Randall, J. B. 1978. The use of femoral spination as a key to instar determination in the Green Lynx spider, *Peucetia viridans* (Hentz) (Araneida, Oxyopidae). J. Arachnol. 6:147-153.

THE USE OF FEMORAL SPINATION AS A KEY TO INSTAR DETERMINATION IN THE GREEN LYNX SPIDER, *PEUCETIA VIRIDANS* (HENTZ) (ARANEIDA:OXYOPIDAE)[1,2]

John B. Randall

Department of Entomology and Nematology
University of Florida
Gainesville, Florida 32611

ABSTRACT

An alternative method of instar determination was sought by documenting femoral spination of successive instars of the Green Lynx Spider, *Peucetia viridans* (Hentz). Instars two through five were accurately determined by femoral spine number. Instars six and seven showed subtle, yet detectable differences in femoral spine relationships. Although instars seven and higher exhibit no easily perceivable differences in femoral spine relationships this spider is either mature or in penultimate stages in those instars. No sex differences in femoral spination were observed.

INTRODUCTION

Immature stages account for much of the predation attributed to spiders and it is often important to be able to determine the instar of immatures quickly and accurately in the field. Carapace widths have been used for instar determinations for many species. Dondale (1961) reported that strongly sclerotized body parts, such as the carapace and legs, were generally less variable than other linear measurements of body parts used to document spider growth. He noted that much of the variation affecting significance of measurements was due to difficulty in orienting the body of the spider in a consistent manner.

Although carapace widths are among the least variable body parts with respect to linear measurements, several authors (Eason and Whitcomb 1965, Whitcomb *et al.* 1966, Peck and Whitcomb 1970) have demonstrated that these overlap from instar to instar. As a consequence instar determinations are frequently in error. Growth varies depending on factors such as diet, humidity, temperature and photoperiod. Such factors in turn account for variations in carapace widths and other highly sclerotized body parts. Turnbull (1962) reported that the influence of the rate of food consumption on the rate of development declines with each consecutive instar. This may account for less variation in carapace width as the spider gets older. Turnbull also found that when feeding rates fell below the amount required for survival the spider will continue to mature. If the spider

---

[1] Florida Agricultural Experiment Staton Journal Series No. 1017

[2] Part of a thesis submitted by the author in partial fulfillment of the requirements for the M.S. degree at the University of Florida.

survives long enough to molt but lacks the extra energy required for molting it will die. A spider that has the energy to molt can complete the molt but emerges from the exuvium in the subsequent stage smaller than it was in the previous stage; a third instar spiderling may become a fourth instar but be the size of a second instar spiderling. If the carapace width was used as the instar determinant the spider would be erroneously described as a second instead of a fourth instar.

Chemicals used for preservation can further complicate linear measurement instar determination by causing shrinkage of body parts.

This investigation was conducted to determine if accurate field identification of instars could be made from examination of the femoral spination of a spider's legs. Because of its availability, size, abundance, and relatively few femoral spines that can all be observed from the dorsal aspect; the Green Lynx Spider, *Peucetia viridans* (Hentz) was chosen as the subject of this investigation.

