

## Synonymy of *Argyrodes rigidus* Exline & Levi, 1962 with *Argyrodes striatus* Keyserling, 1891 (Araneae: Theridiidae), with notes on foraging behaviour and host species selection

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### Summary

Many species of the spider genus *Argyrodes* are known from a single sex. This is the case for two species of the *cancellatus* group previously collected in south and south-east Brazil: *A. rigidus* Exline & Levi, 1962, known only from females, and *A. striatus* Keyserling, 1891, from males. In this study *Argyrodes* were collected from webs of six host species in an area of Atlantic Forest in the State of São Paulo. A large number of females of *A. rigidus* and males of *A. striatus* were collected, sometimes in the same host web, indicating that they are conspecific. Thus, *A. rigidus* is considered a junior synonym of *A. striatus*, **syn. nov.** These spiders were observed feeding on a stored food bundle wrapped by the host and gleaning small Diptera from the host web. *Verrucosa arenata* (Araneidae) was the main host species. The preference for these hosts may be a consequence of their relatively larger webs, tolerance of the presence of kleptoparasites, and their behaviour of storing food bundles, allowing the exploitation of large resource patches by *Argyrodes*.

### Introduction

The worldwide distributed genus *Argyrodes* comprises 226 species, 32 of which are known only from males, 63 from females and 3 from juveniles (Platnick, 2003). Members of this genus exhibit a diversified range of foraging strategies, including particular techniques of araneophagy and kleptoparasitism (Whitehouse *et al.*, 2002). Many species live in webs of other spiders, gleaning small insects, stealing and consuming web threads and stored food bundles, or even feeding with the host, ingesting part of the pre-digested prey items. Some species attack the hosts when they are in the

vulnerable period of moulting. Others capture the hosts, throwing lines of sticky silk over them or simply grabbing small individuals with their front legs (see Eberhard, 1979; Smith Trail, 1980; Tso & Severinghaus, 1998; Whitehouse, 1997; Whitehouse *et al.*, 2002).

Exline & Levi (1962) revised the American species of *Argyrodes*, dividing the genus into six species groups. These groups were established on the basis of the morphology of the cephalic region and clypeus of males, and shape of the abdomen and genitalia. Behavioural observations to date suggest that spiders within four of the species groups use similar foraging strategies. The *Rhomphaea* and *Ariamnes* groups capture spiders by throwing silk over them, while species of the *argyrodes* group seem to be specialised on kleptoparasitism, and members of the *trigonum* group forage using both kleptoparasitism and araneophagy, attacking other spiders and directly biting them. However, there is no information about the *cordillera* group, and the large *cancellatus* group includes species with very distinct habits. This variation, in addition to the size of this last group and its morphological diversity, suggests that the *cancellatus* group is not monophyletic (Whitehouse *et al.*, 2002) and emphasises the need for additional behavioural data on more species of this group.

There are 55 American species of *Argyrodes* included in the *cancellatus* group. However, information about most of them is restricted to morphological descriptions and geographical distribution. Eleven species are known only from females and 8 only from males (Exline & Levi, 1962; González & Carmen, 1996; Levi, 1967).

### Material and methods

I inspected all the webs of 11 species of potential hosts located along the forest borders of 3 trails in the Parque Estadual de Intervalos, a large area of Atlantic Forest (49,000 ha) located in Ribeirão Grande, State of São Paulo, Brazil (24°16'S, 48°25'W). The surveys were initially designed to evaluate the frequency of occupation of webs of *Cyclosa morretes* Levi and *Cyclosa*

