

Analysis of the spider communities in an altitudinal gradient in the French and Spanish Pyrénées*

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Introduction

We first made acquaintance with the spider fauna of the Pyrénées in 1982, during a field trip organised by the British Arachnological Society. During that week, a preliminary study of the altitudinal distribution of spiders on Mount Canigou (Pyrénées Orientales) was carried out, and results are published in Bosmans & De Keer (in press).

At first, we encountered numerous identification problems; in order to overcome these to some extent in the future, a catalogue of all spiders mentioned for the Pyrénées was published (Bosmans & De Keer, 1985).

In 1984, four members of the Belgian Arachnological Club Arabel (Arachnologia Belgica) undertook a second, more detailed study of the altitudinal zonation of spiders, this time in the Central Pyrénées. The results are discussed in the present paper.

Study area

The altitudinal gradient started at St Lary (Hautes Pyrénées) at 700 m, went up to the Puerto de Bielsa (2450 m), and went down again to Bielsa (Huesca,

1100 m). Between 25 and 29 July 1984, 18 stations were set up with an altitudinal interval of 200 m between each station, irrespective of the vegetation present. Samples were taken by different methods: hand collecting, sieving litter, and sweeping vegetation, each for half an hour; also, 6 pitfall traps were installed at each site and emptied one month later. In the highest stations (10-11), no pitfalls could be placed, because of the rocky soil.

The present gradient is compared with an altitudinal gradient on the south-eastern slope of Mount Canigou (Pyrénées Orientales), where 6 stations situated at 750, 1250, 1500, 1750, 2000 and 2200 m were sampled.

The vegetation of each station is described in Tables 1 and 2. Differences are most striking between stations 1-6 and 14-18 on the one hand, and stations 7-13 on the other. The former group comprises forested habitats, the latter open grassland habitats. On the Spanish slope, however, the forest is never as dense as on the French slope, and the herb layer is mainly composed of grasses. For each station, we possess fully documented, qualitative and quantitative lists of plant species. According to the floristic composition, stations 1-2 and 18 belong to the submontane belt ("étage collinéen") of deciduous forest, stations 3-6 and 14-17 to the montane belt of mixed forest, and stations 7-13 to the subalpine belt, where the vegetation cover is still continuous and is a mixture of ericaceous shrubs, grassland and solitary pine trees. The alpine belt, which is occupied by discontinuous grassland, was not sampled. Soil texture, slope and local orientation influence this zonation considerably. The last factor especially causes large differences between the SW (Spanish) slope and the NE (French slope) of the Pyrénées. In its turn the vegetation, and especially the percentage cover and presence or absence of litter and open ground, is very important for the distribution of spider communities.

*This paper was presented at a symposium on spider ecology and behaviour held at Furzebrook Research Station in June 1985.

Station No.	Submontane belt		Montane belt				Subalpine belt						Montane belt				Submontane belt	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Altitude (m)	700	900	1100	1300	1500	1700	1900	2100	2300	2475	2375	2300	2100	1900	1700	1500	1300	1100
Tree layer																		
cover (%)		10	40	10-15	5	20								(x)	1	10		10
height (m)		10-15	10-15	15-20	10-15	15									10	10		10
Shrub layer																		
cover (%)	60	40	70	10	5	30								(x)	1	30	20	80
height (m)	8	6	5	4	2.5	1.5									0.5	0.4	0.5-8	6
Herb layer																		
cover (%)	50	80	15	80	70	80	80	80	80	60	70	70	70	80	30	60	0-40	0-40
height (cm)	30	100	40	25	30	20	20	20	20	20	30	30	30	20-60	40	40	40	40
type: mainly																		
woodland species	+		+	+	(+)	(+)												(+)
mainly grassland species					+	+	+	+	+	+	+	+	+	+	+	+	+	+
heathland species						(+)								(+)	(+)			
rough tall herbs	+	+																(+)

Table 1: General description of vegetation of 18 stations in an altitudinal gradient from St Lary (France) to Bielsa (Spain). Symbols: + = dominant species, (+) = frequent species, (x) = heterogeneous: scattered trees.

