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Photography of orb webs in the field

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Techniques

Although there are a number of notes in the literature on photographing spider webs in the field (e.g. Comstock 1940, Savory 1952), several techniques which I have found valuable are not mentioned. The lack of web records for nearly all orb weavers, the probable usefulness of the webs in genus and perhaps subfamily classifications, their intrinsic beauty, and the relative ease with which good photos can be obtained make a note on techniques seem worthwhile.

Webs in the field must be coated to enhance their visibility in order to record all the threads. The first thing to do is to carefully remove the spider from the hub or from its retreat. This allows a clear view of the most diagnostic part of the web, the hub, and prevents the spider from destroying its web when it is coated (*Theridiosoma, Tetragnatha,* others) or knocking powder off lines as it moves. Water mist from a spray bottle, lycopodium powder, and white spray paint have been used as coating materials in the field. I have found the least expensive and most convenient material to be cornstarch kept in a cloth bag made from a pair of old socks, one inside the other (the double wall insures that globs of powder do not reach the web). Cornstarch is easily dusted from clothing, but the bag should be carried in a plastic bag to protect cameras and other equipment. To coat a web, pat the bag gently about 15 cm upwind; the web gradually "emerges" from the cloud of dust in the same dramatic way a picture emerges when placed in developer.

It is best to stop powdering temporarily as soon as the web begins to be visible and proceed to remove objects from behind the web. The key to getting a good web picture is getting a really dark background for the white threads. Often an otherwise ideal web will have several leaves or twigs just behind it which would mar a photo. The solution is to

1) make sure none of the anchor threads is attached to the twig or leaf in question, and then
2) cut it off carefully. Scissors are best for this, as a knife most invariably makes a jerk when it cuts, and this often damages the web.

Remove as much of the brush within a metre or so of the web as possible, being careful at all times to avoid touching the threads (the light coating of dust will help). If the web is suspended under a branch which has a few leaves which have to be removed, sometimes the removal will lighten the branch enough that it swings up, distorting the web. To avoid this, either bend the leaves out of the way rather than cutting them off, or, if this is impractical, try to place the cut leaves on the branch so that their weight is not lost. Sometimes, especially if one has a helper, it is possible to hang a black cloth behind the web and avoid some cutting. If a flash is used, the farther the cloth is behind the web the better. Whether using a flash or not, shade the cloth to maximize its darkness. The web should also be shaded to avoid unequal lighting if part of it is in the sun.

When the background is cleared and darkened, finish powdering the web and take the picture. Except in windy situations, it pays to get all web lines good and white. Because of the importance of the hub and its fine mesh, it is desirable to take one picture of the entire web, and another close-up of the hub. The f-stop can be left unchanged; the close-up invariably comes out the better of the two pictures. When there is a mesh associated with the orb, it is often useful to take another picture looking more or less parallel to the plane of the orb.

For the record to be complete, the spider should be kept in a separate vial along with a number associating it with notes on the web and the photograph. It is preferable to choose webs made by mature females since the spiders are much more readily identifiable, and since the web forms of mature araneids are usually more distinctive than those of younger ones. Measurements not obtainable from the photo such as the height of the web above the ground, its inclination with respect to horizontal (use a small level mounted on a protractor), and the length of the

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extraordinary webs (e.g. Robinson and Robinson 1972, Clyne 1973, Eberhard 1974) are undoubtedly awaiting the arachnologists who can stir themselves from their after-dinner lethargy to roam the cool, lonely moonlit fields and forests.

Precision of web measurements

Measurements of web characteristics from field photographs are likely to be somewhat imprecise indications of true web dimensions due to several factors: 1) it is not always easy to position the camera perfectly perpendicular to the plane of the orb and avoid foreshortening; 2) when the orb is not perfectly planar it is impossible to avoid some foreshortening; 3) measurements in the field (longest frame thread, slant, scale measurement) are necessarily somewhat imprecise, and, to a lesser extent, so are measurements made from the photographs; and 4) the choices of which parts of a given web to measure are somewhat arbitrary.

