The HERPETOLOGICAL BULLETIN

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THE HERPETOLOGICAL BULLETIN

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Front cover illustration

Chamaeleo chamaeleon from Zaranik, Egypt. See page 17.

ADDENDA TO 'A SURVEY OF THE ANURAN FAUNA OF MONTAGNE BELVÉDERE, COUNTY OF SAÜL, FRENCH GUIANA'

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In a recent paper (Kok, 2000), I mentioned the presence of *Otophryne robusta* on Montagne Belvédère in central French Guiana. In fact, shortly after the submission of my paper, I received a reprint of an article by Campbell & Clarke (1998) in which these authors reviewed the genus *Otophryne*. It appears that the species present in French Guiana is a new species, *Otophryne pyburni* Campbell & Clarke, 1998 and not *Otophryne robusta* Boulenger, 1900. At the time this new information was received my paper was already in press and the modification could not unfortunately be carried out.

I mentioned also the presence of *Colostethus* baeobatrachus Boistel & de Massary, 1999, but Martins (1989), in a poorly known report, described a new species, *Colostethus stepheni*, and mentioned that 'C. baeobatrachus' of Edwards (1974) corresponds to this species. I carefully read the article and the diagnosis of Martins and conclude that the species I called *Colostethus* baeobatrachus Boistel & de Massary is in fact a junior synonym of *Colostethus stepheni* Martins, 1989. This record considerably extends the range of *C. stepheni* which was only known from the region of the type locality (Amazonas, Brazil).

Concerning *Bufo* species 1 and *Bufo* species 2 (page 10), the reader needs to read 'not hypertrophied' instead of 'hypertrophied'.

I would like also to thank Dr. Scott Mori (New York Botanical Garden) for the permission to use the map of Saül and surroundings illustrating the article.

ACKNOWLEDGEMENTS

I thank H. Bringsøe for his judicious comments on *Colostethus stepheni*.

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Editor's note:

The original article referred to here regrettably also contained a number of printing mistakes, for which we apologize; the principal errors that readers should be aware of are listed below.

p. 6, 3rd paragraph; Trois Sauts - and not Trois Sauits.

p. 15, concerning *Hyla minuscula*, line 3; Rivero (1971) - and not Rivero (1968).

p. 18, plate 6; Atelopus flavescens - and not Atelopus flavesens.

p. 18, plate 8; *Colostethus beebei* - and not *Colostethus beehei*.

p. 22, concerning *Leptodactylus pentadactylus* (Laurenti, 1768) - and not (Laurentil, 1768)

p. 23, concerning *Physalaemus petersi*; males were calling - and not 'were called'.

p. 24, concerning *Eleutherodactylus marmoratus*; males were calling - and not 'were called'.

SOME OBSERVATIONS ON DIURNAL ACTIVITY PATTERNS, HABITAT, AND NATURAL HISTORY OF MABUYA AFFINIS (SCINCIDAE) IN THE NIGER DELTA, NIGERIA

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ABSTRACT

Some observations on the activity patterns, habitat, and reproductive phenology of the skink *Mabuya affinis* are presented in this paper. The study was conducted, between April and May 2000, in a locality of the eastern Niger Delta, south-eastern Nigeria. Skinks were diurnal, and exhibited a bi-peaked activity pattern, with a first and small peak around 9-10.00 am, and a second high peak by 2.00 pm. Lizard activity intensity was positively influenced by increases of both air and substratum temperatures, and negatively by increases in relative humidity. *Mabuya affinis* fed mainly upon insects (termites and ants), and was typically linked to altered habitats in the forest-plantation mosaic of the Niger Delta. Oviposition is likely to occur during the dry season, and egg hatching at the end of the dry season.

THE skink Mabuya affinis is one of the most widely distributed reptiles of the Niger Delta Basin (Akani, Luiselli & Politano, 1999). In terms of abundance, and together with the congener Mabuya maculilabris, it is next to the Rainbow Lizard (Agama agama) which is the most abundant, particularly in suburban habitats (Butler, 1986; Reid, 1986; Akani et al., 1999). Specimens of Mabuya affinis are commonly found on the forest floor, and in and around human settlements. According to Reid (1986), it is a typical species of modified vegetation, rarely recorded far into primary forest. Despite their abundance in the field and wide distribution, however, ecological studies on this scincid are scarce, particularly in Nigeria where we can avail ourselves of only a few comments reported by Dunger (1972, 1973), Butler (1986), Reid (1986), and Akani et al. (1999).

As a part of a larger ecological project on forest

reptiles of Nigeria (e.g. see Luiselli, Akani & Capizzi, 1998, 1999; Luiselli, Angelici & Akani, 2000), we conducted a short-term study devoted to the daily activity patterns and habitat preferences of *Mabuya affinis* at a site of the Niger Delta. The present note reports the results of this investigation.

STUDY AREA

The study was conducted between the towns of Rumuosi and Rumuigbo in the suburbs of Port Harcourt - the capital city of Rivers state, Nigeria (Figure 1). Situated within the costal plain, on the eastern flank of the Niger Delta, the area is characterized by secondary forest vegetation adjoined by a series of cultivated and abandoned farmlands, plus some derived grassland due to over cropping. The climate is essentially tropical with approximately six months of dry season (November - April) and six months of rain season (May - October). Rainfall is high, and records over



Fig. 1 Map of south--eastern Nigeria, showing the location of the study area.

1250 mm annually. The major occupations of the people here are farming, hunting and fishing. Others are palm wine tapping, processing of oil palm fruit from the palm Elaeis guineensis, which is quite abundant here to a density of not less than 20 individuals per hectare.

MATERIALS AND METHODS

The skink activity pattern in this study was based on the number of skinks counted along a 200 meter long transect every 30 minutes from 0600 -1800hrs for 10 days, between April and May, 2000. The study transect was walked along only one direction at each sampling, to avoid multiple counts of the same lizard specimens. At each sampling time, air, and soil temperature as well as relative humidity measurement were made (using a mercury. in glass thermometer and whirling hygrometer respectively) to investigate whether or not any correlations exist between skink abundance and time of day, and these ecological factors. All sighted individuals were observed by means of a pair of powerful binoculars to identify the food items they caught during their normal activities, and behaviours elicited at different periods of the day. We considered active all the lizard specimens found above-ground, i.e. including both the individuals sitting and moving in sun and those sitting and moving in shadow. Hidden specimens were considered not active (Anibaldi, Luiselli & Angelici, 1998). The basking



Fig. 2. Relationships between air temperature and density of above-ground active *Mabuya affinis* (number of specimens $x m^{-1}$ at the study area). For statistical details, see text.

duration was determined by using a stopwatch.

To determine habitat preference of *Mabuya* affinis at the study area, seven major skink habitats were identified: Cassava Peel Dump (CPD), Timber Piles (TP), Oil Palm Fruit heap (OPFH), Garbage Dump (GD), Dilapidated building (DB), Ground and Reed (GR), and Shrub/Tree (ST). At intervals of two days, these habitats were visited and skinks found within a 20 meters radius counted at the peak activity period. The numerical abundance obtained in this second experiment was used as a measure of this species' habitat preference.

Statistical analyses, with all tests being twotailed and alpha set at 5%, were performed with Prism 3.0 (GraphPad) PC package.

RESULTS AND DISCUSSION

Raw data showing the activity patterns of *Mabuya affinis* in relation to air and soil temperature, and relative humidity, for 10 different days at the study area, are presented in Table 1. Using the density of above-ground active lizards sighted while walking along the transect (number of specimens $x m^{-1}$) as a measure of activity intensity, it resulted that above-ground lizard density increased significantly with increases of both air

