Sindh Univ. Res. Jour. (Sci. Ser.) Vol.44 (2) 209-214 (2012)

SINDH UNIVERSITY RESEARCH JOURNAL (SCIENCE SERIES)

Bio-ecological status, Management and Conservation of Marsh Crocodiles *(Crocodylus palustris)* in Deh Akro 2, Sindh–Pakistan

M. S CHANG, G. S GACHAL, A. H QADRI, M. Y. SHAIKH

Department of Zoology, University of Sindh Jamshoro, Sindh-Pakistan

Corresponding author, M. S CHANG: email: Saleem_khan74@yahoo.com Cell No. 03332643404

Received 19th July 2011 and Revised 21st February 2012

Abstract: The Marsh Crocodiles perform an integral role in maintaining the structure and function of fresh water ecosystem since they are the top predator and keystone species within their natural environment. This research study investigated for the bio-ecological status, population of Marsh Crocodile at Deh Akro 2 Nawabshah and adjoining areas and suggests certain conservation measures for their in-situ and ex-situ protection.

Present investigation was carried out at Deh Akro 2 during 2006 and 2009, in order to determine the ecology of *Crocodylus palustris.* The observations revealed the total number of Crocodiles was one hundred eighty nine (189) in the studied areas among which, 98 were adult crocodiles, 53 were juveniles and 38 were hatchlings.

Keywords: Marsh Crocodiles (*Crocodylus palustris*), Ecology, Predator, Keystone and Conservation.

1. INTRODUCTION

The Crocodilians (Crocodiles, Alligators, and Gavials/Gharials) are well-known and wide spread occupants of tropical and subtropical habitats. There are 23 species of Crocodiles in the world today. Order Crocodylia comprised of three families viz: (1). Alligatoridae (the Caimans/Alligators), (2). Crocodylidea: *Crocodylus palustris* (the Mugger Crocodile) and (3). Gavilidae: (the Gavial). These three crocodilian families are identified on the bases of: (i) Shape of snout and (ii) Scales behind the head. The Alligators have longer snout; the Crocs/Mugger possesses broad and blunt snout where as the gavials have the thinnest, elongated and beak likes jaws. So far the presence of scales is concerned, the Alligators do not contain large scales behind their heads and the Crocs/mugger possesses large scales behind the head whereas the gavials have the bunch of the smallest scales found with skin away from the head near fore arms.

The mugger is a medium-sized crocodile (maximum length ca. 4.5 m) and has the broadest snout of any living member of the genus Crocodylus, (Ahmed, 1986 and Densmore, 1983). The color generally is light tan in juveniles, with black cross banding on body and tail, (Tarsitano, *et al.,* 1989). Adults are generally grey to brown, with little banding remaining, (Khan and Mirza 1976 and Manolis, *et al.,* 1987). Enlarged scutes present around the throat area may serve a similar protective function when moving through shallow swampy areas. This is a medium to large species 4 to 5 m, (Rao, 1994, Whitaker and Whitaker, 1989).

The Mugger crocodiles are the hole nesting species. As with other hole nesters, egg laying takes place during the annual dry season. Females become sexually mature at a length of approximately 1.82 m, and lay 25-30 eggs, (Whitaker and Whitaker, 1989). Nests are located in a wide variety of habitats, and females have even been known to nest at the opening of, or inside, the burrow, (Choudhury, 2007).

In captivity, some mugger crocodiles are known to lay two clutches in a single year but this has not been observed in the wild. Incubation is relatively short, typically lasting 55-75 days, (Whitaker and Whitaker, 1989).

The Crocodiles also have a habit of aestivation, a period of in activity during the summer season in which the Crocodiles hide in deep burrows that eventually clear out, forcing Crocodiles to bury themselves in the mud to maintain humidity, (Poe, 1996 and Tikadar, 1983). Similarly, after the

beginning of dry season, the female selects a nesting site on a damp, warm spot near bushes or trees; at the nighttime, she digs a hole half a meter into the sand to lay her eggs, (Groombridge and Wright, 1982). The eggs of Marsh Crocodile measure 9 × 6 cm, are equal at both ends, and have a hard calcareous shell. After the hole is covered, the female may maturate on the nesting site to dampen the soil, (Hass, *et al.*, 1992). The hatchlings use a small, sharp piece of lime on the top of the snout to force their way out of the soil. The babies grow rapidly to adapt to their surroundings, (Alderton, 1991, Kalin, 1955 and Thorbjarnarson, 1992).

