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# Assessing spider community structure in a beech forest: Effects of sampling method

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**Abstract.** The spider community of a beech forest on limestone was studied for one year using four sampling techniques: emergence traps, pitfall traps, soil samples, and arboreal eclectors. 87 spider species were recorded. Emergence traps and arboreal eclectors were particularly efficient in detecting spider species. Dominance identity (percentage similarity) was highest for catches from emergence traps and pitfall traps. Species recorded were assigned to various ecological groups. In terms of proportional abundance, representation of the ecological groups varied and appeared related to the sampling method used. Stratum type and type of prey capture strategy accounted for >60% of the variance in the catch results (canonical correspondence analysis). Proportional abundance of funnel-web spiders was much higher in pitfall trap catches (31.7%) than in any other method (1.0–11.6%).

## INTRODUCTION

Various methods are available for sampling soil animals in terrestrial habitats (Dunger & Fiedler, 1989). Many of these techniques, such as pitfall traps, heat extraction of soil samples and emergence traps also collect spiders, with pitfall traps apparently being the method most widely employed in studies of spider communities.

Some previous studies of beech forests on acid soils (*Luzulo-Fagetum*) have used more than one sampling method to describe spider communities (e.g., Albert, 1976, 1979; Dumpert & Platen, 1985; Platen, 1985), and some of these authors have commented on differences in the performance of different methods. The present study was conducted in a beech forest on limestone. First, we evaluate the performance of four methods, i.e., emergence traps, pitfall traps, Kempson extraction of soil samples, and arboreal eclectors (see Funke, 1971), which were concurrently employed during one study year. Our approach in analysing the data, however, differs from earlier comparisons in that we employ rarefaction methods to achieve better comparability of catch results.

Following Tretzel (1952), many arachnologists have attempted to define ecological groups of spiders with respect to moisture and light preferences, periods of maturity, vegetation strata occupied, prey capture strategies, and other characteristics. Different sampling techniques are likely to collect such ecological groups of spiders in different proportions. The second part of this paper will consider the extent to which different sampling methods differ in their estimation of the proportional importance of these ecological groups.

## MATERIAL AND METHODS

### Study site

The study site, a beech forest on limestone (age: 120 years; 420 m asl.), is located some 10 km east of Göttingen (Lower Saxony; Germany) (see Schaefer & Schauermann, 1990). The plant association has been classified as a *Melico-Fagetum* (see Dierschke & Song, 1982; Dierschke, 1989). Two sub-areas were studied, the first of which has a herb layer dominated by *Allium ursinum* L. in spring, while the second one has *Mercurialis perennis* L. as the dominant herb species. The study was conducted in a year characterized by below-average mean monthly temperatures and high monthly precipitation rates (Stippich, 1986).

### Sampling methods

Two identical sampling programmes were performed in each of the sub-areas from 10 March 1981 until 8 December 1981. The sampling programmes included:

Emergence traps [abbreviated: E]: Twelve emergence traps (ground area = 1 $m^2$; Funke, 1971) were set up in each sub-area. They were moved to new places every four weeks in spring and then every eight weeks later in the year.

Pitfall traps [P]: Six pitfall traps (∅ = 5 cm; preservative: aqueous picrinic acid) arranged in a row at 10 m intervals were operated in each sub-area. Catches were collected at weekly intervals.

Kempson extraction of soil samples [K]: Nine soil samples (∅ = 21.3 cm) were taken in each sub-area at biweekly intervals. Litter and soil (depth: 3 cm) sub-samples were extracted separately using a modified Kempson apparatus (Kempson et al., 1963; Schauermann, 1982).

Arboreal photo-eclectors [A]: In each sub-area two beech trees were selected and arboreal eclectors (Funke, 1971) fixed to their stems 2 m above ground (Schauermann & Jordan, 1982).

### Ecological groups of spiders

We considered six aspects of spider biology, which have been used for ecological classifications in the literature (number of classes are given in parenthesis): stratum type (8), moisture type (6), light preferences (6), maturity periods (11), body size (6), and prey capture strategies (8). Information on individual species was derived from Tretzel (1952), Toft (1976, 1978), Platen (1984, 1985), Dumpert & Platen (1985), Maurer & Hänggi (1990), Platen & Wunderlich (1990), Martin (1991), and Schultz (1994). We have largely relied on the data given by these authors, but sometimes changed assignations of species according to our own experience.

