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Contributions should be addressed to the Editor, Dr. Harold Fox, Department of Zoology, University College, Gower Street, London, W.C.1. Articles should be typed in double spacing on *one side* of the paper only. Figures should be drawn in Indian ink on plain white paper, or preferably Bristol Board and suitably lettered for publication.

BIOMASS ESTIMATES AND THERMAL ENVIRONMENT OF A POPULATION OF THE FRINGE-TOED LIZARD, *ACANTHODACTYLUS PARDALIS*

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No field data are available for the lacertid lizard, *Acanthodactylus pardalis*. This study reports the results of a brief study of this species from 28.2km E and 6km S of Medenine, Gouvernorat de Medenine, Tunisia (elev. 50m). This is an area of North-saharan steppe in which over-grazing of *Rhanterium suaveolens* (Leguminosae) by sheep and camels has resulted in extensive dune formation.

Three small (.04-.06 HA) contiguous areas were chosen for population studies. Measurements of site dimensions were taken by pacing; the error in dimensions is about 10%. Specimens were collected from areas I and II from 11-13 May; area III was surveyed from 16-19 May, 1972. Each area was surveyed hourly during the period of activity (Fig. 1) and specimens were collected by stunning them with rubber bands. Specimens (usually dead) were stored at 20° C and weighed after return to the laboratory (a maximum of eight or nine hours after collection). All specimens observed were collected.

Several workers have presented arguments for the removal method of population estimation. Delury (1947) requires a thorough understanding of the biological factors which influence the behaviour of the subjects of the study. Hayne (1949) requires that the probability of capture be constant and that the number of animals present at the beginning of each period be the original population minus the number previously captured. Zippin (1956) requires that the probability of capture during a given trapping be the same for each animal and not vary from trapping to trapping. He (1958) further requires that trapping conditions (climate, effort, etc.) remain the same and hypothesizes that the multinomial method's precision is dependent upon the proportion of the population captured.

Each segment of the sample was analyzed independently using the formulae derived by Zippin (1956 and 1958). A chi-square test was used for the level of significance (Table 1). Since the chi-square for males from area III was too high to be reliable, these data were not considered further. The sample sizes were too low to be reliable at Zippin's 90% level for Standard Error, but I believe one can estimate confidence to be somewhere between 85 and 90% considering the percentage of captures on a theoretical level.

Based on the samples which appear to be reliable, the overall estimate of 148 males and 231 females per hectare would present a biomass of 2154 grams per hectare. The removal method of estimating biological populations is inferior to the mark and recapture technique (Zippin, 1958) but certainly may be useful when time is short and the subjects are as conspicuous and predictable as *Acanthodactylus*.

There were no apparent differences among the sites and data were pooled. Males weighed 5.0 to 11.0 ($x = 7.4 \pm 1.4$), females 3.5 to 6.5 ($x = 5.0 \pm 0.8$), grams, and there is a statistically significant difference in weight ($t = 7.72$, $p < 0.01$).

Cloacal temperatures of active lizards were obtained with a Bureau of Standards calibrated Terumo TN-III thermometer. Because the Terumo registered only between 35 and 42°C, only maximum voluntary tolerance (Cowles and Bogert, 1944: 277) could be measured and is reported as 38.0°C.

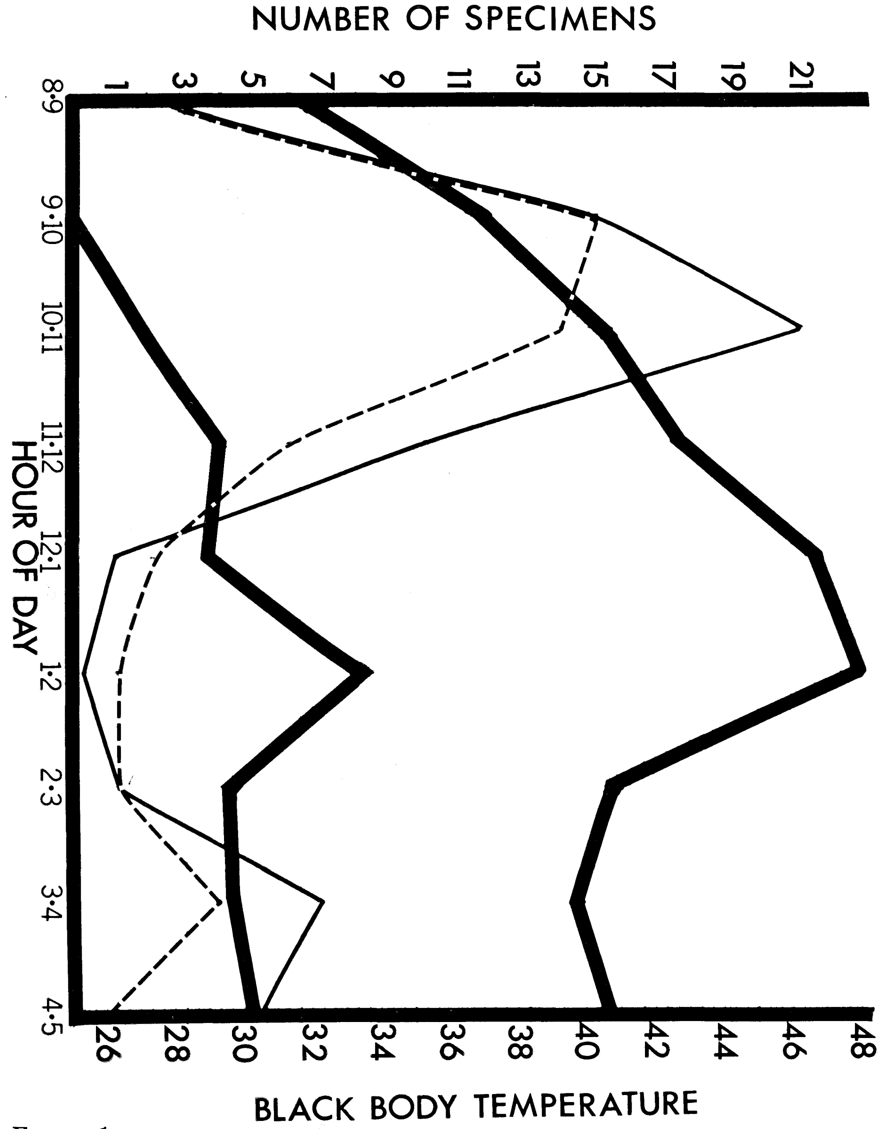

FIGURE 1.

Activity patterns in relation to time and black body temperature. Heavy lines indicate air temperatures (lower, shade; upper, sun); solid thin line denotes numbers of males and the broken line, females.

The relation of activity to mean black-body temperatures is illustrated in Figure 1. Males and females show no apparent differences in activity. Since the start of collecting was alternated between morning and afternoon on different sites on different dates, these composite data were compared with a nearby site from which no specimens were removed. Biomodality is not the result of collecting, but a natural effect; 36 months of data on *A. e. erythrurus* (pers. obs.) in southern Spain also exhibit this pattern.

