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Current conservational status of marsh crocodiles in Haleji Lake Wildlife Sanctuary

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Abstract

The present study on conservational status of Marsh Crocodiles, *Crocodylus palustris* has been carried out from the Haleji Lake Wildlife Sanctuary (HLWS) Thatta, Sindh, Pakistan. This research study was carried out during the year of 2006-09. We observed and recorded the total numbers of *C. palustris* two hundred sixty nine (269) in the HLWLS, among them one hundred seventy nine (179) were adult crocodiles, thirty seven (37) were juveniles and fifty three (53) were hatchlings. Various instances of human-crocodile conflicts were observed including 7 injured and three human causalities. Innumerable types of threats to Crocodiles were also noticed including habitat loss, alteration and soil erosion and mortality due to fishing practices. We were determined that the Crocodile population is increasing in HLWS due to strong conservational strategies and management. The present study suggests that further research to propose strategies to conserve this vulnerable species.

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Introduction

The Marsh Crocodile one of the threatened and vulnerable crocodilian species in Pakistan. This species, *C. palustris* is categorized as nationally "Vulnerable" subsequent to an assessment under the IUCN criteria for threatened species (Molur and Walker, 1998) and has received the highest legal protection in Pakistan as it is listed in Schedule I of the Pakistan Wildlife (Protection) Act 1972. After the early seventies, while the *C. palustris* populations in Pakistan were reported declining including Sindh province. This crocodilian species has reported declined due to hunting, habitat decline and illegal fishing in the Sindh province. The present study was carried out between January 2006 and December 2009 to evaluate its current conservational status and assess issues related to conservation and management. Haleji lake is an important refuge for wintering and an ideal home of thousands of birds and regarded as one of the most suitable wintering areas for migratory waterfowl in Eurasia. Haleji lake globally positioned at 240' 48" N and 600' 47" E and is at distance of 88 Km away from Karachi. Haleji, a salt water lake was constructed by seasonal water, collecting water in a depression. Haleji Lake Wildlife Sanctuary is now considered home to divers, dabblers, surface and deep water feeders, for birds of fresh and brackish water lovers. HLWS covered an area of 12 miles complete circuit and water reservoir covers an area of about 6.58 Sq. miles and it has the maximum depth recorded 17 feet. The area and depth of HLWS was observed variable depending upon the influx of rain water and canal water. Lake is surrounded by shady trees and in reservoir species of Phragmites, Typha, Hydrilla and Lotus covers parts of the wetland in swaying patches of colours. More than 223 bird species have been recorded in the environs of HLWS. The Government of Sindh has been declared a Wildlife Sanctuary and later on as Ramsar wetland site and lake has provided legal cover to preserve and conserve ecology of this wetland. In HLWS, the important key species of biodiversity and vulnerable species of Crocodilian is also reported (WWF-P, 2007).

Order Crocodylia comprised of three families; (1). Alligatoridae (Alligators/Caimans); (2). Crocodyliea (Muggers/Marsh Crocodiles) and (3). Gavilidae, Gavials/Gharials (Chang *et al.,* 2012, King, 1989). In the world there are 23 Crocodilian species is reported. These three Crocodilian families are identified on the bases of; i) Snout shape and presence of scales. Alligators have longer snout; Muggers have broad and blunt snout whereas the gavials have thinnest, elongated and beak like jaws. So for the presence of scales is concerned, the Alligators possess small scales behind their heads, the Muggers have large scales behind the head whereas the gavials have the bunch of the smallest scales found with skin away from the head near the fore arms (Chang *et al.,* 2012, 2013). Muggers have broadest snout and they have maximum length of 4.5 meters (Whitaker, 1989). During the breeding season the females lay 25-30 eggs annually in holes near their habitat (Whitaker and Whitaker, 1989). Their incubation period is short which lasts about the 55-75 days (Whitaker, 1987).

Materials and methods

Present study was conducted for the collection of data in the areas of Haleji Lake Wildlife Sanctuary from the January 2006 to December 2009. Various surveys were undertaken to determine the conservational status and its associated threats in the wetland.

