

Crocodiles. Status Survey and Conservation Action Plan: Mugger Crocodile *Crocodylus palustris*

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Common Names

English: Mugger, marsh crocodile, swamp crocodile, freshwater crocodile, broad-snouted crocodile

French: Crocodile des Marais, Crocodile paludéen, Crocodile palustre

Spanish: Cocodrilo del marjal, Cocodrilo marismeño

Sri Lanka: (Sinhala) Häla Kimbula, Äle Kimbula; (Tamil) Kulathi or Chenganni muthalai

India: (Hindi and Gujarati) Magar; (Tamil) Mothalay; (Oriya) Kuji khumbhira; (Bengali) Kumhîr; (Malayalam) Muthala and Cheengkani; (Kannada) Mossalay; (Telugu) Moseli; (Bihar, terms also used interchangeably for Gharial) Goh, Boch and Nakaar

Iran: Gandou

Pakistan: Magar machh

Reference of First Description of the Species

Lesson, René-Primevère (1831). Catalogue des Reptiles qui font partie d'une collection zoologique recueillie dans l'Inde continentale ou en Afrique, et apportée en France par M. Lamare-Piquot. Bulletin des Sciences Naturelles et de Géologie, Paris 25(4): 119-123.

Synonyms: *Crocodylus zeylanicus* (Ray, 1693), *Lacerta palustris* (Seba, 1735), *Lacerta palustris* (Gronovius, 1756), *Crocodylus natans* (Meyer, 1795)

Type: Type not traced.

Type Locality: Restricted to "Gange" (= River Ganga, northern India and Nepal) (Lesson 1834: 305); Ganges (Smith 1933)

Geographic Range

- **Extant (resident):** India, Islamic Republic of Iran, Nepal, Pakistan, Sri Lanka
- **Extinct:** Bhutan, Myanmar
- **Possibly Extinct:** Bangladesh (transients from India)

Conservation Overview

CITES: Appendix I

CSG Action Plan

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

IUCN Red List: The 2013 Red List assessment resulted in VU (Vulnerable; Criteria: A2cd; Choudhury and de Silva 2013), due to past population decline of 30% over three generations inferred due to declines in abundance, reduction in range and habitat quality and extirpation from part of the range, due to habitat destruction and illegal poaching. Global population in 2013 was estimated at <8700 adults (see Table 1) and overall stable and/or increasing.

Table 1. Estimated numbers of adult Muggers in each range state, in 2013 (see Choudhury and de Silva 2013) and 2025.

Range State	2013	2025	Current trend
Bangladesh	0-0	<10	-
India	3021-4287	10,000-12,000	increasing
Iran	100-200	>500	increasing
Nepal	150-200	<1000	increasing
Pakistan	100-600	<600	stable
Sri Lanka	2400-3500	~7500	increasing
Global	5771-8787	>20,000	increasing

The next Red List assessment will be carried out in late-2025/early 2026, and will rely to a large extent on information contained within this action plan.

Principal Threats: Habitat destruction, fragmentation, and alteration; mortality due to fishing activities; drought and floods (climate change); in some areas, collisions with vehicles and trains are becoming a regular occurrence.

Ecology and Natural History

The Mugger is a medium-sized crocodile, with males usually not exceeding 3.5 m and a maximum length of 4-5 m. Females average 2.5-3 m. The species 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 freshwater habitats including rivers, lakes, streams, agro-wells, man-made ponds and marshes.

The main natural habitats in Iran are deep pools around 6 m deep with clay substrates, and riverine habitat with thick fringing vegetation (Abtin 2012). They tend to avoid shallow and fast-flowing parts of rivers, and a recent survey in Tamil

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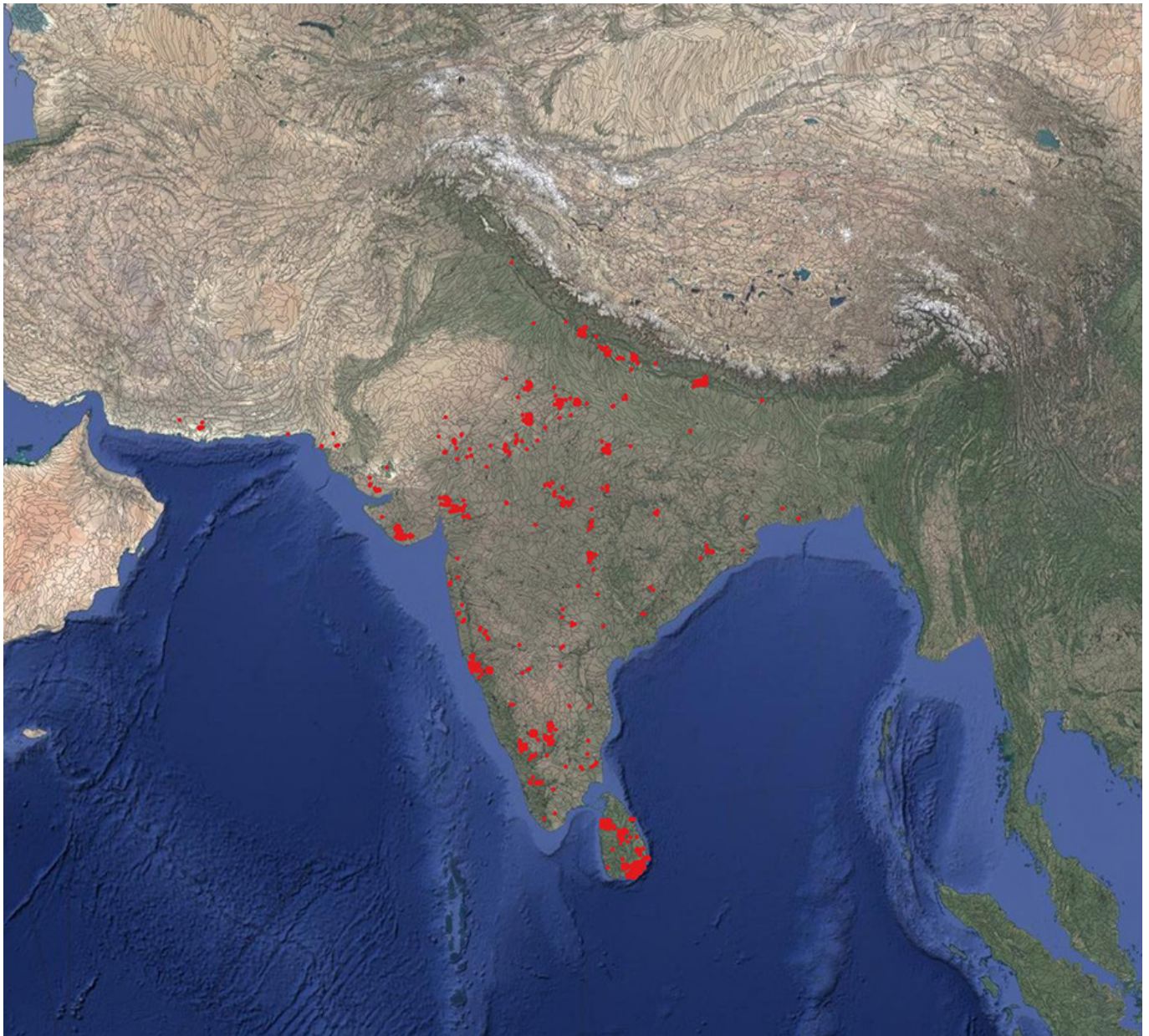


Figure 1. Distribution of *Crocodylus palustris*.

Nadu, India (Gour *et al.* 2022) indicates a preference for sandy banks near deep pools rather than shallow pools, and dense riparian cover - a finding consistent with other studies (eg Belal *et al.* 2022, which also discusses other water quality parameters that might impact *C. palustris* in Uttarakhand). In Nepal, Muggers will quickly disperse into swamps and marshes associated with rivers and lakes (Rajbhandari and Acharya 2014).

In India, Pakistan, Sri Lanka and Iran, *C. palustris* has adapted well to reservoirs, irrigation canals and man-made ponds (called 'Hootak' in Iran, or 'tanks' in Sri Lanka) (de Silva and de Silva 2019). In Nepal, Muggers are often found in aquaculture ponds (Rawat *et al.* 2020; Khadka *et al.* 2014). Muggers can even be found in coastal saltwater lagoons and estuaries in some areas of India (eg Goa, Gujarat), and in man-made saltwater ponds in Sri Lanka (de Silva 2013; de Silva *et al.* 2010; Gabriel 2013; Whitaker 1987; Whitaker and Whitaker 1984; Whitaker and Andrews 2003; Rastegar-

Pouyani *et al.* 2015; D'Souza *et al.* 2015). In Iran, natural ponds subject to tidal influence will see the crocodiles move from these now brackish ponds into the freshwater village ponds (Mobaraki 2015). Given the regular scarcity of water in some areas, it is not unexpected that Muggers adapt to any available water body. Many of these reservoirs also have plentiful fish stocks, and in many regions the crocodiles within these reservoirs are relatively large individuals (Mobaraki 2015).

In northern India and Nepal, Muggers tend to occupy habitats that are marginal for Gharial (*Gavialis gangeticus*) but will sometimes compete for basking and nesting banks where they are sympatric. When found together with Gharial, Muggers will tend to bask on midstream rocks or muddy banks (Groombridge 1982).

Mugger are known to undertake long-distance overland treks in India (Whitaker 1977), Sri Lanka (de Silva 2013; Whitaker

and Whitaker 1979, 1984) and Iran (Mobaraki and Abtin 2007). Muggers are sometimes killed while crossing roads in India, Iran and Sri Lanka, and on railway tracks in Sri Lanka and India (Vyas and Vasava 2019; de Silva 2013; Mobaraki and Abtin 2007; Mobaraki 2015; de Silva and de Silva 2019; Vyas *et al.* 2023). During drought periods, these overland treks are essential for crocodiles to find more permanent water bodies until the rains return. In 2000, due to severe drought, mass crocodile migration was observed at Hiran Dam, Gir Forest, Gujarat (Vyas 2001). “Processions” of crocodiles moving to find water have been observed in Sri Lanka during the dry season (June to August) at Yala National Park between 2100 h and 2300 h, consisting of batches of 2-3 or 5-7 crocodiles (de Silva 2013). This migratory behaviour is an important factor to take into account when developing management programs for Muggers: in the absence of permanent water bodies, Muggers are likely to wander significant distances in search of suitable water, bringing them into farms, villages and community ponds, increasing the likelihood of interactions with people and putting them at increasing threat crossing roads and railway lines.

Like a number of other crocodylians, *C. palustris* is known to dig burrows (see Fig. 2). Whitaker and Whitaker (1984) referred to Muger burrows in Sri Lanka and India (Gujarat and South India) and noted that yearling, sub-adult and adult Muggers 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), and by crocodiles at different life stages (Mobaraki 2015). Several detailed studies on burrows have been conducted in Sri Lanka. The average height and width at the entrance of Muger burrows were 43.16 cm (range 20-90 cm) and 80 cm (range 29-154 cm), respectively, and depth (=length) varied from 100 to 1100 cm with an average of 310 cm (Whitaker *et al.* 2007; Rathnasiri *et al.* 2013). These burrows are presumably utilized as an effective refuge from harsh environments (Whitaker *et al.* 2007), allowing them to avoid exposure to potentially lethal low and high temperatures (<5°C and >38°C, respectively) for long periods of time (Lang 1987).



Figure 2. Muger burrow, Sri Lanka. Photograph: Anslem de Silva.

The Muger is a hole-nesting species, with egg-laying taking place during the annual dry season: February-April in southern India, about one month later in northern India; February-March in Nepal; April-May in Iran; and, June-July, but as late as August, in Sri Lanka (de Silva 2013; Mobaraki 2015; Whitaker and Whitaker 1984, 1989; Andrews and McEachern 1994). Females become sexually mature at approximately 1.8-2 m and lay 10-30 eggs (de Silva *et al.* 2013; 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 (Mobaraki 2015; de Silva *et al.* 2013; B.C. Choudhury, pers. comm. 2019). In a study of 41 nests in Sri Lanka, 41% were situated at the entrance of a burrow, 10% were in sandy habitat near a burrow, 39% were in sandy habitat on tank bunds, and 10% were in anthropogenic habitats (de Silva *et al.* 2013).

Nests are often elevated high on the bank of rivers or ponds. They can be under tree cover (Mobaraki 1998, 2015), but usually require a sandy substrate. In disturbed areas, nesting sites are often inadequate due to a combination of thick shoreline vegetation, too exposed a site (resulting in egg desiccation through overheating), or overly rocky substrates. Trial nests have been recorded for this species, and sometimes multiple trial nests can be observed near the actual nest (de Silva 2013; Mobaraki 2015; Whitaker and Whitaker 1989). Nests can be some distance from the water, with Chaudhury *et al.* (2018) reporting an average distance of 20 m from the nearest water for Muger nests in Katerniaghath Wildlife Sanctuary compared to just over 6 m for sympatric Gharials. Vaghashiya *et al.* (2018) report on a female Muger within Gujarat’s Lal Dhori transporting her hatchlings 178 m from the nest to a muddy pool, then moving them all to the lake by the next morning.

In captivity, some Muggers are known to lay two clutches in a single year (Whitaker and Whitaker 1984; Desai *et al.* 2022), but this has not been observed in the wild and is almost certainly due to a more stable environment and availability of resources and protection in captivity. Incubation is relatively short, typically lasting 55-75 days (Whitaker 1987). Hatching occurs in late April or May in southern India, July in Iran and can be as late as September in Sri Lanka (Lang *et al.* 1986; Mobaraki 2015; de Silva 2013). Whitaker and Whitaker (1989) provide a good review of the behaviour and ecology of this species.

Muger hatchlings average around 25-27 cm total length at hatching. Parental care has been observed in both captive and wild Muggers (Dharmakumarsinji 1947; Whitaker and Whitaker 1984, 1989; Vaghashiya *et al.* 2025). Lang *et al.* (1986) document the opening of a nest and subsequent hatchling transport, opening of eggs, and hatchling defence by a captive male Muger at Madras Crocodile Bank Trust. In that study, hatchlings were defended from birds and even staff by other adult crocodiles in the enclosure and not just the parents. Despite this care, predation can be high. The major predators of young crocodiles include large wading birds, birds of prey, predatory fish, mongoose, jackals and monitor lizards, and larger Muggers (Mobaraki 2015; de Silva 2013; Vyas 2019b).

As with most crocodylian species, Muggers are dietary generalists, with prey including invertebrates, fish, amphibians, reptiles, birds and small mammals (de Silva *et al.* 2018b; Gour 2023). Adult animals may also include monkeys, deer, buffalo and sometimes large cats (Vyas 2021). Given the proximity of many Muger populations to villages throughout their range, large adult male Muggers will also prey on livestock (commonly goats in Iran) and feral dogs. There are several reports of Muggers feeding on elephant carcasses in Sri Lanka (de Silva 2013). Muggers have been observed 'herding' or 'corralling' fish in groups or individually (de Silva 2013; Chavan and Borkar 2023; Vyas *et al.* 2024). Hierarchical feeding on buffalo carcasses has been observed in Sri Lanka (de Silva 2013). One report from Nepal's Bardia National Park records a Muger hunting, then 'storing', a spotted deer (*Axis axis*) within the roots of a fallen *Ficus* tree (Bhattarai 2015).

Muger attacks on humans are common, although the majority of these are from a few conflict hotspots in the Vishwamitri (Gujarat), Krishna (Maharashtra), Terai (Uttar Pradesh) and Chambal (Madhya Pradesh and Rajasthan) Rivers.

Conservation and Status

While the illegal skin trade was a major problem in the past (1950s to 1960s), the principal threats to the Muger over the past few decades have included habitat destruction and fragmentation, drowning in fishing nets, dynamite fishing, egg predation by people, and the use of crocodile parts for medicinal purposes (Groombridge 1982). Most of these threats persist.

