PHASE OF BREEDING BEHAVIOR OF CROCODYLUS MINDORENSIS

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ABSTRACT

Crocodylus mindorensis is an endemic crocodile species in the Philippines that is facing extinction. This report is described to develop an appropriate technology in effectively propagating crocodile through some observations of their behavior such as courting, mating, nesting, egg-laying, hatching during the period between January 19 to September 20, 1988.

SUMMARY

This report is described to investigate the mode of life of the breeding behavior of crocodylus mindorensis. The behavior at courtship starts with air temperature being raised temporarily and the rainfall tempeorarily increased. The behavior of mating starts at the time air temperature can be observed distinctly at its lowest being raised and the rainful increased suddenly around April 23. And then the enlargement of the abdomen and the decrease of appetite of the female crocodile is noticeable from around April 23 to around June 19. The behavior of resembling camouflage of nest building is observed by artificially distrubting the next construction three times in the period of nest building. Egg-laying is presumed to be during a rainy day on June 19 (20:00 - 22:00). The female crocodile intensely watches over the nest, and then irregularly takes care of the nest at such time that the period of the behavior of hatching eggs was considered during the period between the discovery of an egg that was struck by an egg-tooth and indifferenced the nest on Spetember 9. It is presumed that during the breeding season, the female crocodile shows a periodic behavior of instinct protection of its species. However, the relationship between the periodic behavior and the periodism of moon could not be identified as of this study. Further investigation and study has to be done to find some relationships and to draw some conclusions.

MATERIALS AND METHOD

On August 30, 1988 a pair of crocodylus mindorensis breeder, was secured by the C.F.I. This pair was transferred to a breeding pen for obseration on December 17, 1987. The following are relevant information and method of the crocodylus and their breeding environment.

1) Source: Cotabato City, Mindanao Island, Philippines

2) Size: (Male) Length - 222 cm, Weight - 55 kgs, Estimated age - 7 years
(Female) Length - 206 cm, Weight - 55 kgs, Estimated age - 8 years

3) Feed: Satiation feeding twice a week
Mainly marine fishes, irregularly flesh meats.

4) Area of beeeding pen: Land - 2,000 cm x 2,800 cm
Pond - 800 cm x 1,800 cm x 150 cm

5) Changing Water: Totally changed on February 2, 1988, and (no more changing up to) September 15, 1988.

6) Nesting materials: 1st time (Gramiment) Mat grous 16 kgs, river sand 16 kgs.

2nd time (Gramiment) Mat grous 24 kgs, river sand 24 kgs.

7) Water quality: Temperature, Do, pH, Turb, Cond, were checked once a week

8) Temperature, Humidity: Incubators - Observed in the incubators an interval 10 days
Nest - Observed in the nest irregularly

9) Weather Conditions: Observed at the station

10) Incubators: 10°C-50°C (an error $\pm$ 1°C)
60 cm x 50 cm x 50 cm, w/humidifier

11) Observation time:
a. Courtship Behavior (20:00 - 08:00)
b. Mating Behavior (20:00 - 08:00)
c. Nesting Behavior (08:00 - 17:00)
d. Egg-laying Behavior (20:00 - 08:00)
e. Hatching Behavior (08:00 - 17:00)

5 eggs were left in the nest to be observed at natural hatching behavior and incubation, while the remaining 16 eggs were transferred to an incubator that was set at 32°C in. temperature and 90% in humidity.

The eggs in incubators were examined and measured in terms of weight, existence and expansion of the white cross banding every 10 days. Eggs were broken after 92 days fertilized and unfertilized eggs were determined by the existence of embryo.

RESULTS

The behavior of courtship:

The behavior of courtship is first noticed at night time on January 19, 1988. At such time lowest air temperature has been raised from 21°C to 24°C. It has rained during the period between January 8 to January 18 (Figure - 1). It was supposed that the breeding behavior of the male crocodile is stimulated with air temperature being raised temporarily and the rainfall temporarily increased. The chase behavior of the male crocodile had begun from January 19. The chase behavior as the courtship takes only a few minutes, after which the male crocodile overlaps with the female crocodile. They both sink underwater for about a few minutes. And then the male and female separately floats on the surface of the water after a few minutes. This behavior of courtship is observed repeatedly as follows, one time at the minimum time per day, four times at the maximum time per day. The behavior of courtship is not so clear as alligator species.