Specimens collected are deposited in the Carnegie Museum (CM 56692(14), 56693(12), 56698-56705, 56715-56729, and 56731-56746).

Table 1. Actual and estimated *Acanthodactylus pardalis* population sizes.

AREA	♂♂		♀♀		PERCENT CAPTURED		STANDARD ERROR		x^2 (2df) 99	
	N	$\hat{N}$	N	$\hat{N}$	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀
I (.06 HA)	4	4	11	12.3	100	89	±1.0	±.48	0	.14
II (.04 HA)	8	11.4	10	10	70	100	±1.1	±1.0	1.01	0
III (.05 HA)	11	28.5	17	18.3	38	92	±4.0	±.38	10.74	.09

$\hat{N}$ = Estimated population. N = Actual population.
x^2_{99} (2df) = 9.210 or less for significance.

SUMMARY

Preliminary estimates of biomass for *A. pardalis* based on a removal census are given at 2154 grams per hectare. Maximum population density is estimated at 148 males and 231 females per hectare. Males are significantly heavier than females and maximum voluntary temperature was recorded at 38.0°C. Thermal environment and activity patterns are given in Figure 1.

ACKNOWLEDGEMENTS

Transportation funds were provided through Carnegie Museum; work in the field was sponsored by F. H. Wagner and J. Ghiselin of United States International Biological Program. F. H. Pough of Cornell University provided U.S. Bureau of Standards calibration and reviewed an earlier version of the manuscript. The staff of the Division of Amphibians and Reptiles of the U.S. National Museum provided helpful comments, and, to each, I extend my sincere gratitude.

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IS THE PALMATE NEWT A MONTANE SPECIES?

By

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The palmate newt (*Triturus helveticus*) is found only in western Europe and is said to favour hilly or mountainous country (Hellmich, 1962; Steward, 1969). In Britain, Smith (1969) regarded the palmate newt as a "montane species" while the other two indigenous species, the smooth (*T. vulgaris*) and the warty newt (*T. cristatus*), were thought to show marked preference for lowland areas. Since it is also found at sea level (Smith, 1969), the palmate newt is clearly not montane in the same sense as the word is applied to the Continental alpine salamander (*Salamandra atra*), which replaces the fire salamander (*S. salamandra*) above about 2,500 feet (Hellmich, 1962). The palmate newt, like the warty newt, probably suffered population declines in Britain in the 1960s (Prestt, Cooke and Corbett, 1974) and from the conservation viewpoint it is important that its habitat preferences should be known, in particular the extent to which hilly country is favoured.

Many people who contributed information to the Biological Records Centre (B.R.C.) on the distribution of newts in Britain also recorded the altitudes (in feet above sea level) at which the newts were seen. We extracted altitude data from all record cards for the period 1960-1973. Records giving a range exceeding 100 feet, such as "common in hillside ponds between 200 and 500 feet", were not included. If a record card lacked altitude data, but gave a six figure grid reference, then the altitude of the site was determined from a large scale map.

Total altitude data for Britain are given in Table 1 (column (1) for each species). There were only five records above 1,000 feet, including three for the palmate newt. Contingency tests on data up to 100 feet or above 500 feet revealed no significant differences between the distribution of records for the warty and smooth newts. However, there were relatively fewer records up to 100 feet for the palmate compared with either the smooth newt ($x^2 = 5.48$, $P < 0.05$) or the warty newt ($x^2 = 3.84$, $P = 0.05$); and above 500 feet, there were significantly more records for the palmate than for the warty newt ($x^2 = 6.88$, $P < 0.01$).

These differences, although not very marked, are consistent with the view that the palmate newt tends to prefer higher ground in Britain. This could be due to the palmate newt preferring higher altitudes in regions where all three species are found (Smith, 1969) and/or to it being relatively more frequently recorded in upland regions. One area of Britain where all three species are commonly recorded is the mid south-west (Hampshire, Dorset, Somerset, Wiltshire, Gloucestershire, Worcestershire and the southern part of the Welsh borders). When altitude records were examined for this region (100 km squares: 30, 31, 32, 40, 41; Table 1, column (2)) no differences were found between the three species, each showing a preference for sites between 200 and 300 feet. The palmate newt occurs at altitudes above 2,000 feet in the mountains of both Scotland and Wales (Smith, 1969) and we considered that perhaps altitude records from these countries would show differences between the palmate and smooth newts (Table 1, column (3)). There were, however, no obvious differences, and we have no evidence for the palmate newt preferring higher ground than the smooth newt in parts of Britain where the species occur together.

Differences in the altitude records of the three species for Britain seem to be a consequence of the newts' geographical distributions. The latest maps compiled by the B.R.C. (Arnold, 1973) show that the palmate newt is the rarest of the three species in central and eastern England, but is the most common in the south-west. In Scotland and Wales, all three species are poorly recorded, but the warty newt seems to be the rarest. Only the smooth newt occurs in Ireland. Altitude figures for eastern England (100km squares: 51, 52, 53, 54, 61, 62 and 63) are given in Table 1, column (4). In this lowland area the newts tend, not surprisingly, to be found at lower altitudes than elsewhere in Britain. For instance, significantly more sites in the up-to-100-feet altitude range were recorded in eastern England than in the mid south-west for both the smooth newt ($x^2 = 5.88$, $P < 0.05$) and the warty newt ($x^2 = 11.86$, $P < 0.001$). For the warty newt there were significantly more sites up to 100 feet compared with the palmate newt ($x^2 = 4.02$, $P < 0.05$), but this seems to have been due to a preponderance of warty newt records from the 100km squares 52, 53, 54, 62 and 63 (East Anglia and eastern Yorkshire) where 19 of the 28 records related to sites up to 100 feet above sea level. In south-east England (100km squares: 51 and 61) only one out of eight and four out of 22 sites were in the up-to-100-feet altitude class for the palmate and warty newt respectively. Relatively more of the altitude records came from eastern England for the smooth newt (46% of its total records) and the warty newt (39%) compared with the palmate newt (15%), and examination of the altitude figures for elsewhere in Britain (Table 1, column (5)) revealed no significant differences between the species. Thus, the differences in the total altitude records for Britain may be attributed to the relatively high number of records for the smooth and warty newts from lowland England.