### Statistical methods

We used two types of rarefaction (see Hurlbert, 1971; Magurran, 1988; Achtziger et al., 1992) and canonical correspondence analysis (CCA; see Jongman et al., 1987; Ter Braak, 1988, 1990).

## RESULTS

### General results

Our analyses are based on a total catch of 4,257 adult spiders. Overall, 87 species were identified, with 69 and 72 species recorded from the *Allium* and the *Mercurialis* sub-areas, respectively. The linyphiid sub-families Linyphiinae and Erigoninae were particularly species-rich and represented by 28 and 26 species, respectively, while species numbers of the remaining families were much lower and varied between 1 and 7 species per family.

Catches from the arboreal eclectors were strongly dominated by a single species, *Drapetisca socialis* (Sundevall, 1832) (49.0%). *Saloca diceros* (O.P.-Cambridge, 1871) (37.7%) was the dominant species in the soil samples followed by *Hahnia pusilla* C.L. Koch, 1841 (17.1%) and *Micrargus herbigradus* (Blackwall, 1854) (10.9%). With the other two sampling methods, the proportional abundances of species were distributed much more evenly: *Diplostyla concolor* (Wider, 1834) (17.4%) and *S. diceros* (12.5%) were the dominant species in emergence traps. Considering pitfall traps, there are four almost equally abundant species: *Diplocephalus picinus* (Blackwall, 1841) (11.9%), *Coelotes terrestris* (Wider, 1834) (11.2%), *Lepthyphantes zimmermanni* Bertkau, 1890 (13.5%), and *D. concolor* (12.0%).

The species recorded are listed in Appendix 1. A species list containing the full quantitative data and assignations of species to ecological groups is available from the authors on request.

### Similarity of the catches

Only eight out of 87 species were detected by all sampling methods. The proportion of species detected exclusively by a single method was high in the arboreal eclectors (43.8%), lower in emergence traps (20.3%) and pitfall traps (14.3%), and lower still in the soil samples (7.4%) (Fig. 1).

In order to illustrate similarity patterns, cluster analyses were performed. Catch results from the two sub-areas studied were treated separately. First, species identity was calculated using the Sørensen index and an UPGMA-dendrogram generated (Fig. 2a). Catches from the two sub-areas paired according to sampling technique. Spider assemblages as determined by arboreal eclectors (A) differed considerably in species composition from those obtained from the three other methods. Fig. 1 suggests that A shares only few species with P and K, while there is considerable overlap with E.

If the proportional abundances of species are taken into account and percentage similarity used as a similarity measure (Fig. 2b), the composition of the catches differed again considerably between the arboreal eclectors and the

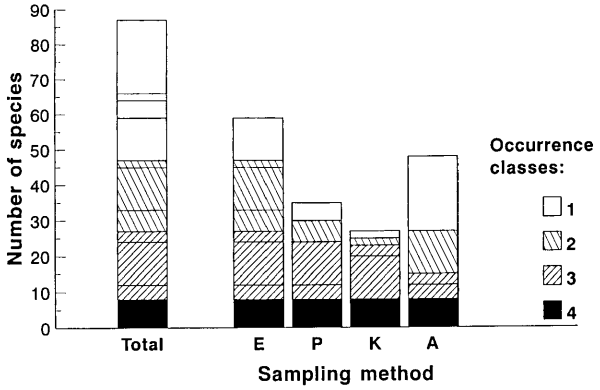


Fig. 1. Species numbers of spiders recorded using four different sampling methods in a beech forest. Sampling methods: E – emergence traps; P – pitfall traps; K – soil samples; A – arboreal eclectors. Proportions of species recorded by one, two, three or four methods (= occurrence classes) are indicated by different hatchings, and sub-divisions of occurrence classes indicate the pattern of overlap between sampling methods.

other three methods, but catches from emergence and pitfall traps were more similar to each other than to Kempson samples. Since assemblages from the two sub-areas paired again according to trapping method, i.e., catches from the two sub-areas were very similar, all subsequent analyses were done using the pooled data.