TIME (HOURS)	Soil T (°C)	AIR T (°C)	% HUMIDITY	NO OF SKINKS	Major Activity Types
0600	25.6 ± 0.7 (25-27)	25.3 ± 0.6 (24.5-26)	92 ± 1.8 (86.94)	0	Hiding
0630	26.3 ± 0.9 (24.5-27)	26.4 ± 1.0 (25-26)	90 ± 2.1	0	Hiding
0700	26.3 ± 0.8 (25.5-27)	26.7 ± 0.8 (25-28)	91 ± 2.5 (84-96)	0	Hiding
0800	29.0 ± 0.9 (26.5-30)	28 ± 1.3 (26-29)	89 ± 2.8 (82-92)	0	Hiding
0830	30 ± 1.5 (26.5-30)	29.5 ± 1.8 (27.0-30)	85 ± 1.6 (80-92)	(0 - 4)	Basking Running
0900	30 ± 0.7 (26-31)	29 ± 1.5 (26-30)	83 ± 2.2 (76-87)	(0-3)	Basking Running
0930	30.5 ± 1.8 (26.5-31)	29.5 ± 1.8 (26-31)	81 ± 3.6 (76-89)	6 (2 - 10)	Basking Running
1000	31 ± 0.4 (27.0-32.5)	29.0 ± 0.6 (27-31.5)	78 ± 2.4 (72-86)	4 (2 - 8)	Basking Running / Eating
1030	31.5 ± 0.6 (28.0-32.1)	30.0 ± 1.4 (27-31.5)	78 ± 2.7 (72-83)	12 (3 - 16)	Basking Running / Eating
1100	31.0 ± 1.3 (29.0-32.0)	30.5 ± 0.9 (27.8-31.5)	75 ± 3.5 (68-82)	(2 - 16)	Basking Running / Eating
1130	32.1 ± 1.2 (30.0-31.8)	31.0 ± 0.9 (30.0-32.0)	75 ± 2.8 (65-80)	(2 - 7)	Basking Running / Eating
1200	32.5 ± 0.8 (29-33.5)	30 ± 0.8 (28-31.8)	58 ± 3.6 (56-60)	6 (2 - 12)	Basking Running / Eating
1230	33.0 ± 1.1 (30.0-34.5)	30.5 ± 0.8 (29-31.5)	56 ± 2.9 (51-63)	10 (2 - 14)	Basking Running / Eating
1300	32 ± 0.9 (30-34.0)	31.0 ± 1.5 (29.5-31.8)	58 ± 3.1 (54-60)	8 (5 - 11)	Basking Running / Eating
1330	33 ± 0.5 (30-34)	30 ± 1.3 (29.8-32.0)	56 ± 0.7 (53-62)	8 (3 - 10)	Basking Running / Eating
1400	33.6 ± 1.4 (30.6-34.5)	31.1 ± 0.9 (29.5-32.7)	48 ± 2.8 (44-52)	16 (5 - 19)	Running Resting
1430	33.2 ± 0.8 (30.0-34.0)	31.5 ± 1.3 (30.0-32.4)	54 ± 3.2 (50-64)	10 (5 - 14)	Running Resting
1500	33.0 ± 1.2 (30.5-33.8)	32.0 ± 0.6 (30.5-33.8)	56 ± 2.7 (53-64)	(2 - 6)	Running Resting
1530	32.6 ± 1.5 (30.0-33.5)	31 ± 1.1 (30.0-33.4)	54 ± 1.9 (50-60)	6 (2 - 9)	Running Resting
1600	32 ± 1.8 (30.5-33.0)	31 ± 1.5 (30.4-32.2)	62 ± 3.1 (56-67)	4 (1 - 6)	Resting
1630	31 ± 1.5 (30.2-32.8)	30 ± 0.8 (29.0-31.2)	62 ± 2.5 (52-67)	2 (1 - 4)	Resting
1700	31.2 ± 0.6 (30.0-31.8)	30 ± 0.9 (29.7-31.2)	64 ± 1.8 (60-69)	(0 - 3)	Resting Hiding
1730	31.2 ± 0.8 (30.5-31.6)	29.2 ± 1.4 (29.0-30.0)	72 ± 2.8 (68-84)	0	Hiding
1800	30 ± 1.4 (29.7-30.9)	28.3 ± 1.9 (27.8-29.5)	78 ± 3.5 (68-88)	0	Hiding

Table 1: Raw data showing the above-ground activity periods of *Mabuya affinis* in relation to air temperature, soil temperature, and relative humidity for 10 different days around Port Harcourt city in south-eastern Nigeria. Means are followed by \pm one Standard Deviation, and ranges are in parenthesis.

DATE	CPD	TP	OPFH	GD	DB	GR	ST
13/4/2000	6	6	4	4	8	3	1
15/4/2000	5	4	2	4	14	2	0
17/4/2000	5	3	2	6	6	1	1
19/4/2000	9	3	6	8	10	0	1
21/4/2000	7	4	1	5	13	4	2
23/4/2000	10	2	3	8	9	1	0
25/4/2000	4	6	2	8	11	0	0
27/4/2000	2	6	4	6	14	3	1
29/4/2000	4	4	3	4	5	3	0
01/5/2000	2	1	3	8	8	1	3
03/5/2000	8	3	6	2	8	2	1
05/5/2000	5	3	1	6	3	1	1
07/5/2000	5	2	1	5	7	2	0
09/5/2000	7	1	2	2	12	4	0
11/5/2000	4	5	1	7	5	0	0
13/5/2000	8	2	4	10	13	2	1
15/5/2000	11	3	2	3	10	2	0
17/5/2000	4	I	3	3	8	3	2
19/5/2000	4	4	3	5	7	1	1
21/5/2000	2	2	5	2	7	3	1
Total	112	65	58	106	178	39	16
Mean	6	3	3	5	9	2	1
Std dev.	2.6	1.6	1.5	2.3	3.2	1.2	0.8

Table 2: Numbers of *Mabuya affinis* specimens sighted in the various habitats surveyed at the study area. Habitats are: Cassava Peel Dump (CPD), Timber Piles (TP) Oil Palm Fruit Heap (OPFH), Garbage Dump (GD) Dilapidated Building (DB); Ground and Reed (GR); and Shrub/ Tree (ST). Observations were made during activity peak periods (0930 - 1430 hrs) between April and May, 2000.



Fig. 3. Relationships between soil temperature and density of above-ground *Mabuya affinis* (number of specimens $x m^{-1}$) at the study area. For statistical details, see text.



Fig. 4. Relationships between relative humidity and density of above-ground active *Mabuya affinis* (number of specimens $x m^{-1}$) at the study area. For statistical details, see text.



Fig. 5. Daily activity pattern of Mabuya affinis at the study area.

temperature ($r^2 = 0.396$, n = 24, ANOVA F = 14.42, df = 1,22, P = 0.001; Figure 2) and soil temperature ($r^2 = 0.462$, n = 24, ANOVA F = 18.93, df = 1,22, P = 0.0003; Figure 3). However, it is obvious that air and soil temperatures are positively correlated (P < 0.000001), and that, when they run against daytime (hr), they show similar trends, although soil temperature profile is slightly above that of air. Skink density was negatively influenced by increases in relative humidity ($r^2 = 0.406$, n = 24, ANOVA F = 15.02, df = 1,22, P = 0.0008; Figure 4).

Plot of daytime against skink numerical abundance (Figure 5) shows that these lizards had two activity peaks: a first and small one around 9 - 10.00 am, while the highest come up later by 2.00 pm. The skinks tend to withdraw by mid day probably due to too much heat.

Basking and feeding occurred more by morning hours (Table 1), when the lizards were also particularly fast in escaping and running performances. Basking duration was approximately 2 - 10 minutes. Skinks were observed on several times while feeding, on insects particularly (termites, ants, grasshoppers, diptera, etc). Numbers of skinks recorded in the various habitats at the study area are presented in table 2. The totals of table 2 show that habitat preference follows the order: DB > CPD > GD > TP > OPFH > GR > ST. Given the relatively preliminary nature of these data, it seems unlikely to present statistical details on this matter.

In summary, our data show that these small lizards are diurnal with a bi-peaked activity pattern, strongly influenced by external factors (soil and air temperatures, and relative humidity), and with a clear tendency to inhabit highly disturbed sites in the forest-plantation mosaic of south-eastern Nigeria. In these habitats, it seems that oviposition occurs during dry season, and egg hatching at the end of dry season. Seven females containing eggs were captured between November and December at Calabar (Cross River State), and newborns were commonly observed in March and April in both Port Harcourt and Calabar. Similar observations were done by Butler (1986), who recorded clutches of eggs in November and December at Ibadan (south-western Nigeria), and egg hatching in late January. Nevertheless, this author suggested that it is likely that *Mabuya affinis* reproduces throughout the year, as he noticed an abundance of juveniles in early July at Ibadan. Our current data could not support nor reject Butler's opinion.

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Lygosoma dorsale (= Ctenotus spaldingi), from a lithographed plate in 'Catalogue of the Lizards in the British Museum' by G.A. Boulenger (1887). Reproduction courtesy of The Natural History Museum, London.

ADVERTISEMENT CALL OF THE INDIAN BRONZED FROG, RANA TEMPORALIS (GUNTHER, 1864)

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COUSTIC signals play a very important role in the breeding activity of frogs and toads and are regarded as one of the key characters responsible for reproductive isolation and specification events in the animal group (Wells, 1977). Male anurans use vocalization to advertise their species identity, sex and location to females for the purpose of breeding. The Western Ghats of India have been identified as one of the hot spots of biodiversity in the world. It harbors more than 100 species of anurans (Daniels, 1997a,b). However, bioacoustic studies on Indian anurans are limited to only a few species (Kanamadi, 1996). The Indian Bronzed Frog Rana temporalis is widely distributed in Western Ghats of India (Daniels, 1997), and also found in Sri Lanka (Dutta, 1992, 1997). Except for the distribution records (Inger & Dutta, 1989) there are practically no other reports on this species. In the present study we describe the advertisement call of R. temporalis for the first time.

