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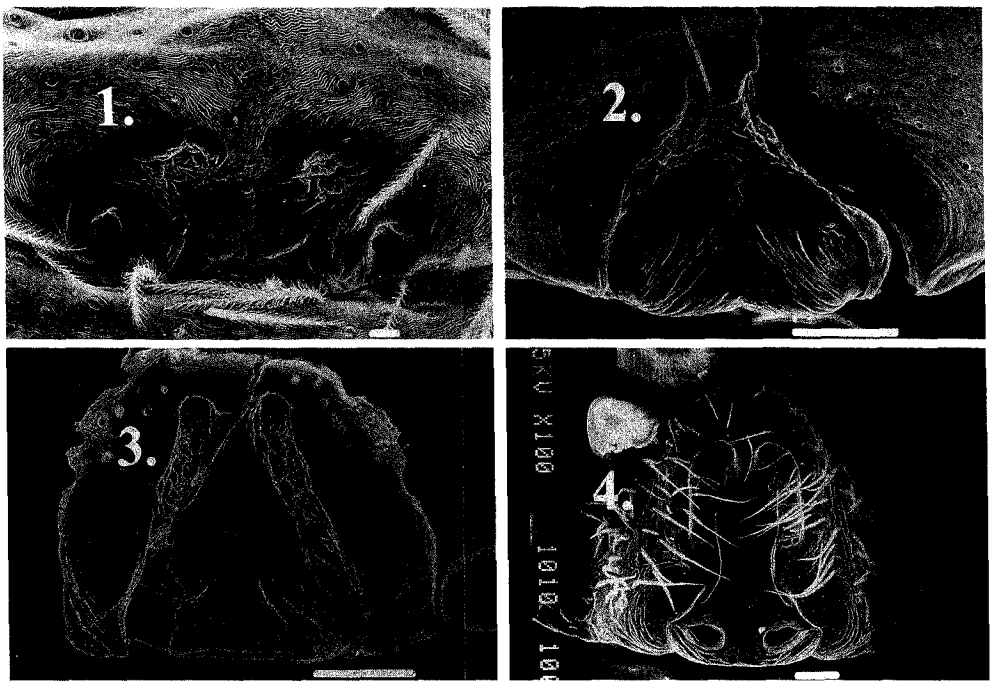
RESEARCH NOTE

A METHOD FOR ASSESSING GENDER IN IMMATURE WOLF SPIDERS (ARANEAE, LYCOSIDAE)

> "Araneists may well be advised to abandon their traditional habit of neglecting or even throwing away the immature specimens that they find, for these have much to teach us, and even the cast-off exoskeletons left after moulting may be profitably examined."
>
> Theodore Savory (1977)

Male and female spiders are typically distinguished by external characters (pedipalps and epigyna) of mature individuals. Texts concerning the biology of spiders (Savory 1928; Gertsch 1949; Foelix 1982; but see Comstock 1948: 130) do not mention ontogenetic variation in these structures although such variation has been known to systematists for many years (Strand 1906; Bhatnager & Rempel 1962; Sadana 1972; Levi 1982; Lachmuth et al. 1985; Sierwald 1989). This phenomenon has been largely unknown to the many ecologists working with spiders or, if known, the earliest stages of the ontogeny of epigynal structures have been unknown in spite of their potential utility. For example, of 69 papers published in volumes 19–20 of the Journal of Arachnology, 16 ecological papers dealt with spider species which had no obvious sexual dimorphism prior to the penultimate instar. These studies might have benefited from knowledge of the gender of immature individuals for a variety of reasons. Field studies concerned with habitat distribution and dispersal could benefit from knowing if male and female juveniles are distributed evenly in the habitat. In experimental studies, the two sexes should be balanced among treatments in order to account for differences due to sex. This would be particularly important in studies of growth rate where allocation rules may differ between sexes. In studies of sex ratio evolution, the predicted sex ratio of 1:1 may change through the development of a cohort resulting from differential selection acting on juvenile males and females. Therefore, knowledge of the gender of individuals can be very important to increasing our understanding of the ecology of spider species if it should prove not too difficult to gain. Herein, we describe a method to distinguish gender based on the ontogenetic development of the epigynum of the wolf spider, *Schizocosa ocreata* (Hentz 1844).

