Biological Forum – An International Journal **9**(2): 217-223(2017)

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Captive Breeding and Conservation Status of Marsh Crocodiles (*Crocodylus palustris*) in New Jatoi Farm Naushehroferoze, Sindh, Pakistan

***Muhammad Saleem Chang*[*,**], *Ghulam Sarwar Gachal*[*] *and Khadim Hussain Memon*[***]**
[*]*Department of Zoology, University of Sindh Jamshoro, 76080, Sindh, Pakistan.*
[**]*Department of Science & Technical Education, University of Sindh Jamshoro, Sindh, Pakistan.*
[***]*Department of Zoology, Shah Abdul Latif University Khairpur, Sindh, Pakistan.*

(Corresponding author: Muhammad Saleem Chang)
(Received 17 July, 2017, Accepted 16 September, 2017)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: A study on captive breeding and conservation status of Marsh Crocodiles (*Crocodylus palustris*) in New Jatoi Farm Naushehroferoze was undertaken during the years 2011-2015. To achieve this objective the study monitored the current population status, feeding, reproductive mode and measurements of hatchling, juvenile, adult and size of eggs. The observation revealed that the total numbers of Marsh Crocodiles were counted 133 in the New Jatoi Farm, among them 20 males and 25 females in Pond-1 were adults, 44 were juveniles in Pond-2, and 76 hatchlings in Pond-3 were counted. With a view to study the breeding behavior, twenty two adult females were observed to lay the eggs per female/per year. However, the breeding habitat of NJF for Crocodiles as observed in subsequent years was found productive and the number of eggs per clutch was recorded as in F-01. 23±2.73, F-02. 25.8±3.42, F-03. 25±3.16, F-04. 25.8±2.86, F-05. 26.2±3.70, F-06. 23.4±4.92, F-07. 25.8±3.27, F-08. 25.2±4.54, F-09. 26.2±2.77, F-10. 26.6±2.88, F-11. 25.6±3.04, F-12. 24.4±4.27, F-13. 26.6±3.04, F-14. 26.4±3.91, F-15. 24.6±4.27, F-16. 25.6±2.96, F-17. 25.4±3.36, F-18. 24.6±3.64, F-19. 26.2±1.48, F-20. 26.2±2.38, F-21. 25±3.16, and F-22. 24.4±3.36, respectively. We selected one hundred eggs randomly and measured the length 65.7 ± 0.74 (mm), Width 41 ± 0.87 (mm) and weight 165.56 ± 4.09 (g), respectively. Further distribution of this species was made to NJF in order to find out suitable habitat for its captive breeding. Since then, the performance of breeding was closely observed and found result in the total stock 133 individuals in NJF. Hatching rate of the species has been recorded low because only less numbers of eggs were hatched due to less availability of space in the ecological condition of three ponds in NJF.

Keywords: Captive breeding, Conservation, Status, Marsh Crocodiles, Habitat.

INTRODUCTION

New Jatoi Farm is located about 15 km away from Moro in district Naushehroferoze at 25° 22' 20" N, 68° 24' 50" E. NJF is non-profit private farm which was established by local landlord. The muggers were kept in captive in NJF before 1970s and were able to rebuild populations, provide muggers for restocking elsewhere, and resort eventually to farming the Crocodiles.

The wildlife farming is a need for private individuals to complement such efforts for conservation of economically important animals. The best ways of achieving to increase wildlife population is by encouraging local community and organizations to participate in wildlife farming and captive management of some wild animal species like as Crocodiles.

All wild mugger populations are legally protected, and management programs intended to restore populations have been very successful (Cox and Rahman, 1994). Widespread captive breeding populations have restocked wild populations and now have a surplus of captive-bred crocodiles as suitable habitat is limited (Cox and Rahman, 1994).

For several animal species the period between mating and egg laying in recognized to be about 3-6 weeks but longer periods have been described (Cardeilhac and Larsen, 1981). In the crocodilian population the breeding starts in the months of summer from late June to July and female lays 25-30 eggs (Whitaker and Whitaker, 1989).

No single agency is responsible for tracking the success of restocking activities. The situation of captive breeding of mugger in Pakistan needs to be addressed as the current crisis 04 of overstocking in captive breeding centers, Khar center Karachi, Haleji Lake Thatta, Deh Akro II Nawabshah (Ahmed, 1990; Chang *et al.,* 2012a, 2013a; Chaudhry, 1993; Ghalib *et al.,* 1981; Javed *et al.,* 2004) and one private center at New Jatoi Farm Naushehroferoze (Chang *et al.,* 2013a) and uncertainty of the success of restocking remains an impediment to developing a coherent new strategy to meet current needs. On-going studies on survival, growth and populations size at restocking locations are needed.

