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PROTECTION OF SPECIES DIVERSITY OF AQUATIC INSECTS IN THE SOUTHEASTERN PART OF BALTIC REGION

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Czachorowski S., Biesiadka E., Aleksandrowicz O. 2001. Protection of species diversity of aquatic insects in the southeastern part of Baltic Region. *Acta Biol. Univ. Daugavp., 1 (1): 3 - 6.*

Southeastern part of Baltic Region is characterized by comparatively good state of environment. Now, in this region called "Green Lungs of Europe", fauna of the aquatic insects is exposed to increasing antropogenous influence. About 30% species of water insects are estimated to be threatened. Some rare and threatened species can recolonize disturbed ecosystems from neighboring regions. Various method of protection must be developing: national and landscape parks, umbrella species, key habitats. Creation of transboundary protected areas in southeastern Baltic Region will allow not only to keep an existing biological diversity, but also to organize monitoring processes of ecosystem's transformation.

Key words: aquatic insects, umbrella species, biodiversity, tranboundary protected area

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Introduction

Southeastern part of the Baltic Region, including basins of the rivers Pasleka, Pregola, and Nieman, is divided into territory of four states: Poland, Belarus, Lithuania and Russia. Geologically this territory is young, and its animal population was generated only on the average Holocene, after reduction of a level of the Baltic Sea. The fauna representing a mixed complex of the European and relict postglacial elements.

Landscapes of the region are various and mosaic. A complicated history of civilization's development in the region to the present time has resulted in a relatively low population and weak degree of ecosystem's transformation. A degree of anthropogenous influence is reduced on many areas. It promotes development a secondary succession, restorations natural ecosystems and renaturalizations of fauna.

Northeastern Poland and Belarus is characterized by comparatively good state of environment, especially in comparison with countries of Western Europe. In northeastern Poland was created functional area "Green Lungs of Poland", and consistently there are suggested to create "Green Lungs of Europe" in southeastern part of the Baltic region including areas from few countries. Geographical position and condition of environment are especially favorable for maintenance of boreal and boreal-mountains fauna. Now, in this region the fauna of aquatic insects is exposed to increasing anthropogenous influence.

Threat of insect's biodiversity

For a rating of anthropogenous transformations of a aquatic fauna it is necessary to have the information on its history and contemporary status. However degree of a fauna studying strongly varies. Aquatic insects are most full investigated in Poland, weaker in Belarus and Lithuania. For the Kaliningrad area of Russia the modern data practically are absent. It is necessary to note non-uniform study of various groups. *Trichoptera*, *Odonata*, *Heteroptera* and *Coleoptera* are recognized comparatively well, whereas *Diptera* are investigated very poor.

More then 3340 species of aquatic insects occur in Poland, the most numerous are dipterans, followed by coleopterans and trichopterans. But only for about 80%

of species the state of threat has not been recognized. Amongst the remaining 36 species are extinct, 53 are danger of extinction and 100 are rare. About 1000 species of water insects are estimated to be threatened (Czachorowski & Buczyński 2000). We think that number of treated species are more numerous. Invertebrates fauna of Belarus is recognized worse.

In both countries the most worst known are dipterans, although this insect order is the most numerous and very important for aquatic and wetlands communities. *Odonata*, *Heteroptera*, *Coleoptera*, *Trichoptera* and *Ephemeroptera* are the best recognized. Entomofauna of lowland running waters are known very poor.

Basic condition efficient protections of biodiversity is recognition of ecology each species. In Poland water entomofauna only just about 20 % species is recognized on so much well, that one can qualify approximate of melting their threats. Additionally, we have not good methodology for categorizing of threat at invertebrates.

Insects are threat by: changes in environment and insect habitat, and a little scale by catching by collectors and exploiting of insects populations during scientific investigations (Czachorowski & Buczyński 2000). So the most important way in insect protection is a protection of wetland landscapes with various water bodies. In Poland all kind of landscapes and types of water habitats occurs in national parks. But we don't know which threatened species are protected in national parks and landscapes parks.

Changes in environment's condition are dangerous for biodiversity in protected areas too. For example, in Poleski National Park (Eastern Poland) now occur 48 species of Odonata. Some of them are threatened, mainly species typical for peat-bogs (Buczyński 1997).

In 1996 22 National Parks, 103 Landscape parks and 1142 reserves were in Poland. Including protected landscapes total surface of protected area was 23 % of area of the country (Radziejowski 1996). Now is little more, 118 Landscape parks, 1201 reserves.

The existing river basin includes protected areas of a various rank: strict national reserves (the Bialowieza Primeval Forest, Zuvintas), national parks (Bialowieski National Park, Wigiesrki NP, Biebrzański NP, Braslavskij NP), landscape parks (Suwalski, Knyszyńska Forest ect.). Logic continuation of development of system of protected areas is creation of their international network, where ecological corridors will connect the rather large protected territories. Species biodiversity of aquatic and semiaquatic insects typical for bogs, fens, lakes and small rivers is kept the existing protected areas. However hydrobionts of large lowland rivers, such as Narew, Neman and Pregola, are investigated poorly and practically are not protected. Protection of invertebrate's biodiversity of these large rivers needs creation of transboundary protected territories.

Methods of Protection

Current laws on nature protection in Poland are grounded on experiences with protection of vertebrates and plants. This law is not useful in insect protection. Activities outside protected areas using so-called "cover species" (umbrella species) were proposed by Czachorowski et al. (2000). But we need successful protection in European scale.

Some anthropogenous water bodies can be good tools for species protection, especially outside of the protected areas. For example, post-exploitation reservoirs, gravel and clay pits are important habitats for some aquatic insects. Many threatened species live in these secondary habitats (Buczyński & Pakulnicka 2000).

Base of aquatic insect protection should be large area, embracing especially characteristic for each regions kinds of water environments. Should this be large scenery complexes, embracing wide adjacent areas minimizing results of external influences. In Poland circumstances such realize national and landscape parks. Polish net of reservations is comparatively thick, but in most of objects are little, about very limited ecological autonomy.

Moroz et al. (2000) suggested, that some little water bodies, such springs, play an important role in keeping of biodiversity. It is necessary to introduce the term "key habitat".

On Belarus, the system of protected areas is only created. Dominates idea, which for base of preservation of nature accepts areas about large surface. Precious success rolling of discussion is elaboration of system for protection of springs simultaneously environments very strongly threatened (Moroz et al. 2000).

Important element efficient protections water insects is recognition and documentary evidence of occurrence of threatened species. Such areas should obtain special status in international scale, and state of population these species should be regularly monitored. An example such area can be the peat bog Zehlau

(Kaliningrad District, Russia), where very numerous are *Dytiscus lapponicus* Gyllenhal,1808 (in Europe greatest population, supplied documentary evidence for many years thirtieth XX), *Laccophilus variegates* (Germar et Kaufuss,1817), *Notonecta reuteri* Hungerford,1928 (color variety – single place in Europe regular and very numerous occurrences), *Notonecta lutea* O.F.Müller,1776 and other (Skwarra 1929, Biesiadka & Moroz 1996), some carabid beetles: *Chlaenius quadrisulcatus* (Paykull,1790), *Carabus menetriesi* Hummel,1827 live on the "Dzikoje" peat bog, near the Bialowieza Primeval Forest (Aleksandrovich 1995 b), very rare in whole Europe representative from family *Cononotidae* (Coleoptera) – *Agnathus decoratus* (Germar,1818) collected at the beach of Augustowski Channel (Aleksandrovich 1995a). Such area should determine specific element of strategy of protection water fauna. In Eastern Europe is surely many of such places. It is strong needed to recognize these areas and include to protection European systems of water.

In Janowskie Forests Landscape Park (eastern Poland) caddisfly fauna of springs and peat-bogs was poor and transformed. In Trichoptera of all water bodies (running waters, ponds, springs, peat-bogs, fens) an impoverishment is visible as result of antropogenic transformations of water habitats: ponds were created in second half of XIX age, deranges in years 60-th, drops of sewage. Gradual recolonization and renaturalization in caddisfly fauna flows probably. (Czachorowski, Buczyński & Stryjecki 2000). The recolonization makes quickly in more dispersal invertebrates for example dragonflies. Some rare and threatened species (typical for wetlands) may recolonize from neighboring regions and ecosystems. But these refuge must occur in the region.

Fischer's (1996) biocenosis naturality index, in modification of Czachorowski (Czachorowski & Buczyński 1999), is proposed for biomonitoring of peat-bogs. The biocenosis naturality indexes are good tool for planning the animal protection: to chose different objects for protection of other species in a national or/and a landscape park or other protected areas in a country.

Conclusions

Certain areas protected and merited on protection are some transboundary areas. At north-east part of Poland such character have: the Romincka Forest, the Augustowska Forest and the Bialowieska Forest.

From initiatives of some scientists from Belarus, Poland and Lithuania comes into being international program focused to creation of the Augustowska Forest transboundary protected area. The Augustowska Primeval Forest is located in territory of Poland, Belarus and Lithuania. Except for Middle course of the Neman River, the inclusion of average and small rivers, bogs, fens, astatic forest pools are supposed.

The Blaclaw Lakeland (Latgalia) is the next possibility to create the transboundary protected area. This area included territory of Berlarus, Lithuania and Latvia.

The creation of a network of protected territories in southeastern Baltic Region will allow not only to keep an existing biological diversity, but also to organize monitoring processes of ecosystem's transformation.

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BIODIVERSITY OF SOIL INVERTEBRATES ON THE FIELDS OF ECOLOGICAL AND CONVENTIONAL FARMS IN ESTONIA

Annely Kuu, Mari Ivask

Kuu A., Ivask M. 2001. Biodiversity of soil invertebrates on the fields of ecological and conventional farms in Estonia. *Acta Biol. Univ. Daugavp., 1 (1): 7 - 10.*

The article content information about biodiversity of soil invertebrates on the fields of ecological and conventional farms in Estonia. The amount of fertilizers and chemicals used by conventional farming is not on the level, what is harmful for invertebrates. The reason could be also, that in some ecofarm soils, there was lack of nutrients, while rotation of crops is incomplete.The higher abundance of some groups with high indicative value (*Collembola, Lumbricidae*) indicates that the conditions in ecologically managed soil are more favourable for sensitive to agricultural activities animal groups.

Key words: biodiversity, soil invertebrates, ecological farms, conventional farms, Estonia

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Introduction

Soils differ greatly in composition, structure, particles, depth and compaction, also in general characteristics depending on plant community (forest, grassland) and land use (arable soils), the soil contains a variety of animals of very different sizes, abundances and life forms. They are often aggregated in horizontal and vertical distribution (Meyer 1996).

Agricultural activities have significant influence on soil organisms. Earthworms are known to have an important impact on soil fertility. In many temperate and tropical ecosystems earthworms are the most important members of the soil fauna involved in the regulation of decomposition and nutrient cycling process and in the modification of soil physical properties (Brown 1995). Animals on the soil surface and in upper soil layer (*Collembola, Acarina, Diptera, Coleoptera*) are in continuous contact with the soil interior and can thus give valuable information on the condition of the soil (Meyer 1996). Agricultural activity usually results in a reduction in abundance of micro arthropods.

Tillage alters many aspects of the soil's physical environment, including soil water, aeration, compaction, porosity and temperature. Ecological tillage generally reduced the physical disturbance of soil. The conventional agricultural system may use more pesticides and mineral fertilizers, chemically affected soil fauna.

The aim of present study is to describe relationships between the abundance of soil communities and type of tillage in soil of ecologically and conventionally managed fields in Estonia.

Material and methods

The experimental fields were situated all over in Estonia. We studied the earthworms in soil of fields of all ecological and conventional farms, compared couple of farms with similar soil type, soil texture and character of crop. For estimating the epigeic fauna we chose a couple of one-year-old clover fields in North-Estonia, one ecologically managed, another one managed conventionally and fertilized with 100 kg N and 50 kg P per ha in year 2000.

The number and species composition of earthworm communities were estimated in September at the time of maximum density, greatest activity and lowest variability of individuals (Nordström and Rundgren 1973). Three soil blocks of 50 □ 50 □ 40 cm were studied by hand sorting method introduced by Meyer (1996), collected individuals were washed, and weighed after 48 hours (by the method of Satchell 1969), the species were identified by Timm (1999). The mean number of individuals per 1 m^2 of soil surface and standard error (SE) were calculated.

For estimating the epigeic fauna we used pitfall-traps method (Meyer 1996) on the differently (ecologically and conventionally) managed one-year-old clover fields with similar soil type and texture. Animals active on the soil surface were caught in seven containers per field that were burrowed level with the ground, the diameter of containers was 7 cm, depth 12 cm. The animals were killed and preserved in formalin with some drops of detergent. The traps were covered for the rain. After 3 weeks the traps were emptied (seven times during the vegetation period, from 21.06 to 20.10). The animal material was sorted out in the laboratory and identified by Remm (1967) to species, genus or family. The activity abundance is given as the sum of animals trapped over a certain trapping period of each taxon and site.

Results and discussion

The soil of fields differs in some parameters. The mean organic matter content was higher in soil of clover fields with ecological tillage in comparison with conventionally managed soils: 5,05±1,01% and 3,44±0,38% of dry soil, respectively. The mean nitrogen content of soils was 0,217±0,046%, there was no statistically significant differences. The soluble phosphorus content (16,45±3,65 mg per 100 g dry soil) was higher in soil by conventional tillage in comparison with the soil of ecofarms (4,45±0,95 mg per 100 g dry soil). Total hydrolytical activity of microorganisms measured in optical density units (OD) characterises metabolic activity of microbial community and correlates well with CO_2 evolution from soils (Schnürer and Roswall 1982). The activity of microbial community in the soil by conventional tillage was 0,343±0,008 $OD \cdot g^{-1}$, in the soil by ecological tillage 0,436±0,047 $OD \cdot g^{-1}$. The number and species composition of earthworm *Lumbricidae* communities were estimated in September. In ecologically managed soil, the mean number of earthworms was 92,7±11,1 individuals per m^2, 5 species of earthworms were found. The individuals of the most common species *Aporrectodea caliginosa* were 64% of total abundance. In the soil of conventional managed field the total number of earthworms was 53,3±11,9 individuals per m^2, number of species was 4. 88% of all earthworms were individuals of species *A.caliginosa*. It can be concluded, that ecological tillage creates better conditions for earthworms, first of all higher content of organic matter in soil.

The number of different species and groups of epigeic fauna was higher on the soil of conventionally managed fields in comparison with ecologically managed soil generally, but the number of individuals of most

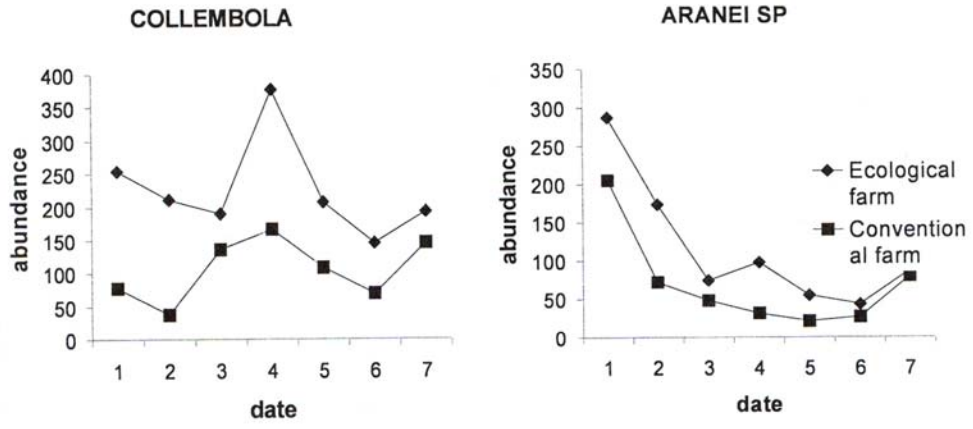

Fig. 1. Seasonal dynamics of abundance of springtails *Collembola* and spiders *Aranei* on soil of ecological and conventional farms.

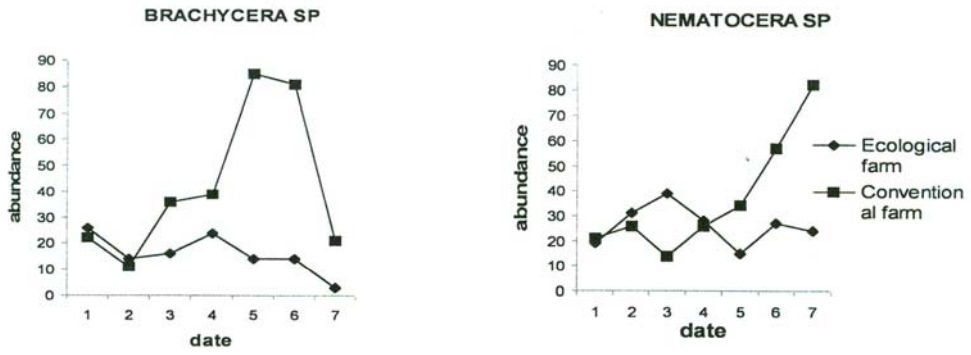

Fig. 2. Seasonal dynamics of abundance of *Brachycera* and *Nematocera* on soil of ecological and conventional farms

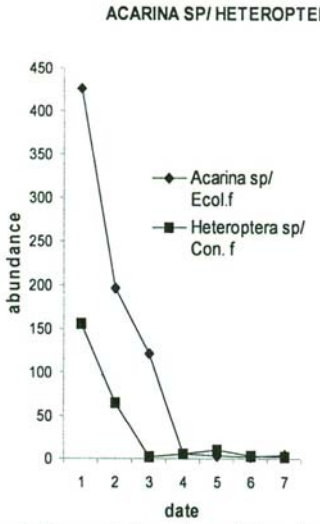

Fig. 3. Seasonal dynamics of abundance of *Acarina* and *Heteroptera* on soil of ecological and conventional farms

important groups of soil fauna was higher in ecologically managed soils. On the soil of ecologically managed farm the spiders *Aranei*, springtails *Collembola* and mites *Acarina* were dominating. The spiders' number was highest at the beginning of summer and decreased in the middle of summer, but in the autumn increased; the number of springtails was at one high level during the whole period (fig.1.). On the soil of conventional farm flies *Diptera* and bugs *Heteroptera* were dominating. At the beginning of summer the number of flies *Brachycera* and gnats *Nematocera* was more or less equal in ecofarm and in conventional farm. But in the autumn the number of flies individuals were at highest level and decreased at the end of autumn. The abundance of another group of *Diptera*, gnats *Nematocera* stayed at high level (fig.2.). By Brown (1978), *Diptera* prefer arable soils fertilized by manure. The number of mites was highest in the beginning of summer and decreased steeply to the very low number in the autumn. There were no mites in the soil of conventionally managed soil. The number of bugs in conventional farms varied similarly - with maximum in beginning of summer and with minimum in autumn (fig.3.).

Conclusions

The amount of fertilizers and chemicals used by conventional farming is not on the level, what is harmful for invertebrates. The reason could be also, that in some ecofarm soils, there was lack of nutrients, while rotation of crops is incomplete.

The higher abundance of some groups with high indicative value (*Collembola, Lumbricidae*) indicates that the conditions in ecologically managed soil are more favourable for sensitive to agricultural activities animal groups.

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CHANGES IN ARTHROPOD SPECIES COMPOSITION AND DENSITY IN THE BURNED AREA OF SUDAS BOG IN LATVIA

Voldemārs Spuņģis

Spuņģis V. 2001. Changes in arthropod species composition and density in the burned area of Sudas bog in Latvia. *Acta Biol. Univ. Davgavp., 1. (1): 11 - 15.*

The post-fire effects on epigeic arthropods were studied in the burned boggy forest area of Sudas bog in the Gauja National Park. Simple pit-fall traps were used and about 2800 arthropods were identified. It was stated that epigeic arthropods successfully survive during the fire and soon after colonise burned areas. Opposite, grass-dwelling arthropods had a significant loss in their populations. A seasonal dynamics with maximum in the beginning of summer was the same as usually in forests. A low density of saproxylophagous and fungivorous species could be explained by absence of significant amount of dead wood and fire-dependant fungi.