More recently, collisions with vehicles and entanglement in or ingestion of discarded rubbish have been reported in Gujarat (Vyas 2014; Vyas and Vasava 2019; Vyas *et al.* 2020a,b, 2023). Intentional destruction of crocodile eggs by local people out of fear of crocodiles, along with collection for consumption were reported in 2012 by de Silva (2013). Habitat destruction or disturbance and entanglement in gillnets, however, remain the key threat across the species' range (Choudhury and de Silva 2013). In Sri Lanka, Muger are invariably killed after attacks on humans (de Silva *et al.* 2013) but are also killed for meat which is sold illegally (de Silva 2013). Retaliatory killing is a problem in other areas as well (eg Gujarat, India; Vyas 2018a). Crocodile predation on livestock generates complaints by local people, sometimes instigating retaliatory killing. Across much of the range, Muggers are vulnerable to droughts, moving overland to more permanent waters, or relying on burrows to retreat into. It is impossible to predict the future impacts of climate change, but given the likelihood of more erratic weather patterns (Ripple *et al.* 2019) this is certainly a potential threat to Muggers (see also Mobaraki *et al.* 2023).

Historical records show that Muggers were common in the past. Shortt (1921) reports on rivers and streams around the Kosi district of Bihar "teeming with the reptiles". Dharmakumarsinhji (1978) mentioned that in 1930, Muggers were found in most tanks and rivers of Kathiawar (Saurashtra Peninsula). Similarly, in Sri Lanka, Muggers and Saltwater

crocodiles (*Crocodylus porosus*) were common (see de Silva 2013), and worldwide demand for crocodylian skins saw Sri Lanka become a supplier of skins from both species. Deraniyagala (1939) states that these species were common in 1925 but were rarely found by the end of the 1930s.

As the interiors of India were opened up for timber operations, crocodile populations were decimated by hunters and settlers (see Whitaker 1987). Daniel (1969) reported 30,000 skins being processed through Calcutta port, and production was estimated at around 50,000 skins per annum in India in the late 1940s, mainly Muger skins. Dam construction in the 1950s almost completed the extermination by permanently altering wetland crocodile habitat. The development of dams for fisheries also resulted in fishery contractors eliminating crocodiles as perceived competitors. By 1974, the global wild Muger population was thought to include around 1000 adults (Whitaker and Whitaker 1989).

Dharmakumarsinhji (1955) was the first to be worried about and propose protection for the three Indian crocodylian species to the Government of India in 1953. Remnant populations of Muggers that survived in forest pools, rivers and streams formed the basis of programs commencing in the 1970s to re-establish crocodylian populations in former habitats. Surveys in the early 1970s confirmed that populations were severely depleted (Whitaker 1974; Whitaker and Whitaker 1989). Following these surveys, the FAO-supported Indian Crocodile Conservation Project helped to establish both in-situ and ex-situ programs, including construction of several crocodylian rearing stations, along with staff training (Bustard 1999; Choudhury 2025). Under the Project, 13 sanctuaries were established for crocodile conservation, totalling 8000 km² (Whitaker 2004). Looking back on the project in 1999, Bustard considered the Muger to have made a 'spectacular recovery', although he also noted the lack of monitoring of released crocodiles in many areas (Bustard 1999). As of 1999, around 1800 Muggers had been released into the wild in India from captive rearing centres (Singh 1999). According to Whitaker and Whitaker (1989), most of the early released Muggers were from rearing centres in Tamil Nadu, since captive breeding had succeeded there better than at other centres (predominantly at Madras Crocodile Bank Trust). Although concerns for introducing crocodiles from other localities were considered, the main priority was establishing, or re-establishing, breeding populations in locations where there were sometimes no longer even remnant populations (Whitaker and Whitaker 1989).

Changes to habitat and mortality in fishing nets continue to be major threats to the species, whilst egg collection and the medicinal use of Muger parts are now marginal (although recent reports from Gujarat suggest it is still a concern - see Vyas 2017). Survey data are available for many parts of India, Pakistan, Iran and Sri Lanka, indicating that populations, while generally small and isolated, are widespread. In 2013, the global wild population was estimated at 5771-8787 adults (Table 1; Choudhury and de Silva 2013). It is now considered to comprise more than 20,000 adults with increasing trends in many parts of India, Nepal and Iran (see Table 1 and country

reports below).

There are several thousand Muggers in captivity in Indian crocodilian breeding facilities and zoos. Excess Muggers in captivity has long been a problem (see Whitaker 2004), and egg production at all of these facilities has either been stopped and/or eggs are routinely destroyed. If suitable habitats in or around Protected Areas of the Muggers' former range are identified and local Government and communities are supportive, surplus stock from these facilities could still be used in reintroduction programs, although this seems unlikely across much of the range. Bangladesh and Bhutan are both candidates for this approach as well as perhaps some states in India (eg Assam) and some areas within Sindh and Balochistan Provinces in Pakistan. With increasing incidence of human-crocodile conflict (HCC) and a need for translocating problem crocodiles, the current capacity in captive facilities remains worryingly limited. Iran has some capacity for relocating crocodiles to a farm within Chabahar Free Zone. Vyas and Stevenson (2017) have expressed concern over the ineffective method of simple translocation that often sees crocodiles move back toward the place of capture (see also Vyas and Bhavsar 2009; Vyas 2010b). A more permanent solution to this will be required within the next few years, especially in places such as Gujarat, to reduce HCC incidents and the resulting negative public backlash. This could include sustainable use programs to generate livelihood benefits that promote the conservation of crocodiles in the wild.

Country Reports

Most survey data for Muggers have been collected through daytime surveys carried out in winter months, which are strongly biased towards the sighting of large crocodiles in the population. Although such surveys still provide an index of relative abundance, they do not necessarily provide detailed information on smaller size classes. In addition, data on crocodile sizes are based on broad size categories (hatchlings, yearlings, juveniles, sub-adults, adults), making detailed analysis of population size structure over time difficult. Unless stated otherwise, survey counts in Country Reports reflect daytime surveys with no correction for sightability biases, etc. (ie relative abundance).

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. More recently, Khandakar and Jeny (2020) also reported that Muggers were locally extinct in Bangladesh. The original stock of Muggers that survived in the Hazrat Khan Jahan Ali shrine pond have since died (the last of the males - known as kalapahar and morbidly obese - died in 2015). S.M.A. Rashid (pers. comm. 2009) reported 40 adult and 28 hatchling Muggers in captivity in seven zoos in 2009. Forty captive adult Muggers (8M:32F) were imported from the Madras Crocodile Bank Trust (India) in June 2005 (Andrews 2005; Masum *et al.* 2012), and a small number of these now reside in the Hazrat Khan Jahan Ali Shrine, with a report of breeding in 2018 (The Daily Star 2018a). Breeding of Muggers appears to still be a struggle for zoos within the country (Masum *et al.* 2012).

Up until 1950, Muggers were frequently seen in most monsoon rivers, except those furthest south toward the coastal mosaic of the Sundarbans (Khan 1982). Khan (1982) reported 10 people being killed by Muggers in the district of Faridpur alone in the mid-1940s, along with records of local people eating crocodile eggs and more than 1000 Muggers being shot for their skins between 1936 and 1946 in the Bangladesh Bengal region. Certainly, after around 1960, sightings of Muggers in Bangladesh became rare, and they were considered extirpated (Rahman 1990; Rahman and Asaduzzaman 2010; Bangladesh Forest Department 2016). The major factor leading to the population collapse was unregulated hunting and disturbance of habitats, along with fishing and the construction of barrages (particularly the Farakkah Barrage) (Khan 1982; Rahman and Asaduzzaman 2010; Bangladesh Forest Department 2016).

In 2015, a Mugger sighted in the Madhumati River was captured and taken to Gazipur Safari Park, near Dhaka. The Madhumati River is a tributary of the upper Padma River (Ganges River) flowing through southwestern Bangladesh. A second Mugger was sighted on 9 November 2018 in an inlet of the Padma River (Ganges) at Char Komorpur in Pabna District (Fig. 3). Due to the receding monsoon waters, the connection with the main Padma River was cut and the crocodile was living in that isolated perennial inlet (The Daily Star 2018b; Fig. 4). During a visit to the site by S.M.A. Rashid on 8 January 2019, it was still there. It is thought that these Muggers moved from India during the monsoon when the water levels were high. India and Bangladesh share many international rivers, the Padma River being a major one (S.M.A. Rashid, pers. comm. 2019).



Figure 3. Rare sighting of a Mugger in the Padma River, Bangladesh, in 2018. Photograph: Ehsan Ali Biswas Lithu.



Figure 4. Habitat of the perennial inlet of the Padma River, Bangladesh, where a Mugger took refuge. Photograph: S.M.A. Rashid/CARINAM.

Suitable habitat remains in Bangladesh, with potential for reintroductions. However, tolerance of crocodiles in the rivers and other wetlands by the local people is very low (S.M.A. Rashid, pers. comm. 2019). The people living near the

rivers and other wetlands are unaccustomed to sharing their waterways with crocodiles. Recent sightings of crocodiles have raised concern among local people, and any plans for reintroduction of Muggers require a commitment to reducing threats from crocodiles, regular monitoring of released animals, and education/community programs to ensure that local communities are included in the plans.

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 so their fate is unknown. In the past there have been sporadic sightings of Muggers in the Bado, Manas, Sunkosh Torsa, Raidak and the Puna Tsongchu Rivers, but there have been no recent records (Whitaker and Andrews 2003). Despite continued reference to crocodilians in Bhutan (Sherpa 1996; National Biodiversity Centre 2009; Wangyal 2013; Ministry of Agriculture and Forests 2014), recent surveys do not report sightings of either Gharials or Muggers in the country (Bauer and Gunther 1992; Wangyal 2014; Das and Palden 2000). Habitat would be more suitable and contiguous with Gharial populations than with Mugger (Wangyal 2014; Whitaker 1987).

India: The majority of Mugger habitat and distribution is within India. Historically, Muggers were common in many Indian river systems (Shortt 1921; Dharmakumarsinhji 1978; Whitaker 1987). Habitat loss and hunting for skins in the 1950s and 1960s further decimated Mugger populations (Dharmakumarsinhji 1955; Whitaker 1987). Whitaker and Whitaker (1989) estimated that the Mugger population in India in 1974 was perhaps as few as 1000 adults, and 1720 non-hatchlings by the late 1980s.

In 1972, the Wildlife Protection Act gave the three crocodilian species in India the highest level of protection (Whitaker 1987). The Indian Crocodile Conservation Project, the widely-publicised and wildly optimistic conservation project aiming to save the three endemic species, began in the mid-1970s (Choudhury 2025), resulted in the rearing and release of, chiefly, Muggers and Gharials into the 1990s. The Project also saw crocodile breeding centres constructed around the country, the declaration of 13 Protected Areas for crocodiles or Gharials, and established crocodilians as a priority for Indian researchers (Bustard 1999). Whilst the Project covered all three crocodilians within India, emphasis has remained on the critically endangered Gharial (Whitaker 1987). There was a view by project staff that, historically at least, wherever Muggers and Gharials co-existed, Muggers were in relatively low numbers. Therefore releases of Muggers under the Project should not occur in Gharial habitat so as to not upset this perceived balance (Sharma and Singh 2015).

Most Mugger populations are found outside of protected areas, and many are coming into conflict with humans. Considering the growing populations, of both people and Muggers, HCC in the country is steadily rising (Vyas and Stevenson 2017; Stevenson *et al.* 2014). There are various causes, but

the primary reasons are increasing Mugger populations and human encroachment into the natural Mugger habitats. Over the past decade (2015-2024), there are reports of 649 attacks on people by Muggers in India, with 255 of these resulting in death of the victim (CrocAttack 2024). Combined with the fragmentation of Mugger habitats and populations, the encroachment of human activities into Mugger habitats is also resulting in injuries and deaths of Muggers on roads and train tracks and due to ingestion of and entanglement in rubbish (see Vyas *et al.* 2020a,b).

Notable Mugger populations have been reported from at least 18 Indian States (Andhra Pradesh, Bihar, Chhattisgarh, Goa, Gujarat, Haryana, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Telangana, Uttar Pradesh, Uttarakhand, West Bengal). There have been no reports of Muggers in northeastern India for the past few decades (Choudhury 2006), and a recent study of water monitors in Assam confirmed that Muggers have been extirpated from there (Mazumder *et al.* 2020).

In the 1980s, the largest breeding populations were in Hiran Lake within Gir National Park, and Amaravathi Reservoir in Tamil Nadu (Whitaker 1987). During the 1990s, significant Mugger populations remained in Tamil Nadu, Goa, Gujarat, Rajasthan and Andhra Pradesh (Whitaker 1999). There have been tentative estimates of the wild population across India made at different times (Whitaker and Andrews 2003; Vyas 2018a), but coordinated survey data across the country were lacking. The most recent estimate (in 2025) suggests that the Indian population probably exceeds 10,000-12,000 Muggers, and in many areas populations are increasing.

National Chambal Sanctuary (Madhya Pradesh, Uttar Pradesh, Rajasthan)

The National Chambal Sanctuary (NCS) is around 625 km along the Chambal River, with tri-state (Madhya Pradesh, Uttar Pradesh, Rajasthan) administrative responsibilities. Much of the crocodilian focus along the Chambal has been for the Gharial, and the river holds the most significant breeding population of that species (Lang 2016). Sharma and Singh (2015) reported seeing no crocodiles in a 100-km stretch of the Chambal River from Kota to Pali, during a survey in 1984 - this section now contains both Gharials and Muggers (Fig. 5), with the latter present also in many tributaries (Tarun Nair, pers. comm. 2021). Sharma and Singh (2015) reported on a drastic increase in Muggers within the broader NCS, from 33 in 1985 (a definite underestimate) to 402 in 2015, and then 694 in 2019 (Sharma *et al.* 2024) - reportedly 886 in 2021, although other conservative estimates for the Chambal put the current number at between 1200 and 1500 non-hatchlings (Tarun Nair, pers. comm. 2021). Sharma and Singh (2015) voiced concerns that increases in Mugger numbers were at the detriment of Gharials within the sanctuary, but Gharial numbers during this period also showed a clear increase (Lang 2016). A significantly higher number of Gharials than Muggers within the UP/MP stretches of the NCS was observed during trips in 2012-13 (Colin Stevenson, pers. comm. 2025).



Figure 5. Adult Mugger, National Chambal Sanctuary. Photograph: Colin Stevenson.

Madhya Pradesh

Elsewhere in Madhya Pradesh, Muggers persist within the Son, Ken, Betwa, Narmada, Tapi and Kuno Rivers, Pench, Tighra, Tawa and Gandhi Sagar Reservoirs, and Chandpata, Jadhav Sagar and Narsimgarh lakes (Rao 1999; Arya 2020). Protected Areas with Muggers include Gandhi Sagar, Kuno-Palpur, Madhav, Orchha, Van Vihar, Nauradehi, Satpura, Pench, Ratapani.

Nair and Katdare (2013) reported: 56 Muggers being observed in Panna Tiger Reserve along the Ken River, and 4 within the Ken Gharial Sanctuary; 19 Muggers plus a number of burrows along the Son River; and, two Muggers along a heavily disturbed part of the lower Betwa River (according to the authors, the Betwa in Madhya Pradesh has good numbers of Muggers). Nair and Katdare (2013) also reported significant disturbance due to human activities (eg large-scale sand mining, fishing, cattle herding, bathing) along both the Betwa and Ken Rivers. The increasing threat of sand mining within the Son Gharial Sanctuary is of major concern, since the area has high conservation potential for Muggers, Gharials and turtles. Gurjwar and Rao (2018) reported 712 adult Muggers at 6 different sites in Madhya Pradesh, and concluded an increase in Mugger numbers within the state between 2016 and 2017. Elsewhere in the state, Muggers are present in growing numbers within the Ganges basin. Some report (eg Sarkar *et al.* 2018; Kumar *et al.* 2019) that Muggers are less common than Gharials in the main river channel, preferring the slower flows of canals, reservoirs and wetlands.

Uttar Pradesh

In Uttar Pradesh, Muggers inhabit the wetlands along the Ganges, although in many places they are not as numerous as Gharials within the main river channel (Sarker *et al.* 2018). The state has a number of protected areas that harbour crocodile populations, including the National Chambal Sanctuary (see above), Hastinapur, Pilibhit, Dudhwa, Sohagi Barwa, Mirzapur Forest Division and Katerniaghat Wildlife Sanctuary. Katerniaghat WS lies along the Girwa River which originates in Nepal and runs west of Bardia NP. Choudhary *et al.* (2018) reported 210 observations of Mugger along a stretch of the Girwa within Katerniaghat WS over several surveys. These authors also noted higher numbers of Gharial observations (718) than Muggers along the main channel, and also report on segregation of habitat selection by these

sympatric species. Recent reports indicate good Mugger numbers (estimated at over 150 adults) within the Ganges floodplain habitats of Hastinapur WS (B.C. Choudhury, pers. comm. 2022).