The feeding of the Juveniles depends upon crustaceans, insects and small fish generally, (Huxley, 1875, Norell, 1989). Adults eat larger fish, amphibians, reptiles (mainly snakes and possibly turtles), birds and mammals (e.g. monkeys). Some times the large adults have been known to take deer and buffalo species, (Ghalib, *et al.*, 1981).

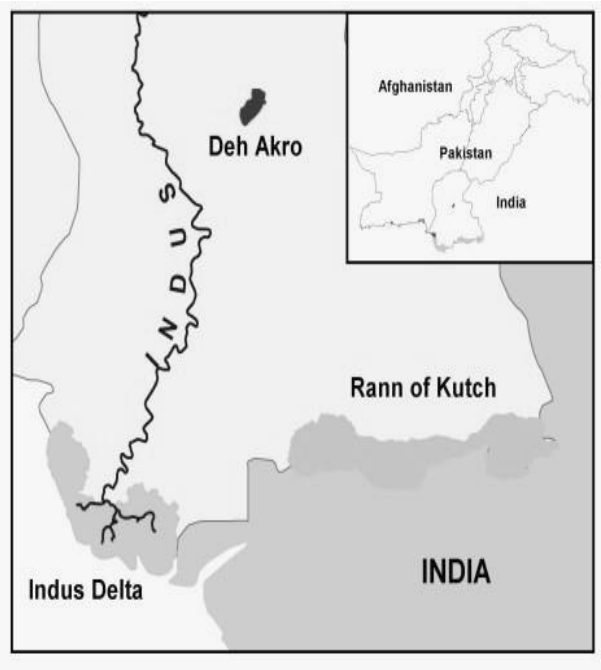


Fig I. Map of Deh Akro 2 Wildlife Sanctuary Nawabshah).

2. MATERIALS AND METHODS

For the collection of data these materials and methods were used for bio-ecological status of Marsh Crocodiles (*Crocodylus palustris*) and its associated threats in the studied areas of Deh Akro 2 Wildlife Sanctuary Nawabshah, **(Fig 1).** Various surveys were conducted in association with WWF-Pakistan and Sindh Wildlife Department.

(a). FIELD EQUIPMENTS

During the investigation we have to use the torch lights for night survey and also we have looked up the burrows. Faecal pallets were collected and saved in plastic and labeled it respectively. The GPS was vey helpful for the identification of areas where the Crocodile population found. It is helpful for measuring, observing and mapping of studied areas. Binocular was used for the identification of gut contents or water analysis etc. The collected individuals of crocodile were measured with tape. Boat was used for counting the Crocodile population in lakes and fishing net was helpful in capturing the individuals of Crocodile. Digital camera was used to take the pictures of Crocodile and its signs. Map was helpful for the identification of studied areas.

(b). METHODS

There are two methods were used for determining the population Marsh Crocodile, direct method and indirect method. During the direct counting we have observed the sighting habitats, basking spots, swimming at surface water and catching the reflection of eyes of Crocodile during night observation. During the investigation of indirect method we have collect the data through the different Crocodile's signs such as faecal pellets, den or tunnels, tracks, egg shell and trials. We have also collected the data from different sources such as interview from the Local community, interview from the Game watchers, interview from the Game inspector and interview from the Fisherman etc, for the collection of data.

3. RESULTS

During present research study, the field survey was carried out in the Deh Akro 2 Wildlife Sanctuary (Nawabshah) to determine the status of Marsh Crocodiles (*Crocodylus palustris*).

The study was carried out from the various areas of Deh Akro 2 Wildlife Sanctuary in the year of 2006 to 2009 for the collection of data.

During present study, Forty four adult crocodiles were recorded in wild, ten juveniles and twelve hatchlings. In Deh Akro 2 Wild Life Sanctuary, the total numbers of Crocodiles One hundred eighty nine (189) were found living, out of this, 98 were adult Crocodiles, 53 were juveniles and 38 were hatchlings, (Table I).

