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Tarsal hairs specialized for prey capture in the Salticid *Portia*

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Résumé

Poils tarsaux spécialisés pour la capture des proies chez les Salticides Portia.

Les Salticides *Portia* chassent à l'approche principalement d'autres araignées. Des insectes sont aussi capturés mais moins fréquemment. L'attaque est guidée visuellement et commencée à grande distance (20cm). Quand la proie est à portée, *Portia* se précipite dessus et la saisit avec ses deux premières paires de pattes.

L'examen microscopique des pattes antérieures révèle deux rangées de poils spécialisés sur les faces ventro-latérales des tarses et métatarses. Ces poils ressemblent fortement à ceux des scopula (poils adhésifs) des griffes. Dans leur position normale, ces poils scopulaires se distinguent difficilement des poils tarsaux réguliers. Cependant, quand la pression de l'hémolymphe s'accroît, ces poils adhésifs sortent de leur alvéole pour former un angle droit avec l'axe de la patte. Leur surface interne porte des centaines de petites terminaisons triangulaires, indiscernables de celles observées sur les poils des touffes des griffes, qui assurent probablement un agrippement ferme sur la proie.

Jusqu'à présent, de tels poils ont été observés seulement sur les pattes de quelques autres Salticidae, tels que *Brettus* et *Cyrba.* Ces derniers genres tendent à agripper des proies de grande taille avec leurs pattes antérieures et c'est au cours de pareilles attaques que les poils scopulaires semblent jouer le plus grand rôle.

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Summary

The cryptic Salticid *Portia* stalks mostly other spiders; insects are also preyed upon but less frequently. The attack is guided visually and initiated at rather large distances (20cm). When the prey is within reach, *Portia* lunges at the prey, grabbing it with its two pairs of front legs. A microscopic examination of the front legs reveals two rows of specialized hairs on the ventro-lateral sides of the tarsi and metatarsi. They closely resemble the scopulate hairs (adhesive hairs) of the claw tufts. In their normal position these scopulate hairs can hardly be distinguished from the regular tarsal hairs. However, when the hemolymph pressure is increased these adhesive hairs move out of their sockets to form a right angle with the leg axis. Their inner surface bears hundreds of small, triangular end feet which are indistinguishable from those seen on the claw tuft hairs, and which probably ensure a firm grip on the prey. So far, such hairs have been observed only in few other salticids (*Brettus, Cyrba*). These genera tend to scoop up oversize prey with their forelegs and it is in such attacks that the scopulate hairs seem to be most important.

Portia fimbriata is a cryptic Salticid that often invades webs of other spiders and preys upon the web owners. Ground spiders, even other Salticids, are also successfully attacked, whereas insects are only occasionally taken as prey (JACKSON, 1982; JACKSON & BLEST, 1982a). When approaching a potential prey, *Portia* orients mainly visually (JACKSON & BLEST, 1982a, b) and moves extremely slowly until it is almost within reach of the victim. Just before leaping or lunging onto the prey the forelegs are extended and the leg spines become erect. The actual grabbing of the prey occurs within a fraction of a second and as soon the chelicerae have delivered the bite, the legs are usually completely withdrawn. It is astounding that *Portia* often tackles oversize prey, i.e. larger than itself, and captures it without any difficulty.

A close examination of the front legs revealed rows of specialized hairs which are situated ventro-laterally. Structurally they closely resemble the scopula hairs (adhe-

Figure 1. — *Portia fimbriata*, metatarsus 1, ventrolateral view (SEM). Three scopulate hairs (SC) are seen between several slender tactile hairs (T) and the base of a spine (EP). Note the large sockets of scopulate hairs as compared to those of tactile hairs. 828×. Inset: surface view of scopulate hair (interference contrast); the plane of focus lies at the emergence of the cuticular endfeet from the leaf-like hair shaft. 1105×.

Portia fimbriata, premier métatarse, vue ventro-latérale (MEB). Entre plusieurs poils tactiles minces (T) et la base d'une épine (EP), on aperçoit trois poils scopulaires (SC). Remarquez la taille des socles des poils scopulaires, qui est grande en comparaison de celle des socles de poils tactiles. 828×. Encadré: vue de face d'un poil scopulaire (contraste interférenciel); le plan de focal se trouve sur l'émergence des terminaisons cuticulaires. 1105×.

