

NATURAL HISTORY OF *Ctenus medius* KEYSERLING, 1891 (ARANEAE, CTENIDAE) II: LIFE CYCLE AND ASPECTS OF REPRODUCTIVE BEHAVIOR UNDER LABORATORY CONDITIONS

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ABSTRACT

Ctenus medius Keyserling, 1891 is a wandering spider common in the Brazilian Atlantic Forest. It has been the subject of few studies. Thus, this work aims to elucidate aspects of its natural history, such as the life cycle and reproductive behavior of this species, through laboratory and field observations. Two females with egg sacs were observed in the laboratory and one was observed in field (Barra Mansa, 22°32'S and 44°10'W) until the emergence of the spiderlings. For observation of the immature stage development, a portion of the spiderlings from the same hatch were taken to the laboratory and watched until sexual maturity. In the field, the period between the oviposition and the emergence of spiderlings was of 36 days. The female selects a site for egg sac deposition and stays there until the spiderlings emerge. Seven days after the emergence, the female abandoned the site where the egg sac was made, concomitant to the spiderlings dispersion from observation's place and until the moment that the spiderlings started to eat. For the spiderlings kept under laboratory conditions, cannibalism was not observed in the first instars (1-4th) when sufficient food was offered. Sexual maturity happened in the 14th or 15th instars, with an average of 309.2 to 344.5 days until the last/sexual molt, respectively. Until the date of sexual maturity, there was a mortality rate of 85%. This species is very fragile in captivity. This hampered deductions concerning longevity. Both females and males collected in the field were induced to mate in the laboratory. Courtship movements of males were registered, but the females did not permit the mating. These data may assist in initial biological studies of *Ctenus* genus and offer comparative parameters for studies of other related species.

Key words: *Ctenus medius*, bionomic studies.

RESUMO

História natural de *Ctenus medius* Keyserling, 1891 (Araneae, Ctenidae) II: Ciclo vital e aspectos do comportamento reprodutivo em condições de laboratório

Ctenus medius Keyserling, 1891 é uma aranha errante, comum na Mata Atlântica brasileira, que tem sido objeto de poucos estudos. Este trabalho visou elucidar aspectos de sua história natural, como o ciclo vital e o comportamento reprodutivo, por meio de observações em laboratório e em campo. Duas fêmeas com ooteca foram observadas em laboratório e uma em campo (Barra Mansa, 22°32'S e 44°10'W) até a emergência da prole. Para as observações sobre o desenvolvimento dos estágios

imaturos, uma porção da prole foi levada ao laboratório e observada até a maturidade sexual. Em campo, o período entre a oviposição e a emergência da prole foi de 36 dias. A fêmea selecionou um local para a confecção da ooteca, onde permaneceu até a emergência dos filhotes. Sete dias após a emergência, a fêmea abandonou o sítio onde a ooteca foi confeccionada, no mesmo dia em que a prole foi observada, aceitando a alimentação e dispersando do local de observação. Os filhotes mantidos em laboratório não apresentaram canibalismo nos primeiros instars (1^o-4^o) quando o alimento foi oferecido. A maturidade sexual de indivíduos deu-se no 14^o ou 15^o instar, com média de 309,2 a 344,5 dias até a última muda, respectivamente. Foi observado índice de 85% de mortalidade até a maturidade sexual, mostrando que esta espécie apresenta grande fragilidade em cativeiro. Isto dificultou deduções sobre sua longevidade. Machos e fêmeas coletados em campo foram induzidos ao acasalamento em laboratório. Foram registrados movimentos de corte dos machos, mas as fêmeas não permitiram o acasalamento. Estes dados podem ser úteis como primeiras noções sobre a biologia de *C. medius* e como parâmetros para outras espécies filogeneticamente afins.

Palavras-chave: *Ctenus medius*, estudos bionômicos.

INTRODUCTION

Although the Ctenidae family is rich in species, little is known about its biology in general. In this family, the *taxa* most recently studied belonged to the genus *Phoneutria* (Simó, 1984; Simó & Bardier, 1989; Ramos *et al.*, 1998) and *Cupiennius* (Melchers, 1963; Höger & Seyfarth, 1995).