During present study, it is recorded that the population of adult Marsh Crocodile was highest in the Wasoo lake, the lowest population of adult

Crocodile was recorded in Chambh Wado lake, the highest population of Juveniles were recorded in Wasoo lake and the lowest population of Juveniles in Takar lake and the highest population of Hatchlings were recorded in Chach lake and the lowest population of Juveniles were recorded in Ganjo lake, **(Fig.2)**.

During present study, it was also observed that due to shortage of water in Deh Akro 2 Nawabshah some lakes were in dry conditions and population of Marsh Crocodiles were not recorded, (Table No. 2). Data were collected from the different sources like as direct and indirect method, **(Fig. No. 3,4,5, and 6).**

4. DISCUSSION

The aim of this study was to determine the ecological, hydrological, environmental, management and conservational threats to crocodile population in wild and captive.

The survey results are described in the (Table I), which indicates the total population of Crocodiles in studied areas of Deh Akro 2 Wild Life Sanctuary. In Pakistan, some previous studies on Marsh Crocodile were carried out by (Groombridge, 1982 and Whitaker, 1993) and they were conducted the different survey population study in the different areas of Pakistan. In Pakistan, the various population survey were conducted by different scientists and in Deh Akro 2 Nawabshah the population survey was conducted and Crocodile population were recorded about 2, 000 by Ahmad in 1988-90, Chaudhury, 1993, and the zoological survey of Pakistan were carried out observation during 1997 and Sind wildlife department 1999-2000. Two surveys of Marsh Crocodiles were carried out by the Zoological Survey Department in 2004 and 2005 and recorded the 93 numbers of Marsh Crocodile in Deh Akro 2 Nawabshah. WWF was conducted the survey of Nara Canal in 2008 and in Chotiari Reservoir and Deh Akro-2 in 2009 for the population survey of Marsh Crocodiles. Crocodile Specialist Group (CSG) carried out the most recent Crocodile survey in Sindh in January 2009 (Volume 28 Number 1). It is reported that the Mugger population becomes extinct in the province of Punjab on account of habitat degradation (Chaudhury, 1993, Khan and Mirza, 1976). While in the rivers of Nari, Hab. Fitiani, Hingol and Dasht, Nahang and Kuch Kuar a little number of Marsh Crocodiles are reported in the province of Balochistan, (Ghalib, *et al.,* 1977 and Khan, 1989). However, in Sindh only small numbers of Marsh Crocodiles were seen along the Nara Canal in Khairpur, (Wild), Deh Akro 2 (Nawabshah), Chotiari Reservoir Sanghar (Wild), New Jatoi Moro (Naushehroferoz), Haleji lake Thatta (Captivity and Wild), Mangho Pir, Karachi Zoological Garden, Shamzoo Park and Khar Center Karachi in Captivity, (Javed, *et al.,* 2004). In last decade, the Crocodile population in Nara Canal, Deh Akro 2 and Chotiari Reservoir were in thousand numbers but unfortunately now days their numbers are small due to fishing practice, hunting, habitat degradation, shortage of water, construction of dam (Chotiari dam) and so on.

During our observation, the Marsh Crocodile population was recorded in the studied areas of Deh Akro 2 Nawabshah, the numbers of Marsh Crocodile were recorded, Adults were 98, Juveniles were 53 and 38 were Hatchlings, **(Table I,2)**. During the investigation, the numbers of Crocodile was counted through the direct (sighting habitats, basking spots, swimming at surface water and catching the reflection of eyes at night) and indirect method (faecal pellets, den or tunnels, tracks, egg shell and trials of Marsh Crocodile) and also collect the information from the different sources such as fisherman, local community, game inspector and game watcher.

Table I: Marsh Crocodile's Status in Deh Akro 2.