From 30 June–3 July 1994 we collected 22 female *S. ocreata* from the Stephen F. Austin Experimental Forest (7.5 km SSW of Nacogdoches), Nacogdoches County, Texas. We returned these females to the lab where they laid egg sacs and hatched young. We reared these young to maturity on an *ad libitum* diet of lab-reared crickets (*Acheta domestica*) in a temperature controlled room (26.1–27.7 °C) on a 14:10 light:dark cycle. We recorded the date of each molt for all individuals which allowed us to know how many instars prior to maturity an individual had been measured. In March of 1995, when the range of variation in development extended from the 7–12th instar beyond the deutovum stage, we began measuring the length and width of the epigynum of all individuals. We accomplished this by placing individuals in three dram shell vials and squeezing them to the bottom of the vial with a plug of cotton, after which we examined under a dissection microscope (63×) the abdomen between the book lungs for signs of epigynal development. All measurements were taken by the junior author. If a pre-epigynum was evident, an optical micrometer was used to measure its length and width from the extreme edges of the raised, sclerified portion of the epigynum (see Figs. 1–4). In addition, we ex-

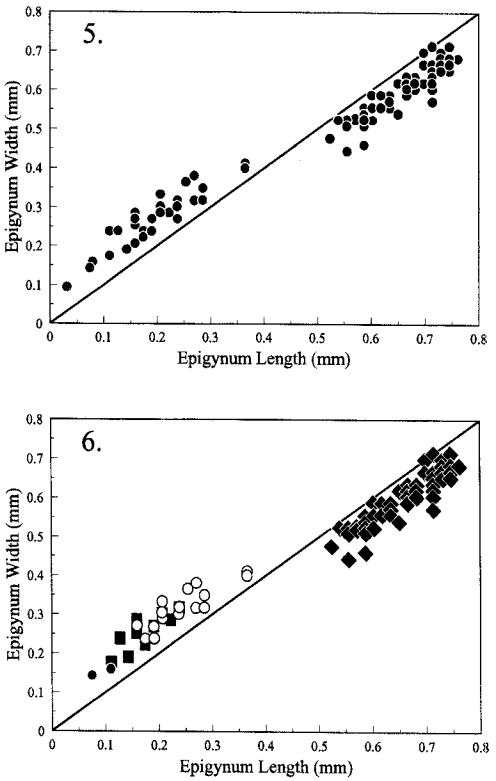


Figures 1–4.—Scanning electron micrographs illustrating the ontogeny of epigynal structures of *Schizocosa ocreata* (Hentz). 1, Third instar, scale bar = 10μm; 2, Three instars prior to maturity, scale bar = 100μm; 3, One instar prior to maturity, scale bar = 100μm; 4, Adult, scale bar = 100μm.

amined alcohol-preserved individuals from the first instar through maturity to determine the earliest age at which the pre-epigynum appears. We constructed plots of epigynum width versus epigynum length for all individuals as well as plots of epigynum width versus epigynum length for individuals for which we had two or more measures during ontogeny. We scored individuals without a pre-epigynum as "absent" (n = 15) and predicted them to be males. We tested this prediction as the individuals grew to maturity. All immatures that were scored as "absent" subsequently matured into adult males at instars similar to their female siblings.

Although the measures we employed were crude (epigynum length and width), we can distinguish immatures and matures based on their epigynum morphology. Mature individuals possess an epigynal structure that is longer (mean = 0.66, SD = 0.06) than wide (mean = 0.60; SD = 0.06) (Figs. 4, 5) while immature individuals possess an epigynum that is shorter (mean = 0.20, SD = 0.07) than wide (mean = 0.27, SD = 0.07) (Figs. 1–3, 5). The immature epigynal structure appears in individuals as early as the third instar as an isosceles triangle bisected from anterior to posterior with what appears to be a precursor to the median septum (Fig. 1). The pre-epigynum maintains this structure until the third or fourth instar prior to maturity at which time the sclerification and lengthening begins (Figs. 2–3). Figure 6 shows that epigynal morphology cannot be used to predict the number of instars remaining to maturity, nor is the instar at which maturity is reached related to the overall size of the epigynum (data not shown).

We have demonstrated a method for determining gender that can be used to distinguish between the sexes in juveniles of the wolf spider *Schizocosa ocreata.* More importantly, this method is simple (requiring only a dissecting scope with 20× magnification for identification; higher if measurements are to be made) and could be utilized in the field with live individuals unlike the chromosomal methods of Avilès & Maddison (1991) which require the death of the specimen. In addition, pre-epigyna can be viewed in exuvia of spiders (field caught and lab-reared) by the methods of Sierwald (1989). The appearance of external pre-epigyna in immature spiders is



Figures 5–6.—Plots of epigynal width versus epigynal length. 5, All individuals which were measured; 6, Epigynal measurements at different numbers of instars prior to maturity. ● = three instars prior to maturity; ○ = antepenultimate instar; ■ = penultimate instar; ♦ = adults. For both figures, the solid line represents a 1:1 relationship between the two measures. Adults fall on or below the line while immatures fall above the line.

common in the Lycosoidea (Sierwald pers. comm.) including the Pisauridae (Sierwald 1989), Psechridae (Levi 1982) and the Agelenidae (Strand 1906). The pre-epigynum is visible internally in the exuvia of the Theridiidae (Bhatnager & Rempel 1962).

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