



First in Situ Breeding Observation of Polillo Forest Frog, *Platymantis polillensis* (Taylor 1922), in a Winged Pitcher Plant (*Nepenthes alata*) in Northern Luzon, Philippines

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Associations between frogs and pitcher plants in the genus *Nepenthes*, particularly the use of pitchers as reproductive sites, are broadly known and have been widely documented in Southeast Asia, especially in Peninsular Malaysia and on the island of Borneo (Dover et al. 1928; Lim and Ng 1991; Adlassnig et al. 2010; Maglangit et al. 2023). At least twelve species of frogs in the families Microhylidae and Rhacophoridae have been documented utilizing *Nepenthes* pitchers as oviposition and breeding sites, including the Rufous-sided Sticky Frog (*Kalophrynus pleurostigma*) in *N. ampullaria* (Lim and Ng 1991; Adlassnig et al. 2010); Variable Sticky Frog (*K. cf. heterochirus*) in *N. stenophylla* (Etter et al. 2021); Matang Narrow-mouthed Frog (*Microhyla nepenthicola*) and Bornean Narrow-mouthed Frog (*M. borneensis*), both in *N. ampullaria* (Das and Haas 2010; Paisal and Wahab 2012); Saffron-bellied Frog (*Chaperina fusca*) and an unidentified species of *Microhyla* in *N. bicalcarata* (Malkmus and Dehling 2008; Biggi 2023) (all microhylids) and rhacophorids in the genus *Philautus*, including the Java Bubble-nest Frog (*P. aurifasciatus*) in *N. sanguinea* (Yong et al. 1988), Kerangas Bubble-nest Frog (*P. kerangae*) in *N. bicalcarata* (Dring 1987), Murud Bubble-nest Frog (*P. mjobergi*) and Sauer's Bush Frog (*P. saueri*) in *N. villosa* (Phillipps and Lamb 1988; Malkmus et al. 2002), *Nepenthes* Bush Frog (*P. nepenthophilus*), a recently described species, in *N. mollis* (Etter et al. 2021), and eggs of unspecified species of *Philautus* in *N. ampullaria*, *N. bicalcarata*, and *N. hurrelliana* (Kiew 1987; Clarke 1997; Phillipps et al. 2008). Some of these frogs are considered nepenthephiles, species that live in close association with *Nepenthes* sp. but do not strictly depend on them for survival, whereas others are identified as nepenthexenes, which opportunistically or incidentally exploit species of *Nepenthes* (Beaver 1979).

In the Philippines, few natural history observations and field-based reports documenting reproductive associations between frogs and species of *Nepenthes* are currently available. Thus far, such records have been reported only from the island of Mindanao. The first instance was in 2016, when A.N. Pili, A.N. Lorenzo II, and A.C. Diesmos photographed a developing clutch of eggs, presumably deposited by a species in the genus *Philautus*, in *N. justinae* at the Mt. Hamiguitan Range Wildlife Sanctuary (pers. comm.). In the second

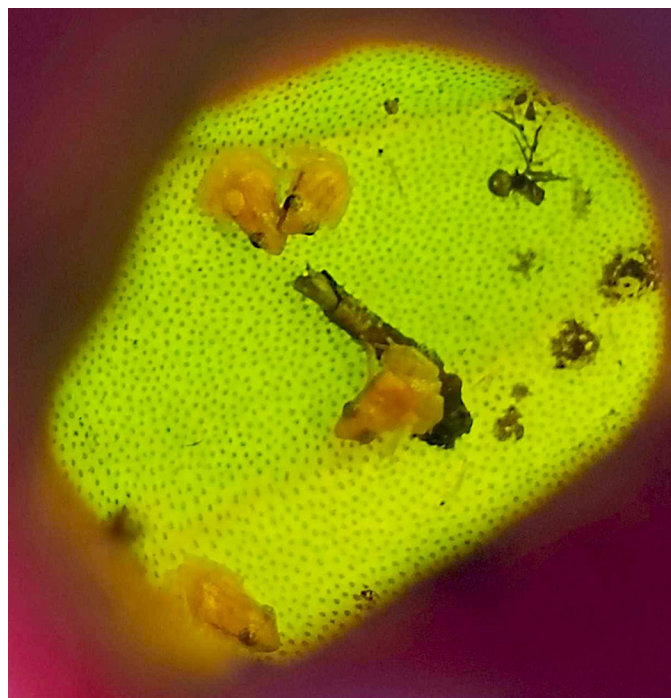


Figure 1. Newly metamorphosed Polillo Forest Frogs (*Platymantis polillensis*) in a Winged Pitcher Plant (*Nepenthes alata*) in the Apayao Lowland Forest of Luzon, Philippines. Photograph by P. Malindog.

instance, Maglangit et al. (2023) documented a Mindanao Cross Frog (*Oreophryne anulata*) in a dormant pitcher of *N. copelandii* at Mt. Apo Natural Park. Interestingly, senescent or damaged pitchers were involved in both records. However, in the present study, we observed a fully functional and active pitcher plant serving as a breeding site for a ceratobatrachid frog, representing the first documented case in the Philippines other than Mindanao Island.

