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Ruth Robinson Eason

University of Arkansas, Fayetteville

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MATERNAL CARE AS EXHIBITED BY WOLF SPIDERS
(LYCOSIDS)¹Ruth Robinson Eason
University of Arkansas

Maternal care by wolf spiders (lycosids) appears to be more highly developed than in most other groups of spiders. This phase of the life phenomenon of wolf spiders, however, has received little attention in the United States. Perhaps one deterrent has been the amount of time required for observations. Besides, wolf spiders generally choose the night hours for most of their activity.

Despite these problems, observations have proceeded, and many notes on maternal behavior have been taken. Female spiders were brought into the laboratory and kept in cages so that their activities could be observed. These spiders were *Lycosa carolinensis* Walckenaer, *L. helluo* Walck., *L. punctulata* Hentz, *L. rabida* Walck., *Pardosa* sp., *P. milvina* (Hentz), *Schizocosa avida* (Walck.). From them we found that maternal care exhibited by wolf spiders is divided into several distinct stages which may be classified as follows: construction, care, and perforation of the egg sac; and care of spiderlings after they emerge from the egg sac.

Some species of wolf spiders indicate the approach of egg sac construction the day before the event takes place. Certain *L. helluo*² females enclose all or part of their cages with a fine sheet of silk prior to egg sac construction. *L. rabida* females construct a fine sheet web about one-half inch above the cage floor. Females of other species were observed to make a light web over the drinking dish and part of the cage floor.

Actual egg sac construction begins when the female starts spinning a circular mat more or less parallel to the ground but on the web background. Turning her body in alternating clockwise and counterclockwise directions, the female moves her abdomen back and forth, laying the silken foundation with long brushing strokes of the spinnerets. Up and down looping strokes with the tip of the abdomen give the mat depth. To finish the mat, a series of short up and down strokes are employed around its edge until a rim is formed giving the mat a bird's nest shape.

Placing her genital aperture over the center of this mat, the female pauses for three or four minutes. Then the egg mass is deposited along with a liquid material. Another brief period of inactivity precedes covering the egg mass.

¹Partially supported by N. S. F. G 17564

²Spiders identified by Harriet Exline (Mrs. Don Frizzell)

To cover the eggs, the female touches her spinnerets to the edge of the mat, raises her abdomen high, and may or may not touch the egg mass with her spinnerets as she moves her abdomen across to the other side of the mat, and continues back and forth in this manner while turning her body in alternating clockwise and counterclockwise directions. After the eggs are well-covered and additional spinning is done around the edges of the structure, the female frees the mat from the light web to which it is moored. This is accomplished by pulling at the covered egg mass with her palpi while tearing silk strands with her chelicerae. Some females were observed to exert extra "freeing" force by pushing with the legs while pulling with the palpi. Once the sac is free, it is turned with the third and first pairs of legs while the seam is turned down with the chelicerae and palpi.

To complete the first stage of her maternal care, she shapes the egg sac, which at this time resembles a poached egg, by pushing and pulling with palpi and chelicerae while turning it with the third pair of legs until it becomes almost spherical in shape. Then she touches it with her spinnerets. A minute or two later she walks off with the egg sac attached.

Eight observations of *L. punctulata* females show that it takes three or more hours to construct an egg sac. This time is divided as follows: mat construction, more than 40 minutes; pre-egg laying pause, about four minutes; egg laying, four or five minutes; post-egg laying pause, about four minutes; covering the eggs, 20 to 30 minutes; freeing the egg sac, about 25 minutes; turning the seam and shaping the egg sac, some 25 minutes; adding a bluish color to the egg sac and attaching it to the spinnerets, nearly an hour.

Observations of other species indicate that all follow the same basic construction pattern, but the amount of time required may vary. One *L. rabida* female was observed to dispense a blackish drop from the genital aperture, this drop giving her white egg sac a bluish color. Not all species of wolf spiders color their egg sacs.

Care of the egg sac is the second stage of maternal care. A wolf spider "mother" will ferociously defend her egg sac from intruders, as was experienced many times when egg sacs were removed for observation. One "mother" *L. rabida*, upon my returning her egg sac which I had cut beyond repair, scooped her spilled eggs into a mass, held them with her palpi, and tried spinning around them. When that failed, she spun a silk sheet over her eggs and hovered over or near them until they had hatched, molted, and ascended her back.

