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Stratum change of *Drapetisca socialis* re-examined (Araneae, Linyphiidae)

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Abstract: It has been widely accepted that the biology of *Drapetisca socialis* includes a pronounced stratum change of this species from the forest soil into the crowns of beech trees. On old pine trees, however, *D. socialis* never exceeded its activity range to heights greater than 10 metres. These results lead to an re-examination of existing results, and to a review of several studies on tree-dwelling spiders. A synopsis of all data revealed that *D. socialis* changes stratum along stems of trees into greater heights in forests, but only very seldom, and then obviously only by chance, reaches high tree crowns. Earlier results of a stratum change into the crowns of old beech are only assumptions. The requirement for studies including samples from the bottom to the top of trees is proposed.

Key words: stratum change, *Drapetisca socialis*, arboreal spider species, stem-eclector.

INTRODUCTION

Reliable facts

Drapetisca socialis has been suggested to be a well known species (TRETZEL 1954, KULLMANN 1961, SCHÜTT 1995); however, it appeared that its ecological requirements and role were only poorly known until the introduction of stem-eclectors by FUNKE (1971). With this type of trap it was possible to study the trunk fauna of arthropods on several tree species. The first extensive studies on spiders on tree trunks were performed by ALBERT (1976, 1982). These widely cited papers deal with the composition of spider assemblages on spruce and young and old beech trunks, and the stratum change of several spider species from the soil onto the trees is described. In subsequent studies other tree species and age-classes of trees were investigated (pine trees: SIMON 1991, 1993, oaks: GUTBERLET 1996, several tree species: NICOLAI 1985). *D. socialis* was found on trunks of all studied tree species. Thus, *D. socialis* is a trunk-dwelling species; furthermore, we know its developmental cycle (TOFT

1976), and its intensity of activity on several tree species (WUNDERLICH 1982).

Suggestions

In the PhD-thesis of ALBERT (1982) a stratum change of *D. socialis* and other spider species was suggested from obtained sampling data. It was concluded that juvenile specimens of *D. socialis* enter tree trunks from the soil, also climb into tree crowns (but how tall these trees were was not described), feed there to adulthood, and return to the soil surface for mating and egg-laying. This cycle was supposed to be annual.

Assumptions

In ELLENBERG et al. (1986) the results of Albert's thesis were compiled, and a figure was drawn showing a beech tree with *D. socialis* moving from the soil up into at least the lower parts of the crowns, and back again (figure 1). Not the text, but the figure suggests that this stratum change happens not only in the crowns of young beech or up to a maximum height of 12 metres (as mentioned in the method chapter of Albert's thesis), but that it also takes place into the crowns of even old and tall trees. No evidence can be found for this suggestion in the original publication (ALBERT 1982).

Resulting question

Does *D. socialis* really move into the crowns of tall trees? To answer this, results of sampling along the vertical extent of tall, old pine trees and the results of several Diploma-theses were examined.

METHODS

In a three year investigation the differences in the composition of spider assemblages along the vertical extent of old pine trees were studied (SIMON 1995). At each of four trunks stem-eclectors (according to BEHRE 1989) were installed at different heights, namely in 1.5 metres, 5 metres, 10 metres and 13 metres. Each of these heights represents a certain trait of the trunk morphology or its ecological conditions. In both lowest sections the bark of the old pines is highly fissured and scaly; in a pre-study

it was found, however, that soil-dwellers use the lower part of the trunks as an additional habitat (SIMON 1991); the height of 5 metres was supposed to contain mainly true trunk-dwelling species. The 10-metre-section is the transition zone between the rough bark of lower trunk and the smooth bark of upper trunk and crown area. 13 metres is the part of the trunk which is immediately adjacent to pine-tree crown. In the crowns of four pine trees branch eclectors (BARSIG & SIMON 1995; SIMON 1995) were installed; they work in a similar way as stem-eclectors and thus results of both traps can be compared. As a killing and preserving agent a 1%-solution of blue vitriol was used. For details see SIMON (1995).

