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Author: Bauer, Tobias

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SHORT COMMUNICATION

The camouflaged silken retreat of *Viridasius* sp. (Araneae: Viridasiidae)

Tobias Bauer: State Museum of Natural History Karlsruhe, Erbprinzenstr. 13, 76133 Karlsruhe, Germany; E-mail: tobias.bauer@smnk.de

Abstract. The natural and life history of the family Viridasiidae is largely unexplored. Laboratory observations on specimens of a species belonging to the genus *Viridasius* Simon, 1889 have shown that it constructs hanging, silken retreats for molting and hiding. These retreats are camouflaged with soil, sand, or debris, similar to the already known egg sac of this species. The retreats are similar to the silken resting cells known in dionychan spider families, such as Gnaphosidae, Clubionidae, Cheiracanthiidae or Salticidae and corroborate the recent classification of Viridasiidae as Dionycha.

Keywords: Ctenidae, life history, natural history, spider, spinnerets

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The Viridasiidae Lehtinen, 1967 has been given family status by Polotow et al. (2015) based on a comprehensive phylogenetic analysis of the Lycosoidea. Although traditionally treated in the Ctenidae (e.g., Silva Dávila 2003), the viridasiids do not belong to this family, and are more closely related to groups in the dionychan clade (Polotow et al. 2015, Wheeler et al. 2017). Their diversity is still unexplored, and both recognized genera (*Viridasius* Simon, 1889 and *Vulsor* Simon, 1889; World Spider Catalog 2020, but see Wheeler et al. 2017) are in need of a taxonomic revision on the species level. At least one species of the family is frequently bred in captivity and used for laboratory studies. It is sometimes referred to as *Viridasius fasciatus* (Lenz, 1886), e.g., in Eggs et al. (2015), although the true identity of the specimens forming the captive population is unclear because many species are still to be described (Silva Dávila in Polotow et al. 2015). Still, this represents a possibility to study the behavior and life history of a nearly unknown evolutionary clade. Life history traits, such as silk use, proved to be of diagnostic and phylogenetic value (e.g., Piacentini & Ramírez 2019) and can be used to describe the functional diversity of spider assemblages in relation to habitat structures (Cardoso et al. 2011). However, for most spider taxa, including species of medical relevance (e.g., Hazzi 2014; Dolejš & Hanko 2018), knowledge on the life history is limited or absent.

Bauer et al. (2018) already described a pendulous, camouflaged egg sac typical for a widespread *Viridasius* species in captivity. They mentioned that silken cells used as a retreat during daytime and for molting were camouflaged with earth and sand in the same way as the egg sac. However, the authors could not exclude an artefact because of the low numbers of observed retreats. Over the last two years, I observed several individuals of the species pictured in Bauer et al. (2018) in the laboratory and noticed that the silken retreats are always camouflaged with substrate such as coco humus or sand. These observations represent insights into the behavior and life history of this little-known family and provide new data on the size and structure of the silken retreats of *Viridasius* sp., which seem to play a central role in the ontogenetic development of these spiders.

Four *Viridasius* specimens were obtained as small juveniles (body length 3–4 mm) from a local breeder in June 2018. They were kept in an office (at room temperature) in commercially available cricket boxes with coco humus mixed with sand. For comparison, one specimen (a male) was kept on black sand without any organic or loamy fractions. Subadult or adult female specimens were transferred to glass containers of $15 \times 15 \times 20$ cm with coco humus or potting soil as substrate and a piece of bark or a potsherd as a hide. Adult or subadult males were transferred to plastic containers with c. $15 \times 10 \times 13$ cm volume with similar equipment. Additional observations were made on three specimens and from several offspring (>10) of the egg sacs shown in Bauer et al. (2018). These spiders were kept in larger containers. All specimens were fed once per week with one or two house crickets (*Acheta domesticus* (Linnaeus, 1758)) of adequate size. Water was sprayed into the containers once or twice per week. To avoid deficiency syndrome due to a unilateral diet, the spiders were additionally fed about once per month with other insects such as dipterans or juvenile grasshoppers (*Schistocerca gregaria* (Forsskål, 1775)).

All specimens, including the male kept on loose sand, built a silken retreat camouflaged with substrate or debris, in which the spiders hid and molted (Fig. 1). The silk of the retreats was tear-resistant, partly transparent and hung loosely from its attachments on the cover. When touched, it was not adhesive. Retreats attached to the cover lid had a bi-convex or oval form (Fig. 2) with two slits of 1–3 cm on both long ends (Fig. 1D). The shapes of retreats under bark or in coconut shells were of a more irregular form and adapted to the shape of the hide. The measurements of silken retreats constructed by four subadult spiders (3 males, 1 females) and one juvenile are given in Table 1. Retreats of juvenile spiders in earlier developmental stages were smaller. A subadult male that was transferred from its smaller cricket box to a larger plastic container with a height of 13 cm built a completely new retreat attached to the cover lid (Table 1, line 4; Fig. 2A). The substrate (potting soil) had to be transported by the spider from the ground level over a vertical distance of at least 10 cm. During a night before the silken retreat appeared, I observed that the subadult male was spinning loose, irregular bands of silk extending from the cover lid to the soil. The silken bands were already partly encrusted with substrate. Two days later, the male must have finished the silken and already camouflaged retreat during the night. I never observed a retreat that was finished, but not at least partly covered with soil or debris.

