ISSN: 2754-4958

Journal of Aquaculture & Livestock Production

SCIENTIFIC Research and Community

Research Article

Open Access

The Role of Tunnels in Predator-Prey Interactions and Their Significance in Mugger Crocodile Survival and Behavior

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ABSTRACT

This study has recorded observations on maintenance behaviour pertaining to basking and use of tunnels by Mugger crocodiles Crocodylus palustris and also the role of tunnels in predator-prey interaction of Bhor-Saidan Crocodile Sanctuary, located in the Kurukshetra district of state Haryana. The Mugger crocodile moves between land and water, driven by its circadian rhythm, primarily to regulate its body temperature. It was observed using a mix of heat-seeking and heat-avoiding behaviors, which include immersing itself in water, basking, and retreating to tunnels. When emerging from the water to bask on land, the Mugger adopts intermediate postures such as pre-basking, surface basking, and shallow water basking, with the amount of time spent in each posture varying with the seasons. Additionally, the Mugger was seen digging separate tunnels along riverbanks for resting and nesting. The study also documents interactions between the Mugger and both conspecifics and other species sharing its habitat. The research highlights the importance of understanding crocodile behavior to gain insights into their species-specific natural history and inform conservation management efforts.

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Received : January 08, 2025; **Accepted:** January 25, 2025; **Published:** January 31, 2025

Keywords: Basking, Circadian Rhythm, Temperature, Behavior, Heat-seeking, Heat-Avoiding.

Introduction

The Mugger, or Indian Marsh Crocodile (Crocodylus palustris), once widely distributed, is now primarily found in the Indian subcontinent and Iran, where it inhabits freshwater environments such as rivers, lakes, and marshes. In India and Sri Lanka, Muggers can also be found in artificial habitats like reservoirs, irrigation canals, ponds, and even estuarine waters [1]. The species is considered a source of conflict in some areas. Once severely endangered, the Mugger has made a remarkable recovery and is now found in healthy, viable populations across India. While crocodilian research primarily focuses on ecology and conflicts, little attention has been paid to their ethology. The study of crocodilian behavior in India is still in its early stages, with much of the understanding of their behavior coming from observations of captive animals [2-5]. Their tendency to remain relatively still presents a challenge for behavioral biologists, compounded by their shyness, quiet nature, elusive behavior, and sensitivity to disturbances. A key aspect of behavioral studies is understanding how the species adapt to their environments, blending innate and learned behaviors to enhance their survival in dynamic and often challenging habitats. Crocodilian behavior is often viewed as stereotypical and driven by innate responses. However, extended in situ observations indicate that these behaviors exhibit plasticity, pointing to potential learning capabilities. Traditionally, crocodile behavior is classified according to its main functions: maintenance, social interaction, and reproduction [6-10]. Since the effective use and occupancy of resources in a habitat depend on the behavior of the species, ethology offers valuable insights for conservation management.

Material and Methods

Since 2023, we have been monitoring the Muggers at the Bhor-Saidan Crocodile Sanctuary in Kurukshetra district, Haryana, through direct field observations. These observations involved long hours using binoculars while sitting on the riverbank to study their basking patterns, tunnel constructions, and usage. Observations were made across all seasons, with each individual being monitored for at least 20 minutes at a time. All basking sites were mapped and regularly visited, and we noted the wariness and distribution patterns during basking. We observed a dominance of intermediate phases between submergence in water and emergence for basking across seasons. The riparian areas along the river were searched for tunnels, and upon finding any, we thoroughly examined them for active and abandoned nests and other indirect signs. Digital and DSLR cameras were used to capture photographs and videos, and additional information was gathered through interviews with local residents.

Results and Discussion

[11] concluded that crocodilian thermoregulation is influenced by both habitat selection and behavioural adaptations. Species like the Mugger use burrows or tunnels as shelters during cold and dry periods. Several studies have documented Muggers digging tunnels to escape extreme sunlight in the summer and to take refuge during the monsoon rains. In our field study, Muggers were observed building nests at the entrances of these tunnels. The link between tunnels and nesting has been well established reported that Mugger crocodiles inhabit holes (likely tunnels) closest to water bodies. Of the four types of tunnels described by, we only found simple tunnels, measuring 12-14 feet long, at all four sites in this study [12-18]. The nests were either just outside the tunnel entrance or located immediately inside. The nesting tunnels, with their crescent-shaped openings, differ from resting tunnels in that they are blocked with stones at the entrance and have an angled passage to prevent flooding. Habitat modifications around nesting areas, such as clearing and

creating trails or runways, have also been reported [19].

The site with the steepest slope we studied contains numerous resting and nesting tunnels. For safety reasons and to preserve the integrity of the tunnels, we refrained from photographing Muggers inside them. However, indirect signs of tunnel use, such as tail drag marks and belly-crawl imprints on the soft mud outside, were observed during the summer months. Additionally, local fishing communities confirmed the presence of many hatchlings during the monsoon season [20-21]. Reported that older Muggers tend to occupy tunnels at higher levels on the earth mound, while younger crocodiles prefer tunnels closer to the water, at the lower edge of the mound. Their use of tunnels is also influenced by the daily light cycle, in alignment with temperature changes. Some tunnels, meanwhile, remain unoccupied and may be from previous seasons [22-25].

Conclusion

The data on tunnel behaviour presented here comes from a long-term monitoring study of Muggers at the Bhor Saidan Crocodile Sanctuary in Haryana, India. This crocodile habitat is under serious threat from rapid urbanization, pollution, and proposed linear infrastructure projects, and it must be preserved. Tunnel construction and use serve both maintenance and reproductive functions. These behaviors have species-specific characteristics and are essential for understanding the Mugger's natural history, as well as for refining conservation management strategies.

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