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REPRODUCTION IN THE GROUND LIZARD, *SITANA PONTICERIANA* AND THE GARDEN LIZARD, *CALOTES NEMORICOLA*

By

M. V. SUBBA RAO* AND B. S. RAJABAI

Department of Zoology, Sri Venkateswara University, Tirupati (A.P.), India.

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INTRODUCTION

No data exist on reproductive ecology of the tropical lizards, *Sitana ponticeriana* and *Calotes nemoricola*. This paper presents information on courtship and reproduction.

Annandale (1900) described courtship, Asana (1930, 1931) the breeding habits and Singh (1968) the sexual cycle and secondary sex characters of *Calotes versicolor*; Smith (1915) reported on the breeding habits and colour change in *Calotes mystaceus*. A summary of the ecophysiology of *Sitana ponticeriana* and *Calotes nemoricola* was presented by Subba Rao (1970).

MATERIALS AND METHODS

The genus *Sitana* common throughout India is not recorded in Sind and East Bengal. The genus *Calotes*, the most common member of the oriental realm, also inhabits the East Indian Archipelago and Western New Guinea (Smith, 1935).

The ground lizard, *Sitana ponticeriana*, Cuvier is found in bushes in the fields at Kapilathirtham, Tirupati, A.P., India. The garden lizard, *Calotes nemoricola*, Jerdon is found in gardens of the Sri Venkateswara University Campus, Tirupati, A.P., India.

Lizards were collected by trapping, hand collection and by noosing. Funnel and pitfall traps of various types were used with varying success.

The head of the male *Sitana* bears a low nuchal crest and a very large folding gular appendage extending backwards to about the middle of a belly covered with large scales. In cases of doubt especially with juveniles, sex was determined by applying gentle pressure to the ventral side of the head which extends its gular appendage. The sex of small individuals (snout-vent length (SV) 17-22 mm) could not be determined.

The degree of keeling of the dorsal crest of *Calotes* is usually stronger, continuous and well developed and composed of long falciform scales directed backwards; the longest which equals the length of the orbit, gradually decreases in height to become a low crest over the sacrum and base of the tail. Moreover, only a fully grown male (not the female) has swollen cheeks, a gular pouch, and the base of its tail swollen with thick scales. In female *Calotes*, nuchal and dorsal crest are very small. The sex of very small lizards (25-40 mm (SV)) could not be determined.

Sexual maturity was determined from dissection by the presence of *corpora lutea* in the female and the size of the testis and extent of convolutions of the *vas deferens* in the male.

All lizards were either marked and released at the place of capture or preserved in formalin and dissected in the University laboratory. The humidity of the habitat was measured with a hygrometer (Range, 0-100%).

*Present address: Post Graduate Department of Zoology, Utkal University, Cuttack - 3, (Orissa), India

RESULTS

Examination of the lizards collected during March to September of 1964-1966 showed that:

(1) Females of *Sitana* and *Calotes* matured when smaller than males (Table 1).

(2) Yolk deposition and ovulation in females and enlargement of testes and vasa deferentia in males occurred during April to September.

(3) The smallest females of *Sitana* and *Calotes*, with corpora lutea, measured 36 mm and 64 mm (SV) respectively. Thus the former of 36 mm or longer and the latter of 64 mm or longer are considered breeding adult females (Table 2).

(4) Male *Sitana* and *Calotes* reached sexual maturity when 42-56.5 mm (SV) and 72-120 mm (SV) respectively.

(5) Gular pouches of the sexually mature male *Calotes* and *Sitana* were pinkish to blood red and yellowish green in hue respectively.

(6) The breeding season in both forms is mainly during April to September. During March, testes are not well developed. Later, during April-September, they are well developed and contain sperm.

COURTSHIP AND MATING BEHAVIOUR

Mating behaviour of *S. ponticeriana* in a laboratory cage was observed on 28th August, 1965, at 3.30 p.m.

(1) The male seemed to be more active; it often extended its gular pouch and nosed the tail and body of its partner.

(2) The female refused the male's actions and escaped (time 10 seconds).

(3) The male succeeded in grasping the female; the tails of the two twisted together (time 2 minutes and 5 sec.).

(4) The passive female closes its eyelids at this stage and relaxes on its belly when the male engaged in mating actively.

(5) The male grips firmly and thrusts its posterior part of body towards that of the female.

(6) Copulation lasted about 2-3 minutes, separation then occurs and the female leaves. However the male attempted to catch the female again but did not succeed.

In both species, the sequence was the same but time of copulation differed. In *S. ponticeriana* and *C. nemoricola* coition lasted for 2-3 minutes and 4-5 minutes respectively (two observations with *Sitana* and one with *Calotes*).

EGG LAYING

Both the species behave similarly but the diameter and depth of the hole differed. The average vertical depth of six egg holes of *Sitana* was about 6 cm and about 2.3 cm in diameter. Six holes of *Calotes* differed only in that the mean diameter was 3.75 cm. *S. ponticeriana* dug a hole 6.05 cm deep vertically and 6.42 cm diagonally (diameter of 2.25 cm) in 48 minutes; this was covered with a wire mesh for observation. *C. nemoricola* dug a hole 6.03 cm deep vertically and 6.95 cm diagonally (diameter of 3.75 cm) in 56 minutes. Digging was observed (usually in a grassy place) soon after the rains when the soil was wet (two observations). Humidity range was 72-75%. The lizard uses its fore limbs and scoops the earth backward with its hind limbs. The lizard occasionally rests over the hole (Figs. 1 and 2). Eggs are laid in a heap, one after another. Owing to the diagonal arrangement of the hole and protection by roots of grass, eggs are not damaged. After egg laying (Fig. 2), the lizard replaced the loose soil with its fore limbs and patted it down with its hind limbs and snout.

In *S. ponticeriana*, the eggs are small and ellipsoidal in shape with a soft chalky white shell. They are not stuck together as often occurs with

reptile eggs. In *C. nemoricola* the eggs are longer than in *S. ponticeriana.*

Ten clutches of 112 eggs (each clutch of 8-13 eggs) were deposited by 7 ground lizards, and 10 garden lizards laid 10 clutches of 133 eggs (each clutch of 8-16 eggs). Percentage of fertility was 89 and 91 in *Sitana* and *Calotes* respectively (Table 3).

The eggs gradually increase in size from the first to the thirtieth day in *S. ponticeriana* and *C. nemoricola,* probably due to absorption of soil water.

Initially eggs of *Sitana* are about 8.8 mm long and 6.0 mm in diameter; those of *Calotes* 11.8 x 7.5 mm. Ten days after laying 8 eggs each of *Sitana* and *Calotes* averaged 10.4 x 7.4 mm and 13.8 x 10.5 mm respectively. By the end of 30 days the surviving 5 eggs of *Sitana* averaged about 12.0 x 9.3 mm and 6 eggs of *Calotes* about 19.3 x 14.3 mm.

The increase in egg weight of *Sitana* and *Calotes* was mainly in the first half of incubation which agrees with Asana's (1931) results. Later increase was very slow. Within 30 days weight increased in *Sitana* and *Calotes* from 0.13 to 0.61 and 0.35 to 1.5 grams respectively.

The hatching of a clutch of eggs extended over 24 hours. The first indication was the intermittent " jerks " of the egg contents, which continued until the snout of the young lizard forced a slit in the shell.

On the 21st December, 1965, the hatching sequence of *C. nemoricola* was observed:

8.35 a.m. " Intermittent jerks " started.
9.00 a.m. Egg shell broken.
1.02 p.m. Snout of specimen protruded through slit.
2.05 p.m. Snout exerted pressure over slit by forward and backward movements.
2.20 p.m. Movements of snout continued. Nostrils and right side eye emerged through slit of shell.
2.24 p.m. Two eyes opened (Fig. 3).
2.25 p.m. Eyelid movements.
2.26 p.m. Complete head emerged.
2.32 p.m. Whole animal emerged.
3.20 p.m. Yolk sac dried up.

The later described features succeeded each other more quickly than the earlier ones. When the whole snout has emerged the entire animal emerged from the shell within 6 minutes. The time taken from breaking the egg to independent movement was 5 hours, 32 minutes.

The hatchlings of *Calotes* were extremely active on leaving the egg. The yolk sac dried rapidly and dropped off 45 to 60 minutes after hatching. However, a ball of yolk approximately 3 mm in diameter was retained at the time of hatching, which disappeared 3-4 days after hatching.

Hatching and emergence of young of *S. ponticeriana* were similar to those in *C. nemoricola* except for size and weight (Table 4).

One observation of *S. ponticeriana* (4th December, 1965) showed the time interval from breaking the shell to hatching was 4 hours, 20 minutes and head emergence to independent activity 1 hour, 15 minutes. The yolk ball was retained for 3 to 7 days. The young was very active like the garden lizard.

DISCUSSION

Sitana ponticeriana and *Calotes nemoricola* usually reach maturity rapidly, during the winter season (November to March) following hatching in the early rainy season (May-July). They mature definitely in less than a year like *Sceloporous undulatus* (Crenshaw, 1955) and *Ameiva quadrilineata* and *Basiliscus vittatus* (Hirth, 1963). During courtship in *S. ponticeriana* and *C.*

nemoricola only the gular pouches are fully extended whereas the courtship of *C. mystaceus* (Smith, 1915) was similar to that of *C. versicolor* (Annandale, 1900) and consists for the most part of absurd bowings and noddings while the gular pouches are extended; in *Varanus monitor* during courtship there was an " all-in " wrestling match (Salim Ali, 1943). In the lizards of the present paper no pre- and post-copulatory phases were observed as reported in *Eumeces fasciatus* (Fitch, 1954) and *E. laticeps* (Goin, 1957). Visual recognition of the female by the male initiated the courtship in *Sitana* and *Calotes.* In *E. obsoletus* visual recognition was invariably followed by olfactory test as the approaching male touched the female with its tongue (Fitch, 1955) but this behaviour did not occur in *Sitana* and *Calotes.*

It should be stressed that parchment shelled reptile eggs kept at high humidity conditions often desiccate unless at least part of the egg is in actual contact with a moist surface (Clark, 1946).

SUMMARY

The mating behaviour and egg laying have been described in the tropical *Sitana ponticeriana* and *Calotes nemoricola.* Though their nesting behaviour was the same, the diameter and depth of their holes differed.

Increase in egg weight and size occurred from the first to thirtieth day in both lizards. The time taken from breaking the egg shell to emergence in *S. ponticeriana* was 4 hours, 20 minutes and in *C. nemoricola* 5 hours, 32 minutes.

