The epigeic spider fauna (Arachnida: Araneae) of 28 forests in eastern Austria

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Milasowszky N., Hepner M., Waitzbauer W. & Zulka K.P. 2015. The epigeic spider fauna (Arachnida: Araneae) of 28 forests in eastern Austria. Biodiversität und Naturschutz in Ostösterreich - BCBEA 1/1: 135–163.

Online seit 5 *Mai* 2015

Abstract

A total of 10,788 adult individuals from 211 spider species and 29 families were collected in 28 study sites in forests in eastern Austria. Four forest types were investigated: Austrian pine (*Seslerio-Pinetum nigrae*, 3 study sites), beech (10), floodplain (4), and oak-hornbeam (*Galio sylvatici-Carpinetum*, 11). Furthermore, within the beech forest data set, five plant associations were distinguished: woodruff beech (*Galio odorati-Fagetum*, 3), acidophilous or white wood-rush beech (*Luzulo-Fagetum*, 1), common cow-wheat beech (*Melampyro-Fagetum*, 3), dog's mercury beech (*Mercuriali-Fagetum*, 1) and spruce-fir-beach forests (*Cardamino trifoliae-Fagetum*, 2). Within the floodplain forests three plant associations were investigated: *Fraxino-Populetum* (1), *Fraxino-Ulmetum* (2) and *Pruno-Fraxinetum* (1). Austrian pine forests had the highest species richness, while floodplain forests the lowest. Highest number and proportion of Red List and rare species were found in Austrian pine forests, and the lowest were in beech and floodplain forests. The highest proportion of forest dependent species was found in beech forests, while the lowest in Austrian pine forests. The highest proportion of forest specialists was found in beech forests, that of forest generalists in floodplain forests and that of forest steppe/edge species in Austrian pine and oak-hornbeam forests. The highest mean Entling shading values were obtained in beech forests, and the lowest Entling moisture (i. e. highest dryness) values were found in Austrian pine forests and oak-hornbeam forests, whereas the highest Entling moisture values were found in floodplain forests. At least 31 species, which represented approximately 15 % of the total spider data set of the 28 study sites, must be considered to have high conservation value. According to the Red List of spiders of the Czech Republic and Slovakia, 27 species were either classified as extinct (EX), critically endangered (CR), endangered (EN) or vulnerable (VU). Further, three species must be considered as rare in central Europe since they are neither reported in the Czech Republic nor in Slovakia: *Coelotes solitarius* L. Koch, 1868, *Dasumia canestrinii* (L. Koch, 1876) and *Xysticus macedonicus* Silhavy, 1944.

Keywords: arachnology, biodiversity, Austrian pine, beech, floodplain, oak-hornbeam forests

Zusammenfassung

Die epigäische Spinnenfauna (Arachnida: Araneae) von 28 Wäldern in Ostösterreich. In Wäldern in Ostösterreich wurden in 28 Untersuchungsflächen insgesamt 10.788 Individuen von 211 Spinnenarten aus 29 Familien gesammelt. Vier Waldtypen wurden untersucht: Schwarzföhrenwälder (*Seslerio-Pinetum nigrae*, 3 Untersuchungsflächen), Buchenwälder (10), Auwälder (4) und Eichen-Hainbuchenwälder (*Galio sylvatici-Carpinetum*, 11). Darüber hinaus wurden innerhalb des Buchenwald-Datensatzes, weitere fünf Pflanzengesellschaften unterschieden: Waldmeister-Buchenwald (*Galio odorati-Fagetum*, 3), Hainsimsen-Buchenwald (*Luzulo-Fagetum*, 1), Wachtelweizen-Buchen-wald (*Melampyro-Fagetum*, 3), Bingelkraut-Buchenwald (*Mercuriali-Fagetum*, 1) und Fichten-Tan-nen-Buchenwald (*Cardamino trifoliae-Fagetum*, 2). Innerhalb der Auwälder wurden drei Pflanzen-gesellschaften untersucht: *Fraxino-Populetum* (1), *Fraxino-Ulmetum* (2) und *Pruno-Fraxinetum* (1). Schwarzföhrenwälder wiesen die höchste Artenzahl auf, Auwälder die niedrigste. Die höchste Anzahl und der höchste Anteil an gefährdeten und seltenen Arten wurde in Schwarzföhrenwäldern gefunden, die niedrigsten Zahlen und Anteile in Buchen- und Auwäldern. Der Anteil der an den Wald gebundenen Arten war in den Buchenwäldern am höchsten und in den Schwarzföhrenwäldern am niedrigsten. Der höchste Anteil an Waldspezialisten war ebenfalls in Buchenwäldern zu finden, jener der Waldgeneralisten war in den Auwäldern am höchsten, und jener der Waldsteppe / Waldrandarten in den Schwarzföhrenwäldern und Eichen-Hainbuchenwäldern. Die höchsten mittleren Entling-Beschattungswerte wurden für die Buchenwälder berechnet. Die niedrigsten Entling-Feuchtigkeitswerte (d. h. höchste Trockenheitswerte) wurden für die Schwarzföhrenwälder und Eichen-

Hainbuchenwälder ermittelt, während die höchsten Entling-Feuchtigkeitswerte in Auwäldern gefunden wurden. Mindestens 31 Arten, die etwa 15 % des gesamten Artenspektrums aller Untersuchungsflächen repräsentieren, wiesen einen hohen Naturschutzwert auf. Gemäß der Roten Liste der Spinnen der Tschechischen Republik und der Slowakei gelten 27 Arten davon entweder als ausgestorben (EX), vom Aussterben bedroht (CR), stark gefährdet (EN) oder gefährdet (VU). Darüber hinaus müssen drei Arten in Mitteleuropa als selten betrachtet werden, da sie weder in der Tschechischen Republik noch in der Slowakei bislang nachgewiesen wurden: *Coelotes solitarius* L. Koch, 1868, *Dasumia canestrinii* (L. Koch, 1876) und *Xysticus macedonicus* Silhavy, 1944.

Introduction

In Austria, studies on colline-montane forest spider assemblages, which were collected by means of pitfall traps during a whole vegetation period/growing season (May-October), were obtained in Burgenland (Steinberger 2004), Carinthia (Komposch 1997, Steinberger 1990), Lower Austria (Kirch 2001, Milasowszky et al. 2009, Thaler et al. 1984, Thaler & Steiner 1987), Styria (Horak 1987, 1988, 1989, Jantscher & Paill 1998, Rupp 1999), Tyrol (Steinberger 1998, Steinberger & Thaler 1990), Upper Austria (Freudenthaler 1989, 1994 a, b), Vienna (Hepner et al. 2011, Milasowszky & Strodl 2006, Strodl et al. 2007) and Vorarlberg (Breuss 1994, 1996, 1999, Steinberger & Meyer 1993, 1995).

The present study reports on the spider fauna of 28 study sites in forests of eastern Austria, particularly in the federal states of Burgenland, Lower Austria, Styria and Vienna. The spider material originates from various sources: (i) the biodiversity monitoring program DIANA (Diversity of Austrian natural forests, see Hackl et al. 2004) (13 study sites), (ii) contract research projects (6), (iii) on-going and completed master theses (6) and (iv) private collection initiatives (3). So far, the faunistic data have - if at all - only been documented in reports (e. g. Milasowszky 2005, Milasowszky et al. 2008, Zulka et al. 1994) or master theses (e. g. Fiedler 2010), i. e. so-called grey literature.

This study aims at providing basic faunistic information on the spider fauna of eastern Austrian forests with regard to total species richness, forest dependent species richness (forest generalists, forest specialists, forest steppe/edge species), red-listed and rare spiders, as well as indicator species (using shading and moisture values from Entling et al. 2007). In addition, we examine the question whether spider assemblages differ between forest types in our data set.

Material and methods

Study area

The study sites were located in four federal states (Burgenland, Lower Austria, Styria and Vienna) and within four forest growth regions according to Kilian et al. (1994) (**Fig. 1**). Forest growth regions are large areas (natural landscapes) characterized by uniform climatic and geomorphologic patterns.

The forest growth region "4.2 Northern fringe of the Alps Eastern part" is characterised by a very humid climate, with annual precipitation in the montane altitude between 1000 and 1700 mm, a maximum precipitation in July, a secondary maximum in winter, very low winter temperature and a shortened vegetation period due to high snowfall. Regarding the geomorphology, the mountains consist of limestone and dolomite; in the northeast towards the "Wienerwald" there is a band of flysch, the so called "Flysch-Zone" consisting of clay and sandstone.

The forest growth region "5.1 Eastern fringe of the Alps in Lower Austria (Thermal Alps)" is situated in the transition zone between the humid climate of forest growth region 4.2 and the pannonic climate of the forest growth region 8.1; in the colline and submontane altitudes the annual precipitation fluctuates between 700 (in the east) and 1000 mm (in the west) with maximum of precipitation in July and mild winters with little snowfall. There are two distinct geomorphological areas: (i) the eastern "Flysch-Wienerwald" made of marl and sandstone, (ii) the eastern fringe of the limestone Alps, where limestone, dolomite and quaterny sediments build the terrain of the Austrian pine forest area.

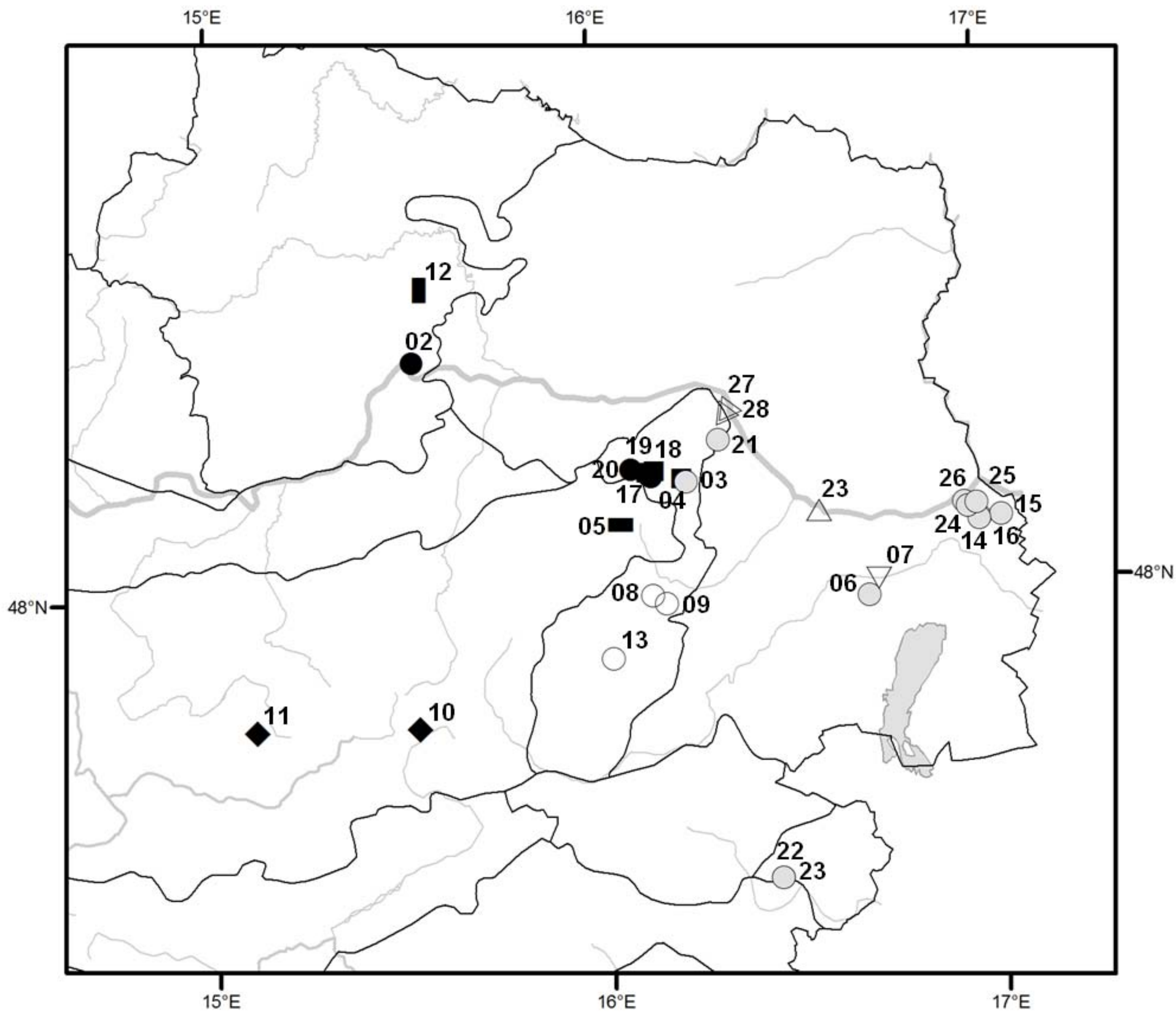

Fig. 1: Geographical position of the 28 study sites. Symbols: open circle = Austrian pine (*Seslerio-Pinetum nigrae*), black = beech (circle: *Melampyro-Fagetum*, diamond: *Cardamino trifoliae-Fagetum*, horizontal rectangle: *Mercuriali-Fagetum*, square: *Galio odorati-Fagetum*, vertical rectangle: *Luzulo-Fagetum*), open triangles = floodplain (pointed up: *Fraxino-Populetum*, pointed right: *Fraxino-Ulmetum*, pointed down: *Pruno-Fraxinetum*), grey circle = oak-hornbeam (*Galio sylvatici-Carpinetum*). For numbers of study sites see Tab. 1. / *Geographische Lage der 28 Untersuchungsflächen. Symbole: offene Kreise = Schwarzföhrenwald (Seslerio-Pinetum nigrae), schwarz = Buchenwald (Kreis: Melampyro-Fagetum, Deltoid: Cardamino trifoliae-Fagetum, horizontales Rechteck: Mercuriali-Fagetum, Quadrat: Galio odorati-Fagetum, vertikales Rechteck: Luzulo-Fagetum), offenes Dreieck = Auwald (Spitze nach oben: Fraxino-Populetum, Spitze nach rechts: Fraxino-Ulmetum, Spitze nach unten: Pruno-Fraxinetum), grauer Kreis = Eichen-Hainbuchenwald (Galio sylvatici-Carpinetum). Für die Nummerierung der Untersuchungsflächen siehe Tab. 1.*

The climate of forest growth region "8.1 Pannonian lowlands and hills" is Pannonic-subcontinental, i. e. dry-warm climate, winters are moderately cold with little snowfall, long dry periods during the summer, annual precipitation is the lowest in Austria fluctuating between 450 and 700 mm, maximum precipitation in summer. Geomorphologically, this region contains mostly tertiary hills and gravel terraces, and an alpine-carpathian crystalline basement below "Leithagebirge" and "Hainburger Berge".

