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THE USE OF A WATER SPRAYER IN WEB BUILDING SPIDER DENSITY DETERMINATIONS[1]

Wayne W. Tolbert

Graduate Program in Ecology
University of Tennessee
Knoxville, Tennessee 37916

ABSTRACT

Use of a water sprayer increases the visibility of webs such that web-building spider population densities can be accurately determined. This method produces statistically superior results to sweep netting and does not adversely affect the populations sampled.

INTRODUCTION

Invertebrate ecologists are becoming increasingly aware of the importance of spiders in community energy dynamics (Van Hook, 1971; Moulder and Reichle, 1972) and population regulation (Watt, 1963; Luczak and Dabrowska-Prot, 1966; Clarke and Grant, 1968; Hardman and Turnbull, 1974; Riechert, 1974). Research of this kind as well as population dynamics studies require accurate estimates of population densities. The methods most commonly used to determine population densities in spiders include Tullgren-Berelese extraction and/or hand sorting for litter spiders and suction sampling or mark-recapture for cursorial spiders.

Web building species, though of importance in the above respects and potentially of great value in examining a variety of other ecological problems, are difficult to sample by existing methods. Sweep netting, which is the technique most often employed to sample web builder populations, is subject to substantial biases. Vulnerability of these species is governed by their vertical distribution in the vegetation and this varies with the developmental stages of both plants and spiders (Turnbull, 1973). Turnbull (1973) further noted that sweep neeting "can, and often does, indicate that more spiders survive to adulthood than ever existed in the juvenile stages." Riechert (1973), Enders (1973) and Tolbert (unpublished data) have visually located and marked web building spiders, relying on visibility during early morning hours. A reliable method of sampling web building spider populations is needed, however, whose estimates are not biased by the vulnerability of animals to census nor limited to certain periods of the day. A description of such a procedure follows.

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PROCEDURE

The total area to be sampled is gridded and sample plots chosen using a random number table. The size and shape of individual plots are of necessity determined by the needs of the particular study. The plots are then individually sprayed with water using a garden sprayer. Many sprayer models and sizes are available in virtually any hardware, garden or farm supply store. The nozzle is held at a 45° to 60° angle from horizontal and the mist fogged over and through the vegetation. The sprayer nozzle can, of course, be directed into small spaces in the vegetation where spiders may be located. The sprayer should be pumped regularly (every 2 to 3 minutes for a 3 gallon sprayer) since strong pressure produces a finer mist which improves web visibility. One gallon of water covers approximately 10 m^2 of herb layer vegetation. The water film, like dew or fog, adheres to the webs making them visible so spiders can be identified and counted.

TESTS OF PROCEDURE

To test this method of density determination 2m x 2m plots were randomly selected in a 800 m^2 broomsedge (*Andropogon* sp.)-blackberry (*Rubus* sp.) habitat in Loudon Co., Tennessee. The criterion for an adequate sample was chosen as the standard error of the mean <10% of the mean. A density estimate of 2.68/m^2 *Argiope trifasciata* Forskal (Araneidae) was obtained using the water sprayer-grid technique on 2 June 1975. The next day six different plots (these 2m x 4m) were selected in the same habitat. A density estimate of 2.67/m^2 *A. trifasciata* was determined. Replicates made in grass (orchard grass and fescue) and weedy vegetation (*Aster-Solidago*) produced similar results. It could be argued, however, that these results were fortuitous since: (1) *A. trifasciata* are mobile and migration was not controlled and (2) different plots were sampled. Therefore, a second test was performed using a 2m x 2m plot enclosed by aluminum flashing (40 cm high). The lower edge of the flashing was buried and mosquito netting was drawn tightly over the top and secured by wooden stakes. Fourteen days after the initial release of *A. trifasciata* this plot was examined three days in succession (8, 9, and 10 June 1975). A total of 49, 47, and 48 *A. trifasciata* were found for the three days, successively. Some reduction in numbers is expected since invertebrate predators (salticid, oxyopid and lycosid spiders and wasps) were also enclosed in the plot. The reappearance of one *A. trifasciata* on day three may be due to oversight on day two or the spiders may not have had a web on day two at the time the examination was made. Since it could be argued that I knew what number to expect on successive days and might search more diligently, a final test was performed. Three aluminum flashing enclosures (identical to the first one), each with a population of *A. trifasciata*, were used. The cover was removed and my wife, who had not previously counted the spiders, sprayed the vegetation within each enclosure. She counted the spiders and waited until I had repeated the procedure 10 minutes later before revealing her results. Our findings of 14, 7, and 13 *A. trifasciata* for the three plots were identical. She also found a total of 15 *A. aurantia* in the three plots; I missed one individual that was located deep in some dense weeds and thus counted only 14.

To compare the relative efficiency of this technique to that of sweep netting, six 5m x 5m grass plots were marked off, sprayed and *A. trifasciata* counted. After the webs had dried and were no longer visible each plot was swept (two sweeps/step) using a 32 cm diameter sweep net with a 90 cm handle. Three plots were done on the afternoon of 16 August and three on the morning of 18 August 1975. Spraying and visual counting determined 7, 11, 14, 15, 7, and 9 per plot for a total of 63 *A. trifasciata*. Sweep netting garnered 0, 1, 3, 3, 1, and 2 spiders and of these, one was dead and three injured. A one-way ANOVA (Sokal and Rohlf, 1969) comparison of the water sprayer procedure and sweep netting yielded a highly significant difference ($F=35.03$, $p<0.001$). Thus the sprayer technique produced over six times as many *A. trifasciata* as sweep netting. Since *A. trifasciata* and many other orb weaver species often drop from the web when disturbed (Tolbert, 1975) it is not surprising that sweep netting is totally inadequate for many studies and a better procedure must be used.

DISCUSSION

The water sprayer procedure yields repeatable results and is an efficient means of determining orb weaver densities. This technique is not limited to orb weavers, however, and can be used with Linyphiidae, Hahniidae and some Agelenidae and probably other web building families as well. Due to the amount of water required, the technique is probably best applied in areas where web densities are relatively high. This procedure also facilitates measuring certain web features in the field. The spiral catching area, distance between supports and "depth" of barrier webs can be more easily measured when visibility of the web is improved by a water film. This technique is not recommended when fine features of the web such as mesh width, thread length and angle regularity are to be measured since the weight of the water may cause the web to sag slightly. It also should not be used after heavy rains since rain often completely destroys many webs.

This technique possesses advantages that are extremely useful in examining certain kinds of problems. Water is non-toxic to spiders and their prey and predators. It can be applied with a minimum of disturbance to the spiders and evaporates rapidly; thus, the webs are conspicious for only a short time. This technique can be employed any time during the day (perhaps with the aid of lights at night as well for some species) and can be used in a variety of habitats.

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