Within of *Ctenus* genus, several ecological and taxonomic aspects were studied for species from Manaus (Höfer *et al.*, 1994; Gasnier, 1996). Important basic data such as time in reaching sexual maturity and longevity limits a better understanding of the biology and ecology of the genus. *Ctenus medius* is a spider of nocturnal habits and it is common in several spots of the Atlantic Forest. Almeida *et al.* (2000) shows that *C. medius* seems to prefer ecotopes characterized by dense shrub vegetation or herbal undergrowth when compared with the remainder of ctenidofauna. The authors also provide data on the development of chromatic patterns during the spider's life cycle, noting that the biology of *C. medius* has been little explored. Thus, this work aims to describe the life cycle of *C. medius* for future ecological works, and offer comparative parameters between the Neotropical species of Ctenidae.

MATERIAL AND METHODS

Study area – Barra Mansa (22°32'S; 44°10'W) is located in the southeast part of the Rio de Janeiro State. In general, the area is a plateau with elevations between 381 m and 400

m where the Paraíba do Sul River crosses the urban zone. Average annual rainfall is 1,380 mm (Andrade, 1995). The animals were collected and observed on the *campus* of the Centro Universitário de Barra Mansa (UBM). The *campus* includes a reforested area of 34,900 m² with exotic and native species and is located about 500 m far from the city center, 50 m above the Paraíba do Sul River. This environment constitutes a refuge for members of the native local fauna because agriculture and cattle raising have deteriorated the neighboring regions.

Animals – Two females collected on the *campus* of UBM, that made their egg sac in laboratory, were used in this work. Another female that had an egg sac found in the same ecotope, was not collected but observed *in situ*. It had its leg marked with a dye made of nitrocellulose and synthetic resin. Offsprings newly emerged from the egg sac of the female were observed *in situ*, and 723 individuals were observed until their dispersion from observation's place. One portion of these offsprings (22 spiderlings) was transported to the laboratory and kept in an individual cylindrical container with an opening of 4 cm in radius and 14 cm high. Another portion of the offspring (50 spiderlings) was kept in a community container 28 cm high by 5.5 cm in radius, both at room temperature ($\bar{X} = 28^{\circ}\text{C}$).

Period between oviposition and emergence of spiderlings – To estimate the time between egg laying and hatching of offspring, three females were monitored: two in the laboratory and one in its natural habitat.

Intermoult period and mortality rate – In the laboratory, offsprings raised in individual containers were fed in first instars with *Drosophila* sp. raised in the laboratory. After first instars, the spiderlings were fed with various insects and arachnids types collected in the field. For standardization the food, the given prey was about 20%-30% smaller than the spider. The spiderlings were fed three times weekly. Insects and arachnids that were not eaten were removed from captivity five hours after their introduction. Water was offered as moist cotton on neutral plastic.

As assumed by Scioscia (1995, 1996a, b), the first instar was considered the one after the emergence from the egg sac. Possible intra-egg sac molts were not considered.

In order to obtain the intermoult, average of for each instar, the time between ecdysis for each sample was registered. The mortality rate was noted in different instars, and then was transformed into a percentage related to the number of individuals that perished before undergoing the next ecdysis.

Behavioral and ecological aspects – For the female monitored in the field with the egg sac, daily morning and nocturnal visits were made for three times a day during its stay at the site where it was found in the campus of the UBM. Female's parental care given to the spiderlings and gregarious behavior of offspring, in the first days after emergence, were recorded.

The data obtained from spiderlings monitored in the field were compared to the ones kept in communitarian containers and individual containers. Three young males and three females were collected in the field and raised in laboratory until maturity. They were used for observations regarding the behavior of courting and mating. Different combinations of males and females among these spiders were used in different periods of the day. For a comparative analysis between the phylogenetically similar external groups, the same experiment on the courtship activity for *Phoneutria nigriventer* (Keyserling, 1891) (Araneae, Ctenidae) was done.

RESULTS

For one of the females, the period between the oviposition and emergence of the spiderlings was of 35 days. For the female monitored in the

field it was noted that it took 36 days for spiderling emergence. To obtain the offspring's number, 795 exuvies were counted in the refuge web (Fig. 1) of the female monitored in the field.

Bionomic data – The highest average of the intermoult period was seen in the 12th instar (\bar{X} = 48 days). The lowest average of the intermoult period was registered in the 3rd instar (\bar{X} = 15,1 days). The highest intermoult period was registered for a spider that remained 50 days in the 12th instar and the lowest was for the one that remained 11 days in the 4th instar. Picture of a spiderling in the 4th instar on the hand of an adult man is shown in Fig. 2.

