This is a PDF version of PECKHAMIA 1(3): 44-50, September 1977. Pagination of the original document has been retained. Author's note [20.1]: *Eris marginata* is now *E. militaris*.

FIELD OBSERVATIONS ON THE BEHAVIOR OF IMMATURE *PHIDIPPUS PRINCEPS* IN MINNESOTA. D. E. Hill

These notes pertain to observations of a very dense population of young *Phidippus princeps* (Fig. 1) in Hennepin County, Minnesota during the month of August, 1976. Observations were made in an old field, formerly a pasture, which was dominated by *Euphorbia esula* and *Solidago* (Goldenrod) in addition to various grasses. None of the events described below were staged in any way. The spiders are designated as either V or VI, roughly corresponding to instar. Stage V is the last stage in which the distinct markings of the dorsal opisthosoma similar to those of an adult *P.clarus* are present. From stage VI on, these markings are indistinct. On this age scale, penultimate males are stage VII. Only two senescent adults (both females) were encountered in August, and both were near the ground.

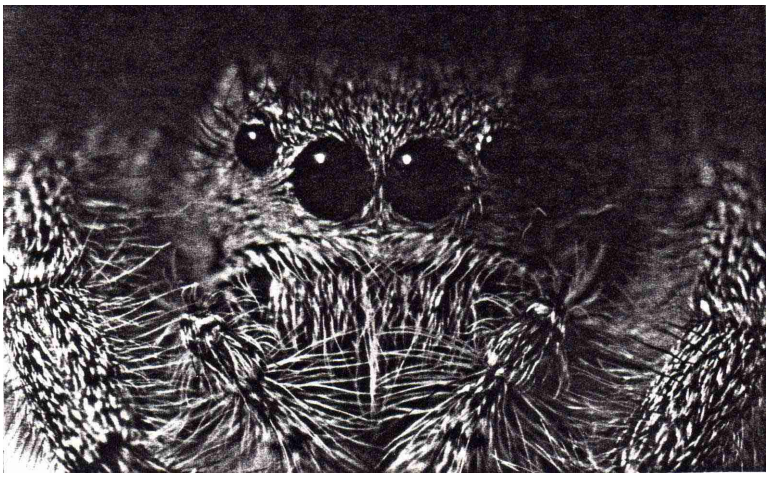


Fig. 1. Face of adult female *Phidippus princeps* from Hennepin County, collected as a juvenile and reared in captivity. The facial (clypeal) scales are white, others are tan.

While on the hunt, these spiders frequently occupy waiting positions on the main-stems of *Euphorbia esula* (Figs. 2, 3). Resting sacs (nests) are situated between leaves in the upper portion of these herbs, and these are often occupied by well-fed (engorged opisthosoma) individuals. The opisthosomata of spiders which move frequently are generally small, suggesting the determinative role of "hunger" in the behavior of these spiders as noted by Gardner (1964, 1966). The waiting behavior of these *Phidippus* is quite different from the constant forays of *Eris marginata* on blackberry bushes (Hill 1975). Enders (1975) would term *Phidippus* a pursuer (wait and then pursue) and *Eris* a searcher. Actually,

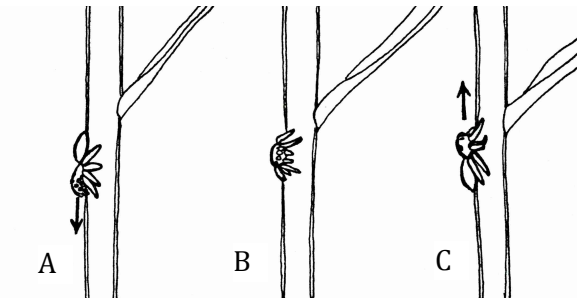


Fig. 2. Waiting positions of *P. princeps* on the main-stem of *Euphorbia*. A. The usual down-stem orientation presumably affords the best combination of vantage and access to prey. The crouched spider holds the legs close to the body. B. Transverse orientation. Pedipalps flicker as the spider turns. Often the spider orients to a leaf blowing in the wind, and the great majority of such stimuli are rejected upon evaluation with the AME, whence the spider returns to the waiting position. C. Less frequently the spider waits in an up-stem orientation. In the heat of the day the spider is commonly on the shaded side of the stem.

