

Short communication

New insights into dermatophagy in Himalayan toad *Duttaphrynus himalayanus* (Günther, 1864) from Pokhara, Nepal

Abhisek Sapkota^{1,2} | Keshab Raj Sapkota¹ | Rishi Baral^{1,3*} ¹ Snake Conservation Society Nepal, Simpani-1, Pokhara, Nepal.² Institute of Forestry, Tribhuvan University, Pokhara Campus, Pokhara 33700, Nepal.³ Laboratory of Wildlife Biology and Medicine, Department of Environmental Veterinary Science, Graduate School of Veterinary Medicine, Hokkaido University, Sapporo, Japan.* **Correspondence:** right.rishi1@gmail.com

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Abstract

Dermatophagy, the act of consuming shed skin, is documented across various amphibians and reptiles but remains understudied. This study presents the first recorded observation of dermatophagy in Himalayan toad (*Duttaphrynus himalayanus*) from Pokhara, Nepal. The toad was observed consuming its entire shed skin during a rainstorm, a behavior captured on video over 6 minutes and 18 seconds. We recorded complete consumption of the old skin, unlike previously reported partial dermatophagy in this genus. This observation expands the knowledge of dermatophagy in amphibians.

Keywords: Amphibians; Cannibalism; Dermatophagy; Himalayan toad; Kaski

nutrients, such as calcium (Smith 1976). Occasionally, undigested skin can be observed in the feces of some species (Bendsen 1956). Dermatophagy is believed to take place in most amphibians and is thought to occur as frequently as daily (Castanho & de Luca 2001) or as infrequently as once a week or every two weeks (Budtz & Larsen 1973; Meyer et al. 2012). To regulate this process various factors such as type of species, age and condition of environment, etc. may play roles (Larsen 1976). Although dermatophagy has been documented in genus *Duttaphrynus* by Patil and Adatrao (2023) in *D. melanostictus*, it has not been previously reported in *D. himalayanus*, making the present case the first documented instance for this species.

1 | Introduction

The behavior of eating one's shed skin, known as dermatophagy, has been documented in various amphibians and reptiles. It was observed in a total of 145 lizards, 94 frogs, 29 salamanders, 1 caecilian, 1 tuatara, 11 snakes, and 5 turtles during a global survey of zoos and aquariums significantly expanding the list of species known to exhibit this behavior (Weldon et al. 1993). While it is well-documented in lizards, particularly geckos (Bustard & Maderson 1965; Ramírez-Velázquez 1992), it is less commonly reported in snakes, where it is often associated with reptile-eating (Groves & Altamari 1977). This behavior is sometimes considered a form of cannibalism (Keown 1973) and has been mentioned in relation to the molting habits of amphibians (Larsen 1976; Tyler 1998). Several potential explanations for dermatophagy have been proposed, including nutrient recovery (Bustard & Maderson 1965), removal and elimination of pathogens (Cramp et al. 2014), and maternal care through the provision of nutrient-rich skin to the offspring (Kupfer et al. 2006).

Dermatophagy in ectothermic vertebrates is significant because shed skin represents a loss of nutrients unless it is consumed. Frequent shedding causes frogs to lose a considerable amount of nutrients, so eating their own skin helps them recover vital

2 | Materials and methods

2.1 | Study area

The toad was observed within the compound of the first author's residence at Pokhara Metropolitan City, Ward Number 25, Hemja, Kaski District, Gandaki Province, Nepal (Fig. 1). The toad was observed during the peak of monsoon season in the study area where they are frequently encountered around human settlement.

2.2 | Methods

During a rainstorm, the toad was encountered by the first author at 4:24 PM. Observation was done at a distance of about 1 meter without disturbing the toad. A video and photos were captured of this moment for 6-minutes and 18-seconds from 'Redmi Note 8' mobile.