In order to estimate the magnitude of these errors in practice, the following experiment was performed. A web (of a mature female *Eustala* sp.) was photographed 11 times (both entire web and close-up of hub area); after each picture I moved back from the web and then reapproached it. Each of the web measurements in the field was also made 11 times. A print was made of each photograph (the scales varied somewhat but were of the order of 1:2.3 for prints of the entire web and 1:0.6 for those of the hubs), and the measurements indicated in Fig. 2 and Table 1 were made from each pair of entire web/close-up photographs (all measurements concerning hub and free zone were taken from the close-ups). (These particular measurements were chosen because at least some of them may provide good characters for distinguishing webs of different species and genera.)

	mean	standard deviation	95% confidence limits of mean
Longest frame thread (x) (cm)	31.2	2.60	31.2 ± 1.5
Slant (angle with horizontal) (x)	74.5	2.91	74.5 ± 1.7
Number of radii	23.1	0.30	23.1 ± 0.2
Maximum number of loops of sticky spiral	40.0	0	40.0
Eccentricity of free zone (1/4)	0.956	0.0676	0.956 ± .040
Hub/free zone (2/1)	0.279	0.0225	0.279 ± .013
Relative size of hub hole (3/2)	0.304	0.0198	0.304 ± .012
Relative size of free zone (8/9)	0.132	0.0029	0.132 ± .002
Eccentricity of sticky spiral (5/6)	0.844	0.0470	0.844 ± .028
Sticky spiral spacing above hub (along 5) (cm)	0.227	0.00873	0.227 ± .005
Sticky spiral spacing below hub (along 6) (cm)	0.237	0.00463	0.237 ± .003
Sticky spiral spacing to side of hub (along 7) (cm)	0.213	0.00396	0.213 ± .002
Hub loop spacing (cm)	0.0499	0.00656	0.0499 ± .0039
Relative size of longest frame thread (frame/9)	2.47	0.0985	2.47 ± .06
Number of radii/maximum number of sticky spirals loops	0.577	0.00754	0.577 ± .004
Sticky spiral spacing above the hub/ sticky spiral spacing below hub	0.879	0.0477	0.879 ± .028
Sticky spiral spacing to side of hub/ sticky spiral spacing below hub	0.961	0.0514	0.961 ± .030

Table 1. Variation in various characters measured from 11 photographs of a web of a mature female *Eustala* sp. (x – measured 11 times in the field; numbers in ratios refer to Fig. 2)

