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Living near humans: new diet items for the Big-headed Treefrog *Polypedates megacephalus* (Amphibia: Anura: Rhacophoridae) and its tadpoles in Vietnam

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Abstract - The predation by the Big-headed Treefrog *Polypedates megacephalus* on the Common House Gecko *Hemidactylus frenatus* and a failed predation attempt on the Tokay Gecko *Gekko gekko* are reported. In addition, for the first time, tadpoles of this treefrog species were observed scavenging on dead Asian Grass Lizard *Takydromus sexlineatus*, Boie's Wart Frog *Fejervarya limnocharis*, and unidentified species of the annelid order Haplotaxida. All observations were carried out in urban environments.

Key word: frog, tadpole, necrophagy, predation, Vietnam.

Riassunto - Vivere accanto agli esseri umani: nuovi alimenti nella dieta della raganella dalla testa grossa *Polypedates megacephalus* (Amphibia: Anura: Rhacophoridae) e dei suoi girini in Vietnam. Si segnalano la predazione da parte della raganella dalla testa grossa *Polypedates megacephalus* sul gecko delle case asiatico *Hemidactylus frenatus* e un tentativo fallito di predazione sul gecko tokay *Gekko gekko*. Inoltre, per la prima volta, sono stati osservati girini di questa specie di raganella che si nutrivano di esemplari morti di lucertola asiatica a sei linee *Takydromus sexlineatus*, rana verrucosa di Boie *Fejervarya limnocharis* e specie non identificate di anellidi dell'ordine Haplotaxida. Tutte le osservazioni sono state condotte in ambiente urbano.

Parole chiave: rana, girino, necrofagia, predazione, Vietnam.

Introduction

The Big-headed Treefrog *Polypedates megacephalus* Hallowell 1861 is known to occur in both human-modified and forest habitats. It occurs widely from subtropical and tropical China to northeastern India, Myanmar, Thailand, Laos, and Vietnam (Frost, 2024; Trinh *et al.* 2023). Although morphologically similar to *Polypedates mutus* (Smith 1940), *P. megacephalus* can be distinguished for the presence of numerous small reticulate markings on the back (only a few large reticulate markings on the back in *P. mutus*); the absence of black or brown spots on the sides, spots arranged in reticulate patterns along the posterior (dark brown spots present laterally, and the posterior lacks any reticulate patterns in *P. mutus*); and tibial-tarsal joints stretching between the eyes and nostrils in *P. megacephalus*, while stretching to the snout or nostrils in *P. mutus* (Liu *et al.*, 2018; Pham *et al.*, 2023). The tadpole of *P. megacephalus* is characterized by having an oval body with spiracle sinistral and directed posteriorly; vent tube directed posteriorly, positioned at the ventral margin; tail slightly convex; oral disc opened anteroventral with Labial Tooth Row Formula in 4(2–4)/3(1); body coloration brown with a light spot on snout, ventral white (Vassilieva *et al.*, 2017; Tesia *et al.* 2017). Previous studies on the feeding ecology of *P. megacephalus* reported its dietary composition to be primarily invertebrates such as arachnids, insects, isopods, gastropods, and occasionally small frogs (Pham *et al.*, 2019; Pham *et al.*, 2023; Trinh *et al.*, 2023). Gut content analysis showed that larval *P.*

megacephalus feed on microalgae, pollen, microcrustaceans, and terrestrial arthropods (Vassilieva *et al.*, 2017). In addition, Vassilieva *et al.* (2017) reported that *P. megacephalus* tadpoles feed on anuran eggs or tadpoles but did not specify which species are involved. However, these studies were conducted in forested areas, distant from anthropogenic habitats. To date, no research has specifically investigated the diet of *P. megacephalus* or its tadpoles in urban habitats. As a general contribution to the knowledge of this anuran species, I report four new records concerning the feeding behaviour of *P. megacephalus* in both its adult and tadpole stages in residential areas of Vietnam.

New predation behaviours recorded in adult *P. megacephalus* individuals

On 28 July 2024 at 20:30 h in a small garden situated in Dang Giang Ward, Ngo Quyen District, Hai Phong City, Vietnam (20°50'11"N 106°42'08"E, WGS 84, 9 m a.s.l.), Nguyen Xuan Thai (*pers. comm.*) encountered an adult *P. megacephalus* preying on an adult Common House Gecko *Hemidactylus frenatus* Duméril & Bibron 1836 on a plastic rope about 3 m above the ground (Fig. 1A). When first noted, the frog was swallowing the gecko's posterior half of the body while using its hands to hold the reptile. The gecko struggled to escape by squeezing but still could not escape. It took 13 min for the frog to swallow the head of the gecko; to avoid disturbing the frog, the observer left before ingestion was complete.