The behavior of mating:

The behavior of mating had been observed prosperously at times when air temperature is at its lowest (raised from 22°C to 25°C) and the rainful increases suddenly around April 23 (Figure -2). After the male and female sink underwater, bubbles appear in the water surface. Then within a few minutes both male and female immerged from underwater and floats separately. This behavior of mating with this bubbles surposed the expiration is under the water during the period between a few seconds to about 6 minutes or an average 3 minutes. This behavior of mating without bubbles under the water occured for a period of about 3 minutes and about 7 minutes, an average of 5 minutes. The enlargement of the abdomen and the decrease of appetite of the female crocodile is noticeable from around April 23 to around June 19 (Figure - 3). The female and male are seen on land from early morning toward evening at this time. However, the female is more cautious. The female offentimes appears on land only after confirmed by the male crocodile that it is safe to do so and that she is out of danger (Figure -4).

The behavior of nest building:

The continuous heavy rainful on May 13 signifies the start of nest building. Nest materials were thrown into the two sites - site A is a shaded area while site D is free of trees and abounds with sunlight. She chose site A fornest building. The female crocodile builts the nest by collecting grass, leaves, small sticks, etc. and mixes these with soil creating a mound nest. The construction is done mainly with her hind legs moving it backwards. After 22 days construction of nest is 55% completed. At day 27 construction is 69% and in day 34 construction is

completed (Figure - 5). On the 39th day we noticed egg chamber with a deepth of 26 cm. It was observed dropes at this time that the female crocodile had lifted her head during a few minutes as it is she lays on top of the nest and positions her cloaca on top of the nest to lay her eggs.

The behavior of resembling camouflage of nest building

The behaviour of resembling camouflage of nest building (Figure-6) is observed by artificially disturbing the nest construction three times. First the female crocodile builds nest A and then she is distrubed by night watch. She stops and builds a new imperfect nest B. However, after one day, she starts to reconstruct nest A from nightfall onwards. Interfered with another disturbance, she stops reconstructing nest A, by supplement of the mat grous of 8 kg. on June 12, and builds a new imperfect nest C. After one day, again she reconstructs nest A. With a third disturbance on June 17, she stops reconstructing nest A and builds a new imperfect nest D continuing until June 19. It was observed the behaviour of D nest building had continued during the period between 18:40 to 24:00. She rested to construct the nest in 7 minutes after that she constructed the nest in 3 minutes, and she rested in 15 minutes on top of the nest. This behavior of constructing the nest has been observed repeatedly during 323 minutes as follows, constructed of 11 times in average 5 minutes, rest of 3 times at an average of 6 minutes rest on the nest of 5 times at an average of 9 minutes. It was not observed such this continuously behaviour as to construct the nest before that the constructed the D nest. The continuous behavior or constructing the D nest had been observed repeatedly during 43 minutes again as follows: constructed 4 times in about 2 minutes, rested 4 times at an average of 7 minutes, rested on the nest once at about 4 minutes. No obsevation was done during the period between 01:00 to 06:00 the behavior of the female crocodile at day time.

Finally, the female crocodile was noted down to lay eggs at nest D on June 20.

The behavior in egg-laying:

In laying eggs, the female crocodile positions herself with her cloaca right on top of the nest (20:00 - 22:00) during a rainy day. The actual egg laying takes place at night time.

The female crocodile emerges from under water and comes up onland near the nest when a visit to the pen is made in order to confirm laying of eggs. On June 20, eggs were confirmed to have been laid because of the protective instinct of the crocodile.

The behavior of hatching:

The eggs lain are found on June 20, 09:00 AM. Total number of eggs is 21 in 3 layers laid in the nest of about 33 cm. deep inthe egg chamber. The average size of the egg at the time they were found is 7.2 cm wide and 4.5 cm high, 85.6 gm weight. On egg is said to befertilized as it has a white band around. From the total 21 eggs, five are left in the nest for natural incubation and 16 are placed in incubator for artificial incubation. It was done so for purposes of comparison.

