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Rove beetles (*Coleoptera: Staphylinidae*) collected during the long term ecological research in a Hungarian oak forest

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Abstract: *A long term ecological research was carried out in a Hungarian oak forest, in "Bükk" National Park starting with 1972. During the faunistical studies 3,602 insect species and more than 200,000 individuals were collected. The dominant orders were Coleoptera (1,051 species), Lepidoptera (803 species), Hymenoptera (470 species) and Diptera (400 species). The relative species abundance (RSA) for all insects collected in all years of sampling period suggests a rather J shape curve than a not clear scaling property. This means that we were able to identify almost three quarters of the insect species from one ha European oak forest during the survey (from 1987 to 2003), and two third of the staphylinides expected. Considering the staphylinid fauna a total number of 160 species and 4,022 individuals were collected. The most widely occurring species in dominance order were: Ocypus biharicus, Pseudocypus mus, Atheta gagatina, Philonthus quisquiliarius, Oxypoda acuminate, Platydracus chalcocephalus, Atheta crassicornis, Latrimaeum atrocephalum, Haploglossa puncticollis, Philonthus succicola and Anotylus mutator. The pooled value of alpha diversity was 1.51. The Shannon-Weiner Index (H`) was relatively high (3.29) in comparison with other studies.*

Key words: *Staphylinidae, Species abundance, Diversity, Activity, Density*
PDF of full length paper is available with author ***(*balogadalbert2002@yahoo.co.uk)***

Introduction

Pál Jakucs established the "Síkfokut Project" in 1972 as a model area for the typical forest community of sessile oak and turkey oak. Currently an area of 64 hectares is under protection and part of "Bükk" National Park. The long-term research can be divided into three main phases.

In 1972-1979 the research was connected with the IBP and MAB international programs and concentrated on the structure, production and function of the ecosystem. The results were summarized in "Ecology of an oak Forest in Hungary" (Jakucs, 1985).

In the second phase of the research (1979-90) a new type of forest decay received a lot of attention. Beginning with 1979-80 until present, a large-scale decline of *Quercus petraea* appeared, with serious consequences for the structure of the shrub and herb layer. Research involved studies on the potential causes of the sessile oak decline (climate change, acid rain, soil changes, toxic elements such as Aluminium ions, mycorrhiza, pathogenic microorganisms: *Ceratocystis* sp and *Armillaria mellea*) (White, 1955; Redfern, 1973; Igmándi *et al.,* 1986; Turna, 2006).

In the third phase, studies on the ecological state and function of the declining forest were carried out, as well as continuous monitoring of the background environmental factors. The main emphasis is on the dynamics and structure of litter layers, the ecophysiology of declining oak trees, the behaviour of dominant plant species in canopy gaps and ecotones, the dominance pattern and the role of phytophagous and predacious insects, litter decomposition and the role of soil micro-organisms. There are efforts to collect information on the changes in diversity of the flora and fauna (Jakucs, 1983; Aselman and Jakucs, 1988; Magurran *et al.,* 2003; McGill, 2003; Néda *et al.,* 2005; Norris, 2003; Ashesh and Chauhan, 2006; Pueyo, 2006; Tripathi, 2006; Avgm, 2006).

In this paper apart from the general results, we focus on the diversity and activity-density of rove beetles (*Coleoptera: Staphylinidae*). Staphyilinidae is one of the richest families of *Coleoptera* with species that are mostly predacious. More than 45,000 species are known worldwide and probably over 75% of tropical species are still undescribed (Howard *et al*., 1998): 1,500-1,700 species were considered from central Europe. However it is still little known about the staphylinid fauna in pine forest and in sub-alpine region (Zerche, 1976).

Materials and Methods

The studied one hectare oak forest is situated in medium high mountain areas in north-east Hungary in "Bükk" National Park. Vertical light traps were used to collect insects at three different levels: soil level, canopy level (25 m from soil) and above canopy level (35 m from soil) in 1987, 1988, 1989, 2000, 2001, 2002 and 2003. Pitfall traps (300 cm³ in size, 8 cm in diameter, half-filled with ethylene

Table - 1: Insect orders and species identified in one hectare research site in a Hungarian oak forest

Insect orders	No. of species
Colembola (Loksa, Traser)	69
Dermaptera (Racz I.)	2
Ortoptera (Nagy B., Racz I.)	25
Thysanoptera (Jenser G.)	40
Heteroptera (Kondorosi E.)	220
Homoptera (Baski Zs., Kozar F., Orosz A.)	139
Coleoptera (Ádam L., Balog A., Czeto Zs., Marko V., Merkl O., Podlusanyi A., Szaloki D., Vigh K.)	1,051
Raphidioptera (Szentkilalyi F.)	7
Neuroptera (Szentkilalyi F., Ábraham L.)	45
Hymenoptera (Csoka Gy., Galle L., Jozan Zs., Papp J., Zombori L., Varkonyi G.)	470
Trichoptera (Schmera D.)	27
Lepidoptera (Meszaros Z., Szaboki Cs., Varga Z.)	803
Mecoptera (Ábrahám L.)	4
Diptera (Csoka Gy., Deli-Draskovits .A, Mihalyi, Papp L.)	400
Total species	**3,602**