The forest growth region "9.2 Waldviertel" is characterised by a cold-boreal climate with a gradual slope from the west to the east and special local climate conditions ("Wachau", "Kremstal"); the annual precipitation in the colline/submontane altitude fluctuates between 500 and 700 mm, with maximum precipitation in summer; further characteristics are a short vegetation period as well as early and late frosts. The geomorphological basement is a crystalline old mountain ridge with flat plateaus (granite and gneiss highland); a conspicuous feature is the steep ravine towards the Danube valley.

Vegetation

Four forest types (scientific nomencature follows Willner & Grabherr 2007) were investigated (**Tab. 1**). Austrian pine (Seslerio-Pinetum nigrae, 3 study sites), beech (10), floodplain (4), and oak-hornbeam (Galio sylvatici-Carpinetum, 11). Furthermore, within the beech forest data set five plant associations were distinguished: woodruff beech (Galio odorati-Fagetum, 3 study sites), acidophilous or white wood-rush beech (Luzulo-Fagetum, 1), common cow-wheat beech (Melampyro-Fagetum, 3), Dog's mercury beech (Mercuriali-Fagetum, 1) and spruce-fir-beach forests (Cardamino trifoliae-Fagetum, 2). Within the floodplain forests three plant associations were investigated: Fraxino-Populetum (1), Fraxino-Ulmetum (2) and Pruno-Fraxinetum (1).

Data on the forest type were assessed by the authors of this study or provided by the following experts: Christian Fiedler (14–16), Franz Starlinger (site numbers 01–13), Markus Strodl (22, 23), Wolfgang Willner (17–20) and Andreas Zapf (24–26). In all forests, the vegetation can be considered as "potential natural". Potential natural vegetation (PNV) (sensu Tüxen 1956) is defined as a climax to be expected at the respective site under present environmental conditions and exclusion of past and present human disturbance (for Austria see Kilian et al. 1994).

Sampling

Spider assemblages in 28 forests of eastern Austria were studied between 1996 and 2007. A detailed overview of the study sites and investigation periods is given in **Tab. 1**.

All study sites were sampled during the whole vegetation period/growing season within a calendar year by means of pitfall traps (Barber 1931) partly filled with ethylene glycol as preservation liquid (killing preserving solution) during an entire vegetation period (growing season). Two pitfall types were used: either white plastic yoghurt cups (opening diameter 65 mm, depth 100 mm) or transparent glass jars (opening diameter 45 mm, depth 90 mm). All traps were covered with a transparent plastic roof (15x15 cm) placed 10 cm above the trap as protecion against rainfall. Recent studies showed that covers do not appear to affect the capture efficiency of pitfall traps (Phillips & Cobb 2005, Buchholz & Hannig 2009). The traps were exposed along a trancect line in a typical part of the forest (**Tab. 1**). The distance between the traps was at least 5–10 m. Trapped individuals were collected at a regular interval of three weeks, in most cases from March/April to October/November. The trapping period covered most of the growing season (May–October) as recommended by Riecken (1999). All adult spiders were identifed to species level by the authors using the determination keys for Central European spiders (Heimer & Nentwig 1991, Nentwig et al. 2013). Nomenclature of spiders follows Platnick (2013).

Tab. 1: Overview of projects, investigated forest sites, number of pitfall traps and investigation period; pitfall traps marked with an * were plastic yoghurt jars of 6.5 cm opening diameter; all other traps were glass jars of 4.5 cm opening diameter. Projects: DI = DIANA, FI = Fiedler, MH = Milasowszky & Hepner, ST = Strodl, ZA = Zapf, ZU = Zulka. Forest types: AP = Austrian pine forest [*Seslerio-Pinetum nigrae*]; B = beech forest: B_gal = woodruff-beech [*Galio odorati-Fagetum*], B_luz = acidophilous or white wood-rush-beech [*Luzulo-Fagetum*]; B_mel = common cow-wheat-beech [*Melampyro-Fagetum*]; B_mer = dog's-mercury beech [*Mercuriali-Fagetum*], FP = floodplain forest: FP_fp [*Fraxino-Populetum*], FP_fu [*Fraxino-Ulmetum*], FP_pf [*Pruno-Fraxinetum*]; OH = oak-hornbeam forest [*Galio sylvatici-Carpinetum*]; SFB = spruce-fir-beech forest [*Cardamino trifoliae-Fagetum*]. Forest growth regions (according to Kilian et al. 1994): 4.2. Northern fringe of the Alps – Eastern part, 5.1. Eastern fringe of the Alps (Thermal Alps), 8.1. Pannonic lowlands and hills, 9.2. "Waldviertel". / *Überblick zu den Projekten, Unterschungsgebieten, Anzahl der Barber-Fallen und Untersuchungszeiträumen; bei Barber-Fallen, die mit einem * markiert sind, handelt es sich um Joghurt-Plastikbecher mit einem Öffnungsdurchmesser von 6,5 cm; alle anderen Barber-Fallen sind Kindernahrungsgläser mit einem Öffnungsdurchmesser von 4,5 cm. Projekte: DI = DIANA, FI = Fiedler, MH = Milasowszky & Hepner, ST = Strodl, ZA = Zapf, ZU = Zulka. Waldtypen: AP = Schwarzföhrenwald [Seslerio-Pinetum nigrae]; B = Buchenwald: B_gal = Waldmeister-Buchenwald [Galio odorati-Fagetum], B_luz = Hainsimsen-Buchenwald [Luzulo-Fagetum]; B_mel = Wachtelweizen-Buchenwald [Melampyro-Fagetum]; B_mer = Bingelkraut-Buchenwald [Mercuriali-Fagetum], FP = Auwald:*

FP_fp [Fraxino-Populetum], FP_fu [Fraxino-Ulmetum], FP_pf [Pruno-Fraxinetum]; OH = Eichen-Hainbuchenwald [Galio sylvatici-Carpinetum]; SFB = Fichten-Tannen-Buchenald [Cardamino trifoliae-Fagetum]. Forstliches Wuchsgebiet (gemäß Kilian et al. 1994): 4.2. Nördliche Randalpen - Ostteil, 5.1. Niederösterreichischer Alpenostrand (Thermenalpen), 8.1. Pannonisches Tief- und Hügelland, 9.2. Waldviertel.

Project	No	Town	Locality	Forest type	Forest growth region	Eastern longitude	Northern latitude	Elevation (m a.s.l)	No of traps	Investigation period
DI01	01	Mannswörth	Beugenau	FP_fp	8.1	16°33'26"	48°07'49"	154	8*	12 April to 24 October 2002
DI02	02	Dürnstein	Dürnstein	B_mel	9.2	15°31'26"	48°24'26"	500	8	25 April to 20 November 2004
DI03	03	Wien [Vienna] Hietzing	Johannser Kogel B	B_gal	5.1	16°12'58"	48°11'39"	302	8*	26 March to 24 October 2002
DI04	04	Wien [Vienna] Hietzing	Johannser Kogel E	OH	5.1	16°13'09"	48°11'20"	373	8*	26 March to- 24 October 2002
DI05	05	Wienerwald	Klausenleopoldsdorf	B_mer	4.2	16°03'25"	48°07'04"	490	8	25 April to 20 November 2004
DI06	06	Sommerein	Kolmberg	OH	8.1	16°40'35"	47°58'56"	345	8	23 April - 20 November 2004
DI07	07	Wilfleinsdorf	Müllerboden	FP_pf	8.1	16°42'43"	48°00'34"	165	8*	03 April to 24 October 2002
DI08	08	Bad Vöslau	Merkenstein-Schöpfeben	AP	5.1	16°07'42"	47°59'39"	588	8	25 April to 20 November 2004
DI09	09	Bad Vöslau	Merkenstein-Vöslauer Hütte	AP	5.1	16°09'41"	47°58'45"	448	8	12 May to 20 November 2004
DI10	10	Sankt Aegyd am Neuwalde	Neuwald	SFB	4.2	15°31'27"	47°46'26"	998	8	14 May - 20 November 2004
DI11	11	Lunz	Kleiner Urwald Rothwald	SFB	4.2	15°06'39"	47°46'26"	1057	8*	9 May to 20 November 2002
DI12	12	Gföhl	Saubrunn	B_luz	9.2	15°32'31"	48°31'56"	551	8	25 April to 20 November 2004
DI13	13	Waldegg Oed	Stampftal	AP	5.1	16°01'59"	47°53'18"	640	8	28 April to 10 November 2006
FI01	14	Hundsheim	Bauernlüsse	OH	8.1	16°58'45"	48°06'31"	254	10*	08 April to 4 November 2003
FI02	15	Wolfsthal	Königswarte	OH	8.1	17°01'37"	48°06'43"	285	10*	08 April to 4 November 2003
FI03	16	Hundsheim	Spitzerberg	OH	8.1	16°58'26"	48°06'22"	248	10*	08 April to 4 November 2003
MH01	17	Purkersdorf	Brunnberg	B_mel	5.1	16°07'10"	48°11'59"	345	6	20 April to 16 November 2007
MH02	18	Purkersdorf	Großer Steinbach	B_gal	5.1	16°08'05"	48°12'27"	391	6	20 April to 16 November 2007
MH03	19	Irenental	Heinratsberg	B_mel	5.1	16°04'45"	48°12'49"	429	6	20 April to 16 November 2007
MH04	20	Purkersdorf	Östlich Chateauwiese	B_gal	5.1	16°07'04"	48°12'21"	393	6	20 April to 16 November 2007
MH05	21	Wien [Vienna] Währing	Am Himmel	OH	5.1	16°18'38"	48°15'33"	381	6	20 April to 17 November 2006
ST01	22	Dörfl	Biri A	OH	8.1	16°26'58"	47°30'01"	306	6	23 April to 05 November 2006
ST02	23	Draßmarkt	Biri B	OH	8.1	16°26'31"	47°30'00"	372	6	15 April to 05 November 2006
ZA01	24	Bad Deutsch-Altenburg	Teichtal	OH	8.1	16°56'55"	48°08'09"	264	10*	03 April to 11 November 2006
ZA02	25	Bad Deutsch-Altenburg	Weißes Kreuz	OH	8.1	16°56'55"	48°07'39"	346	10*	03 April to 11 November 2006
ZA03	26	Wolfsthal	Wolfsthaler Wald	OH	8.1	16°58'33"	48°08'00"	202	10*	03 April to 11 November 2006
ZU01	27	Klosterneuburg	Klosterneuburger Au E	FP_fu	8.1	16°19'12"	48°18'56"	169	6	02 June 1995 to 03 June 1996
ZU02	28	Klosterneuburg	Klosterneuburger Au F	FP_fu	8.1	16°19'41"	48°18'29"	173	6	02 June 1995 to 03 June 1996

Red lists

Since the Red List for spiders of Austria is still in preparation (Komposch, pers. comm.), the Red lists of the Czech Republic (Buchar & Růžička 2002, Růžička 2005) and Slovakia (Gajdoš et al. 1999, Korenko 2004) were consulted. Species extinction risk was expressed in the current IUCN categories (IUCN 2001), which are also used in the Austrian Red Lists (e. g. Zulka et al. 2005, 2007, **Tab. 2**).