### Performance of sampling methods

Since the sampling methods differed with respect to both sampling effort (i.e., number of replicates) and sample size (i.e., numbers of individuals caught), we used the appropriate rarefaction methods to achieve comparability.

Sampling effort: In this analysis, one replicate equals the annual catch of one pitfall trap, one emergence trap, and the arboreal eclector of one beech stem, respectively. Catches from soil samples taken on different dates throughout the season were combined according to the original numbering of the samples; this gives a total of 18 replicates.

Fig. 3a shows "Shinozaki curves" (see Achtziger et al., 1992), which represent the number of species expected to

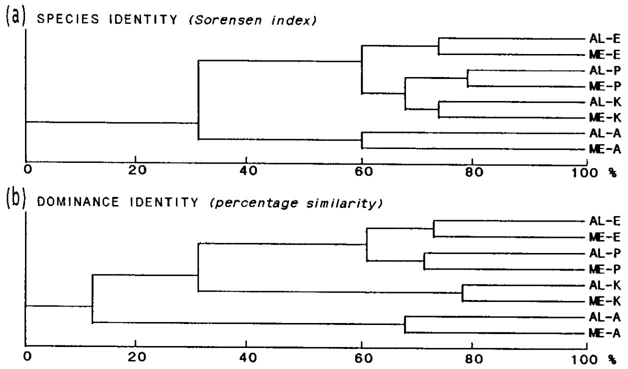


Fig. 2. Species identity (a) and dominance identity (b) of spider assemblages as recorded by four sampling methods in two sub-areas of a beech forest. Sub-areas are indicated by AL (= *Allium* sub-area) and ME (= *Mercurialis* sub-area); attached characters indicate sampling method (see Fig. 1).

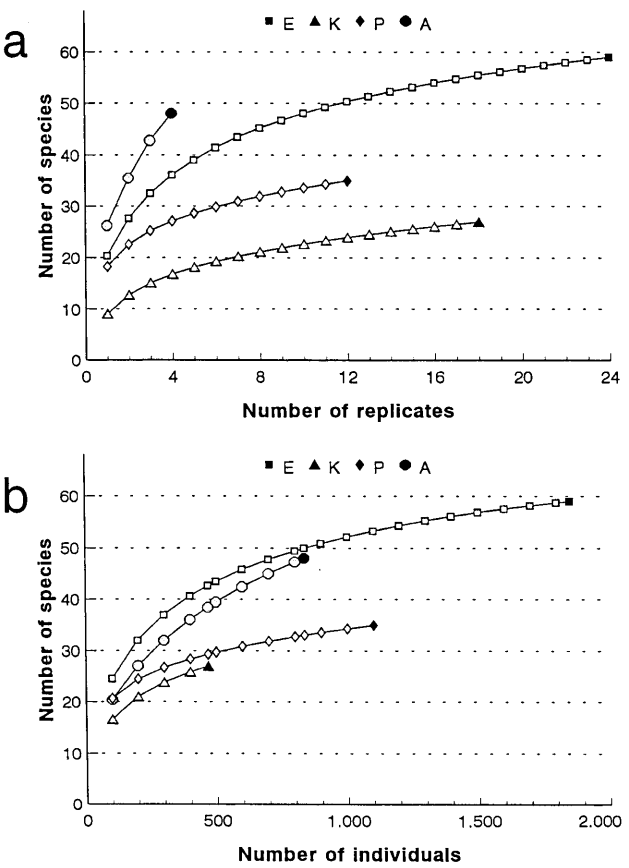


Fig. 3. Effect of sampling effort (a) and sample size (b) on expected species numbers obtained by different sampling methods. (a) Curves were generated by Shinozaki rarefaction; (b) curves were generated by Hurlbert rarefaction; solid symbols – actual values; light symbols – rarefied values.

be detected by a given number of replicates of the respective sampling method. Obviously, emergence traps will yield more species than the same number of both pitfall traps and soil samples. On the other hand, species numbers expected to be returned for a given sampling effort were high for arboreal eclectors compared with emergence traps. It is impossible to tell, however, how quickly the curve for arboreal eclectors will level off. Given the mean numbers of species per replicate (Table 1), one can conclude that species turnover between replicates is high in A and E but low in P and K.