Key words: burned bog, soil arthropods, post-fire effects.

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Introduction

Peat moss bogs are typical for Latvia and cover about 2.5% of the territory. They belong to the ecosystems exposed to irregular fire. Burning is a natural feature of the boreal coniferous forests and bogs.

The studies of the post-fire effects on fauna were done sporadically in Latvia before. The extensive forest and bog fire took place spiders in Bažu bog of the Slītere National Park in 1992, but the consequences of the fire were studied on a limited scale. M.Šternbergs observed ground-dwelling. Saproxylophagous beetles were studied 7 years after the fire by Swedish entomologists. No results were published still. In 1999 after the extensive bog and forest fire in Ķemeri bog of the Ķemeri National Park the study of arthropods has been started. The results have not yet published.

Another research of post-fire effects was performed in Sudas bog situated in the South part of the Gauja National Park after the late spring fire in May of 2000. Sudas bog has burned in a rather insignificant area (about 6 ha) to the North of Zviedru lake. A current article reflects the results of the study of arthropod community during the first season after the fire in Sudas bog.

Materials and methods

Sudas bog is typical peat moss (ombrotrophic) bog. Patches of middle-aged pine forest, heath-land and young pines cover the burned area.

A sample plot was selected in the middle of burned area covered middle-aged boggy pine forest. The closest edge of the unburned bog is situated about 100 m from the sample plot. So, the isolation of the sample plot is weak. The sample plot is well drained to the depression nearby. The herbaceous vegetation, moss cover, shrubs have burned out completely, majority of pines remained alive after the fire. The vegetation started to regenerate slowly. Red cowberry *Vaccinium vitis-idaea*, bilberry *Vaccinium myrtillus*, labrador-tea *Ledum palustre*, cloudberry *Rubus chamaemorus* started to recover by root sprouts during the first year. Recovery of peat mosses *Sphagnum* spp. was limited, but moss *Polytrichum commune* regenerated by protonemas and young mosses started to cover the soil.

Fire dependant plants were found scarce, no fire dependant fungi were observed. The weakened pines were unsuccessfully attacked by bark beetles and longhorn beetles.

30 m long transect was marked. 10 simple pitfall traps were placed on transect after every 3 meters. Plastic glasses of 250 ml and 7.5 cm in diameter were used as pitfall traps. Solution of formaldehyde was used as fixative for preserving animals. The traps were exposed from June 11 to October 15 and were checked every 2 weeks. Totally, 9 series of samples were collected. The samples were gathered by U.Saulītis, specimens were first sorted by V.Spuņģis, then were identified by V.Spuņģis, R.Cibuļskis, M.Kalniņš, D.Telnov.

Epigeic arthropods - beetles, ants and other non-flying insects, millipedes, harvesters, spiders were counted. A dynamic density (specimens/14 trap-days) was calculated. Materials are deposited in the collection of V.Spuņģis.

Results and discussion

Totally, about 2800 arthropods were identified. Aggregated data are inserted in the table 1.

The dynamic density and number of insect species decreased steadily during the sampling period from June to October with slight increase in the autumn (fig. 1). That seasonal dynamic is characteristic for epigeic arthropods in all terrestrial habitats independently from influence. The ants Formicidae, rove beetles Staphylinidae, ground beetles Carabidae dominated in number of species and biomass among insects. A seasonal dynamics and changes in the species numbers were similar for all mentioned families. That could be explained by their survival after the fire and also by immigration of individuals. Unknown par of the population has died during the fire. The open burned soil enhances the movement of beetles and therefore a density is rather high for bogs.

Changes in dynamic density and number of species were similar in ground beetles and row beetles (fig. 2, 3). A characteristic for ombrotrophic bogs ground beetle *Agonum ericeti* were not recorded at all in the bog. Recording of large in size *Carabus* spp. and *Cychrus caraboides* could be explained by presence of boggy forest and proximity of depression. Usually these species are scarce in open bogs. Among rove beetles saprophagous species *Drusilla canaliculata* dominated and indicating that fungi present, but the number of other species feeding on fungi was low.

Table 1. Species and dynamic density (ind./14 trap-days) of arthropods in the burned boggy pine forest in the Sudas bog in 2000.

Taxa	Sampling periods and density*									Σ
	1	2	3	4	5	6	7	8	9	
1	2	3	4	5	6	7	8	9	10	11
Carabidae										
Amara aenea		1								1
Amara brunnea	4		9	11	6					30
Bradycelhus sp.									1	1
Calathus melanocephalus			1							1
Calathus micropterus					1					1
Carabus arvensis	4	1	2		2	3		1	3	16
Carabus cancellatus		2	1							3
Carabus hortensis					1					1
Curtonotus gebleri			1							1
Cychrus caraboides	1	2	2	2	4					11
Harpalus latus	1									1
Miscoderus properans	1	3								2
Notiophilus biguttatus	2		3	1	1	1				8
Notiophilus palustris	1		2	1						4
Pterostichus oblongopunctatus	3		1				1	9	9	23
Pterostichus strenuus	14	24	5	2	1	2		3	7	58
Stomis pumicatus		1								1
Staphylinidae										
Acidota crenata					1		1	1	1	3
Aleocharinae			10	2						12
Baptolinus affinis		1								1
Bolitochara lunulata					1					1
Bryocharis formosus	1			1						2

1	2	3	4	5	6	7	8	9	10	11
Drusilla canaliculata	35	39	40	27	14	5	1		161	
Ischnosoma bergrothi		1								1
Ischnosoma splendidum	10	16	16		3					45
Lordithon brunnipes		1						2	1	4
Lordithon thoracicus				1		1				2
Micropeplus staphylinoides		1	1							2
Mycetoporus lepidus			1							1
Mycetoporus rufescens								1		1
Ocypus fuscatus	5	4	6	2	1	2	1	2		23
Omalium rivulare									1	1
Othius myrmecophilus				1			1			2
Othius punctulatus									2	2
Phylonthus politus			1							1
Platydracus fulvipes	1	3								4
Quedius molochinus	1				1					2
Stenus clavicornis	2	3	1		1				1	10
Stenus excubitor	1		1							2
Xantholinus linearis	1		1						2	4
Coleoptera varia										
Agathidium badium		2	1							3
Agathidium sp.			1							1
Asiorestia sp.				1						1
Byrrhus arietinus					1					1
Byrrhus pilula		1								1
Byrrhus pilula					1					1
Cantharis sp.	1		1							2
Cryptophagidae gen.sp.	2	1							1	4
Cytilus sericeus		1	1							2
Hylobius abietis	11	33	37	8	23	16	5	3		136
Hylobius pinicola					1					1
Malthodes sp.	4	2								6
Nicrophorus investigator			3							3
Nicrophorus vespillo			1							1
Nicrophorus vespilloides			4							4
Pselaphus heisei		2		1						3
Sitona sp.	1									1
Hymenoptera										
Ichneumonidae spp. apterous	2	1								3
Lasius niger	306	74	42	32	10	2		1	2	469
Camponotus herculeanus	1		1						1	3
Formica fusca	19	7	7							33
Leptothorax acervorum	1		1	4						6
Myrmica limanica	272	178	168	94	74	33	20	37	17	893
Other insect taxa										
Cicadodea			1		2					3
Aradus cinnamomeus	1									1
Ceratocombus coleopteratus	1					1				2
Dolycoris baccarum							1			1
Drymus brunneus		1								1
Rhyparochromus pini	1	3		1	1					6
Ectobius sylvestris			3	2	5					10
Omocestus viridulus						1				1
Arthropoda, varia										
Araneae	119	55	71	43	105	59	38	33	23	546
Opilio parietinus	1			1					1	3
Lithobius erythrocephalus			2	6	5	3				16
Lithobius forficatus	3	3	6	3	3	1	2			21
Ommatoiulus sabulosus	3	3	5		1		1	8	3	24
Polydesmus denticulatus	8	5	4	2	13	25	19	22	30	128
Polyzonium germanicum							1			1

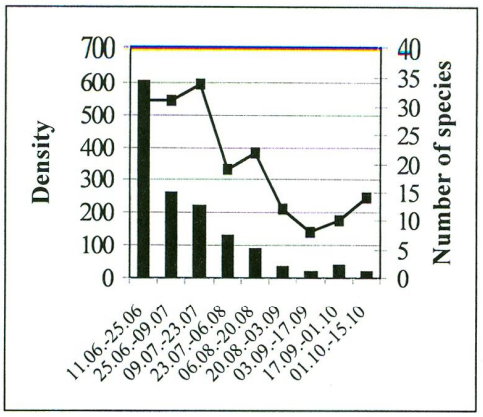

Figure 1. Changes in the dynamic density (ind./14 trap-days) (columns) and number of species (line) of arthropods in the sample plot from 11.06 to 15.10.2000.

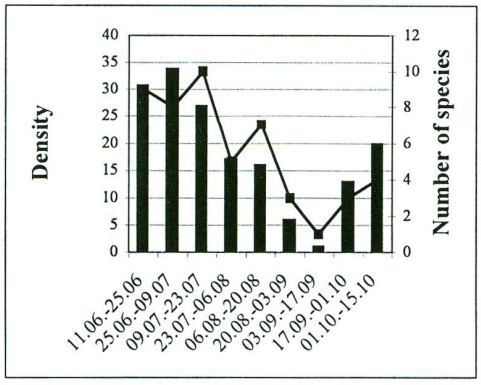

Figure 2. Changes in the dynamic density (ind./ 14 trap-days) (columns) and number of species (line) of ground beetles in the sample plot from 11.06 to 15.10.2000

The low number of saproxylophagous species of beetles could be explained by the absence of dead trees in significant number. Fungi on dead trees did not develop, the soil fungi as *Rhizina inflata* absent. Consequently, the density and species diversity of fungi-dependent species were low. It is expected that diversity of these species will increase in 2001.

Large Pine Weevil *Hylobius abietis* was the most abundant among other than ground beetles and rove beetles. This species can be found in any pine forest and is often. The density of weevil in the burned forests can increase because the larvae live in the dead roots of pines. Darking beetles Tenebrionidae often invade burned forests, but they were not recorded at all during study.

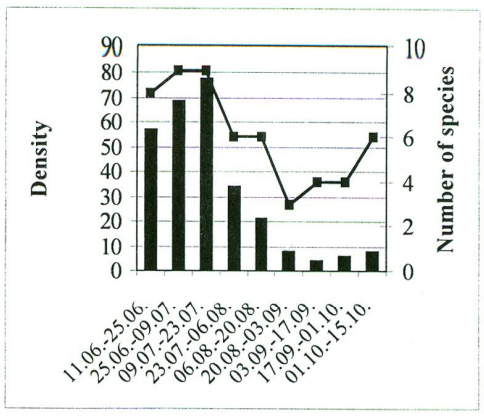

Figure 3. Changes in the dynamic density (ind./14 trap-days) (columns) and number of species (line) of row beetles in the sample plot from 11.06 to 15.10.2000.

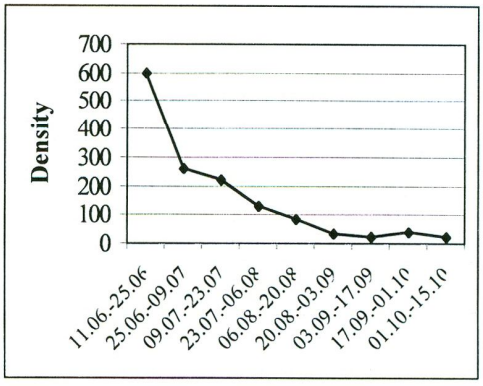

Figure 4. Changes in the dynamic density (ind./ 14 trap-days) of ants in the sample plot from 11.06 to 15.10.2000.

The ants survived fire and their density in June was the highest, then density steadily decreased to autumn (fig. 4). That decrease was much evident in *Lasius niger* and *Formica fusca*, less evident - in *Myrmica limanica*. The density of ants decreased during the season, but ratio of different species has changed (tab. 1). *L. niger* was dominant at the beginning, but their dominance sharply decreased. Opposite, dominance of *M. limanica* increased at the same time. That could be explained both by the interspecific competition and changes in food source. *L. niger* frequently follows the bark beetles and longhorn beetles in the trees after the fire, but this was not the case in Sudas bog. *F. fusca* reacted similarly. *M. limanica* does not depend on dead trees and ants therefore could maintain viable population.

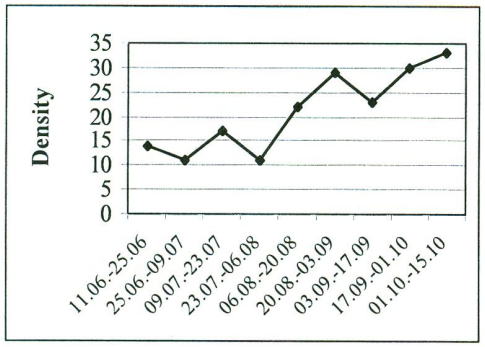

Figure 5. Changes in the dynamic density (ind./ 14 trap-days) of millipedes in the sample plot from 11.06 to 15.10.2000.

The density and species diversity of insects (cicadas, bugs, leaf beetles, locusts) feeding on herbaceous plants were extremely low. Obviously, they have died during the fire and did not occupy burned areas as they had no food source there. Besides, springtails Collembola and shore-flies Ephydridae are characteristic for burned boggy areas, but their number of was low.

The density of harvester *Opilio parietinus* was low, but usually they are common in pine forests. Obviously, population of harvesters was significantly effected by fire.

The density of millipedes Diplopoda and Chilopoda was low after the fire and steadily increased to autumn (fig. 5). This trend was particularly conspicuous for *Polydesmus denticulatus*. That could be explained by the survival of specimens in the soil and successful regeneration until the autumn. Ominivorous *Lithobius* spp. was rather abundant in the summer, but decreased in number to autumn.

It is expected that species diversity in Sudas bog will increase in 2001, because of invasion by fungus feeders, saproxylophagous and phytophagous species.

Conclusions

The majority of soil surface and partly soil dwelling arthropods suffer significantly after the fire, but grass-dwelling arthropods died at least completely. The fauna can be restored both by survived and immigrated specimens which have favourable conditions for feeding and sheltering in the burned areas. The restoration started just after the fire. The density of arthropods was the highest soon after the fire and steadily decreases to autumn. That trend corresponds also their seasonal dynamic in the other non-effected habitats. The fire in general effected all arthropod populations and changed the interspecific relations among them.

Sudas bog has specificity, because some typical bog species and fire-dependant species were not recorded there. That is at least partly due to limited development of fire-dependant fungi, limited restoration of vegetation and late dates of fire not allowing to saproxylic species to colonise the weakened trees effectively soon after the fire.

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THE DEPENDENCE OF THE ABUNDANCE OF THE LARGE WHITE BUTTERFLY, *PIERIS BRASSICAE* L., ON THE CABBAGE GROWTH HABITATS

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In Estonian agriculture the plants of *Cruciferae* family play an important role. On those cultures a massive development of large white butterfly (LWB), *Pieris brassicae,* may occur. The LWB is subject to numerous predators, parasitoids and diseases. *Cotesia glomerata* (Hymenoptera: Braconidae) is a common braconid wasp that develops within the larvae of the LWB. Up to 85 % of the caterpillars of the LWB were infected with parasitoid *C. glomerata* if the caterpillars were collected from a cabbage patch surrounded by lush, permanently blossoming vegetation, hedges and berry. In the second variant, 68% of the caterpillars were parasitized with *C. glomerata,* and approximately 20% died of the diseases, and 22% of the caterpillars pupated. Cabbage had been grown in the area last year as well. Apparently parasitoid *C. glomerata* hibernates in the grass bordering the field, and in spring adults can start feeding on the nectar of blossoming plants. The third variant, there were the rows of cabbage situated in the middle of a 2-ha potato field. In the variant only 38 % of the caterpillars were parasitized. The 38 % died of diseases. In this variant 25% of caterpillars pupated. Potato had been grown in the field during several consecutive years. The cabbage patch had existed there only one year, and last year there were no cabbage fields nearby either, which is why there were no parasitoids overwintering in the area.

Key words: *Pieris brassicae*, *Cotesia glomerata*, and the cabbage growth habitats

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Introduction

A stable ecosystem is self-regulating, and all its components are in balance. There are useful organisms that decompose organic substance, pollinate plants and act as natural enemies to pests, which decrease the possibilities for the mass reproduction of pests. Such regulation is possible in case of a biologically diverse ecosystem.

It is well known, that cultivated plants grown in genetically homogenous monocultures do not possess the necessary ecological defence mechanisms to tolerate pest populations that experience outbreaks. When monocultures are grown in the conditions of regular, or even modest, chemical control, the specific composition of pests remains poor and corresponds best with the hypothesis on the concentration of resources, i.e. pests tend to gather in the places where their food supplies have accumulated (Schoonhoven et al. 1998; Tarang, Luik 2000; Metspalu et al. 2000). Then, modern agricultural practice negatively affects pests natural enemies, which in turn do not find the necessary environmental resources and opportunities in monocultures to effectively suppress pests (Altieri and Nicholls 2000). Fortunately, new directions in agricultural practice involving reduced tillage, cover crops, crop rotations, strip cropping, trap crop buffers, promoting parasites and parasitoids and other diversification's that are coming into greater use do reduce pests and decrease the need for heavy pesticide use (Odum, Barrett 2000). Consequently, conservation, fostering and directing a natural regulation of the number of pests would be a realistic way towards an ecological and economical agriculture.

In Estonian agriculture the plants of *Cruciferae* family play an important role. On those cultures a massive development of large white butterfly (LWB), *Pieris brassicae,* may occur. Vegetable crops like *Brassica oleracea var. capitata f. alba*, *B. oleracea var. botrytis*, *B. oleracea var. acephala*, *B. napus var. napobrassica*

and *Armoracia rusticana* are those usually attacked. Sometimes flowers like *Tropaeolum major* and *Lobularia maritima* and weeds in the family *Cruciferae* are also attacked.

The first (spring) generation of the LWB is commonly not numerous, and it is feeding on wild cruciferous plants, while eggs are not laid on the early white cabbage cultivars. The second generation appears at the beginning of august, in the time of mass immigration of this butterfly, and then the injuries on cabbage cultures may be extensive. In case of favours climatic conditions the LWB may partially give the third generation as well. Daebler et al. (1973) found that if 25% of the cabbage were eaten, 10-15% of the crop would be lost.

All insect pests have natural enemies who can exist and exert their impact on pest populations. The LWB is subject to numerous predators, parasitoids and diseases. *Cotesia glomerata* (Hymenoptera: Braconidae) is a common braconid wasp that develops within the larvae of the LWB. In Estonia, there are two generations of *C. glomerata* in a season. They have little effect on the first generation of the LWB, because the densities of parasites in spring are low. Rates of parasitism rise during the season. Moreover, the *C. glomerata* may be an important factor in the transmission of insect diseases. Viruses, bacteria, microsporidia and fungi are important control factors in the field as well.
The main question is how to direct and stimulate the natural control over the LWB continuously without wavy changes in its abundance. We studied and explained the extent to what the biological environment of cabbage culture influences the abundance of braconid parasitoid *C. glomerata* in LWB and the death rate of LWB pests due to diseases.

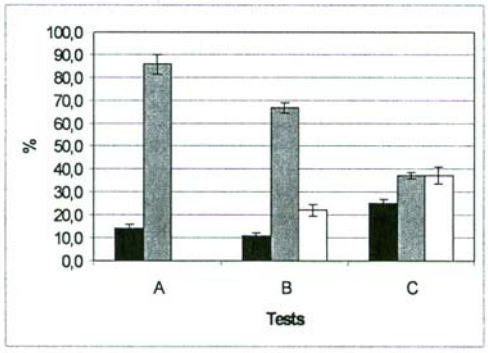

Fig. 1 A, B, C. The per cent of caterpillars of Large white butterfly (*Pieris brassicae*) which pupated (black columns), were killed by parasitoid (striped columns) and by diseases (white columns). About the meaning of A, B and C see text.

