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Results of malacological investigations of the Síkfőkút moss-capped oak forest via use of quadrate and soil trap sampling.

By KÁROLY BÁBA, Szeged.

Abstract

Malacological investigations were performed on quadrate and soil-trap samples from the moss-capped oak forests of Síkfőkút (Bükk Mts., Northern Hungary) between the periods of 1973 and 1984. The regional correlations between main character species of the forest were analyzed in details. Furthermore, the annual reproductive cycles of the dominant species along with the seasonal and annual dynamics of snail assemblages with regards to the climate has been investigated. Further research involved such issues as the consummation dynamics of 1975, quadrate sampling of species for a period lasting from spring to fall and the energy sources of the four dominant species.

According to the findings there is a strong correlation between the 4-year climatic cycles, the actual annual climate and the dynamics of gastropod populations in the analyzed moss-capped oak forest situated on a continental peak regarding microclimatic conditions.

1. Introduction

The climate zonal moss-capped oak forest (Quercetum petraea-cerris) of Síkfőkút is situated on lossey deposits approximately 300 meters above sea level. At the initiation phase of the investigations it was a 60-65 year old forest treated with breed selectional deforestation.

In the workgroup investigating the area my goal was to shed light onto the composition of the gastropod faunas of this typical climate zonal oak forest along with the factors influencing the composition of gastropod assemblages and its seasonal and annual dynamics. The coenological investigations on moss-capped oak forests were extended to other areas of the Bükk Mts. as well. (BÁBA & PODANI 1992)

2. Material and methods

The present study deals with the analysis of mollusks collected from quadrates (10x10x25 cm, 100x25x25 cm) and glycol soil traps between 1973 and 1984. Investigations were complemented with food consumption analysis of the gastropods. Laboratory results were compared to those gained on the field for the individual forest types in the Bükk Mts. The quadrate collections between 1973-84 yielded 314 specimens belonging to 20 different taxa. While for the period between 1975 and 1984 1840 specimens sorted into 12 taxa were collected from the soil traps. 40 specimens from 7 taxa were analyzed in laboratory conditions regarding food consumption in weekly periods for periods of May, September and October. In 1975 weight and food consumption laboratory investigations were carried out on quadrate samples collected in the months of V, VIII, IX and XI.

Food consumption rates were measured on animals kept in laboratory tanks. Daily measurements included the amounts of mucous, dejecta and consumed leaf (control leaf) as well as the bodyweight of the animals under investigation (GERE 1978.). Part of the material was analyzed with Phillipson-type micro fungal calorimeter for energy studies. LÁSZLÓ GALLÉ and LÁSZLÓ PAPP carried out these measurements.

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Quadrate sampling was carried out three times annually: in the months of V, VIII, IX, (1), IV, VI, IX (2) and V, VII, IX (3). Sampling from soil traps occurred from the year of 1979 in the following months: III, IV, VI, VII, VIII, IX, X. The number of snail consuming Silphidae, Carabidae and Heteroptera species was also recorded during collections.

Air and soil temperature as well as precipitation data collected by LAJOS NAGY at the Síkfőkút meteorological observatory were also utilized in my work.

The collected data was analyzed with classificatory statistical methods. The diversity indexes of Shannon-Wiener were also calculated. Oscillation and fluctuation analysis was carried out via Czekanowski Cluster Analysis. Besides this method the following ecological species grouping based on the FEOLI & ORLÓCZI (1979) block-clustering method was applied for data gained from the forests and meadows of the Bükk Mts. between 1980 and 1990: 1. hygrophilous, 2. subhygrophilous forest dwellers, 3.hygrophilous beach dwellers, 4. xerophilous, xeromesophilous meadow and rocky meadow dwellers, 5. ubiquists.

Based on LOŽEK's (1964) habitat classification three groups were formed to indicate structural changes triggered by climatic and anthropogenic effects: 1.forest dweller (F), 2. Bush forest dweller (species preferring forests and semi-shadowed half-open vegetation areas BF), steppe dwellers (S). In order to shed light onto the interactions and origin of faunal elements of the bush forests and successionally related moss-capped oak forests, WR average values of the bottom communities were also taken into consideration during the 10-year investigation period in the Bükk Mts. Cenological character species were formed on the basis of regional constancy values.

Furthermore, a zoogeographical analysis based on BÁBA (1982) was also carried out on the material collected from the quadrates and the soil traps. Here I would like to express my gratitude for the climatic data to LAJOS NAGY PhD., for the WR value data to LÁSZLÓ KÖRMÖCZI PhD., LÁSZLÓ GALLÉ PhD. and László Papp PhD. performed calorimetric measurements. I am greatly in debt to ANDRÁS VARGA for determining the limaces in the samples. BÉLA GASKÓ PhD. determinated the insect fauna feeding on the found gastropods.

3. Relations of gastropod assemblages and the moss-capped oak forests of the Bükk Mts

The moss-capped oak forests of the Bükk Mts. can be regarded as zonal communities of the oak zone with adjacent edaphic bush forest areas (JAKUCS 1961). Fig.1 presents a distributional pattern for the stational relation of edaphic bush forests and moss-capped oak forests based on production site values (humidity, soil interaction) collected via plant coenological investigations of 10 forest areas from the Bükk Mts. Relations of the certain successional stages are displayed in values of soil humidity increase as well as soil deepening and the gradual closure of the foliage. This sort of gradualism is also traceable in the behavioral properties of the ecological species groups as well (Fig.2). The two dominant vegetation units of the Bükk Mts., the Oak and Beech Units, are also differentiated regarding the compositions of the ecological species groups. Percentages of xero-mesophylous species tend to take a decrease from the moss-capped oak forest developmental stage.