Bihar

Nair (2019) reports 80 Muggers from 45 locations within Kaimur Wildlife Sanctuary in Bihar, although an estimate of the entire Karmnasa system is perhaps 200-300 Muggers (Tarun Nair, pers. comm. 2021). Other populations in Bihar are present in the Gandak River, and in the Kosi River and associated wetlands.

Rajasthan

In Rajasthan, Muggers are present in and surrounding a number of protected areas, with key populations in the NCS, Ranthambhore Tiger Reserve, Sariska Tiger Reserve, Jawahar Sagar Wildlife Sanctuary, Kumbhalgarh Wildlife Sanctuary, Phulwari ki Nal Wildlife Sanctuary, Shergarh Wildlife Sanctuary and Sitamata Wildlife Sanctuary (Sharma 1999).

Uttarakhand

In Uttarakhand, key Mugger populations are within Corbett National Park and Rajaji National Park (Joshi *et al.* 2011). Surveys of the Terai Arc region in 2014-2017 reported 341 crocodiles in total (218 adults, 85 sub-adults, 38 juveniles) (Belal *et al.* 2021). The state's Forest Department reported, through social and mainstream media (see Upadhyay 2021), 452 Muggers within the state in 2020 (after a drone-based survey), up from 123 in 2008 - although these numbers are questioned by some (Subir Chowfin, pers. comm. 2021). Corbett Tiger Reserve is the subject of population surveys, chiefly for Gharials, but the Mugger population will also be assessed. Current population within the Tiger Reserve is around 55 adult Muggers (in the same area there are ~90 Gharials), but perhaps as many as 90-100 in total within the entire national park (Subir Chowfin, pers. comm. 2021). Subir Chowfin (pers. comm. 2023) considers the Mugger population within Corbett TR to be stable. Outside of these Protected Areas in Uttarakhand, Muggers are reported from the Laksar and Uddam Singh Nagar areas (Belal *et al.* 2022).

Haryana

Muggers are held in the Bhor Saidan Crocodile Breeding Centre in Haryana, the result of intentional stocking in a temple pond by the local Sadhus for worship (Gupta 2011). There is a small population of around 25 crocodiles in this 'breeding centre'. Possible escapes from this semi-natural facility have seen crocodiles in local waterways (The Tribune 2016).

Odisha

Although Muggers were once widely distributed in Odisha, by 1979 they were virtually wiped out in Similipal Tiger

Reserve (Singh 1999). A 2017 survey reported a total of 218 Muggers within the state, but very low numbers along a 23-km stretch of the Saberi River, which lay within an area under proposal for a reserve (Debata *et al.* 2018). This same study indicated that Muggers were still killed by local people under the belief that certain body parts can help cure various diseases. Mishra *et al.* (2013) reported a total of 85 crocodiles within the ~1200 km² Similipal Tiger Reserve. Since 1981, 812 crocodiles had been released into the reserve through the Crocodile Conservation Project, but a lack of monitoring means that the fate of these released animals is unknown.

Mishra *et al.* (2013) reported threats to Muggers in Odisha, including fishing activities (using nets and explosives), use of DDT to control malaria, destruction of nesting areas due to fires, along with natural predation. The most recent data from the annual wildlife census records 72 Muggers in the Satkosia/Mahanadi River, 77 in Similipal Tiger Reserve, and 76 in the Ghodahada Reservoir (Odisha Wildlife Organisation 2025). A separate study in the Ghodahada Reservoir in 2017 reported an increase from 35 crocodiles in 2008 to 55 in 2017 (Das *et al.* 2021). This study also reports a population structure that comprises hatchlings/yearlings (10%), juveniles (45%), sub-adults (25%) and adults (20%).

Biodiversity surveys in 2017 reported Muggers from five localities along the Saberi River, a tributary of the Godavari system in Koraput District in southern Odisha (Debata *et al.* 2018). This area had not previously been considered in crocodile surveys within the state. The numbers of crocodiles in this tributary are unknown, but very low, based on just a few individuals sighted and observed tracks. Other protected areas in Odisha with reported Muger populations include Debrigarh Wildlife Sanctuary, Chandaka-Dampara Wildlife Sanctuary, Hadagarh Wildlife Sanctuary and Balimela Wildlife Sanctuary (Singh 1999).

Maharashtra

Historically, Muggers were widely distributed in Maharashtra state, but more recently have been confined to the Krishna basin and its tributaries including the Warana, Venna, Tarali, Koyna, Panchaganga, Bhima and Kadavi Rivers (Patil *et al.* 2012; Atigre *et al.* 2013; Whitaker 2007), with a few populations in protected areas in the north and east of the state (eg Tadoba and Pench National Parks and Melghat Tiger Reserve) (Gogate 1999). Around Mumbai, Vihar and other lakes around Sanjay Gandhi National Park also support crocodile populations (Gogate 1999; Dey 2015). Atigre *et al.* (2013) estimated the population in the Warana at 182, although numbers observed were just 29 by day surveys and 52 during night surveys (Atigre 2016). Whitaker (2007) and Atigre (2018) indicate that the crocodile population within the Krishna River basin in Maharashtra is increasing. Despite legal protection since 1972, it wasn't until the late-1980s that any protected areas in Maharashtra included any wetlands (Gogate 1999). Muggers are now also reported in west-flowing rivers of the state, including the Savitri and its tributaries (Kal and Gandhan, Vashishti and Terekhol).

Goa

Goa's Muger population is small, and largely inhabits the estuaries of the Cumbarjua Canal, which connects the Mandovi and Zuari Rivers, with thick mangrove vegetation (Nadaf 2019). In the 1990s, there were an estimated 16 adult Muggers remaining in the canal (Rattanani 1995). These crocodiles are traditionally worshipped (Rattanani 1995; Kulkarni *et al.* 2013). Other reports of Muggers within the state are from the Chapora, Valvanti, Khandepar (Opa), Mapusa, Sal/Sanguem and Cuncolim Rivers (Tarun Nair, pers. comm. 2021).

Kerala

Kerala's crocodile population suffered a "catastrophic" decline in the mid-1900s, with estimates of just 60 Muggers within the state by the late-1970s (Pillai 1999). Releases from the Indian Crocodile Conservation Project concentrated on Neyyar Reservoir in the south of the state, Parambikulam Reservoir and the Kabini River, and by the late-1990s the state's Muger population had increased to 250 (Pillai 1999). A study carried out in 2001-2002 concluded that just 16 Muggers remained in the wild within Neyyar Reservoir. Due to significant HCC problems in the area, the local community was not in support of the release of crocodiles into the dam since it was heavily used by local people (Jayson *et al.* 2006; Jayson and Sivaperuman 2008). In addition to the Kabini River, the Panamaram and Nugu Rivers in Wayanad are also reported to have Muggers, along with the Chalakudy River near Athirapally. By 2004, Muggers had disappeared from the Kalliasseri area (Sreedharan 2004). The Chinnar River near the Tamil Nadu border eventually feeds into the Indira Gandhi Wildlife Sanctuary, and holds a population of Muggers, but specific data are lacking.

Karnataka and Tamil Nadu

The Cauvery River basin that flows through Karnataka and Tamil Nadu provides some key Muger habitat in southern India, and Muggers are found in sporadic populations throughout the river system. In Tamil Nadu, Andrews (1999) reported the Muger population to be fragmented and restricted mainly to protected areas. Rapid assessment surveys by Madras Crocodile Bank Trust in 2013 showed small Muger populations near Tanjore, seasonally influenced by monsoon water levels (Kartick 2013). Similarly, during an otter survey along the Cauvery River in Karnataka in the same year, Chaplod (2013) noted very sporadic signs of Muggers along a 95-km stretch of the river. Ramachandra *et al.* (2017) reported 200+ Muggers in the Kali River in Karnataka. Surveys along the Moyar River in 2016 report sighting 81 crocodiles within a well-preserved habitat (Samson *et al.* 2021), and another carried out in a similar period reported direct sighting of 28 Muggers in a 102-km stretch plus a further 98 Muger scats and tracks (Narasimmarajan *et al.* 2018). These authors report no HCC within the area, but some illegal fishing and agricultural run-off. Andrews (1999) reported 65 adults within the Moyar River system, but also noted the pristine habitat available for Muggers.

Whitaker and Srinivasan (2020) report on crocodile attacks within the Cauvery delta region of Tamil Nadu between 2009 and 2019. Seven fatal and 12 non-fatal attacks were investigated, and it appeared that the frequency of incidents was increasing (see Sampath 2022). Water discharge from some of the many dams in Tamil Nadu (notably Mettur Dam on the Cauvery River and Sathanur Dam on the Pennaiyar River) during the monsoons have been blamed in the media for increased crocodile numbers downstream (see Nithya 2025; DT Next 2019), along with crocodile escapes from a centre at the Sathanur area (Dinamalar 2024).

Areas within Tamil Nadu with crocodile populations include Amaravathi Reservoir (possibly the largest breeding population still within Tamil Nadu, although habitat availability suggests the Cauvery WLS-Mettur and Moyar-Bhavani populations may be larger), Sathanur Reservoir, and “good” populations remain within the Cauvery Wildlife Sanctuary (Daniel *et al.* 2012). Andrews (1999) estimated 326 adults and sub-adults within the state in 1999. Without more thorough and recent survey data, it is difficult to ascertain what that population is now, but based on the available reports and various news reports, it seems that the Mugger population in Tamil Nadu has increased slightly.

Madras Crocodile Bank Trust are currently surveying Muggers within the Cauvery River, including radio-tracking (Nik Whitaker, pers. comm. 2022). Thus far, 5 crocodiles have had transmitters fitted, including a very large 2.9 m long female. A 2019 survey within the Melagiris section of the Cauvery River observed 54 crocodiles during night surveys,

along with nests with evidence of successful hatching (Gour *et al.* 2022). Protected areas still provide the only safe haven for crocodiles in the state, with those outside of these zones at the mercy of seasonal variations in water levels - exacerbated by dams - and a lack of tolerance by local communities. Recent news reports hint at plans for new crocodile rescue centres within the state (Prasad 2021).

Andhra Pradesh and Telangana

The first release of Muggers under the Indian Crocodile Conservation Project took place in Andhra Pradesh in 1977 in a tributary of the Krishna River (Srinivas *et al.* 1999). An earlier survey of the Godavari and Krishna Rivers systems had revealed 30 adult Muggers. In 1981, breeding was recorded for the first time within the Ethipothala Waterfalls area where this initial release had been made. Between 1977 and 1998, 320 Muggers were released in the state (Srinivas *et al.* 1999).

Small breeding populations of Muggers are reported from the Manjeera, Kinnerasani, Siwaram and Pakhal Wildlife Sanctuaries (Srinivas *et al.* 1999), now within the newly formed state of Telangana. Manjeera Wildlife Sanctuary was surveyed between 2011 and 2017, with around 170 crocodiles observed (Prasad *et al.* 2018), an increase from 0.41 to 5.4 individuals per km². The authors considered the population to be increasing. By comparison, in 1978 the Mugger population within the sanctuary was estimated at just 7 adults and 5 sub-adults (Srinivas *et al.* 1999).

Other populations in Andhra Pradesh and Telangana include

Table 2. Daytime (winter) and spotlight (summer) counts of Muggers in Charotar, 2013-2025. CCC= Charotar Crocodile Count; VNC= Voluntary Nature Conservancy; WW= Wetland Watch.

Year	CCC/WW	Month	No. of Villages	Count	Source
<u>Daytime Surveys</u>					
2013	1st CCC	December	18	98	VNC (2017)
2015	2nd CCC	January	26	129	VNC (2017); Vasava <i>et al.</i> (2015)
2016	3rd CCC	January	21	116	VNC (2017)
2017	4th CCC	January	26	140	VNC (2017)
2018	5th CCC	January	21	131	VNC (2018a)
2019	6th CCC	January	22	159	VNC (2019)
2020	7th CCC	January	22	164	VNC (2020)
2021	8th CCC	January	20	216	VNC (2021)
2022	9th CCC	January	25	167	VNC (2022)
2023	10th CCC	January	23	255	VNC (2023)
2024	11th CCC	January	26	120	Anirudh Vasava, pers. comm. 2025
2025	12th CCC	January	25	290	Anirudh Vasava, pers. comm. 2025
<u>Spotlight Surveys</u>					
2018	1st WW	May	20	240	VNC (2018b)
2019	2nd WW	May	25	272	Anirudh Vasava, pers. comm. 2025
2022	3rd WW	May	23	272	Anirudh Vasava, pers. comm. 2025
2023	4th WW	May	24	303	Anirudh Vasava, pers. comm. 2025
2024	5th WW	May	22	358	Anirudh Vasava, pers. comm. 2025
2025	6th WW	May	25	549	Anirudh Vasava, pers. comm. 2025

the Godavari system (Swami-Godavari Rivers near Nirmal town, Kaddam Dam, Papikonda NP, Kothapeta), Krishna system (Bheema-Krishna confluence, Jurala Project, Turukonipally, Somasila-Siddheswaram, Amarabad Tiger Reserve, Nagarjunasagar-Srisailem TR, Chityala, Pulichintala Projects, Prakasam Barrage, and Musi River near Hyderabad.

Gujarat

There is little doubt that Gujarat state holds the largest populations of Muggers within India. The publications of Raju Vyas over the past two decades documents a growing population, along with increasing conflict with people (Vyas 2010a, 2012, 2018a,b, 2019a; Vyas and Stevenson 2017). In 1978, the Mugger population within Gujarat was estimated at 500, with the largest concentration at Hiran Lake within Gir National Park. By 1996, the population within the state was estimated at around 1600 Muggers (Kumar *et al.* 1999). Vyas (2018a) estimated the population to be around 2500. Vyas (2018b) graphs the increase in Muggers within Vadodara City, from just 9 in 1993 to 250 in 2015 (Fig. 6). A recent count in February 2025 shows an increase to 400+ animals of various sizes within the 25-km river stretch (Raju Vyas, pers. comm. 2025).



Figure 6. Muggers in Vadodara, Gujarat. Photograph: Anirudh Vasava.

A key area for Muggers remains Gir Forest. The area is dry deciduous forest, with a topography that drains to the south and is prone to droughts. Man-made water bodies provide crucial permanent water holes for the wildlife within Gir National Park. A 2017 survey reported a total of 647 crocodiles within the park (Vyas 2019a), with the largest population within Hiran Dam estimated to be 153 Muggers. This is an increase from a 2001 report that records a total of 288 Muggers within the Gir Forest (Vyas 2001). From 1984 to 1995, almost 1000 Muggers were released within Gir as part of the restocking project (Vyas 2019a; Kumar 1999), but with only intermittent surveys and a lack of close monitoring of released crocodiles, the fate of these individuals post-release is unknown.

Within the northwestern Kutch region, a 2021 survey recorded 408 direct sightings of Muggers, with an estimate of over 800 crocodiles at 113 sites within the region (Pandhi *et al.* 2022). The last survey in the region was in 1996, with 176 crocodiles reported (Kumar 1999). The region is dry, with no perennial rivers, but in recent years, cyclones have hit the region with huge increases in annual rainfall that have seen dams and

reservoirs, etc., holding water for longer periods than usual (Dax Pandhi, pers. comm. 2021). Most of the crocodiles exist in these dams and reservoirs, so conditions have become more favourable (perhaps an indication of climate change impacts). HCC incidents are low in this area, but reports of crocodiles being killed by cars is increasing (~20 incidents in 2019; over 30 in 2020; CrocAttack 2024). There are also reports of intentional killing of crocodiles by farmers when the animals are discovered in farm ponds (Dax Pandhi, pers. comm. 2021).

In central Gujarat, a key area for Muggers is the Vishwamitri River system, with crocodiles frequently seen basking on the outskirts of Vadodara City. A recent sighting of a Mugger within the Purna River indicates a possible migration of crocodiles into new habitats (Chaudhari *et al.* 2022; Vyas 2023a). Within the Kheda and Anand districts of Gujarat, a 2022 survey reported 220 crocodiles (Talati *et al.* 2022). This area is the site of annual citizen science surveys (see Table 2), with increasing crocodile numbers recorded since the project's inception in 2013.