All retreats were constructed about one to four weeks before the first molt and usually attached to the upper corner or directly on the cover lid of their containers. The spiders always build their retreats during darkness. During the night, the spiders reacted to disturbance with an immediate stop of all activities and often fled into hides. Therefore, the construction of the retreat was never directly observed. Some days after molting, the old exuvia was frequently found on the substrate or attached to outside of the silken retreat (Fig. 1A). Adult males and females never built a new retreat after being transferred to larger containers, but hid in corners and crevices of the introduced bark or potsherds, usually avoiding the soil of the container. All

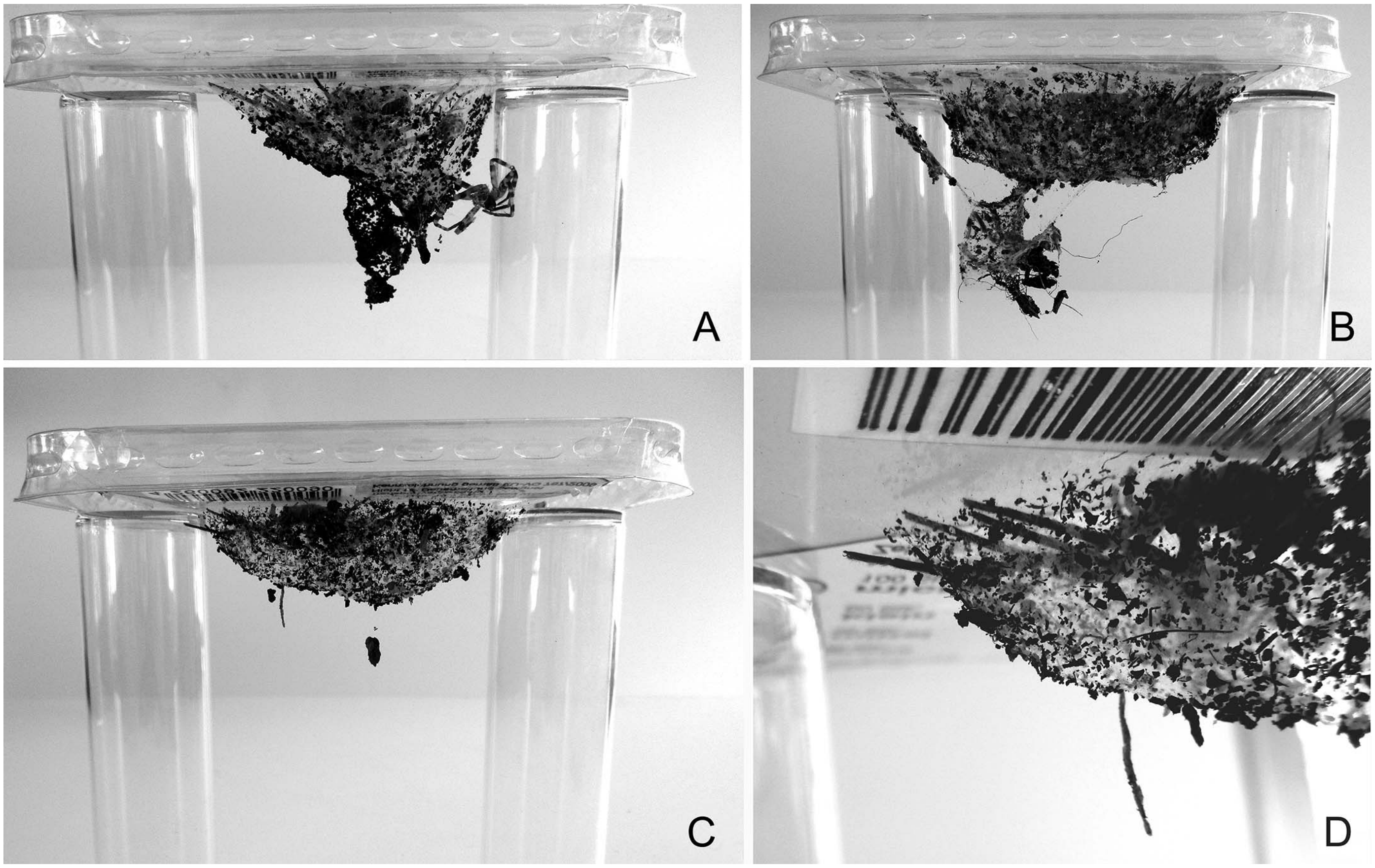

Figure 1.—Inhabited camouflaged silken retreats of three specimens of *Viridasius* sp. built in captivity, lateral view, demonstrating the extent of camouflage by soil or sand. (A) subadult male kept on black sand with exuvia attached to the outside of retreat, (B) subadult female kept on coco humus and sand, (C) juvenile (body length ~13 mm) kept on coco humus and sand, (D) juvenile with protruding legs at the opening of the silken retreat after disturbance (upper left).

developmental stages easily moved on vertical panes, including glass. If the silken retreat was transferred together with the spider, it often remained in use. In some cases, the juvenile spiders built a new retreat attached to the old one, especially when it was damaged during transfer or feeding. The spiders were often sitting next to an opening with protruding legs (Fig. 1D), particularly after disturbances or when insects were introduced into the container. As seen in Fig. 1, the cover lids of the boxes could easily be removed together with the spider and positioned on two glass vials. However, when directly touched, *Viridasius* spiders can emerge extremely fast from their retreats and often escape from their containers (but were always recaptured).

Bauer et al. (2018) showed that the species masks their egg sacs as well, possibly to prevent detection by egg scavengers or parasitoids. A similar protective function can be assumed for the covered retreats. A non-camouflaged silken cell would be very conspicuous due to its whitish color, but in its camouflaged state, it is visually (and possibly olfactorily) more difficult to detect. Although the term “nest” or “resting nest” is sometimes used for silken retreats (e.g., Wolf 1990), this seems inadequate for juvenile or subadult specimens because any reproduction activities are lacking during those life stages. The term “nest” is generally related to reproduction. Therefore, it should not be used for silken retreats that are used solely for resting and/or molting.

