
Spiny loach ***Cobitis taenia***	54 (0.8)	17 (19)		B	EURY	PHYT	
Pond loach ***Misgutnus fossilis***	4 (0.1)	1 (1)		B	LI	PHYT	
Burbot ***Lota lota***	49 (0.7)	10 (12)		B	EURY	LITH	PISC
Three- spined stickleback ***Gasterosteus aculeatus***	6 (0.1)	2 (2)	Tolerant	WC	EURY		OMNI
Nine- spined stickleback ***Pungitius pungitius***	9 (0.1)	4 (4)	Tolerant	WC	LI		OMNI
Perch ***Perca fluviatilis***	239 (3.5)	17 (24)	Tolerant	WC	EURY		
Pikepearch ***Stizostedion lucioperca***	1 (0.0)	1 (1)		WC	EURY		PISC
Ruff ***Gymnocephalus cernua***	3 (0.0)	1 (1)		B	EURY		
Bullhead ***Cottus gobio***	205 (3.0)	25 (37)	Intolerant	B	RH	LITH	INSV
	6813						

Notes: B- benthic species, WC- water column species, RH- rheophil species, EURY- euryphil species, LI- limnophil specis, LITH- lithophil species, PHYT- phytophil species, INSV- insectivores, PISC- piscivores, OMNI- omnivores, *- only presence or absence established number of fish caught at each site was 109 and ranged from 12 to 352.

The relative abundance of fish varied from 1.2 to 51.2 thousand individuals per hectare with average value 14.5. Fish biomass was 143 kg/ha with extremes from 10 to 890 kg per hectare.

Local species richness, fish abundance and fish communities structure in relation with stream spatial characteristics

Results of data analysis demonstrated that local species richness positively correlated with watershed area and stream order (table 6). The relationship between number of fish and stream spatial position was not found, however fish biomass positively correlated with stream order (r=0.483, n=62, į=0.01).

The average number of fish species increased from 4 to 1 order streams, but LSR did not significantly differ between 3rd and 4th order rivers (table 7).

Table 6. Matrix of correlations between stream spatial characteristics and fish metrics

	Watershed area[a]	Stream order
Fish abundance		
Species richness[a]	**0.495**	**0.483**
Habitat type		
Euryphil fish_number[a]	**0.430**	**0.482**
Feeding		
Omnivores_number[a]	**0.478**	**0.455**

Notes: significant values in Bold, [a]- variables expressed in logarithmic values

Table 7. The average fish community˙s metrics in relation with environmental conditions

Variables	Species richness [a]	Number of fish [a] (n/ha)	Fish biomass [a] (kg/ha)
Local habitat variables			
Habitat type			
Pool	**0.70 (0.03) p<0.001**	**3.80 (0.13) p<0.001**	1.83 (0.18) p=0.253
Glide	**0.85 (0.01)**	**4.09 (0.10)**	2.02 (0.18)
Riffle	**0.96 (0.01)**	**4.38 (0.01)**	2.05 (0.01)
Bottom substrate type			
Sand	**0.74 (0.03) p<0.001**	**3.88 (0.14) p<0.005**	**1.79 (0.37) p<0.003**
Pebble/cobble	**0.95 (0.01)**	**4.07 (0.08)**	**1.98 (0.19)**
Rocks	**0.90 (0.01)**	**4.22 (0.08)**	**2.20 (0.10)**
Within- river habitat variables			
Temperature type			
Coldwater	0.76 (0.01) p=0.162	4.01 (0.08) p=0.778	1.75 (0.07) p=0.069
Warmwater	0.83 (0.03)	4.04 (0.14)	2.01 (0.17)
Oxygen type			
<7 mg/l	**0.77 (0.03) p=0.023**	**3.93 (0.18) p=0.048)**	1.85 (0.16) p=0.053
>7 mg/l	**0.86 (0.01)**	**4.11 (0.07)**	2.05 (0.16)
Antrophogenic impact			
Accessibility			
Accessible	**0.87 (0.02) p<0.07)**	**4.15 (0.09) p=0.012**	**2.08 (0.18) p=0.034**
Non- accessible	**0.77 (0.03)**	**3.93 (0.14)**	**1.86 (0.13)**

Notes: The average fish community˙s metrics. In parenthesis- sampling variance. Significant differences between groups in bold. a- variables expressed in logarithmic values

Stream spatial position affects the local fish community`s functional structure. In general, with increasing of stream order and watershed area increases the abundance of ecologically tolerant euryphilic fish species omnivores. In the rivers of Latvia most abundant species of this guild is roach (*Rutilus rutilus).* In same way increases the number of other cyprinid species, as gudgeon *(Gobio gobio),* chub *(Leuciscus cephalus)* and dace *(Leuciscus leuciscus).*

Species richness and fish abundance in relation with environmental variables

A comparison of species richness and fish abundance with habitat type, river bottom substrate type, temperature regime of the rivers and oxygen saturation demonstrated significant influence of these factors. The species richness and number of fish was higher in riffle and glide habitats that in pools areas (table 7). With increasing

Table 8. The abundance of fishes of different ecological guilds in relation with environmental factors

	Feeding habitat		Stream habitat preference			Reproduction habitat		Feeding		
	Benthic [a]	Water column [a]	Euryphil [a]	Rheophil [a]	Limnophil [a]	Lithophyl [a]	Phythophyl [a]	Omnivores [a]	Insectivores [a]	Piscivores [a]
Habitat type										
Pool	**2.82 (1.13)**	3.65 (0.13)	3.09 (1.63)	**2.81 (2.01)**	0.52 (1.33)	**3.07 (0.90)**	1.98 (1.82)	2.68 (1.93)	**0.82 (1.71)**	1.71 (1.83)
Glide	**3.63 (0.21)**	3.74 (0.23)	2.28 (2.38)	**3.91 (0.29)**	0.42 (0.84)	**3.90 (0.24)**	1.29 (1.58)	1.95 (2.80)	**1.95 (2.80)**	0.95 (1.54)
Riffle	**4.22 (0.02)**	3.82 (0.03)	1.92 (2.27)	**4.37 (0.01)**	0.81 (1.60)	**4.33 (0.01)**	0.85 (1.74)	2.06 (2.58)	**3.74 (0.09)**	0.74 (1.42)
Bottom substrate type										
Sand	**3.10 (1.10)**	3.62 (0.27)	2.53 (2.10)	**3.24 (1.69)**	0.34 (0.91)	**3.41 (0.48)**	1.75 (1.82)	1.96 (2.47)	**1.57 (2.64)**	1.56 (1.73)
Pebble/cobble	**3.50 (0.24)**	3.79 (0.10)	2.34 (2.66)	**3.83 (0.31)**	0.41 (0.82)	**3.78 (0.31)**	1.16 (1.69)	2.23 (3.07)	**2.62 (2.04)**	0.71 (1.33)
Rocks	**3.86 (0.18)**	3.82 (0.13)	2.51 (2.28)	**4.04 (0.33)**	0.76 (1.34)	**4.07 (0.20)**	1.26 (1.58)	2.38 (2.43)	**3.12 (1.62)**	0.93 (1.64)
Temperature type										
Coldwater	3.36 (0.24)	3.72 (0.35)	**0.46 (0.93)**	4.00 (0.08)	0.00 (0.00)	**4.01 (0.07)**	**0.40 (0.72)**	**0.00 (0.00)**	**3.62 (0.15)**	0.46 (0.93)
Warmwater	3.49 (0.46)	3.74 (0.19)	**2.85 (1.59)**	3.58 (1.11)	0.58 (1.63)	**1.64 (1.69)**	**1.64 (1.69)**	**2.55 (1.96)**	**2.08 (2.65)**	1.27 (1.74)
Oxygen type										
<7 mg/l	**3.22 (1.20)**	3.64 (0.21)	**2.94 (1.15)**	**3.24 (1.85)**	0.53 (1.33)	**3.43 (0.93)**	**2.03 (1.43)**	2.35 (2.07)	**1.62 (2.60)**	**1.63 (1.84)**
>7 mg/l	**3.64 (0.23)**	3.79 (0.16)	**2.12 (2.83)**	**3.95 (0.21)**	0.46 (0.90)	**3.91 (0.22)**	**1.01 (1.54)**	2.03 (2.95)	**2.84 (1.97)**	**0.78 (1.31)**
Depth class (m)										
<0.2	3.25 (1.55)	3.61 (0.24)	**1.30 (2.38)**	3.73 (1.00)	0.28 (0.70)	3.71 (1.02)	1.14 (1.79)	**1.36 (2.14)**	**2.14 (2.89)**	0.86 (1.63)
0.2- 0.3	3.62 (0.31)	3.75 (0.14)	**2.61 (1.87)**	3.86 (0.34)	0.52 (1.03)	3.87 (0.25)	1.36 (1.53)	**2.11 (2.52)**	**2.91 (1.30)**	1.11 (1.55)
0.3- 0.4	3.48 (0.37)	3.77 (0.27)	**3.41 (0.23)**	3.10 (2.78)	0.29 (0.93)	3.47 (0.65)	1.77 (2.08)	**2.84 (2.10)**	**1.66 (3.82)**	1.50 (2.17)
0.4- 0.5	3.43 (0.23)	3.90 (0.09)	**3.83 (0.14)**	3.39 (0.49)	1.45 (1.77)	3.40 (0.49)	2.24 (1.63)	**3.83 (0.18)**	**1.25 (3.26)**	1.50 (1.94)
Accessibility										
Accessible	3.66 (0.26)	**3.84 (0.18)**	2.22 (2.63)	**4.04 (0.14)**	0.53 (1.01)	**3.99 (0.16)**	**1.09 (1.56)**	2.05 (3.24)	**3.10 (1.75)**	**0.66 (1.11)**
Not-accessible	3.28 (1.02)	**3.61 (0.17)**	2.71 (1.84)	**3.26 (1.57)**	0.44 (1.07)	**3.43 (0.83)**	**1.79 (1.69)**	2.27 (1.96)	**1.56 (2.25)**	**1.62 (1.83)**

Notes: The average number of fish in different ecological guilds. Sampling variance- in parenthesis. Significant differences between groups in bold. a- variables expressed in logarithmic values of river bottom substrate heterogeneity increased the number of species and fish abundance. The significant differences between species richness and fish abundance in cold- and warmwater rivers were not observed. In well oxygenated waters the number of species and fish abundance increases significantly in comparison with lover ones.

The fish communities functioning structure in relation with local environmental conditions

The number of cobble and rock related species increased with the increasing of river bottom heterogeneity. This fish community`s structure element is related with oxygen saturation and riffles habitats. The relation between water column species abundance and environmental variables were not found.

The abundance of rheophil fish increases in the same way. Thus the rheophil fishes are more abundant in glide and riffle areas with hard river bottom substrate (Table 8). The limnophil and euryphil fish abundance are invariable in relation on these factors.

The lithophil species (grawel spawners) are more common in rithral conditions, but abundance of pothamal species increases in warmwater rivers with lover oxygen saturation.

The abundance of insectivorous fish responded on the all environmental metrics analyzed in this

Table 9. The abundance of more common fish species in relation with environmental factors

	Salmo trutta[a]	Noemacheilus barbatulus[a]	Phoxinus phoxinus[a]	Rutilus rutilus[a]	Alburnoides bipunctatus[a]
Habitat type					
Pool	**0.15 (0.36)**	**1.81 (2.61)**	1.74 (2.49)	1.96 (3.10)	**0.00 (0.00)**
Glide	**1.72 (3.65)**	**3.16 (1.13)**	2.75 (0.66)	1.65 (1.92)	**1.36 (2.49)**
Riffle	**1.06 (2.51)**	**4.06 (0.05)**	2.23 (2.55)	1.55 (2.76)	**2.08 (2.84)**
Bottom substrate type					
Sand	0.38 (1.20)	**2.35 (1.60)**	2.13 (2.83)	1.39 (2.64)	**0.44 (1.15)**
Pebble/cobble	1.22 (2.58)	**3.13 (0.89)**	2.10 (2.52)	1.89 (2.82)	**1.43 (2.71)**
Rocks	1.23 (2.88)	**3.39 (1.60)**	2.30 (1.86)	1.86 (2.85)	**1.57 (2.69)**
Temperature type					
Coldwater	**2.30 (3.98)**	3.08 (0.38)	2.40 (2.99)	**0.00 (0.00)**	**0.00 (0.00)**
Warmwater	**0.60 (1.45)**	2.84 (2.20)	2.10 (2.31)	**1.99 (2.60)**	**1.26 (2.44)**
Oxygen type					
<7 mg/l	**0.11 (0.30)**	**2.39 (2.87)**	2.15 (2.77)	1.73 (2.58)	1.02 (2.24)
>7 mg/l	**1.42 (2.86)**	**3.23 (0.95)**	2.15 (2.17)	1.63 (2.89)	1.09 (2.34)
Depth class (m)					
<0.2	1.25 (2.91)	3.06 (1.53)	2.57 (2.28)	**0.74 (1.66)**	0.58 (1.34)
0.2- 0.3	0.96 (2.47)	3.20 (1.19)	2.10 (2.49)	**1.54 (2.70)**	1.23 (2.30)
0.3- 0.4	0.42 (0.89)	2.23 (3.27)	1.69 (2.13)	**2.66 (1.96)**	1.31 (3.42)
0.4- 0.5	0.00 (0.00)	1.89 (3.02)	1.89 (3.02)	**3.57 (0.07)**	1.25 (3.26)
Accessibility					
Accessible	**1.38 (2.99)**	**0.66 (1.11)**	2.08 (2.16)	1.89 (2.88)	0.77 (1.60)
Not- accessible	**0.36 (0.93)**	**1.62 (1.83)**	2.22 (2.67)	1.45 (2.56)	1.34 (2.82)

Notes: The average number of fish in different ecological guilds. Sampling variance- in parenthesis. Significant differences between groups in bold. a- variables expressed in logarithmic values study. Thus there is a positive relationship between number of this fishes with increasing of stream velocity (from pool to riffle habitat), river bottom heterogeneity (from sand to rocks), and oxygen saturation. Contrary, with increasing of water temperature and river depth, abundance of insectivores fishes decreased.

The abundance of more common species in relation with local environmental conditions

The comparison of the abundance of the most common fish species of the rivers of Latvia in streams (stream sites) with different environmental characteristics showed the significant differences.

The most wide distributed Salmonidae species trout *Salmo trutta* (the both sedentary and migratory forms) are more abundant in medium and fast stream velocity conditions and coldwater temperature regime (Table 10). Contrary Cyprinidae species roach *Rutilus rutilus* and riffle minnow *Alburnoides bipunctatus* prefers warmwater rivers, where ecologically tolerant roach inhabits the pools with largest depths, but sensitive species riffle minnow prefers the rapid biotopes (table 9). The riffle minnow and roach were not found in coldwater streams.

The more abundant and wide distributed species in the rivers of Latvia is stone loach *Noemacheilus barbatulus*. This fish belongs to cobble associated species and prefers well oxygenated streams. The abundance of minnow *Phoxinus phoxinus* was invariable in relation with ecological factors.

The river blocking impact of fish community˙s structure

Antrophogenic impact (blocking of the rivers) affects the species richness and fish abundance, overall these fish communities parameters significantly decreased in rivers inaccessible for free fish migrations. In blocked rivers the number of piscivorous fish pike *(Esox lucius)* and burbot *(Lota lota)* increased digificantly. Increased the number of fishes phytophils. For the rivers blocked by dams are typical that decreased the abundance of trout *(Salmo trutta*) (table 9).

Discussion

The results of this study show that fish community˙s structure in the rivers of Latvia conforms to general pattern of river fish distribution. LSR increases with stream order and watershed area. The relationship with species richness and stream order has been frequently discussed (Matthews, 1998, Hitt, 2006). The number of fish species may increase and the decline with increasing of stream size, as observed in hardly regulated large rivers due to loss of connectivity or anthropogenic disturbances affecting habitat and water quality. In Latvia 61% (Figure 1) of the rivers network is blocked by the artificial obstacles HPS and mill dams, therefore distribution of fish species, ie. species richness exhibits a nonlinear relationship with stream order and watershed area. In our study the species richness clearly increase from 1st to 2nd order rivers and the decline in 3rd to 4th order streams.

In fact, our results as earliest findings verify the stream size importance in structuring of fish community˙s. Taylor and Varren (2001) suggested that largest streams characterized by larger habitats diversity and therefore higher species richness, have a greater number of species- potential colonists than upstream areas. Some authors have attempted to use ecological guilds to explain the fish assemblages structure within- basin. For example, transition of fish feeding groups from insectivorous to omnivorous and piscivorous species from the headwaters to large rivers was predicted in river continuum concept (Oberdorff et al, 1993). Our data demonstrated analogous relevance. The number of omnivorous species individuals increased with increasing of stream order and watershed area.

The above mentioned relationships between fish community˙s structure and stream characteristics observed for separate species level, too. Most of the fish species have strong preferences for the local habitat depth, stream velocity, river bottom roughness (Bain, 1988). The use of fast flowing well oxygenated water by the stone loach *(Noemacheilus barbatulus)*, the limnophilic behavior of roach *(Rutilus rutilus)* inhabited slow flowing warmwater rivers have been found in our research.

Apparently, the some ecological factors would be a limitative for species presence or absence. For example, riffle minnow *(Alburnoides bipunctatus)* and roach *(Rutilus rutilus)* were not found in coldwater rivers. Contrary, the same species demonstrated the marked flexibility, because this species is common in all surveyed habitats. For example, the abundance and distribution of minnow *(Phoxinus phoxinus)* was invariable in relation with analyzed environmental factors.

In the rivers of Latvia two ecological forms of trout migratory and sedentary occurred. Both of these forms are one of the more abundant fish in coldwater rivers riffle areas. The reproduction and nursery habitat of trout are the same for migratory and sedentary trout. Apparently, the absence of migratory sea trout in blocked rivers determine the significant decreasing of the number of spawners and further production of one summer old trout.

The number of piscivorous fish species increased in the rivers blocked by the dams. It seems to be related with effect of artificial reservoirs providing the habitat for fishes of these ecological guilds. It approves that in fact by the decreasing of abundance of insectivorous fishes and fishes-gravel spawners (lithophylic fishes).

Table10. The changes of number of fish abundance by different ecological guilds in response to local environmental conditions

Ecological guild	Habitat type	Bottom substrate type	Temperature type	Oxygen type	Depth range	Accessibility
	Pool? riffle	Sand ? rocks	Cold? warmwater	<7 ? >7 mg/l	0.2? 0.5 m	Acces? nAcces
Feeding habitat						
Benthic	Increased	Increased	ns	Increased	ns	ns
Water column	ns	ns	ns	ns	ns	Decreased
Habitat preference						
Eyriphilic	ns	ns	Increased	Decreased	Increased	ns
Rheophilic	Increased	Increased	ns	Increased	ns	Decreased
Limnophilic	ns	ns	ns	ns	ns	ns
Reproduction habitat						
Lithophilic	Increased	Increased	Decreased	Increased	ns	Decreased
Phithophylic	ns	ns	Increased	Decreased	ns	Increased
Feeding						
Omnivores	ns	ns	Increased	ns	Increased	ns
Insectivores	Increased	Increased	Decreased	Increased	Decreased	Decreased
Piscivores	ns	ns	ns	Decreased	ns	Increased

Notes: Increased, decreased- significant changes in fish abundance, ns- non significant, Acces-accessible rivers, nAcces- non- accessible rivers

The data of abundance on more common species in the rivers of Latvia demonstrated the species habitat preference on average but not at any place. Biotic interactions, habitat availability, seasonal changes would be responsible for same shift of species presence or absence and abundance in relation with habitat preference.

The rivers of Latvia are typical lowland streams. Largest elevation difference between source and river mouth can not exceed 200 m. These streams are mainly sandy, pure stony rivers are absent in Latvia. Fast- flowing stages of the rivers and rapids are situated in separate reaches, where the slope is 3- 5 m/km. The largest number of the rivers is warmwater streams, only part of headwaters and few 2nd order rivers are coldwater type. Local habitat circumstances in combination with rivers accessibility in general establish the present fish species richness within- river basins. Therefore fish distribution pattern in the rivers frequently differs from classical fish distribution longitudal picture. Rithral and pothamal biotopes could be located both in lower and upper part of the rivers. Either in small riffle areas located in large, few kilometers long pools develop the riffle fish community.

River habitat conditions (temperature type and dissolved oxygen levels) limit the presence or absence of some frequent species as trout, riffle minnow and roach. These factors affect the abundance of fish in eyriphilic and rheophilic as well as abundance of grawel spawners and phytophilic species. Local habitat conditions as habitat type, bottom substrate heterogeneity and depth affects the abundance of fishes, different stream type specialists. Factors affecting the limnophil (lake) fish abundance in the rivers were not found. These data demonstrated that presence and abundance of lake fishes in the rivers determine by other without- river factors seem to be connection with lakes and reservoirs in the watershed area.

Conclusions

Migration from the sea and the ability of fish to penetrate inland waters are one of the most important factors in establishing and structuring of fish fauna in the riverine fish community˙s. In Latvia 61% of the rivers watersheds were blocked by HPS or milldams. As found in our research, in average the significant decreasing of the production of trout (*Salmo trutta*) observed in blocked rivers and the increasing of piscivorous species pike (Esox lucius) and burbot (Lota lota). On the whole, accessibility of the rivers significantly affect the local fish community structure by the decreasing of species richness, total abundance of fish, decreasing of reophil species component in the community with the increasing of ubiquitous fish species abundance.

The distribution and abundance of fishes within-river basin highly depends from the river type (cold or warmwater, oxygen regime) and local habitat variables (river bottom heterogenity, stream velocity and depth.

The distribution of two from more abundant species roach (*Rutilus rutilus*) and riffle minnow (*Alburnoides bipunctatus*) are limited by river temperature regime.

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References

Bain, M.B., Finn J.T., Booke H.E. 1988. Streamflow regulation and fish community structure. Ecology, 69, 382- 392.

Bohlin T., Hamrin S., Heggberget T.G., Rasmussen G., Saltveit S.J. 1989. Electrofishing- Theory and practice with special emphasis on salmonids. Hydrobiologia, 173, 9- 43.

Goldstein R.M., Meador M.R. 2005. Multilevel assessment of species traits to evaluate habitat degradation in streams of the Upper Midwest. North American Journal of Fisheries Management, 25, 180- 194.

Grenoulett G., Pont D., Herisse C. 2004. Within-basin fish assemblage structure: the relative influence of habitat versus stream spatial position on local species richness. Can. J. Fish Aquat. Sci. 61, 93- 102.

Higgins P.J. 1985. An interactive computer program for population estimation using the Zippin Method. Aquaculture and Fisheries Management, 1, 287 -295.

Hitt N.P., Angemeier P.L. 2006. Effects of adjacent streams on local fish assemblage structure in Western Wirginia. Implications for biomonitoring, 48, 75- 86.

Jowett I.G., Hayes J.W., Deans N. and Eldon G.A. 1998. Comparison of fish communities and in unmodified streams of Kahurangi National Park with other areas of New Zeland. New Zeland Journal of Marine and Freshwater Research, 32, 307- 322.

Lamoroux L., Capra H., Pouilly M., Souchon Y. 1999. Fish habitat preferences in large streams of southern France. Freshwater biology, 42, 673- 687.

Mazzoni R., Fenerich- Verani N., Caramaschi E.P., Iglesias- Rios R. 2006. Stream- Dwelling fish communities from an Atlantic rain forest drainage. Brazilian Archives of biology and technology, 49, 249- 256.

Matthews W.J., Robison H.W. 1998. The distribution of the fishes of Arkansas: a multivariate analysis. Copeia, 358- 374.

Mendonga M.P., Magnusson W.E., Zuanon J. 2005. Relations between habitat characteristics and fish assemblages in small streams of Central Amasonia. Copeia, 4, 751- 764.

Oberdoff T., Guilbert E., Lucchetta J.C. 1993. Patterns of fish species richness in the Seine river basin, France. Hydrobiologia, 259, 157-167.

Springe G., Sundin L., Briede A., and Skuja A. 2006. Biological quality metrics: their variability and appropriate scale of assessing streams. Hydrobiologia, 566, 153- 172.

Stahler A.N. 1957. Quantitative analysis of watershed geomorphology. Trans. Am. Geophys. Union, 38: 913- 920.

Taylor C.M., Warren M.L. 2001. Dynamics in species composition of stream fish assemblages: environmental variability and nested subsets. Ecelogy, 82, 2320- 2330.

Zippin C. 1958. The removal method of population estimation. Journal of Wildlife Management 22(1): 82-90.

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THE DIVERSITY OF BENTHIC INVERTEBRATES IN THREE RIVERS IN LITHUANIA

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Bernotienė R.,Višinskienė G. 2007. The diversity of benthic invertebrates in three rivers in Lithuania. *Acta Biol. Univ. Daugavpil., 7 (2): 87 - 96.*

Benthic invertebrates are important part in aquatic ecosystems, investigations of zoobenthos can provide a lot of information about the state of water body. Physical and chemical factors in rivers provide habitat for benthic invertebrates. The aim of this work was to estimate the peculiarities of the fauna, abundance and biomass of water invertebrates in three rivers and to elucidate some of the factors which can have an influence on the taxon richness, abundance and biomass of water invertebrates. The studies were performed in three rivers located in different regions of Lithuania - the Dubysa, the Merkys and the Šventoji, in 2004. The habitat of each study site was determined with respect to environmental factors: bottom structure, water temperature, depth, velocity. Amount of nitrites, nitrates, phosphates, oxygen dissolved in the water, amount of organic matter, water hardness, pH were investigated. Species composition, biomass, abundance and ecological state of fauna in rivers were analyzed and discussed. During the studies more than 180 taxa of zoobenthos were registered in three investigated rivers. The statistically significant differences in water temperature and carbonate hardness between the Merkys and other rivers were detected. The Merkys and the Dubysa rivers differed in total hardness. Rivers also differed in discharge and were similar in other parameters. The statistically significant difference in abundance of macroinvertebrates was detected between the Merkys river and the Dubysa river. The Merkys river differed from other rivers in low biomass also. Results have shown negative correlation between number of taxa and river discharge. Biomass of benthic invertebrates had negative corelation with temperature in the Merkys river. The density and biomass of water invertebrates correlated with water hardness and carbonate hardness also. The results show that the diversity, abundance, and biomass of benthic organisms depend upon environmental factors of their habitats.

Key words: benthic invertebrates, rivers, fauna, abundance, biomass, physical, chemical parameters

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Introduction

Invertebrates are distributed in various calm and running water bodies with different thermal conditions, pollution level, current speed, and bottom structure. Benthic invertebrates are very important part in aquatic ecosystems, so investigations of water invertebrates can provide a lot of information about the state of water body. Some organisms serve as indicators of water pollution (organically or nutrient enriched waters) such as Oligochaeta, some Diptera (Syrphidae). Tolerance to pollution is important for understanding the distribution of species. One major approach to the study of community patterns in streams and rivers has essentially been to correlate the distribution of species with one or more environmental factors that vary among the streams.

Data on species composition of macroinvertebrates in medium-sized rivers in Lithuania are not abundant. R. Kazlauskas (1959, 1960, 1963) investigated ditribution of Ephemeroptera, Trichoptera and Plecoptera larvae in different rivers. Species composition and diversity of water invertebrates with different kinds of substrata were investigated by Pliuraite and Kesminas (2004).

The aim of this work was to estimate the peculiarities of the fauna, abundance and biomass of water invertebrates in three Ltihuanian rivers and to elucidate some of the factors which can have an influence on the taxon richness, abundance, biomass and distribution of water invertebrates.

Material and Methods

The studies of zoobenthos were performed in three medium – sized rivers located in different regions of Lithuania: in the Merkys River (54°06'26"N, 24°16'33"E), Varėna District, south-eastern part of Lithuania, in the Šventoji River (55°28'28"N, 25°01'06"E), Anykščiai District, eastern Lithuania, and the Dubysa River (55°16'45"N, 23°26'49"E), Raseiniai District, western part, during April – October in 2004 (Fig. 1). The distance between the rivers was about 100-160 km.

The samples of zoobenthos were collected by kick-sampling method in three 0.1m^2 areas (Manual for integrated monitoring 1993) at each study site.

The habitat, physical and chemical parameters, amount of organic matter were investigated three times per year in each study area. Water temperature and velocity were measured monthly from April till October (till September in the Dubysa river). Amount of nitrites, nitrates, phosphates, oxygen dissolved in the water, water hard-

Fig. 1. Three investigated rivers in Lithuania.

ness, pH were investigated (Merck compact laboratory for water testing was used). The amount of organic matter was measured in the laboratory according to general accepted methods (international standard - LST EN ISO 8467). 60 samples were collected and analyzed according to the generally accepted hydrobiological methods. Individuals were defined to species or genera by using special literature (Akew 1998, Edington & Hildrew 1995, Elliot et al. 1988, Hynes 1997, Nilsson 1996, 1997, Wallace et al. 2003, Кутикова & Старобогатов 1977, Лепнева 1964, Цалолихина 1997, 1999, 2001, Янковский 2002, Jensen 1997). Molluscs, worms, turbellarians and water mites were not defined to a species, only abundance and biomass were determined. Species composition, biomass (g/m²), abundance (ind./m²) and ecological state of fauna were analyzed and discussed. Average, standard error and standard deviation were calculated. To estimate differences between physical-chemical parameters in different rivers t-test for dependent samples was used. To identify some of the factors that determine the diversity, abundance and biomass correlation analysis and multiple regressions were used. To determine the species diversity in different hydrocenoses index of Shannon was calculated (Brower & Zar 1984):

$$H' = -\sum (p_i \log p_i),$$

where: $p_i = n_i/N$, is the proportion of the total number of individuals occurring in species i. Sørensen coefficient of similarity of the species content in the investigated rivers was calculated (Brower & Zar 1984):

$$So = \frac{2a}{b+c},$$

Table 1. Physical parameters of the rivers (average ± SD, * - data from Kilkus 1998).

River	Length* km	Basin area* km²	Discharge* (m³/s)	Temperature C°	Velocity m/s	Depth m	Bottom structure
Dubysa	139	2033	13,4	15,1 ± 3,7	0,7 ± 0,1	0,3± 0,04	pebble
Merkys	203	4416	33,4	11,2 ± 3,3	0,6 ± 0,1	0,4 ± 0,1	gravel
Šventoji	246	6889	55,1	14,3 ± 4,3	0,7 ± 0,1	0,4 ± 0,1	pebble

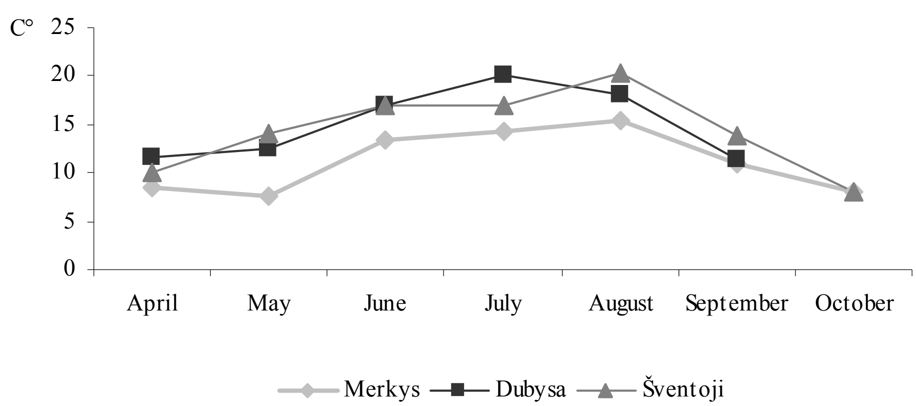

Fig. 2. Water temperature in the investigated rivers in 2004.

where: a – number of species common for both biocenoses, b - number of species in one community, c - number of species in other community.

The dominance of species in community was calculated according to the formula:

$$Di=\frac{n}{N}*100\%,$$

where: n – abundance of species i, N – abundance of all species in community. There are 4 domination groups: eudominants - >15%, dominants – 5,1 - 15%, subdominants 1,1 - 5%, and accessories - <1%.

Results

Water quality. The physical parameters in the study sites were established (table 1). Current velocity in rivers varied from 0,5 m/s (the Merkys River) to 0,8 m/s (all rivers). Depth at study sites differed from 0,2 to 0,6 m. The water temperature varied from 7,5 ^{o}C (the Merkys River, May) to 20,3^{o}C (the Šventoji River, August) (fig. 2). Bottom structure was pebble or gravel.

T-test have shown significant difference ($p<0,05$) between water temperature in the Merkys River and other rivers (Šventoji and Dubysa). Rivers also differed in discharge.

Some chemical parameters were measured in study sites (Table 2). The pH was 8 in all investigated rivers. The amount of oxygen dissolved in the water varied from 6 mg/l (the Dubysa River) to 10,3 (the Šventoji River); The quantity of nitrites varied from 0 to 0,025 mg/l, nitrates - from 0 to 10 mg/l; the quantity of phosphates varied from 0 to 0,25 mg/l. The total hardness varied from 2,5 mmol/l (the Merkys River) to 3,4 mmol/l (the Dubysa River). Carbonate hardness varied from 3,5 (the Merkys) to 5,3 mmol/l (the Dubysa River). The permanganate oxidation of organic matter varied from 5,6 mgO_2/l (the Merkys River) to 8 mgO_2/l (the Dubysa River).

The statistically significant difference ($p<0,05$) in total hardness between the Merkys and the Dubysa rivers was detected. The significant difference ($p<0,05$) in carbonate hardness between the Merkys on the one side and the Šventoji and Dubysa rivers on the other side was also determined. So, investigated rivers differed in temperature, discharge, total hardness and carbonate hardness.

Species composition. 183 taxa of macroinvertebrates were identified during the studies in three rivers: Mollusca (8 taxa), Oligochaeta (2), Arachnida (1), Hirudinea (4), Crustacea (1), Turbellaria (1), Nematomorpha (1) and Insecta: Trichoptera (51 taxa), Ephemeroptera (26), Plecoptera (17), Odonata (6), Coleoptera (12), Megaloptera (1), Heteroptera (3), Diptera (49). Insects were the dominant group of macroinvertebrates in investigated rivers. Number of species varied in all investigated rivers. 98 taxa were detected in the Šventoji River, 111 - in the Merkys River, and 126 - in the Dubysa River (fig. 3). All three rivers, according to the Shannon biodiversity index, had high biodiversity of benthic invertebrates. It went up

Table 2. Chemical parameters of the rivers investigated (average ± SD, * - average ± SE).

River	PH	Total hardness (mmol/l)	Carbonate hardness (mmol/l)	Organic matter (mgO_2/l)	Amount of oxygen (mg/l)	NO_2 (mg/l)	NO_3 (mg/l)	PO_4 (mg/l)
Dubysa	8	3,3 ± 0,1	5,2 ± 0,06	8 ± 0,9	8 ± 1,6	0,02 ± 0,01	6,67 ± 2,9	0,08 ± 0,08*
Merkys	8	2,7 ± 0,1	3,7 ± 0,2	5,6 ± 1,1	9,3 ± 0,8	0	2 ± 1,6	0,08 ± 0,08*
Šventoji	8	3 ± 0,2	5,1 ± 0,1	7,2 ± 0,1	8,9 ± 1,2	0	3,3 ± 3,3*	0

from 1,28 in the Šventoji River to 1,54 in the Dubysa River. Biodiversity index in the Merkys River was 1,42.

Taxon richnes during the season varied slightly, 47 ± 7,8 taxa were detected in one sample. The least taxon number (34) was observed in the Šventoji River in September. The greatest taxon number (65) with dominant of Trichoptera, Diptera and Ephemeroptera was established in the Dubysa River in September. According to the species richness during the season the Dubysa River differed from the other two rivers (t-test, p<0,05).

Some invertebrates were common in all investigated rivers. There were Hydracarina, Oligochaeta, 2 species of Hirudinea (*Erpobdella octoculata* L., *Piscicola geometra* L.), 10 Trichoptera taxa (*Rhyacophila nubila* Zett., *Cheumatopsyche lepida* Pict., *Hydropsyche pellucidula* Curt., *Psychomyia pusilla* Fabr., *Athripsodes albifrons* L., *Brachycentrus subnubilus* Curt., *Halesus digitatus* Schr., *Hydroptila sp., Ithitrychia lamellaris* Eaton, *Lepidostoma hirtum* Fabr.), 9 species of Ephemeroptera (*Baetis fuscatus* L., *B. vernus* Curt., *Caenis luctuosa* Burm., *C. macrura* Steph., *C. rivulorum* Eaton, *Ephemera lineata* Eaton, *Heptagenia sulphurea* Müll., *Potamanthus luteus* L., *Serratella ignita* Poda), 2 genera of Plecoptera (*Isoperla sp., Leuctra hippopus* Kemp.), 1 Odonata species (*Ophiogomphus cecilia* Fourcr.), 1 species of Heteroptera (*Aphelocheirus aestivalis* Fabr.), 7 taxa of Coleoptera (adults: *Elmis maugetii* Latr., *Oulimnius tuberculatus* Müll., *Hydraena riparia* Kugell., larvae: *Orectochilus villosus* Müll., *Elmis* sp., *Limnius* sp., *Oulimnius* sp.), and 9 taxa of Diptera (*Atrichops crassipes* Mg., *Atherix ibis* Fabr., *Cladotanytarsus sp., Cricotopus sp., Endochironomus sp., Hemerodromia sp., Seromyia sp., Culicoides sp., Simulium vernum* Macquart). Most of common species are connected with fast-flow waters, hard structure bottom, and good water quality. *Asellus aquaticus*

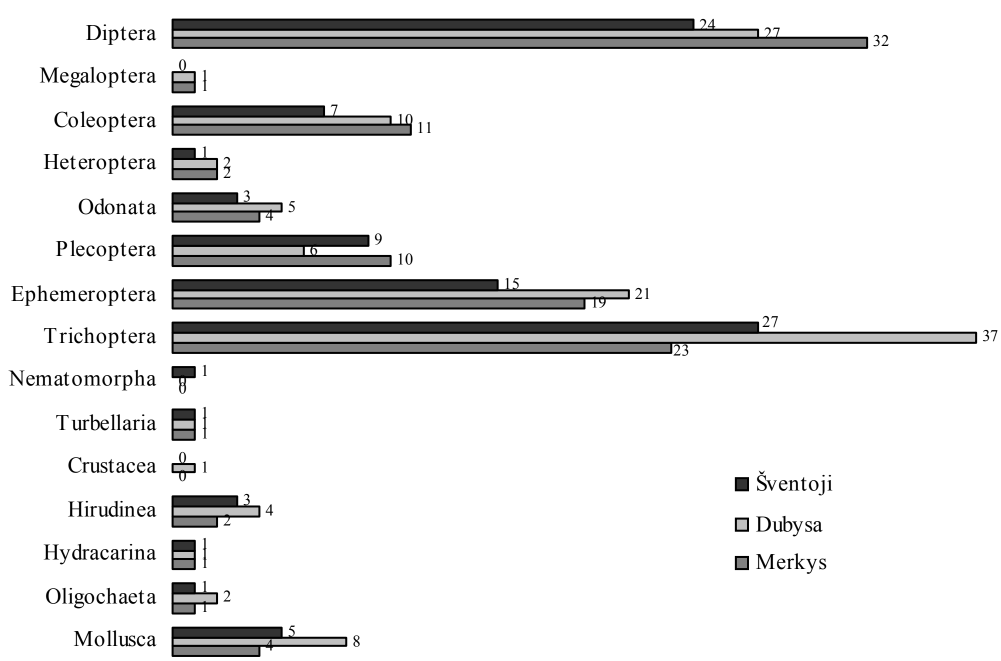

Fig. 3. Number of taxa in the investigated rivers.

L. (Crustacea) specimens were founded only in the Dubysa River. *Gordius aquaticus* L. (Nematomorpha) was detected only in the Šventoji River.

Values of Sørensen similarity index shows the similarity in the species composition of benthic organisms between different rivers. It varied from 0,46 to 0,51. The highest similarity was determined between the Šventoji and the Merkys rivers (0,51). It proves similar conditions of these two hydrocenoses. The lowest similarity was detected between the Merkys and the Dubysa rivers (0,46). Dominant species are the most influential in the habitat. Domination of species differed in all study areas. Hydracarina was eudominant group (31,7% all individuals), and Molluscs were the dominant group (11,9%) in the Šventoji River. Dominance index over 3% had *Hydroptila* sp., *Baetis fuscatus* L., *Caenis macrura* Steph., *Cricotopus* sp., and *Aphelocheirus aestivalis* Fabr. In the Dubysa River dominats were *Caenis luctuosa* Burm. (10,3%), *Cheumatopsyche lepida* Pict. (10,2%), and water mites (9,3%). Dominance over 4% had *Oligochaeta, Baetis vernus* Curt. mayfly, larvae of *Oulimnius* sp. beetles, and blackflies *Simulium lineatum* L. in the Dubysa River. Eudominants in the river of Merkys were *Baetis rhodani* Pict. (21,6% all individuals) and Hydracarina (16,8%). There were no dominants and 20 taxa of invertebrates were subdominants. Dominance index over 3% had *Baetis* sp., *Psectrocladius* sp. and *Micrasema setiferum* Pict. (4,6%, 4,5% and 3,2% respectively).

According to species biomass dominant index was different. The Šventoji River was eudominated by Molluscs (52,8% all biomass), caddisfly *Hydropsyche pellucidula* Curt., bug *Aphelocheirus aestivalis* Fabr. and mayfly *Ephemera lineata* Eaton (8,7%, 7,3% and 5,6% respectively), 7 taxa from Odonata, Diptera, Trichoptera, Hydracarina, Plecoptera were subdominants. In the Dubysa River Molluscs and caddisfly *Hydropsyche pellucidula* Curt. were eudominant groups (33,6% and 15,1% respectively), caddisfly *Rhyacophila nubila* Zett. had dominant status (5,1% all biomass). 16 taxa (5 of them belong to Diptera (*Simulium lineatum* Mg., *S. posticatum* Mg., *S. ornatum* Mg., *Procladius* sp., *Macropelopia* sp.) were subdominant in the Dubysa River Only *Aphelocheirus aestivalis* Fabr. eudominated in the Merkys River (19,1% all biomass). *Atherix ibis* F. (13,9%), molluscs (11,6%), *Baetis rhodani* Pict. (7,8%), *Tipula* sp. (6,8%) and *Hydropsyche pellucidula* Curt. (5,9%) were dominants. 9 species of Ephemeroptera, Plecoptera, Chironomidae, Hydracarina, Hirudinea and Trichoptera were subdominants. All dominant species have ecological adaptations to running waters and hard substratum.

Abundance and biomass. Number of individuals and biomass are basic information in ecological population studies. It is useful in visualizing the trophic structure of a community. The greatest diversity of species in various water bodies generally is in spring and autumn but abundance and biomass often have not positive correlations. The seasonal changes are explained by the imago turning of larvae and their flying out of the water body. Different density during the season can be stipulated by different species composition. The increase in abundance of water invertebrates in spring (Fig. 4) was stipulated by *Caenis luctuosa* Burm. and *Baethis fuscatus* L. development in the Dubysa River, by *Caenis macrura* Steph. and *Baethis fuscatus* L. development in the Šventoji River. The increase in abundance of water invertebrates was detected only in July in the Merkys River. It was stipulated by development *Baethis rhodani* Pict. in this river.

The least abundance of benthic invertebrates was observed in the Šventoji River in September (Fig 4). Average of individuals in square metre was 593 ± 297, with dominants of Mollusca (35,3%), Hydracarina (12%), and Ephemeroptera (11,6%). The highest abundance of benthic invertebrates was observed in the Dubysa River in September also. Average of individuals in square metre was 3024 ± 424,5, with dominants of Trichoptera (38,6%), Ephemeroptera (25,4%) and Hydracarina (13,1%). The least abundance of invertebrates through the season was observed in the Merkys River and the highest abundance was detected in the Dubysa River. The statistically significant difference in abundance of

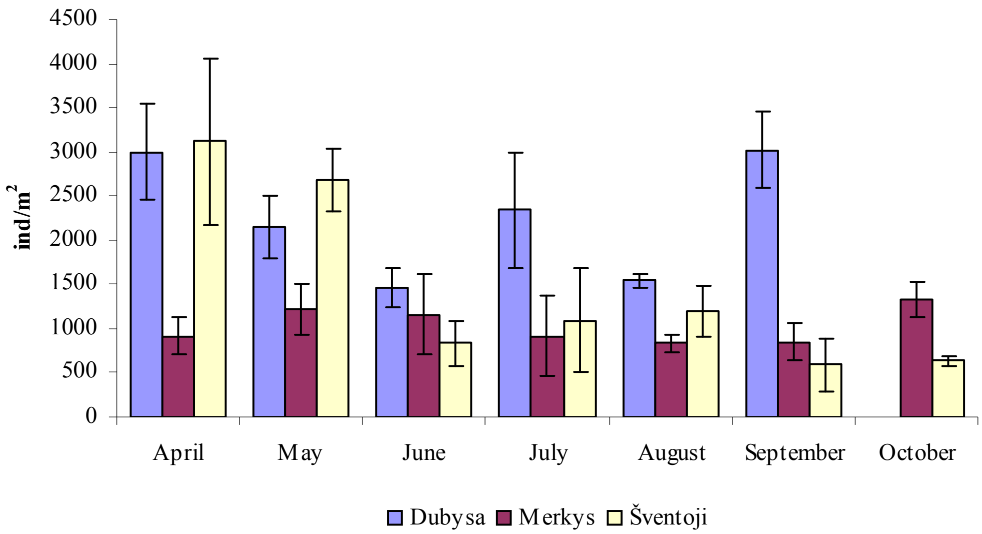

Fig 4. Seasonal changes of species abundance (ind./m^2) in the Šventoji, Merkys and Dubysa rivers.

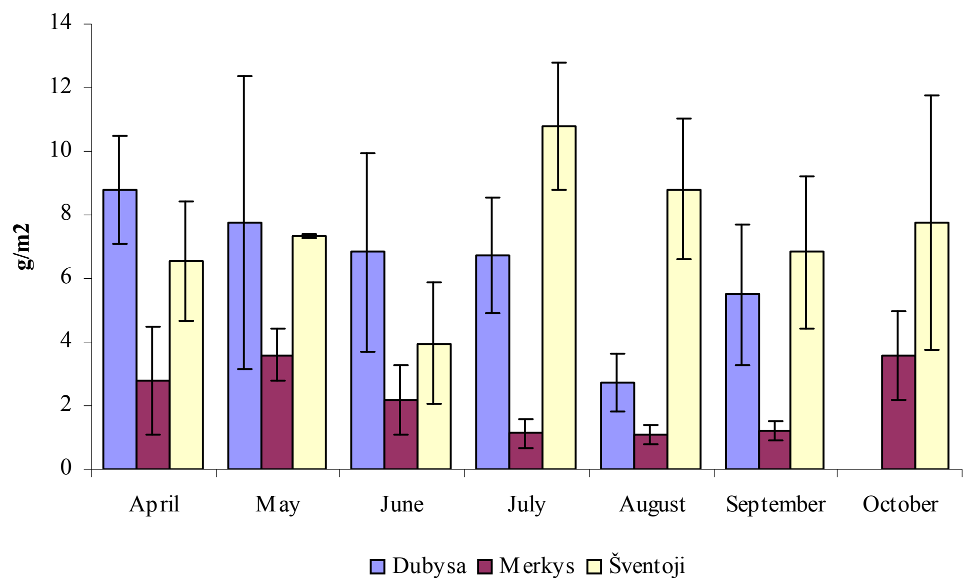

Fig. 5. Seasonal changes of biomass (g/m^2) in the Šventoji, Merkys and Dubysa rivers.

macroinvertebrates was detected between the Merkys River and the Dubysa River ($p<0,05$).

The least biomass of benthic invertebrates was observed in the Merkys River in August (Fig 5). The highest biomass of benthic invertebrates was observed in the Šventoji River in July. The least biomass of invertebrates through the season was observed in the Merkys River and the highest biomass was detected in the Šventoji River. The Merkys River differed from other rivers in low biomass ($p<0,05$).

Disscusion

Invertebrates are distributed in various calm and running water bodies with different thermal conditions, pollution level, current speed, and bottom structure. Some organisms serve as indicators of water pollution (organically or nutrient enriched waters) such as Oligochaeta, some Diptera (Syrphidae). Tolerance to pollution is important for understanding the distribution of species. It is known that water mites are excellent indicators of habitat quality. Along with observations in sampling a wide variety of habitats in North America and elsewhere, lead to the conclusion that water mite diversity is dramatically reduced in habitats that have been degraded by chemical pollution or physical disturbance (Smith & Cook 1991). All investigated rivers were dominated by water mites. Oligochaeta were observed not abundantly in all investigated rivers. According to Shannon biodiversity index (1,28 (Šventoji); 1,42 (Merkys); 1,54 (Dubysa)) all three rivers had high biodiversity of benthic invertebrates. These data have shown that the water of all three rivers was clean. All rivers were determined to be clean also according to chemical parameters.

In spite of the fact that all three rivers were clean and they were similar in many parameters (amount of nitrites, nitrates, phosphates, oxygen dissolved in the water, water hardness, ph, velocity), they differed in temperature, discharge, total and carbonate hardness. All investigated rivers were different in biomass or abundance or taxa richness of benthic invertebrates. The statistically significant difference in abundance of macroinvertebrates was detected between the Merkys River and the Dubysa River, The Merkys River differed from other rivers in low biomass and the Dubysa River differed from other rivers in high taxon richnes. These differences could be determined by termal regime, discharge or water hardness.

The density of invertebrates and the number of species correlated with each other ($r=0,76$, $p<0,05$; $F=24,65$, $p<0,005$). It is known that total density and total taxon richness decrease with discharge (Miserendino & Pizzolon 2003). Results from three investigated Lithuanian rivers have shown negative correlation ($r=-0,64$, $F=12,4$) between number of taxa and river discharge ($p<0,05$). This correlation can explain the great diversity of water invertebrates in the Dubysa River and the low diversity in the Šventoji River. It should be mentioned that not all groups of water invertebrates had negative corelation between abundance and river discharge. Negative correlation between the abundance and river discharge was typical for Trichoptera ($r=-0,6$, $F=10,1$, $p<0,01$), Ephemeroptera ($r=-0,46$, $F=4,95$, $p<0,05$) and Hydracarina ($r=-0,64$, $F=12,5$, $p<0,005$), but was not typical for moluscs. The abundance of moluscs correlated with river discharge positively ($r=0,47$, $F=5,03$, $p<0,05$. So, in spite of the fact that our data proved proposition that total density and total taxon richness decrease with discharge, our data showed that not all groups of invertebrates confirm this. The density of molluscs can increase with discharge.