In the southern region of the state, the Tapi and Purna Rivers host a widespread, but small and fragmented Mugger population (Trivedi *et al.* 2022). Both rivers are a case of reappearance of Muggers within their historical distribution range after 60 years (Vyas 2023b). Identified threats to crocodiles in Gujarat, especially around Vadodara, includes cars (Vyas 2014; Vyas *et al.* 2020a), trains (Vyas 2014; Vyas and Vasava 2019; Vyas *et al.* 2019), removal of Mugger tails for medicinal use (Vyas 2017) and entanglement and ingestion of rubbish (Vyas *et al.* 2020b). One study recorded 75 vehicle collisions with crocodiles in Gujarat in 2005-2022 (Vyas *et al.* 2023). HCC incidents are also reported (Vyas 2017, 2018; Vyas and Stevenson 2017). Unexplained deaths of Muggers have been reported most recently from Gujarat (Vyas 2023b), notably 20 crocodiles varying in size from 0.45 to 3.7 m found dead within the Vishwamitri River system. Despite post-mortems on some of the animals (most were too decomposed for necropsy), the cause of death was not determined. Speculation is that use of toxic chemicals, or intentional killing of the crocodiles for traditional medicines are potential causes. Clearly, if these deaths continue then concerted efforts must be made to determine the cause. Notable explained deaths do occur, such as fatal falls when caught in flash-flood waters washing over dam walls (Vyas and Vaghasiya 2020) or when caught in fires due to an increase in *Typha* burning (Vyas *et al.* 2024).

A framework has been established by the Voluntary Nature Conservancy (VNC) in Charotar, Gujarat, utilising local nature enthusiasts to count crocodiles (Vasava *et al.* 2015; VNC 2017, 2018a,b, 2019, 2020, 2021, 2022, 2023). The 2-day event is carried out each January, with guest crocodile experts talking to the locals about crocodilian biology and conservation. Volunteers then carry out a basic survey of Muggers in the area. This event successfully marries community education with systematic monitoring of the local crocodile population. Notwithstanding observer and other biases affecting visibility of crocodiles (eg effect of

water hyacinth in 2024; Rupera 2024), since the first count in 2013 (98 crocodiles), there has been a gradual increase in sightings, indicating a mean rate of increase of around 7.5% p.a. Spotlight count surveys carried out in summer by Wetland Watch, over a shorter time period (2018-2025; Table 2), indicate a higher mean rate of increase of around 9.5% p.a.

An average of 48% (range 39 to 53%) of daytime sightings in Charotar in 2018-2022 were large (>2 m) Muggers (VNC 2018a, 2019, 2020, 2021, 2022). Notwithstanding the biases associated with daytime surveys, this indicates that the adult portion of the Charotar population is increasing in abundance.

Chhattisgarh

Chhattisgarh has Mugger populations in Achanakmar Tiger Reserve, Kharung River, wetlands in the Kotmi-Sonar area and adjacent Lilagar River, Pamulgautami River (bordering Maharashtra), Indravathi River, Saberi River (bordering Odisha), and the Kanger River/Kanger Valley National Park.

Jharkhand and West Bengal

In Jharkhand and West Bengal, Mugger populations are reported from the lower Ganga between Sahibganj (Jarkhand) and Farakka (West Bengal). A small remnant population is reported from the Bhera River (Jarkhand) and Muggers are occasionally trapped in fishing nets in the tributaries of the Ganga (eg Jalangi River, West Bengal).

Iran: Iran holds the western-most population of *C. palustris*. Populations here are fragmented, inhabiting the drainages, estuaries, small dams, artificial ponds and natural ponds along the Sarbaz and Kajou Rivers, which join together to form the Bahokalat River in Sistan and Balochistan Provinces close to the border with Pakistan (Fig. 7). Part of this area is designated as the 'Gandou Protected Area', and the region includes a Ramsar site along the lower Sarbaz River (Ramsar 1999). Surveys in 2000 concluded that the Mugger population in Iran was around 200-300 crocodiles (Mobaraki 2002). These data were collected after a period of drought within the region (Mobaraki and Abtin 2013). Surveys in 2012 in the Nahang River area along the Pakistan border suggest that *C. palustris* is more widely distributed than previously considered, with some of these populations likely spanning the Pakistan/Iran border and possibly moving between the two countries (Mobaraki 2015).

Based on the last census and related published data, the Mugger population in Iran was estimated by Mobaraki and Abtin (2013) at about 500 adults and sub-adults, indicating a steady growth in population size. By far the largest Mugger population is within Pishin Dam Reservoir, with more than 120 adult crocodiles observed, therefore representing a critical Mugger population (Abtin 2012; Mobaraki 2015). Heidari *et al.* (2022) reports on surveys within the Gandou Protected Areas from 2012, 2015 and 2016 with Mugger numbers of 326, 402 and 355 crocodiles, respectively. This dam is the largest in the Province and is crucial for the human population, with climate change scenarios emphasizing the



Figure 7. Mugger habitat, Iran. Photograph: Asghar Mobaraki.

importance of the dam and suggestions for safeguarding the supply for people in the region (Zahraie *et al.* 2010).

The people in this region believe that Muggers (called 'Gandou'; Abtin and Mobaraki 2017) are lucky animals and consider them to be sacred. Within the 'Gandou Protected Area' the belief is that if there are Muggers there is water (Rafsanjani and Karami 2011). They are therefore tolerant of the crocodiles, rarely harming them despite attacks on livestock - a positive situation for the crocodiles of the area. The 2012 surveys also engaged with local people, capitalizing on this tolerance and respect, and acting as a capacity-building program to gain support for crocodile conservation (Mobaraki and Abtin 2013).

Projects have been planned around the presence of the crocodiles along the Bahokalat River for eco-tourism (Rafsanjani and Karami 2011). Given the positive attitude of the local communities toward crocodiles, this idea has a good chance of succeeding, with the potential to add a financial incentive for protecting the crocodiles within the area. Two crocodile rearing centres are established in Dargas and Rikokash - mainly to hold nuisance crocodiles, rehabilitation of injured crocodiles, but there is also a limited amount of breeding (Mobaraki 2015; Rashid 2008). There were plans to expand these facilities into farming/ranching centres, but this process has been slow and they are currently used as rehabilitation centres. The stock in Rikokash in 2015 was 50 crocodiles, but there are fewer than this now (Mobaraki 2015; Asghar Mobaraki, pers. comm. 2019). These projects are part of the Mugger National Management Plan developed in 2008 (Mobaraki and Abtin 2008). Construction of another large dam, the Zirdan Dam, along the Kaju River, provides a stable habitat with its vast reservoir, supporting an increasing number of crocodiles in the upper parts of the reservoir (Mobaraki 2024).

Following development of the Mugger National Management Plan in 2008, and utilising private sector funding and support for conservation, public education and breeding, a multipurpose farm was established inside the Chababar Free Zone. Initial stock came from nuisance crocodiles

being maintained in the Rikookash Rehabilitation Centre, or from rescued animals from dams for example. The farm has had successful breeding and stock had increased to 120 Muggers in 2023 and in 2025 had more than 200. There are plans for releasing some of the captive-reared juvenile crocodiles annually when needed. As the first Mugger farm in the country, it is now one of the main tourist destinations in the area. Moving forward, the farm requires technical support and information exchange as well as breeding stock from other farms and breeding centres within the Mugger range states (Asghar Mobaraki, pers comm. 2025).

The main threats to crocodiles in Iran are environmental: flooding and conversely drought. Droughts have resulted in significant mortality of younger animals as well as adults. It can drive the animals to search overland for water bodies, which can create HCC issues as well as mortality from car strikes (Mobaraki 2015; Mobaraki and Abtin 2007). Flooding destroys nests and nesting sites, causes the loss of hatchlings and young crocodiles, and can displace adult crocodiles into overflow ponds from which they cannot escape, leaving them to slowly perish with no source of food (Mobaraki 2015). Again, this is perhaps an early indication of climate change impacts on this crocodile population (Mobaraki *et al.* 2023). Urban and agriculture development and increased water usage further threaten crocodile habitats.

Importation of non-native species, mainly Saltwater crocodiles (*C. porosus*) and often illegally, for tourism purposes does occur. This raises the concern of intentional or unintentional releases of these species into the wild as a potential threat to the future management of native Muggers (Asghar Mobaraki, pers. comm. 2025).

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. This was also the opinion of Smith (1931), citing Theobald from 1868 who recorded a large specimen from Thayetmyo on the Irrawaddy River and who stated that it was the only specimen he had ever seen from that country. However, the identity of this specimen has been called into question (Whitaker and Whitaker 1984). No evidence exists to indicate that the species persists in Myanmar (Thorbjarnarson *et al.* 2006; Forest Department 2015).

Nepal: From the Indian border to the outer foothills of the Himalayas, the Gangetic plain covers around 14% of Nepal, and houses nearly half of the Nepalese human population (Siwakoti and Karki 2009). This area of plains lowland under 300 m - the 'terai' - is dotted with 160 wetlands (Siwakoti and Karki 2009) and is home to Nepal's Mugger population. The extent of habitat available to Muggers saw historically large populations (Groombridge 1982), with early reports of 'hundreds of crocodiles' (both Muggers and Gharials) along the Gandak River (Kennion 1921).

Following the loss of wetland habitats, increasing urbanisation and persecution of Muggers by the expanding human population, Nepal's Muggers now persist in a small number

of fragmented populations (Baral and Shah 2013). 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, 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 120-150 wild Muggers in Nepal in 1993. Today, Muggers are confined to areas in and perhaps surrounding four main protected areas: Chitwan, Bardia and Shuklaphanta National Parks, and Koshi Tappu Wildlife Reserve. A small population of Muggers (<30) also occurs at Ghodaghodi Lake Complex, a Ramsar site in Western Nepal. Recent reports estimate Mugger numbers in Nepal at "less than 1000" (NTNC 2020).

In Nepal as in India, the Gharial has received the bulk of the attention for surveys and conservation actions as a key species. Much of the data for Muggers has been collected during surveys for Gharials. Both species in Nepal gained legal protection in 1973 through the National Parks and Wildlife Conservation Act (Khadka 2019).

The easternmost Mugger population in the country is within the Koshi Tappu Wildlife Reserve, established in 1976 and was Nepal's first Ramsar site in 1988. The reserve has a variety of wetland habitats including permanent and seasonal rivers, floodplains, seasonally flooded grasslands, oxbow lakes, and flooded rice fields (Siwakoti and Karki 2009). A survey by Goit and Basnet (2011) reported 21 Muggers in 2008, whilst those by Baral and Shah (2013) in 2012 estimated a total of 30 adults in Koshi Tappu WR. Both reported few juveniles and hatchlings. A more recent survey in 2020 lists 35 crocodiles observed during the December survey and included observations of juveniles, sub-adults and adult crocodiles (Bhattarai *et al.* 2022). The Koshi Barrage presents a barrier for movement of aquatic wildlife, especially from downstream to upstream, obstructing the return for fish, dolphins or crocodiles. Particularly in the monsoons, floodwaters sweep crocodiles downriver into India (Shah and Paudel 2016; Whitaker and Andrews 2003). Hatchlings and juvenile crocodiles are especially vulnerable. High water levels during the monsoons created by the barrage flood most nests near the dam (Maskey 2008; Shah and Paudel 2016). The main threats to the Mugger population in Koshi Tappu WR are the restricted water flows created by the barrage, disturbance of forest habitats within the reserve by people collecting firewood and other forest products as well as illegally killing wildlife. Observations of direct disturbance of Muggers is reported by Goit and Basnet (2011), including fishing with nets, and collection of crocodile eggs (Goit and Basnet 2011; Baral and Shah 2013; Shah and Paudel 2016).

Around 200 miles west of Koshi Tappu is Parsa National Park. Established in 1984 as a wildlife reserve, it was made a National Park in 2017 (Bhattarai *et al.* 2018). Surveys of Parsa Wildlife Reserve in 2012 covered around 60% of the area, but reported no Muggers (Baral and Shah 2013). An inventory of reptiles and amphibian species within Parsa NP between

2014 and 2017 recorded a single Mugger that was released from a captive holding facility into the park and is considered a new record of the species within the park (Bhattarai *et al.* 2018). Parsa NP has a 35-km boundary connecting it with Chitwan National Park (CNP). A 2017 paper reported the growth of Parsa NP's tiger population, with CNP being the source population, and noting that increased security of Parsa NP and the development of the buffer zones has reduced demand on the park's resources, and increased community support (Lamichhane *et al.* 2018b). There is therefore the potential for the Mugger population within the Chitwan/Parsa region to expand further into Parsa NP itself. Currently though, Muggers must be considered as remnant individuals in Parsa NP itself, and potentially mainly within the Rapti River along the northern boundary of the park.

CNP is home to the most significant Mugger (and Gharial) populations within Nepal. Surveys in 2014 reported 245 Muggers within CNP and the associated Buffer Zone area, 171 of which were adults (Khadka *et al.* 2014). Most of the crocodiles (66.5%) were observed in lake, pond and swamp habitat, indicating a preference for these habitats rather than the main rivers (Rapti and Narayani). The authors estimated the total Mugger population in CNP to be around 300-350 non-hatchlings - almost certainly an underestimate given the myriad lakes within the Beeshazar and Associated Lakes complex (known locally as the "20,000 lakes"), which was designated as a Ramsar site in 2003. Rajbhandari and Acharya (2014) reported "a large congregation of Muggers in Beeshazari Lake and its associated wetlands" due to plentiful swamp and marsh habitat. Bhattaral *et al.* (2017) recorded Muggers in a number of these lakes, but were just reporting presence (Bhattaral *et al.* 2017). Khadka (2019) reports that the Mugger populations in the Rapti and Narayani Rivers within CNP clearly show an increasing trend, as do surveys by the National Trust for Nature Conservation (NTNC 2019). In 2022, 46 Muggers were observed during a survey of the Rapti River (Nishan *et al.* 2023).

The main threats to Muggers in CNP were identified as habitat destruction (including sand and gravel mining), sedimentation, food shortage and seasonal fluctuation of water levels (Govt. of Nepal 2015; Nishan *et al.* 2023). Sedimentation and invasive species are causing shrinkage of wetlands, and Muggers have been reported moving into the extensive fish farm ponds within the Buffer Zone, resulting in retaliatory killings in some cases. Generally, farmers will notify authorities to come and rescue the crocodiles from their ponds (Khadka *et al.* 2014). Many of the swamps and wetlands dry up during summer, and the crocodiles will move overland to more permanent lakes and irrigation canals (Rajbhandari and Achyara 2014), increasing the likelihood of conflict situations. Although human-crocodile conflict occurs within CNP, the extent of it appears relatively minor. Silwal *et al.* (2016) considered Muggers to be one of 9 major wildlife 'attackers' within CNP, although Mugger attacks seemed quite rare. Khadka *et al.* (2014) reported 4 attacks on people by Muggers in CNP between 2008 and 2011. Lamichhane *et al.* (2018a) reported a death of one victim and injuries on two people as a result of Mugger attacks.

In the western terai region toward Banke National Park to the west, Muggers have been reported in the Dang District (Khanal 2017), and considering that many of these regions lie outside of protected areas, it is assumed that populations are small and scattered (Khanal and Baniya 2018). The West Rapti River also provide potential habitat for Muggers.

Over 200 km west of CNP lies Royal Bardia National Park. Two perennial rivers drain Bardia NP - the Karnali and Babai Rivers. Both rivers support populations of Muggers (Bashyal and Yadav 2020). Surveys by the National Trust for Nature Conservation indicated an increase in Mugger populations, with the 2019 figures of 7 Muggers observed in the Karnali and 45 seen in the Babai Rivers (NTNC 2019). The Karnali River is subject to anthropogenic disturbances such as sand and stone mining, overfishing, and pollution and both Muggers and Gharials are more plentiful in the Babai River (NTNC 2019). Recent sightings of Gharial nests along the Babai will hopefully result in more information on Muggers as well as Gharials over the coming years (Bashyal 2019). Conflict with crocodiles is low in Bardia NP: a recent report lists just a few instances of attacks by Muggers on domestic goats (Upadhyaya *et al.* 2020).