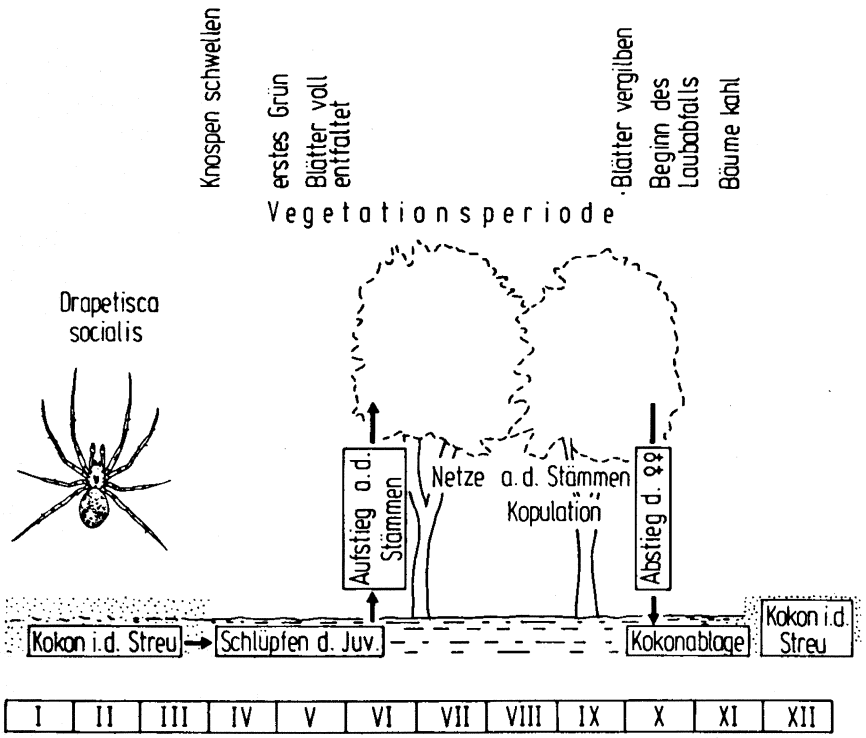

Figure 1: Phenology and stratum change of *D. socialis*, from ELLENBERG et al. (1986) (with kind permission of Verlag Eugen Ulmer).

The study was performed in Berlin, Germany, in a stand of old pines in the Grunewald forest (compartment "Jagen 91"). The study period lasted from April 14th , 1991, until March 29th , 1994. Traps were emptied almost every fortnight except for winter time, or if bad weather conditions prevented sampling.

Examination of the literature comprised two Diploma-theses (GUTBERLET 1996, PAWELKA 1997), and data from literature (ALBERT 1982, HESSE 1940, KLOMP & TEERINK 1973, KOPONEN 1996).

RESULTS AND DISCUSSION

1. Study along the vertical extent of old pine trees

In all samples 131 specimens of *D. socialis* were found. This included 15 (= 11.5%) juveniles (it was quite easy to distinguish juveniles of *D. socialis* from other juvenile Linyphiidae), 65 (= 49.6%) males and 51 (= 38.9%) females.

The seasonal occurrence of the species was very regular. The first juveniles were detected around the end of June, adult females were initially active around end of July or August, respectively. Males either occurred simultaneously with, or a little after, the females. Both sexes vanished with the onset of low temperatures in winter differing from year to year.

The vertical distribution is shown in figure 2. Most specimens were found in the lowest trap, and the species occurred quite rarely in the two higher traps. The species was never, neither as juveniles nor as adults, found at 13 metres or in the crowns of the studied pine trees. This results coincides with a result of BRAUN (1992) who found in his Diploma-thesis a distinct decrease of number of specimens of *D. socialis* with height from 1 metre (40 specimens) to 4 metres (13 specimens) up to 8 metres (3 specimens), also at pine tree trunks. Unfortunately, in his study no higher parts of pine trunks were studied.