Methods and insects

The caterpillars were collected from three cabbage fields surrounded by different plant associations, using the randomised method (Matthews 1997) with five test sample (100 individuals in each) from a field. The caterpillars were placed in 1-litre glass jars, ten individuals in each, and grew till they reached the end of their larval stadium. Each day the numbers of caterpillars of the LWB, dead both due to *C. glomerata* and due to diseases, were counted. The causes of the diseases were determined by a microscopical analysis.

Results

The first variant (Fig. 1A). Up to 85 % of the caterpillars of the LWB were infected with parasitoid *C. glomerata* if the caterpillars were collected from a cabbage patch surrounded by lush, permanently blossoming vegetation, hedges and berry. Among the continuously flowering plants there were found *Achillea millefolium, Tanacetum vulgare, Epilobium angustifolium, Levisticum officinale, Anethum spp., Matricaria spp., Borago officinalis, Phacelia tanacetifolia,* e.a. The trees, houses, brushes and grasslands near the cabbage cultivations offered favourable conditions for parasitoid feeding and hibernating.

In the first variant 15% of caterpillars pupated, while no mortality was caused by diseases. LWB infested in this field 98% of cabbages.

The second variant (Fig. 1B). There was a considerably small cabbage patch surrounded by natural grassland. On the grassland around of that test variant there were growing graminaceous plants, *Phleum pratense* and *Dactylis glomerata,* that have a dense tussock-forming growth habitat. In addition there were flowering *Vicia spp., Achillea millefolium* In the second variant, 68% of the caterpillars were parasitized with *C. glomerata,* and approximately 20% died of the diseases, and 22% of the caterpillars pupated (Fig. 1B). The caterpillars of the LWB injured about 70% of cabbage plants. Cabbage had been grown in the area last year as well. Apparently parasitoid *C. glomerata* hibernates in the grass bordering the field, and in spring adults can start feeding on the nectar of blossoming plants.

The third variant (Fig. 1C). There were the rows of cabbage situated in the middle of a 2-ha potato field. In the variant only 38 % of the caterpillars were parasitized. The 38 % died of diseases. In this variant 25% of caterpillars pupated while 58% of cabbage plants were injured. Potato had been grown in the field during several consecutive years. The cabbage patch had existed there only one year, and last year there were no cabbage fields nearby either, which is why there were no parasitoids overwintering in the area.

Discussion

The lifetime and fecundity of the adult large white butterfly depends on the climatic conditions as well as on the state of nutrition. The water and nectar from favourably yellow blossoms are the necessary food. The main factors in plant selection for egg-laying are the plant colour (green is preferred), the chemical composition, and odour.

The LWB adult female drums the surface of the leaf, using also tarsal receptors, when possible, to test the presence of glycosinolates and the suitability of the plant for oviposition, thus reducing the risk of food shortage for its offspring. Larvae are stimulated to feed on plants when sensory cells on mouthparts come in contact with glycosinolates (David, Gardener 1966; Schoonhoven 1972). Cruciferous plants, when they are free from herbivore, are often relatively odourless but, when attacked by parasitoids, they can release enzymes which rapidly convert inactive mustard oils to volatile parasitoid-attracting derivates (Whitman 1988; Verkerk et al. 1998; Turlings et al. 1991). Steinberg and coworkers (1993) found that caterpillar-infected cabbages initiate the release of volatile allelochemicals that play important role in long-range host location by *C. glomerata.* Kairomones are used by parasitoids to guide them directly to the host.

The hosts are not the only resources that the adults of parasitoid need for successful reproduction. The shelter and food also play important roles in their reproductive success. The adults periodically have to interrupt host foraging and find food to obtain energy for maintenance and locomotion, as well as to sustain high fertility and long life. To maintain a high level of reproductive success, parasitoid should minimise host searching so that most of their time and energy can be allocated to finding hosts. It is important that at the time of egg-laying of parasitoids there are nectar plants available (maturation feeding). Commonly the adults of *C. glomerata* use the nectar from *Apiaceae, Fabaceae* and *Asteraceae*, but essential is also the extrafloral nectar that is produced by various plants, e.g. *Vicia faba* (Rogers, 1985). According to some data the adult *C. glomerata* die during some days without water, using only water they live 10 days, while the life-span of the feeding adults lasts over one month (Моисеева 1960). Essential is the availability of food for adults in the periods when caterpillars are not abundant and much time is needed for finding the host. Thus, the better the food supply near the host (caterpillars of the LWB), the longer time the parasitoids are found in these places, and the greater is the parasitized number of the caterpillars.

According to our results the greatest percentage of caterpillars parasitized by parasitoid was observed on the cabbage grown for years on one and the same location (test variant 1, Fig.1A). In this variant the cabbage was grown in a typical mixed-cropping system, where the vegetables and root crops had been grown together with medical, spice and ornamental plants.

In the second variant (Fig. 1B) the cabbage had been cultivated for years, and for that reason there had been formed a reserve of hibernating braconids. The develpments of the parasitized and healthy caterpillars occur at the same time, and externally they look very similar. Both the parasitized and healthy caterpillars are actively wandering after their feeding has been ended, and they may migrate distances of hundreds of meters in search of hibernating places. At the end of the caterpillars wandering stage the parasitoid larvae emerge from their dying host. The braconid larvae spin the yellow cocoons attached to the perished host larvae, and at the same spot the braconid will hibernate in prepupal stage. In natural grasslands the parasitized caterpillars crawl into the tussocks of *Dactylis glomerata*, bushes, which are the favourite hibernating places for parasitoids (Landis et al. 2000). According to some data only 25-40% of caterpillars of the LWB are parasitized in the trial plots surrounded by rare vegetation poor in flowering plants (Lederer 1938; Kopvillem 1967; Metspalu et al. 2000). The mentioned conditions existed in our third test variant (Fig. 1C), where 38% of caterpillars were parasitized on cabbages planted in the middle of a potato field. The cabbage had not been grown near that field in the last years, and, consequently, a reserve of parasitoids was lacking here. In comparison with the LWB, the braconid *C. glomerata* remains true to a single area. Its migrations are not long lasting and there are more parasitoids in the places were the *Cruciferae* had been

grown for years.

The large white butterfly, on the other hand, may fly long distances and find easily the cabbage plants. It was also possible that the scent of cabbage was disguised by the odour of potato plants, and thus braconids were desoriented.

Moreover, the flight of *C. glomerata* to the fields open to winds is restricted. However, *C. glomerata* is not an ideal parasite because it does not kill the larvae the feeding stage, until the parasitized caterpillar has eaten as much as a healthy ones and completed its larval life. Thus, while parasitoid helps reduce the local pest population, it does not protect a single plant.

It is often possible to isolate several species of insect pathogens from field populations of insects. Fungus-infected LWB caterpillars are often common following the periods of high humidity. The summer of the testing years was warm and dry, thus completely unfavourable for spreading the fungus diseases, and no mortality in LWB caterpillars due to mycoses was not noticed by us.

Microsporidians are the most important entomopathogenic protozoa, and from this pathogenic group mainly *Nosema mesnili* may parasitize in LWB. Nosema does not provide the immediate elimination of the LWB, but may cause some reduction in caterpillar numbers. In general it is a slow acting and chronic infection and is transmitted from an one infected larvae to another, or/and from one infected adult female to its offspring, either on the egg surface or within the egg. Because that disease do not cause dramatic epizootics such as those caused by fungi and viruses, microsporidian infections often go unnoticed, and their role in the population dynamics of insects is often not recognised and underestimated.

In our first test variant the diseases did not cause any mortality of caterpillars. In the second and third variant a part of individuals died during the metamorphosis and/or the lethal intermediates were formed, which is the characteristic symptom of the microsporidiosis. The same we documented by a microscopical analysis.

Our result showed that if the cabbage is cultivated without chemical pest control then it is important to select such surrounding environment for cultivating cabbage where there are existing the needed conditions for the natural control over the LWB. On large cabbage fields, the marginal areas are the first to be exposed to pest danger while in the middle parts of the fields the caterpillars of the LWB are usually not found. The cabbage butterflies prefer the calm air by hedges and thus lay more eggs at the margins of the fields.

Identifying the key elements of diversity may be a difficult process, but the process can be guided by understanding of the resources needed by natural enemies. The best way to make sure that they are nearby is to maintain their natural habitats. Mixed plantings and the provision of flowering borders can increase the diversity of habitats and provide shelter and alternative food sources. They are easily incorporated into home gardens and small-scale crop production. There may also be some conflict with pest control for the large producer because of the difficulty of targeting the pest species and the use of refuges by the pest insects as well as natural enemies.

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BUMBLE BEE DIVERSITY ON ECOLOGICAL AND CONVENTIONAL DAIRY FARMS

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Mänd M., Geherman V., Luik A., Martin A.-J. , Mikk M. , Paimetova V. , Viiralt R. 2001. Bumble bee diversity on ecological and conventional dairy farms. *Acta Biol. Univ. Daugavp., 1 (1): 21 - 25.*

The aim of this study was to assess bumble bee abundance and diversity in relation to their forage resources in the fields of ecological and conventional dairy farms. For these purposes twelve pairs of farms were selected in different areas of Estonia. The transects passed through fields of leguminous crops, field boundaries and wasteland in correlation with the land use of each farm. We found no significant difference in the abundance of flowering plants between ecological and conventional farms. However, the diversity and abundance of bumble bees on the conventional farms was significantly smaller than on the ecological farms. Smaller numbers of bumble bees in the fields on conventional farms can, possibly, be explained by the cultivation practice peculiarities and using of pesticides of these fields, as there was no statistical difference in the abundance of bumble bees in the natural grasslands of ecological and conventional farms.

Key words: bumble bees, ecological and conventional farming, biological diversity, species richness.

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Introduction

Ecosystem health and agricultural wealth depend on the invertebrate fauna to deliver pollination services (Cane, Tepedino 2001). Bumble bees play an important role in agricultural production and in the maintenance of the diversity and quality of natural and semi-natural vegetation. Plant diversity, in its turn, supports the dependent wildlife, in particular, the Lepidoptera and seed-eating small birds and mammals. Pollination is, therefore, a key component of biodiversity directly responsible for the maintenance of ecosystem functioning, and bumble bees form a key group within both agricultural and natural environments in the northern regions (Fussell, Corbet 1991).

The current global pollination crisis demonstrates a crucial link between the maintenance of healthy natural ecosystems and the needs of ecological agriculture. Ecological farming contributing to the development and spread of the use of wild pollinators in agricultural landscapes has been suggested as an alternative to intensive farming. Studies in Denmark have demonstrated that ecological farming is accompanied by a general increase of plant, insect, bird and animal diversity (Chamberlain et al. 1996; Vereijken et al. 1997). Yet, the results of comparative studies carried out in different areas on the size of pollinator populations and the diversity of species by ecological farming and conventional farming are inconsistent. For instance, in Germany the population size by ecological farming is considerably larger than by conventional farming (Von Ammer et al. 1988), while no difference was reported in similar studies in Sweden (Weibull 1999). Laboratory studies in England have clearly demonstrated the ability of bumble bees to discriminate unpolluted and polluted forage (Kearns et al. 1998), yet it is not known whether it will affect the bumble bee behaviour in field conditions. In Estonia, no primary studies have been conducted on the impact of ecological land cultivation on the size

and species diversity of wild pollinator resource. The aim of this study was to assess bumble bee abundance and diversity viewed in correlation with their forage resources in the fields of both ecological and conventional farms.

Material and methods

The field work was carried out in 1998–2000. Twelve pairs of dairy farms located in different regions of Estonia were selected. Each pair consisted of one ecological farm (E) and one conventional farm (C). The data on the farms were obtained from the Centre of Ecological Technologies (Tartu).

The characteristics of transects studied were:

1. Kiratsi, Saaremaa County (1998). Ecological farm (E): natural grassland (44%), red clover and timothy ley (40%), cereal field boundaries (16%). Conventional farm (C) - natural grassland (56%), red clover and timothy ley (32%), cereal field boundaries (12%).

2. Ridala, Läänemaa County (1998). E: natural grassland (30%), red clover and timothy ley (70%). C: natural grassland (56%), lucerne, red clover and timothy ley (32%), roadside (12%).

3. Riisipere, Harjumaa County (1999). E: natural grassland (30%), clover and timothy ley (70%). C: natural grassland (56%), red clover and timothy ley (30%), roadside (14%).

4. Kaiu, Raplamaa County (1999). E: natural grassland (20%), clover and timothy ley (60%), roadside (20%). C: natural grassland (50%), red clover and timothy ley (32%), roadside (18%).

5. Koimla, Saaremaa County (1999). E: red clover ley (20), natural grassland (44%), red clover and timothy ley (20%), cereal field boundaries (16%). C: natural grassland (48%), red clover and timothy ley (32%), roadside (20%).

6. Kiratsi, Saaremaa County (1999). E: natural grassland (44%), red clover and timothy ley (40%), cereal field boundaries (16%). C: natural grassland (56%), red clover and timothy ley (32%), cereal field boundaries (12%).

7. Ridala, Läänemaa County (1999). E: natural grassland (30%), clover and timothy ley (58%), roadside (12%). C: natural grassland (18%), lucerne, red clover and timothy ley (50%), roadside (12%).

8. Kaarma, Saaremaa County (2000). E: natural grassland (44%), red clover and timothy ley (46%), lucerne seed field (10%). C: natural grassland (56%), lucerne seed field (32%), roadside (12%).

9. Ahli Läänemaa County (2000). E: natural grassland (10%), birdsfoot trefoil (20%), clover (70%). C: field boundaries (26%), red clover ley (14%), roadsides running through cereal fields (40%), orchard (20%).

10. Lehetu, Harjumaa County (2000). E: natural grassland (20%), red clover ley (36%), roadside (44%). C: red clover and timothy ley (60%), roadside (40%).

11. Saare, Viljandi County (2000). E: sown pasture (12%), forest edge (14%), roadside (14%), field boundaries (60%). C: roadside (34%), red clover and timothy ley (46%), natural grassland (20%).

12. Haanja Võrumaa County (2000). E: lucerne ley (20%), natural grassland (26%), roadside (14%), red clover and timothy ley (40%). C: natural grassland (22%), roadside (10%), red clover and timothy ley (68%).

Bumble bees were counted using the combined quadrant-transect method described in Teräs (1985) and Prys-Jones and Corbet (1991). A transect of 1000 x 2 meters was selected on each farm. Each transect in its turn was divided into plots of 20x2 meters. Observations were made only in weather conditions optimal for bees with temperature above 16°C, when rain, fog and strong wind were absent. The classification of the *Bombus* species used was that proposed by Løken (1973). Due to the difficulties involved in identification *Bombus lucorum* (Linnaeus), *Bombus cryptarum* (Fabricius) and *Bombus magnus* Vogt, they were grouped together and denoted as *B. lucorum.* In each pair of transects, three observations were made during three consecutive (or at least close) days every year. All counts were taken in July and August, when there is large brood in the nests, and the number of workers is at its peak.

The number of pollinators depends on the number of flowering plants in the area, therefore the density of flowers in each plot of 2 x 20 m was assessed in 1m²

quadrants along each transect, and the counts were used to estimate flower abundance on the whole transect. The number of flowers was estimated using the method described in Cowgill et al. (1993) and Dramstad and Fry (1995).

The abundance of bumble bees in the natural grasslands and clover-grass stands on ecological and conventional farms was the object of a more detailed study. As the number of flowers/inflorescences per 1 m² on red clover-grass leys and natural grasslands varied in the observation areas, it was considered to be more accurate to estimate the mean density of bumble bees not only in the area unit but also per 1000 inflorescences. For each parameter, the differences between the habitats were tested with the t-test for paired samples.

Results and discussion

A total of 17 species of *Bombus* were recorded in all study areas. The species widely distributed were *Bombus lucorum*, *B. pascuorum* and *B. lapidarius*. These species were numerous on both farm types (63-99% of all the species found on the transects). *B. distinguendus*, *B. subterraneus* and *B. humilis* were rare and found only on the ecological farms surrounded with natural and semi-natural habitats. The low number of these species is not surprising, because their distribution is limited, their populations are small and they belong to the species described in the Estonian Red Data Book (Lilleleht 1998). *B. pratorum* was represented in small numbers in our study because, widespread as the species is in Estonia, they reach their peak abundance much earlier than the other species. *B. jonellus* was found only once on a conventional farm. This species is known to prefer wooded landscapes to agricultural landscape (A. Pekkarinen, oral communication).

The number of bumble bees depends on the number of flowering plants (Rathke, Jules, 1993). No significant differences in the abundance of floral resources were found between the ecological and conventional farms under study (t=2.01, df=11, P=0.07). However, there were significant differences in the bumble bee abundance (t=2.70, df=11, P=0.02) and the number of observed species (t=2,639, df=11, P=0,05) between the two types of farming. Both, the bumble bee abundance and the number of species on the conventional farms were significantly smaller than on the ecological farms (Fig. 1, 2). The number of species varied between 2 and 9 on the conventional farms versus 6 – 12 species on the ecological ones (Fig. 2).

A special and detailed study was made of the red clover and timothy leys and natural grasslands on the farms. In the natural grasslands, there was no significant difference in the abundance of bumble bees (per 1000 inflorescence) between the farm types (t=2.15, df=7, P=0.07). However, the abundance of bumble bees in the red clover and timothy leys was significantly lower on the conventional farms compared with the ecological ones (t=5.02, df=19, P<0.001).

The results of our study suggest that the smaller numbers of bumble bees in the cultivated fields of conventional farms can be attributed to the extensive use of pesticides and fertilizers, as the numbers of bumble bees in the natural grasslands around the fields did not differ from the numbers registered in the natural grasslands of ecological farms. It is evident that a great number of bumble bees foraging in agricultural habitats come from semi-natural and natural habitats. Since fields in Estonia are relatively small and the share of semi-natural habitats in the landscapes is still quite large, then the agricultural habitats are quite well visited by bumble bees nesting in the adjacent semi-natural and natural habitats. So bumble bee foragers have a good choice of forage.

The broad-spectrum insecticides that are commonly used (and abused) are often as toxic to beneficial insects as they are to the target species (Johansen, Mayer 1990) in the fields. On the other hand, plant losses from chronic herbicide use can be a reason for losses in pollinator species and abundance.

Conclusion

In conclusion it can be said that bumble bees are able to discriminate unpolluted and polluted forage in the field conditions as it was shown by the results of our study. No marked decline in the abundance of bumble bee communities on natural grasslands of the conventional and ecological dairy farms could be observed. Evidently, the mosaic pattern of agricultural landscape with many refuge areas between small fields will contribute to selective foraging patterns of bumble bees.

Acknowledgements

Our sincere thanks are due to farmers who allowed us work on their fields. The study was supported by Estonian Science Foundation Grants No 4116 and 4114.

Table 1. Numbers of bumble bees observed on ecological (E) and conventional (C) dairy farms in 1998-2000.

