

Population status and distribution of mugger crocodile *Crocodylus palustris* in the Similipal Tiger Reserve, Odisha, India

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The mugger crocodile *Crocodylus palustris* (Lesson, 1831) is one of the 27 extant crocodilians (Grigg, 2015). It is distributed across six countries, Iran, Pakistan, India, Nepal, Sri Lanka and possibly also Bangladesh (Choudhury & de Silva, 2013) although formally it was also found in Bhutan and Myanmar. In India, the mugger has been reported at altitudes up to 420 m a.s.l. in Corbett Tiger Reserve (Whitaker & Whitaker, 1984; Whitaker, 1987) which is listed as its highest altitude by IUCN (Choudhury & de Silva, 2013) but is also present in the lower hill streams up to 700 m a.s.l. (Daniel, 1983; Rao, 1993). In Nepal, most records are from below 200 m a.s.l. (Schleich & Kästle, 2002), while in Sri Lanka it has been recorded at 450 m a.s.l. (Whitaker & Whitaker, 1979).

The International Union for Conservation of Nature (IUCN) recognises the mugger as vulnerable, and in India it is included in Schedule I of the Wildlife (Protection) Act, 1972. Throughout its range, the mugger is highly adaptable and has been found to co-exist with humans in urban landscapes (Vyas, 2012). The mugger is widespread in India except its north-eastern states and it is known to occupy various habitat types such as rivers up to 3-5 m depth, lakes, marshes, human-constructed ponds, reservoirs, irrigation canals, as well as estuaries and coastal saltwater lagoons (Whitaker & Whitaker, 1984; Whitaker, 1987; Whitaker & Andrews, 2003). Similipal Tiger Reserve (STR) in India is a part of the Deccan Peninsula Biogeographic zone and Chhotanagpur Biotic province (Rodgers & Panwar, 1988) that covers 2750 km² in the Mayurbhanj district of Odisha state (Fig. 1). The major forest types in the STR are Tropical Moist Deciduous Forest and Tropical Semi-evergreen (Champion & Seth, 1968). The temperature here ranges from 4° C in winter to 34° C in summer. It is a very moist landscape with an average annual rainfall of 2000 mm, and the landscape is a matrix of numerous perennial streams (Nayak, 2014).

In Odisha, the mugger is found in river systems of the STR (Sagar & Singh, 1993), in the Mahanadi river system of the Satkosia Wildlife Sanctuary (Dutta et al., 2009), the Ghodahada reservoir in Ganjam district, and a few individuals have been recorded from the Saberi river in Koraput district (Debata et al., 2018). In around 1980, the mugger was extirpated in the STR. Possible reasons for this include fishing using explosives and nylon nets and fires at nesting sites

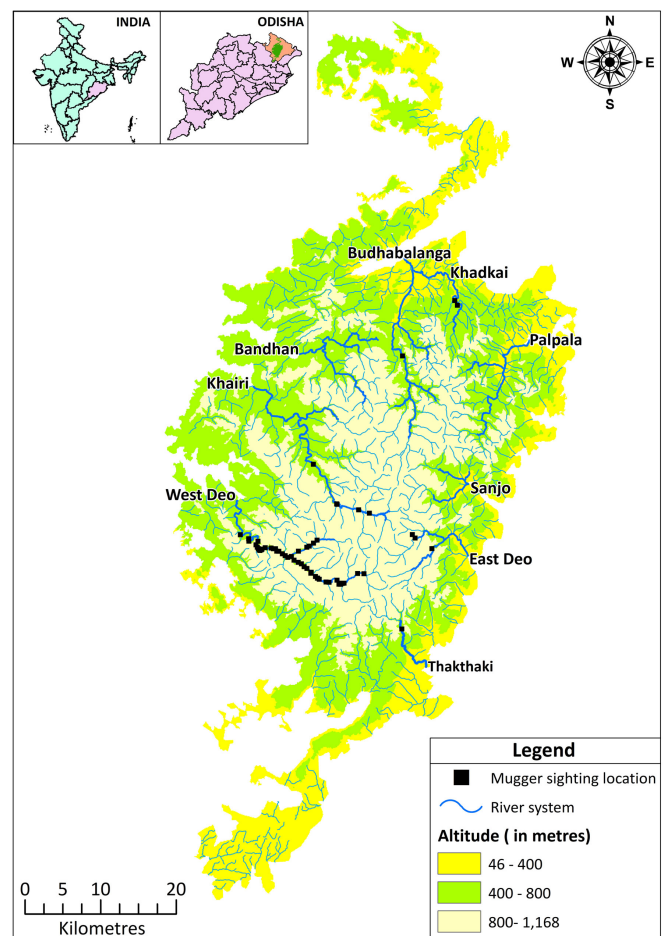


Figure 1. Map of Similipal Tiger Reserve along with the distribution of mugger crocodiles across different river systems and altitudes