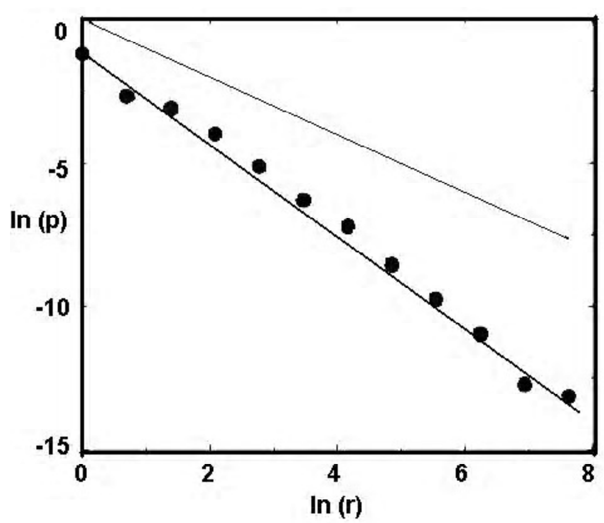

Fig. 1: Results for the relative species abundance for all insects collected during the "Bükk" National Park oak forest census. The dashed line indicates the power-law behaviour with exponent -1

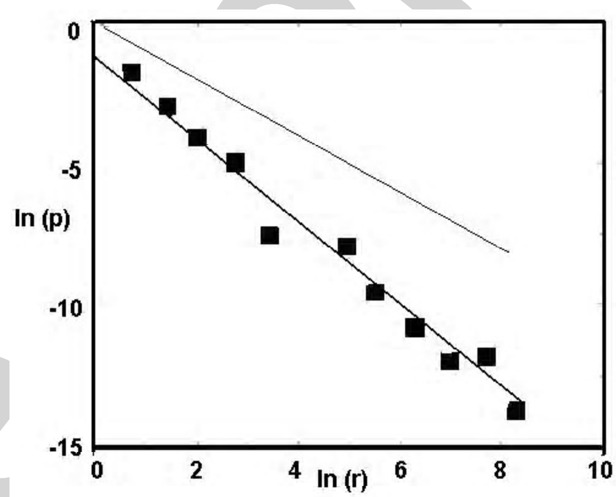

Fig. 2: Relative species abundance for rove beetles *(Coleoptera: Staphylinidae)* computed from one hectare sampling site in "Bükk" National Park oak forest. The dashed line indicates the power-law behaviour with exponent -1

glycol 30% solution) were used to sample the soil active insects from 1999 to 2003. Soil samples were analyzed and suction traps used between 1994 of 1996. A suction trap was constructed of a fan producing air flow through a suction tube to draw an insect from a specific point. These traps are normally used to collect aphids but also small flying insects. Insects collected from different habitats were sorted and identified up to species level with a stereo microscope.

The $\rho(r)$ probability density characterizing the relative species abundance distribution (RSA) was computed by the classical method: Counting the number N_k of species with sizes, *r*, between 2^k and 2^{k+1} (κ=1,2,3 ….), *i.e.* constructing a histogram on intervals that are not of constant length, but are exponentially increasing. The scaling exponent around -1 means, that we know all the insect species from the investigated site.

The Shannon-Weiner (H') and the log series fisher alpha (α) diversity indices were used to measure biodiversity (Fisher *et al.,* 1943; Pielou, 1984). The Shannon-Weiner (H') was used to compare our data with other similar studies where only these indices were performed. The alpha diversity index is considered to be superior to commonly used indices because the sensitivity to sample size is low and use high discriminant ability (Fisher *et al.,* 1943; Shah *et al.,* 2003). The maximum likelihood estimate α can be divided from

$$S = \alpha \log (1+N/\alpha)$$

where S = number of species in the sample, and N = number of individuals in the sample. Values of α were computed using the Past Program 1.18.