Host	Webs inspected	Webs only with <i>A. striatus</i> males	Webs only with <i>A. striatus</i> females	Webs with <i>A. striatus</i> males and females	Total number of <i>A. striatus</i> collected	Total number of the new species collected
<b>Araneidae</b>						
<i>Alpaida veniliae</i> (Keyserling, 1865)	26	0	0	0	0	0
<i>Araneus vincibilis</i> (Keyserling, 1893)	1	0	0	1	3♂ 2♀	0
<i>Argiope argentata</i> (Fabricius, 1775)	6	0	0	0	0	0
<i>Cyclosa fililineata</i> Hingston, 1932	637	2	0	0	3♂	2 juv.
<i>Cyclosa morretes</i> Levi, 1999	168	2	2	3	5♂ 6♀	2 juv.
<i>Eustala</i> sp.	28	0	0	0	0	0
<i>Gasteracantha cancriformis</i> (Linnaeus, 1758)	4	0	0	0	0	0
<i>Micrathena plana</i> (C. L. Koch, 1836)	3	0	0	0	0	0
<i>Parawixia audax</i> (Blackwall, 1863)	11	0	1	0	1♀	0
<i>Verrucosa arenata</i> (Walckenaer, 1842)	158	9	14	3	13♂ 20♀	1♂ 3 juv.
<b>Tetragnathidae</b>						
<i>Leucauge</i> sp.	155	0	2	0	2♀	1♀
<b>Lycosidae</b>						
<i>Aglaoctenus lagotis</i> (Holmberg, 1876)	5	0	0	0	0	0
<b>Total</b>	1202	13	19	7	24♂ 31♀	1♂ 1♀ 7 juv.

Table 1: Total number of webs of potential hosts inspected during the surveys and occupied by *Argyrodes*.

*fililineata* Hingston (Araneidae) by kleptoparasites, and extended later to other possible hosts in the area.

The inspections were done during the day time (08:00 to 17:00) in May and June 2003, corresponding to the dry season. The web owners and any other spiders present or with threads connected to host webs were captured, stored in 70% alcohol and identified in the laboratory. The specimens examined were deposited in the spider collection of the Instituto Butantan, São Paulo.

The first ten webs of each of the most abundant host species located along the main trail were measured (vertical and horizontal diameters), to compare the area available for colonisation by kleptoparasites. Web area was calculated using the ellipse formula  $(d_v/2)(d_h/2)\pi$  and compared by ANOVA and Tukey's HSD test. I also measured the carapace width of hosts and *Argyrodes* specimens collected in their webs to evaluate the relation between the sizes of the hosts and kleptoparasites.

## Results and discussion

### Distribution and taxonomy

I found 64 specimens of *Argyrodes* in webs of 6 host species (Table 1): 24 males of *A. striatus* Keyserling, 31 females of *A. rigidus* Exline & Levi, and 9 specimens of a new species (1 male, 1 female and 7 juveniles), all of them belonging to the *cancellatus* group according to the definition of Exline & Levi (1962). A total of 1130 webs of these 6 host species were examined during the survey. Five species of potential hosts did not have any kleptoparasites in their webs. I also found 3 other males of *A. striatus* and another female of *A. rigidus* on threads without connection with any other web, and two males of *A. striatus* and one female of *A. rigidus* co-occupying an abandoned host web. The absence of males of *A. rigidus* and females of *A. striatus* in Parque Estadual Intervales, in addition to the observation that both species occur in the same host webs, indicates that they are conspecific.

Exline & Levi (1962) described *A. rigidus* based on two females from Teresópolis, State of Rio de Janeiro, Brazil. They included an observation in the diagnosis of *A. rigidus* that this could be the female of *A. striatus*, but did not mention why they came to this conclusion. Males, but not females, of *A. striatus* were collected previously in several localities in south and south-east Brazil, but not in the type locality of *A. rigidus* (Exline & Levi, 1962; Platnick, 2003). This is the first record of males and females collected in the same locality. Thus I consider *Argyrodes rigidus* Exline & Levi, 1962 a junior synonym of *Argyrodes striatus* Keyserling, 1891, **syn. nov.**

### Behavioural observations

I observed one male of *A. striatus* feeding on a large wasp that had been captured and entangled by