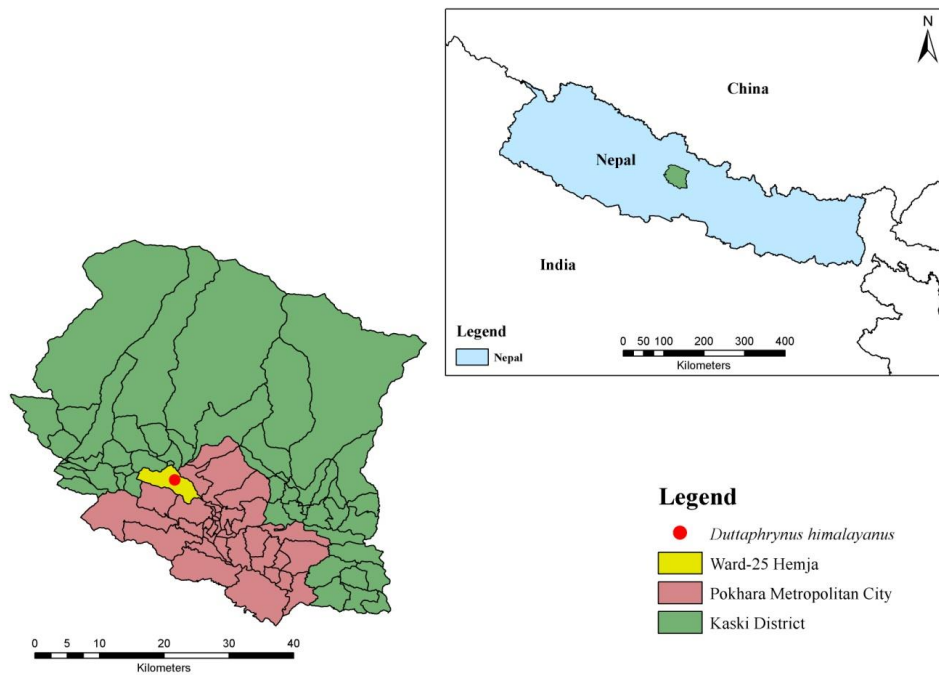


Figure 1. Map of Nepal and Kaski showing the location where dermatophagy was observed

3 | Results

On 14 July 2020, a Himalayan toad (*Duttaphrynus himalayanus*) was observed consuming its shed skin in Pokhara Metropolitan City, Ward No. 25, Hemja, Kaski District, Gandaki Province, Nepal. The toad was initially seen engaging in an unusual feeding

behavior for over a minute. Upon closer inspection, it was confirmed that the toad was eating its own shed skin. The old skin appeared as a stretched layer, which the toad actively pulled towards its mouth using both forelimbs (Fig. 2A). It then consumed the skin systematically from both sides, stretching it with its limbs while making efforts to swallow (Fig. 2B).

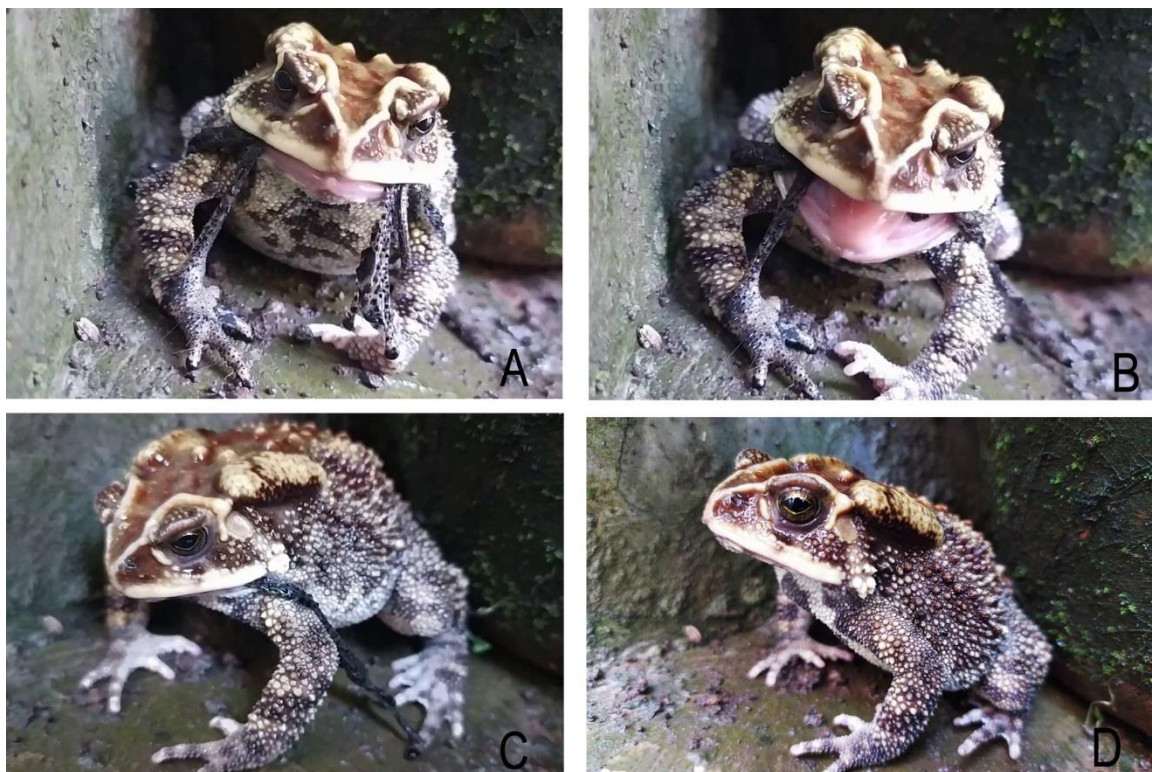


Figure 2. Sequence of a Himalayan toad (*Duttaphrynus himalayanus*) while consuming its own shed skin. A. Initially, the toad started pulling its own shed skin from the forelimbs. B. The toad actively consuming the shed skin. C. Toad lifting its body to pull the shed skin on the hindlimbs. D. Clean and refreshed toad just after completed consuming its own shed skin. All photographs by Abhisek Sapkota.