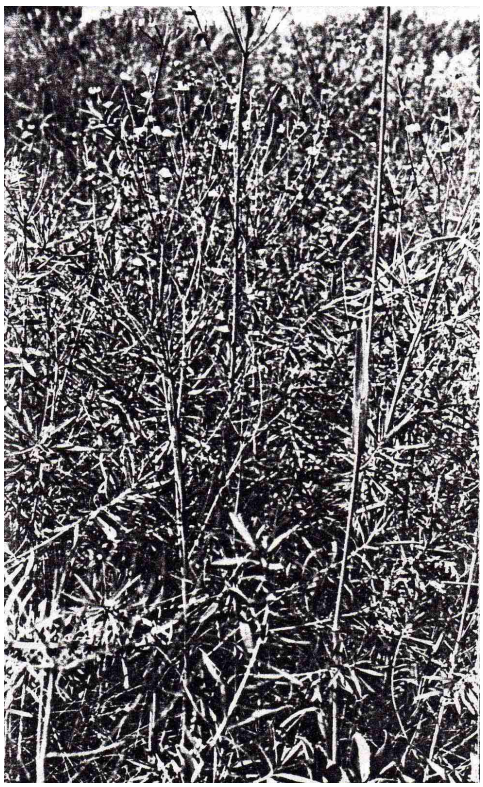


Fig. 3. (*right*) Can you find the spider in this photograph of *P. princeps* on *Euphorbia*? Compare with Fig. 2A. The spiders commonly wait near the top of the plant.

though, these are only extremes in a continuum. Although *Eris* is always on the move, it does stop and survey (visual) the surroundings at frequent intervals. Pursuit can ensue from this survey, so here we have a case of search and pursuit. *Phidippus* may, in general, move less frequently between waiting positions, but it does move.

Rather than summarize my field notes, I will present extracts in the form of descriptions of actual events, each of which is enumerated separately. It should be noted that between each of the more interesting observations lie hours, or even days, of sitting in an open field with little to show save an increased appreciation for the patience of spiders, or a better awareness of spider-time.

1. A spider V, apparently well fed, remains in its resting sac atop a *Euphorbia* throughout the afternoon (25C, partly cloudy with a slight wind which sways and shakes the plants with intermittent vigor). Nonetheless it is quite alert (to visual stimuli), and frequently turns to look out of either of the two open entrances of the sac with pedipalps flickering in unison (apparent excitation). The spider ventures out upon a 10 minute foray to a position on an adjacent *Euphorbia*, about 20 cm from the retreat, and then returns to the original resting sac in as direct a route as is possible, suggesting that the spider has a good notion of the whereabouts of the place from which it has ventured. The spider continues turning about, alternating with periods of immobility, within the retreat, as it looks out.

2. A spider V has captured a young grasshopper of comparable size and climbs up a *Euphorbia* stem to assume a feeding position, oriented toward the main-stem on a leaf in the sun. The spider is alert to visual stimuli, and turns to watch three hikers (*Homo sapiens*) pass on a path 3 m away. For the most part it systematically explores the surface of the prey, macerating and feeding over a period of about 2 hours. The first 2 pairs of legs assist in handling the large prey. The spider uses one leg I to hold the prey as it walks with the other to assume a feeding position on another leaf (Fig. 4). After feeding the spider moves to a nearby position and grooms both AME and chelicerae alternately with the pedipalps, and also grooms the first 2 pairs of legs with the chelicerae [Actually the ends of the legs are drawn anteriorly through the thick brushes on the inner surfaces of the endites].