Habitat affinities

Prior to the statistical analyses, each spider species was classified according to its habitat affinities or preferences using relevant information both from the literature (e. g. Buchar & Růžička 2002, Entling et al. 2007, Grimm 1985, Hänggi et al. 1995, Kreuels & Platen 1999, Matveinen-Huju 2004) and our own databases to identify forest dependent species. We included three different species groups into the forest dependent species data set (see Milasowzsky et al. 2010):

(i) Forest specialist species: species preferring shady forest interior conditions with stable cold humid microclimate, as well as interior forest edges (sensu Whitcomb et al. 1981).

(ii) Forest generalist species: widely distributed species that show a high frequency of occurrence in forests.

(iii) Forest steppe/edge species: species occurring in light and dry open forests with grassy understorey, such as oak-hornbeam forests, (Pannonian) forest steppe and xerothermic forest edges.

Furthermore, each spider species was classified according to its habitat affinities using the niche position values for the environmental factors shading and moisture given in Entling et al. (2007, Appendix S2). Entling et al. (2007) provided shading and moisture data for 590 of the most abundant Central European spiders. Since no data are available for very rare or Eastern European spiders from Entling et al. (2007), differences in shading and moisture values for the four main forest types were calculated by means of Kruskal-Wallis H-tests on a slightly restricted data set.

Data analyses

Due to the differences in sampling intensity and the fact that pitfall data record species specific activities instead of absolute densities of spiders, we used presence-absence data of the surface-active spiders in the ordination analyses as recommended e. g. by Bonte et al. (2002, 2003).

We used non-metric multidimensional scaling analysis (MDS, also NMDS and NMS) to represent each spider assemblage as a point in a two-dimensional space. Non-metric multidimensional scaling is an ordination technique that iteratively seeks an optimal solution, i. e. a meaningful ordination to represent the points (Kruskal 1964 b, Legendre & Legendre 1998, McCune & Grace 2002). Points that are close together represent similar spider assemblages, while dissimilar spider assemblages are represented by points that are far apart. All pairwise distances among the 28 spider assemblage samples were calculated with the binary Lance and Williams dissimilarity measure. The Lance and Williams measure is computed from a fourfold table as (b+c)/(2a+b+c), where “a” represents the cell corresponding to cases present on both items, and “b” and “c” represent the diagonal cells corresponding to cases present on one item but absent on the other. The Lance and Williams measure is also known as the Bray-Curtis non-metric coefficient and has a range of 0 to 1.

Furthermore, we used two measures (Stress and R^2) for judging the goodness of fit of the MDS solution: (i) the stress value measures the degree of correspondence between distances among points on the MDS map and the matrix input. It ranges from 1 (worst possible fit) to 0 (perfect fit). In other words, a small stress value indicates a good fitting solution, whereas a high value indicates a bad fit of the solution. As a guideline for the interpretation of the stress value, a stress value < 0.2 is considered as an acceptable fit (Kruskal 1964 a, Wickelmeier 2003); (ii) the R^2 value is the squared correlation coefficient between the distances and the data, and it is the variance accounted for in the solution. For the MDS analyses the software SPSS Version 15.0 for Windows was used (SPSS 2006).

Results

Faunistics

A total of 10,788 adult individuals of 211 species from 29 families were collected in the 28 study sites (**Tab. 2 a, b, c**) representing about 20 % of the known Austrian spider species.

The following eight species occurred in, at least, half of the 28 study sites: *Histopona torpida* (C. L. Koch, 1837) present in 23 study sites, *Pardosa alacris* (C. L. Koch, 1833) in 22, *Trochosa terricola* Thorell, 1856 in 22, *Tenuiphantes flavipes* (Blackwall, 1854) in 20, *Palliduphantes alutacius* (Simon, 1884) in 18, *Haplodrassus silvestris* (Blackwall, 1833) in 16, *Inermocoelotes inermis* (L. Koch, 1855) in 16 and *Microneta viaria* (Blackwall, 1841) in 15 study sites.

The most frequent spider *H. torpida*, however, did not occur in the floodplain forests, although it was present in all Austrian pine and oak-hornbeam forests and in 90 % of the beech forests.

17 species occurred in all Austrian pine forests, 4 of which were found exclusively in this forest type: *Agroeca proxima* (O. P.-Cambridge, 1871), *Alopecosa pulverulenta* (Clerck, 1757), *Alopecosa sulzeri* (Pavesi, 1873) and *Ozyptila atomaria* (Panzer, 1801).

Only two species *I. inermis* and *Harpactea lepida* (C. L. Koch, 1838) were found in all 10 beech forests; furthermore, *H. torpida* occurred in 9 of the 10 beech forests.

Four species *Diplostyla concolor* (Wider, 1834), *Ozyptila praticola* (C. L. Koch, 1837), *Piratula hygrophila* (Thorell, 1872) and *Pachygnatha listeri* Sundevall, 1830 occurred in all floodplain forests. Of these species, only *P. listeri* was found in no other forest type.

Three spiders *H. torpida*, *P. alacris* and *T. terricola* were found in all 11 oak-hornbeam forests. Furthermore, *T. flavipes* and *Urocoras longispinus* (Kulczyński, 1897) were present in, at least, ten of the eleven oak-hornbeam study sites. However, of these species only *Urocoras longispinus* was exclusively found in oak-hornbeam forests.

Tab. 2 a: List of spider species in the ten beech forests; first number males, second number females. Numbers of study sites refer to Tab. 1. / *Liste der Spinnenarten in den zehn Buchenwäldern; erste Zahl Männchen, zweite Zahl Weibchen. Die Nummerierung der Untersuchungsflächen entspricht jener in Tab. 1.*

Araneae	**B_02**	**B_03**	**B_05**	**B_10**	**B_11**	**B_12**	**B_17**	**B_18**	**B_19**	**B_20**
Atypidae										
Atypus affinis Eichwald, 1830	1/0								2/0	
Dysderidae										
Dasumia canestrinii (L. Koch, 1876)								1/0	0/1	1/3
Dysdera ninnii Canestrini, 1868	1/0	1/0	1/0			0/1		1/3	1/0	0/2
Harpactea hombergi (Scopoli, 1763)	2/0							3/1		
Harpactea lepida (C. L. Koch, 1838)	13/9	20/2	13/2	1/0	14/18	33/34	2/3	8/10	4/2	8/1
Harpactea rubicunda (C. L. Koch, 1838)	3/0									
Theridiidae										
Crustulina guttata (Wider, 1834)								0/1		
Pholcomma gibbum (Westring, 1851)							1/0			
Robertus lividus (Blackwall, 1836)		3/0		5/3	1/0	0/1		2/0	2/0	2/0
Robertus scoticus Jackson, 1914				0/1						
Linyphiidae										
Abacoproeces saltuum (L. Koch, 1872)	1/0									
Agyneta rurestris (C. L. Koch, 1836)							1/0			0/1
Centromerus cavernarum (L. Koch, 1872)	0/1									
Centromerus pabulator (O. P.-Cambridge, 1875)					13/4					
Centromerus sellarius (Simon, 1884)					8/0		1/1	12/2		2/0
Centromerus silvicola (Kulczyński, 1887)							0/5	0/1	0/2	0/1
Centromerus sylvaticus (Blackwall, 1841)		1/1	8/2	5/3				0/1		
Ceratinella brevipes (Westring, 1851)		1/0								
Ceratinella brevis (Wider, 1834)	3/0			2/0						
Diplocephalus latifrons (O. P.-Cambridge, 1863)		1/1		43/31	13/11					
Diplocephalus picinus (Blackwall, 1841)						1/0		2/0	17/4	
Diplostyla concolor (Wider, 1834)		1/2		31/21	10/19					
Drapestica socialis (Sundevall, 1833)	0/1									
Erigone dentipalpis (Wider, 1834)									1/0	
Linyphia triangularis (Clerck, 1757)										1/0
Macrargus rufus (Wider, 1834)		0/9		0/2				0/3	0/1	0/1
Mansuphantes mansuetus (Thorell, 1875)									0/1	
Maso sundevalli (Westring, 1851)								1/0		1/0
Micrargus herbigradus (Blackwall, 1854)						1/1	1/0	0/1	1/0	0/1
Microneta viaria (Blackwall, 1841)	1/1	30/8			1/2	0/2	0/2	0/2	0/2	
Minyriolus pusillus (Wider, 1834)									1/0	
Neriene emphana (Walckenaer, 1842)	0/1									
Palliduphantes alutacius (Simon, 1884)	2/3	1/2	2/0					1/0	1/1	0/2
Palliduphantes pallidus (O. P.-Cambridge, 1871)							1/0	1/2		
Panamomops affinis Miller & Kratochvíl, 1939	40/1						5/0		1/0	2/0
Porrhomma lativelum Tretzel, 1956							0/1	1/0	0/2	
Porrhomma microphthalmum (O. P.-Cambridge, 1871)							0/1			
Pseudomaro aenigmaticus Denis, 1966							0/1			
Saloca diceros (O. P.-Cambridge, 1871)			21/2		3/0					3/1
Tapinocyba pallens (O. P.-Cambridge, 1872)	22/0					10/1	6/1		1/0	

Tapinopa longidens (Wider, 1834)				34/6	1/0					
Tenuiphantes alacris (Blackwall, 1853)				0/1	12/15					
Tenuiphantes cristatus (Menge, 1866)				0/3						
Tenuiphantes flavipes (Blackwall, 1854)	5/6	2/0					3/4	5/15	0/4	0/2
Tenuiphantes tenebricola (Wider, 1834)		16/20	3/10	6/20	38/130			0/2		0/3
Tenuiphantes tenuis (Blackwall, 1852)								0/1		
Trichoncyboides simoni (Lessert, 1904)							1/0		1/0	
Troxochrus scabriculus (Westring, 1851)									0/1	
Walckenaeria alticeps (Denis, 1952)		1/0								
Walckenaeria antica (Wider, 1834)									0/3	
Walckenaeria atrotibialis (O. P.-Cambridge, 1878)				5/1	1/0					
Walckenaeria corniculans (O. P.-Cambridge, 1875)	0/1							0/1		
Walckenaeria cucullata (C. L. Koch, 1836)	4/0	1/0					2/2	0/1	0/2	0/3
Walckenaeria dysderoides (Wider, 1834)	1/0									
Walckenaeria mitrata (Menge, 1868)					0/2					
Walckenaeria nudipalpis (Westring, 1851)									0/1	
Walckenaeria simplex Chyzer, 1894	1/0					1/1	2/0			
Walckenaeria vigilax (Blackwall, 1853)	0/1									
Araneidae										
Cercidia prominens (Westring, 1851)	1/0									0/1
Lycosidae										
Arctosa maculata (Hahn, 1822)					1/0					
Pardosa alacris (C. L. Koch, 1833)	17/18	3/6	5/0				7/2	2/18	29/58	107/147
Piratula hygrophila (Thorell, 1872)		1/0								
Trochosa terricola Thorell, 1856	0/1	4/1			0/1		3/6	1/0	9/7	11/5
Xerolycosa nemoralis (Westring, 1861)									0/1	
Pisauridae										
Pisaura mirabilis (Clerck, 1757)										1/0
Agelenidae										
Histopona luxurians (Kulczyński, 1897)			86/18	16/0			6/0	10/1		15/1
Histopona torpida (C. L. Koch, 1837)	7/1	53/13	64/19		14/0	32/20	9/9	157/83	51/42	96/53
Malthonica campestris (C. L. Koch, 1834)		1/0							0/1	
Malthonica silvestris (Panzer, 1804)							1/0		1/0	1/0
Textrix denticulata (Olivier, 1789)		1/0								
Cybaeidae										
Cybaeus tetricus (C. L. Koch, 1839)				7/0	47/8					
Hahniidae										
Cryphoeca silvicola (C. L. Koch, 1834)				1/0						
Hahnia helveola Simon, 1875									2/0	
Hahnia ononidum Simon, 1875						30/8				
Dictynidae										
Cicurina cicur (Fabricius, 1793)	11/1					4/0	3/0	3/2	1/0	
Amaurobiidae										
Amaurobius fenestralis (Ström, 1768)		2/0	2/0	1/0		3/0	1/0			
Amaurobius jugorum L. Koch, 1868	1/0	4/0	1/0				0/1	1/1	1/0	1/0
Callobius claustrarius (Hahn, 1833)			23/0	7/5		16/1				
Coelotes solitarius L. Koch, 1868				5/0	9/1					
Coelotes terrestris (Wider, 1834)	17/2					45/3				
Inermocoelotes inermis (L. Koch, 1855)	27/1	61/15	35/5	22/7	50/9	38/4	11/5	21/2	8/1	3/0
Miturgidae										
Zora nemoralis (Blackwall, 1861)	1/0							1/0	1/0	
Zora spinimana (Sundevall, 1833)										2/0
Liocranidae										
Agroeca brunnea (Blackwall, 1833)		1/1								
Apostenus fuscus Westring, 1851	23/8									
Liocranum rupicola (Walckenaer, 1830)	2/0									
Sagana rutilans Thorell, 1875		1/0								