Station No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Trees																		
<i>Fraxinus excelsior</i>		a	d															
<i>Picea abies</i>				d	f	d	d											
<i>Pinus</i> species														f	r	r		
Shrubs																		
<i>Corylus avellana</i>		f	a	(x)													x	
<i>Buxus sempervirens</i>		r		d													x	x
<i>Rhododendron</i> species				o		f	(x)						x	d				
<i>Calluna vulgaris</i>				(x)			o						o	x	d			
<i>Vaccinium myrtillus</i>				f		f							o	x				
Herbs																		
Rough, tall herbs																		
<i>Filipendula ulmaria</i>		1d	cd															
<i>Urtica dioica</i>		1d	cd	r														
<i>Galium aparine</i>		a	a															
<i>Eupatorium cannabinum</i>																		r
Woodland species																		
<i>Lamium galeobdolon</i>		o																
<i>Anemone hepatica</i>				s		r							x			x		
<i>Asperula odorata</i>				lf	d	lf												
Grassland species																		
<i>Deschampsia cf. flexuosa</i>					la	ld							x	o	x	x		
<i>Agrostis cf. tenuis</i>					cd	f										x		lf
<i>Festuca (rubra, terkuifolia)</i>					cd	f	a		cd	o	la				x	x	o	
<i>Nardus stricta</i>							r	d	d	d	cd	d	d	d	x			

Table 2: Typical plant species of 18 stations in an altitudinal gradient from St Lary (France) to Bielsa (Spain). Symbols: cf. Tansley-scale; d = dominant, cd = codominant, a = abundant, la = locally abundant, f = frequent, lf = locally frequent, o = occasional, r = rare; x = relative abundance not estimated, (x) = species not in plot, but nearby.

Results and Discussion

Systematics and zoogeography

Appendix 1 gives details of the numbers of spiders caught per station and per species, summed for all sampling methods used. In total, 187 species were captured. At the highest stations, no pitfalls could be placed, and very few adult specimens were caught; therefore these stations sometimes have to be omitted from the discussion.

It is not the aim of this paper to discuss systematic aspects in detail; but we can make some brief comments:

- (1) At least two species are new to science; a *Lepthyphantes* species of the *tenuis* group, of which 15♂ and 31♀ were captured, and a new *Pocadicnemis* species, with 1♂ and 13♀.
- (2) The previously unknown male of *Xysticus ovatus* was discovered at station 9 (64 specimens, see Bosmans & Jacobs, 1985).

(3) Some species were captured for only the second time, e.g. *Pocadicnemis jacksoni* and *Collinsia despaxi*.

These discoveries indicate that the spider fauna of the Pyrénées is still poorly known, and that faunistic studies of this region are badly needed.

In a previous study of the influence of an altitudinal gradient on the spider fauna of the SE slope of Mount Canigou (Pyrénées Orientales), the following preliminary conclusions were drawn (Bosmans & De Keer, in press):

- (1) Mediterranean species are most abundant in the submontane belt (up to 22% of the total).
- (2) Arctic-alpine species are exclusively present in the subalpine and alpine belt.
- (3) Alpine species are present all along the gradient, but most abundant in the alpine belt.
- (4) The largest proportion of endemic species is encountered in the montane belt.

Comparing these results with the zoogeographical species composition of each of the 18 stations of the

Station No.	1	2	3	4	5	6	7	8	9	12	13	14	15	16	17	18
Mediterranean species	3.7	2.6	8.3	6.3	5.9	2.8	5.6	6.7	10.0	8.3	7.1	6.9	10.5	7.1	8.1	7.1
Alpine species	—	5.1	—	6.3	2.9	2.8	22.2	26.7	50.0	33.3	14.2	13.8	10.5	—	5.4	2.4
Arctic-alpine species	—	—	—	—	2.9	5.7	—	—	—	—	7.1	6.9	5.7	—	—	—
Endemic species	—	7.7	8.3	25.0	14.7	11.4	5.6	13.4	30.0	8.3	7.1	10.3	21.1	10.7	5.4	11.9
Total number of species	27	34	24	16	34	35	18	15	10	12	14	29	19	28	37	42

Table 3: Percentages of mediterranean, alpine, arctic-alpine and endemic species at each station in an altitudinal gradient from St Lary (France) to Bielsa (Spain).

Species	Station	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
<i>Lepthyphantes zimmermanni</i>		1/	1/1	1/2	1/4	2/	16/11								/5	1/3	/2		
<i>Cybaeus angustiarum</i>			/4	3/	6/	59/6	38/1	2/									1/	2/1	2/3
<i>Monocephalus fuscipes</i>			/5	/3		/10	/5										/3	1/	
<i>Lepthyphantes cernuus</i>				2/4		/1										3/	1/	1/	
<i>Oonops procerus</i>				1/												/1	/7	2/1	
<i>Leptoneta infuscata</i>				1 juv.												/3			1/
<i>Bolyphantes alticeps</i>						/1	/2								/2	/4			
<i>Pardosa lugubris</i>		/1		/1	/1	/1	/1												
<i>Chorizomma subterraneum</i>		21/4	10/2	1/															
<i>Lepthyphantes n.sp.</i>				/7	/2	13/12	2/												
<i>Pardosa amentata</i>		/2						1/2			6/11	6/24							
<i>Xysticus ibex</i>								4/7		/1				/1					
<i>Pardosa blanda</i>								/10	6/3		1/1	/1	6/1			/1			
<i>Pardosa oreophila</i>								/1	12/18	2/1	1/1	1/	/6	/2	3/67	/3			
<i>Steatoda phalerata</i>								3/	1/1					1/		1/			
<i>Silometopus nitidithorax</i>									3/1	2/10			/1						
<i>Zodarion marginiceps</i>															/1	/1		/2	/1
<i>Dirksia pyrenaea</i>															/1	/1	2/1		
<i>Micaria guttigera</i>															/1			/1	