Species	1998		1999		2000	
	E	C	E	C	E	C
B. pascuorum (Scop.)	71	12	714	233	69	68
B. lapidarius (L.)	146	133	965	261	257	142
B. lucorum (L.)	51	28	139	47	234	316
B. veteranus (Fabr.)	13	3	107	61	12	5
B. schrencki Mor.	2 -	13	1	-	2	
B. ruderarius (Müll.)	5 4	111	21	-	-	
B. hortorum (L.)	38	-	40	32	8	14
B. sylvarum (L.)	15	4	96	54	7	1
B. soroeensis (Fabr.)	9 3	69	24	42	38	
B. hypnorum (L.)	3 3	8	1	11	17	
B. terrestris (L.)	- 2	4	4	38	20	
B. muscorum (L.)	3 -	7	3	-	-	
B. pratorum (L.)	3 -	6	-	-	-	
B. distinguendus Mor.	- -	4	-	3	-	
B. subterraneus L.	2 -	-	-	-	-	
B. humilis Ill.	4 -	-	-	-	-	
B. jonellus (Kirby)	- 1	-	-	-	-	
Total	365	193	2283	742	681	623

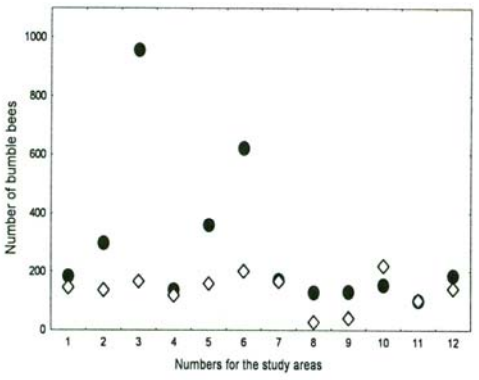

Fig. 1. Abundance of bumble bees in the study areas in 1998–2000. The numbers for the study areas are given in Material and Methods. ? = Ecological farms, ◊ = conventional farms. The difference between the farm types was significant (t=2,639, df=11, P=0,05)

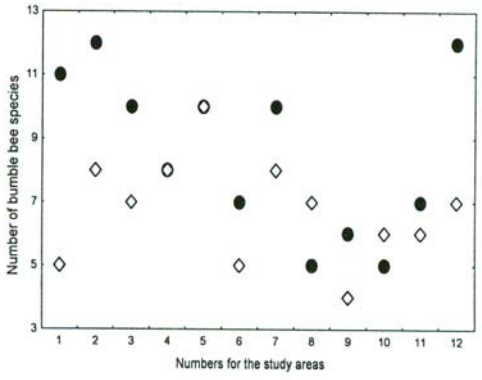

Fig. 2. Species richness of bumble bees in 1998–2000. The numbers for the study areas are given in Material and Methods. ? = Ecological farms, ◊ = conventional farms. The difference between the farm types was significant (t=2,639, df=11, P=0,05)

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AMARA ERRATICA (DUFT.) – A NEW SPECIES OF GROUND BEETLES (COLEOPTERA: CARABIDAE) FOR FAUNA OF LATVIA

Arvīds Barševskis, Valentīna Petrova

Barševskis A., Petrova V. 2001. *Amara erratica* (Duft.) – a new species of ground beetles (Coleoptera: Carabidae) for fauna of Latvia. *Acta Biol. Univ. Daugavp., 1 (1): 26 - 27.*

For the first time in Latvia, *Amara erratica* (Duft.) was collected in Tukums District in 2001. Ground beetle *A. erratica* was found on strawberry fields of the Pūre State Horticultural Research Station.

Key words: *Amara erratica*, fauna, Latvia

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The monitoring of the ground beetles carried out in the strawberry plantation with sody calcareous podzolized, sandy loam soil on dolomite bedrock, and located in the north-western part of Latvia. Using pitfall traps, from 21 May to 4 June, 2001, 3 specimens (I female, 2 males) of ground beetle *Amara erratica* (Duftschmid, 1812) – a new species for fauna Latvia were caught in the 4-year-old strawberry cultivated on the territory of the Pūre State Horticultural Research Station in the Tukums District. The specimens are stored in the collection of the Baltic Institute of Coleopterology in Daugavpils, Latvia.

As the species had been found in countries neighboring with Latvia – Lithuania, Estonia, Sweden, Norway, Finland (Silfverberg 1992; Lundberg 1996), and Belarus (Alexandrovitch et al. 1996), it was mentioned in the List of ground beetles of Latvia as a species possibly occurring here (Barševskis 1996). It has been found also in the West, North, Central and South Europe, Asia Minor, the Caucasus, Syria, Iran, Turkmenia, Siberia, the Far East, and North Africa (Gueorguiev, Gueorguiev 1995; Kryzhanovskij et al. 1995). K. Hurka (1996) pointed out that this is a circumpolar species with boreo-montane distribution.

Taxonomic position of this species within the genus *Amara* Bon. has not been clarifed yet. Some contemporary investigators put this species in the subgenus Celia Zimm. (Gueorguiev, Gueorguiev 1995; Hieke 1995; Kryzhanovskij et al. 1995; Lorenz 1998), but other specialists place it in the subgenus *Amarocelia* Motsch. (Hurka 1996). We suggest, that these opinions have to be taken into account during the subsequent discussions about the position of this species within the genus Amara Bon.

Obviously, *Amara erratica* (Duft.) is very rare in Latvia. Investigations will be continued to acscertain the distribution and status of the local population of this species.

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NEW SPECIES OF THE BEETLES (COLEOPTERA) FOR THE FAUNA EASTERN EUROPE AND BELARUS

Vadim Tsinkevich, Igor Solodovnikov, Evgeni Rud'ko

Tsinkevich V., Solodovnikov I., Rud'ko E. 2001. New species of the beetles (Coleoptera) for the fauna Eastern Europe and Belarus. *Acta Biol. Univ. Daugavp., 1 (1): 28 - 29.*

The article contains information about 24 new species of beetles in the fauna Belarus. *Ephisthemus reitteri* Casey – are new from Eastern Europe.

Key words: *Coleoptera*, fauna, Belarus, Eastern Europe

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Introduction

The present article contains information about 24 new beetles for the fauna of Belarus. This species collected in 1992, 2000-2001 mainly authors on the territory of Belarus. *Ephisthemus reitteri* Casey – new from Eastern Europe are marked in the text (*). Concerning systematics, the authors proceeded from the work of Lawrence J.F., Newton A.F. (1995). The materials are deposited in the author's collections.

Abreviations used in the text are as follow: E – east, S – south, N – north, W – west, vil. – village, the name of collectors (Ts) – V. Tsinkevich, (S) – I. Solodovnikov, (R) – E. Rud'ko, (Sh) – I. Shimko, (L) – A. Lakotko, (M) – M. Maximenkov, (O) – I. Orlov, ex . – speciment(s).

List of species

CARABIDAE Latreille, 1802
Dyschiriodes impunctipennis (Dawson, 1854). – Brest district, Pinsk region, river Yaselda, sand, 5.07.1987, 2 ex. (M); Gomel district, Gomel region, river Uzy, sand, 28.06.1987, 2 ex. (M).

Bembidion deletum Serville, 1821. – Vitebsk district, Verkhnedvinsk region, vil. Sar'ya, river Sar'ya, the bank of the river, 23.05.2000, 1 ex. (S).

Dromius laeviceps Motschulsky, 1850. – Brest, under the bark oak *Populus deltoides*, 17-18.01.2000, 2 ex. (O).

LEIODIDAE Fleming, 1821
Agathidion confusum Brisout, 1863. – Vitebsk district, near Ruba, 12 km NE Vitebsk, dolomit open-pit, Barber's traps 1-12.08.1997, 1 ex. (S); vil. Pridvinie, 13 km W Vitebsk, under the bark *Picea abies*, 1.05.1988, 1 ex. (S). This species absent in the catalogue of *Coleoptera* of Belarus (Alexandrovich et al. 1996), but be found in the near Borisov (Wankowicz 1869).

PSELAPHIDAE Latreille, 1802
Brachygluta haematica (Reichenbach, 1816). – Vitebsk district, 3 km W Vitebsk, reserve "Chertova boroda", 12.03.1997, 22 ex. (S); 4 km S Vitebsk, bank of river Luchesa, Barber's traps, 8-18.05.1990, 7 ex. (S); 1-13.06.1990, 1 ex. (S); 18-29.05.1990, 9 ex. (S).

SCARABAEIDAE Latreille, 1802
Pleurophorus caesus (Creutzer, 1796). – Vitebsk district, Miory region, reserve "El'na", S bank of the lake Berezha, under bark *Betula* sp., 8.05.1997, 1 ex. (S).

BUPRESTIDAE Leach, 1815

Trachys troglodytes (Gyllenhal, 1817). – 10 km E Vitebsk, near vil. Puscha, xerotermic meadow, Barber's traps, 20-30.04.1999, 1 ex. (S).

Poecilonota rutilans (Fabricius, 1777). – 13 km SE Senno, near vil. Andreichiki, 23.06.1991, 1 ex. (L).

Cylindromorphus filum (Gyllenhal, 1817). – Mozyr, xerotermic territory, on the *Festuca* sp., 22.05.2000, 6 ex. (R).

MALACHIIDAE Fleming, 1821
Axinotarsus pulicarius Fabricius, 1776. – Vitebsk, on the wing, 10.07.2000, 1 male. (S).

KATERETIDAE Erichson, 1843
Heterhelus solani Heer, 1841. – Bialowieza Primeval Forest, near vil. Kameniuki, 23.04.1990, 1 ex. (Ts).

NITIDULIDAE Latreille, 1802
Epuraea silesiaca Reitter, 1872. – Mozyr, meadow, on the mint, 11.07.2001, 1 ex. (R).

Meligethes brunnicornis Sturm, 1845. – Berezinsky biospher reserve, near vil. Domzheritsy, 18.06.1998, 1 female (Ts).

Meligethes ovatus Sturm, 1845. – Baranovichi region, park "Tuganovichi", 24.06.2000, 1 male (Ts).

Carpophilus marginellus Motschulsky, 1858 – Mozyr region, near vil. Mikhalki, 10.07.2001, 1 ex.; ibidem, 25.08.2001, 4 ex. (R).

CRYPTOPHAGIDAE Kirby, 1837
Cryptophagus obsoletus Reitter, 1879 – Minsk region, foodstuffs, 2000, 3 ex. (The investigated specimens are stored in the collection of the Institute of Plant Protection).

Cryptophagus pallidus Sturm, 1847. – 12 km SW Dokshitsy, near vil. Polyane, cellar in the house, 15.07.1998, 2 ex. (Sh).

Atomaria attila Reitter, 1878. – Bialowieza Primeval Forest, Dokudovo bog, 30.07.1992. 1 ex. (Ts).

**Ephistemus reitteri* Casey, 1900. – Baranovichi region, park "Tuganovichi", 24.06.2000, 3 ex. (Ts).

CUCUJIDAE Latreille, 1802
Pediacus depressus (Herbst, 1797). – Mozyr region, vil. Pen'ki, under the bark oak, 15.06.2000, 1 ex. (R).

ANTHICIDAE Lacordaire, 1825

Anthicus antherinus (Linnaeus, 1761). – 10 km E Vitebsk, near vil. Puscha, kxerotermic meadow, Barber's traps, 17-26.08.1999, 1 ex. (S).

ANASPIDAE Mulsant, 1856
Anaspis arctica Zetterstedt, 1828. – 14 km SE Bogushevsk, Luzhki, forest, on the umbelliphera, 30.05.2000, 14 ex. (S); ibidem 15.06.2000, 3 ex. (S); ibidem 23.06.2000, 4 ex. (S).

CURCULIONIDAE Latreille, 1802
Lixus sanguineus Rossi, 1790. – 10 km E Vitebsk, near vil. Puscha, kxerotermic meadow, 12.07.1999, 1 ex. (S); Barber's traps, 14-29.05.2000, 4 ex. (S); 1-10.06.2000, 2 ex. (S); 21.06-4.07.2000, 1 ex. (S).

Hylobius piceus (Degeer, 1775). – Vitebsk district, 2 km S Yukhovich, the coniferous forest, 11.06-15.07.2000, 1 ex. (S); 7 km S Polotsk, the coniferous forest, 11.06-15.07.2000, 1 ex. (S).

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SOME DATA ABOUT THE SPECIES OF PSELAPHINAE (COLEOPTERA: STAPHYLINIDAE) CAUGHT INTO WINDOW TRAP IN THE ILGAS NATURE RESERVE (LATVIA)

Arvīds Barševskis

Barševskis A. 2001. Some data about the species of Pselaphinae (Coleoptera: Staphylinidae) caught into window trap in the Ilgas Nature Reserve (Latvia). *Acta Biol. Univ. Daugavp., 1 (1): 30 - 31.*

The article offers information about 8 species of Pselaphinae (Coleoptera: Staphylinidae) caught into window traps by the rotten trunk of a giant oak in the Ilgas Nature Reserve, south-eatern Latvia, in 1999. Three species are new for the fauna of Latvia, two of them are for the first time mentioned for the Baltic States.

Key words: Pselaphinae, Staphylinidae, Coleoptera, fauna, Latvia, Ilgas Nature Reserve

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Introduction

In 1999, in the Ilgas Nature Reserve, situated in south-eastern Latvia, namely in Daugavpils region, about 400 meters from the border with Belarus, saproxylic beetles were collected for study with the help of awindow trap.

Saproxylic beetles lived in the rotten wood of a fallen oak. Diameter of the trunk, lying in the bushes, was over 3 meters long. Under one of the remaining branches, a window trap had been planted on May 23th. It remained there till July 11th.

Among a variety of beetles that the trap ultimately yielded, there were 56 specimens of the subfamily Pselaphinae (Coleoptera: Staphylinidae). Courtsey of the swedish entomologist Mr. N. Jansson, the beetles were passed over to Dr. Stig Lundberg for determination. It helped to determine that the entire sample contained 8 species of the given subfamily.

According to check-lists of Latvian beetles and catalogues of beetles in Fennoscandia, Denmark, and Baltic States (Silfverberg 1992; Lundberg 1995, Telnov et al. 1997), 5 of the discovered 8 species might have been considered new for the fauna of Latvia.

But according to the data included in the unpublished Report of the project "Studies of the Beetle Fauna in Slitere State Nature Reserve in Latvia" (Jansson 1999), and kindly sent to the author by N. Jansson, 2 species happen to have been registered in the Slitere State Nature Reserve, and mentioned as new for the fauna of Latvia. In 2001, N. Jansson found one of these species in the Moricsala State Nature Reserve, in western Latvia. In both places, the beetles were caught with the help of window traps.

Taking into account the above said, it seems possible to claim that the material studied for the present article contains 3 species which are new for the fauna of Latvia; two of these species are for the first time mentioned for the fauna of Baltic states.

List of species

Bibloporus bicolor (Denny, 1825)

1 ex: 06.06.1999. In Northern Europe, this species is known from Denmark, Norway, Sweden, Finland; in Baltic States – from Lithuania and Latvia (Lundberg, 1995). Ecology: eurytop – silvicol – xylodetriticol (Koch 1989).

Bibloporus minutus Raffray, 1914

6 ex: 28.05.1999. (1), 01.06.1999. (1), 10.06.1999. (2), 01.07.1999. (1), 03.07.1999. (1) New species for

the fauna of Latvia and the fauna of Baltic States. In Northern Europe, this species is known from Denmark, Norway, Sweden, Finland (Lundberg 1995). Ecology: eurytop – silvicol – xylodetriticol (Koch 1989).

Bibloplectes minutissimus (Aube, 1833)

1 ex: 31.05.1999. New species for the fauna of Latvia and the fauna of Baltic States. In Northern Europe, this species is known from Denmark, Norway, Sweden, Finland (Lundberg 1995). This species is includet in The 2000 Red List of Swedish Species (2000). Ecology: stenotop – hygrophil – paludicol - humicol (Koch 1989).

Euplectus nanus (Reichenbach, 1816)

13 ex: 06.06.1999. (1), 09.06.1999 (2), 10.06.1999. (2), 27.06.1999. (2), 01.07.1999. (4), 03.07.1999. (1), 05.07.1999.(1). In Northern Europe, this species is known from Denmark, Norway, Sweden, Finland; in Baltic States – from Lithuania and Estonia (Lundberg, 1995). In Latvia is known from Slitere Nature Reserve (Jansson 1999) and Moricsala Nature Reserve (N. Jansson, unpubl. inform.). Ecology: eurytop – hygrophil – xylodetriticol & phytodetriticol (Koch 1989).

Euplectus piceus Motschulsky, 1835

1 ex: 10.06.1999. New species for the fauna of Latvia. In Northern Europe, this species is known from Denmark, Norway, Sweden, Finland; in Baltic States – from Lithuania (Lundberg 1995). Ecology: eurytop – hygrophil – silvicol – xylodetriticol (Koch 1989).

Euplectus punctatus Mulsant, 1861

13 ex: 31.05.1999. (1), 09.06.1999. (2), 10.06.1999. (2), 26.06.1999 (2), 01.07.1999. (2), 02.07.1999. (1), 03.09.1999. (1), 05.07.1999 (2). In Northern Europe, this species is known from Denmark, Norway, Sweden, Finland (Lundberg 1995). In Baltic States this species is known in Latvia from Slitere Nature Reserve (Jansson 1999) and Moricsala Nature Reserve (N. Jansson, unpubl. inform.). Ecology: stenotop – hygrophil – silvicol – xylodetriticol (Koch 1989).

Euplectus karsteni (Reichenbach, 1816)

19 ex: 28.05.1999. (1), 31.05.1999. (1), 01.06.1999. (1), 02.06.1999. (1), 03.06.1999. (1), 06.06.1999. (3), 09.06.1999 (4), 10.06.1999. (5), 01.07.1999. (1), 05.07.1999. (1). In Northern Europe, this species is known from Denmark, Norway, Sweden, Finland and Baltic States (Lundberg 1995). Ecology: eurytop – hygrophil – xylodetriticol & phytodetriticol (Koch 1989).

Bryaxis bulbifer (Reichenbach, 1816)

1 ex: 09.06.1999. In Northern Europe, this species is known from Denmark, Norway, Sweden, Finland and Baltic States (Lundberg 1995). Ecology: eurytop – hygrophil – paludicol – humiicol (Koch 1989).

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STUDY OF MAYFLIES (EPHEMEROPTERA) IN LAKES OF RIGA DISTRICT, LATVIA

Arkādijs Poppels

Poppels A. 2001. Study of mayflies (Ephemeroptera) in lakes of Riga District, Latvia. *Acta Biol. Univ. Daugavp., 1 (1): 32 - 33.*

Studies of Ephemeroptera fauna have been conducted in the 29 lakes of Riga District in the period 1992-2000. 14 species from 6 genus were stated. *Caenis horaria* (Linnaeus, 1758), *Caenis robusta* (Eaton, 1884), *Ephemerella ignita* (Poda, 1761) prevailed among other mayfly species.

Key words: Ephemeroptera, lakes, biodiversity, Latvia, fauna

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Introduction

The fauna of mayflies Ephemeroptera of Riga District were studied in 1960ies by O.Kačalova (Kačalova et all. 1962), Z.Spuris (Spuris 1982), and by scientists from the Institute of Biology (Spriņģe et all. 1999). According to these references 6 species of Ephemeroptera were stated in the study area.

Material and methods

The mayflies have been sampled in 1992-2000 in 29 lakes. The samples were taken at 10 sites in each of the lake. The samples were collected by Ekman-Berge sampler and by entomological net. Over 300 samples of invertebrates were investigated and over 1500 individuals of the mayflies were collected. We have followed the taxonomy of mayflies developed by T.Macan (1970).

Results

The mayfly family, species of Ephemeroptera characteristic for the particular lakes and names of lakes of Riga District are included in the list.

POTAMANTHIDAE

1. *Potamanthus luteus* Linnaeus, 1758 – Mazais Baltezers lake.

EPHEMERIDAE

2. *Ephemera vulgata* Linnaeus, 1758 – Slokas, Babītes lake.

BAETIDAE

3. *Baetis rhodani* (Pictet, 1843-1845) – Lielais Jūgezers, Sudrabezers, Venču lake.

4. *Baetis vernus* Curtis, 1834 – Mazais Baltezers, Slokas lake.

5. *Centroptilum luteolum* (Müller, 1776) – Juglas, Slokas, Babītes lake.

6. *Cloeon dipterum* (Linnaeus, 1761) – Garezers II, Lielais Jūgezers, Mazais Jūgezers, Lielais Baltezers, Ķīšezers, Juglas, Lilastes, Slokas lake.

ECDYONURIDAE

7. *Heptagenia lateralis* (Curtis, 1834) – Mazais Baltezers lake.

8. *Heptagenia sulphurea* (Müller, 1776) – Slokas lake.