The low biomass of water invertebrates in the Merkys River can be explained by the low water temperature. Biomass of benthic invertebrates had negative corelation ($r=-0,95$, $p<0,05$) with temperature in this river. The Merkys River differed from two other rivers in lowest water temperature. Temperature unquestionably sets limits to where species can live and species are generally adapted to certain temperature regimes (Giller & Malmquist 1998). Only in the Merkys River some species of insects (*Oecetis lacustris* Pict., *Brachycentrus maculatum* Fourcr., *Silo pallipes* F., *Lasiocephala basalis* Kol., *Chaetopteryx villosa* Fabr., *Sericostoma personatum* K. et Sp., *Caenis horaria* L., *Ephemerella mucronata* Bengtss., *Isonychia ignota* Walk., *Plea minutissima* Leach, *Prodiamesa olivacea* Mg., *Paratendipes albimanus* Mg.) were detected.

The density and biomass of water invertebrates correlated with water hardness ($r=0,60$, $F=8,83$, $p<0,01$; $r=0,76$, $F=22$, $p<0,005$ respectively) and carbonate hardness ($r=0,53$, $F=7,13$, $p<0,05$; $r=0,74$, $F=21,95$, $p<0,005$ respectively) also. The density and the biomass increased with water hardness. The water of the Merkys River differed from the water of other rivers in carbonate hardness and differed from the Dubysa River in total hardness. Water was the most soft in the Merkys River and hard in the Dubysa River. Not the density of all groups of water invertebrates correlated with water hardness, but moluscs and Trichoptera did ($r=0,51$, $F=5,75$, $p<0,05$; $r=0,52$, $F=5,9$, $p<0,05$ respectively). The hardness of water is due to its content of salts of the alkaline earth metals calcium, magnesium, strontium and barium. Since strontium and barium generally occur in waters only in trace amounts, the hardness is defined as the content in a water of calcium ions and megnesium ions. The carbonate hardness is that proportion of those ions present in one litre of water for which there is an eqvivalent quantity of hydrogen carbonate ions. Streams with a pH as high as 6,5 but low alcality (Ca^{+}) often show similar features to more acidic waters (Willpighby & Mappin 1988). It is known that species richness and total species pools increase with pH (Giller & Malmquist 1998), so it may be related with incease of density of water invertebrates with water hardness. Low calcium level can cause osmotic problems and affect shell or cuticle secretion in invertebrates. This can explain the relationship between the density of moluscs and water hardness.

The results show that the diversity, abundance, and biomass of benthic organisms depend upon environmental factors of their habitats and seasonal changes of species.

References

Akew R.R. 1998. The dragonflies of Europe. p. 194-211.

Brower J. E., Zar J. H. 1984. Field and laboratory methods for general ecology. Win. C. Brown Publishers. Dubuque, Iowa, 226 p.

Edington J.M., Hildrew A.G. 1995. A revised key to the caseless caddis larvae of the British Isles with notes on their ecology. Fresh water Biological association, 119 p.

Elliot J.M., Humpesch U.H., Macan T.T. 1988. Larvae of British Ephemeroptera: a key with ecological notes. Fresh water Biological association, 122 p.

Giller P. S., Malmqvist B. 1998. The biology of Streams and Rivers, 296 p.

Hynes H.B.N. 1997 (reprinted 1984, 1993). A key to the adults and nymphs of the British stoneflies (Plecoptera), with notes on their ecology and distribution. Fresh water Biological association, 87 p.

Jensen F. 1997. Diptera Simuliidae, Blackflies. (A. N. Nilson) *Aquatic Insects of North Europe.* 2: 209 – 241.

Kazlauskas, R. 1959. Material about the mayflies (Ephemeroptera) in the Lithuanian SSR with description of new species *Eurylophella lithuanica* Kazlauskas sp. n. and imago Neoephemera maxima (Joly). Biology, Geograhy and Geology 6: 157.174.

Kazlauskas, R. 1960. Some data on the Trichoptera in the rivers of the Lithuanian SSR. *Scientific worcs of Vilnius V. Kapsukas University, XXXVI. Biology, Geography, Geology* XXXVI (VII): 179-193 (in Lithuania).

Kazlauskas, R. 1963. Entomofauna (Ephemeroptera, Plecoptera, Trichoptera) of Lithuanian rivers and their important for salmon-trout feeding. Summary of dissertation. V: 15 p. (in Russian).

Kilkus K. 1998. Lietuvos vandenų geografija. Vilniaus universitetas, Geografijos institutas, Vilnius: Apyaušris.–248.

Manual for integrated monitoring. 1993. Programme phase 1993-1996. Hydrobiology of streams. Helsinki, 67-68.

Miserendino M.L., Pizzolon L.A., 2003. Distribution of macroinvertebrate assemblages in the Azul –Quemquemtreu river basin, Patagonia, Argentina. New Zeland Journal of Marine and Freshwater Research, Vol. 37: 525-539.

Nilsson A. (ed.) Aquatic Insects of North Europe. A taxonomic hand book. Vol. 1., 1996, 274 p.; Vol. 2., 1997, 440 p.

Pliuraite V., Kesminas V. Species composition of macroinvertebrates in medium-sized Lithuanian rivers. *Acta Zoologica Lituanica* 14 (3): 10-25.

Rosenberg, D.M., Resh V.H. (eds.) 1993. Freshwater biomonitoring and benthic macroinvertebrates. Chapman and Hall, New York. 488 p.

Smith I.M., Cook G.R. Water mites. p. 523-592 in Thorp, J.H., and Covich., A.P. (eds.) 1991. Ecology and Classification of North American Freshwater Invertebrates. Academic Press, XII: 911p.

Wallace I.D., Wallace B., Philipson G.N. 2003. Keys to the case-bearing caddis larvae of Britain and Ireland. Fresh water Biological association, 259 p.

Willpighby lL., Mappin R. 1988. The distribution of Ephemerella ignita (Ephemeroptera) in streams: the role of pH and food resources. Freshwater Biology. 19: 145 – 56.

Кутикова Л. А., Старобогатов Я. И., 1977. Определителъ пресноводных безпозвоночных Европеиской части СССР. Гидрометеоиздат. Ленинград, 477-510 с.

Лепнева С. Г. 1964. Фауна СССР. Ручеиники. Москва - Ленинград.: Наука, I–II, 560, 560.

Цалолихина С.Я. (под ред.) Определителъ пресноводных безпозвоночных России и сопредельных *территорий*. СПб: “Наука”. 1997 – III т., 1999 – IV т., 2001 – V т. Янковский А. В. 2002. Определитель мошек Росии и сопредельных територий. 570.

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Preliminary notes on pyrenomycetes from Pamerkiai (Varėna district, southeastern Lithuania)

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39 herbarium specimens, including 50 samples of pyrenomycetes, were collected during July 2001, April, June 2002 and May 2005 in alluvial forests with *Alnus glutinosa* in Pamerkiai environs, Varėna district (southeastern Lithuania). 18 species of pyrenomycetes were identified on 6 plant host species. The greatest number of species was registered on black alder. *Eutypella extensa* (Fries) Saccardo is recorded for the first time in Lithuania. All identified species represent four orders. Among these orders Xylariales slightly predominates by the number of species (8). Samples with the species of order Xylariales make up more than one third of all material. Order Diaporthales takes the second place according to the number of species (7). Species of this order prevail because of the quantity of samples that form more than half of collected material. In general, the diameter of twigs and branches, inhabited by the studied fungi, was from 0.3 up to 12 cm. The greatest number of samples with identified species had the diameter of 0.8 cm. Species of Diaporthales were registered on twigs and branches with the diameter from 0.3 up to 1.6 cm. The diameter of 0.8 was characteristic of the greatest number of samples with these fungi. Species of Xylariales inhabited substrate with the diameter from 0.6 up to 3,8 cm. The greatest number of samples with above mentioned fungi possessed the diameter over 2 cm.

Key words: *Alnus glutinosa*, pyrenomycetes, Lithuania

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Introduction

Mostly pyrenomycetes are microscopic fungi, belonging to the division Ascomycota. The vast majority of them are inhabiting woody substrate which is abundant in forest. Knowledge on pyrenomycetes found in mixed coniferous-deciduous and deciduous forests is still insufficient in Lithuania (Рукшенене 1989a, b, Rukšėnienė 1996). In addition, it is worth mentioning that we still lack information concerning pyrenomycetes in a lot of other parts of Lithuania. However, diversity of these fungi is better studied in deciduous forests, namely, in oak woods and forests with *Carpinus betulus* (Рукшенене 1989a; Iršėnaitė, Treigienė 2001). Forests with *Alnus glutinosa* have not been investigated yet. Therefore the aim of the present paper is to discuss primary data on diversity and ecology of above mentioned fungi from alluvial forests with *Alnus glutinosa*.

Material and methods

Material was collected in July, 2001, April, June, 2002 and May, 2005 during the field trips in Pamerkiai environs, Varėna district (southeastern Lithuania)(Fig.1). Collection of material was carried out in two alluvial forests with *Alnus glutinosa*: one situated in the valley of rivulet (Barteliai), another one – on the springy slope of the river Merkys (Biekšios). Samples were collected from dead lying twigs and branches, dead attached branches and overwintered leaves. A sample – i.e. one twig, one branch, one leaf, a part of stem or stump. A twig is called a sample which possesses the diameter less than 1.0 cm. The diameter of woody substrate was measured by sliding callipers. During investigation diameter of woody substrate with studied fungi was clasified according to modified Stepanova's (Степанова 1973) scale.

In accordance with routine methods the specimens were analysed in the laboratory. In order to identify specimen microslices of the collected material were observed in water.

39 herbarium specimens, including 50 samples, are deposited in the Herbarium of Vilnius University (WI). The nomenclature follows Index Fungorum (2004).

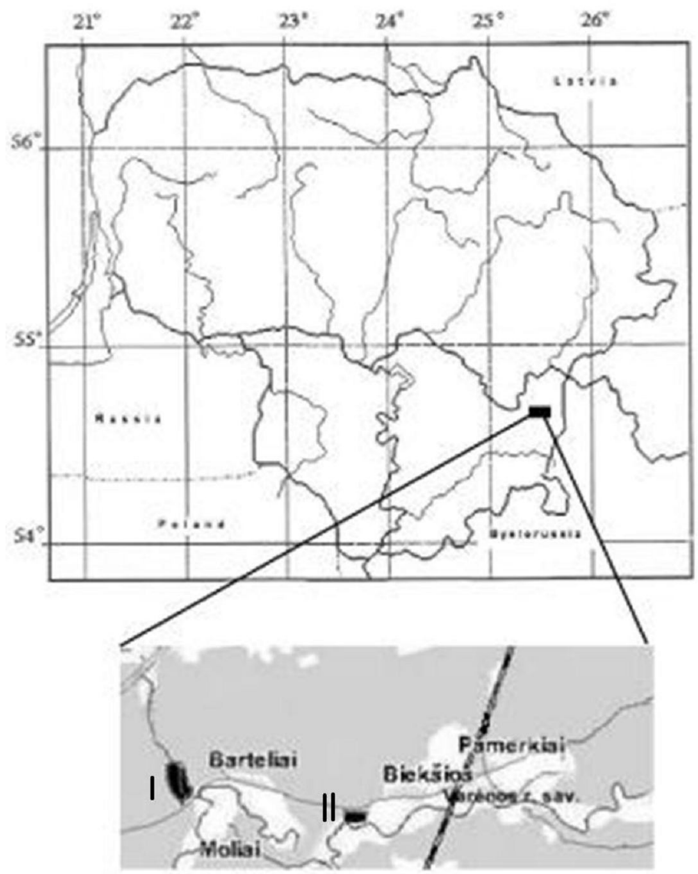

Fig. 1. Location of research area in Varëna district, Pamerkiai environs.
I – alluvial forest with *Alnus glutinosa* in the valley of rivulet;
II – alluvial forest with *Alnus glutinosa* on the springy slope of the river Merkys.

Results and discussion

Studies of the collected material revealed 18 species of pyrenomycetes, belonging to four orders of the division Ascomycota. These species were found on six species of plant hosts: *Alnus glutinosa*, *Betula* sp., *Corylus avellana*, *Rhamnus cathartica*, *Frangula alnus* and *Pinus sylvestris*.

In the species list there are indicated the species name, the habitat place, the range of the diameter of samples, plant host, locality, date of collection.

List os species

Coronophorales Nannfeldt, 1932

1. *Bertia moriformis* (Tode) De Notaris, 1844 – on dead branch, Ø 12 cm, *Alnus glutinosa*, Biekšios, 03.05.2005.

Diaporthales Nannfeldt, 1932

2. *Diaporthe syngenesia* (Fries) Fuckel, 1870 – on dead attached twig, Ø 0.9 cm, *Frangula alnus,* 23.07.2001; on dead lying twigs and branch, Ø 0.4 – 1.4 cm, the same host, 13.04.2002.

3. *Ditopella ditopa* (Fries) J. Schröter, 1888 – on dead attached twigs and lying branch, Ø, 0.4 – 1.0, *Alnus glutinosa*, Barteliai, 02.05. 2005.

4. *Gnomonia setacea* (Persoon) Cesati & De Notaris, 1863 – on overwintered leaf of *Alnus glutinosa*, Barteliai, 02.05.2005.

5. *Leucostoma auerswaldii* (Nitschke) Höhnel, 1928 – on dead attached twig, Ø 0.9 cm, *Frangula alnus*, Biekšios, 23.07.2001; on dead lying twigs and branches, Ø 0.4 – 1.6 cm, *Rhamnus cathartica,* Biekšios, 13.04.2002.

6. *Ophiovalsa suffusa* (Fries) Petrak, 1966 – on dead lying twig, Ø 0.8 cm, *Alnus glutinosa*, Biekšios, 13.04.2002; on dead attached twig and branch, Ø 0.8 – 1.0 cm, the same host, Barteliai 02.05.2005.

7. *Prosthecium auctum* (Berkeley &Broome) Petrak, 1923 – on dead lying branch, Ø 1.6 cm, *Alnus glutinosa*, Biekšios, 03.05.2005.

8. *Valsa pini* (Albertini & Schweinitz) Fries, 1849 – on dead lying branch, Ø 1.0 cm, *Pinus sylvestris*, between Biekšios and Barteliai, 22.07.2001.

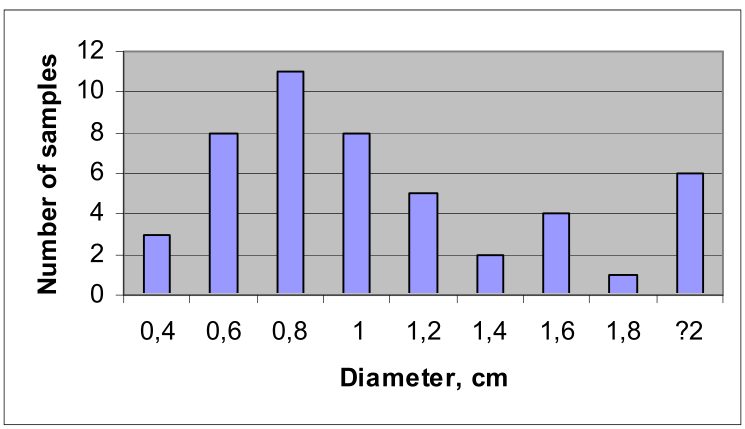

Fig. 2. Distribution of samples with the species of pyrenomycetes according to the diameter.

Hypocreales Lindau 1897

9. *Cosmospora purtonii* (Greville) Rossman & Samuels, 1999 – on dead stromata of ascomycetous fungi, found on lying branch of *Frangula alnus*, Biekšios, 23.07.2001.

10. *Nectria punicea* (Kunze & J.C. Schmidt) Fries, 1864 – on dead attached twig, Ø 0.5 cm, *Frangula alnus*, Barteliai, 02.05.2005. 0.5 cm; on dead lying twig, Ø 0.5 cm, the same host, Biekšios, 13.04.2002.

Xylariales Nannfeldt 1932

11. *Daldinia concentrica* (Bolton) Cesati & De Notaris, 1863 – on dead lying branch, Ø 3,2 – 4,5 cm, *Alnus glutinosa*, Barteliai, 02.05.2005.

12. *Diatrype stigma* (Hoffmann) Fries, 1849 – on dead attached branch, Ø 1.5 cm, *Corylus avellana*, Biekšios, 23.07.2001.

13. *Diatrype undulata* (Persoon) Fries, 1849 – on dead lying branch, Ø 2,1 cm, *Betula* sp., Biekšios, 13.04.2002.

14. *Diatrypella favacea* (Fries) Cesati & De Notaris, 1863 – on dead lying twig, Ø 0.6 – 0.8, *Alnus glutinosa*, Biekšios, 13.04.2002; on dead lying twigs and branches, Ø 0.7 – 1.1 cm, the same host, the same locality, 03.05.2005; on dead lying branches, the same host, Ø 1.1 – 1.3, Barteliai, 02.05.2005.

15. *Eutypella extensa* (Fries) Saccardo, 1882 – on dead attached twigs, Ø 0,8 – 0.9 cm, *Rhamnus cathartica*, Biekšios, 03.05.2005.

16. *Hypoxylon fuscum* (Persoon) Fries, 1849 – on dead lying branch, Ø 2.3 cm, *Alnus glutinosa*, Biekšios, 23.07.2001; on dead lying branches, Ø 1.1 – 1.7 cm, the same host, Barteliai, 02.05.2005.

17. *Hypoxylon howeanum* Peck, 1872 – on dead attached branch, Ø 3,2 cm, *Corylus avellana*, Biekšios, 23.07.2001.

18. *Nemania serpens* (Persoon) Gray, 1821 – on dead lying branch, Ø 3,8 cm, an unidentified woody plant, Biekšios, 13.04.2002.

The greatest number of these species (8) is characteristic of dominating plant host *Alnus glutinosa*. Species of plant hosts found at the edge of alluvial forest differ in the number of fungal species. On *Frangula alnus* three species were identified. Two species inhabited on each *Rhamnus cathartica* and *Corylus avellana*. *Betula* sp. and *Pinus sylvestris* had one species each.

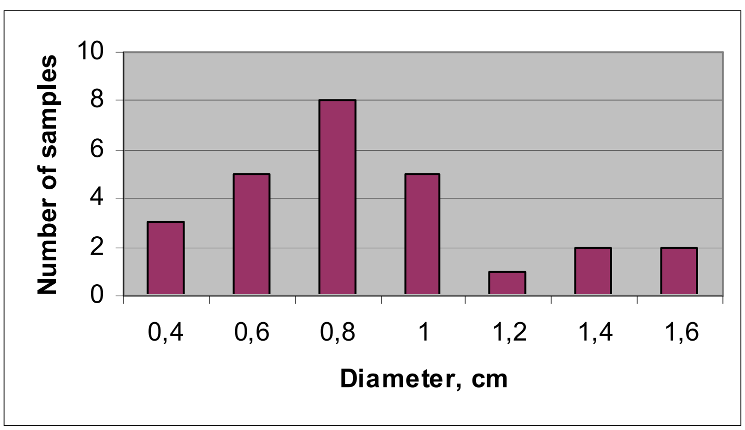

Fig. 3. Distribution of samples with the species of Diaporthales according to the diameter.

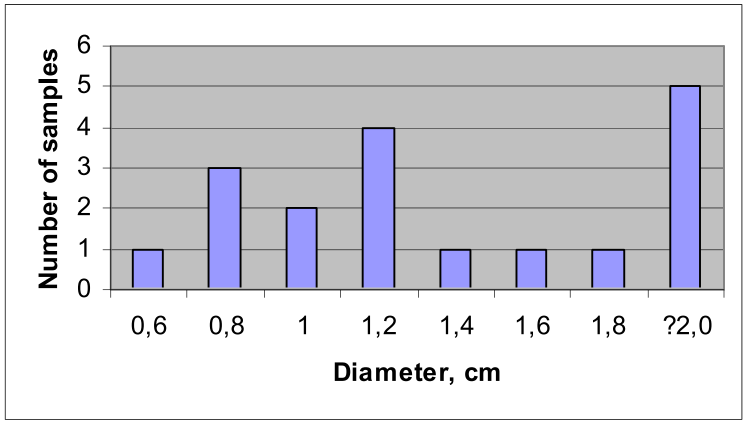

Fig. 4. Distribution of samples with the species of Xylariales according to the diameter.

Identified species of pyrenomycetes belong to four orders, namely, Coronophorales, Diaporthales, Hypocreales and Xylariales. Among these orders Xylariales slightly predominates by the number of species (8). Samples with the species of this order make up more than one third of all material. Order Diaporthales takes the second place according to the number of species (7). Species of this order prevail because of the quantity of samples that form more than half of the collected material.

Ascocarps of majority of identified species were found in bark of twigs and branches. Representative of order Diaporthales *Ditopella ditopa* was the most frequent species on the twigs of *Alnus glutinosa*. Another interesting species found on the same host was *Prosthecium auctum*. This species was registered for the second time in Lithuania. It is not common in our country as well as in Europe (Farr et al. 2007).

Order Xylariales is represented by macroscopic and microscopic species. *Hypoxylon fuscum*, inhabiting *Alnus glutinosa*, can be ascribed to macromycetes due to its ascocarps visible by a bare eye. Microscopic species *Eutypella extensa* found on *Rhamnus cathartica* is recorded for the first time in Lithuania.

Registered species belonging to the order Hypocreales were found on *Frangula alnus*. They differ in substrate preference. *Nectria punicea* is only identified on this plant host and is characteristc of it. However, *Cosmospora purtonii* is inhabiting in old stromata of ascomycetous fungi.

Among all recorded species only *Bertia moriformis* and *Nemania serpens* were found on naked wood.

Studying the habitat of identified pyrenomycetes, the diameter of woody substrate with these fungi was examined. In general, the diameter of twigs and branches, inhabited by studied fungi, was from 0.3 up to 12 cm (Fig.2). The greatest number of samples with identified species possessed the diameter of 0.8 cm.

Species of Diaporthales were registered on twigs and branches with the diameter from 0.3 up to 1.6 cm (Fig.3). The greatest number of samples with these fungi had the diameter of 0.8 cm.

Species of Xylariales were found on woody substrate with the diameter from 0.6 up to 3,8 cm (Fig.4). The diameter over 2 cm was characteristic of the greatest number of samples with above mentioned fungi. At present ranges of diameter for samples with species of Diaporthales and Xylariales are similar to measured earlier ranges of diameter for samples with the species of the same orders (Rukšėnienė 1996).

These notes on diversity and ecology of pyrenomycetes in studied alluvial black alder forests indicate necessity to continue the studies. They should be carried out in other types of black alder forest, especially paying attention to dead stems, stumps and overwintered leaves.

References

Farr, D.F., Rossman, A.Y., Palm, M.E., & McCray, E.B. (n.d.) Fungal Databases, Systematic Botany & Mycology Laboratory, ARS, USDA. Retrieved May 10, 2007, from http://nt.ars-grin.gov/fungaldatabases/.

Iršėnaitė R., Treigienė A. 2001. Pyrenomycetes and loculoascomycetes on oak (Quercus) in Lithuania. Bot. Lithuanica 7 (2):193 – 202.

http://www.indexfungorum.org/Names/Names.asp (retrieved May 10, 2007)

Rukšėnienė J. 1996. Notes on lignicolous Pyrenomycetes and Loculoascomycetes from Mažeikiai district (North-West Lithuania). Bot. Lithuanica 2 (1): 37 – 48.

Рукшенене Й. Й. 1989a. Пиреномицеты сообщества Tilio-Carpinetum южной Литвы. Микология и фитопатология, 23 (4): 349 – 354. (In Russian).

Рукшенене Й. Й. 1989b. Пиреномицеты на отмерших ветвях в ландшафтном заказнике Жалейи эжярай. Науч. тр. высш. учеб. заведений ЛитССР. Биология, 27: 29 – 35. (In Russian; abstracts in Lithuanian, English)

Степанова О. А. 1973. Грибы на порубочных остатках в еловых лесах Ленинградской области. I. Микология и фитопатология, 7 (5): 386 – 391. (In Russian).

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MICROMYCETES INFECTING LINDEN TREES (*TILIA* L.) IN VILNIUS CITY

Vilma Meškauskienė

Meškauskienė V. 2007. Micromycetes infecting linden trees (*Tilia* L.) in Vilnius City. *Acta Biol. Univ. Daugavp., 7 (2): 103 - 107.*

The aim of this work was to investigate the micromycetes infecting linden-trees in the Vilnius city greeneries. The micromycetes were isolated from infected leaves, twigs, branches of small-leaved linden (*Tilia cordata* Mill.) and large-leaved linden (*Tilia platyphyllos* Scop.). In Vilnius city linden-trees are infected with different micromycetes. Over 50 fungal taxa were recorded. Spreading of micromycetes and manifestation of fungal diseases vary every year and depend upon climatic conditions, pests and human activity impact.

Key words: *Tilia*, micromycetes, fungal diseases, climatic conditions

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Introduction

In urban green plantations of Lithuania three linden (*Tilia* L.) species are grown: small-leaved (*Tilia cordata* Mill.), large-leaved (*T. platyphyllos* Scop.) and European linden (*T. europaea* L.). They comprise about 80 % of the total plant assortment. Small-leaved linden is the most popular species spontaneously growing all over the Baltic region (Navasaitis 2004).

In urban areas linden-trees are infected with different most often fungal disease agents and pests (Juronis, Snieškienė 2001). In our cities, 60 % of linden-trees growing along the streets are mechanically damaged because of a particularly small area allotted under the tree, trampled soil, poor root aeration, wrong pruning, deficiency of nutrients, pouring of salt in winter (Grigaliūnaitė, Matelis, Stakvilevičienė 2005). In June early linden-tree leaf necrosis is already observed. Manifestation of fungi varies. Distribution of fungal disease agents on linden-trees mostly depends on climatic conditions, pests and human activity. Nipped or dried upbranches are attacked by saprotrophic and parasitic fungi, which can also affect healthy plants later. The damage of pathogenic fungi varies every year.
Linden-trees growing in natural environment are infected with rather different fungal disease agents, which are found in urban areas too. The most widespread linden-tree leaf disease agents are *Discula umbrinella* (*Apiognomonia errabunda*), *Cercospora microsora* (*Mycosphaerella microsora*) (Butin, Kehr 1999), branch disease agents are *Cytospora* spp. and *Stigmina compacta.*

Green plantations in the city are being observed throughout the year and phytopathogenic fungi causing woody plant rot, desiccation and nipping of branches, leaves or the whole plant are recorded.

Material and Methods

The micromycetes were isolated from infected leaves, twigs, branches of small-leaved linden (*Tilia cordata* Mill.) and large-leaved linden (*Tilia platyphyllos* Scop.) in Vilnius city greeneries.

A nutritious medium – malt extract agar (MEA) with pH 4.8 – was used for the isolation of micromycetes. Pieces of dry branches and leaves were placed on the agar medium into each Petri dish. Till the appearance of fungal mycelium, the closed dishes were incubated in a thermostat at a temperature of 24 °C. The culture was purified employing cloning and microscopy. Later the micromycete colonies were transferred into separate Petri dishes with MEA medium.

The pathogen species were identified basing on macro- and micromorphological properties (colony colour, shape, growth rate, mycelium and spore size, colour, form). Micromycete species were identified according to various manuals and reference books.

Results and Discussion

In spring and autumn of the years 2004–2006, meteorological conditions were extremely favourable for spreading of micromycetes. Under positive air temperature and high relative air humidity micromycetes were spreading intensively. The fungi usually infect weak, mechanically damaged plants. The frosts in the spring of 2006 were particularly hazardous for woody plants in urban areas. In spring, especially in May, quite a lot of nipped or only frozen plants were observed. On such plants the whole complex of parasitic and saprotrophic micromycetes were recorded. During the drought in the summer of 2006, the disease agents were not spreading. A great many incorrectly pruned linden-trees growing along the streets have completely dried up. Fungal disease agents of linden leaves (*Cercospora*, *Discula*) manifested more evidently in August.. The *Cercospora microsora* infected 60 % and *Discula umbrinella* infected – 40 % of the linden-trees growing in urban green plantations.

The most frequently detected micromycetes on linden-trees are: *Cercospora microsora*, *Cytospora* spp., *Corynespora olivacea*, *Diplodia tiliae, Discula umbrinella, Exosporium tiliae, Fusarium* spp., *Lamproconium desmazieresii, Microdiplodia tiliae, Nectria cinnabarina, Phomopsis irregularis, Pseudomassaria chondrospora, Robenhorstia tiliae, Septoria tiliae, Stigmina compacta* (Fig. 1)

The most hazardous micromycetes infecting weak, mechanically injured branches, twigs and leaves of linden-trees in green plantations of Vilnius city are: *Cercospora microsora (Mycosphaerella microsora), Cytospora* spp., *Diaporthe eres, Discula umbrinella (Apiognomonia errabunda), Fusarium* genus fungi*, Phomopsis irregularis, Pseudomassaria chondrospora, Stigmina compacta* (Fig. 2).

The samples taken from linden leaves, drying branches and twigs were herbarized and analysed in the laboratory. The list of micromycetes recorded on linden-trees in Vilnius city is as follows:

Ascomycetes

Exosporium Link: *E. tiliae* Link on branches and leaves of *Tilia cordata.*
Fumago Pers.: *F. tiliae* Fuck. (*Capnodium tiliae* (Fuckel) Sacc. on leaves of *Tilia cordata.*
Lamproconium (Grove) Grove: *L. desmazieri* (Berk.et Broome) Grove on twigs and dead branches of *Tilia cordata.*
Microdiplodia Allesch.: *M. tiliae* Allesch. on drying branches of *Tilia cordata.*
Periconia: Periconia sp**.** Tode: Fr. on branches of *Tilia cordata.*
Trichothecium Link:Fr.: *T. roseum* (Pers.:Fr.) Link on branches of *Tilia cordata* (*in vitro*).

Dothideomycetes

Alternaria Nees: *A. alternata* (Fr.:Fr.) Keissl. on leaves of *Tilia cordata.*
Cercospora Fuckel.: *C. microsora* Sacc. (*Mycosphaerella microsora* Syd.& P. Syd.) on leaves of *Tilia cordata* Mill.
Cladosporium Link:Fr.: *C. cladosporioides* (Fresen) G. A. de Vries on branches of *Tilia cordata.*
Corynespora H. T. Güssow.: *C. olivacea* (Wallr.) M. B. Ellis on branches and leaves of *Tilia cordata.*
Stemphylium Wallr.: *S. botryosum* Sacc. on branches of *Tilia cordata.*
Septoria Sacc.: *S. tiliae West.* on leaves of *Tilia cordata.*
Stigmina Sacc.: *S. compacta* (Sacc.) H. B. on drying branches of *Tilia cordata.*

Eurotiomycetes

Aspergillus P. Mich. Ex Link:Fr.: *Aspergillus* spp. on drying branches and bark of *Tilia cordata* (*in vitro*).
Penicillium Link.: *Penicillium* sp.Link.: Fr. on branches of *Tilia cordata* (*in vitro*).
Taloromyces C.R. Benjamin: *Taloromyces* spp. on branches of *Tilia cordata.*

Leotiomycetes

Botrytis P. Mich.: Pers.: *B. cinerea* Pers.: Fr. on branches of *Tilia cordata* (*in vitro*).

Sordariomycetes

Asteroma DC.:Fr.: *Asteroma* spp. on leaves of *Tilia cordata.*
Cephalosporium Corda*: Cephalosporium* sp. on branches of *Tilia cordata* (*in vitro*).
Chaetomium Kunze:Fr.: *C. chartarum* (Berk.) G. Winter (*Ascotricha chartarum* Berk.) on branches of *Tilia cordata.*
Cytospora Ehrenb.:Fr.: *Cytospora* sp. Ehrenb. W. F. P. L. on young twigs of *Tilia cordata.*
Colletotrichum Corda in Sturm.: *C. gloeosporioides* (Penz.) Penz on branches of *Tilia cordata.*
Diaporthe Nitschke: *D. velata* (Pers.) Nitschke (*Diaporthe eres* Nitschke) on branches of *Tilia cordata.*
Discula Sacc.: *D. umbrinella* (Berk. et Broome) M. Morelet (*Apiognomonia errabunda*

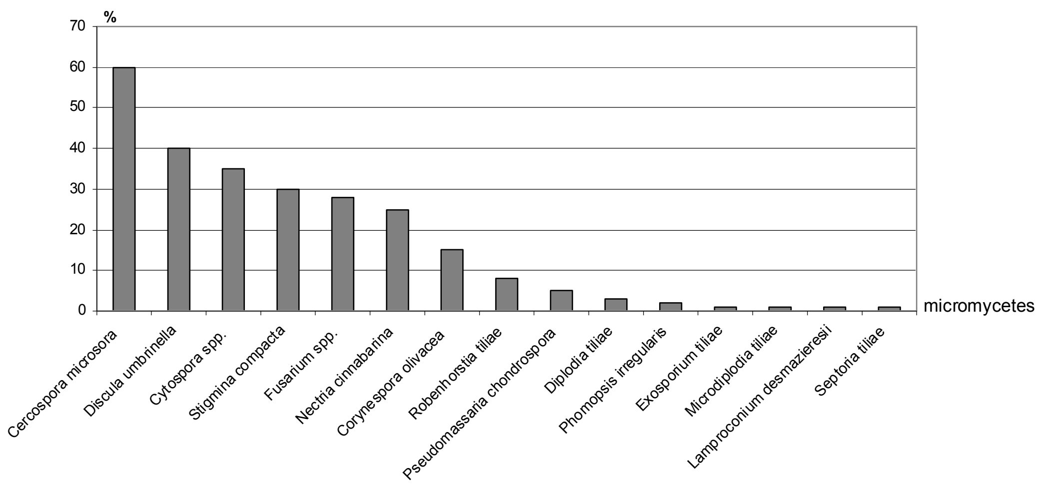

Fig. 1. The spreading of most frequently detected micromycetes on linden-trees (*Tilia* L.) in green plantations of Vilnius city during the years 2004–2006.

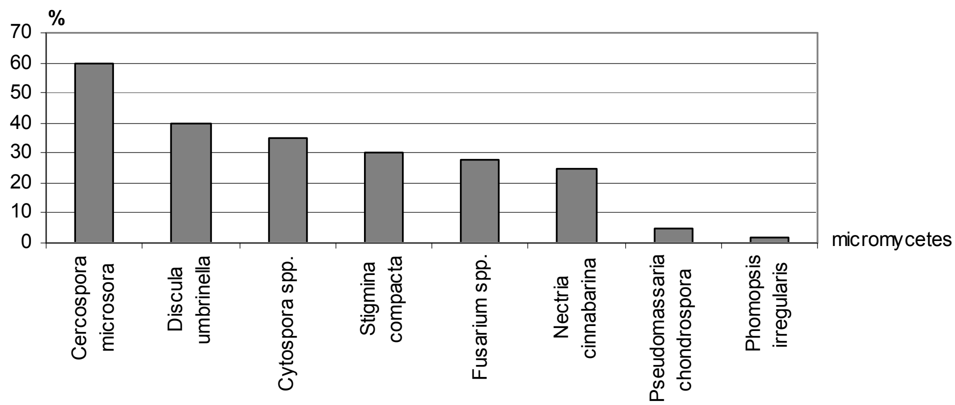

Fig. 2. The spreading of most hazardous micromycetes on linden-trees (*Tilia* L.) in green plantations of Vilnius city during the years 2004–2006.

(Rodberge & Desm.) Hohn.) on leaves of *Tilia cordata* Mill., *T. platyphyllos* Scop.
Fusarium Link:Fr.: *F. culmorum* (W.G.Sm.) Sacc., *F. graminearum* Schwabe on drying branches of *Tilia cordata*, *F. sambucinum* Fuck. on drying branches of *Tilia cordata*, *F. semitectum* Berk. & Ravenel on drying branches of *Tilia cordata*, *F. solani* (Mart.) Sacc. on drying branches of *Tilia cordata*, *F. sporotrichioides* Sherb. on drying branches of *Tilia cordata.*
Hypoxylon Bull.:Fr.: *H. coccineum* Bulliard on branches of *Tilia cordata.*
Nectria (Fr.) Fr.: *N. cinnabarina* (Tode:Fr.) Fr on branches of *Tilia cordata.*
Phomopsis (Sacc.)Bubak: *Ph. irregularis* (Died.) Petr. on young twigs of *Tilia cordata.*
Pseudomassaria Jacz.: *P. chondrospora* (Ces.) Jacz. on branches of *Tilia cordata.*
Rabenhorstia Fr.: *R. tiliae* (Pers.: Fr.) Fr. on branches of *Tilia cordata.*
Seimatosporium Corda: *Seimatosporium* spp. on branches of*Tilia cordata.*
Sordaria Ces.&De Not: *S. fimicola* (Roberte ex Desm.) Ces. & De Not on branches of *Tilia cordata.*
Thielaviopsis Went.: *T. basicola* (Berk. Et Broome) Ferraris on branches of *Tilia cordata.*
Trichoderma Pers.:Fr.: *T. viride* Pers.:Fr. on branches of *Tilia cordata* (*in vitro*).

Zygomycetes

Mucor P. Mich.:Fr.: *M. mucedo* P. Mich. ex Saint-Amans on branches of *Tilia cordata* (*in vitro*).
Rhizopus Ehrenb.: *R. nigricans* Ehrenb. on branches of *Tilia cordata* (*in vitro*).

Conclusions

1. In total, 50 fungal taxa belonging to 55 genera and 6 classes were identified from linden-trees. *Discula umbrinella* (*Apiognomonia errabunda*) and *Cercospora microsora (Mycosphaerella microsora*) – the agents of brown leaf spot – are mostly detected on leaves of *Tilia cordata.* The disease intensity reaches 10–50 %.

2. Most hazardous and frequent micromycetes infecting weak, mechanically injured branches, twigs and leaves of linden-trees in green plantations of Vilnius city are: *Cercospora microsora (Mycosphaerella microsora), Cytospora* spp., *Diaporthe eres, Discula umbrinella (Apiognomonia errabunda), Fumago tiliae, Fusarium* genus fungi, *Microdiplodia tiliae, Nectria cinnabarina Phomopsis irregularis, Pseudomassaria chondrospora, Stigmina compacta.*

3. Linden-trees growing in urban areas are infected with the same micromycetes that are found in natural environment.

4. Spreading of linden microfungi and manifestation of fungal diseases vary every year. It depends upon climatic conditions, pests and human activity impact. In cities, it is reasonable to grow linden trees that are more resistant to fungal diseases and pests.

5. Yearly monitoring of the condition of linden trees is recommended.

References

Grigaliūnaitė B., Matelis A., Stakvilevičienė S., 2005: Sumedėjusių lapuočių augalų būklė miestų želdiniuose / Želdiniai ir jų dizainas. Vilnius.

Juronis V., Snieškienė V., 2001: *Tilia* L. Būklė miestų gatvėse ir ją sąlygojančių žalingų organizmų įvairovė. / Lietuvos biologinė įvairovė. Vilnius: 40.

Juronis V., Snieškienė V., 2001: The influence of intensive pruning on the phytosanitary state of trees in city streets. // Urban forestry in the Nordic and Baltic Countries. Horsholm-No 9: 61-63.

Navasaitis M., 2004. Dendrologija. Vilnius.

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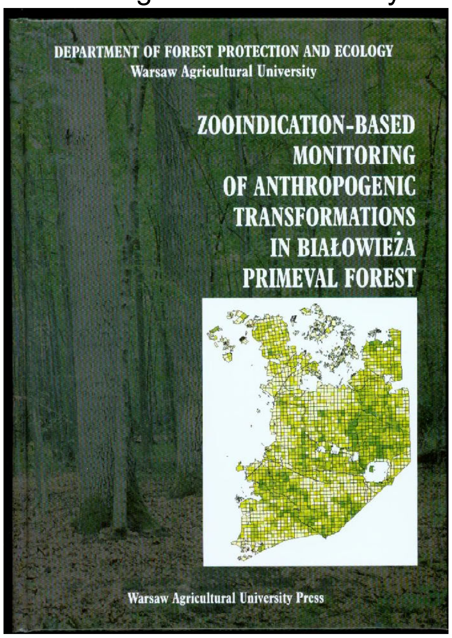

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BROWN ORTHETRUM *ORTHETRUM BRUNNEUM* (FONSCOLUMBE, 1837) (ODONATA, LIBELULLIDAE) - A NEW DRAGONFLY SPECIES IN LATVIA

Mārtiņš Kalniņš

Kalniņš M. 2007. Brown Orthetrum *Orthetrum brunneum* (Fonscolumbe, 1837) - a new dragonfly species in Latvia. *Acta Biol. Univ. Daugavp., 7 (2): 109 - 111.*

At present, there are 57 dragonfly species of nine families ascertained in Latvia, inter alia one immigrated dragonfly species and one other species with discutable status. In 2005, one teneral male specimen of *Orthetrum brunneum* has been collected in Latvia. Southern Skimmer, or Brown Orthetrum *O. brunneum* is a new species for Latvian fauna.

Key words: Odonata, Libelullidae, *Orthetrum brunneum*, fauna, Latvia.

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Introduction

Till now there are 57 species of nine families of dragonflies ascertained in Latvia, inter alia one accidentally immigrated species – *Sympetrum fonscolumbei* (Selys, 1840), and one species with discutable status – *Aeshna caerulea* (Ström, 1783) (Spuris 1993, Rintelen 1997, Kalniņš 2002, Bernard 2003). In his monograph, Z.Spuris (1993) mentioned six dragonfly species as possible but not yet recorded for Latvia. From genus *Orthetrum*, he listed *O. cancellatum* (Linnaeus, 1758) as native, as also *O. caerulescens* (Fabricius, 1798) as possible species.

Materials and Methods

Nature reserve Klāņi mire is a especially protected nature area in Latvia, located in Pope and Tārgale municipalities of Ventspils district (NW Latvia, Fig.1). Total area of this territory is 1615 ha. Main habitats are mires of different types, mostly raised bogs (31%), forests (61%) and Lake Klāņi (4%) (Nature Management Plan… 2006). Studies on invertebrate fauna were made during the preparation of the above mentioned plan. During the inventory of fauna, different types of habitats were inspected. Flying insects (like dragonflies) were mostly collected using entomological net.

Results and discussion

One teneral male specimen of *Orthetrum* sp. was caught in July 12th, 2005 in the Klāņu Nature reserve (leg. V.Spuņģis). This specimen was caught on the ditched road going though the mixed forest, near Lake Klāņi. In laboratory, the male was identified as *Orthetrum brunneum* (Fonscolumbe, 1837) by author and later Rafal Bernard confirmed this identification. The most

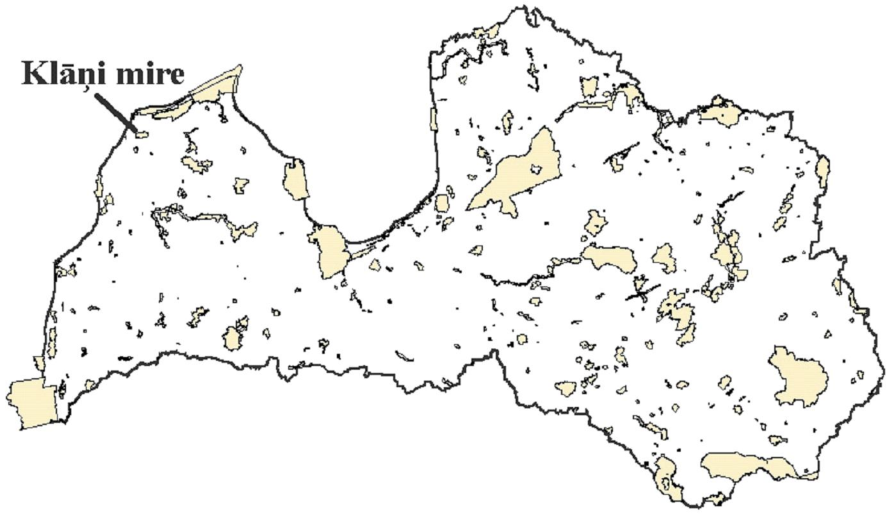

Fig. 1. Location of Nature reserve Klāņi mire between other specially protected nature areas in Latvia.

probably, larva of this specimen has developed in the ditch, as it was freshly emerged. The ditch was two years old, shallow, exposed to sun, with scarce water vegetation and was rich on other dragonfly species. In Europe, typical habitats of *O. brunneum* are small streams, unning ditches and seepages. In comparation to *O. coerulescens* (Fabricius, 1798), *O. brunneum* seems to more prefer scantily vegetated sites. Favors bare runnels in the North, e.g. in chalk or marl quarries (Dijkstra 2006).

O. brunneum is most common in the Mediterranean area, but locally registered also in Western and Central Europe; absent from the British Isles and Scandinavia. In the Netherlands it has been recorded from only two localities in the South. *O. brunneum* also occurs in North Africa, the Middle East and in Asia East to Kashmir, Gobi and Mongolia (Askew 1988).

In 2001-2003, *O. brunneum* was recorded also from Lithuania and is characterized as species increasing it˙s distribution to the North (Bernard, Ivinskis 2004). Some authors (Dijkstra 2006) show, that this species make range extends to Mongolia and since the 1990s expanded direction northwards.

Conclusions

Now there are 58 confirmed dragonfly species known from Latvia, including newly recorded *Orthetrum brunneum*. For all dragonfly species found in Latvia, there are local names given in Latvian, which are often used. *O. brunneum* yet does not have such name. To partake some similarity in names derivation in other languages (Südliche Blaupfeil – in German, Southern Skimmer, or Brown Orthetrum – in English, l˙Orthétrum brun – in French, Zuidelijke oeverlibel – in Dutch), as well as euphony in Latvian and conformity to the species appearance, the possible name could be "brūnā ezerspāre".

Acknowledgements

I am grateful to Dr. Voldemārs Spuņģis (University of Latvia, Rīga) for presented material of *Orthetrum brunneum*, to Dr. Rafal Bernard (Adam

Mickiewicz University, Poland), for the control of identification and to Dmitry Telnov (Entomological Society of Latvia, Rīga) for the English corrections.

References

Askew R.R. 1988. The Dragonflies of Europe. Harley Books, Colchester: 166-167.

Bernard R. 2003. *Aeshna crenata* Hag., a new species for the fauna of Latvia (Anisoptera: Aeshnidae). Notul. odonatol., Vol. 6. No.1.: 8-10.

Bernard R., Ivinskis P. 2004. *Orthetrum brunneum* (Fonscolumbe, 1837) a new dragonfly species in Lithuania (Odonata: Libellulidae). Acta Zoologica Lituanica, Volumen 14, Numerus 3: 31-35.

Dijkstra K.-D. 2006. Field Guide to the Dragonflies of Britain and Europe. 1-320.

Kalniņš M. 2002. Banded Darter *Sympetrum pedemontanum* (Allioni, 1766) (Odonata, Libellulidae) – a new dragonfly species in the fauna of Latvia. Latvijas Entomologs, 39: 44-45.

Nature Management Plan for Klāņi mire, 2006. Latvian Fund for Nature. http://www.dap.gov.lv/public/files_uploaded/aizsardzibas_plani/klanjupurvs_dap.pdf

Rintelen T. 1997. Eine Vogelreuse als Libellenfalle: Beobachtungen in der Vogelwarte Pape, Lettland. Libellula 16 (1/2):61-64.

Spuris Z. 1993. Latvijas spāru (Odonata) noteicējs. [A key to Latvian dragonflies (Odonata).] Rīga, Zinātne: 1-65.

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PECULIARITIES OF DISTRIBUTION AND NATURALISATION OF *EPILOBIUM CILIATUM* RAF. IN LITHUANIA

Dalytė Matulevičiūtė

Matulevičiūtė D. 2007. Peculiarities of distribution and naturalisation of *Epilobium ciliatum* Raf. in Lithuania. *Acta Biol. Univ. Daugavp., 7 (2): 113 - 119.*

Distribution, habitats and naturalisation of *Epilobium ciliatum* in Lithuania were investigated. This species occurs in Lithuania in 21 types of anthropogenic habitats and 22 types of natural and seminatural habitats. Natural plant communities with *E. ciliatum* belong to 8 vegetation classes. The most frequent, most abundant and well-developed *E. ciliatum* plants are in Lithuania in plant communities belonging to the *Calthion palustris* R. Tx. 1937 em. Lebrun et al. 1949 alliance of the *Molinio-Arrhenatheretea* class.

Key words: *Epilobium ciliatum*, alien plant species, habitats, plant communities.

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Introduction

In Europe *Epilobium ciliatum* Raf. is an alien species originating from North America (Raven 1968). The first sample of this species in Europe was collected in Great Britain in 1889. Since then *E. ciliatum* has spread in many European countries (Strugulc Krajsek et Jogan 2004). According to P.H. Raven (1968), it has naturalized as a weed and ruderal in a large part of Europe. This species often occurs in disturbed places, especially on rich soils (Piispala 1964, Jäger 1986). But there are also data about naturalisation of *E. ciliatum* in the natural habitats (Piispala 1964, Doogue et Kelly 1985, Holub et Kmetóvį 1988, Smejkal 1997, Kasperek 2004, Strugulc Krajsek et Jogan 2004). In Czech Republic M. Smejkal (1997) established the naturalisation of this species in plant communities belonging to 13 vegetation classes.

In Lithuania the first herbarium specimen of *E. ciliatum* was collected in 1926. According to Z. Gudžinskas (1998), this species is diffusely distributed throughout the whole territory of the country and has naturalized in natural as well as in anthropogenic habitats: waste lands, ditches, road sides, forest cutting areas, railways, banks of water bodies. Anthropogenic habitats prevail in this list due to concentration of the investigations in this type of the habitats. Plant communities with *E. ciliatum* had not been investigated in Lithuania.

The aim of this work is to specify the character of *E. ciliatum* distribution on the territory of Lithuania and establish the spreading of this species in natural plant communities.

Methods

In this paper *E. ciliatum* is treated sensu stricto, i. e. identified as *E. ciliatum* Raf. subsp. *ciliatum*. *E. adenocaulon* Hausskn. is relegated to synonymy with type subspecies of *E. ciliatum* Raf., i. e. not considering the conception of A. K. Skvorcov (Скворцов 1995).