Efforts to grow and successfully maneuver facilities that commercially exploit crocodilians have always faced considerable challenges. Enormous ongoing investments in money, time, and labor are requisite with scant returns for several years (Elsey *et al.,* 1994; Lever, 1994). Even then, incomes are not assured in an unforgiving industry with a capricious meat and hide export market (Cox and Rahman, 1994; David, 1994; Kelly, 1994). On the other hand, the captive breeding that relies exclusively on rearing captive-born individuals to yield skin and meat for market is considered "closed" progression (Thorbjarnson, 1992; Cox and Rahman, 1994). The captive breeding initiatives can also comprise a tourism component to increase their income, with Crocodiles placed on exhibition for showing (Cox and Rahman, 1994). Though, the captive breeding and rearing is significant to the long-term economic sustainability of any Crocodile innovativeness (Davis, 1994). Combining captive breeding with ranching and tourism may be the greatest inclusive approach for connecting conservation of Crocodiles with economic profits to native communities and governments (Mazzotti, 1987; Thorbjarnarson, 1992).

The main objective of this study was to evaluate the current conservation status, reproductive mode and behavior of Marsh Crocodiles in captivity.

MATERIALS AND METHODS

The field surveys were conducted randomly in the captive farm of New Jatoi during the years of 2011-2015. In NJF three ponds were designed as Pond-01, Pond-02 and Pond-03 and in Pond-01 adults males and females were kept, in Pond-02 juveniles were kept and in Pond-03 the hatchlings were kept, respectively. For the purpose of collecting the eggs each female we tagged from F-01 to F-22 them and recorded the rate of productivity of per female per clutch to determine the hatching rate per year.

Data of spontaneous mating, nesting, breeding and survival rate were collected through observation, questioning the staffs who look after the captive Marsh Crocodile on the above study areas. Special observation was done in late November and December for basking behavior; in mating period from March to April; in nesting period of late June to July and in hatchling production were counted from 2011-2015. We collected the one hundred Crocodile's egg randomly from Pond-01 and measured their length, width and weight.

Mean ± SD was used to determine the significance difference of reproductive mode per female per year. We also evaluate randomly the length, width, and weight of one hundred female Crocodile's egg. The computer program SPSS 16 was performed for statistical analysis.

RESULTS AND DISCUSSION

The data shown in Table 1 represent a summary of the findings which were collected from the studied areas over the five years of monthly field surveys. Over the total area covered and was surveyed, different nests sites were found and so as a result of the nests sites were monitored at the period of their incubation. The observation revealed that the total numbers of Marsh Crocodiles were counted 133 in the New Jatoi Farm, among them 20 males and 25 females in Pond-1 were adults, 44 were juveniles in Pond-2, and 76 hatchlings in Pond-3 were counted (Table 1 and Fig. 1-4).

Table 1: Five years 2011-2015 population status of Marsh Crocodile in New Jatoi Farm.

Location	Year	P-1. Male	P-1. Female	P-2. Juveniles	P-3. Hatchlings
New Jatoi Farm	**2011**	16	22	38	57
	2012	16	22	38	57
	2013	16	22	38	62
	2014	18	24	40	70
	2015	20	25	44	76
Total		**20**	**25**	**44**	**76**

Fig. 1. Adult Crocodile in New Jatoi Farm.

Fig. 2. Adult Crocodile in New Jatoi Farm.

With a view to study the breeding behavior, twenty two adult females were observed to lay the eggs per female/per year. However, the breeding habitat of NJF for Crocodiles as observed in subsequent years was found productive and the number of eggs per clutch was recorded in twenty two female individuals as: F-01. 23±2.73, F-02. 25.8±3.42, F-03. 25±3.16, F-04. 25.8±2.86, F-05. 26.2±3.70, F-06. 23.4±4.92, F-07. 25.8±3.27, F-08. 25.2±4.54, F-09. 26.2±2.77, F-10. 26.6±2.88, F-11. 25.6±3.04, F-12. 24.4±4.27, F-13. 26.6±3.04, F-14. 26.4±3.91, F-15. 24.6±4.27, F-16. 25.6±2.96, F-17. 25.4±3.36, F-18. 24.6±3.64, F-19. 26.2±1.48, F-20. 26.2±2.38, F-21. 25±3.16, and F-22. 24.4±3.36, respectively (Table 2).

Fig. 3. Juveniles in New Jatoi Farm.

Fig. 4. Measurement of hatchling.

There was no significance difference (P> 0.05) found between all the selected individuals of eggs per clutch per female/per year (Table 2). For the measurement purpose of body length and width we took measurement randomly selected one Crocodile of Adult, Juvenile and Hatchling and an egg sample, respectively (Table 3-4). We selected one hundred eggs randomly and measured the length 65.7 ± 0.74 (mm), Width 41 ± 0.87 (mm) and weight 165.56 ± 4.09 (g), respectively (Table 3 and Fig. 5). The feeding habit was also observed that captive Crocodiles took the food weekly according to their age group and their size. The type of feed and their amount was rationed to Marsh Crocodile in captive farm of New Jatoi.

