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Snake shed skin consumed by *Kinosternon vogti*: a case of interspecific keratophagy

Fabio G. Cupul-Magaña[1], Nadin E. López-González[1], Ilse K. Barraza-Soltero[2,3], Torsten Blanck[4], Peter Praschag[4], Shannon Diruzzo[4], Taggert G. Butterfield[5], Armando H. Escobedo-Galván[1]

1 *Centro Universitario de la Costa, Universidad de Guadalajara, Av. Universidad 203, Puerto Vallarta, Jalisco 48280, Mexico*
2 *Laboratorio de Ecología del Comportamiento, Centro de Investigaciones Biológicas del Noroeste, S.C., Av. Instituto Politécnico Nacional 195, Col. Playa Palo de Santa Rita Sur, Apdo. Postal 128; La Paz, BCS 23096, Mexico*
3 *Current address: Staatliches Museum für Naturkunde Stuttgart, Rosenstein 1, 70191, Stuttgart, Germany*
4 *Turtle Island, Am Katzelbach 98, 8054 Graz, Austria*
5 *Estudiantes Conservando la Naturaleza A.C., Plateros 5, Álamos, 85760 Sonora, Mexico*

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Corresponding author: Armando H. Escobedo-Galván (elchorvis@gmail.com)

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Abstract

Some reptile species can consume their own shed skin or that of conspecifics; despite its prevalence, the benefits of eating shed skin remain poorly understood. Here, we report a field observation in which a Vallarta Mud Turtle (*Kinosternon vogti*) consumed a snake shed skin of *Masticophis lineatus* (Bocourt, 1890) in Bahía de Banderas, Nayarit, Mexico. This type of record could allow us to understand the keratophagous behaviour between and within reptile species.

Key Words

aquatic species, food habits, reptiles, urban wetland

Some animals consume their shed skin or that of a conspecific during ecdysis. This behaviour is commonly observed in lizards and snakes in natural habitats and captivity, but it appears less common in turtles and crocodilians (reviewed by Weldon et al. (1993); Mitchell et al. (2006)). Specifically, the reports on consumed shed skin by turtles are available for less than 2% of the 357-turtle species currently recognised (TTWG 2021) and include the families Chelidae, Emydidae and Testudinidae (reviewed by Weldon et al. (1993)). Herein, we report a snake shed skin consumed by the Vallarta Mud Turtle (*Kinosternon vogti* López-Luna, Cupul-Magaña, Escobedo-Galván, González-Hernández, Centenero-Alcalá, Rangel-Mendoza, Ramírez-Ramírez & Cazares-Hernández, 2018; Fig. 1A). This species is endemic to the Bahía de Banderas, situated on the western-central coast of Mexico. Vallarta Mud Turtles inhabit small streams and ponds in this region, although in low population densities (López-Luna et al. 2018; Cupul-Magaña et al. 2022).

We conducted surveys between October 2019 and February 2023, to collect individuals of *Kinosternon vogti* in Bahía de Banderas. The captured turtles were transported in a plastic box to the Biodiversity and Ecosystem Services Laboratory at the Centro Universitario de la Costa of the Universidad de Guadalajara, Mexico. Once in the laboratory, we measured meristic characters and collected their stomach contents using the stomach flushing technique (Legler 1977). Stomach contents were preserved in 70% ethanol for laboratory analysis. Turtles were under observation between 12 to 48 hours before being returned to the capture site and no deaths

