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— Short Communication —

A CASUAL CANTHAROPHILY: THE MEETING BETWEEN *ASTYLUS VARIEGATUS* (COLEOPTERA: MYLERIDAE) AND *OXYPETALUM BANKSII* (APOCYNACEAE: ASCLEPIADOIDEAE)

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Abstract—Cantharophily is reported for the first time in a Brazilian asclepiad, involving the mylerid *Astylus variegatus* and the nectariferous flowers of *Oxypetalum banksii*, a plant mainly pollinated by wasps. The use of nectar as food by *A. variegatus*, considered pollinivorous and granivorous, is also novel. The mutual interaction described here is an example of a plant-pollinator interaction with generalist insects visiting a plant with a specialized pollination system. It's also temporary and occasional and, therefore, is often overlooked in studies of plant-pollinator interactions. In this study, we found that the casual meeting between *O. banksii* and *A. variegatus* was a key event for the reproduction of both.

Key words: *Asclepiad, Atlantic Forest, Brazil, beetles, specialized pollination, wasps*

The asclepiads (Apocynaceae: Asclepiadoideae, *sensu* Endress & Bruyns 2000) have highly elaborate and complicated flowers. There is an unusual synorganization between parts and also between organs of different categories (Endress 1994). This has led to the evolutionary origin of new organs that are not present in other angiosperm groups in this combination: corona (more or less well developed outgrowths of the corolla and/or stamens), gynostegium (congenitally fused and highly synorganized gynoecium and androecium) and pollinaria (pollen aggregated into masses (pollinia) with mechanical clips (translators) which attach them to pollinators).

The pollination in these plants is a result of pollinaria removal (five per flower) and insertion of pollinia in stigmatic chambers (five chambers per flower - more details in Wyatt 1976; Kunze 1991). In Brazil, a country rich in asclepiads and many of them endemic and rare (Rapini et al. 2002), studies on interactions between asclepiads and their pollinators are restricted to that of Vieira and Shepherd (1999a) and Medeiros et al. (2008). According to Ollerton and Liede (1997), pollinators of these plants are diverse, including Diptera (flies), Hymenoptera (bees and wasps) and Lepidoptera (butterflies and moths). These authors commented that specialized beetle pollination is rare in the asclepiads.

In fact, only three recent studies have demonstrated cantharophily (pollination by beetles) in asclepiads. Ollerton et al. (2003) documented for the first time in South Africa, a specialized pollination system that involves asclepiads (*Asclepias woodii*, *Sisyranthus trichostomus* and *Xysmalobium involucratum*) and chafer beetles (Scarabaeidae: Cetoniini). Shuttleworth and Johnson (2008) described, also in South Africa, a bimodal pollination system in the asclepiad *Xysmalobium undulatum*; its pollination is performed by two unrelated species (or functional groups) of pollinators: chafer beetles and pompilid wasps (Hymenoptera: Pompilidae). These authors, in 2009 and at the same study site, described four specialized pollination systems in asclepiads, one of them involving three asclepiad species of *Pachycarpus* and chafer beetles (Shuttleworth & Johnson 2009).

Other studies have reported beetles as flower visitors of asclepiads, but did not confirm their role as pollinators. Woodell (1979) recorded cetoniid chafers (*Mausoleopsis aldabrensis*) visiting flowers of three asclepiads on Aldabra. Forster (1989) documented what may be specialized beetle pollination in *Marsdenia fraseri*, involving the lycid *Metriorrhynchus lateralis* (Coleoptera: Lycidae) in Australia. Hawkeswood (1994) observed, also in Australia, *Micraspis frenata* beetles (Coleoptera: Coccinellidae) on flowers of *Asclepias curassavica* and *Gomphocarpus physocarpus*. The author recorded the novelty of the use of nectar as food for these beetles. Vieira and Shepherd (1999a) studied a floral visitor guild of seven species of *Oxypetalum* in Brazil and found an unidentified species of cantharid (Coleoptera: Cantharidae) and *Enoclerus* sp. (Coleoptera: Cleridae) on flowers of *Oxypetalum banksii* feeding on nectar; they were not seen carrying pollinaria.

Oxypetalum banksii Schult. is an endemic vine from Brazil, inhabiting areas of the Cerrado and Atlantic Forest (Rapini et al. 2010). In the municipality of Coimbra (20°50'07"S and 42°49'52"W), Zona da Mata of Minas Gerais State, southeastern Brazil and site of the present study,

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this plant inhabits areas with highly modified vegetation, such as pastures and roadsides. Individuals are found isolated and flowering occurs throughout the year (Vieira & Sherpherd 1999a). Their flowers are nectariferous (Vieira & Shepherd 2002a) and pollinated by wasps (mainly Vespidae), which carry pollinaria on the mouthparts (Vieira & Sherpherd 1999a). *Oxypetalum banksii* is self-compatible, but depends on pollinators due to herkogamy, which prevents spontaneous self-pollination (Vieira & Shepherd 1999b).