Their feeding type were given chicken, beef, fish, cow, buffaloes and also provide the dead animals. We also recorded the feeding per week per individual as given 1400-2100 g to adults, 700-750 g to juveniles and 70-350 g to hatchlings.

Table 2: The females egg laying from 2011-2015 years.

Individual code	Years of data collection	Mean± SD
F-01	2011-2015	23±2.73
F-02	2011-2015	25.8±3.42
F-03	2011-2015	25±3.16
F-04	2011-2015	25.8±2.86
F-05	2011-2015	26.2±3.70
F-06	2011-2015	23.4±4.92
F-07	2011-2015	25.8±3.27
F-08	2011-2015	25.2±4.54
F-09	2011-2015	26.2±2.77
F-10	2011-2015	26.6±2.88
F-11	2011-2015	25.6±3.04
F-12	2011-2015	24.4±4.27
F-13	2011-2015	26.6±3.04
F-14	2011-2015	26.4±3.91
F-15	2011-2015	24.6±4.27
F-16	2011-2015	25.6±2.96
F-17	2011-2015	25.4±3.36
F-18	2011-2015	24.6±3.64
F-19	2011-2015	26.2±1.48
F-20	2011-2015	26.2±2.38
F-21	2011-2015	25±3.16
F-22	2011-2015	24.4±3.36

Table 3: Measurement and weight of Crocodile's egg (n = 100).

Population	Location	Length of Egg (mm)	Width of Egg (mm)	Weight of Egg (g)
Crocodylus palustris	New Jatoi Farm	65.7 ± 0.74	41 ± 0.87	165.56 ± 4.09

Table 4: Measurement of one selected body length of Hatchling/Juvenile/Adult Crocodile sample.

S. No#	Body Description	Hatchling (mm)	Juvenile (mm)	Adult (mm)
1.	Body condition	Active and alive	Active and alive	Active and alive
2.	Length (total)	279.4	1419.2	3657.6
3.	Width (at center)	76.2	193.5	467.2
4.	Head length	50.8	204.2	468.4
5.	Head width	25.4	115.3	272
6.	Tail length	152.4	645	1776.4
7.	Tail width (at top)	20	89.9	277
8.	Tail width (at center)	15	64.5	198.8
9.	Tail width (at tip)	10	28	47.8
10.	Fore limb length	50.8	187.8	477.2
11.	Fore limb width	25.4	46.8	124.3
12.	Hind limb length	63.5	299.6	619.6
13.	Hind limb width (up)	25.4	78.2	203.2
14.	Hind limb width (down)	12.7	51.8	88.9
15.	Nails of fore limb	6	20	50
16.	Nails of hind limb	6	19	50
17.	Teeth of lower jaw	5	18	40 - 50
18.	Teeth of upper jaw	5	18	40 - 50
19.	Segments in tail	2	2.5	34
20.	Teeth upper and lower jaw	1	4 - 4	30 - 30

Fig. 5. Measurement of Crocodile's egg.

DISCUSSION

The study reveals that captive breeding and rearing program of Marsh Crocodile in NJF have met with success since restocking in 1970s including the three stock places of ponds aimed at captive breeding center. It is observed that the Marsh Crocodiles released at the NJF has been making nest and laying eggs from 2011-2015. Due to lack of space and feeding problem only few eggs were selected for hatchling in these five year study period by the farm owner. During the 2011-2012, hatched no baby Crocodile, so far the stock is also unproductive in these two years and in 2013 five hatchlings, in 2014 eight hatchlings and in 2015 six hatchling were hatched and were transferred to Pond-03. At the Pond-01 of NJF they made nest from 2010-2015 and it bred once in a year and we could not found any female bred twice in a year. It is observed that the Marsh Crocodile captive breeding success has been achieved between 2011-2015. This will lead to increase of Marsh Crocodile population. We observed that there is no significance difference ($P > 0.05$) between all the individuals of studied females per clutch per female/per year.

This is a significance development in the naturally threatened species conservation approaches. Excess numbers of captive-bred Marsh Crocodile at high stock density now reside in captivity, due to lack of suitable release initiatives in the natural habitat. Hence, it is high time to take necessary steps for subsequent release of Marsh Crocodile in the selected natural habitats.

ACKNOWLEDGEMENT

This research study on Marsh Crocodiles (*Crocodylus palustris*) in New Jatoi Farm was carried out by the financial sponsorship of University of Sindh Jamshoro. We also thank to care taker and owner of New Jatoi Farm for this fieldwork assistance and the hospitality during our stay in the New Jatoi Farm Moro, Naushehroferoze, Sindh, Pakistan.

