OBSERVATIONS ON THE LIFE HISTORY OF THE BROWN SPIDER, LOXOSCELES RECLUSA GERTSCH AND MULIAK

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OBSERVATIONS ON THE LIFE HISTORY OF THE BROWN
SPIDER, LOXOSCELES RECLUSA GERTSCH AND MULIAK

THESIS

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By

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CHAPTER I

INTRODUCTION

Background and Literature

In recent years, there has been increased public awareness and scientific investigation of the Brown Spider, *Loxosceles reclusa* Gertsch and Muliak. Gertsch and Muliak (3) gave the original description of the species. Gertsch (2) later elaborated on the description and listed the species in the family Scytodidae, a family of six-eyed spiders. He gave the type locality as Austin, Texas. The genus *Loxosceles* contains eighteen species, widely distributed in temperate and tropical areas of the world. Six of the eighteen species (*L. reclusa* Gertsch and Muliak, *L. devia* Gertsch and Muliak, *L. arizonica* Gertsch and Muliak, *L. unicolor* Keyserling, *L. rufescens* Dufour, and *L. laeta* Nicolet) occur in the United States; all of these except *L. laeta* occur in Texas. *L. reclusa* is the most common and widely distributed species, having been reported from Southern Colorado, Kansas, Missouri, Southern Illinois, North and South Carolina, Georgia, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma, Tennessee, and Texas.
Prior to 1929 the Black Widow Spider, *Latrodectus mactans* Fabricius, was the only spider of serious medical importance in the United States. Most textbooks and literature still reflect this outdated belief. In that year Schmaus (10) first confirmed the symptoms of certain necrotic (gangrenous), hemolytic and systemic reactions in "insect-bite" victims as being caused by Brown Spider bites. Little work followed this important discovery until 1957, when Atkins (1) described similar symptoms in patients in Missouri. Since these initial reports, verifying evidence has been accumulating to the extent that this spider is now considered to equal or even surpass the Black Widow in medical importance in the Southwestern United States.

General symptoms associated with and following a bite from this spider have been described by several authors and include (a) initial pain, usually less severe than that of an ant bite or wasp sting, progressively becoming more severe within about eight hours; (b) formation of a small blister at the point of bite, surrounded by a congested and swollen area showing signs of erythema; (c) progressive development of necrosis in the swollen area between 18-24 hours and 7 days (this is so consistent with bites from this spider that it has led to naming the condition as "gangrenous spot," "necrotic arachnidism," and "black spot"); (d) systemic symptoms including chills, fever, hemolysis, weakness, jaundice and a generalized morbilliform rash
usually developing within 36 hours; and (e) disappearance of symptoms within seven days, debridement of the eschar, and formation of a deep, depressed scar by the tenth week. Hydroxyzine hydrochloride administered in oral doses of 100 mg, four times a day during early stages after bites has been shown to reduce necrosis, and surgical removal of the gangrenous area reduces scar formation and depth (9).

Lessenden and Zimmer (6) described eight clinical cases of *L. reclusa* bites in 1960. Micks (7) indicated that the first Brown Spider bite confirmed from Texas occurred in 1958 and was reported by James et al. (5). Micks reported a total of 60 cases from only 25 counties in Texas between 1955 and 1960. Detailed case histories were given for five of these victims.

The only significant work on the biology of the Brown Spider in the literature has been recently reported by Hite et al. (4). Their research was conducted using specimens reared in the laboratory at year-round temperatures of 21-32° C. Some other fragmentary reports, including a technical release from the National Pest Control Association (3) (in which general information on the life cycle was quoted from an unnumbered Entomology Department Leaflet from Oklahoma State University) are available but do not provide detailed information on this spider's biology.
Statement of Purpose

This research was undertaken primarily to further elucidate the life history of this medically important spider. Special attention was given to rearing experimental spiders under as near-natural environmental conditions as possible. This enabled comparison with results given by Hite et al. (4), whose spiders were reared at relatively constant year-round temperatures of 21–32°C. These authors did not overwinter spiders in natural environments as was done in this study. It was also intended that more information would be collected on natural habitats and distribution of the Brown Spider in Texas.
CHAPTER BIBLIOGRAPHY


