Ability to capture prey in early instars of the subsocial spider *Anelosimus studiosus* (Hentz, 1850) from Uruguay (Araneae, Theridiidae)

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Summary

An obligatory phase of maternal care in social spiders is the feeding of young spiderlings by regurgitation, indicating a strong mother-dependence. First instar juveniles of *Anelosimus studiosus* from Uruguay were occasionally observed capturing small fruit flies under laboratory conditions. We tested this possible predatory precocity by removing the mother and providing live fruit flies to juveniles in the first, second and third post-emergence instars. All instars were able to capture prey, but this ability increased sharply when spiderlings reached the second instar, suggesting that they would capture small prey also under field conditions. This precocity for prey capture is reminiscent of that performed by solitary theridiid species, which are able to capture prey from the first instar. It also suggests that this population has a weak behavioural adaptation to the mother-dependent social lifestyle which characterises other more social species of the genus.

Introduction

Sociality has evolved by increasing the mother-dependence period in various animals (Wilson, 1971). One of the most important pre-adaptations to sociality among spiders is the presence of a web, because it allows the communication necessary for tolerance and cooperation (Shear, 1970). Another important prerequisite is the arachnid mode of feeding (external digestion), allowing communal food sharing and possibly chemical communication (Krafft, 1979). The development of regurgitation to feed the spiderlings permits prolonged maternal care and close contact among broodmates. The mother usually feeds only young spiderlings by regurgitation and when the juveniles grow up she shares prey captured by herself (Buskirk, 1981).

As in other social spiders, the theridiid genus *Anelosimus* Simon, 1891 shows a wide range of sociality: from the sub-social *A. jucundus* (O. P-Cambridge, 1896) or *A. studiosus* (Hentz, 1850) to *A. eximius* (Keyserling, 1884) which was considered eusocial by Vollrath (1986) and Vasconcellos-Neto *et al.* (1995). Brach (1977) investigated the degree of mother-dependence of the first instars of *A. studiosus* from Florida (USA), providing small living and freshly-killed prey items to juvenile groups without their mother. He found that juveniles were capable of capturing prey only after their fourth moult, and reached adulthood in the seventh or eighth instar. This author assumed the occurrence of a high level of mother-dependence for these juveniles, even in this low-social species. This dependence would involve the complete inability of small juveniles to disperse and to found new colonies by themselves, as well as the inability of juvenile groups to survive when the mother dies. However, juveniles of *A. studiosus* could survive by eating their own dead mother (a frequent phenomenon in the genus) or being fed by other females in multi-female nests (Riechert & Jones, 2001). Brach (1977) found that nests in Florida were occupied by only one female, but later Furey (1998) and Jones & Parker (2000) observed multiple female nests in both Tennessee and Florida (USA).

Anelosimus studiosus shows a wide geographical distribution in the Americas (Levi, 1956, 1963), suggesting the occurrence of different populations adapted to varied environmental conditions and/or the existence of several cryptic species. Differences in ecology, sex-ratio, and female–female tolerance between different geographical populations have already been reported (Brach, 1977; Furey, 1998; Avilés & Gelsey, 1998; Jones & Parker, 2002). Uruguayan populations show a certain degree of intolerance among adult females, a factor that would constrain large multi-female nests (Viera *et al.*, submitted). Occasional observations of fly capture (Fig. 1), cannibalism on dead congeners and matriphagy by early instars (second and third) of *A. studiosus* from Uruguay suggested a lower degree of mother-dependence, indicating the ability of these juveniles to survive under hard conditions.

In this paper, we tried to confirm experimentally these occasional observations, which could improve the current knowledge about the predatory characteristics of one of the less social populations in the genus.

Material and methods

Eighty-one broods were obtained from 44 females mated in the laboratory, which were captured as

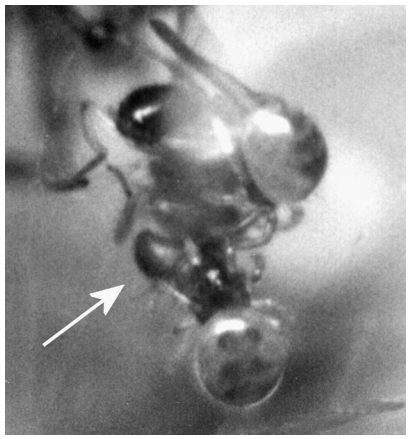

Fig. 1: Two first-instar spiderlings eating a fruit fly, which is hanging head downwards. The mother's legs appear above the juveniles. The arrow indicates the head of the fly. Photo by M. A. Benamú.

