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Spider communities of Belgian coniferous stands

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RIASSUNTO

E' stato condotto uno studio sulla fauna di ragni in 9 foreste di conifere in Belgio, campionate per un intero anno.

Sono state fatte comparazioni ed analisi sulla composizione e la ricchezza di specie, e si è cercato di stabilire come queste comunità di ragni si sviluppano a seconda del tipo di foresta (specie di conifere, sottobosco, etc.) e della loro posizione geografica. Viene effettuato anche un confronto con la fauna delle foreste decidue adiacenti.

Le foreste di conifere non sono naturalmente presenti in Belgio, ma vi sono state impiantate per meri scopi commerciali.

Esse rappresentano comunque nuovi habitats ed offrono nuove nicchie occupabili dagli Artropodi; poichè alcune di queste foreste sono abbastanza vecchie, sembra ci sia stato tempo sufficiente per lo sviluppo di comunità notevolmente stabili.

Parole chiave: Ecologia, Foreste di conifere.

ABSTRACT

In this contribution we compare the araneofaunas of 9 coniferous forest stands scattered over the country. These forests were sampled during a whole year. We analyse species richness and composition and try to establish how these spider communities developed in accordance with type of forest (conifer species, undergrowth, ...) and its geographical position. A further comparison is made with the fauna of adjacent deciduous forests.

Coniferous forests do not naturally occur in our country but they were all planted for purely commercial reasons. These plantations provided new habitats and new niches that could be occupied by arthropods. As some of the plantations are fairly old, quite stable assemblages have apparently had time to develop.

Key words: Ecology, Coniferous forests.

Introduction

During the last two decades a variety of habitat types, scattered over Belgium, were sampled by various researchers throughout a whole year by means of the standardized pitfall method. Most of these data are already published separately with analyses restricted to the habitat-complex studied in a certain locality (e.g. a wood complex at Zwijnaarde, a dune complex at the Westhoek De Panne, a natural reserve, etc.). I here start the analysis and comparison of these data in a more general context. The various habitat types (meadows, dunes, heathland, deciduous forests etc.) will be treated separately to see if there are shifts within the spider communities of a habitat type depending on the localisation of this habitat in the global Belgian landscape.

Coniferous forests do not naturally occur in our country. All of them have been planted for economic reasons such as wood production. Those newly created habitats seemingly offered new niches that could be occupied by invading arthropods. It is supposed though that part of the original fauna could survive the plantation. However, as a result of the different biology of conifers as compared to the deciduous trees, the plantations create a fairly different microenvironment: they produce a different kind of litter and thus alter the physicochemical conditions in the soil.

Depending on the environmental conditions prevailing in these habitats, seemingly stable arthropod communities developed in these habitats.

Location of the coniferous forest stands

The coniferous forests studied are spread throughout the Belgian territory. Each conifer stand was sampled during a campaign for the study of the spider fauna of a more complex area with clearly different adjacent habitats. They can shortly be described as follows.

Stand 1: A corsican fir stand at Zedelgem, West Flanders, on a dry acid sandy soil covered with a thick litter layer (7 cm) and a thin herb layer composed of ferns, black berries and some grasses. It is part of a small forest complex composed of beech, oak, birch and sweet chestnut. Altitude ca 15 m. (SEGERS & POLLET, 1988).

Stands 2 and 3: Both stands are located at Nazareth, East Flanders.

The first one (stand 2) is composed of 75 year old *Pinus sylvestris* trees. This 4.7 ha closed forest stands on a dry acid sandy soil covered with a very thin litter layer and no undergrowth.

The second one (stand 3) is an open 50 year old Douglas fir (*Pseudotsuga mucronata*) stand growing on a dry acid sandy soil covered with a very thin litter layer and a closed herb layer mostly composed of ferns and black berries.

Altitude ca 15 m.

Stand 4: A closed larch (*Larix decidua*) stand situated at Zwijnaarde, East Flanders. It stands on a moist sandy soil covered with a thick litter layer (between 5.6 and 7.3 cm) without any undergrowth. It is part of a 30 ha park forest (the Hutsepotbos) mainly composed of beech and coppiced woodland stands. It is surrounded by agricultural land, mainly pastures.

Altitude ca 10 m.

Stand 5: A larch plantation of the "Walenbos" complex situated in the Province of Brabant at Houwaart, growing on a moist loamy sandy soil with a very thick litter layer (15 cm). It is surrounded by alder carrs and planted canadian poplar stands.

Altitude ca 30 m. (TIPS, 1978).

Stands 6 and 7: These are two spruce stands (*Picea abies*), situated at Antheit, Province of Liège, on top of the southern exposed calcareous hillside of the Meuse valley.

The first one (stand 6) is a very open forest of old trees, the second one (stand 7) a very closed stand of young small trees. Very few light penetrates to the soil as the lower branches nearly reach the litter layer.