The important question now is why should the palmate newt tend to avoid eastern England? The paucity of both pools on acid heathland and hills has been blamed for the comparative rarity of this species in East Anglia (Beebee, 1973). It is difficult to understand why the absence of high ground should make East Anglia so unattractive, since the palmate newt can be common in some lowland areas both on the Continent (Hellmich, 1962) and in Britain (e.g. on the acid heaths of Dorset). Moreover, the species is also relatively infrequently recorded in the 100km squares 33, 42 and 43 (the north and central Midlands of England), a region that is as hilly as the mid south-west. The palmate newt's preference for the south-west and north of Britain is more likely to be due to some other factor(s) such as climate or soil substrate. Steward (1969) remarked that it prefers sites on sand, peat or limestone soils rather than those on clay or alluvial soils. Comparing the B.R.C.'s distribution map (Arnold, 1973) for this newt with pedological and geological maps for Britain suggests that the palmate newt tends to avoid gleys on chalk or clay and perhaps also calcareous soils on chalk and soils on the older Carboniferous limestone. Apparently, the different distributions of the smooth and palmate newts are unlikely to have been caused by interspecific competition since, except in Switzerland (Heusser, 1970), the two species frequently use the same breeding site (Steward, 1969). Where the ranges of the two species overlap, Steward (1969) stated that "the Palmate Newt favours hilly or mountainous regions and is less at home at low levels than the Smooth Newt, so that" . . . "it is possible in some districts to find only the Palmate Newt and in others only the Smooth Newt, with intervening zones where both exist in varying proportions." The situation in England can best be summed up more cautiously: the palmate newt is commoner in some upland regions and tends to be rarer in lowland areas (see Appendix). No one seems to have suggested, as Smith (1969) did for Britain, that in localities on the Continent, the palmate newt tends to be found in the hills, while the smooth newt frequents lower ground. The fact that the subspecies *Triturus helveticus sequeirai* is found above 5,000 feet in the Pyrenees

(Hellmich, 1962; Steward, 1969) may have contributed greatly to the palmate newt's reputation as a montane species.

Table 1 Altitudes at which the smooth newt (*Triturus vulgaris*), the palmate newt (*T. helveticus*) and the warty newt (*T. cristatus*) have been recorded in Britain.

Altitude	Smooth newt					Palmate newt					Warty newt				
(feet)	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
⩽100	68	10	7	44	24	17	3	2	3	14	39	7		26	13
101-200	42	9	2	23	19	17	5	6	4	13	33	10	2	12	21
201-300	53	20	1	23	30	23	14	2	5	18	33	15	1	13	20
301-400	28	6	1	9	19	15	3	2	3	12	17	6		2	15
401-500	12	2		3	9	9	3	1		9	6	3			6
501-600	11	3	1	1	10	4	2			4	3	2			3
601-700	4	3	1		4	2	1	1		2	2	1	1		2
701-800	6		4		6	6		2		6	2				2
801-900	1		1		1	1		1		1					
901-1000															
>1000	1		1		1	3		1		3	1				1
Total	226	53	19	103	123	97	31	18	15	82	136	44	4	53	83

(1) Total for Britain
(2) Mid south-west; 100km squares: 30, 31, 32, 40, 41
(3) Scotland and Wales
(4) Eastern England; 100km squares: 51, 52, 53, 54, 61, 62, 63
(5) Total for Britain minus records for eastern England

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APPENDIX

From the distribution maps (Arnold, 1973) we calculated the factor,

$$\frac{\text{no. of 10km squares with post-1958 palmate newt records}}{\text{no. of sqs. with palmate newt records} + \text{no. of sqs. with smooth newt records}}$$

for each of the twelve 100km squares containing 10 or more records for either species. This factor should give some idea of the relative abundance of the palmate relative to the smooth newt (see Prestt *et al.*, 1974). Then for each 100km square the proportion of land above 400 ft was estimated (this altitude being chosen because it was the most easily discernible contour line within the desirable range on the map in the *Oxford Atlas*). The equation of the best straight line was: —

Factor,

$$\frac{\text{palmate newt records}}{\text{palmate} + \text{smooth newt records}} = 0.608\,(\text{Proportion of land} > 400\text{ft}) + 0.141$$

The relationship between the relative abundance of the two species and altitude was not, however, statistically significant for these areas ($r_{10} = 0.484$, $0.1 < P < 0.2$). Nevertheless, the twelve 100km squares could be split conveniently into three groups, based on altitude, and the group averages for altitude and record factor showed the trend so frequently referred to in the literature.

	100km square	Proportion of land >400 feet	palmate newt records / palmate + smooth newt records
Lowland	52	0.05	0.12
	51	0.12	0.23
		0.09	0.18
Intermediate	44	0.32	0.55
	33	0.37	0.20
	43	0.34	0.25
	42	0.34	0.07
	31	0.36	0.44
	41	0.26	0.48
		0.33	0.33
Highland	45	0.51	0.41
	34	0.55	0.39
	32	0.60	0.35
	20	0.54	0.85
		0.55	0.50

INFLUENCE OF BODY WEIGHT, SEX AND TEMPERATURE ON HEART BEAT IN THE GARDEN LIZARD, *CALOTES VERSICOLOR*

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INTRODUCTION

In American lizards Dawson (1960), Dawson and Bartholomew (1958), Dawson and Templeton (1963) and Templeton (1964) have demonstrated an inverse relationship between body weight and the rate of heart beat, independent of sex. The relation between sex and rate of heart beat (body weight remaining constant) was not studied by them. Information on the rate of heart beat in terms of body weight as well as of sex is lacking in Indian lizards. The present study attempts to fill this gap and in addition to investigate the relationship between temperature and heart beat. This was found to be linear in other animals (Prosser & Brown, 1961).

MATERIALS AND METHODS

The heart of the garden lizard *Calotes versicolor* was exposed (Subba Rao, 1967) and kept immersed in perfusion fluid (Dawson, 1960). The heart beat was counted 15 minutes after dissection, a time interval found to give a stabilized heart beat. Male and female lizards of different weights were studied to observe the effects of body weight and sex on the heart beat. To study temperature and rates of heart beat, lizards were selected of approximately equal weight (about 19gm) and of the same sex.

RESULTS

Relation between the rate of heart beat (HB), body weight (BW) and sex: The HB was measured of 12 lizards (6 males and 6 females). The smaller lizards of both sexes had a higher HB than larger lizards and the HB of males was higher than that of females (Fig. 1). The average HB of male and female *C. versicolor* was 84 and 80 beats per minute respectively.

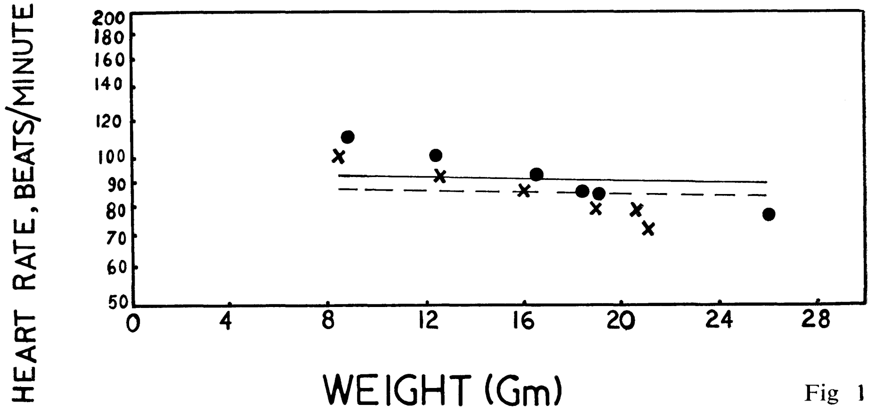

Fig 1

Relation between HB and temperature: Temperature effect on the HB was studied in 6 male and 6 female lizards, more or less of equal weight. With increase in temperature, the HB increased in the temperature range from 5°C to 30°C. Here there is a linear relationship between temperature and HB (Fig. 2). The temperature coefficient (Q_{10}) for HB at low temperature in both sexes (5-10°C) was greater than 3; whereas in the range from 10 to 25°C, it was nearly 2, but above the environmental temperature, the Q_{10} is between 1 and 2 (Table 1).