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	n	Mean SV (mm) and range of observed values
Sitana ponticeriana	24	48 (36-52)
Calotes nemoricola	18	85 (62-107)

Table 1. Comparable data on sizes at maturity of *Sitana ponticeriana* and *Calotes nemoricola*.
n, number of individuals.
SV, Snout vent length.

No.	Snout vent length (mm)	No. of eggs in oviduct Left	Right	No. of *corpora lutea* in Left ovary	Right ovary
1	36.0			6	6
2	38.0			5	6
3	44.0			15	15
4	45.0			14	14
5	45.0			16	16
6	47.0			17	17
7	47.5			18	18
8	48.0			18	18
9	48.5			18	17
10	49.0			18	18
11	49.5			13	13
12	50.0			17	18
13	50.5			18	19
14	51.0	7	6	12	16
15	51.5	6	5	10	11
16	52.0	7	7	11	10
17	52.5	5	4	12	14
18	53.0	7	6	12	16
19	54.0	6	6	16	18
20	55.0	6	6	12	10
21	64.0			8	8
22	67.0			12	18
23	76.0			22	22
24	77.0			18	18
25	78.0			24	24
26	79.0			17	18
27	80.0			19	19
28	81.0			18	18
29	82.0			23	23
30	85.0			19	19
31	86.0			35	34
32	87.0			20	20
33	88.0			18	16
34	89.0			24	22
35	90.0			34	31
36	91.0			18	18
37	92.0	6	7	20	20
38	93.0	7	7	20	21
39	95.0	6	5	32	32
40	96.0	7	5	28	32
41	100.0	6	7	20	21
42	102.0	8	8	28	32
43	103.0	7	6	19	19
44	105.0	11	10	34	30

Table 2. Number of *corpora lutea* in ovaries compared to the number of eggs in oviducts of *Sitana ponticeriana* (1 to 20) and *Calotes nemoricola* (21 to 44).

	No. of eggs laid	No. of days taken for hatching	Fertility No. of young ones emerged	Unfertile eggs	% Fertility
S. ponticeriana					
Mean	11.2	42.2-43.2	10	1.2	89.0
C. nemoricola					
Mean	13.3	49.5-50.5	12	1.2	90.8

Table 3. Egg laying and hatching (10 observations of each species) of *Sitana ponticeriana* and *Calotes nemoricola* in the field (July 1965-October 1966).

	Weight (gms)	Snout vent Length (mm)	Tail Length (mm)	Total Length (mm)
S. ponticeriana				
Mean	0.173	16.960	31.660	48.620
S. D.	0.004	0.389	0.841	0.598
C. nemoricola				
Mean	0.503	25.250	51.100	76.400
S. D.	0.023	0.854	4.512	5.215

Table 4. Total animal weight (gms) and sizes of *Sitana ponticeriana* (5 observations) and *Calotes nemoricola* (6 observations) during hatching.
S.D. Standard Deviation.

Figs. 1 and 2. The sequence of the egg laying of *Sitana ponticeriana* (See the timings in the text).

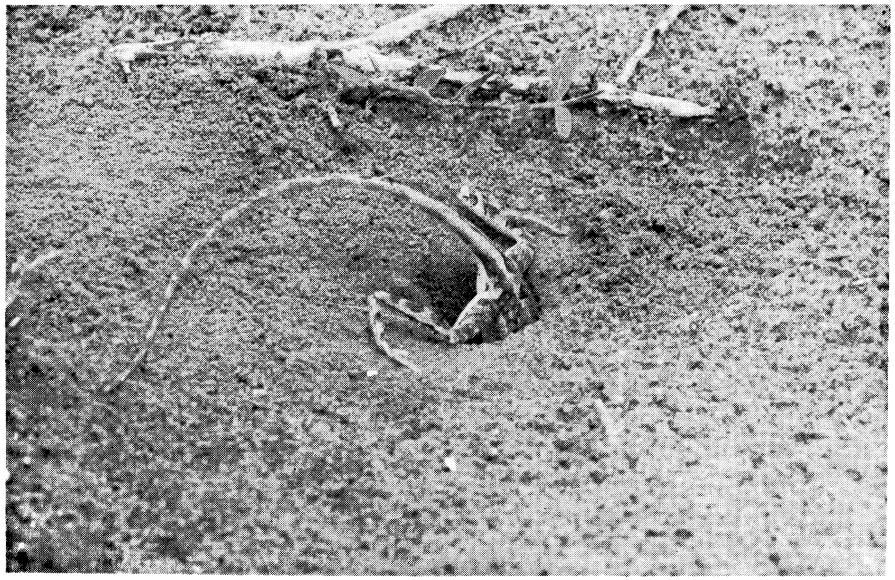

Fig. 1. Half of the body of *S. ponticeriana* has entered the hole; the hind limbs grip the sides.

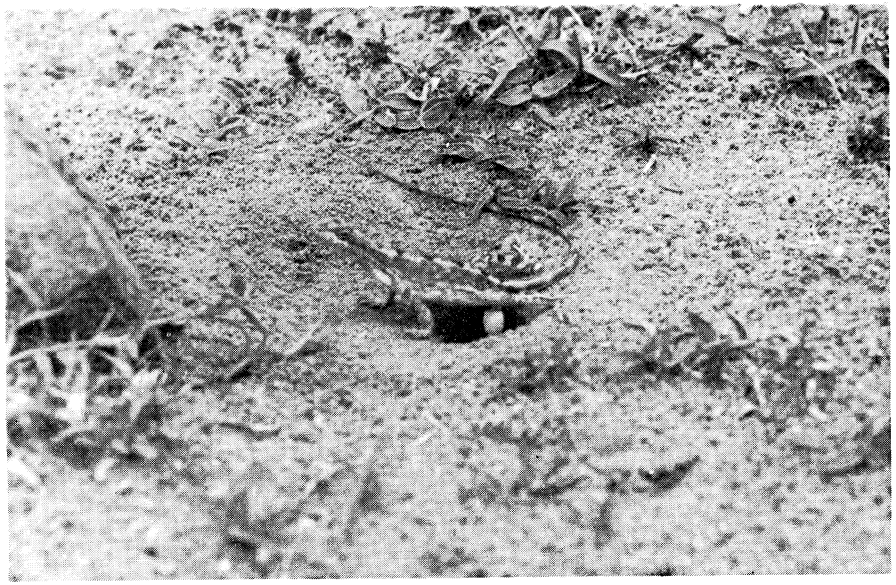

Fig. 2. Resting over the hole the female has laid her first egg. The fore and hind limbs grip the soil.

Fig. 3. Egg shell of *Calotes nemoricola* broken; the snout has emerged through the slit and the eyes are open.

THE LOCOMOTORY ACTIVITY OF THE RAINBOW LIZARD, *AGAMA AGAMA* (L.)

By

S. Afolabi Toye

Department of Zoology,
University of Ibadan, Ibadan, Nigeria.

(*Received* 25/1/71)

INTRODUCTION

In Nigeria, the rainbow lizard, *Agama agama* (L.) is commonly found around human settlements. Harris (1964) has given a detailed account of the general biology of the population at the University of Ibadan. Recent attempts have been made by other authors to study its locomotory activity. Thus, Ekundayo and Otusanya (1969) found that *A. agama,* at the Lagos University campus, had its maximum activity during 10.00 - 11.00 hours and usually escaped from the strong rays of the sun at noon. According to Halstead (1970) the specimens from the University of Ife campus had their peak of activity between 14.00 and 16.00 hours with a tendency to rest at about 18.00 hours. These records of *A. agama* in Nigeria were obtained only from field observations. The aim of the present study was to carry out laboratory experiments on the locomotory activity of the species and relate the results to field observations made mainly during the experiments, and to those of previous authors.

MATERIAL AND METHODS

The lizards used for the experiments were obtained from the University of Ibadan campus and the University of Lagos campus. Thirty seven specimens (25 from Ibadan, and 12 from Lagos) which were used were within the size range 8.5 gm-14.5 gm, a range found suitable for easy movement of the lizards inside the aktograph apparatus. Before the experiment the specimens were kept in wire-fenced enclosures and fed with small grasshoppers. The aktograph apparatus (see Toye, 1971) consisted essentially of a celluloid tube with a transverse beam pivoted on fine grooves of two glass stoppers. During experiments, the floor of the tube was lined with moist soil and dried leaves and contained a piece of branched dry stick on which the lizard was sometimes seen, during preliminary investigation, maintaining a resting posture. When inside the apparatus the lizard was fed small grasshoppers with detached hind legs. Lizard locomotory activity was recorded by the aktograph pointer tracing approximately vertical marks on a smoked paper wound round a weekly-recording thermohygrograph clock. A typical record is shown in Fig. 1 (see method by Toye, 1971). Air temperature and relative humidity were measured by a thermohygrograph kept near the aktograph apparatus. Experiments were made from June to November, 1970 under (a) natural light and darkness, (b) constant artificial light (20 foot candles), (c) constant darkness, and (d) reversed illumination, with darkness during 06.00-18.00 hours and artificial light (20 foot candles) during 18.00-06.00 hours.

RESULTS

Activity under natural light and darkness

Figures 2a and 2b respectively show typical block histograms of activity records for a male *Agama agama* from Ibadan and for a female when experiments were performed under natural light and darkness. The patterns of activity are similar for both sexes. Activity took place during 06.00-18.00 hours although only slight and occasional during 06.00-09.00 hours. There was

no activity during 18.00-06.00 hours. It can be seen from Figs. 2a and 2b that activity was markedly high during 12.00-15.00 hours. Table I shows that 45.9% of the total activity of five lizards during "25 lizard days" took place during 12.00-15.00 hours. Fig. 2c shows that the typical pattern of activity of the lizard from Lagos was essentially similar to that from Ibadan.

ACTIVITY UNDER CONSTANT LIGHT

When experiments were done under constant light, activity took place during 03.00-21.00 hours (Fig. 3a). During 03.00-6.00 hours activity was small but marked during 09.00-18.00 hours. Compared with natural conditions duration of locomotory activity was much longer during constant artificial illumination and activity was not confined to the daytime.

ACTIVITY UNDER CONSTANT DARKNESS

Activity occurred during 06.00-18.00 hours with a maximum during 12.00-15.00 hours (Fig. 3b). In general, the pattern of activity was similar to that shown under natural light and darkness (Figs. 2a, b, c).