For the analyzed samples, it was observed that sexual maturity occurred in the 14th or 15th instar. The average of the intermoult period was 309.2 or 344.5 days respectively. The highest mortality rates were observed in the 7th (4/13) and 14th (1/2 only) instar. One female arrived at the adult period in the 14th instar and two males in the 15th. Thus, the offspring born in January reached sexual maturity in October, November and December. The referring data on the intermoult period and death rate are shown in Table 1.

Behavioral and ecological aspects – the female monitored in the field constructed the egg sac under a roofing tile on the ground, in the midst of bushy vegetation. Picture of a female and its offspring is shown in Fig. 3. Before the emergence of a spiderling, the female's permanence in the site was noticed during all the monitoring visits to the ecotope. As the spiderlings were taken to the laboratory after the first ecdysis outside its egg sac, it was considered that the beginning of its monitoring occurred in the 2nd instar. A sample taken from an individual container and two from the community container were observed capturing *Drosophila* sp. concomitantly with the dispersion of the spiderlings from the observation place in the field (the 7th day after emergence of spiderlings). Twenty days after the emergence of spiderlings, no cannibalism was observed, when *Drosophila* sp. was provided.

In the laboratory, 15 mating attempts were made with all possible combinations of couples, utilizing three males and five females. Mating was not registered for any of the experiments. It was observed that when the males perceived the proximity of the female, they initiated the courtship ritual.

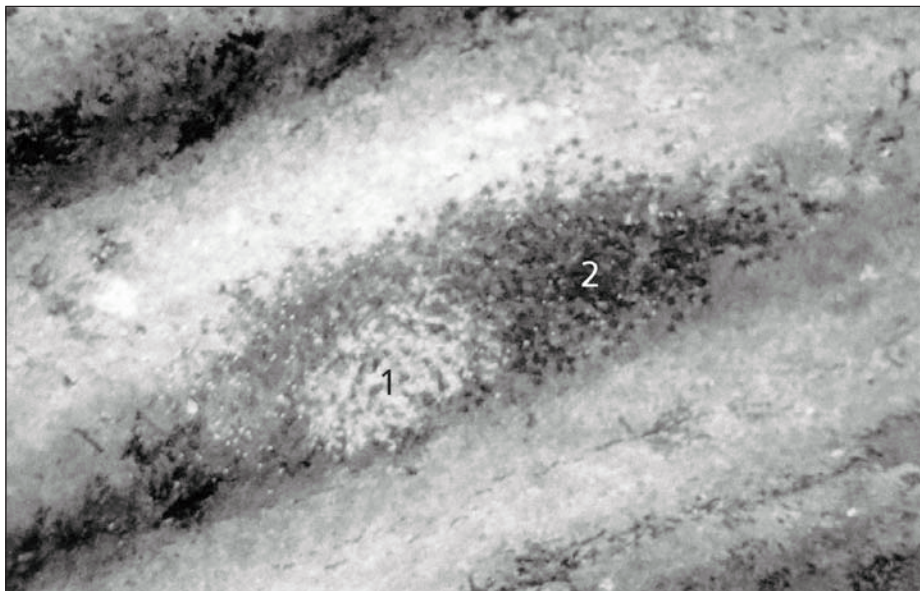


Fig. 1 — Web of *Ctenus medius* with exuvies and offspring: 1. exuvies (795 exuvies were counted) and 2. offspring.



Fig. 2 — Spiderling of *Ctenus medius* in 4th instar on the hand of an adult man.

TABLE 1
Intermoult period (P) of *Ctenus medius* (in days) during its life cycle.

	*P ii n = 20	P iii n = 20	P iv n = 20	P v n = 16	P vi n = 13	P vii n = 9	P viii n = 9	P ix n = 8	P x n = 6	P xi n = 5	P xii n = 4	#P xiii n = 4	#P xiv n = 2
\bar{X}	17	15.1	16.1	20	17.5	21.4	21.4	25.8	31	36.6	48	39.3	35.3
Máx	17	22	21	25	24	28	29	28	38	46	50	49	39
Min	17	12	11	15	14	18	14	23	23	29	45	34	28
S	0	2.737	2.791	2.088	3.201	3.270	4.450	1.615	4.726	5.535	1.871	6.848	5.500
Death rate (%)													
	0	0	0	20	18.7	30.7	0	11.1	25	16	20	0	50

*Soon after they left the egg sac, they made one ecdysis in the web and continued under the care of the mother.

After the 13th ecdysis, a female and a male made the sexual ecdysis and after 14th ecdysis, two males made the sexual ecdysis.