Further west, Ghodaghoodi Lake, a Ramsar site, holds breeding populations of Muggers with one study observing 12 crocodiles, including hatchlings (Khatri and Baral 2012). These wetlands comprise 14 large and small oxbow lakes and associated marshes and swamps, covering an area of around 2500 ha. With Godhaghoodi Lake being the largest natural lake on the terai (around 138 ha), and with many associated wetlands, swamps and marshes (Siwakoti and Karki 2009), more extensive surveys are required to quantify crocodile status. Crocodiles are reported to regularly enter fish farms at night and prey on the fish (Khatri and Baral 2012). Lamichhane *et al.* (2022) observed 26 Muggers within 18 lakes of this complex, and recommended further study on the movement of Muggers within this area.

The western-most population of Muggers in Nepal is found within Shuklaphanta National Park. A 2009 survey directly observed just 4 adult Muggers (Bhatt *et al.* 2012), but a more recent survey recorded presence of Muggers in at least 9 rivers within the reserve, rescuing 5 Muggers from villages or fish ponds from four locations (Rawat *et al.* 2020). A survey of crocodiles in Shuklaphanta NP during 2016 (part of national survey of crocodiles) documented >100 Muggers including Bahuni (50) and Chaudhar (35) Rivers flowing through the park. In 2024, 25 Gharials were also released into the Chaudhar River of Shuklaphanta NP (Joshi 2024).

Pakistan: Sparse Mugger populations are found in the wetlands of the Indus Plains in Sindh and coastal Balochistan Provinces in the south of the country (Javed and Rehman 2004; Javed *et al.* 2005; Rehman 2007). The species is reported to be extinct in Punjab Province (Chaudhry 1993), and the wider Indus River system (Braulik *et al.* 2015). Historically, Muggers were plentiful in both Sindh and Balochistan Provinces (Ahmed 1986), with Smith (1931) reporting on the famous 'mugger pir' near Karachi (a large

swamp with hundreds of Muggers when first reported to Europeans in 1838) and the ease with which Sindh locals could hunt the plentiful Muggers as a “defensive measure in order to protect their fish”. By the time Ahmed (1986) carried out his surveys in 1983, Muger populations in both Sindh and Balochistan had declined.

More recently, over-hunting and habitat fragmentation are all implicated in the extirpation of Muggers from the Indus (Braulik *et al.* 2014, chav2015; Ali *et al.* 2018). Given the climate of the region, certainly the major Indus River system provided optimal habitat for crocodiles, namely a hot summer (>32°C) and mild winter with extensive wetlands (Ali *et al.* 2018). The current population is largely restricted to the fragmented coastal wetlands experiencing warm summers (21-31°C) and mild winters. The populations further inland at the Ramsar site at Deh Akro 2 and Nara Desert Wildlife Sanctuary in Sindh Province experience very hot summers (Ramsar 2002; Chang 2018).

The Balochistan populations are considered vulnerable and diminishing, mainly due to drought, alteration of habitat (eg construction of dams), illegal killing for skins, by fishermen, and for specimens in museums and laboratories, and retaliatory killing of crocodiles after loss of livestock (Rahim *et al.* 2018; Government of Pakistan 2000). Rahim *et al.* (2018) reported a decline of the Muger population overall in the Dasht River from 63 adults in 2007-2008 to around 23 adults in 2018. Many threats to this population were recorded, including droughts and degradation of habitats, retaliatory killing of crocodiles in response to livestock losses, smuggling of juvenile crocodiles into Iran for sale, and increasing agricultural pressures. Only two juveniles were observed during the 2018 survey (down from 18 juveniles in 2008), indicating potentially a lack of reproduction and/or recruitment. Populations are still known from the Hub and Hingold Dam sites in Balochistan (Begum *et al.* 2013; Zafar and Malik 2018; Rahim 2010; Rahim *et al.* 2018), and a more recent report of the presence of crocodiles in Lachhi Canal in Haji Shahr within the Kachhi District of Balochistan (Khan *et al.* 2022).

There are a few key Muger populations in Sindh Province, and the populations there are threatened by hunting, habitat loss, pollution and illegal fishing (Chang *et al.* 2013a,b, 2016). At the Ramsar site Deh Akro 2 Wildlife Sanctuary, about 330 km northeast of Karachi, the Muger is a key species in the site, the lakes of which are fed by seepage from the main irrigation canal system and rainwaters. A 2019 survey determined that the Muger population in Deh Akro 2 Wildlife Sanctuary comprised 98 adults, 53 juveniles and 38 hatchlings (Chang *et al.* 2012b). In the Nara Desert Wildlife Sanctuary, 184 adults, 91 juveniles and 51 hatchlings were recorded during a survey in 2009 (Chang *et al.* 2012a). In Chotiari Wetland Complex, surveys from 2006 to 2009 reported low numbers of Muggers, observing just 66 crocodiles (44 adults, 10 juveniles, 12 hatchlings) (Chang *et al.* 2015). Small numbers of nests were observed during these surveys, with over 20 nesting females estimated, although the authors concluded that despite suitable habitat for hatchlings, there was very low recruitment of youngsters

into the population due to increasing disturbance of this nursery habitat (Chang *et al.* 2015). In Haleji Lake Wildlife Sanctuary, Chang *et al.* (2013d) counted 269 Muggers in both the sanctuary and the captive ‘farm’, and the sanctuary’s crocodile population was considered to be increasing. HCC is a concern for a growing human population within Haleji Lake WS, and attacks on people and livestock are regularly reported from the sanctuary, as are retaliatory killing of the crocodiles and destruction of their eggs (Chang *et al.* 2013d).

Alongside the few remaining wild populations in Pakistan, there are several large captive populations, which include the Manghopir Shrine outside of Karachi, Karachi Zoo, Khar Centre KNP, Samzu Park Karachi, Haleji Lake WS and New Jatoi Farm in Sindh Province (Chang *et al.* 2012b, 2013c, 2017; Khan *et al.* 2015; Zafar and Malik 2018).

Sri Lanka: The southern-most range of *C. palustris* is in Sri Lanka. There is evidence that the Muger population in the country has increased when more recent survey data (Sivaruban and de Silva 2013; de Silva *et al.* 2018a; Rathnasiri *et al.* 2018) is compared to earlier reports [eg Whitaker and Whitaker (1989) estimated around 3000 Muggers in Sri Lanka in 1977].

Rathnasiri *et al.* (2018) estimated a Muger population of 7516 individuals inhabiting 1673 waterbodies in nine provinces of the country during the period 2015-2017 - most of which are concentrated in several national parks (eg Wilpattu, Yala, Bundala) (Fig. 8). The highly-adaptive Muggers are also found in many ‘tanks’ or man-made reservoirs and cattle ponds in the dry plains of the island (locally Muggers are often referred to as the ‘tank crocodile’ because of this) (Rathnasiri *et al.* 2018; de Silva and de Silva 2019). This dry zone makes up 65% of the total land area on the island (de Silva *et al.* 2018a). In other areas, *C. palustris* is threatened by rapid agricultural and industrial developments (de Silva 2013; Rathnasiri *et al.* 2018; de Silva *et al.* 2018a; Whitaker and Whitaker 1989).



Figure 8. Adult *C. palustris*, Yala National Park. Photograph: L. Nadaraja.

In Sri Lanka, the Muger population is large and extensive, the most-dense populations inversely related to human populations across the island (Rathnasiri *et al.* 2018; Department of Census and Statistics, Sri Lanka 2012). The north, east and southern districts of Sri Lanka host the largest

Mugger populations, corresponding to the lower human population densities in the country. Conversely, the highly populous districts of the West and Central regions of Sri Lanka harbour much smaller Mugger populations.

Habitat destruction and disturbance are an overriding factor for the current distribution of Muggers in Sri Lanka (Rathnasiri *et al.* 2018; de Silva 2013). Nesting habitat is being lost with the reduction in mangrove forest in the north and eastern coastal areas (Rathnasiri *et al.* 2018). Other threats include incidental and intentional killing after entanglement in fishing nets, retaliatory killing after conflict incidents, and illegal hunting (Wijethilaka *et al.* 2015; de Silva 2013).

HCC is increasing in Sri Lanka (Wijethilaka *et al.* 2015; de Silva 2013; de Silva and de Silva 2019). An established culture of Crocodile Exclusion Enclosures offers effective protection from attacks for local people (de Silva 2013; Stevenson *et al.* 2014; Somaweera and de Silva 2013). Despite economic losses to local people resulting from crocodiles attacking livestock, the Buddhist people of the Monaragala District are tolerant of crocodiles and recognise the need for conservation actions (Wijethilaka *et al.* 2015). However, a comprehensive survey of people directly affected by crocodile attacks in Sri Lanka found that after such incidents the offending Mugger was invariably killed in retaliation (de Silva *et al.* 2018a).

In 2004, the area of the Jaffna Peninsula of northern Sri Lanka was surveyed for the first time in more than 20 years (armed conflict had prevented access to the region). Both Muggers and Saltwater crocodiles were found to still exist in the area, with further surveys required to document the numbers and assess other population characteristics (Santiapillai and Wijeyamohan 2004). A subsequent study showed a healthy population of Muggers, but hardly any Saltwater crocodiles in Jaffna Peninsula (Anslem de Silva, pers. comm. 2025; Sivaruban and de Silva 2013).

Priority Projects

High priority

1. **Population monitoring:** Surveys on Mugger populations have typically not been carried out in a systematic fashion over time, nor with a view to providing long-term data on population recovery. Detailed comparisons of abundance or size structure with earlier surveys in the same areas are thus difficult to make (eg see Whitaker 2025). Key areas within each State (India) and/or range state should be identified for ongoing, long-term monitoring to provide reliable population indices over time. Standardisation of survey protocols may also benefit long-term monitoring goals
2. **Assess feasibility of implementing reintroduction programs in Bangladesh, Bhutan and Pakistan:** Together with relevant range state authorities, assess the feasibility of developing and implementing reintroduction programs for Muggers in Bangladesh, Bhutan and Pakistan, where Muggers are effectively extinct or largely

extirpated.

3. **Management programs in India, Sri Lanka and Nepal:** Given current trends indicating increases in Mugger populations in most range states, and increasing frequency of HCC, the development of management programs for India, Nepal and Sri Lanka would provide a road map for future management actions (eg problem crocodiles, cross-border movement, eco-tourism, sustainable use), as well as continued conservation action where appropriate (eg Punjab region of India-Pakistan).
4. **Public education and awareness programs:** Living with Muggers is a reality for many rural communities, with crocodiles often viewed with fear and misunderstanding. The development and implementation of suitable public education and awareness programs are considered key actions to mitigate against HCC and improve awareness of crocodiles.
5. **Strengthen legal protection and enforcement:** Habitat alteration/destruction (eg sand/stone extraction) and fishing remain the key threats to Mugger populations in both protected and non-protected areas in India and Nepal. Development of mechanisms to promote overall enforcement, particularly in key Mugger habitats, and to better resource Forest Department staff on the ground is viewed as a key priority. Establishment of a task force (eg see Mobaraki *et al.* 2021) may assist with coordinating such actions.

Moderate priority

6. **Public involvement with crocodiles:** Ways in which communities may become involved with conservation activities merit assessment. The Voluntary Nature Conservancy has created a successful template with its annual citizen-science “Charotar Crocodile Count” in Gujarat, India, but the extent to which this type of initiative can be applied elsewhere in India or other range states is unknown, and merits consideration.

Low priority

7. **Genetic composition:** Head-started Muggers reintroduced in many Indian states were sourced from rearing facilities in Tamil Nadu. Quantifying the genetic make-up of various Mugger populations throughout India would provide information on the extent of the contribution of reintroduced animals to the recruitment and recovery of those populations. Genetic screening could include captive facilities that currently hold Muggers for potential restocking. The inclusion of Muggers from other range states would provide a picture of overall genetic diversity, and the extent of flow across borders.
8. **Inter-species competition:** Although historical literature confirms Gharial and Mugger as being sympatric, there remains a prevailing assumption that Mugger abundance may be detrimental to recovering Gharial populations (see

Sharma and Singh 2015), and has consequently impacted on reintroduction efforts for Muggers at some locations (eg National Chambal Sanctuary). Studies on the species in areas of sympatry with Gharials could expand knowledge on potential competition, and assist future reintroduction efforts for both species.

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References

- Abtin, E. (2012). Habitat suitability of Muger crocodile in Sarbaz River, Iran. *Wildlife Middle East News* 6(2 and 3): 5.
- Abtin, E. and Mobaraki, A. (2017). *Gandou: Marsh Crocodile in Iran*. Nahr-E Talaie Publications: Tehran.
- Ahmed, A. (1986). The distribution and population of crocodiles in the provinces of Sind and Baluchistan (Pakistan). *Journal of the Bombay Natural History Society* 83: 220-222.
- Ali, W., Javid, A., Hussain, A. and Bukhari, S.M. (2018). Diversity and habitat preferences of amphibians and reptiles in Pakistan: a review. *Journal of Asia-Pacific Biodiversity* 11(2): 173-187.
- Andrews, H. (1999). Status and distribution of Muger crocodile in Tamil Nadu. *ENVIS (Wildlife & Protected Areas)* 2(1): 44-57.
- Andrews, H. (2005). Marsh crocodiles sent to Bangladesh. *Crocodile Specialist Group Newsletter* 24(3): 10.
- Andrews, H.V. and McEachern, P. (1994). *Crocodile Conservation in Nepal*. IUCN Nepal & USAID: Kathmandu, Nepal.
- Arya, M. (2020). Studies on habitat and population status of Marsh crocodile (*Crocodylus palustris*) and its conservation problem in the Jadhav Sagar Lake, Shivpuri, Madhya Pradesh, India. *International Journal of Multidisciplinary Research* 9(10-3): 72-81.
- Atigre, R.H. (2016). Estimation of population size of crocodile *Crocodylus palustris* (Lesson, 1831) from two incomplete survey methods - daylight ground counts and night counts. Pp. 99-103 in *Crocodiles*. Proceedings of the 24th Working Meeting of the IUCN-SSC Crocodile Specialist Group. IUCN: Gland, Switzerland.
- Atigre, R.H. (2018). Crocodiles of the River Krishna: Impact on agriculture, economy, and the sociology of human population in Sangli, Maharashtra, India. *Journal of Threatened Taxa* 10(11): 12571-12576.
- Atigre, R.H., Patil, S.R. and Babare, M.G. (2013). Crocodile of Warana basin, Maharashtra, India: Threats to population and strategies for protection and conservation. *Research Journey: Multi-Disciplinary International E-Research Journal Special Issue* 45: 20-24
- Bangladesh Forest Department (2016). *Bangladesh Forestry Master Plan 2017-2036*. Bangladesh Forest Department: Dhaka.
- Baral, H.S. and Shah, K.B. (2013). Status and conservation of the Muger crocodile in Nepal. *Crocodile Specialist Group Newsletter* 32(2): 16-20.
- Bashyal, A. (2019). Confirmed records of gharial (*Gavialis gangeticus*) hatchlings in the Babai River, Bardia National Park, Nepal. *Crocodile Specialist Group Newsletter* 38(3): 10-11.
- Bashyal, A. and Yadav, B.P. (2020). Opportunistic Smooth-coated otter (*Lutrogale perspicillata*) sightings record in the Bardiya National Park of Nepal. *IUCN Otter Specialist Group Bulletin* 37(2). IUCN: Gland, Switzerland.
- Bauer, A.M. and Gunther, R. (1992). A preliminary report on the reptile fauna of the Kingdom of Bhutan with the description of a new species of scincid lizard (Reptilia: Scincidae). *Asiatic Herpetological Research* 4: 23-36.
- Begum, A., Khan, M.Z., Khan, A.R., Zehra, A., Hussain, B., Siddiqui, S. and Tabbassum, F. (2013). Current status of mammals and reptiles at Hub Dam Area, Sindh/Balochistan, Pakistan. *Current World Environment* 8(3): 407-414.
- Belal, S.M., Dhakate, P.M. and Jeet, R. (2021). Status and distribution of Marsh crocodile *Crocodylus palustris* in Terai Arc Landscape, Uttarakhand, India. *Ela Journal of Forestry and Wildlife* 10(1): 855-866.
- Belal, S.M., Dhakate, P.M. and Jeet, R. (2022). Impact of physicochemical status of wetlands on Marsh crocodiles (*Crocodylus palustris* Lesson, 1831) in Terai Landscape, Uttarakhand, India. *International Journal of Ecology and Environmental Sciences*. 48: 399-407.
- Bhatt, H.P., Saund, T.B. and Thapa, J.B. (2012). Status and threats to Muger crocodile *Crocodylus palustris* Lesson, 1831 at Rani Tal, Shuklaphanta Wildlife Reserve, Nepal. *Nepal Journal of Science and Technology* 13(1): 125-131.
- Bhattarai, D., Lamichhane, S., Pandeya, P., Bhattarai, S., Gautam, J., Kandel, R.C. and Pokheral, C.P. (2022).