ACTIVITY UNDER REVERSED ILLUMINATION

When *A. agama* was exposed to artificial light (20 foot candles) at night (approximately 18.00-06.00 hours) and to darkness during the daytime (approximately 06.00-18.00 hours), locomotory activity was confined to the period of illumination (Fig. 3c). On the first day of a five-day experiment some activity took place before the onset of the illuminated period. On subsequent days, however, there was an increasing tendency for activity to be restricted to the illuminated period (18.00-06.00 hours). Thus the natural rhythm of locomotory activity of *A. agama* can be reversed by illuminating the species at night and keeping it in darkness during the daytime.

DISCUSSION

The normal pattern of locomotory activity of *Agama agama* during aktograph experiments agrees with that shown during field observations on its behaviour. From about 07.30 hours until 18.00 hours lizards can be seen in exposed situations, demonstrating alternation of active movement with short rests on lawns, in rain gutters, on bark of trees, and on rough surfaced walls of University buildings. The marked activity (in the aktograph apparatus) during 12.00-15.00 hours was also noticed in the field. The lizards sometimes escape from the hot exposed areas into cooler shaded parts of their habitat, where close observations revealed continued activity. Previous authors probably associated their disappearance from the exposed areas with cessation of locomotory activity. Thus, according to Ekundayo and Otusanya (1969) "at noon on sunny days they hide away from the strong rays of the sun". Further report of field observations made by the authors that the Lagos lizards had maximum activity during 10.00-11.00 hours and a high activity at about 18.00 hours is contrary to the present findings. In contrast, the lizards had a peak of activity during 12.00-15.00 hours and very little activity at 18.00 hours. The account given by Ekundayo and Otusanya (1969) is considered doubtfully reliable since in fact they were primarily concerned with the estimation of an *Agama* population during a specified period of daytime (10.00-12.00 hours). Although Ife lizards were not used during the present study, Halstead's (1970) report on their locomotory activity is in general agreement with the present findings. He found that the lizards appeared between 07.30 and 08.30 hours (depending on weather conditions), had a peak of activity between 14.00 and 16.00 hours, frequently "gave the impression of sleeping" by 17.00 hours, and sluggishly moved away between 18.00 and 19.00 hours. According to Harris (1964) Ibadan lizards were more active in the afternoon than in the morning. Since Harris was concerned primarily with the effect of weather on the territorial behaviour of *A. agama* he did not elaborate specifically on the pattern of locomotory activity of the species.

The present finding in which the normal activity rhythm of *A. agama* was reversed by illuminating the species at night and keeping it in darkness during the daytime is consistent with that of Kayser and Marx (1951) on *Lacerta agilis* and *L. muralis*. The marked effect which illumination had on the normal locomotory activity of *A. agama* during aktograph experiments clearly shows that light plays an important role in regulating this rhythm.

SUMMARY

An account is given of the locomotory activity of *Agama agama* (L.) in the field and during aktograph experiments. In normal daylight and darkness, activity occurred during 06.00-18.00 hours, with a peak during 12.00-15.00 hours when about 46% of the total daily activity occurred. Both male and female lizards weighing 8.5 gm-14.5 gm demonstrated a similar pattern of activity.

The normal rhythm of activity persisted during an experiment lasting five days in constant darkness, but constant light (20 foot candles) destroyed the rhythm. The activity rhythm was reversed by illuminating the lizard at night and keeping it in darkness during the daytime.

Thanks are due to Mr. Folorunsho Williams for supplying grasshoppers on which the lizards fed during this study.

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Specimen	Hourly periods (hours)											
	06.00-07.00	07.00-08.00	08.00-09.00	09.00-10.00	10.00-11.00	11.00-12.00	12.00-13.00	13.00-14.00	14.00-15.00	15.00-16.00	16.00-17.00	17.00-18.00
Lg 1	—	1	9	25	59	62	60	78	92	82	53	22
Lg 2	—	7	18	52	65	62	67	74	56	44	19	3
Lg 3	—	—	3	22	61	40	55	43	32	13	9	2
Ib 1	—	3	10	36	54	62	79	64	53	54	28	—
Ib 2	—	—	1	26	61	48	70	55	62	20	12	5
Total	—	11	41	161	255	274	331	314	295	213	121	32
%	—	0.6	2.0	7.8	12.4	13.4	16.2	15.3	14.4	10.4	5.9	1.6

TABLE 1. Hourly locomotory activity records for five specimens of *Agama agama* (L.) in an aktograph apparatus under natural daylight and darkness. The record for each specimen was obtained during an experiment lasting five days.

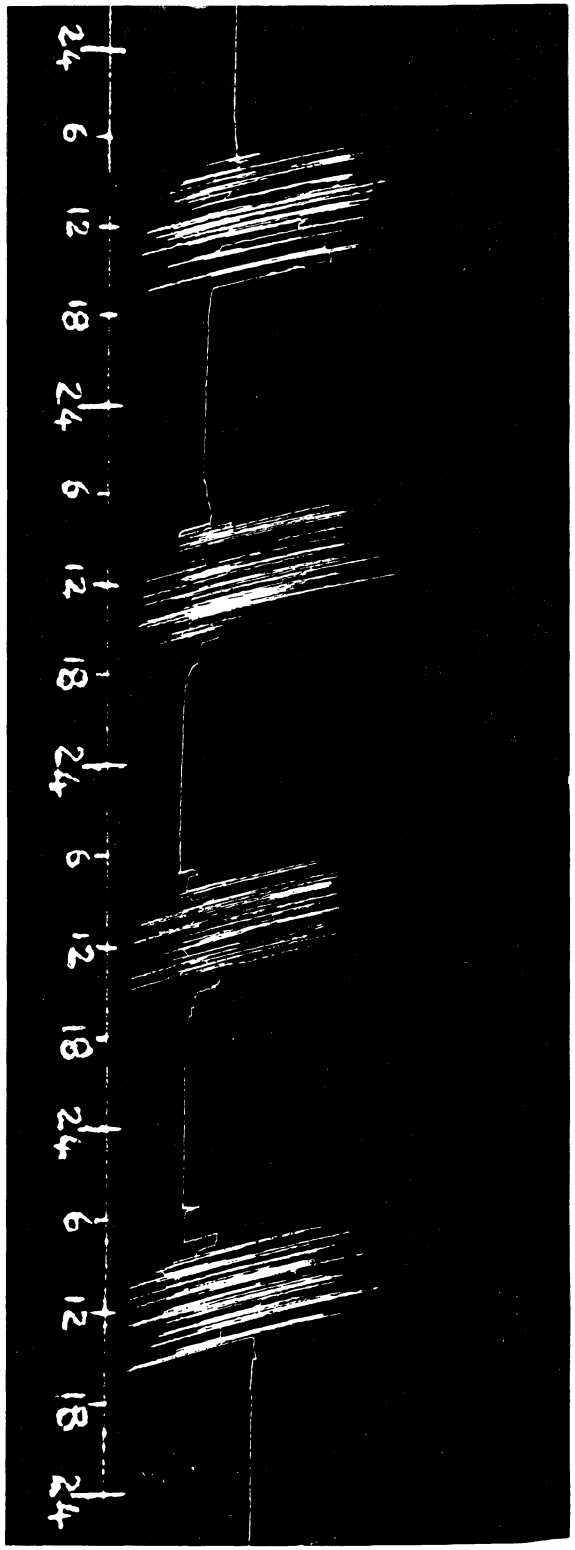

Fig. 1. The typical record of locomotory activity (for 4 days) of *Agama agama* (L.) in an aktograph apparatus. Figures below the record indicate times of day in hours.

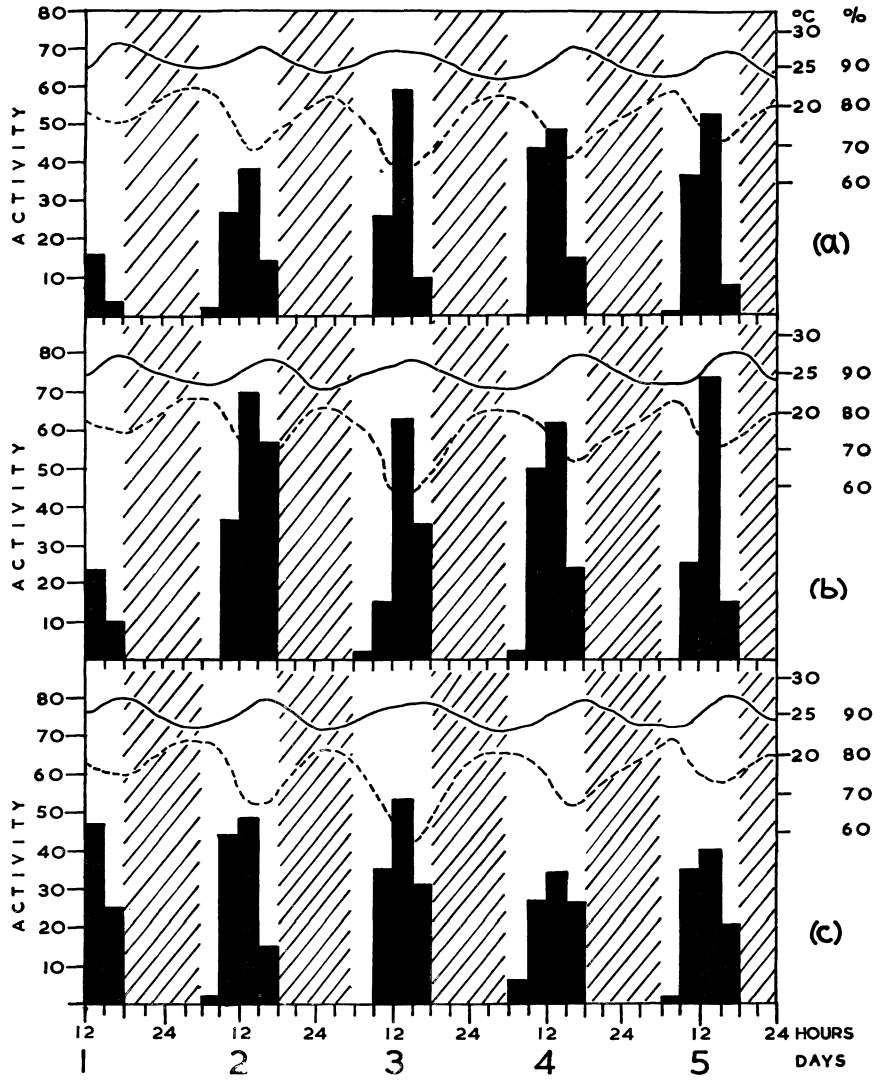

Fig. 2. Three-hourly locomotory activity of (a) a male *Agama* from Ibadan, (b) a female from Ibadan, and (c) a male from Lagos, in normal daylight and darkness. *Ordinates:* activity on the left, temperature (solid line °C) and relative humidity (broken line %) on the right. *Abscissa:* time in hours (above) and days (below). The shaded strips represent 12 hour periods from 18.00-06.00 hours.