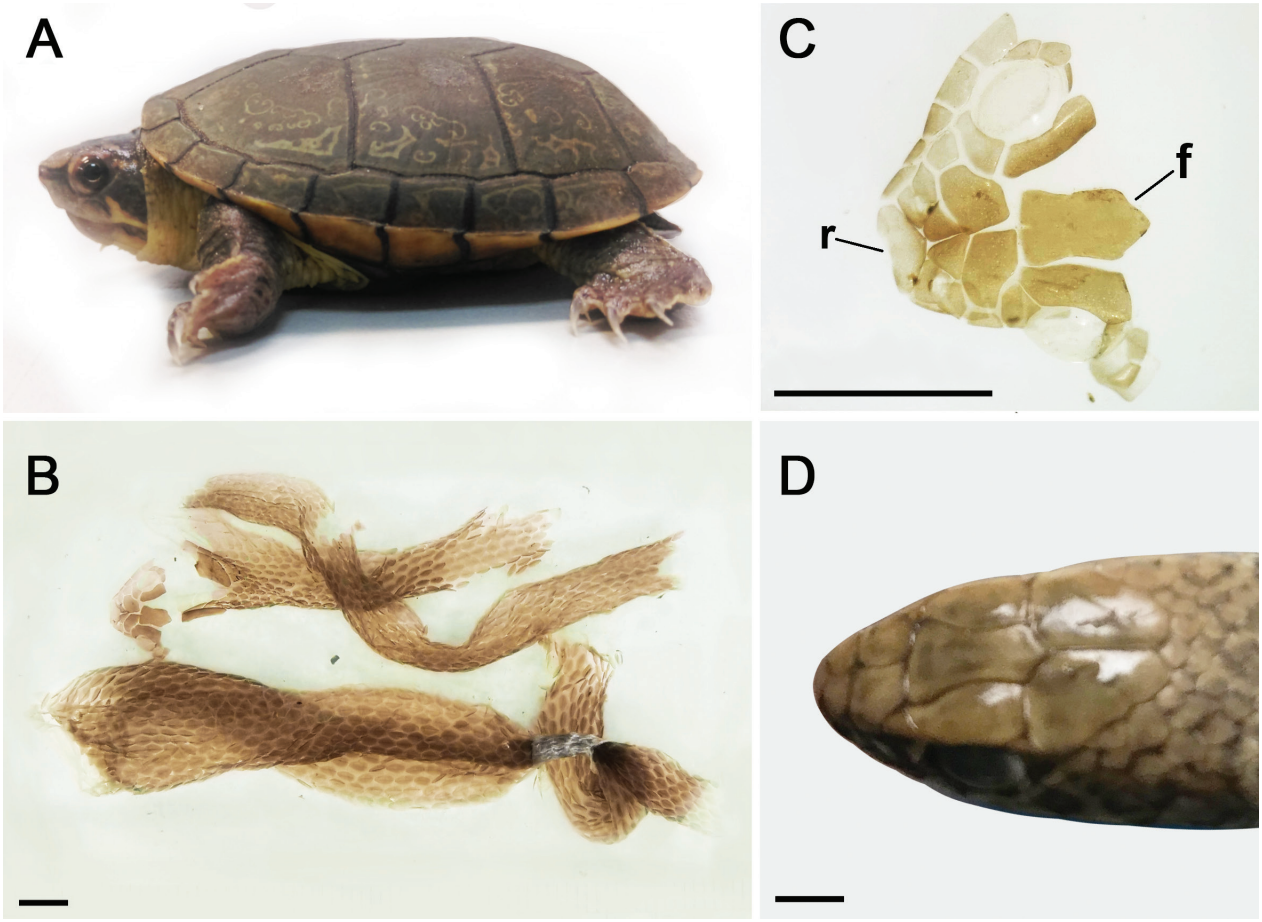

Figure 1. A. Lateral view of an adult female specimen of *Kinosternon vogti* from Puerto Vallarta, Jalisco, Mexico; **B.** Dorsal view of the shed skin of *Masticophis lineatus* obtained from *K. vogti* stomach content; **C.** Dorsal view of the head shed of the skin of *M. lineatus*, r = rostral scale, f = frontal scale; **D.** Dorsal view of the head of *M. lineatus* specimen catalogue from Mayborn Museum Complex of Baylor University. Scale bars: 5 mm (**B–D**).

were observed due to manipulation. During the laboratory analyses, the stomach contents were separated using a Carl Zeiss Stemi DV4 stereoscopic microscope and were examined under an Olympus optical microscope. Prey items were identified to the lowest taxonomic level possible using specialised literature.