EPHEMERELLIDAE

9. *Ephemerella ignita* (Poda, 1761) – Lielais Jūgezers, Mazais Jūgezers, Sudrabezers, Seķītis, Melnezers, Lielais Baltezers, Mazais Baltezers, Ķīšezers lake.

CAENIDAE

10. *Brachycercus harrisellus* Curtis, 1834 – Mazais Baltezers lake.

11. *Caenis horaria* (Linnaeus, 1758) – Aklais, Ataru, Babītes, Dūņezers, Dzirnezers, Garezers I, Garezers II, Jūdažu, Juglas, Kadagas, Ķīšezers, Langstiņu, Lieluikas, Lilastes, Lielais Baltezers, Lielais Jūgezers, Mazuikas, Melnezers, Mazais Baltezers, Seķītis, Slokas, Sudrabezers, Sunīšu, Mazais Jūgezers, Venču, Līņezers, Vidus, Maku, Sēres lake.

12. *Caenis macrura* Stephens, 1835 – Babītes, Dūņezers, Dzirnezers, Juglas, Ķīšezers, Langstiņu, Lieluikas, Mazais Baltezers, Seķītis, Slokas, Sēres lake.

13. *Caenis rivulorum* Eaton, 1884 – Juglas lake.

14. *Caenis robusta* Eaton, 1884 – Babītes, Dzirnezers, Garezers II, Langstiņu, Lielais Baltezers, Melnezers, Mazais Baltezers, Slokas, Ataru, Seķītis lake.

Conclusions

Totally 14 species from 6 genus were stated in the lakes of Riga District. The highest abundance of mayflies was stated in the largest lakes of Riga District with area larger than 200 hectares in comparison with the smaller ones. *Caenis horaria* (Linnaeus, 1758), *Caenis robusta* (Eaton, 1884), *Ephemerella ignita* (Poda, 1761) prevailed among other mayfly species. *Brachycercus harrisellus* Curtis, 1834, *Heptagenia lateralis* (Curtis, 1834), *Heptagenia sulphurea* (Müller, 1776) were rare species in lakes of Latvia, they are more typical for lotic environments.

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FAUNA OF TERRESTRIAL MOLLUSCS IN CONIFEROUS FORESTS OF LATVIA

Digna Pilāte

Pilāte D. 2001. Fauna of terrestrial molluscs in coniferous forests of Latvia. *Acta Biol. Univ. Daugavp., 1 (1): 34 - 37.*

In 1995 and 1997 during the period from May to September, studies of land malacofauna in coniferous forests were carried out at Aizkraukle, Mežole and Slītere forestry. There were selected 6 sample plots in pine forests and 6 sample plots in spruce forests. In pine forests 20 species of land molluscs were stated, in spruce forests this number was 36. The number of species in pine forests ranges within 2-15, the density of specimens- 4-159 ind/m², in spruce forests these numbers are 3-28 and 3-476 ind/m², respectively. In pine forests the fluctuations in number of species and in other quantitative parameters are in general affected by the soil moisture and vegetation, while impact of forest management activities on malacofauna is minimal. In spruce forests mainly the admixture of deciduous trees, moisture conditions and forest management affects the number of species and other quantitative parameters.

Key words: terrestrial molluscs, pine forests, spruce forests

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Introduction

Latvia due to its geographical situation belongs under boreo-nemoral forest zone, and it is located almost in the middle of this zone. Nowadays 2/3 of the forests consist of coniferous trees (Zunde 1999). Coniferous forests, particularly pine forests, generally are regarded as sites of rather low diversity in mollusc species (Лихарев 1962, Лихарев, Раммельмейер1952, Шилейко 1978; Лихарев, Виктор 1980). Up to know it was presumed that up to 10 species of terrestrial molluscs occur in coniferous forests of Latvia (Spuris 1998). Moreover no attention has been paid to particular types of coniferous forests. Studies on mollusc fauna in coniferous forests first were initiated in 1991 as part of mollusc survey in the valley of Daugava River from Piedruja to Daugavpils (Pilāte 1997). More thorough studies on malacofauna of coniferous forests were started in 1995 by the author of this paper as part of investigations on natural forests in Latvia conducted by U. Suško (1998).

Materials and methods

Faunistic studies of forest molluscs were done during May-September period in 1995 and 1997 on the territories of Aizkraukle, Mežole, Līvbērze, and Slītere forestry. 42 sample plots were selected in six groups of forest biotopes. Out of them 12 plots were selected in coniferous forests: six in spruce forests and six in pine forests. Investigations were curried out in all three classes of natural forests represented in Latvia (Braun-Blanquet 1964, Priedītis 1999): Cl.*Vaccinio-Picetea,* Cl.*Querco-Fagetea* and Cl.*Alnetea glutinosae*.

Two methods - volume method and square method (Balogh 1958, Dunger, Fiedler 1997) were used to collect samples of the litter. The volume sample was collected from plot sized 20 x10m. In total, 3-5 liters of forest litter (decomposing leaves and humus) were sifted at random from ground cover in each releve using a soil sieve with 1 x1 cm mesh. In square method 25 samples sized 20 x 20 cm were collected along the transect set in each study plot. Later the litter was sifted using soil sieve with 1 x 1 mm mesh. Approximately 395 l of the litter were sifted and 3 134 mollusc specimen were counted altogether. Species of molluscs were identified using guidebooks of Kerney et al. (1983). The collected material is deposited in the collection of Latvian Museum of Natural History.

Results and discussion

Of 85 terrestrial mollusc species found in Latvia more than 60 species inhabit forests (Rudzīte et.al.1996). Of them 36 land mollusc species representing 15 fami-

lies were found in coniferous forest areas studied (Table 1). Concerning the diversity of land molluscs, the coniferous forests belong basically under the moderately rich group of biotopes and the group of scanty biotopes (Pilāte in press).

Review on mollusc species found in pine forest

Within the studies 6 sample plots represented pine forest biotopes: two at Slītere, three at Mežole, and one at Aizkraukle. According to the multiple dichotomous division of study plots done by classification software TWINSPAN almost all types of pine forests belong to the group of biotopes scanty in respect to mollusc species number. Only in few cases they may be with average number of mollusc species (Pilāte in press).

In total, 20 terrestrial mollusc species were found in pine forests of Latvia (Table 1). The number of species ranges within 2-15, the density of specimens- 4-159 ind/m² (Table 1) in the sample plots of pine forests; compare to 19-26 species and 167-1050 ind/m² respectively in natural broad-leaved forests (Pilāte in press).

Most of the species registered in pine forests are typical for them, generally abundant and ecologically plastic. Although *Vertigo ronnebyensis* by some authors (Spuris 1998, Kerney et al.1983, Rudzīte 2000) is regarded as a species typical for mixed forests, my studies reveal it as more representative of coniferous forests, particularly pine forests (Pilāte in press).

Acicula polita and *Clausilia bidentata* are considered exceptions; they are typical for shady and moderately wet broad-leaved and mixed forests (Kerney et.al. 1983, Spuris 1998, Ehnström, Waldén 1986, ?ихарев 1962). *Acicula polita* was found in damp, little affected pine forest at Me□ole_that had formed in the site of bog drained some 80 years ago. Few specimens of *Clausilia bidentata* were registered in Slītere in a greatly modified pine culture that was planted in the site of old burnings and in natural pine forest. There the pine cultures were planted during 1936-1968. In mentioned study area the dunes are covered by vegetation typical for dry pine forest, but the valleys between dunes - by vegetation of wet pine forest (Suško 1997).

In pine forests the number of mollusc species mainly depends on the humidity as well as on soil acidity (pH) of the site. Dependence on forest management activi-

Table 1. Terrestrial mollusc species found in coniferous forests of Latvia

Species/Family	Pine forest	Spruce forest
Aciculidae		
Acicula polita	x	x
Carychiidae		
Carychium minimum		x
Carychium tridentatum	x	x
Cochlicopidae		
Cochlicopa lubrica	x	x
Cochlicopa nitens		x
Vertiginidae		
Columella edentula	x	x
Columella aspera	x	x
Vertigopusilla	x	x
Vertigo substriata	x	x
Vertigo ronnebyensis	x	x
Vertigo alpestris	x	
Valloniidae		
Acanthinula aculeata		x
Vallonia costata		x
Punctidae		
Punctum pygmaeum	x	x
Discidae		
Discus ruderatus	x	x
Arionidae		
Arion subfuscus	x	x
Vitrinidae		
Vitrina pellucida	x	x
Zonitidae		
Vitrea crystallina	x	x
Aegopinella pura		x
Aegopinella nitidula		x
Nesovitrea hammonis	x	x
Nesovitrea petronella	x	x
Oxychilus alliarius		x
Zonitoides nitidus		x
Euconulidae		
Euconulus fulvus	x	x
Clausiliidae		
Cochlodina laminata		x
Cochlodina orthostoma		x
Macrogastra ventricosa		x
Macrogastra plicatula		x
Macrogastra latestriata		x
Clausilia bidentata	x	x
Clausilia dubia		x
Clausilia cruciata		x
Bulgarica cana		x
Bradybaenidae		
Bradybaena fruticum	x	x
Hygromiidae		
Perforatella bidentata	x	x
Helicidae		
Cepaea hortensis		x
Total:	*20*	*36*

Table 2. Characteristics of sample plots

Pine forests			Spruce forests		
Forest type	density of specimens	number of species	Forest type	density of specimens	number of species
Dry	43 ind./m²	7	Wet	178 ind./m²	28
Wet	84 ind./m²	10	Wet	121 ind./m²	15
Wet	91 ind./m²	15	Wet	353 ind./m²	24
Wet	4 ind./m²	2	Wet	476 ind./m²	28
Mixed (planted)	159 ind./m²	11	Dry (planted)	24 ind./m²	7
Planted after the burning	31 ind./m²	5	Wet (planted)	3 ind./m²	3

ties (e.g. artificial regeneration of forests) is negligible (Table 1). In dry pine forests and in highly wet pine forests of peat bogs the number of mollusc species is small. The species number is greater in swampy pine forests.

Review on mollusc species found in spruce forests

Also spruce forest biotopes within the studies were represented by 6 sample plots: two at Slītere, two at Mežole and two at Aizkraukle. Three of them are grouped by TWINSPAN under medium rich forest biotopes in respect to mollusc species number (Pilāte in press). All these three sample plots are natural, potentially permanent spruce forests with a little admixture of black alder, ash and aspen and have typical vegetation of a wet spruce forest (Suško 1997). One plot was grouped among the rich biotopes because of sufficiently good moisture conditions, a greater admixture of various deciduous tree species and a high pH value in comparison with other plots of spruce forests. Two sample plots are grouped under scarce forest biotopes (Pilāte in press). These plots represent spruce plantations: one growing instead of former natural broad-leaved forest, another - instead of former mire.

Altogether 36 species of land molluscs have been registered in spruce forests in Latvia. The number of species in the sample plots of spruce forests ranges within 3-28, the density of specimens- 3-476 ind/m² (Table 2).

In natural spruce forests the number of mollusc species as well as abundance of specimens mainly depends on the admixture of deciduous trees and the humidity of the site. Spruce cultures planted in places of former broad-leaved-spruce forests are the scarcest in respect to the number of mollusc species.

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STRATEGY FOR CONSERVATION OF THE FRESHWATER PEARL MUSSEL *MARGARITIFERA MARGARITIFERA* L. POPULATIONS IN LATVIA

Mudīte Rudzīte

Rudzīte M. 2001. Strategy for conservation of the Freshwater Pearl Mussel *Margaritifera margaritifera* L. populations in Latvia. *Acta Biol. Univ. Daugavp., 1 (1): 38 - 44.*

The freshwater pearl mussel is a species approaching extinction, now in a critical condition; decreasing populations exist not only in Latvia but throughout its range. The freshwater pearl mussel is included in the Bern Convention (Appendix III) and the EU directive 92/43/EEC (II and V Appendices). Included in the List of Threatened Species of the Nordic countries. There are only 7 populations in Latvia with about 12 000 individuals. Populations of pearl mussels are only in river basins, which include large forest tracts. In river basins where land amelioration and field cultivation dominates, populations are extinct. The action plan for the conservation of this species in Latvia was prepared in 1999. It partly corresponds to the action plan for Europe too. Main goal of the action plan: to halt the decline of the freshwater pearl mussel population; establish conditions for its normal regeneration by improving and stabilizing appropriate habitats in oligotrophic river ecosystems.

Key words: Margaritifera margaritifera, conservation of the freshwater pearl mussel

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Introduction

The freshwater pearl mussel is included in the Bern Convention (Appendix III) and the EU Directive 92/43/EEC (Appendixes II and V). Included in the List of Threatened Species of the Nordic countries. In Latvia the protection of this species is ensured by inclusion in the List of Threatened Species (since 1957), as well as in the 1st category of Latvia's Red Data Book since 1985, and in its new issue (Aigare 1985; Andrusaitis et.al. 1998).

The freshwater pearl mussel is an endangered species, the conditions of the populations are critical, they may become extinct both in Latvia and in the whole species distribution area (Bauer 1986; Eriksson 1998; Valovirta 1998).

Providing approximate evaluation, during the last hundred years the number of freshwater pearl mussels has decreased approximately five times in Latvia. But during the intensive extraction of pearls in the 17th and 18th century, the number of freshwater pearl mussels was several hundreds and thousands times higher. The colonies of freshwater pearl mussels, which were formed during a period of thousands of years, were almost totally destroyed within some centuries, in order to extract pearls for the needs of Swedish and Russian Courts (Kawall 1874; Meder 1925). Nowadays it would take several hundreds of years and the most favourable living conditions in order to regenerate the great deal of freshwater pearl mussel colonies. But the freshwater pearl mussel has become a highly specialized species during its process of evolution: it has adopted to life in the oligotrophic rivers, and its possibilities of survival very rapidly decreases because of the eutrophication of habitat (Bauer 1988; Baer 1995). In Latvia the freshwater pearl mussels have remained intact only in places, where most of the territory of the river basin is covered by forests. In the meliorated and cultivated river basins the freshwater pearl mussels are extinct. In Europe they have remained intact mostly in the mountainous regions, but are extinct in the cultivated plain territories. In Latvia the forests ensure the stability of ecosystem for survival of the species.

The action plan for the protection of the species was developed in 1999, which is partly included in the European plan for the protection of species (Rudzīte,

1999; http://www.varam.gov.lv/vad/Latviski/Plani/Sugu_plani.html http://www.varam.gov.lv/vad/English/SpeciesHabitatsProj/PearlMussel.html).

The developing of the plan took place in the Latvian Fund for Nature with the support of Danish Environmental Protection Agency within the project "Inventories of Species and Habitats, Development of Management Plans and Capacity Building in Relation to Approximation of EU Birds and Habitats Directives".

In 1994 in co-operation with the Latvian Fund for Nature a project under the title "The Freshwater Pearl Mussel" was developed, within which several explorations and searches of rivers in the midland of Vidzeme took place (Bernards 1996). Since 1977 separate explorations took place in the Department of Zoology and Genetics at the University of Latvia (currently the Department of Zoology and Animal Ecology) (Krišāns 1977; Tukiša 1987; Maksimova 1990). Within the last years Latvia's Malacology Society has also gone into searches of rivers and locations of the freshwater pearl mussels.

Methods and results

Since 1977, 58 rivers were explored, where the freshwater pearl mussel might be found (Krišāns 1977; Tukiša 1987; Maksimova 1990; Bernards 1996; Rudzite 1999; Rudzite et.al. 2000). Populations were discovered in 7 places, in all of them the research on the structure of population age and the counting of the freshwater pearl mussels in the form of direct counting was carried out.

In the censuses of 1999 and 2000 approximately 12 000 freshwater pearl mussels were stated. The locations of the freshwater pearl mussels were substituted by letters, in order to prevent spreading information on the freshwater pearl mussel locations (Table 1). Although the freshwater pearl mussels in Latvia are in such a little number that the discovery of qualitative pearls is practically impossible, still some irresponsible people can do much harm to the locations of the freshwater pearl mussels (Rudzīte 1999).

In the research of age structure of the freshwater pearl mussel populations, the length of the shell was measured in the same way, as it was done in the research on populations in Sweden (Erikson et al. 1998). Our research was done in 1999 and 2000.

In the largest populations a sample set of 150 pearl mussels was measured, in the small populations, in the locations A, B, C (Table 1), all pearl mussels were measured. Besides of these measurements two smaller pearl mussel individuals were discovered – 52 mm and 63 mm long. But these are the only findings like that in all locations together. The progeny of pearl mussels were searched for in the sand, but were not discovered. In the location N# G the population differs with a little bit smaller sizes of individual bodies (picture 1), it is situated in a different basin of the river, totally isolated from the other.

Table 1. The number of the freshwater pearl mussels in the locations of the freshwater pearl mussels in the censuses of 1999 and 2000 in Latvia

Name of the Location	Number of Pearl Mussels
Location N# A	144
Location N# B	17
Location N# C	24
Location N# D	Ca. 400
Location N# E	Ca. 2500
Location N# F	Ca. 7700
Location N# G	Ca. 1200

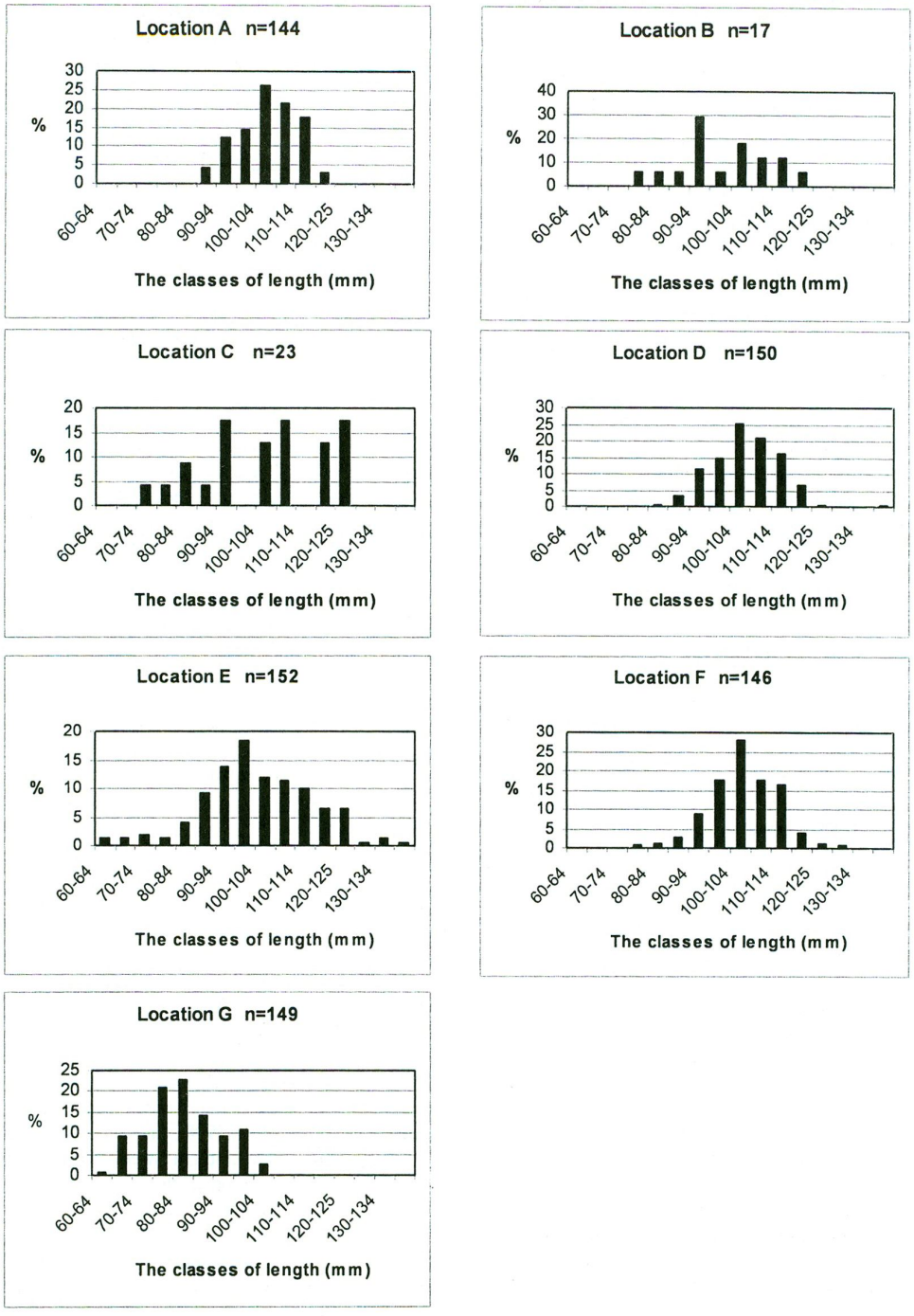
To characterize the location N# D, registries and measurements since 1977 were used (Krišjāns 1977; Tukiša 1987; Bernards 1996; Rudzite 1999).