On 3 November 2024 at 20:00 h in a house sited in Thanh Tan commune, Tay Ninh City, Tay Ninh Province, Vietnam (11°23'07"N 106°11'18"E, WGS 84, 51 m a.s.l.), Thuy Truc (*pers. comm.*) encountered an adult *P. megacephalus* on a wall about 2 m above the ground attempting predation on a large adult Tokay Gecko *Gekko gecko* (Linnaeus 1758) approximately three times the size of the frog's body (Fig. 1B). When first observed, the frog was attempting to swallow the gecko's tail. After 30 min, the gecko vigorously shook its body and moved away from the frog without any injuries. The large size of the gecko clearly contributed to the frog's unsuccessful predation attempt.

New necrophagous behaviours recorded in tadpoles of *P. megacephalus*

On 25 August 2024 at 08:20 h in Da Tong commune, Dam Rong district, Lam Dong province, Vietnam (12°04'30"N 108°22'24"E, WGS 84, 1744 m a.s.l.), I observed a tadpole of *P. megacephalus* at Gosner stage 37 (Gosner, 1960) feeding on an unidentified dead earthworm in the order Haplotaxida (Annelida: Clitellata) in a small pool near the ranger house (Fig. 2A). Initially, the tadpole held the worm in its mouth from the 10th segment to the end. After 3 min, it had swallowed one additional segment while slowly swimming around the pool. After 5 min of observation, I left, allowing the tadpole to continue ingesting the worm undisturbed.

On 8 September 2024 at 20:35 h in Tao Dan Park, Ben Thanh Ward, District 1, Ho Chi Minh City, Vietnam (10°46'22"N 106°41'28"E, WGS 84, 7 m a.s.l.), Duong Thao Nhu Ha and I observed tadpoles of *P. megacephalus* at Gosner stage 27, 28, 32, 34, 35, and 36 (Gosner, 1960) feeding on three dead adult Rice Frogs *Fejervarya limnocharis* (Gravenhorst 1829) and a dead adult Asian Grass Lizard *Takydromus sexlineatus* Daudin 1802 in the same artificial pool (Fig. 2B and C). The tadpoles swallowed fragments while swimming around the body of the dead animals. Additionally, tadpoles of Mukhlesuri's Chorus Frog *Microhyla mukhlesuri* Hasan, Islam, Kuramoto, Kurabayashi & Sumida 2014, dragonfly larvae (Odonata: Anisoptera), and marsh treader (Hemiptera: Hydrometridae) co-occurred with *P. megacephalus* tadpoles in the pool, but only marsh treader and *P. megacephalus* tadpoles were observed feeding on the carcasses (Fig. 2C).

To the best of my knowledge, these are the first recorded observations of this frog preying on *Hemidactylus frenatus* and attempting to feed on *Gekko gecko* as adults, and on dead Haplotaxida,

Takydromus sexlineatus, and *Fejervarya limnocharis* as tadpoles. An updated list of prey species found in the diet of *P. megacephalus* is presented in Table 1 for adults and Table 2 for tadpoles. The observations suggest that *P. megacephalus* tadpoles may opportunistically exhibit necrophagous behaviour. Although these records represent isolated events, they broaden our understanding of the natural history and ecological interactions of *P. megacephalus* and its prey in urban areas.

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Tab. 1 – Published data on the diet of Big-headed Treefrog (*Polypedates megacephalus*) adults (Dashes denote no data). / Dati pubblicati sulla dieta degli adulti di raganella dalla testa grossa *Polypedates megacephalus* (i trattini indicano l'assenza di dati).

