USE OF SPIDER THREADS AS RESTING PLACES BY TROPICAL INSECTS

As spiders move about, they leave behind silken trail lines or safety threads which gradually accumulate until wind or rain breaks them. Some small flies are commonly found hanging on these abandoned spider silk threads in tropical forests (Fig. 1), especially at evening and night. This behavior probably affords them protection from predators, since it both isolates them from small walking animals like ants, and at the same time facilitates rapid escapes (Eberhard, W. G. 1980. Nat. Hist. *89* (1):56-61). In some places the number of insects hanging on threads is very large, and includes many species of several families of flies (principally Cecidomyidae) as well as occasionally wasps and moths (R. Gagné, pers. comm.); this phenomenon is thus of some importance in biology of many small forests insects. The present report is concerned with some aspects of what kind of threads are chosen by these insects as resting places.

Observations were made on 7, 9, and 10 January 1978, at Finca La Selva Research Station, Sarapiquí, Costa Rica. On 7 January a count was made of the number of insects found along the edges of a trail through more or less virgin forest (in the reserve near the buildings). Each abandoned spider thread seen within about 1 m of the trail and from 0 to 2 m above the ground was measured (length) and classified with respect to inclination as horizontal (0-20°), inclined (20-70°), or vertical (70-90°), (angles estimated by eyesight).

On 9 and 10 January, observations were made in three small plots in overgrown cacao groves. Thirty-six forked sticks were strung with trail line threads of different species of spiders stuck into the ground in the afternoon, then checked hourly to determine the

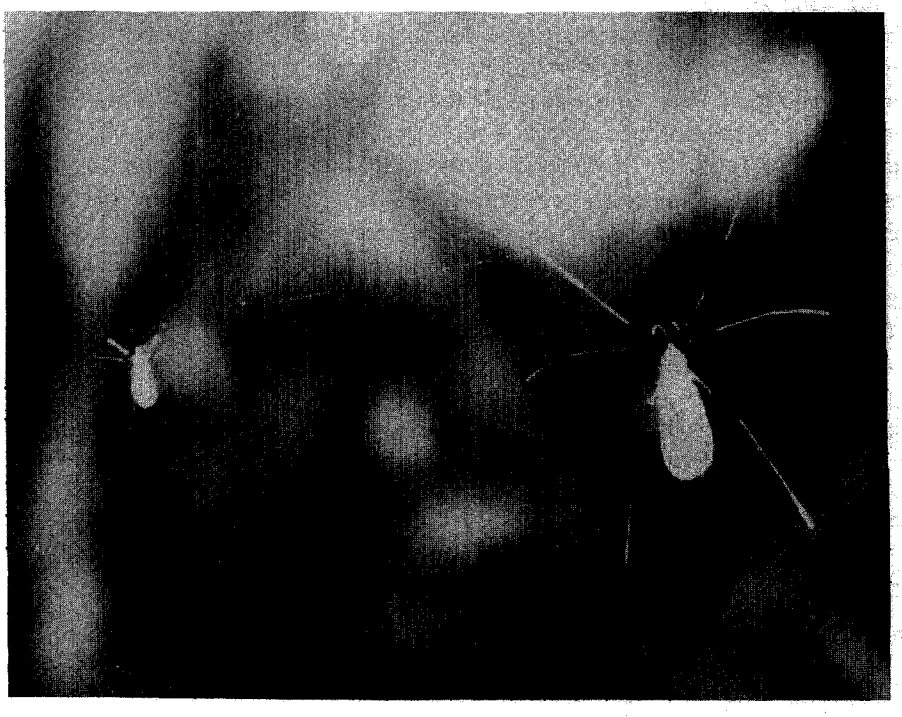

Fig. 1.–Insects hanging on abandoned spider silk threads in tropical forest. (Approximately size of left hand insect: 3 mm).

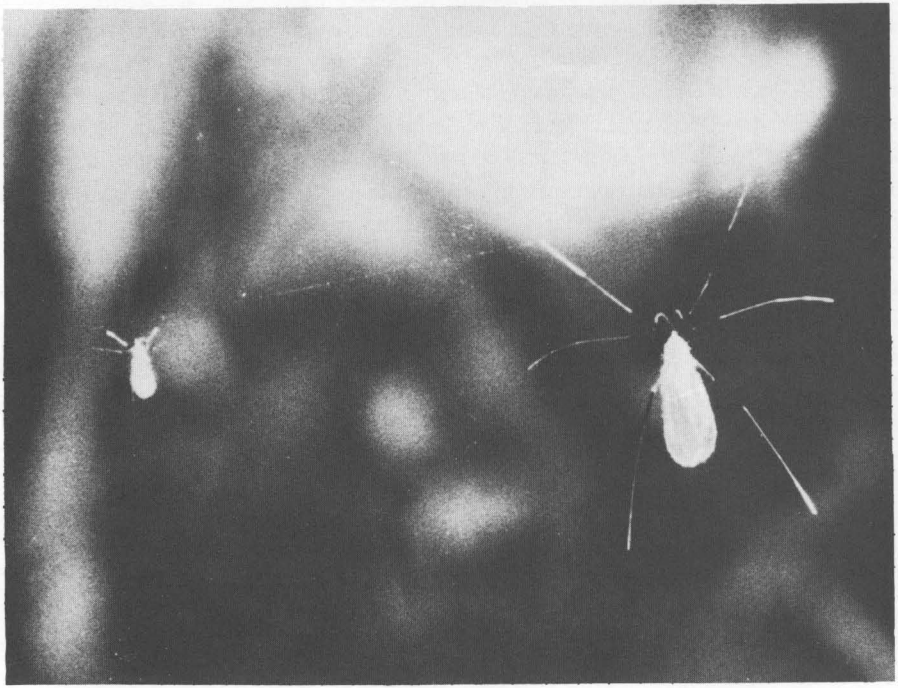

Fig. 1.–Insects hanging on abandoned spider silk threads in tropical forest. (Approximately size of left hand insect: 3 mm).