Disscusion and conclusions

The Condition of Population and the Prognosis of Extinction

The structure of age of the freshwater pearl mussels population was explored. All the populations are in the stage of obsolescence (Pic. 1), the old individuals dominating. A population normally capable to regenerate can be considered to be a population where there is a large number of 5 cm long or shorter pearl mussels found (Eriksson, et al. 1998). In order to evaluate the conditions of a population, a Swedish suggested methodology for evaluation of the age structure of population was used (Eriksson, et al. 1988).

The populations cannot be compared unambiguously, because a very different number of individuals was measured in each of them, still the common situation can be evaluated. The differences in population in the various river basins should also be taken into consideration. The location N# G is totally isolated, it is situ-

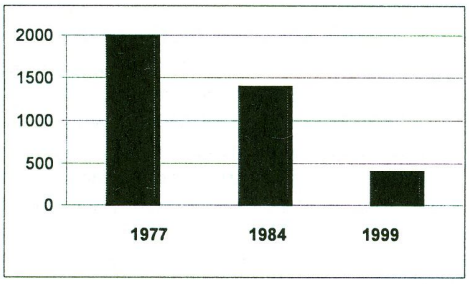


Picture 1. The structure of the freshwater pearl mussel population age in the locations in Latvia. Classes of length were used, because there is a linear connection between the age of individuals and their length (Eriksson, et al.1998).

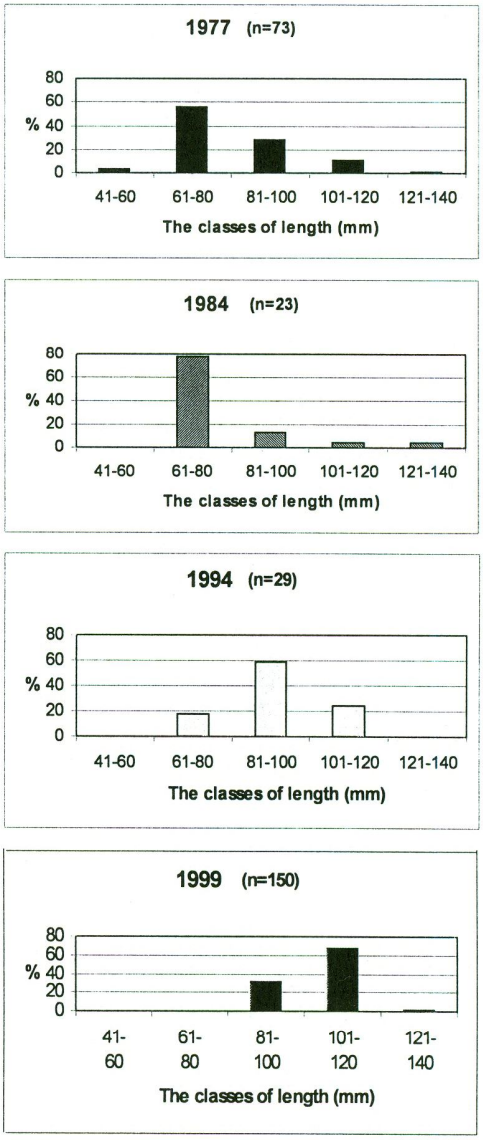
ated in a different river basin, all the individuals in it are smaller in size in comparison with other locations (Pic. 1). This difference of body sizes of population individuals in various river basins can be well seen in the collection materials by R. Kampe, which were collected in the 20-ties and 30-ties of the 20th century in the same river basins, which were explored during the last two years. That is why in order to state their age according to the length of their shell different criterions than in other populations should be used, still the tendencies of the common obsolescence are seen (Pic. 1). Evaluating the stating of age according to the age layers, unconformity of the suggested methods with the previously used method in Latvia was stated (Krišāns 1977; Foeckler 1990; Baer 1995), that is why pro tempore we can make an assertion that between the classes of length and the age of the individuals there is a linear connection (Eriksson, et al. 1998; Foeckler 1990; Baer 1995).

There is only one pearl mussel found, corresponding to the class of length 50-54 mm, besides out of the sample set of the measurement. In the class of length 55-59 mm, no pearl mussels were found. In the class of length 60-64 mm, small number of pearl mussels was found in two locations N# E and G (Pic. 1). Since the location G differs from the others by the size of body, it will not be used in the further comparisons. The locations A, B, C, where all the pearl mussels found were measured, can be considered as the "remains" of populations. Because of the very small number of individuals their extinction can be foreseen within the next 5-10 years. In the location N# D the smallest pearl mussels were stated in the class of length 80-84 mm, the total number of pearl mussels is comparatively small (table I). There are registries on this location since 1977 (Krišāns 1977; Tukiša 1987; Bernards 1996; Rudzīte 1999), that is why it is possible to follow the decline of this population within the last 22 years (Pic. 2), as well as to evaluate changes in the age structure of the population (Pic. 3).

In 1977 in the location N# D there were approximately 2000 pearl mussels (Krišāns 1977), in 1984 – 1400 (Tukiša 1987), in 1999 – not more than 400 pearl mussels (Rudzīte 1999). From 1977 till 1984 the decrease of population was 75 pearl mussels per year, from 1984 till 1999 – 62 pearl mussels per year, and since 1977 approximately 70 pearl mussels per year (Pic. 2).



Picture 2. The decrease of the freshwater pearl mussel population in the location N# D since 1977



Picture 3. The changes in the age structure of the freshwater pearl mussel population in the location N# D since 1977

The changes in the age structure of population in the location clearly show the obsolescence of the population (Pic. 3). In 1977 there were pearl mussels found in the class of length 41-60 mm, but later they were no more stated. The class of length 61-80 mm is in the first three times of registry, but in the last one in 1999, it is no more stated. The next two classes of length are more or less represented in all registries. The class of length 121-140 mm is represented in a very small number, because it is already the limit for the species, which can be reached only by the oldest individuals (Gloer, Meier-Brook 1998). However most of all the obsolescence of the population is showed by the maximum number of individuals, gradually moving to older class of length (Pic. 3). In the first two registries, the maximum is in the class of length 61-80 mm, in 1993 it is already in the class of length 81-100 mm, but in 1999 – 101-120 mm.

Therefore we can foresee this population to perish during the next 5-10 years.

According to distribution of the number of individuals, the location N# G is similar to the previous, where there are also represented nine classes of length in all (Pic. 1). The total number of individuals in 1999 was approximately 1200, so the extinction of this location can be foreseen during the next 10-15 years.

In the locations N# E and F situation is the most favourable (Pic. 1), there are 16 and 11 classes of length represented, the number of pearl mussels is the largest (table 1). Still the smallest, that is youngest groups of ages are represented insufficiently. In comparison with the exploration of pearl mussel population in Sweden, even these populations can be considered as obsolescent (Eriksson, et al. 1998). It means that the disappearance of this location can be foreseen during the next 20-30 years, in case there are no activities undertaken to stimulate its resurgence.

The Reasons for Decrease of Populations

According to the historical records (Kawall 1874; Meder 1925; Eke 1925; Pētersons 1933; Schlesch 1942), one of the main reasons for the rapid decrease of the freshwater pearl mussel population was the insatiable extraction of pearls in the 17th and 18th century.

Since the strategy of survival of the freshwater pearl mussel is very well developed during the period of evolution (Bauer 1987; Hruška, Bauer 1995), this species could regenerate naturally even after the savage expansion of pearl hunters. However the general eutrophication of waters has threatened the survival of the pearl mussels in the whole area of the species (Bauer 1987; Hruška, Bauer 1995; Baer 1995; Valovirta 1998). Evaluating the situation in Latvia during the last 100 years, we should consider the gradually increasing area of the agricultural lands, as well as the meliorated areas of land. It has substantially influenced the conditions of the freshwater pearl mussels in whole (Rudzīte 1999).

Different activities of people have unfavourably influenced the situation of the freshwater pearl mussel population. The building of weirs on the rivers both directly destroys the natural habitat of the freshwater pearl mussels and unfavourably influences the population of stream trout in the whole length of rivers. For instance, the Abuls in the 19th century was mentioned as a good location of pearl extraction (Meder 1927). In 1901 the first hydroelectric power station in the Baltic States was built and later five more large weirs (Avotiņa 1994). In 2000 in the Abuls there were neither freshwater pearl mussels, nor remains of shells. Detailed descriptions have remained on the pearls of Veseta (Kawall 1874). In 1999 there were no remains of the freshwater pearl mussels found. During the last forty years, in the five separate bays, the river waterways were totally dug to straighten and change the direction of the flow (Avotiņa 1998).

Nowadays the locations of the freshwater pearl mussels are also threatened by the hardly predictable action of human behaviour, such as unnecessary buildings of weirs, cutting of forests on the river banks and illegal fishing. Excessive population of the reintroduced beavers has its share of influence as well (Rudzīte 1999).

The Action Plan for the Protection of Species

Up to now the protection of the species in Latvia ensured its inclusion in the List of Threatened Species (since 1957), as well as in the first category of the Latvia's Red Data Book (Andrušaitis et.al 1998). But this protection has not been sufficient in order to ensure the natural regeneration of the species. The population of the freshwater pearl mussel is gradually decreasing. So in 1999 an action plan for protection of the species was developed, which is also partly included in the European plan for the protection activities of the species. The main aim of the protection plan in Latvia is to prevent the decrease of the freshwater pearl mussel population, to ensure normal self-regeneration possibilities, optimising and stabilizing the

ecosystems of the oligotrophic rivers as the habitat of the freshwater pearl mussels (Rudzīte 1999).

The activities mentioned in the plan for protection of the species include:

State nature reserves with a strict regime of protection should be created in all the known locations.

All the institutions, which can be involved in the activities to be undertaken in order to protect the freshwater pearl mussel should be informed and work in cooperation, because the lack of their co-operation separate activities can have little results or no results at all.

A complex hydro biologic, hydro chemical and hydrological evaluation of the conditions in each location should be done immediately, in order to discover the factors, preventing the survival of young.

The conditions of the salmon type fish population should be evaluated in all the locations, and in the case of necessity, their number should be supplemented, as well as any illegal fishing should be abolished in all the locations of the freshwater pearl mussels and in their surroundings.

The number of beavers in the locations of the freshwater pearl mussels and their surroundings should be under strict control.

To learn and make use of the method for infecting trout in order to ensure artificial reproduction of the freshwater pearl mussels.

The programme for reproduction of the freshwater pearl mussels should be continued in the Gauja National Park (Rudzīte et.al. 2000).

The action plan for protection of the freshwater pearl mussels provides a theoretical background for the protection and preservation of the species in Latvia. The evaluation of the expansion of the species and the exploration of the population conditions show, that this is a species in a great need of human aid in order to prevent its extinction in Latvia.

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THE MUTE SWAN (*CYGNUS OLOR*) WINTERING IN LATVIA (1984-2001)

Antra Stīpniece, Ruslans Matrozis

Stīpniece A., Matrozis R. 2001. The mute swan (Cygnus olor) wintering in Latvia (1984 – 2001). *Acta Biol. Univ. Daugavp., 1 (1): 45 - 50.*

During 18 year period since resumption of annual waterfowl mid-January counts in 1984 an increasing trend of Mute Swan wintering population has been observed (max 5110 birds in 2001). Both distribution and total numbers correlate with winter severity. The most important sites are western coast of the Gulf of Riga and big natural coastal lakes. One of them (Lake Liepaja) in mild winters qualifies as IBA. In the site Riga HPS no correlation with winter severity was observed. Seasonal dynamics for the last two seasons at the site showed increase along with cold spells and first ice formation, but no significant correlation was found. Average juvenile rate at the site the last eight winters has been 21%. Mortality during severe winters reached 11%. More than a half (53%) of the mortality cases accounted for natural reasons.

Key words: Mute Swan, Cygnus olor, wintering, Latvia

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Introduction

During 20th century Mute Swan (*Cygnus olor*) has established on the territory of Latvia as a breeder and since 1970-ties also as a regular wintering species (Lipsberg 1983). The first wintering attempts have been registered already in winter 1960/1961 when up to 100 birds were observed on Lake Engures in December, yet after ice formation they left the lake (Viksne, 1963). During January counts in 1967-1974 Mute Swans were observed in inland waterbodies in small numbers (<20 birds) (Viksne 1976). For the first time wintering at the western coast of the Gulf of Riga Mute Swans were observed in winter 1974/1975, but in 1974/1975 already 700 Mute Swans wintered there (Lipsberg 1983).

Aim of this report is to summarize the data on Mute Swan numbers and distribution accumulated since resumption of wintering waterfowl counts in 1984 (Viksne 1984) and to reveal peculiarities of Mute Swan wintering in the surroundings of Riga hydro-power station (HPS).

Material and methods

Every year in mid-January International Waterfowl Counts (coordinated by Wetlands International, in Latvia organized by LU Institute of Biology in collaboration with Latvian Ornithological Society) were performed. Territory coverage characteristics are given in Table 1. In sites covered every winter the number of birds actually counted was compared. For the whole territory where complete coverage during 18 year period has not been achieved, the pair index (Rüger et al. 1986) was used. Swan occurence and population dynamics were compared with winter severity by means of Pearson correlation coefficient. As winter severity indicator the sum of average daily temperatures from November 1 till the count day in mid-January was used (data of State Meteorological Survey Riga station).

At wintering site Riga HPS (includes waters around Dole island – Sausā Daugava, Ceļa Daugava, Daugava oxbow at Dārziņi settlement) counts were performed 10 winters (since 1991/1992) in December-February. In total the territory has been checked 51 times completely and 36 times partly. During the visits all swans were counted (dividing into groups "first winter" and "older", according to plumage characteristics) and ice conditions were put down. Swans were ringed and re-

captured . Site was searched for dead birds and all ones found were registered. The last two winters counts were carried out every decade.

Results

Occurence and distribution in Latvia

During the count period there have been 136 sites where at least one Mute Swan at least once in mid-January has been seen. These sites lie over the whole country except its northeastern part (Figure 1). All winters swans have been registered only at one site: Daugava oxbow at Dārziņi. At most of the sites swans have been met 1-5 years.

Mute Swan occurence (number of sites in the country with the species present) varies along with the winter severity – $n=16$, $r=0.71$, $p<0.01$. Also in a smaller territory (Riga city) correlation with the daily temperature sums is significant - $n=18$, $r=0.61$, $p<0.01$.

In average 70% (30-92%) of all birds concentrate in the coastal lakes (Liepājas, Engures, Kaņieris) and at western coast of the Gulf of Riga (Table 2). Lake Liepājas is the most important Mute Swan wintering site in Latvia. In mild winters (January 1992, 2000, 2001) more than 2100 birds (1% of Northwest European population = internationally important concentration) have been observed there which is one of the reasons of listing the site as Important Bird Area (IBA) (Račinskis, Stīpniece 2000). Two open water areas (near Dzedrupe mouth and east of Lielā Sala island usually are present on Lake Engures. Lake Kanieris sheltered substantial number of swans only during the mild winters of late 80-ties. Still, when also the coastal lakes freeze, most swans leave the country (Fig. 1 c).

Wintering population dynamics

Viewing dynamics of the wintering population it is possible to distinguish a period of exponential growth (1984-1992) followed by a period (1992-2001) when no population trend is expressed (Figure 2 a).There is a significant correlation ($r=0.77$, $n=18$, $p<0.01$) between swan numbers in January (pair index) and sum of daily average temperatures since November 1 till the count day. Despite the fluctuations along with winter severity, the overall population trend is positive ($n=18$, $r=0.60$, $p<0.01$).

At the regular wintering site Riga HPS an increase till year 1992 was observed (similarly like in the whole country), followed by a decrease ($n=10$, $r=-0.88$, $p<0.01$) (Fig. 2 b). For this site correlation between winter severity and swan number in mid-January was not significant ($n=18$, $r=0.39$, $p>0.05$). The site retains unfrozen parts even in the most severe winters. Birds receive additional feeding from inhabitants of Darzini settlement..

Seasonal dynamics at Riga HPS surroundings

Decadal counts performed the last two winters showed the importance of the site for wintering swans during cold spells (Fig. 3). In 1999/2000 in early December a small number of swans and the local brood occured in the territory. The first permanent ice formed during 2nd-3rd decades of December. Simultaneously, swan numbers at the site considerably increased and reached the maximum. The next winter was much milder and

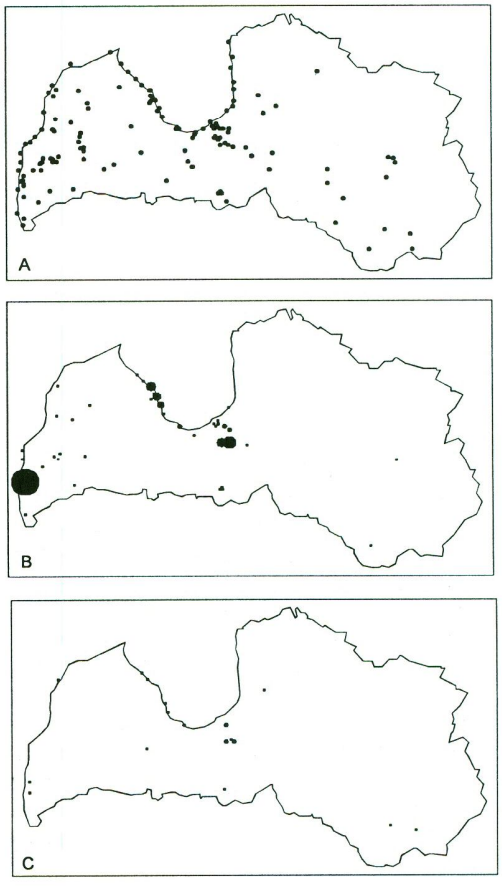

Figure 1. Mute Swan winter distribution in Latvia: a) general (1984-2001) b) mild winter (January 1993), c) severe winter (January 1997).

Table 1. Winter severity, territory coverage and occurence of Mute Swans in Latvia, 1984-2001

Year	Sum of average daily temperatures November 1 – mid - January	Sites visited			Sites with swans		
		inland	seacoast	total	inland	seacoast	total
1984	45,2	142	17	159	15	4	19
1985	-240,7	14	1	15	3	0	3
1986	-177,9	17	2	19	4	0	4
1987	-415,1	70	4	74	2	1	3
1988	-7,4	199	15	214	17	4	21
1989	-54,4	233	6	239	22	1	23
1990	-4,2	258	18	276	22	9	31
1991	123,8	171	20	191	28	12	40
1992	166,1	148	26	174	30	13	43
1993	65,8	165	34	199	37	13	50
1994	-133,1	174	37	211	22	15	37
1995	-1,4	161	39	200	21	14	35
1996	-271,4	162	26	188	12	9	21
1997	-68,2	167	45	212	11	6	17
1998	-27,3	223	46	269	24	12	36
1999	-255,4	207	44	251	22	11	33
2000	112	223	43	266	26	9	35
2001	204	187	41	228	29	24	53

the first ice formed a little later – late December-early January. Swan numbers reached the maximum in early February along with a rapid decrease in temperature. With getting warmer the swan numbers decreased again. Recoveries of ringed swans indicated that they fly to other waterbodies. During the same winter birds checked at Riga HPS have been resighted on Lake Kisezers (3 birds), Lake Juglas (4), Bullupe (1), Ogre (1), Kegums (1), Jelgava (1), Lake Lielais Baltezers (1). Two recoveries the same winter were from Poland (Gdansk) and Lithuania (Kaunas). In the period from the first ice till mid-February in average about 35% of swans leave the territory. Yet the correlation between bird number changes since the previous count and sum of daily temperatures in the period since the previous count was not significant.