- Status, distribution and habitat use by Mugger crocodile (*Crocodylus palustris*) in and around Koshi Tappu Wildlife Reserve, Nepal. *Heliyon* 8: 1-8.
- Bhattarai, S. (2015). Notes on a Mugger crocodile *Crocodylus palustris* (Lesson, 1831) hunting on *Axis axis* in Bardia National Park, Nepal. *Hyla* 2015(2): 41-44.
- Bhattarai, S., Pokheral, C., Lamichhane, B. and Subedi, N. (2017). Herpetofauna of a Ramsar site: Beeshazar and Associated Lakes, Chitwan National Park, Nepal. *Reptiles & Amphibians* 24(1): 17-29.
- Bhattarai, S., Pokheral C.P., Lamichhane, B.R., Regmi, U.R., Ram, A.K. and Subedi, N. (2018). Amphibians and reptiles of Parsa National Park, Nepal. *Amphibian & Reptile Conservation* 12(1): 35-48.
- Braulik, G.T., Arshas, M., Noureen, U. and Northridge, S.P. (2014). Habitat fragmentation and species extirpation in freshwater ecosystems; Causes of range decline of the Indus River Dolphin (*Platanista gangetica minor*). *PLoS ONE* 9(7): e101657.
- Braulik, G.T., Noureen, U., Arshad, M. and Reeves, R.R. (2015). Review of status, threats, and conservation management options for the endangered Indus River Blind dolphin. *Biological Conservation* 192(2015): 30-41.
- Bustard, H.R. (1999). Indian Crocodile Conservation Project. *ENVIS (Wildlife and Protected Areas)* 2(1): 5-9.
- Chang, M.S. (2018). Ecological and environmental assessment of Nara Desert Wetland Complex (NDWC), Khairpur, Sindh-Pakistan. In: *Community and Global Ecology of Deserts*, ed. by L. Hufnagel. [IntechOpen Limited](#).
- Chang, M.S. Gachal, G.S., Qadri, A.H., Jabeen, T., Baloach, S. and Sheikh, M.Y. (2012a). Distribution and population of Marsh crocodiles, *Crocodylus palustris*, in Nara Desert Wildlife Sanctuary (NDWS), Sindh, Pakistan. *Sindh University Research Journal* 44(3): 453-456.
- Chang, M.S. Gachal, G.S., Qadri, A.H., Khowaja, Z., Khowaja, M. and Sheikh, M.Y. (2013a). Ecological status and threats of Marsh crocodiles (*Crocodylus palustris*) in Manghopir Karachi. *International Journal of Biosciences* 3(9): 44-54.
- Chang, M.S. Gachal, G.S., Qadri, A.H., Khowaja, Z. and Sheikh, M.Y. (2013c). Population and conservation status of Marsh crocodiles, *Crocodylus palustris*, in Karachi Zoological Garden, Samzu Park and Khar Center Karachi, Sindh-Pakistan. *Sindh University Research Journal* 45(3): 534-541.
- Chang, M.S. Gachal, G.S., Qadri, A.H., Khowaja, Z. and Sheikh, M.Y. (2013d). Current conservational status of Marsh crocodiles in Haleji Lake Wildlife Sanctuary. *Journal of Biodiversity and Environmental Sciences* 3(8): 64-72.
- Chang, M.S., Gachal, G.S., Qadri, A.H. and Memon, K.H. (2016). Physico-chemical assessment of water quality and its effects of Marsh crocodiles, *Crocodylus palustris* population in Haleji Lake Wildlife Sanctuary, Thatta, Sindh, Pakistan. *Sindh University Research Journal* 48(1): 41-44.
- Chang, M.S., Gachal, G.S. and Memon, K.H. (2017). Captive breeding and conservation status of Marsh crocodiles (*Crocodylus palustris*) in New Jatoi Farm Naushehroferoze, Sindh, Pakistan. *Biological Forum* 9(2): 217-223.
- Chang, M.S. Gachal, G.S., Qadri, A.H., Memon, K.H., Sheikh, M.Y. and Nawaz, R. (2015). Distribution, population status and threats of Marsh crocodiles in Chotiari Wetland Complex Sanghar, Sindh-Pakistan. *Biharean Biologist* 9(1): 22-28.
- Chang, M.S. Gachal, G.S., Qadri, A.H. and Sheikh, M.Y. (2012b). Bio-ecological status, management and conservation of Marsh crocodiles, *Crocodylus palustris*, in Deh-Akro 2, Sindh-Pakistan. *Sindh University Research Journal* 44(2): 209-214.
- Chang, M.S., Gachal, G.S., Qadri, A.H. and Sheikh, M.Y. (2013b). Ecological impacts on the status of Marsh crocodiles in Manghopir Karachi. *International Journal of Advanced Research* 1(1): 42-46.
- Chaplod, S. (2013). Status of Mugger (*Crocodylus palustris*) in the Cauvery River, Karnataka. Report to Madras Crocodile Bank Trust, India.
- Chaudhari, D.B., Chaudhari, A., Vaidh, I. and Patel, H.J. (2022). First confirmed record of the Mugger crocodile (*Crocodylus palustris*) from the Purna River, Tapi District, Gujarat. *Reptiles & Amphibians* 29: 436-438.
- Chaudhry, A.A. (1993). Status of crocodiles in Pakistan. *Crocodile Specialist Group Newsletter* 12(1): 19-20.
- Chavan, U.M. and Borkar, M.R. (2023). Observations on cooperative fishing, use of bait for hunting, propensity for marigold flowers and sentient behaviour in Mugger crocodiles *Crocodylus palustris* (Lesson, 1831) of river Savitri at Mahad, Maharashtra, India. *Journal of Threatened Taxa* 15(8): 23750-23762.
- Choudhary, S., Choudhury, B.C. and Gopi, G.V. (2018). Spatio-temporal partitioning between two sympatric crocodilians (*Gavialis gangeticus* & *Crocodylus palustris*) in Katarniaghat Wildlife Sanctuary, India. *Aquatic Conservation: Marine and Freshwater Ecosystems* 28(5): 1067-1076.
- Choudhury, A. (2006). The status of endangered species in northeast India. *Journal of the Bombay Natural History*

- Society 103(2-3): 157-167.
- Choudhury, B.C. (2025). 50 years (1975-2025) of conservation action in India brings back three species of crocodilian from the brink of extinction. *Crocodile Specialist Group Newsletter* 44(2): 7-10.
- Choudhury, B.C. and de Silva, A. (2013). *Crocodylus palustris*. The IUCN Red List of Threatened Species 2013: e.T5667A3046723.
- Cox, J.H. and Rahman, M.M. (1994). An assessment of crocodile resource potential in Bangladesh. Pp. 232-258 in *Crocodiles. Proceedings of the 12th Working Meeting of the IUCN-SSC Crocodile Specialist Group*. IUCN: Gland, Switzerland.
- CrocAttack (2024). CrocAttack (<http://www.crocattack.org>; accessed 19 December 2024).
- Daniel, J.C. (1969). A review of the present status and position of endangered species of Indian reptiles. Pp. 75-76 in *Papers and Proceedings of the IUCN Eleventh Technical Meeting, New Delhi, India, 25-28 November 1969*. Vol. II. IUCN: Switzerland.
- Daniel, J.C., Manakadan, R., Ramesh Babu, M., Balasubramanian, G. and Swaminathan, S. (2012). An Assessment of the Population, Distribution and Conservation Issues of the Asian Elephant in the Eastern Ghats Areas of Karnataka State, India. Final Report. Bombay Natural History Society: Mumbai and U.S. Fish and Wildlife Service: Washington, D.C.
- Das, I. and Palden, J. (2000). A herpetological collection from Bhutan, with new country records. *Herpetological Review* 31(4): 256-258.
- Das, U.K., Pradhan, R.K., Dash, A.P. and Panth, S. (2021). Study on habitat preference and conservation of mugger crocodile (*Crocodylus palustris* Lesson 1831) in Ghodahada Dam of Ganjam District, Odisha, India. *International Educational Scientific Research Journal* 7(7): 2-11.
- Debata, S., Purohit, S., Mahata, A., Jena, S.K. and 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(6): 11770-11774.
- Department of Census and Statistics, Sri Lanka (2012). Census of Population and Housing - [Final Report](#).
- Desai, B., Mukherjee, S., Whitaker, N. and Ghosal, R. (2022). Anecdotal observations of 'double clutching' behaviour in captive Mugger crocodiles (*Crocodylus palustris*). *Behaviour* 159(8-9): 887-897.
- de Silva, A. (2013). The Crocodiles of Sri Lanka (Including Archaeology, History, Folklore, Traditional Medicine, Human-Crocodile Conflict and a Bibliography of the Literature on Crocodiles of Sri Lanka). Ansem de Silva: Gampola.
- de Silva, A., Dawundasekara, D.M.N.P.K., Whitaker, R., Indrajith, W.A.A.D.U. and Susantha, H.K. (2010). Recent observations of the mugger crocodile (*Crocodylus palustris*) at Ruhuna National Park, Sri Lanka. *Lyriocephalus Special issue* 7(1&2): 191-195.
- de Silva, A., de Silva, P. and Dawundasekara, D.M.N.K. (2013). Crocodile attacks in Sri Lanka. Pp. 227-233 in *Crocodiles. Proceedings of the 22nd Working Meeting of the IUCN-SSC Crocodile Specialist Group*. IUCN: Gland, Switzerland.
- de Silva, A., Jayasundara, J.M.A.S. and Bandara, D.G.G. (2018a). Preliminary report of the mugger crocodile (*Crocodylus palustris*) inhabiting Kahalla Pallakele Sanctuary, Sri Lanka. *WILDLANKA* 6(4): 213-220.
- de Silva, A., Probst, J.M., de Silva, P.D.D.S. and Karunarathna, S. (2018b). An incident of a mugger crocodile (*Crocodylus palustris*) devouring a pangolin (*Manus crassicaudata*). *WILDLANKA* 6(3): 147-150.
- de Silva, A. and de Silva, P. (2019). Mugger crocodile (*Crocodylus palustris*) in water bodies around Sigiriya Citadel and Dambulla, Sri Lanka. *WILDLANKA* 7(1): 1-11.
- Deraniyagala, P.E.P. (1939). The Tetrapod Reptiles of Ceylon Vol. 1. Testudines and crocodylians. Colombo Museum: Colombo.
- Dey, M. (2015). Factors affecting lakeshore use of Muggers (*Crocodylus palustris*) in Vihay Lake, Sanjay Gandhi National Park, Mumbai, India. [SRAS Final Report \(15/2\)](#) to the IUCN SSC Crocodile Specialist Group.
- Dharmakumarsinhji, K.S. (1947). Mating and the parental instinct of the Marsh crocodile (*C. palustris*, Lesson). *Journal of the Bombay Natural History Society* 47: 174-176.
- Dharmakumarsinhji, K.S. (1955). Wild Life Preservation in India. Annual Report for 1953 on the Western Region. *Journal of the Bombay Natural History Society* 52: 865-873.
- Dharmakumarsinhji, K.S. (1978). The changing wildlife of Kathiawar. *Journal of the Bombay Natural History Society* 75(3): 632-650.
- Dinamalar (2024). 150 Crocodiles escape from Sathanur dam floods; The forest department has kept the secret! [Dinamalar, 23 December 2024](#).

- D'Souza, F., Giriyan, A. and Patil, K. (2015). Ecological Status and Management of Dr Salim Ali Bird Sanctuary and Estuarine Areas of Chorao Island: A Desk Review. CMPA Technical Series No. 03. Indo-German Biodiversity Programme, GIZ-India: New Delhi.
- DT Next (2019). Croc scare in Kollidam after discharge from Mettur dam. [DT Next, 19 December 2019](#).
- Forest Department (2015). National Biodiversity Strategy and Action Plan (2015-2020). The Republic of the Union of Myanmar, Ministry of Environmental Conservation and Forestry.
- Gabrial, A.R. (2013). The status of the mugger crocodile (*Crocodylus palustris*) inhabiting the Wilpattu National Park, Sri Lanka. Pp. 239 in *Crocodyles*. Proceedings of the 22nd Working Meeting of the IUCN-SSC Crocodile Specialist Group. IUCN: Gland, Switzerland.
- Gogate, M.G. (1999). Crocodile conservation in Maharashtra: Problems and prospects. *ENVIS (Wildlife & Protected Areas)* 2(1): 62-68.
- Goit, R.K. and Basnet, K. (2011). Status and conservation of crocodiles in the Koshi Tappu Wildlife Reserve, eastern Nepal. *Journal of Threatened Taxa* 3(8): 2001-2010.
- Gour, R. (2023). Predation by Mugger crocodiles (*Crocodylus palustris*) on Spotted Deer (*Axis axis*). *Reptiles & Amphibians* 30(1): e19754.
- Gour, R., Whitaker, N. and Kartik, A. (2022). Status and distribution of Mugger crocodile (*Crocodylus palustris*) in the southern stretch of river Cauvery in Melagiris, India. *Journal of Threatened Taxa* 14(3): 20733-20739.
- Government of Nepal (2015). Status of Wetlands and Mugger Crocodile in and around Chitwan National Park. Department of National Parks and Wildlife Conservation, Chitwan National Park Office: Kasara, Chitwan.
- Government of Pakistan (2000). First National Report on the Implementation of the Convention on Biological Diversity, Pakistan. Convention on Biological Diversity.
- Groombridge, B. (1982). The IUCN Amphibia-Reptilia Red Data Book. IUCN: Gland.
- Gupta, R.C. (2011). Indian marsh mugger and its tunnel residency behavioural patterns in a sanctuary premises in Haryana, India. *Journal of Applied and Natural Science* 3(1): 25-28.
- Gurjwar, R.K. and Rao, R.J. (2018). Impact of Crocodile Conservation on Livelihoods in North, Madhya Pradesh, India. *International Journal of Advanced and Innovative Research* 8(1): 1-7.
- Heidari, N., Ebrahim Tehrani, M., Hosseini, M.R., Mohammadpour, O., Jan Parvar, H. and Ali Hosseini, A.A. (2022). Population survey and census of marsh crocodile, *Crocodylus palustris* in SE Iran. *Biodiversity and Animal Taxonomy* 2(1): 156-163.
- Javed, H.I. and Rehman, H. (2004). Status of Marsh crocodile (*Crocodylus palustris*) in Sindh. *Records of Zoological Survey Pakistan* 15: 22-30.
- Javed, H.I., Rehman, H. and Fakhari, S. (2005). On the status of Marsh crocodile in Balochistan. *Records of Zoological Survey Pakistan* 16: 40-45.
- Jayson, E.A., Sivaperuman, C. and Padmanabhan, P. (2006). Review of the reintroduction programme of the Mugger crocodile *Crocodylus palustris* in Neyyar Reservoir, India. *The Herpetological Journal* 16(1): 69-76.
- Jayson, E.A. and Sivaperuman, C. (2008). Population of Mugger crocodiles in Neyyar Wildlife Sanctuary, Kerala, India. *Reintro Redeux* 3: 7-10.
- Joshi, A.R. (2024). Nepal's release of endangered crocs into historical habitat raises concerns. [Mongabay, 23 March 2024](#).
- Joshi, R., Singh, R. and Negi, M.S. (2011). First record of mugger crocodile *Crocodylus palustris* (Lesson, 1831) from the Rajaji National Park, North India. *International Journal of Biodiversity and Conservation* 3(9): 444-450.
- Kartick, A. (2013). Preliminary Status Report on the Mugger Crocodile (*Crocodylus palustris*) in selected areas of Tamil Nadu. Unpublished report by Madras Crocodile Bank Trust.
- Kennion, M. (1921). Crocodile shooting in Nepal. *Journal of the Bombay Natural History Society* 28(1): 291.
- Khadka, B. (2019). Status of Mugger crocodiles (*Crocodylus palustris*) in the Rapti and Narayani Rivers of Chitwan National Park, Nepal. *Crocodile Specialist Group Newsletter* 38(3): 11-15.
- Khadka, B.B., Maharjan, A., Thapalia, B.P. and Lamichhane, B.R. (2014). Population status of the Mugger in Chitwan National Park, Nepal. *Crocodile Specialist Group Newsletter* 33(3): 9-12.
- Khan, M.A.R. (1982). Present status and distribution of the crocodiles and gharial of Bangladesh. Pp. 229-236 in *Crocodyles*. Proceedings of the 5th Working Meeting of the IUCN-SSC Crocodile Specialist Group. IUCN: Gland, Switzerland.
- Khan, M.Z., Latif, T.A., Ghalib, S.A., Khan, I.S., Hussain, B., Zehra, A., Siddiqui, S., Kanwal, R., Jabeen, T. and Fozia, T. (2015). Breeding and population status of Marsh crocodile (*Crocodylus palustris*) in Manghopir Shrine Area, Karachi. *Canadian Journal of Pure and Applied*