CHAPTER II

MATERIALS AND METHODS

Collection and Rearing of Spiders

Spiders used in this study were field-collected L. reclusa or their progeny. Most specimens were collected in sheet metal piles, stacked lumber, feed sacks in a barn, and in several other places on the Stockard farm, one mile north of Denton, Texas. Spiders were captured with 32-dram shell vials and were subsequently isolated in half pint milk bottles. These bottles contained a 4 X 6 cm. piece of paper toweling, used by spiders to gain adequate footing during movements associated with feeding, web formation, and ecdysis. Bottles containing individual spiders were numbered and kept in a dark incubator during eight months of the year (March-October), at monitored room temperatures of 24-36°C. The incubator was kept ventilated with a small squirrel-cage fan. During winter months (November-February) adults and most spiderlings were overwintered in a 15 cm. deep pit in the dirt floor of a garage. This simulated the natural environment in which wild spiders overwinter. The pit was enclosed with a framed, plastic-covered box.
One group of 244 third instar laboratory-hatched spiderlings representing seven different broods were randomly divided into two groups and one of these was kept under the same conditions as mentioned above for adults. The other group was kept in a controlled environmental chamber at 15±1°C. One half of the latter group was released to monitored room temperature after 240 days.

**Feeding**

Adult spiders were offered ten to twelve *Drosophila* four days per week during June-September, and twice per week in March, April, May and October. The young spiderlings were offered three to five *Drosophila* five days per week until the fourth instar, after which they were fed the same as adults. *Drosophila* were reared on a basic corn meal medium containing 150 ml. of unsulphured molasses, 75 gm. white corn meal, 15 gm. brewers yeast, and 8 gm. agar. At irregular intervals, termites and other small insects were also given to the spiders.

**Matings**

Laboratory matings were made in 6 X 8 X 7.5 cm. plexiglass chambers (Fig. 1). Sliding partitions fitting into slotted grooves in the center and at both ends of the chamber allowed separation of the males and females in opposite ends until they became somewhat accustomed to the surroundings. After acclimation, the center partition was
Loxosceles Mating Chamber

Material - $\frac{4}{5}$" Plexiglass

Dimensions in Centimeters

Fig. 1
lifted, allowing free movement of the male or female anywhere in the chamber. After mating, or at times when males and females were incompatible, careful manipulation of the center partition was used in separation. The bottom of the mating chamber was covered with paper toweling to provide good footing for the spiders. Numerous mating sequences were recorded on eight mm. color film for later close analysis and description of behavior.

Egg Sac Deposition

Egg sacs deposited by lab-mated or field-mated females were usually left with the female, but in some instances were separated from them. Egg sacs were observed daily and eggs were measured with an ocular micrometer.

Spiderling Measurements

Cephalothoracic widths and body lengths of spiderlings kept at room temperatures were measured, using an ocular micrometer, just prior to and subsequent to each true molt. After approximately half of a group of spiderlings molted, their measurements were taken. Measurements of the remaining half of that group of the same age, gave a pre-molt measurement. Using this technique, it was possible to determine (a) change in cephalothoracic width and body length between molts, (b) change within a given stadium, and (c) change resulting from the molting process itself. Time to
maturity was determined as the number of days from hatching until first mating.

Since the group of spiderlings grown at 15±1°C did not molt, their measurements were taken at the same times as were those from spiderlings growing at monitored room temperature.
CHAPTER III

RESULTS

Distribution and Habitat

Collection records obtained during this study show L. reclusa distributed in seven counties not included in the map given by Micks (4). These include Bowie, Grayson, Hamilton, Harrison, Jack, Llano, and Wise. Typical habitats of over 300 collected specimens in Denton County include inside walls of barns, around feed sacks, between and under hay bales, in closets of dormitory rooms, garages and closets of homes, under miscellaneous rubbish in old barns and sheds, outdoors under rocks and in stacks of wood or posts, in decaying logs, and under corrugated metal. These and similar records by several workers suggest that this species occupies almost any dry niche, indoors or outdoors, that offers seclusion during daylight hours.