Our observation occurred during a Philippine Eagle field expedition in the pristine forest of the Apayao Lowland Forest Key Biodiversity Area (KBA-4), which was recently designated as the fourth Biosphere Reserve in the Philippines (PEF 2024) in Barangay Eva, Calanasan, Apayao (18.41700, 121.06128; elev. 911 m asl) on 18 April 2024. Observations were made from a tree platform 15 m above the ground that was used to detect Philippine Eagles and other raptors. We unexpectedly discovered four froglets, presumably *Platymantis* sp., with no attending adult in a fluid-filled, fully developed pitcher of *Nepenthes alata*. We examined the other 15 active pitchers of the same plant without finding additional froglets. The metamorphosed froglets had cream-colored dorsums and lateral body surfaces and blackish masks extending from the tip of the snout to the thighs (Fig. 1). Based on published descriptions of developing *P. hazelae* (Bucol et al. 2019), we estimated that the froglets were 3–5 days post-hatching.

On 19 April 2024, an unsexed attending adult (27 mm SVL) was present (Fig. 2). The frog was in the center of the pitcher, facing the lip, similar to observations by Hua and Lee (2004) and Maglangit et al. (2023). We captured this individual, which allowed us to identify it as a Polillo Forest Frog (*Platymantis polillensis*), family Ceratobatrachidae, based on a pointed head about as wide as the body; a conical snout tip; nostrils located much closer to the tip of the snout than to the

eye; a distinct, large conical tubercle on the upper eyelid near its outer middle edge; a horizontal pupil; smooth dorsal skin; smooth throat skin with numerous minute pit-like depressions; a strongly granular belly and underside of the femur; tips of the three outer fingers with strongly dilated pads, nearly twice the width of the digits, and inner fingers tiny, slender, and lacking a pad; large, flat, moderately defined sub-articular tubercles; a single large carpal tubercle; no webbing between the toes; dilated toe tips, about 1.5 times the width of the digits; a very long fourth toe, with the third and fifth toes equal in length and barely reaching the third subarticular tubercle on the fourth toe; a creamy white to yellow dorsum, lightly pigmented with minute cinnamon-brown dots; a cinnamon bar between the eyes, with dim spots around the dorsal tubercles; upper eyelids dark gray to blackish; spots on the outer digits of all limbs; faint bars on the tibiae and femurs; chin and throat yellow with sparse brown peppering; undersides of the hands and belly immaculate but those of the legs and feet strongly peppered with brown. These characteristics closely matched the original species description by Taylor (1922), based on holotypes collected from an unspecified locality on southern Polillo Island.

On 20 April 2024, we found no froglets and assumed that they had independently moved out of the pitcher. The same adult *P. polillensis* was present but resting on a different pitcher of the same plant. Dover et al. (1928) suggested that fauna living in pitcher fluid possess antiproteases (antipepsin and antitrypsin), which render them resistant to the digestive fluids in the pitcher. However, this has been confirmed only in *Sarcophaga sarcophagina*, a dipteran species that breeds in Yellow Pitcher Plants (*Sarracenia flava*). To the best of our knowledge, no studies have been conducted on fauna living in *Nepenthes* spp., including the *Nepenthes*-breeding species of



Figure 2. Field documentation of the association of Winged Pitcher Plants (*Nepenthes alata*) and Polillo Forest Frogs (*Platymantis polillensis*) in the Apayao Lowland Forest of Luzon, Philippines: A Winged Pitcher Plant growing epiphytically on a tree trunk (left); an adult Polillo Forest Frog resting in a fluid-filled pitcher (center); and the same adult outside a pitcher (right). Photographs by P. Malindog (A–B) and T.L.P. Senarillos (C).

frogs. How these *Nepenthes*-breeding frogs are able to withstand the digestive enzymes secreted by the plant should be the focus of future studies.

Given that both species are endemic and have overlapping distributions, reproductive associations between *N. alata* and *P. polillensis* might be common albeit undocumented. *Nepenthes alata* is known to occur on all major islands in the Philippines except Palawan (Pelsner et al. 2011). It grows terrestrially or epiphytically in a variety of habitats at elevations from sea level to about 1,400 m asl (McPherson and Amoroso 2011). *Platymantis polillensis* is known to be arboreal and to utilize epiphytic microhabitats in lowland and lower montane forests to elevations of 915 m asl (Brown et al. 2012, 2013; IUCN SSC Amphibian Specialist Group 2018).

Our observation suggests that pitcher plants in the genus *Nepenthes* serve as oviposition sites for *P. polillensis*; however, further observations are needed to assess the frequency and ecological significance of this behavior. These pitchers might also provide a readily available food source for the developing frogs, in particular dipteran larvae that dominate the phytotelmata of these pitcher plants (Dover et al. 1928; Beaver 1979; Kitching 2000; Adlansnig et al. 2010). Still, given the limited ecological information and the potentially novel nature of this association, several questions remain unanswered and characterizing *P. polillensis* as a *Nepenthes*-breeding specialist is premature. Nevertheless, given the apparent abundance of *P. polillensis* in the study area and its known use of epiphytic microhabitats, we speculate that it might also utilize other phytotelmata, such as pockets of water in leaf axils or water-filled tree holes, as breeding sites (Kitching 2000).

Our observation also suggests that documenting other *Nepenthes*-vertebrate interactions in the Philippines, similar to those observed in Sabah, Malaysia, is plausible. Examples include the mutualistic relationship between the Mountain Treeshrew (*Tupaia montana*) and several species of pitcher plants, including *N. lowii*, *N. macrophylla*, and *N. rajah* (Clarke et al. 2009, 2010), and an association of the Woolly Bat (*Kerivoula hardwickii*) and *N. hemsleyana* (Lim et al. 2014; Schöner et al. 2015). Since the Philippines hosts endemic species of treeshrews and native bats in the genus *Kerivoula* with distributions that overlap with those of several species of *Nepenthes*, such interactions are highly plausible.

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