Field equipments

In present study we were used the strong torch lights to focus the movements of muggers and other activities during night time and we have looked up the burrows of Crocodiles during the nocturnal survey. We were used the diurnal survey and collected the fecal pellets of Crocodiles and saved them in plastic bags and labeled it respectively. For the identification and location of studied areas where the Crocodile individuals found we were used the Global Positioning System (GPS) which is very helpful for recording the positions of specimens. It is also very helpful for the measuring, observing and mapping of studied areas. Binocular was used to focus the Crocodile which is away from our position and also

used for the identification of individuals to locate them in the lake. For capturing the Crocodiles we were used the different nets and strong ropes and they were measured with measuring tape when any individuals captured during the field survey. Measuring tape also used for the measurement of eggs, fecal pellets and measured all the physical parts of Crocodile individuals. Digital camera was used for taking the snaps, pictures and videos and also used for taking the pictures of Crocodile tracks, trials, sign, footprints, egg shell and other related evidences of Crocodiles. Maps were used which were very useful for the location and identification of Crocodile population in the studied areas.

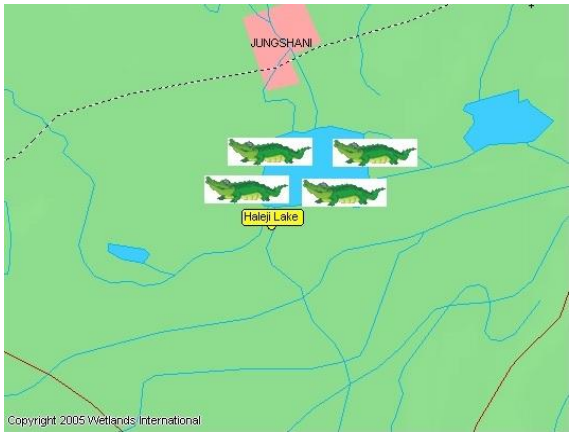

Fig. 1. Map of Haljei Lake.

Methods

During present study we were determined the conservational status of C. palustris in HLWS during the year of January 2006 to December 2009. This study was based on already published data, direct observation and indirect observation conducted and it was obtained during the interviewing of governments officials, game watcher, game warden, game watcher, fisherman and from the local communities of studied areas. In direct method, we were counted and observed the sighting habitats, basking spots, swimming at water surface and catching the reflection of eyes of Crocodiles during the nocturnal survey. During the diurnal surveys, we were carried out to detect the active Crocodiles, tracks, trials and their nest sites. Most Crocodile population were found at the time of emergence of individuals and counting was done by the snap shot method and recorded the duration required by the Crocodiles for leaving the roosting site. When we were observed every sighting of individuals then their numbers, location, nest sites, movement and behavior were recorded. Whenever possible, the specimens were recognized on their based of shape of snout, scales, body color and their abdomen and estimated visually and measured their body size with the help of measuring tape. We were applied three categories for the identification of specimens; i). the hatchlings (<0.5 meter), ii). Juveniles (0.5±1.0 meter) and iii). adults (>2 meters). Population of Crocodiles were internationally categorized based on their numbers in habitat; (i). Rare (<10 individuals), (ii). Common (10±30 individuals), (iii). Abundant (> 30 individuals) and (vi). Extinct (there were no individuals available but available in the past time). During the nocturnal spotlight surveys we were applied the standard method of surveying of crocodiles as applied by Web and Smith 1987 and reflection of light from a 200, 000 candle power spotlight/floodlight off the eyes for the detection of individuals. Water samples were also collected and then tested using a professional heavy metal kit for the presence and concentration of hazard chemical in the water samples.

Results and discussion

In present stud, we were carried out the field survey carried out in the Haljei Wildlife Sanctuary to determine the conservational status of Marsh Crocodiles during the January 2006 to December 2009. Counts of muggers during the day were carried November-January 2006, 2007, 2008 and 2009. Counts of muggers during the nocturnal survey were carried out randomly in the months of March to August. In present study, in the areas of HLWS, the total number of counted Crocodiles were two sixty nine (269), among them, one hundred seventy nine (179) were adult Crocodiles, thirty seven were juveniles and fifty three (53) hatchlings recorded (Table 1). During the study, we were recorded that the population of adult Crocodile was highest one hundred seventy nine (179) in HLWS, lowest juveniles

were thirty seven (37) and fifty three were hatchlings were recorded in the captive form and in the area of lake of HLWS (Table 1). We were counted these individuals through the direct and indirect sightings during diurnal and nocturnal surveys (Table 1). In present study, when we were found any alive or died individuals we used the measuring tape for the measurement of individuals. We measured the selected adult Crocodile, juvenile and hatchling (Table 2 and Figure 2 and 4). In the breeding season we were found eggs of female Crocodile and we were measured and took weight of egg (Table 3). Crocodilian species are recognized internationally on the bases of their body length size and their weight (Table 4). In captive farm, we were assessed the weight and weekly feeding requirement of each individuals in HLWS (Table 5).

