

## Further crossing experiments in *Latrodectus* species (Araneida: Theridiidae)

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**Summary:** In continuation of earlier tests, crossing experiments were performed with the following species: *Latrodectus lugubris* (Dufour, 1820), Kazakhstan, *L. tredecimguttatus* (Rossi, 1790), Corsica, *L. hesperus* Chamberlin & Ivie, 1935, California, *L. geometricus* C. L. Koch, 1841, South Africa, Argentina, *L. g. obscurior* Dahl 1902, Madagascar, and *L. hasselti* Thorell, 1870, Australia.

Variably, large males of *L. 13-guttatus* did not copulate with a female of *L. lugubris*, whereas a small male of *L. hesperus* mated with this female on the 18th day of the trial. The male of *L. lugubris* did not copulate with females of *L. geometricus* (Argentina) and *L. hasselti*. However, a very intensive courtship behaviour could be observed with females of these species. Males of *L. geometricus* did not copulate with females of *L. g. obscurior*. The male of *L. hesperus* did not react on females of *L. geometricus* and *L. g. obscurior*. A female of *L. g. obscurior* which had killed a male of *L. geometricus* before, copulated totally unexpectedly with a large male of *L. 13-guttatus*. This male and several other males of this species did not react to females of *L. geometricus*. or only weak to females of *L. hesperus*. There was no reaction between males of *L. geometricus* and females of *L. hesperus* and *L. lugubris*, but a very intensive courtship of the male of *L. lugubris* in front of a female of *L. hesperus*. One day later the male was found dead and wrapped (after copulation?). The female of *L. hesperus* constructed an egg-sac with infertile eggs. After the successful matings between *L. hesperus* x *L. lugubris* and *L. 13-guttatus* x *L. g. obscurior* no egg laying occurred however.

**Zusammenfassung:** In Fortsetzung früherer Versuche wurden Kreuzungsexperimente mit folgenden Spezies durchgeführt: *Latrodectus lugubris* (Kasachstan), *L. tredecimguttatus* (Korsika), *L. hesperus* (Kalifornien), *L. geometricus* (Südafrika, Argentinien),

*L. g. obscurior* (Madagaskar) und *L. hasselti* (Australien).

Während verschieden große Männchen von *L. 13-guttatus* nicht mit dem Weibchen von *L. lugubris* kopulierten, wurde dieses nach 17 Tagen Versuchsdauer von einem kleinen *L. hesperus*-Männchen begattet. Das *L. lugubris*-Männchen kopulierte nicht mit Weibchen von *L. geometricus* (Argentinien) und *L. hasselti*. Jedoch wurde sehr intensives Werbeverhalten vor Weibchen dieser Arten beobachtet. Männchen von *L. geometricus* kopulierten nicht mit Weibchen von *L. g. obscurior*. Das Männchen von *L. hesperus* reagierte nicht auf Weibchen von *L. geometricus* und *L. g. obscurior*. Ein *L.g.obscurior*-Weibchen, das zuvor ein *L. geometricus*-Männchen getötet hatte, wurde völlig unerwartet von einem großen *L. 13-guttatus*-Männchen begattet. Dieses und andere *L.13-guttatus*-Männchen reagierten nicht auf *L. geometricus*-Weibchen oder nur schwach auf Weibchen von *L. hesperus*. Es erfolgte auch keine Reaktion von *L. geometricus*-Männchen auf Weibchen von *L. hesperus* oder auf das *L. lugubris*-Weibchen. Das *L. lugubris*-Männchen warb sehr intensiv vor dem *L. hesperus*-Weibchen. Einen Tag später wurde es tot und eingesponnen aufgefunden (nach Kopulation?). Das *L. hesperus*-Weibchen baute einen Eierkokon, der unbefruchtete Eier enthielt. Nach den gelungenen Paarungen von *L. hesperus* x *L. lugubris* und *L. 13-guttatus* x *L. g. obscurior* fand keine Herstellung von Eikokons statt.

## 1. INTRODUCTION

**I**n a previous investigation (SCHMIDT 1990 b) it could be shown that sexual reaction between different species of *Latrodectus* occurs within the *mactans*-group only. There the different degrees of sexual attraction confirm the rank of relationship and reflect the genetical relations between single species in a similar way as morphological criteria do.

The courtship behaviour in american *Latrodectus* species was reported exactly by KASTON (1970). On that occasion he also mentioned the curious gathering up of threads of the female's web in concentrated bands and sheets by the male, a behaviour that can last some days especially in all cases where the male courted in vain. In some cases this is the only sign of courtship at all, particularly with large "nervous" males, as I could show in earlier experiments (SCHMIDT 1990 b).