The distribution data of *E. ciliatum* are based on revision of all specimens of the genus *Epilobium* in the herbaria of the Institute of Botany (BILAS), Vilnius University (WI) and the Station of Nature Investigations and Ecological Education of Marijampolė, as well as 109 specimens of *E. ciliatum* collected by the author in different parts of Lithuania in the period from 2003 to 2006 and 16 specimens collected by other botanists. The total number of the investigated specimens of *E. ciliatum* is 184.

For characterization of plant communities 68 relevés of communities were made following J. Braun-Blanquet (1964) methodological guidelines. Investigations were mostly concentrated in the natural habitats in different parts of Lithuania. The data of detailed investigations of natural and seminatural open habitats of Vilnius and Šalčininkai districts performed in 2004 and 2005 were used.

The distribution map is compiled applying a grid system (Gudžinskas, 1993).

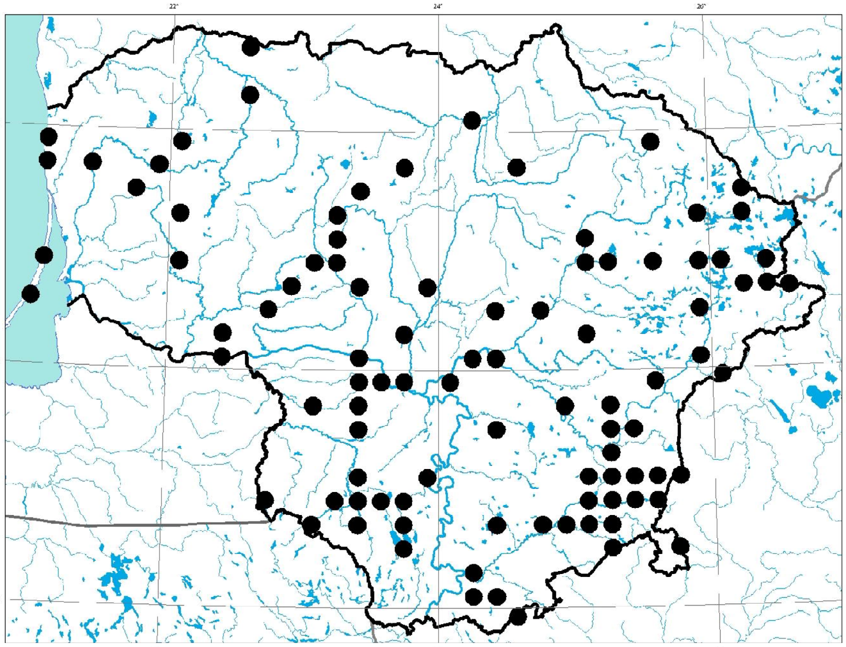

Fig. 1. Distribution of *E. ciliatum* in Lithuania

Material and discussions

The investigations have revealed that *E. ciliatum* is found throughout the whole territory of Lithuania, but the number of localities in different parts of the country is not equal (Fig. 1). The data of the detailed investigations of natural and seminatural open habitats in Vilnius and Šalčininkai districts carried out in 2003–2005 indicate that density of the distribution of *E. ciliatum* depends on areas occupied by wet natural and seminatural habitats and density of water bodies. This species is more frequent in territories abounding in natural and seminatural open wet habitats. 70.7 % of *E. ciliatum* plants were collected on the banks and in surroundings of water bodies. Majority of them (89.6 %) were found on the banks of water streams or in river valleys.

Particularly low number of localities is established in the northern part of the country. This part of Lithuania is the most anthropogenised – the ameliorated arable fields with prevailing clay and loam soils predominate in the landscape; a lot of water streams are regulated (Lietuvos ... 1981). There is little area of natural habitats fit to *E. ciliatum* in this part of the country. On the other hand, no special investigations of this species in arable fields of Lithuania were performed. Based on solitary specimens from gardens and from virgin clayey soils we can suppose that the

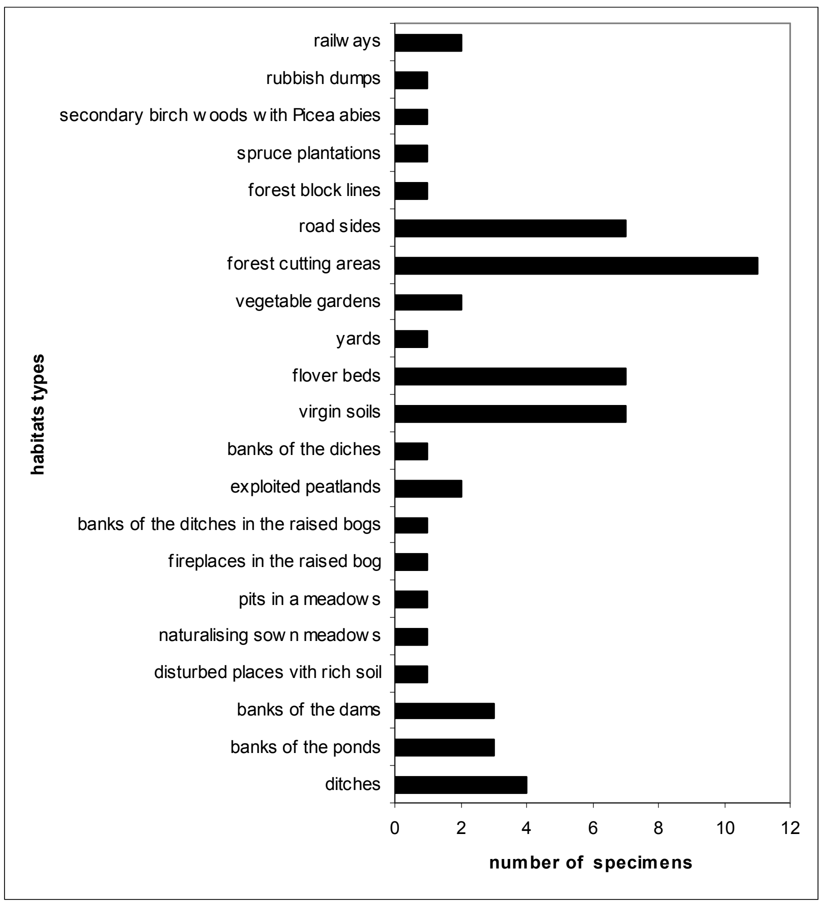

Fig. 2. Anthropogenic habitats of *E. ciliatum*

species may be found in many districts of Central and Northern Lithuania where segetal vegetation prevail.

Analysis of hydrographic, geomorphologic and soil cover peculiarities in different parts of Lithuania (Lietuvos ... 1981) and their comparison with distribution map of *E. ciliatum* reveal that different density of *E. ciliatum* localities is determined by the objective and subjective causes. The most important objective causes are the diverse areas occupied by natural and anthropogenic habitats, irregular hydrographical network and different geomorphologic characteristics of river valleys in various parts of the country. *E. ciliatum* is especially frequent in the territories with abundance of wet habitats, such as banks of water bodies and periodically flooded habitats. This species is particularly frequent in flooded river valleys. Abundance of such habitats is typical of the eastern part of Lithuania. The main subjective causes are unequal investigation of the territories, habitats and plant communities.

The number of specimens collected in various types of habitats varies. The majority of the analysed specimens of *E. ciliatum* (68.5 %) are collected in natural or semi natural habitats. Most

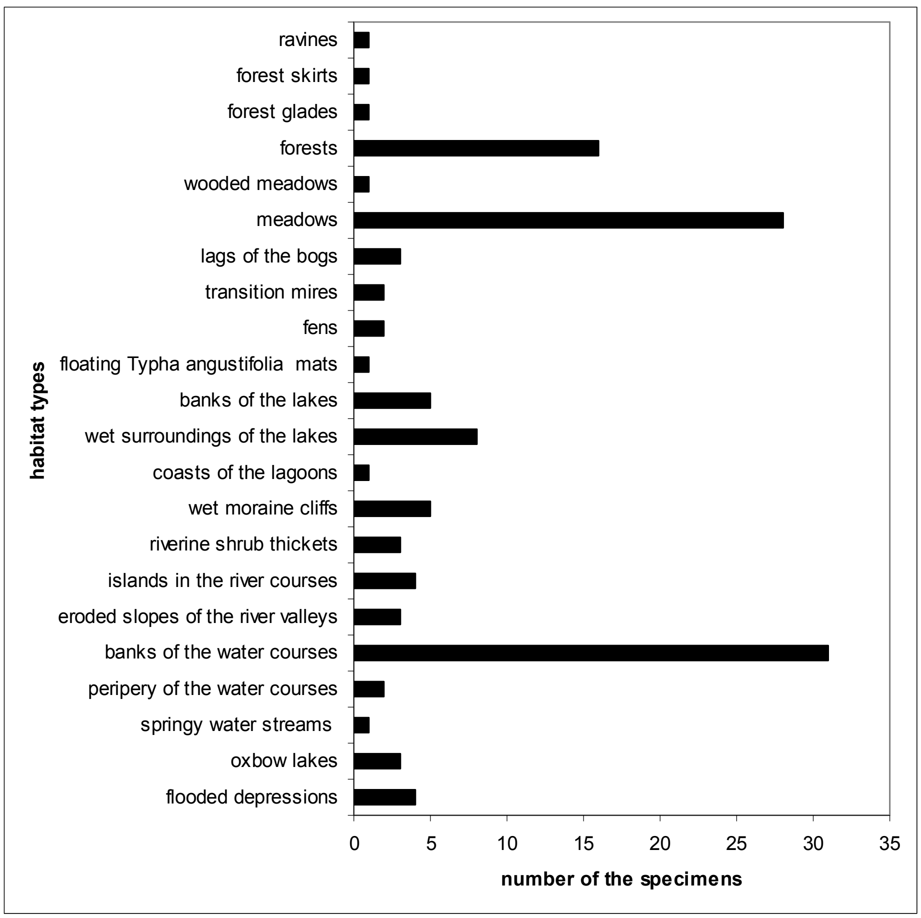

Fig. 3. Natural and seminatural habitats of *E. ciliatum*

habitats (87.5 %) are open. The open habitats prevail in natural and seminatural (87.3 %) as well as in anthropogenic (88.7 %) habitat types. *E. ciliatum* plants inter alia are not abundant in shaded habitats; usually just solitary plants are recorded. So we can suppose that ecological optimum of the species is in the well lit conditions.

There were 21 type of anthropogenic habitats of *E. ciliatum* registered (Fig. 2). The most frequent being forest cutting areas, road sides, flower beds and virgin soils. The diversity of natural habitats is also high – 22 habitat types were identified (Fig. 3). Most frequently *E. ciliatum* occurs on the banks of water courses, meadows, forests and wet surroundings of the lakes, but it is abundant only in wet meadows and in surroundings of the lakes.

Natural plant communities with *E. ciliatum* belong to 8 vegetation classes (Fig. 4). This species occurs in all of in Lithuania indicated plant communities, excluding *Vaccinio-Piceetea*, in Czech Republic as well (Smejkal 1997).

Most frequently *E. ciliatum* occurs in Lithuania in plant communities belonging to the *Molinio-Arrhenatheretea, Phragmito-Magnocaricetea* and *Isoeto-Nanojuncetea* classes. These plants are usually abundant in these communities and form groups reaching 50 individuals. But *E. ciliatum* prefers only some communities from the *Molinio-Arrhenatheretea* class. It most frequently and abundantly occurs in the *Deschampsietum cespitosae* Horvatić 1930 communities but rarely in other communities such as *Ranunculo-Alopecuretum geniculati* R. Tx. 1937, *Scirpetum sylvatici* Ralski 1931, *Filipendulo-Geranietum palustris* W. Koch 1926 and com-

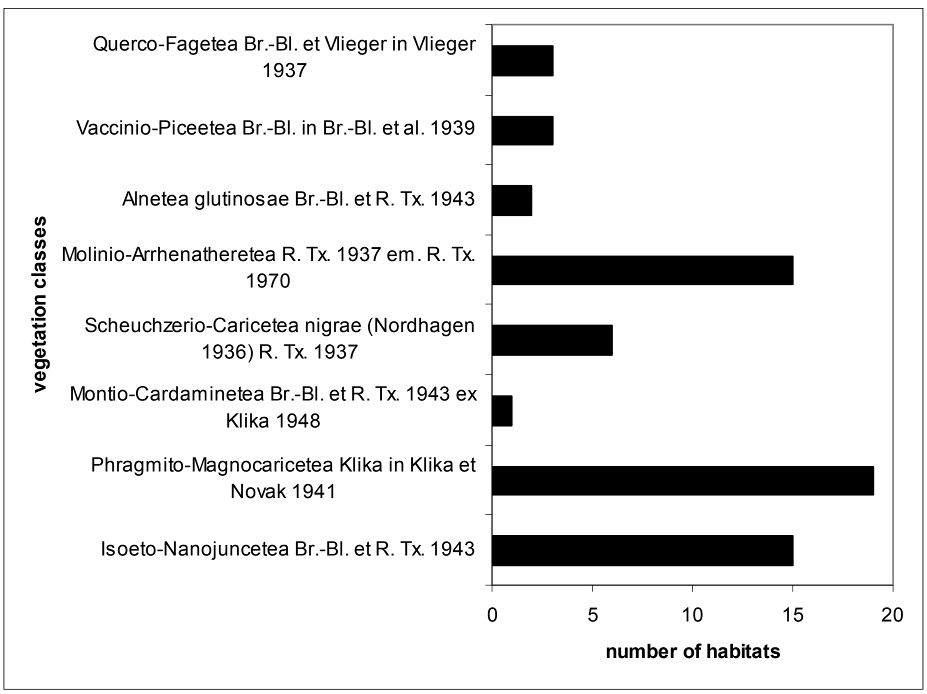

Fig. 4. Plant communities in which *E. ciliatum* occurs

munities with predominating of *Juncus effusus*. In plant communities belonging to the *Phragmito-Magnocaricetea* class, *Epilobium ciliatum* most frequently occurs in the *Phragmitetum australis* (Gams 1927) Schmale 1939 communities, sometimes the species is found in the *Caricetum gracilis* (Almquist 1929) Graebner et Hueck 1931, *Caricetum rostratae* Rübel 1912, *Caricteum paniculatae* Wangerin 1916 ex von Rochow 1951, *Phalaridetum arundinaceae* (W. Koch 1926) Libbert 1931 and *Glycerietum maximae* Hueck 1931 communities, rarely – in the *Catabrosetum aquaticae* Rübel 1912, *Caricetum acutiformis* Sauer 1937 and *Caricteum vesicariae* Br.-Bl. et Denis 1926 communities.

Although *Epilobium ciliatum* is neither frequent nor abundant in plant communities belonging to the *Scheuchzerio-Caricetea nigrae* class, but in mires habitats it most frequently occurs in *Caricetum nigrae* Braun 1915, rarely in the *Caricetum lasiocarpae* Osvald 1923 em. Dierssen 1982, *Caricetum paniceo-lepidocarpae* W. Braun 1968 and *Sphagno-Caricetum rostratae* Osvald 1923 em. Steffen 1931 communities. Only solitary *Epilobium ciliatum* plants were found in all forest plant communities. *Carici elongatae-Alnetum glutinosae* Schwickerath 1933, *Circaeo-Alnetum* Oberd. 1953, *Tilio-Carpinetum betuli* Traczyk 1962 wet oak and spruce woodland communities with *Epilobium ciliatum* were natural, while the soil surface in *Peucedano-Pinetum* W.Mat. (1962) 1973 was eroded by the water stream floating from the road.

Resuming conditions of habitats and plant communities, we can suppose that *E. ciliatum* is a species with a very high ecological plasticity. The habitats of this species in Lithuania can be very different: the light conditions vary from shaded to well-lit, the hydrological conditions – from averagely moist to wet, the soil reaction – from acid to alkaline, the trophic conditions – from oligomesotrophic to eutrophic. This species in Lithuania has never been found in dry habitats while in Slovenia and Croatia *E. ciliatum* occurs in dry meadows and shrubs (Strugulc Krajšek et Jogan 2004). In Lithuania these plants are the most frequent, most abundant and well-developed in well-lit, moist, mesotrophic or eutrophic habitats with neutral soil reaction. *E. ciliatum* can find such conditions in plant communities belonging to the *Calthion palustris* R. Tx. 1937 em. Lebrun et al. 1949 alliance of the *Molinio-Arrhenatheretea* class.

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References

Doogue D., Kelly D. L. 1985. The progress of *Epilobium ciliatum* Rafin. (*E. adenocaulon* Hausskn.) in Ireland, with some notes on its hybrids, irish Naturalist᾽s Journal, 21(10): 444–446.

Gudzinskas Z. 1993. Genus *Ambrosia* L. (*Asteraceae*) in Lithuania. Thaiszia (Košice), 3: 89–96.

Gudzinskas Z. 1998. Conspectus of alien plant species of Lithuania. 8. *Aceraceae, Balsaminaceae, Elaeagnaceae, Geraniaceae, Geraniaceae, Hippocastanaceae, Linaceae. Lythraceae, Onagraceae, Oxalidaceae, Rutaceae*, and *Vitaceae*. Botanica Lithuanica, 4(4): 363–377.

Holub J., Kmetóvį E. 1988. *Epilobium* L. – vrbovka. Flóra Slovenska, 4/4: 441–489.

Jäger E. J. 1986. *Epilobium ciliatum* RAF. (*E. adenocaulon* HAUSSKN.) in Europa. Wissenschaftliche Zeitschrift der Martin-Luther-Universität Halle-Wittenberg, Mathematisch-Naturwissenschaftliche Reihe, 35 (5): 122-130.

Kasperek G. 2004. Fluctuations in numbers of neophytes, especially Impatiens glandulifera, in permanent plots in a West German floodplain during 13 years. Neobiota, 3: 27–37.

Lietuvos TSR atlasas. 1981. Maskva.

Piispala E., 1964. *Epilobium adenocaulon* Hausskn. und *E. rubescens* Rydb. in Ostfennoskandien. Annales Botanici Fennici, 1 (1): 36–46.

Raven P.H. 1968. *Epilobium* L. Flora Europaea, 2: 308–311.

Smejkal M. 1997. *Epilobium* L. – vrbovka. Kvġtena České Republiky, 5: 99–132.

Strugulc Krajsek S., Jogan N. 2004. *Epilobium ciliatum* Raf., a new plant invader in Slovenia and Croatia. Acta Botanica Croatica, 63(1): 49–58.

Скворцов А. К. 1995. К систематике и номенклатуре адвентивных видов рода *Epilobium* (*Onagraceae*) во флоре России. Бюлетень Московского Общества Испытателей Природы. Отдел Биологический, 100(1): 74–78.

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THE IMPACT OF COLONIAL SEA BIRDS ON THE VEGETATION COVER OF THE ISLANDS IN THE GULF OF FINLAND (WITHIN RUSSIA)

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Glazkova E. A. 2007. The impact of colonial sea bids on the vegetation cover of the islands in the gulf of Finland (Within Russia). *Acta biol. Univ. Daugavp., 7 (2): 121 - 128.*

The detailed investigations of vegetation cover at the seabird colonies have been carried out in 2002-2005 on the islands in the Gulf of Finland within Russia. It was shown, that very special ornithocoprophilous flora and vegetation forms on the islands with large bird colonies under the effect of activity of seabirds. The main typical features of the ornithocoprophilous vegetation of the islands in the Gulf of Finland are discussed. It was shown, that the formation of vegetation cover at the seabird colonies is influenced by many factors. The characteristic of different aspects of colonial seabird impact on the flora and vegetation of the "bird" islands is given.

Key words: ornithocoprophilous flora, vegetation, colonial sea birds, biogeography, islands, Gulf of Finland.

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Introduction

Most scientists, who worked on islands with large bird colonies, noticed very special flora and vegetation formed on the islands under the effect of activity of colonial seabirds. Most plant species occurring in the area of the bird colonies find best habitat conditions for their growth in the sites with large accumulation of nitrates and phosphorus, coming with bird dung. To specify this group of «dung-loving» plants, a Scandinavian scientist R. Sernander (Sernander, 1912) offered the special term «ornithocoprophilous species». He distinguished this group from the group of nitrophilous plants, because bird dung (guano) consists of faeces and urine and differs essentially from excrements of mammals. The bird dung contains tremendously more uric acid and chlorides, which results in a difference in physiological effect on vegetation.

Many factors affect the formation of vegetation cover on the islands with seabird colonies in different regions, from the geographical position, size of the islands and the diversity of their landscapes, to the population number and the species composition of nesting birds.

In foreign literature, studies devoted to the influence of colonial seabirds on the vegetation cover of islands are rather numerous. Among them, deserving special attention are the works on the islands of the Northern Atlantic (Grønlie, 1948; Gillham, 1956; Sobey, 1976; Sobey, Kenworthy, 1979), which not only give a detailed characteristics of the special flora and vegetation formed on the islands with large seabird colonies, but also discuss in detail the mechanism of the influence of the birds on the vegetation cover. A number of interesting works is devoted to the study of the penguin colonies influence on the flora and vegetation of Antarctic islands (Vidal et al., 2003). A great contribution to the study of this problem was made by Scandinavian scientists**,** who described the vegetation of some islands with large gull colonies (Sernander, 1912; Luther, Nordgren, 1966; Niemi, 1967; Jonsell, 1961, etc.). Among works on the flora and vegetation of the Baltic Sea islands discussing the influence of birds on the flora and vegetation of the islands, the works by Estonian scientists also deserve notice (Ребассоо, 1987; Ratas et al., 1995; Small islands…, 1997).

As concerns Russian islands of the Baltic Sea with seabird colonies, an information on the flora and vegetation of most of them was not available until our research (Глазкова, 2001; Glazkova, 2006; Глазкова, Глазков, 2007), which was due to the difficulty of access to many of the islands and impossibility of their free visiting because of a strict boundary regime.

Materials and methods

We chose as «model» objects to characterize the influence of the birds on island vegetation cover, small-sized, the most remote from the mainland, peopleless islets with large seabird colonies. Most of them are almost devoid of arboreous vegetation and are a true haven for the birds.

Surveyed were: 20 islets, located in the northern part of the Gulf of Finland near the Russian–Finnish border (Doldyj Rif, the Bolshoy Fiskar Archipelago, Zubetz, etc.), and 16 minor islets included in the Berezovye Island Archipelago. Botanical research on the islands of the northern part of the Gulf of Finland were carried out in the summers 2002–2004, and on the Berezovye Island Archipelago in the summers 2004–2005. Field works on the Berezovye Islands in 2005 were made together with ornithological investigations. In addition, owing to long-term ornithological investigations supervised by A. R. Gaginskaya, the data on population of the cormorant and gull colonies on the number of islands located in the zone near the Finnish border were available.

The species of colonial seabirds do not all exert a considerable influence on the vegetation cover in their nesting sites, this resulting from peculiarities of their behaviour, and first of all depends on their excreting and trampling activity. According to our observations, a special ornithocoprophilous flora and vegetation in the Gulf of Finland islands are formed in the gull (mainly, herring gull) and cormorant nesting sites.

Peculiarities of the vegetation cover on islands with cormorant colonies

The cormorant (*Phalacrocorax carbo sinensis)* began nesting on the Gulf of Finland islands rather recently. Several large breeding colonies of the cormorants in the eastern part of the Gulf of Finland were first discovered in the summer 1994, namely in the islands of the Bolshoy Fiskar Archipelago, Dolgy Rif and Zubets (Ossipov, Gaginskaya, 1994). In the opinion of ornithologists, the cormorants began nesting on these islands in the middle 1980s–early 1990s. The total amount of the cormorants nesting on these islands, according to an approximate estimation in 1995 was 1000–1300 couples (Gaginskaya, 1995). At present, on Russian islands in the Gulf of Finland cormorant colonies are located on four of seven islands of the Bolshoy Fiskar Archipelago, on Dolgy Rif and the Severny Virgin Island; on the latter island a small cormorant colony (about 50 nests) being first found by us in 2004. Nesting in abundance on all these islands are also gulls (herring gulls, lesser black-backed gulls, as well as common gull (*Larus canus)* and great black-backed gull (*Larus marinus*), with the herring gull (*Larus argentatus*) dominating. In 2006 the team of Russian ornithologists supervised by A.R. Gaginskaya (Laboratory of bird Ecology and Conservation, Biological Institute of St. Petersburg University) carried out the census of seabird populations on the islands Dolgyj Reef, Malyj Fiskar, the Virgin Islands and the Bolshoyj Fiskar Archipelago. According to their data, the number of breeding couples of the cormorants has increased for the last several years more than twice, and continues the increase year by year. The increase in number of breeding and wintering *Phalacrocorax carbo sinensis,* recently occurred in the Baltic region is likely to have caused their effective expansion to the East. For example, during our work on the Berezovye Island Archipelago in 2005 J. Bublichenko (Zoological Institute of RAS, St. Petersburg) discovered on a small island Rondo several empty nests, which cormorants started to built, but did not finish. These nests have been built on pine and birch trees, about 4-6 m above the ground. These observations indicate that along with the increase in number of nests in colonies there is a certain tendency of setting up new colonies on other islands in the eastern part of the Gulf of Finland. The influence of the cormorant colonies on the vegetation cover of islands is determined by the ecological and biological peculiarities of the species. The cormorants stay in their nesting sites longer than other seabirds, from May to the middle September. Their colonies are very dense, the nests quite often being located at 0.5–1 m from each other. The birds are rather large and produce large amount of dung. The colonies areas are poured by dung in plenty, and the surface around the nests is covered with its continuous layer.

It is remarkable, that at a distance of as little as several tens of meters many islands with large cormorant colonies look completely devoid of any vegetation. For example, Dolgy Rif represents a surrealistic sight of flat rock outcrops, snow-white with the guano, with white dead trees protruding here and there against a bright blue water surface. However, when landing to the island, one is astonished at the luxuriant and mosaic vegetation cover, formed there under the effect of bird colonies, though the total species number in the flora of "cormorant" islands is small, usually varying from 50 till 90 species of vascular plants.

Margrethe Grønlie (1948) has formulated the main peculiarity of the ornithocoprophilous flora in the best way: «If the vegetation be poor in species it is, on the other hand, all the more luxuriant». The income of excessive amount of the bird dung has a distinct selective effect on the vegetation. Some species die out, because excessive dung income kills them, others are able to exist, but in suppressed or underdeveloped state. On the other hand, a variety of plants prove to be resistant to the excessive income of organic substances, or this factor advantages their growth.

Perhaps, the most distinct destructive effect is exerted by the cormorants on arboreous vegetation. Most arboreous plants in the bird nesting areas die, and survived plants look stunted, and distinctly suffering from unfavourable effect of excessive dung income. The arboreous vegetation in the cormorant nesting areas suffers severely not only from the excessive income of bird excrements, but also from mechanical damages. Thus, when visiting Dolgy Rif, we observed the cormorants breaking pine and aspen branches on the nearby Zubets Island, to use them as a frame for building their big nests.

Finnish scientists Terhi Ryttari and Timo Asanti during several years studied the influence of cormorant colonies on the vegetation of two small islets included in the Tammisaari (Nylandia) Archipelago. They also paid attention to the harmful effect of the cormorant colonies on the arboreous vegetation. According to their observations, as a result of mechanical damages and excessive excrement income, some species of arboreous plants have died on the islands (for example, *Padus avium* and most *Juniperus* bushes), and survived ones (*Sorbus aucuparia,* *Salix phylicifolia)* suffer severely in the nesting areas of the cormorants. The Finnish scientists emphasize, however, that the harmful effect of the bird excrements on the vegetation appears only closely to the cormorant nests, and as near as at several meters from the nest the vegetation is luxuriant. We observed a similar pattern on the islets under our study.

The areas taken by large cormorant colonies demonstrate a clearly distinct zonation of the vegetation depending on the distance from a nest. In the immediate vicinity of the nests, the vegetation is almost lacking because of abundant dung income. A huge amount of organic detritus is accumulated around a nest and added every season, since cormorants rebuild their nests every year on the same place. These detritus is always wet and intensely manured with the bird dung during breeding season, and able to grow there is only *Tripleurospermum maritimum*, not only able to survive, but thrive even in the close vicinity to the nests. This typical ornithocoprophilous species, absolutely dominating in nesting areas of cormorants, forms huge thickets on the rock surface, or forms a continuous cover when the thickets join. As near as at several meters from the cormorant nests, there is a luxuriant vegetation of many ornithocoprophilous species (for example, *Tanacetum vulgare, Lepidotheca suaveolens*, *Atriplex prostrata, Viola tricolor, Urtica dioica, Chenopodium album, Barbarea arcuata, Epilobium adenocaulon, etc*.), represented by strong, well developed specimens. Some of these species were obviously introduced to the island by gulls, since cormorants are ichthyophagous, and usually pick up nest material nearby, therefore, they add nothing new to the flora.

In places where the cormorants do not nest, there are luxuriant colourful tall-herbage maritime meadows developed on stony coasts, with dominating *Valeriana sambucifolia, Veronica longifolia, Tripleutospermum maritimum, Lythrum salicaria, Tanacetum vulgare, Rumex crispus, Artemisia coarctata, Urtica dioica, Arrhenatherum elatius* and other species. Despite these meadows are typical maritime communities, their characteristic peculiarity is a «gigantism» of most species growing there, which look very strong and tall, with bright green fleshy leaves. This results from a considerable content of nitrogen and phosphorus, incoming with the bird excrements, so the intensive development of plant vegetative parts takes place, and their vegetation period prolongs. On the one hand, these meadows are not subject to direct influence of the birds: the cormorants do not nest there, the gulls choose for their nests less tall-herbage sites, though their chicks often find their shelter among maritime tall herbage. On the other hand, since they are located on lower parts of the coast, rainwater or seawater during storms bring there organic substances of the guano, washed away from higher parts of the island, where the cormorants and gulls breed. In addition, when flying over the meadows, the birds manure this area as well. Thus, soils rich in organics form in terrain depressions among rocks, and this stimulates a luxuriant growth of plants. Some plant species (for example, *Tripleurospermum maritimum* and *Chenopodium rubrum*) reach so giant size there, that become hardly recognizable.

Peculiarities of vegetation cover on the islands with gull colonies

The vegetation cover formed on minor rocky islets located in the open sea far from the coast and bearing large gull colonies, has a number of peculiarities to differ it from that of the islands with the cormorant colonies. The gull colonies exert a significant effect on the vegetation cover of the islets, mainly by excessive manuring the soil with nitrogen and phosphorus, mechanical destroying soil cover and transporting plant seeds, including many alien species. In such conditions a peculiar ornithocoprophilous flora is formed, distinguished by its poverty in species (usually, under 100 species), the luxuriant growth of many nitrophilous plants and presence of a number of weed species (for instance, *Stellaria media, Senecio vulgaris, Tripleurospermum* *maritimum, Potentilla norvegica, Chenopodium album, Capsella bursa-pastoris, Polygonum aviculare* s. str.*, etc.*).

As distinct from the cormorants, the gulls produce less dung and spend less time in their nests, so many plant species grow in close touch with the nest. Dominating on the rocky «gull» islands, like cormorant colonies, is *Tripleurospermum maritimum*. This species especially thrives in hollows, depressions and rock fissures, where forms continuous band-shaped mats. Besides such a fragmentary vegetation, observed rather often on the islands is merging the thickets of *Tripleurospermum maritimum* and some other species (*Trifolium repens, Viola maritima, Sedum acre, Rumex acetosella, Festuca rubra,* etc.), to form a continuous cover of these species. In all appearances, on many minor exposed rocky islets with large gull colonies, we observe the process of forming primary ornithogenic vegetation, so similar to the process forming primary ornithogenic cover on the islands of the Subarctic Kola Peninsula, described in detail by I.P. Breslina (Бреслина, 1987).

Many species occurring in the areas of gull nesting have no special device for anemo- and hydrochory, and were brought to the island by ornithochory (mainly, by endoornithochory). They are these species, which most often occur directly at the gull nests and feeding areas.

The effect of the birds on the vegetation cover of the islands significantly depends on their colony population. On the islands where the population of the gull colonies does not exceed several tens of couples, this effect is insignificant, the changes of vegetation take place only in the areas of the bird nesting, and chiefly manifests in appearing some weed plant species, introduced by the gulls. These species generally occur immediately near gull nests and on their paths. Their range is small, usually 3–5 species: *Lepidotheca suaveolens, Stellaria media, Capsella bursa-pastoris, Chenopodium album, Polygonum aviculare* s.str. The moderate income of nitrogen and phosphorus with bird excrements stimulated the growth of some nitrophilous plant species: *Elymus repens, Poa pratensis, Arrhenatherum elatius, Galeopsis bifida, Isatis tinctoria, Artemisia campestris, Senecio viscosus, Chelidonium majus, Chamaenerion angustifolium, Atriplex littoralis, Artemisia vulgaris, Anthriscus sylvestris, Rumex acetosella, Polygonum boreale, Persicaria lapathifolia,* including several arboreous species - *Sambucus racemosa* and *Rubus idaeus.*

A different sight is observed on the islands with population of breeding couples reaches several hundreds. For example, the largest bird colonies (mainly, herring gull and lesser black-backed gull *Larus fuscus*) on the Berezovye Island Archipelago are located on Rondo Island (750–900 couples on the area 10.49 hectares) and Bolshaya Otmel (350–580 couples on 10.27 hectares) (according to unpublished data by J. Bublichenko). Birds on Rondo take not only the coastal, but also the central, wooded part of the island, where they settle in a thinned forest of birch, bird cherry, rowan tree, juniper and alpine currant, and make their nests among herbaceous vegetation and stones. The gull colonies on these islands are very dense, and distance between the nests reaches 0.8–3 m. As a result of excessive income of bird excrements as well as trampling and mechanical damage of plants by the gulls, many plant species die off, at the same time an intense growth of many nitrophilous and trampling-resistant species is observed. Following species are to be mentioned among the most often occurring ornithocoprophilous species: *Galeopsis bifida, Viola maritima, V. tricolor, Sedum acre, Urtica dioica, Elymus repens, Achillea millefolium, Chelidonium majus, Taraxacum officinalis, Arabidopsis thaliana, Arabis glabra, Artemisia vulgaris, Rumex crispus, Artemisia campestris, Rumex acetosella, Silene nutans, Solidago virgaurea, Potentilla argentea, Chamaenerion angustifolium.* The maritime tall-herbage meadows are also represented by strong, tall, well-developed *Valeriana sambucifolia, Artemisia coarctata, Phalaroides arundinacea,* etc. The range of alien species becomes more diverse (10–15 species): *Capsella bursa-pastoris, Chenopodium album, Viola maritima, Senecio vulgaris, Polygonum aviculare* s.str., *Poa* *pratensis, P. annua, Descurainia sophia, Stellaria media, Fallopia convolvulus, Epilobium adenocaulon, Lepidotheca suaveolens, Spergularia rubra, Elymus repens, Tripleurospermum perforatum, Potentilla norvegica*.

The areas of meadow vegetation are severely trampled by the gulls. Trampling by plays a great part, as a factor exerting an effect on the island vegetation. Like grazing and wing activity, it restricts the number of plant species and promoted their dwarfness. Along gull paths, completely trampled vegetation is observed in some places. Many species of maritime meadows (for example, (for example, *Phalaroides arundinacea, Atriplex litoralis*) are severely damaged (browsed) by the birds. The mechanical destruction of plants also takes place, since when building nests, the gulls pick up and stock plants nearby. In areas of the closest gull flocks, under influence of the birds, the change of the communities˙ structure takes place, and a secondary ornithogenic cover is being formed. Similar changes of the vegetation cover are recorded, for example, for a number of «bird» islets in the Gulf of Finland near the northern coast of Estonia (Ratas et al., 1995, 1997).

Many authors noticed, that as a result of excessive dung income the vegetation on some islands with large bird colonies is eliminated completely. Quite often foreign scientists took as a classical example of a complete degradation of vegetation cover under the effect of birds Saint Paul Island in the Atlantic Ocean near the North American coast, and quoted Ch. Darwin, who had visited this island in 1832 during his voyage on the “Beagle”. Darwin (1840) wrote: “Not a single plant, not even a lichen, grows on this island”. The same regularity was mentioned by Far Eastern researchers (Mochalova, 2001; Õīšåāą, 2003) when studied the influence of slaty-backed gull (*Larus schistisagus*) colonies on the vegetation cover of the Okhotsk Sea islands, on some of them its population reaching 6–8 thousand of breeding couples.

On the islands of the Gulf of Finland under our survey, we have not noticed an extreme degradation of the vegetation cover under gull effect. Obviously this is resulted from both less population of the seabird colonies, and a shorter period of existence of the colonies on the islands in the Gulf of Finland. Another factor to prevent from the complete degradation of the vegetation on the islands with large seabird colonies in the Boreal zone is, probably, leaving the islands by the birds in wintertime, when the Gulf is frozen.

Conclusions

Ornithogenic influence is a strong factor to form special ornithocoprophilous vegetation in nesting sites of colonial seabirds. Despite the characteristic composition and image (peculiar features) of ornithogenic vegetation of different islands, we can distinguish main features, typical of the ornithocoprophilous vegetation of the islands of the Gulf of Finland as a whole:

- poorness in species;

- the luxuriant growth of the ornithocoprophilous species;

- the decrease of abundance or elimination of many non-ornithocoprophilous species (first of all, trees and dwarf shrubs);

- the increase of alien species number in the vegetation cover;

- biomorphological changes of the plant habit (intense development of the vegetative, and in some instances generative plant organs).

The study of the mechanism of the vegetation cover changes on the islands under the influence of the activity of colonial birds was not among the aims of our research. However, the main agents are, obviously, the same as on many other «bird» islands, described by both foreign and Russian scientists: mechanical impact of the birds on the soil (trampling, scratching and digging the soil); changes of the soil chemical composition under the effect of a large amount of excrements and other organic substances (food remnants, nest material); transporting plant germs by the birds (by means of endo-, syn- and epiornithochory); mechanical damage of the plants by the birds (browsing, breaking, trampling the plants).

The presented results of the study are preliminary. No doubt, it is necessary to carry out more detailed complex investigations on islands with large colonies of seabirds to reveal regularities of the vegetation cover formation on the «bird» islands, and to characterize in more details different facets of impact of the colonial seabirds on the vegetation cover of the islands in the Gulf of Finland.

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References

Darwin Ch. 1840. Journal of researches into the Geology and Natural History of the Countries Visited by Beagle. London.

Gaginskaja A. R. 1995. The cormorant *Phalacrocorax carbo* as a breeding species of the Leningrad Region // Russian Journal of Ornithology. [1] 4 (3/4). P. 93-96. (In English and Russian).

Gillham M.E. 1956. Ecology of the Pembrokeshire Islands // The Journal of Ecology. Vol. 44, [1] 1. P. 51-82.

Glazkova E. 2006. Merimetso muuttaa kasvillisuuden // Ympäristö. [1] 8. P. 10–11.

Grønlie A.M. 1948. The Ornithocoprophilous Vegetation of the Bird-Cliffs of Røst in the Lofoten Islands, Northern Norway. Nytt Magasin for Naturvidenskapene. Oslo. Bd 86. P. 117-243.

Jonsell B. 1961. Kärlväxtfloran på exponerade skär i Oxelösunds skärgård // Svensk Botanisk Tidskrift. Bd 55, H. 2. S. 313-339.

Luther H., Nordgren C. 1966. Måsarnas inverkan på utskärens växtlighet // Finlands natur. [1] 25. S. 2-5.

Mochalova O. A. 2001. Flora and vegetation at the seabird colonies of the Commander Islands // The biology and conservation of the birds of Kamchatka. Moscow. [1] 3. P. 72–80.

Niemi A. Hemerophilous plants on gull skerries in the archipelago SW of Helsingfors // Memor. Soc. Fauna Fl. Fenn. 1967. Ny ser. 43. S. 8–16.

Ossipov D., Gaginskaya A. 1994. The Bolshoy Fiskar Archipelago – not yet protected, but should be // WWF Baltic Bulletin. [1] 5. P. 27-28.

Ratas U., Nilson E. et al. 1995. Development of landscapes on the islands of the Kolga Bay // Year-Book of the Estonian Naturalists' Society. Vol. 76. Nature of the Islands of the Gulf of Finland. P. 137–163.

Sernander R. 1912. Studier öfver lafvarnes biologi. Nitrofila lafvar // Svensk Botanisk Tidskrift. Bd 6, H. 3.

Small islands of Estonia: Landscape ecological studies. 1997. // Ratas U., Nilson E. (eds). Institute of Ecology. Publications.

Sobey D. G. 1976. The effect of herring gulls on the vegetation of the isle of May // Trans. Bot. Soc. Edinburgh. Vol. 42. Pt. 4. P. 469-485.

Sobey D. G., Kenworthy J. B. 1979. The relation between herring gulls and vegetation of their breeding colonies // J. Ecology. Vol. 67, No 2. P. 469-496.

Vidal E., Jouventin P., Frenot Y. Contribution of alien and indigenous species to plant-community assemblages near penguin rookeries at Crozet archipelago // Polar Bioljgy, 2003. Vol. 26. No 7. P. 432-437.

Бреслина И.П. 1987. Растения и водоплавающие птицы морских островов Кольской Субарктики. Ленинград. (In Russian).

Глазкова Е.А. 2001. Флора островов восточной части Финского залива: состав и анализ (Vascular flora of the islands of the eastern Gulf of Finland: structure and analysis). Ред. Р.В. Камелин. СПб, Изд-во С.-Петерб. ун-та, 348 с. (In Russian; abstract in English).

Глазкова Е. А., Глазков П. Б. 2007. Таинственный архипелаг в Финском заливе (Mysterious archipelago in the Gulf of Finland) // Природа. № 1. С. 55–66. (in Russian).

Ребассоо Х.-Э. 1987. Биоценозы островков восточной части Балтийского моря, их состав, классификация и сохранение (Biocoenoses of eastern Baltic islets, their composition and protection). Таллинн. Т. 1–2. (In Russian; abstract in English).

Хорева М.Г. 2003. Флора островов Северной Охотии (Island flora of the Northern Okhotia). Магадан. (In Russian).

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POSSIBILITY OF SURVIVAL OF *ROBINIA PSEUDACCACIA* IN DECIDUOUS FOREST

Daiva Patalauskaitė

Patalauskaitė D. 2007. Possibility of survival of *Robinia pseudaccacia* in decidous forest. *Acta Biol. Univ. Daugavp., 7 (2): 129 - 132.*

The deciduous forest communities (as. *Tilio-Quercetum roboris* Czerwinski 1973) with introduced *Robinia pseudaccacia* in Romainiai forest were investigated. The investigations revealed that young plants of *Robinia pseudaccacia* in natural deciduous communities are not concurentable. It shows good ability of regeneration and is found in the 2nd tree layer and undergrowth and occurs only in the erodated part of the slope.

Key words: *Robinia pseudaccacia,* introduction, deciduous forest, Lithuania

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Introduction

Lithuanian forests are quite rich in alien ligneous plants. Some are refugees from ornamental plantations and have spread into natural communities now. In some areas they were planted for various purposes. Some decades ago Lithuanian forest industry began to search of technically valuable and rapidly growing species. This was the main reason for introduction of alien ligneous species in some forestries. The most common species are *Larix decidua, Larix sibirica, Pinus banksiana, Quercus rubra, Padus serotina* (Matuliauskas & Ramanauskas, 1962). *Robinia pseudaccacia* was introduced in poor sandy soils. Plantations of this species were found in Romainiai forest in Kaunas (Kaunas forestry enterprise, Sitkūnai forestry district, quarter 179, plots 15, 16). Investigations were carried out to ascertain tendencies of distribution of *Robinia pseudaccacia* in natural deciduous forests.

Material and Methods

Investigations were carried out in Romainiai forest in Kaunas (Kaunas forestry enterprise, Sitkūnai forestry district, quarter 179, plots 15, 16). Forest communities were investigated in 2006 according the approach of the French-Swiss geobotanical school (Braun-Blanquet, 1964). Geobotanical relevés were 20 x 20 m with homogenous vegetation. The abundance and coverage of each species were determinated according to J. Braun-Blanquet scale. Total vegetation coverage was evaluated visually and recorded in a percentage scale for each vegetation layer. Plant names follow Z. Gudžinskas (1999).

Results and Discusion

The investigated territory (quarter 179, plots 15, 16) is situated on the southern slopes of the Nemunas River valley terraces and in plains over

Table 1. Floristic composition of the forest communities with *Robinia pseudaccac*

Current number	1	2	3
Cover % trees a	70	70	80
b	20	25	30
c	70	20	10
d	20	-	1
shrubs	10	15	20
herbs	30	60	70
bryophytes	-	-	-
Number of species in record	16	12	25
Acer platanoides a	-	-	3
b	1	2	2
c	3	2	1
d	2	-	-
Aesculus hippocastanum d	-	-	+
Fraxinus excelsior a	-	-	2
c	-	-	+
d	1	-	-
Quercus robur a	-	-	1
b	2	-	-
c	-	-	-
Rhamnus carthartica c	-	+	-
Robinia pseudaccacia a	3	3	-
b	+	1	-
c	-	+	+
Tilia cordata a	-	-	2
b	2	-	1
c	-	-	1
Ulmus minor c	-	+	-
Ulmus glabra b	-	1	-
c	-	+	-
Cl. Querco-Fagetea			
Adoxa moschatellina	1	-	+
Aegopodium podagraria	-	-	3
Brachypodium sylvaticum	-	-	+
Corylus avellana	2	+	1
Ficaria verna	+	-	2
Lamiastrum`galeobdolon	-	-	2
Lonicera xylosteum	-	-	1
Polygonatum multiflorum	-	-	+
Stachys sylvatica	-	-	+
Stellaria holostea	-	-	3
Accompanying species			
Alliaria petiolata	1	-	-
Allium oleraceum	+	2	-
Chelidonium majus	+	3	-
Cornus sanguineus	-	-	+
Galeopsis sp.	+	-	-
Geranium robertianum	-	2	+
Geum urbanum	-	-	+
Lamium purpureum	-	+	-
Majanthemum bifolium	-	-	1
Moehringia trinervia	+	-	-
Oxalis acetosella	2	-	-
Ribes uva-crispa	+	-	+
Sorbaria sorbarioides	-	2	-
Torilis japonica	-	+	-
Urtica dioica	+	-	-
Viola riviniana	-	-	+

Relevé sites:

No 1 (2006-6). Kaunas forestry enterprise, Romainiai forest, Sitkûnai forestry district, quarter 179, plot 16, in plain over the terraces slopes.

No 2 (2006-7). Kaunas forestry enterprise, Romainiai forest, Sitkûnai forestry district, quarter 179, plot 15 on steep southern slope, the inclination about 45-55°.

No 3 (2006-9). Kaunas forestry enterprise, Romainiai forest, Sitkûnai forestry district, quarter 179, plot 15, on plane southern slope.

the terraces. The territory is rich in ravines, rivulets and springs. These plots are occupied by deciduous forest communities (as. *Tilio-Quercetum roboris* Czerwinski 1973). In some areas *Robinia pseudaccacia* have been planted. In these communities (Table 1, relevés 1and 2) *Robinia pseudaccacia* is dominating in the upper canopy. In the relevé 1 *Robinia pseudaccacia* is absent in other layer except upper canopy. Deciduous trees are abundant there and it is evident that the *Tilio-Quercetum* communities are restoring. In the 2nd tree layer and undergrowth deciduous trees *Acer platanoides, Quercus robur, Tilia cordata* dominate. Coverage of the undergrowth and shrub layer is 80 %. The lower layers get small amount of light therefore coverage of herbs is only 30 %. The most abundant species are *Oxalis acetosella, Adoxa moschatellina, Alliaria petiolata.* The moss cover is absent due to thick litter of leaves accumulated from the last year. The second relevé was made in the quarter 179, plot 15, on steep southern slope (the inclination about 45-55°). The part of the slope is erodated, the soil is friable sand. In the lower tree layer *Robinia pseudaccacia* is found in the erodated part only. On the non-erodated part of the slope deciduous trees *Acer platanoides, Ulmus glabra* are dominating in the lower canopy. The same tendencies were revealed in the undergrowth: *Robinia pseudaccacia* was scarcely growing only in the erodated part of the slope: in the plot of 10 x 10 m only 3 individuals of 1,5 m hight were found. In the non-erodated part of the slope nemoral species *Acer platanoides, Ulmus minor, Ulmus glabra* are dominating. The coverage of herb layer was 60 %. Dominating species were *Chelidonium majus* (non-erodated part) and *Allium oleraceum* (the erodated part). Other herb species were not abundant. Moss species have not been found.

In the relevé No 3 the communities of deciduous forest (as. *Tilio-Quercetum roboris*) neighbouring with planted *Robinia pseudaccacia* plot was described. In the tree layers and undergrowth nemoral species *Acer platanoides, Fraxinus excelsior, Quercus robur, Tilia cordata* were dominating. *Robinia pseudaccacia* was found in the undergrowth only; here it was distributed by root sprouts. 7 living and 5 dead individuals (about 1 m high) were found. Living individuals were weak viable with damaged top shoots.

Conclusion

Investigations carried out in Romainiai forest revealed that young plants of *Robinia pseudaccacia* are not concurentable in natural deciduous forest (as. *Tilio-Quercetum roboris*). Planted trees dominate in the upper layer, but the regenerated individuals are dying in lower layers. *Robinia pseudaccacia* was found in the 2nd tree layer and undergrowth in the erodated part of the slope, where it regenerates from root shoots and is more concurentable than native species.

References

Braun-Blanquet J., 1964. Pflanzensoziologie. Grundzuge der vegetationskunde. Wien-New York.

Gudžinskas Z., 1999. Lietuvos induočiai augalai. Vilnius. (In Lithuanian).

Matuliauskas B., Ramanauskas V., 1962. Egzotai Lietuvos miškuose. In: Kairiūkštis L.(ed.): Lietuvos TSR miškai. Pp. 292-310. – Vilnius. (In Lithuanian, summary in russian and german).