The natural incubation. The female crocodile irregularly takes care of the nest. The interval is 2 days at the minimum time and 14 days at the maximum time, 6 days at the average time. It was observed 9 times during the period between June 20 to August 5. Periodically it was observed that the humidity in the nest averaged 95% and the air temperature averaged 30°C. The five eggs left in the nest for natural incubation was examined on Spetember 20 but since no embryo is noticed, they are considered unfertilized eggs.

The artificial incubation. Average air temperature in the incubator is 31.2°C, average humidity is 90-95%. The process of incubation of the fertilized egg with white cross band is indicated in (Figure-7). When found on June 20, white cross band is 3.1 cm in length, 100% after 47 days. The accumulated temperture in the incubator is 15.57°c during the period between June 20 to August 6. The process of weighting both the fertilized egg and the unferrilized eggs is indicated on (Figure-8). There is a 5 gm variation after 30 days, a conspecuously variation after 49 days, 10.9 g variation after 78 days, 12.0 variation after 83 days. The accumulated temperature in the incubator is 2556°C during the period between June 20 to September 9. On September 15 the fertilized egg weighs 18.9 gs while the unfertilized eggs weighs 9.2 gs. We observed the eggs between the period September 9 to September 20. We found a crack with 2mm x 1.5 mm as if was struck with an egg tooth on September 9. It was reconfirmed to have a dead fetus and embryo when the egg shell was finally broken on September 20. The thickness of shell was 0.43 mn on fertilized egg, and 0.50 $\pm$ 0.07 mn on unfertilized eggs. The thickness of shell membranes 0.29 mm on fertilized egg, and 0.35$\pm$ 0.08 mm on unfertilized eggs. The fetus indicated in (Figure-9) has a normal body with egg tooth 0.45 mm.

CONSIDERATION

We obtained some results about the mode of life of the crocodylus mindorensis. The results of this study could not be compared to other studies considering that this is the first study on this species. So this report was considered by only a pair in this institute. It was found out that an important factor on the secual excitement of the male crocodile was stimulated with air temperature being raised temporarily and the rainfall temporarily increased. It is considered that the ovarium of the maturity was quikened with chase behavior of male and the pheromone secreted from the secretion gland through air temperature being

raised were the rainfall increased. The enlargement of the abdomen was noticeable from such a time when the hormone of the sexual excitement was considered to have secreted with the physiological function after the maturity of the ovarium. The behavior of mating can be observed distinctly at time when the ovarium matured. Ovulation is considered to have occured. The chase behavior of male crocodile had continued until around June 19. The sexual excitement was considered during 17 weeks. The decrease of appetite of the female crocodile is considered to be due to monotype of fish.

But the feeding record during the period between January to April was at the ratio of 67% fishes to 33% meat. So it is possible that the decrease of appetite due to either the involution of the digestive organ within the period of maturity and the accumulation of fat before the egg-laying rather than the intoxication of the Cyaminase (1). The behavior of resembling a camouflaged nest building was observed by artificially disturbing the nest during the period between May 13 to June 19. This could be taken as a crocodile behavior within an artificial pen. An investigation and comparison with A and another nest was done. Data are (Table-1 as follows), distance from A nest, distance from waterside, lux of site, size of nest, period of nest building. The behavior of camouflage was hard to consider according to the materials of nest and environment. D nest was the site of egg-laying because of the suitability of materials of nest an instinct to lay eggs. The period of the behavior of hatching was considered for 77 days - 81 days from the time an egg was discovered to be strucked with crocodile tooth up September 9. The process of incubation of the egg with white cross band indifferenced. The fertilized egg was observed to have developed until stage 24 (4) (5) (6) (7) (8) by variation of the gas exchange ratio which has been raised (9). The weight of egg shell (plus egg membrane) of the fertilized egg was heavier than those of another crocodile eggs (10) (11), (12), and then this fertilized egg was heavier than the egg crocodylus noraeguinea which has the heaviest egg compared with (Alligator mississippiensis, crocodylus johnstoni, crocodylus porosos). A case of the infertilized egg was observed to be about 13.7 ± 3.5 weight. The fetus has a normal body in the egg-shell but the fetus was suffocated because it could not break the egg-shell with its thickness. The beginning of each behavior within the breeding season took place during the following, from last quarter moon to new moon, from new moon to first quarter moon. The female crocodile shows a periodic behavior instinct protection of its species. However the relationship between the periodic behavior and the periodism of moon could not be identified as this study.