Table 1.—Measurements of silken retreats constructed by *Viridasius* sp. in captivity on cover lids of plastic containers. All measurements in cm.

length	width	development stage	body length
8.1	4.1	subadult female	~2.0
7.8	3.3	subadult male	~1.9
8.8	3.7	subadult male	~1.9
10.2	5.2	Subadult male	~2.0
7.2	2	juvenile	~1.3

Silken retreats are documented for a large number of dionychan spiders. Wolf (1990) and Peck & Whitcomb (1970) described the different types of silken cells in species of the genus *Cheiracanthium* C.L. Koch, 1839, which are often located between leaves or stems connected with silk (Wolf 1990). Most jumping spiders (Salticidae) are known to build silken tubes for resting, molting and reproduction (Richman & Jackson 1992); Grimm (1985) presented pictures of the silken nests and retreats of various gnaphosid species from Central Europe. Silken resting and molting cells were also described by Austin (1984) for Australian species of Clubionidae.

In contrast, Lycosoidea do not construct silken retreats similar to those of dionychan spiders. Large wolf spiders (Lycosidae), especially representatives of Lycosinae like *Lycosa tarantula* (Linnaeus, 1758) often live and hide in burrows lined with silk (Bellmann 2010). Others, like species of *Pardosa* C. L. Koch, 1847, are nearly complete vagrants, even in the the period of reproduction (e.g., Edgar 1971). Other Lycosoidea behave similarly. Species of *Ancylometes* Bertkau, 1880 and *Dolomedes* Latreille, 1804 live most of their life as vagrants and construct a large nursery web for their offspring (Höfer &

Figure 2.—Inhabited silken retreats of *Viridasius* sp. from below, built in captivity. (A) subadult male kept on potting soil, (B) juvenile (body length ~13 mm) kept on coco humus and sand

Brescovit 2000, Zimmermann & Spence 1992). *Ctenus medius* Keyserling, 1891 was found during the day sitting under rocks and tree trunks, while wandering around at night (Almeida et al. 2000), similar to *Phoneutria boliviensis* (F. O. Pickard-Cambridge, 1897) (Hazzi 2014). Therefore, the herein described silken retreats of *Viridasius* sp. are more similar to those found in several dionychan spider families, and corroborate the classification of Viridasiidae as members of the Dionycha (Polotow et al. 2015, Wheeler et al. 2017).

I hope that this note might also be of help in the field when in search of new species of Viridasiidae. The spider fauna of Madagascar is largely unexplored, and probably contains a high number of endemics with a very restricted distribution (see, e.g., Jocque et al. 2017; Pett & Bailey 2019). The herein described observations suggest that searching for viridasiids at night and on tree trunks and low branches might be more effective than the extensive use of pitfall traps at ground level.

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