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juveniles on a native tree (*Rapanea laetivirens*, Myrsinaceae) in Montevideo. During the inter-experimental periods, each brood (composed of approximately 30 spiderlings) was kept with the mother in a small Petri dish of 3.5 cm diameter and 0.9 cm height, with water provided. Room temperature averaged 23.2°C (± 2.9 SD). They were fed with fruit flies (*Drosophila* spp.) *ad libitum*. We checked daily for juvenile survival and occurrence of moulting, and measured the carapace length of the exuviae to estimate the instar of development.

Experiments were carried out from August to December 2001. We removed the mother and remains of prey from the dish; the juveniles were kept in the same dish and were deprived of prey for 24 hrs. Then, juveniles were provided with five living fruit flies, and their immediate predatory responses were observed. Twenty-four hrs later, we recorded the number of dead flies — as an indirect measurement of capture — and replaced the mother. During this 48 hr-period, the mother was fed *ad libitum*. The same broods were tested at the first, second and third instar after emergence from the egg sac. Each instar was assigned when at least half plus one individual reached the same degree of development (same number of moults). As control groups, five living fruit flies were placed in similar Petri dishes, simultaneously with the experimental groups. These dishes contained threads of silk left by females removed just before the experiments. Chi-square test for two independent samples was used.

Results

Some first-instar spiderlings were observed attacking and biting fruit flies that were entangled in the silk threads. Juveniles in their second and third instar were frequently observed attacking and capturing the flies immediately after they were placed into the dishes. Quantitative data of dead prey from each experimental group of spiderlings, as well as from the control groups, are given in Table 1. We found significant differences of mortality between the control group and the three experimental groups (first instar: $\chi^2=13.91$, $p=0.0002$; second instar: $\chi^2=281.28$, $p<0.0001$; third instar: $\chi^2=307.49$, $p<0.0001$). There were also differences in mortality among the experimental groups: $\chi^2=217.57$ ($p<0.0001$) between first and second instar; $\chi^2=241.06$ ($p<0.0001$) between first and third instar; $\chi^2=6.08$ ($p=0.0136$) between second and third instar.

	N	Given flies	Dead flies	Mortality (%)
1st instar	77	385	179	46.5
2nd instar	68	340	329	96.8
3rd instar	66	330	328	99.4
Control (flies only)	45	225	70	31.1

Table 1: Total given flies, dead flies and mortality observed after a 24 hr-period in dishes with broods of *Anelosimus studiosus* at different instars of development, and without spiderlings (control group). N = number of experiments.

Discussion

The ability of young spiderlings to eat and capture small prey under laboratory conditions was confirmed, even during the first instar. These findings disagree with Brach's observations (1977) on North American populations, in which juvenile *A. studiosus* caught prey only from the fifth instar, also under laboratory conditions. Uruguayan populations clearly show a low level of mother-dependence, suggesting also a low degree of sociality. The small first-instar spiderlings showed a low but significant ability to capture flies when compared with the mortality of flies in the controls. However, these spiderlings probably do not capture prey in the field, considering their low performance under experimental conditions, which greatly facilitate prey capture.

Capturing ability increased sharply when the spiderlings reached the second instar, suggesting that they could use this capacity also under field conditions. This precocity for prey capture is similar to that performed by solitary theridiid species, suggesting a weak behavioural adaptation to the mother-dependent social lifestyle that characterises the more social species of the genus. The Uruguayan populations of *A. studiosus* are near the southern distribution limit for the species and frequently the nests are composed of a single female and her brood: spiderlings emerge in summer, the mother dies in late autumn, and juveniles face winter in the fourth or fifth instar (Viera *et al.*, submitted). If the mother dies early, spiderling precocity for capturing prey — in addition to matriphagy — could help them to survive by themselves, mainly in one-female nests where they do not have substitute maternal care from other adult females.

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