Field studies were carried out from 1996-1999 in different parts of the Western Ghats. Calling sites were marked based on the vocalization around Sagar (16° 37' N 76° 51' E), Jog (14° 45' N 74° 53' E), Shimoga (13° 56' N 75° 38' E), Sringeri (13° 25' N 75° 15' E) and Kollur (13° 53' N 74° 53' E). A few calling frogs were collected for taxonomic studies. The frogs were identified in the laboratory by using available taxonomic keys (Boulenger, 1890., Daniel & Sekar,1989). Later they were confirmed by the Zoological Survey of India, Southern Regional Station, and Dr. M.S. Swaminathan Research Foundation, Chennai. Advertisement calls were recorded on SONY, Super FE cassette tapes using AKAI AJ 490 FS tape recorder (4.8cm/s speed) and AKG, D707, C/190 directional microphones. Microphones were held at a distance of 4-6 cm away from the frogs. Sound pressure level was measured from a distance of 1m by using a LUTRON SPL meter. Air temperature and relative humidity of the calling sites were also recorded. Calls of 10 frogs were analysed at the Zoological Institute, University of Bonn, Germany by using the

Parameter	Sample size	Mean $\pm s \bar{x}$	Range
Call duration (ms)	120	62.8 ± 0.8	47 - 88
Call interval (s)	102	1.41 ± 0.09	0.54 - 5.68
Call period (s)	101	1.46 ± 0.09	0.60 - 5.80

Table 1. Acoustic features of advertisement call ofR. temporalis (calls of 10 randomly selected individualswere used for statistical analysis)

computer program MOSIP (R) Spectro analysis V6 8, 41 /89, MEDAV GmbH. The statistical analysis was carried out with Statagraphics Program STSC Inc., Knoxville, USA.

Rana temporalis is a medium sized frog (male SVL \bar{x} =55.3mm, n=10). Vocalization began after 2 to 3 heavy monsoon showers (June/July) and the maximum activity was observed in the early phase of monsoon (June-August). Males possess single subgular vocal sacs and emit advertisement calls by sitting on the floating vegetation or under the submerged grass. Daily calling activity began when it grew dark and continued late into the night. Calls were given in series with a long call interval (Fig. 1A). Each call consisted of a single pulse group, and the pulses within each pulse



Fig. 1 (A) Oscillogram of two advertisement calls showing long call interval, (B) oscillogram and (C) sonogram of expanded single advertisement call of *Rana temporalis* recorded at Agumbe (air temperature 20°C).

group overlap. The first 3-4 pulses are separated from the remaining pulses by a negligible interval. Acoustical features of the advertisement call are summarized in Table 1. The amplitude of the pulses in the beginning was low and later it gradually increased to maximum in the middle of the call, thereafter gradually decreasing (Fig. 1B). The sound energy was concentrated between 37 to 7200 Hz, with a dominant frequency between 2300 and 3000 Hz. The energy spectra consist of indistinct harmonics (Fig. 1C), and the sound pressure level of the call varied from 67-75 dB. Air temperature and the relative humidity at the recording site varied from 19-22° C and 87- 91% respectively.

Advertisement calls of the Indian ranids. Rana crassa (Kanamadi, Hiremath & Schneider, 1992), R. limnocharis (Kanamadi et al., 1995) and Tomopterna rufescens (Kadadevaru, Kanamadi & Schneider, 2000) consist of a series of pulse groups, whereas in R. tigrina, T. breviceps (Kanamadi et al., 1994), and Indirana beddomii (Kadadevaru et al., 2000) the call consists of a single pulse group. Similarly, in Rana temporalis also the call consists of a single pulse group. The call interval of R. temporalis (ranging between 0.54s and 3.5s) is high compared to R. tigrina and T. breviceps, but it is low when compared with I. beddomii, where the call interval extends upto 35.12s. Amongst the Indian ranids described so far the frequency spectra of R. tigrina and I. beddomii consist of two energy bands. In R. temporalis also the frequency spectra consists of two bands of energy. The energy spectra of R. temporalis, extending between 37 and 7200 Hz, is comparable with that of I. beddomii (37 to 6820 Hz). In both the frogs the spectra consists of indistinct harmonics. Variations in the spectral and temporal features in the advertisement call and absence of sympatric species isolate R. temporalis from other frogs and helps in species recognition.

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THERMOREGULATION AND ACTIVITY PATTERNS IN CAPTIVE GROUND IGUANAS (CTENOSAURA SIMILIS)

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THE iguanas of the genus *Ctenosaura* are a conspicuous element of the Central American herpetofauna. Herpetologists have studied certain aspects of the biology and ecology of several species including one of the larger forms *Ctenosaura similis* (e.g. Henderson, 1973; Fitch, 1973; Fitch & Henderson, 1978; van Devender, 1979; Janzen & Brodie, 1995). The results have indicated that *C. similis* is associated with dry open woodland and savannah (Fitch, 1973, van Devender, 1979; Fitch & Hackforth-Jones, 1983), and is both terrestrial and arboreal using hollows

in tree trunks, tree roots, old buildings or rock piles as retreat sites (Fitch, 1973; Burger & Gochfield, 1991). The juveniles are mainly insectivorous, but as growth proceeds shift to a mainly herbivorous diet, although when resources are scarce, may consume small vertebrates and large insects (Fitch, 1973; van Devender, 1979). Under certain circumstances they are known to travel distances to feed (Fitch & Henderson, 1978; Fitch & Hackforth - Jones, 1983).

Field workers have commented on the difficulties of studying this species under natural

conditions, pointing out that they are wary and difficult to capture as a result of their close location to retreat sites. Under captive conditions, on the other hand, certain individuals quickly become accustomed to human presence and in large naturalistic enclosures make ideal subjects for detailed continuous observation. There is little information on the behaviour and biology of captive C. similis - most texts are confined to a few paragraphs (e.g. Rogner, 1997), presence despite its in herpetological collections including those of zoological gardens. In this paper we have attempted to provide baseline observations on activity, behaviour and thermal biology in captive C. similis in the hope that the information will contribute to improving the design of appropriate naturalistic housing (see Warwick & Steedman, 1995). The results are based on a second year BTEC National Diploma Animal Behaviour at Huddersfield Assignment Technical College in which two adult C. similis were studied in a large naturalistic enclosure. Our assignment brief was to compare the behaviour of captive C. similis with what is known in the literature of the field biology of this species.

METHODS

observations Our were made at the Herpetological Unit of Huddersfield Technical College between September 1999 and May 2000. We also employed data recorded between February 1998 and June 1999 on the same lizards by two previous second year BTEC National Diploma students. A male with a body mass of 1.6 kg (Plate 1) and a female of 1.2 kg were observed for a total of 47 hours over 17 days. The enclosure layout measured 4m by 5m in ground area with a height of 4m at the apex. Natural light through glass was supplemented with four 275w spot lamps and five UV Desert Lights with additional heating supplied by pipes underneath the rockwork around the enclosure periphery. A major visual barrier for the lizards were two 1.5m high walls which partially

divided the unit in addition to a series of rocky outcrops and tunnels that served as retreat areas. The unit was planted with dry adapted succulent plants including two trees (*Ficus benjamina & Dracaena* sp.). These features served to enhance both the physical and thermal complexity of the enclosure (see Avery, 1985).

The amount of time (in minutes) the lizards spent in each behaviour was recorded. Behaviours were defined as 1) *basking*; either under a heat lamp or sitting in sunshine 2) *partial basking*; where part of the body was under a lamp or in sunshine 3) *shade*; no part of the body was under a heat lamp or in sunshine and 4) *hiding*; the animals were in tunnels. *Active* or *feeding* is self-explanatory. The number of activity bursts and the distances travelled were recorded.

Body temperatures were obtained bv measuring skin surface temperature every 10 minutes or so using an Omega OS204 infrared detector directed at the central area of the body a few cm from skin surface. This instrument has a residual error of $\pm 1^{\circ}$ C but in practice the closer the instrument to the skin surface the more accurate the reading. Generally skin surface temperature exceeds cloacal temperature in lizards and is usually dependent on body mass. For example, the difference between skin surface and core temperature was measured in a series of Cyclura nubila of different body masses (Alberts & Grant, 1997). Meek (1999) quantified these measurements and defined the relationship between core temperature (T_b) and skin surface temperature (T_{ss}) as:

$$(T_b - T_{ss}) = 0.00114x + 1.1195 \ (r^2 = 0.7)$$

where x is body mass in g and r^2 is the coefficient of determination. When this equation was applied to our C. similis, it predicted a general overestimate of core temperature from skin surface temperature of 2.9°C in our 1600g male and 2.5°C in our 1200g female. Measuring skin surface temperatures has two important benefits 1) skin surface temperature appears to be the principle input for thermoregulation in lizards (Crawshaw, 1980) and 2) it is non - invasive and hence minimises the disturbance of behaviour patterns. Therefore although the measurements were made by placing the IR detector within a few centimeters of the skin surface of the lizards, this did not appear to disturb them in any way. A mercury bulb thermometer was used to measure shaded air temperatures 0.5m above the ground



and the IR detector for substrate surface temperatures under a heat lamp.

Fig. 1. Graphs showing behaviour changes as percentage frequencies of total behaviour within each hourly time period. In graph A basking is represented as cross-hatched bars and partial basking as solid bars. Graph B shows shade as cross hatching and locomotory activity as solid bars.

We recorded a total of 342 body temperatures in addition to corresponding air and substrate temperatures ($\Sigma n = 684$). A further 87 records of body temperature and associated air and substrate temperatures were employed from a previous student assignment on *C. similis* giving an overall



total of 429 body and 858 air and substrate temperatures.