LITERATURE REVIEW

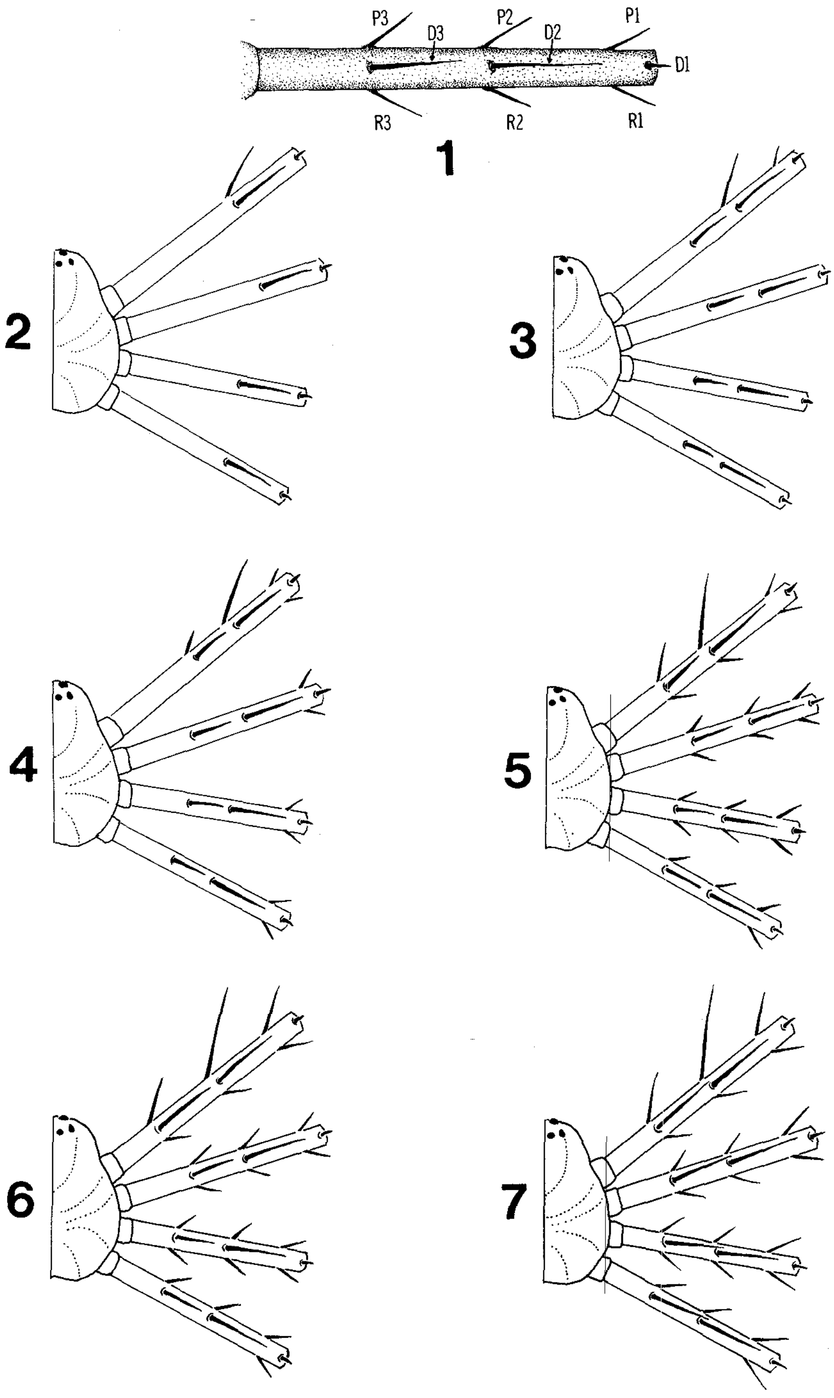
The usefulness of chaetotaxy in taxonomy has been noted by several authors. The term "spine" used in this report as in most arachnological literature, defines the largest of the three generally accepted classes of arachnid setae: spines, bristles and trichobothria. All three classes are setae in the entomological sense since they extend from an alveolar socket. Spines are large heavy setae; bristles are finer and shorter than spines; and the finest setae are termed trichobothria. Kaston (1948) stated that the presence, arrangement, and location of trichobothria on the different leg segments was fairly constant for various higher taxa. Lehtinen (1967) considered the setae of spiders to be of phylogenetic significance at the family and generic levels. According to Stahnke (1973) the trichobothrial clusters of Vaejovidae and other scorpion families seem to be transmitted genetically and that certain clusters are relatively constant within those families. Chamberlin and Ivie (1940) used leg spination in their key to the species of the genus *Cicurina* (Agelenidae). They formulated a "typical leg" with all the spines that might occur on any leg of any species of *Cicurina*. Spines were assigned a code number and in the descriptions "absent" spines were noted for each particular species.

Carmichael (1973) found the spines of the second tibia of *Araneus trifolium* (Hentz) and *Araneus marmoreus* Clerck were consistent enough to be distinct for those two species. Reiskind (1969) noted that the ventral spination of the tibia of leg I in the sub-family Castianeirinae was fairly constant and easily observable and was useful in distinguishing between species and species groups.

Emerit (1964) reported that the trichobothria of *Gasteracantha veriscolor* Walckenaer followed a progressive developmental pattern and it was possible to identify the different instars of *G. veriscolor* using the trichobothrial patterns.

Peck and Whitcomb (1970) using a system similar to that of Chamberlin and Ivie, found the leg spination of *Chiracanthium inclusum* (Hentz) to be different in successive instars. The carapace width measurements of *C. inclusum* were unreliable for accurate instar determination. Although the developmental chaetotaxy showed no constant condition for any instar except the first and second, the combination of carapace width and leg spination was found to be of value as an indicator of instar for *C. inclusum*.