Sample size: Mean sample sizes per replicate differed between methods (Table 1). For E, P, K and A, rarefaction (see Hurlbert, 1971; Magurran, 1988) was used to

TABLE 1. Sampling statistics for the four methods used for catching spiders. S – number of species; N – number of individuals; SE – standard error; n – number of replicates; see Fig. 1 for abbreviations of sampling methods.

| Sampling method | S total | N total | S/replicate | | N/replicate | |
|---|---|---|---|---|---|---|
| | | | mean | SE | mean | SE |
| E (n = 24) | 59 | 1850 | 20.25 | 0.77 | 77.08 | 5.90 |
| P (n = 12) | 35 | 1102 | 17.91 | 0.48 | 91.83 | 4.39 |
| K (n = 18) | 27 | 469 | 9.00 | 0.69 | 26.05 | 1.74 |
| A (n = 4) | 48 | 836 | 25.50 | 2.72 | 209.00 | 28.95 |

calculate species numbers expected in samples of standardized size (Fig. 3b). Again, given identical sample sizes, expected species numbers for both emergence traps and arboreal eclectors were much higher than the respective values for pitfall traps and soil samples.

**Representation of ecological groups**

If sampling techniques differ in species composition (see Fig. 2), it does not follow that catches also differ in the representation of ecological groups.

Species numbers: Litter-dwelling species (Str1) formed the most species-rich stratum type in the catches of each sampling method but their relative importance varied: it was particularly high (74.1%) in soil samples and low (29.2%) in arboreal eclectors, the assemblage of which was characterized by stratum types associated with higher vegetation strata. In the arboreal eclectors, stenochronous summer-breeders represented 35.4% of the species, while the respective values varied between 11.1 and 15.3% for the three other methods. Apart from these examples, relative importance of ecological types in terms of species numbers was fairly similar for all sampling methods.

Proportional abundance: Differences between sampling methods become more pronounced when we look at the proportional abundance of ecological groups. In order to summarize our results, we applied canonical correspondence analysis (CCA) using ecological groups as explanatory (nominal) variables. First, we did separate CCAs for each of the six ecological categories (i.e., moisture types, size classes, etc.) to identify the ones with the highest explanatory potential. We found that prey capture strategy and stratum type performed best. So we conducted a CCA with the ecological types represented by these two categories and also included three maturity types. Species represented by six or fewer individuals were removed from the analysis. The sum of all unconstrained Eigenvalues was 0.749, of which 63.2% were explained by the first two axes.

The resulting ordination graph (Fig. 4) shows a triangular arrangement of sampling methods: catches from arboreal eclectors (A) and soil samples (K) are more or less isolated, while those from emergence (E) and pitfall traps (P) are fairly similar. Some species are strongly associated with individual sampling methods but there are also groups of species which are intermediate between P/E and K, and P/E/K and A: Axis 1 separates A from P, E and K. Abundance of spider species constructing webs on bark (WB), inhabitants of higher vegetation (Str4), and sit-and-wait predators (SW) were positively correlated with this axis, while the correlation was negative for litter-dwelling species (Str1). Axis 2 separates sampling methods (P and E) with high abundance of funnel-web spiders (WF) from those where such species are underrepresented (A and K).