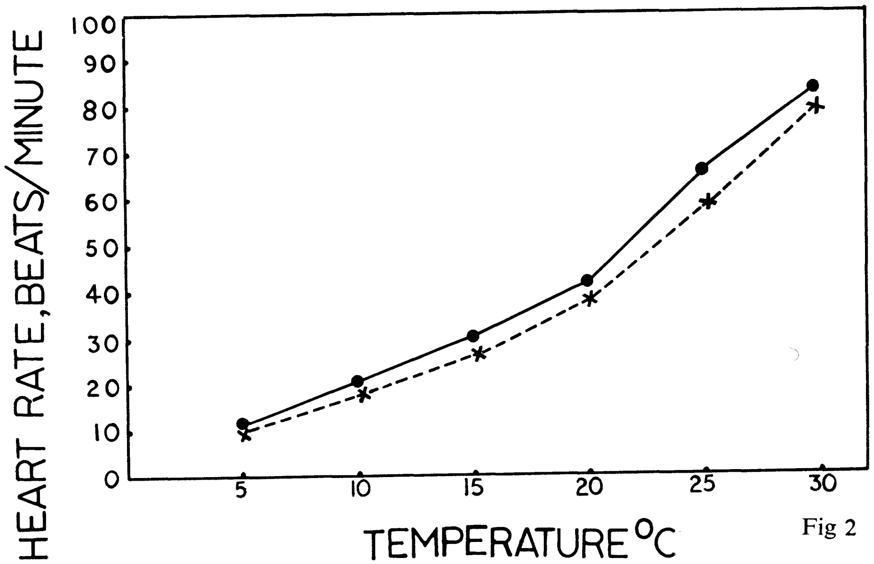

Fig 2

DISCUSSION

The HB is lower in the larger animals of same species (Prosser & Brown, 1961). The average HB for *C. versicolor* (both sexes) is 82 beats/min. The individual regression lines for male and female *C. versicolor* appear to be very similar to those of land pulmonates (Schwartzkopff, 1955) and of American lizards (Dawson, 1960; Dawson & Bartholomew, 1958).

In the present work male lizards have a higher HB than the females. The HB is related to activity and metabolism.

The linear relationship between temperature and HB (range: 5°C-30°C) in *C. versicolor*, was similarly reported in American lizards (Dawson, 1960; Dawson & Bartholomew, 1958; Templeton, 1964; Dawson & Templeton, 1963).

SUMMARY

1. Rate of heart beat is higher in smaller lizards (*Calotes versicolor*) than in larger ones.

2. Male lizards have a higher rate of heart beat than females.

3. Within the range 5°C-30°C, there is a linear relationship between temperature and rate of heart beat.

4. Temperature coefficients (Q_{10}) in both sexes are 3 (HB: 5°C-10°C); about 2 (10°C-25°C) and between 1 and 2 (25°C-30°C).

ACKNOWLEDGEMENTS

Thanks are due to: Dr. R. Mohanty, Vice-Chancellor, Utkal University for permission to collect lizards in his residential garden and his keen interest in this work; Professor B. K. Behura, Head of the Zoology Department, Utkal University for laboratory facilities and encouragement. Financial assistance was received from the University Grants Commission, New Delhi under the scheme " Financial assistance to teachers for research ".

Thanks are also due to Dr. Harold Fox of University College, London for reading the manuscript and offering helpful suggestions.

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Table 1: Temperature coefficient (Q_{10}) value for HB in *Calotes versicolor.*

No.	Temperature interval °C.	Q_{10} males	Q_{10} females
1.	5-10	3.352	3.240
2.	10-15	2.250	2.074
3.	15-20	1.960	2.132
4.	20-25	2.465	2.341
5.	25-30	1.615	1.769

Fig. 1: Single logarithmic grid: effect of Body weight and sex on HB of *Calotes versicolor.*

Male: ●——●
Female: X- - - - -X

—— Regression coefficient: b-value, male: −0.0433
- - - - - Regression coefficient: b-value, female: −0.0311

Fig. 2: Relation between temperature and HB of *Calotes versicolor* (average of 6 readings; range: 5°C to 30°C).

Male: ●——●
Female: X- - - - -X

STUDIES ON THE FOOD AND FEEDING BEHAVIOUR OF THE AGAMID GARDEN LIZARD, *CALOTES VERSICOLOR*

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INTRODUCTION

The stomach contents and feeding behaviour of other than Indian lizards have previously been discussed (Hallinan, 1920; Beebe, 1945; Fitch, 1954; 1955; Dessauer, 1955; Inger, 1959; Hirth, 1963a, 1963b; Lee *et al*, 1963; Bellis, 1964). Very little is known of the food and feeding behaviour of Indian lizards (Subba Rao, 1970). The low number of primarily flying insects in their diet was noteworthy. Moreover, the presence of an earthworm (6.5cm long) and a lizard (2.1cm snout-vent) inside the stomach of the garden lizard, *C. versicolor* is recorded.

MATERIALS AND METHODS

Calotes versicolor is found in the gardens of the Ravenshaw college campus and the residential quarter of the Vice-chancellor, Utkal University at Cuttack, Orissa.

Lizards were collected by trapping, hand collection and noosing. Funnel and pit fall traps of various types were used with varying success. Immediately after collection lizards were killed with chloroform and the stomach contents were removed and preserved in 10% alcohol for identification.

Thirty-six adult lizards (of varied size and sex) were collected during the winter season in 3 groups, each consisting of 12 lizards. There was an interval of one month between the successive collections.

RESULTS

Examination of the stomach contents of *Calotes versicolor* showed that they are mainly insectivorous. *C. versicolor* feeds on a wide variety of insects (Fig. 1 and Table 1), which they swallow without chewing or macerating. The size of the prey is within the limits of the size of the mouth. The type of prey varies according to the season and age of the lizard. *C. versicolor* mainly feeds on black ants, *Camponotus compressus* (85%). When *C. versicolor* captures black ants, beetles or lepidopteran larva, plant matter, egg shells and stones also accidentally pass into the stomach (Table 1). Plants, egg shells and stones remain undigested.

An earthworm (6.5cm long) in the stomach of a female *C. versicolor* (snout-vent length 10.6cm) and a small lizard (2.1cm, snout-vent length) in the stomach of a male *C. versicolor* (snout-vent length of 9.2cm) were discovered. Both specimens were undigested.

When *C. versicolor* sees its prey, it moves its tail and slowly crawls along the ground. It nods its head and protrudes its tongue at frequent intervals. The foraging garden lizard stops, raises its head and trunk, rests on its hind limbs and after swallowing the prey shakes its head sidewards whipping its tongue frequently. Such behaviour begins when the prey is at about 4cm away.