Scotina celans (Blackwall, 1841)	2/0									
Clubionidae										
Clubiona pallidula (Clerck, 1757)									1/0	
Clubiona terrestris Westring, 1851		1/0						0/1	1/1	0/1
Phrurolithidae										
Phrurolithus festivus (C. L. Koch, 1835)	2/0									
Gnaphosidae										
Drassodes lapidosus (Walckenaer, 1802)									0/1	
Drassyllus villicus (Thorell, 1875)		0/1					1/0			2/0
Gnaphosa bicolor (Hahn, 1833)									3/1	1/1
Haplodrassus silvestris (Blackwall, 1833)	15/14	9/4				3/3		7/3	2/1	7/0
Trachyzelotes pedestris (C. L. Koch, 1837)										1/0
Zelotes apricorum (L. Koch, 1876)								1/0		3/0
Zelotes erebeus (Thorell, 1871)							2/0	1/0	0/1	1/0
Zelotes subterraneus (C. L. Koch, 1833)	0/1									
Philodromidae										
Philodromus dispar Walckenaer, 1826							1/0			
Thomisidae										
Xysticus luctator L. Koch, 1870		2/0							2/0	
Salticidae										
Evarcha falcata (Clerck, 1757)										1/0
Pseudeuophrys erratica (Walckenaer, 1826)								0/1		

Tab. 2b: List of spider species in the eleven oak-hornbeam forests forests; first number males, second number females. Numbers of study sites refer to Tab. 1. / *Liste der Spinnenarten in den elf Eichen-Hainbuchenwäldern; erste Zahl Männchen, zweite Zahl Weibchen. Die Nummerierung der Untersuchungsflächen entspricht jener in Tab. 1.*

Araneae	**OH_04**	**OH_06**	**OH_14**	**OH_15**	**OH_16**	**OH_21**	**OH_22**	**OH_23**	**OH_24**	**OH_25**	**OH_26**
Atypidae											
Atypus affinis Eichwald, 1830			3/0	2/0		1/0					8/0
Atypus muralis Bertkau, 1890			1/0								
Segestriidae											
Segestria senoculata (Linnaeus, 1758)		1/0									
Dysderidae											
Dasumia canestrinii (L. Koch, 1876)		1/0					0/1				
Dysdera crocata C. L. Koch, 1838					0/1						
Dysdera erythrina (Walckenaer, 1802)		6/5	2/5	10/17	3/4				6/5	2/5	3/2
Dysdera hungarica Kulczyński, 1897					0/1			0/1	0/2	0/3	0/1
Dysdera longirostris Doblika, 1853							1/1				
Dysdera ninnii Canestrini, 1868	0/2						1/1				
Harpactea hombergi (Scopoli, 1763)		1/0				1/0	2/1				
Harpactea lepida (C. L. Koch, 1838)	8/4							2/0			
Harpactea rubicunda (C. L. Koch, 1838)		4/3	21/5	27/3	34/9		1/1	0/1	9/6	2/2	6/1
Mimetidae											
Ero furcata (Villers, 1789)					1/0						
Theridiidae											
Enoplognatha thoracica (Hahn, 1833)			6/0	2/0	1/0						4/0
Episinus truncatus Latreille, 1809						0/1					
Euryopis flavomaculata (C. L. Koch, 1836)		6/0	6/0		42/0						3/1
Robertus lividus (Blackwall, 1836)		1/0	0/1	1/0						2/0	
Steatoda bipunctata (Linnaeus, 1758)							0/1				
Anapidae											
Comaroma simoni Bertkau, 1889							0/1				
Linyphiidae											
Abacoproeces saltuum (L. Koch, 1872)							1/0	31/5			
Anguliphantes angulipalpis (Westring, 1851)		2/0	1/0		1/1				0/1	0/1	
Centromerus brevivulvatus Dahl, 1912								1/0			

Centromerus leruthi Fage, 1933	2/0										
Centromerus sylvaticus (Blackwall, 1841)			0/1	0/2	0/1				0/1	1/3	0/2
Ceratinella brevipes (Westring, 1851)								0/1			
Ceratinella brevis (Wider, 1834)		7/0	11/0	16/3					0/1		3/0
Ceratinella major Kulczyński, 1894			1/0								
Ceratinella scabrosa (O.P.-Cambridge, 1871)			1/0								
Diplocephalus latifrons (O. P.-Cambridge, 1863)	3/0										
Diplocephalus picinus (Blackwall, 1841)							1/0	1/0			
Diplostyla concolor (Wider, 1834)	1/0				3/1			1/0			1/1
Erigone dentipalpis (Wider, 1834)								1/0			
Gonatium paradoxum (L. Koch, 1869)			0/1								
Linyphia hortensis Sundevall, 1830		0/1	1/0	3/1	5/3			0/3	4/3	3/0	2/0
Linyphia tenuipalpis Simon, 1884			1/0								
Linyphia triangularis (Clerck, 1757)			1/0		1/2						
Macrargus rufus (Wider, 1834)							0/1				
Mansuphantes mansuetus (Thorell, 1875)							0/1				
Megalepthyphantes pseudocollinus Saaristo, 1997		3/3	1/0		2/0				0/1		
Micrargus herbigradus (Blackwall, 1854)		4/0	3/0	1/0	3/0		1/1	8/1	3/1		
Microneta viaria (Blackwall, 1841)	19/11	4/3	7/0	2/0	22/9		7/1	8/2			
Neriene clathrata (Sundevall, 1830)				1/3							
Palliduphantes alutacius (Simon, 1884)	0/2	3/1		0/1	0/2	0/6	0/2	1/2	0/1		1/0
Palliduphantes pallidus (O. P.-Cambridge, 1871)	0/1										
Panamomops affinis Miller & Kratochvíl, 1939			4/0	6/0	12/2				1/1	2/0	
Pelecopsis elongata (Wider, 1834)							1/0				
Scotargus pilosus Simon, 1913							1/0				
Tapinocyba insecta (L. Koch, 1869)				4/0	2/0						2/0
Tapinopa longidens (Wider, 1834)							0/1				
Tenuiphantes flavipes (Blackwall, 1854)	5/16		12/9	5/18	9/21	16/44	9/14	18/35	13/19	12/22	16/34
Tenuiphantes mengei (Kulczyński, 1887)		9/16									
Tenuiphantes tenebricola (Wider, 1834)	4/10							0/1			
Tenuiphantes tenuis (Blackwall, 1852)					0/2						
Trichoncus affinis Kulczyński, 1894							1/0				
Trichoncyboides simoni (Lessert, 1904)		1/0									
Walckenaeria antica (Wider, 1834)								0/7			
Walckenaeria atrotibialis (O. P.-Cambridge, 1878)			0/2								
Walckenaeria corniculans (O. P.-Cambridge, 1875)		0/2									
Walckenaeria cucullata (C. L. Koch, 1836)	1/0		4/0		2/3			1/0			
Walckenaeria dysderoides (Wider, 1834)			0/1								
Walckenaeria furcillata (Menge, 1869)		1/0	5/7	2/2	7/6				0/1	1/2	4/5
Walckenaeria incisa (O. P.-Cambridge, 1871)		1/0									
Walckenaeria mitrata (Menge, 1868)									1/0		
Walckenaeria monoceros (Wider, 1834)							0/1	0/1			
Walckenaeria simplex Chyzer, 1894		1/2						1/0			
Tetragnathidae											
Metellina mengei (Blackwall, 1870)									1/0	1/0	
Araneidae											
Araneus diadematus Clerck, 1757										0/1	
Lycosidae											
Pardosa alacris (C. L. Koch, 1833)	32/13	39/42	275/152	227/112	67/33	101/40	12/10	11/17	2/2	4/3	3/5
Pardosa lugubris s.s. (Walckenaer, 1802)											1/3
Trochosa terricola Thorell, 1856	4/0	17/8	45/45	111/53	55/36	5/0	1/1	0/1	51/8	28/2	112/39
Agelenidae											
Agelena labyrinthica (Clerck, 1757)			1/0								
Histopona torpida (C. L. Koch, 1837)	35/15	15/3	47/13	46/23	27/9	1/0	2/4	7/3	34/14	25/11	54/31
Malthonica campestris (C. L. Koch, 1834)		6/11	11/2	11/2	5/0		2/1		32/5	4/0	20/5
Malthonica ferruginea (Panzer, 1804)									0/1		
Tegenaria atrica C. L. Koch, 1843						1/1					
Textrix denticulata (Olivier, 1789)	1/0										

Anyphaenidae											
Anyphaena accentuata (Walckenaer, 1802)				0/1							
Hahniidae											
Hahnia nava (Blackwall, 1841)									1/0	1/0	
Hahnia pusilla C. L. Koch, 1841								2/0			
Dictynidae											
Cicurina cicur (Fabricius, 1793)		3/0	2/1	5/2	5/1	1/0			2/0		7/0
Lathys humilis (Blackwall, 1855)			1/0					1/0			
Amaurobiidae											
Amaurobius fenestralis (Ström, 1768)	26/1										
Amaurobius ferox (Walckenaer, 1830)				19/6						5/0	0/1
Amaurobius jugorum L. Koch, 1868	32/4					0/4					
Inermocoelotes inermis (L. Koch, 1855)	30/7						3/0	7/0			
Urocoras longispinus (Kulczyński, 1897)		147/ 11	91/3	97/11	111/4	36/1	2/0	1/0	51/2	118/7	71/6
Miturgidae											
Cheiracanthium elegans Thorell, 1875			1/0								
Zora nemoralis (Blackwall, 1861)		1/0		1/3							
Zora spinimana (Sundevall, 1833)				4/2							
Liocranidae											
Agroeca brunnea (Blackwall, 1833)	7/2	3/3	2/2	0/2	4/8				3/0	3/1	2/1
Agroeca cuprea Menge, 1873	1/0	0/1	0/1		1/0						
Agroeca inopina O. P.-Cambridge, 1886							0/1				
Apostenus fuscus Westring, 1851		23/1	14/2	18/14			5/1	8/0	29/3	59/4	9/1
Liocranoeca striata (Kulczyński, 1882)			1/0								
Sagana rutilans Thorell, 1875	1/0										
Scotina celans (Blackwall, 1841)			23/7	27/6	34/3	9/2	2/1	0/1	5/10	16/4	9/1
Clubionidae											
Clubiona caerulescens L. Koch, 1867			0/1								
Clubiona pallidula (Clerck, 1757)			1/0								
Clubiona terrestris Westring, 1851			3/2	6/5	1/1				3/3	2/0	8/8
Phrurolithidae											
Phrurolithus festivus (C. L. Koch, 1835)				2/4		0/8	2/1				
Zodariidae											
Zodarion germanicum (C. L. Koch, 1837)			0/1	2/1		18/3	1/0				
Gnaphosidae											
Callilepis schuszteri (Herman, 1879)						9/3					
Drassyllus praeficus (L. Koch, 1866)				1/0	1/0						
Drassyllus villicus (Thorell, 1875)	1/0	0/2	9/4	37/18		46/13			5/1		1/1
Haplodrassus silvestris (Blackwall, 1833)	8/4	3/0	12/2	3/2	14/10	2/0	0/2	2/1			
Micaria fulgens (Walckenaer, 1802)				1/0							
Trachyzelotes pedestris (C. L. Koch, 1837)	0/1	1/1	5/2	21/2							
Zelotes apricorum (L. Koch, 1876)				7/4		4/0	1/0				
Zelotes erebeus (Thorell, 1871)						10/13					
Zelotes latreillei (Simon, 1878)											1/0
Philodromidae											
Philodromus aureolus (Clerck, 1757)		1/0							1/0		
Philodromus margaritatus (Clerck, 1757)								0/1			
Thomisidae											
Cozyptila blackwalli (Simon, 1875)			12/1	2/0	3/1	2/0			16/6	1/0	
Ozyptila praticola (C. L. Koch, 1837)		19/4	49/1		51/3		3/0	1/0		1/0	88/9
Synaema globosum (Fabricius, 1775)								0/1			
Xysticus lanio C. L. Koch, 1835				3/0	4/0						
Xysticus luctator L. Koch, 1870	7/1	20/1	1	23/2		4/2			3/0		1/0
Salticidae											
Asianellus festivus (C. L. Koch, 1834)								0/1			
Ballus chalybeius (Walckenaer, 1802)			2/2	0/1	2/0						1/0
Evarcha falcata (Clerck, 1757)									0/1		
Marpissa muscosa (Clerck, 1757)			1/0								
Neon reticulatus (Blackwall, 1853)	2/0			0/1	2/0						1/1

Tab. 2c: List of spider species in the three Austrian pine forests and the four floodplain forests; first number males, second number females. Numbers of study sites refer to Tab. 1. / *Liste der Spinnenarten in den drei Schwarzföhrenwäldern und den vier Auwäldern; erste Zahl Männchen, zweite Zahl Weibchen. Die Nummerierung der Untersuchungsflächen entspricht jener in Tab. 1.*

