Humidity retaining function of the catching web of *Tapinopa longidens* (Wider) (Araneae: Linyphiidae)

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Experiments demonstrate that the exceptionally dense web of *Tapinopa longidens* (Wider) is able to reduce evaporation through the web, creating a humidity chamber around the spider. It is suggested that web structure and persistence, web sites and attachment, together with other biological characteristics, form an interdependent set of adaptations peculiar for the species.

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Introduction

Tapinopa longidens (Wider) occurs in a variety of biotopes in Central and North Europe, mostly in open country (Wiehle, 1956), but also in woods (Locket and Millidge, 1953; Palmgren, 1975). Especially Palmgren (1975) stresses its affinity to humid situations by noting its absence from dry forests with no moss cover. In Denmark, the species, according to my own experience, is common only on heaths. In the *Erica tetralix*-heaths of North-western Jutland it is a very abundant species, whereas in the dry *Calluna*-heaths at Mols, Eastern Jutland, it is much less frequent, though by no means rare. My subjective impression from this latter site is that *T. longidens* is more common on northfacing hillslopes than on southfacing ones. Here, it must be searched for deep below the heather bushes, and it is found only in small patches where living and dead branches of the *Calluna*-bushes are so dense that the mor-layer below is visibly wet, again stressing the species' requirement for high humidities, though the habitat in general is very dry.

The catching web of *T. longidens* is quite outstanding among the sheet-web spiders, easily recognized by the extreme density with which it is woven. It is spun over depressions in the soil, as also noted by Wiehle (1956), attached along the whole circumference, thus making a closed room for the spider and its egg-sacs, a feature described already by Nielsen (1928). This arrangement may protect both the spider and the egg-sacs from being attacked by predators and parasitoids. An alternative hypothesis, to be tested here by two simple experiments, is that the web may serve to conserve humidity in the air surrounding the spider.

Experiments and results

Adult females were kept in small plastic cups (diameter 3.4 cm, height 3.0 cm), half filled with wetted commercial sphagnum, and allowed to spin webs within the cups. A hole in the bottom of the cups allowed the sphagnum to be moistened without disturbing the web. The size of the cups purposely was smaller than ordinary webs, to ensure that the webs would be attached all the way round. At least two weeks elapsed before the webs had reached the characteristic density, but still became denser with time.

In two experiments the same 11 cups with webs and 10 controls without webs were used. The cups were allowed to take up as much water as possible; thus evaporation could take place as if from an open water surface.

The first experiment was designed to find out whether the web was able to inhibit evaporation, by reducing the effect of wind. Experimental cups and control cups were placed on a tray in random mixture and subjected to a horizontal air current, produced by a vacuum cleaner.

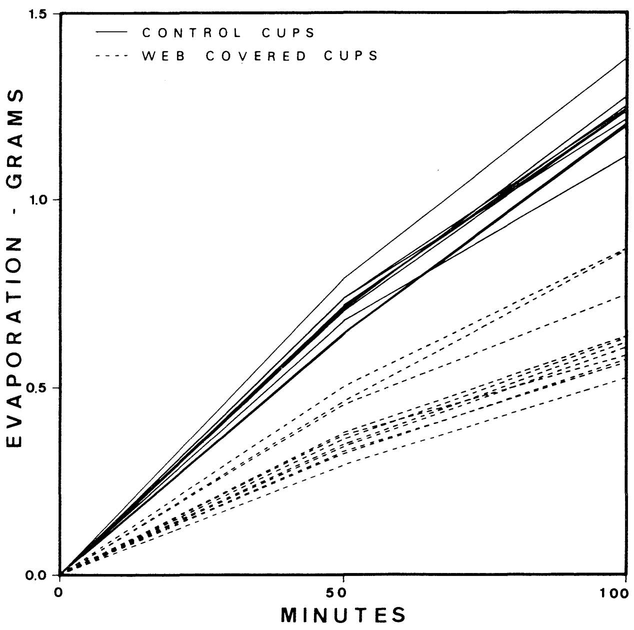

Fig. 1. Water loss from 11 experimental cups, covered with webs of *T. longidens,* and 10 control cups, when subjected to a horizontal air current (wind speed 4 m/sec.).

Evaporation was measured as weight loss. Two readings were made, after 50 and 100 minutes. Following the first reading the tray was turned 180°, so that all cups have been subjected to the same average wind speed, about 4 m/sec.

Results are shown in Fig. 1. They display a very clearcut effect: After 100 minutes, mean water loss from control cups amounted to 1.238 grams, from experimental cups to 0.659 grams, i.e. the web reduces evaporation to half the value. Three of the experimental cups show higher evaporation than the rest; in these the webs had rather large holes, very insufficiently repaired by the spiders.

To see if the web might have a *direct* inhibitory effect on evaporation, all 21 cups were placed in the oven at 27°C for 20 h. This produced no difference at all between experimental and control cups.