Adults

An adult male Brown Spider is shown in Figure 2. The characteristic violin-shaped dark brown figure is exhibited on the antero-dorsal carapace with the "neck" projecting backward. The six eyes are located anteriorly or at the
base of the dark figure. Adult males collected in the field averaged 7.22 mm. in total body length and 2.61 mm. in carapace width. Males are readily distinguished from females by the bulbous appearance of the pedipalps (Figure 2) which function as sperm transfer organs. Gertsch (2) gave a detailed description of the bulb and emboli of the male pedipalps. The legs of males, especially the first pair, are longer than those of females. The first leg of the female is 4.42 times the length of the carapace compared to 5.9 times in the male (2).

Adult females generally resemble males, except that the pedipalps are filiform, and the abdomen is lighter in color when distended with eggs. Females collected in the field averaged 7.92 mm. in body length and 2.84 mm. in carapace width. Gertsch (2) gave a detailed description of both sexes. A random field collection of 120 adult spiders exhibited a sex ratio of 1:2 (males:females). Sex ratios of one group of 52 laboratory-reared spiders was 2:3.

Thirty female spiders, collected as adults early in the spring of 1964, survived continuous rearing for 880 days. It can be assumed, because of time of collection, that these spiders were a minimum of about 540 days old when collected, and had overwintered twice. These observations suggest that these 30 females were a minimum of approximately 1,420 days old and had overwintered four
times at the time of initial writing of this manuscript in October, 1966.

Forty successful laboratory matings were observed and/or recorded on eight mm. movie film. Receptiveness of the female appeared to be primarily a function of whether she was gravid. This in turn depended largely on the time of year, under the simulated natural conditions of the study. Overwintered females were first observed becoming gravid in May. The earliest successful matings were made in early June. The latest successful matings were recorded in September. Hite et al. (3) observed matings in spiders kept at year-round 21-32° C. temperatures from early February to October, with the most successful period being in June and July. Based on these data and the fact that adult spiders have been collected in late March and early April in Denton County, Texas, while still in the winter hibernaculum, it is suggested that spiders in natural environments mate between May and September, with variations depending on seasonal temperatures. The following description of mating behavior is based on direct observation or films of the above forty matings, and includes descriptions of (a) initial contact and pursuit, (b) caress and embrace, (c) copulation, and (d) behavioral variations.

Initial contact of individual pairs of spiders placed in the mating chamber appeared at times to be a result of
chance rather than directed action of either sex toward the other. At other times, paired individuals seemed to be "aware" of one another. After initial tactile contact, pairs either remained motionless, sometimes for as long as two or three minutes, or exhibited a "fleeing" response with the male, female or both moving to the periphery of the mating chamber. A slow re-approach and pursuit, usually by the male, initiated courtship if the female was receptive. The male approached very cautiously and appeared to walk on the "tips" of the posterior three pair of legs, with the front pair held high and directly forward. Both sexes intermittently vibrated the palpi.

The caress began with re-contact in a "head-on" position; the male used his first pair of legs to rhythmically stroke the female over her abdomen and anterior legs. The male and female vibrated the palpi together, with the tips barely touching with each cycle. The intensity of palpal vibration in the female appeared to be less than that of the male. During this vibration, palpi of both sexes were positioned anteriorly with a downward bend of the apical segments. In some instances there were rhythmic pulsations of the male's or female's abdomen. Caress (stroking and palpal contact) lasted from five to twenty seconds.

The female responded to caress by moving her first two pairs of legs posterio-dorsally to a "throw-back" position. The male then positioned his first pair of legs
posterior to the female's second pair or, less frequently, to the first pair in a typical "embrace."