Beatty (1970), studying the genus *Ariadna* Audouin (Dysderidae) found the femoral spines of the adult females and juveniles to be constant. The dorsal femoral spination of the adult males was highly variable both inter- and intraspecifically. Of the several hundred adult specimens examined, none had total symmetrical spination and spine



Figs. 1-7.–Femoral spination of *Peucetia viridans* (Hentz) (P, prolateral; R, retrolateral; D, dorsal): 1, adult; 2, second instar; 3, third instar; 4, fourth instar; 5, fifth instar; 6, sixth instar; 7, seventh instar.

patterns were individually unique. Beatty also found that in *Ariadna bicolor* (Hentz) spination changes could be induced by transient or local physiological changes, including injury.

METHODS AND MATERIALS

Adult *P. viridans* females were collected from several different locations in northern Florida and brought to the laboratory. After producing an egg sac, the females were allowed to remain with their egg sacs until the young emerged. After emergence the spiderlings were placed in separate rearing containers. The young were considered to be second instar spiderlings at emergence since they had molted from the deutovum while still in the egg sac (Whitcomb *et al.* 1966) and had functional eyes, digestive system and spines upon emergence from the egg sac.

The exuvia were removed from the rearing containers after each molt thus insuring against mistakes in instar identification of laboratory specimens.

Spiderlings representing the different instars were removed from the rearing containers and femoral spination examined as they became available. Samples (spiderlings) of the different instars were taken from as many of the egg sacs as possible to study the variation from egg sac to egg sac as well as the variation within a single egg sac.

Few spines occur on the femora of *P. viridans* (legs I-III have 9 spines and leg IV has 7 spines on the adult femora). Although possible to predict the relative positions of the femoral spines on immatures from the spination of the adult *P. viridans* (Fig. 1), the

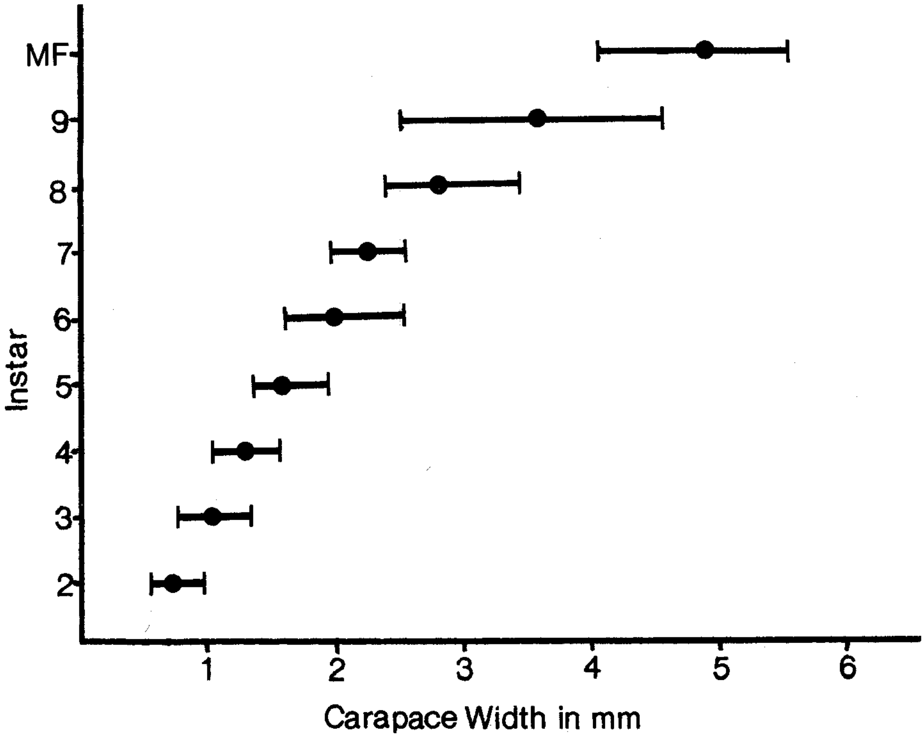


Fig. 8.–Carapace width measurements of successive instars of laboratory reared *Peucetia viridans* (Hentz), and mature females caught in the field (MF).

succession and progressive alterations in size relationships of the femoral spines of immatures could not be predicted form examination of adults. If spines were broken off, the sockets remained so the number and position of those spines could be documented.

RESULTS

The succession of spine number for the dorsal, prolateral and retrolateral aspects of the femora of legs I-IV is shown in Table 1.

The progressive intra-instar femoral spine relationships for legs I-IV, using the D1 spine as a size standard are shown in Table 2. Femoral spination for legs I-IV of instars two through seven is shown in Figures 2-7. Since these spiders are bilaterally symmetric only the right half is illustrated.