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BIOLOGICAL DIVERSITY POLITICS: CONSERVING PLANT DIVERSITY FROM GLOBAL TO LOCAL SCALE

Vida Motiekaitytė

Motiekaitytė V. 2007. Biological diversity politics: conserving plant diversity from global to local scale. *Acta Biol. Univ. Daugavp., 7 (2): 133 - 138.*

Conservation biology research is being performed together with social economic research in search of sustainable use of biological diversity and developing protected territories management plans. The long-term goal of in situ conservation is to protect, manage and monitor populations in natural habitats so the evolutionary processes can be handled, thus allowing new variation to be generated in the gene pool that will allow the species to survive in changing environmental conditions. It is not so simple to assess risk level of majority of endemic species and so a part of them are not included into the Red lists. The purpose of Important Plant Areas conception is to select territories, which would form the pool of territories "waiting their turn" to be integrated into the system of national protected territories. If threatened species are to be effectively conserved within boundaries of protected territories, it requires that they be adequately managed and monitored, but very few protected areas report having comprehensive monitoring and management planes.

Key words: biological diversity politics, plant diversity, conservation in situ, Pan-Europe, hotspots, GSPC

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Introduction

More than one decade passed after International Convention of Biological Diversity (CDB) was initiated. The aim of biological diversity research programs is to answer the following question: What are the ways to stop the loss of biological diversity significantly until 2010? Starting with the last decade of the twentieth century, research of plant diversity in East and Central Europe was being developed from changed reference point, as other social and economical factors started influencing ecosystems. After Lithuania joined CBD, plant diversity and landscape politics became one of the priorities in research of natural and social sciences (Eringis, Pakalnis, 2005).

The aim of the paper: to summarize relevant studies of plants and their communities diversity conservation in situ, sustainable use of ecosystems, and approval of selection criteria of planned to be established protected areas.

Material and methods

The paper includes the newest data on biological diversity politics published and/or announced in international conferences. The most important attention is given to Pan-Europe as per territory description presented in Flora Europaea (Richard et al., 2004) and its regions including East and Central Europe. In the paper analysis on the data of applied conservation biology, directly related with the first two objectives of Global Strategy for Plant Conservation (CBD Secretariat, 2002): 1. Understanding and Documenting Plant Diversity (includes 1-3 planned targets), 2. Conserving Plant Diversity (4-5) is carried out. Data and material collected by the author during scientific expeditions in Lithuanian conserved territories in 1981 – 2005 are also used in this paper.

Results and discussions

The main aims of CDB are as follow: conservation of biological diversity, sustainable use of its components, fair and equality based distribution of benefit, received from genetic resources (Zedan, 2004). Global Strategy for Plant Conservation (decision VI/9) was approved during CBD conference in Hague, 2002. In some countries (USA, Australia, a few of European countries) considerable attention is paid to in situ conservation and management plans are in place for some species. In others there is a lively interest but little action. The global number of species that are covered by conservation or management plans is about 1 percent of the total. All activity related to CBD include conservation biology research, which is being performed together with social economic research: in search of sustainable use of biological diversity and developing protected territories management plans. In West Europe International Plant Exchange Network (IPEN) system has been established, which defends the rights of origination countries to plant diversity and regulates benefit received from plant resources distribution order (Feit et al., 2005).

Understanding and Documenting Plant Diversity
The list of UK plant (and fungi) species, which summarizes overspread information on taxonomy, systematics, nomenclature, prevalence, frequency, habitat details, functioning of ecosystems, is nearly finished except some of fungi groups (JNCC et al., 2005). Diversity of vascular plants is relatively small – 2300 species, however, its cultural and ecological value is very high (GSPC targets 3-5). In other countries (and regions) data on plant (and fungi) diversity in situ and especially on structure of all organism groups, in respect to quality and quantity as well as distribution patterns, are not generalized. Constantly renewed species conservation status evaluation is one of the most important targets, as it is a basis of prioritizing conservation activities and assessing efficiency of measures used. IUCN has developed a set of criteria for conservation status evaluation recognized in international level (Hilton-Taylor, 2000). Frequent species monitoring is being performed in UK, as only evaluation of all plant species conservation status enables to get a view of relative threat for each species. The number of threatened plant species in Europe is estimated at 2000-3000, depending on the criteria adopted. CBN (Conservatoire Botanique National de Brest) carried out research to evaluate actual situation of 650 taxa prevailing in Europe and belonging to IUCN global categories extinct, extinct in the wild, critical rare (Richard et al., 2004). 83 species of 650 do not exist in wild habitats any more.

Only one fifth of species (131) investigated prevail in the Central and West Europe.

The most significant reason of extinction (90 % of all cases) is destruction of habitats, caused by: 1) agricultural activity (43 % of the cases); 2) development of infrastructure (34 %); 3) other causes (9%).

Bern Convention list (Annex I) includes only 159 species of European plant endemics, which are close to extinction group (24.5% of 650). The directive of EU Habitats (Annex II and IV) protects only 24.5% of close to extinction plant species.

Conserving Plant Diversity

In situ conservation is a meanly understood concept which covers a range of different situations that include native plant populations, ecosystems and landscapes (Leadley, 2006). Conservation of species in situ is widely interpreted as meaning their presence within a protected area, i.e. with the focus primarily on the ecosystem. In order to develop alternative conceptions of protected territories and set selection criteria, it is necessary to have thorough data on biological diversity distribution in the level of regions, continents, the Earth. Starting with evaluation of territories having global importance to plant diversity, we will discuss theoretical perfection of protected territory models. United nations have announced the list of protected territories (Chape et al., 2003). Globally important biological diversity territories are called territories of hotspots (Mittermeier et al., 2004). Now the number of these areas is increased from 25 to 34 by Conservation International proposal. Very important criteria of territory refer to hotspots ecosystems in respect to theoretical aspect: 1) hotspot has at least 1500 endemic vascular plant species; 2) at least 70% of original vegetation is destroyed. One half of all plant species in the planet prevail in hot spots, but destroyed vegetation of these territories occupies only 2.3% of the Earth area. Some of plant species evaluations are only approximate, as hot spots limits do not coincide with national limits, used in floras. Further conservation activities in hot spots territories cover risk species inclusion into global IUCN red list and Important Plant Areas (IPA) identification within their limits.

Natura 2000 network is established in order to preserve rare endangered species of plants, animals as well as their habitats all over Europe (Evans, 2006). The first list of community importance territories was approved by EU in 2001 – Macaronesia (Azores, Madeira, Canary), in 2003 – Alpine region, in 2004 – Atlantic and Continental region, in the end of 2005 – Boreal region. The next list is being developed for Mediterranean region, which is very rich in respect to plant diversity. Currently 20 000 territories are included, which occupy 600 000 km^2 (for comparison – National Parks of USA occupy 200 000 km^2.)

Habitats Directive includes: 1)225 habitats, for which SAC shall be established (Annex I); 2)869 species under extinction, SAC are also required, including 572 plants (Annex II); 3) the species, which require special protection means (Annex IV); 4) the species, which have conservation concern, but controlled use is allowed (Annex V).

It showed up a strict tendency to give priorities to some new types of habitats, but not include new species into the list (the same with endemic species). The plant diversity conservation in situ depends critically on identification of habitats and protecting both the habitat and the species through management or monitoring. Habitats (Annex I), in respect to size and homogeneity, are very different, from discrete, minimal size to landscape units. About one third of habitats are semi natural: grasslands and meadows, dehesas and other wooded meadows, dry heaths (Motiekaityte et al., 2004).

Different EU countries select different strategies of habitat directive implementation: territory selection, especially determining of limits, and their management. Some of the countries set the limits of territories considering scientific concerns and apply planned control for their protection due to neighborhood activities. Network of Sites of special Scientific Interest (SSSI) is validated in UK. Now, UK conservation territories system includes 6761 SSSI type territories (total area 2 377 714 ha).

The system of IPA development coincides with GSPC target 5. IPA is natural or semi natural area with distinctive botanical richness and/or having distinctive set of rare, endangered and/or endemic species and/or vegetation of high botanical value. In contradiction to other protected territories selection criteria, three plant diversity criteria are applied in IPA: threatened species (A); botanic richness (B); threatened habitats (C).

A criterion: the territory has to include one or more species population of global or regional value; B criterion: territory is to have distinctively rich flora on regional basis and its biogeographic zone. C criterion: territory shall be distinctive example of global and regional conservation and habitat or vegetation type of botanic importance. IPA conception establishers underline improvement of lists of species and habitats valid in particular region (GSPC target 1).

The purpose of IPA conception is to select territories, which would form the pool of territories "waiting their turn" to be integrated into the system of national protected territories. IPA is not a legal designation. IPA (796 territories, 14 739 174 ha) was selected for the first time in 7 countries of Central and East Europe (Belarus, Czech, Estonia, Poland, Romania, Slovakia, Slovenia) (Anderson et al., 2005). In Central and East Europe 21% of IPA network is not yet included into legally protected territory systems. Specific risks for each IPA have been assessed. The main risk is bad practice of forestry (it formed half of all cases). Most important reason is that there is no efficient forestry policy in EU level, contrary in agriculture. The second risk is caused by tourism and recreation activity (affects 38 % of IPA). First Plant microreserves (PMR) were established in Valencia region, in 1994. It is a new model of conservation adopted in European and other regions (Laguna et al., 2004). Objectives PMR until 2006: inventory all PMR in Valencia region; target species (600 taxa, 350 endemic) and vegetation types (habitats of the first priority) long term tendencies monitoring; ecological restoration, reinforcement of populations, or new populations establishment.

PMR areas are legally limited to 20 ha because of two reasons. First, PMR purpose is not territories conservation (isolation), but their plant diversity inventory and monitoring. Second, the best populations of target species usually are distributed in territories larger than 20 ha. Exclusively, 2 or 3 PMR may be established nearby. PMR may be identified for the only species, high botanic value zones. PMR are reserves protected by the law, and they ensure severe protection of plants and substratum, where traditional activity is harmonized with plant conservation. PMR may be established in large protected territories in order to observe target species.

Now 230 PMR are established, all together they occupy 1440 ha or 0,057% of Valencia region. Management plan is being executed after PMR establishment.

The "hands-off" strategy for plant diversity conservation

The strategy of preserving enough habitats to ensure the presence of viable populations of all wild species of a region is known as the "hands-off" strategy in conservation. It is recommended for species which are not under threat. In this case the most sensible and effective policy is to leave the species to conserve itself in the natural habitats. The hands-off approach is based on the premise that plant diversity is safely protected in ecosystems and when various habitats and species became threatened, peculiar management action could be taken. Unfortunately, now about a quarter of the Earth plant species are threatened and proportion can only get worse. For most wild species the best that we can hope for is to establish and monitor their presence in some form of protected area. If threatened species are to be effectively conserved within their boundaries, it requires that they be adequately managed and monitored, but very few protected areas report having the programmes of comprehensive monitoring and management.

Conclusions

1. The applied significance and public interest of the plant diversity conservation research is the preparation of universally acceptable working list of known plant species; effective conservation of important plant areas; measure of intensively used production land and plant diversity conservation; the

conservation of threatened species joining in situ and ex situ methods.

2. In situ plant conservation is related with such activities as preparation of detailed single-species recovery plans, single-species management and monitoring plans, multi-species recovery and management plans, habitat protection and management. Although, in situ species conservation is a species-driven process, it also necessarily involves habitat protection.

3. The strategic aim of biological diversity conservation is the conservation of each population variety in a maximum possible number of biotic community contours, and within their limits maximum possible number of ecotops. The objectives of the plant diversity conservation taking into consideration the global change of the climate; 1) the conservation of habitats including the unique ones; 2) the conservation of vital, capable to evolve populations preferably all known species.

References

Anderson S., Kušik T., Radford E. (eds.). Important Plant Areas in Central and Eastern Europe. Priority Sites for Plant Conservation. U.K.: Plantlife International, 2005. 102 P.

Chape, S., Blyth, S., Fish, L., Fox, P., and Spalding, M. (compilers). 2003 United Nations List of Protected Areas. Gland, Switzerland and Cambridge, UK: IUCN, and Cambridge, UK: UNEP World Conservation Monitoring Centre, 2003.

Eringis K., Pakalnis R. (Sud.). Kraštovaizdžio politikos ištakos. Vilnius: Botanikos instituto leidykla, 2005. 192 P.

Evans D. Natura 2000. Completing the EU s network of sites to conserve flora and fauna. Plant Talk, 2005, N 39. P. 22-27

Feit U., Driesch von den M., Lobin W. (eds.) Access and Benefit-Sharing of Genetic Resources. Ways and means for facilitating biodiversity research and conservation while safeguarding ABC provisions. Report of an international workshop in Bonn, Germany held in 2005, 8-10 November. 2005. Bonn: Federal Agency for Nature Conservation. 122P.

Hilton-Taylor C. (compiler). 2000 IUCN Red List of Threatened Species. Gland, Switzerland and Cambridge, UK: IUCN, 2000.

JNCC, Plantlife, Royal Botanic Gardens Kew. Plant Diversity Challenge. The UK s response to the Global Strategy for Plant Conservation. Peterborough: JNCC, Plantlife, Royal Botanic Gardens Kew, 2004. 53 P.

Laguna E., Deltoro V., Perez-Botella V., Serra L., Olivares A., Fabregat C. The role of small reserves in plant conservation in aregion of high diversity in eastern Spain. Biological Conservation, 2004 Vol. 119, 421-426 P.

Leadley E. (ed.). Taxonomy and plant conservation: the cornerstone of the conservation and sustainable use of plants. Cambrige: Cambrige Univ. Press, 2006. 343 S.

Mittermeier R.A., Robles-Gil P., Hoffmann M., Pilgrim J.D., Brooks T.B., Mittermeier C.G., Lamoreux J.L., Fonseca G.A.B. 2004. Hotspots Revisited: Earth's Biologically Richest and Most Endangered Ecoregions. CEMEX, Mexico City, Mexico: CEMEX, 2004. 391P.

Motiekaityte V., Meškauskaite E., Vainorienė R. Phytosociological analysis of vegetation of Šaukliai and Kulaliai (Skuodas district) boulder accumulations. Botanica Lithuanica, 2004. Vol.10. N4. P. 261–269.

Richard D., Buord S., Lesouef J.Y. Consolidating knowledge on plant species in need for urgen attention at european level. 4th European Conference on the Conservation of Wild Plants, 17-20 September 2004, Valencia, Spain. Electronic Database accessible at www.nerium.net/plantaeuropa/Download/Procedings/Richard_et_al.pdf

Zedan H. Reducing biodiversity loss by 2010: a challenge for the CBD and for botanic gardens. Botanic Gardens: A World of Resources and Heritage for Humankind: 2nd World Botanic Gardens Congress, 17-22 April, Barcelona. (BGCI, eds.). Barcelona: BGCI, CSIC (electronic resource).

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GENUS *CHARA* L. IN LATVIA – FRESHWATER SPECIES AND THEIR IDENTIFICATION

Egita Zviedre

Zviedre E. 2007. Genus *Chara* L. in Latvia – freshwater species and their identification. *Acta Biol. Univ. Daugavp., 7 (2): 139 - 147.*

Chara L. is the richest of freshwater Charophyta genera in species in Latvia. Investigation of the genus *Chara* was carried out in summers 2002–2005 throughout Latvia. 11 species of *Chara* were recorded and herbaria were collected: *C. aspera, C. contraria*, *C. filiformis, C. globularis*, *C. hispida, C. intermedia, C. rudis*, *C. strigosa*, *C. tomentosa*, *C. virgata* and *C. vulgaris*. Species descriptions with the nomenclature and an identification key are made. For this purpose collected herbaria and literature were used. All herbarium material of the genus *Chara* (end of 19th and begining of 20th century) in the Herbarium of University of Latvia (RIG) and Latvian Museum of Natural History (LDM) was checked.

Key words: Chara, Charophyta, Latvia, macrophytes

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Introduction

Chara L. is the richest freshwater Charophyta genera in species in Latvia. *Chara* algae that grow in Latvia have a double ring of spines on the base of the branchlet whorls - stipulodes. Cortex cell rows are characteristic for all *Chara* species in Latvia. On the cortex, spine cells are present in many species of *Chara*.

The first record of *Chara* in the present territory of Latvia is found in the J. Fischer (Fischer 1791) paper, where only one species *C. vulgaris* is mentioned. The paper gives a short morphological description of the species and information about the habitats where these algae grow.

Heugel and Lindeman collected the first herbaria, which have remained in the Herbarium of Faculty of Biology (RIG). At that time quite a lot information about charophytes in Estonia had accumulated, which promoted investigations in the territory of Latvia. The list of *Chara* species and short information about the localities where the herbaria were collected was published by C. A. Heugel in "Bemerkungen und Beiträge zur Flora der Ostsee-Provinzen" (Heugel 1852). In the territory of Latvia six species were recorded – *C. aspera*, *C. canescens*, *C. globularis*, *C. hispida*, *C. tomentosa* and *C. vulgaris*.

"Vorarbeiten zu einer Algenflora vo Lettland. IV." (Skuja 1928) was the first extensive overview of charophytes in Latvia. Eight freswater *Chara* species were included in the list - *C. aspera*, *C. contraria*, *C. globularis*, *C. hispida*, *C. intermedia*, *C. rudis*, *C. tomentosa* and *C. vulgaris*.

The investigations of the flora and vegetation of Lake Usma by E. Ozoliņa (Ozoliņa 1931) were very significant. This was the first major investigation of the charophytes local flora in Latvia. She reported a new *Chara* species for Latvia, *C. virgata* from this lake. Herbaria of E. Ozoliņa are stored at the Latvian Museum of Natural History (LDM).

The fist identification key for the most common algae, which included five species of freshwater *Chara* was published by A. Rudzroga (Rudzroga 1995). A short description of species morphology and ecology was given.

Significant regional and local surveys of the occurence of *Chara* in freshwater later were published by Z. Spuris (Spuris 1952) and U. Suško (Suško 1994; Suško 1997).

Irrespective of the previous investigations of *Chara* only some herbaria were preserved. There was no identification key for all freshwater species in Latvia

Materials and Methods

Investigation of the genus *Chara* was carried out in summer 2002–2005 in Latvia. A total of 150 localities (lakes, pits, ponds, rivers, ditches and bogs) were surveyed. New herbaria were collected and stored in the Latvian Museum of Natural History. One or more herbaria of each found species were collected from each investigated locality. The new information about *Chara* habitats and occurrence was prepared. *Chara* herbaria collected by A. Opmanis, L. Eņģele, Z. Deķere, and P. Evarts-Bunders were identified and included in this investigation, too. The short herbaria label information was registered in a publicly available database www.meandrs.lv (in Latvian).

Previously collected *Chara* herbaria were analysed in all publicly available herbaria: University of Latvia, Faculty of Biology (RIG) and Latvian Museum of Natural History (LDM).

A species identification keys and descriptions were made. For this purpose, the collected herbaria and literature (Krause 1997; Langangen et al. 2002; Schubert, Blindow (eds) 2003; Ćīėėåšįąõ, Źšąńąāčķą 1986) were used. Minimal and maximal length of algae, diameter of main axis, length of branchlets and internodes was measured for all collected herbaria.

Results and discussion

Key to *Chara*

1 Cortex diplostichous (i.e. spine-cells on every second row) ………..........................……………2

1* Cortex triplostichous (i.e. spine-cells, if present, on every third cortical row) ....……8

2 Cortex aulacanthous (i.e. cortical rows with spine cells less prominent) …......................……….3

2* Cortex tylacanthous (i.e. cortical rows with spine cells more prominent) ……........................…..5

3 Spine-cells only single ……………………..........................…………………....11. *Chara vulgaris*

3* Spine-cells often 2-4 together, sometimes single ……..……………..……4

4 Spine-cells do not give the algae a spiny appearance. Aulacanthous cortex with marked difference between primary and secondary cortical rows…..… 7. *Chara rudis*

4* Spine-cells acute and give the algae a spiny appearance. Aulacanthous, often isostichous on older internodes. Do not have marked difference between primary and secondary cortical rows.. 5. *Chara hispida*

5 Branchlets reduced .... 3. *Chara filiformis*

5* Branchlets well developed 6

6 Spine-cells only single .... 2. *Chara contraria*

6* Spine-cells often 2-3 together, sometimes single 7

7 Dioecious. Spine-cells, stipulodes and bract-cells tumid .... 9. *Chara tomentosa*

7* Monoecious. Spine-cells, stipulodes and bract-cells not tumid .... 6. *Chara intermedia*

8 Spine-cells long, acute 9

8* Spine-cells absent or small, papilloform 10

9 Monoecious. Spine cells in bunces of 2-3. On rhizoids sometimes bulbils .... 8. *Chara strigosa*

9* Dioecious. Spine-cells single. White, circular bulbils often on rhizoids .... 1. *Chara aspera*

10 Both rows of stipulodes reduced. Spine-cells not present .... 4. *Chara globularis*

10* Upper row of stipulodes acute, lower papilliform. Spine-cells present, but small, papilliform .... 10. *Chara virgata*

The species

1. Chara aspera Willd.

Chara aspera Willd. 1809, Gesell. Nat. Freunde **3**: 298; Heugel, 1852, Correspondenzbl. des Naturf. Vereins zu Riga, **5**: 137; Skuja, 1928, Acta Horti Bot. Univers. Latv. **3**: 199; Голлербах, Красавина 1983, Опред. пресновод. водорослей СССР, **14**: 152; Rudzroga, 1995, Izplat. Latvijas aļģu not.: 85; Krause 1997, Charales. Süsswasserfl. von Mitteleuropa: 95.

Algae 3-50 cm high, axes 0.2-0.5 mm in diameter. Thalli of algae very variable, depending on water depth. The shorter specimens from shallower water are more branched than longer algae from deeper water. Each whorl has 6-9 branchlets, up to 2 cm long. Two rows of well developed stipulodes. Cortex triplostichous with generally solitary, acute spine-cells, often as long as the main axis diameter. Dioecious. Most studied specimens are fertile. Unicellular, globular white bulbils on rhizoids are very characteristic for the species. In standing waters on sand, gravel, mud, dolomite. Common in all territory, mainly in lakes and pits.

Herbarium material. RIG: Some *C. aspera* herbaria were occasionaly determined as *C. canescens* (Kurzeme region – according to geography of the end of 19th, Heugel, Lindemann), *C. vulgaris* (Lake Engure, 1906), *C. globularis* (Čužu bog, Kupfer, 1921) and *Nitella flexilis* (Unknown locality, possibly from Estonia). Herbaria collected in Lake Usma (Kupfer, 1913) and in Daugavpils region (Elerne, Sīķele) in a small pond (Kupfer) were identified correctly as *C. aspera*.

LDM: No misidentifications of *C. aspera* herbaria (Ozoliņa, 1929-1930).

2. *Chara contraria* A. Braun ex Kütz.

Chara contraria A. Braun ex Kütz. 1845, Phyc. Germ., p. 258, s. str.; Skuja, 1928, Acta Horti Bot. Univers. Latv. **3**: 199; Голлербах, Красавина 1983, Опред. пресновод. водорослей СССР, **14**: 136; Krause 1997, Charales. Süsswasserfl. von Mitteleuropa: 83.

Algae 5-40 (60) cm high. Axes 0.4-1.1 mm in diameter. Thalli of algae very variable, depending on water depth. Smaller specimens are common in shallow waters of lakes and pits. The colour is greyish green or sometimes brownish green, usually incrusted. Each whorl has 6-8 (10) branchlets. They have 4-7 segments, of which the upper 2-3 usually are ecorticated. The internodes are 2-4 times as long as branchlets. Two rows of stipulodes. Stipulodes can be both - well developed and short. Bract cells are well developed or reduced. Cortex diplostichous, tylacanthous with single, variable length spine-cells. Monoecious. Most collected herbaria are fertile. In standing waters or slowly running water on sand, gravel, mud, carbonate sediments in springs. Common in all territory. Mainly in lakes, pits and pounds.

Herbarium material. RIG: Some herbaria of *C. vulgaris* (Lake Engure, Kupfer, 1906) and *C. globularis* (Daugavpils, ditch in Grīva, 1894) turned out to be *C. contaria*. Misidentified *C. contaria* was collected in Virbupe (Kupfer, 1921) and in vicinity of Berģi in Riga (Kupfer, 1918).

3. *Chara filiformis* Hertzsch

Chara filiformis Hertzsch, 1855, Hedwigia, **1(12)**: 81; Голлербах, Красавина 1983, Опред. пресновод. водорослей СССР, **14**: 128; Suško 1997, Daba un muzejs **7**: 37; Krause 1997, Charales. Süsswasserfl. von Mitteleuropa: 86.

Algae up to 40 cm high. Axes 0.3-1 mm in diameter. The colour is greyish green, usually incrusted. Branches well developed, especially smaller individuals. Each whorl has 4-8 very reduced (5 – 50 mm) branchlets. The internodes are 3-6 (10) cm long. Two less or more reduced rows of stipulodes. Cortex diplostichous, tylacanthous, rarely - isostichous with single, almost reduced spine cells. Monoecious. Most collected herbaria are fertile. Irregular bulbils can be on rhizoids. In standing waters, with good light conditions on sand or mud. Quite common, only in southeast part of Latvia. In lakes and pits.

Herbarium material. No previously collected publicly available herbaria.

4. *Chara globularis* Thuill.

Chara globularis Thuill. 1799, Fl. Envir. Paris, ed. 2: 472; Krause 1997, Charales. Süsswasserfl. von Mitteleuropa: 87.

Chara fragilis Desv. 1810, Not. Pl. Fl. France: 137; Heugel, 1852, Correspondenzbl. des Naturf. Vereins zu Riga, **5**: 137; Skuja, 1928, Acta Horti Bot. Univers. Latv. **3**: 200; Голлербах, Красавина 1983, Опред. пресновод. водорослей СССР, **14**: 178; Rudzroga, 1995, Izplat. Latvijas aļģu not.: 85.

Algae 10-30 cm high, sometimes up to 60 cm. Axes 0.3-0.8 mm in diameter. Specimens green, can be incrusted. Each whorl has (6) 7-8 (9) branchlets, 0.7-3 cm long. Axis of individuals which grow in running waters are stronger, more robust and internodes are slightly longer as branchlets. Both rows of stipulodes rudimentary. Cortex triplostichous, isostichous without spines. Monoecious. Both fertile and sterile plants are common. Sometimes irregular, multicellular bulbils can be found on rhizoids. In standing and running waters on sand, mud and silt. Very common in all territory. In lakes, pits, pounds, rivers and ditches.

Herbarium material. RIG: Some *C. globularis* herbaria were occasionally identified as *C. vulgaris* (Riga, Heugel, 1852; Ķemeri, Heugel, 1850; Lake Engure, Kupfer, 1906). *C. globularis* was collected in Ķemeri (Heugel 1850), Smārde (Kupfer, 1924), Cērkstes river (Kupfer, 1906), vicinity of Ikšķile (Kupfer, 1922) and Čužu bog (Kupfer, 1921) as well as in Lake Laveru (Leg. F. Ludwig, I. Mikutowicz, 1906).

LDM: Some herbaria collected as *C. globularis* in Lake Usma (Ozoliņa, 1929-1930) turned out to be *C. virgata*.

5. *Chara hispida* (L.) Hartm.

Chara hispida (L.) Hartm. 1820, Handb. Skand. Fl., ed. 1: 376, Grindel, 1803, Bot. Taschenb. Liv. Cur. Ehst.: 272; Skuja, 1928, Acta Horti Bot. Univers. Latv. **3**: 200; Голлербах, Красавина 1983, Опред. пресновод. водорослей СССР, **14**: 160; Rudzroga, 1995, Izplat. Latvijas aļģu not.: 85; Krause 1997, Charales. Süsswasserfl. von Mitteleuropa: 71.

Algae 15-60 (80) cm high. Axes 1-4 mm in diameter. Algae often are robust, greyish green, incrusted. Each whorl has 8-11 branchlets, which can be up to 7 cm long. They have 7-9 segments, of which the lower 5-7 usually are corticated. The internodes are up to 10 cm long. Two rows of well developed stipulodes. There are 5-7 bract cells. Longer bract cells can be up to twice as long as oogonia. Cortex diplostichous, aulacanthous, often isostichous on older internodes. Spine-cells are acute, dense on younger internodes, mainly in bunches of 2-4. Spine-cells usually are as long as axis diameter or on older internodes shorter than axis diameter. Most collected specimens are fertile. In standing waters on sand, mud, silt, carbonate sediments in springs. Quite common, mainly in central part and southeast of Latvia. In lakes, sometimes in pits.

Herbarium material. RIG, LDM: No misidentifications of the species. Herbaria of *C. hispida* were collected in Lake Engure (Kupfer,1906), Abava river next to Kandava (Ozoliņa, 1927), in Lake Valgums (Kupfer 1924), in Tukums (unknown) and in Lake Dzirnezers (Kupfer, 1906)

6. *Chara intermedia* A. Braun

Chara intermedia A. Braun 1859, in: A. Braun, Rabenh. & Stizenb., Char. Exs. No. 46; Skuja, 1928, Acta Horti Bot. Univers. Latv. **3**: 200; Krause 1997, Charales. Süsswasserfl. von Mitteleuropa: 79.
Chara aculeolata Kütz. in Rchb., 1832, Flora Germanica, 1; Голлербах, Красавина 1983, Опред. пресновод. водорослей СССР, 14: 133; Suško 1994, Dabas izpētes vēstis, 1 (4): 13. Rudzroga, 1995, Izplat. Latvijas aļģu not.: 85.

Algae 15-50 cm high. Axes 0.6-2 mm in diameter. Algae often are robust, greyish green up to brownish green, incrusted. Cortex generally is slightly shiny. Each whorl has 8-12 branchlets, which can be up to 7 cm long, usually 2-3 cm long. Branchlets on the top of thallom, except last whorls, are of approximately equal size. The branchlets have 5-7 corticate and 1-2 ecorticate segments. Two rows of well developed stipulodes. Bract cells are short or longer than the branchlet diameter. Cortex diplostichous, tylacanthous, sometimes - isostichous. Spine-cells are normaly shorter than axis diameter, longer – acute, shorter – papiloform, single or in bunches of 2-3. Monoecious. Most studies specimens are fertile. In standing waters on sand, mud, silt. Quite common in all territory of Latvia. Mainly in lakes, sometimes in pits.

Herbarium material. RIG: Herbaria collected as *C. tomentosa* in Kurzeme (according to the country borders of the end of 19th) turned out to be *C. intermedia* (Heugel).

7. *Chara rudis* A. Braun

Chara rudis A. Braun 1882, In: Leonhardi. Österr. Arml.-Gew. p.66; Skuja, 1928, Acta Horti Bot. Univers. Latv. **3**: 200; Голлербах, Красавина 1983, Опред. пресновод. водорослей СССР, **14**: 158; Krause 1997, Charales. Süsswasserfl. von Mitteleuropa: 126.

Algae 15-70 cm high. Axes 1-2 mm in diameter. Algae often are robust, greyish green, incrusted. Each whorl has (6) 7-9 (10) branchlets, which can be up to 7.5 cm long. The branchlets have 6-8 segments, of which 4-5 are corticated. Two rows of well developed stipulodes. 5-7 bract cells are situated along the branchlets. Longer bract cells are slighty longer than oogonia. Cortex diplostichous, aulacanthous. The diameter significantly differs between primary and secondary cortical rows. Spine-cells are shorter than axis diameter, do not give the algae a spiny appearance, usually in groups of 2 (3), rarely – single. On oldest axis the spine-cells can be erect. Most studied specimens are fertile. In standing waters on sand, mud, silt. Quite common, mainly in central part and southeast part of Latvia. In lakes, sometimes in artificially made water reservoirs.

Herbarium material. No previously collected publicly available herbaria.

8. *Chara strigosa* A. Braun

Chara strigosa A. Braun 1847, Neue Denkschr. Schweiz. Ges. Naturw., **10**; Голлербах, Красавина 1983, Опред. пресновод. водорослей СССР, **14**: 147; Susko 1997, Daba un muzejs **7**: 37; Krause 1997, Charales. Süsswasserfl. von Mitteleuropa: 102.

Algae 10-30 cm high. Axes up to 1 mm in diameter. Each whorl has 6-8 branchlets, up to 1.5 cm long. The branchlets have 6-9 segments. Two rows of well developed stipulodes. Cortex triplostichous, tylacanthous with acute spine-cells no shorter than axis diameter. Spine-cells single or in groups of 1-4, densely covering the young internodes which gives the algae a spiny apperance. Monoecious. Sometimes irregular bulbils can be found on rhizoids**.** In standing, clear waters on sand, mud. Rare, in lakes.

Herbarium material. No previously collected publicly available herbaria.

9. *Chara tomentosa* L.

Chara tomentosa L. 1753, Sp. Pl. **2**: 1156; Heugel, 1852, Correspondenzbl. des Naturf. Vereins zu Riga, **5**: 137; Голлербах, Красавина 1983, Опред. пресновод. водорослей СССР, **14**: 130; Krause 1997, Charales. Süsswasserfl. von Mitteleuropa: 68.

Chara ceratophylla Wallr. 1815, Fl. Crypt. Germ. **2**: 113; Skuja, 1928, Acta Horti Bot. Univers. Latv. **3**: 199;

Algae up to 70 cm high. Axes 1.5-3 mm in diameter. Algae are robust, branched, brownish to reddish-brown, incrusted. Individuls from the deeper water are green. Each whorl has 6-8 branchlets, usually 2-3 (5) cm long. The branchlets have 4-6 segments of which 1-2 are ecorticated. The ultimate cell of the branchlet is ecorticated, 0.2-2.7 cm long and mostly swollen. Swollen ultimate cells are very characteristic for the species. Two rows of well developed stipulodes. Bract cells up to 5 mm. Both stipulodes and bract cells are robust, swollen. Cortex diplostichous, tylacanthous. Spine-cells are shorter or longer than axis diameter, robust, swollen, single or in groups of 2-3. Dioecious. Most studied specimens are fertile. In standing waters on sand, mud, silt, gravel, carbonate sediments in springs. Common in all territory of Latvia. Mainly in lakes, sometimes in pits.

Herbarium material. RIG: Herbaria collected as *C. tomentosa* in Kurzeme (according to the country borders of the end of 19th) turned out to be *C. intermedia* (Heugel). *C. tomentosa* was collected and identified without misidentifications in Lake Kaņieris (Kupfer, 1896, 1897) and Lake Engure (Kupfer, 1906).

10. *Chara virgata* Kütz.

Chara virgata Kütz. 1834, Flora, **17**: 705.
Chara delicatula C. Agardh 1824, Syst. Alg., p.130; Ozoliņa, 1931, Acta Horti Bot. Univ. Latv., **6**: 10; Голлербах, Красавина 1983, Опред. пресновод. водорослей СССР, **14**: 182; Krause 1997, Charales. Süsswasserfl. von Mitteleuropa: 89.

Algae 3-30 cm high, sometimes up to 60 cm. Axes 0.3-0.5 mm in diameter. Algae are green, with characteristic, harsh smell, can be incrusted. Each whorl has 7-8 branchlets, which consist of 9-11 segments, the upper 1-3 are ecorticated. Branchlets of the thallom are of approximately equal size 7-17 m. Only on the top of thallom branchlets are shorter. Species has well developed upper row of stipulodes, but lower row of stipulodes is rudimentary. Bract cells are 2-3 longer as oogonia. Cortex triplostichous, tends to be tylacanthous. Spine-cells single, small, papilliform, sometimes - elongated. Monoecious. Most studied specimens are fertile. Bushy growth forms with multicellular bulbils are common in shallower water. In standing waters on sand, mud, silt. Common in all territory of Latvia. In lakes, pouns and pits.

Herbarium material. RIG: in *C. aspera* herbaria was found some specimens of *C. virgata* (Heugel, 1850). LDM: Some herbaria collected as *C. globularis* in Lake Usma (Ozoliņa, 1929-1930) turned out to be *C. virgata*.

11. *Chara vulgaris* L.

Chara vulgaris L. 1753, Sp. Pl. **2**: 1156, J. Fisch., 1791, Vers. Natrurg. Livl., 2. Aufl.: 617, sine auct.; Голлербах, Красавина 1983, Опред. пресновод. водорослей СССР, **14**: 154; Rudzroga, 1995, Izplat. Latvijas aļģu not.: 85; Krause 1997, Charales. Süsswasserfl. von Mitteleuropa: 81.

Chara foetida A. Braun, 1834, ann. Sci. Nat., sér. 2, **1**: 354**;** Skuja, 1928, Acta Horti Bot. Univers. Latv. **3**: 199;

Algae 15-30 (50) cm high. Axes 0.5-1 mm in diameter. Algae are green or greyish green, usually incrusted. Thalli of algae are branched. Each whorl has 5-9 (11) branchlets, up to 1.5 cm. Branchlets consist of 5-9 (11) segments, of which the upper 2-4 are ecorticated. Branchlets, except last whorls, are of approximately equal size. The internodes on the top of thallom are as long as branchlets, but on lower and central parts of thalli 2-4 as long as branchlets. Two rows of well developed stipulodes. Bract cells are usually very long which gives the algae a spiny apperance. Cortex diplostichous, aulacanthous with single, variable length spine-cells. Monoecious. Most studied specimens are fertile. In standing waters on sand, mud, gravel. Quite common in all territory. Mainly in pits or lakes.

Herbarium material. RIG: Herbaria collected as *C. vulgaris* in Ķemeri turned out to be *C. globularis* (Heugel, 1850) and *C. globularis* collected in Irlava (Det. I. Mikutowicz. 1894, Leg. Kupfer) turned out to be *C. vulgaris*. Herbaria of *C. aspera*, *C. contaria* and *C. globularis* were occasionally identified as *C. vulgaris* (Lake Engure, Kupfer, 1906). *C. tomentosa* was collected and identified without misidentifications in Tukums (unknown) and in Koknese (Kupfer, 1913).

Morphological variability in *Chara*.

The morphology of Charophyta depends greatly on ecological conditions of the environment (Голлербах, Красавина 1986). Therefore is very important to compare morphology of *Chara* growing in Latvia with descriptions of morphology in literature to develop correct identification keys to species and descriptions of *Chara*. For this purpose, collected herbaria and literature descriptions (Krause 1997; Langangen et al. 2002; Schubert, Blindow (eds) 2003; Голлербах, Красавина 1986) were used. Differences between literature and herbaria collected were found: minimal and maximal length of algae, diameter of main axis and length of branchlets and internodes.

C. aspera can reach 50 cm high in some lakes and water bodies of Latvia, which is 10-20 cm more than mentioned in the literature from Europe (Krause 1997; Moore 1986; Schubert, Blindow (ed) 2003; Голлербах, Красавина 1986). Thalli of algae are very variable, depending on water depth. In shallow water the thalli are small. In deep waters, *C. aspera* thalli are longer and always form large or small mats.

C. hispida usually is 15-60 (80) cm high. Longer *C. hispida* speciments have not been found in Latvia. This species can reach 2 m high in Germany (Krause 1997). As the thallus of *C. hispida* is shorter in Latvia, the longest internodes do not reach 15 cm (Krause 1997) and usually are shorter than 10 cm.

C. intermedia is 15-50 cm high. Shorter *C. intermedia* have not been found in this research. In Europe this species can be quite small - 8 cm high (Krause 1997) and even 5 cm high in Finland (Langangen, Koistinen u.c. 2002). Nonetheless it is possible that in shallow, well light waters, smaller individuals of this species can be found.

The main reasons, affecting height of *Chara*, are transparency of water and climate. The main effect is by transparency of water: when more light can penetrate into the water, *Chara* can form dense mats which stimulates them to grow longer. No other differences of the minimal and maximal height of other *Chara* species have been found. Branchlets of *C. rudis* can be up to 7.5 cm long, which is much longer than mentioned in the literature – 5 cm. Also *C. tomentosa* branchlets can reach 5 cm (up to 3 cm in the literature) and *C. strigosa* branchlets are slightly longer (1.5 cm) than described in the literature (1.2 cm) (Голлербах, Красавина 1986; Krause 1997). The length of branchlets depends on growing conditions and especially on light. The length of branchlets can differ due to ecological conditions, or because it is not a good feature for species identification and therefore has had less attention. The length of branchlets has not always been given in morphological descriptions of *Chara* (Krause 1997; Moore 1986; Schubert, Blindow (ed) 2003; Голлербах, Красавина 1986). No differences in length of branchlets for other species have been found between herbaria and the studied literature.

For most of species the diameter of main axis conforms to that in literature (Krause 1997; Moore 1986; Schubert, Blindow (ed) 2003; Голлербах, Красавина 1986). One exception is that the diameter of the main axis of *C. filiformis* can reach up to 1 mm in Latvia. Comparatively, the diameter of the *C. filiformis* main axis is 0.3-0.5 (0.75) mm (Голлербах, Красавина 1986; Krause 1997) in Europe.

The describe differences in morphological features (minimal and maximal length of algae, diameter of main axis, length of branchlets and internodes) are not essential for species identification, but characterize the diversity of *Chara* growing in Latvia.

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References

Fischer J. 1791. Versuch einer Naturgeschichte von Livland. 2. Aufl. –Königsberg: F. Nicolovius, 826 S.

Heugel, C. A. 1852. Bemerkungen und Beiträge zur Flora der Ostsee-Provinzen. - Correspondenzblatt des Naturforschenden Vereins zu Riga, **5**: 9-152.

Krause, W. 1997. Charales (Charophyceae). Süsswasserflora von Mitteleuropa, Band 18. Gustav Fischer Verlag, 202 S.

Langangen A., Koistinen M., Blindow I. 2002. The charophytes of Finland. – Memoranda Soc. Fauna Flora Fennica, **78**: 17-48.

Ozoliņa E. 1931. Ueber die höhere Vegetation des Usma-Sees. - Acta Horti Botanici Universitatis Latviensis, **6**: 1-74.

Rudzroga A., 1995. Izplatītāko Latvijas aļģu noteicējs. Rīga: Zinātne, 83-86.

Schubert H., Blindow I. (eds) 2003. Charophytes of the Baltic sea. The Baltic Marine Biologists Publication No. 19. Koeltz Scientific, Königstein. 326 p.

Skuja H. 1928. Vorarbeiten zu einer Algenflora von Lettland. IV. - Acta Horti Botanici Universitatis Latviensis, **3**: 103-218.

Spuris, Z. 1952. Lielauces ezera svarīgākās augstāko augu fitocenozes un ezera aizaugšana. - Latvijas ZA vēstis, 3 (56): 127-137.

Suško U. 1994. Mieturaļģu floristiskie pētījumi. - Dabas izpētes vēstis, 1 (4): 8-14.

Suško U. 1997. Augsdaugavas dabisko ezeru botāniski-limnoloģisko pētījumu rezultāti Indricas un Varnaviču ezerainēs. - Daba un Muzejs, **7**: 33-39.

Голлербах, М., Красавина, Л. 1986. Определитель пресноводных водорослей СССР. Выпуск 14. Харовые водоросли - Charophyta. Ленинград: Наука, 188

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New book from Warsaw Agricultural University Press:

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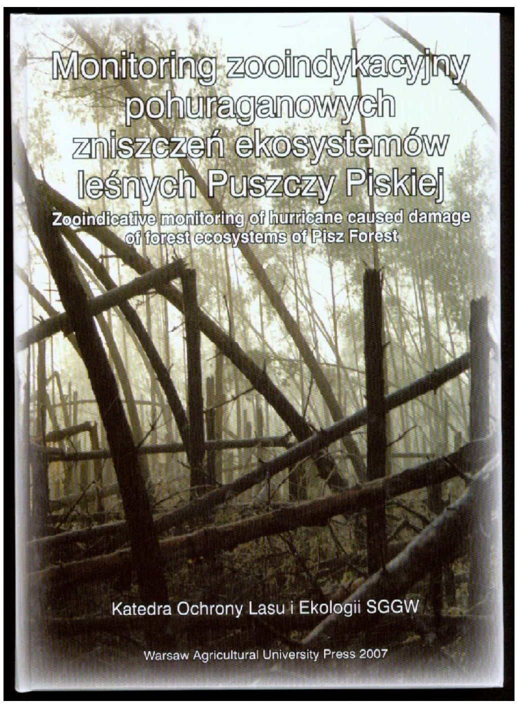

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Contents:

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INVASIVE TREE TAXA IN MAJOR DENDROLOGICAL PLANTATIONS IN JELGAVA DISTRICT

Gunta Jurševska

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This article content first information about invasive tree taxa in 10 major dendrological plantations in Jelgava district.

Key words: invasive species, trees, introduction, Jelgava district, dendrological plantations.

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Introduction

More and more territories are occupied by invasive species; they often even supersede local species from their natural area. In 2007 the amendments for the Law of Plants protection will come in force and there is given the following definition: Invasive plant species – a species which is not characteristic for nature of Latvia and which endangers local species and their habitats or causes economical losses, environmental or people health damages (Law project).

Occurrence of invasive or strange species in territory of Latvia or any other region has begun simultaneously with the introduction. Introduction of nutrition plants in the modern territory of Latvia has begun together with agriculture 2000 BC (Мауринь 1970), but the introduction of trees has begun in the 17th century together with the formation of the first parks. In the 19th century several big seed-plots existed in the territory of Latvia. For example, already in 1805 in Cigra seed-plot 150 kinds of decorative trees and bushes were offered for introduction, but in 1888 in Vagner's seed-plot – 489 trees (Мауринь 1970). At the moment the biggest in Latvia and one of the major live plant collections in Europe has been gathered in the National Botanic Garden in Salaspils; among all 5000 taxa of various trees have been introduced there (Svilāns 2005).

The introduced species, which were planted in plantations (parks, squares a.o.), can be traced more and more in habitats, which are subjected to anthropogenic influence: forests, ruderal biotopes, buffer zone near the roads (motorways, railways); the origins of the invasive species are even more common. These origins are unattended old parks near manor houses, seed-plots a.o. full of exotic species, wide invasions can be observed there. For example, in Jelgava district Vircava municipality *Spiraea* x *rosalba* Dipp. forms a dense, approximately 100 m^2 wide stand; in Mežciems, Jaunsvirlauka municipality *Rosa rugosa* Thunb. ex Murray stand occupies territory of the same size.

The task of the research is to recognize invasive species in the biggest dendrological plantations in Jelgava district and make the analysis of the results.

Material and methods

Available literature about the invasive species in Latvia and all over the world was investigated at the outset. 10 dendrologically richest stands in Jelgava district were taken at the basis of the research, these stands were chosen on the basis of the results of the auditing done before (Cinovskis, Bice, Knape, Šmite 1989). In Jelgava district the following objects were surveyed: Bērvircava park (45 introduced species), greenery near Glūda Elementary School (52), park near Eleja manor house (47), park near Lielplatone manor house (50), plantations in the centre of Ozolnieki (80), Mežciems, Sila street 3 (236), „Lībieši", Sidrabene municipality (130), park near Vilce Elementary School (35), Vircava park (38) and Park near Zaļā manor house (45). The layout of the objects in the district was taken into consideration, the aim was to observe as wide territory as possible (see picture 1). One of the criteria was also the historical value of the object, for example, in the end of the 17th century Vircava park was mentioned as one of the biggest gardens belonging to the Duke of Kurland (Kurzeme). All the chosen objects were surveyed in the summer 2006 and the herbarium of the peregrine taxons with a tendency to transfer wild was collected. The herbarium lies in Laboratory of Systematic Botany at Daugavpils University Institute of Systematic Biology (DAU).

The model developed by A.Svilāns in 2003 – classification of peregrine taxa according to their invasion abilities – was used for the classification of the invasive species (Svilāns 2003).

1st level: **Naturalized peregrine taxa** – taxa, whose distribution (invasion) has subsided (become stable) in the territory of Latvia; as well as taxa, which are to be exterminated, consumption of resources is needed for this reason and the negative consequences of the extermination are incommensurable wider than the damages done by these taxa to the environment. This group includes both archeophytes and neophytes.

2nd level: **Aggressive peregrine taxa** – taxa, whose distribution (invasion) speed or amount (in country, any region or habitat type) creates direct and obvious danger to environment. The interference is needed for the prevention of the invasion.

3rd level: **Temperate invasive peregrine taxa** – taxa, which have caused clear tendencies of distribution (invasion), but the dormant danger to the environment is unknown. Constant monitoring is needed.

4th level: **Little invasive peregrine taxa** – taxa, which do not distribute or distribute very rarely. Periodic monitoring is needed.

The following features are outlined for more precise classification of invasive trees according to invasivity in some region:

- Distribution rapidity of the taxa – it is capable to reproduce many new specimens in short terms, it becomes apparent as distribution of vegetative or generative material in vast amount or far from mother plant or as an ability to provide migration of specific genes by pollinating cognate plants of taxa of a local origin;

- Frequency of occurrence – this criterion is used more for the taxa, which feature vegetative pullulation. The significance of this ability increases when the taxa occurs farer north or in any other more adverse conditions. As often as not distribution of a separate plant is not rapid, but if the taxa is common (planted) frequently and in vast amounts, then the territory it occupies can be wide. As an example stands of *Sorbaria sorbifolia* (L.) A. Br. a.o. taxa in neglected parks, greeneries near rural houses, railway protective plantations can be mentioned;

- Impact on affected eco-systems – ability of invasive taxa to occupy and indigenous taxa to preserve dominant role in the eco-system, as well as the amount of the changes caused by peregrine taxa in the eco-system (Svilāns 2003).

Results

During the survey of the objects 59 introduced tree species with a tendency to transfer wild (see picture 1 in the appendix) were found. In the park of Zaļā manor house (22 invasive species) it was easy to find the majority of strange species because the park occupies a vast territory 27,7 ha (the biggest park in Jelgava district). The invasive species can be traced in the periphery of the park, which is not so spruce as the central part near the manor house. The following taxa with a tendency to transfer wild were traced in this part of the park: *Acer campestre* L., *Acer saccharinum* L., *Populus alba* L., *Prunus cerasifera*, *Spiraea* x *billardii*, *Tilia* x *euchlora* C. Koch., *Tilia platyphyllos*, *Tilia* x *vulgaris* Hayne a.o. The least number of invasive species (4) was traced in "Lībieši", Sidrabene municipality: *Acer ginaala*, *Acer negundo*, *Rhus typhina* un *Syringa vulgaris*, most credibly it is so because the private collections are cultivated more carefully and occupy significantly smaller territory. One of the reasons may be the fact that the formation of the collection was initiated only in the 60-ies of the last century, but the parks were formed mainly in the middle of the 18th or at the beginning of the 19th century. The number of taxa found in other surveyed territories ranges between 8 and 15 units (see picture 2).

Fig. 1. Researched dendrological objects in Jelgava district.