DISCUSSION

Calotes versicolor depends chiefly upon sight to obtain food, like *Sitana ponticeriana, Calotes nemoricola* (Subba Rao, 1970), *Ameiva quadrilineata* and *Basiliscus vittatus* (Hirth, 1963b). No differences in food preferences are found between the sexes in these lizards. During the winter (November, 1971-February, 1972), the main food of *C. versicolor* comprised black ants, beetles and lepidopteran larvae. *Calotes* can be compared with *Mabuya* and *Sphenomorphus* (Inger, 1959), where the dominant food and size of prey are not identical.

If the habitat requirements of all the lizards are satisfied, there can be no competition for food. However, this occurs where habitats of lizards coincide, since they search for similar types of prey (see Inger, 1959 in *Mabuya* and *Sphenomorphus*).

SUMMARY

The agamid garden lizards, *Calotes versicolor*, depend chiefly upon sight in finding food. They swallow food without chewing or macerating. *C. versicolor* feeds mostly on black ants, *Camponotus compressus*. Earthworm and the lizard are also found in the stomach of *C. versicolor*.

ACKNOWLEDGEMENTS

Thanks are due to: Dr. R. Mohanty, Vice-Chancellor, Utkal University for permission to study the lizards in his residential garden; Prof. B. K. Behura, Head of the Department of Zoology for laboratory facilities and encouragement; Mr. M. M. Dash, Research Asst., for his identification of some insects; the Secretary, University Grants Commission, New-Delhi for financial support and Dr. Harold Fox, Department of Zoology, University College, London for reading the manuscript and offering helpful suggestions.

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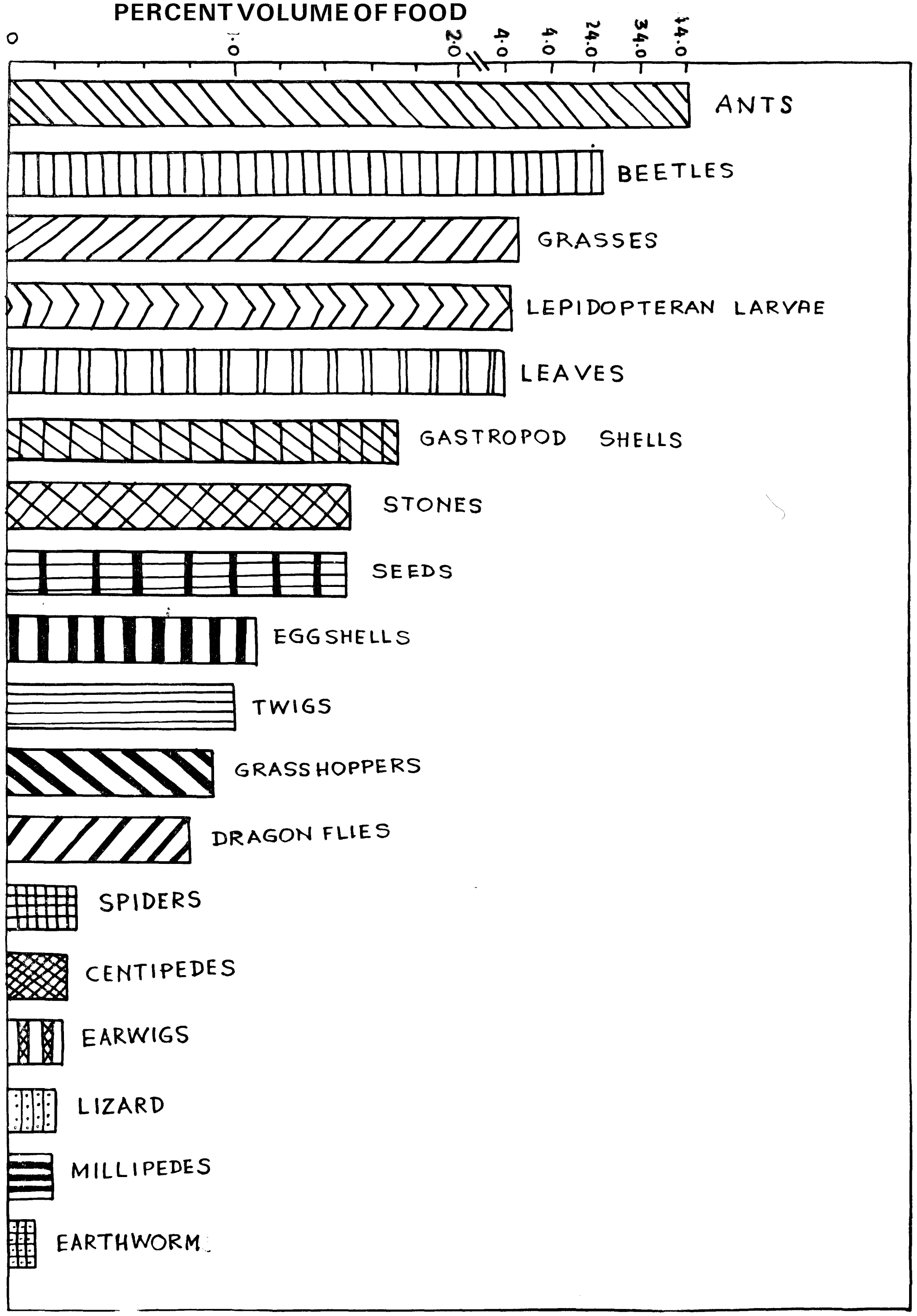

No.	Food type	Total volume	% volume	% Frequency occurrence
INSECTS				
	Hymenoptera—Felicidae:			
1.	Ants	1625.86	45.161	85.93
	Coleoptera:			
2.	Beetles	930.60	25.850	88.89
	Lepidoptera:			
3.	Lepidopteran larva	228.56	6.349	41.69
	Orthoptera—Acriididae:			
4.	Grasshoppers	32.22	0.895	11.11
	Odonata:			
5.	Dragon flies	28.73	0.799	13.89
	Dermaptera:			
6.	Ear wigs	8.81	0.245	5.55
MYRIAPODA				
7.	Centipedes	10.00	0.278	2.78
8.	Millipedes	7.40	0.206	5.55
ARACHNIDA				
9.	Spiders	11.00	0.305	5.55
ANNELIDA				
10.	Earthworm	3.44	0.096	2.78
MOLLUSCA—Gastropoda:				
11.	Gastropod shells	62.70	1.741	13.89
REPTILIA—Lacertilia:				
12.	Lizard	8.33	0.231	2.78
PLANT MATERIALS				
13.	Grasses	282.15	7.837	52.76
14.	Leaves	164.61	4.572	16.94
15.	Seeds	53.33	1.481	5.55
16.	Twigs	36.67	1.018	5.55
OTHER MATERIALS				
17.	Stones	54.71	1.519	8.33
18.	Egg shells	39.92	1.109	8.33

TABLE 1: Stomach contents of *Calotes versicolor* during November 1971-February 1972. (No. of lizards sacrificed: 36).