The carapace width measurements taken during this investigation are indicated in Figure 8.

Table 1.–Succession of femoral spination on the legs of *Peucetia viridans* Hentz, indicated as follows–prolateral:dorsal:retrolateral.

Instar	N	Leg I	Legs II-III	Leg IV
2	78	1:2:0	0:2:0	0:2:0
3	54	2:3:0	0:3:0	0:3:0
4	42	3:3:1	1:3:1	1:3:1
5-9	85	3:3:3	3:3:3	3:3:1

Table 2.–Progressive intra-instar femoral spine relationships for legs I-IV in *Peucetia viridans* (Hentz). (Spines are numbered from distal to proximal: L, leg; I, instar; P, prolateral; D, dorsal; R, retrolateral). The number of plus (+) marks denotes the spine size relationships within an instar. When plus marks appear in parenthesis (++), that spine or spines are usually absent but have appeared in a few cases, the number of which also appear in parenthesis.

L	I	N	P1	P2	P3	D1	D2	D3	R1	R2	R3
I	2	78	–	++	–	+	++	–	–	–	–
	3	54	++	+++	–	+	+++	++	–	–	–
	4	42	++	++++	++	+	++++	+++	–	–	–
	5	21	++	++++	++	+	++++	+++	++	++	++
	6	22	+++++	+++++++	++++	+	++++++	+++++	+++	++	++
	7	23	+++++	+++++++	+++++	+	++++++	++++++	+++	++	++
	8	12	+++++	+++++++	+++++	+	++++++	++++++	+++	++	++
	9	7	+++++	+++++++	+++++	+	++++++	++++++	+++	++	++
II-III	2	78	–	–	–	+	++	–	–	–	–
	3	54	–	–	–	+	+++	++	–	–	–
	4	42	++	–	–	+	++++	+++	++	–	–
	5	21	++	++	++	+	++++	+++	++	++	++
	6	22	+++	++	++	+	+++++	++++	+++	++	++
	7	23	+++	++	++	+	+++++	+++++	+++	++	++
	8	12	+++	++	++	+	+++++	+++++	+++	++	++
	9	7	+++	++	++	+	+++++	+++++	+++	++	++
IV	2	78	–	–	–	+	++	–	–	–	–
	3	54	–	–	–	+	+++	++	–	–	–
	4	42	++	–	–	+	++++	+++	++	–	–
	5	21	++	++	++	+	++++	+++	++	–	–
	6	22	+++	++	++	+	+++++	++++	+++	(++)(1)	–
	7	23	+++	++	++	+	+++++	+++++	+++	–	–
	8	12	+++	++	++	+	+++++	+++++	+++	–	–
	9	7	+++	++	++	+	+++++	+++++	+++	(++)(2)	–

Second Instar—The femoral spines of *P. viridans* are conspicuous as soon as the spiderlings emerge from the egg sac. None of the spiderlings examined showed any deviation from the pattern and spine number indicated in Fig. 2. Leg I has the P2, D1 and D2 spines and legs II-IV have only the D1 and D2.

Third Instar—The spiderlings acquired two more spines; P1 and D3 on leg I and one more spine, D3 on legs II-IV. The spiderlings have their full complement of dorsal spines as indicated in Fig. 3.

Fourth Instar—All the prolateral spines of leg I are present with the addition of the P3 spine. The P1 and R1 spines of legs II-IV are present. Only a single specimen showed any variance from the pattern and number shown in Fig. 4. That specimen had an R2 spine on leg IV of the left side with no spine or alveolar socket at the corresponding site of the same leg on the right side. This is in contrast to other variations observed in this investigation since individual variations were generally bilaterally symetric.

Fifth Instar—The spiderlings have the full complement of nine femoral spines on legs I-III and seven femoral spines on leg IV as indicated in Fig. 5. Leg I has the R2 and R3 spines; legs II and III have the P2, P3, R2 and R3 spines; and leg IV has the P2 and P3 spines. Instars two through five can be distinguished by spine number alone. The P1 spine is longer than the P3 spine on leg I.

As evident from examination of Table 2 the subsequent sixth and seventh instars show only slight, yet measureable changes in femoral spine relationships.

Sixth Instar—Following the molt to the sixth instar the P1 and P3 spines of leg I are the same length. Legs II-IV of the fifth instar exhibit the following relationship with respect to spine length: P1 = R1>P2 = P3, R2, and R3. In the sixth instar all prolateral and retrolateral spines of legs II-IV are the same length.