ACKNOWLEDGEMENT

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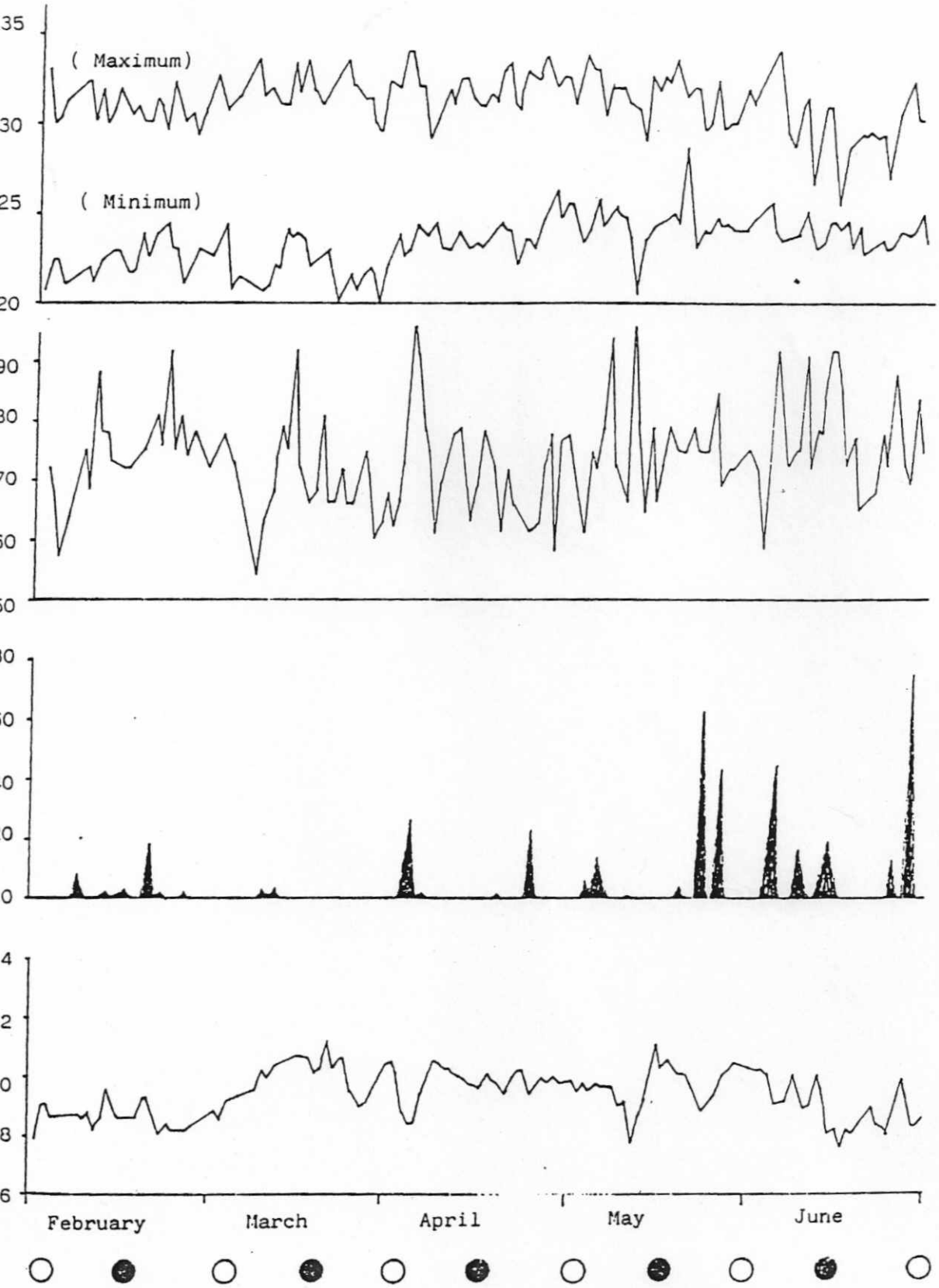