Fig. 2. Proportional differences in behaviours (shown as percentages of total observations) observed during the study period alongside the mean body temperatures recorded during each behaviour for comparison.

RESULTS

Behaviour and Activity - Figure 1 shows the behaviour patterns of both C. similis over hourly periods from 0900 - 1600hrs. Basking was the dominant activity during the early part of the day but gradually declined as the morning progressed and was lowest between 1200 - 1300hrs. In the afternoon basking gradually increased again as did time spent in the shade, which was greatest during midday and late afternoon. Figure 2 shows these behaviours when the data sets from the time periods are pooled. The majority of time was spent either basking (44.8%) or inactive in shaded areas (27.9%). Smaller amounts of time were spent partially basking (8.7%) in retreat areas (9.6%) or in locomotory activity and feeding (9%).

The animals did not, however, display rigid behaviour patterns. Time in hide areas could be high on certain days, either as a result of late emergence or early retreat. For example, on 9/2/99 most observations (78%) showed that the female was in retreat until 1415hrs, and on two other days (19/10/99 & 2/11/99) the male spent 70.6% and 31% of the day in retreat. The two former instances relate to late emergence, the latter to early afternoon retreat. Environmental temperatures were not particularly low on these days, although the weather was overcast. On other days with overcast weather, the lizards were



abroad throughout the daily period and emerged early.

Fig. 3. Hourly changes in body temperatures defined as medians and interquartile ranges (solid circles and attached bars) in comparison to the absolute distances travelled within any given hourly period.

In general, locomotory activity involved shuttling between basking and shaded areas, foraging for food or to defecation sites. Early morning locomotory activity mainly concerned movement from retreat to basking sites. Figure 3 shows the total distances travelled in metres at different times of the day, indicating that locomotory activity was greatest during midday and early afternoon particularly between 1300 -1400hrs. In general the male covered 2.1 metres per hour and the female 0.55 metres per hour. Figure 4 shows the frequency of the distances travelled during bursts of locomotory activity. These results show that most movement involved distances of less than 1 metre, although distances up to 5 - 6 metres were recorded.

Body temperatures - Table 1 gives details of the body temperature levels recorded during the study periods. The mean body temperatures (with standard errors) of the male $(33.9 \pm 5.8^{\circ}C)$ and female $(34.5 \pm 5.7^{\circ}C)$ were not significantly different (ANOVA, p > 0.05) and therefore the data sets have been pooled. Mean shaded air temperatures and standard errors were 22.5 ± 3.7 , range =15 - 34.2°C, and substrate temperatures 29.1±4.9, range = 21 - 45°C. Body temperatures ranged from 23 - 44.2°C with a general mean of 34.4°C and were significantly higher than either air (F $_{(1.856)}$ = 1203.2, p< 0.0001) or substrate (F $_{(1.856)}$ = 190.6, p< 0.0001) temperatures.

Regression analysis has been applied to body temperatures and associated air and substrate temperatures as a test for thermoregulation. Here a regression coefficient of 0 indicates thermoregulation and 1 thermoconformity (Huey & Slatkin, 1979). A coefficient of determination (r^2) was then applied to the data to determine the amount of variation in body temperature that could be accounted for by variation in air or substrate temperatures. Values of r^2 range from 0 - no relationship, to 1 - all variation in y (body temperature) can be accounted for by variation in x (air or substrate temperatures). The results gave regression coefficients close to, but significantly different from 0 ; air temperature = 0.27, (t = 3.7, p < 0.001), substrate temperatures = 0.22, (t = 4.05, p < 0.001). The coefficients of determination were low (air temperature, $r^2 =$ 0.04; substrate temperatures, $r^2 = 0.05$). These results indicate active thermoregulation in the lizards.

Body temperatures, behaviour and time of day - Behaviour related body temperature levels are shown in Fig. 2. The highest body temperatures were recorded when the animals were in open areas (basking or partial basking) or when they were active. Comparison of these 'open area body temperatures' by analysis of variance indicated a significant difference (F (2.268) = 8.35, p < 0.001). Further analysis using a multiple range test showed that partial basking body temperatures were significantly lower (p < 0.05). There was a significant difference between body temperatures of the lizards when they were abroad but in the shade, and when they were in hide areas in the afternoon or morning ($F_{(2, 155)} =$ 10.2, p < 0.0001). Morning retreat area body temperatures were significantly lower (multiple range test, p < 0.05).

In general body temperatures in excess of 30°C were attained between 1000 - 1100hrs, just before the initiation of major locomotory activity. Body temperatures were relatively stable throughout the daily period from 1000hrs



onwards although the interquartile ranges were narrower during the afternoon (1400 - 1600hrs).



The results are shown in Figure 3 as the hourly changes in median and interquartile ranges in body temperatures and in relation to levels of locomotory activity during the daily period.

DISCUSSION

The results of this study, based on continuous observation, have shown that two C. similis spent most of their time inactive in shaded or basking areas with locomotory activity and feeding accounting for only a limited amount of the daily time budget. Thermoregulation was achieved by the selection of favourable microhabitats involving shuttling between sunlit, shaded and hide areas. Relatively high and constant body temperatures throughout the daily period (Fig.3) were mainly achieved through partial basking and also the low skin surface area-to-body mass ratio that accompanies large size. This resulted in slow rates of heating and cooling giving relative thermal stability, particularly once the target body temperature range had been achieved; this must ultimately



reduce the frequency and energy costs of shuttling. Other large iguanids maintain high

Male Ctenosaura similis. Photograph by J. Avison.

constant body temperatures, for example *C. hemilopha* (Soule, 1963) and *Iguana iguana* (McGinnis & Brown, 1966). Improved digestive efficiency may be one of the principle benefits here, since even small differences in body temperature are known to affect digestion in reptilian herbivores (Troyer, 1987).

Through the placement of carefully selected hot spots, walls, tunnels and vegetation, our study enclosure provided both thermal and environmental complexity. In general a test for the suitability of a captive enclosure could be the degree of departure of captive animals behaviour and physiology from free-living individuals although it should be noted that unlike our observations, the field studies of C. similis have been based on spot sample records. However, a general comparison of our data with current field knowledge of C. similis, does suggest that our lizards maintained some degree of naturalistic behaviour. For example, the extensive basking observed in our animals is similar to the field observations of both Fitch (1973) and van Devender (1979). Fitch noted that Ctenosaurs 'spend much of their time basking in sunshine even when temperature is relatively high' and suggested that 'absorption of heat may be reduced by position and orientation'. He also described what appears to be partial basking in C. similis. Additionally, Burger & Gochfield

(1991) found the behaviour of free-living C. similis in Costa Rica to be largely a function of temperature, since in this region they bask early in the morning but seek shade as the temperatures observations rise. Our of behavioural thermoregulation in captive C. similis showed that after a period of high early morning basking intensity, body temperatures were relatively stable with hourly median temperatures ranging between 35.5 and 38.9°C (Fig.3). These body temperatures are generally in good agreement with the field study of Fitch (1973) who indicated a thermal preferendum of 36 - 37°C based on 54 measurements of juvenile C. similis body temperatures in Costa Rica, although it should be noted that these were cloacal measurements.

Low levels of activity are a feature of adult *C. similis* whether they are wild (van Devender, 1979) or captive. Burger & Gochfield (1991) found that activity in *C. similis* may be bimodal with a midday retreat to burrows to escape excessive heat loads before emerging later in the afternoon. Since our study was undertaken mainly during the winter months, the enclosure was not subjected to high solar intensity and heat loads. However, bimodal activity has been observed in our animals during the summer months when temperatures are particularly hot (R.Meek, personal communication). Under such conditions our captive and wild lizards emerged earlier in the day (0730 - 0800hrs).

In its natural environment C. similis apparently forages at distances of only a few metres from retreats sites. Our observations indicate that retreat sites were particularly important to C. similis, since movement at distances from hide areas was infrequent despite their familiarity with human observers. At the completion of our study, the male lizard had used the same burrow for over two years regardless of the availability of other borrows in the enclosure. In one field study nine wild C. similis occupied the same burrow over a two-year study period (Burger & Gochfield, 1991). Burrows that are wider than they are high with an entrance that is exposed are the preferred types. It has been suggested that this is to facilitate basking at the

burrow entrance in the morning and to optimise predator detection (Burger & Gochfield, 1991).

Retreat sites are particularly important when introducing animals into a new environment. Our male lizard when first introduced into the enclosure spent nearly 3 weeks inactive in his burrow before finally emerging. This hypoactivity has been defined as shutdown behaviour and a response to an inadequate environment (Warwick, 1995). However it could also be a temporary stress reducing mechanism (he was left undisturbed during this period) and not necessarily a long-term condition. Moving into hide areas enabled our lizards to select body temperatures lower than normal 'activity' temperatures (see Table 1); movement into hide areas forms an important part of thermoregulatory repertoires in reptiles (Huey, 1982). Licht (1965) observed deleterious effects on the physiology of certain reptiles that were unable to cool to below normal activity temperatures.