On the other hand there is a sharp boundary between the zonal forest communities of the Beech Unit and the Oak Unit with the adjacent hornbeam oak forests based on malacological investigations (Fig.3). In all likelihood climatic factors must have a crucial role in the creation of such a sharp boundary. Communities of the Beech zone along with the bush forests are situated on slopes bearing different aspects. Emission from the slopes is relatively low

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(JUSTYÁK & TAR 1974). When we take into consideration the humidity value changes with the closure of the foliage besides the previously mentioned factors we will find that the majority of these forests are under sub-Atlantic climatic influence. Temperature fluctuations in the biotopes occupying the peaks and plateaus (Qp-cerris, Qp. Carpinetum) are higher than those of the slopes and thus are under continental influence (BACÓ 1959). Within the plant communities under investigation behavioral patterns of the climate tested continental and sub Atlantic species groups refer to the micro- and macroclimatic changes (BÁBA 1982.) (Fig.4). There is a sharp increase for the sub-Atlantic species within the Beech zone.

Based on the above-mentioned factors annual climatic fluctuations must have been preserved in the malacofauna of the Síkfőkút moss-capped oak forests as well. These are investigated for a period of 10-years.

3.1 Character species of the moss-capped oak forests

A general condition of the moss-capped oak forests with the adjacent bush forests is displayed in the distribution of coenological character species. These character species can be divided into four major groups based on distributional frequency values: 1. frequent dominant (50-100%), subfrequent dominant (25-49%), accessorial (0-20%), and ubiquists (Table 1). There is a gradual decrease of species numbers within the succession lines (31,22,23) indicating anthropogenic influences in the area (BÁBA 1992.). The decrease observed in the subfrequent-dominant group within the succession line seems to underlie this hypothesis as well. Low dominance values of frequent-dominant species as well as the high values for the ubiquists refer to a very strong anthropogenic influence in case of the Corno-Quercetum communities.

Classifications based on LOŽEK's (1964) habitat types (forest dwellers E) refer to an increase in foliage closure and thus greater human influence in the area (Fig.5.,1,2.). Percentage values of species and specimen numbers were separately displayed for the five control moss-capped oak forests and the Síkfőkút quadrate sampling area.

Higher dominance values of bush forest dwellers as opposed to the forest dwellers based on species numbers indicate the increasing human activities in the area. A similar tendency can be observed considering specimen numbers for the moss-capped oak forests indicating forestation human activities in these woodlands. Investigations in the Síkfőkút area took place following breed selectional deforestation and general & growth-enhancing treatments of the forest communities. These were accompanied with a drying of oaks in the 1980s. These factors resulted in a decrease of foliage closure in the area and an increase, both qualitative and quantitative, in photophilous bush forest dweller species.

The disadvantages of forestation activities observable on Fig.5. are also noticeable in the species, diversity and abundance numbers of the control group of moss-capped oak forests. Growth-enhancing treatment took place in the oak forests of Pozsag and Lökbérc (Fig.6) in the years preceding our investigations. Here there is a steady decrease in the character species as opposed to the untreated wood communities of Gábalápa and Nagy-Fari.

4. Síkfőkút

4.1 Species found

Quadrate and soil trap sampling yielded 24 species in the area of Síkfőkút. This was more by 10 than the species of the control group of moss-capped oak forests. Several ubiquist species, which are present in the control group as a result of growth-enhancing treatments, are missing in Síkfőkút such as *Euconulus, Acanthinula, Cochlodina cerata, Aegopinella pura,*

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Helicodonta, Oxychilus glaber and *Perforatella incarnata* (Table 2.). In the control forests the ubiquist *Punctum* and *Oxychilus depressus* along with the omnivor limaces *Deroceras reticulatum, Limax cinereoniger, Tandonia budapestiensis, Lehmannia marginata* and *Malacolimax tenellus* are not present. Similarly some species coming from the soil traps such as *Arion cirsumscriptus, Lehmania nyctelius* and the culture-dwelling *Arion hortensis* are also missing here. From the inlet well of the research cabin at Síkfőkút some specimens of culture-dwelling *Limax maximus* L. 1758 have also come to light. From the thin outs at the margin of the Síkfőkút forest some specimens of *Cepea vindobonensis* were collected.

4.2 Reproductive cycles

Monthly soil trap collections between 1979 and 1982 and the comparative analysis of macroclimatic data shed light onto the climatic factors influencing the reproductive cycles of the two dominant species, *Arion subfuscus* and *Deroceras reticulatum*. Data regarding the previously mentioned species was compiled by Frömming in 1954 partly from the literature and personal investigations as well. There is no specific reproductive period for the species Arion, which is very sensitive to aridity and warmth (FRÖMMING 1964.). We could decipher an annual one or two reproductive cycles around temperatures of 10°C in the months III-IV. and IX-XI. (Fig.6).

The species *Deroceras* ovulates during the whole year in laboratory conditions. Hatchlings appear in the months of IV-V. and VIII-IX. based on the literature. Hatchlings of this latter species appeared in the months of III-V. and VII-X. at Síkfőkút when humidity was higher than 60%. (Among Atlantic climatic conditions this species becomes pestiferous on the plough lands, when longer exposed to humidity above 60%. No such pestiferous activity is known in Hungary.)

4.3 Gastropod assemblages of quadrate and soil trap sampling analysis

4.3.1 Quadrate sampling

Results of the two sampling methods are partially different, because soil traps entrap active dwelling specimens from a larger area (limaces might have an area of locomotion around 100 mm at night (FRÖMMING 1964)). Soil traps tend to be selective primarily for limaces. The numbers of constant-dominant and dominant species also differ for the two sampling methods.