Table 1.–Distribution of insects with respect to inclination of threads in natural conditions. Horizontal threads are favored over inclined ($p<0.025$) and vertical ($p<0.005$) threads.

Inclination	Percent of threads occupied by insects	Total number of insects	Total length of thread(m)	Number of insect/m	Average length of thread(m)
Horizontal	50 (n=271)	165	34.95	4.72	0.129
Inclined	39 (n=188)	77	22.49	3.42	0.120
Vertical	35 (n= 74)	27	10.38	2.60	0.140
TOTALS	44 (n=533)	269	67.82		

number of insects which settled on each kind of thread. The threads were placed on the frames by inducing the spider to fall free on its trail line, and turning the stick so that the thread was wound onto the arms of the fork.

On 9 January, the spiders used were mature females of *Nephila clavipes* (Linnaeus) (9 stakes), *Argiope savigni* Levi (3 stakes), *Micrathena* sp. (9 stakes), and a theridiid (probably *Acharaeanea* or *Tidarren*) which was collected on buildings (3 stakes). In addition, thin white cotton thread was used on nine other stakes. The stakes were placed in three plots, varying their inclination so that some threads were horizontal and others inclined or vertical. On 10 January the same distribution was used, but all stakes were horizontal. Nine stakes each with threads of *N. clavipes, Micrathena* sp., a theridiid, and with cotton threads were used.

The statistical test performed on the data was Chi-Square.

The distribution of flies found hanging on threads in natural conditions is shown in tables 1 and 2. There were clear tendencies to favor both horizontal and shorter threads. The data have the weakness that occupied threads were more easily noticed, and the "percent occupied" is thus an overestimate. There is no reason to think, however, that the vertical threads were any more visible than other unoccupied threads, and the insects' tendency to favor horizontal threads is real (Table 1). On the other hand, longer unoccupied threads might be more easily noticed than shorter ones, suggesting that the observed tendency is an artifact of our searching behavior. Nevertheless, the preference for short threads is very strong: for example, longer threads ($\geq$ 20 cm, $\bar{x}$ = 35.6 cm) would be expected, because of their size, to be more than seven times more frequently occupied than the shortest threads, when in fact they were occupied less than twice as often (Table 2). In balance we suspect that there was a real preference for shorter threads.

Table 2.–Distribution of insects with respect to the length and inclination of threads in natural conditions. The values are non-random ($p<0.001$), using the values of threads 0-4.9 cm long as standard and assuming that threads twice as long would be twice as likely to be occupied.

Length of thread (cm)	Percent of threads occupied			Number of insects per occupied thread		
	Horizontal	Inclined	Vertical	H	I	V
0-4.9	32.56% (n=43)	33.33% (n=50)	31.25% (n=16)	1.00	1.00	1.00
5.0-9.9	42.21% (n=95)	43.75% (n=64)	44.00% (n=25)	1.26	1.04	1.00
10.0-14.9	55.36% (n=56)	38.89% (n=36)	36.37% (n=11)	1.19	1.07	1.00
15.0-19.9	78.57% (n=28)	40.74% (n=27)	22.22% (n= 9)	1.23	1.09	1.00
>20	53.06% (n=49)	32.26% (n=31)	30.77% (n=13)	1.30	1.10	1.25

Table 3.–Distribution of insects according to the kind of thread and its inclination for threads on forked sticks.

	January 9						January 10			Total
Type of thread	H	I	V	Total	Meters of thread	Av. number per meter (H,I,&V)	H	M of thread	Av. number per meter	Number of insects/m horizontal thread Av. of both days
Nephila	3	0	1	4	5.43	0.75	10	5.66	1.76	1.26
Theridiid	1	0	1	2	1.12	1.78	6	5.34	1.12	1.23
Micrathena	5	0	1	6	4.19	1.43	13	6.28	2.10	1.81
Argiope	0	0	0	0	1.26	0	–	–	–	–
Cotton thread	1	1	0	2	5.67	0.35	11	5.67	1.93	1.14
Totals	10	1	3	14	17.67	0.79	40	22.95	1.73	

The numbers of insects found on the threads laid on forked sticks are shown in Table 3. Again there was a tendency for more flies to rest on horizontal threads, and for this reason all stakes were positioned to hold the threads horizontally on 10 January.

Although the total numbers of insects observed during the two nights were different, the numbers per meter of horizontal thread were almost the same (1.63 and 1.73). These are substantially lower than the numbers per meter of horizontal thread in natural conditions (Table 1).

Table 3 also shows the distribution of insects on the different types of threads used. Although the threads differed in thickness, strength, and consistency, the number of insects found on them are similar; there were no statistically differences.

The behavior of insects hanging on spiders' silk threads has been reported by Robinson, M. H. and B. Robinson (1976. Entom. Mon. Mag. *112*:1-3). However, in the present observations, the insects rest on abandoned individual lines, while the insects studied by those authors, rest on threads that form part of an entire spider's web.

It would seem that the situation here described offers more security because the risk of resting close to a potential predator is eliminated; yet, it still retains the advantage of being associated to a very sensitive line in case of an approach by other animals. This is supported by the fact that in almost all cases the lines were occupied by only one fly (Table 2).

In summary, the insects' choice of kind of thread seems to be random. However, with respect to thread orientation, horizontal threads are more attractive than vertical and inclined threads; and shorter threads are probably preferred to longer ones.

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