Altitude 140 m. (BAERT *et al.*, 1992).

Stand 8: A moist, closed old spruce stand situated at the bottom of the Gros Ruiseau valley at Buzenol, Province of Luxembourg. There is a thin litter layer but no undergrowth. It is part of a great woodland complex dominated by beech and oak.

Altitude 300 m. (BAERT *et al.*, 1983).

Stand 9: This is a small 80 year old, closed spruce stand in a vast moorland area, the "Hautes Fagnes" at a relatively high altitude (ca 675 m). Soil nearly totally covered with a herb layer mostly composed of grasses and *Vaccinium*. The shrub layer has a covery of 15%. (BAERT & KEKENBOSCH, 1982).

Methods

For each stand we determined for each species the number of individuals caught in four pitfall traps (diameter 9,5 cm, half-filled with a fixative) which were operative during a complete year cycle. A total of 191 species was caught for the 9 stands here together considered. Only the most abundantly caught species, the species caught in a total number larger than or equal to 15, were used in the analyses we performed, i.e. 76 species. In order to avoid the influence of differences in activity between the species, each species was given equal weight. This was done by transforming the catch per sampled habitat to the percentage of the total catch of the species. An ordination technique (Detrented Correspondence Analysis or DCA) (HILL, 1979a), as well as a divisive classification technique (Two-Way Indicator Species Analysis or TWINSPAN) (HILL, 1979b), were applied for the analysis of the data.

Results

As a first step in our analysis we performed a detrended correspondance analysis. This resulted in an ordination which was not interpretable in terms of variation caused by structural factors observed in the stands, as for instance a separation along the first axis between dry and wet stands and a separation of stands with a thin litter layer and a mor humus along the second axis. This was indeed the case when all the different sampled habitats of one site were analysed.

The ordination (Fig. 1) shows a separation along the first axis of the coniferous stands according to their longitudinal position, and thus in relation with their topographical position or altitude. Left the lowland stands (Flanders) and right the Ardenese stands (Wallonia).

It is clear that the separation occurs according to the (small) climatological conditions of the regions in which the stands are localised, climatological conditions which determine the composition of the living fauna.

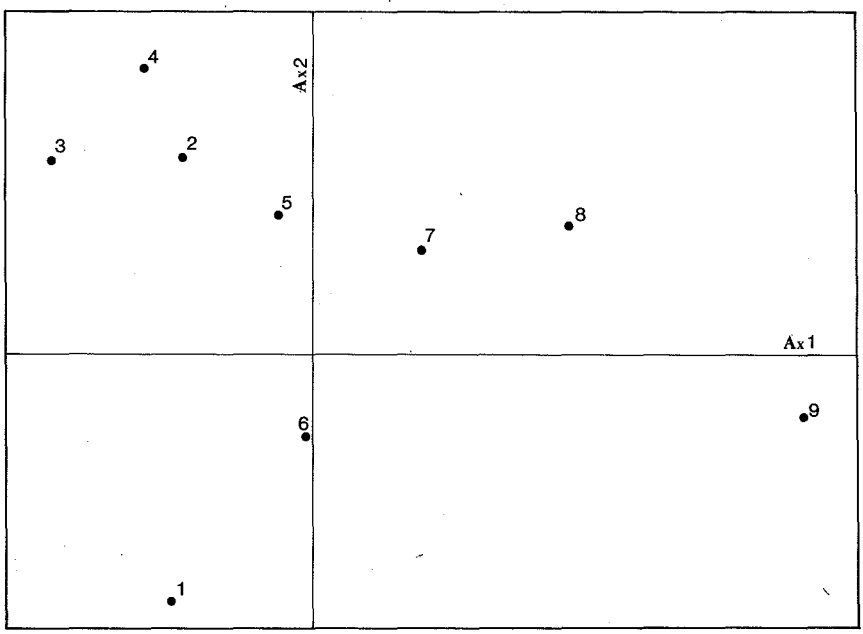

Fig. 1 - Ordination along first and second axis after a detrended correspondance analysis of the 9 sampling sites.

In an earlier general analysis of a series of wood complexes (MAELFAIT *et al.*, 1990 & 1991) also scattered over Belgium we also found a separation of the wood complexes according to their topographical position. In that analysis the coniferous stands separated according to the woodcomplex they belong to.

This means that the spider species composition of the coniferous stands is largely influenced by the surrounding local fauna. For example the larch stand at Zwijnaarde with a thick litter layer is more similar to the adjacent coppiced woodland with a very thin litter layer of the same wood complex than to a comparable larch stand of another complex.

Each conifer stand was part of a sample campaign for the study of the spider fauna of a certain wood complex or area with clearly different adjacent habitats. The analysis of each of these independant surveys showed that the coniferous stands always have the lowest similarity to the adjacent habitats.

