



Status and conservation of marsh or mugger crocodile: A review

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Abstract

Crocodylus palustris belongs to family Crocodylidae. It is only crocodile which is present in Pakistan. It is also found in India, Nepal, Sri Lanka and Iran. According to IUCN, this specie is vulnerable due to illegal trade for its skin, habitat loss, excessive agricultural activities, construction of dams and roads, shortage of water, drying of streams, deterioration of freshwater ecosystem, incidentally catch in fishing net and hunting. It is listed in Appendix I of Cites and there is prohibition in the trading of this specie. It has variety in its feeding habits, and undergo aestivation and basking to maintain its body temperature. Till now marsh crocodile become extinct in Bangladesh, Bhutan and Myanmar. In eastern Nepal, marsh crocodile was reported in Koshi Tappu Wildlife Reserve. In Pakistan, marsh crocodile is reported at Sindh and coastal areas of Balochistan. In the province of Sindh small number of marsh crocodiles were reported along the Nara Canal in Khairpur, Chotiari reservoir Sanghar, Deh Akro, Naushahro Feroze, New Jatoi Moro, Mangho Pir, Haleji lake Thatta, Shamzoo Park, khar center Karachi and Karachi Zoological Garden. However, in Balochistan in the rivers of Hab, Fitiani, Nari, Dasht, Nahang, Kuch kuar and Hingol. There are 500 crocodiles in the areas of Makhi Lake, 1000 in Chotiari Reservoir & 226 in Nara Desert Wildlife Sanctuary. In India, mugger crocodiles have been reported from ten states and estimated population is about 2500 to 3500. WWF Pakistan and Zoological Society of Pakistan are working for the conservation of Pakistan.

Keywords: marsh crocodile, mugger crocodile, conservation, status, population, distribution, ecology

Introduction

Marsh or Mugger crocodile belongs to family Crocodylidae. *Crocodylus palustris* is the only specie that has been reported in Pakistan^[1]. The Marsh Crocodile is top predator and keystone specie, plays an integral role in maintaining the structure and function of fresh water ecosystem^[2]. Crocodiles are found in hot tropical areas of the world *Crocodylus palustris* is restricted to the Indian subcontinent, in Pakistan, India, Nepal, Sri Lanka and Iran. This species has numerous common names in Pakistan, it is locally called Mugger Much, the name "Mugger" derives from the Indian 'Magar-Machh', that can also mean swamp crocodile^[3]. It inhabits all types of freshwater habitats including rivers, lakes and marshes, reservoirs, irrigation canals, man-made ponds, hill streams, coastal saltwater lagoons and estuaries^[4, 5, 6]. Usually in case of water streams, it prefers stagnant and stumpy water. It shows great tolerance to aquatic environments with a greater saline concentration^[3]. For the conservation of wildlife, information on biodiversity such as population, status, distribution, abundance, home range, interactions to community and their contribution to ecosystem is necessary^[7].

Morphological Description of Marsh Crocodile

The marsh crocodile has a medium size with maximum length of about 4.5 m, and snout of marsh crocodile is broadest of any living specie of the genus *Crocodylus*^[3, 8]. Juveniles are light tan in color, having black cross banding on tail and body^[9]. Adults are usually grey to brown in color^[10]. Enlarged scutes are present around the throat area provide protection

when they move through shallow swampy areas^[11].

Feeding Habits and Behavior of Marsh Crocodile

The Juveniles of marsh crocodile generally feed upon small fish, insects and crustaceans^[12, 13]. Adults eat larger fish, snakes, turtles, amphibians, birds, monkeys, and deer and buffalo species^[14].

The mugger crocodiles live in the holes nearest to water bodies^[6]. During the summer crocodiles undergo aestivation, a period of inactivity in which they buried themselves in deep burrows for maintenance of humidity^[15, 16]. During the winter, marsh crocodiles come out to take bask in the direct sunlight to maintain their body temperature. The female marsh crocodile digs about 2 feet deep holes in the sand to lay their eggs^[6].

Reproduction of Marsh Crocodile

The marsh crocodile is among the hole nesting species. Eggs are laid annually during the dry season. Females reach the stage of sexually maturity at a length of 1.82 m and lay approximately 25-30 eggs^[6]. Nests are positioned at various habitats and females have been found inside or at the opening of the burrow^[17]. In captivity it was observed that mugger crocodiles laid two clutches per year, but situation varies in the wild conditions. Incubation period is relatively short and typically lasts for 55-75 days^[6].

