Journal of Advanced Zoology
ISSN: 0253-7214
Volume 45 Issue 2 Year 2024 Page 1864-1868

A new record of nesting site of Crocodile *Crocodylus Palustris* in River Panchaganga at Takawade, Tal-Shirol, Dist-Kolhapur: Expanding habitat of Crocodile

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Abstract

The crocodile habitats in the tributaries of the Krishna River in Western Maharashtra are expanding day by day. A new location of crocodile nesting was reported in River Panchaganga at Takawade, Tal-Shirol, Dist-Kolhapur in April-May 2023. Recent observations in 2023 confirm a new record of active nesting at Takawade, identifying it as an important site for the species' local reproductive cycle. Conversation with residents and Field data confirm the nesting of crocodiles at this new site. The discovery of a nest at Takawade follows a pattern of population expansion in the Shirol tehsil. The present nesting site is located on a riverbank approximately 10 feet from the water's edge in the form of an excavated hole nest. This new record highlights a persistent shift in the species' range within the Krishna basin and underscores the rising potential for human-crocodile conflict as nesting sites increasingly overlap with agricultural and domestic river use areas. Conservation of these sites is deemed vital for maintaining regional biodiversity, though it necessitates urgent management strategies by the forest officials to ensure the safety of local communities.

Keywords: *Crocodylus palustris*, Mugger Crocodile, nesting site, Takawade, Panchaganga River, habitat expansion.

Introduction

The Mugger crocodile (*Crocodylus palustris*) is a medium-sized crocodilian, attaining a maximum length of approximately 4–5 m, and is distinguished by possessing the broadest snout among extant members of the genus *Crocodylus*. It is categorized under the vulnerable category in the 'IUCN Red List of Threatened Species' and protected under Schedule I of the Wildlife Protection Act 1972 (WTI, 2003; Da Silva and Lenin, 2010). Its distribution is largely confined to the Indian subcontinent, where it occupies a wide range of freshwater habitats, including rivers, lakes, reservoirs, and marshes. In addition, the species has been recorded from coastal saltwater lagoons and estuarine environments (Whitaker 1987; Whitaker and Whitaker 1984; Whitaker and Andrews 2003).

Breeding activity occurs during the dry season, with females excavating hole nests between December and February. Nest sites are mostly located on sloping banks, although alternative sites are occasionally selected. Once a suitable nesting location is established, it is often reused by the same female across multiple breeding seasons. Egg laying typically occurs approximately one month after mating, between February and April. Upon

hatching, the offspring are transported to nearby water bodies by the mother, and in some cases by the male. Hatchlings remain in loosely structured groups under adult association for up to one year before dispersing independently.

The Mugger crocodile (*Crocodylus palustris*) is a hole-nesting species, with oviposition occurring during the annual dry season. Females attain sexual maturity at a total length of approximately 6-7 ft and typically lay clutches of 25–30 eggs (Whitaker and Whitaker 1989). Nest sites occur across a broad range of habitats, and females have occasionally been observed nesting at the entrance to, or within, their own burrows. Although captive individuals have been reported to produce two clutches within a single year (Whitaker and Whitaker 1984), such behaviour has not been documented in wild populations. The incubation period is relatively brief, generally lasting between 55 and 75 days (Whitaker 1987).

The expanding habitat of crocodiles refers to the increase in areas where crocodiles are now found beyond their traditional ranges. This expansion is mainly due to factors such as climate change, which creates warmer conditions suitable for crocodiles, conservation efforts that have helped their populations recover, and changes in land and water use. Crocodiles are now being seen in new rivers, lakes, and coastal areas, sometimes closer to human settlements, which can lead to increased human–crocodile interactions. (Luis Sigler, 1995). The River Grijalva of Mexico was surveyed in 1995 by Luis Sigler. The confluence of the River Sabinal with the River Grijalva has a patch of 50 meters of polluted water containing plastic bags and bottles, methane bubbles, and a very unpleasant smell. This area has four well-developed crocodiles, which were detected as trails in the soapy water. The animals appeared to be a breeding group, with one male of nearly 4 m and other 3 smaller animals measuring 2 to 3 m. Hatchlings have been seen at this location in the previous seven years by the locals. Adequate sandy areas for nesting are present along the shore. In subsequent inspections, the same four animals were observed, and during night inspections, eight individuals were counted.