Catches from arboreal eclectors differ from the overall pattern in that stenochronous autumn-breeders (stau) are very abundant. This is largely due to the dominant species *D. socialis*, and, hence, collinear with variable WB (and also variable Str5, which is not shown in Fig. 4). Soil sample assemblages are characterized by high num-

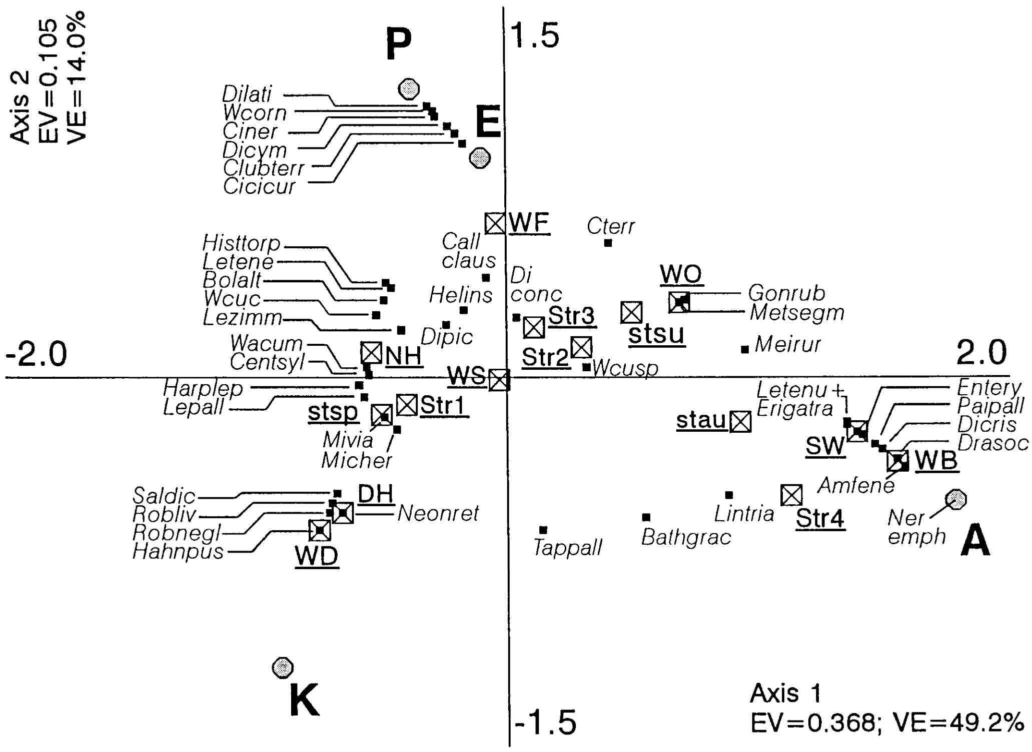


Fig. 4. Results of a canonical correspondence analysis demonstrating relationships between sampling methods (circles/labels: bold; see Fig. 1 for abbreviations), spider species (small squares/italics; see Appendix 1 for full species names) and ecological groups [quadrats (= centroids) / underlined]. Abbreviations for ecological groups: Prey capture strategies: DH – diurnal hunters; NH – nocturnal hunters; WB – webs on bark; WD – small diffuse nets; WF – funnel-web spiders; WO – orb-web spiders; WS – sheet-web spiders; SW – sit-and-wait predators. Stratum types: Str1 – litter-dwelling species; Str2 – species occurring in the litter and the herb layer; Str3 – species also occurring on higher vegetation; Str4 – species normally restricted to the herb layer and bushes. Maturity types: stsp – stenochronous spring breeders; stsu – stenochronous summer breeders, stau – stenochronous autumn breeders. Only species represented by >6 individuals were included; data were square root transformed. EV – eigenvalues; VE – variance explained.

bers of stenochronous spring-breeders (stsp), while stenochronous summer-breeding species (stsu) are virtually lacking.

## DISCUSSION

Our 1-year sampling programme involving four sampling methods yielded 87 species for the Göttingen beech forest. As suggested by the shapes of rarefaction curves (Figs 3a, b), the sampling programme did not detect all the spider species occurring in the Göttingen beech forest, and 31 additional species (see Appendix 1) have been recorded during later studies (mostly from the *Allium* subarea) giving a total of 118 species (Stippich 1981, 1986). Further species have been added to the list recently by the pitfall trap studies of Sührig (1997) and Rothländer (1998), which were, however, conducted in a larger area covering differently aged beech stands. Some earlier studies using various combinations of sampling methods were conducted in beech forests on acid soils and reported roughly similar species numbers: S = 83 (Platen, 1985), S = 95 (Dumpert & Platen, 1985), and S = 109 (Albert, 1979).