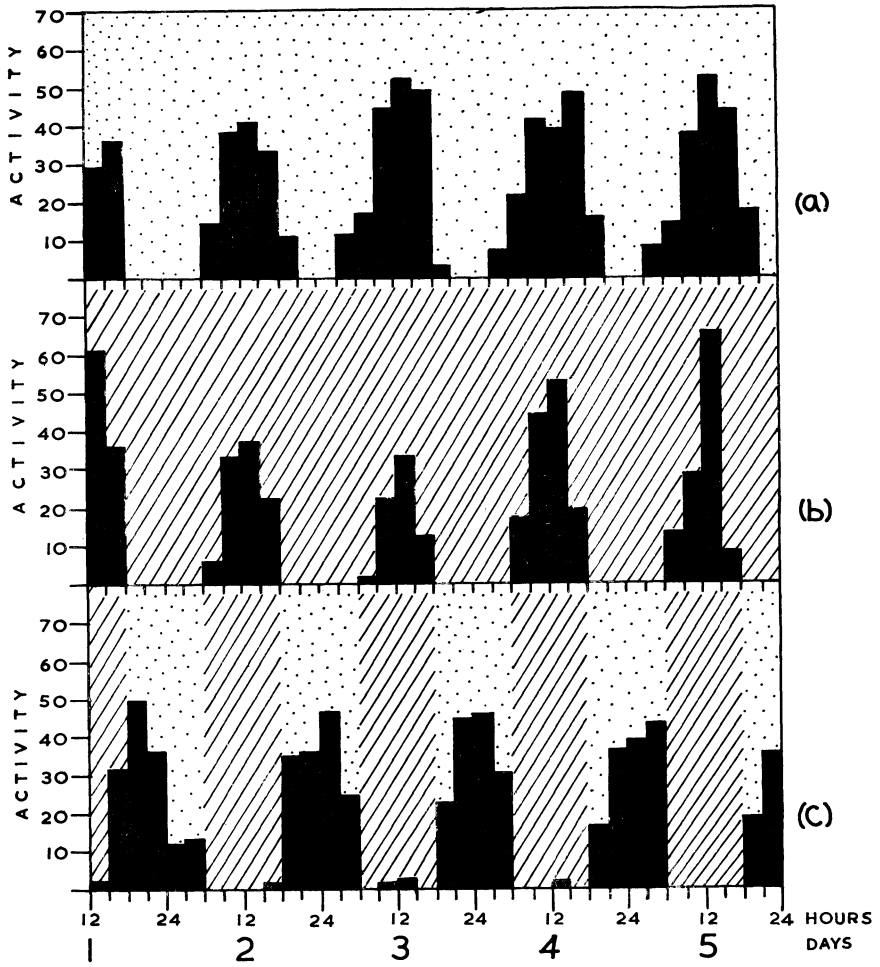

Fig. 3. Three-hourly locomotory activity of *A. agama* in (a) constant light, (b) constant darkness, and (c) alternating light (18.00-06.00 hours) and darkness (06.00-18.00 hours). Dotted areas represent illuminated periods; shaded strips represent periods of darkness.

NOTES ON A THIRD COLLECTION OF REPTILES MADE IN TURKEY

By

RICHARD J. CLARK

2 The Street, Molash, Canterbury.

(*Received* 26/5/70)

During August and September 1969 the author and his wife spent 5 weeks in Turkey, mainly to collect populations of the Rock Lizard, *Lacerta saxicola,* an analysis of which is intended at a future date. Inevitably a number of other species were found which are reported here.

Brief comments on activity and biotope are indicated where relevant. Colour descriptions made on freshly killed material are given. No systematic notes are given for the lizards; taxonomic data are presented for the snakes (Table 1). Collecting sites are indicated on the accompanying map (Fig. 1). At the time of writing all the material is preserved in the author's personal collection; dates and specimen numbers are according to the system used by the author in the field e.g. 16.8.69, 69/819. In the text M, F, MM and FF denote male, female and the plurals respectively.

Coluber r. ravergieri (Ménétries)

Material collected: 1 F.

Locality: Oltu (24 Km SW), 5450′, 19.8.69, 69/526.

The snake was seen lying partly concealed in a stone wall near a field, (09.00 hours, air temperature 20.0°C.). When picked up the snake showed considerable activity.

Description: ground colour light fawn-grey. A buff, zig-zag line down the vertebral position for most of the length, but broken into bars on the neck and represented as a solid line on the tail and just anterior to it. Very faint buff bars down the flanks, again uniting into an ill-defined line on the tail. Head with various dark markings. Dark streak from lower orbit to nos. 5/6 supralabials and another from upper orbit to angle of jaw. Labials whitish with a few dark specks. Venter cream-ochre with darker dustings, especially ventro-laterally. This specimen differed markedly from one caught by the author in N.W. Iran in 1968 (Clark and Clark, b) in having a zig-zag band down the dorsum instead of single cross bars.

Coluber najadum dahlii (Schinz)

Material collected: 1 F.

Locality: Mudurnu (5 Km S.E.), 3950′, 7.9.69, 69/953.

This specimen was caught up a low tree near a stream in thickly wooded country. It was not very active and was subsequently found to have eaten a semi-adult *Lacerta trilineata.*

Description: ground fawn-brown but head and immediate anterior part of body olive-grey. 6 pairs of large white-ringed spots on the neck decreasing to small dots and gradually fading. Venter cream-white.

Natrix natrix subsp.?

Material collected: 2.

Localities: Koyulhisar (8 Km N.), 11.8.69, 69/392; Sivas, 4500′, 4.9.69, 69/933, 1 F.

69/392 was found dead and partly decomposed in a field near some water. It could not be preserved but certain scale counts were possible. 69/933 was collected in some bush cover on an otherwise arid hillside with no water in the vicinity. *Lacerta parva* colonised the more open parts.

Description: ground colour olive-green with a double row of small black flecks down the dorsum and, in 69/933, a dorso-lateral and ventro-lateral row of black spots. In 69/392 a single row of very short black bars on the flanks. No light dorso-lateral stripes. Large yellow moon patches, bordered posteriorly with black. Labials cream-yellow with black sutures. Throat and neck white, remainder of venter predominantly black with green-white edges to some scales. This form is not referred to *N. n. persa* because of the absence of dorso-lateral stripes and the much reduced black markings.

Natrix n. persa (Pallas)

Material collected: 1 semi adult.

Locality: Kars (20 km N.), 5600′, 21.8.69, 69/573.

This was taken at the bottom of a cliff (14,00 hours, air temperature 28.5°C.). *Lacerta agilis exigua, L. parva* and *L. saxicola* were in the neighbourhood.

Description: about to slough. Moon patches large and clear, pink in colour. Dorso-lateral stripes faint. No dark markings dorsally. A row of short black bars on the flanks just below the stripe and another larger row ventro-laterally. Belly white, with some black increasing rapidly posteriorly with white reduced to the scale extremities. Throat and neck white, immaculate.

Natrix n. scutata (Eichwald)

Material collected: 3.

Localities: Of, 200′, 16.8.69, 69/469, 1 M; Findikli (10 km E.), 50′, 27.8.69, 69/819, 1 juv. M; Vakfikebir, 100′, 30.8.69, 69/823, 1 F.

The specimen from near Of was taken on a shady bank with thick undergrowth not far from a river (11.00 hours, air temperature 25.0°C.), 69/819 was found in a stream close to the sea (13.15 hours, air temperature 27.0°C.) and the large F from Vakfikebir at the same site as the *N. tessellata* from this locality, (12.00 hours, air temperature 26.0°C.).

Description: all showed some degree of melanism, especially 69/823 which was completely black except for the throat, neck and some of the ventral plates which were green-white near the extremities. The moon patches on this individual were faint and dusty white. The other two snakes were a uniform dark olive-grey with no markings dorsally and with small scattered spots laterally. The moon patches very bold, rich cream and nearly meeting in the midline. Venter with more white than 69/823 but still predominantly black, especially posteriorly.

Natrix t. tessellata (Laurenti)

Material collected: 4.

Localities: Gole, (20 km S.W.), 5050′, 19.8.69, 69/537, 1 F; Vakfikebir, 30.8.69, 69/820-822, 2 MM, 1 juv.

All specimens were taken in the vicinity of running water: the Gole specimen while crossing the stony edge of a stream in the evening (17.00 hours, air temperature 31.0°C.), and the Vakfikebir snakes from shady wooded banks close to a small river.

Description: it has been observed before (Clark and Clark, in press, a) that *N. tessellata* from the eastern end of the Black Sea shows a marked tendency towards melanism. 69/820-822 ground colour very dark grey-olive with faint dark bars down the vertebral line in a single row. Venter almost completely black except for throat and neck which were cream. Some cream spots on edges of ventral acutes in 69/821. Throat and neck pink in 69/820. In contrast the Gole individual was fawn-grey with roughly a double row of faint dark spots dorsally and a similar row of spots down the flank. Venter pink; some black on neck, increasing posteriorly. Tail completely black. Throat and chin cream, immaculate.

Lacerta agilis exigua (Eichwald)

Total collected: 3.

Localities: Kars (20 km N.), 5600′, 21.9.69, 69/574, 1 M; Kars (8 km N.), 5700′, 23.8.69, 69/606-607, 2 FF.

69/574 was found under a rocky ledge in close proximity to *L. saxicola* and *L. parva*. The other two were taken in a damp, grassy hollow close to rock outcrops. This lizard was found at the same locality in May 1967, (Clark and Clark, in press, a).

Lacerta derjugini (Nikolskij)

Total collected: 3.

Localities: Ardanuc (45 km E.), 4700′, 25.8.69, 69/753, 1 M; Borcka (15 km W.), 2200′, 26.8.69, 69/791-792, 2 adults.

69/753 was caught near a small stream amongst rocks. The other two were found in deep shade near a tree stump in wooded terrain (13.00 hours, air temperature 22.5°C.).

Lacerta muralis muralis (Laurenti)

Total collected: 3.

Locality: Tekirdag (15 km W.), 300′, 9.9.69, 69/957-959, 1 M, 1 F, 1 juv. F.