The analysis of the found invasive trees was done according to belonging to families. Mentioned 59 invasive taxa are included in 16 various families. Rosaceae family has the biggest amount of invasive species (19 taxa belonging to the family), it can be explained by the fact that it is one of the biggest families in the world, which includes very many trees. Family of Roses includes the following especially invasive taxa: *Coteneaster lucidus* Schlecht., *Rosa rugosa*, *Sorbaria sorbifolia*, several *Spiraea* species. Seven taxa belong to Aceraceae, it is worth mentioning that the most aggressive of them is *Acer negundo* L. Five taxa belong to Salicaceae, the invasions are formed by *Populus alba*. Oleaceae and Tiliaceae on their turn include four peregrine species, which transfer wild. Caprifoliaceae, Cornaceae and Hydrangeaceae include three species each. Two families were found, whose all included (2) species transfer wild, for example, Sambucaceae includes *Sambucus nigra* and *Sambucus racemosa*.

In several families one species transfers wild (see picture 3).

The detected species were divided into four levels according to the offered classification model of the invasive peregrine taxa (see picture 4).

1st level – Naturalized peregrine taxa, whose distribution in territory of Latvia has become stable. 3 taxa (5%) can be included in this level. A separate research was done about the distribution of *Amelanchier spicata* in August and September, 2003 in surroundings of Jūrmala (in territory between Lielupe and Bulduri). The author states that annual and biennial seedlings were not found in the sampling plots. It has been mentioned that it may point at the fact that during the last six years the distribution of this species has diminished in this territory (Rurāne 2004). It should be mentioned that *Amelanchier spicata* (Lam.) c. Koch was traced only in Bervircava park as having transferred wild, though according to the data published in 1989 it has grown in six objects (Cinovskis, Bice, Knape, Šmite 1989). *Carpinus betulus* is also included in this level, because its distribution area is Europe, inter alia South-western part of Latvia, hornbeam stand in Lukna. It has been found as invasive species in Vircava park.

In its turn *Salix fragilis* is allocthonous species in Latvia, it has transferred wild from greeneries (P. Evarts – Bunders 2005). It has been traced in four objects, mainly near water basins.

2nd level – these taxa are able to supersede indigenous species from the habitats. 16 (27%) out of the found 59 taxa shoul be mentioned as aggressive. These are: *Acer negundo*, *Acer platanoides* 'Schwedleri˙, *Caragana arborescens*, *Cotoneaster lucidus*, *Populus alba*, *Robinia pseudoacacia*, *Rosa rugosa*, *Sorbaria sorbifolia*,

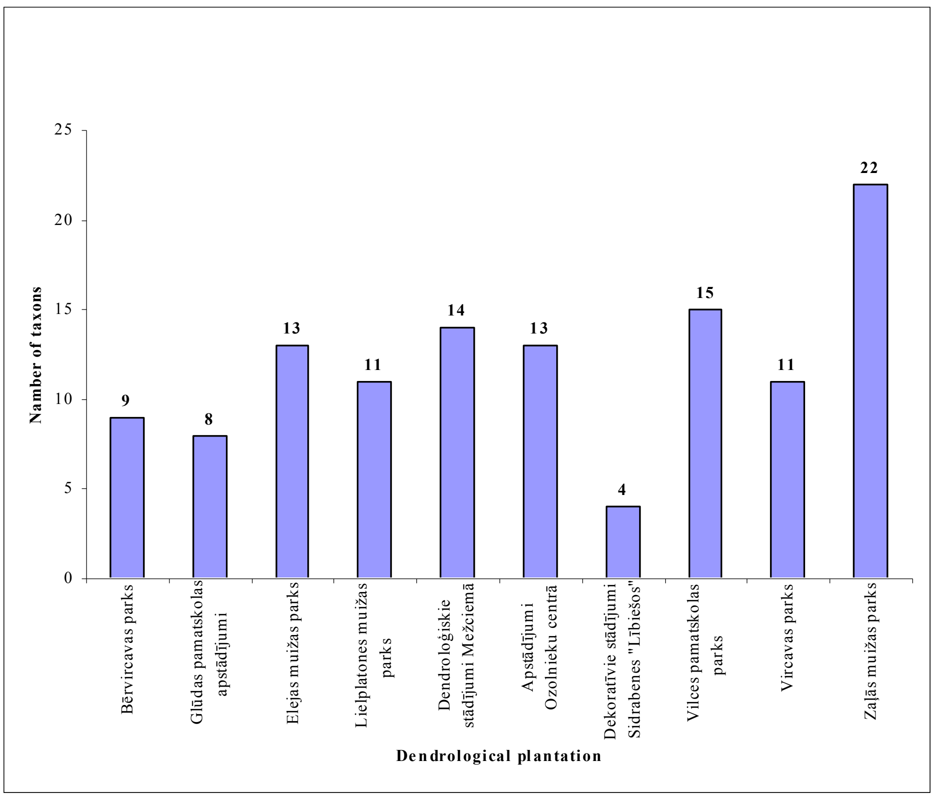

Fig. 2. Number of invasive taxa in the plantations

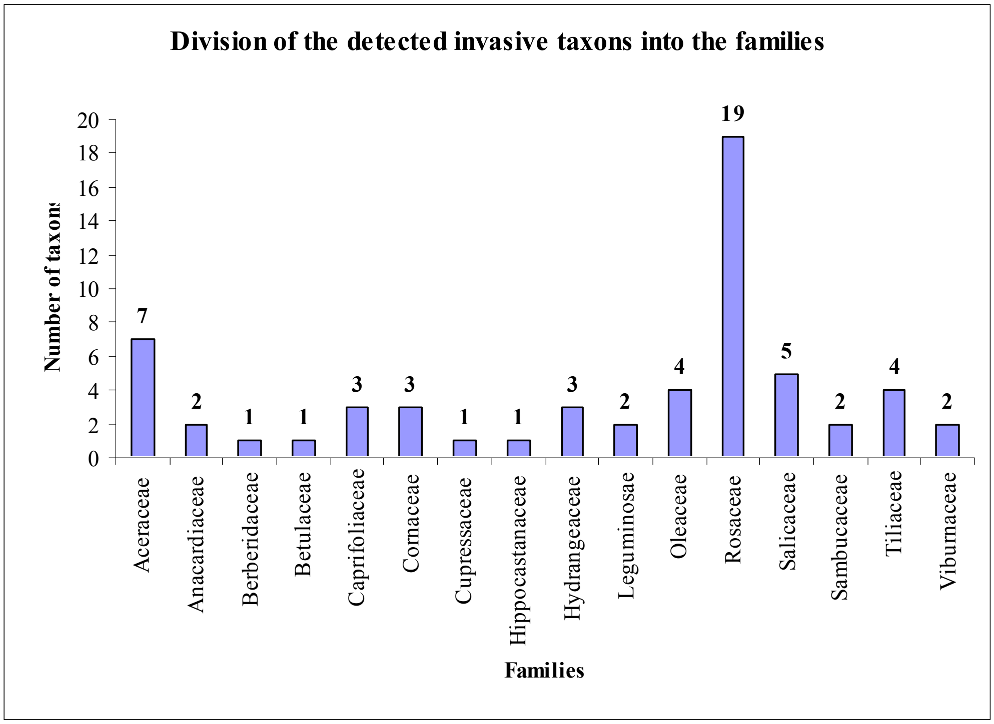

Fig. 3. Division of the detected invasive taxa into the families

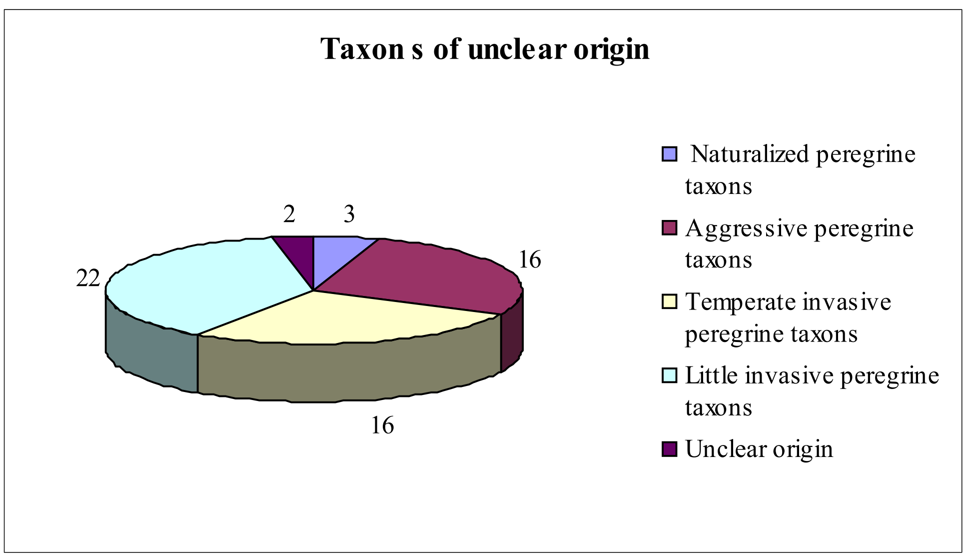

Fig. 4. classification of taxa according to their invasion abilities

Spiraea x *billardii*, *Spiraea media*, *Spiraea* x *rosalba*, *Swida alba*, *Swida sericea*, *Syringa vulgaris*, *Tilia platyphylus* and *Tilia* x *vulgaris*. The frequency of occurrence of the aggressive taxa is shown in the diagram (see picture 5).

3rd level – 16 taxons (27%) have been included here: *Acer ginnala* x *tataricum*, *Cerasus vulgaris*, *Crataegus allemanniensis* var. *orientobaltica*, *Fraxinus pennsylvanica* var. *subintegerrima*, *Ligustrum vulgare*, *Physocarpus opulifolius*, *Prunus cerasifera*, *Prunus divaricata*, *Prunus insitita*, *Rhus typhina*, *Rosa pimpinelifolia* var. *pimpinelifolia* 'Plena', *Sambucus nigra*, *Sambucus racemosa*, *Symphoricarpos albus* var. *levigatus*, Tilia x *euchlora*, *Viburnum opulus*. The frequency of distribution of the taxa is given in table 1 in the appendix.

4th level – Little invasive peregrine taxa, which distribute very rarely. This level is given to 24 taxa (37%) of the found invasive species. The following examples can be mentioned: *Acer saccharinum*, *Chaenomeles japonica*, *Lonicera alpigena*, *Philadelphus lewisii* var. *lewisii*, *Salix alba* šķīrnes, *Salix* x *rubens*, *Thuja occidentalis* a.o. (see table 2 in appendix).

In addition to the mentioned ones the taxa of unclear origin were also found: *Cotinus coggygria*, *Spiraea* x *vanhoutei*, as well as the taxa the origin of which in some object is unclear: *Philadelphus lewisii* var. *lewisii, Salix alba* 'Vitellina'.

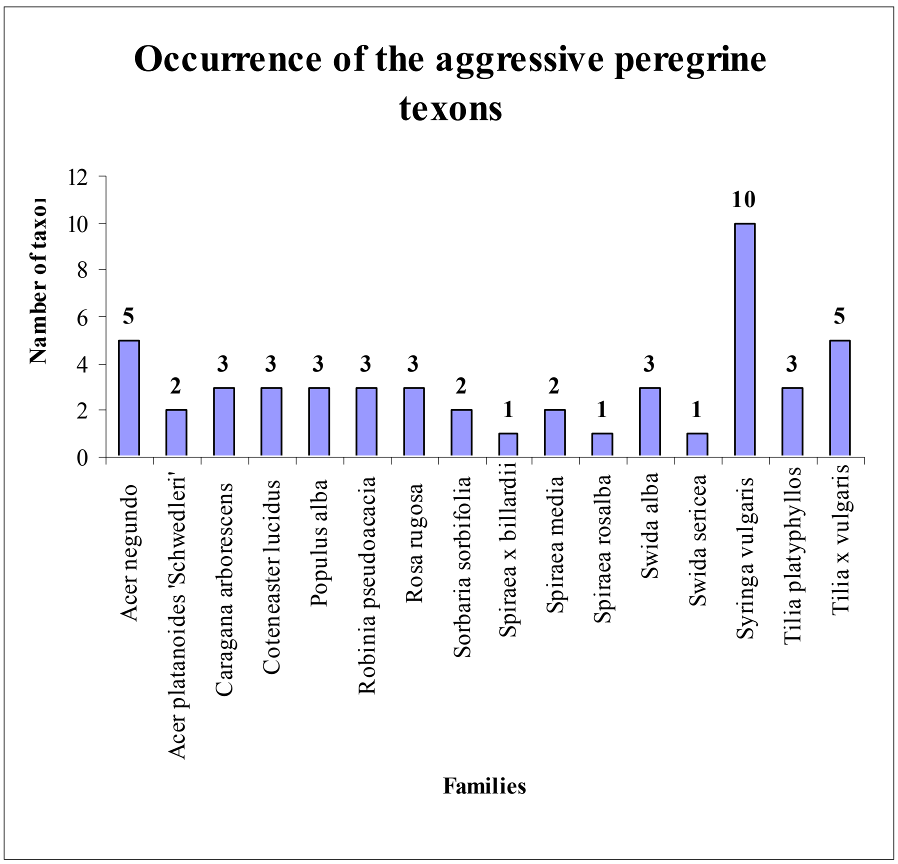

Fig. 5. Occurrence of the aggressive peregrine taxa.

Discussion

The geographical fauna of each specific place is not a constat unit, but it develops in the course of time. What will happen in future with those species, which we now consider to be invasive? Theree is agreat possibility that these species will become an un alienable aprt of our flora. As the climate of the world becomes warmer in directon from the equator to the poles the shift of the distributoin of species can be observed. Such species as *Hippophae rhamnoides, Sambucus nigra, Sambucus recenosa, Fagus sylavatica* a.o. Central-european and South-european species can be considered as indigenous or potential indigenous species in Latvia (Svilāns 2003). Though all these species are neophytes in the territory of Latvia they are mainly introduced in the 18th and 19th centuries.

It would be much easier to count the proportion of inavsivity in time (in the period of time when it became aggressive) if precise times of the introduction of species would be known. *Swida alba* was introduced at the beginning of the 19th century, but it was found in wild during last 60 years. *Syringa vulgaris* in its turn can be traced in each garden (Mauriņš 1970), now bothe these species are considered to be aggressive peregrine taxa.

It would be very important to know the place of origin of the mother plant, because invasion of a plant very often can be observed in one place, but in another no. For example, *Acer campestre* was found in two objects, but the featuers of invasivity it shows only in one place. In wild the plant can be traced in Western Europe and Asia. Most probably the tendency to transfer wild is expressed by the specimens, which are introduced from Western Europe, not from the distant regions in Asia, where the climate is sharp diverse.

Amelanchier spicata is considered to be a particularly aggressive taxon in Latvia, but according to the data of researches it turns wild only in 17% of cases. It is supposed that if a more thorough investigation of species of shadberies genera would be done, that it would become obvious that several species have been planted in the territory of Latvia, but only some of them express invasivity.

Taxa of unclear origin are considered to be those, which have expressed minimal features of inavsivity, which often are not distinctly realizable. For example, *Cotinus coggygria* is considered to be a non-invasive taxa in Latvia, but it was found durinfg the investigation. Several species of *Philadelphus* genera have also expressed unclear features of inavsivity.

References

Cinovskis R., Bice M., Knape Dz., Šmite D. 1989. Jelgavas rajonā konstotētie koki un krūmi. Rīga: LatZTIZPI, 54 lpp.

Evarts – Bunders P. 2005. Vītolu (Salix L.) ģints Latvijā. Daugavpils: DU BRIPI, 107 lpp.

Svilāns A. 2003. Invazīvie citzemju taksoni Latvijā. – In Latvijas veģetācija. **7.** – Rīga: LU izdevniecība, 95 – 104 lpp.

Svilāns A. 2005. Invazīvie citzemju koku un krūmu taksoni Latvijas Nacionālajā botāniskajā dārzā. – In Latvijas Universitātes 63. zinātniskā konference. Ģeogrāfija, ģeoloģija, vides zinātnes. – Rīga: LU akadēmiskais apgāds, 93 – 94 lpp.

Мауринь А. 1970. Опыт интродукции древесных пород в Латвии. - Рига: Звайгзне 257 с.

(Law project) www.mk.gov.lv

Appendix

Table 1. Invasive species list (see pp. 156)

Appendix

Table 1. Invasive species list

Nr	Taxa	Bērvircava park	Greenery near Glūda Elementary School	Park near Eleja manor house	Park near Lielplatone manor house	Dendrological plantations in Mežciems	Plantations in the centre of Ozolnieki	Decorative plantations in „Lībieši", Sidrabene	park near Vilce Elementary School	Vircava park	Park near Zaļā manor house	Level of invasivity
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1.	*Acer campestre* L.										+	**4**
2.	*Acer ginnala* Maxim.					+	+	+				**4**
3.	*Acer ginnala* x *tataricum*									+		**3**
4.	*Acer negundo* L.	+	+			+		+		+		**2**
5.	*Acer platanoides* 'Schwedleri'					+			+			**2**
6.	*Acer pseudoplatanus* L.			+								**4**
7.	*Acer saccharinum* L.										+	**4**
8.	*Aesculus hippocastanum* L.	+	+		+				+		+	**4**
9.	*Amelanchier spicata* (Lam.) c. Koch	+										**1**
10.	*Berberis thunbergii* DC.					+	+					**4**
11.	*Carpinus betulus* L.									+		**1**
12.	*Caragana arborescens* Lam.			+	+						+	**2**
13.	*Cerasus vulgaris*			+								**3**
14.	*Chaenomeles japonica* (Thunb.) Lindl. ex Spach				+							**4**
15.	*Cotinus coggygria* Scop.					**?**						**4**
16.	*Cotoneaster lucidus* Schlecht.		+		+					+		**2**
17.	*Crataegus alamanniensis* var. *orentobaltica*	+					+			+		**3**
18.	*Crataegus flabellata* (Bosc) C. Koch						+					**4**

19.	*Forsythia viridissima* Lindl.										+	**4**
20.	*Fraxinus pennsylvanica* var. *subintegerrima* (Vahl) Fern.						+					**3**
21.	*Ligustrum vulgare* L.										+	**3**
22.	*Lonicera alpigena*								+			**4**
23.	*Lonicera tatarica* L.				+							**4**
24.	*Malus* x *zumi* var. *calocarpa*										+	**4**
25.	*Philadelphus coronarius* L.					+			+			**4**
26.	*Philadelphus indorus* L.				+							**4**
27.	*Philadelphus lewisii* var. *lewisii*			**?**							+	**4**
28.	*Physocarpus opulifolius* (L.) Maxim.								+			**3**
29.	*Populus alba* L.		+	+							+	**2**
30.	*Prunus cerasifera*					+	+		+	+	+	**3**
31.	*Prunus divaricata*								+			**3**
32.	*Prunus insitita*								+			**3**
33.	*Rhus typhina* L.						+	+				**3**
34.	*Robinia pseudoacacia*						+		+		+	**2**
35.	*Rosa pimpinellifolia* var. *pimpinellifolia* 'Plena'					+			+	+		**3**
36.	*Rosa rugosa* Thunb. Ex Murray	+	+			+						**2**
37.	*Salix alba* 'Sericea'					+						**4**
38.	*Salix alba* 'Vitellina'								**?**		+	**4**
39.	*Salix fragilis* L.	+			+				+	+	+	**1**
40.	*Salix* x *rubens* Scrank									+		**4**
41.	*Sambucus nigra* L.										+	**3**
42.	*Sambucus racemosa* L.			+							+	**3**
43.	Sorbaria sorbifolia (L.) A. Br.				+				+			**2**
44.	*Spiraea* x *arguta* Zabel										+	**4**
45.	*Spiraea* x *billardii*										+	**2**
46.	*Spiraea media* Fr. Schmidt		+	+								**2**
47.	*Spiraea rosalba*									+		**2**
48.	*Spiraea* x *vanhouttei* (Briot) Zabel										**?**	**4**
49.	*Swida alba* (L.) Opiz		+	+			+					**2**
50.	*Swida sericea*	+										**2**

51.	*Symphoricarpos albus* var. *levigatus*						+				+	**3**
52.	*Syringa vulgaris* L.	+	+	+	+	+	+	+	+	+	+	**2**
53.	*Thuja occidentalis* L.				+							**4**
54.	*Tilia* x *euchlora* C. Koch.										+	**3**
55.	*Tilia platyphyllos* var. *grandifolia*			+								**4**
56.	*Tilia platyphyllos*					+	+				+	**2**
57.	*Tilia* x *vulgaris* Hayne	+		+		+	+				+	**2**
58.	*Viburnum lantana* L.			+								**4**
59.	*Viburnum opulus*					+						**3**

? – unclear origin

Levels of invasivity:

1. – naturalized peregrine taxons
2. – aggressive peregrine taxons
3. – temperate invasive peregrine taxons
4. – little invasive peregrine taxons

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COMMUNITIES OF *QUERCUS PETRAEA* IN LITHUANIA

Daiva Patalauskaitė

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Quercus petraea is known naturally growing in the southern part of Lithuania (Trakas forest, Lazdijai district). There *Quercus petraea* and its hybrids with *Quercus robur* form forest communities. In this paper the syntaxonomical position of *Quercus petraea* forest communities in Lithuania is discussed.

Key words: Lithuania, communities, *Quercus petraeae,* syntaxonomical position.

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Introduction

The distribution area of *Quercus petraea* covers the major part of Europe and only in the north-eastern Poland is the closest to Lithuania (Ozolinčius, 2003). In the sixth decade S. Tuminauskas (1957) publicated the data on a locality of naturally growing *Quercus petraea* in the area of 70 ha (Trakas forest, Lazdijai district). That forest was considered to be the locality behind the areal border. In Ąžuolija (Utena distr.), Begėdžiai (Šilutė distr.) forests and Šešuoliai park (Ukmergė distr.) *Quercus petraea* is planted as alien species (Gelaževičius, 1973).

The origin of *Quercus petraea* locality in Lithuania is the question of discussion. There are three versions: first, *Quercus petraea* is imported from the neighbouring countries and planted in Lithuanian forests as alien plant; second, Trakas forest is the locality of natural spreading of the species; third, Trakas forest is the locality behind the distribution area (Baliuckas, 2000, Ozolinčius, 2003). *Quercus petraea* and its hybrids with *Quercus robur* form forest communities in 8 quarters of Trakas forest (Baliuckas, 2000). The syntaxonomical position of *Quercus petraea* forest communities in Lithuania is still the question of discussion.

Material and Methods

Forest communities were investigated according to the approach of the Braun-Blanquet geobotanical school (Braun-Blanquet, 1964; Aleksandrova, 1969). Geobotanical relevés were made in the plots of 400 m² with typical homogenous vegetation. The abundance and coverage of each species were determinated according to Braun- Blanquet scale. Total vegetation coverage was evaluated visually and recorded in a percentage scale for each vegetation layer. Investigations of *Quercus petraea* forest communities were carried out in Trakas forest (Seirijai forestry district , Lazdijai district). The records were made in the quarter 25, plot 20 and quarter 27, plot 2 in *Quercus petraea* stand without *Quercus robur*.

Plant names follow Z. Gudžinskas (1999) and I. Jukonienė (2002).

Results and discussion

Quercus petraea and their hybrids were found in 608 ha of Trakas forest. It comprised 18 % of the total number of trees, their hybrids – 38 % (Baliuckas, 2000). In this area *Quercus petraea* stand without *Quercus robur* was registred only in a few plots. In such plots (quarter 25, plot 20 and quarter 27, plot 2) forest communities were described

Tree layers were formed by *Quercus petraea* and some other species: 3 species from the *Querco-Fagetea* class (*Acer platanoides, Carpinus betulus, Tilia cordata*), 2 species from the *Vaccinio-Piceetea* class (*Pinus sylvestris, Picea abies*) and 3 accompanying species (*Betula pendula, Populus tremula. Malus sylvestris*). In these plots *Quercus robur* is absent, but in neighbouring quarters and plots it occurs in different number of frequency. The dominants of shrubs layer are *Corylus avellana* and *Lonicera xylosteum* from the *Querco-Fagetea* class. In herb layer, dominate *Lamiastrum galeobdolon, Hepatica nobilis, Stellaria nobilis* from the *Querco-Fagetea* class and *Convallaria majalis, Calamagrostis arundinacea, Rubus saxatilis* in several records. Moss layer isn˙t abundant. The only *Atrichum undulatum* and *Eurhynchium angustirete* are quite abundant. In these communities species from the *Querco-Fagetea* and *Vaccinio-Piceetea* classes are found, but species of *Querco-Fagetea* are prevailing. 35 species from the *Querco-Fagetea* class, 4 species from the *Vaccinio-Piceetea* class and 41 accompanying species were registred.

Syntaxonomic position of *Quercus petraea* forest communities in Lithuania has been interpreted different. J. Balevičienė (1984) ascribed *Quercus petraea* communities from Trakas forest to as. *Pino-Quercetum* Kozlowska 1925, var. *Quercus petraea*. In floristic composition of Polish communities of as. *Querco roboris-Pinetum* (W. Mat. 1981) J. Mat. 1988 (Cl. *Vaccinio-Piceetea,* All. *Dicrano-Pinion*) (Matuszkiewicz W., 2006) some nemoral species of trees (*Quercus petraea, Quercus robur, Carpinus betulus*), shrubs and herbs (*Carex digitata, Corylus avellana, Euonymus verrucosus, Melampyrum nemorosum, Melica nutans, Viola reichenbachiana*) are found. Thus, there is a resemblance between as. *Querco roboris-Pinetum* and Lithuanian *Quercus petraea* forest communities. Anyway, in chorological analysis of communities of as. *Pino-Quercetum* Kozlowska 1925, J. Balevičienė (1984) distinguished two variants: var. *typicum* and var. *Quercus petraea*. In var. *Quercus petraea* there is a small number of boreotemperate species and a lot of temperate European species and in the later publication (Balevičienė, 1991), *Quercus petraea* forest communities were ascribed to as. *Calamagrostio-Quercetum petraeae* (Cl. *Querco-Fagetea,* O. *Quercetalia robori-petraeae* Tx. 1931).

The communities of as. *Calamagrostio-Quercetum petraeae* are distributed in the south-western part of Poland (Matuszkiewicz J. M., 1988; Matuszkiewicz J. M., 2007; Matuszkiewicz W., 2006) and its range area is quite far from Lithuania. In Poland, in the communities of as. *Calamagrostio-Quercetum petraeae,* dominate *Calamagrostis arundinacea, Melampyrum pratense, Holcus mollis, Pteridium aquilinum, Convallaria majalis, Festuca ovina, Vaccinium myrtillus, Deschampsia flexuosa*. In the floristic composition of these communities, some groups of species are distinguished: species from the *Vaccinio-Piceetea* class (*Vaccinium myrtillus, Vaccinium vitis-idaea, Pinus sylvestris, Pleurozium schreberi*), species from the *Quercetea robori-petraeae* class (moderately constant species - *Holcus mollis, Hieracium sabaudum, Hieracium laevigatum*) and species from the *Querco-Fagetea* class (not constant and not abundant – *Carpinus betulus, Melica nutans, Anemone nemorosa, Corylus avellana, Viola reichenbachiana*). In total, in these comunities, 7 species from the order of *Quercetalia roboris* (*Hieracium laevigatum, Hieracium umbellatum* ssp., *Hieracium sabaudum, Hieracium racemosum, Holcus mollis, Hypnum*

Table 1. Floristic composition of *Quercus petraea* stand in Trakas forest (Lazdijai district)

Current number	1	2	3	4	5	6	7	8
Cover % Trees a	80	80	80	80	70	70	60	Presens 1-7
b	40	30	40	40	40	70	40	
c	10	30	1	1	20	10	5	
d	5	1	1	1	1	1	1	
Shrubs	70	40	70	30	70	10	70	
Herbs	60	60	70	70	70	60	60	
Bryophytes	20	10	1	10	10	1	60	
Number of species in record	44	42	42	41	47	34	35	
Quercus petraea a	4	3	3	4	3	3	1	V
b	-	1	2	2	2	1	2	V
c	-	-	-	-	+	+	+	III
d	+	+	+	+	+	+	-	V
Carpinus betulus b	2	2	-	1	1	3	-	IV
c	1	1	-	-	1	2	+	IV
d	1	-	+	-	+	-	-	III
Pinus sylvestris a	-	1	1	1	1	2	-	IV
Picea abies a	-	1	1	-	-	+	3	III
b	-	-	-	-	-	-	2	I
c	-	2	-	-	2	-	1	III
Tilia cordata b	-	-	-	1	1	+	-	III
c	-	-	-	-	+	+	+	III
Acer platanoides c	+	+	-	-	-	-	-	II
d	+	+	-	-	+	+	+	IV
Populus tremula b	1	-	+	-	-	-	-	II
c	-	-	-	-	-	+	-	I
Malus sylvestris c	+	-	-	-	+	-	-	II
Betula pendula b	+	-	-	-	-	-	-	I
Ch. Cl. Querco-Fagetea								
Carex digitata	+	+	+	+	+	+	+	V
Corylus avellana	3	2	3	2	3	1	3	V
Euonymus verrucosus	+	1	1	+	+	+	+	V
Hepatica nobilis	2	1	2	1	1	2	2	V
Lonicera xylosteum	1	1	1	1	2	+	1	V
Melica nutans	+	+	+	+	+	-	+	V
Aegopodium podagraria	+	+	-	2	+	-	-	IV
Brachypodium sylvaticum	-	+	-	-	-	-	-	I
Campanula trachelium	-	+	-	-	-	-	-	I
Poa nemoralis	-	-	-	+	-	-	-	I
Ch. O. Fagetalia sylvaticae								
Daphne mezereum	1	+	+	+	+	-	+	V
Lamiastrum galeobdolon	2	2	3	2	2	2	-	V
Viola reichenbachiana	+	+	+	+	+	-	+	V
Asarum europaeum	1	1	+	-	-	+	+	IV
Atrichum undulatum	2	2	+	1	1	-	-	IV
Dryopteris filix-mas	+	+	+	-	+	-	-	IV
Lathyrus vernus	-	+	+	+	+	+	-	IV

Milium effusum	+	1	-	-	-	+	+	IV
Actaea spicata	-	+	-	-	-	+	1	III
Eurhynchium angustirete	+	1	-	-	-	-	3	III
Impatiens noli-tangere	-	-	1	-	1	+	-	III
Ranunculus lanuginosus	+	-	-	+	-	-	+	III
Lilium martagon	-	-	+	-	-	+	-	II
Sanicula europaea	+	-	-	-	-	-	+	II
Carex sylvatica	+	-	-	-	-	-	-	I
Epilobium montanum	-	-	-	-	+	-	-	I
Paris quadrifolia	-	-	-	-	-	r	-	I
Phyteuma spicatum	-	-	+	-	-	-	-	I
Pulmonaria obscura	-	-	-	+	-	-	-	I
Ch. All. Carpinion betuli								
Stellaria holostea	2	1	2	+	+	1	-	V
Melampyrum nemorosum	1	-	-	-	-	-	-	I
Ch. All. Alnion incanae								
Festuca gigantea	-	-	+	+	+	-	-	III
Ch. Cl. Vaccinio-Piceetea								
Vaccinium myrtillus	+	+	+	-	+	1	+	V
Trientalis europaea	+	+	-	-	+	-	+	IV
Accompanying species								
Ajuga repens	+	+	+	-	+	+	+	V
Convallaria majalis	1	+	+	3	3	1	-	V
Calamagrostis arundinacea	-	+	+	2	2	+	+	V
Luzula pilosa	+	+	+	+	-	+	+	V
Majanthemum bifolium	1	1	1	+	+	+	-	V
Oxalis acetosella	1	+	-	+	1	3	3	V
Rubus saxatilis	2	1	1	+	+	+	1	V
Viburnum opulus	+	+	+	-	+	+	+	V
Brachythecium oedipodium	1	-	-	+	1	-	1	IV
Clinopodium vulgare	+	-	+	+	-	-	+	IV
Fragaria vesca	+	+	-	-	+	-	+	IV
Mycelis muralis	-	-	+	+	+	-	+	IV
Plagiomnium affine	+	1	+	+	+	-	1	IV
Pteridium aquilinum	-	+	-	1	+	-	+	IV
Sorbus aucuparia	+	+	-	-	+	+	+	IV
Urtica dioica	-	-	+	+	+	+	+	IV
Veronica chamaedrys	+	-	+	+	-	-	+	IV
Geum urbanum	-	-	+	-	+	-	+	III
Polygonatum odoratum	+	-	-	+	-	+	-	III
Vicia sepium	-	-	+	+	+	-	-	III

Field number, locality of phytosociological record and inconstant accompanying species in the record: 1 – Nr. 179, quarter 25, plot 20. Angelica sylvestris +, Deschampsia caespitosa + ; 2 – Nr. 180, qv. 25, pl. 20. Frangula alnus +, Hieracium laevigatum + Vicia sylvatica +; 3 – Nr. 181, qv. 25, pl. 20. Anthriscus sylvestris +, Brachythecium velutinum +, Campanula persicifolia +, Veronica officinalis + ; 4 – Nr. 182, qv. 25, pl. 20. Brachypodium pinnatum 1, Brachythecium velutinum +, Deschampsia caespitosa + , Hieracium laevigatum + , Solidago virgaurea +; 5 – Nr. 183, qv. 25, pl. 20. Athyrium filixfemina +, Crataegus sp. +, Geranium sylvaticum +, Lathyrus nigricans +, Rubus idaeus 1, Torilis japonica +; 6 – Nr. 184, qv. 25, pl. 20. Dryopteris carthusiana + ; 7 – Nr. 188, qv. 27, pl. 2.Cirriphylum piliferum 2, Frangula alnus +, Plagiomnium cuspidatum 1, Rhodobryum rozeum +, Rhytidiadelphus triquetrus 1.

cupressiforme, Pseudoscleropodium purum) were registered,whereas in Lithuanian *Quercus petraea* communities, ascribed to as. *Calamagrostio-Quercetum petraeae* (Balevičienė, 1991) – only 1 (*Hieracium umbellatum*) species. In the floristic composition of this association, a group of mesotrophic acidophilic species was found. In Polish communities, 6 species were constant (*Calamagrostis arundinacea, Deschampsia flexuosa, Melampyrum pratense, Pteridium aquilinum, Solidago virgaurea, Majanthemum bifolium),* in Lithuanian –3 species were found (*Majanthemum bifolium, Solidago virgaurea, Calamagrostis arundinacea*), but only 1 is constant. In the floristic composition of *Quercus petraea* forest communities in Lithuania, species from the *Querco-Fagetea* class (total number 39 (Balevičienė, 1991) and 36 (Table 1)) dominate, in Polish communities – only 5 species not constant and not abundant are found (*Anemone nemorosa, Carpinus betulus*, *Coryllus avellana, Melica nutans, Viola reichenbachiana*).

The numerous *Querco-Fagetea* species and very few species from *Quercetea robori-petraeae* Br.-Bl. et R. Tx. 1943 signify that Lithuanian *Quercus petraea* forest communities can˙t be ascribed to the *Quercetea robori-petraeae* communities. The floristic composition of *Quercus petraea* forest communities with a large number of species of *Querco-Fagetea* class, *Fagetalia sylvaticae* order allow to ascribe these communities to this class. Nemoral forests on a slightly acidified soils with a small amount of species from the *Vaccinio-Piceetea* class (*Pinus sylvestris, Picea abies, Vaccinium myrtillus, Trientalis europaea*) and a group of acidophilic mesotrophic species (*Calamagrostis arundinacea, Majanthemum bifolium, Solidago virgaurea*) in the floristic composition are ascribed to the *Tilio-Carpinetum betuli* Traczyk 1962 association, the *calamagrostetosum* W. et A. Matuszkiewicz 1985 subassociation (alliance *Carpinion betuli* Issler 1931 em. Oberdorfer 1953) (Matuszkiewicz W, 2006; Matuszkiewicz J. M., 2007). Beside of the above-mentioned species, constant presence of *Convallaria majalis, Pteridium aquilinum, Rubus saxatilis* is characteristic to this subassotiation (Matuszkiewicz J. M., 2007). All these species from the *Vaccinio-Piceetea* class (*Pinus sylvestris, Picea abies, Vaccinium myrtillus, Trientalis europaea*), a group of acidophilic mesotrophic species (*Calamagrostis arundinacea, Majanthemum bifolium, Solidago virgaurea*) and *Convallaria majalis, Pteridium aquilinum, Rubus saxatilis* are present in Lithuanian *Quercus petraea* forest communities (Table 1).

Conclusions

A great distance of distribution area of as. *Calamagrostio-Quercetum petraeae* from Lithuania and differences in the floristic composition of communities allow to draw a conclusion that Lithuanian *Quercus petraea* forest communities do not belong to the *Calamagrostio-Quercetum petraeae* association. A large number of nemoral species and only few species from the *Vaccinio-Piceetea* and *Quercetea robori-petraeae* classes, leads to a conclusion that these communities belong not to the *Vaccinio-Piceetea* and *Quercetea robori-petraeae* classes, but to the *Querco-Fagetea* class, the *Fagetalia sylvaticae* Pawłowski 1928 order, the *Carpinion betuli* alliance, the *Tilio-Carpinetum betuli* Traczyk 1962 assotiacion, the *calamagrostetosum* subassociation. The communities of *Tilio-Carpinetum calamagrostetosum* are found on a slightly acidified soils, the floristic composition of these communities includes a small amount of species from the *Vaccinio-*

Piceetea class (*Pinus sylvestris, Picea abies, Vaccinium myrtillus, Trientalis europaea*) and a group of acidophilic mesotrophic species (*Calamagrostis arundinacea, Majanthemum bifolium, Solidago virgaurea*).

References

Aleksandrova V. D. 1969. Klasifikacija rastitel'nosti. Obzor principov klasifikacini i klassifikacionnykh sistem vraznykh geobotaničeskikh školakh. – Leningrad.

Balevičienė J. 1984. Primenenije florističeskikh kriterijev dlia raspoznanija reliktovykh soobščestv. In: Lekavičius A. A. (ed.): Pribaltijskaja flora i jejo istoriografija: 43-44. Vilnius.

Balevičienė J. 1991. Sintaksonomo-fitogeografičeskaja struktūra rastitel'nosti Litvy. Vilnius.

4.Baliuckas V. 2000. Paprastojo (*Quercus robur*) ir bekočio (*Q. petraea*) ąžuolo rūšių introgresijaTrako miške [Introgression of pedunculate (*Quercus robur*) and sessile(*Q petraea*) oak species in Trakas forest]. Botanica Lithuanica, 6(4): 375-386.

Braun-Blabquet J. 1964. Pflanzensoziologie. Grundzüge der vegetationskunde. Wien-New York.

Gelaževičius J. 1973. Bukiniai – *Fagaceae*. In: Dendrologija: 125-138. Vilnius.

Jukonienė I. 2002. Checklists of Lithuanian mosses [Lietuvos lapsamanių sąvadas]. Botanica Lithuanica, 8(4): 303-322.

Matuszkiewicz J. M. 1988. Przegląd fitosocjologiczny zbiorowisk leśnych Polski. Bory mieszane i acidifilne dąbrowy – Phytosociological review of the forest communities of Poland. Mixed pine-oak forests and acidophilous oak forests. Fragmenta floristika et geobotanica. Ann. XXXIII, Pars 1-2: 107-190.

Matuszkiewicz J. M. 2007. Zespoły leśne Polski. Warszawa.

Matuszkiewicz W. 2006. Przewodnik do oznaczania zbiorowisk róslinnych Polski. Warszawa.

Natkevičaitė-Ivanauskienė M., 1983. Botaninė geografija ir fitocenologijos pagrindai. Vilnius.

Ozolinčius R. 2003. Bukiniai – *Fagaceae*. In: Lietuvos dendroflora: 140-159. Kaunas.

Snarskis P. 1972. Lietuvos TSR ąžuolynai. Vilnius.

Strazdaitė J., Jankevičienė R., Lazdauskaitė Ž. 1980. Žagarės botaninio-zoologinio draustinio augalija. In: Žagarės miškas:7-29. Vilnius.

Tuminauskas S. 1957. Bekotis ąžuolas

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ECOLOGICAL CHARACTERISTIC OF GROUPS OF ZOOPLANKTON IN THE DEEPEST LAKES OF EAST-LATVIA

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Brakovska A., Škute R. 2007. Ecological characteristic of groups of zooplankton in the deepest lakes of East-Latvia. *Acta Biol. Univ. Daugavp., 7 (2): 165 - 174.*

The lake of Dridzis is the deepest lake of Latvia; its maximum depth is 65,1m. The lake of Rica is the eighth deepest lake in Latvia, its maximum depth is 39,7m, but the lake of Svente is the ninth deepest lake of Latvia, its maximum depth is 38m. Making research in the lakes of Rica, Dridzis and Svente, there were found 3 groups of organisms of zooplankton: *Rotatoria, Cladocera* and *Copepoda*. Analysing the data of literature (Cimdiņš 2001), one can come to a conclusion that the qualitative composition is similar to the composition of zooplankton of other eutrophic lakes of Latvia. Analysing the physically chemical water parameters of lakes, one can conclude, that every year these indices don`t change substantially. The water temperature of lakes gets changed when the depth is changing. In the lakes the stratification in metalimny is characteristic, i.e., in the depth of 4-8 metres. The amount of disintegrated oxygen in lakes diminishes, enlarging the depth. The amount mg/l of disintegrated oxygen in water depends on the chemical and biological processes. High amount of oxygen can appear directly on the upper layer, when the plants discharge the oxygen in the result of photosynthesis., or when the waves wash in the oxygen from the atmosphere . The biggest concentration of oxygen in the lakes of Dridzis and Svente is up to 7m depth, then the diminishing of concentration is observed. It could be connected with the multiplication of plankton algaes and the utilisation if oxygen in the life processes. In the lake of Rica the amount of disintegrated oxygen mg/l the changes are not so sharply marked. The amount of disintegrated substances has been constant, i.e., 0,2g/l during all the years.

Key words: the lakes of Dridzis, Rica, Svente, *Rotatoria*, *Cladocera*, *Copepoda*, Sorensen index, Renkonen index, physically chemical parameters.

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Introduction

Lakes are common feature of landscape in Latvia, moreover location of the lakes in Latvia is not regular. The greatest amount of lakes is situated in Latgale. In the highland there are about 40% of all the lakes of Latvia. Here are hundreds of lakes, different in size, depth and in singularity of forms. Our researched lakes of Dridzis, Svente and Rica are situated in the highland and are included in the first ten of the deepest lakes of Latvia.

Dridzis is situated in the hillock of Dagda of the highland of Latgale,in parishes of Skaista and Kombuļu of Kraslava district. Dridzis is in the first position of depth. Moreover, it is the deepest lake in Baltia(www.ezeri.lv).

The lake of Svente is situated in the hillock of Ilukste, in the parish of Svente of Daugavpils district. It is included in the region of protected landscapes of Augshzeme and its surroundings makes the complex protected area of landscapes. The biggest depth of the lake of Svente is 38m (in the part of North-East), but average depth is 7,7m and it takes the ninth position out of ten of the deepest lakes of Latvia (www.ezeri.lv).

In its turn, the lake of Rica is situated in the borderland of hillock of Skrudaliena, in Augshzeme, on the border of Latvia and Byelorussia. Its biggest depth is 39,7m, but average depth is 9,7m and it is the eighth deepest lake of Latvia. Also the surroundings of the lake of Rica are the complex protected area of landscapes (www.ezeri.lv).

Nowadays there are different factors that can endanger the ecological situation of lakes. To the lakes, more than to the rivers and entry bays, is related the cognition, that the organisms depend on the peculiarities of water, but also the peculiarities of water depend on organisms. In the course of historical development, in lakes there is developed a self-government, which is made of aquatic dwellers themselves and it keeps the necessary balance in the environment which is necessary for it. Wherewith, they have obtained such biological qualities, from which the physical ability depends to cope with the changes of climatic conditions. Here one must agree with the statements, that the dwellers of lakes are extremely sensitive even to the temporary changes in the environment and they can˙t completely accommodate themselves with completely different conditions.

Essential importance for the transformation of energy and substances in the water body is to zooplankton. Zooplankton is a convenient object to estimate the variety of water biocenosis, because not only taxonomically different groups represent it, but it also represents different food levels.

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Materials and methods

The research of zooplankton of Dridzis, the deepest lake of East-Latvia, was done on August of year 2004, on July of 2005 and on July of 2006. But the research of zooplankton of the lake of Svente was done on August of 2006, but that of the lake of Rica – on July of 2006. In these lakes the following researches were done:

- Identified the ecological diversity of zooplankton of the lakes of Dridzis, Svente and Rica;
- Identified the physically chemical parameters of the lakes of Dridzis, Svente and Rica
- Done statistical and graphical data processing, got in the area investigation, using Microsoft® Excel 2000 program.

Topographical adjustment of hydrometrical measurement to the survey (fixation of geographical coordinates) was done with the help of GPS Scout Master® of advice of GPS (satellite navigation). Fixation exactitude of the location in Acute Locate regime is ±2m. For the measuring of the relief of bottom and the depth of the lakes of Dridzis, Svente and Richa the probe HYDRLAB "Mini Sonde 4 Multiprobe" was used. With the probe it˙s possible to get the measurement of water temperature, electro conductance, the total amount of disintegrated substances, the amount of disintegrated oxygen, the per cent amount of the disintegrated oxygen, α-chlorophyll, turbidity, potential of reduction of oxidation in one supposed line. The probe was lowered to the bottom of water basin. When the physically chemical parameters had become stable in the display of probe, they were saved in the memory of advice. The probe was raised for one metre. Operations were repeated till the probe reached the water upper. Final researches were done in the depth of one metre and the half a metre.

To explore the ecological groups of zooplankton of the lakes of Rica, Dridzis and Svente, the zooplankton samples were taken: in the lake of Rica on July of 2006, in the lake of Svente on August of 2006 and in the lake of Dridzis on August of 2004, on July of 2005 and on July of 2006.

The samples were taken from different areas and depths of the lakes.
In the research Apshtein plankton net and Gedi plankton net was utilized. Utilizing the Apshtein plankton net, zooplankton sample is taken from the depth of 0,5-1m filtrating 100l of water. Utilizing Gedi plankton net water column is filtrated. Jedi plankton net is fixed in an inelastic cord and soused till the bottom of water basin, and then it is pulled out of the water. The concentrated sample from the net is poured in plastic bottles.

To prepare the sample 0,33l bottles are utilized. The collected sample is fixed with 37-40% formaldehyde solution. To the nine capacity parts of the sample add one part of capacity of formalin. In the bottle a sample with the concentration of 4% of formalin develops. The storage time of the sample fixed with formalin is unlimited.

The capacity of the filtered water with Gedi plankton net in the lake of Rica was 363l, in the lake of Svente –681l, in Dridzis-658l in 2004, 681l- in 2005 and in 2006.

To distinguish the capacity of the sample in millilitres, the gathered samples are poured in measuring glass. When the capacity of the sample is distinguished the samples are poured back into the bottle prescribed for the sample. With the colibrated Henzen-Schtempel dropper from the bottle 2ml of the sample are taken, then it is diffused evenly on the especial glass slide. For the analysis countable camera of zooplankton organisms (countable camera of Bogorov type) is used. Then this sample is examined in luminous microscope. From the examining of the sample the magnification of Ampival (Carl Zeiss Jena) 16x10(160) was used. Every sample is examined three times. To distinguish the groups of zooplankton organisms key-books were used (Introduction to … 2001; Krauter und Streble 1988; Sloka 1981; Źóņčźīāą 1970).

To calculate the amount of organisms in the sample such kind of formula is used:
N = (a x b x 1000) / (c x d), where

a. Listed amount of organisms (recalculating to the average);
b. The capacity of the concentrated sample;
c. The capacity of the examined sample;
d. The capacity of the filtred sample;

N The amount of organisms on $1m^3$.

To compare the qualitative composition of zooplankton we used Sorensen coefficient (Sorensen 1948).

$$S_S = \frac{2a}{2a+b+c}, \text{ where}$$

S_s- Sorensen similarity coefficient
a- the number of species in the samples A and B (frequency of currency);
b- the number of species, , which are in the sample A, but are not in the sample B;
c- the number of species, which are in the sample A, but are not in the sample B;
This coefficient is important reference indicator of similarity of the content (composition) of species.

To compare the quantitative composition of zooplankton, we utilized Renkonen index of similarities (Renkonen 1938)of per cent correlation

P=”min *i*mum (p_{li} , p_{2i}), where

P- percent proportion (correlation) between the first and the second sample;
p_{li} - the per cent number of species in the first sample;
p_{2i} = the percent number of species in the second sample.

To calculate the number of organisms and to analyze the physically chemical parameters of the lake Microsoft® Excel 2000 computer program was used.

Results and discussion

Making the researches in the lakes of Rica, Dridzis and Svente 3 groups of zooplankton organisms were found out: *Cladocera, Rotatoria* and *Cope-*

poda. (see the table 1). The biggest diversity of species in the lakes of Dridzis, Svente and Rica is in *Rotatoria* group, and then follows the group of *Cladocera* and *Copepoda.* Hereto among the copepodites in all the lakes there were very big number of underage cyclopes: *Copepodite cyclopoid* and *Nauplii*.