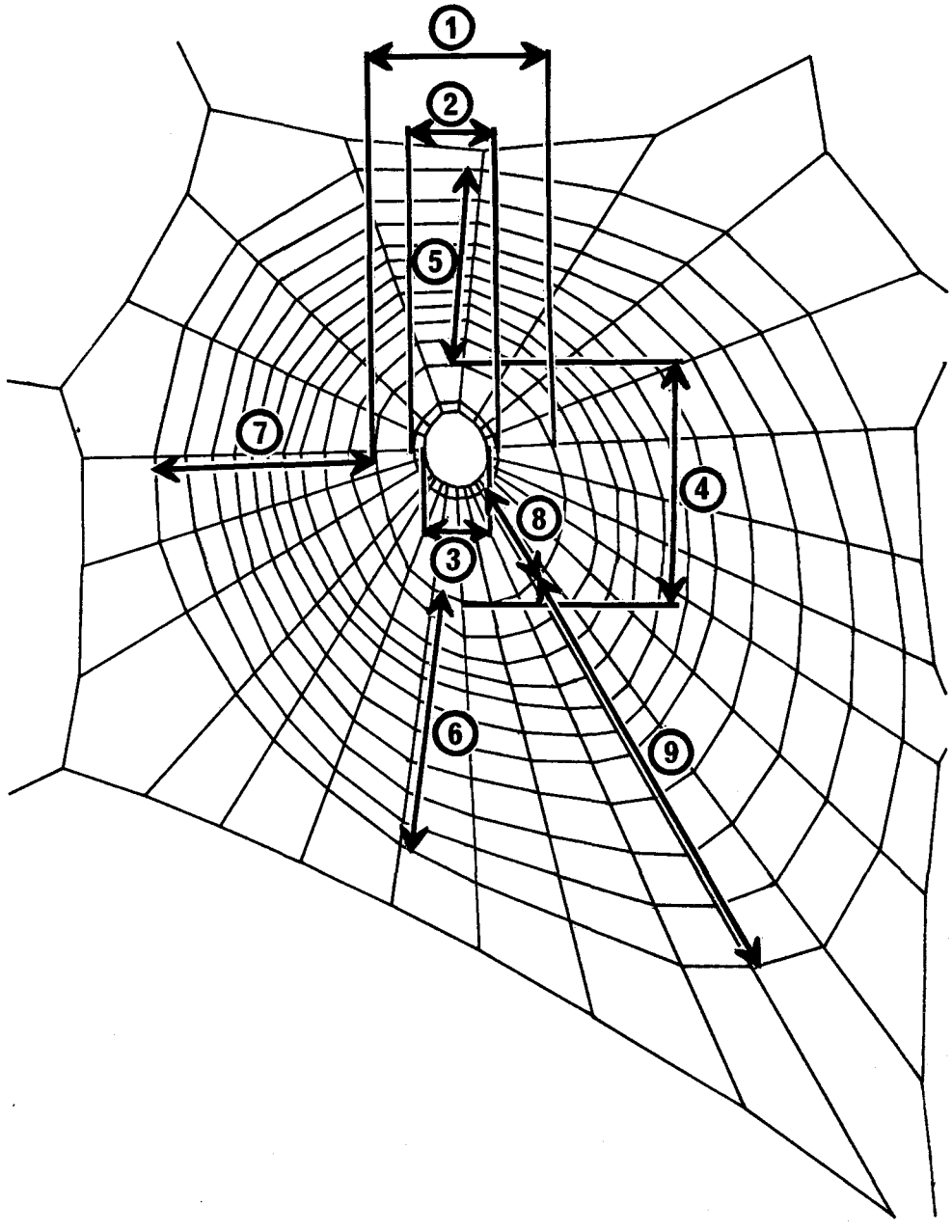

Fig. 2: Stylized drawing of an orb web showing some of the characteristics included in Table 1.

Table 1 gives the amount of variation in the measurements and the 95% confidence limits for each measurement. In general, the agreement between measurements of different prints was relatively close. The most important source of variation was not the process of photographing and measuring, but rather the difficulty (and resultant inconsistency) in deciding *what* to measure. For example, in the web in Fig. 2, the eccentricity of the sticky spiral would be altered if one chose to measure along the radius just to the right of the radius indicated. Decisions such as this are rather arbitrary in printed pictures since the direction of gravity is only roughly indicated by the sag of the sticky spiral lines.

In sum, there was slight but consistent variation in the measurements from pictures taken in the field, with some characters varying more than others. It is likely that measurements from field photographs will give sufficiently accurate indications of web characters to permit their use in comparative studies of web structure.