Araneae	**AP_08**	**AP_09**	**AP_13**	**F_01**	**F_07**	**F_27**	**F_28**
Atypidae							
Atypus affinis Eichwald, 1830	9/0	2/0	1/0				
Pholcidae							
Pholcus opilionoides (Schrank, 1781)			0/1				
Dysderidae							
Dasumia canestrinii (L. Koch, 1876)	1/0	1/0					
Dysdera erythrina (Walckenaer, 1802)							1/0
Dysdera ninnii Canestrini, 1868	3/3	2/1	3/5				
Harpactea hombergi (Scopoli, 1763)	2/0		1/0				
Harpactea lepida (C. L. Koch, 1838)	1/3		4/6				
Harpactea rubicunda (C. L. Koch, 1838)		3/1					
Mimetidae							
Ero furcata (Villers, 1789)		1/0					
Theridiidae							
Crustulina guttata (Wider, 1834)	2/1		1/0				
Episinus truncatus Latreille, 1809		1/0					
Euryopis flavomaculata (C. L. Koch, 1836)			3/1				
Robertus lividus (Blackwall, 1836)				3/2			
Theridiosomatidae							
Theridiosoma gemmosum (L. Koch, 1877)					1/0		
Linyphiidae							
Agyneta equestris (L. Koch, 1881)		1/0					
Agyneta rurestris (C. L. Koch, 1836)		1/0					
Agyneta saxatilis (Blackwall, 1844)			0/1				
Araeoncus humilis (Blackwall, 1841)							1/0
Bathyphantes nigrinus (Westring, 1851)				1/3			0/1
Centromerus brevivulvatus Dahl, 1912			1/0				
Centromerus incilium (L. Koch, 1881)							1/0
Centromerus silvicola (Kulczyński, 1887)	0/1	0/1	0/1				
Centromerus sylvaticus (Blackwall, 1841)	1/0				1/5	0/1	
Dicymbium nigrum (Blackwall, 1834)						0/1	
Diplocephalus latifrons (O. P.-Cambridge, 1863)				7/6	2/1	2/0	
Diplocephalus picinus (Blackwall, 1841)						3/0	5/6
Diplostyla concolor (Wider, 1834)				89/47	248/137	10/5	50/14
Dismodicus bifrons (Blackwall, 1841)	1/0						
Gonatium paradoxum (L. Koch, 1869)			0/1				
Incestophantes crucifer (Menge, 1866)			1/0				
Macrargus rufus (Wider, 1834)			1/1				
Mansuphantes mansuetus (Thorell, 1875)			4/1				
Mecopisthes silus (O. P.-Cambridge, 1872)	3/4		3/2				
Metopobactrus prominulus (O. P.-Cambridge, 1872)		1/0					
Microneta viaria (Blackwall, 1841)							7/2
Minyriolus pusillus (Wider, 1834)	1/0		1/0				
Neriene clathrata (Sundevall, 1830)						0/2	0/1
Oedothorax retusus (Westring, 1851)				0/2			
Palliduphantes alutacius (Simon, 1884)		1/1	0/1				19/13
Porrhomma lativelum Tretzel, 1956				0/3	3/7		1/0
Sauron rayi (Simon, 1881)	12/0		2/1				
Scotargus pilosus Simon, 1913	3/0						
Silometopus bonessi Casemir, 1970		0/1					
Tapinocyba insecta (L. Koch, 1869)					51/6		
Tapinocyba pallens (O. P.-Cambridge, 1872)	1/0		5/0				

Tenuiphantes cristatus (Menge, 1866)			0/1		0/1		
Tenuiphantes flavipes (Blackwall, 1854)		0/1	0/6		0/1		1/2
Tenuiphantes tenebricola (Wider, 1834)							3/1
Tenuiphantes tenuis (Blackwall, 1852)				0/1			
Walckenaeria antica (Wider, 1834)			1/0				
Walckenaeria atrotibialis (O. P.-Cambridge, 1878)			4/1	1/0		2/0	11/0
Walckenaeria cucullata (C. L. Koch, 1836)	0/1						
Walckenaeria dysderoides (Wider, 1834)	1/0			1/0	0/4		
Walckenaeria furcillata (Menge, 1869)			0/2				
Walckenaeria obtusa Blackwall, 1836					2/4	0/1	
Tetragnathidae							
Pachygnatha listeri Sundevall, 1830				9/6	4/12	2/5	0/1
Lycosidae							
Alopecosa aculeata (Clerck, 1757)			0/5				
Alopecosa inquilina (Clerck, 1757)		1/1	2/3				
Alopecosa pulverulenta (Clerck, 1757)	6/2	1/1	7/7				
Alopecosa sulzeri (Pavesi, 1873)	0/2	21/1	19/3				
Alopecosa trabalis (Clerck, 1757)	1/0		9/3				
Arctosa maculata (Hahn, 1822)					0/1		
Aulonia albimana (Walckenaer, 1805)			1/0				
Pardosa alacris (C. L. Koch, 1833)	7/14		1/0		24/14	18/3	
Pardosa amentata (Clerck, 1757)					13/16		
Piratula hygrophila (Thorell, 1872)				56/11	43/4	15/6	10/3
Trochosa ruricola (De Geer, 1778)					1/0	2/0	
Trochosa terricola Thorell, 1856	12/12	1/5	13/3		1/0		
Xerolycosa nemoralis (Westring, 1861)	3/0	1/0	1/0				
Pisauridae							
Pisaura mirabilis (Clerck, 1757)		1/0	0/1				
Agelenidae							
Histopona luxurians (Kulczyński, 1897)	3/0						
Histopona torpida (C. L. Koch, 1837)	3/1	10/1	2/1				
Malthonica campestris (C. L. Koch, 1834)			0/1		1/0	3/1	1/0
Textrix denticulata (Olivier, 1789)	8/1	1/0	1/0				
Anyphaenidae							
Anyphaena accentuata (Walckenaer, 1802)				1/0			
Hahniidae							
Antistea elegans (Blackwall, 1841)					0/2		
Dictynidae							
Cicurina cicur (Fabricius, 1793)	1/0		2/0				
Amaurobiidae							
Amaurobius jugorum L. Koch, 1868	6/0	1/0	3/1				
Inermocoelotes inermis (L. Koch, 1855)	11/0	18/0	10/1				
Miturgidae							
Zora nemoralis (Blackwall, 1861)			1/0				
Zora spinimana (Sundevall, 1833)		2/1					
Liocranidae							
Agroeca brunnea (Blackwall, 1833)	0/1			2/1	2/3	2/0	
Agroeca cuprea Menge, 1873			1/6				
Agroeca proxima (O. P.-Cambridge, 1871)	0/5	2/3	13/8				
Apostenus fuscus Westring, 1851	0/1						
Liocranoeca striata (Kulczyński, 1882)					1/0		
Scotina celans (Blackwall, 1841)		9/2	0/1				
Clubionidae							
Clubiona comta C. L. Koch, 1839							1/0
Clubiona lutescens Westring, 1851				0/1	1/0	0/1	
Phrurolithidae							
Phrurolithus festivus (C. L. Koch, 1835)	3/2	3/1	6/1		2/1		
Zodariidae							
Zodarion germanicum (C. L. Koch, 1837)	4/0						

Zodarion rubidum Simon, 1914		3/2					
Gnaphosidae							
Berlandina cinerea (Menge, 1872)		2/0					
Callilepis schuszteri (Herman, 1879)	3/1						
Drassodes lapidosus (Walckenaer, 1802)	2/0	1/2	1/7				
Drassyllus lutetianus (L. Koch, 1866)				1/0			
Drassyllus pumilus (C. L. Koch, 1839)			0/1				
Drassyllus villicus (Thorell, 1875)		1/0					
Gnaphosa bicolor (Hahn, 1833)	12/7						
Haplodrassus silvestris (Blackwall, 1833)	0/1	3/0					
Micaria fulgens (Walckenaer, 1802)	1/0						
Phaeocedus braccatus (L. Koch, 1866)		1/0					
Trachyzelotes pedestris (C. L. Koch, 1837)					2/0		
Zelotes aurantiacus Miller, 1967	2/1						
Zelotes electus (C. L. Koch, 1839)		2/0	1/0				
Zelotes erebeus (Thorell, 1871)	11/4	8/2	13/7				
Zelotes longipes (L. Koch, 1866)			3/0				
Zelotes petrensis (C. L. Koch, 1839)	6/4						
Zelotes subterraneus (C. L. Koch, 1833)	2/3	3/3	9/4				
Philodromidae							
Thanatus sabulosus (Menge, 1875)	1/3						
Thomisidae							
Cozyptila blackwalli (Simon, 1875)	2/1						
Ozyptila atomaria (Panzer, 1801)	0/1	1/2	0/4				
Ozyptila claveata (Walckenaer, 1837)	0/1	1/0					
Ozyptila praticola (C. L. Koch, 1837)				12/1	41/3	2/0	36/1
Xysticus erraticus (Blackwall, 1834)			1/0				
Xysticus macedonicus Silhavy, 1944	1/0						
Salticidae							
Aelurillus v-insignitus (Clerck, 1757)	3/1						
Euophrys frontalis (Walckenaer, 1802)			2/0				
Evarcha falcata (Clerck, 1757)	0/1	1/0					
Talavera aequipes (O. P.-Cambridge, 1871)	2/0						

Conservation value

According to the Red List of spiders of the Czech Republic (Buchar & Růžička 2002, Růžička 2005) and Slovakia (Gajdoš et al. 1999, Korenko 2004), 27 of the total 211 species found in our study are either classified as extinct (EX, which, precisely spoken should be RE = Regionally Extinct), critically endangered (CR), endangered (EN) or vulnerable (VU) (**Tab. 3**). Further three species must be considered as rare since they are neither reported in the Czech Republic nor in Slovakia: *Coelotes solitarius* L. Koch, 1868, *Dasumia canestrinii* (L. Koch, 1876) and *Xysticus macedonicus* Silhavy, 1944. One species, *Sauron rayi* (Simon, 1881), which was recorded in Slovakia, but not in the Czech Republic, was recently reported in Austria for the first time (see Milasowszky & Hepner 2014). Thus, at least 31 species, which represent approximately 15 % of the total spider data set of the 28 study sites, must be considered to have high conservation value. Six species are on the Red List in both countries: *Atypus muralis* Bertkau, 1890, *Dysdera hungarica* Kulczyński, 1897, *Berlandina cinerea* (Menge, 1872), *Walckenaeria monoceros* (Wider, 1834), *Sagana rutilans* Thorell, 1875 and *Thanatus sabulosus* (Menge, 1875). Eleven species are listed exclusively in the Czech Republic and ten exclusively in Slovakia. Only one species, *Comaroma simoni* Bertkau 1889, is reported to be extinct (RE, i. e. Regionally Extinct) in Slovakia. Three species are categorized as critically endangered (CR): *Dysdera hungarica* Kulczyński, 1897 and *Linyphia tenuipalpis* Simon, 1884 in the Czech Republic and *Dysdera longirostris* Doblika, 1853 in Slovakia.

Tab. 3: Red List and rare spiders with regard to the data from the Czech Republic (BUCHAR & RŮŽIČKA 2002, RŮŽIČKA 2005) and Slovakia (GAJDOŠ et al. 1999, KORENKO 2004). Abbreviations: RE = regional extinct, CR = critically endangered, EN = endangered, VU = vulnerable. / *Rote Liste Arten und seltene Spinnenarten in Bezug auf die Daten aus der Tschechischen Republik (BUCHAR & RŮŽIČKA 2002, RŮŽIČKA 2005) und der Slowakei (GAJDOŠ et al. 1999, KORENKO 2004). Abkürzungen: RE = regional ausgestorben, CR = vom Aussterben bedroht, EN = stark gefährdet, VU = gefährdet.*

Family	**Araneae**	**CZE**	**SLK**
Atypidae	*Atypus muralis* Bertkau, 1890	VU	EN
Dysderidae	*Dysdera hungarica* Kulczyński, 1897	CR	VU
Gnaphosidae	*Berlandina cinerea* (Menge, 1872)	VU	VU
Linyphiidae	*Walckenaeria monoceros* (Wider, 1834)	EN	EN
Liocranidae	*Sagana rutilans* Thorell, 1875	VU	VU
Philodromidae	*Thanatus sabulosus* (Menge, 1875)	EN	EN
Dysderidae	*Dysdera ninnii* Canestrini, 1868	VU	
Gnaphosidae	*Phaeocedus braccatus* (L. Koch, 1866)	EN	
Linyphiidae	*Centromerus leruthi* Fage, 1933	EN	
Linyphiidae	*Linyphia tenuipalpis* Simon, 1884	CR	
Linyphiidae	*Megalepthyphantes pseudocollinus* Saaristo, 1997	EN	
Linyphiidae	*Trichoncus affin*is Kulczyński, 1894	VU	
Linyphiidae	*Trichoncyboides simoni* (Lessert, 1904)	VU	
Liocranidae	*Scotina celans* (Blackwall, 1841)	VU	
Lycosidae	*Arctosa maculata* (Hahn, 1822)	VU	
Miturgidae	*Cheiracanthium elegans* Thorell, 1875	EN	
Thomisidae	*Cozyptila blackwalli* (Simon, 1875)	VU	
Anapidae	*Comaroma simoni* Bertkau, 1889		RE
Dysderidae	*Dysdera crocata* C. L. Koch, 1838		EN
Dysderidae	*Dysdera longirostris* Doblika, 1853		CR
Linyphiidae	*Meioneta equestris* (L. Koch, 1881)		VU
Linyphiidae	*Metopobactrus prominulus* (O. P.-Cambridge, 1872)		VU
Linyphiidae	*Scotargus pilosus* Simon, 1913		EN
Linyphiidae	*Walckenaeria incisa* (O. P.-Cambridge, 1871)		EN
Liocranidae	*Agroeca proxima* (O. P.-Cambridge, 1871)		EN
Theridiidae	*Robertus scoticus* Jackson, 1914		EN
Theridiosomatidae	*Theridiosoma gemmosum* (L. Koch, 1877)		VU
Amaurobiidae	*Coelotes solitarius* L. Koch, 1868	-	-
Dysderidae	*Dasumia canestrinii* (L. Koch, 1876)	-	-
Thomisidae	*Xysticus macedonicus* Silhavy, 1944	-	-
Linyphiidae	*Sauron rayi* (Simon, 1881)	-	

Biodiversity

The four forest types differ significantly in total species richness (Kruskal-Wallis-Test, $P = 0.007$, **Fig. 2a**). Austrian pine forests have the highest species richness values and floodplain forests the lowest. There are no significant differences in the number of individuals (Kruskal-Wallis-Test, $P < 0.069$, **Fig. 2b**).