8-21 % of the species found in the conifer stands were not found in the adjacent habitattypes of the wood- or habitat complex they belong to (cfr. Table 1). However, most of these species have been found in very small numbers and must be considered as accidental species.

Table 1 - Number of species of the conifer stands (N_S), of the global wood- or habitat complex (N_C) and confined to the conifer stands (n).

	Locality	N_S	N_C	n	%
1	Zedelgem	92	111(3)	21	18.9
2	Zwijnaarde	56	89(3)	12	13.5
6, 7	Antheit	85/72	212(4)	43	20.3
8	Buzenol	70	173(4)	19	11.0
9	Mont Rigi	54	110(3)	9	8.2

From the 76 most abundant species only six species are known from the literature to have a certain preference for coniferous woods (WIEHLE, 1956 & 1960). *Lepthyphantes minutus* and *Lepthyphantes mengei* are almost nearly especially found in the lowland conifer-woods; *Walckenaeria cucullata*, *Lepthyphantes pallidus* and *Lepthyphantes obscurus* occur nearly in all Belgian stands, whereas *Centromerus pabulator* is confined to the eastern Ardenese woods.

A Twinspan analysis (Fig. 2) classifies the stands in two major groups:

1° those situated in the Flamish lowland between 10 and 30 m of altitude, north of the Meuse. This region of Belgium is characterised by Tertiary sediments like sand and loam;

2° those situated on the higher Belgian plateau south of the Meuse between 140 and 675 m of altitude. All four stands are *Picea abies* plantations. This region of Belgium is covered with sediments originating from the secundary (chalk) and primary epoch.

Both groups are further separated so that five groups can be recognized:

1° The corsican fir stand at Zedelgem;
2° the two lowland stands adjacent to each other with a thin litter layer localized at Nazareth;
3° the remaining two lowland larch stands with a thick litter layer;
4° the three Wallonian *Picea* stands without any undergrowth;
5° the *Picea* stand of the High Fenns with a thick grass cover.

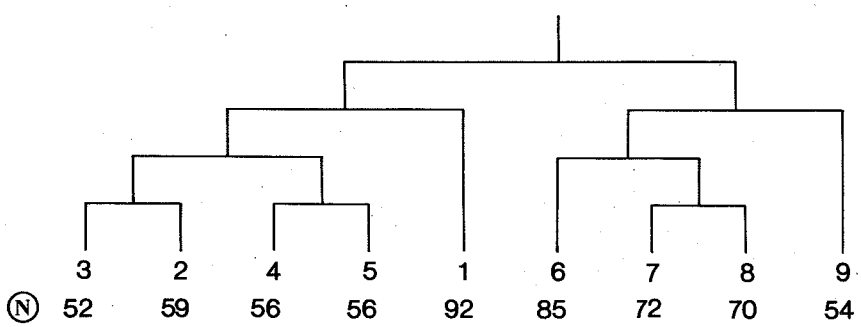

Fig. 2 - Clustering of the coniferous stands based on a Twinspan analysis.

The Twinspan classification shows further that:
10 species are confined to the lowland coniferous stands: *Pachygnatha listeri*, *Agroeca brunnea*, *Lepthyphantes minutus*, *Lepthyphantes mengei*, *Oxyptila trux*, *Dicymbium nigrum*, *Microneta viaria*, *Pirata hygrophilus*, *Walckenaeria cuspidata* and *Agyneta subtilis*;
52 species have a distribution all over the country;
14 species are confined to the Ardenese (in the broad sense) highland stands: *Asthenargus paganus*, *Sintula corniger*, *Pirata uliginosus*, *Diplocephalus latifrons*, *Lepthyphantes alacris*, *Lepthyphantes tenebricola*, *Centromerus pabulator*, *Centromerus leruthi*, *Centromerus ser-*

ratus, Metellina mengei, Coelotes inermis, Aulonia albimana, Dismodicus elevatus and *Pachygnatha degeeri.*

The lowland stands have a lower species number (Table 2). The number of species ranges between 52 and 59. The corsican fir stand at Zedelgem makes an exception with its 92 species. This high number is due to the high diversity in landscape-types of this wood complex. It's a mosaic of different kinds of wood types alternating with open habitat types (meadow, heath). Such a richness in habitats results in higher animal diversity.

The Wallonian stands are richer, between 70 and 85, with the exception of the *Picea abies* stand of the High Fenns with 54 species.

Conclusions

The small coniferous wood stands of Belgium have no typical spider communities dependent on that kind of habitat. Their spider communities are composed of the abundant species occurring in the adjacent stands of the wood complex they are part of. There is a segregation according to their topographical position, the Wallonian stands being populated by more continental species.

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