In the lake of Svente there were identified 23 groups of zooplankton. Between *Rotatoria* –12 species, where *Keratella cochlearis, Kellicotia longispina* and *Polyarthra remata* dominate, but in the group of *Cladocera*- 8 species, the dominant specie is *Bosmina crassicoris*, in the group of *Copepoda*- 3 species, where *Cyclops sp., Eudiaptomus gracilis, Macrocyclops olbidus* dominate. But in the lake of Richa there were distinguished 19 groups of zooplankton. In the lake of Rica in *Rotatoria* group- 10 species, were the most frequently found species are *Keratella cochlearis, Conochilus hippocrepis* and *Polyarthra remata*. In the group of *Cladocera*- 7 species, where the most frequent species are *Bosmina crassicornis* and *Daphnia longispina*, but in the group of *Copepoda*- 2 species: *Cyclpos sp., Macrocyclops olbidus, Eudiaptomus gacilis*. Analyzing the diversity of species in the lakes of Dridzis (see the table 2), we see that in the composition of species little changes have occurred. From the species of *Rotatoria, Trichocerca capucina* and *Synchaeta tremula* are found only in the samples which were taken in 2005, but in the samples of the years 2004 and 2006 these species were no found. In

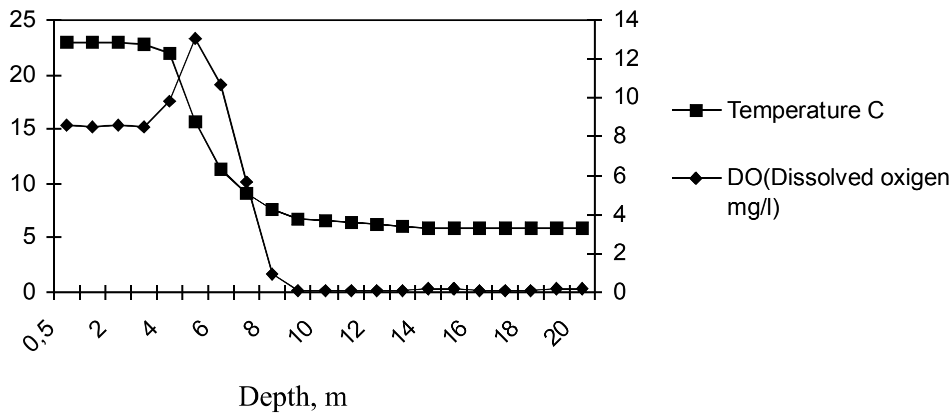

Fig.1. Comparison of physically chemical parameters of water in Lake Dridzis on 14th July, 2006

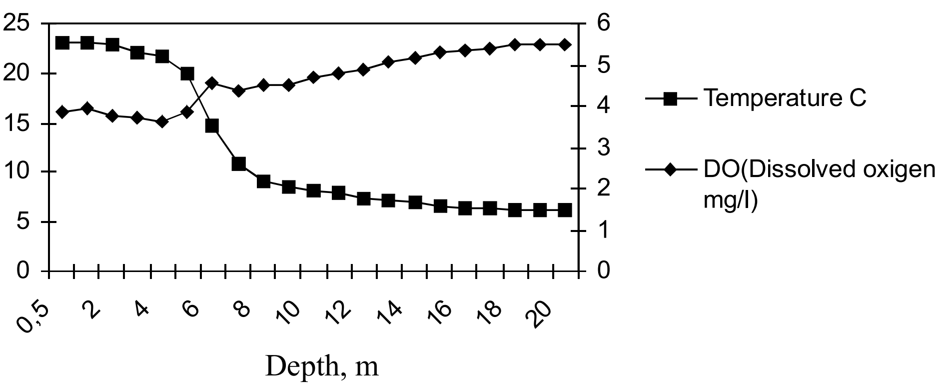

Fig.2. Comparison of physically chemical parameters of water in Lake Dridzis on 30th July, 2005

Table 1. Zooplankton community composition of Lakes Dridzis, Rica and Sventes

	Lake Dridzis 2004.- 2006.	Lake Rica 2006.	Lake Sventes 2006	Common Species
ROTATORIA				
Asplancha priodonta	+	+	+	+
Conochilus hippocrepis	+	+	+	+
Conochilus unicornis	+			
Euchlanis dilatata			+	
Filinia longiseta	+	+	+	+
Kellicotia longispina	+	+	+	+
Keratella cochlearis	+	+	+	+
Keratella quadrata quadrata	+	+	+	+
Polyarthra remata	+	+	+	+
Pompholux sulcata	+			
Rotatoria rotoria	+		+	
Synchaeta tremula	+*	+	+	+
Testudinella patina patina	+	+	+	+
Trichocerca capucina	+*	+	+	+
CLADOCERA				
Bosmina coregoni			+	
Bosmina crassicornis	+	+	+	+
Bosmina longispina	+	+		
Ceriodaphnia affinis	+			
Chydorus sphaericus	+**	+	+	+
Daphnia capucina	+			
Daphnia cucullata	+	+	+	+
Daphnia longispina	+	+	+	+
Diaphanosoma brachyurum	+	+	+	+
Kurzia latissima			+	
Polyphemus pediculus		+	+	
COPEPODA				
Copepodite cyclopoid	+	+	+	+
Cyclops sp.	+	+	+	+
Eudiaptomus gracilis	+	+	+	+
Macrocyclops olbidus	+		+	
Nauplii	+	+	+	+
Sum	**24**	**19**	**23**	**19**

* - 2005.

** - 2004., 2005.

its turn, in the group of *Cladocera* the specie *Chydorus sphaericus* was found only in 2006, but among the species of *Copepoda* changes were not found. Summarising the data about the taken samples during three years, we see that in the lake of Dridzis there were found 24 groups of zooplankton. Among *Rotatoria* widely spread species *are Polyarthra remata, Keratella cochlearis, Kellicotia longispina, Conochilus hipocrepis*. In the group of *Cladocera* there are

Table 2. Zooplankton community composition of Lake Dridzis

	Lake Dridzis 16.07.2006.	Lake Dridzis 30.07.2005.	Lake Dridzis 24.08.2004.
ROTATORIA			
Asplancha priodonta	+	+	+
Conochilus hippocrepis	+	+	+
Conochilus unicornis	+	+	+
Filinia longiseta	+	+	+
Kellicotia longispina	+	+	+
Keratella cochlearis	+	+	+
Keratella quadrata quadrata	+	+	+
Polyarthra remata	+	+	+
Pompholux sulcata		+	+
Rotatoria rotoria	+	+	+
Synchaeta sp.			+
Synchaeta tremula		+	
Testudinella patina patina	+	+	+
Trichocerca capucina		+	
CLADOCERA			
Bosmina crassicornis	+	+	+
Bosmina longispina	+	+	+
Ceriodaphnia affinis		+	
Chydorus sphaericus		+	+
Daphnia capucina			+
Daphnia cucullata	+	+	+
Daphnia longispina	+	+	+
Diaphanosoma brachyurum	+	+	+
COPEPODA			
Copepodite cyclopoid	+	+	+
Cyclops sp.	+	+	+
Eudiaptomus gracilis	+	+	+
Macrocyclops olbidus			+
Nauplii	+	+	+
Sum	**17**	**22**	**22**

8 species. Among *Cladocera* in majority one can find such species as *Bosmina crassicornis*, *Daphnia cucullata* and *Diaphanosoma brachyurum*, but among *Copepoda* dominate: *Cyclops sp.*, *Eudiaptomus gracilis*, *Macrocyclops olbidus*. For our examined lakes it is characteristic that they had big common diversity of species of zooplankton- 19 species (see the table 1).

Summarising the data about the diversity of species of zooplankton in the lakes of Dridzis, Rica and Svente, one can recognize, that the level of pollution in these lake is low, because in the lakes oligosaprobe species are found, which in the shortage of oxygen perish in few hours. For example, *Keratella cochlearis* and *Keratella quadrata* perish in 1-4 hours, *Asplancha priodonta* in 3-4 hours, but *Filinia longiseta* in

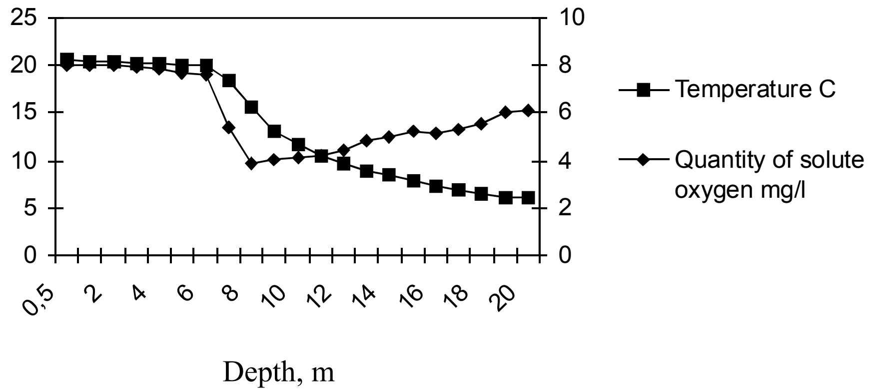

Fig.3. Comparison of physically chemical parameters of water in Lake Dridzis on 24th August, 2004

1-2 hours. In its turn, analyzing the data of bibliography (Cimdiņš 2001), one can conclude, that in the lakes of Rica, Dridzis and Svente the qualitative composition of zooplankton is similar to other compositions of zooplankton of eutrophic lakes of Latvia.

Observing the indicators of quality of zooplankton (Sorensen index) (see the table 3), the similarity of the samples of the explored lakes is within 0,81 to 0,87 that shows that the similarity between them is very big. The biggest similarity, basing on the indicators of quality of zooplankton, is between the lakes of Dridzis and Rica, i.e., within 0,81 to 0,83.

Also basing on the comparative indicators of quantity (Renkonen index) it is seen, that the similarity between these lakes is very big, and it is within 54%to 71% (see the table 4). The biggest similarity, basing also on Renkonen index is between the lakes Rica and Dridzis (70%) It shows, that the diversity of species in these lakes is very similar.

Analyzing the physically chemical parameters of the lakes of Dridzis, Rica and Svente, we see that these indicators change every year. For example, in Dridzis on 14 july 2006 the water temperature ranges from 22,98^{0}C in the depth of 0,5m (see the figure 1, 4). The water temperature tends to diminish getting deeper. The amount of disintegrated substances mg/l is within 13,01mh/l to 0,06mg/l. The biggest concentration of disintegrated substances is in the depth of 5m, in its turn the lowest one is in the depth of 9m (see the figure 1, 5). The amount of disintegrated oxygen on 30 July 2005 was within 5,51mg/l in the depth

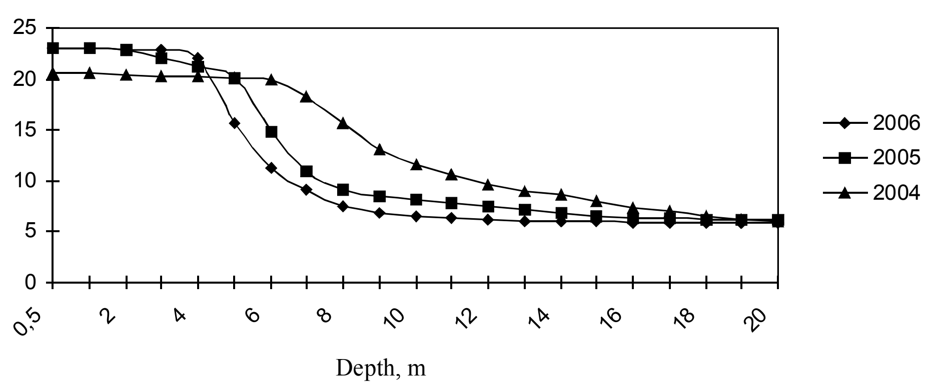

Fig.4. Temperature Indicators of Water in Lake Dridzis in 2006, 2005, 2004

Table 3. Sorensen index

Sampling place	Lake Sventes	Lake Rica	Lake Dridzis
Lake Sventes			
Lake Rica	0,87		
Lake Dridzis	0,81	0,83	

of 20m to 3,63 mg/l in the depth of 4m. In the depth of 0,5m the concentration of disintegrated oxygen is 3,87 mg/l (see the figure 2, 5). But on 24 August 2004 the amount of disintegrated oxygen was within 8,04 mg/l in the depth of 0,5m to 3,86 mg/l in the depth of 8m. In the depth of 2m the amount of disintegrated oxygen was 6,14 mg/l (see the figure 3, 5). If analyze the indicators of the water temperature in the lake of Dridzis in 2006, 2005 and in 2004, we can see that essential changes of water temperature during years are not identified (see the figure 4). Every year water temperature in the depth of 0,5m is within 20-25^{0}C and with the depth of 5 m it gradually begin to diminish. A slightly different scene in the lake of Dridzis is with the indicators of amount of disintegrated oxygen in 2006, 2005 and 2004 (see the figure 5), where we can see small differences. For example in 2006 the concentration of disintegrated oxygen mg/l in the depth of 0,5 m is 8,65 mg/l, but in the depth of 5m it increases sharp till 13,01mg/l, in its turn in the depth of 6m this concentration starts to diminish very sharp. In the researches of the years 2005 and 2004 so sharp

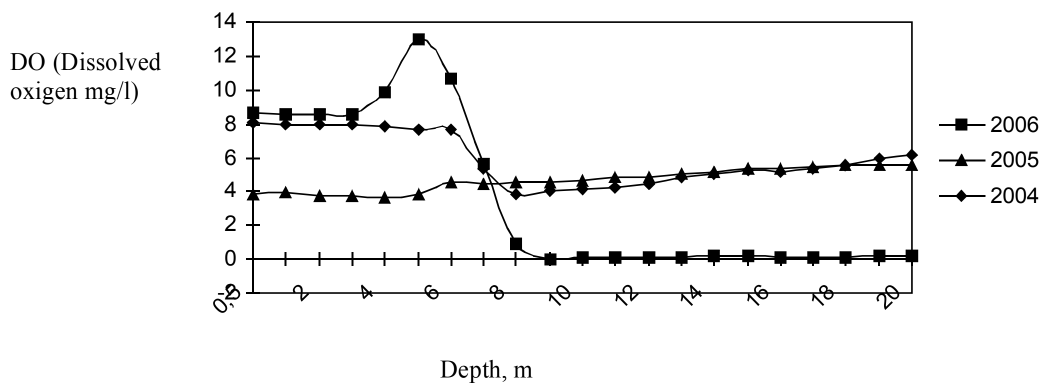

Fig.5. Indicators of Dissolved Oxygenўs Quantity in Water of Lake Dridzis in 2006, 2005, 2004

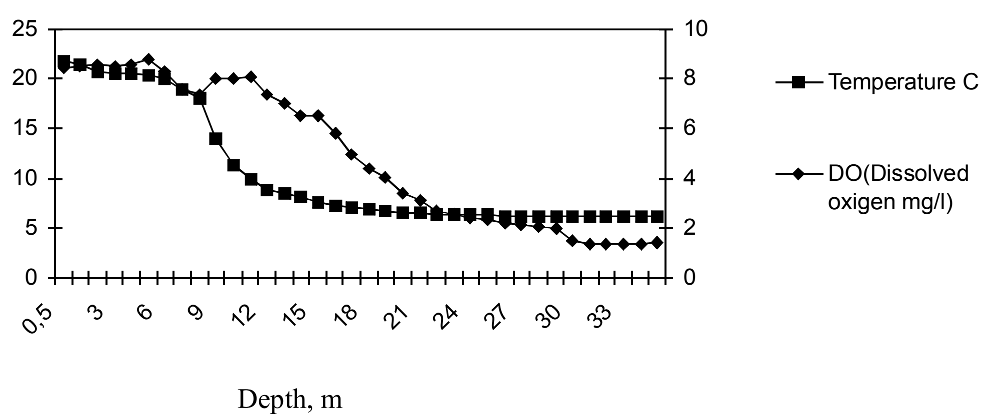

Fig.6. Comparison of physically chemical parameters of water in Lake Sventes on 18th August, 2006

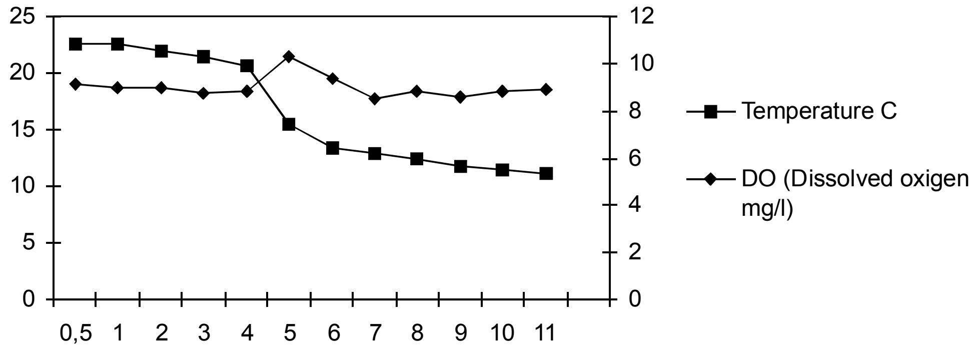

Fig.7. Comparison of physically chemical parameters of water in Lake Rica on 1st July, 2006

Table 4. Renkonen index

Sampling place	Lake Sventes 18.08.06.	Lake Rica 01.07.06.	Lake Dridzis 16.07.06.	Lake Dridzis 30.07.05.	Lake Dridzis 24.08.04.
Lake Sventes 18.08.06.					
Lake Rica 01.07.06.	57				
Lake Dridzis 16.07.06.	54	70			
Lake Dridzis 30.07.05.	57	70	71		
Lake Dridzis 24.08.04.	42	58	56	70	

changes of the disintegrated oxygen were not distinguished (see the figure 5). High level of oxygen in the upper layers of water could be connected with the plants, which discharge the oxygen in the process of photosynthesis, or else the oxygen with the waves is washed in from the atmosphere. The decrease of the oxygen concentration could be explained with multiplying of plankton algaes in large quantities and utilization of oxygen in the life processes.

In the lake of Svente on18 august of 2006 the water temperature was within 21,74^{0}C in the depth of 0,5m to 6,18^{0}C in the depth of 31m. From the depth of 31m to the depth of 35m the water temperature slightly increases, i.e., in the depth of 35m – 6,21 ^{0}C (see the figure 6). The biggest concentration of disintegrated oxygen is in the depth of 5m- 8,76 mg/l, but the lowest is in the depth of 32m- 1,33 mg/l. Also the amount of the disintegrated oxygen, similarly to the water temperature, from the depth of 32m to the depth of 35m is tended slightly to increase (see the figure 6).

Analyzing the physically chemical parameters of the lake of Rica on 1 July of 2006 (see the figure 7), we see, that the water temperature with the depth slightly decreases, but concentration of the disintegrated oxygen reaches the maximum in the depth of 5m- 10,29mg/l, but the lowest it is in the depth of 7m- 8,54 mg/l (see the figure 7).

Conclusion

Basing on the data got in the research, one can conclude:

1. In the lakes of Dridzis, Rica and Svente there were found 3 groups of zooplankton: *Cladocera, Rotatoria* and *Copepoda.* In Dridzis there were found

24 species of zooplankton, in the lake of Svente- 23 species, but in the lake of Rica- 19 species.

2. The lakes of Dridzis, Svente and Rica according to the qualitative content of zooplankton species are similar to other eutrophic lakes of Latvia.

3. In the lakes of Dridzis, Svente and Rica there is a very low level of pollution, because there are oligasoprobe species of zooplankton in these lakes.

4. Basing on the comparative indicators of the quality of zooplankton (Sorensen index) the biggest similarity of the samples is from 0,81 to 0,83m between the lakes of Dridzis and Rica. Basing on the comparative indicators of the quantity of zooplankton (Renkonen index) also the biggest similarity is between the samples of the lakes of Dridzis and Rica, i.e., 70%.
5. The physically chemical parameters of the lakes of Dridzis, Svente and Rica don`t show any essential changes through the years. The water temperature of the lakes changes when the depth changes. In the lakes in the depth of 4-8m, i.e., in metalimny the stratification is characteristic. The lowest temperature is in the lowest water layers of the lakes. The amount of the disintegrated oxygen in the lakes decreases, when the depth increases.

References

Cimdiņš P. 2001. Limnoekoloģija. Rīga, Mācību grāmata. 159.

Introduction to the copepoda. Backhuys Publishers, Leiden, 2001. 344.

Krauter D., Streble H. 1988. Das Leben im Wassertropfen. Mikroflora und Mikrofauna des Süāwassers Ein Bestimmugsbuch. Kosmos. 429.

Sloka N. 1981. Latvijas pSR dzīvnieku noteicējs. Latvijas kladoceru fauna un noteicējs. Rīga, LVU. 146.

Sorensen T. 1948. A method of establishing groups of equal amplitude in plant sociology based on similarity of species content and its application to analyses of the vegetation on Danish commons. Kong. Danish Vidensk. Selsk. Biol. Skr. (Copenhagen) 5:1-34.

Renkonen O. 1938. Statisch-okologische Untersuchungen uber die terrestiche kaferwelt der finnischen bruchmoore. Ann. Zool. Soc. Bot. Fenn. Vanamo 6:1-231.

Кутикова Л.А. 1970. Коловратки фауны СССР. Наука. Ленинград. 743

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STUDY OF DIPTERA FAUNA (NEMATOCERA, BRACHYCERA) FROM THE STRAWBERRY PLANTINGS

Aina Karpa, Valentīna Petrova, Zigrīda Čudare

Karpa A., Petrova V., Čudare Z. 2007. Study of Diptera fauna (Nematocera, Brachycera) from the strawberry plantings. *Acta Biol. Univ. Daugavp., 7 (2): 175 - 180.*

This investigation was carried out in 1997-2004. This is a part of study of species diversity of the strawberry agrocenosis. A list of 120 species from 45 families has been recorded from cultivated strawberry in north-western Latvia. Almost all Diptera species found on strawberry were widely distributed in Latvia. Five species were rare in the ecosystems of Latvia. The seasonal occurrence and food specialisation of Dipterous discussed.

Key words: strawberry, Diptera, fauna, occurrence, food specialisation

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Introduction

Diptera are widely distributed in Latvia and more than 2000 species are noted up to 1996 (Spuris 1996). The Diptera fauna was investigated in the strawberry fields of the Pure Horticultural Research Station (PHRS) (Tukums Region) located in the north-west of Latvia as a part of complex research project of the fauna of Latvian strawberry agrocenosis,

The aims of our investigation were to obtain specific information on the fauna of Diptera and its food specialisation. We wanted to ascertain beneficial species that can play important role in limiting of the injurious strawberry pests.

Material and Methods

The material was collected from the commercial strawberry fields (approximately 6 ha) in the PHRS in 1999-2002, 2004. Random sweep netting in 1999 (June, July, September), 2000 (August, September), 2004 (June-July) and monthly pit-fall trapping (from April to November) with two-week interval (2001-2002) were used.

Results

Altogether 7240 Diptera specimens (Nematocera - 1028, Brachycera - 6212) represented 120 species (Nematocera - 34, Brachycera - 86), and 45 families (Nematocera - 9 families, Brachycera - 36) are noted. The species found on strawberry are given in Table 1.

From the total number of dipterans the greatest share - 5644 specimens (78%) were trapped by means of pit-fall traps and only 1596 specimens (22%) (Nematocera - 2,5%, Brachycera - 97,5%) were collected by means of sweep net.

From the total number of dipterans 14,2% were Nematocera and 85,8% - Brachycera. The 12 families of Brachycera were recorded during the one year. From them 9 families (Asilidae, Asteiidae, Diastatidae, Micropezidae, Milichiidae, Pipunculidae, Rhagionidae, Sciomyzidae, Stratiomyidae) were captured only by sweep net and 3 families (Heleomyzidae, Opomyzidae, Otitidae) only by pit-fall trapping. Thirteen families were found within all years of investigations: Anthomyiidae, Chloropidae, Dolichopodidae, Drosophilidae, Ephydridae, Hybotidae, Lauxanyidae, Muscidae, Phoridae, Sepsidae, Sphaeroceridae, Syrphidae and Tachinidae.

The following Diptera families had the highest number of species: Cecidomyiidae (33 species), Calliphoridae (11), Chloropidae (11), Drosophilidae (9), Dolichopodidae (8), Syrphidae (7), Ephydridae (6). In strawberry in this investigation period thirteen families of Brachycera (Asilidae, Asteiidae, Diastatidae, Empididae, Heleomyzidae, Micropezidae, Milichiidae, Opomyzidae, Otitidae Pipunculidae, Rhagionidae, Sciomyzidae, Stratiomyidae) were recorded as scarce - noted 1-3 specimens.

The more numerous families were Anthomyiidae (17% specimens from total Diptera), Chloropidae (14,3%), Drosophilidae (12,5%), Muscidae (8,4%). The most abundant Brachycera species were noted in some years and months. Species *Calliophum aeneum* Fll. (Lauxanyidae) was the most abundant in September 1999 (22,8% from total species), *Oscinella frit* L. (Chloropidae) - in August 2000 (47,7%), *Drosophila melanogaster* L. (Drosophilidae) in July 2001 (24,2%), *Mesembrina meridiana* L. (Muscidae) (16,3%) and *Pollenia* sp. (Calliphoridae) (7,3%) in September 2001.

According to the species food specialisation, 39,7% of species from total of Diptera were saprophagous, coprophagous, xylophagous and necrophagous, 34,7% - beneficial (predators and parasites), and 25,6% phytophagous and fungivorous.

Figure 1 shows a dominance survey of two groups of fly species: (A) non-beneficial and (B) beneficial in 2001. Adults of beneficial flies have three distinct flight maximum periods: in the first period from April to the end of May with the most abundant of Muscidae (12%) and some zoophagous Phoridae (88%). The second period from the end of June to the beginning of July was less abundant with majority of Calliphoridae (2%), Muscidae (12%) and some zoophagous Phoridae (34,7%). The third maximum period from the end of August to the beginning of October

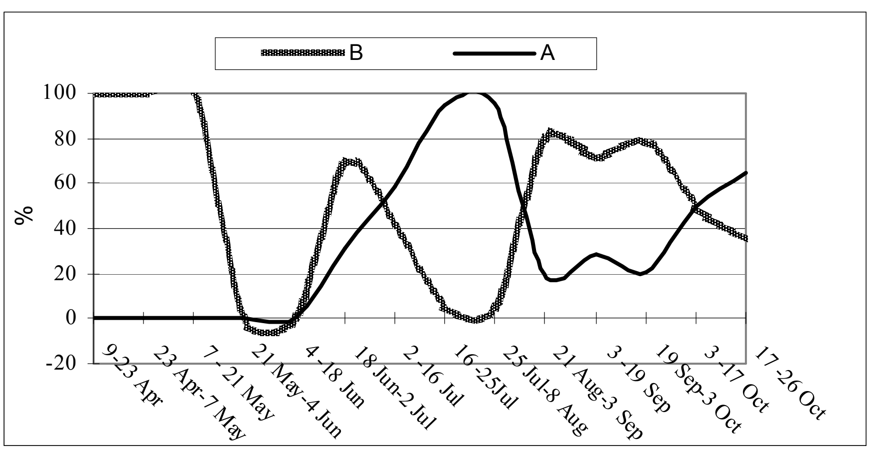

Fig. 1. Survey of dominancy of fly species: (A) - saprophagous, phytophagous, xylophagous,fungivorous, necrophagous, and (B) - beneficials, recorded in 2001 by pit-fall trapping.

Table 1. Diptera of the strawberry agrocenosis collected in 1999-2004. (A) food specialisation, (B) captured by sweep net, (C) - by pit-fall traps. (f) fungivorous, (k) coprophagous, (nec) necrophagous, (par) parasite, (ph) phytophagous, (s) saprophagous, (z) zoophagous, (x) xylophagous.

	A	B	C
NEMATOCERA			
CECIDOMYIIDAE	f-s-z	+	+
Anaretella strobli Edwards	s	+	+
Aprionus sp.	s	-	+
Asynaptina sp.	s	-	+
Arthrocnodax sp.	z	+	+
Brachyneura fungicola Mamajev	s	-	+
Campylomyza flavipes Mg.	s	+	+
Campylomyza sp.	s	+	+
Catocha latipes Haliday	s	-	+
Claspettomyia montana Mamajev	s	-	+
Clinodiplosis cilicrus (Kieffer)	f-s	+	+
Clinodiplosis spp.	f-s	-	+
Coccodea sp.	f	-	+
Contarinia sp.	f-s	-	+
Coquillettomyia sp.	s	-	+
Dasineura sp.	f	-	+
Holobremia sp.	f-s	-	+
Isogynandromyia terricola Spungis	s	-	+
Jaapiella sp.	f	-	+
Lestodiplosis sp. 1	z	+	+
Lestodiplosis sp. 2	z	-	+
Lestodiplosis spp. 3	z	-	+
Miastor metraloas Meinert	s	-	+
Monardia sp. 1	s	-	+
Monardia spp. 2	s	-	+
Mycodiplosis pucciniae Rubsaamen	f-ph-z	+	+
Mycodiplosis sp.	ph-f	-	+
Parepidosis sp.	s	-	+
Peromyia palustris Kieff	s	-	+
Peromyia sp. 1	s	+	+
Peromyia sp. 2	s	-	+
Porricondyla distinguenda Mamajev	s	-	+
Porricondyla sp.	s	-	+
Winnertzia sp.	x	-	+
CERATOPOGONIDAE	s	-	+
CHRONOMIDAE	s	+	+
ENCHYTRAEIDAE	s	-	+
MYMARIDAE	par	-	+
PSYCHODIDAE	s	-	+
SCATOPSIDAE	s	-	+
SCIARIDAE	ph-s	+	+
TIPULIDAE	ph-s	+	+
Tipula paludosa Meig.	ph	+	+
BRACHYCERA			

was less abundant also with majority of zoophagous Calliphoridae (27,2%), Muscidae (30,9%), and parasitic Antomyiidae species during September (32,5%).

The group of non-beneficial species has only one maximum period from the beginning of July to the beginning of August with the peak of saprophagous *D. melanogaster*.

The most numerous predatory fly larvae Cecidomyiidae and hoverflies Syrphidae were observed in strawberry leaf samples from June to September with the prevalence of larvae Cecidomyiidae in colonies of strawberry pest-mites *Phytonemus pallidus* Banks and *Tetranychus urticae* Koch. Their leaf infestations vary among years and months: in June 9-17%, in July 6-25%, in August 5-58%, in September 11-35%.

Discussion

A wide variety of Diptera families were collected from the strawberries. Fauna of dipterous was quite rich in species - 120 taxa were identified. Of them, 1 species from the family Tachinidae have been recorded and separated earlier from the strawberry pest *Hydroecia micacea* Esp. (Lepidoptera, Noctuidae) (Ozols 1973). The real Diptera fauna is more diverse, as the share of more than 2000 specimens was not able to identify. The numbers of species that were recorded on strawberry in Latvia are considerable, however more intensive sampling would reveal more species of the order Diptera. Among the recorded phytophagous species were not found any strawberry pest. Several species were found to be associated with specific food plants like weeds

AGROMYZIDAE	ph	+	-
ANTHOMYIIDAE	ph-s-z-par	+	+
ANTHOMYZIDAE	s	+	+
Anthomyza collini Andersson	s	+	-
Stiprosoma sabulosum Haliday	s	-	+
ASILIDAE	z	+	-
Machimus cingulatus Fll.	z	+	-
ASTEIIDAE	s	+	-
CALLIPHORIDAE	s-k-par	+	+
Calliphora vicina R.-D.	k	-	+
Lucilia illustris Mg.	k	-	+
Lucilia silvarum Mg.	k	-	+
Lucilia spp.	k	-	+
Melinda caerulea Mg.	par	-	+
Pollenia atramentaria Mg.	par	-	+
Pollenia rudis F.	par	-	+
Pollenia spp.	par	-	+
CHAMAEMYIIDAE	par	-	-
Leucopis argenticollis Ztt.	par	-	-
CHLOROPIDAE	ph-s-z	+	+
Aphanotrigonum trilineatum Mg.	s	+	+
Chlorops pumilionis Bjerkander	f	-	+
Dasyopa scutellata v. Roser	s	-	+
Elachiptera tuberculifera Corti	s	+	-
Incertella albipalpis Mg.	s	+	-
Microcelis trigonella Duda	ph	-	+
Oscinella frit L. s.l.	ph	+	+
Oscinella pusilla Mg.	ph	+	-
Thaumatomyia notata Mg.	z	+	-
Thaumatomyia glabra Mg.	z	+	-
Thaumatomyia rufa Mcq.	z	+	+
DIASTATIDAE	s	+	-
Diastata fuscula Fll.	s	+	-
DOLICHOPODIDAE	z	+	+
Campsicnemus curvipes Fll.	z	+	-
Campsicnemus lumcatus Lw.	z	+	-
Campicnemus scambus Fll.	z	-	+
Campsicnemus sp.	z	-	+
Dolichopus longicornis Stannins	z	-	+
Dolichopus plumipes Scopoli	z	-	+
Medetera sp.	z	-	+
Sciopus sp.	z	-	+
DROSOPHILIDAE	ph-s	+	+
Drosophila bifasciata Pomini	s	-	+
Drosophila busckii Coquillett	s	-	+
Drosophila griseola Ztt.	s	-	+
Drosophila histrio Mg.	f	-	+
Drosophila hydei Sturtevant	s	-	+
Drosophila melanogaster Mg.	s	-	+
Drosophila transversa Fll.	f	-	+
Drosophila sp.	s	+	-
Scaptomyza pallida Ztt.	s	+	+
EMPIDIDAE	z	+	-

(Compositae, Cruciferae, Gramineae) in strawberry plantations, wild grasses and herbaceous flower plants from the surrounding vegetation.

The abundance of saprophagous species of Drosophilidae with majority of *D. melanogaster* in July and August indicate this period to be entailed with strawberry fruiting period and the appearance of decaying berries, especially, during the rainy months of this year.

We recorded some beneficial species that may play an important role in the regulation of the injurious species inhabiting strawberry fields. The predatory larvae of Asilidae, Cecidomyiidae, Dolichopodidae, Empididae, Hybotidae, Rhagionidae, Syrphidae, Stratiomyidae, Therevidae and of some species of Chloropidae, Muscidae, Scatophagidae, can be excellent control agents of strawberry pest arthropods.

According to our laboratory and field observations the fungivore *Mycodiplosis pucciniae* Rub. (Cecidomyiidae) was noted as active predator of the phytophagous mite *T. urticae* and *P. pallidus*. This species actively fed on mobile stages of both mite pests within their colonies on the strawberry leaves. According to our data, we consider that *M. pucciniae* may be the predator also. In Cecidomyiidae are known the predatory species of *Arthrocnodax, Aphidoletes* and *Lestodiplosis* limiting the population density of phytophagous mites, aphids and gall midges (Spuņģis 1977).

Species *Machimus cingulatus* Fll. from Asilidae is an active control agent of the larvae of Elateridae, Scarabaeidae, and other soil-dwelling harmful in-

Empis prodromus Lw.	z	+	-
EPHYDRIDAE	ph-s	+	+
Hydrellia maculiventris Beck.	ph	+	+
Hydrina nigricauda Stehammar	ph	+	+
Hydrina sexmaculata Beck.	ph	-	+
Noctima picta Fll.	ph	-	+
Psilopa nitidula Fll.	ph	+	-
Scatella stagnalis Fll.	s	+	-
HELEOMYZIDAE	s	-	+
Suillia flava Mg.	s	-	+
Suillia fuscicornis Ztt.	s	-	+
HYBOTIDAE	z	+	+
Platypalpus spp.	z	+	-
Tachydromia sp.	z	-	+
LAUXANIIDAE	s	+	+
Calliopum aeneum Fll.	s	+	+
Calliopum elisae Mg.	s	-	-
Minettia longipennis F.	s	+	-
Minettia lupulina Fabr.	s	-	+
Minettia plumicornis Fll.	s	-	+
LONCHOPTERIDAE	s	+	-
Lonchoptera furcata Fll.	s	+	-
MICROPEZIDAE	ph-s	+	-
MILICHIIDAE	s-k-nec	+	-
Madiza glabra Fll.	k	+	-
MUSCIDAE	s-z	+	+
Mesembrina meridiana L.	z	-	+
OPOMYZIDAE	ph	-	+
Geomyza apicalis Mg.	ph	-	+
OTITIDAE	s	+	-
Herina frondescentia L.	s	+	-
Tetanops myopina Fll.	s	+	-
PIPUNCULIDAE	par	+	-
PHORIDAE	s-f-ph-par	+	+
PSILLIDAE	ph	+	-
Psila nigicornis Mg.	ph	+	-
RHAGIONIDAE	z	+	-
SARCOPHAGIDAE	s-nec-par	+	+
Sarcophaga carnaria L.	nec-par	-	+
Sarcophaga lehmani ? Muller	nec-par	-	+
Sarcophaga subvicina Rohd.	nec-par	+	-
SCATHOPHAGIDAE	ph-s-z	+	+
Scathophaga stercoraria L.	z	+	+
SCIOMYZIDAE	par	+	-
Limnia unguicornis Scopoli	par	+	-
SEPSIDAE	s	+	+
Sepsis fulgens Hoffmannsegg	s	+	-
Themira annulipes Mg.	s	+	+
SPHAEROCERIDAE	s	+	+
STRATIOMYIDAE	s-z	+	-
SYRPHIDAE	ph-s-z	+	+
Chalcosyrphus nemorum (F.)	z	+	-
Eupeodes corollae (F.)	z	+	-
Melanostoma mellinum (L.)	z	+	-

sects (Bondarenko 1986). The larvae of *Eupeodes corollae* (F.), *Sphaerophoria scripta* L., *S. rueppellis* Wied, and some other syrphid species fed on cicada, thrips, aphid, small larvae of the leafrollers and eaworms (Bondarenko 1986). Some species of the family Tephritidae are beneficial biological control agents of weeds.
Parasite species of Antomyiidae, Calliphoridae, Chamaemyiidae, Mymaridae, Pipunculidae, Sciomyzidae, Tachinidae, and some species of Phoridae, Sarcophagidae also are known to be an active biological control agents of strawberry pest arthropods: aphids, beetles, leafrollers, eaworms, and sawflies species (Bondarenko 1986). The species *Melinda caerulea* Mg. (Calliphoridae) and the Pipunculidae flies developing as the larval parasites of plant hopper bugs. Flies of the Sciomyzidae prey on or parasite the snails. They are potentially important in the biological control of the snails, which act as the hosts of disease organisms affecting livestock and humans (Hammond 2003). *Sarcophaga carnaria* L. have tendency to entomophagy on Lepidoptera, Orthoptera and earthworms (Bondarenko 1986). Many species of Tachinidae are recorded in the Latvian orchards, potato fields, pine and spruce woods as effective parasites of harmful moths and sawflies (Liepa 1961; E.Ozols 1973; G.Ozols 1987).

Almost all of the Diptera species found on strawberry were widely distributed in Latvia. Five species *Hydrina sexmaculata* Beck., *Sphenella marginata* Fll., *Geomyza apicalis* Mg., *Diastata fuscula* Fll., and *Minettia longipennis* F. were rare species in the ecosystems of Latvia.

Data on strawberry Diptera fauna in Latvia was unknown until now and making comparison impossible.

Melanostoma scalare F.	z	+	-
Sphaerophoria rueppellis Wied	z	+	-
Sphaerophoria scripta L.	z	+	-
Sphaerophoria taeniata Mg.	z	+	-
TACHINIDAE	par	+	+
Ceromasia stabulans Meig.	par	-	-
TEPHRITIDAE	ph	+	-
Ensina sonchi L.	ph	+	-
Oxyna parietina L.	ph	+	-
Sphenella marginata Fll.	ph	+	-
Tephritis crepidis Hendel	ph	+	-
Tephritis stellata Fuessly	ph	+	-
THEREVIDAE	z	+	+
Acrsathe annulata F.	z	-	+
Dialineura annulata L.	z	-	+

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We are particularly grateful to our colleague V. Spungis for identified species of Nematocera, Cecidomyiidae and K. Vilks for identified species of Dolichopodidae. We are also grateful I. Samsone and A. Hramejeva to invaluable assistance with fieldwork. The authors would like to thank I. Salmane for any comments on manuscript. Research was supported by grants No 96.0120 and 03.09.57.

References

Bondarenko, N.V. 1986. Biological plants protection. M., Agropromizdat: 1-278. (In Russian).

Hammond, M. 2003. A survey of invertabrates on land at Metcalfe Lane, Osbaldwick, York (2003). York: 1-47.

Liepa, I. 1961 Some data about parasites of leafrollers. In Book: Short results of the investigations of plant protection in Baltic countries. (Ozols, E. eds.), 66-67. (In Russian).

Ozols, E. 1973. Agricultural entomology. Zvaigzne, Rīga: 1-495. (In Latvian)

Ozols, G. 1987. Tachinid flies (Diptera, Tachinidae) reared from the dendrophagous insects of pine and spruce in Latvia. Latvijas Entomologs 30: 5-7. (In Latvian).

Spuņģis, V. 1977. Faunistic materials on the Latvian gall midges. Latvijas Entomologs 20: 57-67. (In Latvian).

Spuris Z. 1996. How much species of Diptera are in Latvia? Latv. Entomol. Archîvs 3: 32-38. (In Latvian).

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NEW AND RARE FOR LITHUANIA BEETLES (*COLEOPTERA*) SPECIES

Romas Ferenca, Povilas Ivinskis, Vytautas Tamutis

Ferenca R., Ivinskis P., Tamutis V. 2007. New and rare for Lithuania beetles (Coleoptera) species. *Acta Biol. Univ. Daugavp., 7 (2): 181 - 190.*

The present paper contains information about 81 rare and 27 new for Lithuania Coleoptera species.

Key words: Fauna, Lithuania Coleoptera, new and rare species, distribution

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Introduction

Information about Coleoptera fauna and distribution of its species in Lithuania remains incomplete. A list of 2879 species of Lithuanian beetles is given in the monograph „Lietuvos fauna. Vabalai“. Information about another 430 species recorded in Lithuania has been published latter (Barševskis, 2001; Šablevičius, Ferenca, 1995; Šablevičius, 2003, 2004; Tamutis, 1996, 1999, 2001, 2001, 2003, 2004; Monsevičius, 1998, 1999; Barševskis, 2001; Monsevičius, Pankevičius, 2001; Ferenca et al., 2002; Ferenca, 2003, 2004; Inokaitis, 2004).

The present paper contains information about 81 rare and 27 new for Lithuania Coleoptera species.

8 species: *Acupalpus luteatus* (Duftshmidt, 1812) (*Carabidae*); *Callicerus obscurus* (Gravenhorst, 1802), *Gyrophaena rugipennis* (Mulstant & Rey,1861), *Gabrius astutoides* (Strand, 1946) (*Staphylinidae*); *Melasis buprestoides* (Linnaeus, 1761) (*Eucnemidae*); *Globicornis corticalis* (Eichhoff, 1863) (*Dermestidae*); *Glischrochilus quadrisignatus* (Say, 1835) (*Nitidulidae*); *Notolaemus castaneus* (Erichson, 1845) (*Laemophloeidae*) have been registered in the fauna of Baltic states for the first time.

16 species: *Acupalpus suturalis* Dejean, 1829 (*Carabidae*); *Acrotrichis sitkaensis* (Motschulsky, 1845), *Acrotrichis sericans* (Heer, 1841) (*Ptiliidae*); *Coproporus colchicus* (Kraatz, 1858), *Dinarda maerkelii* (Kiesenwetter, 1843), *Sunius melanocephalus* (Fabricius, 1793),

(*Staphylinidae*); *Trogoderma angustum* (Solier, 1849) (*Dermestidae*); *Ernobius abietinus* (Gyllenhal, 1808) (*Anobiidae*); *Glischrochilus grandis* (Tournier. 1872) (*Nitidulidae*); *Orthoperus brunnipes* (Gyllenhal, 1808) (*Corylophidae*); *Corticaria umbilicata* (Beck, 1817) (*Lathridiidae*); *Cis glabratus* (Mellié, 1848) (*Cisidae*); *Mesosa myops* (Dalman, 1817) (*Cerambycidae*); *Oulema tristis* (Herbst, 1786); *Crepidodera plutus* (Latreille, 1804) (*Chrysomelidae*); *Stenocarus umbrinus* (Gyllenhal, 1827) (*Curculionidae*), are new to the Lithuanian fauna.

There are no information about following species in Lithuanian scientific papers: *Agonum afrum* (Duftschmid, 1812), *Amara gebleri* (Dejean, 1831) (*Carabidae*), *Euglenes pygmaeus* (Degeer, 1774) (*Aderidae*), *Poecilium alni* (Linnaeus, 1767) (*Cerambycidae*), but in the latest cheklist of the northern European Coleoptera H. Silfverberg (Silfverberg, 2004) already noted these species.

Data published by R. Ferenca on *Mesosa curculionoides* (Ferenca, 2004) was wrong. Repeatedly made examination proved that this specimen belongs to species *Mesosa myops* (det. B. Ehnström). This mistake is corrected in the papaer.

Material and Methods

The material was collected in different parts of Lithuania by authors: Romas Ferenca (R.F.), Vytautas Tamutis (V.T.) and Povilas Ivinskis (P.I.). Some specimens were collected by Artūras Gedminas (A.G.), Aleksandras Meržijevskis (A.M.), Norbertas Noreika (N.N.), Brigita Paulavičiūtė (B.P), Simonas Pileckis (S. P.) Giedrius Švitra (G. Š.), Paulius Zolubas (P.Z.). Insects were collected using Barber's and pheromone traps, applyng netting, seeking in a dead wood, under bark and caught by hand.
The nomenclature of beetles is given according J.F.Lawrence & A.F.Newton (1995). Beetles were identified according to folloving literature: Bielawski, 1959; Borowiec, Tornawski, 1983; Burakowski, 1976; Freude, Harde, Lohse, 1969-81; Hůrka, 1996; Nunberg, 1987; Smreczynski,1965,1972; Szujecki, 1965, 1980.

Information on localities

Akmenė distr., Kamanos State Strict Nature, 56°182 36,23N, 22°38236,53E;

Alytus distr., Punios Šilas f.,54°32231,73N, 24°04247,33E;

Vidzgiris botanical reserve, 54°22´51,93N, 24°00211,33E;

Birštonas mun., Nemuno kilpų regional park, 54°362 19,63N, 24°00212,73E;

Ignalina distr., Pakasas lake env. 55°26253,43N, 25°56232,03E;

Jurbarkas distr., Armena river valley, - ?

Viešvilė State Strict Nature, 55°07202,33N, 22°25210,33E;

Kaišiadorys distr., Gastilionių Miškas f., 54°52224,83N, 24°10212,03E;

Kaišiadorys t., 54°54226,43N, 24°28225,03E

Kaunas t., Ąžuolynas parkland, 54°54'07,23N, 23°56'48,33E;

Kaunas distr., Dubravos Miškas f. (1), 54°50212,63N, 24°04222,33E;

Dubravos Miškas f. (2), 54°52226,43N, 24°03244,03E;

Dubravos Miškas f. (3), 54°52213,23N, 24°04206,63E;

Dubravos Miškas f. (4), 54°522 53,43N, 24°03244,03E;

Jiesia landscape preserve (1), 54°51212,93N, 23°56220,83E;

Jiesia landscape preserve (2), 54°52226,43N, 23°55259,03E;

Pajiesio Miškas f., 54°46237,03N, 23°51218,53E;

Margininkai, 54°50246,83N, 24°02248,03E;

Kamšos miškas f., 54°57246,83N, 23°50234,03E;

Ringaudai, 54°58240,23N, 23°37229,03E;

Braziūkai, 54°59206,63N, 23°28247,03E;

Kazliškiai, 54°55219,83N, 23°51241,03E;

Noreikiškės, 54°56226,43N, 23°50222,03E;

Girininkai, 54°51219,83N, 23°40200,03E;

Kėdainiai distr., Šlapaberžė, 55°25240,23N, 23°55214,03E;

Klaipėda distr., Pajūrio regional park, 55°47228,23N, 21°04221,33E;

Karkle, Pajūrio regional park, 55°51253,23N, 21°03248,03E;

Plocis lake env., Pajūrio regional park, 55°57226,43N, 21°05241,23E;

Nemirseta, Smiltynė, 54°42220,33N, 21°06208,33E;

Lazdijai distr., Baltoji Ančia entomol. Preserve, Gerdašiai, 53°56252,43N, 23°52255,83E;

Marijampolė distr., Jūrė env., 54°482 22,63N, 23°29214,43E;

Molėtai distr., Kertuojai lake env., 55°10226,43N, 25°34206,63E;
Neringa t., Grobštas nature preserve, 55°17218,93N, 20°58237,23E;

Juodkrantė env,. 55°31218,83N, 21°06258,83E;

Pervalka env., 55°24201,33N, 21°07205,53E;

Radviliškis distr., Šniūraičiai tsh., 55°532N, 23°302E;

Šakiai distr., Juškinės Miškas f., 55°01200,33N, 23°26217,53E;

Tervydoniai tsh.,55°01240,73N, 23°26257,03E;

Šiauliai distr., Dzidai, 55°55206,63N, 23°09209,63E;

Bazilionai, 55°50233,63N, 23°08213,03E;

Šilutė distr., Mikytų Miškas f., 55°07216,93N, 21°56221,03E;

Palanga t., Airport,55°59225,03N, 21°05245,63E;

Ukmergė district,Dukstynos Miškas f., - ?

Balninkai env., Pašilės miškas f. 55°15246,83N, 24°43237,03E;

Vilnius t., 54°462 N, 25°152E;

Varėna distr., Čepkeliai State Strict Nature, 54°01211,03N, 24°25224,53E;

Marcinkonys env., 54°04227,13N, 24°28222,63E;

Vilnius distr., Neris regional park, 54°49210,33N, 24°55254,33E;

Karmazinai mound, Verkiai, 54°462N, 25°182E

New for Lithuania beetle species are marked with single asterisk (*), species mentioned in the Lithuania for the first time with double asterisk (**).

List of species

CARABIDAE

***Trechus obtusus* (Erichson, 1837)** Kaišiadorys, park, 07 07 2004, 1 spec. (V. T.).

*****Agonum afrum* (Duftschmid, 1812)** Noreikiškės, bank of pound, 04 04 1991, 1 spec. (V. T.).

*****Amara gebleri* (Dejean, 1831)** Braziūkai, forest clearcut with Urtica and Cirsium plants, 30 07 2005, 1 spec., 15 08 2005, 1 spec. (V. T.).

***Diachromus germanus* (Linnaeus, 1758)** Armena river valley,16 06 2005,1B& (G.Š.).

***Acupalpus exiquus* Dejean, 1829** Juodkrantė env., shore of the Curonian lagoon, 06 07 2004, 1 spec. (R.F.).

****Acupalpus luteatus* (Duftshmidt, 1812)** Margininkai, wet meadow, with Carex plants, 31 8 1997, 1 spec. (V.T.).

****Acupalpus suturalis* Dejean, 1829** Juodkrantė env., sand – dunes near the Baltic Sea, 06 07 2004, 1B&1@& (R.F.).

***Masoreus wetterhallii* (Gyllenhal, 1813)** Nemirseta, 08 06-29 07 2004, 8 spec. (P.I.).

***Lebia chlorocephala* (Hoffmann, 1803)** Nemirseta, 08 06-29 07 2004, 1 spec. (P.I.).

***Demetrias monostigma* Samouelle, 1819** Smiltynė, 11 04 2004, 1 spec. (R.F.).

***Dromius linearis* (Olivier, 1795)** Verkiai, 1978 04 02, 1 spec. (G.Š.).

***Lionychus quadrillum* (Duftschmid, 1812)** Nemuno kilpų regional park, slope of Nemunas river, 17 08 2005, 7 spec. (R.F.).