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THE HERPETOFAUNA OF ZARANIK PROTECTED AREA, EGYPT, WITH NOTES ON THEIR ECOLOGY AND CONSERVATION

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S INAI is herpetologically the richest region in Egypt (Flower, 1933; Saleh, 1997), with 67 of Egypt's 110 reptile and amphibian species, or about 63% of the country's known herpetofauna. This is due in part to the peninsula's varied topography and climatic conditions and to its unique location at the juncture of three biogegraphical regions: the Saharo-Arabian, Irano-Turanian and Sudanian (Werner, 1987). Northern Sinai, where Zaranik Protected Area is located, constitutes a distinct physiographic subregion of the peninsula. The topography in this area has a much lower profile than that of mountainous South Sinai, and extensive dune fields dominate the landscape.

Zaranik Protected Area (approx. 31°05'N 33°28'E) occupies 250 km². The main herpetofaunal habitats are undulating sand and dunes (occupying the largest area), salt marshes, beaches, and the marine waters of the Mediterranean. There are limited areas of harder substrates (coarse compacted sand), but some 20 km further inland extensive gravel plains exist. Annual rainfall ranges between 50-100 mm. Vegetation is generally sparse (5-10% coverage on average). The dominant species in the salt marshes are Halocnemum strobilaceum and Salicornia europaea. Zygophyllum aegyptium shrubs are found on higher and less saline ground. On sand dunes the prominent species are the two grasses Stipagrostis scoparia and Panicum turgidum. Other common species include Artemisia monosperma, Retama raetam, and Thymelaea hirsuta.

This paper reports general preliminary observations made during extensive herpetological studies and discusses relevant features of Zaranik's herpetofaunal communities and their conservation status.

THE HERPETOFAUNA OF ZARANIK

To date, 24 species of reptiles have been recorded from Zaranik (Table 1). No amphibians are known, although the Green Toad *Bufo viridis* could occur on a limited basis in some depressions with cultivations on the southern boundary of the Protected Area.

Fifteen species of lizards have been recorded. These include four Gekkonids: Petrie's Gecko Stenodactvlus petrii. Elegant Gecko S. sthenodactylus, Turkish Gecko Hemidactylus turcicus and Fan-toed Gecko Ptyodactylus hasselquistii. The first, being cursorial and sand dwelling, is by far the most common and widespread. The latter two rupicolous geckos are recent introductions whose distribution is currently limited to a few man-made structures. This is the first report of P. hasselquistii from North Sinai. The species was previously known only from South Sinai and further west in Egypt (e.g. Werner & Sivan, 1994; Saleh, 1997). In fact the Zaranik animals show similarity with Nile Valley rather than South Sinai populations. indicating that probably they were carried with materials originating from the Nile Valley. The Fan-toed Gecko, P. guttatus, is the congener typically known from elsewhere in North Sinai. S. sthenodactylus is apparently rare in the Protected Area, being recorded only once in August 1999. The species is typical of hard coarse substrates but seems to penetrate the dunes in small numbers, probably along corridors of suitable habitat. Werner (1987) reports the species on coastal dunes of the Levant to a point north of Haifa.

Two Agamids are found: Savigni's Agama Trapelus savignii, and Uromastyx aegyptia. Trapelus savignii is a species of special conservation concern. The world range of this species is almost wholly restricted to northern Sinai and Zaranik Protected Area therefore provides an important conservation opportunity for lizard. Only one record this of U. aegyptia is known, this was of an immature animal found as a traffic casualty on the southern boundary of the Protected Area (Varty & Baha El Din, 1991).

Four lacertids are found: Saharan Fringe-toed Lizard Acanthodactylus longipes, Nidua Lizard A. scuttellatus, Bosc's Lizard A. boskianus, and Oliver's Lizard Mesalina olivieri. Acanthodactylus longipes is the most common and prominent reptile species throughout much of the Protected Area, where it shares sandy habitats with its congener A. scutellatus. These two very similar species partition their fairly simple habitat along spatial, thermal and temporal dimensions (Baha El Din, 1996 & in prep.). Acanthodactvlus boskianus is found amongst dense halophytic vegetation on several small islands in Lake Bardawil within the limits of the Protected Area. The nominate subspecies (large in size, with numerous dorsals) is present here. Animals belonging to the subspecies asper are to be found at the eastern perimeter of the Protected Area. Mesalina olivieri is also strongly associated with densely vegetated microhabitats and is found in both halophytic vegetation near shores and also in dune vegetation.

Three skinks occur: Sand Fish Scincus scincus, Audouin's Skink Sphenops sepsoides, and Ocellated Skink Chalcides ocellatus. Sphenops sepsoides is the most common nocturnal reptile during the summer season; in winter, it is frequently observed during the day. Scincus scincus is diurnal, while the generalist C. ocellatus is mostly crepuscular.

Despite it being an arboreal species the Common Chameleon Chamaeleo chamaeleon is widespread throughout much of the Protected Area, especially in dune areas. Here it is almost exclusively found amongst patches of desert vegetation. Infrequently individuals are found crossing open ground in haste, moving from one cluster of vegetation to another.

Varanidae is represented by the Desert Monitor, Varanus griseus. The species is the top diurnal terrestrial predator at Zaranik, often feeding on nestlings of breeding waterbirds on the shores of Lake Bardawil (in the summer) and on the abundant resting migrant birds (during migration seasons).

Only five species of snakes have been recorded with certainty. These are the Lesser Sand Viper Cerastes vipera and the four colubrids, Schokari Sand Snake Psammophis schokari, Diademed Sand Snake Lytorhynchus Clifford's Snake **Spaleorsophis** diadema. diadema and Moila Snake Malpolon moilensis. Cerastes vipera is the only venomous snake known in the Protected Area. Both S. diadema and M. moilensis have been recorded on single occasions at the southern boundary of the Protected Area (Varty & Baha El Din, 1991). The three other species are equally common and widespread. Both L. diadema and C. vipera are largely confined to sandy biotopes and are nocturnal. Psammophis schockari is diurnal and can be found in salt marshes, as well as dunes.

Four species of Chelonia have been recorded, including the highly endangered Egyptian Tortoise Testudo kleinmanni and three marine turtles, the Loggerhead Turtle Caretta caretta, Green Turtle Chelonia mydas, and Leatherbacked Turtle Dermochelys coriacea. Testudo kleinmanni has become almost extinct from North Sinai, due to severe habitat degradation and intense collection pressure for the pet trade. The occurrence of the species in the Protected Area has been suspected for a long time (Baha El Din, 1994). In Spring 2000 a small and highly fragmented population was found within the limits of the Protected Area (Baha El Din et al. in prep.). Caretta caretta has recently been found to have its largest nesting site along the Egyptian Mediterranean coast near Zaranik (Waheed Salama pers. com.). Chelonia mydas is also believed to breed, but in smaller numbers.



Mesalina olivieri. Zaranik. All photographs by authors.



Trapelus savignii. Zaranik.



Scincus scincus. Zaranik.



Sphenops sepsoides. Zaranik.



Stenodactylus petrii. Zaranik.



Testudo klienmanni. Zaranik.

			Habit	at			
Species	1	2	3	4	5	6	7
Stenodactylus petrii Anderson, 1896	X	X		_			
Stenodactylus sthenodactylus (Lichtenstein, 1823)			X				
Ptyodactylus hasselquistii (Donnodorff, 1798)					X		
Hemidactylus turcicus (Linnaeus, 1758)					X		
Trapelus savignii Duméril & Bibron, 1837	X	X	X				
Uromastyx aegyptia Forskål, 1775			X				
Chamaeleo chamaeleon (Linnaeus, 1758)	X	X	X	X			
Acanthodactylus boskianus (Daudin, 1802)			X	X			
Acanthodactylus scutellatus (Audouin, 1829)	X	X	X				
Acanthodactvlus longipes Boulenger, 1918	X	X					
Mesalina olivieri (Audouin, 1829)	x	X	X	X			
Varanus griseus (Daudin, 1803)		X	X	X			
Chalcides ocellatus (Forskål, 1775)	x	X					
Sphenops sepsoides (Audouin, 1827	x	Х					
Scincus scincus (Linnaeus, 1758)	X	Х					
Lytorhynchus diadema (Duméril, Bibron &							
Duméril, 1854)	X	X				I	
Malpolon moilensis (Reuss, 1834)			x				
Spalerosophis diadema (Schlegel, 1837			х			x	
Psammophis schokari (Forskål, 1775)	x	x	x	X			
Cerastes vipera (Linnaeus, 1758)	x	x					
Testudo kleinmanni Lortet, 1883	x	x	x				
Caretta caretta (Linnaeus, 1758)						x	х
Chelonia mydas (Linnaeus, 1758)						l x	x
Dermochelys coriacea (Vandelli, 1761)							X
1 = Dunes, $2 = Undulating sand$, $3 = Harder substra$	tes, 4 =	= Salt n	narsh•	s = Bui	ldings,	6 = Be	ach,
7 = Marine waters.							

Table 1. The reptiles of Zaranik Protected Area and their habitat use.

Dermochelys coriacea was recorded only once, when an old carcass was found in 1985 (Baha El Din, 1992).