Immediately following assumption of the embrace, the male made forward thrusts under the female with his whole body, extending the embol of the palpi to the area of the epigynum (anterio-ventral on female abdomen). Copulation was accomplished by inserting the two emboli into the openings of the spermathecae, situated in the epigastric furrow. Actual insertion of both bulbs was usually simultaneous, but in some instances the male appeared to make a successful insertion with the bulb of only one palpus, in which event, repeated thrusts were made with the free embolus until insertion, if at all. The female was tilted backward by this thrust, until the tip of her abdomen touched the floor. Cessation of movement, which normally signifies sperm transfer, was used as an indicator of successful insertion, although it could not be definitely ascertained whether both bulbs were inserted correctly each time.

In some instances, females became non-receptive to a male after first insertion; in others, courtship and mating were repeated up to nine times. Of the forty matings reported, only one male spider was killed by a female. In this instance, the male was very aggressive and the female non-receptive. In another instance, a female was bitten
by an aggressive male, but she was paralyzed only for a short time, then fully recovered.

Hite et al. (3) stated that it appeared from their data that a female mated late in the season might be able to pass the winter and produce viable eggs the following spring. This phenomenon was actually demonstrated in the current study. Thirteen females, mated prior to overwintering or field collected (therefore exposed to mating), produced at least one egg sac the following spring with some degree of viability. However, the mean hatching percentage was well below that of first egg sacs deposited by females mated after overwintering. Furthermore, two and four females mated prior to overwintering produced second and third egg sacs, respectively, the following season, with a regression of viability with each one. It was not determined whether sperm could be carried over two winters. These data shed important light on distribution of the species. It is suggested that overwintering females, transported in old clothing, furniture, feed sacks, etc., to points outside the range of the species, could produce a brood the following spring without males.

Egg Sacs and Eggs

An average of 1.6 egg sacs was produced by forty-four females in a given year. Twenty-three females produced more than one egg sac in a season during the entire study.
Maximum egg sacs per female in one season was three (Table I). Figure 3 shows that there was a regression in number of eggs per sac and number hatched per sac from the first through third egg sacs. The minimum days between egg sacs of given females was fourteen, and the maximum was fifty-nine.

Egg sacs consist of (a) a base web, (b) the eggs deposited in layers, and (c) a dome-shaped covering web with a dense lower layer and a floculent cap. Construction of the egg sac required about six hours. The base web construction took about one hour. The female laid down this web by slowly moving the abdomen and spinnerets back and forth over a circular area about seventeen mm. in diameter. The creamy-white and nearly perfectly spherical eggs were deposited on the base web. The deposition of eggs usually took four to five minutes for an average of twenty-three eggs. Over 200 measured eggs averaged 1.2±.04 mm. in diameter. After oviposition the female usually remained motionless for about fifteen minutes before initiating construction of the covering web. This was made in essentially the same manner as was the base web. After this covering was completed, a thick floculent cap was deposited on top.

Mated females usually deposited eggs within twelve days. Mean number of eggs per egg sac was twenty-three (Table I). Figure 4 shows that peak egg production was in
July. A mean of ten days at room temperatures during May-September was required for incubation. Eggs deposited during cooler months required up to nineteen days to hatch, whereas those deposited in June and July required as little as six days (Table I). Seventy per cent of all eggs deposited during the study hatched at room temperatures. Per cent hatch of eggs from first egg sacs of females mated during the same season was eighty-three. In contrast, only forty-one per cent of all eggs deposited by females not mated in the same season hatched.

Spiderlings

Cephalothorax width and body length measurements for a group of 107 spiderlings reared under monitored room temperatures, and overwintered, are shown in Tables II and III. Mean post-to post-molt cephalothorax and body length indicate change in size between instars, post-to pre-molt measurements indicate change in size within an instar, and pre-to post-molt means indicate size change resulting from the actual process of molting. Measurements were not made on first post-embryo individuals, and all 107 individuals were not measured until the second molt.

The first instar of most spiders is divided into two stages, the first post-embryo and second post-embryo, collectively called the deutovum by Gertsch (1). The first post-embryo stage in L. reclusa began with rupture of the
chorion. The body was creamy white, and was covered with a clear membrane (embryonal membrane) that confined the legs and pedipalps. This stage was nonmotile. After approximately three days the embryonal membrane was shed along with the chorion. This initiated the second post-embryo stage. Individuals in this stage resembled older reclusa except that the abdomen was much larger in proportion to the rest of the body. This stage lasted two to three days, and spiderlings were relatively inactive.