Figure - 1 Weather

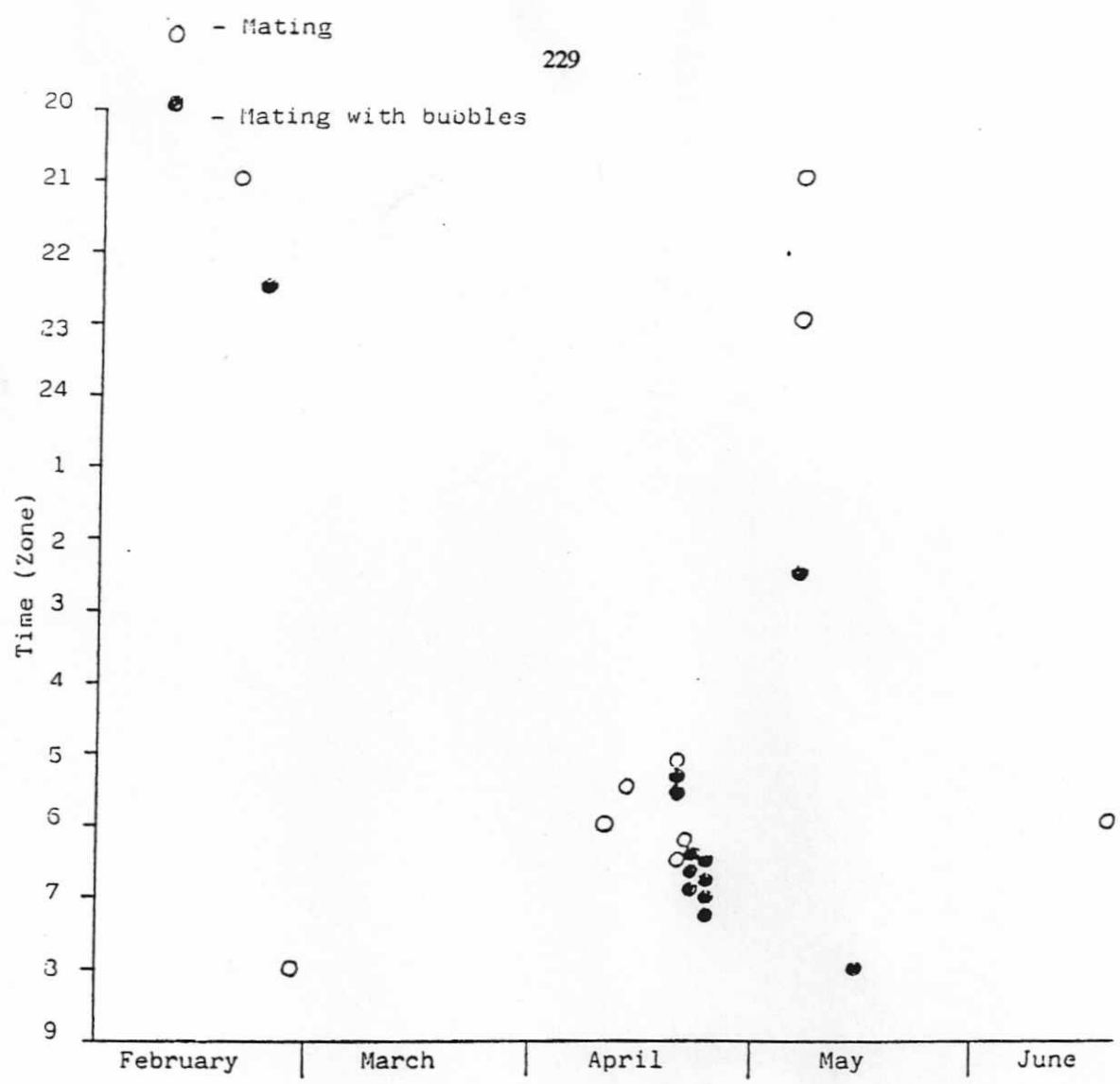

Fig. - 2 Frequency of mating

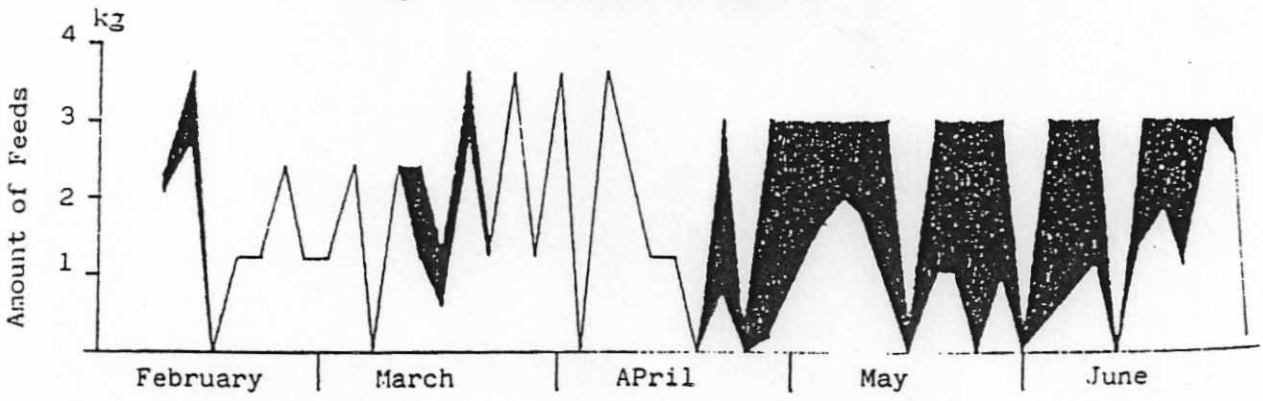

Fig. - 3 Feed leftovers

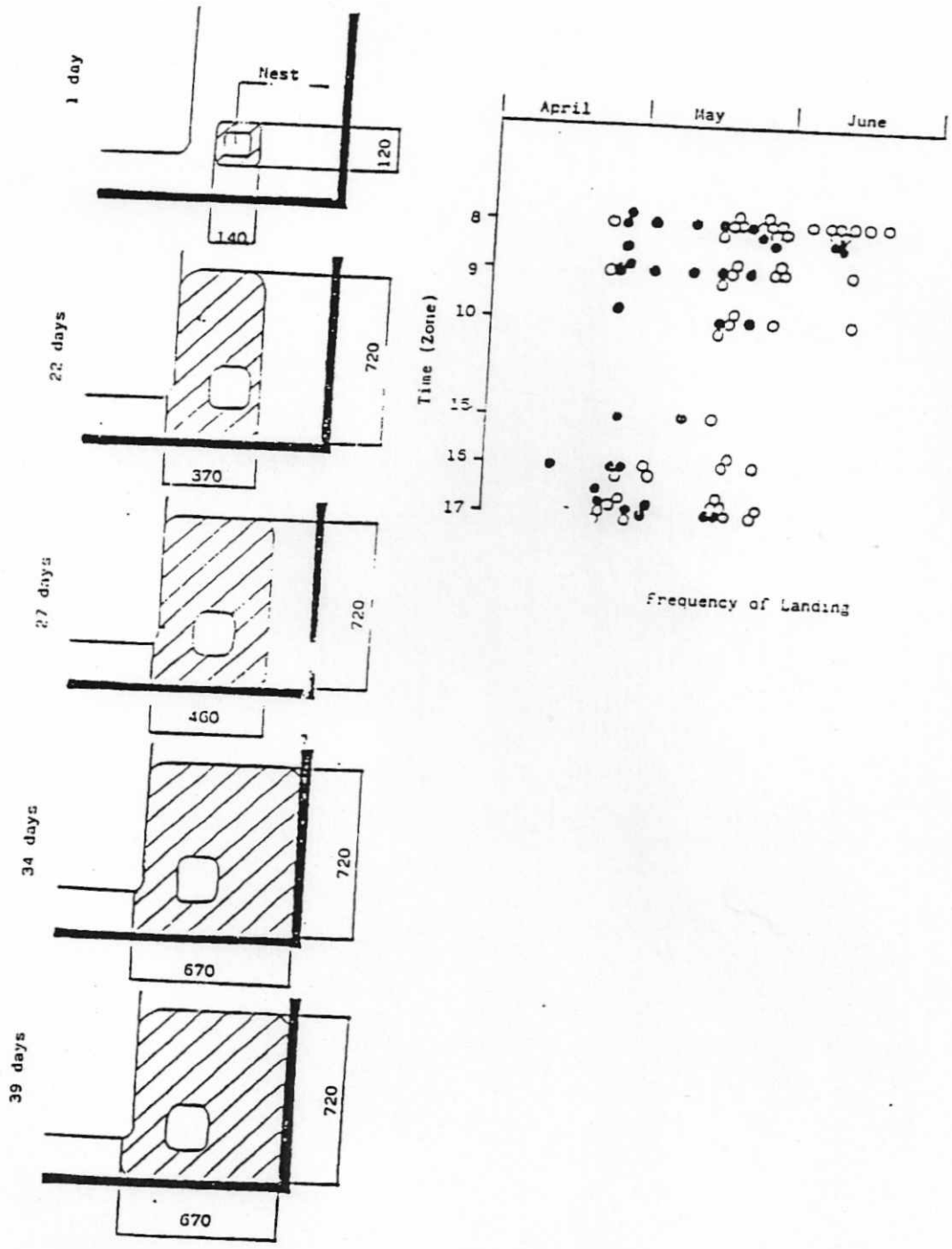

Fig. - 5 Sphere of Activity for nesting materials

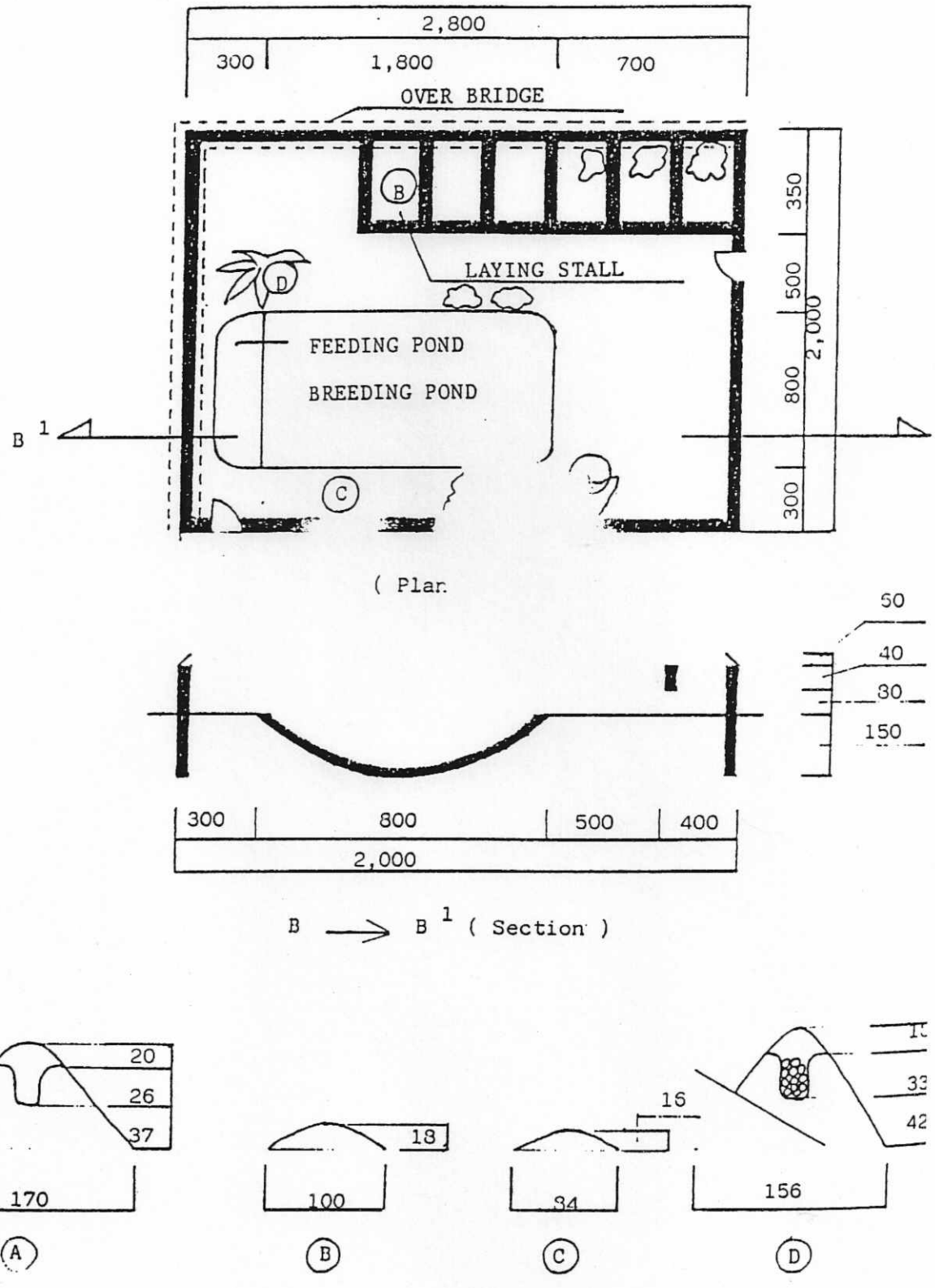