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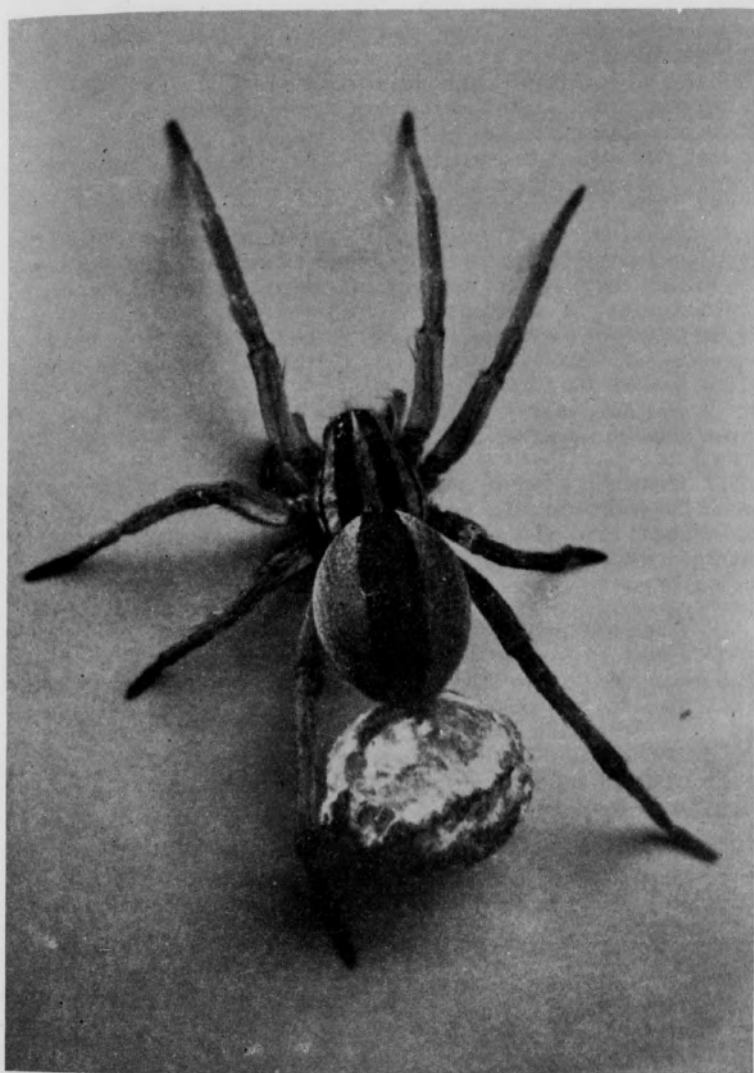


Fig. 1 Female *Lycosa punctulata* with egg sac.
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"Mother" lycosids sun their egg sacs in either natural or artificial sunlight. Some were observed to soak the egg sac a brief time in the water dish. "Mothers" with heavily diseased or parasitized egg sacs have been known to destroy them around the hatching date of the eggs, which hatch within the egg sac. Females with infertile eggs also destroy them at this time if they have not done so following egg sac construction or shortly thereafter. Some females have destroyed their egg sacs for no apparent reasons, or because they may have been lacking some essential in their diet, or may have been distressed.

"Mother" wolf spiders will mend torn or cut places in the egg sacs. This makes it possible to examine an egg sac to determine the stage of its contents, return it to the "mother", and examine the same egg sac again a day or two later — and again a day or two after that, if necessary. This is particularly valuable to the observer since spiderlings remain in the egg sac from one to three weeks after the eggs hatch, and it is difficult to determine actual incubation time without this unwitting help from the "mother" spiders.

When eggs begin hatching, barely perceptible movements made 20 to 30 minutes apart can be seen by removing eggs from the egg sac and using a microscope. These movements become stronger and closer together until the eggs hatch more than six hours later.

Time required for egg incubation varies from species to species and has ranged from six to fourteen days. From the hatching date within the egg sac until emergence, the time ranges from four to 22 days. Total days from egg sac construction until emergence has ranged from 12 to 35 days, the total length of time required for mothers to carry their egg sacs varying according to the species and time of year. *L. rabida* and *carolinensis* females have carried egg sacs the longest.

Number of eggs per egg sac has varied from eight for a *Pardosa* species to 1035 for *L. rabida*. Number of egg sacs constructed per female has varied from one to six, depending mostly on species. Smaller species have tended to be more prolific in number of egg sacs, and larger species in number of eggs.

Maternal care of the spiderlings begins hours before they emerge. The "mother" perforates the egg sac around the seam, either part way or all the way. This double perforation is made by the "mother" rotating the egg sac with her legs and palpi while jerking at the seam with her chelicerae. Thus far no wolf spiderlings have been observed to leave an egg sac without help when the sac is taken away from the "mother" prior to this perforation.