(Sagar & Singh, 1993). In the past, the core of the STR had villages with fishing folk but now all but one village has been relocated outside the STR boundary, thereby significantly minimising fishing pressure. A mugger reintroduction programme took off in the STR's river systems after the establishment of the Ramatirtha Captive Breeding Center in 1980. A few individuals from the Madras Crocodile Bank, Tamil Nadu and Nandankanan Zoological Park, Odisha were also released. From 1981-2010, 812 muggers were released



Figure 2. An adult mugger and a hatchling (in the inset) basking near a pond at an altitude of 822 m a.s.l.

in the water bodies of the STR, which consist primarily of river systems and a few pools (Mishra et al., 2013). As per the unpublished records of the Odisha Forest Department, 55 %, 21 % and 16 % of these muggers were released in West Deo, Budhabalanga, Khairi river systems respectively. The remaining individuals were released in Khadkei and East Deo river systems.

We assessed the current population status and distribution of the mugger in the STR as a contribution to better conservation management of the species. We counted the basking individuals in winter on 9th - 10th January 2019, as at this time of the year the crocodiles spend many hours of the day basking on the banks or partially exposed rocks in the rivers resulting in reliable counts. The survey was conducted by the trained frontline force of the STR, which includes range officers, foresters, beat guards and protection assistants. The smallest administrative unit here is called the beat (approximately 12 km² under the charge of a beat guard). The survey was conducted at beat level and all the teams headed by a forester/beat guard covered the entire stretch of the river systems in their respective beats. Thus the cumulative effort of the frontline staff of the STR led to intensive sampling of a large geographical area in just two days. Boats were not used because the rivers here are shallow, narrow, and rocky, which makes them un-navigable, instead the teams walked along the banks of the rivers to record the number of muggers, the GPS location of each sighting, and the muggers' body size classes based on the approximate ocular length following the method of Santiapillai & de Silva (2001) in Sri Lanka.

In total, we recorded 82 individuals from all the rivers of the STR during the survey. Of these, 70 individuals (85 %) were recorded from the West Deo river system. In 2005, 85 muggers were counted of which 50 (59 %) were from the West Deo river and approximately 40 % were from the other four river systems (Sahu et al., 2007). A survey in 2011 detected 85 individuals in the rivers systems of the STR with 64 (75 %)

coming from the West Deo River (Mishra et al., 2013). The total number of muggers recorded in our survey and those reported in previous studies remained fairly constant with the bulk of the observations coming from the West Deo river system. It is suggested that there are greater number of muggers in the West Deo river due to it being longer than the other rivers, with greater availability of fish than the others, the majority of the river lying in the core of the STR thereby greatly reducing the anthropogenic interference (Sahu et al., 2007), and because more than 50 % of the reintroduced stock was released in the West Deo river.

During our survey, 90 % of individuals observed were recorded above an altitude of 750 m a.s.l. with the lowest record being from 380 m a.s.l. (Fig. 1). In 2004, a dead sub-adult mugger was reported at an elevation of 800 m in the Khairi river system of the STR; this was the highest recorded altitude for a mugger in India (Sahu & Swain, 2004). In the current survey we observed an adult and three hatchlings basking near a pond (21° 38'59.44" N, 86° 18'1.45" E) in the vicinity of West Deo River at an altitude of 822 m a.s.l. (Fig. 2).

From 1981, the reintroduction programme for muggers in the STR, coupled with the relocation of much of the human population away from the reserve, has successfully resulted in the establishment of a sustainable population of muggers. Furthermore, this population occurs up to an altitude of 822 m making it the highest altitude habitat for this species in India. The STR population provides a unique opportunity for research on various facets of mugger ecology.