Sampling methods differed in species numbers detected: Emergence traps and arboreal eclectors proved to be more efficient than pitfall traps and soil samples. This was not only true considering absolute species numbers (Fig. 1) but also when expected species numbers had been calculated for standardized sample sizes using rarefaction (Figs 3a, b). These patterns agree with the findings from two earlier studies: Dumpert & Platen (1985) recorded higher species numbers from emergence traps than pitfall traps and soil samples in spite of much larger sample sizes obtained by the latter two techniques, and in Albert's (1979) study, species numbers were much higher for arboreal eclectors than for pitfall traps and soil samples (see Table 2). While in the present study more species were recorded from emergence traps than from arboreal eclectors, Platen's (1985) 2-year study resulted in the opposite pattern with 69 species trapped by a single arboreal eclector and 43 species recorded from six emergence traps. So, the relative efficiencies of arboreal eclectors and emergence traps remain uncertain. Based on our results, we would think that arboreal eclectors offering open access to spiders are more likely to collect high spe-

TABLE 2. Species numbers (S) and sample sizes (N) recorded during studies on spider communities of beech forests using four different sampling methods. See Fig. 1 for abbreviations of sampling methods; a – duration of the study (years).

| Source | | E | | P | | K | | A | |
|---|---|---|---|---|---|---|---|---|---|
| | a | S | N | S | N | S | S | S | N |
| This study | 1 | 59 | 1850 | 35 | 1102 | 27 | 469 | 48 | 836 |
| Albert (1979) | 1 | – | – | 36 | 1601 | 24 | 1818 | 67 | 1525 |
| Bauchhenss et al. (1987) | 1 | – | – | 21 | 70 | – | – | – | – |
| Hofmann (1986) 2 | 1 | – | – | 53 | 757 | – | – | – | – |
| Hofmann (1986) 3 | 1 | – | – | 39 | 754 | – | – | – | – |
| Hofmann (1986) 4 | 1 | – | – | 47 | 1211 | – | – | – | – |
| Baehr (1983) B | 1 | – | – | 32 | 320 | – | – | – | – |
| Baehr (1983) C | 1 | – | – | 53 | 1081 | – | – | – | – |
| Baehr (1983) D | 1 | – | – | 35 | 1339 | – | – | – | – |
| Baehr (1983) E | 1 | – | – | 48 | 944 | – | – | – | – |
| Baehr & Baehr (1984) | 1 | – | – | 37 | 347 | – | – | – | – |
| Platen (1985) | 2 | 43 | 463 | – | – | – | – | 69 | 786 |
| Dumpert & Platen (1985) | 4 | 72 | 2169 | – | – | – | – | – | – |
| Dumpert & Platen (1985) | 6 | – | – | 64 | 2991 | 36 | 3704 | – | – |
| Mean percentage of funnel web spiders | | | 11.6 | | 31.7 | | 1.0 | | 5.2 |
| SE | | | 5.6 | | 5.5 | | 1.0 | | 1.0 |

cies numbers compared with emergence traps, which form closed systems.

Sampling effort and sample size may not be the only factors influencing the number of species recorded. In methods strongly dependent on the activity of adult spiders (e.g., pitfall traps and arboreal eclectors), an extra increase may be achieved by extending the study period to more than one year. Thereby, the chances of the maturity periods of individual species coinciding with favourable weather conditions will increase and so will the probability of detecting additional species.

Representation of ecological groups can obviously be related to specific properties of the sampling method. For example, arboreal eclectors are efficient in sampling species associated with higher strata, and not surprisingly, such stratum types are over-represented. Since *Drapetisca socialis* is the dominant species in arboreal eclectors, proportional abundances of ecological types is strongly biased towards the ecological characteristics of this species. Assemblages of soil samples are characterized by high proportional abundance of litter-dwelling species, whereas funnel web spiders such as *Coelotes terrestris* and *C. inermis* are over-represented in pitfall trap catches. This is not a special feature of our study but a general pattern (Table 2; bottom).