HYDROPHILIDAE

***Hydrochus carinatus* Germar, 1824** Pajūrio regional park, Plocis lake env., 30 07 2004, 1 spec. (R.F.).

HISTERIDAE

***Saprinus immundus* (Gyllenhal, 1827)** Nemirseta, 08 06-29 07 2004, 5 spec. (P.I.).

***Saprinus planiusculus* (Motschulsky, 1849)** Nemirseta, 08 06-29 07 2004, 4 spec. (P.I.).

PTILIIDAE

***Ptenidium nitidum* (Heer, 1841)** Pajūrio regional park, Plocis lake env., 25 05 2005, 2 spec. (R.F.); Jiesia landscape preserve (1), 24 08 2005, 1 spec. (R.F).

***Nephanes titan* (Newman,1834)** Jiesia landscape preserve, 24 08 2005, 1 (R.F).

***Acrotrichis fascicularis* (Herbst, 1793)** Dubravos Miškas f. (1), 28 08 2005, 1@&, 29 08 2005, 1 (R.F.).

****Acrotrichis sitkaensis* (Motschulsky, 1845)** Pajūrio regional park, Plocis lake env., 25 05 2005, 13 (R.F.); Juodkrantė env., shore of the Curonian lagoon, 08 09 2005, 6 (R.F.).

****Acrotrichis sericans* (Heer, 1841)** Jiesia landscape preserve, 24 08 2005, 1 (R.F).

LEIODIDAE

***Leiodes ciliaris* (Schmidt, 1841)** Nemirseta, 08 06-29 07 2004, 1 spec. (P.I.).

SCYDMAENIDAE

***Scydmaenus tarsatus* Muller& Kunze, 1822** Čepkeliai State Strict Nature, 09 06 2004, 1 spec. (R.F.).

STAPHYLINIDAE

****Coproporus colchicus* (Kraatz, 1858)** Kamšos miškas f., forest litter, 07 08 2003, 1 spec. (V.T.).

****Dinarda maerkelii* (Kiesenwetter, 1843)** Pašilės miškas f., Barber's trap, 20 04 2004, 1 spec. (N.N.).

***Callicerus obscurus* (Gravenhorst, 1802)** Ringaudai, orchard litter, 30 03 2004, 1 spec. (V.T.).

***Gyrophaena joyi* Wendeler, 1924** Jiesia landscape preserve (1), 25 09 2005, 1B& (R.F.).

***Gyrophaena pulhella* Heer, 1839** Juškinės Miškas f., 01 10 2005, 4B& (R.F.).

***Gyrophaena rugipennis* Mulsant & Rey, 1861** Jiesia landscape preserve (1), 25 09 2005, 3@& (R.F).

***Hygronoma dimidiata* (Gravenhorst, 1806)** Pajūrio regional park, Plocis lake env., 30 07 2004, 1 spec. (R.F.).

***Anotylus fairmairei* (Pandelle, 1867)** Tervydoniai tsh., 13 07 2005, 3 spec. (R.F.).

***Astenus gracilis* Paykull, 1789** Palanga airport, 06 05 2001, 1 spec. (R.F.).

***Rugilus fragilis* (Gravenhorst, 1806)** Juodkrantė env., shore of the Curonian lagoon, 08 09 2005, 1 spec. (R.F.).

***Sunius melanocephalus* (Fabricius, 1793)** Ringaudai, orchard litter, 05 04 2004, 4 spec. (V.T.).

***Lithocharis ochracea* (Gravenhorst, 1802)** Tervydoniai tsh., 13 07 2005, 2 spec. (R.F.).

***Gabrius astutoides* (Strand, 1946)** Ringaudai, orchard litter, 19 03 2004, 1 spec. (V.T.).

BOLBOCERATIDAE

***Odontaeus armiger* (Scopoli, 1772)** Tervydoniai tsh., 07 08 2005, 1(R.F.).

SCARABAEIDAE

***Copris lunaris* (Linnaeus, 1758)** Kamanos State Strict Nature, 15 07 1999, 1B& (B.P).

***Aegalia arenaria* (Fabricius, 1787)** Nemirseta, 08 06 2004, 1 spec. (P.I.).

EUCINETIDAE

***Eucinetus haemorrhoidalis* (Germar,1818)** Nemirseta, 08 06–29 07 2004, 1 spec. (P.I.).

BUPRESTIDAE

***Agrilus cyanescens* Ratzeburg, 1837** Jiesia landscape preserve (1), 12 06 2005, 1B& (R.F.).

BYRRHIDAE

***Pelochares versicolor* (Waltl, 1833)** Nemuno kilpų regional park, slope of Nemunas river, 17 08 2005, 1 spec. (R.F.).

EUCNEMIDAE

***Melasis buprestoides* (Linnaeus, 1761)** Dubravos Miškas f. (2), pheromone trap for *Ips typographus*, 02 05 2002, 1 spec. (P.Z.).

***Eucnemis capucina*, Ahrens, 1812** Jiesia landscape preserve (1), 12 06 2005, 1 spec. (R.F.).

ELATERIDAE

***Anostirus castaneus* (Linnaeus, 1758)** Pajiesio Miškas f., 30 05 2004, 1B& (P.I.).

DERMESTIDAE

***Trogoderma angustum* (Solier, 1849)** Kaunas t., quarantine station, in the grains, 27 08 1990, 1 spec. (S.P.).

***Globicornis corticalis* (Eichhoff, 1863)** Dubravos Miškas f., (2), pheromone trap for *Ips typographus*, 04 05 2002, 1 spec. (P.Z.).

NOSODENDRIDAE

***Nosodendron fasciculare* (Olivier, 1790)** Jiesia landscape preserve (1), 24 06 2005, 4 spec.(R.F.).

ANOBIIDAE

***Ernobius abietinus* (Gyllenhal, 1808)** Dubravos Miškas f. (3), under bark, 15 04 1997, 1 spec. (V.T.).

***Dorcatoma dresdensis* Herbst, 1792** Pervalka env., 10 07 2003, 1 spec. (R.F.).

***Dorcatoma lomnickii* Reitter, 1903** Vilnius, 19 05 1999, 1 spec. (B.P.).

TROGOSSITIDAE

***Grynocharis oblonga* (Linnaeus, 1758)** Čepkeliai State Strict Nature, 09 06 2004, 1 spec. (R.F.).

MELYRIDAE

***Anthocomus rufus* (Herbst, 1784)** Ringovė, 19 08 2004, 1B&, (P.I.).

***Paratinus femoralis* (Erichson, 1840)** Nemirseta, 08 06 2004, 1 spec. (P.I.).

NITIDULIDAE

***Nitidula carnaria* (Schaller, 1783)** Nemirseta, 08 06- 29 07 2004, 1 spec. (P.I.).

***Nitidula rufipes* (Linnaeus,1767)** Juškinės Miškas f., 03 07 2004, 1B& (R.F.).

***Cryptarcha undata* (Olivier, 1790)** Gastilionių Miškas f., 27 05 2003, 1 spec. (R.F.).

***Glischrochilus quadrisignatus* (Say, 1835)** Pakasas lake env., flied, 05 08 1997, 1 spec. (V.T.); Noreikiškės, Barber's trap in the barley, 03 05 1994, 1 spec. (V.T.). Kazliškiai, Barber's trap in the wheat, 21 05 1998, 1 spec. (V.T.).

***Glischrochilus grandis* (Tournier. 1872)** Šlapaberžė, 07 04 2000, 1 spec. (V. T.). Jiesia landscape reserve (2), on flovers, 06 08 2001, 1 spec. (V.T.).Bazilionai, on flowers, 01 05 2005, 1 spec. (V.T.).

MONOTOMIDAE

***Monotoma picipes* (Olivier, 1790)** Tervydoniai tsh., 13 07 2005, 2 spec. (R.F.).

SILVANIDAE

***Dendrophagus crenatus* (Paykull, 1799)** Dubravos Miškas f. (1), 30 04 21005, 1 (R.F.).

LAEMOPHLOEIDAE

***Notolaemus castaneus* (Erichson,1845)** Jiesia landscape preserve (1), 18 06 2005, 2 (A.M).

BOTHRIDERIDAE

***Bothrideres contractus* (Olivier, 1790)** Čepkeliai State Strict Nature, 09 06 2004, 2 spec. (R.F.).

COCCINELLIDAE

***Platynaspis luteorubra* (Goeze, 1777)** Nemirseta, 08 06- 29 07 2004, 4 (P.I.).

CORYLOPHIDAE

***Orthoperus brunnipes* (Gyllenhal, 1808)** Kazliškiai, Barber's trap in the wheat, 29 07 1998, 1 spec. (V.T.).

LATHRIDIIDAE

***Corticaria umbilicata* (Beck, 1817)** Noreikiškės, the Salix bush litter, 09 04 1994, 1 spec. (V.T.).

MYCETOPHAGIDAE

***Mycetophagus ater* (Reitter,1789)** Jiesia landscape preserve (1), 25 06 2005, 1 spec. (A.M).

CIIDAE

***Cis glabratus* (Mellié, 1848)** Margininkai, in the wood sponge, 02 05 1997, 1 spec. (V.T.). Girininkai, in the wood sponge, 27 08 1992, 1 spec. (V.T.). Noreikiškės, in the wood sponge, 21 03 2000, 1 spec. (V.T.). Dzidai, in the wood sponge, 04 07 2002, 10 spec. (V.T.).

***Sulcacis affinis* (Gyllenhal, 1827)** Juodkrantė env., 15 07 2000, 1 spec. (R.F.).

MELANDRYIDAE

***Orchesia micans* (Panzer,1794)** Pajiesio Miškas f., 30 05 2004, 1 spec. (P.I.).

***Orchesia minor* Walker, 1837** Jiesia landscape reserve (1),10 11 2005, 2 spec. (R.F.).

***Hypulus quercinus* (Quensel, 1790)** Jiesia landscape reserve (1), 22 05 2005, 2 spec., 12 06 2005, 2 spec. (R.F.).

COLYDIIDAE

***Synhita humeralis* (Fabricius, 1792)** Čepkeliai State Strict Nature, 09 06 2004, 1 spec. (R.F.).

***Orthocerus clavicornis* (Linnaeus, 1758)** Nemirseta, 08 06- 29 07 2004, 1 spec. (P.I).

TENEBRIONIDAE

***Tenebrio obscurus* Fabricius, 1792** Ąžuolynas parkland, 29 06 2005, 1 spec. (G.Š.).

***Isomira murina* (Linnaeus, 1758)** Karklė, 09 06 2004, 1 spec. (P.I.), Nemirseta, 08 06 – 29 07 2004, 3 spec. (P.I.).

***Mycetochara flavipes* (Fabricius, 1792)** Čepkeliai State Strict Nature, 09 06 2004, 1 (R.F.); Dubravos Miškas f., 26 06 2005, 1 (R.F.).

***Corticeus fasciatus* (Fabricius, 1790)** Jiesia landscape preserve (1), 26 05 2003, 1 spec. (R.F.).

***Oplocephala haemorrhoidalis* (Fabricius, 1787)** Čepkeliai State Strict Nature, 09 06 2004, 5B& 4 (R.F.).

***Scaphidema metallicum* (Fabricius, 1792)** Tervydoniai tsh., 23 10 2005, 1 spec. (R.F.).

MELOIDAE

***Meloe brevicollis* Panzer, 1793** Grobštas nature preserve, 15 06 2005, 1 (R.F.).

ANTHICIDAE

***Anthicus bimaculatus* (Illiger, 1801)** Nemirseta, 08 06 2004, 1 spec. (P.I.).

ADERIDAE

*****Euglenes pygmaeus* (Degeer, 1774)** Pajūrio regional park, Plocis lake env., 30 07 2004, 1 (R.F.).

CERAMBYCIDAE

***Anoplodera rufipes* (Schaller, 1783)** Vidzgiris botanical preserve, 16 06 2003, 1 spec. (R.F.).

*****Poecilium alni* (Linnaeus, 1767)** Dubravos Miškas f. (2), pheromone trap for *Ips typographus*, 04 05 2002, 1 spec. (P.Z.). Dubravos Miškas f. (4), under bark of the branch, 08 07 2003, 1 spec. (A.G.).

****Mesosa myops* (Dalman, 1817)** Vidzgiris botanical preserve, 09 06 2003, 1 spec. (R.F.).

***Phytoecia virgula* (Charpentier, 1825)** Šniūraičiai, 12 06 2004, 1(P.I.).

CHRYSOMELIDAE

***Bruchidius marginalis* (Fabricius, 1775)** Nemuno kilpų regional park, slope of Nemunas river, 17 08 2005, 1 spec. (R.F.).

****Oulema tristis* (Herbst, 1786)** Nemuno kilpų regional park, slope of Nemunas river, 17 08 2005, 3 spec. (R.F.).

***Longitarsus tabidus* (Fabricius, 1775)** Nemuno kilpų regional park, slope of Nemunas river, 17 08 2005, 2 spec. (R.F.).

***Derocrepis rufipes* (Linnaeus, 1758)** Neris regional park, Karmazinai mound, 06-07 05 2003, 2 spec. (R.F.).

***Crepidodera plutus* (Latreille, 1804)** Kamšos miškas, on the leaves of Salix, 24 05 1995, 1 spec. (V.T.).

***Cryptocephalus parvulus* Muller, 1766** Tervydoniai tsh., 23 05 2004, 1 (R.F.).

***Cryptocephalus pusillus* Fabricius, 1777** Pajūrio regional park, Plocis lake env., 30 07 2004, 4 (R.F.).

***Cryptocephalus querceti* Suffrian, 1843** Tervydoniai tsh., 17 05 2005, 1@& (R.F.).

ANTHRIBIDAE

***Tropideres albirostris* (Herbst, 1783)** Tervydoniai tsh., 14 08 2005, 1 spec. (R.F.).

***Dissoleucas niveirostris* (Fabricius, 1798)** Balninkai env., 12 06 1977, 1 spec. (G.Š.); Jiesia landscape preserve, 12 06 2005, 1 spec. (R.F.).

ATTELABIDAE

***Apoderus erythropterus* (Gmelin, 1790)** Marcinkonys env., valley of Gruda river, 10 06 2004, 3 spec. (R.F.).

APIONIDAE

***Taeniapion urticarium* (Herbst, 1784)** Tervydoniai tsh., 13 07 2005, 1@& (R.F.).

CURCULIONIDAE

***Dorytomus edoughensis* Desbrochers des Loges, 1875** Tervydoniai tsh., 13 07 2005, 1 spec. (R.F.).

***Steronychus fraxini* (Degeer,1775)** Pajiesio Miškas f. 30 05 2004, 1 spec. (P.I.).

***Bagous lutosus* (Gyllenhal, 1813)** Nemirseta, 06 08 – 07 29 2004 1 spec. (P.I.).

***Trachodes hispidus* (Linnaeus, 1758)** Jiesia landscape preserve (1), 12 06 2005, 1B& 1 (R.F.).

***Acalles camelus* (Fabricius, 1792)** Jiesia landscape preserve (1), 12 06 2005, 1 (R.F.).

***Dryophthorus corticalis* (Paykull, 1792)** Dubravos Miškas f. (1), 30 04 2005, 1 spec. (R.F.).

***Rhyncolus elongatus* (Gyllenhal, 1827)** Gerdašiai tsh.,15 07 1999, 3 (R.F.), Gelednė, 21 06 2001, 2 (R.F.), Juškinės Miškas f., 09 03 2003, 1 (R.F.), Punios Šilas f., 10 06 2003 1 (R.F.), Juškinės Miškas f., 21 06 2003 1 (R.F.), Gerdašiai tsh., 07 08 2003, 2 (R.F.), Čepkeliai State Strict Nature, 09 06 2004, 8 (R.F.).

***Rhyncolus sculpturatus* Waltl, 1839** Gerdašiai tsh.,15 07 1999, 1 spec. (R.F.).

***Brchytemnus porcatus* (Germar, 1824)** Jūrė env. 06 06 2002, 1 spec. (R.F.), Dubravos Miškas f., 24 04 2003, 1spec. (R.F.), Viešvilė State Strict Nature, 06 07 2004, 4 spec. (R.F.).

***Stereocorynes truncorum* (Germar, 1824)** Palanga airport, 09-30 05 2001, 1 spec. (R.F.), Ąžuolynas parkland, 19 06 2005, 1 spec. (R.F.).

***Stenocarus umbrinus* (Gyllenhal, 1827)** Braziūkai, on the poppy plant, 03 06 2005, 1 spec. (V.T.).

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References

Barsevskis A., 2001. New and rare species of beetles (Insecta, Coleoptera) in the Baltic countries and Byelorus. *Baltic J. of Coleopterology* 1 (1-2): 3-18.

Bielawski R., 1959: *Kłucze do oznaczania owadow Polski*. Cz. XIX. Coleoptea. Zesz. 76. Coccinellidae. –Warszawa.

Borowiec L., Tornawski D., 1983: *Kłucze do oznaczania owadow Polski*. Cz. XIX. Coleoptea. Zesz. 67. Mycetophagidae. – Warszawa.

Burakowski B., 1976: *Kłucze do oznaczania owadow Polski*. Cz. XIX. Coleoptea. Zesz. 88 -90. Pythidae, Lagriidae, Alleculidae. – Warszawa.

Ferenca R., Ivinskis P., Meržijevskis A., 2002: New and rare Coleoptera species in Lithuania. – *Ekologija*, 3, 25 – 31.

Ferenca R., 2003: Retos ir naujos Lietuvos entomofaunos Vabalų (Coleoptera) rūšys, rastos 1997 – 2002 metais.- *Naujos ir retos Lietuvos vabalų rūšys*. 15**:** 32-36.

Ferenca R., 2004: New and rare for Lithuania beetle (Coleoptera) species registered in 1978 – 2004.- *New and rare for Lithuania insects species*. 16**:** 11-22.

Freude H., Harde K.W., Lohse G.A., 1969-81: Die Käfer Mitteleuropas. Bds: 3-8 & 10. – Krefeld.

Hłrka K. 1996.Carabidae of the Czech and Slovak republics.- Zlin.

Inokaitis V., 2004. Naujos ir retos Lietuvos entomofaunos vabalų (Coleoptera) rūšys, aptiktos 2000-2003 metais. *New and rare for Lithuania insects species*. 16**:** 7-10.

Lawrence J.F., Newton A. F.,1995: Families and subfamilies of Coleoptera (with selected genera, notes, refrences and data on family – group names). – In: Pakaluk J., Slipinski S.A.(eds.). *Biology, phylogeny and clasification of Coleoptera*. Warszawa. 779 -1006.

Monsevičius Vidm. 1998. Vabalų (Coleoptera) faunos tyrimai Ventos regioniniame parke. Kn.: *Biologinės įvairovės tyrimai ir aplinkosauginis švietimas regionuose*. Vilnius, 54-55.

Monsevičius Vidm. 1999. Indėlis į Lietuvos nidikolinių vabalų (Coleoptera) faunos pažinimą. Kn.: *Lietuvos bioįvairovė (būklė, struktūra, apsauga).* Vilnius, 66-67.

Monsevičius Vidm., Pankevičius R., 2001: Coleoptera species new for Lithuania. – *Ekologija*, 2, 40 – 45.

Nunberg M., 1987: *Kłucze do oznaczania owadow Polski*. Cz. XIX. Coleoptea. Zesz. 15. Leiodidae.- Warszawa.

Pileckis S., Monsevičius V., 1995: *Lietuvos fauna. Vabalai*.T.1. – Vilnius.

Pileckis S., Monsevičius V., 1997: *Lietuvos fauna. Vabalai*.T.2 – Vilnius.

Silfverberg H. 2004. Enumeratio nova Coleopterorum Fennoscandiae, Daniae et Baltiae. Sahlbergia 9: 1-111.

Smreczynski S.,1965: *Kłucze do oznaczania owadow Polski*. Cz. XIX. Coleoptea. Zesz. 98a. Curculionidae. – Warszawa.

Smreczynski S.,1972: *Kłucze do oznaczania owadow Polski*. Cz. XIX. Coleoptea. Zesz. 98d.Curculionidae. – Warszawa.

Szujecki A. 1965. *Kłucze do oznaczania owadow Polski*. Cz. XIX. Coleoptea. Zesz. 24e.Kusakowate - Staphylinidae. – Warszawa.

Szujecki A. 1965. *Kłucze do oznaczania owadow Polski*. Cz. XIX. Coleoptea. Zesz. 24c.Kusakowate - Staphylinidae. – Warszawa.

Šablevičius B., 2003: New and rare for Lithuania Beetle (Coleoptera) species.- *New and rare for Lithuania insct species*.15**:** 11-24.

Šablevičius B., 2004: New and rare for Lithuania Beetle (Coleoptera) species colected in 1988

-2004. - *New and rare for Lithuania insct species*.16**:** 27-31.

Tamutis V., 1996. Paslėptastraublių (Coleoptera, Curculionidae, Ceutorhynchus Germ.)fauna Lietuvoje. Kn.: V. Jonaitis (red.) Lietuvos entomologų darbai. Vilnius, 68-77.

Tamutis V., Zolubas P. 2001. Non target beetles trappped in Ips typographus L. pheromone traps. *Baltic J. of Coleopterology* 1 (1-2): 65-70.

Tamutis V., Pankevičius R. 2001. Indėlis į Lietuvos straubliukų (Curculionidae, Apionidae, Coleoptera) faunos pažinimą. Lietuvos bioįvairovė (būklė, struktūra, apsauga). Vilnius, 93-94.

Tamutis V., 2003: Eighty - two New for Lithuania Beetle (Coleoptera) species.- *New and rare for Lithuania insect species*.15**:** 54-62.

Tamutis V., 2004: Nine new apionid and weevil (Coleoptera: Apionidae, Curculionidae) Species found in Lithuania. - *New and rare for Lithuania insct species*.16: 23-25.

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MATERIALS ABOUT THE FAUNA OF BEETLES (INSECTA: COLEOPTERA) OF NAUJENE RURAL MUNICIPALITY (DAUGAVPILS DISTRICT, LATVIA). PART 2.

Andris Bukejs & Dmitry Telnov

Bukejs A., Telnov D. 2007. Materials about the fauna of beetles (Insecta: Coleoptera) of Naujene rural municipality (Daugavpils district, Latvia). Part 2. *Acta Biol. Univ. Daugavp., 7 (2): 191 - 208.*

This paper is the second part of our research of the beetles of Naujene rural municipality (Latvia). During the research periods (2000-2007) in this area 254 beetles species that belong to 17 families were found. Among recorded species 97 are new for the fauna of Naujene rural municipality and 17 species are new for eastern Latvia (for Latgale).

Key words: Coleoptera, fauna, Naujene rural municipality, Daugavpils district, Latvia.

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Introduction

This paper continues a series of the publications, devoted to study of Coleoptera fauna of Naujene rural municipality. It is in a southeast part of Latvia. The general area of Naujene rural municipality is 12939,3 hectares, including, the forests occupy 3602 ha, agricultural grounds - 6683 ha.

The first part (Bukejs 2006) contains the information about 166 beetles species that belong to 28 families, from which 5 species are protected in Latvia, and review of the literature on this theme.

This year some more articles (Telnov et al. 2007; Cibuļskis 2006, 2007) were published, in which the separate data on beetles species recorded also in Naujene rural municipality are presented.

There is the information about 254 species of Coleoptera from 17 families (Carabidae, Hydrophilidae, Sphaeritidae, Scarabaeidae, Buprestidae, Trogossitidae, Cleridae, Monotomidae, Zopheridae, Tenebrionidae, Mycetophagidae, Melandryidae, Pythidae, Pyrochroidae, Cerambycidae, Megalopodidae, Chrysomelidae) is given.

Materials and methods

The material was collected since 2000 till 2007 in different places of Naujene rural municipality (Daugavpils district, Latvia) (fig.1). In the given area various habitats were investigated: pine, deciduous and mixed forests, cutting areas, burnt area, skirts, valley and bank of river Daugava (part of Nature Park "Daugavas Loki"), bank of Lielais Stropu lake, ponds, meadows, agrocenosises, park and others.

For the collecting of a material the different methods were used: entomological net, pitfall traps, visual observation of habitats (under different objects, on soil, on plants etc.) and collecting in places of hibernation. While studying the fauna of Coleoptera of Naujene rural municipality more than 1790 specimens were collected.

The systematics, which is applied in H. Silfverberg's (2004) catalogue, is used as the basis in this list of species.

The material is stored in the private collections of authors and in the collection of Institute of Systematic Biology Daugavpils University (DUBC) (Daugavpils, Latvia).

Results

According to the results of the investigation hold on the area of Naujene rural municipality 254 species of Coleoptera belonging to 17 families were recorded.

In the species list after the species name the place where it was found and the collecting date are indicated, in the brackets are indicated the number of collected specimens, information about habitat and collector˙s name abbreviation: A.Ba. – Arvīds Barševskis, A.Bu. – Andris Bukejs, D.T. – Dmitry Telnov, G.L. – Guntis Lociks, M.B. – Maksims Balalaikins, M.K. – Mārtiņš Kalniņš.

List of species

Carabidae Latreille, 1802

1. *Omophron limbatum* (Fabricius, 1776) – Butiški, 02.VII.2007. (2, valley of river Daugava, sandy bank with scarce vegetation, A.Bu.).

2. *Cicindela hybrida hybrida* Linnaeus, 1758 – Stropi, 27.VI.2006. (4, sandy agrocenosis, A.Bu.).

3. *Cicindela campestris campestris* Linnaeus, 1758 – Stropi, 16.VI.2006. (2, old cutting area, A.Bu.), 09.VII.2006. (1, old cutting area, A.Bu.).

4. *Notiophilus palustris* (Duftschmid, 1812) – Stropi, X.2003. (1, deciduous forest, A.Bu.), 06.V.2006. (1, deciduous forest, A.Bu.).

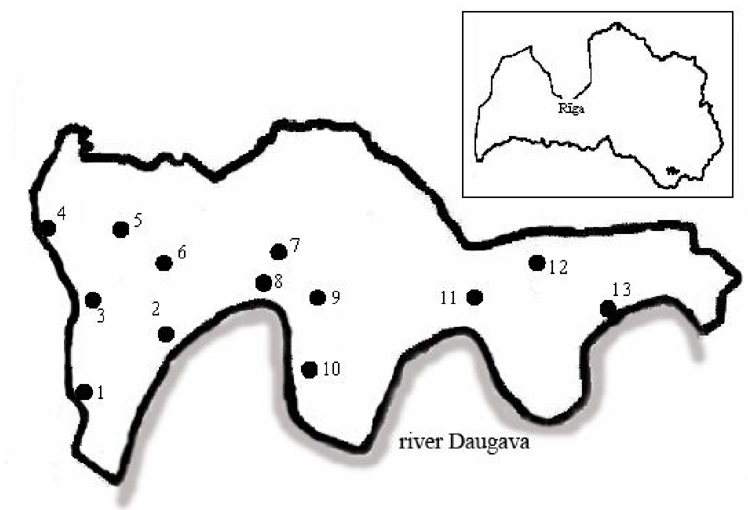

Fig. 1. Location of research area. Naujene rural municipality: 1 – Vecstropi, 2 – Krauja, 3 – Stropi, 4 – 0,5 km E from Križi (Daugavpis City), 5 – Kašatniki, 6 – Lociki, 7 – Naujene, 8 – Juzefova park, 9 – Vecpils, 10 – Butiški, 11 – Vasargeliški, 12 – Bukšti, 13 - Slutiški.

5. *Leistus terminatus* (Panzer, 1793) – Stropi, X.2003. (1, deciduous forest, A.Bu.), 09.VI.2006. (1, old cutting area, A.Bu.); Vecstropi, 24.VIII.2007. (1, in coniferous forest, A.Bu.) .

6. *Carabus arcensis arcensis* Herbst, 1784 – Vecstropi, 16.VI. 2007. (1, dry pine forest, A.Bu.).

7. *Carabus granulatus granulatus* Linnaeus, 1758 – Butiški, 27.V.2007. (1, valley of river Daugava, A.Bu.); Naujene, 15.X.2004. (8, Juzefova park, A.Ba.); Stropi, VI-IX.2000-2004. (43, deciduous forest, pitfall traps, A.Bu.), VIII.2004. (1, xeric meadow, A.Bu.), 29.-30.IV.2006. (2, A.Bu.), 12.V.2007. (1, moist deciduous forest, A.Bu.); Vecstropi, 31.V.2007. (3, mixed forest, A.Bu.).

8. *Carabus cancellatus cancellatus* Illiger, 1798 – Naujene, 24.V.2002. (2, Juzefova park, A.Ba.), 15.X.2004. (2, Juzefova park, A.Ba.); Stropi, 18.VI.2007. (1, agrocenosis, A.Bu.); Vecstropi, 20.V.2007. (1, in coniferous forest, A.Bu.).

9. *Carabus hortensis hortensis* Linnaeus, 1758 – Krauja, 28.VII.2006. (1, mixed forest, A.Bu.), 29.V.2007. (1, old cutting area, under rotten trunk of birch, A.Bu.); Stropi, VI-IX.2000-2004. (>70, deciduous forest, pitfall traps, A.Bu.), 16.VI.2006. (1, A.Bu.), 12.V.2007. (1, moist deciduous forest, A.Bu.); Vecstropi, 31.V.2007. (2, mixed forest, A.Bu.).

10. *Carabus glabratus glabratus* Paykull, 1790 – Krauja, 29.V.2007. (1, old cutting area, under rotten birch trunk, A.Bu.); Vecstropi, V. – IX.2007. (>30, burnt area in coniferous forest, pitfall traps, A.Bu.).

11. *Carabus convexus convexus* Fabricius, 1775 – Stropi, 05.IX.2007. (1, agrocenosis, A.Bu.).

12. *Cychrus caraboides* (Linnaeus, 1758) – Stropi, VIII.2000. (3, A.Bu.), VII.2003. (1, A.Bu.), VIII.2003. (3, A.Bu.), IX.2003. (2, A.Bu.), VIII.2004. (1, forest near Lielais Stropu lake, A.Bu.), 13.VI.2007. (1, edge of deciduous forest, A.Bu.).

13. *Loricera pilicornis pilicornis* (Fabricius, 1775) – Stropi, 14.V.2006. (5, swampy bank of Lielais Stropu lake, A.Bu.), 16.VI.2006. (3, old cutting area, A.Bu.), 17.IV.2007. (1, moist deciduous forest, under bark of rotten grey alder, A.Bu.).

14. *Elaphrus cupreus* Duftschmid, 1812 – Krauja, 29.V.2007. (1, old cutting area, A.Bu.); Stropi, 14.V.2006. (7, swampy bank of Lielais Stropu lake, A.Bu.), 03.VI.2006. (1, A.Bu.), 16.VI.2006. (2, A.Bu.), 20.V.2007. (7, swampy bank of Lielais Stropu lake, A.Bu.), 21.V.2007. (2, bank of pond, A.Bu.), 21.V.2007. (1, moist deciduous forest, A.Bu.), 12.VI.2007. (1, bank of Lielais Stropu lake, A.Bu.).

15. *Elaphrus riparius* (Linnaeus, 1758) – Butiški, 27.V.2007. (1, valley of river Daugava, river bank, A.Bu.), 02.VII.2007. (1, bank of river Daugava, A.Bu.), 03.VIII.2007. (1, sandy bank of river Daugava, A.Bu. & M.B.); Stropi, 01.VII.2006. (1, bank of Lielais Stropu lake, D.T.), 25.V.2007. (1, swampy bank of Lielais Stropu lake, A.Bu.), 12.VI.2007. (2, bank of Lielais Stropu lake, A.Bu.), 19.VII.2007. (2, bank of Lielais Stropu lake, A.Bu.); Vecpils, 21.VIII.2006. (1, stony bank of river Daugava, A.Bu.).

16. *Clivina fossor fossor* (Linnaeus, 1758) – Stropi, 29.VII.2006. (1, sandy agrocenosis, under fresh cow excrements, A.Bu.), 30.IV.2007. (1, agrocenosis, A.Bu.), 21.V.2007. (1, agrocenosis, A.Bu.).

17. *Dyschirius globosus* (Herbst, 1784) – Stropi, 16.VI.2006. (1, old cutting area, A.Bu.).

18. *Broscu cephalotes* (Linnaeus, 1758) – Butiški, 12.VIII.2006. (1, valley of river Daugava, xeric meadow, under stone, A.Bu. & M.B.); Naujene, 2006. (>10, open xeric habitat, sands, D.T.); Stropi, 15.IX.2005. (1, agrocenosis, A.Bu.), 04.VIII.2006. (1, sandy agrocenosis, under fresh cow excrements, A.Bu.), 28.V.2007.(1, meadow near Lielais Stropu lake, A.Bu.), 13.VI.2007. (2, meadow, under hay, A.Bu.).

19. *Patrobus atrorufus* (Stroem, 1768) – Stropi, VII.2003. (6, deciduous forest, A.Bu.), VIII.2003. (5, A.Bu.), IX.2006. (3, A.Bu.).

20. *Trechus quadristriatus* (Schrank, 1781) – Stropi, 13.VIII.2006. (1, A.Bu.).

21. *Trechus rubens* (Fabricius, 1792) – Stropi, 20.V.2007. (1, swampy bank of Lielais Stropu lake, A.Bu.).

22. *Trechus (Epaphius) secalis secalis* (Paykull, 1790) – Stropi, 09.VII.2006. (1, old cutting area, A.Bu.).

23. *Tachyta nana nana* (Gyllenhal, 1810) – Krauja, 28.VII.2006. (1, A.Bu.), 29.V.2007. (2, old cutting area, A.Bu.), 06.VI.2007. (1, old cutting area, A.Bu.), 04.VIII.2007. (4, old cutting area, under wet bark of fallen spruce and aspen, A.Bu.); Stropi, 09.VI.2006. (6, A.Bu.), 19.VII.2007. (1, old cutting area, under bark of fallen pine, A.Bu).
On forest cuttings under a bark of deciduous and coniferous trees this species was observed in a plenty.

24. *Asaphidion flavipes* (Linnaeus, 1761) – Naujene, 15.X.2004. (1, Juzefova park, A.Ba.).

25. *Asaphidion pallipes* (Duftschmid, 1812) – Stropi, 10.IX.2005. (4, agrocenosis, A.Bu.), 02.IX.2006. (2, agrocenosis, A.Bu.), 03.VIII.2007. (1, agrocenosis, A.Bu.).

26. *Bembidion velox* (Linnaeus, 1761) – Butiški, 12.VIII.2006. (2, sandy bank of river Daugva, A.Bu. & M.B.), 21.VIII.2006. (2, bank of river Daugava, A.Bu. & M.B.); Stropi, 19.VII.2007. (1, bank of Lielais Stropu lake, A.Bu.).

27. *Bembidion litorale* (Olivier, 1791) – Butiški, 27.V.2007. (3, sandy bank of river Daugava, A.Bu. & M.B.), 02.VII.2007. (4, sandy bank of river Daugava, A.Bu.), 03.VIII.20007. (2, bank of river Daugava, A.Bu. & M.B.); Stropi, 19.VII.2007. (1, sandy bank of Lielais Stropu lake, A.Bu.).

28. *Bembidion nigricorne* Gyllenhal, 1827 – Butiški, 21.VIII.2006. (3, xeric meadow, A.Bu. & M.B.); Stropi, VII.2001. (1, sandy agrocenosis, A.Bu.), VIII.2002. (1, sandy agrocenosis, A.Bu.), 13.V.2006. (1, sandy agrocenosis, A.Bu.), 13.V.2007. (1, dandy agrocenosis, A.Bu.).

29. *Bembidion pygmaeum* (Fabricius, 1792) – Stropi, IX.2002. (1, sandy agrocenosis, A.Bu.).

30. *Bembidion lampros* (Herbst, 1784) – Stropi, 13.V.2006. (1, A.Bu.), 27.VI.2006. (1, A.Bu.), 02.IX.2006. (1, sandy agrocenosis, A.Bu.), 15.VIII.2007. (4, A.Bu.); Vecstropi, 20-25.V.2007. (2, burnt area in coniferous forest, A.Bu.), 05.VII.2007. (1, burnt area, A.Bu.).

31. *Bembidion properans* (Stephens, 1828) – Butiški, 12.VIII.2006. (1, valley of river Daugava, A.Bu. & M.B.), 21.VIII.2006. (1, valley of river Daugava, A.Bu. & M.B.); Stropi, VII.2002. (2, sandy agrocenosis, A.Bu.), 13.V.2007. (1, agrocenosis, A.Bu.), 20.V.2007. (1, sandy sandy agrocenosis, A.Bu.).

32. *Bembidion punctulatum punctulatum* Drapiez, 1820 – Butiški, 27.V.2007. (3, stony bank of river Daugava, A.Bu.), 03.VIII.20007. (2, sandy bank of river Daugava, A.Bu. & M.B.).

33. *Bembidion ruficolle* (Panzer, 1796) – Butiški, 12.VIII.2006. (1, sandy bank of river Daugava, A.Bu. & M.B.); Stropi, 25.V.2007. (1, bank of Lielais Stropu lake, A.Bu.).

34. *Bembidion biguttatum* (Fabricius, 1779) – Stropi, IX.2003. (1, deciduous forest, A.Bu.), 20.V.2007. (1, swampy bank of Lielais Stropu lake, A.Bu.), 21.V.2007. (1, bank of pond, A.Bu.).

35. *Bembidion guttula guttula* (Fabricius, 1792) – Stropi, 17.IV.2007. (3, moist deciduous forest, near a pool, A.Bu.), 21.V.2007. (1, moist deciduous forest, A.Bu.).

36. *Bembidion assimile* Gyllenhal, 1810 – Naujene, 24.V.2002. (1, Juzefova park, A.Ba.).

37. *Bembidion transparens transparens* (Gebler, 1829) – Stropi, 14.V.2006. (4, bank of Lielais Stropu lake, A.Bu.).

38. *Bembidion tenellum tenellum* (Erichson, 1837) – Butiški, 21.VIII.2006. (1, sandy bank of river Daugava, A.Bu. & M.B.), 27.V.2007. (9, sandy bank of river Daugava, A.Bu.), 02.VII.2007. (1, sandy bank of river Daugava, A.Bu.), 03.VIII.2007. (9, sandy bank of river Daugava, A.Bu. & M.B.).

39. *Bembidion azurescens azurescens* Dalla Torre, 1877 – Stropi, 16.IV.2007. (4, bank of pond, A.Bu.), 17.IV.2007. (1, moist deciduous forest, near a pool, A.Bu.), 20.V.2007. (5, swampy bank of Lielais Stropu lake, A.Bu.).

40. *Bembidion quadrimaculatum quadrimaculatum* (Linnaeus, 1761) – Butiški, 27.V.2007. (1, sandy bank of river Daugava, A.Bu.); Naujene, 24.VII.2005. (1, valley of river Daugava, D.T.); Stropi, 15.X.2006. (8, A.Bu.).
In sandy agrocenosis it was observed very frequently.

41. *Bembidion articulatum* (Panzer, 1796) – Butiški, 27.V.2007. (2, valley of river Daugava, sandy bank, A.Bu.), 02.VII.2007. (5, sandy bank of river Daugava, A.Bu.), 03.VIII.2007. (5, sandy bank of river Daugava, A.Bu. & M.B.); Stropi, 06.V.2007. (1, bank of pond, A.Bu.), 20.V.2007. (3, swampy bank of Lielais Stropu lake, A.Bu.), 12.VI.2007. (5, sandy and clayey bank of Lielais Stropu lake, A.Bu.), 19.VII.2007. (8, sandy bank of Lielais Stropu lake, A.Bu.), 27.VII.2007. (2, swampy bank of Lielais Stropu lake, A.Bu.).

42. *Bembidion obliquum* Sturm, 1825 – Butiški, 12.III.2006. (1, valley of river Daugava, A.Bu. & M.B.), 27.V.2007. (1, bank of river Daugava, A.Bu.), 03.VIII.2007. (2, bank of river Daugava, A.Bu. & M.B.); Stropi, 14.V.2006. (3, swampy bank of Lielais Stropu lake, A.Bu.), 01.VII.2006. (3, bank of Lielais Strou lake, D.T.), 16.IV.2007. (3, bank of pond, A.Bu.), 06.V.2007. (5, bank of pond, A.Bu.), 25.V.2007. (1, swampy bank of Lielais Stropu lake, A.Bu.), 12.VI.2007. (6, sandy and clayey bank of Lielais Stropu lake, in drifts, A.Bu.), 19.VII.2007. (3, bank of Lielais Stropu lake, A.Bu.).

43. *Bembidion semipunctatum* (Donovan, 1806) - Butiški, 12.VIII.2006. (5, sandy bank of river Daugava, A.Bu. & M.B.), 21.VIII.2006. (3, bank of river Daugava, A.Bu. & M.B.), 27.V.2007. (3, sandy bank of river Daugava, A.Bu.), 02.VII.2007. (1, sandy bank of river Daugava, A.Bu.), 03.VIII.2007. (5, sandy bank of river Daugava, A.Bu. & M.B.); Naujene, 24.V.2002. (1, Juzefova park, A.Ba.); Stropi, 20.V.2007. (1, swampy bank of Lielais Stropu lake, A.Bu.).

44. *Bembidion varium* (Olivier, 1795) – Butiški, 12.VIII.2006. (1, sandy bank of river Daugava, A.Bu. & M.B.), 03.VIII.2007. (1, sandy bank of river Daugava, A.Bu.).

45. *Bembidion dentellum* (Thunberg, 1787) – Butiški, 03.VIII.2007. (1, bank of river Daugava, A.Bu. & M.B.); Naujene, 15.X.2004. (5, Juzefova park, A.Ba.); Vecpils, 21.VIII.2006. (2, stony bank of river Daugava, A.Bu.).

46. *Bembidion bruxellense* Wesmael, 1835 – Stropi, 16.VI.2006. (13, old cutting area, near a pool, A.Bu.), 20.V.2007. (5, swampy bank of Lielais Stropu lake, A.Bu.), 12.VI.2007. (1, sandy and clayey bank of Lielais Stropu lake, A.Bu.).

47. *Bembidion femoratum femoratum* (Sturm, 1825) – Stropi, 20.V.2007. (1, A.Bu.).

48. *Anchomenus dorsalis* (Pontoppidan, 1763) – Stropi, 20.IX.2005. (1, A.Bu.).

49. *Oxypselaphus obscurus* (Herbst, 1784) – Stropi, VIII.2003. (6, moist deciduous forest, A.Bu.), X.2003. (7, A.Bu.), 06.V.2006. (1, A.Bu.), 09.VII.2006. (2, old cutting area, A.Bu.), 10.XII.2006. (1, mixed forest, under bark of aspen *Populus tremula*, A.Bu.).

50. *Platynus assimilis* (Paykull, 1790) – Naujene, 15.X.2004. (17, Juzefova park, A.Ba.), 30.VI.2006. (1, forest, D.T.); Stropi, VII.2003. (2, deciduous forest, A.Bu.), VIII.2003. (3, A.Bu.), IX.2003. (1, A.Bu.), X.2003. (3, A.Bu.), 03.VI.2006. (1, old cutting area, A.Bu.), 11.VIII.2006. (1, A.Bu.), 06.V.2007. (2, bank of pond, under plank, A.Bu.), 12.V.2007. (1, moist deciduous forest, under rotten bark of birch, A.Bu.).

51. *Sericoda quadripunctata* (DeGeer, 1774) – Vecstropi, V.-VII.2007. (>30, burnt area in coniferous forest, on soil and in fallen needles, A.Bu.). This species is included on the list of indicator species of natural forest habitats. On burnt area this species was observed in a plenty. It is specified also by other authors (Barševskis et al. 2004).

52. *Agonum impressum* (Panzer, 1796) – Butiški, 27.V.2007. (4, stony bank of river Daugava, A.Bu.), 03.VIII.2007. (1, stony and sandy bank of river Daugava, A.Bu. & M.B.).
In Latvia this species is know only from valley of river Daugava (Barševskis 1993).

53. *Agonum sexpunctatum* (Linnaeus, 1758) – Stropi, 29-30.IV.2006. (2, A.Bu.).

54. *Agonum muelleri* (Herbst, 1784) – Butiški, 27.VII.2007. (1, bank of river Daugava, A.Bu.).

55. *Agonum viduum* (Panzer, 1797) – Butiški, 27.V.2007. (4, bank of river Daugava, A.Bu. & M.B.); Stropi, 20.V.2007. (3, swampy bank of Lielais Stropu lake, A.Bu.), 25.V.2007. (2, swampy bank of Lielais Stropu lake, A.Bu.).

56. *Agonum thoreyi thoreyi* Dejean, 1828 – Stropi, VII.2003. (1, A.Bu.), VIII.2003. (10, A.Bu.), IX.2003. (3, A.Bu.), X.2003. (1, A.Bu.), 10.XII.2006. (1, mixed forest, under bark of aspen, A.Bu.), 20.V.2007. (>10, swampy bank of Lielais Stropu lake, A.Bu.).

57. *Agonum fuliginosum* (Panzer, 1809) – Stropi, VII.2003. (4, deciduous forest, A.Bu.), VIII.2003. (1, A.Bu.), X.2003. (4, A.Bu.), 03.VI.2006. (1, A.Bu.), 25.V.2007. (1, old cutting area, A.Bu.).

58. *Agonum piceus* (Linnaeus, 1758) – Butiški, 27.V.2007. (1, bank of river Daugava, A.Bu.); Stropi, 20.V.2007. (6, swampy bank of Lielais Stropu lake, A.Bu.).

59. *Agonum gracile* Sturm, 1824 – Stropi, 14.V.2006. (1, swampy bank of Lielais Stropu lake, A.Bu.), 03.VI.2006. (1, A.Bu.), 20.V.2007. (2, swampy bank of Lielais Stropu lake, A.Bu.).

60. *Calathus fuscipes fuscipes* (Goeze, 1777) – Stropi, VII.2004. (3, xeric meadow, A.Bu.), VIII.2004. (2, xeric meadow, A.Bu.).

61. *Calathus erratus erratus* (C.R.Sahlberg, 1827) – Stropi, VIII.2003. (1, deciduous forest, A.Bu.), VII.2004. (12, xeric meadow, A.Bu.), VIII.2004. (7, xeric meadow, A.Bu.).

62. *Calathus micropterus* (Duftschmid, 1812) – Stropi, VI.2000. (4, dry pine forest, pitfall traps, A.Bu.), VIII.2000. (4, A.Bu.), VII.2002. (4, A.Bu.), IX.2002. (1, A.Bu.), VI.2003. (3, A.Bu.), VII.2003. (3, A.Bu.), VIII.2003. (7, A.Bu.), IX.2003. (3, A.Bu.), VII.2004. (1, xeric meadow, A.Bu.), VIII.2004. (1, xeric meadow, A.Bu.).

63. *Calathus melanocephalus melanocephalus* (Linnaeus, 1758) – Stropi, VII.2004. (19, xeric meadow, A.Bu.), VIII.2004. (7, xeric meadow, A.Bu.).

64. *Calathus mollis mollis* (Marsham, 1802) – Stropi, 09.VII.2006. (1, old cutting area, A.Bu.).

65. *Stomis pumicatus* (Panzer, 1796) – Stropi, VII.2003. (1, mixed forest, A.Bu.), 25.V.2007. (1, old cutting area, A.Bu.).

66. *Poecilus lepidus lepidus* (Leske, 1785) – Križi, ~1 km NE, 07.VIII.2007. (1, edge of dry pine forest, A.Bu.).

67. *Poecilus versicolor* (Sturm, 1824) – Butiški, 27.V.2007. (1, valley of river Daugava, A.Bu.); Stropi, VII.2003. (1, A.Bu.), VIII.2003. (1, A.Bu.), VIII.2004 (1, xeric meadow, A.Bu.), 03.VI.2006. (1, A.Bu.), 30.IV.2007. (1, agrocenosis, in soil, A.Bu.), 28.V.2007. (1, A.Bu.).

68. *Poecilu cupreus cupreus* (Linnaeus, 1758) – Stropi, 29-30.IV.2006. (1, A.Bu.), 29.V.2007. (1, sandy agrocenosis, A.Bu.).

69. *Pterostichus vernalis* (Panzer, 1796) – Stropi, VII.2004. (1, xeric meadow, A.Bu.).

70. *Pterostichus aethiops* (Panzer, 1796) – Stropi, X.2004. (9, deciduous forest, A.Bu.), 09.VII.2006. (1, old cutting area, A.Bu.); Vecstropi, 19.-31.V.2007. (2, burnt area in coniferous forest, pitfall traps, A.Bu.).

71. *Pterostichus melanarius melanarius* (Illiger, 1798) – Krauja, 28.VII.2006. (1, mixed forest, A.Bu.); Stropi, VI-IX.2000-2004. (68, deciduous forest, pitfall traps, A.Bu.), 09.VII.2006. (1, old cutting area, A.Bu.).

72. *Pterostichus oblongopunctatus oblongopunctatus* (Fabricius, 1787) – Butiški, 27.V.2007. (1, valley of river Daugava, A.Bu.); Krauja, 29.V.2007. (1, old cutting area, A.Bu.); Stropi, VI-IX.2000-2004. (71, deciduous forest, pitfall traps, A.Bu.), 29-30.IV.2006. (1, A.Bu.), 06.V.2006. (1, A.Bu.), 16.VI.2006. (1, A.Bu.), 17.IV.2007. (2, moist deciduous forest, under rotten trunk of birch, A.Bu.).

73. *Pterostichus quadrifoveolatus* Letzner, 1852 – Stropi, 09.VII.2006. (1, old cutting area, A.Bu.); Vecstropi, 20.V.2007. (>10, burnt area in coniferous forest, A.Bu.).
On burnt area this species was observed in a plenty. It is specified also by other authors (Barševskis et al. 2004).

74. *Pterostichus niger niger* (Schaller, 1783) – Butiški, 12.VIII.2006. (1, valley of river Daugava, A.Bu. & M.B.), 27.V.2007. (1, valley of river Daugava, A.Bu.); Krauja, 29.V.2007. (1, old cutting area, under rotten trunk of birch, A.Bu.); Naujene, 24.VII.2005. (1, valley of river Daugava, D.T.); Stropi, VI-IX.2000-2004. (219, forest, pitfall traps, A.Bu.), VII.2004. (3, meadow, A.Bu.), VIII.2004. (5, A.Bu.), 10.IX.2005. (1, sandy agrocenosis, A.Bu.), 14.V.2006. (1, swampy bank of Lielais Stropu lake, A.Bu.), 03.VI.2006. (1, A.Bu.); Vecstropi, 20.V.2007. (1, burnt area in coniferous forest, A.Bu.).