DISCUSSION

The sand dune community, comprised of 14 species (columns 1 & 2, Table 1), is the most prominent and best represented reptile community at Zaranik. Only half of the sand dune community could be considered to be composed of truly sand-dwelling or psammophilous species. These are species solely found in sandy biotopes and have morphological and behavioral adaptations for life in a sandy

environment. For example, the excellent sand swimming adaptation of S. sepsoides, the burrowing adaptation of L. diadema and the sand shuffling techniques of C. vipera. The other half of the sand dune community at Zaranik is comprised of either generalists that have wide ecological niches (e.g. V. griseus) or species that specific microhabitats exploit (e.g. С. chamaeleon), but that may also be present in other types of habitats. Werner (1982 & 1987) made similar observations of the sand dune community in both Israel and Sinai. However, his interpretation of psammophilous species is rather liberal and includes taxa that are best

classified as generalists or vegetation dependent, e.g. *T. savignii* and *M. olivieri*, both of which are found on gravel plains, as well as dunes.

With the exception of the chelonia, most of the reptiles of the region are still common. However, in the Protected are populations Area diminishing due to continued habitat degradation. Our studies show a marked decline in populations and reduction in diversity due primarily to excessive over grazing, and cutting and clearing of vegetation for firewood and cultivation. There is an urgent need to curb and manage these ecologically disruptive practices. Outside the Protected Area some of the herpetofauna is faced by the complete loss of habitat due to rapid expansion of, particularly coastal development. Marine turtles are suffering the most as some of their prime nesting beaches are being converted to holiday resorts. In addition, unregulated quarrying and cultivation are seriously degrading some of the most important and unique habitats of the region.

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THE AGONISTIC BEHAVIOUR OF BOSC'S MONITOR (VARANUS EXANTHEMATICUS BOSC, 1792) IN CAPTIVITY

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ABSTRACT

This paper summarizes the aggressive interactions observed between Bosc's Monitors (*Varanus exanthematicus*) over a two year period. A synopsis of male-male and male-female combat and the resource over which the conflict took place is given. In male-male combat, the winner of the agonistic bout was usually the larger of the two males; the subdominant male was subsequently excluded from feeding and basking sites. Male-female combat occurred only when the female resisted a breeding attempt initiated by the male.

Our observations document the first recorded instance of female-female combat. The aggressive encounter between females occurred over access to a basking site. In contrast to male-male combat, size did not determine the winner of the female-female bout; rather residency was the most important factor. Although bipedal, or clinch, phase has been observed in all other large monitors for which combat has been described, this phase did not occur in any interactions between the Bosc's Monitors. This lack of a clinch phase may be attributable either to morphological constraints (high snout-vent length:tail length ratio) or to captive conditions.

CINCE the early 1900's, varanid combat Dehaviour has been the focus of many anecdotal and descriptive reports (e.g. Sterling, 1912; Lederer, 1929; Ali, 1944). Only recently have more quantitative approaches been applied to the study of varanid fighting behaviour (Auffenberg, 1981, 1988, 1994; Daltry, 1991). The agonisitc behavior and combat rituals have been examined in a large number of varanid species (see Horn et al., 1994 for a review) and have been shown to occur frequently between males (e.g. Davis et al., 1986; Tsellarius & Tsellarius, 1997). However, female-female agonistic bouts have rarely been described and have only been observed in captive specimens (Auffenberg, 1981; Delean, 1981; Daltry, 1991).

Adult male varanids are often larger than females (Auffenberg, 1988). An observer can readily determine the sex of the combatants when two large males are fighting; however, in a fight between two smaller individuals, the combatants could be a small male and a female, two females, or two small males (e.g. Ali, 1944). Hence, for most monitor species, it would be extremely difficult to recognize female-female combat in the wild. It is perhaps not surprising, then, that female-female combat has only been observed in captivity where the sex of the participants is known.

This paper describes intraspecific combat behaviour in captive Bosc's Monitors, V. exanthematicus, a species that has been little studied in this respect (but see Bayless, 1994), and serves as the first documentation of femalefemale combat in this species. An extensive description of the combat events is given only for the conflict between females. The observations made herein will be discussed in a behavioural ecological context.

METHODS

Two male and two female V. exanthematicus were observed from November 1994 to April 1996. All four Bosc's Monitors were housed separately, except for periods during which one individual was introduced into another's cage. Female A was housed in an $1.8m \times 0.46m \times 0.5m$ aquarium and Female B in a wooden enclosure measuring $1.25m \times 0.62m \times 0.61m$. Male SE was housed in a wooden enclosure measuring $2.45m \times 1.22m \times 1.22m$ and Male AS in an enclosure of identical measurements as Male SE. The substrate in each of the enclosures was a sand-gravel mixture. Table 1 provides the snoutvent length (SVL), tail length (TL), and weight for the four individuals.

In the summer months, the Bosc's Monitors were kept in isolation at temperatures between 18° and 21°C. Artificial light was provided, and the monitors fasted during this period. For the remainder of the year, when the introduction trials were conducted, the Bosc's Monitors were kept at an ambient temperature of 27° to 29°C with the basking spots reaching temperatures of 32° to 38°C during the light hours. During the dark hours, the ambient low was approximately 21°C. Throughout this period, the light:dark cycle remained at 12L:12D. The staple foods for the monitors were assorted rodents, chicks, earthworms, aquatic snails, hissing cockroaches and giant mealworms.

OBSERVATIONS AND DISCUSSION

Male-male combat: When one male was introduced to the other's cage, combat occurred in a variety of different circumstances: for access to a territory, food, or basking spot. The larger male, Male SE, emerged as the dominant after every contest with Male AS regardless of the resource over which the fight took place. Hence, it seems that size may play an integral role in determining the outcome of a contest between two Bosc's Monitors, as it does in other species of varanids (Murphy & Mitchell, 1974; Daltry, 1991; McCoid & Hensley, 1991). Indeed, size differences between combatants have been used extensively in behavioural ecological studies to predict the winner of contests.

Parker (1974) suggested that size may be a direct measure of an individual's resource holding power (RHP), with larger individuals having a higher RHP in comparison to smaller conspecifics if all else (e.g. resource value, prior experience) is equal. Generally, in a contest where size serves as the only asymmetry between combatants and where the individuals engaged in the fight are able to assess one another's RHP, the larger individual becomes the dominant while the smaller assumes the subordinate role (e.g. Tokarz, 1985 Anolis sagrei). Male-male combat in V exanthematicus offers yet another situation in which this pattern seems to holds true.

The contests between male Bosc's Monitors had detrimental effects upon the subordinate, Male AS, who subsequently fed and basked significantly less frequently than did Male SE (Attum, unpublished data), and lost weight. A similar dominant-subordinate relationship was found in captive V. bengalensis, where the socially dominant male obtained more food, grew faster, and gained access to the best basking sites at the expense of the subordinate individual (Auffenberg, 1981). This finding implies a significant cost to being the subordinate individual of a pair, namely decreased opportunities to gain access to food and optimal sites at which to thermoregulate.

In order to determine the extent to which the motive for male-male aggression was access to basking sites, three additional basking sites were placed in the arena. Installation of more basking spots within the males' enclosures decreased the frequency of aggression when the opposing male was introduced (Attum, pers. observation). This suggests that increasing the availability of a resource may result in a reduction in male-male competition/combat. Accordingly, we would expect to find common occurrences of male-male combat in environments in which resources are limited (e.g. dry season, reproductive season), while in an environment with plentiful resources, the frequency of aggressive interactions among male Bosc's Monitors should be relatively low.

The observed male-male contest included four of the five major stages of ritualized combat commonly described for varanids (Horn et al., 1994): [1] display phase, in which the two lizards exhibit head-jerking and tongue-flicking behaviors; [2] encompassing phase, in which the two combatants orient themselves side by side, often engaging in lateral display and intense headjerking behaviors; [3] catch phase, which involves a series of wrestling bouts where the individuals twist around one another; [4] subpressive phase, in which the victor is determined and subsequently mounts the subordinate lizard. The bipedal embrace, or clinch phase was not present in any of the contests witnessed during this study.

Male-female combat: Male-female combat occurred only when the female resisted a breeding attempt initiated by the male. Male and female V. exanthematicus regularly shared basking spots without conflict; the smaller females would often bask on top of the male. Similarly, no aggressive interactions over a food source were ever observed; the females never challenged the males for food and would eat only after the male had finished. Thus, it can be inferred that the male-female combat observed in this study was associated with breeding. The phases of combat observed in the male-female interactions were display, encompassing, catch and subpressive.

Female-female combat: The female-female combat observed herein occurred only over available basking spots. The following is a description of the combat sequence which took place on the only basking site available (large rocks elevated above the substrate); it is probable that the following behaviours were exhibited in order to gain access to a superior position at this single basking site.

Female A was placed into Female B's enclosure. This was the first time the two females had been placed together in the absence of one of the two male V_{\cdot} exanthematicus. Immediately after the introduction of Female A, Female B Female A's back, covering climbed atop approximately seventy-five percent of Female A's dorsum. At this point, both Female A and B were aligned and facing in the same direction. Female B then grasped Female A's chest with her front claws, but neither combatant exhibited threat displays (e.g. hissing, gular expansion). Female A failed in multiple attempts to dislodge Female B from her position because Female B's hold was, apparently, too strong. Female B attempted to bite Female A's right front leg but her positioning didn't allow her to do so. Female A then began to move away from the basking site toward the refuge (a drainage tube) with Female B still attached. Female A arrived at the refuge and crawled into it, disappearing completely within the tube; Female B was either forced to release her grip on Female A or did so because of the size restriction of the tube. Following this stage, actual physical combat ceased.