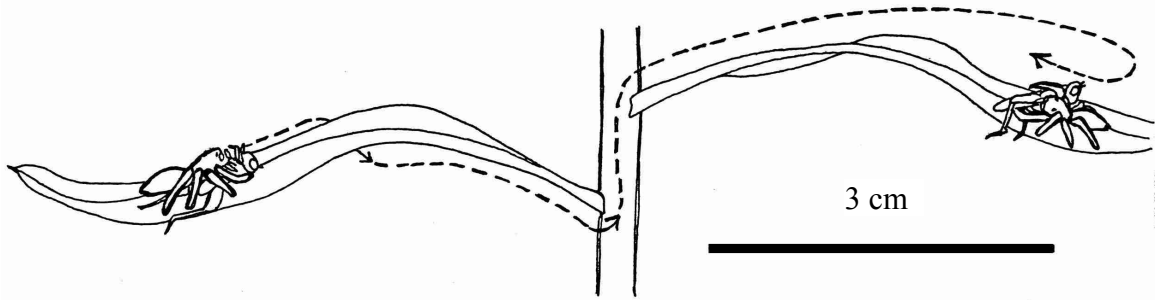
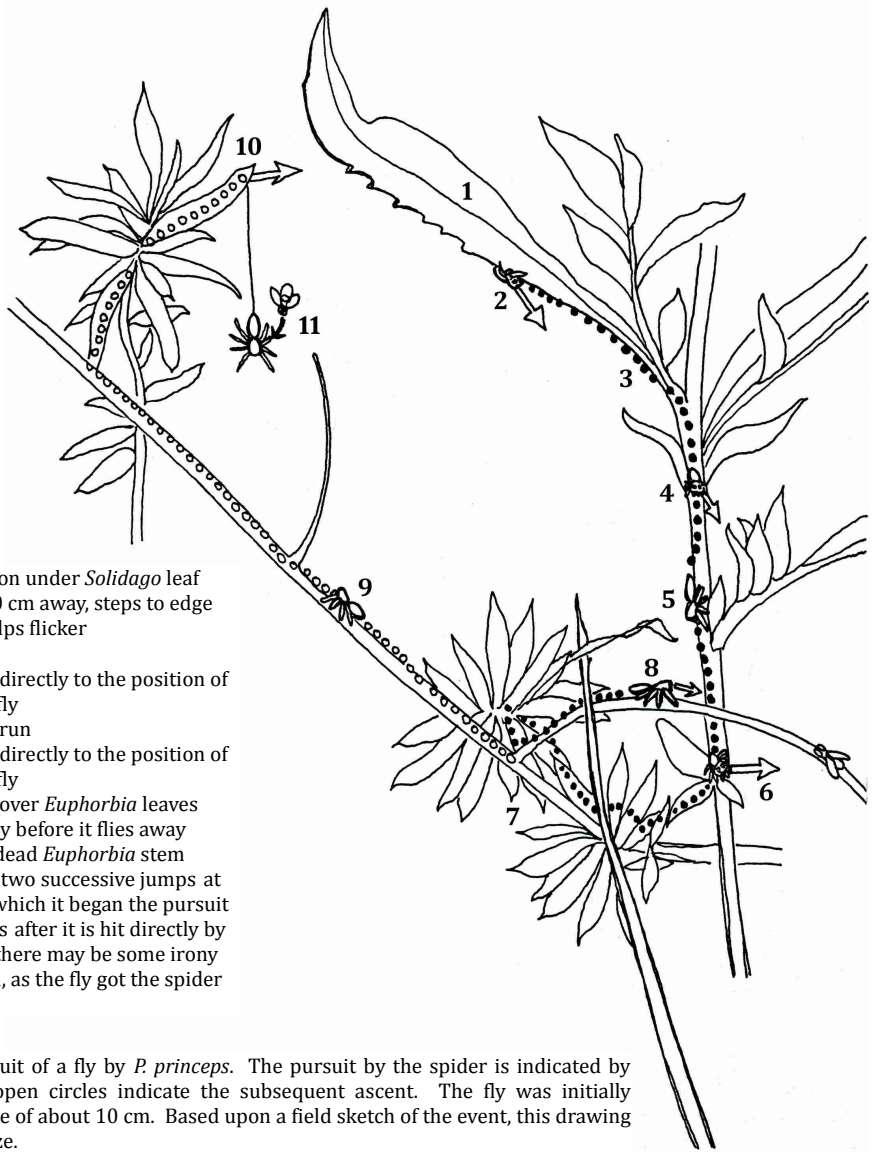


Fig. 4. A spider moves from one feeding position to a similar position on a nearby leaf. A similar feeding position was observed for another individual.