Figure 2. — Higher magnification of scopulate hairs. The rim of the socket has a distinct notch (arrow head); the shaft bears many pointed extentions but endfeet are only visible around the distal end (arrows). 2975×.

Fort grossissement de poils scopulaires. Le pourtour du socle présente une encoche bien visible (tête de flèche); la tige porte de nombreux renflements pointus mais les «terminaisons» ne sont observées que vers son extrémité distale (flèches). 2975×.


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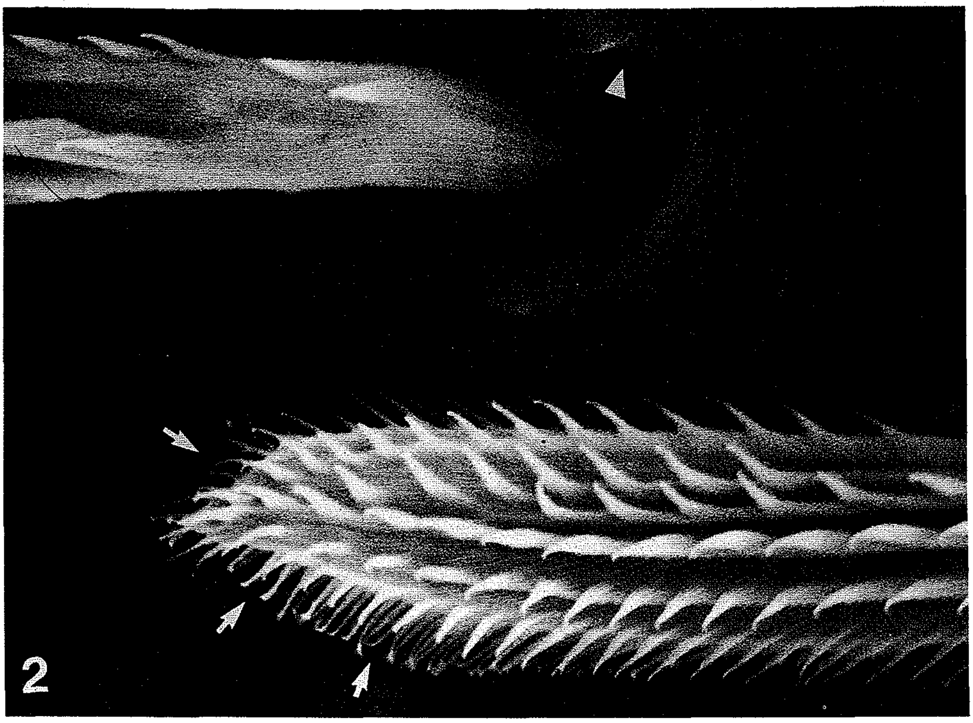
