Review

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Review

The Influence of Habitat on the Hunting Strategies of *Baryonyx walkeri*

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Abstract: This literature review investigates how the diverse habitats of *Baryonyx walkeri* influenced its hunting strategies, with a focus on adaptations for piscivory and generalist predation. The spinosaurid theropod *Baryonyx walkeri*, known for its distinctive elongated snout and conical teeth, inhabited a variety of environments during the Early Cretaceous period. Fossil evidence suggests that *Baryonyx* frequented fluvial and lacustrine environments, leading to the hypothesis that its primary diet consisted of fish and other aquatic organisms. Detailed analysis of its cranial morphology reveals a suite of adaptations, including robust forelimbs with a large, sickle-shaped claw, ideal for catching slippery prey. Isotopic analysis of oxygen in *Baryonyx* indicates a significant reliance on fish and other similar organisms. Comparisons with modern analogs, such as crocodilians, provide further insight into the behavioral ecology of *Baryonyx*. This review integrates paleontological data with modern ecological analogs to reconstruct the hunting strategies of *Baryonyx walkeri*. The findings underscore the importance of habitat diversity in shaping the evolutionary pathways of predatory dinosaurs and contribute to a broader understanding of spinosaurid ecology and behavior.

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1. The Influence of Habitat on the Hunting Strategies of *Baryonyx walkeri*

Baryonyx walkeri was a medium-sized theropod from the Early Cretaceous Period of the Mesozoic Era. Standing at approximately 2.4 m tall, having a length of 7.5-10.0 m from head to tail, and weighing 1.2-2.0 metric tons, *Baryonyx* was relatively lighter and smaller than other larger theropods, such as *Spinosaurus aegyptiacus*. Their presence mostly extended throughout what is now Africa and Europe. It is widely suggested that *Baryonyx* tended to prefer areas near aquatic systems. Among its prominent characteristics are its elongated rostrum and conical teeth, which are adapted for catching and handling slippery prey such as fish. The robust forelimbs and large claws of *Baryonyx* further indicate an adaptation for grasping and manipulating prey, providing insights into its feeding behavior.

Unlike its spinosaurid relative *Spinosaurus aegyptiacus*, which is renowned for its sail-like structure formed by elongated neural spines, *Baryonyx* did not exhibit such a dorsal sail. Instead, *Baryonyx* displays a different set of adaptations that suggest a semi-aquatic lifestyle. Its body plan and dentition are reflective of its potential role as a predator adapted to both aquatic and terrestrial environments. The anatomical characteristics of *Baryonyx*, including its robust limbs and conical teeth, reveal its versatility in exploiting a range of food sources within its habitat.

The unique combination of characteristics in *Baryonyx* highlights its evolutionary niche and adaptation strategies. This literature review aims to explore the implications of these features for understanding *Baryonyx*'s role within its ecosystem and how its adaptations compare to those of other spinosaurids like *Spinosaurus*. By examining the anatomical and ecological aspects of

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Baryonyx, we can gain valuable insights into its dietary habits and habitat preferences, allowing us to understand the relationship between habitat and hunting.

2. Habitat of *Baryonyx walkeri*

Understanding the habitat and environment that *Baryonyx walkeri* lived in is essential to determining its hunting strategies. It is believed that *Baryonyx walkeri* tended to prefer regions around lakes, floodplains, rivers, and streams. These aquatic systems would have provided a diverse array of prey, including fish, amphibians, and possibly small terrestrial animals located near the water's edge. The morphological characteristics of *Baryonyx walkeri* also suggest that it wielded numerous adaptations that would have proved especially useful in an aquatic environment.

A study conducted by Charig & Milner (1997) determined that *Baryonyx* inhabited a range of aquatic environments, including lakes, rivers, and floodplains. The Wealden formation in the Isle of Wight, where *Baryonyx* fossils were found, was characterized by such settings, which would have been abundant in aquatic and semi-aquatic resources. The environment of the Wealden was a complex system of river deltas and floodplains with abundant freshwater and diverse vegetation, supporting a plethora of marine animals, which *Baryonyx* could have exploited. Furthermore, the scientists noted the presence of fossilized fish scales and bones in the stomach region of various *Baryonyx* specimens. This evidence indicates that *Baryonyx* lived in and around aquatic environments where it had access to fish and other aquatic prey.