Our study was characterised by an exceptionally high sampling effort in terms of replicates (e.g., 24 emergence traps). This enabled us to generate fairly reliable rarefaction curves, and we feel it might be helpful to summarize our results in the form of a few recommendations, which should also be applicable to studies with lower input of labour.

## CONCLUSIONS

Which sampling methods should be applied depends on the type of study. (i) If the major goal is to record as many species as possible from a habitat, the best choice is probably a combination of emergence traps and arboreal eclectors, since both these methods collect most species detectable by pitfall traps and soil sample extraction and high numbers of additional species. (ii) If the major goal is to analyse community patterns, quantitative sampling is required. Soil samples yield highly quantitative results but are restricted to a single habitat stratum, whereas catches from pitfall traps and arboreal eclectors depend completely on spider activity and cannot be related to a defined sampling area. While emergence trap catches, too, will depend on the inclination of spiders to move, they sample a defined area of ground and provide at least a semi-quantitative abundance estimate of spiders ranging from litter-dwellers to inhabitants of the herb layer. Whenever catches from emergence traps are available, we would, therefore, recommend to use them in studies of spider communities. (iii) While we only considered results from beech forests, we feel our conclusions should apply to many other woodland habitats.

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APPENDIX 1. Spider species recorded from a beech forest on limestone. Nomenclature follows Platen et al. (1995). Species recorded during additional sampling programmes in the same site are marked by *; underlined letters have been used as species labels in Fig. 4.

DYSDERIDAE: **Dysdera erythrina* (Walckenaer, 1802); *Harpactea lepida* (C.L. Koch, 1839); THERIDIIDAE: **Achaearanea lunata* (Clerck, 1757); *Enoplognatha ovata* (Clerck, 1757); *Paidiscura pallens* (Blackwall, 1834); *Robertus lividus* (Blackwall, 1836); *Rob. neglectus* (O.P.-Cambridge, 1871); *R. scoticus* Jackson, 1914; *Theridion bimaculatum* (L., 1767); *T. varians* Hahn, 1831; LINYPHIIDAE: Linyphiinae: *Agyneta conigera* (O.P.-Cambridge, 1863); *Bathyphantes gracilis* (Blackwall, 1841); *B. nigrinus* (Westring, 1851); **B. parvulus* (Westring, 1851); *Bolyphantes alticeps* (Sundevall, 1832); **Centromerus dilutus* (O.P.-Cambridge, 1875); *C. jacksoni* Denis, 1952; **C. pabulator* (Cambridge, 1875); **C. sellarius* (Simon, 1884); *Cent. sylvaticus* (Blackwall, 1841); *Diplostyla concolor* (Wider, 1834); *Drapetisca socialis* (Sundevall, 1832); *Helophora insignis* (Blackwall, 1841); *Labulla thoracica* (Wider, 1834); *Lepthyphantes alacris* (Blackwall, 1853); *L. cristatus* (Menge, 1866); *L. ericaeus* (Blackwall, 1853); *L. flavipes* (Blackwall, 1854); **L. lepthyphantiformis* (Strand, 1907); *L. mengei* Kulczynski, 1887; *L. minutus* (Blackwall, 1833); **L. obscurus* (Blackwall, 1841); *Le. pallidus* (O.P.-Cambridge, 1871); *Le. tenebricola* (Wider, 1834); *Le. tenuis* (Blackwall, 1852); *Le. zimmermanni* Bertkau, 1890; *Linyphia hortensis* Sundevall, 1830; *Lin. triangularis* (Clerck, 1757); *Macrargus rufus* (Wider, 1834); *Meioneta rurestris* (C.L. Koch, 1836); **Microlinyphia pusilla* (Sundevall, 1830); *Microneta viaria* (Blackwall, 1841); *Neriene emphana* (Walckenaer, 1842); **N. marginata* C.L. Koch, 1834; *Poeciloneta globosa* (Wider, 1834); **Porrhomma egeria* Simon, 1884; *P. microphthalmum* (O.P.-Cambridge, 1871); **Pseudocarorita thaleri* (Saaristo, 1971); LINYPHIIDAE: Erigoninae: **Asthenargus paganus* (Simon, 1884); *Dicymbium nigrum* (Blackwall, 1834); *D. tibiale* (Blackwall, 1836); *Diplocephalus cristatus* (Blackwall, 1833); *Di. latifrons* (O.P.-Cambridge, 1863); *Di. picinus* (Blackwall, 1841); *Entelecara congenera*