While feeding on the old skin from the right side, it pulled the skin to the left to pluck and consume it more easily, and similarly, while consuming the skin from the left side, it pulled it to the right to facilitate the process. While the toad was consuming, it rotated its head and pushed its limbs in opposite directions, which enabled it to consume the shed skin from its forelimbs at first, followed by that of the hindlimbs. Once it reached the hindlimbs, the toad lifted its body slightly and gripped the skin firmly as it slowly pulled it toward its mouth, all the while moving its hindlimbs to aid the process. The toad used its forelimbs as a pivot to pull off and consume the shed skin on hindlimbs. The arch in the toad's posture and grip of its forelimbs showed how the toad uses different parts of its body to maneuver the shed skin free and consume it (Fig. 2C).

The toad paused briefly, around 6 seconds between each attempt to continue feeding. Throughout the process, the toad remained in the same spot, steadily consuming the shed skin until it was completely ingested. Once the shedding was completed, the toad's skin appeared bright in color, clean, and healthier than compared to the first observation (Fig. 2D). After a few minutes, the toad moved inside a drainage pipe and disappeared.

4 | Discussion

The hypothesis that dermatophagy might render animals less conspicuous to predators has been proposed (Weldon et al. 1993). Although this behavior has not been definitively demonstrated, it is generally believed to act as a mechanism for reclaiming epidermal proteins (Bustard & Maderson 1965; Frye 1991; Weldon et al. 1993). This behavior has been enlisted by Weldon et al. (1993) on various other frog species such as *Agalychnis callidryas*, *Bufo americanus*, *Centrolenella albomaculata*, *Dyscophus antongilii*, and *Litoria caerulea*. An earlier report of such behavior on this genus *Duttaphrynus* made by Patil & Adatrao (2023) in *D. melanostictus* was while the toad was consuming the remaining skin on its forelegs, while our observation is based on consumption of whole shed skin in *D. himalayanus*. Our observation of this behavior correlates with (Patil & Adatrao 2023) where both species used both corners of the mouth while consuming the skin on its foreleg. Our observations indicate an association between dermatophagy and the molting phases (c) and (d) as described by (Budtz & Larsen 1973) among the five molting phases: (a) intermolt, (b) preparation, (c) early shedding, (d) late shedding, and (e) differentiation in *Bufo bufo* based upon histochemical and histological changes in the skin. In the early shedding phase (c), molting behavior begins with specific postural adjustments and movements to loosen the stratum corneum. We observed similar behavior in *D. himalayanus*, where unusual changes of posture and movements preceded dermatophagy, aligning with findings of (Budtz & Larsen 1973). In late shedding phase (d), dermatophagy observed during our study coincides with complete removal of the stratum corneum and the appearance of a slimy layer on the exposed skin. In *D. himalayanus*, the removal of the stratum corneum was also observed on its body with glossy appearance which seemed to aid in pulling the shed

skin away. Although the glossy appearance of the toad was noted, confirmation was limited due to our non-intrusive handling approach. Additionally, the clean and refreshed appearance of the toad following dermatophagy suggests that phase (e) may have also been underway, during which the sliminess gradually decreases. Our observations revealed that the toad, when ready to shed, adopted a crouched position, created a rip in its old skin, and then stretched to remove it like that on the molting cycle but consumed shed for additional benefits. Subsequent confirmation by other authors verified that this behavior had not been previously reported in Nepal. While similar cannibalistic behavior has been observed in snakes in Nepal, this specific instance in *D. himalayanus* was unprecedented.

5 | Conclusions

Despite increasing attention to dermatophagy among amphibians, many amphibian and reptile species remain unexplored for this behavior. Several important questions remain unanswered, such as whether dermatophagy is a deliberate behavior or occurs by chance, whether the shed skin is ingested in one piece or in smaller fragments, and whether individuals consume their own skin or that of other conspecifics. Our observation of *D. himalayanus* provides new insight by addressing one of these questions, demonstrating that the toad actively ingests entire shed skin in a continuous process. Also, this behavior may not merely be a byproduct of molting but could be rather an integrated behavior with multiple potential benefits from it. Even so, further detailed research is needed to uncover the ecological and physiological significances of dermatophagy and to address other important questions across other different species as well.

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Authors' contributions

Sapkota, A. made the field observation, prepared the map, drafted and revised the manuscript. Sapkota, K. R. reviewed the manuscript. Baral, R. supervised the entire work and contributed to reviewing and revising the manuscript. All authors contributed to the drafts and gave final approval for publication.

Conflicts of interest

The authors declare no conflict of interest.

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