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REFERENCES

- Champion, H.G. & Seth, S.K. (1968). *A revised survey of the forest types of India*. New Delhi, India, Government of India Press. 81-155 pp.
- Choudhury, B.C. & de Silva, A. (2013). *Crocodylus palustris*. The IUCN Red List of Threatened Species 2013. DOI:10.2305/IUCN.UK.2013-2.RLTS.T5667A3046723.en. Downloaded on 23 December 2020.
- Daniel, J.C. (1983). *The Book of Indian Reptiles*. Bombay, India, Bombay Natural History Society, 10 pp.
- Debata, S., Purohit, S., Mahata, A., Jena, S. K. & Palita, S. K. (2018). Mugger Crocodile *Crocodylus palustris* Lesson, 1831 (Reptilia: Crocodylia: Crocodylidae) in river Saberi of Godavari system in southern Odisha, India: conservation implications. *Journal of Threatened Taxa* 10: 11770-11774.
- Dutta, S.K., Nair, M.V., Mohapatra, P.P. & Mohapatra A.K. (2009). *Amphibians and Reptiles of Similipal Biosphere Reserve*. Regional Plant Resource Centre, Bhubaneswar, 63 pp.
- Grigg, G. (2015). *Biology and Evolution of Crocodylians*. Melbourne, CSIRO Publishing, 11 pp.
- Mishra, S.R., Nayak, A.K. & Nandi D. (2013). Population status of mugger crocodile (*Crocodylus palustris*) in Similipal Tiger Reserve, Odisha, India. *International Research Journal of Environmental Sciences* 2: 92-94.
- Nayak, A.K. (2014). *Tiger Conservation Plan of Similipal Tiger Reserve, Odisha* (2013-14 TO 2022-23). Odisha, India, Forest Department, Government of Odisha, 13 pp.
- Rao, M.V.S. (1993). *A Handbook of Indian Crocodiles*. Vishakapatnam, India, Andhra University Press and Publications, 18 pp.
- Rodgers, W.A. & Panwar, S.H. (1988). *Planning a Wildlife Protected Area Network in India*. Volume I, Wildlife Institute of India, New Forest, Dehra Dun, India, 235-243 pp.
- Sagar, S.R. & Singh, L.K. (1993). Captive breeding and rehabilitation of mugger crocodile (*Crocodylus palustris*) in Similipal Tiger Reserve, Orissa, India. *Indian Forester* 119(10): 807-815.
- Sahu, H. K. & Swain, D. (2004). Report on death of a mugger *Crocodylus palustris* in wild inside Similipal Tiger Reserve, Orissa, India. *Indian Forester* 130: 1211-1213.
- Sahu, H. K., Dutta, S. K. & Rout, S. D. (2007). Survey of mugger crocodile (*Crocodylus palustris*) in Similipal tiger reserve, Orissa, India. *Tigerpaper* (FAO) 34: 27-32.
- Santiapillai, C. & de Silva, M. (2001). Status, distribution and conservation of crocodiles in Sri Lanka. *Biological Conservation* 97: 305-318.
- Schleich, H.H. & Kästle, W. (2002). *Amphibians and Reptiles of Nepal*. Biology, Systematics, Field Guide. Koenigstein: Koeltz Scientific Books, 483 pp.
- Vyas, R. (2012). Current status of Marsh Crocodiles *Crocodylus palustris* (Reptilia: Crocodylidae) in Vishwamitri River, Vadodara City, Gujarat, India. *Journal of Threatened Taxa* 4: 3333-3341.
- Whitaker, R. & Andrews, H. (2003). Crocodile conservation, Western Asia region: an update. *Journal of the Bombay Natural History Society* 100: 432-445.
- Whitaker, R. & Whitaker, Z. (1979). Preliminary crocodile survey- Sri Lanka. *Journal of the Bombay Natural History Society* 76: 66-85.
- Whitaker, R. & Whitaker, Z. (1984). Reproductive biology of the mugger (*Crocodylus palustris*). *Journal of the Bombay Natural History Society* 81: 297-317.
- Whitaker, R. (1987). The management of crocodilians in India. In: *Wildlife Management: Crocodiles and Alligators*, pp. 63-72. Webb, G.J.W., Manolis, S.C., Whitehead P.J. (Eds.), Sydney, Australia, Surrey Beatty and Sons.

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