These were found close to and on a fallen tree near a small stream. There was some dense but limited undergrowth in the vicinity in otherwise open, cultivated country (15.00 hours, air temperature 23.0°C.).

Lacerta parva (Boulenger)

Material collected: 42.

Localities: Kars (20 km N.), 5600′, 22.8.69, 69/576-577, 2 adults; Susehri (20 km W.), 4700′, 3.9.69, 69/888-893, 3 adults, 3 juvs.; Sivas, 4000′-5100′, 4.9.69, 69/912-929, 69/934-944, 8 adults, 6 semi-adults, 15 juvs.; Ayas (8 km E.), 3700′, 7.9.69, 69/948-952, 5 juvs.

The majority of the *L. parva* seen and caught were the current year's hatchlings. Adults were not only much scarcer but elusive, hiding in deep cracks in the earth and down holes which could not be excavated. Activity was greater in the early morning and again towards sunset. A midday temperature of 28.5°C. near Sivas was apparently too high, no lizards being seen in the open. For more detailed accounts of the activity of this species in the spring see Clark and Clark (in press, a).

Lacerta parva is virtually endemic to Turkey, though extends some way into Armenia (Terent'ev and Chernov, 1949; Peters, 1962). It colonises open barren country and hides away down holes or at the base of small woody plants.

Lacerta t. taurica (Pallas)

Total collected: 4.

Localities: Cersikoy (12 km S.), 400′, 7.8.69, 69/360-361, 2 juvs.; Tekirdag (25 km E. and 15 km W.), 300′, 9.9.69, 69/955-956, 2 MM.

Near Cersikoy it occurred amongst the oak scrub and at the other two sites near Tekirdag in fields where it hid down holes. *L. t. taurica* has not been found east of the Bosphorous, though see Bodenheimer (1944).

Lacerta trilineata dobrogica (Fuhn and Mertens)

Material collected: 7.

Localities: Kirklarelli (15 km E.), 750′, 6.8.69, 69/354-356, 2 MM, 1 F; Cersikoy (12 km S.), 7.8.69, 69/357-359, 2 MM, 1 F; Mudurnu (5 km S.E.), 3950′, 7.9.69, 69/954, 1 M.

Near Kirklarelli this lizard occurred quite commonly amongst bushes

and in an area of small woodland. It was active during the afternoon with an air temperature of 26.5°C., though keeping to the shade. At Cersikoy the specimens were taken around low oak scrub during the morning (07.15 to 08.15 hours, air temperature 14.5°C. to 22.5°C.). Much of this region from the Greek and Bulgarian frontiers to Istanbul is partly cultivated or consists of rolling grassland with wooded areas of rather limited extent. These lizards are included with a sample from Thrace in northern Greece and discussed in a report in preparation on Greek material.

Lacerta trilineata subsp.

Material collected: 11.

Localities: Tosya (20 km W.), 2450′, 10.8.69, 69/383-384, 2 MM; Koyulhisar (8 km N.), 4850′, 11.8.69, 69/390, 1 M; Oltu (5-7 km S.W.), 4550′, 19.8.69, 69/532, 534-536, 2 MM, 2 FF; Susehri (20 km W.), 4700′, 3.9.69, 69/894-896, 3 MM; Sivas, 5100′, 4.9.69, 69/931, 1 M.

Near Tosya the biotope was open grassland with bushes in a river valley, (08.15 hours, air temperature 19.5°C.). Above Koyulhisar the single lizard was caught around bushes on the steep mountainside close to the pine forest zone. A few more were seen in this locality. Near Susehri and Sivas the environment was much more barren with sparse bush and shrub cover. But at Oltu the lizards were all congregated in a damp area close to the river. Activity was as follows: Oltu, 12.00-14.00 hours, air temperature 30.0°C.-32.0°C., with lizards moving around in the shade. Susehri, 14.00 hours, air temperature 25.0°C.; Sivas 11.00 hours, air temperature 26.0°C.

This *L. trilineata* material will be included in an overall renew of Turkish Green Lizards. The taxonomic status of the Anatolian forms is still undecided.

Lacerta viridis subsp.

Material collected: 5.

Localities: Ordu (10 km S.), 450′, 13.8.69, 69/446, 1 F; Vakfikebir, 0′, 15.8.69, 69/447-450, 2 MM, 2 FF.

At Vakfikebir these lizards were found amongst bramble bushes and scrub close to the sea. They were difficult to approach and were less common than in May 1967.

Ophisops elegans (Ménétries)

Material collected: 3.

Localities: Tasova (30 km W.), 1100′, 11.8.69, 69/388, 1 M; Oltu (5 km S.W.), 4550′, 19.8.69, 69/533, 1 F; Ardanuc (30 km E.), 4200′, 25.8.69, 69/755, 1 F.

This small lacertid, which was so plentifully represented in the author's 1967 collection, was seldom encountered on this trip, particularly lacking along the eastern Black Sea zone.

Agama stellio stellio (Linnaeus)

Material collected: 4.

Localities: Tasova (30 Km W.), 1100′, 11.8.69, 69/385-387, 3 adults; Niksar (34 Km W.), 1200′, 11.8.69, 69/389, 1 adult.

The Tasova specimens were caught on rocks close to the river (06.45 hrs., air temperature 23.8°C.). Only one more Agama was seen at this site, a small juvenile. Near Niksar it was found on stones by the road around noon.

Although *A. stellio* has been recorded from near Amasya (Bodenheimer, 1944) the author has seen no other reference to this species from northern Anatolia. Doubtless records do exist but clearly this species is not as abundant nor as widely distributed in this region a it is along the Aegean and Mediterranean coastal areas. It also penetrates the interior of the country over a wide

part of its range and extends east towards the Iran and Syria borders. The author did not observe any other populations along the route from Bolu to Koyulhisar.

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TABLE I

69/	Species		(a)	(b)	(c)	(d)	(e)
526	*Coluber r. ravergieri*	F	763.0	580.0	199	85	4/5, 5/6
953	*C. najadum dahlii*	F	947.5	670.0	218	121	5/6, 4/5
392	*Natrix natrix* sub sp.	M	x	x	x	76	x
933	*N. natrix*	F	867.0+	725.0	174	50+	3/4
573	*N. n. persa*	?	403.0	397.0	172	61	3/4
469	*N. n. scutata*	M	677.0	520.0	172	70	3/4
819	*N. n. scutata* juv.	M	352.5	275.0	173	68	3/4
823	*N. n. scutata*	F	943.0	752.0	170	65	3/4
537	*N. t. tessellata*	M	629.0+	528.0	177	45+	4
820	*N. t. tessellata* juv.		321.0	256.0	179	69	4, 3
821	*N. t. tessellata*	M	511.0	410.0	179	68	4
822	*N. t. tessellata*	M	563.0	450.0	173	70	4

(a) Total length (mm).
(b) Snout to vent (mm).
(c) Ventral count (anal always divided).
(d) Subcaudal count (x2).
(e) Number in sequence of scale(s) in the supralabial series bordering the eye.
N.B. Dorsal count at mid-body 19, except in *Coluber r. ravergieri* which has 21.

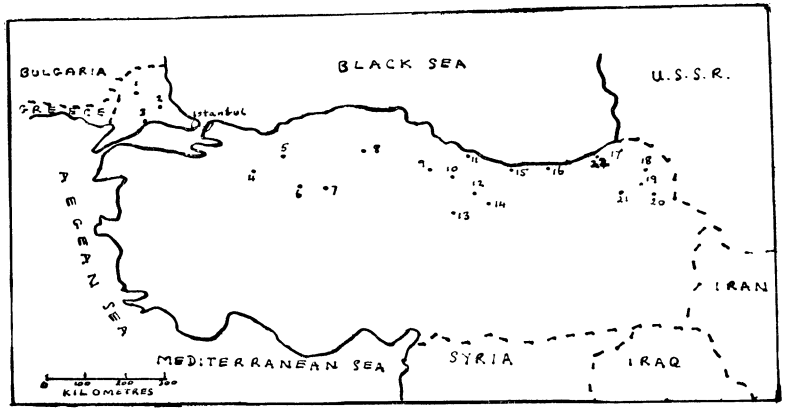

FIG. 1. Map of Turkey showing localities mentioned in the text. (1) Kirklarelli; (2) Cersikoy; (3) Tekirdag; (4) Mudurnu; (5) Bolu; (6) Ayas; (7) Ankara; (8) Tosya; (9) Tasova; (10) Niksar; (11) Ordu; (12) Koyulhisar; (13) Sivas; (14) Susehri; (15) Vakfikebir; (16) Of; (17) Borcka; (18) Ardanuc; (19) Gole; (20) Kars; (21) Oltu; (22) Findikli.

REARING HATCHLINGS OF CHELONIA MYDAS (L.)

By
JOY O. I. SPOCZYNSKA,
10 Christchurch Road, Northampton.

(*Received* 8/9/71)

The following notes concern six hatchlings of the green turtle (*Chelonia mydas* (L.)) received from Florida in November 1968. The methods employed to overcome some of the problems which occurred during rearing and in dealing with various other points, are outlined, in the hope that they may be of assistance to others who have the opportunity of rearing this turtle.

At the date of writing (1st January, 1970) four hatchlings remain. The death of the other two would appear to have followed attacks by their brethren who persistently bit their flippers. This habit appears, from the available literature, to be a well-known vice among hatchlings of this turtle in capitivity. Koschmann (1965) states: " . . . a month or two later, one turtle consistently nipped the feet of the others, sending them into a frenzied streak across the tank. The victims never retaliated, but would refuse food and eventually die. I partitioned a section of the tank for the 'nipper' and, as long as the turtles could only see each other, they got along fine. If the partition was removed, however, the 'nipper' at once attacked the others."

I have found no reference to this habit among hatchlings of other species of marine turtles, nor was it observed among hatchlings of *Dermochelys coriacea* (Spoczynska, 1970 a, b).

Koschmann (1965) kept hatchlings of the loggerhead (*Caretta caretta*), the Pacific or Kemp's ridley (*Lepidochelys kempi*) and the hawksbill (*Eretmochelys imbricata*) but did not mention this feature among hatchlings of any of them. It is scarcely warrantable to assume on such scanty evidence that *Chelonia mydas* is the only sea turtle to indulge in this habit when immature. The author would welcome observations from others who have kept hatchlings of any of the marine turtles.

The bites of the aggressors were directed only towards the flippers of the victims, usually the anterior pair which, being the larger, afforded a greater area of marginal skin—the area to which bites appeared to be exclusively directed. After attacks the edges of the flippers were somewhat ragged in appearance, though bites rarely caused bleeding.