The following first true molt yielded second instar spiderlings. They emerged from the egg sac after one to two days, and were light tan with dark setae, with the violin-shaped mark not yet evident on the carapace. Little mortality occurred during development within the egg sac. The number of spiderlings emerging was usually near the number hatched. Maternal help was not needed for emergence of spiderlings since they successfully emerged from egg sacs isolated from the female. However, when egg sacs were left with the female, she frequently helped spiderlings to escape the egg sac by pulling the cover webbing back.

Subsequent development, from the second through seventh instars, was outside the egg sac. All individuals surviving each succeeding molt were measured. The mean post-molt cephalothorax widths from Table II shows that there is a linear increase in size of the cephalothorax and body length with each instar through seven instars.
Immediately prior to molting, spiderlings became darker in color and often refused to take food. A vertical position was assumed on paper toweling with anterior end up, legs widely spread, and tarsal claws hooked into the toweling. The cuticle split around the sides and front of the carapace, leaving the posterior portion "hinged" to the rest of the body. This "cap" (top of carapace) was raised as the cephalothorax of the emerging spider was thrust upward. The legs were freed in stages by rhythmic contractions of the cephalothorax, the front ones being the first freed. In most instances failure of complete release of the old cuticle surrounding the legs resulted in death. Autotomy followed in some cases where only one leg was bound. According to Gertsch (1) most young spiders that undergo autotomy exhibit regeneration of the lost appendages. This was never observed in any of the spiderlings grown in this study.

Early Molts (second and third instar) required approximately five to ten minutes, whereas the last molt required two to three hours. Mortality associated with molting was progressively greater with succeeding molts.

Table IV shows growth of 105 second instar spiderlings held at 15±1° C. over a 395 day period. Increase in mean cephalothoracic width over this long period was only .03 mm, and increase in mean body length was only .23 mm. None of the spiderlings kept at this temperature molted to the third
instar. After ten months, only thirteen of the 105 spiderlings had died (12.4 per cent).

Forty-six (half) of the second instar spiderlings remaining alive under the 15±1°C temperature after ten months were released to normal room temperature ranging from 24-36°C. Table V shows that forty-five of these molted into the third instar, forty-four into the fourth, and twenty-seven into the fifth. After 120 days all released spiderlings had died (mostly at molting) and none achieved the sixth instar.
Fig. 2--An adult *Loxosceles reclusa* male
Fig. 3--Regression in mean numbers of eggs per sac and number hatched per sac from the first through third egg sacs in one season (once-mated females).

*Number in parentheses indicates number of egg sacs observed.
Fig. 4—Seasonal egg sac production by forty-four female spiders.
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<thead>
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<th></th>
<th>Observations</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
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<tbody>
<tr>
<td>Eggs/female/year</td>
<td>44</td>
<td>12</td>
<td>77</td>
<td>36</td>
</tr>
<tr>
<td>Egg sacs/female/year</td>
<td>44</td>
<td>1</td>
<td>3</td>
<td>1.6</td>
</tr>
<tr>
<td>Days between egg sacs in one season</td>
<td>20</td>
<td>14</td>
<td>59</td>
<td>32</td>
</tr>
<tr>
<td>Days between the last egg sac of one season to the first egg sac of the following, without remating</td>
<td>13</td>
<td>282</td>
<td>368</td>
<td>312</td>
</tr>
<tr>
<td>Eggs/egg sac</td>
<td>69</td>
<td>10</td>
<td>62</td>
<td>23</td>
</tr>
<tr>
<td>Incubation in days with monitored room temperature</td>
<td>19</td>
<td>6</td>
<td>19</td>
<td>10</td>
</tr>
</tbody>
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TABLE II

GROWTH IN CEPHALOTHORAX WIDTH OF LOXOSCELES RECLUSA SPIDERLINGS AT MONITORED ROOM TEMPERATURES OF 24-36° C.