In case of the quadrate samplings the following character species were found for the areas of moss-capped oak forests: *Agopinella minor, Helix, Hygromia*. When the preceding years experienced higher rates of precipitation (1974) the species *Deroceras* can be regarded as constant-dominant in the following year (1975) (Fig.7., Table 2.). Following the years with higher precipitations there is an increase in abundance, H' and species numbers. In the distributional values of ecological species groups and Ložek's habitat types after an increase in the abudance for 1975 a decrease can be observed for the group of xeromesophilous (4) species with a simultaneous increase in hygrophilous (1) and mesohygrophilous species. The species groups 2,4 tend to be in complementary relationship in the years investigated.
Changes in the relations of bush forest dwellers (BF) and forest dwellers (W) considering habitat types also set off in a complementary way following the rainy 1974.year.
The effects of steady population growths (A/m^2) induced by high precipitation rates following the year of 1973 seem to get stabilized by 1978, reaching the values of the 1973 annum, as a result of gradual decrease in annual rainfall (Fig.7). Thus on the Czekanowski cluster diagram the first and the last years are clustering together, indicating the climate dependence of gastropod assemblages and a four-year cycle.

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Seasonal changes for the individual years were analyzed via quadrate collections in different months for three years. Data was analyzed in relation to rainfall rates. (1973. Festucetosum: VI.,VII,XI; 1975. Poa nemoralis: V,VIII,IX,XI.,1978. Poa nemoralis: V,VII,IX)

Seasonal changes tend to well correlate with fluctuations of the annual precipitation in the area in both underwood units under investigaton. Within the rates of precipitation the following aspects could have been differentiated via application of all four types of Czekanowski clustering (simple, group average, simple, whole-chain): spring, summer and fall and winter aspects in the years of 1973 and 1975, spring summer and fall aspects in the year of 1978 as a result of low summer and even lower fall precipitation rates.

4.3.2 Soil trap sampling

The two dominant species trapped by the soil traps were the Continental *Arion subfuscus* and the Euro-siberian *Deroceras reticulatum*. According to data in Table 1 and 2 there is a steady deacrease in both species and specimen numbers until the year of 1984. This was ignited by the gradual decrease of annual precipitation and as a consequence the reduction of shadowed habitats via exterination of the oak trees in the area. The annual diversity decreases tend to well correlate with the decreasing rates of annual rainfall (Fig.9). The ecological species groups (2, 4) as well as LOŽEK's habitat type groups (W, BF) tend to fluctuate in a complementary way similar to data from quadrate collections. In the last two years the xeromesophilous and bush forest dweller species became dominant via steady decrease in specimen and species numbers. On the Czekanowski dendrograms (in all four levels) two core groups can be observed. The first one signifies the years with lower (< 500mm), while the second one signifies the years with higher rates of precipitations (600mm<). Fluctuations in precipitation rates reach almost 100 mm as well and tend to follow a 3-4 year cycle (1976-78, 1980-1982).

In the years of 1980 and 1981 soil traps were emptied monthly thus data from these collections could have been used for seasonal analysis in the area (Fig.10). There was a monthly difference in seasonal distributions in both years. The clustering core groups form in relation to the fluctuations of juvenile specimen numbers depending on higher or lower reproduction rates of the two dominant species *Arion* and *Deroceras*, which is strongly tied to climatic variations.

4.3.3. Factors influencing specimen numbers

Gastropod eating insects trapped in the soil traps tend to show a spring-summer activity cycle (Table 3). Predator-prey relations are clearly displayed on diagrams showing the monthly fluctuations of insect and gastropod species numbers (BLESS 1978). When insect numbers are high, gastropod numbers are low and vica versa (Fig.11).

According to data on Fig.12 the predator-prey relations of gastropods and insects are highly influenced by the fluctuations of the precipitation rates from the year of 1979. There is a gradual increase in insect numbers (*Carabus* pubas, *Abax ater, Necrophorus humator*) with the decrease in annual and monthly rainfall rates. According to investigations of BLESS (1978) near Bonn the insects *Abax ater* and *Carabus problematicus* L. tend to be the largest consumers of limax-populations.

During the years investigated the year of 1982 seems to be a critical one regarding the survival of gastropods as the low precipitation rates below 400 mm, which is harmful to the

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successful reproduction of snails, was followed by an increase in insect numbers resulting in a steady decrease in the numbers of gastropods. By the years of 1983 and 1984 specimen numbers have been reduced to 8,41-10,89%.

5. Production analysis

5.1 Weight and consumption

We have very few data concerning the production of gastropods in the literature or from the field. The majority of data at hand comes from calorimetric measurements. Most of the data published here are for specimens from the literature, English and German sources, most of which do not even appear at Síkfőkút (VEWEL 1970, BLESS 1978). The only exceptions are *Arion subfuscus, Deroceras reticulatum* and *Helix pomatia*. Thus our results for weights and litter consumption could only be indirectly compared to data from the literature. FRÖMMING (1958) was to first to draw our attenton to the role of gastropods in litter feeding and breakdown. BLESS (1978) published kcal values per m^2 for four major forest types (felling, marsh, beech and pine) based on seasonal spring, summer and fall quadrate collections. In our example of the Síkfőkút forests these values, both seasonal and cumulative, tend to display high fluctuations within and among the major forest types during spring, summer and fall periods. 90% of the calory values come from the limaxes.