3. An alert spider V occupies a waiting position, and pursues a fly which is sighted at a distance of 10 cm (Fig. 5). It may only be coincidence, but subsequent to its failure to capture the fly, the spider attempts a return to the initial waiting position via a different route, only to be foiled by a chance (!) collision with a fly in flight, resulting in a free-fall to a lower position by the spider.

This record (Fig. 5) illustrates the remarkable ability of these spiders to pursue an indirect pathway to a goal as noted by Heil (1936). Note the alternation between each turn toward the objective and the subsequent run. Also, each turn is on target, with scarcely any correction required, despite the fact that the fly itself is motionless. Both the evaluation of plant configurations in the selection of a detour and the continuing awareness of the spider of the relative position of the prey as the spider mores (orientation) are currently the subjects of an extensive laboratory study by myself. Heil correctly emphasized the necessity of this ability for *Evarcha* living on plants for the exploitation (access) of sighted prey (vantage). The sequence also illustrates how certain positions in the vegetation afford both vantage and access to prey.

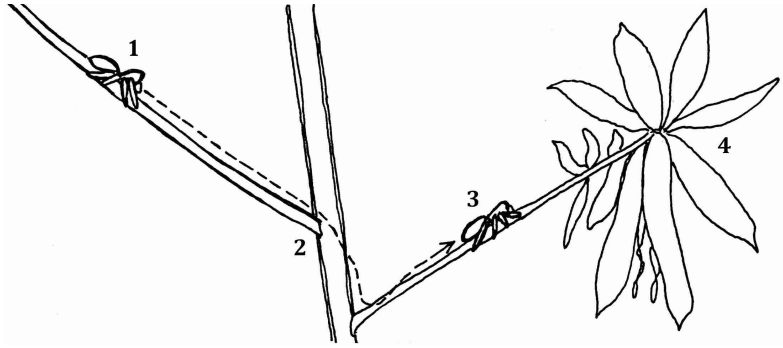
4. A patrolling spider V surveys and runs to a group of *Euphorbia* leaves on a side-stem (Fig. 6). After a lengthy period of tactile exploration among this group of leaves, the spider constructs a shelter (Fig. 7). This begins with the application of framework threads to extreme positions. As more framework threads are applied, the spider begins to move in a more defined manner, from exit to exit;



1. Waiting position under *Solidago* leaf
2. Turns to fly 10 cm away, steps to edge of leaf, pedipalps flicker
3. Fast run
4. Stop and turn directly to the position of the immobile fly
5. Fast non-stop run
6. Stop and turn directly to the position of the immobile fly
7. Ascend-climb over *Euphorbia* leaves
8. Final turn to fly before it flies away
9. Fast run up a dead *Euphorbia* stem
10. Spider misses two successive jumps at the leaf from which it began the pursuit
11. Spider freefalls after it is hit directly by a passing fly- there may be some irony in this after all, as the fly got the spider

Fig. 5. Active pursuit of a fly by *P. princeps*. The pursuit by the spider is indicated by solid dots, while open circles indicate the subsequent ascent. The fly was initially sighted at a distance of about 10 cm. Based upon a field sketch of the event, this drawing is close to actual size.

this behavior clearly shows the site of the shelter-to-be to be established. Following this initial definition of space with structural fibers, the spider begins to lay down silk with "earnest." This is accomplished in a very patterned way. In this the spider first works on one of the two surfaces (upper or lower) for a period of time, then switches to the other. While on a particular surface the spinnerets describe a zigzag pattern, alternately stopping to the left or right as the spider moves from one exit to the other (Fig. 8). When the spider reaches an exit, it reaches over the leaf edge or stem which defines this position with legs I and stops momentarily before turning 180° to continue the same pattern of silk deposition to the other exit. After completing about 6 round-trips across the lower surface in this manner, the spider climbs to the upper surface and repeats the pattern there. Thus the spider continues to alternate between upper and lower surfaces during this phase of silk application. After a subsequent