Fig. 1: Percentage volume of the stomach contents of *Calotes versicolor* during November 1971-February 1972.

OCCURRENCE OF THE UROPELTID SNAKE *BRACHYOPHIDIUM RHODOGASTER* WALL (SERPENTES: UROPELTIDAE) FROM TENMALAI, KERALA, INDIA

By

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(*Received* 21/1/1974)

In the course of extensive faunistic investigations recently carried out by Dr. Koshy Mathew and party of the Southern Regional Station of Zoological Survey of India, Madras, three examples of a rough tailed snake were picked up from loose sandy soil in the forested area of Andoorpacha, Quilon district, Kerala.

On detailed examination these specimens were recognised as *Brachyophidium rhodogaster* Wall because of the presence of the light whitish spot on their heads and by the compressed tail ending in a point.

Wall (1921: *J. B. Nh. Soc.*, **28** (2), 556-7) described this species based on four examples he secured from Shembagnur, Kodaikanal (Palanis). Colonel Beddome, the noted uropeltid worker, to whom we owe much of our knowledge on the group, has failed to take a single specimen from this area. As recently as February, 1972 three more examples of this species were taken from Shembagnur by one of us (T.S.N.M.).

Smith (1943: F B I, serpentes, 3:70) gives the range of this species as Palanis.

With the present record of this species from Tenmalai, Kerala, we can definitely say that it is not as rare as to be restricted to Palanis and it is probable that further investigations, in the unexplored wooded districts of South India, may yield interesting results to ascertain the distribution of this rare snake.

The authors are grateful to Dr. K. C. Jayaramakrishnan, Superintending Zoologist and Officer-in-Charge, Southern Regional Station, Zoological Survey of India, Madras, for encouragement and laboratory facilities and to Dr. Koshy Mathew, for having allowed us to work on the material.

REPORT ON THE REPRODUCTION OF CAPTIVE INDIAN PYTHONS (*PYTHON MOLURUS BIVITTATUS*)

By

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(*Received* 25/10/73)

On the morning of 18th April 1973, a routine inspection of the reptile exhibits revealed that our 10 feet long female Indian Python (*Python molurus bivittatus*), had laid 27 eggs on top of a mound of gravel, which she had scraped together from the cage floor. The snake was coiled around most of the eggs but a further 6 lay outside the coils. It was decided to remove the latter and attempt artificial incubation, while the bulk was left with the parent. The 6 eggs averaged: length—9.2cm, width—5.7cm, and weight—170gms.

They were placed in a mixture of dampened peat and sand in a plastic tray, thence installed in a simple incubator maintained at 85°F. The eggs were sprayed daily with lukewarm water but they slowly shrivelled and eventually the specimen. Small specimens were left in for approximately 12-18 hours, larger ones slightly longer.

6. Specimens were next placed in 2 changes of water of 6 hours each to remove the glycerol. It was noted that during this step, the cartilage was intensified if it had faded in the glycerol—KOH solution.

7. They were then placed in a 1% aqueous solution of KOH to which a few drops of alizarin red S (saturated in 1% KOH) had been added. This solution was changed daily until the soft tissue had been adequately macerated and the osseous material had reached the desired intensity of redness. Hydrogen peroxide (1-2ml per 200ml of KOH) was added to bleach the soft tissue.

8. Specimens were placed in various concentrations of glycerol and KOH (1:3, 1:1, and 3:1 respectively) over a 4-5 day period. They were then stored in pure glycerol to which had been added 1 or 2 crystals of thymol to prevent growth of mould. The thicker areas of muscle tissue were completely destained at this time.

The above procedure was successful on snakes and several specimens of small frogs, but has not been tried on other small vertebrates. The times indicated are a guide and may be changed according to the requirements of the individual specimen. Victoria blue has been suggested as a substitute for toluidine blue. An illustration of a double stained group of ribs is presented.

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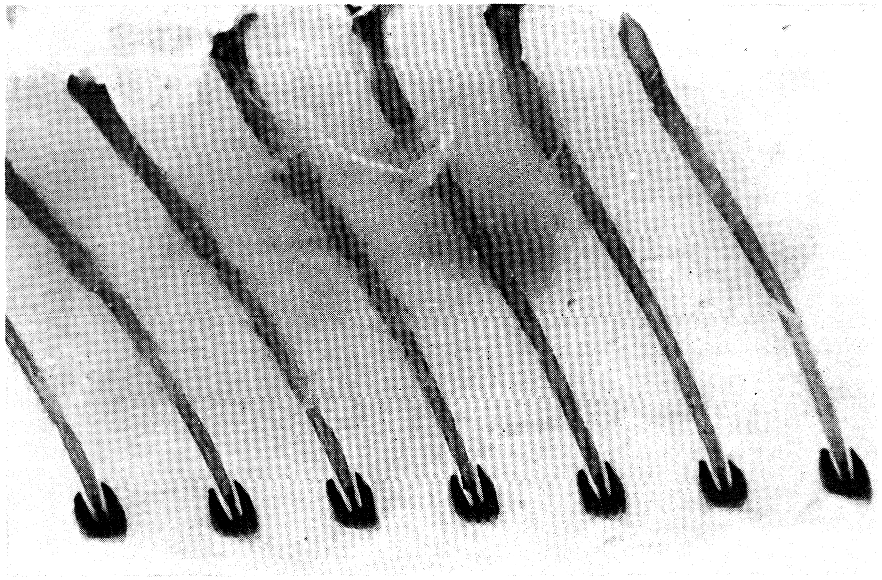

EXPLANATION OF TEXT FIGURE

Illustrated are a series of ribs from one side of a coach whip snake (*Masticophis flagellum*) showing the results of the double staining procedure. The lighter portions of the ribs have taken up alizarin red stain (bone), while the dark distal end of the ribs has taken up toluidine blue stain (cartilage).

LETTERS TO THE EDITOR

While I have some sympathy for many of the sentiments expressed by Mr. Pearce (*Br. J. Herpet.*, **5**, 455-6, 1974), I was naturally surprised by his attack on me for having used 24 frogs in a dosing experiment with DDT (see *Br. J. Herpet.*, **5**, 390-6, 1974). Over the last six years I have attempted to assess the effects of pesticides on British Amphibia, and my research programme included the following necessary investigations. (1) Surveys at national and local levels were required to find out whether the various species suffered population declines and, if they did, where, when and perhaps why. (2) Toxicological studies in the laboratory were essential to determine which are (a) the most sensitive species, (b) the most sensitive stages of the life cycle, (c) the most toxic pesticides and (d) the most characteristic and easily-observable sublethal effects. Armed with this information and having some knowledge of pesticide levels in the environment, it is possible to predict (a) whether field effects are likely and (b) if they are, where and when to look for them and what to look for. (3) Field trials in polluted situations were necessary to support these laboratory tests. (4) Analysis of field specimens was needed to determine whether animals had significant residue levels in their tissues. (5) The effects of other factors such as habitat destruction, collection, etc., also had to be evaluated. Mr. Pearce's figure for frogs used in education is probably derived from data given in one of my papers (*J. Zool.*, **167**, 161-78, 1972). (6) Since we still know little about the ecology of our amphibians, I also had to assimilate basic information on topics such as breeding site selection, colony size, survival of spawn, tadpoles and adults, predation pressures, etc., in order to (a) relate laboratory findings to field situations and (b) interpret field observations. Rather surprisingly, my paper in the same issue of the *Journal* (pages 389-90) describing predation trials in which newts consumed nearly 200 frog and toad tadpoles evoked no response from Mr. Pearce.