<table>
<thead>
<tr>
<th>Instar</th>
<th>Number Measured</th>
<th>Cephalothorax Width (mm.)</th>
<th>Pre-Molt</th>
<th>Post-Molt</th>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Range</td>
<td>Mean</td>
</tr>
<tr>
<td>(1st post embryo)*</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>(2nd post embryo)*</td>
<td>9</td>
<td>--</td>
<td>.60-.64</td>
<td>.60</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>3</td>
<td>.60-.64</td>
<td>.62</td>
</tr>
<tr>
<td>3</td>
<td>60</td>
<td>47</td>
<td>.72-.92</td>
<td>.85</td>
</tr>
<tr>
<td>4</td>
<td>45</td>
<td>50</td>
<td>1.08-1.20</td>
<td>1.08</td>
</tr>
<tr>
<td>5</td>
<td>35</td>
<td>57</td>
<td>1.20-1.52</td>
<td>1.33</td>
</tr>
<tr>
<td>6</td>
<td>7</td>
<td>7</td>
<td>1.54-1.81</td>
<td>1.69</td>
</tr>
<tr>
<td>7</td>
<td>3</td>
<td>10</td>
<td>2.14-2.20</td>
<td>2.18</td>
</tr>
</tbody>
</table>

*First and second post embryo are collectively called the deutovum by Gertsch (1).
TABLE III
GROWTH IN BODY LENGTH OF LOXOSCELES RECLUSA SPIDERLINGS AT MONITORED ROOM TEMPERATURES OF 24-36° C.

<table>
<thead>
<tr>
<th>Instar</th>
<th>Number Measured</th>
<th>Body Length (mm.)</th>
<th>Pre-Molt</th>
<th>Post-Molt</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
<td>Range</td>
<td>Mean</td>
</tr>
<tr>
<td>(1st post embryo)</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>(2nd post embryo)</td>
<td>9</td>
<td></td>
<td>1.00-2.00</td>
<td>1.68</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1.60</td>
<td>1.60</td>
</tr>
<tr>
<td>3</td>
<td>60</td>
<td>47</td>
<td>2.20-2.80</td>
<td>2.51</td>
</tr>
<tr>
<td>4</td>
<td>45</td>
<td>50</td>
<td>2.96-3.72</td>
<td>3.38</td>
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<tr>
<td>5</td>
<td>35</td>
<td>57</td>
<td>3.60-4.42</td>
<td>4.16</td>
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<tr>
<td>6</td>
<td>7</td>
<td>7</td>
<td>4.35-5.36</td>
<td>5.02</td>
</tr>
<tr>
<td>7</td>
<td>3</td>
<td>10</td>
<td>5.36-6.70</td>
<td>6.04</td>
</tr>
</tbody>
</table>

*First and second post embryo are collectively called the deutovum by Gertsch (1).
### TABLE IV

**GROWTH OF LOXOSCELES RECLUSA SPIDERLINGS AT 15±1° C. OVER A 395 DAY PERIOD**

<table>
<thead>
<tr>
<th>Equivalent Instar</th>
<th>Number Measured</th>
<th>Cephalothorax Width (mm.)</th>
<th>Body Length (mm.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Range</td>
<td>Mean</td>
</tr>
<tr>
<td>Moved to 15±1° C. in 2nd Instar</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>105</td>
<td>.60-.88</td>
<td>.78</td>
</tr>
<tr>
<td>4</td>
<td>105</td>
<td>.72-.88</td>
<td>.79</td>
</tr>
<tr>
<td>5</td>
<td>105</td>
<td>.72-.92</td>
<td>.80</td>
</tr>
<tr>
<td>6</td>
<td>48</td>
<td>.76-.88</td>
<td>.80</td>
</tr>
<tr>
<td>7</td>
<td>35</td>
<td>.80-.88</td>
<td>.81</td>
</tr>
</tbody>
</table>
TABLE V

GROWTH OF LOXOSCELES RECLUSA SPIDERLINGS, RELEASED FROM 15±1°C. AFTER TEN MONTHS TO ROOM TEMPERATURES OF 25-36°C.