TREATMENT OF BITES

The bitten areas were painted with gentian violet twice daily, the affected turtles being kept out of water for about 20 minutes to allow the lotion to dry. Before the subsequent segregation of healthy specimens, their reactions to their victims after painting the flipper lesions were observed. Applications of lotion did not appear to have any deterrent effect for the aggressors continued to bite the affected flippers.

After the death of the two hatchlings the remaining four were separated by glass tank dividers, in order to prevent further attacks and subsequent losses. As however there then appeared to be insufficient swimming space for them, another 40-gallon tank was set up similar to the one which housed the four survivors. By removing two of the three glass dividers from the first tank and resiting one divider in the middle of each tank, each turtle had ample space. This arrangement is still maintained; the hatchlings continue to thrive without any trouble.

WATER SALINITY

Tidman's Sea Salt in a concentration of 1 lb. to every 12 gallons of water appears to suit the young turtles. There are no problems associated with maintaining a constant level of salinity when " topping up " after evaporation, since tank cleaning and complete water change are essential twice weekly.

WATER TEMPERATURE

A temperature range of 26°-28°C. (about 78°-82°F.) suits these turtles admirably. Lower temperatures appear to inhibit feeding and movement patterns, while higher temperatures tend to encourage the turtles to rush madly about the tank. Extremes should be avoided.

FEEDING

The turtles are removed to a separate container for feeding. This should be standard procedure for all aquatic chelonians, for it avoids fouling the tank water with decomposed uneaten food. Water temperature in the feeding container must be the same as that in the tank; violent fluctuations of temperature are extremely harmful to tropical marine turtles.

FOOD PREFERENCES OF HATCHLING *Chelonia mydas*

The block histogram (Fig. 2) shows the observed food preferences of hatchling *Chelonia mydas* in captivity, expressed as a percentage of their total diet. Foods offered but invariably refused, e.g. herring, sprat, sardine, salmon and tuna have been omitted. It will be noted that all the above mentioned items are fishes with a high oil content. Shellfish and crustaceans form by far the major proportion of the preferred diet of hatchling *Chelonia mydas* in captivity.

It is probable that the preference for cooked spinach in contrast to other vegetable foods may be attributed to its resemblance to seaweed!

FEEDING PATTERNS

Unlike hatchlings of *Dermochelys coriacea*, which appear (at least in captivity) to have a definite preference for feeding in the evening, captive *Chelonia mydas* hatchlings will feed at almost any time. They do, however, tend to exhibit a self-imposed limit on the actual amount of food taken at any one time; after eating a certain quantity (which does not seem to vary much between individuals) they will refuse any food remaining in the water, until their next feeding period. When fresh food was introduced into the feeding container in which the remainder of previously-given food was still present, the turtles invariably completely ignored the latter and ate only fresh food.

Hatchling *Chelonia mydas* in captivity feed only at the bottom of the tank. They make a series of little dives towards the food, at first only shallow ones in its general direction, followed by a succession of gradually deeper dives, until they finally contact it. Between each dive the turtle returns to the surface, propelling itself backwards by a forward movement of the flippers.

On several occasions the turtles were timed from the commencement of the first dive to the final contact with the food. An average result showed:

	Feeding time 10 a.m. (*seconds*)	*Ditto, 6 p.m.* (*seconds*)
Turtle A	50	70
Turtle B	40	72
Turtle C	51	69
Turtle D	53	78

There does not seem to be any correlation between the time taken to contact the food at 10 a.m. and at 6 p.m., although in each case the times were greater at 6 p.m. Nor did the type of food offered appear to have any bearing on these times. When any kind of food was refused the hatchlings still investigated it in exactly the same manner, but after contact they returned to the surface and did not dive towards the same portion again.

MOBILITY PATTERNS

These turtles are much less active than hatchling *Dermochelys coriacea*. However, *Chelonia mydas* had definite periods of incessant activity during

daylight, not usually at definite or regular times though they tended to occur more frequently between 10 and 11 a.m. and between 2 and 3 p.m.; periods of incessant activity also occurred at other times. This activity was mainly swimming and diving, the latter when not in pursuit of food usually confined to short sorties below the surface. Swimming speeds were considerably lower than those of hatchling *Dermochelys coriacea.*

Unlike the latter, baby green turtles follow motile activity by long periods of immobility. A typical " resting position " is adopted, in which the forelimbs are folded over the anterior lateral edges of the carapace (Fig. 1). Here the head is either situated at the surface, with nares exposed, or held just below the surface, in which case the turtle will come up for air at varying intervals.

This state of immobility is frequently maintained for several hours. It was not apparent why this should be so, but it is probably easier to account for than the fact that *Dermochelys coriacea* hatchlings have been observed to maintain incessant activity non-stop for 9 hours, with no apparent rest. After an unbroken activity period of 7 hours 17 minutes a hatchling *Dermochelys coriacea* took a short rest of 7 minutes before starting another marathon swim which lasted at least 4½ hours, and possibly longer for observations ceased at this point. When they were resumed 9 hours later the turtle was still swimming vigorously!

SUMMARY

Behavioural aspects of hatchling *Chelonia mydas* (L.) were described, including measures taken to combat patterns of aggression and the treatment of bites inflicted during aggression.

Water salinity and temperature were discussed and food preferences in captivity outlined, together with feeding patterns.

Motor activities were described, with observations on the resting position and on the duration of resting as compared with periods of activity, comparisons being made with *Dermochelys coriacea* (L.).

I am indebted to M. Sivapragasam for the block histogram of Fig. 2.

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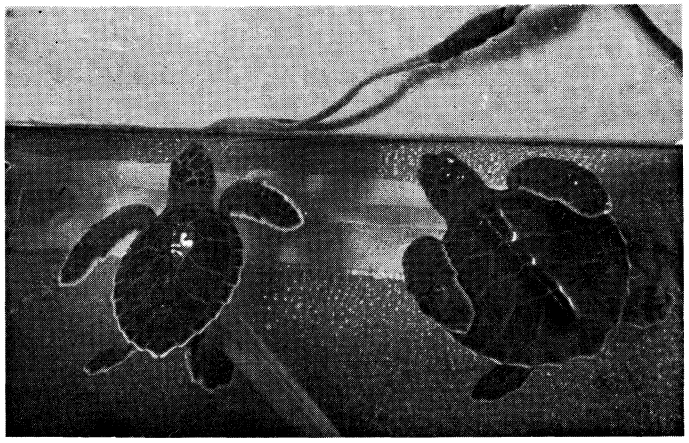

Fig. 1 Baby green turtles (*Chelonia mydas*)

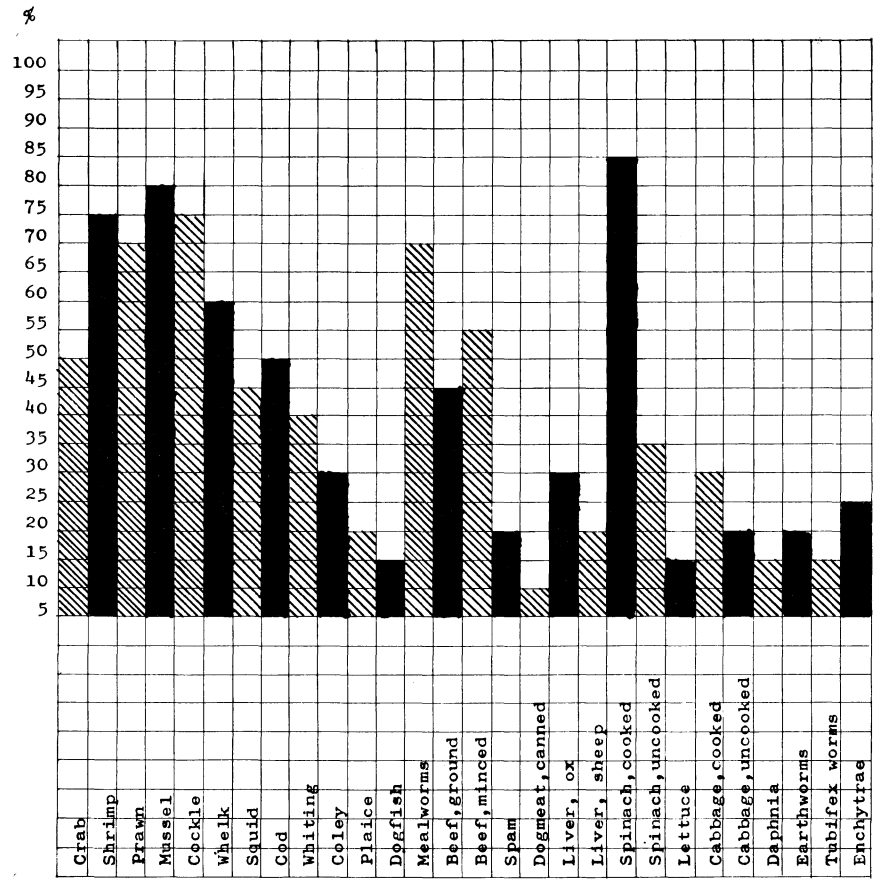

Fig. 2 Food preferences of hatchling *Chelonia mydas* L.

AN ATTACK BY A SOLPUGID ON AN IGUANID LIZARD HATCHLING

By

BENJAMIN H. BANTA AND PATRICK J. MARER

Dept. of Biology, U.S. International University,
San Diego, California, U.S.A.

(*Received* 12/8/71)

We have been conducting a long-term repetitive pitfall sampling along Nate Harrison Grade, Palomar Mountain, San Diego County, California. In the course of our weekly checking of the 63 sampling stations, we almost always encountered something which we had not seen before. Of more than unusual interest was an observation of a hatchling *Uta stansburiana hesperis* Richardson attacked in a swift and vicious manner by an adult solpugid of the family *Ammotrechidae,* probably *Ammotrecha californica.* The whole episode took place in seconds and the lizard was attacked on the neck and died almost instantaneously. Both animals were then preserved in a fixative solution. We know of the account by Hutton (1843) in which lizards were devoured by solpugids, but we are unfamiliar with such behaviour in western North America.

The solpugid rapidly worked its chelicerae into the neck alternately, grasping with the right while boring with the left, then grasping with the left while boring with the right.

The solpugid measured a total length, including chelicerae, of 18.6 mm. The uta hatchling measured 55.2 mm including its tail. This incident took place on July 24th, 1971. The specimens were collected at an altitude of 2,259 feet at sampling station number 44.