Significant differences were found in the number (Kruskal-Wallis-Test $P < 0.001$, **Fig. 3a**) and the proportion of Red List species (Kruskal-Wallis-Test $P = 0.002$, **Fig. 3b**). Highest number and proportion of Red List species were found in Austrian pine forest, lowest in beech and floodplain forests.

The four forest types differ significantly in the proportion of all forest dependent spiders (Kruskal-Wallis-Test, $P = 0.001$, **Fig. 4a**). The highest proportion of forest dependent species was found in beech forests, the lowest proportion in Austrian pine forests (**Fig. 4a**). Four beech forest study sites (No. 05, 10, 12 and 18) consisted of 100 % forest dependent spiders.

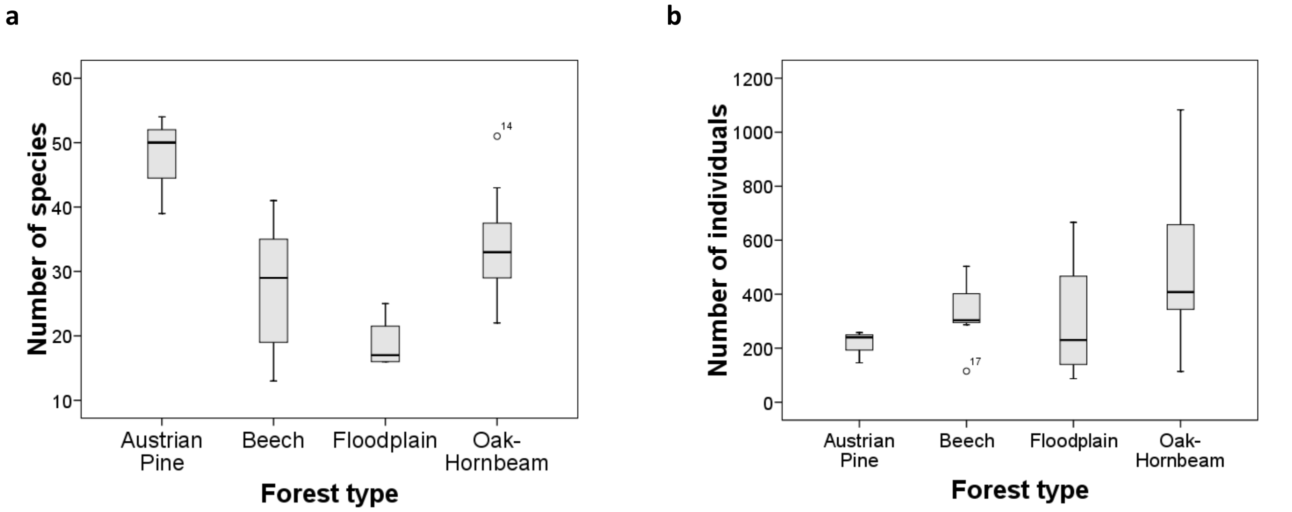

Fig. 2: Boxplots showing (a) the total number of species and (b) the total number of individuals in the four investigated forest types. / *Die Boxplots zeigen (a) die Anzahl der Arten and (b) die Anzahl der Individuen in den vier untersuchten Waldtypen*.

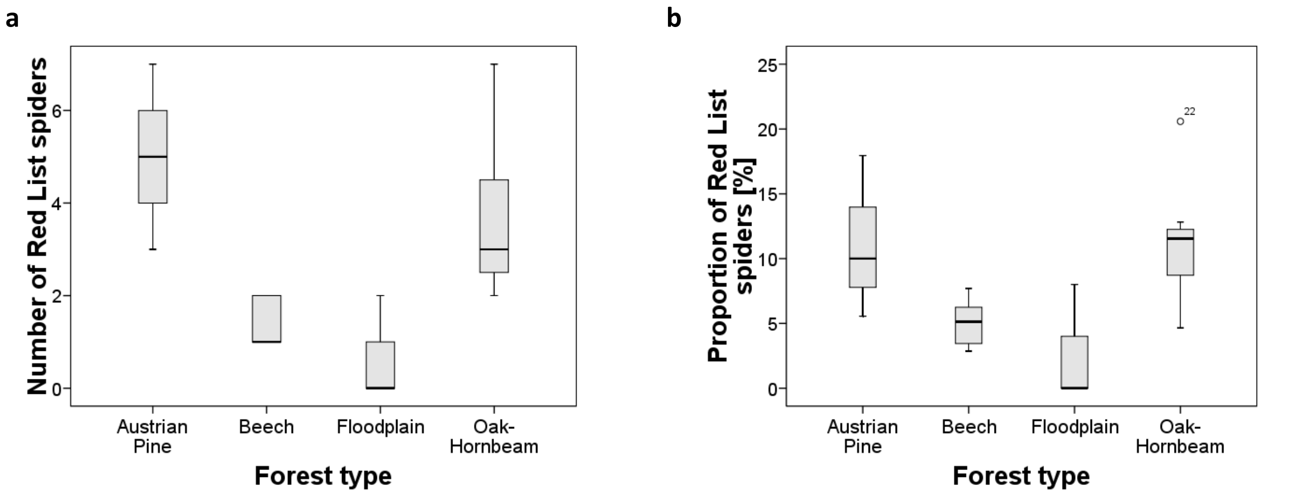

Fig. 3: Boxplots showing (a) the total number of Red List spider species and (b) the proportion of Red List spider species in the four forest types. / *Die Boxplots zeigen (a) die Anzahl der Rote Liste-Arten und (b) den Anteil der Rote Liste-Arten in den vier untersuchten Waldtypen.*

Such extreme dependence only occurred in the beech forests. Significant differences between the four forest types were also found in a subset of forest specialists (Kruskal-Wallis-Test, $P < 0.001$, **Fig. 4 b**), forest generalists (Kruskal-Wallis-Test, $P < 0.018$, **Fig. 4 c**), and forest steppe/edge species (Kruskal-Wallis-Test, $P = 0.001$, Fig. 3 d). The highest proportion of forest specialists was found in beech forests, (**Fig. 4 b**), while that of forest generalists was in floodplain forests (**Fig. 4 c**) and that of forest steppe species in Austrian pine and oak-hornbeam forests (**Fig. 4 d**). Finally, the four forest types show significant differences in the mean shading (Kruskal-Wallis-Test, $P < 0.001$, **Fig. 5 a**) and mean moisture values (Kruskal-Wallis-Test, $P < 0.001$, **Fig. 5 b**) taken from Entling et al. (2009, Appendix 2). The highest mean shading values were found in beech forests, the lowest moisture (= highest dryness) values were found in Austrian pine forests and oak-hornbeam forests, whereas the highest moisture values were found in floodplain forests.

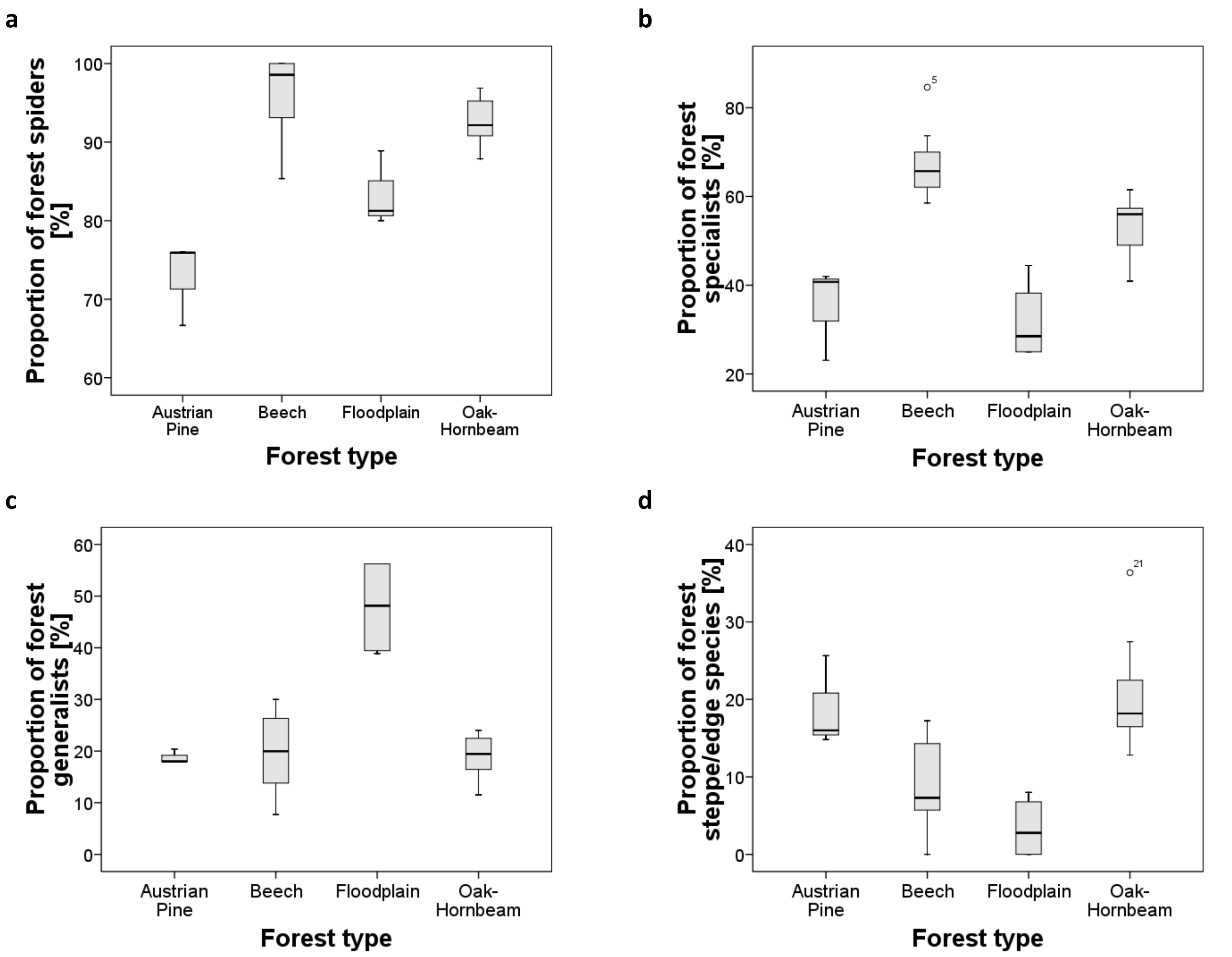

Fig. 4: Boxplots showing (a) the proportion of forest dependent species, (b) the proportion of forest specialists, (c) the proportion of forest generalists and (d) the proportion of forest “steppe”/edge species in the four forest types. / *Die Boxplots zeigen (a) den Anteil der an den Wald gebundenen Arten, (b) den Anteil der Waldspezialisten, (c) den Anteil der Waldgeneralisten und (d) den Anteil der „Waldsteppe"/Waldrand-Arten in den vier untersuchten Waldtypen*.