T
SC
SC
SC
1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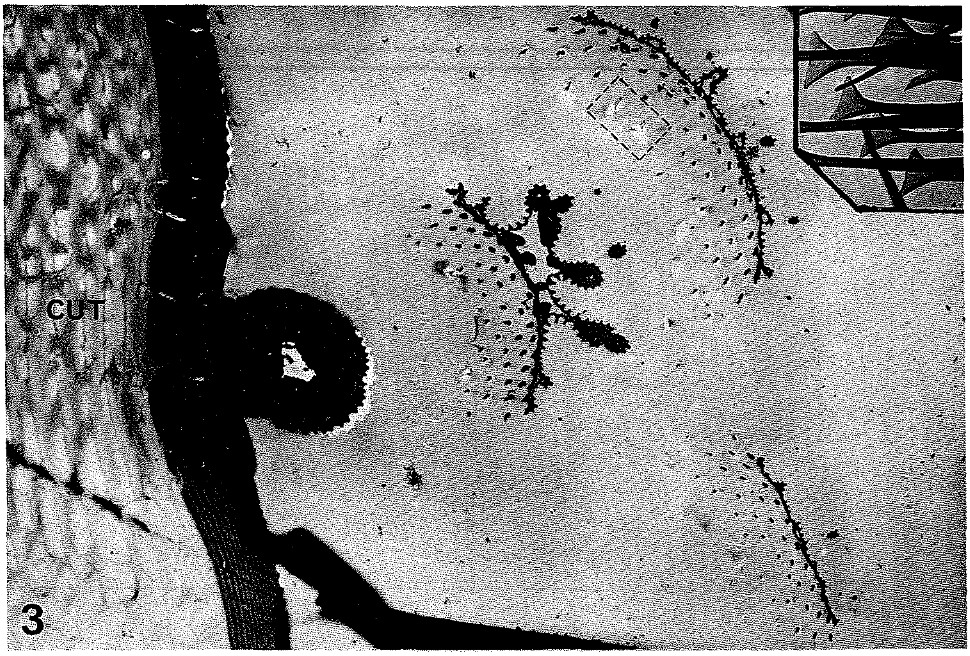
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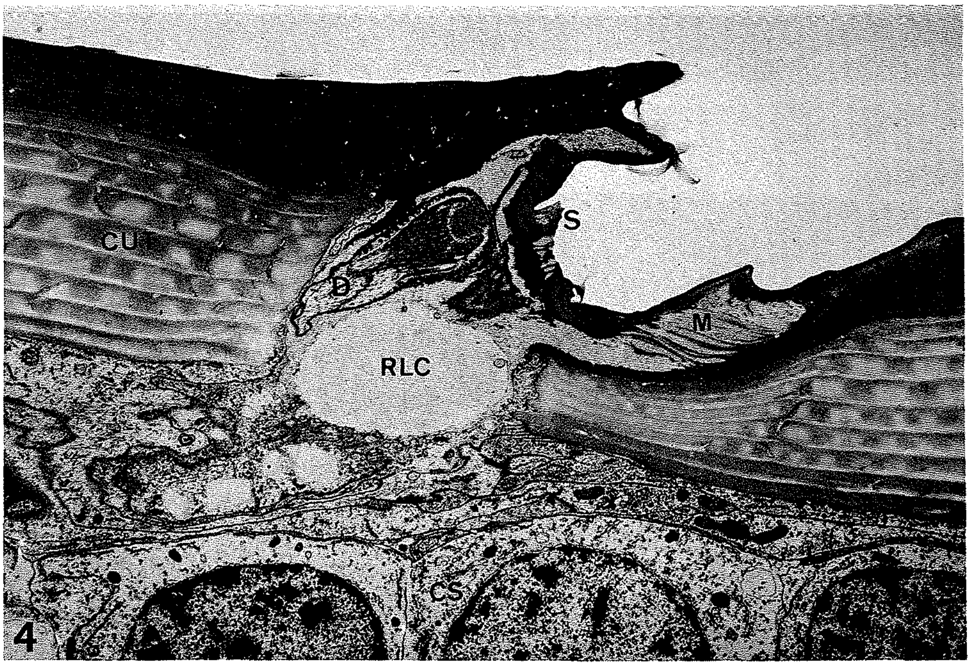
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sive hairs) of the claw tufts and therefore we refer to them as *scopulate* hairs. Functionally these scopulate hairs seem to play an important role while grasping prey, similar to the adhesive hairs found on the forelegs of wolf spiders (ROVNER, 1978).