Table 1. Population status of Marsh Crocodiles in Haleji Lake.

S. No.	Name of the Wetland	Adults	Juveniles	Hatchlings
1.	Haleji (Captive Farm)	9	2	8
2.	Haleji Lake	170	35	45
Total		179	37	53

Table 2. Measurement of one selected Adult/juvenile/hatchling Crocodile Sample.

S. No.	Description	Adult (m)	Juvenile (m)	Hatchling (m)
1.	Body condition	Active and alive	Active and alive	Active and alive
2.	Length (total)	2.9858	1.4192	0.2794
3.	Width (at center)	0.4872	0.1935	0.0762
4.	Head length	0.4872	0.2042	0.0508
5.	Head width	0.284	0.1153	0.0254
6.	Tail length Tail	1.8764	0.645	0.1524
7.	Tail width (at top)	0.284	0.0899	0.02
8.	Tail width (at center)	0.1998	0.0645	0.015
9.	Tail width (at top)	0.0398	0.028	0.01
10.	Fore limb length	0.4872	0.1878	0.0508
11.	Fore limb width	0.1173	0.0468	0.0254
12.	Hind limb length	0.6196	0.2996	0.0635
13.	Hind limb width (up)	0.2062	0.0782	0.0254
14.	Hind limb width (down)	0.0899	0.0518	0.0127
15.	Nails of fore limb	0.05	0.020	0.006
16.	Nails of hind limb	0.05	0.019	0.006
17.	Teeth of lower jaw	0.05 – 0.06	0.018	0.005
18.	Teeth of upper jaw	0.05 – 0.06	0.018	0.005
19.	Segments in tail	0.038	0.0025	0.002
20.	Teeth upper and lower jaw	0.04 – 0.04	0.004 – 0.004	0.001

Table 3. Measurement and Weight of Crocodile's egg.

S. No.	Location	Length of Egg (mm)	Width of Egg (mm)	Weight of Egg (g)
1.	Haleji Lake	65	40	160

Table 4. International Parameters for identification of Marsh Crocodiles.

S. No.	Body length (m)	Body weight (Kg)
1.	0.5	0.3
2.	1.0	3
3.	2.0	30
4.	3.0	100
5.	4.0	300
6.	5.0	700

Table 5. Food intake by captive Farmed Marsh Crocodiles.

S. No.	Crocodile length (m)	% of body weight eaten per week	Food eaten per week (g)
1.	≥ 0.5	25	150
2.	1	15	500
3.	≥ 2	10	3,000

Discussion

In the present study, we were determined the current conservational, ecological status and associated threats of Marsh Crocodiles in HLWS Thatta and during the surveys we were counted the total numbers of different age levels of individuals (Table 1). In order to assess the population status of Marsh Crocodiles in Pakistan various surveys were conducted by different researchers and institutions (Ahmed, 1986, Chang *et al.,* 2012, 2013, Chaudhury *et al.,* 1993, CSG, Volume 28 Number 1, March 2009, De Silva *et al.,* 2009, De Silva and Lenin 2010, Ghalib *et al.,* 1981, Groombridge, 1992, Khan *et la.,* 1974, Khan, 1988, 1999, Whitaker, 1993, WWF-P, 2008, 2009). However, it is reported that in the Sindh province small numbers of Crocodiles were recorded in the areas of Manghopir, Karachi Zoological Garden, Samzu Park and Khar Center Khirthar Park, Karachi District (Captivity), Haleji Lake Wildlife Sanctuary Thatta District (Captive farm and Wild), Chotiari Wetland Complex Sanghar district (Wild), Deh Akro II Shaheed Benazir Abad district (Wild), Nara Desert Wildlife Sanctuary Khairpur district (Wild) and New Jatoi Farm Naushehroferroze district in captivity (Ahmed, 1990, Chang *et al.,* 2012, 2013, Javed *et al.,* 2004, 2005). The four years of Mugger count has shown an increasing in its population in HLWS. Results on the conservational status of Muggers is summarized in table 1. We were observed that the nocturnal counts were relatively a better method to assess the population of Mugger compared to surveys during the diurnal counts. A total of 269 Crocodile individuals were counted in captive farm and in lake area during the four years surveys (Table 1). As human populations inflate and natural habitats are converted into agricultural land, people and wild animals are increasingly coming into conflict between them for food and space (Joshi *et al.,* 2011, Saberwal *et al.,* 1994). The impacts are often severe; people lose their livestock's, crops, fishes resources and many times their lives (Karanth and Madhusudan, 2002). The Crocodile menace was found to be very prominent in HLWS and the actual number of human casualties (Including mauling) was actually perhaps 4 times higher than the reported figures. Due to heavy security development, the extent of poaching apparently has been reduced significantly, which perhaps contributed to an increase in the population of Marsh Crocodiles to humans too; hence, encounters with people had been frequent in the HLWS. However, attacks of Crocodiles on humans do not appear to be result of predatory behavior, but rather a result of the Crocodiles defending itself or its fledglings from humans or trying to secure food and their eggs or juveniles. Many people have gotten hurt or killed by a mother Crocodile with striplings when she is disturbed by local communities. It was reported that the villagers of Haleji Lake was attacked by Crocodile and one 11 years old girl was died and other girl with her was badly injured in 2006. On the different occasion more than 8 villagers were injured by the Crocodile attack near the Haleji Lake. Most attacks of Crocodiles were witnessed during the breeding season when the females lay their eggs in the holes near the lake. Due to many attacks of Crocodiles the villagers have no sympathy with crocodiles of Haleji Lake, if they find out any Crocodile or juvenile outside the lake even eggs of Crocodiles they were destroy and Crocodiles killed by them. Crocodiles have also dragged away more than 23 goats, four cows, two buffalo and attacked on some other cattle near the banks of Haleji Lake. There is urgent need to collect reliable information on the population status of Marsh Crocodiles to deal with the human-crocodile conflict for a long term basis. People must change their intolerant attitude towards crocodile population and play an active role in resolving conflicts between human and Crocodiles. To