Data concerning individual weights and monthly consumptions based on my personal investigations are presented in Table 4. There are large scale differences in monthly individual weights and food consumption rates in relation to climatic and reproductive cycle fluctuations. Our data comes from the laboratory analysis of 6 day specimens collected from the quadrates. The largest differences concerning individual weights could be observed in the months of May and September. While the months between September and November tend to show the largest differences in food consumption rates (total consumption in Sept. 40%, in Nov. 22%). Regarding individual weights and food consumptions the omnivore limaxes (*Deroceras, Arion, Limax*) and the *Helix* tend to show dominant values (FRÖMMING 1954). Cummulative rates of litter production between 16th June and 17th November 1972. were 3681,490 kg/ha (TÓTH & PAPP 1973). 82.8 % of this amount produced during a half year period is consumed by gastropods alone considering the average annual laboratory consumption rates of these animals. The predicted annual amount of food consumed by gastropods is around 40-50%, green vegetation also included underlying Frömming's assumptions. Largest foliage production was documented in October (2506,45 kg/ha). On the other hand the smallest rate was documented in June (86,870 kg/ha) ((TÓTH & PAPP 1973. According to laboratory results (Table 4.) consumption rates are the lowest in May and June and the highest during the fall months. This refers to a decisive role of litter formation in the reproduction of snails during the fall period following a relative stasis during the summer months.

5.2 Calorimetric rates

During the laboratory production analysis 4 species were put under calorimetric measurements (Table 4). Data gained for the species correlate well with those published by BLESS (1978). Calorimetric values display seasonal variations, which can be explained by differences in living and dry weights of the animals and fluctuations in the cal values of food resources and consuming gastropods as well during a year cycle (Table 4).

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Summary

The forests of Síkfőkút are under human influence as a result of forestation treatments. However the number of ubiquist species is lower in these areas than in the control (breed selectionally treated forests) forests. Next to the wood investigation cabin even the culture-dwelling Limax maximus appears as well. The constant dominant species of Síkfőkút are the same as the character species of the moss-capped oak forests (control group) (Table 1, 2) on the basis of quadrate sampling investigations. However in case of the soil traps there is a difference between the dominant species of these two areas, as the soil traps tend to be selective considering movement areas and activity of gastropods. The annual reproduction cycles of the omnivore limaxes coming from the soil traps (*Deroceras reticulatum, Arion subfuscus*) well correlate with the climatic fluctuations. The reproduction of *Arion* is influenced by temperatures below 10°C. While that of the species *Deroceras reticulatum* is influenced by relative humidity rates above 60%. They tend to have an annual one or two reproductive cycle in relation to climatic fluctuations (Fig.6, 8, 10). Seasonal distributions are largely influenced by climatic factors (Fig.8) and the selectively dominant (soil trap sampling) limacidae (Fig. 7-8). Annual fluctuations tend to follow a 3-4 year cycle as displayed on the Czekanowski dendograms in case of both the soil trap sampling and the quadrate collection methods in relation to the 3-4 year cyclic fluctuations of precipitation. This observation greatly underlies the climatic continentality hypothesis of platform and peak biotopes (BACSÓ 1959).

The predator-prey relations of gastropods and insects are highly influenced by the fluctuations of the precipitation rates from the year of 1979 (Fig.12). There is a gradual increase in insect numbers with the decrease in annual and monthly rainfall rates resulting in a cut back of gastropod abundancies and an increase in mesoxerophilous (4) species group and bush forest dweller (BF) species (Fig.9).

The limacidae also have a decisive role in food consumption and the natural cycle of elements. Increases in consumption rates correlate with fall increases in foliage and litter production (Table 4). Furthermore the second reproductive cycle starts at this time of the year for the dominant limacidae as well (Sept-Nov).According to laboratory results calorimetric values tend to show similar rates in both the plants consumed and the consuming gastropods.

The survival of gastropod faunas for the microclimatically continental Qp. Cerris forests is subjected to large scale climatic fluctuations as displayed in annual variations of species numbers.

References

BÁBA K. (1982): Eine neue zoographische Gruppierung der ungarischen Landmollusken und die Wertung des Faunabildes. - Malacologia 22(1-2):441-454.

BÁBA K. (1992): The influence of sylviculture on the structure of snail assembles. - p. 27-34, Proceedings of the IX. International Malacological Congress Edinbourgh, 1986, Leiden.

BÁBA K. & J. PODANI (1992): Multivariate analysis of snail distribution in the Bükk Mountains, Hungary. - Proceedings of the IX. International Malacological Congress Edinbourgh, 1986. Leiden, p. 35-40.

BACSÓ N. (1959): Magyarország éghajlata. - Bp. 1-302, Akad. Kiadó, Budapest.

BLESS R. (1978): Organische Substanz und Energiegehalt von Pflanzen, Schnecken und Käfern aus Waldstandorten des Naturparks Kottenforst Ville bei Bonn. - Pedobiologia 18:48-56.

FEOLI E. & L. ORLÓCZI (1979): Analysis of concentration and detection of underlying factors in strutured tables. - Vegetatio 40:49-54.

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FRÖMMING E. (1954): Biologie der mitteleuropäischen Landgastropoden. - 404 pp., Duncker-Humblot: Berlin.

FRÖMMING E. (1958): Die Rolle unserer Landschnecken bei der Stoffumwandlung und Humusbildung. - Z. angew. Zool. 45:341-350.

GERE G. (1978): Száratföldi izeltlábtiak és gerincesek produktivitásának alaptipusai. - 152 pp., Doktori értekezés, Budapest.

JAKUCS P. (1961): Die Pflanzendecke der Osthälfte des Nördlichen Mittelgebirges.- Akad. Sci. Hung. Inst. Geographicum 10(3):357-377.

JUSTYÁK J. & K. TAR (1974): Investigation on the ratio of direct and global radiations amounts - Part I. Radiation on a horizontal surface and on a Southern Slope. - Acta Geographica. Debrecina 12:127-148.