- Sciences 9(2): 3399-3407.
- Khan, M., Ahmed, S., Ahmad, Z. and Saeed, S. (2022). First record of Mugger crocodile (*Crocodylus palustris* Lesson, 1831) from Haji Shahr, District Kachhi, Balochistan, Pakistan. *International Journal of Biology and Biotechnology* 19(4): 549-552.
- Khanal, C. (2017). First confirmed record of mugger crocodile (*Crocodylus palustris*) in Dang. *Crocodile Specialist Group Newsletter* 36(3): 11-13.
- Khanal, C. and Baniya, S. (2018). Deukhuri Valley: A wildlife haven in the Shiwalik hills, Nepal. *The Himalayan Naturalist* 1(1): 8-10.
- Khandakar, N. and Jeny, K.N. (2020). Conservation status of wildlife of Bangladesh. *Zoo's Print* 35(5): 104-106.
- Khatri, T.P. and Baral, H.S. (2012). Survey of Ghodaghodi Lake Complex for Cotton Pygmy Goose *Nettapus coromandelianus* and Marsh Mugger *Crocodylus palustris*. *Our Nature* 10: 137-144.
- Kulkarni, N., Chaplod, S. and Mallapur, G. (2013). Rituals and symbolism for crocodiles in Goa. Pp. 270 in *Crocodiles*. Proceedings of the 22nd Working Meeting of the IUCN-SSC Crocodile Specialist Group. IUCN: Gland, Switzerland.
- Kumar, V.V., Vyas, R. and Choudhury, B.C. (1999). Status of Mugger and its conservation problems in Gujarat. *ENVIS (Wildlife & Protected Areas)* 2(1): 62-76.
- Kumar, A., Kushwaha, S. and Namdev, A. (2019). Mugger (*Crocodylus palustris*) sightings in water bodies of Bundelkhand Region, India. *International Journal of Zoology Studies* 4(2): 63-67.
- Lamichhane, B.R., Persoon, G.A., Leirs, H., Poudel, S., Subedi, N., Pokheral, C.P. and De Iongh, H.H. (2018a). Spatio-temporal patterns of attacks on human and economic losses from wildlife in Chitwan National Park, Nepal. *PloS ONE* 13(4): e0195373.
- Lamichhane, B.R., Pokheral, C.P., Poudel, S., Adhikari, D., Giri, S.R., Bhattarai, S. and Subedi, N. (2018b). Rapid recovery of tigers *Panthera tigris* in Parsa Wildlife Reserve, Nepal. *Oryx* 52(1): 16-24.
- Lamichhane, S., Bhattarai, D., Karki, J.B., Gautam, A.P., Pandeya, P., Tripathi, S. and Mahat, N. (2022). Population status, habitat occupancy and conservation threats to Mugger crocodile (*Crocodylus palustris*) in Ghodaghodi lake complex, Nepal. *Global Ecology and Conservation* 33: 1-10.
- Lang, J.W. (1987). Crocodilian behaviour: Implications for management. Pp. 273-294 in *Wildlife Management: Crocodiles and Alligators*, ed. by G.J.W. Webb, S.C. Manolis and P.J. Whitehead. Surrey Beatty and Sons: Sydney.
- Lang, J.W. (2016). India - Gharial Ecology Project. *Crocodile Specialist Group Newsletter* 35(1): 10-14.
- Lang, J.W., Whitaker, R. and Andrews, H. (1986). Male parental care in Mugger crocodiles. *National Geographic Research* 2(1986): 519-525.
- Lesson, R.-P. (1831). Catalogue des Reptiles qui font partie d'une Collection zoologique recueillie dans l'Inde continentale ou en Afrique, et apportée en France par M. Lamare-Piquot. *Bulletin des Sciences Naturelles et de Géologie*, Paris 25(4): 119-123.
- Masum, K.M., Rahman, Z.M.M., Alamgir, M., Mamun, A.A. and Abdullah-Al-Mamun, M.M. (2012). Breeding difficulty of Marsh crocodile (*Crocodylus palustris*, Lesson, 1831) in Safari Park of Bangladesh. *Journal of Forest and Environmental Science* 28(4): 220-226.
- Mazumder, M.K., Choudhury, A.S., Barbhuiya, R.A., Chakravarty, H. and Barbhuiya, B. (2020). The ecology, distribution, status, threats, and conservation of the Common Water Monitor (*Varanus salvator*) in the Dhaleswari River of Assam, India. *Amphibian & Reptile Conservation* 14(1): 1-9.
- McEachern, P. (1994). Interim results of the IUCN Nepal Crocodile Survey. Pp. 199-217 in *Crocodiles*. Proceedings of the 12th Working Meeting of the IUCN-SSC Crocodile Specialist Group. IUCN: Gland, Switzerland.
- Ministry of Agriculture and Forests (2014). National Biodiversity Strategies and Action Plan: Bhutan 2014. National Biodiversity Centre, Ministry of Agriculture and Forests, Royal Government of Bhutan: Bhutan.
- Mishra, S.R., Nayak, A.K. and Nandi, D. (2013). Population status of Mugger crocodile (*Crocodylus palustris*) in Similipal Tiger Reserve, Odisha, India. *International Research Journal of Environmental Sciences* 2(5): 92-94.
- Mobaraki, A. (1998). Mugger studies continue. *Crocodile Specialist Group Newsletter* 17(3): 6.
- Mobaraki A. (2002). Snub-nosed crocodile (*Crocodylus palustris*) study in Iran. Pp. 253-256 in *Crocodiles*. Proceedings of the 16th Working Meeting of the IUCN-SSC Crocodile Specialist Group. IUCN: Gland.
- Mobaraki, A. (2015). Sustainable Management and Conservation of the Mugger Crocodile (*Crocodylus palustris*) in Iran. MSc thesis, International University of Andalusia, Baeza, Spain.
- Mobaraki, A. (2024). Iran. In *South Asia and Iran report to the Crocodile Specialist Group Steering Committee Meeting*, Darwin, Australia.

- Mobaraki, A. and Abtin, E. (2007). Movement behaviour of Muggers, a potential threat. *Crocodile Specialist Group Newsletter* 26(1): 4.
- Mobaraki, A. and Abtin, E. (2008). National Management and Conservation Plan for Mugger Crocodile. *Crocodile Specialist Group Newsletter* 27(3): 15-16.
- Mobaraki, A. and Abtin, E. (2013). Estimate of Mugger population in Iran. *Crocodile Specialist Group Newsletter* 32(1): 21-22.
- Mobaraki, A., Erfani, M., Abtin, E., Brito, J.C., Tan, W.C., Ziegler, T. and Rödder, D. (2023). Last chance to see? Iran and India as strongholds for the Mugger Crocodile (*Crocodylus palustris*). *Salamandra* 59(4): 327-335.
- Mobaraki, A., McCaskill, L., Schepp, U., Abtin, E., Masroor, R., Pandhi, D., Desai, B., Muckerjee, S., Rasheed, T., Razzaque, S.A., de Silva, A., Stevenson, C., Rauhaus, A., Le, M.D., Rödder, D. and Ziegler, T. (2021). Conservation status of the Mugger (*Crocodylus palustris*): Establishing a task force for a poster species of climate change. *Crocodile Specialist Group Newsletter* 40(3): 12-20.
- Nadaf, F.M. (2019). Geographical diagnosis of Goa's tourism beyond sun and sand. *Online International Interdisciplinary Research Journal* 9(2): 29-38.
- Nair, T. (2019). Marsh crocodiles of Karkatgarh-Kaimur (Bihar, India). *Crocodile Specialist Group Newsletter* 38(4): 10.
- Nair, T. and Katdare, S. (2013). Dry-season assessment of gharials (*Gavialis gangeticus*) in the Betwa, Ken and Son Rivers, India. Pp. 53-65 in *Crocodiles. Proceedings of the 22nd Working Meeting of the IUCN-SSC Crocodile Specialist Group*. IUCN: Gland, Switzerland.
- Narasimmarajan, K., Gopal, A., Palanivel, S. and Mathai, M.T. (2018). Status of mugger crocodiles (*Crocodylus palustris*) in River Moyar, Southern India. *Cobra* XII(2): 1-9.
- National Biodiversity Centre (2009). *Bhutan Biodiversity Action Plan 2009*. Ministry of Agriculture, Royal Government of Bhutan: Bhutan.
- Nishan, K.C., Neupane, B., Belbase, B., Dhimi, B., Bist, B.S., Basyal, C.R. and Bhattarai, S. (2023). Factors influencing the habitat selection of Mugger crocodile (*Crocodylus palustris*) and its conservation threats in the Rapti River of Chitwan National Park, Nepal. *Global Ecology and Conservation* 42: e02406.
- Nithya (2025). Crocodile in the field! 7-foot crocodile arrives as 'guest' with Mettur water - Forest Department Action! [Seithipunal, 30 October 2025](#).
- NTNC (National Trust for Nature Conservation) (2019). [Annual Report 2019](#). NTNC: Khumaltar, Lalitpur.
- NTNC (National Trust for Nature Conservation) (2020). *Amphibians and Reptiles of Chure Range, Nepal*. President Chure-Terai Madhesh Conservation Development Board and National Trust for Nature Conservation: Khumaltar, Lalitpur.
- Odisha Wildlife Organisation (2025). Odisha Wildlife Organisation: [Official Website of PCCP \(Wildlife\) & Chief Wildlife Warden, Odisha](#).
- Pandhi, D., Ansari, P. and Shah, H. (2022) Status of *Crocodylus palustris* in Kutch district, Gujarat, India. *Crocodile Specialist Group Newsletter* 41(2): 4-8.
- Patil, S.R., Atigre, R.H. and Patil, S.V. (2012). First record of Mugger crocodile *Crocodylus palustris* (Lesson, 1831) from River Kadavi at Sarud, Tal, Shahuwadi, Dist. Kolhapur, M.S., India. Pp. 100-104 in *4th International Conference on Agriculture and Animal Science Vol. 47*. IACSIT Press: Singapore.
- Pillai, K.G.M. (1999). Crocodile conservation in Kerala. *ENVIS (Wildlife & Protected Areas)* 2(1): 58-68.
- Prasad, K.K., Srinivasulu, C., Srinivasulu, A., Rao, G.R.K. and Shivalah, C. (2018). Reassessment of status and spatial analysis of the distribution of *Crocodylus palustris* in Manjeera Wildlife Sanctuary, Telangana State, India. *Herpetological Conservation and Biology* 13(3): 569-575.
- Prasad, S. (2021). Forest Dept. plans rescue centre to house crocodiles in Chidambaram. *The Hindu*, 7 February 2021.
- Rafsanjani, A.K. and Karami, M. (2011). Eco-tourism necessity to preserve and maintain endangered species: A case study of mugger crocodiles. *Journal Geography and Regional Planning* 4(14): 708-714.
- Rahim, A. (2010). Threats and population assessment of Marsh Crocodile at Dasht River, Gwader. *Crocodile Specialist Group Newsletter* 29(3): 18-19.
- Rahim, A., Gabol, K., Ahmed, W., Manzoor, B. and Batool, A. (2018). Population assessment, threats and conservation measures of Marsh crocodile at Dasht River, Gwadar, Pakistan *Journal of Marine Sciences* 27(1): 45-53.
- Rahman, M.M. (1990). Status of crocodiles in Bangladesh. *Crocodile Specialist Group Newsletter* 9(3): 9-11.
- Rahman, M.R. and Asaduzzaman, M. (2010). Ecology of Sundarban, Bangladesh. *Journal of Science Foundation* 8(1&2): 35-47.
- Rajbhandari, S.L. and Acharya, P.M. (2014). Habitat use and conservation of Marsh Crocodile (*Crocodylus palustris*, Lesson, 1831) in Beeshazari Lake Complex, Nepal. *Journal of Indian Research* 2(3): 40-48.

- Ramachandra, T.V., Bharath S., Chandran, S, Rao, G.R., Vishnu, D. and Joshi, N.V. (2017). Ecologically Sensitive Regions in the Kali River Basin, Karnataka: Delineation based on Ecological Principles and People's Livelihood, ENVIS Technical Report 125, Sahyadri Conservation Series 68, Energy & Wetlands Research Group, CES, Indian Institute of Science: Bangalore.
- Ramsar (1999) Information Sheet on Ramsar Wetlands 15 May 1998. [Information](#) downloaded on 3 January 2020.
- Ramsar (2002) Information Sheet on Ramsar Wetlands 10 September 2002. [Information](#) downloaded on 29 December 2019.
- Rao, R.J. (1999) Status and conservation of crocodiles in Madhya Pradesh: An Update. ENVIS (Wildlife and Protected Areas) 2(1): 80-83.
- Rashid, S.M.A. (2008). First steps towards establishment of a crocodile rehabilitation centre. Crocodile Specialist Group Newsletter 27(4): 13-14.
- Rastegar-Pouyani, N., Gholamifard, A., Karamiani, R., Bahmani, Z., Mobaraki, A., Abtin, E., Faizi, H., Heidari, N., Takesh, M., Sayyadi, F., Ahsani, N. and Browne, R.K. (2015). Sustainable management of the herpetofauna of the Iranian Plateau and coastal Iran. Amphibian and Reptile Conservation 9(1): 1-15.
- Rathnasiri, G.W.R.P., de Silva, A., Gabriel, A. and de Silva, P. (2013). Mugger burrows: Preliminary investigations into the unique tunnels excavated by *Crocodylus palustris* in Sri Lanka. Pp. 246-250 in Crocodiles. Proceedings of the 22nd Working Meeting of the IUCN-SSC Crocodile Specialist Group. IUCN: Gland, Switzerland
- Rathnasiri, G.W.R.P., de Silva, A., Mahanama, D.C., Jayasooriya, A. and Priyadharshana, P. (2018). Preliminary report of the status of the mugger crocodile (*Crocodylus palustris*) in nine provinces during the years 2015-2017 in Sri Lanka. WILDLANKA 6(4): 159-167.
- Rattanani, L. (1995). The crocodile is God in Goa. Crocodile Specialist Group Newsletter 14(1): 8-9.
- Rawat, Y.B., Bhattarai, S., Poudyal, L.P. and Subedi, N. (2020). Herpetofauna of Shuklaphanta National Park, Nepal. Journal of Threatened Taxa 12(5): 15587-15611.
- Rehman, H. (2007). Baseline Surveys of Reptilian Fauna of Hingol National Park, Balochistan. Report submitted to Forest & Wildlife Department, Balochistan, Quetta.
- Ripple, W.J, Wolf, C., Newsome, T.M., Barnard, P. and Moomaw, W.R. (2019). World scientists' warning of climate emergency. BioScience 70(1): 8-12.
- Rupera, P. (2024). Water hyacinth edges crocodiles out of Charotar. The Times of India, 7 February 2024.
- Sampath, N. (2022). Crocodile drags teen bathing in Kollidam River; body retrieved. [DT Next, 27 November 2022](#).
- Samson, A., Santhoshkumar, P., Princy, J.L. and Ramakrishnan, B. (2021). Population status of mugger crocodile (*Crocodylus palustris*) in Moyar River, Tamil Nadu, Southern India. International Journal of Pure Applied Zoology 9(2): 1-3.
- Santiapillai, C. and Wijeyamohan, S. (2004) Rediscovery of crocodiles in the Jaffna Peninsula, Sri Lanka. Crocodile Specialist Group Newsletter 23(1): 15-16.
- Sarkar, D., Ramesh, C., Hussain, S.A., Mondal, R. and Talukdar, G. (2018). A field observation of the Critically Endangered Indian Gharial, *Gavialis gangeticus* (Gmelin 1789), in the Lower Ganga Canal, Narora, Uttar Pradesh, India. Reptiles & Amphibians 25(3): 204-207.
- Shah, K.B. and Paudel, S. (2016). Ecology of crocodile and dolphin in the Koshi Basin. Pp. 123-138 in Connecting Flows and Ecology in Nepal: Current State of Knowledge for the Koshi Basin, ed. by T.M. Doody, S.M. Cuddy and L.D. Bhatta. Sustainable Development Investment Portfolio Project. CSIRO: Australia.
- Sharma, R.K. (1999). Survey of Gharial in National Chambal Sanctuary - 1993-97. ENVIS (Wildlife & Protected Areas) 2(1): 84-86.
- Sharma, R.K. and Singh, L.A.K. (2015). Status of Mugger crocodile (*Crocodylus palustris*) in National Chambal Sanctuary after thirty years and its implications on conservation of Gharial (*Gavialis gangeticus*). Zoo's Print 30(5): 9-16.
- Sharma, R.K., Mathur, R. and Sharma, S. (1995). Status and distribution of fauna in National Chambal Sanctuary. Indian Forester 121(10): 912-916.
- Sharma, S.P., Ghazi, M.G., Katdare, S., Badola, R. and Hussain, S.A. (2024). Population status and genetic assessment of mugger (*Crocodylus palustris*) in a tropical regulated river system in North India. Scientific Reports 14: 7438.
- Sherpa, M.N. (1996). Biodiversity Conservation in Bhutan. Pp. 105-130 in Banking on Biodiversity: Report on the Regional Consultation on Biodiversity Assessment in the Hindu Kush-Himalayas, ed. by P. Shengji. International Centre for Integrated Mountain Development: Kathmandu.
- Shortt, W.H.O. (1921). A few hints on crocodile shooting. Journal of the Bombay Natural History Society 28: 76-84.
- Silwal, T., Kolejka, J., Bhatta, B.P., Rayamajhi, S., Sharma, R.P. and Poudel, B.S. (2016). When, where and whom: assessing wildlife attacks on people in Chitwan National Park, Nepal. Oryx 51(2): 370-377.