According to KASTON, it was impossible to cross *L. mactans* (Fabricius, 1775) with *L. variolus* Walckenaes, 1837, and *L. variolus* with *L. hesperus*. 3 of 27 attempts between *L. mactans* and *L. hesperus* only were successful. But there was no development of eggs. Other unsuccessful trials between 6 different species of *Latrodectus* in Argentina were reported by ABALOS (1962) and ABALOS & BAEZ (1967) and between *L. mactans* and *L. tredecimguttatus* by LEVI (1966) and MARTINDALE & NEWLANDS (1982).

In these cases, after matings no fertile eggs were produced. The same result brought out from matings between *L. tredecimguttatus* males and *L. hasselti* females (TES-

MOINGT 1987, cit. SCHMIDT 1990 b). Only trials with *L. hasselti* males and *L. tredecimguttatus* females WEICKMANN (1988) could get offspring. The same could be proved in matings between *L. hasselti* and *L. katipo* Powell, 1870 (FORSTER, pers. comm. 1989).

## 2. MATERIAL AND METHODS

The trials were performed with 1 female of *L. lugubris* from Kazakhstan, 1 male of its offspring, 3 females and 1 male of *L. hesperus* from California, 1 female of *L. geometricus* from Argentina, 1 female and 1 male from South Africa, 2 females of *L. g. obscurior* from Madagascar, 4 males of *L. tredecimguttatus* from Corsica and 1 female of *L. hasselti* from Australia (offspring).

The caging and rearing was described in a previous paper (SCHMIDT 1990 b). The identification of the *Latrodectus* species was done according to KATNER (1956), LEVI (1959), KASTON (1970) and SOUTHCOFF (1976).

In all cases the males were added to the female for a specified time depending on the sexual activity, usually at least 1 week.

## 3. RESULTS

### *L. lugubris* male x *L. hesperus* female

The very large male started its courtship immediately by cutting and gathering up the threads of the female's web which were wrapped. In doing so it came up to the female within a few millimeters, reacted very intensely by aroused jerking, was chased away by the female, started again its courtship, was chased away once again and so on. The next day the male was found enwrapped up. It is not clear whether a copulation took place during the night or not. The female built an egg-sac with infertilized eggs 3 weeks later.

### *L. lugubris* male x *L. geometricus* female

Very intense jerking in front of the female from Argentina for 2 hours. The female chased up the male and tracked it. Repeated courtship behaviour including plucking the threads.

### *L. lugubris* male x *L. hasselti* female

The male immediately approached the female and showed intense jerking and plucking movements, but also showed the curious cutting of threads of the female's web which were wrapped up. Despite the tracking by the female the courtship was continued. The partners were separated 4 hours later because the female was absolutely uninterested.

*L. hesperus* male x *L. lugubris* female

On November 26, 1990 one male of *L. hesperus* and *L. tredecim-guttatus* each were put at the margin of the web of *L. lugubris*. The male of *L. hesperus* left the web uninterested some hours later and stayed outside up to 10 days. Then it approached the female up to 3 cm, once again without courtship reactions. On December 12, 10 h. a. m. the copulation took place in the dome-shaped retreat of the female's web. The first series of copulations lasted 22 min. The female made weak enwrapping movements at the end of this period. The next series lasted 17 min. Then the male squatted on the belly of the female for hours. Next copulation series: 13,26 h. 15,55 h: the male left the female. 18.30 h: Courtship behaviour and spinning round the abdomen of the female, then copulation. 20.00 h: The male left the body of the female, but stayed in the retreat of the female's web. The female was very peaceful. On the next morning I found the male outside of the female's web, with only 6 legs. One day later it died from exhaustion.

*L. hesperus* male x *L. hesperus* female

Normal copulation and fertile egg.

*L. hesperus* male x *L. geometricus* females

No courtship behaviour was seen.

*L. hesperus* male x *L. geometricus obscurior* females

No sexual reaction.

*L. geometricus* male x *L. geometricus* female

Normal copulation without killing the male.

*L. geometricus* male x *L. geometricus obscurior* females

Courtship behaviour could be observed, but the females drove away the male and reacted very aggressively. One day later the once more courting male was wrapped up and killed.

*L. geometricus* male x *L. lugubris* female

No reaction between the partners.

*L. geometricus* male x *L. hesperus* females

No sexual behaviour.

*L. tredecimguttatus* males x *L. lugubris* female

No male produced any kind of intense courtship behaviour. Some approached the female and sat nearby, other demonstrated total lack of interest.

*L. tredecimguttatus* males x *L. hesperus* females

In 3 cases, no reaction. In one case, after about 34 hours male and female sat opposite each other peacefully.

*L. tredecimguttatus* males x *L. geometricus* females

No reaction besides searching for the female and sitting closely by it (1 cm distance). In one case weak jerking and plucking.