KERNEY M. P. E, R. A. D. CAMERON & J. H. JUNGBLUTH (1983): Die Landschnecken Nord- und Mitteleuropas. - 384 p., Paul Parey: Hamburg-Berlin.

LOZEK V. (1964): Quartärmollusken der Tschechoslowakei. - 374pp.,Verlag der Tschechoslowakischen Akademie der Wissenschaften, Praha.

NEWELL P. F. (1970): Molluscs: methods for estimating prodution and energy flow. - Methods of study in Soilecology, Unesco, 285-291.

SOÓ R. (1964): Synopsis systematico Geobotanica Florae Vegetationisque Hungariae I. - Akad. Kiadó, Bp. 1-589.

TÓTH J. A. & PAPP L.(1973): Az avarlebontás tanulmányozása a sikfôküti bioszférakutatás keretében 1. - Az avar lebontás sebességének meghatározŕsa. Bot. Közl. 3.

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Figures

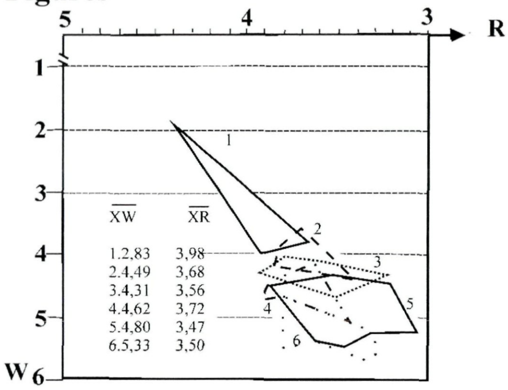

Fig.1 Distributional view of edaphic bush forests, moss-capped oak forests (1-3), horn-beem oak forests and beech forests on the basis of WR vegetation averages

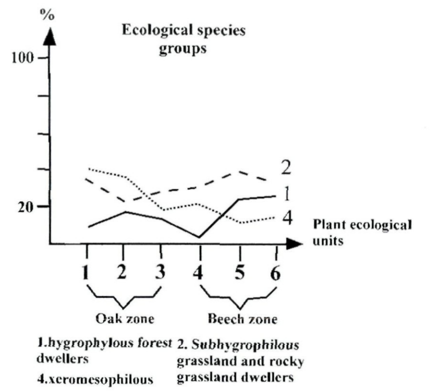

Fig.2 Distribution of ecological species groups in the Oak and Beech Zones

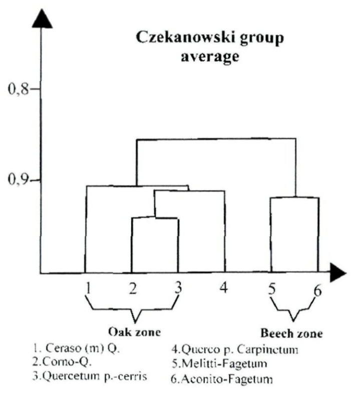

Fig 3 The division of the Oak and Beech Zone based on their gastropod assemblages is clearly visible on the Czekanowski dendograms

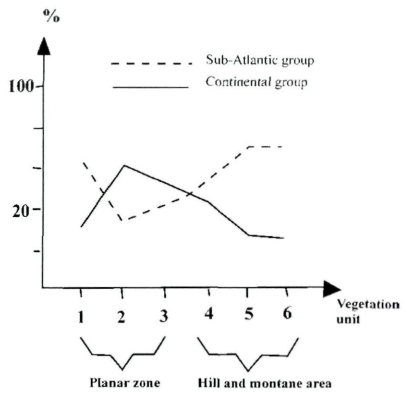

Fig.4 Zoogeographical distributions in the Oak and Beech Zones

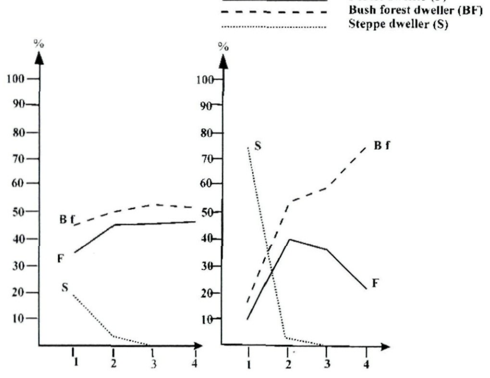

Fig.5 Relations of the bush forests and the Síkfőkút moss-capped oak forest based on Ložek's habitat typological species number (1) and specimen number (2) distributions

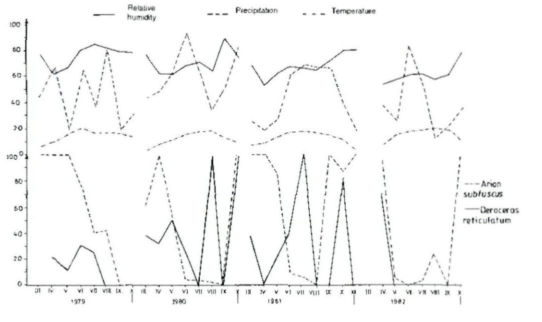

Fig.6 Reproductive cycles of *Arion subfuscens* and *Deroceras reticulatum* in relation to the major macroclimatic factors and the percentage of juvenile specimens

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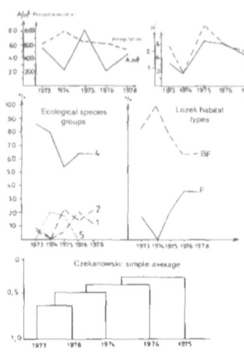

Fig.7 Organizatinal properties of quadrate sampling (species No., H, ecological species group, Ložek's habitat type grouping in relation to climatic factors between 1973 and 1978. Relations between the years investigated based on Czekanowski cluster analysis)

