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# A Documented Case of Ichthyophagy in the Malayan Krait (*Bungarus candidus*) and Its Implications for Toxinology

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**Abstract:** Snakebite is a neglected tropical disease, and the high potency of snake venoms has been evolutionary refined for trophic interactions. Hence, understanding the feeding ecology of snakes is a major element needed to meaningfully interpret toxinological data gathered for snake toxins. However, the diet of several medically important snakes is vastly understudied. Here, the first case of *in situ* observed ichthyophagy in the Malayan Krait (*Bungarus candidus*), a highly venomous Asian elapid, which is supposedly an ophiophagous specialist, is reported. This report has important repercussions for Krait toxinology as it shows that fish as prey need to be considered when analyzing their venoms in light of eco-evolutionary and functional studies. It also suggests that this snake may be more trophically opportunistic than previously thought, which must be taken into account when calculating distribution ranges in the context of snakebite analyses.

**Keywords:** Krait; diet; predator–prey interactions; natural history; venom evolution

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Academic Editor: Michael Wink

Received: 17 April 2025
Revised: 29 April 2025
Accepted: 30 April 2025
Published: 30 April 2025

**Citation:** Lüddecke, T. A Documented Case of Ichthyophagy in the Malayan Krait (*Bungarus candidus*) and Its Implications for Toxinology. *Diversity* **2025**, *17*, 326. https://doi.org/10.3390/d17050326

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Snakebite is a neglected tropical disease of highest importance [1]. The damaging and potentially lethal effects caused by snake venom stem from biochemical activities of the diverse arsenal of protein toxins recruited into a snake's venom [1,2]. That said, these toxins evolved primarily to subdue prey [3–5]. Hence, to better understand the eco-evolutionary framework in which snake venom toxins evolved and to interpret their activities in a meaningful functional context, detailed knowledge of natural history, particularly the feeding ecology of venomous snakes, is needed. Nevertheless, for several medically important species, these critical insights are either missing or widely dispersed in difficult-to-access literature [6]. Accordingly, much remains to be learned on the natural history of several venomous snakes.

A particularly enigmatic group where limited data on feeding ecology are available are the Kraits of the genus *Bungarus*. They comprise approximately 18 species of mainly nocturnal elapids that are widely dispersed across Asia [7]. Kraits are infamous for their extremely neurotoxic venom that causes severe and often fatal, paralysis [8–10]. Several species of the genus are of highest medical importance across their distribution range and, thus, are responsible for a larger fraction of snakebites and snakebite-related deaths [8–10]. The Malayan or Blue Krait (*Bungarus candidus*) is a relatively large member of the genus, reaching a maximum length of ca. 160 cm. It occurs in Cambodia, Laos, Indonesia, Malaysia, Vietnam, and Thailand, among others, where it roams various moist lowland habitats, including forests, agricultural areas, and mangroves [7]. Kraits, including the Malayan Krait, are considered to be primarily ophiophagous (feeding on snakes). Yet, the

diet of this species is largely unknown, but few specimens have already been reported to sporadically hunt other animals besides snakes, such as amphibians, lizards, or even small mammals. As for amphibian prey, at least one field of observation reports a hunting event on a caecilian [11], while lizard prey (skinks) has been reported from analyzed gut contents [12,13]. Also, rodent prey has been recovered from analyzed feces [14]. However, it has also been reported that Malayan Kraits do accept fish (*Monopterus albus* eels) as prey when kept in captivity [14]. Whether they actively hunt fish in the wild has remained subject to speculation [14]. Here, I report a photographically verified case of ichthyophagy (fish feeding) in the Malayan Krait that I observed in Krabi, Thailand.

On the 12 December 2024, I visited the publicly open mangrove forest (locally known as the mangrove boardwalk) in Krabi, which is a well-known habitat for several venomous snake species, including mangrove pitvipers (*Trimeresurus purpureomaculatus*), Wagler's pitviper (*Tropidolaemus wagleri*), and Malayan Kraits. The area is easy to access, and a wooden boardwalk has been constructed ca. 2 m above the ground. From this boardwalk, wildlife can be observed easily and without causing disturbance. After the switch from high- to low tide, a multitude of small water bodies emerge that attract several animals, and these water bodies are particularly attractive for in situ observations (Figure 1).