It is possible to calculate a mean height of activity (MHA) using the number of individuals at a certain sampling time:

$$MHA\ (t) = \Sigma\ (N(t)\ [\text{height i}]^*\ \text{height I})/N_{ges}(t)$$

with crown height calculated as 18 metres.

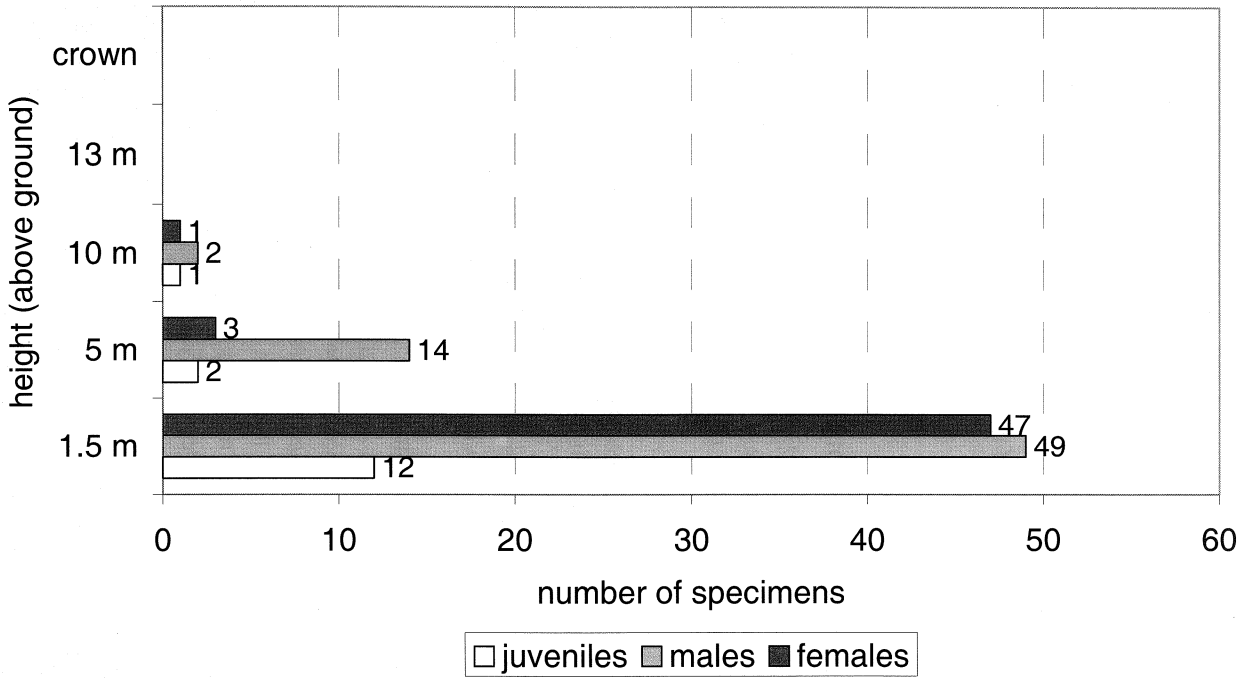

Figure 2: Distribution of juvenile, male and female specimens of *D. socialis* at five heights along the vertical extent of old pine trees.

Three conspicuous results were obtained (figure 3): 1) As already mentioned *D. socialis* never occurred in greater heights, thus MHA never exceeded 10 metres. 2) In these data from old pine trees no stratum change was detectable, neither into the tree crowns as suggested in the book of ELLENBERG et al. (1986) nor at the lower parts of the trunks as suggested by ALBERT (1982) for beech. 3) The MHA increased at the end of autumn indicating that a few individuals of *D. socialis* were active even on higher parts of the trunks (but never above 10 metres!) during that time.

D. socialis in this study showed a similar seasonal activity compared to other studies (TOFT 1976, ALBERT 1982, NICOLAI 1985, BÜCHS 1988, BRAUN 1992, GUTBERLET 1996, PAWELKA 1997). The number of individuals is relatively low compared to beech but this goes along with comparative studies (NICOLAI 1985, PLATEN 1989). Conditions in pine tree dominated forests might not be the most suitable for this species. Nevertheless, the applied method as well as the obtained data are reliable. The presented results are neither arbitrary nor artificial, and thus useful for understanding the biology of *D. socialis*.