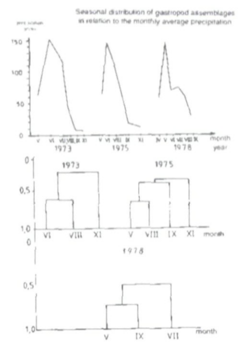

Fig.8 Seasonal distributions of gastropod assemblages in the years 1973, 1975, 1978 based on quadrate data

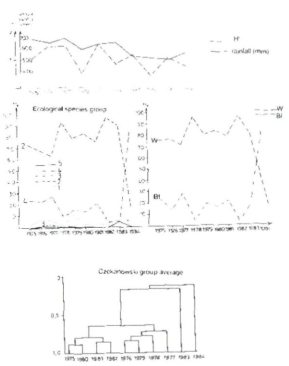

Fig.9 Structural varaiants of quadrate samplings, and correlations of the years investigated on the basis of the Czekanowski dendogram

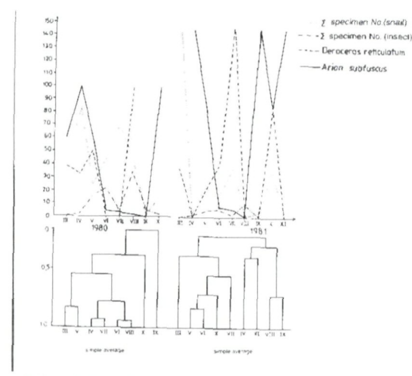

Fig.10 Specimen numbers for the insects and gastropods based on percentage distributions of two species. Dendograms displaying seasonal distributions based on soil trap collections bw 1980-81

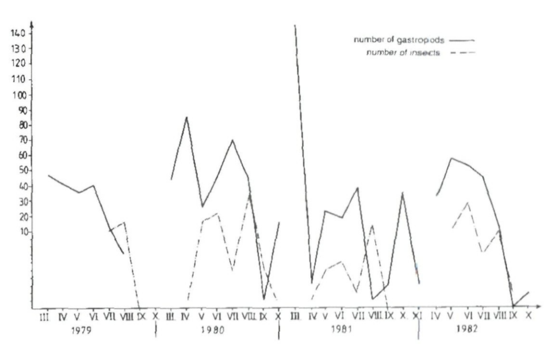

Fig.11 Monthly fluctuations of gastropod and insect specimen numbers between 1979 and 1982 based on soil trap sampling

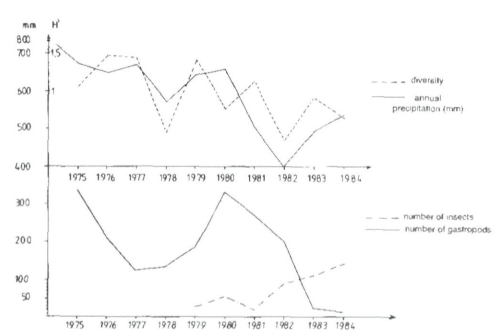

Fig.12 Relations of annual precipitation and related insect and gastropod diversity on the basis of material from the soil traps

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Table1. Coenological character species in the moss-capped oak forests and the adjacent bush forests

Table 2. Species lists of quadrate and soil sampling, ecological species groups, zoogeographical categories, habitat typology and climatic data from Síkfőkút

Zoogeo-graphy	Eco-logical factor	Habitat type	Species	Control forests					Síkfőkút														
				Quadrate sampling										Soil traps									
				1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	6	7	8	9	10
				1981	1981	1982	1982	1984	1973	1974	1975	1976	1978	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
5.21	4	W(s)	Aegopinella minor /Stabile 1864/	7	7	6	13	25	28	12	6	5	16	2	4	2	-	-	-	1	-	-	-
5.3	4	W(s)	Helix pomatia /Linné 1758/	1	-	1	1	2	-	-	3	2	4	3	3	-	1	-	-	-	-	1	-
9.5	1	W	Hygromia transsylvanica /Westerlund 1876/	-	-	1	2		2	-	-	1	2	-	1	-	-	1	-	-	-	-	-
1.1	2	W	Arion subfuscus /Draparnaud 1805/	-	-	-	-	1	2	-	7	2	7	250	143	80	129	118	278	200	192	18	3
1.3	4	W(s)	Deroceras reticulatum /O.F. Müller 1774/	-	-	-	-	-	1	-	18	2	-	77	42	32	5	47	49	53	7	-	14
3	4	S(w)	Cepea vindobonensis /Ferussac 1821/	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5.21	2	Wm	Oxychilus glaber /Rossmassler 1835/	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	1	W	Limax cinereoniger /Wolf 1803/	-	-	-	-	-	-	-	3	2	2	6	10	4	3	2	-	8	1	-	-
6	2	W(s)	Lehmania marginata /O.F. Müller 1774/	-	-	-	-	-	-	-	5	-	-	-	-	-	-	12	7	6	2	2	-
5.22	2	W(s)	Tandonia budapestensis /Hazay 1881/	-	-	-	-	-	-	-	4	-	-	-	-	-	-	1	1	-	-	1	-
7	3	W	Arion circumscriptus /Johnston 1828/	-	-	-	-	-	-	-	-	-	-	-	1	1	-	1	-	-	-	-	-
5.22	3	W	Perforatella incarnata /O.F. Müller 1774/	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	4	W	Lehmania nyctelia /Bourguignat 1861/	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
5.22	4	W	Oxychilus depressus /Sterki 1880/	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-
8	5	W(s)	Arion hortensis /Ferussac 1819/	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-
5.22	1	W	Malacolimax tenellus /O.F. Müller 1774/	-	-	-	-	-	1	-	-	-	-	-	5	4	-	2	-	-	-	-	-
6	5	W	Helicodonta obvoluta /O.F. Müller 1774/	21	-	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.2	5	W	Aegopinella pura /Alder 1830/	-	6	-	-	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	5	W(s)	Euomphalia strigella /Draparnaud 1801/	5	-	1	1	1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-
1.4	5	M	Punctum pygmaeum /Draparnaud 1801/	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-
1.4	5	W	Acanthinula aculeata /O.F. Müller 1774/	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.4	5	M	Euconulus fulvus /O.F.Müller 1774/	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9.1	5	W(s)	Cochlodina cerata /Rossmassler 1836/	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Specimen number				63	13	9	17	58	35	15	52	14	31	338	210	124	138	184	335	270	202	22	17
Species number				9	2	4	4	8	6	2	9	6	5	5	9	7	4	8	4	6	4	4	2
Diversity				2,416	0,996	1,447	1,14	2,527	1,169	0,722	2,798	2,487	1,869	1,016	1,486	1,44	0,436	1,435	0,771	1,137	0,342	0,957	0,672
A/m2				100,8	20,8	14,4	27,2	89,6	56	24	83,2	22,4	49,6										
number of gastropod eating insects																		25	59	22	93	116	143
Species number																		4	7	2	7	5	4
annual averages of precipitation									623,3	807,8				650,3	649,7	672	572,5	622	630	509	398	475	539
relative humidity X %										68,8	47,8			63,77	78,5		76,75	80	76,75	72,66	68	70,08	74,66
air temperatures X 0.5 cm															9,38	9,62	9,1	9,8	8,13	9,38	9,82	10,9	9,57

