

State in Central India (now part of Madhya Pradesh) the "white" crocodiles are not true albinos since they possess the normal black markings (spots or blotches, and stripes in crocodiles and tigers respectively). However, they both completely lack pigment in the ground colour.

At the time of the census conducted in December 1976 and January 1977, 35 adult and sub-adult saltwater crocodiles inhabited the sanctuary four of which were "white" crocodiles. These four are all present today. They comprise a female measuring 3.4–3.8 m and a juvenile (sex unknown) of about 1.2 m. A male of 5.2–5.5 m and a female of 4.0–4.3 m have a whitish face and a totally white face respectively. In adult crocodiles, the white colour is not as pale as in the baby crocodiles since, like other large reptiles, the colouring in *C. porosus* becomes dull with increasing size and age. The local people state that in very large (old) crocodiles the whitish colour of the body may become so dulled as to be indistinguishable from normal-coloured crocodiles. The face, however, is stated to remain white throughout life.

It is to be expected that the survival prospects for

such albinoid individuals in the wild would be poorer than for normally coloured individuals. However, there is good evidence from local people of their occurring in the Bhitarkanika mangroves over a long time-span and the data given in the preceding paragraph show that they can recruit to the breeding cohort of the population.

A clutch of 48 eggs was collected for hatchery incubation at Kalibhanjadian within this sanctuary. The mother is thought to be the 4.0–4.3 m "white" crocodile referred to above. The clutch produced 24 hatchlings between 21–23 August 1975, one of which was a "white" crocodile. The other 23 were all normal *porosus* hatchlings. The "white" crocodile and a normal-coloured member of the same brood are shown in Plate 1.

The "white" crocodile, which is a female, has been retained in captivity at the Centre at Dangmal. It has increased its birth weight of 55 g and length of 280 mm to 45.4 kg and 2.18 m respectively (November 1980).

It is hoped in due course to breed this female at the Centre.

BRITISH JOURNAL OF HERPETOLOGY, Vol. 6, pp. 221–222 (1982)

EMBRYONIC TAIL DEFORMATION IN THE SALTWATER CROCODILE (*CROCODYLUS POROSUS*, SCHNEIDER) IN ORISSA, INDIA

S. K. KAR¹ AND H. R. BUSTARD²

¹ Saltwater Crocodile Research and Conservation Centre, Dangmal, Via Rajknika, District Cuttack, Orissa and

² Central Crocodile Breeding and Management Training Institute, Rajendranagar Road, Hyderabad 500 264
(now at Airlie Brae, Aylth PH11 8AX, U.K.)

(Received 2 March 1981)

The clutch of 48 eggs laid in 1975 which gave rise to a "white" hatchling described in the paper immediately preceding (Kar and Bustard, 1982) also produced one abnormal embryo. This embryo developed to full-term but died without slitting the egg shell. On examination it was found to have a deformed and stunted tail similar to that described and figured for *Crocodylus novaeguineae* by Bustard (1969), where the cause was thought to be the result of high temperature egg incubation.

Saltwater crocodile eggs are usually laid during the last week of May/first week of June in Bhitarkanika. It is assumed that this nest was laid on 1 June then it incubated for 50 days prior to collection under an imperfectly known temperature regime. The nest was collected at 11 a.m. on 20 August 1975 (monsoon season). However, there was no rain on that day or on the two preceding days and the weather had alternated between sunny and overcast. The nest tem-

perature at the top of the egg mass at the time of collection was 31.0°C. This compares with a mean nest temperature of 31.9°C for a sample of 25 nests (Kar, 1981). Kar found that the mean nest temperature was considerably lower than air temperature throughout the day (by a mean of 2.3°C in the morning and 2.0°C in the afternoon) presumably due to evaporative cooling. In the present case air temperature was only 31.5°C, that is 0.5°C above nest temperature, at the time of collection. This is explicable on the basis that this nest was dry, so evaporation was minimal. The nest was also very compacted with much mud used in its construction resulting in reduced gaseous exchange with the outside. The nest was located in a generally shady place which may also account for the temperature being slightly lower than normal.