We captured a total of 24 individuals of *K. vogti* (17 females and 7 males). During the analysis of stomach contents, we found seeds and partially digested snake shed skin (total length < 28 cm; Fig. 1B) in one adult female *K. vogti* captured on 24 October 2022 (carapace length: 96.1 cm, plastron length: 76.6 cm and height: 35.5 cm). By examining the characteristics of the shed skin, particularly the frontal and rostral scales as described by Johnson (1977), we were able to identify the snakeskin as belonging to the species *Masticophis lineatus* (Bocourt, 1890) (for its current taxonomic status, see O'Connell and Smith (2018)). In addition, we also used a photograph of the *M. lineatus* specimen from the Mayborn Museum Complex at Baylor University for comparison of head squamation (R 14597, 67-566; Fig. 1C, D). *Masticophis lineatus* has been recorded in Arizona and New Mexico (USA), as well as from the western coast of Mexico, from southern Sonora to Colima, including islands in the Islas Marías Archipelago Biosphere Reserve (O'Connell and Smith 2018; Nolasco-Luna et al. 2022).

Our observation provides a field record of interspecific ingestion of shed skin involving a turtle and a snake. This record not only sheds light on the food habits of *K. vogti*, but also on its terrestrial foraging strategy. Although the specific food habits of *K. vogti* are still unknown, Ramírez-Ramírez et al. (2019) classified it as an omnivorous species, based on the presence of unidentified plants, isopods and hemipterans in the stomach contents. That *K. vogti* consumed opportunistically the snake shed skin confirms that this species will forage terrestrially and occasionally consume the items it encounters. The Vallarta Mud Turtle shares its habitat with other turtle species such as *Kinosternon integrum* and *Trachemys ornata* and two non-native species, *Trachemys scripta* and *Staurotypus triporcatus* (Cupul-Magaña et al. 2022). Assessing the dietary habits of these species could provide us with valuable insights into whether the consumption of snake shed skin is a shared behaviour and how competition amongst species could expand the food habits of turtle species. However, this idea must be studied in more detail.

The benefits of consuming shed skin remain unexplained. However, hypotheses primarily based on lizards

and snakes have been proposed to explain this behaviour (see Mitchell et al. (2006)). Briefly, the consumption of shed skin has been related to ectoparasite load. According to Watkins and Blouin-Demers (2019), larger lizard individuals tend to have a higher ectoparasite load due to increased surface area available for parasites to inhabit. Consequently, the consumption of their own skin or that of conspecifics might offer advantages in social interactions. On the other hand, dry environmental conditions and low prey availability may explain the ingestion of shed skin (Barraza-Soltero and Escobedo-Galván 2020; Rojas-Carranza and Anderson 2021). Another angle to consider is the nutritional aspect. The hypothesis proposes that this behaviour allows the acquisition of epidermal proteins, such as alfa keratin and beta keratin present in shed skin (Weldon et al. 1993; Fabrício-Neto et al. 2016; Pough et al. 2016). Herein, we found a snake shed skin in the stomach contents of an adult female *K. vogti* during the reproductive season (Montaño-Ruvalcaba et al. 2020; Rosales-Martínez et al. 2022), which may be related to the nutritional hypothesis. For instance, Vacheva (2018) observed that of the 17 cases of keratophagy in the European common lizard *Zootoca vivipara*, with 76.5% of the cases occurring in subadults and adult females. The author suggests that this behaviour could be associated with the nutritional requirements for gravid females. In the case of kinosternid turtles, Macip-Ríos et al. (2010) observed that females shift food resources seasonally unlike males, favouring this type of opportunistic ingestion. On the other hand, an anonymous reviewer suggests that our observation could be influenced by odour cues. Given that *Masticophis lineatus* is a terrestrial species and that female turtles exhibit greater mobility than males in their search for food, if the shed skin were fresh, it could have contained chemosensory cues leading the turtle to mistake it for a food item. In recent years, there has been an increased publication on keratophagous behaviour (e.g. Vacheva and Naumov (2022); Sandoval-Ponce et al. (2023)); therefore, the records of this type of behaviour offer us a window into understanding the reasons for shed skin ingestion between and within reptile species.

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