Discussion

The experiments clearly demonstrate that the web of *T. longidens* reduces evaporation from the area below the web, and that it does so by inhibiting the exchange of air from the chamber it encloses, i.e. by reducing the effect of wind. It is significant that all the specific adaptations of *T. longidens,* the use of soil depressions for web sites, the density of the sheet, and the circumferential attachment, are necessary requirements for this way of functioning. The web creates a humidity chamber for the spider. If no web is present a steep humidity gradient may exist at the soil-air interface. This is now displaced to web-air interface.

However, the peculiar web of *T. longidens* shall probably be viewed only as part of a large set of interdependent adaptations. As already noted it takes more weeks to produce a complete web, and energetically it must be costly (cf. Ford, 1977). The persistence of the web is difficult to study directly in nature, but it probably lasts for most of the life of the spider, at least in the adult stage. One prerequisite for this is a structurally stable environment, and the attachment of the web directly to the soil may be considered a primary adaptation, allowing for persistence of the web. This in turn has made it profitable to invest more energy and material into each web, thereby gaining control over the microclimate surrounding the spider. This again has allowed still another adaptation, for which *T. longidens* is outstanding among the linyphiids: it deposits its egg-sacs on the web itself. Normally these are well hidden in the litter.

Acknowledgements

I am deeply indebted to Else Ørnbøl who performed the experiments, and to Boy Overgaard Nielsen for commenting on the manuscript.

Litterature

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Sammendrag

Fugtighedsbevarende funktion af fangstnettet hos *Tapinopa longidens* (Wider) (Araneae: Linyphiidae).

Tæppespinderen *Tapinopa longidens* (Wider) findes i Danmark hovedsagelig på heder. Den er særdeles almindelig på de lavtliggende klokkelyngsheder i Nordvestjylland, men er også hyppig på de tørre lyngheder på Mols. Her er den dog kun at finde under de tætteste lyngbuske, hvor mor-laget kan holde sig fugtigt. Fangstnettet er ganske usædvanligt tæt spundet; det placeres gerne henover en lille fordybning i jorden, fastgøres til underlaget langs hele omkredsen og danner således et lukket rum, i hvilket edderkoppen, der bevæger sig omvendt på spindets underside, befinder sig.

Der er flere mulige forklaringer på, at arten laver så tæt et spind, som tilfældet er. Man kan forestille sig, at edderkoppen må være ganske godt beskyttet mod rovdyr og snyltere. Det er dog en anden mulig hypotese, som her er blevet efterprøvet, nemlig at spindet kan tjene til at opretholde en høj fugtighed i luften omkring dyret.

Dyrene blev holdt i en serie små plasticbægre, halvt fyldt med fugtig sphagnum. Her lavede de deres spind, så hele bægermundingen var dækket. Ved hjælp af en støvsuger blev en luftstrøm sendt henover en gruppe bægre, dels nogle med spind, dels nogle uden spind (kontrol). Vand-fordampningen blev målt ved at veje bægrene før og efter forsøget.

Det viste sig, at spindet var i stand til at reducere vandtabet til det halve. Den rimeligste tolkning af dette er, at spindet hæmmer udskiftningen af luftmassen i rummet mellem spind og underlag. For helt at kunne udelukke den, ganske vist usandsynlige, mulighed, at nettet direkte kunne hæmme diffusionen af vanddamp, udførtes endnu et forsøg. Bægrene blev her anbragt i varmeovn ved 27°C i 20 timer. Som forventet fandtes ingen forskel i vandtab.

Disse forsøg tyder således på, at *T. longidens* ved hjælp af sit meget tætte spind opnår at kunne opretholde en relativt høj fugtighed i luftrummet omkring sig. Dette kan være en vigtig tilpasning for en art i åbne, forblæste biotoper.

Anmeldelse

Arne Fjellberg: Identification keys to Norwegian Collembola. 152 sider, 416 figurer. Udgivet af Norsk Entomologisk Forening, 1980. Pris: N.kr. 50. Kan bestilles fra: Norsk Entomologisk Forening v/ Jac. Fjelddalen, postbox 70, N-1432 Ås-NLH, Norge.

Denne publikation er afgjort af interesse også for andre end norske collembolspecialister. Udover alle kendte norske arter er også medtaget adskillige arter fra nabolandene inklusive Danmark. Efter en kort indledning med afsnit om morfologi, præparation og bestemmelsesteknik følger nøgler til familier, slægter og arter. Under hver art findes en lapidarisk beskrivelse af morfologi, udbredelse i Norge, biotop og eventuelt yderligere biologiske oplysninger. Nøglerne er rigt illustrerede, og til trods for den billige reprodutionsteknik fremtræder tegningerne særdeles klart. En fem siders litteraturliste, med hovedvægten lagt på arbejder af norsk relevans, afrunder værket.

Henrik Enghoff