Fig. 3 — Female of *Ctenus medius* and its offspring.

For the courtship ritual, the males reacted slowly, raising and lowering the two pairs of anterior legs in rhythmic movements. The females allowed the males to touch them. However, the females did not allow the males to stay for more than thirty seconds. When the male attempted to continue the mating process, the female moved the male away with a voracious attack. However, none of the females abated the male when they were left

for more than four hours in the same container. The same experimental procedure utilizing *P. nigriventer* showed that the females of this species allowed the mating in the laboratory with more easiness and frequently they abated the males before or after the mating process. For *P. nigriventer* the presence of a detached courtship ritual was not observed, it was restricted to unobtrusive palpal movements of the male.

DISCUSSION

With the obtained data, it was concluded that in the laboratory *C. medius* reached sexual maturity in the 14th or 15th instar, which occurs in the 10th or 11th month after its emergence. According to Schuster *et al.* (1994), *Cupiennius* sp. reaches maturity at approximately 9 months of age.

It was observed that the female monitored in the field stayed in the same site where it was found with its egg sac until the emergence and dispersion from observation's place of its offspring. It appeared that moving the egg sac was not common. However, to arrive at this conclusion, a larger sampling would be necessary. We believe that eventually the female moved the egg sac outside of its shelter. Gasnier (1996) observed that occasionally females of *C. amphora*, *C. crulsi* and *C. manauara* carry their egg sac. These authors did not state that they had been expelled from their refuge by some animal.

In the field, the female was monitored daily raising the "roofing tile shelter", and securing it in place. Höfer *et al.* (1994) also mentioned that *Ctenus* species were seldom found to be carrying egg sacs in the field.

The results of the study of the chromatic patterns by Almeida *et al.* (2000) show that it is possible to separate *C. medius* from *Ctenus ornatus* (Keyserling, 1891) in the field though chromatic patterns. With *C. ornatus*, only one female carrying its egg sac was found on the UBM campus. In Petrópolis (municipality of Rio de Janeiro State), a mountain region in an area dominated by secondary Atlantic Forest, 28 adult females of *C. ornatus* were observed and collected. Three of them carrying their egg sac, and three/four days after its capture, spiderlings emerged from the egg sac.

In this study, the female spider was not observed making a web bed for its spiderlings in the field. It was observed that on the 7th day after the emergence, when the spiderlings started dispersing from the site, the female still remained in the place where the egg sac was constructed. The obtained data corroborates with what was observed by Höfer *et al.* (1994) for the *Ctenus* spp. from the Amazon. These authors reported that the Amazonian spiderlings also spent 7 days under the care of their mother.

The female abandoned the site where the offspring emerged on the 8th day after their emergence (one day after offspring dispersion from the observation place). It was observed that the dispersion of the spiderlings from observation place occurred at the same time that the first spiderling was observed eating. This proves the assumption that offspring departure from their mother's care occurs due to feeding needs, when the viteline resources diminish.

The data obtained through observation of the spiderlings kept in the community container, as compared to the ones kept in individual container, suggests that cannibalism among brother spiderlings, in the first instars, is not probable. When they were maintained together, with adequate food, they did not practice cannibalism.

While *P. nigriventer* frequently killed the males, during the mating process, *C. medius* did not kill them. Bücherl (1951) mentions that frequently *P. nigriventer* practices cannibalism among its brothers. This indicates a lesser interspecific aggressiveness for *C. medius*. Cannibalism among brothers of this species in samples kept in a community container was rarely observed. *Phoneutria nigriventer* also shows better adaptability to laboratory conditions, since its mating and development were easily obtained by Bücherl (1951). These results were not obtained for *C. medius*, in this research.

Phoneutria spp. is the second most important cause of spider bites in the central-western, southeastern and southern parts of Brazil. These accidents are more common in March and April and are probably related to the mating period of these spiders when they are more easily seen and captured (Bücherl, 1951, 1985; Lucas, 1988; Ramos *et al.*, 1998). Although without statistical data, we observed that males of *C. medius* on the UBM campus also are easily seen in March and April, together with *P. nigriventer*. It indicates that these species have a similar reproductive period. This fact can cause confusion for arachnid identification in biting cases.

It is known that laboratory studies cannot be used as precise models for the real biology of a species. However, these data may assist in initial bionomic studies of the biology of *C. medius* and offer comparative parameters for studies of other species of this family.

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