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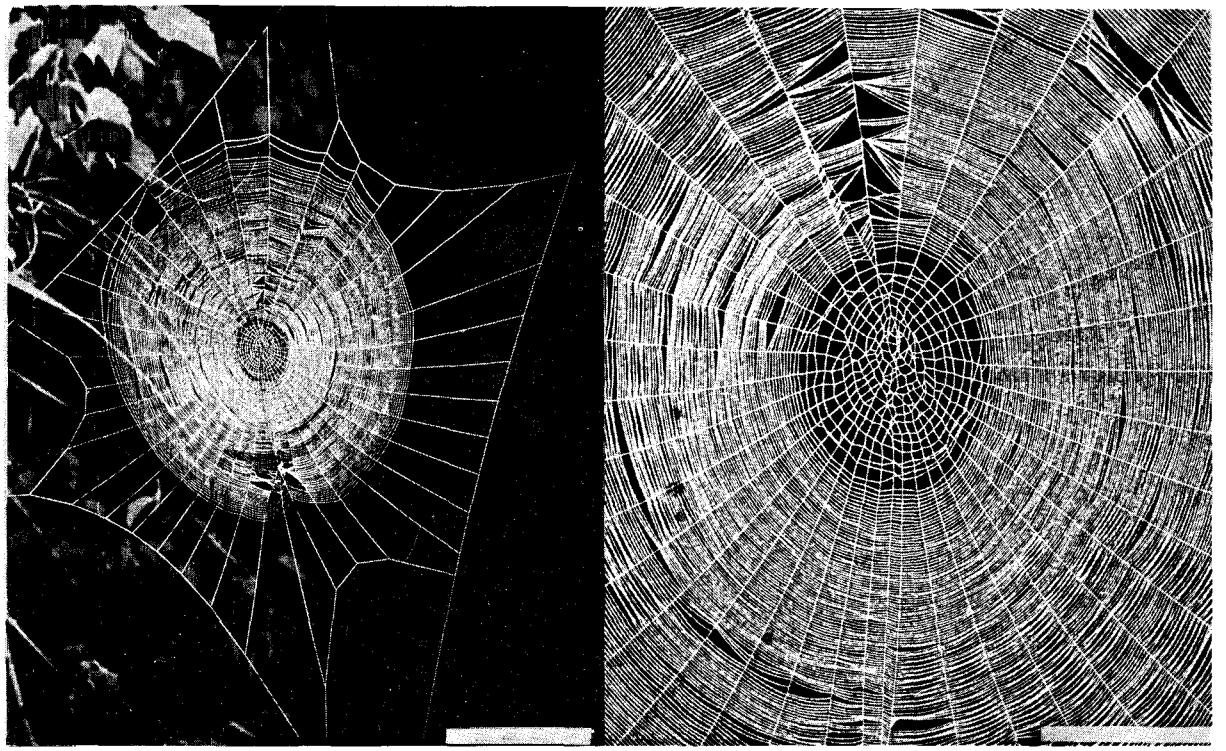

Fig. 1: Photograph of the web of a mature female *Acacesia haemata* taken at night near Cali, Colombia. Left – entire web (scale marker 10 cm); right – close-up of central portion (scale marker 3 cm).

longest frame thread (an indication of the space spanned by the web) should be noted along with the time of day, type of vegetation, etc. A measurement of some web character easily recognized in the photograph (length of the shortest radius, maximum diameter of the hub, etc.) to permit the determination of the scale of the final print is also necessary.

Pictures taken with a flash are consistently superior to those with natural lighting. Small rechargeable flash units give satisfactory results; the automatic photometer ("electronic eye") available with some models is not necessary. The short duration of the flash prevents blurring caused by small web movements in the wind, and the camera f-stop can also be closed farther down, giving greater depth of field. Relatively bright objects far behind the web which would otherwise damage the photo are also eliminated. In addition, webs built in dark shady sites and those found at night can be photographed.

Nighttime is particularly good for spider webs. Many (perhaps most) orb weavers spin their webs at night, and many of these destroy their webs in the early morning. In addition, some of the background problems of daytime photography are not present at night, since the nighttime sky forms a perfect velvet black background (Fig. 1). The only additional piece of equipment necessary is a headlamp; a small 6V model is perfectly adequate. By far the best batteries I have found are "Eveready No. 565" 6V rechargeable alkaline batteries (a pair costs about $6 plus $2 for a charger from Electronic Distributors, Inc., 4900 N. Elston, Chicago, Ill. 60630, USA); one of these can replace the four or five 1.5V size D batteries most commonly used. One charge is good for several nights, and each battery is good for about 50 charges.

Despite the advantages of nighttime observations, it appears that until recently no one has ever seriously looked at orb webs at night, and many new and