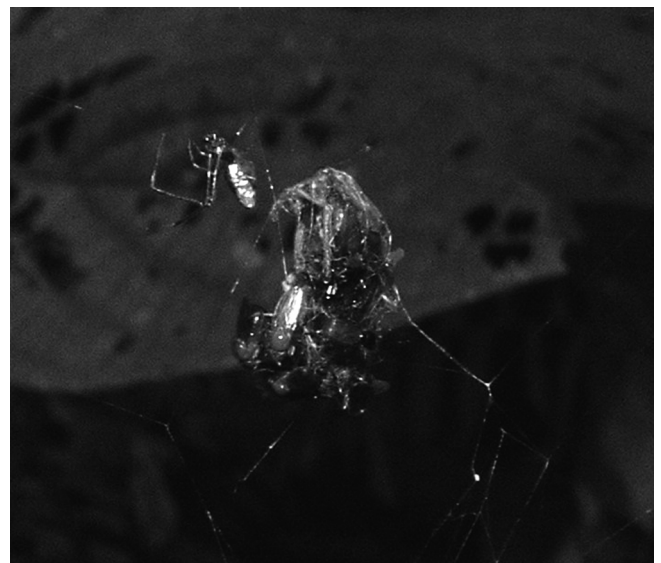


Fig. 1: Male of *Argyrodes striatus* after feeding on a prey captured by *Verrucosa arenata*. This food bundle was also attacked by kleptoparasitic flies.

Host species	Host carapace width (mean $\pm$ SD) (n)	<i>A. striatus</i> carapace width (mean $\pm$ SD) (n)
<i>Verrucosa arenata</i>	2.46 $\pm$ 0.42 (26)	0.56 $\pm$ 0.07 (33)
<i>Araneus vincibilis</i>	3.8 (1)	0.55 $\pm$ 0.11 (5)
<i>Leucauge</i> sp.	0.77 $\pm$ 0.05 (2)	0.50 (1)
<i>Cyclosa fililineata</i>	0.62 $\pm$ 0.07 (2)	0.57 (1)
<i>Cyclosa morretes</i>	1.37 $\pm$ 0.09 (4)	0.54 $\pm$ 0.07 (10)
<i>Parawixia audax</i>	3.33 (1)	0.47 (1)

Table 2: Carapace width (mm) of hosts and kleptoparasites found in their webs.

*Verrucosa arenata* (Walckenaer) (Fig. 1) and a female gleaning small Diptera entangled in a web of another individual of the same host species. Specimens of *A. striatus* were generally found on their own threads connected with the webs of their hosts, but I observed many individuals entering the sticky spiral region without attracting the attention of the resident spider. The number of specimens of *A. striatus* per host web varied from 1 to 5 (mean=1.41, SD=0.84,  $n=39$  webs). Most hosts, with the exception of some immature individuals of *Cyclosa fililineata*, are larger than the invaders (Table 2) and probably are not susceptible to predation by them.

The relatively larger number of individuals of *A. striatus* in webs of *V. arenata* in relation to the other most abundant host species in Parque Estadual Intervales may be related to the larger web area available for occupation (Fig. 2) (ANOVA,  $F_{4,45}=36.3$ ,  $p<0.001$ ). Besides, webs constructed by *Verrucosa* often intercept large prey items and the host behaviour of wrapping and fixing food bundles in the web allows the exploitation of profitable resource patches by the kleptoparasites. In addition, large hosts often neglect very small insects, which could be captured by *A. striatus*, and probably are less capable of locating and attacking the small invaders. Henaud (2000) observed that *V. arenata*, and especially *Gasteracantha cancriformis* (Linnaeus), rarely show aggressive behaviours towards *Argyroides globosus* (Keyserling). Other smaller hosts, such as *Leucauge argyra* (White), were much more aggressive.

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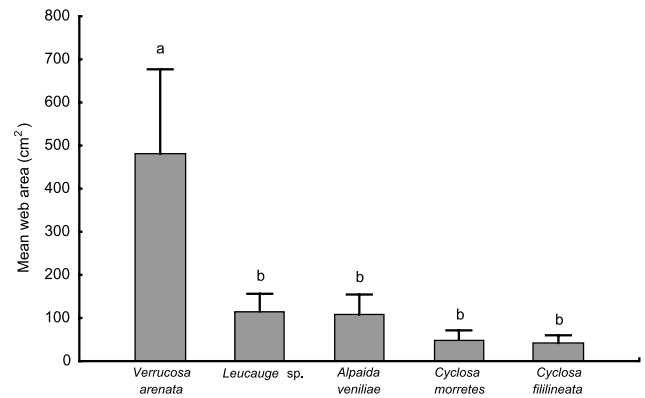


Fig. 2: Web area of the most abundant potential hosts for *A. striatus* in Parque Estadual Intervales (mean  $\pm$  SD,  $n=10$  for all host species). Columns labelled with the same letter do not differ significantly from each other, while those with different letters differ at the 0.05 level according to Tukey's HSD test.

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