The eggs were incubated in an artificially prepared mound consisting of vegetation used in the natural nest. The temperature in the nest at egg level, measured

through a stoppered bamboo pipe permanently inserted into the middle of the egg mass, averaged 28.5°C (range 27–30°C) during the remaining 31–33 days of incubation. Possible morphological abnormalities resulting from low temperature incubation are not known.

It is possible, though unlikely, that water deficiency could have caused the deformity as has been described for chelonian embryos by Lynn & Ullrich (1950). However, the 24 eggs which hatched all produced normal hatchlings except for the "white" individual described in the preceding paper. The remaining 23 eggs, which failed to hatch, were apparently infertile. Water relationships of crocodile eggs are little known. Preliminary work carried out by Bustard (1976) indicated, that eggs desiccated rapidly when water was not available in the external medium. However, Bustard noted that eggs which had lost approximately 20% of their weight as a result of desiccation still produced normal hatchlings.

A detailed study of the water relationships of crocodile eggs at different developmental stages, par-

ticularly if related to the natural situation, would be most valuable.

REFERENCES

- Bustard, H. R. (1969). Tail abnormalities in reptiles resulting from high temperature egg incubation. *British Journal of Herpetology* **4**, 121–123.
- Bustard, H. R. (1971). Temperature and water tolerance of incubating crocodile eggs. *British Journal of Herpetology* **4**, 198–200.
- Kar, S. K. & Bustard, H. R. (1982). Occurrence of partial albinism in a wild population of the saltwater crocodile (*Crocodylus porosus*, Schneider) in Orissa, India. *British Journal of Herpetology* **6**, 220–221.
- Kar, S. K. (1981). Studies on the Saltwater Crocodile (*Crocodylus porosus* Schneider) Ph.D Thesis submitted to Utkal University, Orissa, India.
- Lynn, W. G. & Ullrich, M. C. (1950). Experimental production of shell abnormalities in turtles. *Copeia* 1950, 253–262.

BRITISH JOURNAL OF HERPETOLOGY, Vol. 6, pp. 222–223 (1982)

CROCODILE PREDATION ON MAN

H. R. BUSTARD¹ AND S. K. KAR²

¹Airlie Brae, Alyth PH11 8AX, U.K. and ²Saltwater Crocodile Research and Conservation Centre, Dangmal, Via Rajkanika, District Cuttack, Orissa, India

(Received 24 June 1981)

Crocodiles are much maligned animals. Instances of human predation have been greatly exaggerated, initially by early explorers. Herpetologists, however, have also been guilty of sensationalism. For instance, Arthur Loveridge (1954) writing of the saltwater crocodile (*C. porosus*) referred to it as "this man-eating monster"—an unfortunate turn of phrase. Loveridge also stated, "... once it has found how defenceless is the average man or woman when taken unawares, the estuarine crocodile becomes as confirmed a man-eater as the most persistent man-killing tiger".

After many years of work on the ecology of this species we have no evidence to support this statement (see below).

The saltwater crocodile is widely stated to be the most dangerous crocodylian species from a human standpoint (Neill, 1971) hence it is the species in which the frequency of human predation should be investigated. It is significant, therefore, that in 10 years in Bhitarkanika, Orissa, India, where indepth ecological studies on the saltwater crocodile have been in progress since 1975, only four instances of attempted human predation have occurred. This is despite this sanctuary,

declared for the saltwater crocodile, (a) holding some of the largest, if not the largest, individuals of *C. porosus* alive in the world today, and (b) there being a large human population settled in and around the sanctuary. Since it is usually very large individuals which are responsible for attempted human predation, all of which are males, all the ingredients for human predation exist in Bhitarkanika.

Since, as pointed out by Loveridge, man is well within the prey size of large saltwater crocodiles, it is surprising to us that attacks on man are so rare, since, as also pointed out by Loveridge, man is an easy victim. In Bhitarkanika people freely entered the water to fish (until fishing was banned under sanctuary legislation in 1975) as well as moving about at the water's edge.

We note, in the saltwater crocodile, the same apparent reluctance to prey on man as is observed in the tiger and also in sharks in most areas of the world. From the rarity of human predation in relation to the opportunities available for this, it is clear that not only are all these groups of animals not attracted to man, but that they appear to avoid him. It may even be that the occasional instances of human predation are cases of