Another study by Amiot et al. (2010) examined oxygen isotopes for spinosaurids, including *Baryonyx*. The isotopic signatures indicated that these dinosaurs spent a significant portion of their time in water, which is consistent with a semi-aquatic or aquatic habitat. The oxygen isotope ratios (δ^18O values) for spinosaurid teeth were determined to be approximately -7.4 to -6.7‰ (per mil) relative to the Vienna Standard Mean Ocean Water (VSMOW), significantly lower than those of terrestrial vertebrates. The δ^18O values for modern aquatic reptiles, such as crocodiles, were found to be around -5.0‰ to -6.0‰, indicating a similar aquatic lifestyle. This comparison reinforces the interpretation of *Baryonyx* as a semi-aquatic predator. These findings support the notion that *Baryonyx* occupied environments with substantial water bodies, such as rivers, lakes, and floodplains, where they could have hunted for fish and other aquatic prey.

Baryonyx walkeri's morphological characteristics, such as conical teeth and robust forelimbs, align with an environment where it could hunt efficiently both in water and at the water's edge. The conical teeth would have allowed *Baryonyx* to slice and tear flesh from prey. The sturdy forelimbs would aid in grasping and manipulating prey. The elongated snout likely served to probe the water and function as a simpler means of catching prey through reduced distances from rostrum to target. In addition, its dense bones would have enabled *Baryonyx* to efficiently swim in its various aquatic environments. Furthermore, the structure of its nasal region would have proved useful in respiration while *Baryonyx* was submerged underwater.

Based on the above studies, it is likely that *Baryonyx walkeri* likely was a semi-aquatic predator. Its various morphological characteristics, such as its strong forelimbs, conical teeth, elongated rostrum, and bone density, allowed it to take advantage of its surrounding fluvial and lacustrine environment, grasping and manipulating its prey. Further evidence is presented with oxygen isotopes that are similar to crocodilians but significantly lower than terrestrial organisms, as well as marine organisms like fish observed in *Baryonyx* stomachs, suggesting a semi-aquatic lifestyle.

3. Hunting Strategies of Baryonyx walkeri

Since we have now determined that *Baryonyx walkeri* engaged in a semi-aquatic lifestyle and preyed on organisms near the water's edge, we will now evaluate the hunting strategies of *Baryonyx* and the techniques it used to capture its prey. Useful insights can be provided via comparative analysis with crocodilians, an order of reptiles with similar morphologies to *Baryonyx*.

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One study by Grigg (2015) investigated the cranial morphology of crocodilians and its implications on their feeding styles. It was discovered that crocodilians wield a highly specialized jaw structure with a unique combination of muscles and bones to maximize jaw strength. They are also equipped with conical teeth designed to tear and grip slippery prey, also observed by Charig & Milner (1997), Rosenblatt (2013), Cuff & Rayfield (2013), and Thorbjarnarson (1989). In addition, crocodilians utilize a muscular stomach filled with strong acids and enzymes that allow for the digestion of bones and scales. These characteristics observed in crocodilians are also present in *Baryonyx walkeri*, suggesting that *Baryonyx* likely engaged in similar feeding habits to crocodilians. Grigg (2015) determined that while crocodilians would typically rely on their cranial structure to catch their prey, they would occasionally engage in a death-roll technique to overpower and disorient larger, stronger prey items. However, before applying this feeding technique to *Baryonyx*, we must first take into account the relative size differences between crocodilians and *Baryonyx*. While crocodilians may have been larger than most of their prey, some prey items were either of similar size or perhaps even of greater size. However, given the habitat of *Baryonyx*, it is probable that *Baryonyx* was the largest predator in its ecosystem by a significant margin, playing the role of apex predator. In addition, unlike crocodilians, *Baryonyx walkeri* wielded strong forelimbs with claws to aid it in its feeding habits. Thus, it is more likely that *Baryonyx* did not engage in the death-roll behavior observed in crocodilians but instead relied solely on its cranial morphology, such as its musculature and bone structure, as well as its forelimbs, to hunt its prey.