S.N0.	Name of the wetland	Adult	Juvenile	Hatchlings
1.	Saledi	2	2	0
2.	Waeil	2	2	0
3.	Bolahi	5	4	2
4.	Khararo	5	3	2
5.	Murkhi	2	2	0
6.	Wasoo	25	10	8
7.	Chambh Wado	1	0	0
8.	Baro	8	5	4
9.	Khenhwari	4	2	0
10.	Sanahri-I	2	2	0
11.	Muredwaro	2	0	0
12.	Morakhi	4	4	3
13.	Chach	20	7	12
14.	Drigh	5	3	2
15.	Takar	3	1	0
16.	Shora	5	4	4
17.	Ganjo	3	2	1
Total:		**98**	**53**	**38**

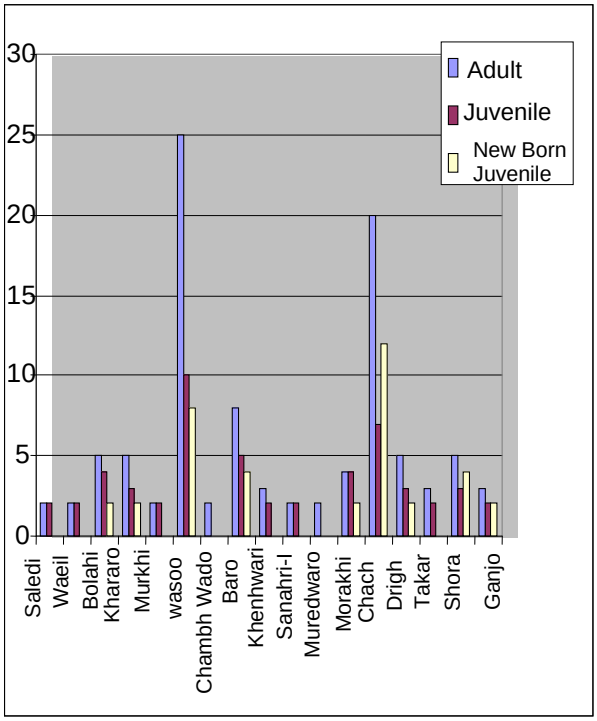


Fig. 2: Mean graph showing the population of Crocodiles in Nawabshah

Table 2: Mrsh Crocodiles not recorded in these lakes.

S.N0.	Name of the wetland	Adult	Juvenile	Hatchlings
1.	Akanwari	0	0	0
2.	Chambh Nandho	0	0	0
3.	Sanahri-II	0	0	0
4.	Bitariyon	0	0	0
5.	Chughari	0	0	0
6.	Sanhro	0	0	0
7.	Karangh	0	0	0
8.	Ghorewaro	0	0	0
9.	Sipianwaro	0	0	0
10.	Phandarwaro	0	0	0
11.	Kandewaro	0	0	0
12.	Naramwaro	0	0	0
13.	Lailawaro	0	0	0
14.	Lamwaro	0	0	0



Fig. 3. Marsh Crocodile in Deh Akro 2.



Fig. 4. Den/tunnel of Marsh Crocodile.



Fig. 5. A view of lake in Deh Akro 2.



Fig. 6. Marsh Crocodile Deh Akro 2.

Development and other human influence have result the declination of Marsh Crocodile and other wildlife population from the Deh Akro 2 Wildlife Sanctuary and its surroundings. The change in environmental factors has drastically effect on the population of Marsh Crocodile. The pollution has been brought the declination of the specie of Marsh Crocodile and other fauna of Deh Akro 2 Wildlife Sanctuary. The hunting pressure and accidentally captured in fishing nets were recorded the major threats for the Marsh Crocodiles of Deh Akro 2. The shortage of water in Deh Akro 2 Wildlife Sanctuary was also recorded serious effect on the Marsh Crocodiles. The change in the quality of water was recorded that the hazard chemicals were found during the analysis of water in the laboratory, which result the harmful effect on the Marsh Crocodiles.

The overall disturbance is very high, however, especially the Marsh Crocodile is facing threatened along with the other wildlife of Deh Akro 2 Wildlife Sanctuary. It is evidenced that the remaining population of Marsh Crocodile in Deh Akro 2 are extremely disturbed from noise, lights and general disturbance associated with a large number of people such as boats, fishing nets; forest clearing fires usually reduces the suitability of the habitat for the Crocodiles.

5. ACKNOWLEDGEMENT

This research study on Marsh Crocodiles (*Crocodylus palustris*) in Deh Akro 2 Wildlife Sanctuary (Nawabshah) was carried out by the financial support of WWF-Pakistan.

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