1. The spider maintains an orientation toward the leaves of a nearby side-stem
2. Non-stop run onto side-stem "objective"
3. Stop momentarily
4. Tactile exploration of various leaves

Fig. 6. A rapid run to the object of orientation. After sighting the leaves on a side-stem of *Euphorbia*, the spider runs non-stop down to the main-stem and ascends the side-stem. This survey and direct pursuit of objective positions in vegetation occurs constantly during periods of active search.

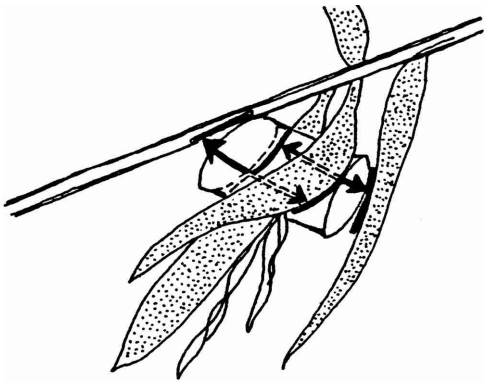


Fig. 7. Shelter position among *Euphorbia* leaves, which are stippled. The situation of the sac is diagrammed as a flattened cylinder. The limits of the upper and lower surfaces of the shelter are defined by the edges of the various leaves and the stem as shown with arrows.

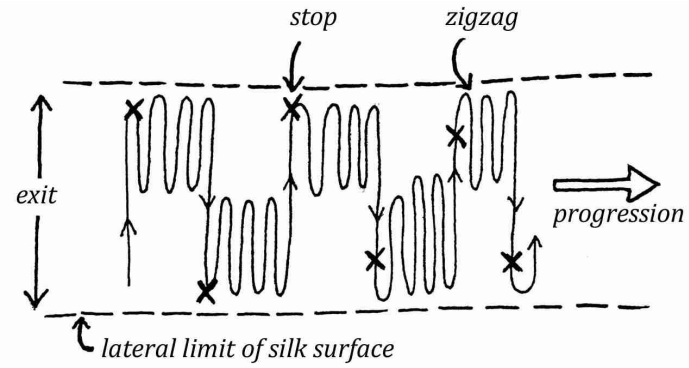
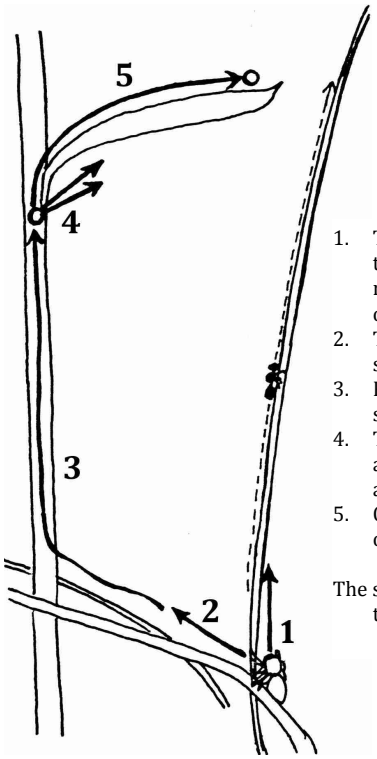


Fig. 8. Pattern of silk deposition within the resting sac, upon one of the two (upper, lower) surfaces.

period of about 2 hours of immobility, the spider molts and departs the shelter before nightfall.