achieve this, there is immediate need to educate people through organizing seminars and symposiums about crocodile conservation, coexisting with crocodiles and making them aware of ways to avoid Marsh Crocodiles confrontations. To reduce the frequency of Crocodiles coming to outside the lake, proper disposal of left fishes is required. People need to be paid reasonable compensation by the Wildlife Department in cases of crocodile attack and loss of their resources. It was observed that in last decades the Crocodile population in Chotiari Wetland Complex, Deh Akro II and Nara Desert Wildlife Sanctuary was recorded in thousand numbers but unfortunately their current population was decreased and remained few hundred numbers in Sindh province, due to the hunting pressure, fishing practices, habitat loss, ecological changes, construction of Dam, land used for agriculture, expand human population, water shortage and low quality of water (Chang *et al.,* 2012, 2013). Currently, the captive breeding is the major source of income and production for skin transport in various countries in the world (Ross, 2001). In modern world, the Crocodiles are major source of raw materials where their skin are transported and its used for the manufacturing of shoes, belts, handbags, medicines and various ornamental stuffs due to its high demand for skin trade in the world (Young, 1981). The keystone species of ecosystem, the Crocodiles are considered as bio indicator which really focused attention on the major issues related with the pollution which directly concerned with the human health and other aquatic life that can directly use the polluted water (Chang *et al.,* 2012, 2013, Grizmeks *et al.,* 1975). It was observed that the shortage and quality of water effect on the health of Crocodile population (Abtin, 2012, Chang *et al.,* 2012, 2013). For the survival of Crocodile and other wildlife the sanctuaries, game reserve areas and conservational strategies and strict law should be enforced in the Sindh. It is reported that the seasonal flooding can also destroy the nesting and eggs of Crocodiles (Santiapillai *et al.,* 2001). Flooding in the wetland areas not only inundated the fertile land but also caused the excessive water seepage of wetland and its adjoining agricultural lands became waterlogged, salinized and barren. In the wetland the stocks of fish are slowly and gradually depleting caused by unsustainable practices and overfishing. It is reported that the current population of Crocodile disturbed with the interaction of peoples, boats, fishing nets and forest clearing fires usually reduces the suitability of habitat. This small and dense population of Marsh Crocodile survives in the Haleji Lake Wildlife Sanctuary Thatta, Sindh Pakistan is a notable example of Crocodilian conservation and human-crocodile concordance. The preservation and conservation of this population now lies in the hands of the residents of Haleji and various local governmental agencies, including the Sindh Wildlife Department, Pakistan Zoological Survey Department, local and international NGO's of Pakistan. Continuous monitoring of the population of this species is required strongly recommended.

Fig. 2. Measurement of hatchling in Haleji Lake.

Fig. 3. Measurement of Crocodile's egg.

Fig. 4. A Marsh Crocodile basking in Haleji Lake.

Fig. 5. Tunnel of Marsh Crocodile in Haleji Lake.

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