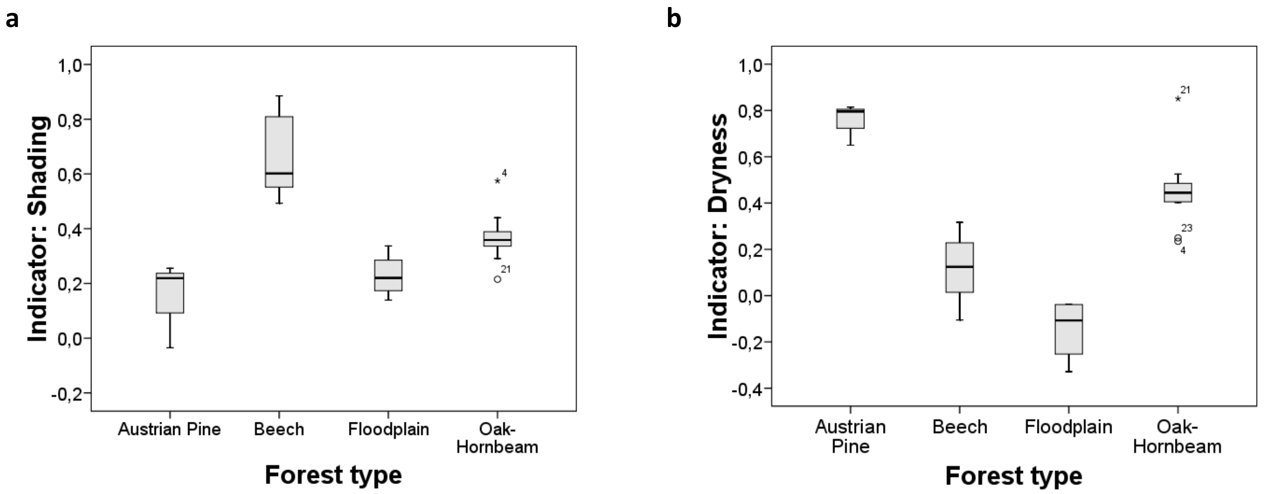

Fig. 5: Boxplots showing (a) the mean/average Entling shading values and (b) mean/average Entling dryness values for the four forest types. / *Die Boxplots zeigen (a) die mittleren Entling-Beschattungswerte und (b) die mittleren Entling-Trockenheitswerte in den vier untersuchten Waldtypen.*

Assemblages

Spider assemblages form distinct groups according to the four *a priori* defined forest types with one exception (**Fig. 6**).

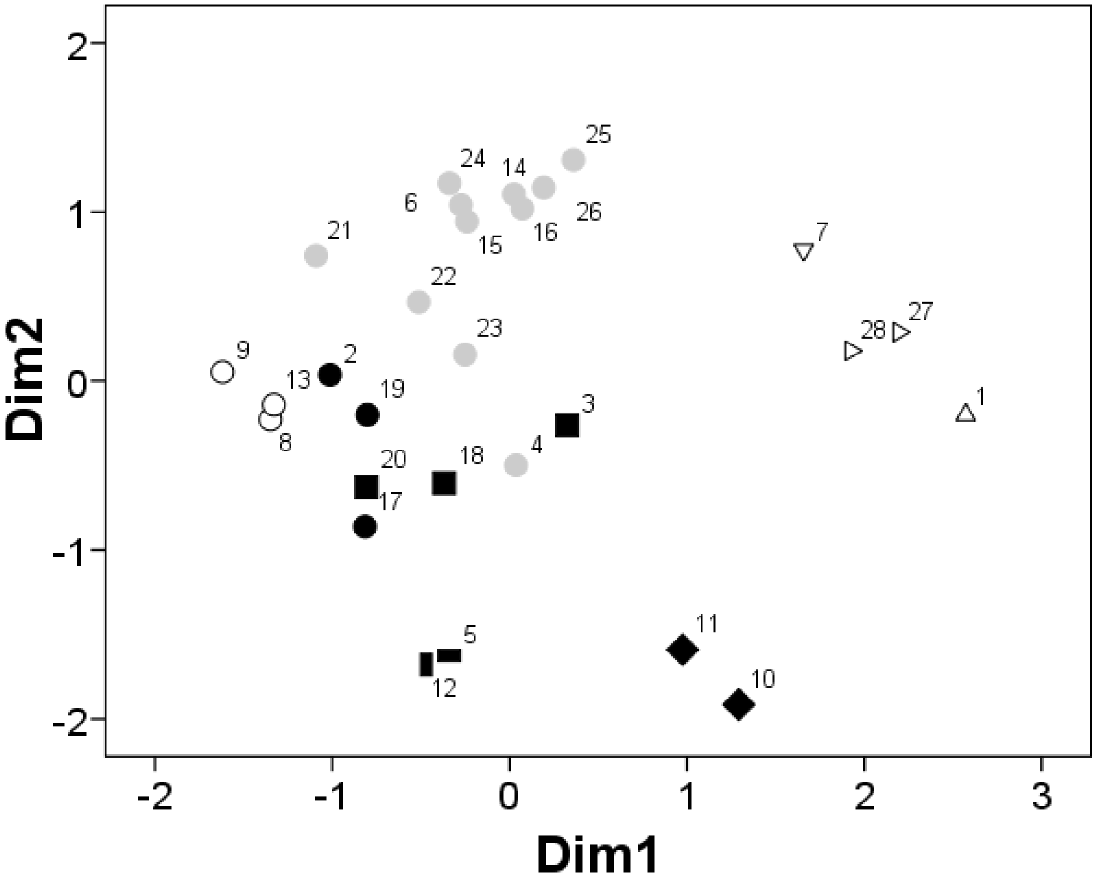

Fig. 6: Multidimensional scaling plot showing the 28 study sites and four forest types using presence-absence data of 211 spider species and the Lance and Williams index as dissimilarity measure. Stress = 0.148 (fair fit); R2 = 0.896 (acceptable fit, indicating that 89.6 % of variance in the model is explained by the two dimensions, i. e. Dim1 and Dim2). Symbols refer to habitat types: open circle = Austrian pine (*Seslerio-Pinetum nigrae*), black = beech (circle: *Melampyro-Fagetum*, diamond: *Cardamino trifoliae-Fagetum*, horizontal rectangle: *Mercuriali-Fagetum*, square: *Galio odorati-Fagetum*, vertical rectangle: *Luzulo-Fagetum*), open triangles = floodplain (pointed up: *Fraxino-Populetum*, pointed right: *Fraxino-Ulmetum*, pointed down: *Pruno-Fraxinetum*), grey circle = oak-hornbeam (*Galio sylvatici-Carpinetum*). Study site number next to symbol, see Table 1 for description. / *Das Diagramm zeigt die 28 Untersuchungsflächen und die vier Waldtypen, berechnet mittels multidimensionaler Skalierung auf der Basis von Präsenz/Absenz-Daten von 211 Spinnenarten und dem Lance & Williams-Index als Unähnlichkeitsmaß. Stress = 0.148 (fair fit); R2 = 0.896 (acceptable fit, d.h. dass 89,6 % der Varianz im Modell durch die zwei Dimensionen, Dim1 und Dim2, erklärt wird). Symbole: offene Kreise = Schwarzföhrenwald (Seslerio-Pinetum nigrae), schwarz = Buchenwald (Kreis: Melampyro-Fagetum, Deltoid: Cardamino trifoliae-Fagetum, horizontales Rechteck: Mercuriali-Fagetum, Quadrat: Galio odorati-Fagetum, vertikales Rechteck: Luzulo-Fagetum), offenes Dreieck = Auwald (Spitze nach oben: Fraxino-Populetum, Spitze nach rechts: Fraxino-Ulmetum, Spitze nach unten: Pruno-Fraxinetum), grauer Kreis = Eichen-Hainbuchenwald (Galio sylvatici-Carpinetum). Für die Nummerierung der Untersuchungsflächen siehe Tab. 1.*

The spider assemblage of the oak-hornbeam forest No 03 lies within the beech-forest cluster and is very similar to that of woodruff beech forest No 04. Within the beech forests, the spider assemblages of the two old growth spruce-fir-beech "Urwald" forests - "Rothwald Kleiner Urwald" (11) and "Neuwald" (10) are also very similar with each other, and they form a distinct sub-group within the beech forests. The floodplain forest spider assemblages (01, 07, 27, 28) are clearly different from all other spider assemblages. Also, the Austrian pine forest spider assemblages (08, 09, 13) can be separated from the other spider assemblages; however, they show similarities with nutrient-poor beech forest study sites, especially the common cow-wheat beech forests (Melampyro-Fagetum) "Dürnstein" (02) and "Heinratsberg" (19). Within the beech forests the single white wood-rush beech (Luzulo-Fagetum) "Saubrunn" (12), and the dog's mercury beech (Mercuriali-Fagetum) "Klausenleopoldsdorf" (05) have also very similar spider assemblages.

Discussion

The 28 spider assemblages that were the subject of the present study can be separated into four non-overlapping, i.e., distinct groups which correspond to the four *a priori* defined forest types. The spider assemablages of beech forests and oak-hornbeam forests form two distinct groups not only due to the fact that both forest types differ ecologically from each other, but also in terms of biogeography. Evidently, all beech forests studied were situated in the west of the study area on montane elevations, while all oak-hornbeam forests were situated in the east on lower elevation (see **Fig. 1**). Since habitat and biogegeography factors are to some extent confounded in the present study, it is difficult to determine which factor has the greater influence on this separation. However, there is one interesting outlier among the oak-hornbeam forests: The spider fauna of the oak-hornbeam forest (No 03) at the Johannser Kogel is very similar to that of the beech forest (No 04) at the Johannser Kogel. We suggest four possible reasons for that:

(i) Both forests consist of the same local forest species pool, since they are situated close together. In fact, these study sites are geographically the closest to each other in our data set, lying one 1 km apart from each other in the "Urwald" Johannser Kogel. (ii) The oak-hornbeam stand in the Johannser Kogel area might not have established a typical Eastern Austrian/Pannonian oak hornbeam spider fauna due to the small size of the stand and the influence of edge effects from the surrounding beech forest. (iii) The habitat structure of the oak-hornbeam forest resembles that of the beech forests and vice versa, since both sites are actually old-growth forests characterised by a structure-rich forest floor with high amounts of lying deadwood. The "Johannser Kogel" is situated in the "Lainzer Tiergarten", which is a particularly well-known refugium for endangered saproxylic species (Zabransky 1998). (iv) Since the oak-hornbeam stand in the Johannser Kogel is situated at the edge of the Pannonian forest growth area, the spider assemblages might be less influenced by a typical Pannonian oak-hornbeam spider fauna and more dominated by a typical Eastern Alpine forest spider fauna. Preliminary results from an on-going study of forest spider assemblages in the biosphere reserve Wienerwald underpin this assumption.

Regarding biodiversity/faunistics, the four forest types significantly differ in the number of total species richness and number of Red List species in the Entling shading and moisture values, as well as in the proportions of Red List species, total forest dependent species, forest specialists, forest generalists and forest steppe/edge species. The Entling values enable us to differentiate among the four forest types in accord with the moisture-gradient from extremely dry (Austrian pine forest) to medium dry (oak-hornbeam) to medium moist (beech forests) to very moist/wet (floodplain forests). The shading gradient is less pronounced. However, it reveals that beech forests are characterised by a high degree of shading. With respect to the shading gradient, the following comparatively light forests types occur in descending order: oak hornbeam forests, floodplain forests and Austrian pine forests.

Austrian pine forests

Austrian pine forests (**Fig. 7**) have the highest total species richness, the highest total number of Red List species, as well as the highest proportion of Red List species. These results are also reflected by the Entling values, which in the Austrian pine forests exhibit the lowest values for shading and the lowest values for moisture (i.e. highest values for dryness). The high total species richness values are certainly a result of the habitat structure. One might consider a typical Austrian pine forest as a very light tree stand with a full grassy surface or as a dry grassland with pine trees. Moreover, an Austrian pine forest can be considered as an edge habitat where spider assemblages are a combination of both forest and grassland spiders (e.g. Downie et al. 1996, Ries et al. 2004). However, the high number and proportion of Red List species is due to non-forest species. Accordingly, in comparison to the other forest types, Austrian pine forests consists of lower proportions of forest generalists and forest specialists, but have at least the second highest proportions of forest steppe/edge species. The four spiders which occur in all Austrian pine forests species are non-forest spiders: *Agroeca proxima*, *Alopecosa pulverulenta*, *Alopecosa sulzeri* and *Ozyptila atomaria*. We know of no forest study site in the literature where all four species occurred together. Horak (1987) found *A. sulzeri*, *A. pulverulenta* and *O. atomaria* together in a xerothermic oak forest, and Horak (1988) reported *A. proxima*, *A. sulzeri* and *A. atomaria* to be syntopic in a pine forest in East Styria. In addition, Horak (1987, 1988) also identified *Z. subterraneus* from the same study sites.

Fig. 7: Austrian pine forest (No 08 Merkenstein-Schöpfeben). / *Schwarzföhrenwald (Nr. 8: Merkenstein-Schöpfeben)*. © Alexander Pernstich.