Table 4: Distribution of 19 species of spiders in an altitudinal gradient from St Lary (France) to Bielsa (Spain) (♂♂/♀♀).

present study, as summarised in Table 3, we can make the following remarks:

(1) Mediterranean species are represented all along the gradient, but never in such relatively large numbers as on Mount Canigou. Indeed, Mount Canigou is situated in the mediterranean zoogeographical region, whereas the larger part of the new gradient is situated in the temperate region. Highest relative numbers are obtained on the Spanish slope.

(2) Arctic-alpine species are present only in the uppermost stations of the montane belt and in the subalpine belt. On Mount Canigou, the uppermost part of the montane belt was not sampled, and the results are thus not necessarily contradictory.

(3) Alpine species are present all along the gradient, as on Mount Canigou, and likewise, they have maximal relative abundances in the stations with montane grassland.

(4) Endemic species can reach relatively high numbers in the montane belt (up to 25%), as on Mount Canigou. At one station of the subalpine belt, however, the fraction of endemics is still larger.

The results of the Mount Canigou gradient are thus largely confirmed. The last conclusion is especially interesting, as the ecological and zoogeographical importance of the montane belt is generally underestimated.

Distribution patterns

The majority of the species were caught in relatively low numbers, and little can be said about their habitat preferences. For the most abundant species, we can distinguish four main distribution patterns (Table 4):

(1) Species occurring in the forested habitats of both sides of the mountain. This is the largest group, and includes species with large distribution areas in the palearctic region (e.g. *Lepthyphantes zimmermanni*) as well as endemic species (*Leptoneta infuscata*, *Oonops procerus*). *Bolyphantes alticeps* only occurs in the

uppermost part of the forested area.

(2) Species only occurring in the woodland habitats of the French slope. This group has the same composition as the preceding one, as it contains very common species (*Pardosa lugubris*) as well as endemic ones (*Lepthyphantes n.sp.*).

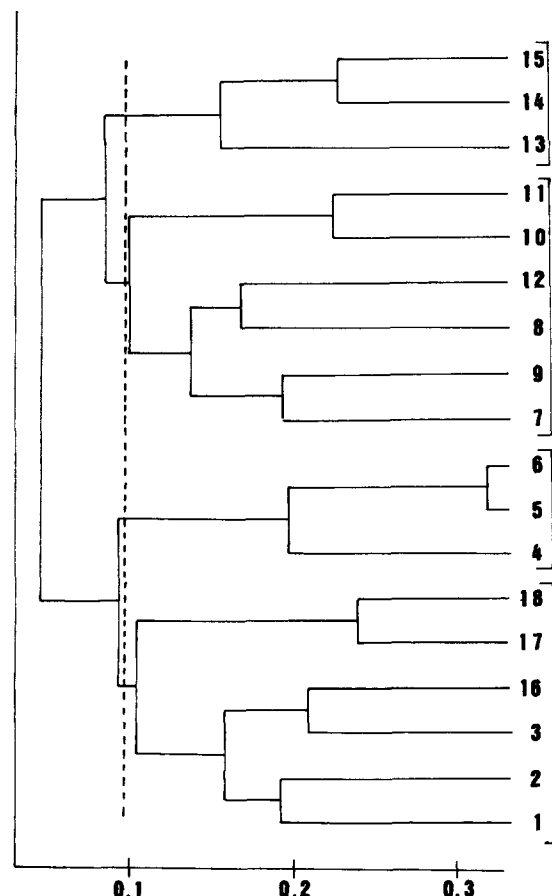


Fig. 1: Fractional Sørensen similarity between the spider fauna of 18 stations in an altitudinal gradient from St Lary (France) to Bielsa (Spain).

(3) Species occurring in the open forest habitats of the Spanish slope. This group contains species with large distribution areas in the mediterranean region (*Micaria guttigera*) and also endemic species (*Dirksia pyrenaica*, *Zodarion marginiceps*).

(4) Species inhabiting the subalpine grassland. The majority of these have an alpine distribution, but common species of dry grassland and heathland (*Steatoda phalerata*) also occur. The endemic species of the subalpine belt were either found in very low numbers, or at only one station.

Pardosa amentata has a striking distribution pattern, as it is present at the lowest station of the submontane belt, and in the subalpine belt. Montane grassland could be its original habitat.