Smith (1946) did not include solpugids as enemies of this species. Tinkle (1967) did not cite any arthropods as causes of death in *Uta stansburiana* populations studied near Kermit, Texas and Fruita, Colorado. It is conceivable that solpugids may be a primary predator on hatchling and juvenile lizards in many areas of western North America.

All species of arthropods obtained from our sampling stations will be deposited in the collections of the Department of Entomology, California Academy of Sciences, San Francisco.

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THE ASIATIC GECKO *HEMIDACTYLUS FRENATUS* IN MANZANILLO, MEXICO

By

ROBERT G. WEBB

Department of Biology, University of Texas at El Paso, El Paso, Texas, U.S.A.

(*Received* 22/3/71)

It is of interest to note another record of occurrence for the non-indigenous gecko *Hemidactylus frenatus* on the west coast of Mexico. To my knowledge individuals of the neotropical population of *H. frenatus* have been reported previously from only six Mexican localities on the Pacific slope. Smith (1942), Edgren (1950), Grant (1956), and Pianka and Smith (1959) have noted the occurrence of this gecko at Acapulco, Guerrero, which seems to have been the first site of introduction for the species; the first author also reported the species from Tierra Colorada, an inland village to the north of Acapulco. The other four localities are Puerto Angel, Oaxaca (Chrapliwy, 1956), Zihuatanejo, Guerrero and Los Mochis, Sinaloa (Hardy and McDiarmid, 1969), and Pinotepa Nacional, Oaxaca (Liner and Dundee, 1969). Marcellini (1971) noted the species in Chiapas, as well as from two localities in the state of San Luis Potosi on the east coast of Mexico. Although not unexpected, *H. frenatus* is herein reported from the seaport of Manzanillo in the state of Colima.

Dr. James R. Dixon and I spent the night of June 13th, 1964, at the Motel y Playa San Pedrita in Manzanillo; our special efforts to ascertain the presence of nocturnal geckos in Manzanillo, and in (Playa de) Santiago, about nine miles to the northwest, were negative. I again had occasion to stay at this same motel the night of July 15th, 1966, and again no geckos were observed. However, individuals of *H. frenatus* were abundant at night on the

bungalow walls of the Motel y Playa San Pedrita on July 22nd-24th, 1970; the proprietor related that the geckos occurred elsewhere in Manzanillo, and that they were first noticed at the motel about three years ago. The data suggest that *H. frenatus* became established in Manzanillo in either 1967 or 1968.

Although many more specimens could have been collected, only three were obtained—an adult male, a gravid female, and a smaller unsexed gecko, 52, 50, and 41 mm in snout-vent length, respectively. *Hemidactylus frenatus* is most readily confused, in Mexico, with two other introduced geckos, *Gehyra mutilata* and *Hemidactylus turcicus*, and perhaps with indigenous geckos of the genus *Phyllodactylus*. The three specimens are identified as *H. frenatus* in having the undersurface of the digits expanded (not expanded except for a pair of terminal lamellae in species of *Phyllodactylus*), in having enlarged tubercles arranged in whorls on the tail and a few enlarged tubercles on the back (areas smooth in *Gehyra mutilata*), and in having the preanal and femoral pores in a continuous series (many enlarged tubercles on back, and femoral pores lacking in *Hemidactylus turcicus*).

I am grateful to Dr. Rollin H. Baker and the Michigan State Development Fund, and the University of Texas at El Paso University Research Institute for defraying expenses, in part, in the field.

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SHIFT IN A POPULATION OF NORTHERN VIPERS

By

C. SIMMS

The Yorkshire Museum, York

(*Received* 19/10/71)

INTRODUCTION AND METHODS

Since 1965 the western part of Strensall Common in the North Riding of Yorkshire (S.E. 637601) has been visited between March and October (inclusive) to observe the wildlife, particularly: *Rana temporaria* L., *Lacerta vivipara* Jacq. (Simms, 1969), *Vipera berus* L.

This herpetofauna is typical of lowland heaths developed on postglacial aeolian and morainic sands in the eastern Vale of York, but before 1968 vipers were not found in the study area, although a hibernaculum was known a quarter of a mile to the east and they are common enough over much of the eastern part of the Common, to be regularly noted (and too often killed) by walkers and military personnel. Mark-and-recapture studies, using subcaudal clips, were begun as soon as vipers were first noted in the study area (see

Simms, 1969) near its eastern boundary late in the season of 1968. Twice-weekly visits, often only of a few hours duration, were made to find and watch vipers. Many caught by hand were encouraged to regurgitate recently-ingested food; otherwise apart from marking and weighing-and-measuring the snakes were not disturbed and were released where caught usually within minutes of capture. The ground was walked on a grid, but an element of bias in the cover appeared when gravid females in particular, evidently showed preferred basking sites.

Not all the vipers present were known at any one time but efforts were made to ensure that new litters were all marked. Visits were mainly in weather suitable for basking; avoiding wet periods and the hottest parts of fine days; they totalled over 150 hours per season. Each visit included a patrol of the open heathland area to the east of the shrubby heath study area in an attempt to monitor movement into or out of the study area, which is surrounded by unfavourable reptile habitat (roads and a large picnic area) on three sides.

RESULTS

The study area held no vipers prior to the 1968 season. Concentrated work on lizards there, and irregular observations on other ground fauna (*Orthoptera, Saltatoria*), which involved covering all the ground often, revealed no snakes or sign of them. Mapping of the movements of marked vipers by recapture data indicated, for the few individuals often recaptured, that during seasons 1969/1970 they moved from hibernacula near the eastern edge of the study area out into grass heath and back to hibernacula near its western border (Fig. 1). Mating in the spring and the birth of young late in the summer took place near the hibernacula, but viper activity in the study area declined during 1970 and especially 1971 to the time of writing, when half the vipers found in the area are young of 1971.

Marked dispersed individuals were found up to half a mile away from the study area in 1971. The study area, judging from "vole-sick" carpet and the activities of Kestrels *Falco tinnunculus* L. suffered a marked peak of Short-tailed Voles (*Microtus agrestis* L.) during 1967-8, but no systematic trapping was carried out to check this impression. During the same period there was a relatively high population of Common Lizards (*Lacerta vivipara* Jacquin) which still persists. The voles and lizards are likely to have been major prey items of the vipers over the period, and it may be that the snakes moved into the study area in response to high populations of prey. This hypothesis cannot, of course, be proven from these results, nor can the 1970-71 apparent decline in snake numbers. What can be demonstrated is the immigration (Table 1) indicated by an increasing number of females breeding during 1968 and 1969. These could not have been born in the study area, since the Northern Viper female needs four or five years (Smith, 1959) to reach sexual maturity. Army authorities posted snake-warning notices near the study area upon the confirmation of viper presence there early in the season of 1969, and there was certainly some human predation, perhaps partly the result of this publicity.

SUMMARY

Vipers migrated into a small area where they had not been known for at least three or four seasons. Their food included two small vertebrate species known to be relatively abundant there during the study period; a subsequent decline in the viper population was noted. In future seasons it is hoped to find "study-area" marked vipers further to the east and so to monitor their movements further.

Acknowledgements

Observations were made during the course of fieldwork from the Yorkshire Museum, York, whose Curators have encouraged study of vertebrates in the field as well as in the Museum. Mrs. S. T. Walsh and P. R. Balch assisted in the field, and there has been discussion with M. P. Baby and P. R. Balch. For other assistance I have to thank Major Athoe, Northern Command.

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Season	Hibernacula used: (1) March	Hibernacula used: (1) October	Estimate of population: (2) April	Estimate of population: (2) September	Number of gravid females	Recaptures (3) marked in 1968	Recaptures (3) marked in 1969	Recaptures (3) marked in 1970
1968	—	1	0	3+ 8	1	—	—	—
1969	1	1, 2	10	8+28	4	4	—	—
1970	1, 2	2, 3, 4	30	10+12	3	2	10	4
1971	2, 3, 4	1, 3	15	7+ 6	1	—	4	3

Notes:
(1) See Figure. Other hibernacula, especially of single individuals, may of course, have been missed.
(2) Based on proportions of recaptures to "new" captives. The first September figure is for adults; the second for juveniles.
(3) Individuals, not occasions. (A few vipers were recaptured very often).

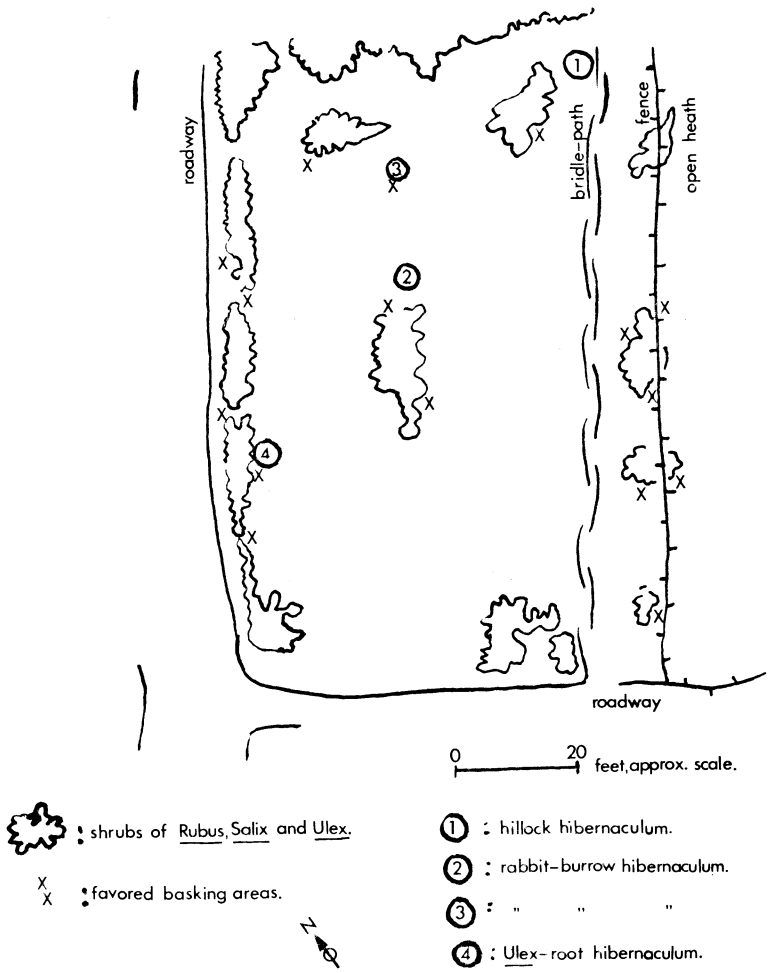
Table 1. *Increase in Viper Population*

Season	Total examined	Including "Vole" (1)	Including *M. agrestis*	Including Other Mammals	Including Birds (2)	Including *L. vivipara*	Other food (3)
1968	0	—	—	—	—	—	—
1969	17	8	8	1 *Apodemus* sp.	5	3	—
1970	24	16 or 17	14	2 *Clethrionomys glareolus* Schreber	2	4	2
1971	8	7	6	1 (uncertain)	—	—	—

Notes:
(1) Voles (*Microtinae*) recognised by teeth (whole specimens were ingested, of course).
(2) Birds—nestlings undetermined. Viper watched taking Willow Warbler nestlings *Phylloscopus trochilus* (L.) from nest on two occasions.
(3) Juveniles regurgitated Bog Bush Crickets *Metrioptera brachyptera* (L.).