The dosing experiment with the 24 frogs was an essential part of the laboratory programme and, contrary to Mr. Pearce's assertion, no investigation had previously been carried out to determine residue levels or effects on hiding, food consumption, faecal sac production, jumping ability, etc. Neither, again despite what is stated in Mr. Pearce's letter, has anyone ever directly monitored the effects of DDT on population levels. Here he seems to have misinterpreted a statement in my discussion, just as he has misquoted what he calls my " conclusion ".

My investigations indicate that (1) while many *sites* must have become harmfully polluted with pesticides since the 1940s, and (2) although, in some heavily-polluted *regions*, a sufficient number of local populations may have been affected to contribute to an overall decline, (3) nevertheless pesticides have been relatively unimportant in a *national* context. The main reason for the general population decline is destruction or modification of wetland habitat. I hope that my work is of use to other people (such as Mr. Pearce), who are interested in conserving amphibians, by increasing our understanding of amphibian ecology and, in particular, by indicating how individuals and populations respond to changing environmental pressures.

ARNOLD COOKE,
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Abbots Ripton,
Huntingdon.
(*Received* 20/2/75)

I find it interesting to read some recent letters (*Br. J. Herpet.* June and December 1974) commenting on wasteful research and blaming this for dramatic reduction of indigenous herpetofauna. There are some fundamental confusions here that should probably be clarified.

First of all I would argue that the collecting of specimens for research and instruction would be unlikely to have much effect unless the population had previously been reduced to a low level by environmental changes. Wide ranging species, as opposed to relict populations, can generally withstand a limited amount of cropping, whether by natural or human predators. However, there should be no question that collecting must be controlled.

There are two fundamental problems. The first is that the author does not make any distinction between the use of amphibians and reptiles in instruction and their use in research. One may have differing opinions about the use of living lower vertebrates in high-school projects and the requirement that each student dissect a frog. It may be less certain that one could reasonably object to the practice of dissection for university students, particularly for those planning to major in medicine or Zoology. However, none of these uses represents research, and one wonders how many of those " 200,000 frogs " are actually used in non-instructional projects.

Mr. Pearce also seems to equate research with conservation, rehabilitation and education. While commendable, these activities do not increase our knowledge of the subject. Furthermore, misguided conservation may lead to the destruction of habitat and extinction of species. The construction of " new ponds " in a previously dry area may lead to the introduction of frogs. Unless ponds have been a natural part of the particular environment they may only be aiding the spread of species not natural to the area and hastening the demise of other forms. The literature is full of cases in which inadequately defined park boundaries and control measures have led to destruction of habitat and endangerment of species. Not all " reforestation " means survival of the fauna and flora of native forest, advertisement to the contrary.

We are only beginning to understand where our reptiles and amphibians live, how many of them survive from year to year and how such survival and reproduction is influenced by the physiology of their muscle and endocrine glands, gonads and gut. To stop investigation now is to assure that all future decisions must be based on the level of our present ignorance. This is hardly an adequate legacy, nor one likely to have a significant chance for promoting the survival of the denizens of our endangered environment.

CARL GANS,
The University of Michigan,
Ann Arbor, Michigan.
(*Received* 12/3/75).

BOOK REVIEWS

Smith, Hobart M. and Smith, Rozella B. *Synopsis of the Herpetofauna of Mexico.* Volume II. Analysis of the literature exclusive of the Mexican Axolotl. 1973. Eric Lundberg, West Virginia.

The second volume of the *Synopsis* completes the survey of literature on the Mexican herpetofauna, although the authors indicated they would update the literature in the future volumes on the herpetofauna. Volume I contained the literature on the Mexican Axolotl. Volume II in addition to the 5,278 literature entries contains 21 pages of introductory material. This includes procedural matters, an historical account subdivided into a (1) pre-Linnaean period, (2) Linnaean and post-Linnaean 18th Century, (3) 19th Century, and (4) 20th Century. This is followed by an interesting section entitled " Analysis of the Indices ". Here such things as the number of papers published during

10 year intervals, starting with 1600-1609 (none published), continuing through 1960-1969 (over 1,400 published), and they project during the period 1970-1979 that 1,750 papers will be published. They present number of total papers published by country, during 10 year spans, and various other data that can be gathered from a literature compilation of this sort.

Besides the introduction there are indices (from titles) to scientific names, place names, disciplines, general terms, and co-authors. The last index is to the serial abbreviations. This section should be extremely useful to anyone trying to run down an obscure or foreign publication that happens to be included and there are many. The German citations are very accurately done, likely the result of painstaking work by Mrs. Smith, an expert in the German language.

This book will likely become a source book for many herpetologists, not just for Mexican specialists. It is exhaustively thorough; I am certain there are omissions, but I have not yet found one. Of course its major use will come as the subsequent volumes of the *Synopsis* arrive on the market.

KEN WILLIAMS.
Louisiana.

Eakin, R. M. (1973). *The Third Eye.* University of California Press. pp. 157. Figg. 78. $7.50; £3.75.

It must be most gratifying to all herpetologists to have, under one cover, an up-to-date account of the present state of our knowledge on a structure which has puzzled zoologists for a hundred years. Professor Eakin, who has written about 25 papers on the parietal eye in the course of many years of the most intricate investigation, is certainly among the best qualified to bring us a résumé of our present day knowledge of this enigmatic structure. The book might have been entitled *The Third Eye and the Electron Microscope,* because it is this instrument which is at the heart of the advances which have been made in unravelling the incredibly complicated ultramiscoscopic structure of the lateral and the median eye. The author's research was naturally carried out on the material most readily available to him: the frog, the lamprey and particularly the Western Fence Lizard (*Sceloporus occidentalis*). Our humble slow worm which has an equally well developed third eye, does not even figure in the index, although it intrudes in almost every page of the book. Whether the author has succeeded to make this treatise equally digestible for the scientist and the layman I leave the reader to decide. Your reviewer has his own idea about that. And he would also like to learn whether Prof. Eakin regards the third eye—in the species equipped with such an organ—as a structure on the way in, out or stable. Like all good scientific books, the present one leaves the reader with a string of problems to be tackled by future generations of electron microscopists. In the meantime no herpetologist can fail to be fascinated by the cornucopia of knowledge presented to us in the 157 pages of this book.

