TOLERANCE OF WEB DESTRUCTION IN THE GOLDEN ORB-SPIDER (NEPHILA CLAVIPES), OR WHY WON'T THEY GO AWAY?

Lisa Taboada and Eddie Gilmartin

Abstract (E.G.)

Spiders invest energy in web construction for capturing insect prey. Should a spider construct a web in a location where it is subjected to repeated destruction, moving to a more stable web site might decrease energy costs to the spider and increase the spiders fitness by enhancing feeding efficiency. We hypothesized that Golden Orb-Spiders would abandon a web site more readily as the intensity of web disturbance increased. After causing a maximum of five partial or total web destructions per spider over a two day period, we saw four total web site abandonments, and several local web relocations. There was a positive correlation between the amount of disturbance and web site abandonment ($r = .487$, $n = 20$, $p < .05$).

Introduction (L.T.)

One of the most important tools a web building spider has for prey capture is its web. However, because webs are fragile, they are not able to withstand disturbance and require a great deal of maintenance. It would seem likely, then, that spiders have some way of analyzing the suitability of a web site. Factors which would affect this site selection would be prey density, threat of predation, and likelihood of web destruction. Assessment of these factors before web building would save the spider the cost of abandoning its web and moving to a new site. We used the Golden Orb-Spider (Nephila clavipes), to test the effects of web destruction on the spider's decision to rebuild or relocate. We predicted that there is a point at which the cost of rebuilding outweighs the benefit a spider receives from that site. Therefore, our hypothesis was that, other factors (prey density, etc.) being equal, as the intensity of web destruction increased the number of spiders who leave their original web sites would increase.

Methods (L.T.)

We located twenty Golden Orb-Spiders at the La Selva Field Station, Costa Rica. Seventeen webs were on the main compound in trees or on the eaves of buildings and supports of metal towers. Three webs were in the arboretum in fallen tree branches or the buttresses of trees. We divided the twenty webs by similar location into 4 groups of 3 and

2 groups of 4. Each treatment was represented in a group so we can attribute any difference in the data as a response to the treatments and not to prey density in that location. We attempted to measure the prey density in the area of each group by hanging sticky traps (acetate strips covered with Tanglefoot). However, we did not find these data useful because the traps did not capture any insect larger than a mosquito or small moth, and all of the prey we observed spiders eating was larger than this.

Each of the spiders within a group was randomly assigned to one of three treatments: control (the web was left undisturbed), partially destroyed (approximately 50% of the orb and structural elements were removed), and total destruction (100% of the orb and structural elements were removed). We performed these treatments five times during 48 hours. We recorded the reaction of spider (rebuilding, relocating of web, distance to relocation, or leaving the site altogether), and generally we did not repeat the treatment until the majority of the spiders had rebuilt their webs (ranging from 3.6 hrs to 15.5 hrs).

Results (L.T.)

We performed a linear regression between level of disturbance and movement or non-movement of spiders and found significance ($r = 0.487$, $n = 20$, $p < 0.05$ $r^2 = 0.237$) (Fig. 1). Table 1 summarizes the spiders reactions to the treatments.

Discussion (E.G.)

We conclude from these results that Golden Orb-Spiders will relocate their webs after experiencing total web destruction. Partial web destruction resulted in only one of seven spiders relocating. This spider did not seem to relocate as a result of the partial web disturbance. A larger Orb-spider in an adjacent location had its web totally destroyed, and it then took over the partially destroyed web. Spiders whose webs were totally destroyed did not consistently move large distances from their original web site. Of the eight, one never moved, and three only moved to web sites adjacent to their original sites. We suspect that these small movements were not attempts by the spiders to relocate. In these instances, spiders seemed to be constructing a new web from their last position following web destruction, rather than purposefully traveling away from the original site. However, in four cases the spider did leave the web site entirely, which indicates that they will occasionally abandon web sites after total web disturbance. Our regression indicates that there is a significant correlation of web site abandonment to intensity of web destruction.

Our finding that spiders don't relocate after partial web destruction is consistent with our observations of the controls. Large portions of the control webs were naturally damaged and repaired during the course of the study. These gaps in the web were discovered at the same time we observed the resident spiders handling large prey items. Thus, we believe that partial web destruction occurs often, due to large prey items struggling. Therefore, partial web destruction may not be a pressure which would result in a spider's relocating, but rather just reconstructing.