Study Area

River Panchaganga is a major tributary of the River Krishna in the Deccan Plateau of India. It is a river formed by the confluence of five rivers, Bhogawati, Kumbhi, Kasari, Tulashi, and Dhamani, on the western side of Kolhapur city in a patch of 35 to 40 kms. River Bhogawati is a main river of Panchaganga, as it is the main source of water in all seasons for River Panchaganga. It begins its course in the Sahyadri ranges near Dajipur. A gravity dam built up of a special mix of lime and lead is constructed on this river at Fejiwade (16^0 41' N, 73^0 96'E), west of Radhanagari city. This River Bhogawati confluences with River Panchaganga (16^0 66'N, 74^0 12'E) at the center point of the villages Bahireswar, Koge, and Kuditre. From here, the River Panchaganga runs eastward for a distance of about 96 kms up to Narasobawadi, where it confluences with the River Krishna (16^0 69'N, 74^0 60'E). The present nest site of the crocodile observed at Takawade is at 16^0 68'N, 74^0 51'E (Fig. 1). It is on the left bank of the River Panchaganga. The soil observed at the location is red with a mixture of sand, clay, and gravel.

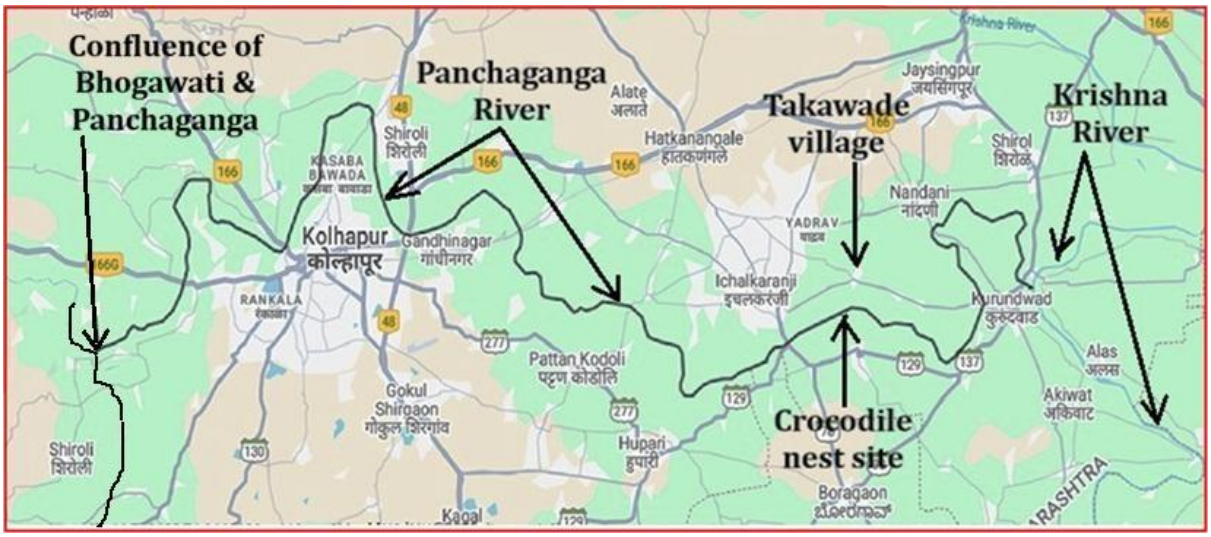

Fig. 1 – Map of the Panchaganga River showing the crocodile nest site at Takawade

Methodology

The personal observations can be made, and information about the problem can be collected when one visits the study area for other reasons. Moore (1953), Charnock-Wilson (1970), Abercrombie (1978), and Whitaker

(1978) have used this method for crocodile surveys. Crocodiles leave marks or trails in the mud and sand, which are the most common artifacts that can be used for crocodile surveys.
Based on information provided by local farmers regarding the frequent presence of a crocodile in a specific area during the winter season of 2022-23, the authors visited the study site and confirmed the presence of a crocodile. Subsequent visits were conducted regularly to document nesting activity. Field evidence, such as body slides and footprints, was recorded and photographed. Local farmers were interviewed, and their observations and perceptions were documented. Further, Photographs of nests with empty eggshells and hatchlings, along with crocodile were obtained from the nesting site. Morphometric measurements of the nest, clutch, eggs, and hatchlings were recorded.