75. *Pterostichus nigrita* (Paykull, 1790) – Stropi, X.2003. (1, deciduous forest, A.Bu.), 29-30.IV.2006. (2, A.Bu.), 03.VI.2006. (1, A.Bu.), 16.VI.2006. (1, A.Bu.), 20.V.2007. (1, swampy bank of Lielais Stropu lake, A.Bu.).

76. *Pterostichus rhaeticus* Heer, 1837 – Stropi, VIII.2003. (1, deciduous forest, A.B.), X.2003. (2, deciduous forest, A.Bu.), 12.V.2007. (1, moist deciduous forest, A.Bu.), 20.V.2007. (1, swampy bankof Lielais Stropu lake, A.Bu.).

77. *Pterostichus anthracinus anthracinus* (Illiger, 1798) – Naujene, 24.V.2002. (1, Juzefova park, A.Ba.); Stropi, 17.IV.2007. (1, moist deciduous forest, A.Bu.), 27.VII.2007. (1, swampy bank of Lielais Stropu lake, A.Bu.).

78. *Pterostichus gracilis gracilis* (Dejean, 1828) – Naujene, 15.X.2004. (1, Juzefova park, A.Ba.).

79. *Pterostichus minor minor* (Gyllenhal, 1827) – Stropi, VIII.2003. (1, deciduous forest, A.Bu.), X.2003. (1, A.Bu.), 16.VI.2006. (2, old cutting area, A.Bu.), 17.IV.2007. (1, moist deciduous forest, under bark of fallen birch, A.Bu.), 12.V.2007. (4, moist deciduous forest, A.Bu.), 20.V.2007. (5, swampy bank of Lielais Stropu lake, A.Bu.), 21.V.2007. (2, moist deciduous forets, A.Bu.), 22.VI.2007. (1, old cutting area, A.Bu.), .

80. *Pterostichus strenuus* (Panzer, 1796) – Stropi, VII.2003. (1, A.Bu.), 12.V.2007. (1, moist deciduous forets, A.Bu.), 20.V.2007. (1, swampy bank of Lielais Stropu lake, A.Bu.), 21.V.2007. (3, bank of pond near moist deciduous forest, A.Bu.).

81. *Pterostichus diligens* (Sturm, 1824) – Stropi, X.2003. (1, deciduous forest, A.Bu.).

82. *Amara equestris equestris* (Duftschmid, 1812) – Stropi, VII.2004. (2, xeric meadow, pitfall traps, A.Bu.), 29-30.IV.2006. (1, A.Bu.), 10.VIII.2006. (1, A.Bu.), 10.IX.2006. (1, sandy agrocenosis, A.Bu.).

83. *Amara eurynota* (Panzer, 1796) – Stropi, 13.V.2006. (1, A.Bu.).

84. *Amara spreta* Dejean, 1831 – Stropi, 29-30.IV.2006. (1, A.Bu.), 13.V.2006. (1, A.Bu.), 17.VII.2006. (1, A.Bu.).

85. *Amara brunnea* (Gyllenhal, 1810) – Stropi, VIII.2003. (1, mixed forest, A.Bu.), IX.2004. (1, A.Bu.).

86. *Amara cursitans* Zimmermann, 1832 – Stropi, VIII.2004. (1, xeric meadow, A.Bu.).

87. *Amara municipalis municipalis* (Duftschmid, 1812) – Stropi, VIII.2003. (1, mixed forest, A.Bu.), VII.2004. (1, xeric meadow, A.Bu.), VIII.2004. (1, xeric meadow, A.Bu.).

88. *Amara bifrons* (Gyllenhal, 1810) – Stropi, VIII.2004. (1, meadow, A.Bu.), 13.V.2006. (1, A.Bu.).

89. *Amara consularis* (Duftschmid, 1812) – Stropi, VII.2003. (2, mixed forest, A.Bu.), VIII.2003. (2, A.Bu.), VII.2004. (2, xeric meadow, A.Bu.).

90. *Amara apricaria* (Paykull, 1790) – Stropi, 01.V.2006. (1, A.Bu.), 02.VI.2006. (1, A.Bu.).

91. *Harpalus rufipes* (DeGeer, 1774) – Stropi, VII.2004. (1, xeric meadow, A.Bu.), VIII.2004. (2, xeric meadow, A.Bu.).
In agrocenosises it meets frequently.

92. *Harpalus affinis* (Schrank, 1781) – Stropi, 10.VIII.2006. (1, A.Bu.).
In agrocenosises it meets frequently.

93. *Harpalus rubripes* (Duftschmid, 1812) – Stropi, VIII.2004. (2, xeric meadow, A.Bu.).

94. *Harpalus smaragdinus* (Duftschmid, 1812) – Butiki, 12.VIII.2006. (1, valley of river Daugava, xeric meadow, A.Bu. & M.B.)

95. *Harpalus laevipes* Zetterstedt, 1828 – Stropi, VII.2004. (4, xeric meadow, A.Bu.), IX.2004. (1, deciduous forest, A.Bu.).

96. *Harpalus luteicornis* (Duftschmid, 1812) – Naujene, 24.V.2002. (4, Juzefova park, A.Ba.); Stropi, VII.2003. (1, deciduous forest, A.Bu.).

97. *Harpalus anxius* (Duftschmid, 1812) – Butiški, 21.VIII.2006. (1, old gravel-pit, A.Bu. & M.B.); Stropi, VII.2004. (1, xeric meadow, A.Bu.), 29-30.IV.2006. (1, A.Bu.).

98. *Harpalus tardus* (Panzer, 1796) – Stropi, 29-30.IV.2006. (1, A.Bu.), 05.V.2006. (2, A.Bu.).

99. *Panagaeus cruxmajor* (Linnaeus, 1758) – Lociki, 13.X.2001. (1, G.L.).

100. *Claenius nigricornis* (Fabricius, 1787) – Stropi, 20.V.2007. (1, swampy bank of Lielais Stropu lake, A.Bu.).

101. *Oodes helopioides helopioides* (Fabricius, 1792) – Butiški, 27.V.2007. (1, bank of river Daugava, A.Bu. & M.B.); Stropi, 29-30.IV.2006. (1, A.Bu.), 11.VIII.2006. (1, A.Bu.), 20.V.2007. (9, swampy bank of Lielais Stropu lake, A.Bu.).

102. *Odacantha melanura* (Linnaeus, 1767) – Stropi, 20.V.2007. (>20, swampy bank of Lielais Stropu lake, on old reeds *Phragmites communis*, A.Bu.).

103. *Lebia chlorocephala* (J.J.Hoffmann, 1803) – Slutiški, 24.V.2003. (1, valley of river Daugava, M.K.); Stropi, 29.V.2007. (1, sandy agrocenosis, on grass, A.Bu.), 08.VIII.2007. (1, meadow, on grass, A.Bu.).

104. *Lebia cruxminor cruxminor* (Linnaeus, 1758) – Stropi, 08.VIII.2007. (2, meadow, on grass, A.Bu.).

105. *Syntomus truncatellus* (Linnaeus, 1761) – Stropi, VII.2004. (1, xeric meadow, A.Bu.), 15.X.2005. (7, A.Bu.), 29-30.IV.2006. (1, A.Bu.), 01.V.2006. (2, A.Bu.), 22.VI.2007. (1, sandy agrocenosis, A.Bu.).

106. *Syntomus foveatus* (Geoffroy, 1785) – Stropi, 15.X.2005. (1, A.Bu.).

107. *Microlestes minutulus* (Goeze, 1777) – Stropi, 29-30.IV.2006. (1, A.Bu.), 30.IV.2007. (1, sandy agrocenosis, A.Bu.).

108. *Microlestes maurus maurus* (Sturm, 1827) – Stropi, 15.VIII.2007. (1, sandy agrocenosis, A.Bu.).

109. *Dromius quadrimaculatus* (Linnaeus, 1758) – Stropi, 01.V.2006. (3, garden, under apple-tree bark, A.Bu.), 10.XII.2006. (1, mixed forest, under bark of aspen *Populus tremula*, A.Bu.).

110. *Philorhizus sigma* (Rossi, 1790) – Stropi, 20.V.2007. (16, swampy bank of Lielais Stropu lake, on old reeds *Phragmites communis*, A.Bu.), 25.V.2007. (1, swampy bank of Lielais Stropu lake, A.Bu.).

Hydrophilidae Latreille, 1802

111. *Sphaeridium bipustulatum* Fabricius, 1781 – Lociki, 18.VII.2001. (2, G.L.), 27.VIII.2001. (3, G.L.).

112. *Sphaeridium lunatum* Fabricius, 1792 – Lociki, 18.VII.2001. (1, G.L.).

113. *Sphaeridium scarabaeoides* (Linnaeus, 1758) – Lociki, 18.VII.2001. (1, G.L.), 27.VIII.2001. (1, G.L.); Stropi, 29.VII.2006. (1, sandy agrocenosis, on fresh cow excrements, A.Bu.), 04.VIII.2006. (4, sandy agrocenosis, on fresh cow excrements, A.Bu.), 05.VIII.2006. (10, sandy agrocenosis, on fresh cow excrements, A.Bu.).

Sphaeritidae Shuckard, 1839

114. *Sphaerites glabratus* (Fabricius, 1792) – Stropi, 29-30.IV.2006. (3, deciduous forest, fresh birch (*Betula sp.*) stump, on sap, A.Bu.), 06.V.2006. (5, on birch (*Betula sp.*) sap, A.Bu.).
In Latvia this species is known only from few localities (in Daugavpils and Valka districts).

Scarabaeidae Latreille, 1802

115. *Aphodius erraticus* (Linnaeus, 1758) – Stropi, 29.V.2007. (2, sandy agrocenosis, on fresh horse excrements, A.Bu.).

116. *Aphodius subterraneus* (Linnaeus, 1758) – Stropi, 29.V.2007. (1, sandy agrocenosis, on fresh horse excrements, A.Bu.).

117. *Aphodius haemorrhoidalis* (Linnaeus, 1758) – Stropi, 29.V.2007. (1, sandy agrocenosis, on fresh horse excrements, A.Bu.).

118. *Onthophagus nuchicornis* (Linnaeus, 1758) – Stropi, 29.V.2007. (>10, sandy agrocenosis, on fresh horse excrements, A.Bu.).

119. *Melolontha melolontha* (Linnaeus, 1758) – Butiški, 27.V.2007. (1, valley of river Daugava, on oak, A.Bu.); Stropi, 29.V.2007. (1, old cutting area, on oak, A.Bu.).

120. *Oxythyrea funesta* (Poda, 1761) – Butiški, 02.VII.2007. (1, valley of river Daugava, on *Centaurea sp.* flower, A.Bu.); Krauja, 06.VI.2007. (2, on Umbelliferae flowers not far from the railway, A.Bu.); Vecstropi, 29.V.2007. (observed 1 specimen in flight, road in forest, A.Bu.).
Increasing its range in Latvia. About distribution of this species in Latvian fauna see in article (Bukejs et al. 2006).

121. *Cetonia aurata aurata* (Linnaeus, 1758) – Krauja, 06.VI.2007. (>20, old cutting area, on fresh fallen aspen *Populus tremula*, on sap, A.Bu.); Naujene, 24.VII.2005. (3, Daugava river v., D.T.).

122. *Potosia cuprea metallica* (Herbst, 1782) – Krauja, 06.VI.2007. (>10, old cutting area, on fresh fallen aspen *Populus tremula*, on sap, A.Bu.).

Buprestidae Leach, 1815

123. *Phaenops cyanea* (Fabricius, 1775) – Stropi, 25.V.2007. (1, old cutting area, on trunk of dead standing pine, A.Bu.), 19.VII.2007. (1, old cutting area, on trunk of dead standing pine, A.Bu.); Vecstropi, 30.V.2007. (1, burnt area in coniferous forest, on pine trunk, A.Bu.).

124. *Anthaxia quadripunctata* (Linnaeus, 1758) – Butiški, 27.V.2007. (1, valley of river Daugava, A.Bu.); Krauja, 29.V.2007. (7, old cutting area and edge of mixed forest; on trunks of spruces, pines and aspens, A.Bu.), 06.VI.2007. (1, old cutting area, on spruce, A.Bu.).

125. *Agrilus pratensis pratensis* Ratzeburg 1837 (*syn.: roberti* Chevrolat, 1837) – Stropi, 25.V.2007. (1, old cutting area, A.Bu.).
In Latvia it is rare species (Barševskis, Savenkov 2001).

Trogossitidae Latreille, 1802

126. *Peltis grossa* (Linnaeus, 1758) – Stropi, 17.IV.2007. (1 dead specimen; moist deciduous forest, under rotten bark of fallen birch; A.Bu.).
This species is included on the list of indicator species of natural forest habitats.

Cleridae Latreille, 1802

127. *Thanasimus formicarius* (Linnaeus, 1758) – Vecstropi, 20.V.2007. (>20, burnt area in coniferous forest, on trunks of standing pines, A.Bu.).

128. *Trichodes apiarius* (Linnaeus, 1758) – Krauja, 05.VI.2007. (1, old cutting area, on trunk of dead standing aspen *Populus tremula*, A.Bu.).

129. *Korynetes caeruleus* (DeGeer, 1775) – Stropi, 20.V.2007. (1, agrocenosis, A.Bu.).

MONOTOMIDAE Laporte de Castelnau, 1840

130. *Rhizophagus perphoratus* Erichson, 1845 – Stropi, 29-30.IV.2006. (1, A.Bu.).

131. *Rhizophagus dispar* (Paykull, 1800) – Stropi, 09.VI.2006. (2, A.Bu.), 06.V.2006. (3, A.Bu.).

132. *Rhizophagus bipustulatus* (Fabricius, 1792) – Stropi, 29-30.IV.2006. (1, A.Bu.), 06.V.2006. (1, A.Bu.).

133. *Rhizophagus parvulus* (Paykull, 1800) – Stropi, 29-30.IV.2006. (3, A.Bu.), 05.V.2006. (1, A.Bu.).

ZOPHERIDAE Solier, 1834

134. *Synchita humeralis* (Fabricius, 1792) – Lociki, 17.V.2001. (1, G.L.).

135. *Bitoma crenata* (Fabricius, 1775) – Krauja, 29.V.2007. (>10, old cutting area, under bark of pine stump and under bark of fallen spruce, A.Bu.), 04.VIII.2007. (>20, old cutting area, under bark of birch and aspen stumps, A.Bu.); Lociki, 17.V.2001. (1, G.L.); Stropi, 09.VI.2006. (2, A.Bu.), 20.V.2007. (1, old cutting area, under bark of fallen pine, A.Bu.).

TENEBRIONIDAE Latreille, 1802

136. *Crypticus quisquilius* (Linnaeus, 1761) – Butiški, 27.V.2007. (1, Daugava river v., A.Bu.).

137. *Opatrum sabulosum* (Linnaeus, 1761) – Butiški, 27.V.2007. (2, valley of Daugava river, A.Bu.).

138. *Tenebrio molitor* (Linnaeus, 1758) – Stropi, 03.VIII.2007. (8, in shed, A.Bu.). Sinanthropus species.

139. *Neomida (=Hoplocephala) haemorrhoidalis* (Fabricius, 1787) – Krauja, 04.VIII.2007. (5, old cutting area, inside sporophore on rotten birch (*Betula sp.*) stump, A.Bu.). This species is included on the list of indicator species of natural forest habitats.

MYCETOPHAGIDAE Leach, 1815

140. *Litargus connexus* (Geoffroy, 1785) – Lociki, 17.V.2001. (1, G.L.); Stropi, 29-30.IV.2006. (1, A.Bu.), 06.V.2006. (2, A.Bu.).

141. *Mycetophagus quadripustulatus* (Linnaeus, 1761) – Stropi, 17.IV.2007. (1, moist deciduous forest, A.Bu.).
This species is included on the list of indicator species of natural forest habitats.

142. *Mycetophagus piceus* (Fabricius, 1776) – Krauja, 04.VIII.2007. (2, old cutting area, in fungi on birch stump, A.Bu.).

143. *Mycetophagus multipunctatus* Fabricius, 1792 – Stropi, 14.V.2006. (1, moist deciduous forest near Lielais Stropu lake, A.Bu.).

144. *Typhaea stercorea* (Linnaeus, 1758) – Slutiški, 18.VIII.1997. (1, A.Ba.).

MELANDRYIDAE Leach, 1815

145. *Xylita laevigata* (Hellenius, 1786) – Vecstropi, 20.V.2007. (2, burnt area in coniferous forest, A.Bu.).

PYTHIDAE Blanchard, 1845

146. *Pytho depressus* (Linnaeus, 1767) – Vecstropi, 20.V.2007. (3, burnt area in coniferous forest, on trunk of *Pinus sylvestris*, A.Bu.).

PYROCHROIDAE Latreille, 1807

147. *Pyrochroa coccinea* (Linnaeus, 1761) – Krauja, 29.V.2007. (1, old cutting area, A.Bu.).

Cerambycidae Latreille, 1802

148. *Spondylis buprestoides* (Linnaeus, 1758) - Vecstropi, 05.VII.2007. (1, burnt area in coniferous forest, leg. A.Bu.), 10.VIII.2007. (1 dead specimen, burnt area in coniferous forest, A.Bu.).

149. *Arhopalus rusticus* (Linnaeus, 1758) – Stropi, 29.V.2007. (1 dead specimen, old cutting area, under bark of dead standing pine, A.Bu.); Vecstropi, 17.VII.2007. (1, burnt area in coniferous forest, on spruce trunk, A.Bu.), 10.VIII.2007. (1 dead specimen, burnt area in coniferous forest, under bark of burnt pine, A.Bu.).

150. *Tetropium castaneum* (Linnaeus, 1758) – Vecstropi, 25.V.2007. (2, burnt area in coniferous forest, on pine, A.Bu.); Krauja, 06.VI.2007. (1, old cutting area, A.Bu.).

151. *Rhagium mordax* (DeGeer, 1775) – Krauja, 05.VI.2007. (1, old cutting area, A.Bu.).

152. *Rhagium inquisitor inquisitor* (Linnaeus, 1758) – Stropi, 20.V.2007. (1, old cutting area, on fallen pine, A.Bu.); Vecstropi, V-VI.2007. (>20, burnt area in coniferous forest, on trunks of pines and spruces, A.Bu.).

153. *Oxymirus cursor* (Linnaeus, 1758) – Butiški, 27.V.2007. (1, valley of river Daugava, river bank with *Salix sp*., in flight, A.Bu.).

154. *Gaurotes virginea virginea* (Linnaeus, 1758) – Krauja, 06.VI.2007. (1, old cutting area, in flight, A.Bu.).

155. *Dinoptera collaris* (Linnaeus, 1758) – Naujene, 30.VI.2006. (1, forest, D.T.).

156. *Cortodera femorata* (Fabricius, 1787) – Stropi, 28.V.2007. (1, glade in mixed forest near Lielais Stropu lake, A.Bu.).

157. *Stictoleptura rubra rubra* (Linnaeus, 1758) – Vecstropi, 17.VII.2007. (1, burnt area in coniferous forest, in flight, A.Bu.).

158. *Anastrangalia reyi* (Heyden, 1889) – Krauja, 06.VI.2007. (1, on Umbelliferae flower not far from the railway, A.Bu.); Vecstropi, 05.VII.2007. (1, burnt area in coniferous forest, A.Bu.).

159. *Leptura quadrifasciata quadrifasciata* Linnaeus, 1758 – Naujene, 24.VII.2005. (2, valley of Daugava river, D.T.).

160. *Stenurella bifasciata bifasciata* (Müller, 1776) – Naujene, 24.VII.2005. (1, valley of river Daugava, on Umbelliferae flowers, D.T); Stropi, 27.VII.2007. (1, meadow, A.Bu.).

161. *Xylotrechus rusticus* (Linnaeus, 1758) – Krauja, 29.V.2007. (6, old cutting area, on fallen trunk of aspen *Populus tremula*, A.Bu.).

162. *Lamia textor* (Linnaeus, 1758) – Butiški, 02.VII.2007. (1, valley of river Daugava, on *Salix sp*., A.Bu.).

163. *Agapanthia villosoviridescens* (DeGeer, 1775) – Krauja, 29.V.2007. (1, old cutting area, A.Bu.); Stropi, 25.V.2007. (1, swampy bank of Lielais Stropu lake, netting, A.Bu.), 28.V.2007. (1, meadow near Lielais Stropu lake, A.Bu.), 12.VI.2007. (3, meadow near Lielais Stropu lake, on *Arctium sp*., A.Bu.).

164. *Saperda perforata* (Pallas, 1773) – Krauja, 29.V.2007. (1, old cutting area, in trunk of daed standing aspen *Populus tremula*, A.Bu.).
This species is included on the list of indicator species of natural forest habitats.

165. *Phytoecia virgula* (Charpentier, 1825) – Stropi, 13.VI.2007. (1, xeric meadow, on grass, A.Bu.).This species is known from few localities in SE Latvia (Daugavpils district). Steppe species. North border of main distribution area.

Megalopodidae Latreille, 1802

166. *Zeugophora subspinosa* (Fabricius, 1781) – Stropi, 28.V.2007. (1, meadow near Lielais Stropu lake, A.Bu.).

Chrysomelidae Latreille, 1802

167. *Donacia brevicornis* Ahrens, 1810 – Stropi, 20.V.2007. (1, bank of Lielais Stropu lake, on water plant, A.Bu.), 25.V.2007. (16, swampy bank of Lielais Stropu lake, on water plants, A.Bu.).

168. *Oulema erichsonii* (Suffrian, 1841) – Butiški, 12.VIII.2006. (1, valley of river Daugava, A.Bu. & M.B.), 27.V.2007. (2, valley of river Daugava, A.Bu.); Lociki, 06.VIII.2001. (1, G.L.), 24.VIII.2001. (1, G.L.); Stropi, 25.V.2007. (1, swampy bank of Lielais Stropu lake, A.Bu.), Vecstropi, 10.VIII.2007. (1, burnt area in coniferous forest, A.Bu.).

169. *Oulema obscura* (Stephens, 1831) (=*gallaeciana* (Heyden, 1870); *lichenis* (Voet, 1806) – Butiški, 27.V.2007. (1, valley of river Daugava, A.Bu.); Stropi, 09.VII.2006. (1, old cutting area, A.Bu.), 25.V.2007. (1, old cutting area, A.Bu.), 28.V.2007. (2, meadow near Lielais Stropu lake, A.Bu.), 29.V.2007. (1, agrocenosis, A.Bu.), 22.VI.2007. (1, old cutting area, A.Bu.); 08.VIII.2007. (1, meadow, A.Bu.), 15.VIII.2007. (1, meadow, A.Bu.).

170. *Oulema melanopus* (Linnaeus, 1758) – Butiški, 12.VIII.2006. (1, valley of river Daugava, A.Bu. & M.B.); Krauja, 04.VIII.2007. (2, old cutting area, A.Bu.).

171. *Labidostomis tridentata* (Linnaeus, 1758) – Naujene env., 8 km S Naujene, Nature Park "Daugavas Loki", 11-12.VI.2002. (1, bank of river Daugava, D.T.).

172. *Labidostomis longimana* (Linnaeus, 1761) – Stropi, 08.VIII.2007. (5, meadow, A.Bu.).

173. *Clytra quadripunctata* (Linnaeus, 1758) – Stropi, 05.VI.2007. (1, old cutting area, A.Bu.).

174. *Smaragdina salicina* (Scopoli, 1763) (= *cyanea* (Fabricius, 1775) – Lociki, 22.VI.2001. (1, G.L.).

175. *Smaragdina flavicollis* Charpentier, 1825 – Lociki, 24.VII.2001. (1, G.L.).

176. *Coptocephala unifasciata* (Scopoli, 1763) – Butiški, 12.VIII.2006. (3, valley of river Daugava, A.Bu. & M.B.), 21.VIII.2006. (1, valley of river Daugava, xeric meadow, A.Bu. & M.B.), 03.VIII.2007. (1, valley of river Daugava, xeric meadow, A.Bu. & M.B.).

177. *Pachybrachis hieroglyphicus hieroglyphicus* (Laicharting, 1781) – Butiški, 12.VIII.2006. (1, valley of river Daugava, xeric meadow, A.Bu. & M.B.), 21.VIII.2006. (2, valley of river Daugava, xeric meadow, A.Bu. & M.B.), 03.VIII.2007. (1, xeric meadow near Daugava river, A.Bu. & M.B.).

178. *Cryptocephalus octopunctatus* (Scopoli, 1763) – Butiški, 27.V.2007. (1, valley of river Daugava, M.B.); Lociki, 15.V.2001. (1, G.L.), 26.V.2001. (1, G.L.); Naujene, 24.VII.2005. (1, valley of river Daugava, D.T.); Stropi, 03.VI.2006. (1, A.Bu.).

179. *Cryptocephalus sericeus* (Linnaeus, 1758) – Krauja, 06.VI.2007. (2, on *Centaurea sp*. flowers not far from the railway, A.Bu.); Stropi, 08.VIII.2007. (4, meadow, A.Bu.), 10.VIII.2007. (1, agrocenosis, on *Compositae* flower, A.Bu.).

180. *Cryptocephalus moraei* (Linnaeus, 1758) – Stropi, 17.VII.2006. (1, A.Bu.).

181. *Cryptocephalus bilineatus* (Linnaeus, 1767) – Stropi, 08.VIII.2007. (1, meadow, A.Bu.), 15.VIII.2007. (1, meadow, A.Bu.).

182. *Cryptocephalus ocellatus* Drapiez, 1819 – Naujene env., 8 km S Naujene, Nature Park "Daugavas Loki", 11.VI.2002. (>10, bank of river Daugava, D.T.).

183. *Cryptocephalus labiatus* (Linnaeus, 1761) – Butiški, 06.VIII.2001. (1, G.L.); Lociki, 05.VIII.2001. (1, G.L.).

184. *Cryptocephalus fulvus* Goeze, 1777 – Butiški, 21.VIII.2006. (1, valley of river Daugava, A.Bu. & M.B.); Stropi, 08.VIII.2007. (8, meadow, A.Bu.).

185. *Cryptocephalus pusillus* Fabricius, 1777 – Stropi, 19.VII.2007. (1, old cutting area, A.Bu.).

186. *Pachnephorus pilosus* (Rossi, 1790) – Lociki, 20.VIII.2001. (6, G.L.); Stropi, 27.VI.2006. (1, A.Bu.), 02.VII.2006. (1, A.Bu.), 13.V.2007. (10, sandy agrocenosis, on soil, A.Bu.).
This species considered to be quite common in specific xeric microhabitats in Latvia.

187. *Bromius (=Adoxus) obscurus* (Linnaeus, 1758) – Naujene, 30.VI.2006. (1, meadow, D.T.); Stropi, 21.V.2007. (1, sandy agrocenosis, A.Bu.), 25.V.2007. (3, swampy bank of Lielais Stropu lake, on grass, A.Bu.), 29.V.2007. (1, sandy agrocenosis, A.Bu.).

188. *Leptinotarsa decemlineata* (Say, 1824) – Butiški 12.VIII.2006. (>20, agrocenosis, A.Bu. & M.B.); Lociki, 08.VIII.2001. (2, G.L.); Naujene, 08.VII.2003. (7, agrocenosis, A.Bu.), Stropi, 16.VI.2006. (4, agrocenosis, A.Bu.); Vecpils, 21.VIII.2006. (3, agrocenosis, A.Bu.); Vecstropi, 15.VII.2007. (>10, agrocenosis of potato field, A.Bu.).
This species frequently was observed on potato fields of Naujene rural municipality.

189. *Chrysolina graminis* (Linnaeus, 1758) – Butiški, 12.VIII.2006. (2, valley of river Daugava, A.Bu. & M.B.); Stropi, 10.IX.2005. (1, agrocenosis, A.Bu.), 29.V.2007. (1, sandy agrocenosis, A.Bu.).

190. *Chrysolina polita* (Linnaeus, 1758) – Butiški, 12.VIII.2006. (4, valley of river Daugava, A.Bu. & M.B.), 21.VIII.2006. (1, valley of river Daugava, A.Bu.), 26.V.2007. (1, sandy agrocenosis, A.Bu.); Krauja, 29.V.2007. (1, old cutting area, A.Bu.); Lociki, 26.V.2001. (2, G.L.); Stropi, 07.V.2006. (1, A.Bu.), 03.VI.2006. (1, A.Bu.), 30.IV.2007.(1, agrocenosis, in soil, A.Bu.), 25.V.2007. (1, old cutting area, A.Bu.), 22.VI.2007. (2, old cutting area, A.Bu.).

191. *Chrysolina staphylea* (Linnaeus, 1758) – Stropi, 29-30.IV.2006. (1, A.Bu.).

192. *Chrysolina varians* (Schaller, 1783) – Krauja, 04.VIII.2007. (1, old cutting area, A.Bu.); Stropi, 15.VIII.2007. (3, meadow, on *Hypericum sp.*, A.Bu.).

193. *Chrysolina hyperici* (Forster, 1771) – Stropi, 15.VIII.2007. (1, meadow, A.Bu.).

194. *Chrysolina analis* (Linnaeus, 1767) – Krauja, 04.VIII.2007. (1, old cutting area, A.Bu.); Stropi, 08.VIII.2007. (1, meadow, A.Bu.).

195. *Chrysolina fastuosa speciosa* (Linnaeus, 1767) – Naujene, 30.VI.2006. (1, forest, D.T.); Stropi, VII.2001. (1, A.Bu.), 08.VII.2006. (1, A.Bu.), 25.V.2007. (2, swampy bank of Lielais Stropu lake, A.Bu.), 28.V.2007. (1, meadow near Lielais Stropu lake, A.Bu.).

196. *Gastrophysa polygoni* (Linnaeus, 1758) – Butiški, 21.VIII.2006. (1, valley of river Daugava, dry meadow, A.Bu. & M.B.); Stropi, 13.V.2006. (1, A.Bu.), 03.VI.2006. (1, A.Bu.), 27.VI.2006. (1, A.Bu.), 13.V.2007. (1, agrocenosis, A.Bu.), 20.V.2007. (1, agrocenosis, A.Bu.), 26.V.2007. (1, agrocenosis, A.Bu.), 28.V.2007. (1, meadow near Lielais Stropu lake, A.Bu.), 29.V.2007. (1, agrocenosis, A.Bu.), 05.VI. 2007. (1, old cutting area, A.Bu.).

197. *Gastrophysa viridula* (DeGeer, 1775) – Butiški, 06.VIII.2001. (3, G.L.), 12.VIII.2006. (1, valley of river Daugava, A.Bu. & M.B.), 27.V.2007. (2, valley of river Daugava, A.Bu.), 02.VII.2007. (>20, valley of river Daugava, on *Rumex sp.*, A.Bu.); Lociki, 26.V.2001. (1, G.L.), 06.VIII.2001. (1, G.L.), 08.VIII.2001. (2, G.L.); Naujene, 24.VII.2005. (4, valley of Daugava river, on *Rumex sp.*, D.T); Naujene env., 8 km S Naujene, Nature Park "Daugavas Loki", 11-12.VI.2002. (>10, bank of river Daugava, D.T.); Slutiški, 24.V.2003. (>10,

valley of river Daugava, M.K.); Stropi, 26-27.V.2006. (2, A.Bu.), 21.V.2007. (1, agrocenosis, A.Bu.), 20.VII.2007. (1, agrocenosis, on *Rumex sp*., A.Bu.); Vasargeliški, 26.VI.2001. (1, G.L.).

198. *Phaedon laevigatus* (Duftschmid, 1825) – Lociki, 13.X.2000. (1, G.L.).

199. *Phaedon cochleariae* (Fabricius, 1792) – Butiški, 06.VIII.2001. (4, G.L.).

200. *Prasocuris junci* (Brahm, 1790) – Lociki, 05.VIII.2001. (1, G.L.).

201. *Plagiodera versicolora* (Laicharting, 1781) – Lociki, 26.V.2001. (1, G.L.); Naujene, 24.VII.2005. (5, valley of river Daugava, on *Salix sp*., D.T.); Stropi, 03.VI.2006.(1, A.Bu.), 09.VI.2006. (9. A.Bu.), 25.V.2007. (11, old cutting area, A.Bu.).

202. *Chrysomela vigintipunctata* (Scopoli, 1763) – Naujene, 15.X.2004. (1, Juzefova park, A.Ba.).

203. *Chrysomela populi* Linnaeus, 1758 – Butiški, 27.V.2007. (2, valley of river Daugava, A.Bu.); Krauja, 29.V.2007. (3, old cutting area, A.Bu.); Stropi, 03.VI.2006. (4, edge of forest, on aspen, A.Bu.), 09.VI.2006. (1, A.Bu.), 25.V.2007. (8, old cutting area, on young aspen, A.Bu.).

204. *Chrysomela tremula* Fabricius, 1787 – Butiški, 27.V.2007. (1, valley of river Daugava, A.Bu.); Stropi, 25.V.2007. (1, old cutting area, A.Bu.).

205. *Plagiosterna aenea* (Linnaeus, 1758) – Stropi, 06.V.2006. (1, A.Bu.), 03.VI.2006. (1, A.Bu.), 09.VI.2006. (2, A.Bu.), 25.V.2007. (1, old cutting area, A.Bu.).

206. *Gonioctena viminalis* (Linnaeus, 1758) – Butiški, 27.V.2007. (1, valley of river Daugava, M.B.); Slutiški, 24.V.2003. (>10, valley of river Daugava, M.K.); Stropi, 03.VI.2006. (5, A.Bu.), 25.V.2007. (1, old cutting area, A.Bu.).

207. *Gonioctena rufipes* (DeGeer, 1775) (= *decemnotata* (Marsham, 1802) – Stropi, 03.VI.2006. (4, A.Bu.), 09.VI.2006. (1, A.Bu.), 28.V.2007. (1, swampy bank of Lielais Stropu lake, A.Bu.).

208. *Gonioctena linnaeana* (Schrank, 1781) – Butiški, 27.V.2007. (1, valley of river Daugava, A.Bu. & M.B.).

209. *Gonioctena quinquepunctata* (Fabricius, 1787) – Stropi, 13.V.2006. (1, A.Bu.), 14.V.2006. (1, A.Bu.), 03.VI.2006. (1, A.Bu.).

210. *Gonioctena pallida* (Linnaeus, 1758) – Stropi, 14.V.2006. (2, A.Bu.); Vasargeliški, 26.VI.2001. (1, G.L.).

211. *Phratora vulgatissima* (Linnaeus, 1758) – Butiški, 21.X.2000. (6, G.L.), 27.V.2007. (1, valley of river Daugava, A.Bu.); Stropi, 25.V.2007. (1, swampy bank of Lielais Stropu lake, A.Bu.).

212. *Phratora tibialis* (Suffrian, 1851) – Butiški, 21.X.2000. (2, G.L.), 12.VIII.2006. (1, valley of river Daugava, A.Bu. & M.B.), 27.V.2007. (1, valley of river Daugava, A.Bu.).

213. *Phratora laticollis* (Suffrian, 1851) – Lociki, 06.VIII.2001. (1, G.L.).

214. *Phratora vitellinae* (Linnaeus, 1758) – Butiški, 21.X.2000. (1, G.L.), 27.V.2007. (1, valley river of Daugava, M.B.); Lociki, 26.V.2001. (1, G.L.), 05.VIII.2001. (1, G.L.), 06.VIII.2001. (2, G.L.); Stropi, 14.V.2006. (1, A.Bu.), 26-27.V.2006. (1, A.Bu.), 03.VI.2006. (2, A.Bu.), 09.VI.2006. (4, A.Bu.), 25.V.2007. (2, old cuttin area, A.Bu.).

215. *Phratora atrovirens* (Cornelius, 1857) – Stropi, 03.VI.2006. (2, A.Bu.), 09.VI.2006. (1, A.Bu.).

216. *Galerucella grisescens* (Joannis, 1866) – Krauja, 29.V.2007. (2, old wet cutting area, A.Bu.); Stropi, 27.V.2006. (1, A.Bu.), 20.V.2007. (1, swampy bank of Lielais Stropu lake, A.Bu.).

217. *Galerucella lineola* (Fabricius, 1781) – Butiški, 12.VIII.2006. (1, valley of river Daugava, A.Bu. & M.B.); Lociki, 05.VIII.2001. (2, G.L.);

Stropi, 20.V.2007. (4, swampy bank of Lielais Stropu lake, A.Bu.), 25.V.2007. (5, swampy bank of Lielais Stropu lake, A.Bu.), 28.V.2007. (1, meadow near Lielais Stropu lake, A.Bu.).

218. *Galerucella calmariensis* (Linnaeus, 1767) – Stropi, 25.V.2007. (1, swampy bank of Lielais Stropu lake, A.Bu.).

219. *Galerucella pusilla* (Duftschmid, 1825) - Butiški, 12.VIII.2006. (1, valley of river Daugava, A.Bu. & M.B.).

220. *Galerucella tenella* (Linnaeus, 1761) – Lociki, 21.VII.2001. (1, G.L.); Krauja, 29.V.2007. (1, old wet cutting area, A.Bu.); Stropi, 25.V.2007. (1, swampy bank of Lielais Stropu lake, A.Bu.).

221. *Pyrrhalta viburni* (Paykull, 1799) – Lociki, 24.VII.2001. (1, G.L.), 20.VIII.2001. (1, G.L.); Slutiški, 24.V.2003. (2, valley of river Daugava, M.K.).

222. *Lochmaea caprea* (Linnaeus, 1758) – Butiški, 12.VIII.2006. (1, valley of river Daugava, A.Bu. & M.B.), 21.VIII.2006. (1, valley of river Daugava, A.Bu. & M.B.); Lociki, 26.V.2001. (1, G.L.), 21.VII.2001. (1, G.L.), 07.VIII.2001. (1, G.L.); Stropi, 26-27.V.2006. (1, A.Bu.), 03.VI.2006. (1, A.Bu.), 09.VI.2006. (1, A.Bu.), 11.VIII.2006. (1, A.Bu.), 20.V.2007. (1, swampy bank of Lielais Stropu lake, A.Bu.), 25.V.2007. (5, swampy bank of Lielais Stropu lake, A.Bu.).

223. *Galeruca tanaceti* (Linnaeus, 1758) – Butiški, 03.VIII.2007. (1, valley of river Daugava, A.Bu. & M.B.); Stropi, 13.VI.2007. (1, A.Bu.), 15.VIII.2007. (4, meadow, A.Bu.).

224. *Agelastica alni* (Linnaeus, 1758) – Butiški, 12.VIII.2006. (1, valley of river Daugava, A.Bu. & M.B.), 21.VIII.2006. (1, valley of river Daugava, A.Bu.), 27.V.2007. (1, valley of river Daugava, A.Bu.); Lociki, 26.V.2001. (1, G.L.); Naujene, 24.VII.2005. (>10, valley of river Daugava, on alder, D.T.); Stropi, 03.VI.2006. (5, on alder, A.Bu.), 09.VI.2006. (3, on alder, A.Bu.), 01.VII.2006. (>10, bank of Lielais Stropu lake, D.T.). On a young alder (*Alnus incana* L.) it was observed in a plenty.

225. *Phyllobrotica quadrimaculata* (Linnaeus, 1758) – Stropi, 17.VII.2006. (2, A.Bu.).

226. *Luperus flavipes* (Linnaeus, 1767) – Lociki, 26.V.2001. (4, G.L.), 22.VI.2001. (1, G.L.).

227. *Phyllotreta vittula* (Redtenbacher, 1849) – Butiški, 12.VIII.2006. (1, valley of river Daugava, A.Bu. & M.B.); Stropi, 04.VIII.2006. (5, sandy agrocenosis, A.Bu.).

228. *Phyllotreta nemorum* (Linnaeus, 1758) – Stropi, 25.V.2007. (1, swampy bank of Lielais Stropu lake, A.Bu.), 08.VIII.2007. (1, meadow, A.Bu.).

229. *Phyllotreta undulata* Kutschera, 1860 – Butiški, 21.VIII.2006. (1, valley of river Daugava, dry meadow, A.Bu. & M.B.); Stropi, 04.VIII.2006. (2, sandy agrocenosis, A.Bu.), 10.VIII.2006. (1, A.Bu.), 28.V.2007. (1, meadow near Lielais Stropu lake, A.Bu.), 19.VII.2007. (1, bank of Lielais Stropu lake, A.Bu.).

230. *Phyllotreta striolata* (Fabricius, 1803) – Butiški, 12.VIII.2006. (1, valley of river Daugava, A.Bu. & M.B.), 21.VIII.2006. (1, valley of river Daugava, dry meadow, A.Bu. & M.B.); Stropi, 10.VIII.2006, (1, A.Bu.).

231. *Phyllotreta ochripes* (Curtis, 1837) – Butiški, 27.V.2007. (1, valley of river Daugava, A.Bu.).

232. *Aphhona nonstriata* (Goeze, 1777) - Butiški, 06.VIII.2001. (1, G.L.); Lociki, 22.V.2001. (1, G.L.), 26.V.2001. (2, A.Bu.), 05.VIII.2001. (1, G.L.).

233. *Longitarsus niger* (Kch, 1803) – Stropi, 25.V.2007. (1, old cutting area, A.Bu.).

234. *Altica tamaricis* Schrank, 1785 – Butiški, 12.VIII.2006. (8, valley of river Daugava, A.Bu. & M.B.), 21.VIII.2007. (3, valley of river Daugava, A.Bu. & M.B.), 27.V.2007. (1, valley of river

Daugava, A.Bu.); Lociki, 06.VIII.2001. (2, G.L.), 20.VIII.2001. (1, G.L).

235. *Batophila rubi* (Paykull, 1799) – Stropi, 25.V.2007. (10, old cutting area, A.Bu.); Vecstropi, 25.V.2007. (5, burnt area in coniferous forest, A.Bu.).

236. *Lythraria salicariae* (Paykull, 1800) – Krauja, 28.VII.2006. (1, A.Bu.), 04.VIII.2007. (6, old cutting area, A.Bu.); Stropi, 25.V.2007. (1, old cutting area, A.Bu.).

237. *Neocrepidodera transversa* (Marsham, 1802) – Lociki, 20.VIII.2001. (1, G.L.); Stropi, 29.VII.2006. (1, A.Bu.), 22.VI.2007. (1, old cutting area, A.Bu.), 20.VII.2007. (4, meadow, A.Bu.); Vasargeliški, 26.VI.2001. (1, G.L.).

238. *Neocrepidodera ferruginea* (Scopoli, 1763) – Lociki, 20.VIII.2001. (1, G.L.); Stropi, 20.VII.2007. (1, meadow, A.Bu.).

239. *Crepidodera fulvicornis* (Fabricius, 1792) – Butiški, 21.VIII.2006. (1, valley of river Daugava, A.Bu. & M.B.); Lociki, 19.V.2001. (1, G.L.), 07.VIII.2001. (1, G.L.); Stropi, 25.V.2007. (5, swampy bank of Lielais Stropu lake, A.Bu.), 26.V.2007. (1, agrocenosis, A.Bu.), 28.V.2007. (1, meadow near Lielais Stropu lake, A.Bu.), Stropi, 22.VI.2007. (1, old cutting area, A.Bu.).

240. *Crepidodera aurata* (Marsham, 1802) – Butiški, 21.VIII.2006. (1, valley of river Daugava, A.Bu. & M.B.); Lociki, 26.V.2001. (2, G.L.), 26.VIII.2001. (1, G.L.); Stropi, 26-27.V.2006. (1, A.Bu.), 26.V.2007. (6, agrocenosis, A.Bu.), 29.V.2007. (3, agrocenosis, A.Bu.), 22.VI.2007. (1, old cutting area, A.Bu.).

241. *Epithrix pubescens* (Koch, 1803) – Stropi, 01.VII.2006. (1, bank of Lielais Stropu lake, on *Solanum sp*., D.T.).

242. *Chaetocnema semicoerulea* (Koch, 1803) – Butiški, 06.VIII.2001. (1, G.L.).

243. *Chaetocnema hortensis* (Geoffroy, 1785) – Krauja, 29.V.2007. (1, old cutting area, A.Bu.).

244. *Sphaeroderma rubidum* (Graėlls, 1858) – Lociki, 20.VIII.2001. (1, G.L.); Krauja, 04.VIII.2007. (2, old cutting area, A.Bu.).

245. *Psylliodes dulcamarae* (Koch, 1803) – Stropi, 01.VII.2006. (1, bank of Lielais Stropu lake, on *Solanum sp*., D.T.).

246. *Cassida viridis* Linnaeus, 1758 – Butiški, 12.VIII.2006. (2, valley of river Daugava, A.Bu. & M.B.); Stropi, 13.V.2007. (1, agrocenosis, A.Bu.).

247. *Cassida nebulosa* Linnaeus, 1758 – Stropi, 16-17.VI.2006. (1, bank of Lielais Stropu lake, A.Bu.), 29.V.2007. (1, agrocenosis, A.Bu.), 08.VIII.2007. (2, meadow, A.Bu.).

248. *Cassida flaveola* Thunberg, 1794 – Lociki, 20.VIII.2001. (1, G.L.); Stropi, 28.V.2007. (1, meadow near Lielais Stropu lake, A.Bu.), 20.VII.2007. (1, meadow, A.Bu.), 08.VIII.2007. (1, meadow, A.Bu.), 15.VIII.2007. (2, meadow, A.Bu.).

249. *Cassida vibex* Linnaeus, 1767 – Lociki, 07.VIII.2001. (1, G.L.); Stropi, 11.VIII.2006. (1, bank of Lielais Stropu lake, A.Bu.), 25.V.2007. (2, swampy bank of Lielais Stropu lake, on grass, A.Bu.).

250. *Cassida stigmatica* Suffrian, 1844 – Naujene env., 8 km S Naujene, Nature Park “Daugavas Loki”, 11-12.VI.2002. (1, bank of river Daugava, D.T.).

251. *Cassida sanguinosa* Suffrian, 1844 – Butiški, 12.VIII.2006. (12, valley of river Daugava, A.Bu. & M.B.);

252. *Cassida denticollis* Suffrian, 1844 – Butiški, 12.VIII.2006. (1, bank of river Daugava, A.Bu. & M.B.), 27.V.2007. (4, valley of river Daugava, A.Bu. & M.B.); Stropi, 11.VIII.2006. (1, bank of Lielais Stropu lake, A.Bu.), 28.V.2007. (2, meadow near Lielais Stropu lake, A.Bu.), 20.VII.2007. (6, meadow, A.Bu.), 08.VIII.2007. (12, meadow, A.Bu.), 15.VIII.2007. (5, meadow, A.Bu.).

253. *Cassida margaritacea* Schaller, 1783 – Stropi, 08.VIII.2007. (3, meadow, A.Bu.).

254. *Cassida nobilis* Linnaeus, 1758 – Stropi, 29.V.2007. (1, agrocenosis, A.Bu.).

Among recorded species 97 are new for fauna of Naujene rural municipality: Carabidae (30 species), Hydrophilidae (1), Scarabaeidae (3), Buprestidae (1), Trogossitidae (1), Cleridae (1), Monotomidae (1), Zopheridae (1), Tenebrionidae (2), Mycetophagidae (3), Melandryidae (1), Pythidae (1), Cerambycidae (8), Megalopodidae (1) and Chrysomelidae (42).

17 species were found for the first time in eastern Latvia.

Recorded several species which are included on the list of indicators of natural forest habitats: *Sericoda quadripunctata* (DeGeer, 1774) (Carabidae), *Peltis grossa* (Linnaeus, 1758) (Trogossitidae), *Neomida (=Hoplocephala) haemorrhoidalis* (Fabricius, 1787) (Tenebrionidae), *Mycetophagus quadripustulatus* (Linnaeus, 1761) (Mycetophagidae) and *Saperda perforata* (Pallas, 1773) (Cerambycidae).

The records published in the article will complete the information about Coleoptera species distribution in Latvia.

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References

Barševskis A. 2003. Ground beetles (Coleoptera: Carabidae, Trachypachidae & Rhysodidae) of Latvia. Baltic Institute of Coleopterology, Daugavpils: 1 - 264. (in Latvian, English summary).

Barševskis A., Savenkov N. 2001. Materials on Latvian Buprestidae (Coleoptera) fauna. *Latv. Entomol.,* 38: 4 – 12.

Barševskis A., Valainis U., Bičevskis M., Savienkovs N., Cibuļskis R., Kalniņš M., Strode N. 2004. Faunistic records of the beetles (Hexapoda: Coleoptera) in Latvia. 1. *Acta Biol. Univ. Daugavp.*, 4 (2): 93 – 106.

Barševskis A., Kalniņš M., Cibuļskis R. 2005. Adephagous water beetles (Coleoptera, Dytisciformia) of Latvia. Baltic Coleopterological Society, Daugavpils: 1 – 136. (in Latvian, English summary).

Bukejs A. 2006. Materials about the fauna of beetles (Insecta: Coleoptera) of Naujene rural municipality (Daugavpils district, Latvia). Part 1. *Acta Biol. Univ. Daugavp.,* 6 (1-2): 65 – 75.

Bukejs A., Barševskis A., Rudāns E. 2006. *Oxythyrea funesta* (Poda, 1761) (Coleoptera: Scarabaeidae: Cetoniinae) in the fauna of Latvia. *Acta Biol. Univ. Daugavp.,* 6 (1-2): 51 – 55.

Cibuļskis R. 2006. Materials about the tribe Xantholinini Erichson, 1839 (Coleoptera: Staphylinidae) in the fauna of Latvia. *Acta Biol. Univ. Daugavp.,* 6 (1-2): 57 – 64.

Cibuļskis R. 2007. A review of the subtribe Staphylinina Latreille, 1802 (Coleoptera: Staphylinidae) in the fauna of Latvia. *Baltic J. Coleopterol.,* 7(1): 99 – 120.

Silfverberg H. 2004. Enumeratio nova Coleopterorum Fennoscandiae, Daniae et Baltiae. Sahlbergia, 9: 1 - 111.

Telnov D., Bukejs A., Gailis J., Kalniņš M., Napolov A., Sörensson M. 2007. Contributions to the knowledge of Latvian Coleoptera. 6. *Latv. Entomol.,* 44: 47 – 54.

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