

Mugger Crocodile *Crocodylus palustris*

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Common Names: Mugger, marsh crocodile, swamp crocodile

Range: Iran, India, Nepal, Pakistan, Sri Lanka, Bangladesh (extinct in wild?), Bhutan (extinct?), Myanmar (probably extinct)

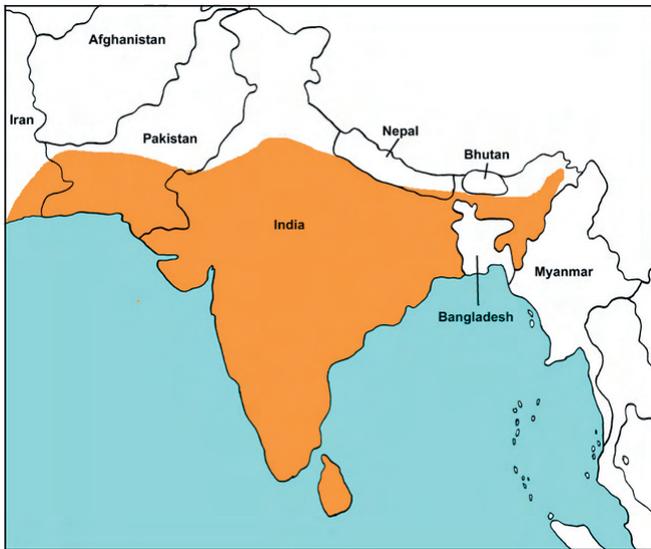


Figure 1. Distribution of *Crocodylus palustris*, based on Whitaker and Andrews (2003). Presence in Bangladesh is unclear (see text).

Conservation Overview

CITES: Appendix I

CSG Action Plan:

- Availability of survey data: Poor
- Need for wild population recovery: High
- Potential for sustainable management: Moderate

2009 IUCN Red List: VU (Vulnerable; Criteria: A1a. decline of 20% in 3 generations in extent of occurrence. C2a. Wild population less than 2500 adults and habitat fragmented and declining; IUCN 2009) (last assessed in 1996).

Principal threats: Habitat destruction, fragmentation, and transformation, mortality due to increased fishing activities.

Ecology and Natural History

The Mugger is a medium-sized crocodile (maximum length 4-5 m), and has the broadest snout of any living member of the genus *Crocodylus*. It is principally restricted to the Indian subcontinent where it may be found in a number of freshwater habitat types including rivers, lakes and marshes. In India, Pakistan, Sri Lanka and Iran, *C. palustris* has adapted well to reservoirs, irrigation canals and man-made ponds. The Mugger can even be found in coastal saltwater lagoons and estuaries (Whitaker 1987; Whitaker and Whitaker 1984; Whitaker and Andrews 2003). In some areas of northern India and Nepal, Mugger tend to occupy habitat that is marginal for Gharial (*Gavialis gangeticus*), but will sometimes compete for basking and nesting banks where they are sympatric. When found together with Gharial, Mugger will bask on midstream rocks or muddy banks (Groombridge 1982).



Figure 2. Adult *C. palustris*. Photograph: Jeff Lang.



Figure 3. *Crocodylus palustris*. Photograph: Jeff Lang.

The mugger is a hole-nesting species, with egg-laying taking place during the annual dry season. Females become sexually mature at approximately 1.8-2 m, and lay 25-30 eggs (Whitaker and Whitaker 1989). Nests are located in a wide variety of habitats, and females have even been known to nest at the opening of, or inside, their burrow (B.C. Choudhury, pers. comm.). In captivity, some Muggers are known to lay two clutches in a single year (Whitaker and Whitaker 1984), but this has not been observed in the wild. Incubation is relatively short, typically lasting 55-75 days (Whitaker 1987). Whitaker and Whitaker (1989) provide a good review of the behaviour and ecology of this species.

Like a number of other crocodylians, *C. palustris* is known to dig burrows. Whitaker and Whitaker (1984) referred to mugger burrows in Sri Lanka and India (Gujarat and South India) and noted that yearling, sub-adult and adult mugger all dig burrows. In Iran they are sometimes known to dig two burrows close to each other, which may be used by one or more crocodiles (Mobaraki 2002). These burrows are presumably utilized as an effective refuge from hot daytime ambient temperatures. These burrows play a critical role in the survival of crocodiles living in harsh environments (Whitaker *et al.* 2007), allowing them to avoid exposure to excessively low and high temperatures (<5°C and >38°C respectively) for long periods of time, which may be lethal (Lang 1987).