We do not know how often these spiders capture prey. If they require only low numbers of prey per day, they would not necessarily need to have their web intact for long. Thus, they might be more apt to tolerate web destruction, particularly if they were satiated at destruction, because it wouldn't represent a threat to their immediate survival. It would take several days of repeated web destruction to cause a spider to need to relocate if they don't feed daily. Another possible explanation for the unexpectedly high web destruction tolerance is as follows. If a spider had occupied a prosperous location for months, perhaps a day and a half of intermittent disturbance wasn't enough to convince the spider its web location had become suboptimal. Prey density, which we were unable to monitor sufficiently, might also affect a spider's readiness to relocate. We would predict a higher tolerance for web destruction at higher prey densities, though, we believe our sampling method adequately controlled for this bias.

We made some interesting observations during the course of this study. One web site had three Golden Orb-Spiders utilizing an interconnected web scaffolding. As mentioned previously upon losing its web the largest of these spiders occupied the web of the spider closest to it. At a different site, we discovered a dead Golden Orb-Spider entangled in the web, with a second, live Orb-Spider on the web. There had previously only been one spider at the site (we don't know which was the original spider). These interactions lead us to question what the possible costs and benefits of web sharing might be, and what the nature of such intraspecific interactions are.

In summary, our study revealed that Golden Orb-Spiders are more likely to relocate their webs with greater web disturbances and have a higher tolerance for partial web destruction than we expected. Intraspecific interactions may play a role in web-site selection and retention. Using similar methods, but with larger sample sizes, an extended experimental period, and better controls of prey density, we believe a study of this nature could help define and quantify factors which affect web-site selection.

Table 1 Reactions of Individual Golden Orb-Spiders to repeated web destruction at La Selva, Costa Rica (9-2-91 to 11-2-91).

	Post Dist. 1 1730-0900	Post Dist. 2 0930-1420	Post Dist. 3 1420-2245	Post Dist. 4 2245-0930	Post Dist. 5 0930-1430	Web Final Condition
#1 C	NC	NC	NC	NC	NC	maintained web
P	R	R	NC	R	R	rebuilt in same spot
T	NC	NC	NC	NC	NC	never rebuilt or left
#2 C	NC	NC	NC	NC	NC	maintained web
P	R	R	NC	R	R	rebuilt in same spot
T	R	M^{50cm}	M^{gone}	–	–	left site
#3 C	NC	NC	NC	NC	NC	maintained web
Piab	R	R	NC	R	R	rebuilt in same spot
T	R	M^{1M}	M^{2M}	Rw/dead spider	NC	Moved 2xs, but to adjacent sites
P	–	R	NC	R	NC	rebuilt in same spot
#4 C	NC	NC	NC	NC	NC	maintained web
P	R	R	NC	R	R	rebuilt in same spot
T	R	R	NC	R	R	rebuilt in same spot
#5 C	NC	NC	NC	NC	NC	maintained web
P	M^{10cm}	M^{50cm}	NCno web	M^{1m}	NC	moved 2xs, 1m total
T	NC	R	NC	M^{75cm}	$M^{1.25m}$	moved to adjacent site
Piab	R	R	NC	R	R	rebuilt in same spot
#6 T	NC	M^{75cm}	M^{gone}	–	–	left site
T	M^{20cm}	M^{gone}	–	–	–	left site
T	NC	M^{gone}	–	–	–	left site

Times = (the time of treatment - the time of observation)

C= Control
P= Partially destroyed
T= Totally Destroyed
NC= No change in Web Condition
R= Rebuilt
M=Moved and established some new web structure total distance moved given to right

Figure 1 The positive correlation between level of web disturbance and web relocation response in the Golden Orb spider ($r=0.487$, $n=20$, $p<0.05$). The web disturbance was ranked as follows; 0=control, 1=partial web destruction, 2=total web destruction. The web relocation response was ranked as follows; 0=spider remained, 1=spider relocated. Numbers in parenthesis indicate the number of data points represented by each dot. Line slope=0.254.