We must also analyze the biomechanical stress involved with the jaw and dentition of *Baryonyx*. The jaws of *Baryonyx* were likely designed to withstand the forces involved in catching and processing fish without excessive strain. Furthermore, the elongated snout helps to reduce the mechanical stress on the skull during feeding, suggested by Fabbri et al. (2022). The streamlined design of the snout aids in focusing biting forces, enhancing the ability to capture and manipulate prey effectively. The conical teeth and jaw structure facilitate a firm grip and minimal lateral movement, which is advantageous for ingesting prey whole or in large chunks. The lack of serrations in the dentition would have helped in reducing the risk of teeth breaking or becoming damaged when handling slippery aquatic prey.

A study conducted by Rosenblatt (2013) further examines the predation techniques employed by crocodilians. The scientist found a trend in the frequency of feeding events and the seasonal variations in feeding behavior. It was determined that feeding frequency can vary based on factors such as prey availability and crocodile size. Additionally, crocodiles may feed more frequently during certain times of the year when fish are more abundant. This behavior could likely apply to *Baryonyx walkeri*, as all bodies of water experience temporal fluctuations in fish abundance.

Therefore, it is reasonable to conclude that *Baryonyx walkeri* relied on its cranial morphology, such as its musculature and bone structure, as well as its robust forelimbs, to hunt its prey. Its jaw structure and dentition were designed to withstand forces associated with catching prey like fish, while also minimizing stress and the risk of losing teeth. Additionally, *Baryonyx* likely fed more frequently during certain times of the year when fish were more abundant, similar to crocodilians.

4. Conclusion

4.1. Limitations on Existing Research

Though many existing studies were able to help us in our review of the impact of *Baryonyx walkeri*'s habitat on its hunting strategies, there is still much more research to be done to fully understand this aspect of *Baryonyx*'s lifestyle. There are several limitations on existing research that prevent us from currently achieving this. For instance, the sparse fossil record restricts the comprehensiveness of anatomical and ecological studies, potentially leading to incomplete reconstructions of its morphology and behavior. Comparative analyses with modern crocodilians and other spinosaurids involve assumptions that may not fully account for evolutionary and ecological differences. Furthermore, environmental reconstructions rely on generalized data from

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isotopic analyses, which may overlook temporal and spatial variability. Additionally, functional morphology studies, such as those involving finite element analysis (FEA), use simplified models that may not capture the full complexity of biological interactions. Overall, these limitations suggest that while valuable insights have been gained, further research is needed to address these gaps and refine our understanding of *Baryonyx walkeri*'s ecological role and behavior.

4.2. Takeaway

Baryonyx walkeri was a semi-aquatic predator well-adapted to a habitat characterized by lakes, rivers, and floodplains. Its anatomical features, including its elongated rostrum, conical teeth, and robust forelimbs, reveal a specialized diet primarily consisting of fish and other aquatic prey. The presence of fish scales and bones in the stomach region of fossil specimens, along with oxygen isotopic evidence suggesting a semi-aquatic lifestyle, supports the interpretation of *Baryonyx* as a versatile predator in its environment. Comparative analyses with modern reptiles like crocodilians further enhance our understanding of its feeding strategies, indicating that *Baryonyx walkeri* primarily relied on its cranial morphology and strong forelimbs for capturing and processing prey. Additionally, *Baryonyx* likely fed more frequently during certain times of the year when fish were more abundant, similar to crocodilians. Overall, the evidence highlights *Baryonyx walkeri*'s role as a significant predator in its ecosystem, effectively exploiting the diverse resources available in its aquatic habitat.

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