Mugger are known to undertake long-distance overland treks in Gir (India) (Whitaker 1977), Sri Lanka (Whitaker and Whitaker 1979) and Iran (Mobaraki and Abtin 2007). Some Muggers are killed while crossing roads in Iran (Mobaraki and Abtin 2007).

Conservation and Status

While the illegal skin trade was a major problem in the past (1950s to 1960s), the principal threats to the Mugger were previously identified as habitat destruction and fragmentation, drowning in fishing nets, egg predation by people, and the use of crocodile parts for medicinal purposes (Groombridge 1982).

Changes to habitat and mortality in fishing nets continue to be major threats to the species, whilst egg collection and the medicinal use of Mugger parts are now marginal. Although adequate survey data are lacking for India, Pakistan, Iran and Sri Lanka, existing records indicate that populations, while generally small and isolated, are widespread. The current global wild population is estimated at 5400 to 7100 non-hatchlings

There is no collation of data to suggest whether the overall wild *C. palustris* population is increasing or decreasing. Numbers of non-hatchling Mugger in National Chambal Sanctuary (India) have apparently increased from 105 to 226 in 16 years (R.K.Sharma, data collected for the Madhya Pradesh Forest Department; Sharma *et al.* 1995). Human-Mugger conflict has been reported from different parts of the country (Whitaker 2007, 2008), indicating possible increases in population and/or Mugger reaching larger sizes.

There are several thousand Mugger in captivity in Indian crocodylian breeding facilities. The Madras Crocodile Bank alone has over 2000. Egg production at all of these facilities has either been stopped or eggs are routinely destroyed. If suitable habitats in Protected Areas of the Muggers' former range are identified, surplus stock from these facilities can be used in reintroduction programs. Bangladesh and Bhutan are both candidates for this approach as well as several states in India.



Figure 4. *Crocodylus palustris*. Photograph: Jeff Lang.

Bangladesh: Cox and Rahman (1994) reported *C. palustris* to be extinct in the wild, and only two wild Muggers were known to live in community ponds. However, S.M.A. Rashid (pers. comm.) reported 40 adult and 28 hatchling Muggers in captivity in seven zoos in 2009. Forty captive adult *C. palustris* (8M:32F) were obtained from the Madras Crocodile Bank Trust (India) in June 2005 (Andrews 2005).

Bhutan: Muggers are considered to have become extinct in Bhutan in the 1960s. A captive breeding program was initiated at Phuentsholing and some individuals were reportedly released in the Manas River, but no detailed information is

available. The released crocodiles were not monitored, and so their fate is unknown. In the past there have been sporadic sightings of *C. palustris* in the Bado, Manas, Sunkosh Torsa, Raidak and the Puna Tsongchu River, but there have been no recent records (Whitaker and Andrews 2003).

India: Muggers are reported from over 10 States and the wild population is tentatively estimated as 2500 to 3500 non-hatchlings (Whitaker and Andrews 2003; R. Whitaker, pers. comm.).

Iran: Muggers are known from the drainages, small dams, artificial ponds and the natural ponds along the Sarbaz and Kajou Rivers, which join together to form the Bahokalat River in Sistan and Balochistan Provinces close to the Pakistan border. Recent surveys in the Nahang River area along the Pakistan border suggest that *C. palustris* is more widely distributed than previously considered. Mobaraki (unpublished data) estimated 200-300 *C. palustris* following a survey undertaken in 2007.



Figure 5. *Crocodylus palustris*. Photograph: Jeff Lang.

Pakistan: About 600 *C. palustris* are estimated to exist in four major wetland systems of Sindh, including a man-made lake (Javed and Rehman 2004; WWF, unpublished 2007-2009 reports). Small populations are sparsely spread in Balochistan rivers, mainly near estuaries (Javed and Rehman 2004; Rehman 2007). These populations are considered to be vulnerable and diminishing, mainly due to drought and alteration of habitat (eg construction of dams). The species is reported to be extinct in the Punjab Province (Chaudhry 1993). Recent surveys undertaken in Sindh in 2006-09 (Masroor, unpublished data) and 2008-09 (Chang, unpublished data) may shed more light on status once they are available. More than 150 individuals are held in captivity in five facilities (four in Sindh and one in Punjab).

Nepal: The results of a 1993 survey indicated that the Muggers were restricted to isolated populations, primarily in protected habitats. Small numbers of individuals were known or suspected from the Mahakali, Nala, Karnali, Babai, Rapti, Narayani and Koshi River systems. Modification of habitat

by river disruption and damming, and mortality in fisheries operations were major problems (McEachern 1994). Andrews and McEachern (1994) estimated 200 wild *C. palustris* in Nepal in 1993.