Juvenile rate in the Riga HPS surroundings

The age structure registered during last 8 years is depicted in Table 3. In December the average juvenile rate is 26% (22-34%), but in years with early winter (e.g. November 1998) only 10% were registered. This could indicate that in early winters more juveniles move to other wintering sites. The last two winters were mild and more juveniles were wintering at Riga HPS. Also juveniles use to change wintering sites during one winter. Ringing data showed that they often move together with parents and siblings. Till the end of winter up to 30% of first-winter swans leave the territory.

Mortality in Riga HPS surroundings

In tolal during last nine years (1992/1993-2000/2001) 69 dead swans were found (Fig. 4). Presumably 37 were victims of frost, hunger and other natural causes. Three birds had fragments of fishing net tangled around

Table 2. Mute Swan mid-January numbers in the main wintering sites in Latvia, 1984-2001 (- site not covered, * internationally important concentration)

Year	Seacoast Roja-Kauguri 103 km	Lake Engures	Lake Kanieris	Lake Liepajas		Riga HPS	Latvia total
				Mute Swan	Unident. swans		
1984	120	-	-	78	0	26	318
1985	-	-	-	-	-	35	38
1986	-	-	-	-	-	56	68
1987	-	-	0	0	0	56	72
1988	160	-	0	540	0	62	957
1989	-	2	11	225	0	77	471
1990	161	43	0	1200	0	62	1662
1991	154	5	200	1030	0	116	1764
1992	715	255	100	2120*	0	286	3952
1993	657	13	0	868	580	284	2894
1994	159	107	21	614	100	212	1515
1995	167	176	0	1740	0	200	2430
1996	180	0	1	0	0	133	456
1997	79	0	0	22	0	139	338
1998	124	521	0	1483	0	142	2384
1999	144	166	5	38	0	56	536
2000	293	215	0	2900*	1750	122	3657
2001	378	599	31	3703*	0	114	5110

Table 3 Average wintering Mute Swan juvenile rates (%) at the site Riga HPS (- no count)

Winter	December	January	February	Average
1993/1994	-	7	6	7
1994/1995	23	11	9	14
1995/1996	32	9	-	21
1996/1997	28	30	-	29
1997/1998	34	14	-	24
1998/1999	10	10	13	11
1999/2000	34	33	23	30
2000/2001	22	42	38	34
Average	26	20	18	21

body. Two were found below high voltage lines. Two were victims of oil pollution. In March 1993 25 dead swans were foun in the upper part of Sausa Daugava. Several canals that cross agricultural territories inflow near this place. Water colour in the nearby stream and the canals, so many dead birds together in a mild winter and similar postures of corpses suggested poisoning. Most birds died from natural causes (cold) in 1993/1994 – 20 birds or 11% of the wintering. In winter 1995/1996 (a cold and long one – snow thawed only in late April) 14 corpses or 10% of the wintering population were found.

Discussion

Exponential growth of Mute Swan wintering population in late 80-ties-early 90-ties has been observed also in the neighbouring countries (Kuresoo 1992; Svažas et al. 1997) as well as in whole Nordic-Baltic region (Delany et al. 1999). Also the whole Nordic-Baltic population reached its maximum in 1992, but showed a decrease with the following colder winters.

Counts and bird marking at a single site Riga HPS

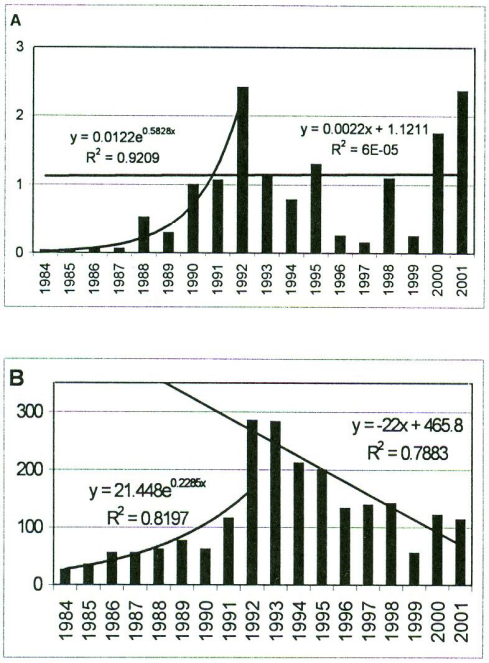

Figure 2. Mute Swan wintering population trends in 1984-2001 according to mid-winter counts: A. Whole country, pair index, B. Site Riga HPS, total counts

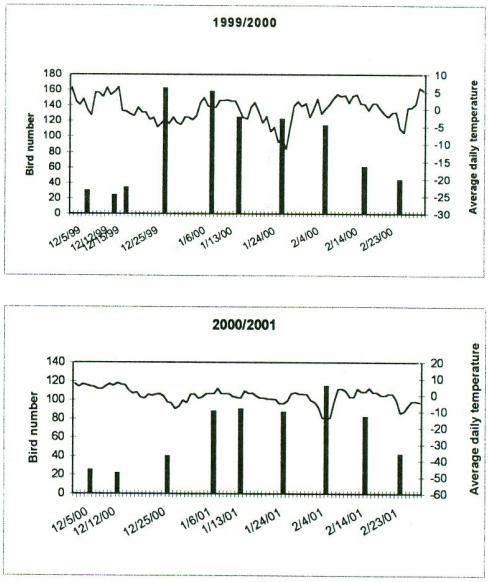

Figure 3. Mute Swan seasonal dynamics at site Riga HPS and average daily temperatures in winters 1999/2000 and 2000/2001.

showed that despite the fact the site never freezes swans use to change wintering sites during course of winter. The decadal counts showed that at least one third of swans move away. The fact that birds concentrate with decrease of temperature and disperse when the weather becomes milder has been observed e.g. for Mallard (Viksne 1972).

After 1992 the mid-January dynamics at site Riga HPS differs from that of the whole country which could be explained by the site becoming "more natural" (in the recent years additional feeding has decreased) and by bird dispersal during the last two warm winters.

Rate of juveniles in the period from early December till late February in average was 21%. Similar numbers have been observed during counts in Estonia – 22.4% in 1983-1987 (Kuresoo 1990) and in Lithuania – 21% in 1993 (Mačikunas 1994).

Increased natural mortality was observed during winters with short but significant cold spells and in winters with long-standing snow and ice cover. In winters 1993/1994 and 1995/1996 about 10-11% of swans at site Riga HPS perished.

Majority of our wintering swans inhabit natural waterbodies and depend on weather conditions.

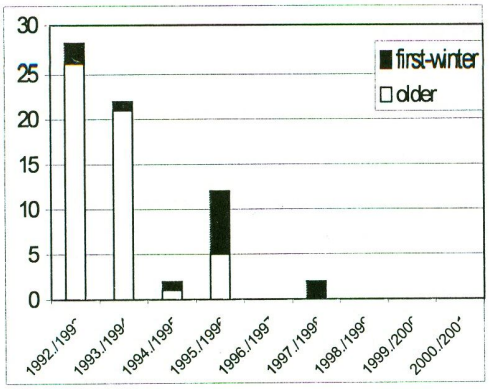

Figure 4. Number of Swans found dead at site Riga HPS.

Presumably, the dynamics are more influenced by bird movements than by mortality. When trying to evaluate the total wintering population it is necessary to choose sufficient number of sites, because for a sigle site the trends in number dynamics can differ.

Acknowledgrements

Authors are thankful to all 635 observers having contributed to the database since resuming International Waterfowl counts in Latvia in 1984. Special thanks to Mārtiņš Kalniņš and Floriāns Savičs who participated in counts in the Riga HPS surroundings. Lita Lizuma and Agrita Briede helped to access recent meteorological data. Jānis Vīksne helped with valuable remarks for the text.

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ECOLOGICAL STUDIES OF ALGAE FLORA IN SLĪTERE NACIONAL PARK, LATVIA

Ivars Druvietis

Druvietis I. 2001. Ecological studies of algae flora in Slītere Nacional park, Latvia. *Acta Biol. Univ. Daugavp., 1 (1): 51 - 53.*

Phytoplankton of rivers was characterized by a poor diatom and green algae community. *Hildenbrandia rivularis* was common on the rocks. Potentially reare species *Chantransia* sp., *Batrachospermum moniliforme* were stated. Desmidiales dominated in the *Shagnum* substrate.

Key words: Algae, phytoplankton, periphyton

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Introduction

In Kurzeme rivers worldwide famous latvian phycologist H. Skuja (1936) described the rare for Latvia and characteristic for this region red and brown algae species.

In small streams of Slītere National Park hydroecological inwestigations were done and species lists of hydrobionts were published (Cimdiņš 1987; Druvietis 1987; Liepa 1987; Kačalova, Parele 1987). Phycological and ecological research were carried out in small streams and in original geomorphological formations of the Western Latvia Coastal Plain. Much of this research was focused on the algae ecology in the Slītere reserve.

Material and methods

Flora of algae were studied in June and August of 1985. In small streams phytoplankton samples were collected by Ruttner type water sampler. Samples were immediately fixed with fomalin to 4% solution. Fresh algal mass was established by means of volume measurement method, comparing algal shapes of particular species to geometrical solids and by computing numerosity of population for particular species and their individual volume. Periphytic algae were collected from the surfaces of submerged stones and wood. Periphytic algae and algae obtained in the bog from Sphagnum substrate were analysed in vivo by Zeiss bright field microscope. The species of algae were identified with the help of taxonomic literature (Hollerbach 1953, 1959, 1982; Starmach 1964, 1969, 1972).

Results and discussion

Small streams

Investigated the streams are typologically non - uniform, with spring and mixed inputs, and they have relatively rapid flows and variable anthrophogenic effects. Some of them show strict vertical zonation with a rhitron to potamon transition (Liepa et al. 1987) . Some of the rivers have an "inverted "zonation, with rhitron communities observed in estuaries and mouths, at the Riga Gulf or Baltic Sea (Cimdiņš et al. 1985). The rivers are characterized by a poor diatom and green algae community with low biomass (0.01- 0.26 mgL^{-1}). Rhitron phytoplankton assemblage was characterised by *Navicula spp., Synedra spp., Nitzschia acicularis, Cyclotella meneghiniana, Synedra acus, Scenedesmus quadricauda, Oscillatoria tenuis.*

Potamon phytoplankton assemblage is characterised by *Navicula spp., Oscillatoria tenuis, Cyclotella meneghiniana, Nitzschia acicularis, Cocconeis placentula.* In rhitron and also potamon communities of rivers, the flows sweep the diatoms and blue - green

algae from periphyton and phytobenthos communities, causing their occurrence in phytoplankton communities.

The periphyton algal flora differs between rhitron and potamon communities of rivers, an in relation to disturbance. In rhitron communities of undisturbed small streams, in Western Kurzeme the red algae *Hildenbrandia rivularis* was common on the rocks. On snags and other substrates, the rare filamentous red algae *Batrachospermum moniliforme* was found, and also the rare green algae *Draparnaldia glomerata*. In the upper reaches of the Mazirbe River, on dolomite cascades, the rare *Chantransia leibleinii* and *Batrachospermum sp.* were found. *Fontinalis antipyretica* is a habitat for diatoms (*Navicula spp., Nitzschia spp., Meridion circulare*). In disturbed rhitron reaches, the blue - greens *Oscillatoria tenuis* and diatoms *Nitzschia spp.,Navicula spp., Synedra spp.* are found in habitats together with the oxygen demanding red algae *Hildenbrandia rivularis*. In rhitron reaches that are exposed to direct sun light, *Cladophora glomerata* is common, with filaments covered with *Cocconeis placentula* epiphytes, which are characteristic of eutrophication. *Oscillatoria spp.* and diatoms are typical in disturbed periphyton and phytobenthos communities.

Rhitron periphyton assemblages in shaded river lengths are characterised by *Hildenbrandia rivularis, Batrachospermum spp., Chantransia sp.* and Bacillariophyta. Rhitron periphyton in exposed river lenghts are characterised by *Cladophora glomerata, Navicula spp., Nitzschia spp.,Cymbella spp., Cocconeis placentula, C. pediculus, Gyrosigma spp.*

Potamon phytoplankton assemblages in undisturbed river lenghts are characterised by *Aulacoseira varians, Nitzschia acicularis, Navicula spp., Chaetomorpha sp, Fragilaria capucina, Oscillatoria tenuis.*

Algae flora of some geomorphological formations near by lake Pēterezers

Investigations of algae flora of geomorphological formations of the Western Latvia Coastal Plain was done in bog of Slītere Reserve in 1985 near by lake Pēterezers. Lake Pēterezers is small lake (2.8 ha), situated in Talsi District. Lake is surrounded by conifer forests and by low bog.

Sampling saites were chosen accordind biotopes typical for bog ecosystems.

List of algae species stated in 2 most of characteristic sampling sites

Sampling site : Pēterezera krauja (near by lake Pēterezers): Substrate: Sphagnum sp.

Cyanophyta

Microcystis pulverea, Oscillatoria sp., Phormidium autumnale, Schizothrix lacustris,Schizothrix valderiae.

Chrysophyta

Dinobryon sertularia.

Euglenophyta

Euglena sp., Trachelomonas sp.

Chlorophyta

Bambusina brebissonii, Closterium strigosum, Closterium striolatum, Desmidium cylindricum, Euastrum affine, Euastrum boldtii, Mictrasterias truncata, Mougeotia sp., Netrium digitus, Netrium oblongum, Staurastrum conspicuum, Staurastrum lapponicum, Staurastrum punctulatum, Tetmemorus granulatus, Tetraspora gelatinosa.

Bacillariophyta

Navicula cryptocephala, Pinnularia sp., Cyclotella sp.

Sampling site: small stream in the bog: Substrates: Comarum palustre, Calla palustris, Sphagnum sp.

Chrysophyta

Synura uvella

Euglenophyta

Euglena sp., Phacus pleuronectes, Trachelomonas sp.

Dinophyta

Glenodinium gymnodinium, Peridinium sp.

Rhodophyta

Batrachospermum moniliforme.

Bacillariophyta

Cymbella sp., Diatoma vulgare, Fragilaria construens, Nitzschia acicularis, Synedra pulchella

Chlorophyta

Bulbochaete intermedia, Mougeotia sp., Staurastrum sp., Ulothrix sp.

Conclusions

The phytoplankton community structure and species composition in small streams of Slītere National park are characterized by a poor diatom and green algae community.

Periphyton of small streams contains red algae *Hildenbrandia rivularis* typical for oxygen rich, shadded biotopes.

Red algae *Batrachospermum moniliforme* typical for clean waters were stated.

Desmidiales characteristic for Shagnum substrate were dominated in biotopes typical for bog in Slītere Reserve .

Reachest flora of algae dominated by Desmidiales are stated in June.

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NEW SPECIES OF FUNGI INCLUDED IN THE LIST OF PROTECTED SPECIES OF LATVIA

Inita Dāniele, Diāna Meiere

Dāniele I., Meiere D. 2001. New species of fungi included in the list of Protected species of Latvia. *Acta Biol. Univ. Daugavp., 1 (1): 54 - 57.*

Fungi were for the first time included in the Red Data Book of Latvia in 1985. There were mainly conspicuous species, which are easy to find and determine in field. Our knowledge on fungi has been improved since 1985. However, majority of fungi are still very insufficiently investigated in Latvia. There are several hundreds of macro fungi species known from only one or two localities. Now the list of protected species of Latvia is approved and 59 species of fungi are included in it. There are 17 new species in comparison with the Red Data Book. The list of these species with notes on their habitat, distribution in Latvia and threats is given in paper.

Key words: mycoflora, fungi, Latvia, threatened species, protected species

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Introduction

Fungi are well known to have important roles in ecosystem functioning. They are involved in a wide range of symbioses. They are a source of food for a very wide range of animals, vertebrates and invertebrates. Fungi are primary agents of organic matter decomposition, allowing nutrient recycling and elemental release. At the same time fungi are quite often neglected by nature conservationists. Only in the last time more attention has been paid to this subject. European Council for Conservation of Fungi (ECCF) proposed a list of fungi species to introduce them into the Bern Convention Appendix.

In Latvia the number of macrofungi, producing macroscopic fruitbodies, is about 4,000 species. The knowledge on fungi distribution and abundance is insufficient even in comparison with other groups of organisms. There are several hundreds of macrofungi found only few times in Latvia and in most cases it is difficult to say which of them are really rare and which - only overlooked. At the same time a range of species with specific ecological demands are clearly endangered due to changes in their natural habitats.

For the first time fungi were included in the Red Data Book of Latvia in 1996. There were 38 species of fungi included in it. Most of them has quite conspicuous fruitbodies which are easy to find and determine in field. Knowledge on fungi in Latvia has been improved since that time. The List of Protected Species was approved last year (Decision Nr.396, 2000. by the Council of Ministers of Latvia) with 59 species of fungi included in it. There are 17 new species in comparison with the Red Data Book. However, the practical protection of these species is rather problematic. The best way to protect species is to protect natural habitats in a wide sense. But in many cases it seems to be very difficult in the present situation.

List of species

The new fungi species included in the List of Protected Species are given below with notes on their habitat and distribution in Latvia. Data are registered and herbarium collections are stored at the Latvian Museum of Natural History and at the Faculty of Biology of the University of Latvia. Fungi were collected in expeditions from different parts of Latvia, especially from protected areas. The previous written information and F. E. Stoll's paintings in water color of Latvian fungi were used. A lot of localities of rare fungi were discovered by schoolchildren and by other interested people, visitors of fungi exhibitions held regularly at the museum.

Abbreviations:

HDM – collection of Latvian Museum of Natural History
HBI - collection of Institute of Biology
RIG - collection of Faculty of Biology of the University of Latvia

Amanita eliae Quél.

Mycorrhizal species, grows in hardwood and mixed forests, at forest edges on acidic soils. For the first time was found by K. R. Kupffer in 1931 in Ventspils distr., Moricsala (Kupffer 1931), in deciduous forest. In 1995 it was collected by I.D., in. Krāslava distr, Sloboda, in birch stand (HDM), (Avota 1996).

Amanita strobiliformis (Paulet) Bertilloni

Mycorrhizal species, grows in hardwood and mixed forests, in parks on moist, base-rich soils. For the first time this species has been mentioned in F. E. Stoll's paintings in water colour of Latvian fungi, and has been found in Jelgava distr., Lielvircava, Oglaine, in 1919 in deciduous forest. Later it has been found by O. Lapiņš in 1951, (Lapiņš 1951) Jelgava distr., Lielplatone, in deciduous forest, and in 1961, Jelgava distr., Eleja, in park and birch stand. (Lapiņš 1963).

Asterodon ferruginosus Pat.

This species has been found in Latvia in two localities. For this species it is very characteristic to form large patches on wet partly decomposed logs in shady coniferous or mixtured forests. *Asterodon ferruginosus* is known from: Mežole, Valka distr. (HDM), Zaube Cēsis distr. (HDM).

Boletus satanas Lenz

Mycorrhizal species, grows in hardwood forests on calcareous soils, near *Fagus* and *Quercus*.
For the first time was found in Aizkraukle distr., the valley of river Pērse, in the 30thys. (Bucholtz,1904). 1996 was collected by E. Vimba in Aizkraukle distr. in arboretum of Skrīveri, in deciduous forest near *Quercus robur* L. (HDM).

Fomitopsis rosea (Alb. et Schw.: Fr.) P. Karst.