Seventh Instar—Up to and including the sixth instar the D2 spine is longer than the D3 on legs I-IV; in the seventh instar they are of equal length. The intra-instar femoral spine relationships remain unchanged from instars seven through nine which is of little practical consequence since by these stages of the life history the spiders are reaching sexual maturity. The earliest penultimate individual observed was a seventh instar male and by the ninth instar all specimens were sexually mature. No sex differences in femoral spination were observed.

The only variations evident from this investigation were on leg IV of the sixth instar (1 case) and the ninth instar (2 cases). These variations were cases of neotrichy where the normally absent R2 spines of leg IV were present.

A double-blind test of twenty-five field and twenty laboratory specimens was performed resulting in the correct instar determination of all spiderlings examined using only femoral spination as the key.

CONCLUSION

As Carmichael (1973) stated concerning the leg spines of *A. trifolium* (Hentz) and *A. marmoreus* Clerck, three important factors are evident: (1) there is a clear difference between spines and hairs, (2) the presence of a socket will indicate location of a lost spine, and (3) it is possible to recognize each spine. Those factors apply especially well to the femoral spination of *P. viridans*. I consider the femoral spination of the Green Lynx spider to be the best indicator of instar for this species.

Spine number alone can be used for determination of instars two through five. Instars six and seven exhibit subtle yet detectable differences in intra-instar femoral spine relationships. Carapace width measurements may serve as a secondary aid to accurate instar determination. Although instars seven and higher exhibit no easily perceivable differences in femoral spine relationships *P. viridans* is either mature or in penultimate stages in those instars. No sex differences in femoral spination were observed.

No generalizations should be drawn from this report. The use of femoral or entire leg spination as an instar determinant must be investigated on a species to species basis; however, I firmly believe that examination of leg segment or entire leg spination is a likely character for accurate instar determination in other spider species.

ACKNOWLEDGEMENTS

I thank Dr. W. H. Whitcomb, Dr. J. Lloyd and Dr. J. Reiskind for their continual interest, aid and invaluable criticism of this investigation and manuscript. I also thank Dr. R. Sailer and Dr. S. Poe for reviewing the manuscript. I especially thank my wife, Carol, for the many hours of aid given to this investigation both in the field and laboratory.

LITERATURE CITED

Beatty, J. A. 1970. The spider genus *Ariadna* in the Americas (Araneae, Dysderidae). Bull. Mus. Comp. Zoo. 139(8).

Carmichael, L. D. 1973. Correlation between segment length and spine counts in two species of *Araneus* (Araneae:Araneidae). Psyche 80(1-2):62-69.

Chamberlin, R. V., and W. Ivie. 1940. Agelenid spiders of the genus *Cicurina*. Bull. Univ. Utah 30(13):1-107.

Dondale, C. D. 1961. Life histories of some common spiders from the trees and shrubs in Nova Scotia. Canadian J. Zoo. 39:777-787.

Eason, R. R. and W. H. Whitcomb. 1965. Life history of the dotted wolf spider, *Lycosa punctulata* Hentz (Araneida:Lycosidae). Arkansas Acad. Sci. Proc. 19:11-20.

Emerit, M. 1964. La trichobothria et ses variations du developpement post embryonnaire chez l'araignee *Gasteracantha veriscolor*. C. R. Acad. Sci. Paris 258:4843-4845.

Kaston, B. J. 1948. Spiders of Connecticut. Bull. Connecticut Geol. Natur. Hist. Surv. 70.

Lehtinen, P. T. 1967. Classification of the cribellate spiders and some allied families, with notes on the evolution of the suborder Araneomorpha. Ann. Zool. Fenn. 4:199-468.

Peck, W. B. and W. H. Whitcomb. 1970. Studies on the biology of the spider *Chiracanthium inclusum* (Hentz). Ag. Exp. Sta. Univ. Arkansas Bull. 753.

Reiskind, J. 1969. The spider subfamily Castianeirinae of North and Central America (Araneae: Clubionidae). Bull. Mus. Comp. Zoo. 138(5):163-325.

Stahnke, H. L. 1973. Revision and keys to the higher categories of Vejovidae (Scorpionidae). J. Arachnol. 1:107-141.

Turnbull, A. L. 1962. Quantitative studies of the food of *Linyphia triangularis* Clerck (Araneae: Linyphiidae). Canadian Enthmol. 94(12):1233-1245.

Whitcomb, W. H., M. Hite, and R. Eason. 1966. Life history of the green lynx spider, *Peucetia viridans* (Araneida:Oxyopidae). J. Kansas Ent. Soc. 39:259-267.