Thus shelter formation consists of a sequence of distinct behaviors (site location- visual; site exploration- tactile and visual; shelter definition by the application of framework fibers stretched between attachment disks formed at the periphery of the space as it is defined by the movements of the spider; patterned application of silk to form sheets constituting the upper and lower surfaces of the flattened tubular sac). Laboratory observation of *Phidippus* within the sac confirms the importance of the pretarsal claws (Hill 1977) in walking within the sac. Once formed, the two walls can be drawn together at each exit to seal the sac for protection, just as these exits can be opened. *Phidippus* also remove foreign material, such as exuviae and the remains of prey, from their sacs by pushing and carrying. These spiders can also modify and repair existing shelters.

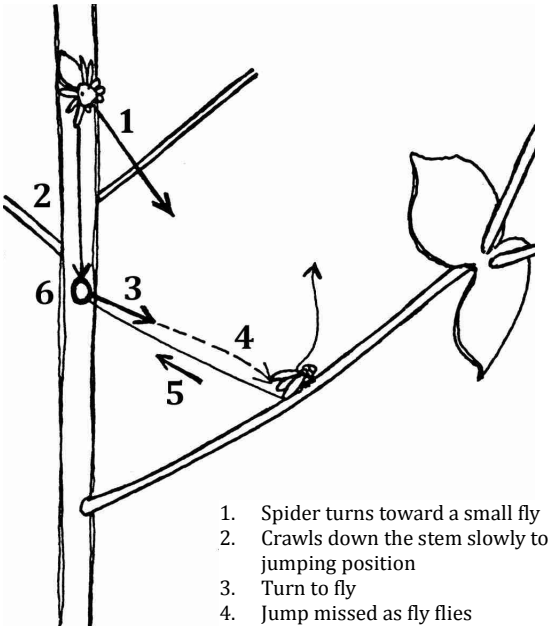
5. A spider V pursues a small ant through vegetation (Fig. 9), using a nearby *Euphorbia* stem for rapid ascent.



1. The spider turns toward an ant running up a blade of grass
2. Turns to E*uphorbia* stem
3. Runs and ascends stem
4. Turns to area where ant is running, orient to ant
5. Continues pursuit over leaf

The spider eventually lost the ant.

Figure 9. Indirect pursuit of an ant running up a grass blade by the utilization of a main-stem of *Euphorbia esula.*



1. Spider turns toward a small fly
2. Crawls down the stem slowly to a jumping position
3. Turn to fly
4. Jump missed as fly flies
5. Climb back to main stem
6. Return to down-stem waiting position

Fig. 10. A simple pursuit of a fly which failed the stealthy spider.

6. This individual initially occupies a series of waiting positions on a *Euphorbia* main-stem. The spider quickly grabs a small gnat with a short jump and continues to move, climbing across to a nearby plant to ascend to a vantage position. From this position the spider looks down and quickly runs, over a fairly direct route of 40 cm length, to a hidden shelter under leaves of a side stem of the plant, which it immediately occupies. This "search for shelter" seemed so deliberate, that it is hard to believe that the location of the sac was fortuitous. The spider groomed extensively within the sac, alternately rubbing the extended fangs with the pedipalps. Earlier the spider scratched the right ventral opisthosoma with the right leg IV on three separate occasions. This would seem to indicate the presence of a local irritant which we might term an "itch."

7. A spider VI assumes a crouched down-stem waiting position, and quickly side-steps out of the view of a large steel-blue wasp that passes by at 1 m distance. Subsequently the spider returns to the original orientation.

8. A spider VI in a waiting position sights a small fly, slowly crawls down the stem to a closer jumping position, but misses the jump as the fly flies away (Fig. 10). In this case, the advantage of stealth was offset by the limited amount of time available to capture this prey prior to its flight.

Hopefully this small collection of events will encourage others to seek out the details of the day-to-day ethology of various salticids. This sort of information is really quite lacking for most spiders. I have hoped to provide a selection to illustrate the nature of *events* in local history, as opposed to the more abstract perspective of isolated *behaviors*. One is greatly impressed by the substantial effect of even so small an event as the blowing of a dry leaf in the wind upon the life of a spider. Encounters with predators, prey, or con-

specifics can easily lead to immediate, and dire, consequences for the individual. Yet beyond the realm of individual histories of survival or defeat, populations of these animals continue to inhabit an old field year after year in succession.

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