Class	Order	Family	References
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Gastropoda	-	-	Pham <i>et al.</i> , 2019, 2023; Trinh <i>et al.</i> , 2023
Arachnida	Araneae	Araneidae	Pham <i>et al.</i> , 2019, 2023; Trinh <i>et al.</i> , 2023
		Corinnidae	Pham <i>et al.</i> , 2019, 2023; Trinh <i>et al.</i> , 2023
		Linyphiidae	Pham <i>et al.</i> , 2019, 2023; Trinh <i>et al.</i> , 2023
		Lycosidae	Pham <i>et al.</i> , 2019, 2023; Trinh <i>et al.</i> , 2023
		Pisauridae	Pham <i>et al.</i> , 2019, 2023; Trinh <i>et al.</i> , 2023
		Salticidae	Pham <i>et al.</i> , 2019, 2023; Trinh <i>et al.</i> , 2023
	Sparassidae	Pham <i>et al.</i> , 2019, 2023; Trinh <i>et al.</i> , 2023	
Opiliones	Sclerosomatidae	Pham <i>et al.</i> , 2023; Trinh <i>et al.</i> , 2023	
Oribatida	Otocephidae	Trinh <i>et al.</i> , 2023	
Malacostraca	Isopoda	Armadillidae	Trinh <i>et al.</i> , 2023
Diplopoda	Polydesmida	Polydesmoidea	Pham <i>et al.</i> , 2023
Chilopoda	Scolopendromorpha	-	Pham <i>et al.</i> , 2023
Insecta	Coleoptera	Carabidae	Pham <i>et al.</i> , 2019, 2023; Trinh <i>et al.</i> , 2023
		Coccinellidae	Pham <i>et al.</i> , 2019, 2023; Trinh <i>et al.</i> , 2023
		Scarabaeidae	Pham <i>et al.</i> , 2019, 2023; Trinh <i>et al.</i> , 2023
		Tenebrionidae	Pham <i>et al.</i> , 2019, 2023; Trinh <i>et al.</i> , 2023
	Hemiptera	Reduviidae	Pham <i>et al.</i> , 2019, 2023; Trinh <i>et al.</i> , 2023
	Hymenoptera	Formicidae	Pham <i>et al.</i> , 2019, 2023; Trinh <i>et al.</i> , 2023
	Isoptera	Kalotermitidae	Pham <i>et al.</i> , 2019, 2023; Trinh <i>et al.</i> , 2023
		Rhinotermitidae	Pham <i>et al.</i> , 2019, 2023; Trinh <i>et al.</i> , 2023
	Orthoptera	Gryllotalpidae	Pham <i>et al.</i> , 2019, 2023; Trinh <i>et al.</i> , 2023
		Tettigoniidae	Pham <i>et al.</i> , 2019, 2023; Trinh <i>et al.</i> , 2023
	Blattodea	-	Pham <i>et al.</i> , 2023
	Dermaptera	-	Pham <i>et al.</i> , 2019, 2023
	Lepidoptera	-	Pham <i>et al.</i> , 2019, 2023
	Phasmatodea	-	Pham <i>et al.</i> , 2023
	Plecoptera	-	Pham <i>et al.</i> , 2019
	Odonata	-	Pham <i>et al.</i> , 2023
	Isoptera	-	Pham <i>et al.</i> , 2019, 2023
Amphibia	-	-	Pham <i>et al.</i> , 2023
Reptilia	Squamata	Gekkonidae	This study
Plant materials	-	-	Pham <i>et al.</i> , 2019, 2023

Tab. 2 – Published data on the diet of Big-headed Treefrog *Polypedates megacephalus* tadpoles (Dashes denote no data). / Dati pubblicati sulla dieta dei girini della raganella dalla testa grossa *Polypedates megacephalus* (i trattini indicano l'assenza di dati).

Food items	Status	References
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Animals		
Terrestrial arthropods	alive	Vassilieva <i>et al.</i> , 2017
Insect eggs	alive	Vassilieva <i>et al.</i> , 2017
Rotifers	alive	Vassilieva <i>et al.</i> , 2017
Testaceans	alive	Vassilieva <i>et al.</i> , 2017
Copepoda	alive	Vassilieva <i>et al.</i> , 2017
Ostracoda	alive	Vassilieva <i>et al.</i> , 2017
Cladocera	alive	Vassilieva <i>et al.</i> , 2017
Annelida (Haplotaxida)	dead	This study
Reptilia (<i>Takydromus sexlineatus</i>)	dead	This study
Amphibia (<i>Fejervarya limnocharis</i>)	dead	This study
Plants		
Pollen	-	Vassilieva <i>et al.</i> , 2017
Diatoms	alive	Vassilieva <i>et al.</i> , 2017
Green microalgae	alive	Vassilieva <i>et al.</i> , 2017
Filamentous algae	alive	Vassilieva <i>et al.</i> , 2017
Macrophytes	alive	Vassilieva <i>et al.</i> , 2017
Other		
Soil particles	-	Vassilieva <i>et al.</i> , 2017
Detritus	-	Vassilieva <i>et al.</i> , 2017



Fig. 1 – A) An adult *P. megacephalus* consuming on an adult *Hemidactylus frenatus* (Photo: Nguyen Xuan Thai); B) An adult *P. megacephalus* trying to swallow the tail of *Gekko gekko* (Photo: Thuy

Truc). / A) Un *P. megacephalus* adulto che divora un *Hemidactylus frenatus* adulto (Foto: Nguyen Xuan Thai); B) Un *P. megacephalus* adulto che cerca di ingoiare la coda di un *Gekko gecko*.