The beetle *Astylus variegatus* (Germar, 1824) (Coleoptera: Myleridae) occurs in several states of Brazil, including Minas Gerais, as well as Paraguay and Argentina (Souza & Carvalho 1994). Adults are seen in flowers of native or cultivated plants, feeding on pollen (Schlottfeldt 1944; Costa Lima 1953; Silva et al. 1968; Matioli & Figueira 1988). Rossetto and Rossetto (1976) observed for the first time, in southeastern Brazil, a large number of adults of *A. variegatus* feeding in panicles of sorghum (*Sorghum bicolor* (L.) Moench) and damaging seeds. These authors commented that the population of beetles disappeared abruptly; one day after a finding of infestation, no insect was found in the field or nearby. Their larvae, which live in soil, are considered agricultural pests because they feed on corn seeds, in newly-sown crops (Matioli et al. 1990).

In March 2011, a month in which *A. variegatus* adults are commonly observed in southeastern Brazil (Rossetto & Rossetto 1976; Matioli & Figueira 1988; Matioli et al. 1990), 300 individuals of this species were recorded in a flowering plant of *O. banksii*. Given this fact, the objectives of this study were to describe the visiting behaviour of *A. variegatus* on flowers of *O. banksii*, in order to understand its role in the plant reproduction. For this, we carried out observations and quantified pollinaria removal and insertion of pollinia in 136 flowers. In addition, photographic records were made and 82 beetles were collected to confirm pollinaria attached to their bodies, the number of beetles with pollinaria and the number of pollinaria carried by insects.

In the plant, the ratio of individuals of *A. variegatus* and flowers was balanced (about 1:1). No other insect was observed, except a few individuals (about six) of an unidentified species of cantharid beetle. In a flower, up to seven individuals of *A. variegatus* were observed, including couples in copulation (Fig. 1).

Astylus variegatus remained for long periods in a single flower and visited several flowers of the plant without damaging the flowers. During copulation and flower visitation, the female takes the nectar as food, the only resource available, while the male is loaded in her back (Fig. 1b, c). Males were also observed feeding on nectar. The use of this floral resource by *A. variegatus*, considered pollinivorous (Matioli & Figueira 1988; Matioli et al. 1990) and granivorous (Rossetto & Rossetto 1976) is a new record.

Beetles introduced the mouthparts in the corolla tube to access the nectar, placing the head between the corona and the gynostegium (Fig. 1a), in a behaviour similar to wasps (see Vieira & Shepherd 1999a). Individuals of *A. variegatus* were also observed in panicles of the grass *Brachiaria decumbens* Stapf, close to individual of *O. banksii*. These beetles probably fed on their seeds, similar to that observed by Rossetto and Rossetto (1976).

We observed flowers with up to five pollinaria removed, the average being 2.04 per flower (Tab. 1). This value is higher than that recorded by Vieira and Shepherd (2002b), of 1.45 pollinaria removed per flower by wasps. According to these authors, in a study with seven species of *Oxypetalum*, *O. banksii* showed one of the highest values of pollinaria removal and one the lowest values of pollinia insertions (0.02 pollinia per flower). This tendency of higher pollinaria removal and low pollinia insertions was maintained because