Observations and Results

Takawade village is situated on the left bank of the river in Shirol Tehsil, Kolhapur district. After receiving information on the presence of crocodiles at the study site, the authors conducted frequent visits between February and early June 2023. Continuous surveys, direct observations, and interactions with local farmers were undertaken during this period. Farmers reported observing the crocodile at the nest site during the mornings in Winter, often with its mouth open – a basking state (Atigre et al, 2015). In February 2023, an approximately 8-ft-long crocodile was observed on the left bank of the River Panchaganga near Takawade village (Fig. 2). Subsequent visits confirmed nesting activity at the site. A crocodile alongside its nest was recorded on the left bank of the River Panchaganga at Takawade (16°68′N, 74°51′E) (Fig. 3) on 10 March 2023. It was about 10–12 ft from the waterline, covered with grass.
Hatching of the eggs occurred on 29 May 2023, and the hatchlings measured approximately 10–12 inches in length. Around 24 empty eggshells were found in and around the empty nest (Fig. 4) on 31 May 2023. The average egg length was about 8 cm. The depth of the nest was approximately 1.5 ft. A hatchling with an adult crocodile (Fig. 5) and a freely swimming hatchling (Fig. 6) were seen in the river water close to the waterline on 05 June 2023. The field evidence, such as body slides and footprints, was also recorded and photographed (Fig. 7). No incidents of human–crocodile conflict were recorded in the study area during the study period.

Fig. 2 Crocodile at rest

Fig. 3 Crocodile at nest

Fig. 4 Empty egg shells at an empty nest

Fig. 5 Hatchling with adult

Fig. 6 Hatchling in water

Fig. 7 Body slide of crocodile

Discussion and conclusion

This is the first report of crocodiles from the River Panchaganga. This report is similar to Patil et al. (2012), who reported the crocodile for the first time from the river Kadavi, one of the major tributaries of the river Warana, in 2007. But the question is, from where did this crocodile come here? And is it acclimatized to the geological, hydrobiological, and climatic conditions of this new habitat? The most likely answer for the first question is- This crocodile migrated here from the river Krishna, as the river Panchaganga is a tributary of the river Krishna. It meets the river Krishna near Narasobawadi village. The presence of Crocodiles and their impact, as well as human-crocodile conflict in the river Krishna, has been previously reported by various workers like Nikhil Whittaker (2007) and Atigre (2018). In July 2019 and in August 2021 whole of western Maharashtra experienced heavy rainfall and heavy floods in all its rivers. This rainfall and flood lasted for about 15-20 days. The present Mugger crocodile must have migrated from the river Krishna into the river Panchaganga during this heavy rainfall and heavy flood period. The answer for the second question is that the habitat characteristics of the Panchaganga river are similar to the general habitat preference of the species in much of its distribution range (Choudhury & de Silva 2013). Also, the increasing population of crocodiles in the Krishna River might be causing competition for food, which results in the migration of crocodiles to the Panchaganga River. The crocodile is now well acclimatized to the conditions of the present location. This crocodile can have an impact on the agricultural patterns, the economy of farmers, and the sociology of the human population residing in the vicinity of crocodiles (Atigre, 2018). It is also necessary to study the population size in the river Doodhganga. So, population estimation studies can also be undertaken (Atigre, 2022). The human population must also be made aware of the presence of crocodiles in this area.

The present finding of crocodile nest indicate that the crocodile nesting site is relatively undisturbed, even though farmers visit the river banks regularly for their routine work. The Crocodile might have selected this site for nesting because of the type of soil. The banks of the river Panchaganga have a clay type of soil with a mixture of sand and gravel, which is useful for making a hole in it. Also, the temperature of this area in summer ranges between 31^0C to 40^0C which is suitable for incubation of crocodile's eggs. The present location of nesting is a good source of food in the form of fingerlings for the young crocodiles. Thus, adequate food and suitable climatic conditions might also be the reason behind the selection of this site by crocodiles. The egg laying and incubation were recorded in the summer months. This is in contrast to the observations made by Joanen (1969) in *A. mississippiensis*. The clutch size recorded is similar to the reports of G. J. W. Webb for *C. johnstoni* (1983).

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