- Singh, L.A.K. (1999). Status of Gharial and Mugger in Orissa. *ENVIS (Wildlife and Protected Areas)* 2(1): 17-23.
- Sivaruban, A. and de Silva, A. (2013). Preliminary observations of the status of crocodiles and peoples' attitudes towards crocodiles in the Northern Province of Sri Lanka. Pp. 257 *in* Crocodiles. Proceedings of the 22nd Working Meeting of the IUCN-SSC Crocodile Specialist Group. IUCN: Gland, Switzerland.
- Siwakoti, M. and Karki, J.B. (2009). Conservation status of Ramsar sites of Nepal Terai: an overview. *Journal of Plant Science* 6: 76-84.
- Smith, M.A. (1931). Reptilia and Amphibia Vol. 1 Loricata and Testudines. *In: The Fauna of British India, including Ceylon and Burma*, ed. by J. Stephenson. Secretary of State for India in Council: India.
- Somaweera, R. and de Silva, A. (2013). Using traditional knowledge to minimize human-crocodile conflict in Sri Lanka. Pp. 257 *in* Crocodiles. Proceedings of the 22nd Working Meeting of the IUCN-SSC Crocodile Specialist Group. IUCN: Gland. Switzerland.
- Sreedharan, T.P. (2004) Biological Diversity of Kerala: A Survey of Kalliasseri Panchayat, Kannur District. Discussion Paper No. 62, Kerala Research Programme on Local Level Development. Centre for Development Studies: Thiruvananthapuram.
- Srinivas, B., Prasad, K.V. and Choudhury, B.C. (1999). Status of crocodiles in Andhra Pradesh. *ENVIS (Wildlife and Protected Areas)* 2(1): 33-37.
- Stevenson, C., de Silva, A., Vyas, R., Nair, T., Mobaraki, A. and Chaudhry, A.A. (2014). Human-crocodile conflict in South Asia and Iran. Pp. 209-226 *in* Crocodiles. Proceedings of the 23rd Working Meeting of the IUCN-SSC Crocodile Specialist Group. IUCN: Gland, Switzerland.
- Talati, N., Kumar, R.N., Tuteja, D. and Kumar, N. (2022). Ongoing assessment of the Marsh crocodile (*Crocodylus palustris*) population in the wetlands of Anand and Kheda Districts, Gujarat, India. *Reptiles & Amphibians* 29: 103-106.
- The Daily Star (2018a). Crocodile lays eggs at Khan Jahan Ali's shrine. [Star Online Report, 19 May 2018](#).
- The Daily Star (2018b). 2nd freshwater crocodile spotted in 50 years. [Our Correspondent, Pabna, 7 December 2018](#).
- The Tribune (2016). Crocodile rescued in Kurukshetra. [The Tribune, 12 August 2016](#).
- Thorbjarnarson, J.B., Platt, S.G., Win Ko Ko, Khin Myo Myo, Lay Lay Khaing, Kalyar and Holmstrom, B. (2006). Crocodiles in Myanmar: species diversity, historic accounts, and current population status and conservation. *Herpetological Natural History* 10: 77-89.
- Trivedi, K., Patel, C. and Goyani, M. (2022). Status of Mugger crocodile (*Crocodylus palustris*) and human-crocodile interactions in Surat, India. *Reptiles & Amphibians* 29: 329-334.
- Upadhyay, V. (2021). Will Uttarakhand soon get a crocodile rescue and breeding centre? [New Indian Express, August 2021](#).
- Upadhyaya, S.K., Musters, C.J.M., Lamichhane, B.R., de Snoo, G.R., Dhakal, M. and de Iongh, H.H. (2020). Determining the risk of predator attacks around protected areas: the case of Bardia National Park, Nepal. *Oryx* 54(5): 670-677.
- Vaghashiya, P.M., Dudhatra, B. and Vyas, R. (2018). Monitoring a breeding Mugger (*Crocodylus palustris*) population in the Girnar Wildlife Sanctuary near Junagadh, Gujarat, India. *Reptiles & Amphibians* 26(3): 211-215.
- Vaghashiya, P., Chauhan, D. and Vyas, R. (2025). Nesting and parental care by a disabled Mugger crocodile (*Crocodylus palustris*) and a record of a congenital defect in a hatchling from Junagadh, Gujarat, India. *Reptiles & Amphibians* 32: e22290.
- Van Dink, P.P. (1993). Myanmar Turtles. Report on a Preliminary Survey of the Testudines of the Ayeyarwady Basin. Unpublished WWF report.
- Vasava, A., Patel, D., Vyas, R., Mistry, V. and Patel, M. (2015). Crocs of Charotar: Status, distribution and conservation of Mugger crocodiles in Charotar region, Gujarat, India. Voluntary Nature Conservancy: Vallabh Vidyanagar, India.
- VNC (Voluntary Nature Conservancy) (2017). 4th Charotar Crocodile Count - 2017. Voluntary Nature Conservancy: Gujarat, India.
- VNC (Voluntary Nature Conservancy) (2018a). 5th Charotar Crocodile Count - 2018. Voluntary Nature Conservancy: Vallabh Vidyanagar, Gujarat, India.
- VNC (Voluntary Nature Conservancy) (2018b). Charotar Crocodile Count, Summer - 2018. Voluntary Nature Conservancy: Vallabh Vidyanagar, Gujarat, India.
- VNC (Voluntary Nature Conservancy) (2019). 6th Charotar Crocodile Count - 2019. Voluntary Nature Conservancy: Vallabh Vidyanagar, Gujarat, India.
- VNC (Voluntary Nature Conservancy) (2020). 7th Charotar Crocodile Count - 2020. Voluntary Nature Conservancy: Vallabh Vidyanagar, Gujarat, India.
- VNC (Voluntary Nature Conservancy) (2021). 8th Charotar Crocodile Count - 2021. Voluntary Nature Conservancy: Vallabh Vidyanagar, Gujarat, India.

- VNC (Voluntary Nature Conservancy) (2022). 9th Charotar Crocodile Count - 2022. Voluntary Nature Conservancy: Gujarat, India.
- VNC (Voluntary Nature Conservancy) (2023). 10th Charotar Crocodile Count - 2023. Voluntary Nature Conservancy: Gujarat, India.
- Vyas, R. (2001). Mass migration of muggers in the Gir Forest. Crocodile Specialist Group Newsletter 20(1): 8-9.
- Vyas, R. (2010a). The Muggers (*Crocodylus palustris*) of Vishwamitri River: Past and Present. Herpetology & Environmental Research Project: Vadodara.
- Vyas, R. (2010b). Mugger (*Crocodylus palustris*) population in and around Vadodara City Gujarat State, India. Russian Journal of Herpetology 17(1): 43-50.
- Vyas, R. (2012). Current status of Marsh crocodiles *Crocodylus palustris* (Reptilia: Crocodylidae) in Vishwamitri River, Vadodara City, Gujarat, India. Journal of Threatened Taxa 4(14): 3333-3341.
- Vyas, R. (2014). Roads and railways: Cause for mortality of Muggers (*Crocodylus palustris*), Gujarat State, India. Russian Journal of Herpetology 21(3): 237-240.
- Vyas, R. (2017). Emergence of a new potential threat to the Mugger (*Crocodylus palustris*) population of Gujarat State, India. Crocodile Specialist Group Newsletter 36(4): 16-17.
- Vyas, R. (2018a). Muggers of Vadodara. Voluntary Nature Conservancy: Gujarat.
- Vyas, R. (2018b). Results of the 2015 Mugger crocodile (*Crocodylus palustris*) count at Vadodara, Gujarat, India. Reptiles & Amphibians 25(1): 20-25.
- Vyas, R. (2019a). Population status of Muggers (*Crocodylus palustris*) in and around Gir Forest, Gujarat, India. Crocodile Specialist Group Newsletter 38(1): 8-13.
- Vyas, R. (2019b). Note on interactions between predator and prey: Indian crocs and birds. Crocodile Specialist Group Newsletter 38(2): 4-7.
- Vyas, R. (2023a). Critiques: On the first sighting report of Mugger Crocodile from the Purna River, South Gujarat, India. Reptiles & Amphibians 30: e18961.
- Vyas, R. (2023b). The mysterious deaths of Mugger crocodiles (*Crocodylus palustris*) near Vadadara, Gujarat, India. Reptiles & Amphibians 30: 1-5.
- Vyas, R.V. (2021). Remarkable predatory skills in Mugger crocodiles makes them the apex predators of freshwater ecosystems. Zoo's Print 36(2): 2-6.
- Vyas, R. and Bhavsar, S.R. (2009). Movement of an individual mugger into urban areas of Vadodara City, Gujarat state, India. Crocodile Specialist Group Newsletter 28(3): 5-7.
- Vyas, R., Mistry, V., Vaghasiya, P. and Chauhan, D. (2023). Review of mugger *Crocodylus palustris* Lesson, 1831 mortality by vehicle collisions in Gujarat state, India. Journal of Animal Diversity 5(1): 80-91.
- Vyas, R. and Stevenson, C. (2017). Review and analysis of human and Mugger crocodile conflict in Gujarat, India from 1960 to 2013. Journal of Threatened Taxa 9(12): 11016-11024.
- Vyas, R. and Vaghashiya, P. (2020). Death of mugger crocodiles *Crocodylus palustris* falling from small dams in Gujarat, India. Herpetological Bulletin 154: 20-23.
- Vyas, R. and Vasava, A. (2019). Mugger crocodile (*Crocodylus palustris*) mortality due to roads and railways in Gujarat, India. Herpetological Conservation and Biology 14(3): 615-626.
- Vyas, R., Vasava, A. and Mistry, V. (2020a). Crocodile-vehicle collision: New threat to Mugger crocodile (*Crocodylus palustris*) in Gujarat, India. Crocodile Specialist Group Newsletter 39(1): 15-19.
- Vyas, R., Vasava, A. and Mistry, V. (2020b). Mugger crocodile (*Crocodylus palustris*) interactions with discarded rubbish in Central Gujarat, India. Crocodile Specialist Group Newsletter 39(2): 5-11.
- Vyas, R., Vasava, A. and Mistry, V. (2024). Several mugger crocodiles burn and die in wetland fire. Crocodile Specialist Group Newsletter 43(3): 17-19.
- Wangyal, J.T. (2013). New records of reptiles and amphibians from Bhutan. Journal of Threatened Taxa 5(13): 4774-4783.
- Wangyal, J.T. (2014). The status of herpetofauna of Bhutan. Journal of the Bhutan Ecological Society 1: 20-39.
- Whitaker, N. (2007). [Survey of Human/Crocodile Conflict in India, Maharashtra State, December 2007](#).
- Whitaker, N. (2025). A preliminary survey of Mugger crocodile (*Crocodylus palustris*) at Bhaghdarra Lake, Udaipur, Rajasthan, India. Crocodile Specialist Group Newsletter 44(2): 10-13.
- Whitaker, N. and Srinivasan, M. (2020). Human crocodile conflict on the Cauvery River delta region, Tamil Nadu, South India. International Journal of Fisheries and Aquatic Studies 8(5): 1-5.
- Whitaker, R. (1974). Gharial Survey Report. Madras Snake Park Publ. No. 1: 1-16.

- Whitaker, R. (1977). Note on the status of Gir crocodiles. *Journal of the Bombay Natural History Society* 75(1): 224-227.
- Whitaker, R. (1987). The management of crocodilians in India. Pp. 63-72 *in* *Wildlife Management: Crocodiles and Alligators*, ed. by G.J.W. Webb, S.C. Manolis and P.J. Whitehead. Surrey Beatty and Sons: Sydney.
- Whitaker, R. (1999). Crocodile survey report. *Crocodile Specialist Group Newsletter* 18(2): 10-11.
- Whitaker, R. (2004). Report on South Asia. *Crocodile Specialist Group Newsletter* 23(2): 18-19.
- Whitaker, R. and Andrews, H. (2003). Crocodile conservation, Western Asia Region: an update. *Journal of the Bombay Natural History Society* 100(2&3): 432-445.
- Whitaker, R., Barr, B., de Silva, A. and Ratnasiri, P. (2007). Observations on burrows dug by mugger crocodiles (*Crocodylus palustris*) in Bundala National Park, Sri Lanka. *Journal of the Bombay Natural History Society* 104(2): 19-24.
- Whitaker, R. and Whitaker, Z. (1979). Preliminary crocodile survey - Sri Lanka. *Journal of the Bombay Natural History Society* 76(1): 66-85.
- Whitaker, R. and Whitaker, Z. (1984). Reproductive biology of Mugger. *Journal of the Bombay Natural History Society* 81(2): 297-316.
- Whitaker, R. and Whitaker, Z. (1989). Ecology of the Mugger crocodile. Pp. 276-296 *in* *Crocodiles: Their Management, Ecology and Conservation*. IUCN Publication New Series. IUCN: Gland, Switzerland.
- Wijethilaka, W.G.R.I., Samaraweera, A.M. and Abesinghe, A.M.N.L. (2015). A study on crocodile behaviour (*Crocodylus palustris*) and public value orientation in Ethimale of Monaragala District. *In: Proceedings of the Research Symposium of Uva Wellassa University*, 29-30 January 2015.
- Wildlife Conservation Society (2013). Myanmar Biodiversity Conservation Investment Vision. Wildlife Conservation Society: Yangon, Myanmar.
- Zafar, M. and Malik, M.F. (2018). A review on status and conservation of Mugger crocodile. *Journal of Advanced Botany and Zoology* 6(3): 1-4.
- Zahraie, B., Salamat, A.R. and Roozbahani, A. (2010). Climate change adaptation: A case study of Sistan and Baluchestan Province in Iran. *In: Proceedings of the 2nd International Interdisciplinary Conference of Hydropredict*, 20-23 September 2010, Prague, Czech Republic.