Beech forests

Beech forest spider assemblages consist on average of nearly 95 % forest dependent species. This is mainly due to the fact that beech forests have the highest proportion of forest specialists. This is also reflected by the highest Entling shading values. On the one hand, four study sites in the beech forests (the natural forest No 05 [**Fig. 8**], and three old growths forests No 10, 12 and 18) consisted of 100 % forest dependent spiders. On the other hand, beech forests have a comparatively low number and proportion of Red List species. There are two studies of spider assemblages from beech forests in the region, a mixed beech forest in Lower Austria (Milasowszky & al. 2009) and a not closer defined beech forest in Styria (Jantscher & Paill 1998). Regarding the mixed beech forest, 15 out of 19 species (i. e. 79 %) of the "Großer Urwald Rothwald" (see Milasowszky et al. 2009) were also found in our beech forest data set: *Centromerus pabulator* (O. P.-Cambridge, 1875), *Centromerus sellarius* (Simon, 1884), *Cybaeus tetricus* (C. L. Koch, 1839), *Diplocephalus latifrons* (O. P.-Cambridge, 1863), *Diplostyla concolor* (Wider, 1834), *Drapestica socialis* (Sundevall, 1833), *Harpactea lepida* (C. L. Koch, 1838), *Histopona luxurians* (Kulczyński, 1897), *Histopona torpida* (C. L. Koch, 1837), *Inermocoelotes inermis* (L. Koch, 1855), *Robertus lividus* (Blackwall, 1836), *Saloca diceros* (O. P.-Cambridge, 1871), *Tenuiphantes alacris* (Blackwall, 1853), *Tenuiphantes cristatus* (Menge, 1866) and *Tenuiphantes tenebricola* (Wider, 1834). Moreover, with the exception of *Drapestica socialis*, all other 14 species occur in the mixed forest data set that consists only of the two "Urwald" sites, i. e. Neuwald and Kleiner Urwald Rothwald (No 10 and 11). We thus conclude that the 14 species mentioned above can be considered as constant representatives of mixed beech forest spider assemblages in Eastern Austria. It is noteworthy that no lycosid spiders are present in these spider data sets. We thus further conclude that characteristic old-growth mixed beech forest does not inhabit lycosid spiders due to highly shaded and stable cool interior conditions. Since lycosids are opportunistic ground runners that depend on light (Uetz et al. 1999), old growth forests are dominated by amaurobiid and agelenid spiders, which are sheet web builders (Uetz et al. 1999). We assume that the structure-rich forest floor of old-growth forest which is covered with lying deadwood provides a magnitude of microhabitats for web builders, while it is not suitable for ground runners. Jantscher & Paill (1998) found 63 species in a beech forest near Frohnleiten in Styria, of which 53 species (or 84 %) were also found in the beech forests of the present study. However, regarding the 5 beech forest types separately, the proportion of shared species varies widely: 55 % in the three Galio-odorati Fagetum, 51 % in three Melampyro Fagetum, 26 % in the two spruce-fir-beech forests, 23 % in the Luzulo-Fagetum and 15 % in the Mercuriali-Fagetum.

Fig. 8: Beech forest (No 05 Klausenleopoldsdorf). / *Buchenwald (Nr. 5: Klausen-Leopoldsdorf)*. © Alexander Pernstich.

Although the sample size is very low, one might expect further subdivisions within the beech forest data set. The three most frequent species in beech forests *Harpactea lepida*, *Histopona torpida*, and *Inermocoelotes inermis* nevertheless, are characteristic forest spiders that are widely distributed across Europe (Nentwig et al. 2013, Platnick 2013). Therefore, the combination of these three spiders can be frequently found in forest spider assemblages in Central Europe. Most often this combination appears in beech forests (e.g. Baehr 1983, Baehr & Baehr 1983, Bauchhenss et al. 1987, Breinl 1990, Breuss 1994, Engel 2001, Hofmann 1986, Jantscher & Paill 1998, Stippich 1986), and mixed beech forests (e.g. Juncker et al. 2000, Polenec 1967, Steinberger 1989, Steinberger & Mayer 1993). There are also syntopic records of these three species in coniferous forests, i.e. Norway spruce, fir and pine forests (e.g. Baehr 1983, Baehr & Baehr 1983, Bauchhenss et al. 1987, Breinl 1990, Breuss 1994, Engel 2001, Freudenthaler 1989, Hofmann 1986, Horak 1988, 1989, Komposch 1997, Steinberger 1998, Steinberger & Meyer 1993). In addition, the three species were also found together in oak-hornbeam forests (e.g. Freudenthaler 1994 b, Heimer 1978, Horak 1987, Polenec 1974, Steinberger 1989), and even in a xerothermic hop-hornbeam forest (e.g. Horak 1988). Freudenthaler (1994 a) reports the syntopic occurrence of these species from a young poplar-birch forest stand consisting also of hornbeam and beech trees. Based on our examination of at least five different beech forest types in our beech data beech data set, it is very likely that each of these types might have their own characteristic species assemblage. For example, *C. solitarius* was only found in the "Urwald" sites Neuwald (No 10) and Rothwald (No 11), indicating a possible preference of this species for moist mixed beech forests in Eastern Austria.

Floodplain forests

Bonn et al. (2002) pointed out that long inundated floodplains have usually a low species richness, are most of all dominated by mobile generalists, but also provide habitats for very hygrophilous species. The same is true in our study. Floodplain forests (**Fig. 9**) are characterised by the lowest number of total species richness, the lowest number and proportion of Red List species as well as the lowest proportion of forest specialists and forest steppe/edge species. In contrast, the proportion of forest generalists is the highest for all forest types. Furthermore, as expected, floodplain forests are characterised by the highest Entling moisture values. The high proportion of generalists is also in accordance with data from the literature: periodically inundated floodplains are inhabited by mobile generalists, which are good dispersers, and which may quickly colonize pioneer habitats after a disturbance event. However, with increased length of flood duration Bonn et al. (2002) found a general reduction in species number. At such sites, only a few specialists with adaptations to floods survive and many generalists, otherwise dominant in periodically inundated sites, are not able to persist (Bonn & Kleinwächter 1999).

Fig. 9: Floodplain forest (No 07 Müllerboden). / *Auwald (Nr. 7: Müllerboden)*. © Wolfgang Waitzbauer.

Within the study region, Thaler & Steiner (1987) investigated two softwood floodplain forests and one hardwood floodplain forest along the Danube River in Vienna and its surroundings. 18 species that were found by Thaler & Steiner (1987) in all three floodplain forests also were found in our floodplain spider fauna: *Agroeca brunnea* (Blackwall, 1833), *Bathyphantes nigrinus* (Westring, 1851), *Clubiona comta* C.L. Koch, 1839, *Clubiona lutescens* Westring, 1851, *Diplocephalus latifrons* (O.P.-Cambridge, 1863), *Diplocephalus picinus* (Blackwall, 1841), *Diplostyla concolor* (Wider, 1834), *Malthonica campestris* (C.L. Koch, 1834), *Neriene clathrata* (Sundevall, 1830), *Ozyptila praticola* (C.L. Koch, 1837), *Pachygnatha listeri* Sundevall, 1830, *Piratula hygrophila* (Thorell, 1872), *Robertus lividus* (Blackwall, 1836), *Tenuiphantes flavipes* (Blackwall, 1854), *Tenuiphantes tenebricola* (Wider, 1834), *Trochosa terricola* Thorell, 1856, *Walckenaeria dysderoides* (Wider, 1834) and *Walckenaeria obtusa*

Blackwall, 1836. However, the proportion of shared species is not very high, since it varies between 45 and 52%, indicating high beta diversity between the floodplain study sites of Thaler & Steiner (1987) and the floodplain forests of the present study.

In the four floodplain forests of our study, we found at least three species that show high affinity to these habitats: *Pachygnatha listeri*, *Piratula hygrophila* and *Diplostyla concolor*. *Pachygnatha listeri* was exclusively found in floodplain sites, while *P. hygrophila* also occurs, however with only one specimen, in a beech forest (No 03). Likewise, *D. concolor* was present in small numbers (< 4) in seven other forests (No 03, 04, 10, 11, 16, 23, 26). In Central Europe, these three species were found together mostly in floodplain forests and alder carrs (Baehr 1983, Bauchhenss 1991, Breuss 1996, Finch 2001, Heimer 1978, Jedličková 1988, Meier & Sauter 1989, Miller & Obrtel 1975, Roth 1991, Rupp 1999, Steinberger 1998, Steinberger & Thaler 1990, Thaler & Steiner 1987, Zulka et al. 1994). There are syntopic records of these species in oak-hornbeam forests (Bönisch & vonBroen 1989, Finch 2001, Heimer 1978), mesophilic beech forests (Finch 2001), and Norway spruce forests (Baehr 1983, Breuss 1996, Finch 2001), as well as pine and *Douglasia*-forests (Alderweireldt et al. 1989).

Oak-hornbeam forests

Oak-hornbeam forests **(Fig. 10)** had the highest proportion of forest steppe/edge species, as well as the second highest proportion of forest dependent species and forest specialists. 25 of 38 species (i.e. 66%) identified by Thaler et al. (1988) in the "Zurndorfer Eichenwald", which is situated within our study area, were also found in the oak-hornbeam forests of the present study. Particularly, *Trochosa terricola* Thorell, 1856, *Tenuiphantes flavipes* (Blackwall, 1854) and *Urocoras longispinus* (Kulczyński, 1897), which occur in at least ten of the eleven oak-hornbeam sites, can be considered as typical species in oak-hornbeam forests of Eastern Austria. However, of these three spiders, only *U. longispinus* shows a significant habitat affinity towards the oak-hornbeam forests while the other spiders must be regarded as more or less ubiquitous forest spiders, i.e. forest generalists. With only one exception (forest No 04), *Urocoras longispinus* occurred in all oak-hornbeam forests. Since it was not found in any other forest type, it is a nearly perfect indicator species for oak-hornbeam forests in Eastern Austria. Interestingly, the only oak-hornbeam forest in which *U. longispinus* was absent was the one that showed the highest similarities in its spider assemblages with beech forests.

The highest number of *U. longispinus* was found in the natural forest reserve "Kolmberg" (No 06) with 147 males and 11 females. According to the overview of Milasowszky & Strodl (2006), *U. longispinus* is a rare spider in Central Europe, since it is mainly distributed in South-East European countries (Austria, Kropf & Horak 1996), Bulgaria (Blagoev et al. 2002), Hungary (Samu & Szinetár 1999), Macedonia (Blagoev 2002), Romania (Weiss & Urák 2009), Slovakia (Gajdoš et al. 1999), Serbia-Montenegro (Nikolic & Polenec 1981) und the Ukraine (Mikhailov 1997). It reaches the westernmost border of its distribution at the Eastern fringe of the Alps (Steinberger 2004, p. 423). In Austria, it is solely reported from the four eastern federal states, i.e. Styria (Horak 1992, Kropf & Horak 1996), Burgenland (Hebar 1980, Steinberger & Haas, 1990; Steinberger 2004), Lower Austria (Malicky 1972a, b, Schaberreiter 1999, Kirch 2001) and Vienna (Hepner et al. 2010, 2011). *U. longispinus* occurs, on the one hand, in various dry habitats, i.e. open dry grasslands (e.g. Malicky 1972a, b, Hebar 1980, Steinberger & Haas 1990, Kropf & Horak 1996), and, on the other hand, in xerothermic forests and hedges (e.g. Hebar 1980, Horak 1992, Thaler & Steiner 1993, Schaberreiter 1999, Kirch 2001). Recently, *U. longispinus* was reported from a maple-ash forest stand in the park of the University Observatory in Vienna (Milasowszky & Strodl 2006) and an urban forest in the Jewish Cemetery "Währing" in Vienna (Hepner et al. 2011). Steinberger (2004) assumed that *U. longispinus* has a preference for forests and forest edges, an assumption which is confirmed, e.g. by records in an alder carr and oak-forests in Slovakia (Jedličková 1988), an Austrian pine forest in Slovenia (Polenec 1967), several xerothermic *Quercus pubescens* oak forests in Hungary (Loksa 1988) and a very dry oak forest in Romania (Weiss & Andrei 1989). There are also indications that *U. longispinus* is bound to edge habitats, such as forest steppes, field hedges, field boundaries or abandoned dry grasslands overgrown with bushes. In Slovakia, Gajdoš (1994) reported *U. longispinus* as the most dominant species (about 26 % of all specimens) in a poplar hedge while in the adjacent arable field it occurred in dominance values below 1%. According to Weiss & Andrei (1989) *U. longispinus* can thus be best described as a South-east European thermophilic forest steppe species.

Fig. 10: Oak-hornbeam forest (No 16 Spitzerberg). / *Eichen-Hainbuchenwald (Nr. 16: Spitzerberg)*. © Christian Fiedler.

Acknowledgements

This study was carried out with the financial support of various institutions. As representative for all those who contributed in one way or another, we would like to express our gratitude to Sophie Zechmeister-Boltenstern who laid the foundation of this study while leading the DIANA-project. We are grateful to Christian Fiedler, Markus Strodl and Andreas Zapf for providing their spider material, and to Dietmar Moser for the drawing of the study site map. We are particularly grateful to Franz Starlinger and Wolfgang Willner for sharing their expertise on forest types and forest growth regions. We thank Christoph Hörweg and Valerian Franc for help with literature and John Plant for his helpful comments on the text and especially for checking the English. We are also very grateful to Theo Blick and an anonymous reviewer, who critically commented on a previous version of the manuscript.

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