In the tropics, vertebrates play an important role as pollinators in many ecosystems. Rodents, birds, and bats are the best-known vertebrate pollinators in tropical regions (Nabhan and Buchmann, 1997). Apart from these, many lizard species have been documented to feed on flowers and potentially act as a pollinator (Godínez-Álvarez, 2004). Yet, lizard pollination remains understudied since the beginning of the 20th century (Olesen and Valido, 2003). At present, there are 34 species of lizards known to feed on nectar and flowers of 97 known plant species (Godínez-Álvarez, 2004). Presumably, lizards feeding on nectar are effective pollinators because they transport pollen grains from one flower to another (Godínez-Álvarez, 2004). There are several examples of lizard species which are known to transport pollen such as Podarcis lilfordi (Günther, 1874) which was observed to carry pollen grains of Euphorbia dendroides L. (Traveset and Saez, 1997) and Crithmum maritimum L. (Perez-Mellado and Casas, 1997). Geckos of the genus Hoplodactylus collect large amounts of pollen on their throats and transport it up to at least 50 m for 12 hours to another flower (Whitaker, 1987).

The calabash tree (Crescentia cujete L., 1753) is a perennial species, native to tropical America and widely introduced across Asia (Burger and Gentry, 2000; Arango-Ulloa et al., 2009). It usually grows in lowland and semi-evergreen tropical forests (Gentry, 1980, 1992) and is cultivated in many gardens for aesthetic purposes and natural fences and medicines (Heinrich et al., 1998; Reyes and Rosado, 2000; Das et al., 2014). The Long-Nosed Bat, Glossophaga soricina (Pallas, 1766) has been reported as a pollinator of C. cujete in the Neotropics (Lemke, 1984; Lemke, 1985). In the Paleotropics, the pollinators of this species remain understudied, but the Dagger-toothed Nectar Bat Macroglossus minimus (É. Geoffroy, 1810) was observed by the first author to visit the flowers of C. cujete. In May 2016, we discovered that the introduced gecko Gehyra mutilata (Wiegmann, 1834) visits the flowers of C. cujete during the evening, and we subsequently documented this behaviour over a period of seven months.

Photo and video documentation of the gecko-plant interaction was conducted between mid-2016 to early-2017 in the lowland rural area at Bagumbayan, Tulunan, North Cotabato, Philippines (6.8444°N, 124.8788°E). We recorded the habit and behavior of G. mutilata to determine if the observed behaviour was opportunistic or a regular interaction between the plant and the gecko (see supplementary file for full video documentation). A single flowering C. cujete tree with a height of approximately 6 m was regularly monitored from 1900–0000 h. Individuals of G. mutilata started their activity at around 2000 h when the flowers of C. cujete were fully open and started to emit a pungent sulphurous odour.

The feeding activity of the geckos started by locating a fully-opened, cauliflorous flower (Fig. 1A,B). After an individual gecko had located a target flower, it moved to the outer part of the flower (Fig. 1C–E), presumably to check the presence of available nectar.
In some observations, individual *G. mutilata* moved on to another flower without feeding on the first one. After the individual gecko found a target flower, it moved at least a third of its body inside it and started feeding (Fig. 1G,H). *Gehyra mutilata* are good climbers and easily reached cauliflorous flowers laying on stems or hanging down from different heights. The feeding on an individual flower usually lasted a few minutes, after which a gecko moved along the branches to look for another flower. Flowers were not visited by more than...
one individual *G. mutilata* at the same time. Geckos remained active until 0100 h when flowers started to close their petals.

This is the first documented evidence of *G. mutilata* feeding on *C. cujete*, a species that is otherwise known to be pollinated by bats. *Gehyra mutilata* is widely distributed throughout Southeast Asia and other tropical regions (e.g., Fisher, 1997; Devan-Song and Brown, 2012). It is a nocturnal predator of small insects and common in urbanized areas (Devan-Song and Brown, 2012). A recent comprehensive diet analysis revealed that *G. mutilata* mainly consumes arthropods, particularly Diptera (Nematocera), and has never been recorded to feed on nectar (Barragán-Ramírez et al., 2015). In the family Gekkonidae, the genera *Hoplodactylus*, *Naultinus*, and *Phelsuma* have been recorded and are known as nectar feeders and potential pollinators (Whitaker, 1987; Nyhagen et al., 2001). The day gecko *Phelsuma mutabilis* (Grandidier, 1869) was observed to feed on the nectar of the mangrove tree *Sonneratia alba* Smith, 1816 from southwest Madagascar (Taylor and Gardner, 2014), and *Phelsuma borbonica* Mertens, 1966 was reported to feed on the nectar of the orchid *Angraecum cadetti* Bosser, 1988 (Bégue et al., 2014).

On this occasion, we did not examine the pollination role of *G. mutilata* but observed that pollen sticking to the gecko’s snout and body came in contact with the flowers’ stigmata (Fig. 1F,G) which indicates that *G. mutilata* is a potential pollinator of *C. cujete*. Additionally, we observed few *G. mutilata* individuals carrying pollen grains of *C. cujete* on their throats (Fig. 1I), similar to other nectarivorous gecko. The capacity of the gecko to transfer pollen from the anther to the stigma remains to be studied in further investigations. Nonetheless, similar observations of the gekkonid species *Hoplodactylus duvauceli* (Duméril and Bibron, 1836), *Woodworthia maculata* (Gray, 1845), and *Phelsuma ornata* Gray, 1825 found that these species deposit on their throats a considerable amount of pollen grains of the flowers they visit (Sáez and Traveset, 1995; Godinez-Alvarez, 2004). We hope that our observation will encourage ecologists to further explore this previously undocumented plant-animal interaction. The only known pollinator of *C. cujete* is a nectarivorous bat from the Neotropics and it will be interesting to investigate how the Calabash Tree is pollinated in the absence of its natural pollinators.

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References


**Supplementary Video**

A supplementary video documentation of the nectarivory of Gehyra mutilata on C. cujete tree was deposited and accessible from here: https://doi.org/10.6084/m9.figshare.5285995.v1.