Structure. — The scopulate hairs form two rows on the ventral side of the first and second pair of legs; on leg three scopulate hairs are restricted to a single row on the tarsus and on leg four these hairs are lacking altogether. At lower magnification the scopulate hairs are difficult to detect among the regular tactile hairs, but at higher magnification several characteristics become apparent (fig. 1, 2): **1.** The socket is circular and relatively large (12 µm diameter), and its rim is characteristically notched; **2.** the hair shaft flattens to an extreme (from 4 µm at the base to 0.4 µm distally), giving the hair a leaf-like appearance; **3.** one side of the flattened shaft is studded with 800-1000 cuticular extensions which flare into triangular endfeet (fig. 3, inset). The opposite side of the hair shaft is reinforced by several ridges which also show cuticular extensions but of a coarser type and without endfeet (fig. 2).

Basically the same fine structure was found for the adhesive hairs in the claw tufts of other cursorial spiders (FOELIX & CHU-WANG, 1975; HILL, 1977). However, there is one important difference. Whereas the typical scopula hairs bear their endfeet on the ventral side of the hair shaft, i.e. facing the substrate, the scopulate hairs have endfeet which point toward the leg surface (fig. 2, 3). How then can any effective contact be made between the adhesive hair and the substrate (or prey, respectively)?

Function. — ROVNER (1978) had already observed that the leg scopula hairs can be activated by an increase in haemolymph pressure. In other words, in the resting state the scopula hairs lie rather flat above the leg surface but with an increase in haemolymph pressure they raise out of their sockets to a nearly perpendicular position. This mechanism could be duplicated by gently squeezing a spider's leg with forceps. The same is true for the scopulate hairs in *Portia*: a slight pressure exerted proximal on the leg causes first the erection of the leg spines and then the elevation of the entire row of scopulate hairs. Each hair shaft is pushed into the notch of the socket and thus forms almost a right angle with respect to the leg surface. It is only in this erect position that the adhesive surface becomes available for a possible contact. A reexamination of the wolf spiders which ROVNER (1978) had used in this studies showed that there too the adhesive side actually faces the leg surface. Thus we suppose that the leg

Figure 3. — Cross-section of three scopulate hairs showing that endfeet are only present on that side of the hair shaft facing the leg surface (CUT). S, hair shaft. 4680×. The boxed-in area indicates triangular endfeet, which are shown at higher magnification in the inset. 21840×.

Coupe transversale de trois poils scopulaires. La tige foliée du poil ne porte des terminaisons que du côté regardant vers la surface de la patte (CUT). S, tige du poil. 4680×. La région hachurée renferme deux terminaisons triangulaires qui sont reprises à plus fort grossissement dans l'encadré. 21840×.

Figure 4. — Longitudinal section of the base of a scopulate hair. The hair shaft (S), which is here broken out of the socket, is attached to a dendritic terminal (D) via a cuticular membrane (M). CUT, leg cuticule; CS, sensory cells; RLC, receptor lymph cavity. 4680×.

Coupe longitudinale de la base d'un poil scopulaire. La tige du poil (S) est ici arrachée du socle; elle est attachée à une terminaison dendritique (D) par une membrane cuticulaire (M). CUT, cuticule de la patte; CS, cellules sensorielles; RLC, cavité lymphatique réceptrice. 4680×.

scopula hairs in general are only useful when erect but are largely ineffective when in the resting position. In contrast, the scopula hairs of the claw tufts always have their adhesive side ventrally, facing the substrate. As one can easily observe, it is only the claw tuft that contacts the substrate while a spider is walking on smooth surfaces. The scopulate hairs on the tarsi and metatarsi of the forelegs seem to be specialized for the grasping of prey and are only briefly put to use. In fact, it is exceedingly difficult to observe the action of the scopulate hairs in *Portia* directly, because the grip of prey happens so quickly and may last only a second. In a few cases, however, we could observe prey capture under a dissecting microscope and confirm that scopulate hairs do ideed become erect immediately before contact with prey.

The presence of such specialized scopulate hairs is obviously not restricted to *Portia* but seems to be quite common among many other cursorial spiders. Compared to Lycosids and Gnaphosids, for example, where the leg scopulae form a dense, fur-like cover, *Portia* has a rather reduced number of scopulate hairs (80 or less per leg). However, among the Salticids such scopulate hairs are very exceptional. So far, they have been found only in the two related genera *Brettus* and *Cyrba*. All of these Salticids tend to scoop up oversize prey with their forelegs and we surmise that it is in such attacks on large prey that the scopulate hairs are most important.

Finally, we could like to mention an interesting neurobiological point with regard to the scopulate hairs in *Portia*. It was stated previously that adhesive hairs are generally not innervated (FOELIX & CHU-WANG, 1973). However, in *Portia* most of the claw tuft and scopulate hairs were found to be supplied by one sensory cell (fig. 4). This implies that these hairs have not only an adhesive function but also provide a sensory feed-back about having made contact with prey or a substrate.

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