The eggs of Marsh Crocodile are approximately 9×6 cm in size, both ends are equal and made up of hard calcareous shell. After covering the hole, the female may maturate on the nesting site to keep the soil damp^[18]. The hatchlings come out

of soil using small, sharp piece of lime present on the tip of the snout. The hatchlings rapidly adapt themselves to their surrounding environment^[19, 20, 21].

Distribution and Population of Marsh Crocodile

Historical records showed that wild population of marsh crocodile was extinct in Bangladesh and in community ponds only two wild crocodiles were found. In Myanmar, last record of crocodile was observed in 1867 and 1868. In 1960s, in Bhutan mugger crocodiles are considered to have become extinct^[22].

In 2011, a study was conducted by Rajesh in Koshi Tappu Wildlife Reserve in eastern Nepal. Survey was conducted by questionnaire and direct observation during spring and winter. Crocodiles were observed by photo shoots and binoculars, sites were visited by bicycle, boat and on foot during the daytime. Previously, both *Crocodylus palustris* and *Gavialis gangeticus* were found in the reserve, while *Crocodylus palustris* was only observed in this study. The population of crocodiles has been declined due to human interruptions by cattle grazing, wood collection and fishing. The conservation of crocodiles is done by giving awareness to the local public. Conservation and protection of *Gavialis gangeticus* is done by transboundary conservation efforts and continuous release^[23].

Marsh Crocodile in Pakistan

In Pakistan, marsh crocodile is restricted to the certain areas of Sindh and coastal areas of Balochistan^[24]. In Pakistan, in 1982 Groom conducted studies on marsh crocodile^[25]. In 1997, Zoological Survey of Pakistan reported about five hundred crocodiles in the areas of Makhi Lake. In 1999, Sindh Wildlife Department reported more than one thousand marsh crocodile population in Chotiari Reservoir and surrounding areas. In 2004 and 2005, Zoological Survey Department of Pakistan conducted two surveys on Marsh crocodile, about 226 marsh Crocodiles were reported in Nara Desert Wildlife Sanctuary. In 2008, WWF-Pakistan conducted the marsh crocodile's population survey in Nara canal^[26]. In 2008 and 2009, Crocodile Specialist Group conducted most recent survey of crocodile in Chotiari Reservoir, NDWS and different areas of Sindh^[17]. In Punjab, it was reported that the population of marsh crocodile became extinct due to rapid loss of habitat^[10]. A few crocodiles were reported in the province of Balochistan in the rivers of Hab, Fitiani, Nari, Dasht, Nahang, Kuch kuar and Hingol^[3, 27]. However, in the province of Sindh small number of marsh crocodiles were reported along the Nara Canal in Khairpur, Chotiari reservoir Sanghar, Deh Akro, Naushahro Feroze, New Jatoi Moro, Mangho Pir, Haleji lake Thatta, Shamzoo Park, khar center Karachi and Karachi Zoological Garden^[24, 28]. Population of marsh crocodile is declining in Deh Akro, Chotiari reservoir and Nara canal due to hunting, fishing practices, habitat degradation, and construction of dam and shortage of water^[29].

During 2006 and 2009, ecology of *Crocodylus palustris* was investigated at Deh Akro. Total one hundred eighty-nine crocodiles were observed during the study, of which thirty-eight were hatchlings, fifty-three were juveniles and ninety-eight were adult^[29]. In 2011, marsh crocodile was reported during a qualitative study in Chotiari Reservoir, in Sindh

Pakistan^[30]. In Pakistan, Nara Desert Wildlife Sanctuary of Sindh, about 326 marsh crocodiles were observed, of which 51 were hatchlings, 91 were juveniles and 184 were adult^[29]. The population of marsh crocodile was determined from three sites of Karachi Zoological Garden, Samzu Park and Khar Center. It was observed that there were 93 individuals, among them 61 were adults, 08 were juveniles and 24 were hatchlings^[31].

Spotlight surveys were conducted from 2006 to 2009 to determine the distribution, population status and threats of Marsh Crocodiles in Chotiari Wetland Complex, Sanghar Sindh, Pakistan. A total of 66 Crocodiles were observed and 862 km surveyed. We observed the total number of Marsh Crocodiles were sixty-six in the CWC among them forty-four were adult Crocodile, ten were juveniles and twelve were hatchlings^[32].

A study on breeding and population status of Marsh crocodile (*Crocodylus palustris*) in Manghopir Shrine Area of Karachi was undertaken during the years 2010-2013. There is a 61 meters wide and 122 meters long water pond adjacent to the shrine. This pond is home to 144 Marsh crocodiles among them, there are 98 adults, 28 subadults, 15 juveniles and 3 hatchlings^[33].