(O.P.-Cambridge, 1879); *Ent. erythropus* (Westring, 1851); *Erigone atra* (Blackwall, 1841); **E. dentipalpis* (Wider, 1834); *Gonatium rubellum* (Blackwall, 1841); **G. rubens* (Blackwall, 1833); **Hypomma bituberculatum* (Wider 1834); *Maso sundevalli* (Westring, 1851); *Micrargus herbigradus* (Blackwall, 1854); **Minyriolus pusillus* (Wider, 1834); **Oedothorax apicatus* (Blackwall, 1850); *O. fuscus* (Blackwall, 1834); *Saloca diceros* (O.P.-Cambridge, 1871); *Silometopus reussi* (Thorell, 1871); *Tapinocyba insecta* (L. Koch, 1869); *Tap. pallens* (O.P.-Cambridge, 1872); *Thyreosthenius parasiticus* (Westring, 1851); *Tiso vagans* (Blackwall, 1834); *Walckenaeria acuminata* Blackwall, 1833; *W. corniculans* (O.P.-Cambridge, 1875); *W. cucullata* (C.L. Koch, 1836); *W. cuspidata* Blackwall, 1833; *W. dysderoides* (Wider, 1834); *W. monoceros* (Wider, 1834); *W. obtusa* Blackwall, 1836; *W. unicornis* O.P.-Cambridge, 1861; ARANEIDAE: **Araneus diadematus* Clerck, 1757; *Araniella cucurbitina* (Clerck, 1757); **A. displicata* (Hentz, 1847); *Atea sturmi* (Hahn, 1831); *Cyclosa conica* (Pallas, 1772); **Gibbaranea omoeda* (Thorell, 1870); *Mangora acalypha* (Walckenaer, 1802); METIDAE: *Metellina mengei* (Blackwall, 1869); *Met. segmentata* (Clerck, 1757); TETRAGNATHIDAE: **Pachygnatha degeeri* Sundevall, 1830; AGELENIDAE: *Cicurina cicur* (F., 1793); *Coelotes inermis* (C.L. Koch, 1855); *C. terrestris* (Wider, 1834); *Histopona torpida* (C.L. Koch, 1834); **Tegenaria silvestris* L. Koch, 1872; CYBAEIDAE: **Cybaeus angustiarum* L. Koch, 1868; HAHNIIDAE: *Hahnia pusilla* C.L. Koch, 1841; PISAURIDAE: **Pisaura mirabilis* (Clerck, 1757); LYCOSIDAE: *Alopecosa pulverulenta* (Clerck, 1757); *Pardosa lugubris* (Walckenaer, 1802); *Trochosa ruricola* (De Geer, 1778); GNAPHOSIDAE: *Zelotes subterranus* (C.L. Koch, 1833); LIOCRANIDAE: **Agroeca brunnea* (Blackwall, 1833); CLUBIONIDAE: *Clubiona compta* C.L Koch, 1839; **C. diversa* O.P.-Cambridge, 1862; *Club. terrestris* Westring, 1851; ANYPHAENIDAE: **Anyphaena accentuata* (Walckenaer, 1802); ZORIDAE: **Zora spinimana* (Sundevall, 1833); THOMISIDAE: *Diaea dorsata* (F., 1777); **Xysticus cristatus* (Clerck, 1757); *X. lanio* C.L. Koch, 1824; PHILODROMIDAE: *Philodromus aureolus* (Clerck, 1757); *Ph. collinus* (C.L. Koch, 1835); SALTICIDAE: **Evarcha falcata* (Clerck, 1757); *Neon reticulatus* (Blackwall, 1853); DICTYNIDAE: *Lathys humilis* (Blackwall, 1855); AMAUROBIIDAE: *Amaurobius fenestralis* (Stroem, 1768); *Callobius claustrarius* (Hahn, 1831).