The habitat use of molluscs in the forests of Latvia

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Introduction

General information about habitat preferences of terrestrial molluscs in Northern Europe can be found in several papers, mainly handbooks (Sloka & Sloka 1957, Kerney et al.1983, Ehnström & Waldén 1986, Лихарев1962, Лихарев & Виктор 1980, Лихарев & Раммельмейер 1952, Шилейко 1978). By now there were little relevant data regarding molluscs in Latvia. In most cases the studies deals with deciduous forests, more rarely with coniferous forests (Pētersons 1932, 1933, Schlesch 1942, Pilāte 1997, Spuris 1998). The aim of this study was to find out habitat preferences of forest molluscs and identify factors determining distribution of mollusc species according the groups of forest biotopes in Latvia.

Materials and methods

The studies were carried out in 1995 and 1997 as a part of the complex investigation on natural forests of Latvia conducted by Suško (1997). Collection of material is described in another paper (Pilāte 2003). Data were processed and analysed using classification software (TWINSPAN) (Hill 1979). Of 42 study plots two were excluded from the analyses because the transect was set in heterogeneous biotopes.

Results and discussion

In the forest areas studied, 52 species were found. 16 of them were found in all forest biotope groups studied. Three species - *Discus ruderatus, Euconulus fulvus* and *Nesovitrea hammonis*, were recorded in all study plots regardless of biotope's transformation stage and it's biological features. The number of species found in each forest biotope group varies from 20 to 46 species, but in each study plot from 2 to 30 species. The multiple dichotomous divisions of study plots were done until the second level (Fig. 1). At the first distribution level all 40 study plots are grouped in two groups, each differing with species composition and mollusc abundance. Forests of pioneer tree species, mixed spruce forests, wet black alder forests and broad-leaved forests are included in group *0, representing forest biotopes the most rich with mollusc species. It means that the mentioned biotopes are the most typical for forest molluscs. They correspond with mollusc ecological demands, i.e. they give sufficient shadowness and humidity, stable microclimate, sufficient amount of coarse woody debris, to species requiring specific conditions in prolonged time period (e.g., forest continuity, rich vegetation and forest litter). In respect to forest management these biotopes are rather untouched or with limited influence: selective cutting or single clear-cut followed by natural regeneration.

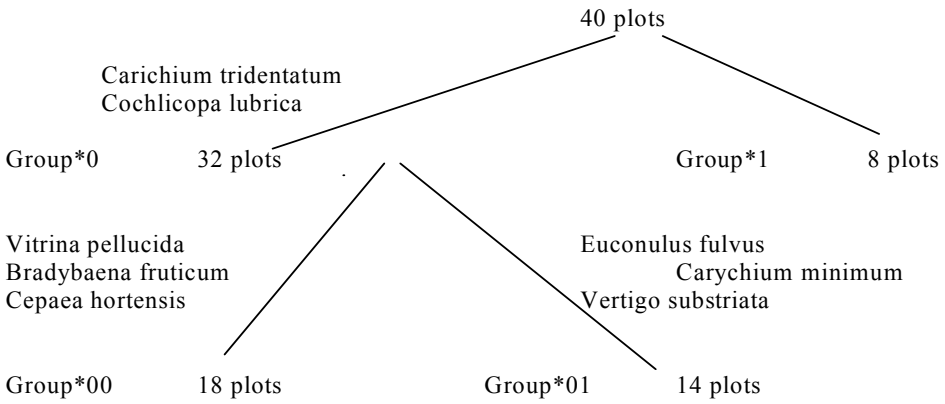

Figure 1. TWINSPAN dendrogram of 40 study plots

Forest biotopes most scarce with the mollusc species are separated at group *1. Dry pine forests as well as pine and spruce forest plantations are present in this group. These are biotopes not corresponding with mollusc ecological demands. Forest management there includes repeated clear-cuttings, drainage, soil tillage and artificial regeneration. Among these biotopes are also spruce plantations growing even on rich deciduous woodland soils. An exception in this group of biotopes is one study plot (29), a wet black alder forest, which was too wet to be suitable for terrestrial molluscs.

A large number of diagnostic species (20) representing III-V incidence class is characteristic for the group *0 (Table 1). All these species are typical and widely distributed forest dwellers. II - I incidence class includes 28 mollusc species. Distinguishing species for group *0 are hygrophilous *Carychium tridentatum* and *Cochlicopa lubrica* - typical for fertile to moderately fertile litter.

Forest biotopes most scarce with the mollusc species (group *1) are represented by species of V, IV and II incidence class. These are the most common and highly adaptive terrestrial molluscs in Latvia. An exception is *Vertigo ronnebyensis*, a species typical for pine forests.

At the second distribution level the 32 study plots of group *0 are furthermore divided into two groups (Fig.1) with different forest vegetation types and mollusc species compositions. Distinguishing species for group *00, such as *Vitrina pellucida, Bradybaena fruticum* and *Cepaea hortensis* are typical for moderately wet and fertile litter. Group *00 includes forest biotopes with the most rich forest mollusc fauna. These are mainly forests of pioneer tree species and broad-leaved forests. These biotopes have limited amount of the spruce, optimal moisture conditions and shadowness, rich vegetation and forest litter. In respect to forest management these biotopes are almost untouched or with limited influence.