Myanmar: Van Dink (1993) reported that the last record of *C. palustris* in Myanmar was in 1867-68 and that the species was probably extinct there.

Sri Lanka: Approximately 1500 to 2500 individuals are estimated to exist in the wild, most of which are concentrated in several National Parks (eg Wilpattu, Yala, Bundala). Muggers are also found in many 'tanks' or man-made reservoirs in the dry plains of the island. In other areas, *C. palustris* is threatened by rapid agricultural and industrial developments (Whitaker and Whitaker 1989).

Priority Projects

High priority

1. **Conservation and Management Plan:** While there are numerous proposed conservation actions for the Mugger, these are all "stand-alones". At this time no state or federal Government has a conservation plan for the species.
2. **Population monitoring:** A program of regular, systematic monitoring of known *C. palustris* populations is essential. Nesting and basking sites should be identified and mapped, and census techniques need to be refined and standardized so that they are scientifically credible. Initially this should be carried out in protected areas.
3. **Protection of habitats:** Within Protected Areas, Mugger habitats require monitoring (eg siltation and drying up during drought). All Protected Areas that harbour Mugger require protection from illegal activities that threaten all wildlife and Mugger in particular - especially netting, disturbance at nesting and basking spots and killing of prey species. Adequate protection should be afforded to Mugger burrows especially from livestock.

The central and state Governments need to maintain the integrity of river and lake (reservoir) ecosystems so that they continue to harbour aquatic fauna. This includes controlling pollution by urban waste and industries, development of potentially disastrous water harnessing projects (such as the highly ambitious river inter-linking project in India).

Mugger populations across international borders, such as Pakistan-Iran, need to be discussed by relevant Government authorities to arrive at habitat management and protection protocols acceptable for the relevant countries.

4. **Post-release monitoring of restocked Muggers in India:** No single agency is responsible for tracking the success of restocking activities. The situation of captive breeding of Mugger in India needs to be addressed as the current crisis

of overstocking in captive breeding centres and uncertainty of the success of restocking remains an impediment to developing a coherent new strategy to meet current needs. On-going studies on survival, growth and population size at restocking locations are needed.

5. **Identification and minimisation of negative anthropogenic influences:** Some of the major anthropogenic threats are known but need to be pinpointed and mapped. Thus multidisciplinary actions involving all stakeholders, such as the people living in Mugger areas, relevant Government departments (Wildlife, Forest, Irrigation and Fisheries) are needed. Identification and mitigation of human/livestock disturbances to Mugger habitats are needed.
6. **Integration of local people into conservation programs:** Major threats to *C. palustris* include accidental drowning in fishing nets, and animals found entangled are often intentionally killed by fishermen. In some areas, Mugger eggs are collected for local consumption. A conservation awareness program that involves local people in the conservation of Mugger is vital to ensure long-term success of any management plan. Plans should include educational materials, signs, and instill pride amongst the locals as caretakers of the last populations of crocodiles in their water bodies. There is an equally compelling need for a concerted human/crocodile conflict mitigation program.

Moderate priority

7. **Species competition:** Although historical literature describes Gharial (*Gavialis gangeticus*) and Mugger as being sympatric, the relative proportions of each species in different habitats remains unknown. It has been suggested that a study be done on possible competition between the two species considering both the Critically Endangered status of the Gharial and the adaptability of the Mugger to a range of habitats other than riverine.
8. **Public awareness/education about crocodiles:** Public awareness is an important priority within the scope of overall management plans for the species. Zoos could play a greater role in lobbying for public sympathy. Conservation NGOs need to utilize the media as part of awareness programs.
9. **Sustainable use schemes, eco-tourism:** Placing a value on crocodiles is a proven technique for gaining acceptance of them from local people. Eco-tourism could potentially bring in additional income to local communities, and provided economic incentives for people to be more tolerant of crocodiles. The surplus captive animals and recent human-crocodile conflicts have made the sustainable utilization (ranching or farming) of this species a potential alternative management strategy. The feasibility of limited commercial use needs to be examined as a means to invigorate the crocodile conservation program. In several other parts of the world the crocodiles are a profitable resource - a conservation strategy that can, if implemented

correctly, be far more dynamic and successful than simple, well-meaning protective legislation.

Acknowledgements

Abdul Aleem Chaudhry, Rafaqat Masroor and Dhruvajyoti Bas provided valuable input into this plan.

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Figure 6. *Crocodylus palustris*. Photograph: Jeff Lang.