*L. tredecimguttatus* males x *L. geometricus obscurior* females

In 3 cases, no sexual reaction. In one case, on December 25, 11 h a. m., violent courting appeared immediately after touching the threads of the female, including spinning round the female and attempts to copulate. The very large male could mate the female after the 5th attempt (11.58 h). 30 seconds later the female drove away the male by its 4th leg. At 12.00 h renewed spinning round the female and further attempts to copulate. 12.12 h: renewed insertion of the palp for about 30 seconds. Then the male was chased away by the 4th leg of the female. The partners stayed together up to 4 p. m. For a longer time the male sat on the back of the female.

On December 27, the female constructed its third egg-sac without the green wrapping and the spikes. The eggs remained infertilized.

*L. tredecimguttatus* males x *L. hasselti* female

TESMOINGT succeeded in hybridizing in 2 of 7 cases. The duration of the copulations lasted up to 4 hours. Then the males were killed by the females. The egg-sacs constructed after the copulations were infertilized.




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|                            | L.t.            | L.L. | L.c.            | L.e. | L.h.            | L.he.  | L.g. | L.g.o. | L.p. |
|----------------------------|-----------------|------|-----------------|------|-----------------|--------|------|--------|------|
| <i>L. tredecimguttatus</i> | 4               | 1    | -               | -    | 3 <sup>1)</sup> | 0-1    | 1    | 3      | -    |
| <i>L. lugubris</i>         | -               | 4    | -               | -    | 2               | 2 (3?) | 2    | 2      | -    |
| <i>L. hasselti</i>         | 4 <sup>2)</sup> | 2    | 1 <sup>3)</sup> | 2    | 4               | -      | 0    | -      | 0    |
| <i>L. hesperus</i>         | -               | 3    | -               | -    | -               | 4      | 0    | 0      | -    |
| <i>L. geometricus</i>      | -               | 0    | -               | 0    | 0               | 0      | 4    | 1-2    | 0    |
| <i>L. antheratus</i>       | -               | -    | -               | 0    | -               | -      | -    | -      | 0    |

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- = not examined
  - 0 = no reaction
  - 1 = weak reactions: searching for female and sitting closely by it
  - 2 = violent reaction, including intense courting, spinning round the female and attempts to copulate
  - 3 = copulation, but no fertile eggs
  - 4 = normal copulation and fertile eggs.
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- L. t. = *Latrodectus tredecimguttatus*
  - L. L. = *Latrodectus lugubris*
  - L. c. = *Latrodectus cinctus* (= *L. indistinctus*)
  - L. e. = *Latrodectus erythromelas*
  - L. h. = *Latrodectus hasselti*
  - L. he. = *Latrodectus hesperus*
  - L. g. = *Latrodectus geometricus*
  - L. g. o. = *Latrodectus geometricus obscurior*
  - L. p. = *Latrodectus pallidus*

- <sup>1)</sup> Termoingt
- <sup>2)</sup> Weickmann
- <sup>3)</sup> Bloss

#### 4. DISCUSSION

In contrast to earlier experiments it could be shown that not only within the *L. mactans*-group courtship reactions and copulations between different species occur, but also between members of the *mactans*- and the *geometricus*-group. Therefore it can be supposed that not only in the *L. mactans*-group but also generally in the genus *Latrodectus* the process of speciation has not been completed yet. It seems that there are differences between *L. tredecim-guttatus* and *L. lugubris* in the courtship behaviour. It was impossible to bring about matings between these species. These two members of the *mactans*-group have to be considered as true species. They differ in the pH of toxins (WEICKMANN 1988), in the body size, in the coloration and in the geographical distribution (SCHMIDT 1990 a). In *L. geometricus* it is very likely that populations from different regions of the earth have not only variable body color and markings, different shape and color of egg-sacs, but also variable sex pheromones. This has to be clarified in further experiments. Anyway, it was impossible to cross *L. geometricus* with *L. g. obscurior*. A further point has to be mentioned: not only in *L. hasselti* and *L. geometricus* are there differences in the sexual behaviour

depending on the size of the males. This seems to be the case also in other species of this genus. Therefore one may only compare the results of experiments with males of similar body size.

## 5. CONCLUSIONS

**T**he sexual behaviour can reflect the degree of genetic relationship between different species within the genus *Latrodectus* in all cases, in which males and females communicate sexually with each other. The courting behaviour of the males itself can be misinterpreted because males of *Latrodectus* in some cases even court females of *Steatoda* (WEICKMANN, in litteris, 1991). For instance, a male of *L. hesperus* attempted to copulate with a female of *S. grossa* (in trials of my own a male of *L. lugubris* did not court a female of *S. bipunctata*). Not only the *L. mactans*-group but also the *L. geometricus*-group represents a complex of species or subspecies.

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