Table 3.Gastropod feeding insects and gastropods collected from the soil traps between 1979-84 with additional climatic data

	1979								1980							
	III	IV	V	VI	VII	VIII	IX	X	III	IV	V	VI	VII	VIII	IX	X
Carabidae																
Carabidae pupa																
Carabus coriaceus Linné 1758					1	3					8		1	16		
Calosoma sicophanta Linné 1758											1					
Calosoma incvisitor Linné 1758											2					
Pterosticha vulgaris Linné 1758											1			2		
Staphylinidae																
Ocypus olens Linné 1758														2		
Silphidae																
Silpha carinata Herbst 1783						1					1					
Silpha obscura Linné 1758					1	1										1
Necrophorus humator Olivier 1790					5									5		
Abaxater Villers 1789					3	11				1	5	22	4	9	5	
sum of insect numbers					10	16				1	18	22	5	34	5	1
Aegopinella minor /Stabile 1864/																
Helix pomatia /Linné 1758/																
Hygromia transsylvanica /Westerlund 1876/			1													
Arion subfuscus /Draparnaud 1805/	27	21	17	36	10	7			23	81	21	41	69	41		2
Deroceras reticulatum /O.F. Müller 1774/		9	18	16	4				21	3	4	5		2		14
Limax cinereoniger /Wolf 1803/	1		1													
Lehmania marginata /O.F. Müller 1774/	11		1											3	1	
Tandonia budapestensis /Hazay 1881/			1										1			
Arion circumscriptus /Johnston 1828/			1													
Lehmania nyctelia /Bourguignat 1861/																
Malacolimax tenellus /O.F. Müller 1774/					2											
Arion hortensis /Ferussac 1819/																
sum of specimen number	39	30	40	52	16	7			44	84	25	46	70	46	1	16
sum of species number	3	4	5	2	2	1			2	2	2	2	2	3	1	2
H'	1,406	1,277	1,462	0,469	0,65	0	0	0	0,999	0,222	0,634	0,496	0,108	0,602	0	0,544
monthly precipitation X	44	67	19	65	37	79	18	32	44	48	63	93	62	34	50	81
monthly temperature (at 5cm) X	6,60	10,00	16,70	20,10	17,00	17,80	16,40	8,80	4,20	9,00	12,90	16,30	17,00	17,70	13,80	9,70
monthly relative humidity X	77	62	66	80	84	82	78	77	76	62	61	68	70	64	89	73

	1981									1982						
	III	IV	V	VI	VII	VIII	IX	X	XI	IV	V	VI	VII	VIII	IX	X
Carabidae																
Carabidae pupa												28				
Carabus coriaceus Linné 1758											8		7		2	
Calosoma sicophanta Linné 1758											1					
Calosoma incvisitor Linné 1758											2					
Pterosticha vulgaris Linné 1758																
Staphylinidae																
Ocypus olens Linné 1758																
Silphidae																
Silpha carinata Herbst 1783																
Silpha obscura Linné 1758																
Necrophorus humator Olivier 1790						7										
Abaxater Villers 1789		1	5	6	2	5								10		
sum of insect numbers		1	5	6	2	12					11	28	7	10	2	
Aegopinella minor /Stabile 1864/																
Helix pomatia /Linné 1758/																
Hygromia transsylvanica /Westerlund 1876/																
Arion subfuscus /Draparnaud 1805/	121	1	14	12	33		1	15	3	25	56	53	45	12		1
Deroceras reticulatum /O.F. Müller 1774/	21	2	9	5	3			13		7						
Limax cinereoniger /Wolf 1803/								8						1		
Lehmania marginata /O.F. Müller 1774/	3					1	2				1					1
Tandonia budapestensis /Hazay 1881/																
Arion circumscriptus /Johnston 1828/																
Lehmania nyctelia /Bourguignat 1861/					2											
Malacolimax tenellus /O.F. Müller 1774/																
Arion hortensis /Ferussac 1819/																
sum of specimen number	145	3	23	18	38	1	3	36	3	32	57	53	45	13		2
sum of species number	3	2	2	3	3	1	2	3	1	2	2	1	1	2		2
H'	0,737	0,918	0,966	1,135	0,69	0	0,918	1,539	0	0,758	0,127	0	0	0,391		1
monthly precipitation X	25	19	26	61	69	67	66	38	19	38	27	83	52	12	23	36
monthly temperature (at 5cm) X	7,80	9,70	14,00	18,20	18,60	17,80	15,20	12,60	3,30	8,30	16,00	18,20	19,60	20,50	19,40	11,20
monthly relative humidity X	68	53	62	67	66	65	72	80	80	54	57	61	61	57	61	78