<table>
<thead>
<tr>
<th>Instar</th>
<th>Number Measured</th>
<th>Cephalothoracic Width (mm.)</th>
<th>Body Length (mm.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Range</td>
<td>Mean</td>
</tr>
<tr>
<td>3</td>
<td>45</td>
<td>.92-1.20</td>
<td>1.03</td>
</tr>
<tr>
<td>4</td>
<td>44</td>
<td>1.20-1.48</td>
<td>1.32</td>
</tr>
<tr>
<td>5</td>
<td>27</td>
<td>1.60-2.14</td>
<td>1.80</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>all died</td>
<td></td>
</tr>
</tbody>
</table>
CHAPTER BIBLIOGRAPHY


CHAPTER IV

DISCUSSION AND SUMMARY

Discussion

Results of this study have established that *L. reclusa* has a longer life span than many other spiders whose longevity is known. Hite et al. (2) gave the mean life span of *L. reclusa* at 543.2 days for males and 627.9 days for females. They also indicated that spiders probably pass through two winters. Since spiders used in the current study were kept at natural room temperatures in summer, and were overwintered in a near-natural environment, the indicated life span of at least 1,420 days is probably a more accurate estimation of life span of females in wild spiders of this species. Little data were collected on longevity of males, with some males living an estimated 1,000 days.

G. and E. Deevey (1) found that *Lactrodectus mactans* (Black Widow) males mature in 70 days and live 100 days with a maximum of 160 days. Females mature in 90 days and live about 271 days with a maximum of 550 days.

The regressing number of eggs per sac and number hatched per sac from the first through third egg sacs was probably due in most cases to females being mated only once.
in a season with probable subsequent gradual loss of viability or numbers of sperm stored in the spermatheca. In nature, females may mate repeatedly during a season, and later egg sacs possibly exhibit higher numbers of eggs and degree of hatching. The minimum and maximum days between egg sacs, 14 and 59 days, respectively, were observed during this study. This closely corresponds with 13 and 65 days, respectively, given by Hite et al. (2).

Peak egg production by females retained during this study was in July. Hite et al. (2) reported that eggs were deposited from February through September by females held at 21-32°C, room temperature, with maximum production in May. Overwintering of females in the present study probably gave a more accurate indication of the natural period of oviposition, although it is understood that variations in seasonal temperatures from year to year probably largely determine peaks in mating frequency and oviposition of natural populations of spiders.

Hite et al. (2) showed spiderlings going through eight instars when reared at 21-32°C. A group of 100 spiderlings reared in the early phase of the present study (for which measurements were not kept), under similar artificial conditions, also exhibited eight instars. The group of 107 spiderlings reared under simulated natural conditions (monitored normal room temperature and overwintering) passed through only seven instars after fifteen
months. Ranges of cephalothorax size for each instar compared favorably with those given by Hite et al. (2), and the mean cephalothorax widths for each instar were slightly greater. Mortality was high in this group, with 13 of the original 107 surviving to the seventh instar. Eighty-one (75.7 per cent) of all spiderlings in this group failed to survive the winter or the first molt (fifth) after simulated natural overwintering. Most died attempting the first post-overwintering molt. This indicates that this is a very vulnerable and critical point in the life history of this species. As of November 1, 1966, the four remaining spiders (two males and two females) of this group had been in the seventh instar a minimum of ninety days, indicating that they probably would not undergo another molt. Furthermore, these showed normal adult sexual development, and the two males exhibited normal mating behavior during August. All four compared favorably in cephalothorax measurements with the eighth instar individuals of Hite et al. (2). These comparisons, and data on temperature effect on development, indicate that L. reclusa may go through a variable number of instars (seven or eight), depending on temperatures during development. Under natural conditions in northernmost portions of the natural range, where spiders overwinter (simulated in the present study), they may undergo seven or eight instars, whereas under favorable constant room
conditions and continuous development, eight instars are exhibited. Further testing of this hypothesis is needed.