Female B then repeatedly inserted her head into the entrance of the refuge and tongue-flicked continually; Female A responded with threat display behavior (e.g. hissing, gular expansion). After a few moments, Female B withdrew her head from the refuge entrance and returned to the basking spot. A few minutes later, Female A exited the drainage tube and slowly returned to the base of the basking rock, while Female B watched intently. Female A did not attempt to climb onto the basking site rocks but, rather, planted her ventral side onto the substrate, neither touching Female B nor in a position to engage in thermoregulatory behavior. No activity occurred for the next fifteen minutes. at which time observations ended. These two females exhibited display, catch, and subpressive combat behaviors, but the encompassing and clinch phases were not observed in this incident.

The above aggressive interaction occurred in Female B's home cage and may have been initiated

Sex	Identity	SVL (cm)	TL (cm)	Weight (g)
Female	А	35.5	30.4	1270
Female	В	33.2	22.0	954
Male	AS	37.0	37.0	>2000
Male	SE	42.0	38.0	>2000

Table 1. Measurements of Varanus exanthematicus

solely by the introduction of Female A (a territory dispute) or may have been a fight over the only available basking site (resource acquisition). This interaction illustrates that, in this instance, the dominant individual is not always the larger: the smaller Female B won the contest against the larger Female A. It seems as though Female A's size advantage was overridden by the fact that she was the intruder in Female B's home cage. This is formally known as the 'resident effect' where the resident has presumably invested more in the resource (territory) than has the intruder, and should therefore be willing to defend the resource at a higher cost than the intruder (Hammerstein, 1981). It follows that the resident, in most cases, will win the contest.

Why the lack of clinch phase in Varanus exanthematicus?

Other African varanids, V. abligularis, V. griseus, and V. niloticus, have been found to engage in all five varanid ritualized combat behaviours (display, encompassing, clinch, catch, and subpressive; Horn et al., 1994). Contrary to these findings, we observed only four of the five phases in V. exanthematicus; none of the interactions among the individual V. exanthematicus that occurred during this study period included the clinch or bipedal phase of combat. Horn et al. (1994) ascribes the lack of clinch phase in the Odatria subgenus to its being a primitive trait; odatrian species have been considered ancestral in many phylogenetic studies (Becker, 1991; King et al, 1991; but see Sprackland, 1991). However, the lack of clinch phase in the Polydaedalus clade, to which V. exanthematicus belongs, has been speculated as a secondary loss (Horn et al., 1994).

Although the observations herein suggest that *V. exanthematicus* does not engage in clinch phase, as predicted by Horn et al. (1994), more observational data is needed before considering this potential loss of a behavioral trait in a phylogenetic context.

Another possible explanation for the lack of clinch phase is morphological constraints in Bosc's Monitors. In comparison with bipedal varanids such as *V. gouldii*, *V. exanthematicus* has a relatively high SVL:TL ratio. This high ratio of body length to tail length could present a significant constraint on the coordination needed to sustain a bipedal stance for any length of time because the tail is critical for balance during the clinch phase. The *V. exanthematicus* in this study appeared to be barely capable of bipedal stance for more than a few seconds; this stance occurred only when food was presented above them.

The lack of clinch phase could also simply be a byproduct of captive conditions rather than a morphological constraint. The most likely explanation for why it has not been observed in captive Bosc's Monitors is that these individuals are confined to enclosures that are not nearly large enough to enable them to exercise properly (the home ranges of similar large varanids can exceed kilometers) and thus may not facilitate the development of muscle strength that would allow them to stand bipedally. If *V. exanthematicus* engages in the clinch phase, it has yet to be observed.

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A SHORT NOTE ON THE HERPETOFAUNA OF BRISBANE AND ITS SUBURBS

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visit to Brisbane, ostensibly to visit the Australian based members of my family, from Tuesday 23 March to Friday 9 April, 1999, gave me an opportunity, between bouts of serious tribal business, to observe a few of the more familiar reptiles and amphibians to be found in urban and suburban locations. It is always very intriguing to arrive in a completely new country without any realistic preconceptions of what the fauna might be like, and noting with interest everything that one encounters. Although it was the antipodean autumn and even subtropical Brisbane was no longer warm enough to demonstrate the larger monitors or pythons, there was still much to be discovered. Armed with a cap to keep off the sun and a pocket sized copy of 'A Photographic Guide to Snakes and Other Reptiles of Australia' by Gerry Swan of the Australian Museum, I sought as many opportunities as possible to mix family obligations with herpetology.

Brisbane is situated at the mouth of the Brisbane river at latitude 27 degrees 30 south, and is enclosed by a C-shaped range of mountains of average height 600 metres. They are part of the Great Dividing Range, and still are clad in part by significant fragments of both rain and sclerophyll forest, forming a habitat for many of Australia's 760 odd reptile species. Lying off the coast of Brisbane, in Moreton Bay, are several sand islands clad with rain forest; Moreton Island furthest offshore, with Bribie Island to the north and North Stradbroke Island to the south. The city itself, though only having a population of one million inhabitants, covers an area as large as Greater London, though most of this is very low density suburbia, consisting for the most part of small bungalows in very large gardens. The centre of Brisbane consists of the original early 19th century town built in a decorative Regency style both in

brick and timber; the earlier suburbs with many wooden houses known as Queensland cottages; later urban architecture from turn of the century and the exciting modern high-rise inner City development. Despite being in the sub-tropics, the general ambience is very southern English, both in architecture and affect. We spent a few days in Springhill, an old suburb in the north-west of the city; several days in Logan City, a very new suburb in the south; the Easter weekend near Montville, a tourist village in the rain forests 60 miles to the north and visits to Bribie and North Stradbroke Islands. We also visited the national park rain forests in the Tamborine Mountains 30 miles to the south of central Brisbane.

AMPHIBIA

We only saw two species of amphibian; one easily identified toad which was seen both in its adult and larval form, and an unrecognised anuran seen briefly at night.

Bufonidae

Bufo marinus. Cane Toad, Giant Toad

This huge toad, which can grow to 24 cm in length, secretes toxins from its paratoid gland which are capable of killing most potential predators, including quite large snakes. An adult was observed on the night of 4 April noisily micturating against a lamp standard base on a garden footpath in Montville. Scores of newly metamorphosed specimens were seen leaving a pond in Springhill's public park on 27 March.

? Hylidae

A virtually unmarked brown coloured frog about 10 cm long with a primitive face seen briefly jumping through vegetation after rain on the night of 3 April.

REPTILIA

Gekkonidae

? Hemidactylus frenatus. Three small, pinkish brown geckos, about 10 cm long, seen at night on an illuminated motel sign in Springhill. Neither their appearance nor habitat seemed correct for any native Queensland species; We therefore wondered whether they could be imported examples of this common Asiatic animal.

Agamidae

Pogona barbata. Eastern Bearded Dragon. A 50 cm long example of this heavy headed, spiky lizard whose throat is covered with enlarged spines was seen basking on a tree stump right at the side of a path in the Botanic gardens, in the City centre, about midday, 24 March. It made no effort to move even though it was less than a metre from my feet.

Physignathus lesueurii. Eastern Water Dragon. This dramatically handsome, 90 cm long animal, the largest lizard that we saw in Australia, was observed in a characteristic position basking on a fallen log bridging a fast flowing river in the Cedar Creek National Park in the Tamborine mountains, 30 miles south of Brisbane, in the early afternoon of 27 March.

Diporiphora australis. Eastern Two-lined Dragon. This small, approximately 17 cm long lizard was observed basking on a tree stump right in the centre of Brisbane in a children's play park by the river. A series of broad brown bars across its light grey body were divided by three yellowish-white longitudinal stripes, which gave it a very striking appearance.

Amphibolurus muricatus. Jacky Lizard. We saw an example of this sombre coloured, robust agamid of approximately 30 cm in length basking on some dead vegetation on the shore-line at Redlands Bay, departure point for ferries to North Stradbroke Island which is about 12 miles south-east of the city centre. It seemed quite unconcerned by our presence, and let me approach very close to photograph it.

Scincidae

Cryptoblepharus virgatus. Cream-striped Shining Skink. A tiny 8-10 cm metallic textured lizard with a black bordered silver stripe along each side of its grey-bronze back which is very abundant on wooden garden fences, though it can be found on waste-ground right in the centre of Brisbane. Very numerous in both Logan City and Springhill.

Ctenotus robustus. Robust Ctenotus. We saw two of these 24-35 cm long skinks; one basking in wooden waste-ground adjacent to Logan City's public park on 24 March, the other on Bribie Island on 6 April, concealed under a thorny hedge by the beach. This lizard is distinguished by its characteristic chequered and linear pattern.