REFERENCES

Ahmed, A. (1986). The distribution and population of Crocodiles in the province of Sindh and Baluchistan (Pakistan). *J. Bom. Nat. Soc.,* **83**: 220-223.

Ahmed, A. (1990). Pakistan. *Crocodile Specialist Group Newsletter,* **9**(2): 15-16.

Chaudhry, A.A. (1993). Status of crocodiles in Pakistan. *Crocodile Specialist Group Newsletter*, **12**(1): 19-20.

Chang, M.S., Gachal, G.S. and Sheikh, M.Y. (2012a). Bio-ecological status, Management and Conservation of Marsh Crocodiles (*Crocodylus palustris*) in Deh Akro 2. *Sindh University Research Journal* (Science Series.). **44**(2): 209-214.

Chang, M.S., Gachal, G.S., Qadri, A.H., Jabeen, T., Baloach, S. and Sheikh, M.Y. (2012b). Distribution and Population Status of Marsh Crocodiles, *Crocodylus Palustris* in Nara Desert Wildlife Sanctuary (NDWS) Sindh, Pakistan. *Sindh University Research Journal* (Science Series). **44**(3): 453-456.

Chang, M.S., Gachal, G.S., Qadri, A.H., Sheikh, M.Y. and Chang, S. (2013a). Ecological impacts on the population of Marsh Crocodiles (*Crocodylus palustris*) in Chotiari Wetland Complex Sanghar, Sindh: A survey report. *Canadian Journal of Pure and Applied Science*, **7**(2): 2363-2373.

Cardeilhac, P. and Larsen, R. (1981). A Summary of the Reproductive Physiology of the Captive Florida Alligator. Paper presented at the 1st Annual Alligator Production Conf. University of Florida.

Cox, J.H. and Rahman, M.M. (1994). "An assessment of crocodile resource potential in Bangladesh." In: Proceedings of the 12th Working Meeting of the Crocodile Specialist Group, IUCN- The World Conservation Union, Gland, Switzerland. Volume **1**.

David, D.N. (1994). "Harvesting wild crocodilians: Guidelines for developing a sustainable use program." pp. 274–292. In: Crocodiles. Proceedings of the 12th Working Meeting of the Crocodile Specialist Group, IUCN- The World Conservation Union, Gland, Switzerland. Volume **1**.

Davis, G.W. (1994). Crocodile conservation: The benefits of farming and ranching. pp. 1-6. In: Crocodiles. Proceedings of the 2nd Regional (Eastern Asia, Oceania, Australasia) Meeting of the Crocodile Specialist Group, IUCN- The World Conservation Union, Gland, Switzerland.

Elsey, R.M., Joanen, T. and McNease, L. (1994). "Captive breeding of alligators and other crocodilians." pp. 1-27. In: Crocodiles. Proceedings of the 2nd Regional (Eastern Asia, Oceania, Australasia) meeting of the Crocodile Specialist Group, IUCN- The World Conservation Union, Gland, Switzerland.

Ghalib, S.A., Rehman, H., Iffat, F. and Hasnain, S.A. (1981). A checklist of the reptiles of Pakistan. *Record: Zoological Survey Pakistan***. 8**: 37-59.

Javed, H.I. and Rehman, H. (2004). Status of marsh crocodile (*Crocodilus palustris*) in Sindh. *Record: Zoological Survey Pakistan*. **15**: 22-30.

Javed, H.I., Rehman, H. and Fakhri, S. (2005). On the status of Marsh crocodile in Balochistan. *Record: Zoological Survey Pakistan.* **16**: 40-45.

Kelly, H.R. (1994). "A comparison between the breeding results of captive and wild Nile crocodiles and the conservation merits of closed cycle breeding in South Africa." pp. 182-186. In: Crocodiles. Proceedings of the 12th Working meeting of the Crocodile Specialist Group, IUCN- The World Conservation Union, Gland, Switzerland. Volume **1**.

Lever, J. (1994). "Captive breeding and conservation. Allies or enemies?" pp. 162-166. In: Crocodiles. Proceedings of the 12th Working Meeting of the Crocodile Specialist Group, IUCN-The World Conservation Union, Gland, Switzer-land. Volume **1**.

Mazzotti, F.J. (1987). "Developing a management plan for Morelet's crocodile in the Usamacinta and Grijalva Delta, Tabasco, Mexico." pp. 569–574. Trans. Del Symp. Inter.

Thorbjarnarson, J.B. (1992). Crocodiles: An action plan for their conservation. pp. 90-135. Compiled by IUCN/SSC Crocodile Specialist Group. IUCN, Gland, Switzerland.

Whitaker, R. and Whitaker, Z. (1989). Ecology of the mugger crocodile. In: *Crocodiles: Their Ecology, Management and Conservation. A Special Publication of the Crocodile Specialist Group*, pp. 276-297. IUCN, Gland, Switzerland.