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Apparently most spiderlings leave the egg sac during the night. However a number of observations have also been made during the day. The first spiderling to leave the sac pokes its head out of one of the perforated holes somewhat hesitantly, then scrambles out of the hole and up and over the egg sac, and on up over the posterior portion of the "mother's" abdomen. Once on the "mother's" back, it finds an acceptable spot, lowers its body, and clings there. Its siblings follow, sometimes in groups, and sometimes singly. In the species observed the egg sac is usually emptied within 3 hours, and the spiderlings have stacked themselves on top of each other over the "mother's" abdomen, and may be spilling over onto the sides and onto her cephalothorax — which keeps her busy, occasionally, brushing them out of her eyes with her palpi.

Spiderlings remain on a "mother's" back a varying length of time depending on the species and time of year. For *P. milvina* this ranged from four to six days. For the medium-large *L. rabida* the young remained with the "mother" about 50 days. Medium-sized *L. belluo* and *S. avida* "mothers" carried their young from eight to 13 days. Large *L. carolinensis* "mothers" also carried their young from one to two weeks. The time taken for all spiderlings to leave a "mother's" back has ranged from several hours to two days for *P. milvina*, but over three weeks for *L. rabida*.

Mortality rate was higher among spiderlings removed from a "mother's" back than among those allowed to leave naturally.

Maternal care of the young while they are on the "mother's" back includes providing them with water. *L. carolinensis*, *L. belluo*, and *L. punctulata*, and *L. rabida* spiderlings were observed drinking water with their "mothers".

Experiments were conducted with a typical vagabond wolf spider, *L. rabida*, in order to have more detailed information on water consumption by spiderlings. To make it possible to observe the young drinking without continuous surveillance, water was withheld from the "mothers" from one to three days. Since the response was basically the same in all cases, the description of one observation will suffice.

The thirsty "mother" pawed the dry cotton in her drinking dish with her fore tarsi. The top-most spiderlings began untangling their legs from their siblings, hesitated, and settled again. Water was placed in the drinking dish. Immediately the "mother" moved to the dish, lowered the anterior portion of her body, began to drink, then resumed her usual standing position and placed tarsi of both fore legs and one second leg into the drinking dish.

Following this act, the top-most spiderlings again untangled their legs, walked hurriedly over the backs of their siblings, and continued in the direction of the "mother's" legs which were placed in the water. They climbed down her legs to the drinking dish, and immediately began drinking. The other spiderlings followed in rapid succession, and the "mother" resumed drinking. Upon finishing, the "mother" waited with legs in the water dish until the spiderlings had finished drinking and climbed onto her back. Then she moved away from the water dish.

On only one occasion during all the observations were spiderlings observed to descend a leg not placed in water. Even so, they stopped part way down the "mother's" leg hesitated, climbed up again, and walked across her back and down the legs placed in the water.

Time required for drinking varied from ten to thirty minutes in the observed cases. Age of the spiderlings ranged from newly emerged to a week old.

In one instance a female died the day after her young emerged. When her body was gently shaken her spiderlings began to untangle their legs, hesitated, then settled down again. Even when her body was gently shaken and placed in the water dish they would not leave her back. Those forcibly removed drank thirstily. The others eventually died, apparently of thirst.

Maternal care has been found to extend to the realm of foster "mothers." In an experiment with *L. rabida*, it was discovered that a "mother" with offspring of her own upon her back would accept offspring of another *L. rabida* without hesitation, even though her own back was well-covered with young. A "mother" with an egg sac from which spiderlings were due to emerge in several days also accepted a brood of spiderlings although she exhibited some slight leg twitching as they mounted. Several days later it was impossible to tell her spiderlings from the adopted ones.

An unmated female with no egg sac was not so calm about a brood of young ones. She exhibited extreme agitation whenever any tried to mount, and jerked and shook her legs vigorously in an attempt to prevent their mounting. However, she apparently tired of her preventive exercises because, when observed several hours later, all had mounted her back, and she was jerking cotton out of her drinking dish with her chelicerae in the manner of a very distressed spider.

Adoption of a different species by a "mother" has not yet been attempted. In several instances, however, egg sacs were adopted in an interchange between spiders, but more observations are yet needed. One frustrated *L. carolinensis* female con-

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constructed an imitation egg sac from cotton in her drinking dish four days after removal of her infertile egg sac. She dropped this substitute about the time fertile eggs would have hatched.

Maternal care ends when the spiderlings leave their "mother's" back and disperse by ballooning.



Fig. 2 Female lycosid with young on her back.