E. ELKAN.

Bustard, R. (1973). *Kay's Turtles.* VIII + Pp. 126. Collins. London and Sydney. £1.95.

This book is about the life history and behaviour of the green turtles (*Chelonis mydas*), ingeniously presented by Bustard as seen through the eyes of Kay Pau, a young Melanesian girl, who was born and bred on a remote island in the Torres Strait, between New-Guinea—Papua and Australia.

Being a native and thus used to turtles, Kay is quite at home with them and automatically behaves in a manner least likely to upset breeding turtles, so that she could see them at close quarters. The descriptions of her association with Ruth and Gemai (called after her grandmother) and a large male called Barry are delightful and fascinating.

Though the turtles are the *raison d'être* of the book, the unspoilt young Melanesian girl almost steals the scene. The book left a pleasant feeling after reading it.

H. Fox.

Bustard, R. (1972). *Sea Turtles. Their Natural History and Conservation.* X + Pp. 217. Collins. London and Sydney. £3.00.

In contrast to *Kay's Turtles* this work is more professional and business-like. The lives of the 7 species of sea turtles, in 2 Families and 5 genera are described. These are: the Family Cheloniidae which includes the loggerhead (*Caretta caretta*), the hawksbill (*Eretmochelys imbricata*), the green turtle (*Chelonia mydas*), the flatback (*Chelonia depressa*), the olive or Pacific Ridley (*Lepidochelys olivacea*), and Kemp's Ridley (*Lepidochelys kempi*). The Family Dermochelyidae includes *Dermochelys coriacea*, the leathery turtle. Apart from Kemp's Ridley all the sea turtles occur in Queensland waters where Bustard worked.

After an initial " Introduction ", sea turtles are described and illustrated. The research pursued by Bustard and his colleagues is described and thence turtle conservation in general is discussed with suggestions made to preserve them. There are a number of interesting black and white photographs. The book concludes with an " Appendix " of an Identification Key for the world's sea turtles.

This book (as indeed is *Kay's Turtles*) is mainly concerned with the life history and reproductive behaviour of the females, as they migrate up the beach to nest and thence lay their eggs. The intense predation by a variety of predators, including man, is deplored and the author suggests various ways of saving sea turtles (before some species could well be completely eliminated), including sea farming, where eggs are protected in artificial rookeries and breeding is controlled. It is ironical that the greater the predation initially, of hatchlings, crossing the reef platform to the open sea, when most of the sharks and other large fish become satiated with prey, the greater is the probability that larger numbers of turtles will survive—the market is flooded as the author says—provided of course that there is a substantial surplus of hatchlings.

Conservation is discussed in some detail and Dr. Bustard and his colleagues should be commended for their efforts to stimulate legislation and thus assist in the preservation of sea turtles in Queensland, Australia.

The book is well worth reading and having in one's " herpetological " library.

H. Fox.

Elkan, E. and Reichenbach-Klinke. *Color Atlas of the Diseases of Fishes, Amphibians and Reptiles.* 1974. Edited by Marsha Landolt. Available in Britain through T. F. H. Publications, Inc. Ltd. 13 Nutley Lane, Reigate, Surrey.

Professor Reichenbach-Klinke's and Dr. Elkan's book *The Principal Diseases of Lower Vertebrates* was published 10 years ago and since then has established itself as the standard reference book on the subject. Now the authors have collaborated again, this time with Dr. Elkan as senior author, and have produced the first colour atlas of diseases of fish, amphibians and reptiles.

The book consists of 256 pages and, with the exception of a short preface and index, is composed entirely of 385 pictures, the majority of which are coloured. The subjects are divided into Viral Diseases, Bacterial Diseases, Parasitic Diseases, Genetic Disorders and Trauma, Nutritional Disorders, Environmental and Hematological Diseases and Neoplastic Diseases. On most pages there are two plates showing both macroscopical views of affected animals and microscopical views of pathological lesions and organisms.

This book is attractively produced but is smaller in size (21cm x 14.5cm) than its price (approximately £14 in Britain) might suggest; however, this makes it a compact volume which can be more easily transported and read than most " atlases ". There is very little text—in most cases only one or two explanatory sentences under each picture—and the spelling is American.

This is a fine piece of work and it is perhaps pedantic to draw attention to its mistakes. However, it is a highly priced book and it would seem only fair to potential purchasers to mention errors and omissions.

In view of the paucity of text it is disappointing to find spelling and printing mistakes and one wonders at the role of the Editor in the production of this work. Certainly there are errors that would not have been permitted or overlooked by such experienced authors. Many pages are not numbered and there are spelling mistakes such as the scientific name " *Dendraspis jamesi* " erroneously given to the black mamba (plates 284, 289 and 290). A number of typographical errata have been pointed out to the reviewer by the senior author and these include wrong labelling and transposition of plates. Two photographs are shown upside-down but fortunately this mistake does not appreciably reduce their scientific value. A number of other minor errors were noted by the reviewer such as plate 286 where *Ophionyssus natricis* is called a tick. *Entamoeba invadens* (and *E. histolytica*) are given the earlier generic name of *Amoeba* and the taxonomy of *Pseudomonas* and *Aeromonas* is rather outdated.

The acknowledgements are a little confusing. Certain names, e.g. " Crewehr " and " Herschel " are given without title and without initials. Some plates bear the name of the photographer after the caption and some do not; many people (e.g. Mawdesley-Thomas, plates 339, 360, 361 and 375) have their names appended to photographs but no acknowledgement is made to them.

Some of the photographs, and particularly the photomicrographs, are not as clear as one might wish but it must be remembered that they represent several years of work, much of it without access to highly sophisticated photographic facilities. The reviewer was pleased to find some of Dr. Elkan's excellent and informative drawings (plates 303, 316 and 352) and would have been happy to see more of them in the text. There is, perhaps, some imbalance in the use of plates; there are thirteen pictures of *Ichthyophthirius* and the same basic lesions are shown in plates 74 and 75 and 350 and 351.

The reviewer would have welcomed a list of references or "Further Reading" in the book. Rafferty's paper on renal adenocarcinoma in Cancer Research is referred to on page 241; similar mention of other publications would have enhanced the value of the book to scientific workers. There is no reference to other works on the anatomy, histology and haematology of lower vertebrates and this too would have proved helpful. Another notable omission is mention of the Registry of Tumors in Lower Animals in Washington. The Registry has a large collection of lower vertebrate pathology material and is extremely generous in the lending of material and proffering of advice; reference to its work and facilities would have not been out of place.

To conclude, this book covers a subject that has largely been neglected in the past. The atlas is the first pictorial guide to the diseases of lower vertebrates and covers a wide range of species and conditions. Its price is, unfortunately, very high, and this may deter the interested non-professional from purchasing the book. However, for all students of lower vertebrate biology, whether they be zoologists, herpetologists, veterinary surgeons or comparative pathologists, the book is strongly recommended. In their preface the authors express the hope that the book ". . . may at least form the basis of a complete text of lower vertebrate pathology which will certainly be written in the foreseeable future". There is little doubt that this will be the case.

J. E. COOPER

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