	1983					1984					
	VI	VII	VIII	IX	X	IV	V	VI	VII	VIII	IX
Carabidae											
Carabidae pupa	42							37			
Carabus coriaceus Linné 1758		1	1	1			1		1	6	6
Calosoma sicophanta Linné 1758						5					
Calosoma incvisitor Linné 1758											
Pterosticha vulgaris Linné 1758											
Staphylinidae											
Ocypus olens Linné 1758											
Silphidae											
Silpha carinata Herbst 1783											
Silpha obscura Linné 1758	2	2		1							
Necrophorus humator Olivier 1790			59						17	3	3
Abaxater Villers 1789			8			1		16	29	31	31
sum of insect numbers	44	3	68	2		6	1	53	47	40	40
Aegopinella minor /Stabile 1864/											
Helix pomatia /Linné 1758/	1										
Hygromia transsylvanica /Westerlund 1876/											
Arion subfuscus /Draparnaud 1805/	18							2	1		
Deroceras reticulatum /O.F. Müller 1774/						3	8	3			
Limax cinereoniger /Wolf 1803/											
Lehmania marginata /O.F. Müller 1774/	2										
Tandonia budapestensis /Hazay 1881/	1										
Arion circumscriptus /Johnston 1828/											
Lehmania nyctelia /Bourguignat 1861/											
Malacolimax tenellus /O.F. Müller 1774/											
Arion hortensis /Ferussac 1819/											
sum of specimen number	22					3	8	5	1		
sum of species number	4					1	1	2	1		
H'	0,957					0	0	0,971	0		
monthly precipitation X	61	47	49	42	16	52	72	60	68	65	65
monthly temperature (at 5cm) X	18,40	22,00	20,60	16,10	10,00	11,00	14,50	16,80	18,70	17,90	17,90
monthly relative humidity X	57	54	62	65	68	52	72	60	68	65	65

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Table 4: Results of weight and food consumption analyses for different months of the year 1975. Correlations of living and dry weights with the size of three species analyzed. Energy source (cal/g) values of food resources and gastropods.

Species	**10x25x25 cm quadrate**				**Weight (g) from quadrates**				**Weight /m2**				**Monthly consumption m2/30days/g**			
	1975				1975				1975				1975			
	V	VIII	IX	XI	V	VIII	IX	XI	V	VIII	IX	XI	V	VIII	IX	XI
Helix pomatia	1		2		26,9184		54,3813		43,0684		87,01		8,6568		4,6963	
Deroceras reticulatum	4	1	10	3	1,3055	0,2524	2,9753	1,305	2,0888	0,4038	4,7605	2,088	3,8424	5,832	19,1674	9,842
Arion subfuscus	2	2	2	1	1,0981	0,506	2,415	0,247	1,7569	50,8056	3,864	0,3952	1,4688	4,9008	4,9008	4,3104
Limax cinereoniger		1	1	1		2,6905	1,699	9,8456		4,3048	2,718	15,7529		46,9152	79,296	39,7776
Tandonia budapestensis	2	2			0,5695	0,7578			0,9112	1,2124			5,0528	27,6432		
Lehmania marginata				5				2,9871				4,7794				?
Oxychilus depressus			1				0,022				0,0352				?	
Aegopinella minor		1	3	2		0,005	0,1878	0,03605		0,008	0,3004	0,0576		8,016	16,4352	14,0784
Punctum pygmaeum			5				0,0042				0,0067				?	
sum /g	9	7	24	12	29,8935	2,2117	58,5846	14,4275	47,8264	6,7386	98,6948	23,0732	19,0208	33,3072	24,4557	68,0084
annual average/kg																

Cal /g data of consumed plants Tóth-Papp 1973	1972. Foliage production 368,149 kg	Quercus leaf 4554 Cal/g	Euonymus leaf 4564 cal/g	Cornus mas leaf 3987 Cal/g	monthly consumption snail ha/month/kg 3048,219
Snail Cal /g data (ash free)	Helix pomatia 5438,92 Cal/g	Arion subfuscus Bless 3201,2 Cal/g, 4568 Cal/g	Limax cinereoniger 5588 Cal/g	Deroceras reticulatum Bless 4574 Cal/g 4599 Cal/g	

Correlations of living and dry weights with the size of gastropods

Gastropod species	**Date length/diameter (mm)**	**living weight (g)**	**dry weight (g)**	**length/diameter**	**living weight (g)**	**dry weight (g)**
Arion subfuscus	1982 V. 20:4	5,46	1,052	VI. 15:5	0,0754	0,0141
Deroceras reticulatum	1982 VI. 35:5	0,1597	0,0374	29;5	0,1881	0,0447
	27;4	0,164	0,334	25;4	0,1378	0,0351
Limax cinereoniger	1982 V.35:10	4,8532	0,4694	58;13	3,654	1,082
	1982 VI. 70:17	1,6758	0,2204	77;17	2,5766	0,3802
	80; 17	2,2886	0,3362	85;20	5,1096	0,923
	87; 22	7,407	1,234			

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