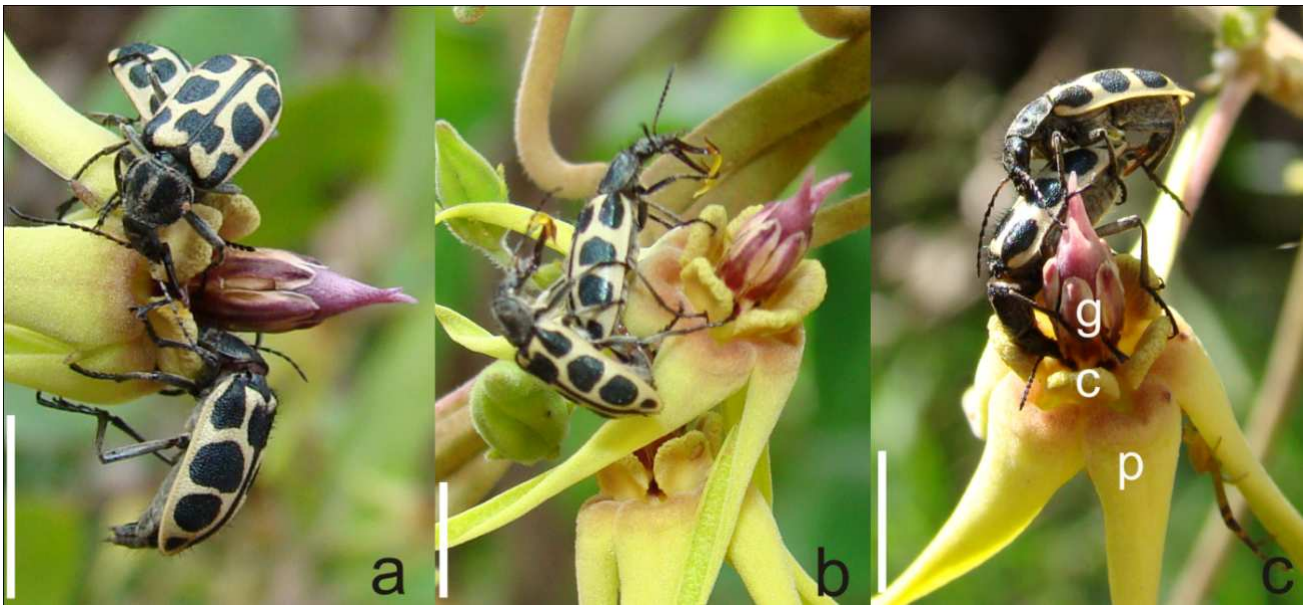

FIG. 1. *Astylus variegates* on flowers of *Oxypetalum banksii*. (a) Three beetles on the flower, one with the mouthparts inserted in the corolla tube between the corona and gynostegium. (b) Couple in copulation on flowers, female with two pollinaria and male with one pollinarium on the mouthparts. (c) Couple in copulation, the female with the mouthparts inserted in the corolla tube. c, corona; g, gynostegium; p, petal. Bar = 5 mm.

Flowers examined (no.)	Pollinaria removed (no. flower / % flower)						Pollinaria removed per flower (mean)
	0	I	2	3	4	5	
136	13	38	36	33	11	5	2.04
	9.56	27.94	26.47	24.26	8.09	3.68	

TAB. I. Pollinarium removal in flowers of *Oxypetalum banksii*.

only two flowers were pollinated, each flower with one pollinium inserted (0.01 pollinia per flower). Low insertion of pollinia seems to be the reason for the low natural fruit set in *O. banksii* (0.8%; Vieira & Shepherd 1999b) which has also been commonly recorded in other asclepiads (see Wyatt & Broyles 1990).

Our findings included zero (69.50%), one (26.80%), two (2.44%) and three pollinaria (1.22%) on beetles' mouthparts. Vieira and Shepherd (1999a) observed one or two pollinaria on wasps' mouthparts. Among the 25 insects (of 82 in total) seen with pollinaria, 11 were males and 14 were females.

The visiting behaviour of females and males of *A. variegatus* on flowers of *O. banksii*, their ability to remove pollinaria and most likely insert pollinia, are factors that favour their role as pollinators. It is the first record of cantharophily in a Brazilian asclepiad and of mylerid beetles acting as pollinators of this group of plants.

Another factor that favours the role of *A. variegatus* as pollinator of this asclepiad is its self-compatibility (Vieira & Shepherd 1999b), therefore independent of pollen flow between plants for fruiting. Moreover, the flowers of *O. banksii* have a peculiar morphological feature described by Vieira and Shepherd (2002a), which allows a production of two fruits (twin follicles) after one inserted pollinium in a flower. The other asclepiads, including other *Oxypetalum* species, after the insertion of one pollinium, produce only one follicle per flower (more details in Sage et al. 1990; Vieira & Shepherd 2002a). Twin follicles result in higher production of seeds and thus there seems to be a compensation for their low reproductive success. To illustrate, after the insertion of one pollinium per flower, *Oxypetalum appendicultum* Mart. produces a single follicle with up to 166 seeds, while the twin follicles of *O. banksii* produce up to 282 seeds (Vieira & Shepherd 1999b). Thus, the two pollinated flowers observed in this study could produce up to 564 seeds.

Pollination of *O. banksii* by *A. variegatus* is dependent on an opportunistic meeting between the plant and beetle. It is an example of a plant-pollinator interaction with generalist insects visiting plants with a specialized pollination system. This interaction favours the reproduction of *O. banksii*, especially considering its unstable habitat (pastures and roadsides), where the presence of pollinators is uncertain. The mutualistic interaction described here is temporary and occasional and, therefore, is often overlooked in studies on plant-pollinator interactions. The present study, however, shows that the casual meeting between *O. banksii* and *A. variegatus* is a key event for the reproduction of both.

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