The sex ratios of the species, but especially those of *Cybaeus angustiarum*, *Lepthyphantes* n.sp. and *Zodarion marginiceps*, reveal another aspect of the influence of altitude on spiders. At the lower stations, only females were caught, and at the higher stations, only males. The samples taken at different altitudes are obviously taken at different phases of the life cycle of the species; at the lower stations, it is almost completed, whereas it has just begun at the higher stations.

Cluster analysis

Figure 1 shows the dendrogram based on the "Fractional Sørensen Similarity" (Hublé & Maelfait, 1982) between all stations, and for all species captured. Four main groups can be distinguished:

(1) The lower stations of each slope (1-3, 16-18). These include the stations of the submontane belt, and the lower stations of the montane belt.

(2) The remaining stations of the montane belt of the French slope (4-6). These are closely related to group 1.

(3) All stations of the subalpine belt, the lowest station of the Spanish slope excluded (7-12).

(4) The lowest station of the subalpine belt and the highest stations of the montane belt of the Spanish slope (13-15). This group is closely related to group 3.

These results indicate that a distinction into vegetation belts, and especially into submontane and montane belts, is not necessarily coincident with the occurrence of spider communities.

Considering now the Renkonen similarity (Renkonen, 1944) between the 36 most abundant species, we distinguish 4 groups (Fig. 2):

(1) Species inhabiting the lower part of the Spanish slope.

(2) Species inhabiting the montane grassland. Both

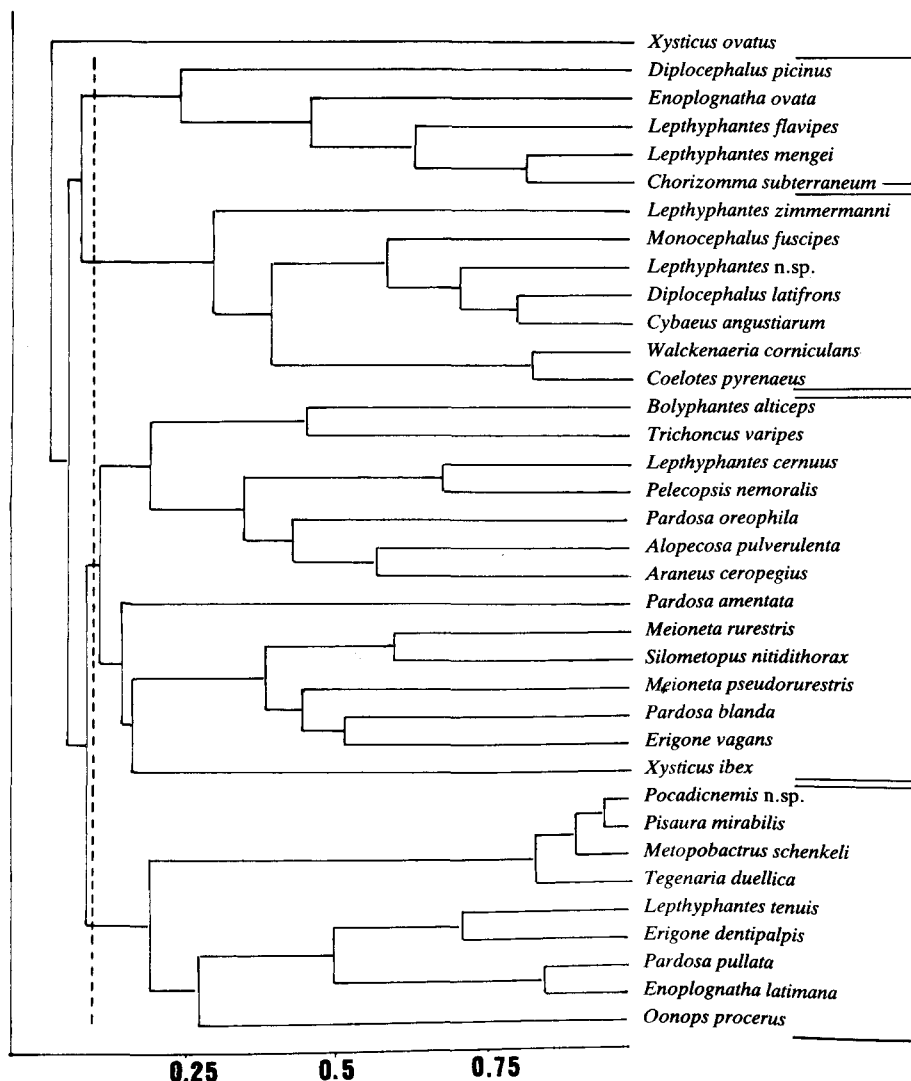


Fig. 2: Renkonen similarity between 36 species of spiders, occurring in an altitudinal gradient from St Lary (France) to Bielsa (Spain).