Another group, *01 includes forest biotopes not so rich with forest mollusc species, and is represented mainly by wet mixed spruce and wet black alder forests. Increased moisture, greater admixture of spruce and rather scarce vegetation is typical for biotopes of this group. In respect to forest management they have different degree of influence. Among them are untouched wet forests and also broad-leaved forests where repeated clear-cuts have been done. Three distinguishing species, the hygrophilous *Euconulus fulvus, Vertigo substriata* and *Carychium minimum* are found in the group *01.

Group *00 is characterized by a great number of diagnostic species, 24 of all 43 identified within this group. In the group *00 II and I incidence class is reached by 19 species. 18 diagnostic species of 39 recorded are distributed for the group *01. In this group, II and I incidence class is reached by 21 species (Table 1).

Table 1. Frequency classes of terrestrial mollusc species in forests groups of Latvia (using TWINSPAN, see Fig. 1)

At the 1st level	Groups and frequency classes		At the 2nd level	Groups and frequency classes	
Species	*0	*1	Species	*00	*01
Carychium tridentatum	V	-	Vitrina pellucida	V	I
Cochlicopa lubrica	V	-	Aegopinella pura	V	III
Vitrea crystallina	V	I	Carychium tridentatum	V	V
Punctum pygmaeum	V	II	Cochlicopa lubrica	V	V
Vertigo substriata	V	II	Perforatella bidentata	V	IV
Columella edentula	V	II	Vitrea crystallina	V	V
Nesovitrea hammonis	V	V	Vertigo pusilla	V	III
Nesovitrea petronella	V	IV	Punctum pygmaeum	V	V
Euconulus fulvus	V	IV	Vertigo substriata	V	V
Columella aspera	V	II	Columella edentula	V	IV
Aegopinella pura	IV	-	Nesovitrea hammonis	V	V
Acanthynula aculeata	IV	-	Nesovitrea petronella	V	V
Cochlodina laminata	IV	-	Euconulus fulvus	V	V
Perforatella bidentata	IV	-	Columella aspera	V	IV
Vertigo pusilla	IV	I	Acanthynula aculeata	IV	III
Carychium minimum	IV	-	Cochlodina laminata	IV	III
Vitrina pellucida	III	I	Carychium minimum	IV	IV
Acicula polita	III	-	Cepaea hortensis	III	I
Succinea oblonga	III	-	Bradybaena fruticum	III	-
Discus ruderatus	III	II	Macrogastra plicatula	III	II
Cepaea hortensis	II	I	Acicula polita	III	II
Bradybaena fruticum	II	-	Succinea putris	III	II
Ruthenica filograna	II	-	Macrogastra ventricosa	III	I
Macrogastra plicatula	II	-	Succinea oblonga	III	II
Clausilia bidentata	II	-	Vallonia costata	II	-
Succinea putris	II	-	Oxychilus alliarius	II	-
Macrogastra ventricosa	II	-	Trichia hispida	II	-
Vallonia costata	II	-	Clausilia pumila	II	I
Zonitoides nitidus	II	-	Ruthenica filograna	II	I
Cochlicopa lubricella	I	-	Clausilia bidentata	II	I
Limax cinereoniger	I	-	Discus ruderatus	II	IV
Oxychilus allearius	I	-	Cochlicopa lubricella	I	-
Trichia hispida	I	-	Limax cinereoniger	I	-
Bulgarica cana	I	-	Spermodea lammelata	I	-
Clausilia pumila	I	-	Vertigo alpestris	I	-
Clausilia cruciata	I	-	Arion circumscriptus	I	-
Macrogastra latestriata	I	-	Bulgarica cana	I	I
Aegopinella nitidula	I	-	Clausilia dubia	I	I
Arion subfuscus	I	-	Clausilia cruciata	I	I
Vertigo antivertigo	I	-	Macrogastra latestriata	I	I
Vertigo geyeri	I	-	Aegopinella nitidula	I	I
Vertigo ronnebyensis	I	II	Zonitoides nitidus	I	III
Spermodea lammelata	I	-	Arion subfuscus	I	II
Vertigo alpestris	I	-	Vertigo ronnebyensis	-	II
Arion circumscriptus	I	-	Vertigo antivertigo	-	I
Perforatella rubiginosa	I	-	Vertigo geyeri	-	I
Vertigo genesii	I	-	Vertigo genesii	-	I
			Perforatella rubiginosa	-	I
Total:	49 sp.	13 sp.		43 sp.	39 sp.

In group *01 diagnostic level in respect to group *00 is reached by *Zonitoides nitidus*, which indicates wet biotopes, as well as *Discus ruderatus*. The species *Vertigo antivertigo, V. geyeri, V. genesii* and *Perforatella rubiginosa* are found only in the group *01 as they are typical for wet and marshy biotopes. At the same time, most species of the group *00 (such as *Aegopinella pura, Vertigo pusilla* and *Acanthynula acuelata*) in group *01 have incidence class lower for 1-2 steps. It can be explained by more wet conditions, scarce litter and by the presence of spruce.

The data treated by TWINSPAN reveals that all forest biotopes can be divided in 3 major groups: biotopes with rich mollusc fauna, with moderate richness and with poor fauna. This difference is determined by the richness of vegetation, humidity and forest management activities such as main felling, drainage, and artificial regeneration.

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