Traps were sufficient in sampling specimens of this species. Since at all heights at trunks similar traps were used, and branch eclectors work in the same way as stem-eclectors (which is indicated by similar sampling results in species which occur uniformly along the vertical range of the studied trees (SIMON 1995)) it can be concluded that there really were no specimens of *D. socialis* active at greater heights. Thus, *D. socialis* obviously never exceeds its activity range above 10 metres on old pine trees.

2. Review of literature

The oldest data on *D. socialis* in a tree crown was obtained from HESSE (1940); he felled entire trees on white sheets, and helpers collected arthropods, in particular spiders, from these sheets. Hesse found *D. socialis* very rarely in tree crowns of spruce and pine trees. But there were two drawbacks on this very early but valuable study: a) one can not exclude that helpers collected spiders which had entered sheets from the surface of the soil after tree-felling; b) the falling tree crown could also have brushed specimens of *D. socialis* from surrounding tree trunks. Consequently, there

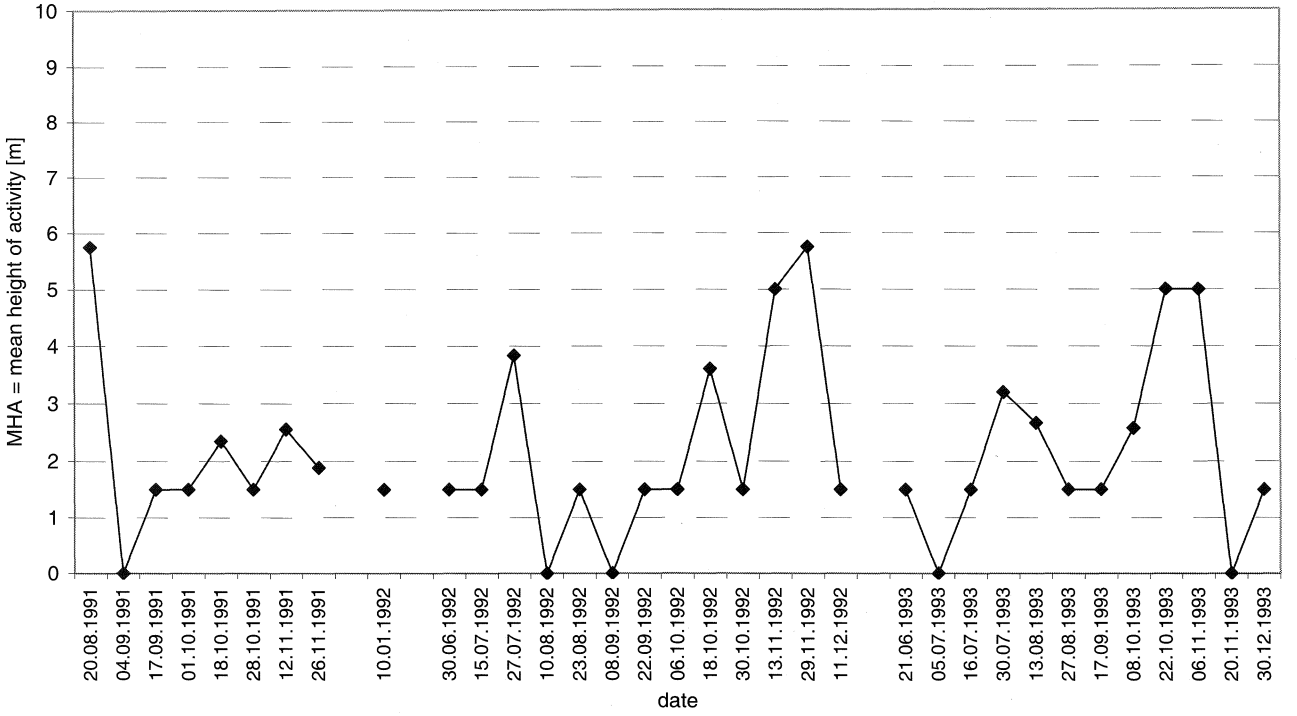

Figure 3: Mean height of activity (MHA) of *D. socialis* on trunks of old pine trees. For calculation see text.

is no unequivocal result on the occurrence of *D. socialis* in tree crowns in Hesse's study.