Figure - 6 Nest Position

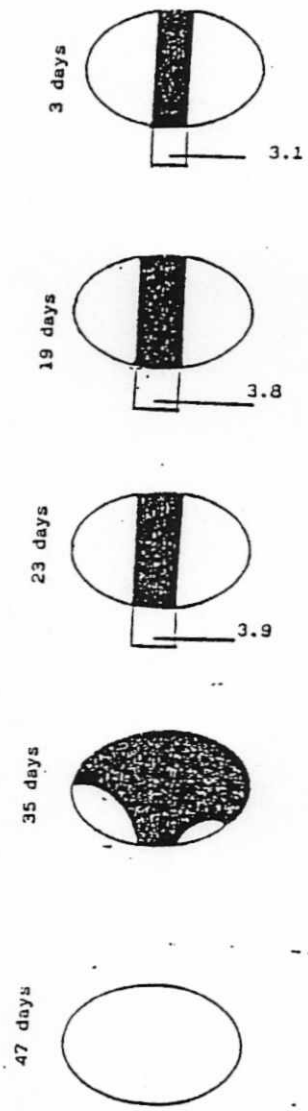

Fig. - 7 Development of white cross band

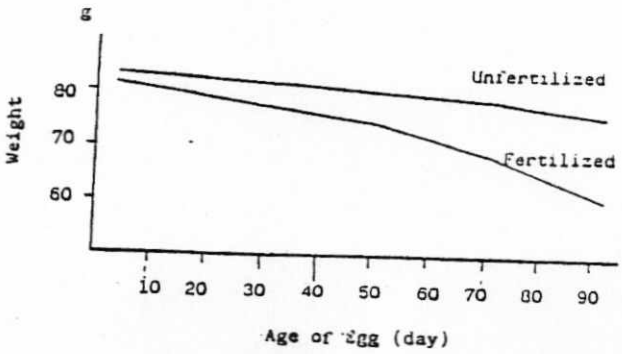

Fig. - 8 Egg weight

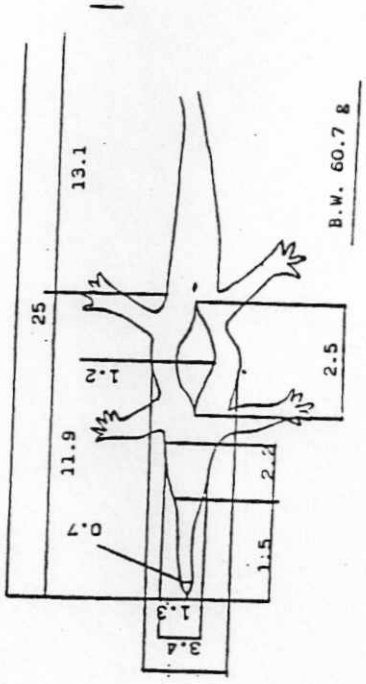

Fig. - 9 Development of Embryonic

Table -1 Nest Building

Items \ Time	May 5/3		June	6/
Period of Nest Building (days)	39	1	1	2
Date of carrying (materials for nest)	4/7			4/
Amount of materials: Mat gross (kg)	16			2
: Sand (kg)	16			2
Artificially interference		5/21	6/12	6/
Date of Nest Building	5/13	5/22	6/13	6/
Date of egg-laying				6/

Site of Nest	A	B	C	D
Distance from A nest (cm)		1910	1200	19
Distance from watterside (cm)	140	670	150	2
Lux of site	180	3000	3100	26
Height of nest (cm)	83	18	16	
Short diameter (cm)	150	90	84	1
Long diameter (cm)	170	100	90	1
Depth of egg-chamber (cm)	26			
Height of covering (egg-chamber)	20			
Number of egg				