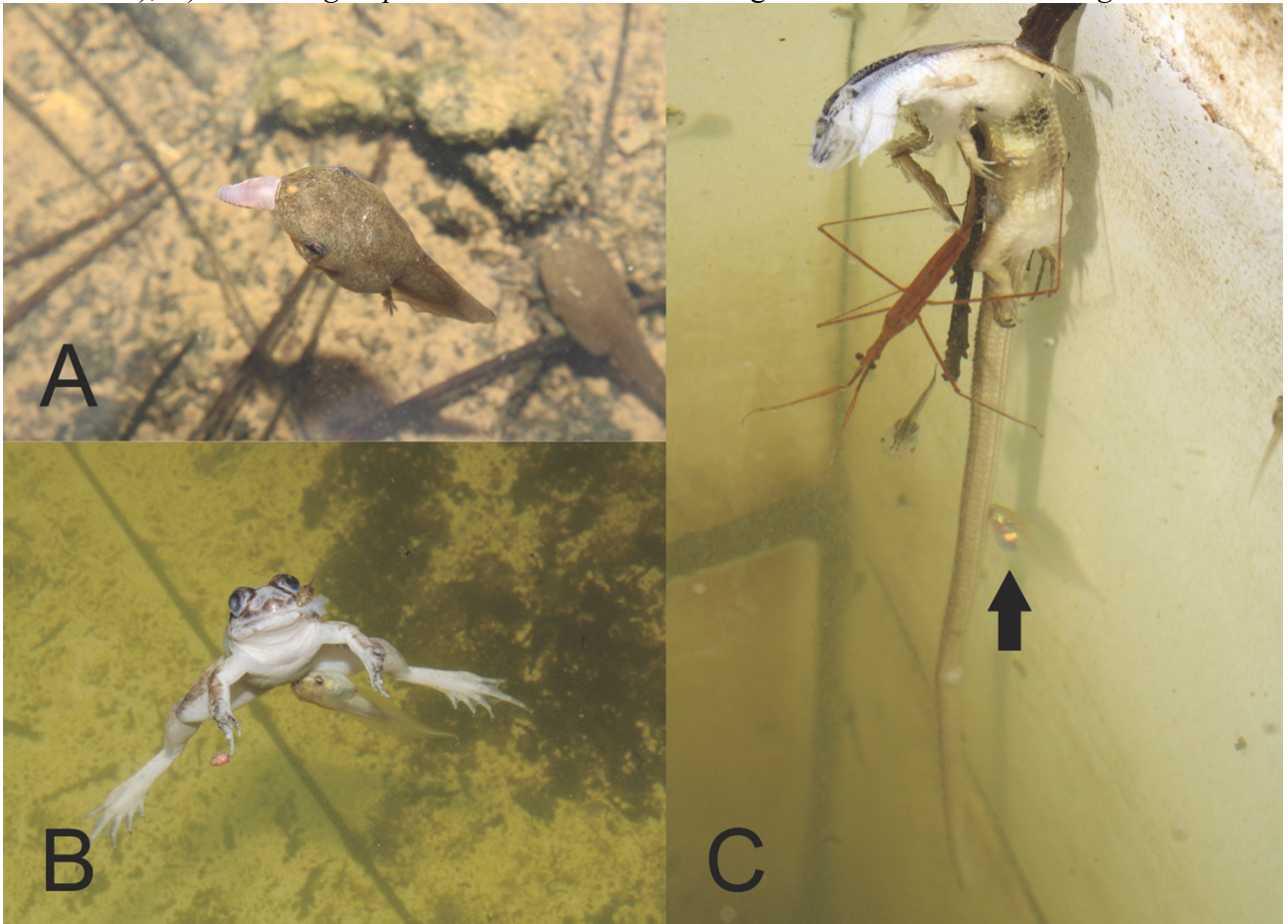


Fig. 2 – A) The *P. megacephalus* tadpole feeding on an unidentified earthworm of Haplotaxida; B) *P. megacephalus* tadpole feeding on dead *Fejervarya limnocharis*; C) *P. megacephalus* tadpole feeding on dead *Takydromus sexlineatus* (black arrow). / A) Girino di *P. megacephalus* che si nutre di un lombrico non identificato dell'ordine Haplotaxida; B) Girino di *P. megacephalus* che si nutre di un *Fejervarya limnocharis* morto; C) Il girino di *P. megacephalus* (freccia nera) si nutre di un *Takydromus sexlineatus* morto (Photo/foto: Thinh Gia Tran and Duong Thao Nhu Ha).