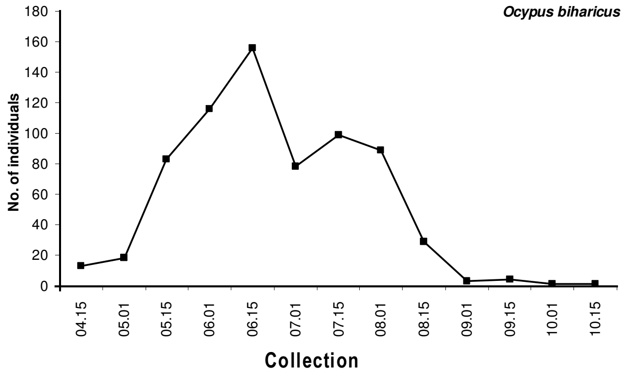

Fig. 3: The seasonal dynamics of the species, *Ocypus biharicus* in "Bükki" National Park oak forest

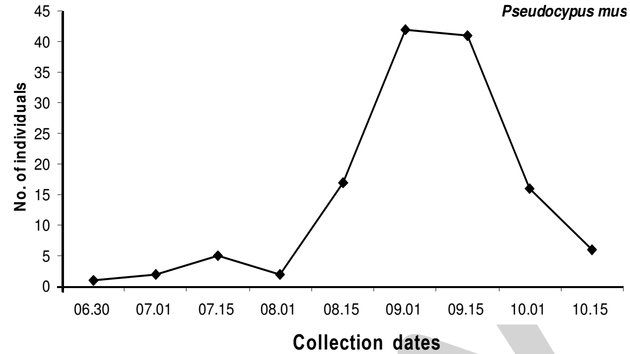

Fig. 4: The seasonal dynamics of the species, *Pseudocypus mus* in "Bükk" National Park oak forest

Results and Discussion

During the survey more than 200,000 individuals were collected belonging to more than 3,600 species. The insect orders and the number of species identified until now are presented in Table 1. Plotting the relative species abundance (RSA) for all insects collected in all the years of sampling period from the one hectare research site, the results suggest a J shape curve rather than a clear scaling property (Fig. 1). For this abundance limit the scaling exponent is around -1.4.

Considering the staphylinid fauna, a total number of 160 species and 4,022 individuals were collected. The most dominant species in dominance order were: *Ocypus biharicus, Pseudocypus mus, Atheta gagatina, Philonthus quisquiliarius, Oxypoda acuminate, Platydracus chalcocephalus, Atheta crassicornis, Latrimaeum atrocephalum, Haploglossa puncticollis, Philonthus succicola* and *Anotylus mutator.* These 11 species represent 70% of all staphylinides collected. On Fig. 2 we plots the RSA only for staphylinides. Due to the poorer statistics the data has bigger statistical fluctuation, and the power-law scaling exponent is around -1.5. This scaling property should be treated with much caution, since it is a well-known fact that for poor statistics (*i.e.* for a short abundance interval) many distributions plotted on a log-log scale could be mistaken with a power-law.

The pooled value of α diversity was 1.51. The Shannon-Weiner Index (H') was computed in order to facilitate direct comparisons with other studies that had not used the alpha index. We found that H' was relatively high (3.29) compared to other studies (2.2-2.4 reported by Lubke, 1991 in Austria; 1.6 and 1.5 in southern England reported by Shah *et al.,* 2003). There is no similar report about the staphylinid diversity from the central-European ecosystems. However any assessments from the above comparisons have to be treated with caution because of the poor practical performance of the H' indices, also mentioned by Shah *et al.* (2003).

The activity-density was calculated only for the two most common species: *Ocypus biharicus* and *Pseudocypus mus*. The highest number of the species, *Ocypus biharicus* was captured from May to September (Fig. 3). They could overwinter as eggs or larvae, while they can not be found as adults during the autumn. Species, *Pseudocypus mus* was collected in a high number only in September (Fig. 4). This means that the species overwinter as adults and during the summer they can be found in larval stage in soil.

During this long term ecological survey more than 3,600 species were collected. Although this is the highest insect species number ever described in one hectare forest from Europe, we were able to identify only approximately three quarters of the insect species and two thirds of the staphylinide species.

The pooled value of α diversity was 1.51, while the Shannon-Weiner Index (H') was 3.29. There is no similar report about the staphylinid diversity from central European ecosystems.

The two dominant species, *Ocypus biharicus* overwinter as eggs or larvae, while *Pseudocypus mus* as adults.

We believe that most of the insect species and many of the specimens are invisible for many sampling methods even if a long term ecological research is involved. Especially the larval stage of many species could not be sampled as adults or the activity-density period of the adults is not known. This incomplete sampling could be also responsible for the fact that the scaling observed in the rare species limit does not show the 1/r –type behaviour (-1 scaling exponent) observed for other well countable communities (tropical trees, breeding birds) by other authors (Tokeshi, 1993, 1999; Harte *et al.,* 1999; Harte, 2000; Hubbel, 2001; Sizling and Storch, 2004).

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