Grows mainly in coniferous forests with long continuity on spruce or pine logs. It is known from 3 localities in Latvia. *Fomitopsis rosea* is known from: Katleši Balvi distr. (HDM, collected by U.Suško), Mežole, Valka distr. (HDM), Slītere, Talsi distr. (HDM).

Hapalopilus croceus (Pers.: Fr.) Murr.

The only habitat of this species is old oak-trees of large diameter. One locality was known from 1935 (collection of Kārlis Starcs, RIG). Recently mycological research revealed 7 new localities of *Hapalopilus croceus* in Latvia, one of them are extremly rich in specimens. *Hapalopilus croceus* is known from: Ādaži, Rīga distr. (HDM), Elkšņi, Jēkabpils distr. (HDM), Kaltiņu oak, Rīga (HDM), Marsi, Valka distr. (HDM, RIG), Moricsala, Ventspils distr. (RIG), Ungurmuiža, Cēsis distr. (HDM), Vestiena, Madona distr. (RIG).

Leucopaxillus compactus (Fr.) Neuh. - *L. tricolor* (Peck) Kühner

Grows in hardwood forests on calcareous soils. For the first time was collected in 1993 and 1996 by I.D., both in Daugavpils distr., Ilgas, near Riču lake in mixed forest, by *Tilia cordata* L. (HDM), (Avota, Krastiņa 1994). In 2000 was collected by M. Eipure in Aizkraukle distr., by railway station Lāčplēsis, in mixed forest.

Peziza ammophila Dur. et Mont.

Grows in foredunes of the Baltic sea. For the first time this species has been mentioned in F. E. Stoll's paintings in water colour of Latvian fungi, and it has been found in Rīga distr., Garciems in 1925. In 1964 was collected in Rīga distr., Mangaļi by A. Piterāns (RIG). Later was collected by E. Vimba in 1995 and in 1996 in Talsi distr., Kolka and by B. Laime in 1995 in Liepāja distr., Jūrmalciems on foredune (RIG).

Phellinus ferugineofuscus (P.Karst.) Boud.

This species has been found on spruce and pine logs, often together with another polypore species - *Antrodia serialis*. There are several collections from different places in one region of Latvia. *Phellinus ferrugineofuscus* is known from: Drabeši, Cēsis distr. (HDM), Mežole, Valka distr. (HDM).

Phellinus nigrolimitatus (Rom.) Bourd.

Grows mainly in boreal "taiga" forests with long continuity on coniferous logs. This species has been found in Latvia in coniferous forests with high biodiversity (on old, partly decomposed spruce logs of large diameter) and twice - on big log of hay shed. *Phellinus nigrolimitatus* is known from: Drabeši, Cēsis distr. (HDM), Mežole, Valka distr. (HDM), Slītere, Talsu distr. (HDM), Tīre|purvs forestry, Jelgava distr.

(HDM), Vecpiebalga, Cēsis distr. (HDM, collected by U.Suško).

Rigidoporus crocatus (Pat.) Ryvarden

Grows on logs of coniferous and deciduous trees, prefers wet old-grows forests. This species is considered to be an indicator of continuity of forests. It has been found in three distant places in Latvia, both in the regions of boreal forests, and nemoral forests. *Rigidoporus crocatus* is known from: Jaunbērze, Dobele distr. (HDM), Mežole, Valka distr. (HDM), Slītere, Talsi distr. (HDM).

Stropharia albocrenulata (Peck) Kreisel

Grows on fallen dead or on damaged trees of *Populus tremula.* For the first time was mentioned in literature with no locality indicated place (Lūkins 1970). Later was collected in 1992 by I.D., and 1996 by A. Liepiņš in Tukums distr., Jaunmokas, in deciduous forest by *Populus tremula* (HDM).

Tubaria confragosa (Fr.) Kühner

Grows in mixed forests on fallen dead wood, especially on small branches of hardwood. For the first time was collected in 1995 by D. Pilāte in Cēsis distr., Nītaure, in mixed forest (Avota 1996b). For the second time was found in 1997 by I. Krastiņa in Valmiera distr., Saule, in mixed forest (HBI). In 1999 it was collected by I.D., in Valka distr., Trikāta, "Zaltes" in old garden on fallen twigs of *Corylus avellana* L., mass find (HDM).

Tulostoma brumale Pers.: Pers.

Grows in dunes and sandy pine forests. For the first time this species has been mentioned in F. E. Stoll's paintings in water colour of Latvian fungi, and it has been found in Rīga in1923. Later was collected by I.D. in Rīga, Bu]]usala, in dunes, 1988, and in Open-air museum 1990 (HDM). Species grows on foredunes and older dunes (Vimba, 1997).

Tulostoma fimbriatum Fr.

Grows in dunes and sandy pine forests. For the first time this species has been mentioned in F. E. Stoll's paintings in water colour of Latvian fungi, and it has been found in Rīga, 1924. Are distributed on foredunes and older dunes (Vimba 1997).

Volvariella bombycina (Schaeff.: Fr.)

Singer Grows on living or dead hardwoods also on roots or on sawdust of *Populus, Acer, Tilia, Salix, Quercus.* For the first time this species has been mentioned in F. E. Stoll's paintings in water colour of Latvian fungi, and it has been found in1923 in Rīga. Later has been found in 1951 by O. Lapiņš in Bauska distr., Mežotne, by E. Vimba in 1973 in Madona distr., Cesvaine, and in Rīga distr. Vaivari, in 1973 (Lūkins 1981). For the last time was collected in 1988 by T. Ārgale and in 2000 by I.D., both in Rīga in garden on wood.

Xerula radicata (Relhan: Fr.) Dorfelt - *Oudemansiella radicata* (Rehlan: Fr.)

Singer Grows on or near rotten stumps in mixed hardwood forests, commonly near *Fagus* or *Quercus*. For the first time this species has been mentioned in F. E. Stoll's paintings in water colour of Latvian fungi, and has been found in 1935 in Liepāja distr., Lukna, in deciduous forest. Later was collected by I.D. in 1988 in Talsi distr., Šķēde, in deciduous forest near *Fagus sylvatica* L. and in 1995 in Aizkraukle distr., bog Aizkraukle in deciduous forest near *Quercus robur* L.

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NOVEL ENVIRONMENTALY HARMLESS MEAN FOR THE CULTIVATED PLANTS PESTS

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On the base of conifer extractive substances was created a novel ecological harmless preparation with fungicidal and insecticidal properties for plant protection. Repeated application of the preparation during the vegetation session may reduce the development of fungus infection up to 64 – 85% and suction insect reproduction decrease up to 63 – 80%. Obtaining of the phytopreparation proved to be more profitable than production of other biological preparations, because as raw material would be used by-product from conifer processing – foliage of pine and spruce.

Key words: Plant protection, phytopreparation, fungicidal and insecticidal properties of extractive substances.

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Introduction

Several extractive substances containing terphenylene compounds, could possess a certain extent of fungicidal and insecticidal activity (Micales et al. 1994; Ohira et al. 1993; Vyrodov et al. 1987; Theander 1982; Harvey 1969).

Simultaneously were carried out large-scale investigations that proved, that the plant extracts are harmless for environment: warm-blooded animals, birds, useful entomofauna, including the population of pollination insects, as well as for soil microfauna and flora (Ismailovs et al. 1996; Sirinins et al. 1996; Ismailovs et al. 1998).

During several years researchers of the Institute of Biology at the University of Latvian in co-operation with partners from the LFRI "Silava" are studying plant extractive substances, to obtain the phytopreparation, determine it's activities, as well evaluating possible applications of the preparation in practice against infections caused by plant pests and fungus. Calculated soda, slaked lime, emulsifiers and surface active substances.

In this study as raw material was used extracted substances from pine and spruce foliage containg salts of resinous and fatty acids and chlorophylene derivatives.

Resinous acids, make basic mass of the products dray matter, is ¾ of the total organics acid amount, and are the principal active component. Moreover the formed preparation contains: calcinated soda, slaked lime, emulsifiers and surface active substances.

In composition of the phytopreparations produced by foreign researchers mainly dominate foliage tree extracts, for example, coriander, Indian's foliage tree – *Azadirachta indica* or special cultivated annual plants – tansy, sage, lavander, which cultivation requires much attention and work, and the output of extracts was comparative expensive (Nelm-Info 1997).

In our phytopreparation was utilises the conifer processing by-products – pine and spruce needles foliage without conifer sorting. Thereby the output of such biopreparation technology is simpler and more profitable.

In this paper we present a suevey about the improved preparative form of biopreparation and it's fungicidal and insecticidal activities during experiments in the years 1999 and 2000 in greenhouses and field conditions. The results of our investigations were compared with those, obtained during standard preparation processing: with biological preparation "Mycostop" that was offered by – Finland company "Kemira" and the universal chemical preparation "Bordo".

Materials and methods

The bio-preparation was produced as paste that is homogenous, dark green mass with specific needle smell. pH of the preparation is in 7.5 to 8.5. Steady mixed in warm water during 30 – 45 minutes, a homogenous aqueous suspension was obtained. The sedimentation degree of working suspension was determined in a 5-point scale. It corresponded to 4 points that meant that it was stable and sedimentation degree after 90 minutes didn't reach 20%. The preparation in a sufficient quality fixed on the plant's surface. Evaluating by a 5-point scale it corresponds to 5 points and requirements. It means, that after intensive rainfall, the preparation's raising degree is small and didn't reach 10%.

The bio-preparation would be used at concentration 1 – 2%. The use of working suspension was 50 – 100 l/ha or 0.35 l/m^2, depending on the sprayer type, size of the culture plant and other conditions. Using the back-sprayer with a nozzle diameter 1.6 to 2.0 mm at the air pressure 1.5 – 2.0 at, the size of working suspension drops with droplet weight about 90 to 100 mg, than didn't tend the drops to flow together on the plant substrate.

Fungicidal and insecticidal activity of the bio-preparation was determined in greenhouse and field conditions. The average air temperature in greenhouse conditions was 20^0 to 25^0 C, the air relative humidity – 80 to 95%. The air average temperature in field conditions was 17^0 to 21^0 C, the air relative humidity – 60 to 75%. Experimental plants were horticulture (tomatoes, cucumbers), ornamental plants (chrysanthemum, rose), fruit-trees (apple-tree, plum tree) and berry bushes (gooseberry bush).

The fungicidal activity of the bio-preparation was determined in greenhouse conditions on the grey rot (*Botrytis cinerea*), leaf brown mould (*Cladosporium fulvum*), mildew (*Oidium chrysanthemi*), true mildew (*Erysiphe communis*), at field conditions on the: mildew of gooseberry bush (*Microsphaera grossulariae*).

The insicticidal activity of the bio-preparation was determined in greenhouse conditions on the little white flea (*Trialenrodes vaporariorum*), peach plant louse (*Myzodes persicae*), and at field conditions on the rose plant louse (*Macrosiphum rosae*), apple little flea (*Psylla mali*), apple green plant louse (*Aphis pomi*), plum plant louse (*Hyalopterus arundinis*) and bean plant louse (*Aphis fabae*).

During the vegetation period 2 or 4 treatments were done: the first – prophylactic for variants with the infection of fungus, the next – after every 10 or 14 days. Every experimental variant was repeated 3 or 4 times. Each area of repetition in greenhouse conditions was 4 – 6 m^2. The pest's stocktaking was carried out diagonally on 20 plant samples.

In field conditions the variant consisted from 5 fruit-trees or bushes. The stocktaking was carried out on the sample branches of 6 trees in different altitudes. The activity of the preparation was estimated, compared with the control variant and expressed in percents, compared with generally accepted formula of Abbota.

Results

It was cleared up that; extracted substances of conifer in combined with correspond stuff substances formed the preparation in paste form. In warm water it formed the working suspension, that very well fixed on the surface of plant and was steady. Thereby for insects, especially of suction type (plant louse, little white flea, thrips and others) feeding on the plant leaves, migration to the non-worked plant parts, and normal conditions for development of eggs was retarded. In addition to the mechanical effect the bio-preparation possesses systematic effect as well, as some quantities of active substrate the plant through the pores of leaves and roots system. In this way formation of insect's hormones was blocked, delayed maturation of the eggs, hindered the normal feeding process. The multiform effect of the preparation and complex action of active substrate has retarded formation of insect's resistance during several (up to 20) generation period.

Phytopreparation, produced on the basis of conifer extracted substances, possesses a high enough fungicidal activity. Applying the bio-preparation to the culture plants 3 to 4 times during the vegetation period it was possible to limit a large scale development of fungicidal infections up to 64 to 85% in greenhouse as well as field conditions. Thereby, was eliminated mul-

tiplying of infection. The effectiveness of the bio-preparation "Mycostop" produced in Finland, in similar conditions was on average lower by 16%. The universal chemical fungicide "Bordo" for protection against fungicidal diseases was only a bit more effective (on average 2%) than the novel produced bio-preparation (Table 1).

The novel phytopreparation possesses certain insecticidal properties, too, that we have considered as a by-effect. In vegetation season using 2 or 3 times the bio-preparation the suction-type's insect multiplication was decreased, in comparison with control test by 63 to 80%, thereby managing the density of insects below the critical threshold. The achieved effectiveness was considerable dependent on insect species, plant culture and quality of treatment. Separate suction-type insect species was of very great endurance against the phytopreparation, for example, bean plant louse.

The effectiveness of the bio-preparation "Neko" produced by Estonia and Finnish researchers was approximately similar – 72 to 83%. It must be marked up, that this preparation was provided for application only in small areas in greenhouses.

It can be marked, that researchers of the Russia Institute of Plant Protectiona and the Academy of Sankt-Peterburg of Forest Technology tested the bio-preparation, produced on the basis of extractive substances of conifer, showed good results also applied for protection against the rodent type insects insects in the area of Krasnodara: green apple plant louse (*Aphis pomi*) and plum leaf roller (*Laspeyresia funebrana*) was reduced – on average by 53%, in comparison with control, apple leaf roller (*Laspeyresia pomenella*) –

Table 1. The activity of the preparation to limit the phytopatogenic fungus infection development on the culture plants (in field conditions)

Preparation	Culture	Phytopathogenic	Titre of working suspension, %	Protection effect compared with control, %
Phyto-preparation	Cucumbers	True mildew *(Erysiphe communis)*	2.0	68.0 ± 3.10
"	Tomatoes	True mildew *(Erysiphe communis)*	"	72.2 ± 3.00
"	"	Grey rot *(Botrytis cinerea)*	"	63.7 ± 2.50
"	Gooseberry bush	Mildew *(Microsphaera grossulariae)*	"	68.8 ± 3.40
Mycostop	Cucumbers	True mildew *(Erysiphe communis)*	1.0	66.7 ± 3.70
"	Tomatoes	True mildew *(Erysiphe communis)*	"	73.8 ± 3.20
"	"	Grey rot *(Botrytis cinerea)*	"	62.7 ± 2.30
Bordo	Cucumbers	True mildew *(Erysiphe communis)*	0.5	88.0 ± 4.12
"	Tomatoes	True mildew *(Erysiphe communis)*	"	80.7 ± 3.75
"	"	Grey rot *(Botrytis cinerea)*	"	75.3 ± 3.15
"	Gooseberry bush	Mildew *(Microsphaera grossulariae)*	"	77.5 ± 3.60

Table 2. The preparation activity to limit the development of phytopatogenic fungus infection on the culture plants (in greenhouse conditions)

Preparation	Culture	Phytopathogenic	Titre of working suspension, %	Protection effect compared with control, %
Phyto-preparation	Cucumbers	*(Botrrytis cinerea)*	2.0	72.5 ± 2.60
"	"	*(Erysiphe communis)*	"	75.3 ± 3.20
"	Tomatoes	*(Cladosporium fulvum)*	"	64.7 ± 2.18
"	"	*(Erysiphe communis)*	"	84.8 ± 3.48
"	"	*(Botrytis cinerea)*	"	68.5 ± 2.15
"	Chrysanthemum	*(Oidium chrysanthemi)*	1.0	72.7 ± 3.10
Mycostop	Cucumbers	*(Botrytis cinerea)*	0.5	55.7 ± 2.30
"	"	*(Erysiphe communis)*	"	68.2 ± 2.80
"	Tomatoes	*(Cladosporium fulvum)*	"	47.7 ± 2.10
"	"	*(Erysiphe communis)*	"	70.0 ± 3.18
"	"	*(Erysiphe communis)*	"	65.2 ± 2.16
"	Chrysanthemum	*(Oidium chrysanthemi)*	"	66.7 ± 2.10
Bordo	Cucumbers	*(Botrytis cinerea)*	1.0	78.5 ± 3.15
"	"	*(Erysiphe communis)*	"	82.0 ± 3.45
"	Tomatoes	*(Cladosporium fulvum)*	"	65.4 ± 2.17
"	"	*(Erysiphe communis)*	"	86.2 ± 3.10
"	"	*(Botrytis cinerea)*	"	78.0 ± 4.00
"	Chrysanthemum	*(Oidium chrysanthemi)*	"	76.8 ± 3.50

on average by 68% and potato leaf-cutting beetle (*Laspeyresia pomonella*) – on averange 66% (Table 2).

In this geographic zone the preparation also demonstrated good enough fungicidal properties as well, especially in limitation of scab (*Venturia inaequalis*) on the fruit-trees and against mildew (*Podosphaera leucotricha, Oidium farinos*) (Proc. Of Practice Conference, 1980).

Conclusions

1. Is produced the bio-preparation on the basis of conifer extractive substances with fungicidal and insecticidal properties. Preparation may be used for culture plant protection in greenhouse and field conditions.

2. Repeated treatment during the vegetation period may limit the development of fungal infection up to 64 to 85%, and limit spreading of the fungus spores as well.

3. in protection of culture plants against the pests – suction type insects, their multiplication during the vegetation period may be decreased up to 63 to 80%. The effectiveness of the preparation depends on insects species, culture plant and treatment quality.

4. The activity of the bio-preparation, produced on the basis of conifer extractive substances, is not essentially different that the phytopreparations "Mycostop" and "Neko" (Finland company), but it's productions is economically more profitable, because the raw material is the conifer processing by-product – spruce and pine foliage.

5. Phytopreparation is ecologically harmless (The Conclusion of the Ministry of Prosperity and Centre of Environment Health of Latvian Republic No 06.4-14-319 from 30.05.93).

Table 3. The bio-preparation activity to limit the multiplication of suction-type insects (in greenhouse and field conditions)

Preparation	Culture	Insect species	Titre of working suspension, %	Technical effectiveness, %
		In greenhouse conditions		
Phytopreparation (on the basis of conifer extractive substances)	Cucumbers	*(Trialenrodes vaporariorum)*	2.0	75.3 ± 3.20
"	"	*(Myzodes persicae)*	"	61.2 ± 2.75
"	Tomatoes	*(Trialenrodes vaporariorum)*	"	71.8 ± 3.00
"	Roses	*(Macrosiphum rosae)*	"	78.2 ± 3.12
Phytopreparation "Neko" (on the basis of foliage trees)	Cucumbers	*(Trialenrodes vaporariorum)*	Standard	80.5 ± 3.40
"	"	*(Myzodes persicae)*	"	67.8 ± 2.45
"	Tomatoes	*(Trialenrodes vaporariorum)*	"	82.7 ± 3.70
"	Roses	*(Macrosiphum rosae)*	"	76.7 ± 2.65
		In field conditions		
Phytopreparation (on the basis of conifer extractive substances)	Apple-tree	*(Psylla mali)*	2.0	65.2 ± 3.40
"	"	*(Aphis pomi)*	"	68.3 ± 3.12
"	Plum-tree	*(Hyalopterus arundinis)*	"	62.5 ± 2.32
"	Rose	*(Macrosiphum rosae)*	"	75.8 ± 3.60
"	Bean	*(Aphis fabae)*	"	45.3 ± 2.30
Phytopreparation "Neko" (on the basis of foliage trees)	Rose	*(Macrosiphum rosae)*	Standard	72.0 ± 3.70

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