Herpetology Notes, volume 7: 689-692 (2014) (published online on 25 November 2014)

New record of day geckos feeding on orchid nectar in Reunion Island: can lizards pollinate orchid species?

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Lizard pollination is common among insular floras, often being viewed as an island phenomenon (e.g. Withaker, 1987; Olesen and Valido, 2003; Godinez-Alvarez, 2004). Especially, the genus *Phelsuma* represents a key taxon in the reproduction of many native plant species (Nyhagen et al., 2001; Hansen, Beer and Muller, 2006; Hansen and Muller 2009; Le Péchon et al., 2013). Day geckos are mainly distributed in the southwestern region of the Indian Ocean (e.g. Austin, Arnold and Jones, 2004). These arboreal lizards are known to include a major component of nectar and pollen in their diet (e.g. Nyhagen et al., 2001; Olesen, Eskildsen and Venkatasamy, 2002; Kaiser 2006; Deso et al., 2008; Olesen et al., 2012; Clémencet et al., 2013; Minaar et al., 2013), and recent studies, conducted on Mauritius' and Reunion's floras (Mascarene Archipelago), have shown that lizard pollination involves a wide range of plant families, including Rousseaceae (Hansen and Müller 2009), Malvaceae (Hansen, Beer and Muller, 2006; Hansen et al., 2007; Le Péchon et al., 2013) and Araliaceae (Nyhagen et al., 2001). In some cases, pollination by *Phelsuma* species is vital to ensure sexual reproduction of native endangered plants species (Nyhagen et al., 2001; Hansen, Beer and Muller, 2006; Hansen and Müller 2009). To date, only one observation of a *Phelsuma* visiting orchid flowers has been reported (Micheneau et al., 2010), and beside this "single day gecko visit" in Reunion Island, only one case of lizard feeding on orchid nectar has been reported in Caymans Island (Burton, 2008), but on extra-floral nectaries only without visiting the flowers of *Myrmecophila thomsoniana* (Rchb. f.) Rolfe. Here we described and discussed the first case of *Phelsuma* interactions with flowers from the orchid family in Reunion Island, involving the endemic day gecko *Phelsuma borbonica* Mertens, 1966 visiting flowers of *Angraecum cadetii* Bosser (endemic to Reunion and Mauritius) and *Angraecum bracteosum* Balf. & S. Moore (endemic to Reunion).

The first observation has been briefly reported by Micheneau et al. (2010) but yet no picture has been published. During field experiments in a *Pandanus* forest in La Plaine des Palmistes (860 m a.s.l.), JF observed an adult *P. borbonica* feeding on nectar in a flower of *A. cadetii* (Fig. 1) on 03.03.2008 at approximately 8.00 am. The observation lasted approximately two minutes, during which time the gecko returned twice to the same flower, for 10 to 15s each time. No pollen removal has been recorded, but flower's pollinaria was already removed before the visit of the gecko.

The second interaction was recorded by JFB during three consecutive days, from 10.03.2014 to 12.03.2014, in the morning between 10.00 am and 12.30 pm, in a *Pandanus* forest in La Plaine des Palmistes (1100 m a.s.l.). Three individuals of *P. borbonica* were observed visiting flowers of the same plant of *A. bracteosum*. The first two days, a single immature day gecko was observed visiting at least 10 flowers (Fig. 2) for approximately 6 minutes each day. The last day, three geckos (the same immature, an adult male and another immature) were observed during 26 minutes, probing at least 50 flowers. During these observations, some flowers were visited several times (three times as a maximum). Each single flower visit lasted from 10 to 20s, during which time geckos licked nectar with their tongue. One pollinium

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Figure 1. The day gecko *Phelsuma borbonica* and *Angraecum cadetii*. A: an adult male arriving at orchid flowers; B: the same individual feeding on nectar. Photo: J. Fournel.

removal was observed but the pollinarium was eaten by the gecko.

These *Phelsuma-Angraecum* observations represent the first documented case of lizards as orchid nectar consumers in the Mascarenes. Pollinators of both orchid species are already known: *A. bracteosum* is pollinated by two passerines, *Zosterops borbonicus* (Forster, 1781) and *Zosterops olivaceus* (Linnaeus, 1766) (Micheneau et al., 2008) and *A. cadetii* is pollinated by a raspy cricket, *Glomeremus orchidophilus* Hugel, 2010 (Micheneau et al., 2010). Despite many hours of video observations of orchid flowers at the same study site in la Plaine des Palmistes (i.e. 392h34min for *A. bracteosum* and 171h35min for *A. cadetii*, see Micheneau et al, 2008; 2010), geckos were never observed probing nectar on *A. bracteosum* flowers, while only one visit was observed in *A. cadetii*. This suggests that visits by day geckos seem to be rare or happen only in localized places. However, because nectar is an important part of *P. borbonica*'s diet (e.g. Deso et al., 2008) and because orchid flowers seem to be morphologically adapted to allow geckos reaching nectar into the spur, to what extent *P. borbonica* is occasionally involved in *Angraecum* orchids' pollination in Reunion remains an open question. Further observations are needed, especially in areas where high density of *P. borbonica* and *Angraecum* have been recorded. Although the pollinator of *A. cadetii* is thought to be exclusively nocturnal (Hugel et al., 2010; Micheneau et al., 2010), a few potential cases of pollen removal have been reported occurring during the day (JF pers. obs.). The two other known daily visitor species of *A. cadetti* are endemic passerines from the Zosteropidae family, namely *Z. borbonicus* and *Z. olivaceus*, but daily video records have never shown these birds removing or depositing pollinaria (Micheneau et al., 2010). In *A. bracteosum*, the flower opening is very narrow (see Micheneau et al., 2008 for flower measurements) and adult geckos do not seem to become in contact with the pollinaria with their head but rather with their tongue, so that pollinaria are expected to be predominantly consumed by geckos while being removed from the flowers. It is possible, however, that younger geckos may go deeper into the flowers and thus get in contact with the pollinaria with their head. Morphological comparisons would be useful to determine if pollen removal and deposition by *P. borbonica* are "mechanically" possible in both orchid species.

Acknowledgements. We would like to thank Jens M. Olesen for reviewing this manuscript. We also thank Jean Marie Pausé and Stéphane Baret (Parc National de la Réunion).

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Figure 2. Immature *Phelsuma borbonica* feeding on nectar in flowers of *Angraecum bracteosum*. A: upside position, B: upright position. Photo: J.F. Bègue.

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Accepted by Zoltán Nagy