Table 2. *Regurgitations*

FIGURE ONE : THE STUDY AREA, 1971.



LETTERS TO THE EDITOR

Amelanotic specimens—even colonies—have been described for *Rana temporaria* from this country on several occasions. But I am not aware that a picture of one has ever appeared in our journal. So I am sending you one. The frog was captured in Northwood, Middlesex in June this year and is still alive. It is extremely light shy and never comes out of hiding in the day. Its colour is a light orange. Only the eyes are pigmented black. I have never

seen it feed but since the flies in the cage disappear it must catch them at some time or other. The size of the frog at the time of writing is (mouth to anus) 35 mm.

E. ELKAN,
62 Woodhall Gate,
Pinner, Middlesex.
(*Received* 21/7/71)

Reference: *Br. J. Herpet.* 4 (6), 135-138. Notes on four lizard species from the Peloponnese, Greece: *Algyroides moreoticus* Bibron and Bory, *Anguis fragilis peloponnesiacus* Stepanek, *Ophiomorus punctatissimus* (Bibron and Bory) and *Ophisaurus apodus* (Pallas).

In this recent paper the authors remarked that they believed their record of *O. apodus* to be new for the Peloponnese. Professor Mertens, Senckenberg Museum, Frankfurt, has recently communicated with the authors and has most kindly provided them with some locality records from the Peloponnese of which they were unaware. The authors are most grateful to Professor Mertens for this information and are here reproducing his remarks: *O. apodus* is recorded for the first time in the Peloponnese by Bribon and Bory (Exped. sci. Moree, 1833). Also by Cyren (1935) from Vasiliko (Bl. Aquar. Terr. Kde. **46**, 133) and again by Cyren (1941) from Vasiliko and Sparta and the Parnon Mountains (Mitt. naturwiss. Inst. Sofia 14, 46).

R. I. CLARK,
Palio Limani,
Spetsai, Greece.
(*Received* 17/8/70)

What a pity it is that Dr. Ahrenfeldt did not bother to check the literature before criticising my reply to Nickerson's article. Had he done so he would have found that the composition of reptilian blood plasma is very similar to that of mammals and that the notion (for that is all it ever was) that amphibian and reptilian plasma have a similar composition had finally been laid to rest with the coming of the flame photometer during the 1950's. I have just shown Ahrenfeldt's letter to a well-known physiologist. His only comment was, " I thought we left that idea on the ark ". I therefore repeat that 0.9% sodium chloride is as suitable for injecting into reptiles as it is for mammals. It is of course impossible to have the perfect solution for exact isotonicity but this is good enough and all physiological media for mammals, birds and most reptiles can be of the same composition. I am afraid that Ahrenfeldt's " fact " is very much fiction.

I quite agree that disposable syringes are the most suitable but in my experience most amateur herpetologists keep a glass syringe (I am told that this is because a number of pharmacists suspect them to be drug-addicts if they ask for disposable syringes) and hence my advice. I really cannot imagine anyone not taking the simple precaution of swabbing the skin (the scales, Dr. Ahrenfeldt, are part of the skin) with 70% ethyl alcohol. It may not be necessary but why take risks when there is no need?

(Dr.) M. Peaker,
Agricultural Research Council,
Institute of Animal Physiology,
Babraham, Cambridge.
(*Received* 18/2/72)

BOOK REVIEWS

The Temperature and Water Relations of Reptiles. By J. L. Cloudsley-Thompson. Merrow Technical Library, Watford. 1971. Pp. vi + 159. Illustrated.

During the last few years, great advances have been made in our knowledge of the physiology of reptiles and some of our ideas about the lives of these animals have been transformed. It is now appreciated, for example, that reptiles, at least in the wild, do not passively assume the temperature of their surroundings but possess quite sophisticated methods for regulating the temperature of their bodies. Much of this work has been done in the U.S.A., and Dr. Cloudsey-Thompson, formerly Professor of Zoology in the University of Khartoum, is one of the few British zoologists who have made significant contributions to the field.

The author deals very thoroughly with the topic of thermo-regulation, and discusses both behavioural methods such as basking and physiological ones which involve adjustments of the blood circulation, and colour change. The importance of diurnal rhythms, a field of which the author has made a special study, is indicated. Later sections of the book deal with the means by which reptiles regulate the composition of their internal fluids and conserve the water in their bodies; these are vital physiological problems, especially for forms which live in habitats such as the desert or the sea.

This well-written and attractively produced book will make fascinating reading for the general student of reptiles, as well as for comparative physiologists. It covers its subject very thoroughly and contains an excellent bibliography.

A. d'A. Bellairs

Les etangs a monstres. Jean Rostand, Stock, 1971.

The subtitle of this paperback is " Historie d'une recherche (1947-1970) ", and this is exactly what it is. British herpetologists will remember Jean Rostand particularly by his book which was translated as " Toads and toad life ". The present book starts with his work on toads reared from unfertilised

eggs, and the appearance amongst them of toadlets with abnormal numbers of toes, leading to the query whether such creatures might also be found in the wild. Examination of large numbers captured showed a few with 6 toes: a normal female crossed with a polydactylous male produced 123 normals and 125 polydactyl offspring.

From this, Rostand goes on to the appearance in certain lakes of numbers of edible frogs (*Rana esculenta*) with six or more toes. These could arise from as many as 70% of the tadpoles there, and subsequent research has shown no genetic cause. Abnormal froglets developed, though from apparently normal tadpoles caged with fish from these habitats, but not in the absence of these fish. The temporary conclusion seems to be that there must be some " teratogenic " agent associated with the presence of the fish. What is puzzling is the variation in the proportion of abnormal froglets in one locality from one season to the next.

John F. D. Frazer

The Hylid Frogs of Middle America. Duellman, William E. (1970). Monograph No. 1 of the Museum of Natural History. The University of Kansas, U.S.A. Vol. I, pp. 1-427; Vol. II, pp. 428-753. 72 plates. Price: $25. Copies from: The Publications Secretary, Museum of Natural History, University of Kansas, Lawrence, Kansas, 66044, U.S.A.

It must have caused the author of this monumental work immense satisfaction to see the results of 20 years of loving labour put between hard covers so as to make them available to the world of Herpetology. Compared with what is written about the higher vertebrates it is not often that a group of Amphibia is found worthy of such an honour and we must be equally grateful to the various scientific bodies in the U.S.A. who, at obviously considerable expense, made the publication of these volumes possible.

On 749 pages the book deals with 15 genera and 135 species of hylid frogs from Central America. The genus *Hyla*, understandably the largest of these genera, is subdivided into 28 groups. The text is illustrated by many excellent black and white drawings and at the end of Vol. II we find 72 plates showing 14 spp. in black and white and 150 spp. hand-painted in colour from colour photographs taken by the author. There are, furthermore, 29 audiographs of various species and five ecological photographs, the only ones which have suffered badly in the printing. Based on the 32,569 anuran Museum specimens of the Kansas Nat. Hist. collection and the many, often very arduous journeys he made through the area covered, the author, helped by many of the other prominent U.S.A. herpetologists, gives a detailed, ecological, taxonomic and, so far as possible, even audiographic description of the Central American Hylids. Tadpoles as far as they are known are included. As usual in works of this kind, histology is largely excluded from the text, which is to be regretted because the dermo-skeletal relations of the helmeted hylids offer some interesting features not found in other Anura.

A book of this size and price will not be within the reach of every herpetologist but it will certainly have to find its place on the shelves of every Institution dealing with lower vertebrates where it will remain the standard work on the subject for many years to come.

E. Elkan

Sowerby and Lear's " Tortoises, Terrapins and Turtles " with a new introduction by E. E. Williams. (SSAR Facsimile Reprints in Herpetology No. 28, 1970.)

This is a re-publication, in very slightly changed format, of the uncoloured edition of " Tortoises, Terrapins and Turtles ", drawn from life by James de Carle Sowerby, F.L.S. and Edward Lear (Henry Sotheran, Joseph Baer and Co., 1872). The original work was part of Thos. Bell's " Monograph of the Testudinata ", intended as a review of all known (including fossil) chelonians

but probably only issued (with coloured plates) in very small numbers to some subscribers in 1836-42.

This publication makes available again, at a very reasonable price, some of the finest figures of the external morphology of reptiles. There is the original Introduction by J. E. Gray, Bell's names, a very valuable list of current nomenclature, and Gray's notes on each species from such workers as Bell, Blyth, Darwin, Holbrook, Leconte and Theobald. For this the price of $14 represents very good value indeed (hardbound); $13 is the price for the paperback. Members of S.S.A.R. receive some re-publications free: altogether a worthwhile investment, this subscription!

The biographic notes on Edward Lear (pp. V-VI) are unfortunately incorrect in some respects. Lear did *not* leave England in 1837 never to "live there again"; he was resident in England 1845-6, 1849-53, some of 1854-55, and tended to summer there every year until 1870 and again in 1875, 1877 and 1880.[1]. Nor were his lithographs for this work his last zoological illustrations. He worked for Gould and Gray. Most of the bird prints attributed to Gould were by other hands, including his wife and Edward Lear. Williams infers (pp. III-IV) that all the drawings used in this work were by Sowerby; Lear being responsible for the lithography, but it is at least possible that some were entirely the work of Lear.

Available from the Society for the Study of Amphibians and Reptiles, Secretary, H. C. Seibert, Department of Zoology, Ohio University, Athens, Ohio, from whom details of other reprints can be obtained.

C. SIMMS

REFERENCE

1. *Vide* V. Noakes: "Edward Lear". Collins, 1968, pp. 315-6.

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