Marsh Crocodile in India

In India, mugger crocodiles have been reported from ten states and estimated population of non-hatchlings is about 2500 to 3500^[34]. In Uttarakhand state of India, it was estimated that marsh crocodile found in Corbett Tiger Reserve of Ram-Ganga River and Sonanadi reservoir and in Baan Ganga wetland of district Haridwar adjacent to river Ganges. A study was conducted for first time to record the presence of mugger crocodile in river Ganges flowing across the Rajaji National Park and in Haridwar forest division^[35]. In 2013 Joshi indicated that the distributional range of the mugger crocodile is increasing in upper catchment of river Ganges near to Rajaji National Park and in parts of Haridwar and Lansdowne forest divisions^[36].

In Gujarat State of India, a three-year study was conducted in Vishwamitri River from 2008 to 2011. Total 155 Muggers were reported during study period, 40 burrows were observed along the certain portions of river and river bank. It was estimated that in addition to scavenging, muggers feed on eight species of birds, and domestic livestock. About 90 Muggers were rescued from the urban areas and were repositioned in the river system^[37].

Status and Conservation of Marsh Crocodile

According to IUCN red list of Threatened Species, marsh crocodile is categorized as vulnerable^[38]. There is need to conserve endangered species of Pakistan. Government of Pakistan has signed the agreement on the Convention on International Trade in Endangered Species to enhance the population of marsh crocodile. However, illegal trade and poaching still continues in several parts of the country with impunity which have been attributed to inadequate enforcement of wildlife legislation, irregular game patrol and lack of incentives to staff in game preservation areas. There is need to encourage individuals and organizations to participate in wildlife farming and captive management of some wild

animal species such as crocodiles which is endangered in Pakistan. This may reduce illegal hunting pressure in wildlife conservation areas. Marsh Crocodile has received the legal protection under the Appendix I listed in Cites.

Groombridge in 1982 reported that the Crocodiles are threatened from their origin habitat due to the illegal hunting for their valuable skin and meat and in some extent due to alteration of habitat. When these practices are eliminated than we may able to recover their population in wild if we provided suitable habitat^[39]. It is the real facts that many crocodilian species have declined from their habitat as compare to another wild species in the world. In Pakistan in adequate scientific data has been published and less research had been done on Crocodiles previously^[31].

Reasons of Decline of Marsh Crocodile

In Pakistan, Population of marsh crocodile is declining due to increase in agricultural practices, construction of dams and diversion of water channels for irrigation purpose, soil erosion and mortality due to railway tracks, further degradation in its habitat may lead to extinction in Pakistan^[24]. In Sindh, population of marsh crocodile from the Nara Desert Wildlife Sanctuary has declined due to human interventions. The changes in the environmental conditions has drastic effects on the population of crocodile and other biodiversity. The hunting pressure and habitat destruction are the major threats for the decline of population of marsh crocodile^[29].

In the Manghopir pool of Karachi, marsh crocodiles were reported endangered due to the vulnerability of marshy habitats to increase pollution and environmental deterioration. Study was conducted to find out the reason of decline of population of marsh crocodile, it was estimated that toxic chemical contaminants, pollution and metabolites are serious threats to the marsh crocodiles. The Crocodile population is going to decline rapidly from their original habitat and their number at the turn of the last 20th century due to over hunting for their valuable skin and meat. They can be ranched but unfortunately in our country the concept of sustainable utilization of wildlife is still not practiced to a large segment of the population. If any loss of this valuable species from the ecosystem it would be consider loss of biodiversity, economic prospective and steadiness of biota^[31].

Conclusion

Crocodiles are key stone species which play a major role to help maintain the ecosystem structure and function through predation on fish, recycling of nutrients in food chains and they also maintain of aquatic habitat during the droughts period. As reported by Baillie and Groombridge in 1996 that Marsh Crocodiles are listed "Vulnerable" reptilian species in the world today. In Pakistan the *C. palustris* has received the criterion "Critically Endangered" and "Endangered" by IUCN, respectively. Marsh Crocodile has received the legal protection under the Appendix I listed in Cites. WWF and Zoological Society of Pakistan are working to conserve this keystone specie of Pakistan.

Recommendations

It is recommended to have ground based surveys to monitor the potential habitats to find out distribution range of

crocodile. Breeding season of marsh crocodile is between February and April so steps should be taken for the protection of eggs in sandbanks. Hatchlings of mugger crocodile should be released in Nara Desert Wildlife Sanctuary for the conservation of population at that area. There is need to grow more lagoons & mangroves at marshy sites as these are the nesting sites of crocodiles. There is need of proper legislation for the protection of wildlife in Pakistan.

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