Comparison of mean carapace widths and body lengths (Tables III and V) for the third, fourth and fifth instars indicate that spiderlings released from 15±1°C. to room conditions grew at about the same rate in the third and fourth instars as those grown under constant room temperatures, and that they were slightly larger in the fifth instar. All these died before attaining the sixth instar. After 455 days, 33 (69 per cent) of the group of 48 left at 15±1°C. were still alive. These data indicate an amazing ability of *L. reclusa* to survive long periods of sub-development threshold environmental temperatures, but relative incapacity to successfully continue development when spontaneously released to higher summertime temperatures, after the period of stress. Future work may show that a more gradual release of spiderlings (such as might occur in nature) that have undergone such stress might result in some degree of survival to the adult stage. If demonstrated, this would indicate capacity for future northward extension of range of this species.

**Summary**

1. *Loxosceles reclusa* is widely distributed in central and eastern sections of Texas, and occupies niches in and under debris or objects in buildings or outdoors.
2. Adult males are readily distinguished from females by the bulbous enlargement of the pedipalps. Both sexes exhibit a violin-shaped dark brown figure on the anteriodorsal carapace, with the "neck" projecting backward. Females are slightly larger than males, except that the front legs of males are longer than those of females.

3. Sex ratios in field-collected and laboratory reared spiders were 1:2 (males:females) and 2:3, respectively.

4. Longevity appears much longer than in other spiders, such as the Black Widow, with indicated lifespans for females and males being approximately 1,420 days and 1,000 days, respectively.

5. Spiders mate in a "head-on" position during May-September. Females will mate only when gravid. Courtship and caress consist mainly of stroking by the male with the front legs, and mutual "vibrational contact" of palpi of both sexes. Actual copulation consists of the male thrusting under the female (female in "throw-back" position and legs of male and female interlocked) with the Pedipalps, and insertion of the emboluses into the spermathecal ducts situation in a transverse groove (epigastric furrow) of the female. Number of copulations varied from one to nine times, each time spiders were paired.

6. Sperm storage from one season to another (over winter) was demonstrated, although viability was not as
high as in recently-mated females. However, some viability was maintained even through the third egg sacs in the second season.

7. An overall average of twenty-three white spherical eggs measuring 1.2 mm. in diameter was deposited in one to three egg sacs during a season. Mean number of eggs decreased with each succeeding egg sac in a season. Egg sac construction and oviposition required about six hours. Egg sacs consisted of a base web, eggs deposited in layers, and a dome-shaped covering web with a dense lower layer and a floculent cap.

8. Inclusion required a mean of ten days, with up to nineteen days required for eggs deposited during cooler months, and as little as six days for eggs produced in June and July. Seventy per cent of all eggs deposited during the study hatched at room temperatures.

9. Spiderlings passed through seven or eight instars, depending on whether they were reared under room conditions year-round, or whether they were kept under simulated natural conditions (room temperatures during March to November and overwintered during November to March). All of the first instar, consisting of first and second post-embryos (or deutovum), was passed in the egg sac over a period of approximately five to six days. The first true molt occurred in the egg sac, with second instar spiderlings
emerging from the egg sac after one or two days. Subsequent
development was outside the egg sac. There was a linear
increase in size of the cephalothorax and body length with
each succeeding instar.

10. Growth of second instar spiderlings kept at
15±1°C. was almost completely arrested, with increases in
mean cephalothoracic widths and body lengths, over a 395
day period, being only .03 and .23 mm., respectively. None
of the 105 spiderlings kept under such conditions molted to
the third instar and mortality was only 12.4 per cent after
395 days.

11. Release of forty-six spiderlings, whose growth was
arrested by 15±1°C. temperature for 330 days, to room
temperatures in June resulted in somewhat normal resumption
of growth, except that mortality was very high between the
fourth and fifth and in the fifth instars; all had died
within 120 days after release, and none achieved the sixth
instar.
CHAPTER BIBLIOGRAPHY


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