**Figure 1.** Habitat in the mangroves around Krabi at low tide. After the water left the interior of the mangroves during low tide, a multitude of small leftover waterbodies is left and animals can be spotted easily from the adjacent boardwalk.

After sunset and at low tide, the area was searched for snakes using high-lumen flashlights. At 9:30 pm, the author noticed a series of suspicious splashing noises from inside the mangrove forest and decided to follow them across the boardwalk. Within ca. 30 s, a Malayan Krait of approximately 100 cm in total length was spotted, leaving a small water body. Interestingly, the individual was found to carry a still moving fish (approximately 10 cm in total length) of unidentified species in its mouth and was subsequently proceeding to feed on it (Figure 2A). The entire process was observed, and it took less than five minutes until the fish was swallowed completely. The feeding was performed head-first and outside the water body. Afterward, the snake swiftly disappeared into the vegetation.




**Figure 2.** Malayan Krait feeding on a fish. (**A**) The situation is described in the text. The Krait was spotted leaving a water body whilst carrying the fish and then proceeded to swallow it. (**B**) Magnification of the image displayed above. The overpowered fish shows no evident signs of physical wounds.

This observation reports that Malayan Kraits prey on fish in their natural environment. That said, I only observed the situation partially and was unable to witness the hunting process itself. Therefore, while it cannot be excluded that the fish was initially subdued by a different animal and then was lost to the Krait, I believe this is a relatively unlikely scenario. I came to this conclusion as I witnessed the Krait leaving the water body with the fish already in its mouth, which suggests that the Krait actively entered the water body to hunt. Second, most other fish-hunting animals would leave noticeable wounds, but a closer investigation of the magnified photo does not show any signs of physical battle, which supports the idea that the Krait was the initial predator (Figure 2B). The fact that the fish

was still moving in the Krait's mouth indicates a very recent capture. Since this timing matches the noises heard just before the discovery, it is highly likely the Krait was actively hunting the fish when found.

My observation shows that Malayan Kraits indeed complement their snake-based diet with fish prey in natural settings and not only in captivity [14]. While this adds to our understanding of the species feeding ecology, it also may help to better understand the toxinology of this species. Venom is primarily a trophic weapon in snakes and is used to facilitate prey capture [3–5]. The biological activity of venom and its toxins is accordingly tightly linked to prey physiology, and functional discussions on snake venom need to consider this aspect [3–5]. At the time of writing, Krait toxinology data are usually either interpreted solely in the context of human envenoming or for its trophic role in ophiophagy. However, my observation that at least Malayan Kraits hunt for fish indicates that physiological targets present in fish could also play a role in evolutionary shaping the venom activity of Kraits. This is particularly true as it cannot be ruled out that other species of Krait likewise integrate fish into their diet and that fish capture must be considered more broadly when studying Kraits and their venoms. At least for one other species, the many-banded Krait (*Bungarus multicinctus*), similar cases of ichthyophagy were occasionally reported, providing additional evidence for the potential relevance of fish prey [15]. It would be very interesting to test the activity of Krait venom on fish to evaluate this question in a functional context.

Overall, this report provides initial evidence that Malayan Kraits are indeed actively hunting for fish, which highlights the lack of knowledge that is prevailing around Krait feeding ecology [14]. It further suggests that this species, and potentially other Kraits species, are more opportunistic than commonly acknowledged. This has major repercussions as this potential expansion of the trophic spectrum influences the species' potential to thrive in various habitats and may be of importance for distribution mapping when analyzing the snakebite threat potential of Malayan Kraits across their distribution range.

**Funding:** This research received no external funding.

**Institutional Review Board Statement:** Not applicable.

**Data Availability Statement:** No data were generated in the present work.

**Conflicts of Interest:** The authors declare no conflicts of interest.

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