Egernia major. Land Mullet. This huge 60 cm long black skink gets its name from its fish-like shiny scaled body and its strange slithering movements. We saw one travelling slowly through leafy undergrowth in a shady part of the Cedar Creek National Park, in the late afternoon of 27 March.

Eulamprus quoyii. Eastern Water Skink. Five adults of this 30 cm. long, typical brown skink were observed basking on fallen trees by a river in a wooded creek adjacent to Logan City's public park. This is a golden olive-brown animal with scattered dark flecks and with a creamish-white stripe extending from the eye down each side of the back.

Eulamprus tenuis. Bar-sided Forest Skink. One specimen of this 18 cm long lizard, identified by its brown, reticulated pattern was seen on a railway bank near Springhill public park on the afternoon of 8 April.

Lampropholis delicata. Dark-flecked Garden Sunskink. This is like both the Cream-striped Shinning Skink and the following animal, the Pale-flecked Garden Sunskink, which is very abundant in suburban gardens. In colour it is a metallic brown with tiny dark flecks. Unlike the Shinning Skink which basks on vertical surfaces, this lizard tends to remain on the ground.

Lampropholis guichenoti. Pale-flecked Garden Sunskink. Distinguished from the previous species by its bright copper coloured head and the scattering of light as well as dark flecks on its dorsal surfaces, this tiny lizard of 6-10 cm in length is equally abundant in suburban gardens.

Varanidae

Varanus varius. Lace Monitor (100-200 cm). Several of these large, impressive, but common lizards were seen rummaging in litter bins in a carpark at the sea-side resort of Noosa a fortnight before our visit to Australia had begun. When we visited the town we saw nothing.

Elapidae

Demansia psammophis. Yellow-faced Whipsnake, 80-100 cm in length. Four of these very attractive slender, olive coloured snakes were seen basking on flower-beds and pathways after several days of heavy rain at Montville, in our garden near the rain-forest park. This timid little snake is slightly venomous, and can be distinguished from similar species by a very distinctive yellow shape surrounding its prominent eyes. It also has a reddish-brown flush on the foreparts of its body.

DISCUSSION

When one considers that there are over 760 species of reptile in Australia, one can hardly give oneself a pat on the back for only observing a dozen lizard species and one snake. Nevertheless coming to a country where one can sit in the garden supping an iced beer and observe three reptile species quietly going about their business at the same time is quite a unique experience. The abundance and proximity of reptile species is a delight in itself, transforming the dullest little park and the most manicured of suburban gardens into a herpetological wonderland.

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Les Serpents d'Afrique Occidentale et Centrale

By Jean-Philippe Chippaux. Faune et Flore Tropicales (35), IRD ed. 1999. 278 pp. Fr 170.

The author of this work aims to provide a replacement for the now lapsed, 'Les Serpents de l'ouest africain' (1950, 1963, 1975) of the late André Villiers. The latter work reached a maximum size of 195 pp. in its last edition, whereas the present work reaches 278 pp. but covers a larger area: 21 West African countries, extending eastward to and including the hithertoo poorly known Chad and Central African Republic, in total an area of about 9,103,000 km² as compared to the 609,000 km² covered earlier by Villiers. In including Cameroon, Gabon, Congo (ex-française) and CAR, the author is extending the work to include many species not known from the West Africa of Villiers. The many line drawings and small distribution maps, with dot plots, are admirably clear and supplemented by 55 excellent colour photographs, most supplied by Heuglin, of unknown provenance. The first 30 pages are devoted to generalities and the symptoms and treatment of snake bite, 208 pages to systematic treatment by family, genus and species - with keys at each hierarchial level, followed by 31 pages of bibliography - surely too much? - and a page index.

Dr Chippaux, in his foreword, writes of his 25 yrs experience in field and laboratory, of aiming to provide an accessible summary of present knowledge of the subject, and of synthesising data from the literature. Perusal of the distribution maps quickly casts doubt on the fulfilment of this ambition: out of 143, no fewer than 20 show Ghana to be bereft of a particular species, and Nigeria is represented by an empty space in 41 instances. In the case of Nigeria, 34 of

the blanks should have been occupied by plots of localities to be found in a paper by Butler & Reid (1990) - a paper not listed in the 31 pages of bibliography. But papers by Dunger (1971a,b, 1972) which are listed include localities for six species recording blanks on Chippaux's maps of Nigeria. Another paper by Dunger (1973) with Nigerian records is not listed and may be assumed to have been overlooked. So, the bibliography, impressive in its length, is incomplete and items listed have not necessarily been made use of. What then is the function of this long list of sources: checking the authors cited after one species entry in the main text suggests that all references have been documented in full in the bibliography. Such citation is in order in an academic, journal publication but unnecessary in a work of this kind. What the reader wants is the latest summary - such as those taxonomic revisions by Broadley, et al mentioned on p. 6 of the foreword, and a guide to further reading, perhaps to earlier works still of use, such as Angel (1933b in Chippaux's bibliogr.) which preceded Villiers (1950, 1963, 1975), editions that this work purports to supplant. Such older works are likely to be more readily available than, for example, Dorandeu (1991) in Médecine tropicale which journal is not available in the British Library, London University or Welcome or British Medical Association libraries! And how many readers want to use Reinhardt (1860) in the original Danish when an English translation is available (Rasmussen & Hughes, 1997)? The easy way to provide access to primary literature for the few who want that is to cite a work such as Broadley's (1990) edition of FitzSimon's Snakes of southern Africa which lists much of the relevant literature.

To return for a moment to the maps: given their scale and lack of identification of the plots with geographic place names, quarter degree squares, or museum specimens, why depart from the earlier practice of Villiers (op. cit.) who

simply listed countries in which a particular species occurred or gave the limits of its range? One may question other assumptions underlying the format of this book: the line drawings of head scale patterns reproduce well but what is their utility? None is labelled so as to indicate distinctive features, as is done in Petersen's field guides to North American birds, etc. Some contradict the text eg. in Causus maculatus (p. 223) the loreal is said to have a larger contact with the internasal rather than with the prefrontal scale but the accompanying figure shows the reverse condition! Colour patterns are available as textual descriptions or in the form of the fine coloured photographs which, however, are sometimes misidentified eg. 18 as Dasypeltis 'fasciata' is clearly D. scabra, 30 of Thelotornis 'kirtlandii' is clearly of T. capensis, not found within the area dealt with, 36 as Psammophis 'phillipsii (juvénile)' is of P. sibilans, 38 of Psammophis rukwae may be of P. sudanensis, and, perhaps worst of all, 52 of Echis 'leucogaster' is of E. ocellatus, its 'eyes' apparent in all directions! Much of the description of each species is devoted to scalation but without indication of the source of this information except that one suspects that it is a repetitious digest of older presentations based on inadequate samples. This has led to keys which depend on characters long-since shown to be undiagnostic and use of which has been avoided by the better-informed eg. couplets 12, 21, 25, & 26 at p. 44 et seq. use pupil shape which often dilates at death and can vary in life (Werner, 1970): and both Gravia and Pseudohaje include specimens with/out a loreal scale although no allowance is made for this in the key (couplet 11 at p. 44) and contradictory statements at p. 199 ('La loréal et toujours absente' in Elapidae) and at p. 212 ('La loréal est présente chez certains spécimens, parfois d'un seul côté' of Pseudohaje nigra). These are also the mistakes of others and should not occur with the experience the author claims for himself in his foreword.

The treatment of the Scolecophidia - *Typhlops* and *Leptotyphlops* of earlier accounts, is accomplished in three pages (30-32), one alone for the Typhlopidae; this is a scandal considering that Roux-Estève's (1974) monograph on African Typhlopidae has been so long available but is not listed in the bibliography or made use of.

After each species entry are given names used by earlier authors, some being a different combination from that currently favoured, others being completely different and now considered junior synonyms. The author appears to have been less than careful with these listings if the few obvious ones to which I now draw attention are representative. These come from species of medical importance and might be expected to warrant particular attention: Naja melanoleuca was first described by Hallowell (1857) as a variety of Naia haie. not as N. melanoleuca: Naja katiensis similarly was first described by Angel (1922) as a variety of Naja nigricollis, not as N. katiensis; likewise Roman (1972) first described Echis leucogaster as E. carinatus leucogaster and he (1975) and I (Hughes, 1974a) both treated it as a species, not as E. c. leucogaster!

On almost any page turned to at random errors are found: eg. at p. 156 *Rhamphiophis* oxyrhynchus is given a range from Senegal to Chad, the eastern limit seemingly derived from Chirio & Ineich (1991) although long ago given accurately by David Barry and myself (1968) as Uganda and repeated by Pitman (1974) in his definitive work on that country: and all three sources are listed in Chippaux's bibliography! 'Publish or perish' has long been a fetish of our times yet with such little attention to what is published for readers ill-equipped to make value judgements, one might as well say, 'Publish and be misquoted or ignored'.

Had this book been intended for the field - as Chippaux says was his use of the earlier Villiers, its narrow double columns and matching figures might well have been fitted to a size more suitable to the pocket. How much use it will prove in the field or laboratory is another matter: the book is reasonably priced and can be recommended only Book review

in the abssence of anything better.

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THE HERPETOLOGICAL BULLETIN

Number 73, Autumn 2000

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Book review



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