There is a published paper (KOPONEN 1996) and the PhD-thesis of ALBERT (1982) offering data on *D. socialis* in crowns of oaks and beech, respectively. Koponen performed a study with newly developed branch eclectors; he found *D. socialis* to be very abundant on branches of old oaks. The height of the traps, however, was about six to eight metres above ground.

Regarding the methods in Albert's thesis, he used stem-eclectors for the study of trunk-dwellers, pitfall-traps for the activity of spiders on the soil surface, and branch-beating to obtain results for the tree crowns. A careful examination of the methods reveals that branch-beating took place on young beech trees at a height of about 12 metres. The crowns of old trees were only examined up to a height which was reachable from the ground, i.e. again around 10 to 12 metres. His results are, regarding height above ground, comparable to Koponen's; both authors studied the lowest parts of a tree crown, and this became commonly accepted as a result of "also occurring in tree crowns".

A Diploma-thesis (GUTBERLET 1996) found in a study on spider fauna of stems and branches of old oaks that despite an abundant occurrence of *D. socialis* on the lower parts of oak-tree trunks it never was found in oak-tree crowns. In her Diploma-thesis PAWELKA (1997) found *D. socialis* in flight interception traps, installed in the crowns of old beech, but only in low numbers. This, in her opinion, suggests an aerial arrival of this species into the studied tree crowns; but no evidence was found for an existence of a stable population of this species via simultaneous sampling using branch eclectors; according to the author, it could be that a small proportion of *D. socialis* in forests balloons into the stands, but most likely they immediately descend to lower strata of the forest, due to climatic factors in tree crowns with low values of humidity and high temperatures in combination with high solar radiation (SIMON 1995). But another possibility is that during letting down the flight interception traps a few specimens of *D. socialis* may have entered this trap while rushing through small beech.

CONCLUSIONS

In most of the mentioned studies no occurrence of *D. socialis* in tree crowns of old trees was found. Whenever there was a record of (only a small individual number) of this species in a tree crown it could also be referred to a deficiency in methods. Hitherto, there is no evidence for the occurrence of *D. socialis* at greater heights of tall trees.

If we want to better understand the occurrence along the vertical extent of trees and an assumed stratum change of *D. socialis* it is necessary to perform studies which regard also different tree species. Results of this paper made it obvious that one cannot simply extrapolate data obtained in lower strata to the upper parts of the crowns of trees. This is also true for other tree-dwelling spider species and, of course, for all other arboreal arthropod species.

ZUSAMMENFASSUNG

In den Beschreibungen zur Biologie von *Drapetisca socialis* wurde immer wieder der ausgeprägte Stratenwechsel vom Boden in die Kronen von Waldbäumen beschrieben. In einer Untersuchung an alten Kiefern wurde die Art nie in einer größeren Höhe als 10 Meter gefunden. Dies führte zu einer Durchsicht der Literatur, auch von Diplomarbeiten zum Thema. Eine Zusammenschau der Daten zeigt, dass *D. socialis* zwar möglicherweise einen Stratenwechsel durchführt, für Höhen über 12 Metern über Grund an Bäumen gibt es aber definitiv keinen eindeutigen Nachweis der Art. Es wird diskutiert, dass frühere Ergebnisse zum Wechsel der Art in die Kronen hoher Bäume nur Annahmen darstellen. Die Notwendigkeit von Untersuchungen zu Spinnen und anderen Arthropoden in höheren Bereichen an Bäumen wird festgestellt.

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